number 159 | August 2014

bulletin

→ space for europe

1964-2014

→ SERVING EUROPEAN COOPERATION AND INNOVATION

European Space Agency

The European Space Agency was formed out of, and took over the rights and obligations of, the two earlier European space organisations – the European Space Research Organisation (ESRO) and the European Launcher Development Organisation (ELDO). The Member States are Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom. Canada is a Cooperating State.

In the words of its Convention: the purpose of the Agency shall be to provide for and to promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems:

- by elaborating and implementing a long-term European space policy, by recommending space objectives to the Member States, and by concerting the policies of the Member States with respect to other national and international organisations and institutions;
- by elaborating and implementing activities and programmes in the space field;
- by coordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of applications satellites;
- by elaborating and implementing the industrial policy appropriate to its programme and by recommending a coherent industrial policy to the Member States.

The Agency is directed by a Council composed of representatives of the Member States. The Director General is the chief executive of the Agency and its legal representative.

The ESA headquarters are in Paris.

The major establishments of ESA are:

ESTEC, Noordwijk, Netherlands.

ESOC, Darmstadt, Germany.

ESRIN, Frascati, Italy.

ESAC, Madrid, Spain.

EAC, Cologne, Germany.

ECSAT, Harwell, United Kingdom.

ESA Redu, Belgium.

Chairman of the Council:
Harald Posch

Vice-Chairs:
Jean-Yves Le Gall and Bo Andersen

Director General:
Jean-Jacques Dordain

←

On cover:
Comet 67P/Churyumov-Gerasimenko imaged by the Osiris narrow angle camera of ESA's Rosetta spacecraft on 7 August from a distance of 104 km (ESA/Rosetta/MPS for Osiris Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)

esa

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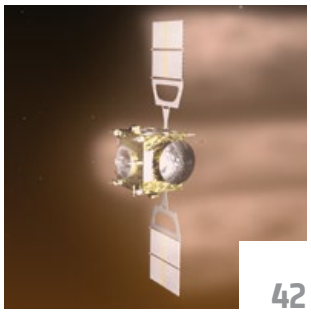

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ESA's Columbus laboratory installed on the ISS in 2008 (ESA/NASA)

→ A CHRONOLOGY OF EUROPEAN COOPERATION IN SPACE

Part 3: 1995–2014

1995

1 January
Finland becomes 14th ESA Member State

10 April
Establishment of an ESA office in Moscow

20 April
Launch of ERS-2 on Ariane 4 (V72)

3 September
Launch of the 179-day Euromir '95 mission with ESA astronaut Thomas Reiter (DE) on Soyuz TM-22

18 October
ESA Ministerial Council in Toulouse: ministers agree on Europe's contribution to the ISS. They agree to develop the Columbus Orbital Facility and the Automated Transfer Vehicle to be launched on Ariane 5, as well as definition studies for a Crew Transport Vehicle and preparation for ISS utilisation. They also agree to programmes for Ariane 5 Evolution, Ariane 5 Infrastructure and Ariane 5 ARTA

17 November
Launch of ISO, the first infrared observatory, on Ariane 4 (V80)

ESA's Thomas Reiter is the first German astronaut to make a spacewalk from Mir, on 20 October 1995. This photo shows Reiter on his second EVA, the third of the mission, with cosmonaut Yuri Gidzenko (top)

2 December
Launch of SOHO (Solar and Heliospheric Observatory) on Atlas rocket from Cape Canaveral

1996

22 February
Launch of the 15-day STS-75 Space Shuttle mission to refly the Tethered Satellite System, with ESA astronauts Claude Nicollier (CH) and Maurizio Cheli (IT) together with ASI astronaut Umberto Guidoni (IT)

4 June
Ariane 5's first test flight (V88/501) fails due to the complete loss of guidance and attitude information 37 seconds after start of the main engine ignition sequence. The payload of four Cluster spacecraft is lost

20 June
Launch of Spacelab LMS-1 mission on STS-78 with CNES astronaut Jean-Jacques Favier (FR)

25 June
Hugo Parr (NO) replaces Gaele Winters as Chairman of ESA Council

24 July
Signing of Cooperation Agreements with Portugal and Czech Republic

17 August
Launch of the Cassiopée mission to Mir with CNES cosmonaut Claudie André-Deshays (FR) on Soyuz TM-24 (16 days). She is the first French woman in space

1997

10 February
Launch of the Mir '97 mission with astronaut Reinhold Ewald (DE) on Soyuz TM-25 (18 days)

4 March
ESA Ministerial Council in Paris: follow-up to Toulouse 1995; important decisions on reforming ESA's industrial policy with the introduction of more flexibility in placing contracts with industry

15 May
Launch of the STS-84 *Atlantis* Space Shuttle mission to Mir, with ESA astronaut Jean-François Clervoy (FR)

16 June
Signing of Partnership Charter by ESA and Russian Federal Space Agency on development and exchange of expertise in aerospace between Russia and Western Europe

← Hugo Parr, Chair of ESA Council, 1997–99

↑ Claudie André-Deshays becomes the first French woman in space on Soyuz TM-24

← Antonio Rodotà, fifth Director General of ESA

1 July
Antonio Rodotà (IT) succeeds Jean-Marie Luton as Director General of ESA

2 September
Launch of Meteosat 7 by Ariane 4 (V99)

15 October 1997
Launch of NASA/ESA/ASI Cassini-Huygens from Cape Canaveral on a Titan IV rocket, starting its seven-year journey to Saturn and its moon Titan (NASA)

30 October
Launch of second Ariane 5, flight V101/502, from Europe's Spaceport in French Guiana. First stage roll-control problems cause a slight loss of velocity and the test payloads fall short of their planned geosychronous transfer orbit

1998

29 January
Signing of the (Second) Intergovernmental Agreement on Space Station Cooperation by 15 countries, and of the Memorandum of Understanding between ESA and NASA, in Washington DC

29 January
Launch of Pégase mission to Mir with cosmonaut Léopold Eyharts (FR) on Soyuz TM-27 (21 days)

25 March
ESA Council approves the proposal to set up a unified European Astronaut Corps by merging existing national astronaut programmes with the ESA programme

June
Jean-Pierre Haigneré (FR) joins ESA's European Astronaut Corps

23 June
ESA Council in Brussels approves the first step of the Global Navigation Satellite System, the Earth Observation 'Living Planet' Programme, development of a more powerful version of Ariane 5 and a small launcher called Vega. Council adopts a Resolution on the reinforcement of the synergy between ESA and the European Community (adopted in parallel by EU Research Ministers)

↓ The Atmospheric Reentry Demonstrator, flown on Ariane 5 flight V112 in 1998

August
Astronauts Léopold Eyharts, Umberto Guidoni, Paolo Nespoli (IT), Hans Schlegel (DE), Gerhard Thiele (DE) and Roberto Vittori (IT) join ESA's European Astronaut Corps

21 October
Launch of third Ariane 5, flight V112/503, qualifying the vehicle with a successful flight. One of the payloads is the Atmospheric Reentry Demonstrator, completing ESA's first Earth-return mission from launch to landing

29 October
Launch of ESA astronaut Pedro Duque (ES) on STS-95 *Discovery* (9 days). Duque becomes the first Spanish astronaut

1999

February
Astronaut Reinhold Ewald joins ESA's European Astronaut Corps

20 February
Launch of the Perseus mission to Mir with ESA cosmonaut Jean-Pierre Haigneré on Soyuz TM-29, the longest flight performed by a non-Russian cosmonaut to date (189 days)

11 May
ESA Ministerial Council in Brussels approves definition phase of the Galileo programme

23 June
Alain Bensoussan (FR) replaces Hugo Parr as Chairman of ESA Council

← Alain Bensoussan, Chairman of ESA Council, 1999–2002

July
André Kuipers (NL) joins ESA's European Astronaut Corps

22 July
Launch of STS-93 *Columbia* with astronaut Michel Tognini (FR), on the NASA Chandra X-Ray observatory deployment mission

↑ Jean-Pierre Haigneré returns from the Perseus mission on 28 August 1999 after the longest flight performed by a non-Russian cosmonaut to date

1 November
Claudie Haigneré (nee André-Deshays) joins ESA's European Astronaut Corps

3 December
Ariane 4 sets a world record with 50th consecutive launch (V124)

19 December
Launch of the third Hubble Space Telescope servicing and repair mission (STS-103, *Discovery*, 7 days) with ESA astronauts Jean-François Clervoy and Claude Nicollier. Nicollier performs the first European spacewalk on a Shuttle flight

↓ Claude Nicollier performing the first European spacewalk on a US Space Shuttle flight STS-103 in 1999 (NASA)

10 December 1999
First operational flight of Ariane 5 (V119), carrying ESA's XMM-Newton X-ray observatory (ESA/CNES/ Arianespace)

↑ ESA astronaut Umberto Guidoni, the first European to visit the ISS, 21 April 2001 (NASA)

2000

11 February
Launch of the Shuttle Radar Topography mission with ESA astronaut Gerhard Thiele (STS-99, *Endeavour*, 11 days)

16 July 2000
Launch of the Cluster mission's first pair of satellites on a Soyuz rocket from Baikonur Cosmodrome in Kazakhstan. The second pair is launched on 9 August (ESA/Starsem)

20 June
Following the Unispace III Conference in Vienna, ESA and CNES initiated the International Charter 'Space and Major Disasters'

14 November
Portugal becomes 15th ESA Member State

16 November
ESA and the European Union adopt a common strategy for space

2001

17 January
Signing of Cooperation Agreement with Greece

21 March
ESA Council adopts a Resolution on the implementation of a plan for European Cooperating States

19 April
Launch of STS-100, *Endeavour* (11 days) with ESA astronaut Umberto Guidoni, the first European to visit the ISS

12 July
Launch of Artemis by Ariane 5 (V142). A final trim manoeuvre nudged Artemis into its originally intended orbit in January 2003

21 October
Launch of the Andromède mission with ESA astronaut Claudie Haigneré on Soyuz TM-33 (8 days). She is the first female ESA astronaut and the first European woman to visit the ISS

2002

1 February
Signing of Cooperation Agreement with Brazil

28 February
Launch of Envisat on Ariane 5 (V145)

11 March
Signing of Cooperation Agreement with Argentina

25 April
Launch of the Marco Polo mission to the ISS with ESA astronaut Roberto Vittori on Soyuz TM-34 (10 days)

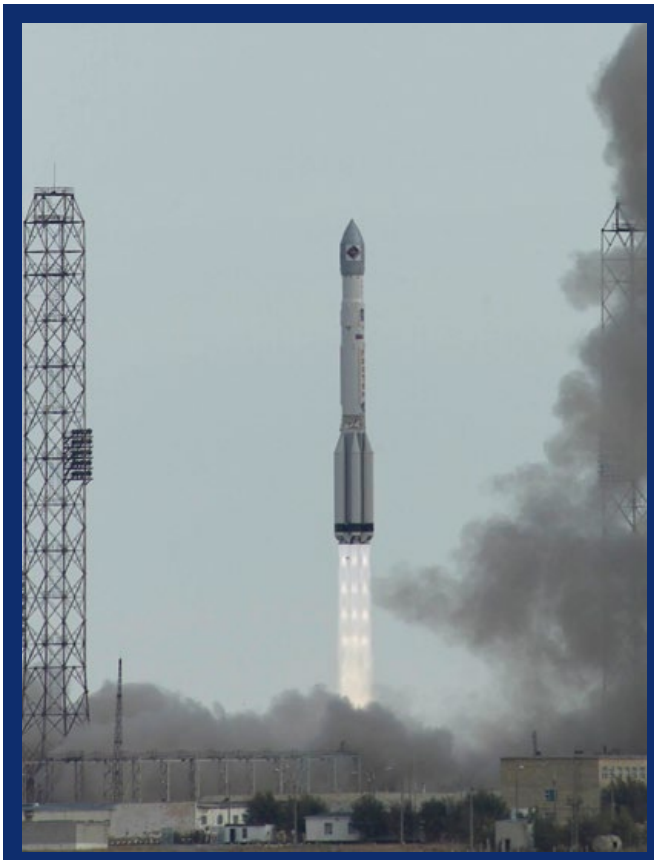
12 June
Per Tegnér (SE) replaces Alain Bensoussan as Chairman of ESA Council

28 August
Launch of MSG-1 (Meteosat-8) by Ariane 5 (V155)

↓ Envisat, the largest Earth Observation satellite to date, during integration at ESTEC in 2000

←

Per Tegnér, Chairman of ESA Council, 2002–5, 2007–8



17 October 2002
Launch of Integral (International Gamma-Ray Astrophysics Laboratory) on a Proton rocket from Baikonur Cosmodrome

30 October
Launch of the OdISSea mission to ISS with ESA astronaut Frank de Winne (BE) on Soyuz TMA-1 (11 days)

December
Philippe Perrin (FR) joins ESA's European Astronaut Corps

11 December
Maiden flight of Ariane 5 ECA (V157) suffers engine failure and vehicle is lost

2003

11 February
Signing of Cooperation Agreement with Russia

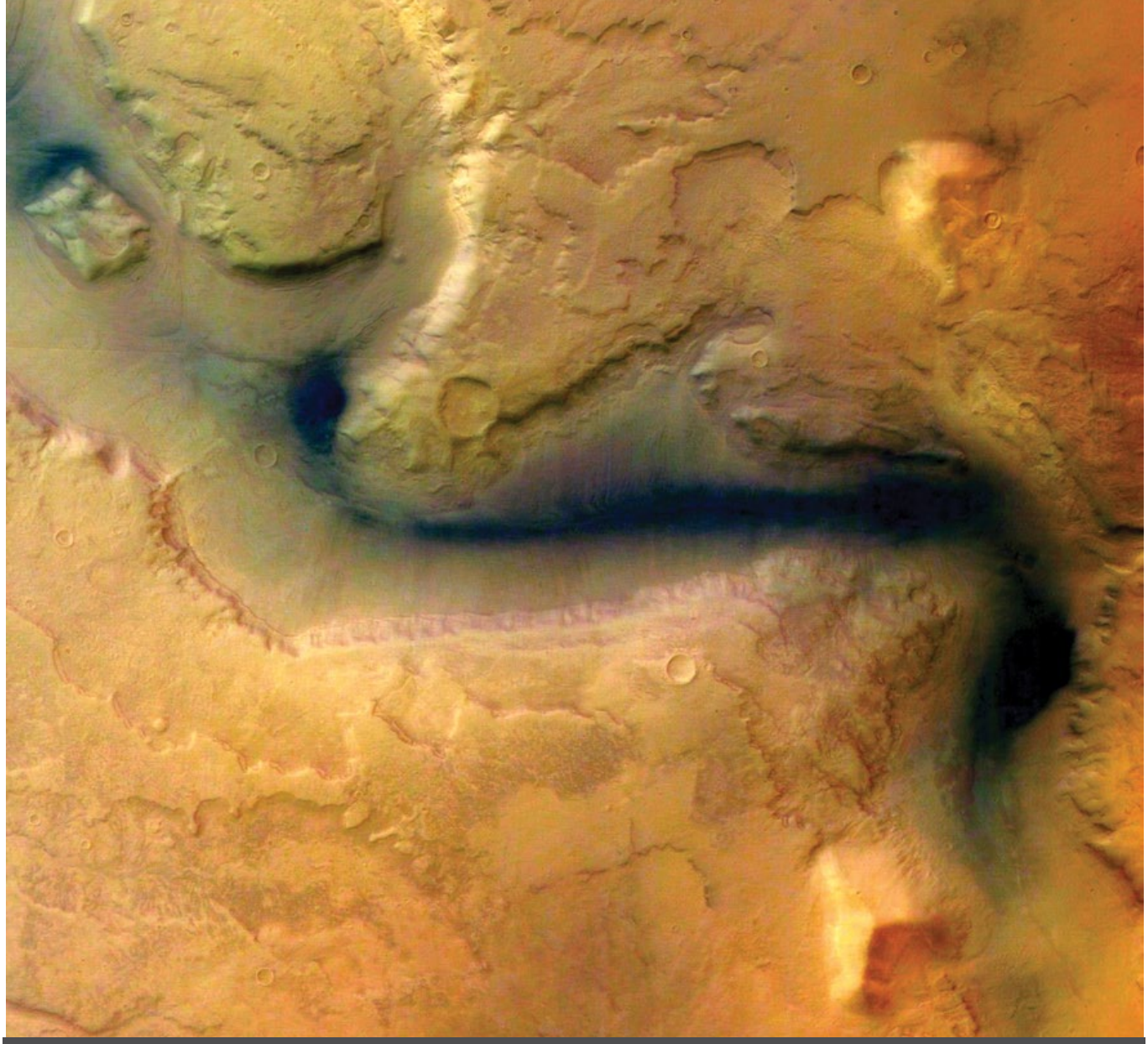
15 February
Last launch of an Ariane 4 (V159) after 116 flights

7 April
Hungary becomes ESA's first European Cooperating State

26 May
ESA Ministerial Council in Paris: ESA Member States agree on the development and validation phase of Galileo programme; decisions taken on restructuring the Ariane launcher sector, freeing funds for ISS and a Resolution on strengthening relations with the EU

2 June
Launch of Mars Express, Europe's first mission to another planet, from Baikonur Cosmodrome

27 September 2003
Launch of SMART-1, Europe's first mission to the Moon mission, on an Ariane 5 flight V162 (ESA/CNES/Arianespace)



↑ One of the first images returned by ESA's Mars Express, which arrived in martian orbit in December 2003 (ESA/DLR/FU Berlin)

←

Jean-Jacques Dordain, sixth Director General of ESA

1 July
Jean-Jacques Dordain (FR) succeeds Antonio Rodotà as Director General of ESA

18 October
Launch of the Cervantes mission to ISS with ESA's astronaut Pedro Duque on Soyuz TMA-3 (10 days)

24 November
Czech Republic becomes ESA's second European Cooperating State

25 November
Signing of Framework Agreement with the EC in Brussels

25 December
Mars Express goes into orbit around Mars. The UK's Beagle 2 probe is released from Mars Express but contact is lost. Mars Express continues to operate in Mars orbit

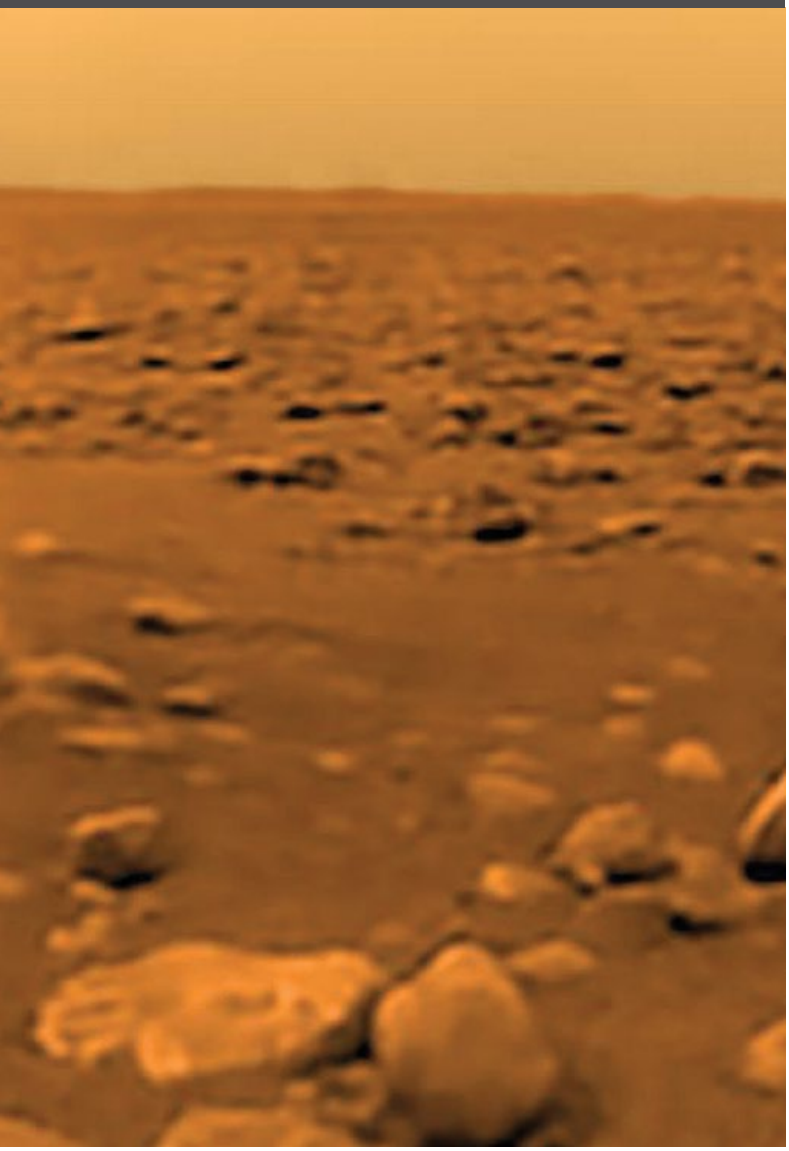
2004

4 February
Project approved to build a Soyuz complex at the Guiana Space Centre for commercial launches

2 March
Launch of Rosetta, to rendezvous and land on a comet, on an Ariane 5 (V158)

↑ The first European 'Space Council' in Brussels, with ministers from the 27 EU and ESA Member States discussing a coherent overall European space programme

↓ The first image taken on the surface of Saturn's moon Titan, after ESA's Huygens probe made the most distant landing of any manmade craft in January 2005



19 April
Launch of the Delta mission to ISS with ESA astronaut André Kuipers on Soyuz TMA-4 (11 days)

24 November
Czech Republic becomes ESA's second European Cooperating State

25 November
First ESA/EU 'Space Council', Brussels

2005

14 January
ESA's Huygens probe lands on Saturn's moon Titan, the first landing ever accomplished in the outer Solar System and the most distant landing of any manmade craft

9 March
Greece becomes 16th ESA Member State

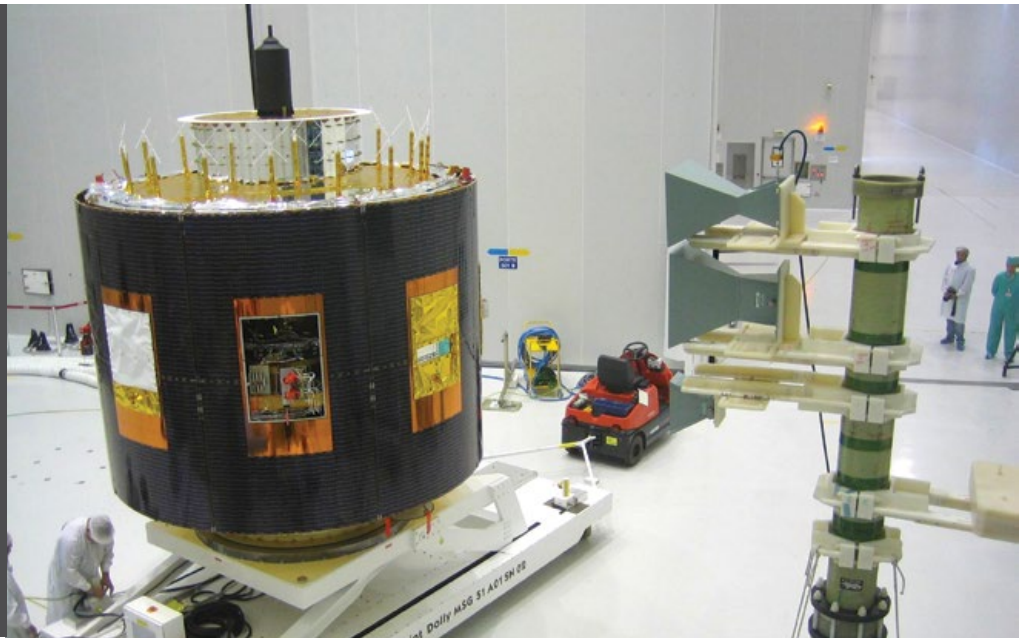
15 April
Launch of Eneide mission to ISS with ESA astronaut Roberto Vittori on Soyuz TMA-6 (10 days)

21 June
Sigmar Wittig (DE) replaces Per Tegnér as Chairman of ESA Council

← Sigmar Wittig, Chairman of ESA Council, 2005-7

→

Meteosat Second Generation satellite MSG-2 (Meteosat-9) being readied for launch in 2005



30 June
Luxembourg becomes 17th ESA Member State

8 October
Loss of first Cryosat mission in Rockot launch failure from Plesetsk, Russia

9 November
Launch of Venus Express on a Soyuz rocket from Baikonur Cosmodrome

18 November
Signing of Cooperation Agreement with China

5 December
ESA Ministerial Council in Berlin: ministers approve new programmes, GMES Space Component and Aurora (ExoMars and future exploration missions), and an overall European launcher policy

21 December
Launch of MSG-2 (Meteosat-9) by Ariane 5 (V169)

28 December
Launch of the first Galileo In-Orbit Validation Element satellite (GIOVE-A) on a Soyuz rocket from Baikonur Cosmodrome

2006

17 February
Romania becomes ESA's third European Cooperating State

4 July
Launch of Astrolab, ESA's first long-duration mission on the ISS, with ESA astronaut Thomas Reiter on STS-121 *Discovery* (171 days)

19 October
Launch of MetOp-A on a Soyuz-Fregat from Baikonur Cosmodrome

10 December
Launch of Celsius mission to ISS with ESA astronaut Christer Fuglesang (SE) on STS-116 *Discovery* (13 days). Fuglesang becomes the first Swedish citizen in space

27 December
Launch of COROT (a CNES-led exoplanet mission involving ESA and various Member States) on a Soyuz from Baikonur Cosmodrome

↓ Thomas Reiter pictured just before launch on ESA's first long-duration mission to the ISS

2007

27 April
Poland becomes ESA's fourth European Cooperating State

22 May
Fourth 4th ESA/EU 'Space Council', Brussels: 29 Ministers adopt the European Space Policy, creating a common political framework for space activities

13 June
Per Tegnér replaces Sigmar Wittig as Chairman of ESA Council

20 June
Signing of Cooperation Agreement with Estonia

23 October
Launch of the Esperia mission to ISS with ESA astronaut Paolo Nespoli on STS-120 *Discovery* (15 days). Italian-built ISS Node-2 (Harmony) module is installed

2008

25 January
Signing of Cooperation Agreement with Ukraine

7 February 2008
Launch of STS-122 *Atlantis* carrying the European Columbus laboratory to the ISS, with ESA astronauts Leopold Eyharts and Hans Schlegel (NASA)

7 February
Inauguration of the European Space Astronomy Centre (ESAC) in Spain with presence of HRH Prince Felipe of Spain

9 March
Launch of ATV *Jules Verne*, the most complex spacecraft ever produced in Europe and the first European resupply mission to the ISS, on an Ariane 5. This is the largest payload to date for an Ariane 5 and the first automated docking of a European spacecraft in orbit

12 March
Maurici Lucena (ES) replaces Per Tegnér as Chairman of ESA Council

← Maurici Lucena, Chairman of ESA Council, 2008–10

27 April
Launch of ESA's second Galileo satellite (GIOVE-B) on a Soyuz rocket from Baikonur Cosmodrome

26 September
Fifth ESA/EU 'Space Council' in Brussels agrees major milestones for implementation of the European space policy

12 November
Czech Republic becomes 18th ESA Member State

↓ ATV *Jules Verne* seen during first automated docking of a European spacecraft with the ISS in 2008 (ESA/NASA)

Six new ESA astronauts: Timothy Peake (GB), Samantha Cristoforetti (IT), Andreas Mogensen (DK), Alexander Gerst (DE), Thomas Pesquet (FR) and Luca Parmitano (IT)

2009

17 March
Launch of GOCE, the first of ESA's Earth Explorer missions, to study Earth's gravity field, on a Rockot from Plesetsk, Russia

14 May 2009
Launch of Herschel and Planck observatories on an Ariane 5 ECA (V188) from Europe's Spaceport in French Guiana (ESA/CNES/Arianespace)

20 May
ESA announces selection of six new astronaut candidates

27 May
Launch of the OasISS mission to the ISS with Frank De Winne on Soyuz TMA-15 (six months). De Winne becomes the first European ISS commander on 11 October. The ISS houses six crewmembers for the first time

22 July
Opening of ESA's first facility in UK at Harwell, Oxon

23 July
Signing of Cooperation Agreement with Latvia

27 August
Signing of Cooperation Agreement with Cyprus

29 August
Launch of the Alissé mission to ISS with ESA astronaut Christer Fuglesang on STS-128 *Discovery* (11 days)

2 November
Launch of SMOS (Soil Moisture and Ocean Salinity) and Proba-2 satellites on a Rockot from Plesetsk, Russia

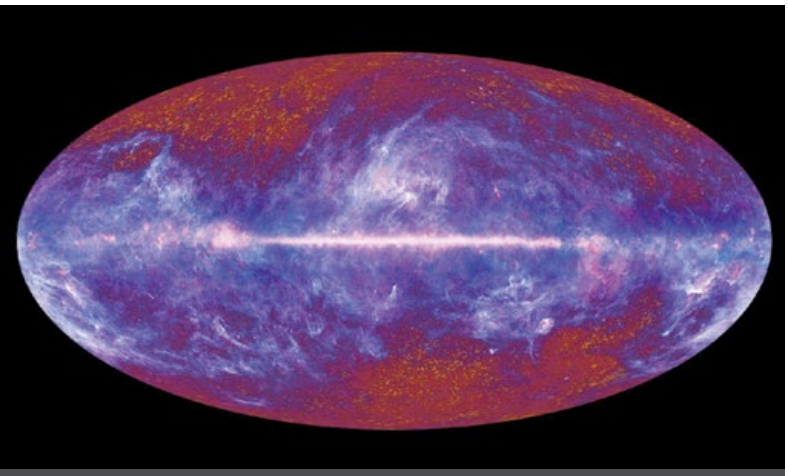
10 November
Estonia becomes ESA's fifth European Cooperating State

2010

22 January
Slovenia becomes ESA's sixth European Cooperating State

8 February
Launch of STS-130 *Endeavour* carrying European-built Node-3 Tranquility and Cupola to the ISS

1 April
UK Space Agency established to replace British National Space Centre



↑ ESA's Planck mission delivered its first all-sky view, the product of the first 10 months of its mission (ESA/HFI/LFI)

8 April 2010
Launch of ESA's 'ice mission', Cryosat-2, on a Dnepr rocket from Baikonur Cosmodrome

↑ ESA astronauts Frank De Winne, the first European commander of the ISS, and Christer Fuglesang, the first non-Russian/US spacewalker to make more than three spacewalks, during the STS-128 flight to the ISS in August 2009 (ESA/NASA)

28 April
Signing of Cooperation Agreement with Slovak Republic

3 June
Mars500, the first full-length simulation of a human mission to Mars begins in Moscow with six international volunteers

16 June
David Williams (GB) replaces Maurici Lucena as Chairman of ESA Council

← David Williams, Chairman of ESA Council, 2010–12

5 July
ESA's Planck mission delivers its first all-sky image

15 December
Launch of the MagISStra mission to the ISS with ESA astronaut Paolo Nespoli on Soyuz TMA-20 (six months)

2011

31 January
Signing of Cooperation Agreement with Israel

16 February
Launch of ESA's second Automated Transfer Vehicle, ATV *Johannes Kepler*, on an Ariane 5 ES (V200)

16 May
Launch of the DAMA mission to the ISS with ESA astronaut Roberto Vittori on STS-134 *Endeavour* (16 days)

21 October 2011
Launch of a Soyuz (VS01) for the first time from Europe's Spaceport in French Guiana, carrying the first two Galileo In-Orbit Validation satellites

21 November
ESA Council opens for 10 EU Member States to sit as observers: Bulgaria, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic and Slovenia

21 December
Launch of the PromISSe mission with ESA astronaut André Kuipers on Soyuz TMA-03M. Kuipers now holds the record for the longest stay in space by an ESA astronaut (193 days)

22 December
Romania becomes ESA's 19th Member State

13 February 2012
Launch of ESA's new small launcher Vega (VV01) from Europe's Spaceport in French Guiana

2012

23 March
Launch of ATV *Edoardo Amaldi* on an Ariane 5 ES (VA205) from Europe's Spaceport in French Guiana

9 May
The end of the 10-year Envisat mission is declared after communications were suddenly lost on 8 April

17 September
Launch of MetOp-B on a Soyuz rocket from Baikonur Cosmodrome

↑ A stunning view of ESA's new 35 m deep-space station in Malargüe, Argentina. On 24 August 2012, Mars Express became the first mission to downlink telemetry via Malargüe. The station was inaugurated on 18 December 2012 (ESA/S.Marti)

←

Johann-Dietrich Wörner, Chairman of ESA Council, 2012–14

19 November
Poland becomes ESA's 20th Member State

19 November
ESA Ministerial Council in Naples: Ministers secure investments for the new Ariane 6 launcher studies and Adapted Ariane 5 ME, and approve provision of the Service Module for NASA's Orion Multipurpose Crew Vehicle

December
Johann-Dietrich Wörner (DE) replaces David Williams as Chairman of ESA Council

18 December
Inauguration of the deep-space tracking station at Malargüe, Argentina

2013

20 February
Signing of Cooperation Agreement with Malta

14 May
ESA's first UK facility, at Harwell, named ECSAT (European Centre for Space Applications and Telecommunications)

28 May
Launch of the Volare mission to ISS with ESA astronaut Luca Parmitano on Soyuz TMA-09M (six months)

5 June
Launch of ATV *Albert Einstein* on Ariane 5 ES (VA213) from Europe's Spaceport in French Guiana

25 July
Launch of Alphasat, Europe's largest telecommunications satellite, on an Ariane 5 ECA (VA214) from Europe's Spaceport in French Guiana

22 November
Launch of the three-satellite Swarm constellation, ESA's magnetic field mission, on a Rockot launcher from Plesetsk, Russia

19 December
Launch of Gaia, ESA's galaxy-mapping satellite, on a Soyuz (VS06) from Europe's Spaceport in French Guiana

2014

→ CELEBRATING 50 YEARS OF EUROPEAN COOPERATION IN SPACE

→

ESA's celebration of 50 years in space was launched on 5 December 2013 at the ECSAT naming ceremony at Harwell, Oxfordshire. Here, Director General Jean-Jacques Dordain presents UK Minister David Willetts with a framed image the Cosmic Microwave Background as seen by the Planck satellite, to celebrate the achievements of the European space sector

↑ ESA's 2014 corporate calendar featured key dates from 1964 to 2014 within its notes section

This year the space community is celebrating the anniversary of the construction of a spacefaring Europe and 50 years of unique achievements in space.

The collaborative European space effort was officially born 50 years ago. This is an anniversary for the whole space sector in Europe, which can be proud of its results and achievements. When Member States share the same challenging objectives and join forces, they put Europe at the leading edge of progress, innovation and growth, for the benefit of all citizens. Here are just a few of the events and activities that have taken place during 2014 to mark the 50 years of European cooperation in space.

→

The logo for the '50 years of European cooperation' is applied with the ESA logo to the fairing for Ariane 5 flight VA219, which carried ATV *Georges Lemaître* into orbit on 30 July (ESA/CNES/Arianespace/Optique video du CSG/P.Piron)

↑ ESA Director of Technology and Quality Management, Head of ESTEC, Franco Ongaro at the inauguration of the 'European cooperation in space' exhibition at the European Parliament, 1 April 2014 (EPP Group)

←

Cake baked for naming ceremony of ECSAT, UK

←

A new book by eminent historian John Krige details fifty years of European collaboration in space, from the origins of the space programmes of the early 1960s, to the many activities and rich complexity of ESA today. *Fifty years of European cooperation in space: Building on its past, ESA shapes the future* is published by Les Editions Beauchesne (June 2014)

→

The Monnaie de Paris, France's national mint, issued a set of collectors' coins in gold and silver to celebrate Europe's exploits in space. The collection, dubbed '50 Years of European Space Cooperation', forms part of the Europa series, which every year since 2002 has featured on the reverse side of these coins individuals or events that have made contributions to European cooperation and construction

Representatives of the Alphasat/ Alphabus Public–Private Partnership celebrate the project at the Paris Air & Space Show: from left: Jan Wörner (DLR), Eric Béranger (Astrium), David Parker (UK Space Agency), Magali Vaissière (ESA Director of Telecommunications and Integrated Applications), Ruy Pinto (Inmarsat) and Sami Ben-Amor (Thales Alenia Space)

→ ALPHASAT

Partnership in orbit

Philippe Sivac and Eloy Torres
Directorate of Telecommunications and Integrated Applications,
Toulouse Space Centre, Toulouse, France

Edoardo Benzi, Juan Rivera Castro and Simon Weinberg
Directorate of Telecommunications and Integrated Applications
ESTEC, Noordwijk, the Netherlands

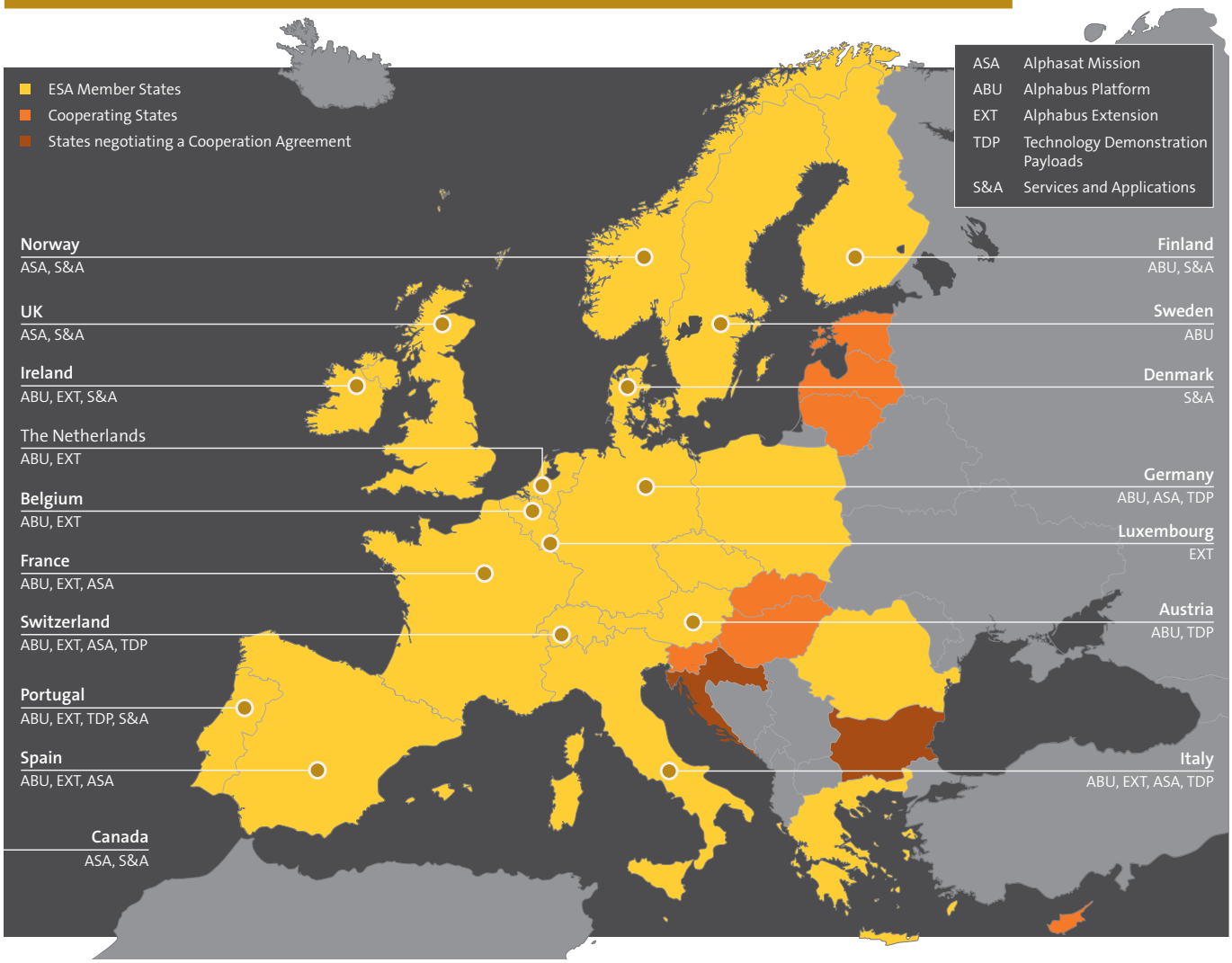
Marina Bernard
Ajilon Technology Aerospace BV, Eindhoven, The Netherlands

Europe's largest telecommunications satellite, Alphasat, was launched on 25 July 2013, on an Ariane 5 from Europe's Spaceport in Kourou, French Guiana.

This launch marked a significant milestone for an ambitious Public–Private Partnership between ESA and Inmarsat, joining forces to develop, launch and operate an innovative telecommunications satellite. Since then, the success of this partnership is being demonstrated on a daily basis. Using its sophisticated payload, Alphasat extends Inmarsat's capacity in orbit for mobile telecommunications.

One of the main focus areas of Alphasat is the provision of safety services over Europe, Middle East and Africa plus oceanic areas under its coverage. The maritime and aeronautical communities in particular will benefit from improved applications and a new range of services that have been developed in ESA's ARTES programme.

→ PARTICIPATING STATES IN ALPHASAT AND ALPHABUS



The new Alphabus platform, developed by Airbus Defence & Space and Thales Alenia Space under contract to ESA and CNES and on which Alphasat is built, is also fulfilling its mission: first by completing its in-orbit testing phase, then fully supporting Alphasat commercial operations. In addition, four ESA and national agency Technology Demonstration Payloads (TDPs) have been operated since January 2014, after having completed their in-orbit check-out at the end of 2013.

Improving safety services

The ARTES programme has been instrumental in developing new safety-of-life services for the maritime community. After more than 20 years of operation, the ancillary Inmarsat-C service will be complemented with the introduction of an advanced maritime safety data communication service and a maritime safety voice service, both over BGAN (Broadband Global Area Network). These new safety services will benefit from the high data rate capabilities of BGAN in providing value-added services (for example, Long Range Identification and Tracking service, engine monitoring, weather forecast data, and maritime safety alerts).

The Voice Distress service is already operational and allows '505' emergency calling, which immediately connects a sea-faring vessel in distress to a marine rescue centre. This service won the 2012 Safety at Sea Award. Implementation of the ground segment infrastructure and development of prototype user terminals for this service are complete, and it is undergoing a rigorous certification process with International Maritime Organization. An online demonstration of these services was presented to the maritime community and media in June this year.

For the aeronautical community, a safety service called SwiftBroadband Safety has been developed over the last five years. This service will be operated in coordination with the ancillary Classic Aero service provided by Inmarsat to aircraft over oceanic air space. SwiftBroadband Safety meets the high-availability requirements imposed by International Civil Aviation Organization (ICAO) on their operational guidelines.

The new service will provide better aircraft monitoring and will allow safe shorter separation between aircraft that will translate into, among other things, higher savings in fuel consumption when crossing oceans. SwiftBroadband Safety is the corner stone over which future Inmarsat aeronautical services will be developed through other ARTES lines, for example, the Iris Precursor programme initiated in 2014, which aims to extend the capabilities of SwiftBroadband Safety to continental airspace, or the ambitious ESA Iris programme, which aims to provide satellite communications for air traffic management over Europe beyond 2020.

The introduction of Alphasat also provides a great opportunity to increase the maximum bit rate for BGAN high-gain terminals through the use of higher order modulation schemes together with the bonding of multiple transceivers operating over multiple BGAN channels. The prime user group for this high-bit rate streaming service is likely to be media/broadcasting organisations, as well as defence customers.

In the low end, new low-gain, low-cost terminals will be available and will benefit from Alphasat's extended L-band coverage and its improved power and sensitivity performance.

↓ An example of the new services made possible by Alphasat is the Voice Distress service for sea-faring vessels in distress (Mercator Media)

Other services developed in ESA's ARTES programme include the introduction of simultaneous voice communications over Inmarsat's maritime service. ESA has helped to improve Inmarsat's FleetBroadband system: instead of a single call, the same terminal now offers up to nine simultaneous telephone calls. This unique development separates the crew's personal use from operational communications while on the high seas. Crew and passengers can now make personal voice calls away from the bridge, all at the same time.

Competitiveness boost

The boost of competitiveness linked to the Alphabus and Alphasat programmes can be clearly measured. Alphasat is now a key asset for Inmarsat, and the associated services developed under the ARTES programme will benefit the maritime and aeronautical communities. For the satellite primes, some of the technologies developed and validated under Alphabus, such as power or plasmic propulsion, are now also largely incorporated into the susbsystems of each of the primes main product lines. At unit level, the sensors, power supplies and digital processors developed under the Alphabus and Alphasat programmes have all been actively marketed and sold on various other satellite programme.

The TDP6 startracker, for example, has been particularly successful on the commercial market, thanks in part to its qualification and in-orbit demonstration phase on Alphasat. TDP8 is expected to complement this success with its *in situ* measurement of the radiation environment in the most commercially relevant orbit (geostationary), while the Aldo Paraboni payload and the Laser Communications Terminal will both be instrumental in demonstrating new telecommunications technologies in orbit and opening new commercial markets, as indicated by the interest they are triggering in an increasingly large international community.

At system level, Alphabus is ready to address the upper range of the satellite telecommunications market and complement the existing European product offerings.

←

The SwiftBroadband Oceanic Safety Service provides voice and broadband data safety applications to the aircraft cockpit (Inmarsat)

→

Alphasat in orbit

Looking to the future

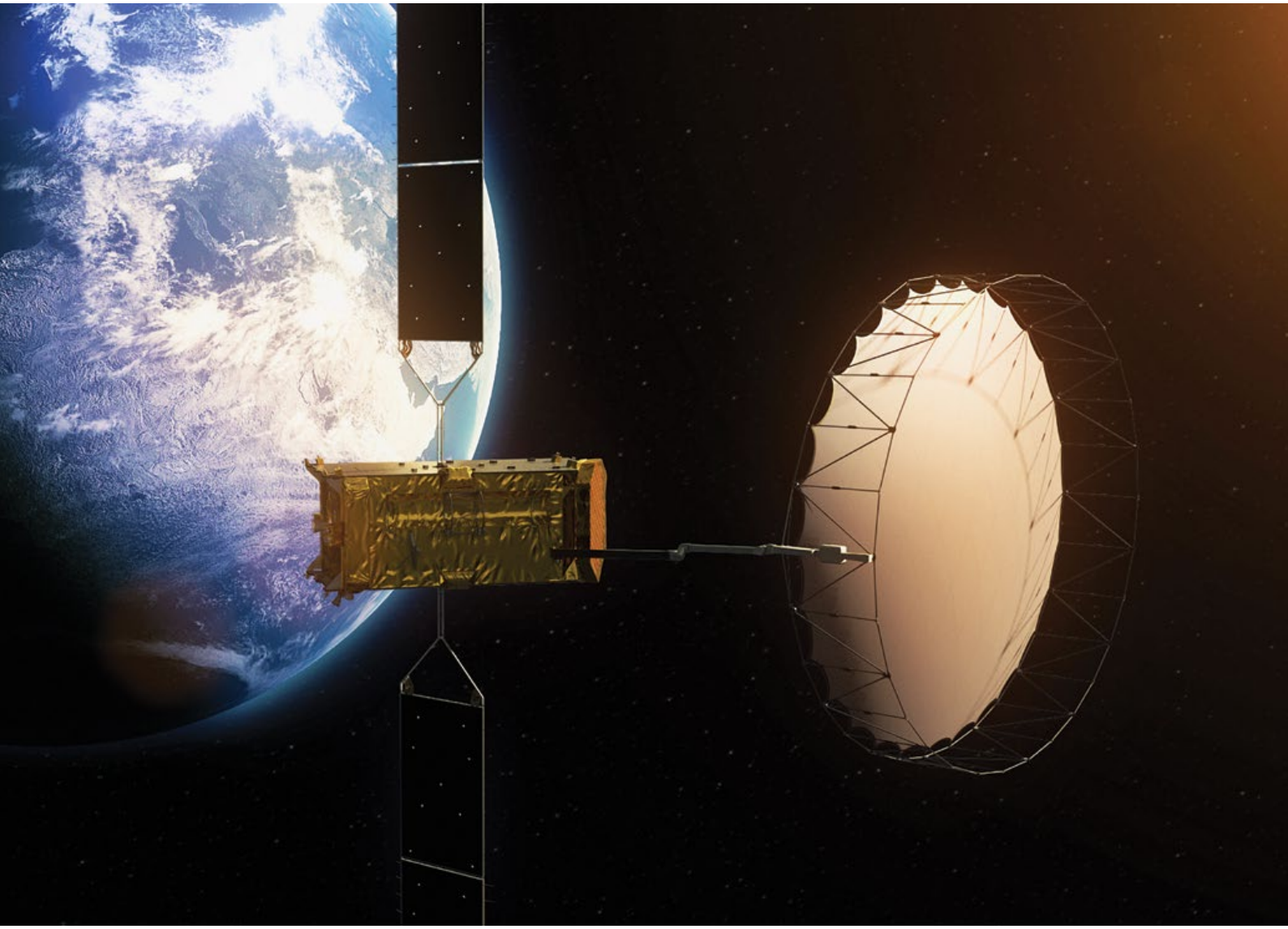
The planned lifetime of the Alphasat mission will most likely exceed the required 15-year period, because of more than adequate fuel available on board. As for the TDPs, they will be operated until end of 2016 in the first instance, at which point an extension may be considered.

Even though the current Alphabus platform has met its objectives on the ground and in orbit with the mission of Alphasat, an Alphabus Extension Programme is running in parallel to further develop the capabilities of the product line. The main features being developed are, among others, additional spacecraft power for payloads up to 22 kW, increased heat rejection capabilities (up to 19 kW) including the addition of a Deployable Panel Radiator, and improved avionics.

These new developments were reviewed at the Critical Design Review in June. The next step of this extension programme will take place in early 2015, with an incremental system Qualification Review that will introduce the majority of these developments into the qualified Alphabus system. A remaining qualification step will be required for the introduction of the Deployable Panel Radiator in the product line at the end of 2015, after an extensive qualification programme.

This complex Public–Private Partnership is operating well, with all major objectives met. The Alphabus Extension Programme will enhance Alphabus performance and, as opportunities arise on the world market, enable it to address more demanding missions in the future that are not currently accessible to European satellite platforms. ■

The authors wish to thank all the teams involved in this unique partnership, in particular CNES, Inmarsat, Airbus Defence and Space and Thales Alenia Space.



The joint ESA/CNES/ Inmarsat team take a look at Alphasat before thermal testing begins at Intespace in Toulouse, France: from left, David Schwaller (ESA), Romain Peyrou-Lauga (ESA), Paul Masters (Inmarsat), Valérie Frard (CNES) and Philippe Sivac (ESA)

→ Getting into orbit

The Alphasat satellite design was driven by the accommodation of Inmarsat's mobile communications payload, which includes a large complex antenna based on an 11 m diameter deployable reflector, as well as extensive L-band payload related hardware. While DC power demand is at the low end of the Alphabus capability, the number of units, the payload mass (more than 1200 kg) and the power dissipation are significant, resulting in a complex satellite.

The Alphasat project entered its final development phase in 2011, when the Repeater Module, hosting Inmarsat's technologically advanced payload, was mated with the first Flight Model of Alphabus. From then on, the project began its system and environmental testing phase. Supported by the French space agency CNES, ESA established a 'customer team', in collaboration with Inmarsat's 'procurement team', to monitor the platform performances throughout the test phases and to act as focal point for all ESA TDPs during their integration and testing.

↑ Fuelling operations were completed on 5 July 2013. A specialist Thales Alenia Space team, dressed in safety suits, loaded the nearly three tonnes of chemical propellant inside the Hazardous Processing Facility at Europe's Spaceport in French Guiana (ESA/CNES/Arianespace)

Mechanical tests, covering vibration and acoustic testing, were performed first and in two configurations. An empty tank configuration was used to perform the proto-qualification, in compliance with launch authority requirements. A full tank test campaign was also performed to validate the mathematical models of the product line and ensure the behavioural changes between full and empty tank configurations were completely characterised and understood. The results were satisfactory and validated the empty tank testing approach for future Alphabus-based satellites.

Alphasat's thermal testing was completed at the end of 2012, some time after the mechanical test phase, to allow for late hardware integration and some retrofitting during the period. A thorough thermal test was required, because of the needs of the mission, use of the new Alphabus platform and Inmarsat's specific requirements for thermal cycling.

A final acoustic test, aimed at detecting any workmanship issues that could have come up since the early mechanical campaign, was then performed, leading the way to the final functional tests before Alphasat was shipped to the launch site.

The joint ESA/CNES team continued to collaborate with Inmarsat throughout the launch campaign, focusing on the final preparations of the Alphabus platform and final operations of the TDPs. The campaign ran according to plan for a standard telecommunications mission. The fuelling phase was clearly the highlight, since it included large loadings of xenon gas and chemical propellant.

Throughout the launch campaign, Alphabus showed complete compliance with the launch operations requirements, including Guiana Space Centre's stringent safety requirements. Except for a specific purging line, disconnected before payload encapsulation in the fairing, all TDPs conformed to the main preparation flow and imposed no constraints on the campaign.

Alphasat was launched as planned from Kourou, French Guiana, on 25 July 2013. Geostationary orbit was reached on 31 July, thanks to four apogee engine firings totalling about five hours of thrust and consuming 2.5 tonnes of propellant. The overall performance of the chemical propulsion subsystem was as expected and very stable, allowing a highly accurate final insertion manoeuvre. Thrust and specific impulse uncertainties were better than 1% with respect to predictions. After the first activities in geostationary orbit (chemical propulsion system isolation, solar array and large reflector deployment), the in-orbit bus tests were completed by 12 August.

Satellite operational modes were used and functional chains operated normally, showing excellent performances, with very good correlation with ground predictions. During the in-orbit bus tests, both main and redundant branches of the xenon propulsion system were primed, and all four plasma engines (including the two cathodes for each engine) were commissioned for station-keeping cycles.

After this initial phase, the satellite was handed over to the Inmarsat Control Centre in London on 12 August 2013 to continue monitoring the Alphabus platform and to complete in-orbit testing on the Inmarsat payload and the TDPs.

The Inmarsat payload was tested in various configurations, allowing the start of voice traffic delivery to handheld terminals, on a commercial basis, in November 2013.

Inmarsat Broadband Global Area Network (BGAN) voice and data services have been also demonstrated and tested end-to-end using Alphasat. Good results have been shown when comparing its performance to that obtained when using the Inmarsat-4 satellites (the previous generation of Inmarsat satellites). Such performance comparison has been done in similar locations and configurations, using the same portfolio of user terminals or upgraded user terminals, which can exploit the unique capabilities of Alphasat. BGAN voice and data services will be brought online commercially over Alphasat by early 2015, as soon as the fleet of aeronautical user terminals has been fully upgraded to make use of Alphasat.

The Alphabus platform test results were all analysed and confirmed as positive. In October 2013, a Review held between Inmarsat, Airbus Defence & Space, Thales Alenia Space, ESA and CNES declared platform had passed its In-Orbit Acceptance. Every TDP was tested up to the end of 2013, and each also passed their In-Orbit Acceptance Reviews.

Specifically, TDP6, the new active pixel sensor-based startracker from Jena Optronik (DE), had been switched on since launch to check its behaviour in low Earth orbit in difficult conditions, with sun blinding. The results are good and are being monitored regularly.

TDP1, a Laser Communications Terminal and its Ka-band repeater from TESAT (DE), provided by the DLR, went through its full set of commissioning operations, including unlocking of the telescope and check of its various operating modes. Some adjustments to the large dedicated radiator thermal control on the spacecraft allowed to drive the terminal temperatures into its operating range, which then enabled extensive link tests with ESA's Optical Ground Station in Tenerife. The tests were conducted over two sessions, and despite the perturbations of the atmosphere, allowed tracking mode to be achieved, making possible a first validation of the pointing mechanism. The next important test campaign will be conducted with Sentinel-1, where full communications between a low-orbit satellite and Alphasat will be demonstrated.

↑ Alphasat launch on 25 July 2013 (ESA/CNES/Arianespace)

→ Operations

Alphasat is now operated the Inmarsat Control Centre in London. It is fully integrated in Inmarsat's satellite fleet and is operated like any other of their satellites in orbit, apart from the ESA-provided TDPs.

← ↑ The Inmarsat Control Centre, London

Every week, each TDP team prepares its operations request, which is consolidated automatically in a TDP Operations Centre (the TDP ESA Coordination Office, or 'TECO') located at ESA's European Space Operations Centre in Darmstadt.

After verification and checking for conflicts with the platform and commercial activities notified by Inmarsat, the resulting plan is sent to Inmarsat's Operations Centre for upload and execution on board the satellite. This regular and largely automated sequence is proving very effective and is a key to limit any disturbance of the main Inmarsat operations by the TDPs.

An automated telemetry distribution system, based on Inmarsat's infrastructure, also allows each TDP team access to the real-time and archived telemetry concerning their experiment.

Samantha Cristoforetti (NASA)

→ THE SKY IS NOT THE LIMIT

Samantha Cristoforetti's Futura mission

Nadjejda Vicente
Directorate of Human Spaceflight and Operations, ESTEC, Noordwijk, the Netherlands

This is an exciting and busy period for European human spaceflight. For the first time, two ESA astronauts begin their long-duration missions to the International Space Station in the same year: Alexander Gerst was launched to the orbital complex in May, followed by Samantha Cristoforetti in November.

Samantha has been dreaming of going into space ever since she was a child. She was born in Milan, Italy, in 1977. During her childhood, space-themed posters lined the walls of her room and she avidly read science-fiction novels.

She doesn't remember exactly when she decided to become an astronaut or what triggered her fascination for space. "I think it was a combination of many things. The starry nights, along with my excellent teachers in elementary school, inspired me with the wonders and mysteries of nature. The days spent exploring in the woods increased my sense of adventure, curiosity and confidence in myself," says Samantha.

As she grew older, becoming an astronaut was the dream job that combined her greatest passions: flying, science and technology. All of that led her to study aerospace

engineering and earn technical degrees from several international universities. She specialised in solid rocket propellants, lightweight structures and aerodynamics.

As soon as it became possible in Italy for women to join the military, she entered the Italian air force and fulfilled her passion to fly. Samantha became a fighter pilot, climbing to the rank of captain and logging over 500 flying hours in six types of military aircraft.

The path to the stars

When ESA called for candidates in 2008 to reinforce the European Astronaut Corps, more than 8000 highly qualified people from 17 countries applied. Samantha was the only woman to pass the demanding year-long selection process. Together with five other candidates, she became part of the new generation of European astronauts.

Speaking at the press event in Paris introducing the new group of astronauts, she thanked ESA for offering her 'the best job in the world'. It was difficult for her to express with words the feelings she had at that moment, explained Samantha. "For all of us is the beginning of a new life," she said.

Space is now an integral part of her work and her life. She will be the seventh Italian astronaut in space, following the path of her compatriots Franco Malerba, the first Italian in space, and Umberto Guidoni, the first European astronaut to work and live on the International Space Station.

She will also be the 59th woman, the second female ESA astronaut and first Italian woman to fly in space. But she doesn't consider herself an expert on gender issues. "I do not have the trained eye to capture these aspects, nor the mind to think about it. It is very unlikely that I have something clever and original to say," she concedes.

↓ ESA's new astronaut candidates in September 2009: Andreas Mogensen, Tim Peake, Samantha Cristoforetti, Thomas Pesquet, Luca Parmitano and Alexander Gerst (ESA/J.Mai)

However modest though, Samantha is a multilingual astronaut with experience in working in multicultural environments. As part of her career abroad, she learned German, French, English and Russian. She has started studying Chinese as a hobby.

She has broad interests, which include technology and nutrition. She enjoys hiking, scuba diving and interacting with space enthusiasts on blogs and Twitter as **@AstroSamantha**.

After receiving the news of her assignment in 2012, she began keeping a very detailed account of her training activities on Google Plus in a countdown that started at the 'L-500 days' milestone (500 days to launch).

Since then, she has also been training hard to gain the knowledge and skills required for her mission. "The past years as a European astronaut have been an amazing time of personal and professional growth," said Samantha.

The Futura mission

Samantha is set for a long-duration mission to the International Space Station and will be launched on a Russian Soyuz spacecraft from Baikonur cosmodrome in Kazakhstan on 23 November and returning to Earth on 12 May 2015.

Serving as Flight Engineer for Expeditions 42 and 43, Samantha will travel in the left-hand seat of the Soyuz TMA-15M capsule for the journey into space, accompanied by cosmonaut Anton Shkaplerov and NASA astronaut Terry Virts. This co-pilot position carries a lot of responsibility – she is trained to assist the Russian commander during the ascent and descent phases, looking after all the onboard systems and taking over when necessary.

↓ Samantha and Alexander Gerst enjoying microgravity during a parabolic flight exercise, 2011 (DLR)

↑ The Soyuz TMA-15M crew: Samantha Cristoforetti with NASA astronaut Terry Virts and commander Anton Shkaplerov

This is Samantha's first mission to space, and the eighth long-duration mission for an ESA astronaut. She will work on the orbital complex as part of the international six-astronaut crew, heavily involved in Station operations and science experiments covering a range of disciplines.

One of her tasks will be to monitor the undocking of the fifth and final Automated Transfer Vehicle, ATV *Georges Lemaître*. At the end of its mission, the vehicle will undock from the orbital outpost filled with a few tonnes of waste water, materials and equipment. A set of cameras and sensors will record data during re-entry, as ATV-5 falls through Earth's atmosphere, following a new shallow trajectory. Samantha will also support berthing and cargo operations of Dragon and Cygnus commercial cargo vehicles.

→ Futura

The mission name 'Futura' and its logo were chosen after a call for ideas in Samantha's home country. Hundreds of proposals were received, each trying to capture the essence of her mission. 'Futura' was a favourite name among them, and also the most recurrent – eight different people proposed it!

The logo shows a stylised orbit of the International Space Station circling Earth – symbolising the connection between our planet and the orbital outpost. The sunrise represents the future of discoveries and new horizons for humankind. "Both the mission name and logo represent beautifully a positive momentum towards space exploration, and the voyage of discovery," explains Samantha.

↑ Serving as Flight Engineer for Expeditions 42/43, Samantha will travel in the left-hand seat of the Soyuz TMA-15M capsule (Associazione ISAA)

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Italian ticket to space

Samantha Cristoforetti will reach orbit on a flight provided by the Italian space agency ASI in a bilateral agreement with NASA, in exchange for producing US-owned modules for the Station. Many of the European parts of the Space Station were built in Italy, and the country is the third largest contributor to the project from ESA.

Out-of-this-world science

The Futura mission's extensive scientific programme comprises dozens of experiments to be carried out 400 km above Earth. Samantha will take full advantage of the European Columbus laboratory to perform high-level science in microgravity, including some first-time experiments for ESA.

The 'Airway Monitoring' experiment, for example, will check Samantha's pulmonary system. Dust particles float in the Station's atmosphere and could pose a problem to an astronaut's well-being during space missions. On Earth, patients suffering from asthma could benefit from this research. The 'Grip' experiment will study the effects of long-duration spaceflight on Samantha's dexterity. This research could help patients with impairment in manipulating objects.

The 'PK-4' experiment investigates the creation of plasma microparticles in weightlessness (plasma is an ionised gas). Microchip production or plasma medicine applications can benefit from this fundamental research in orbit.

↑ Responsible for development and supply of space food for European astronauts, Argotec have developed the 'Space Food Lab' for the study of nutritional food dedicated to the astronauts, and in 2012 they employed Stefano Polato (of the Restaurant Campiello, Padua, Italy), now the official chef of Samantha Cristoforetti's Futura mission

Cooking and inspiring for the future

One of the key elements of Samantha's mission will be on health and nutrition. She is very aware of the impact eating habits have on our body, and regards food as a sort of medicine. Since the space environment puts a lot of stress on the human body from a health point of view, providing astronauts with the right nutrients becomes even more important.

The future space traveller has been working on her bonus food with nutrition experts and an Italian chef. Together they have designed a special menu to suit her tastes, such as quinoa, mackerel and bluefish. They are including healthy proteins, whole grains, fruit, olive oil and even dark chocolate – all quality ingredients for Samantha to eat well and feel healthy.

Samantha wants to open up space to children on Earth. She will be involved in several education activities based around fitness, healthy eating, food production and recycling in microgravity. "As the privileged temporary inhabitant of humanity's outpost in space, I will make every effort to share the orbital perspective and virtually take along all those who want to join our journey," she says.

Students will be able to investigate the process of photosynthesis by blowing carbon dioxide on samples of Spirulina algae, one of the earliest lifeforms on our planet. She will help them understand the important role of recycling carbon dioxide to produce food and oxygen.

Next year, Samantha will kick off the worldwide challenge 'Mission-X 2015' talking about regular exercise and nutrition, both on Earth and in space. This is an international programme in which thousands of children, aged 8 to 12 years, from more than 25 countries are encouraged to train like astronauts for nine weeks.

The next ESA astronaut insists that her mission wouldn't be possible without the support of their colleagues. "I derive a strong sense of purpose from being part of the space community, and I will try my best to be worthy of their trust," she says.

The Futura mission will take Samantha higher than she's ever flown before. She invites you to follow this collective journey towards the future.

Follow her at:
http://samanthacristoforetti.esa.int/ ■

Nadjejda Vicente is an HE Space writer for ESA

↑ Several food-tasting events are scheduled during training. Each time Samantha tasted and evaluated about 60 items from the ISS menu (NASA)

→ Gallery: Samantha in training

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Samantha, Terry and Anton during water survival training in Moscow

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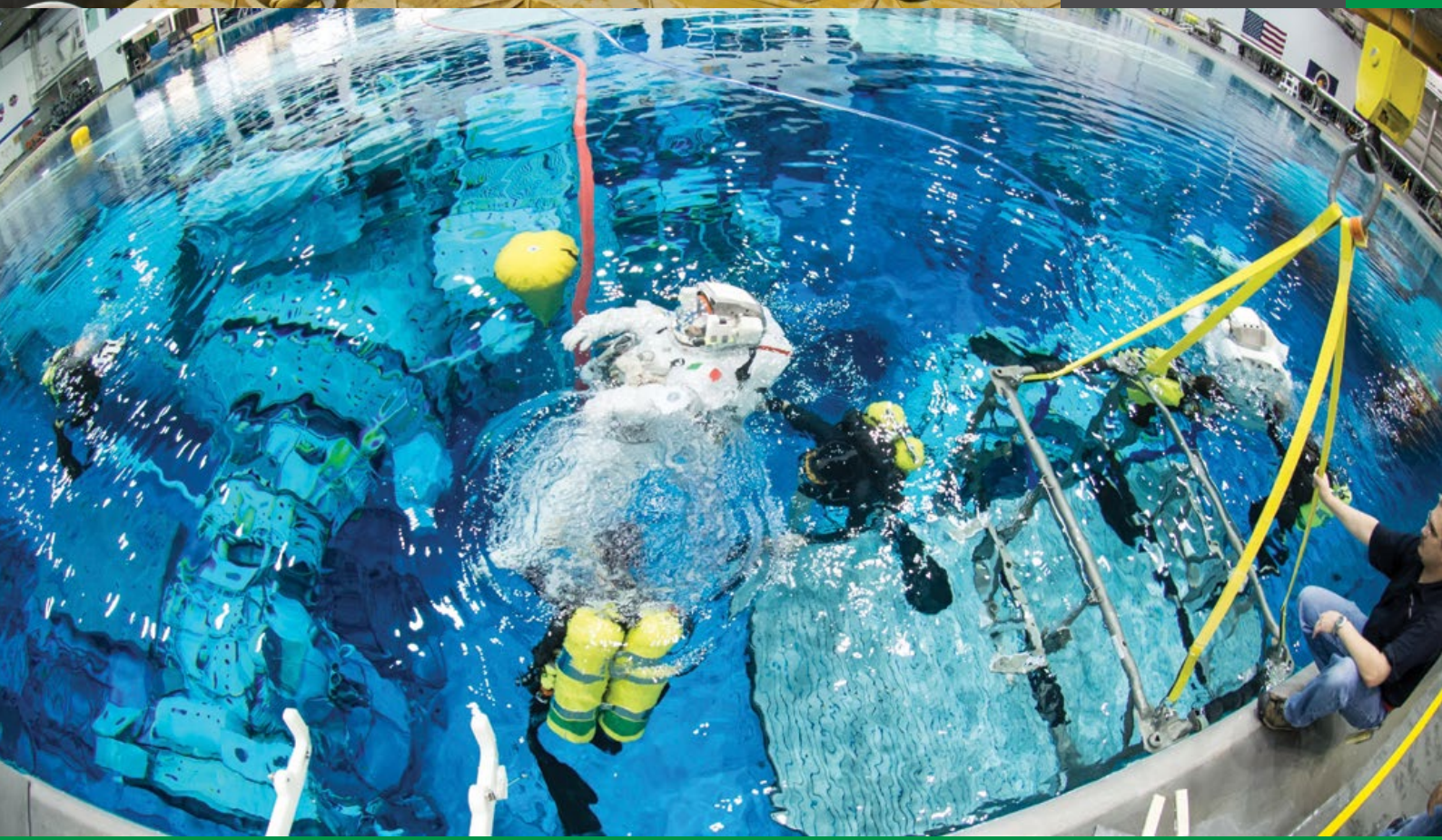
Samantha in the Neutral Buoyancy Laboratory pool, Houston, for spacewalk training (NASA)



↑ A spacewalk training session in the Partial Gravity Simulator test area at NASA's Johnson Space Center, Houston (NASA)

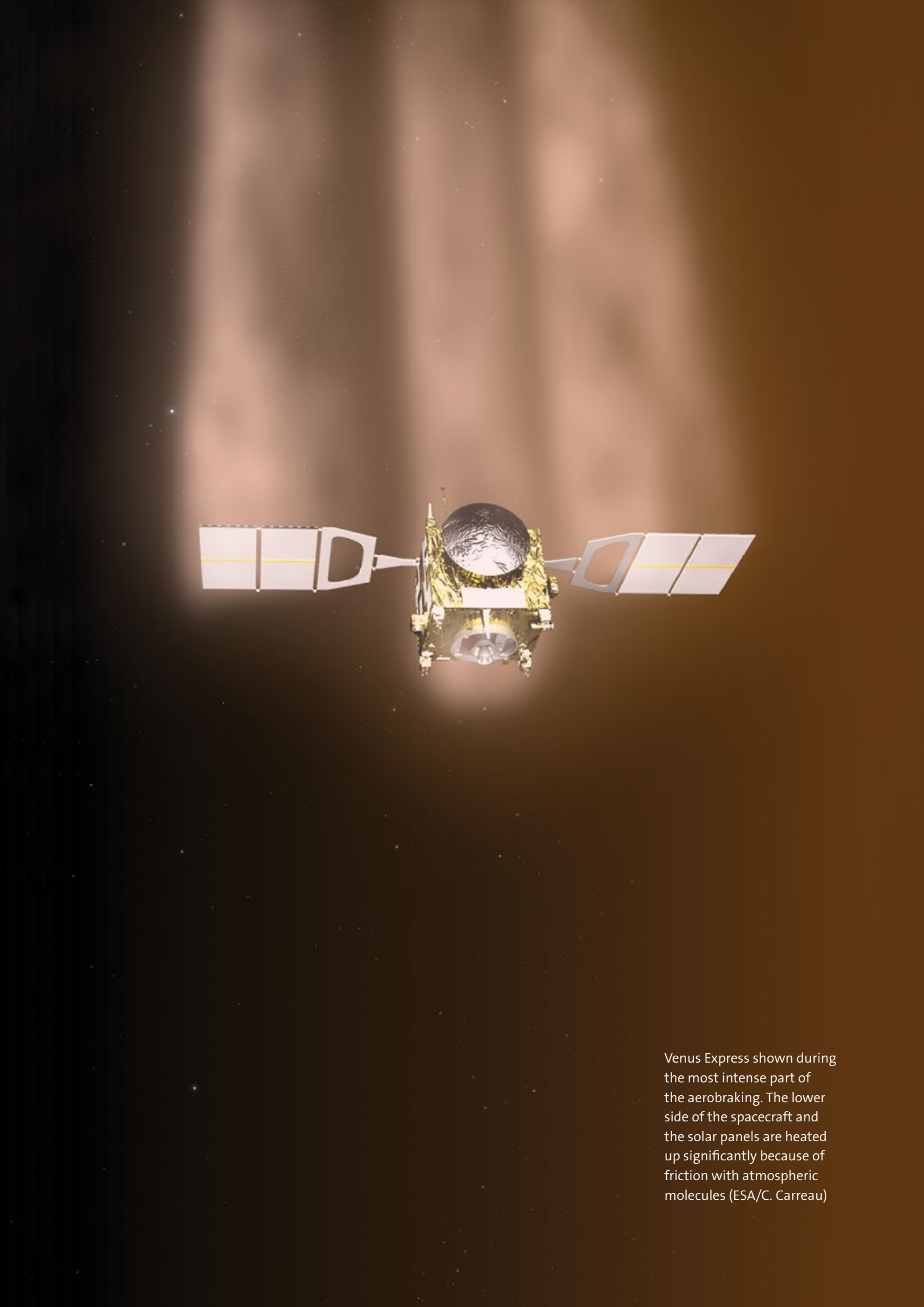
↓ Samantha prepares for Russian Orlan spacesuit training in Moscow (GCTC)

↑ Getting suited up for spacewalk training at NASA's Johnson Space Center, Houston (NASA)

↑ Samantha checks out the US Extravehicular Mobility Unit spacesuit (NASA)

↓ Samantha during winter survival training, Moscow (GCTC)

↓ Samantha enjoys a light moment during a training session in the Space Vehicle Mock-up Facility at NASA's Johnson Space Center (NASA)



Venus Express shown during the most intense part of the aerobraking. The lower side of the spacecraft and the solar panels are heated up significantly because of friction with atmospheric molecules (ESA/C. Carreau)

→ THE RIDE OF A LIFETIME

Aerobraking with Venus Express

Håkan Svedhem
Directorate of Science and Robotic Exploration, ESTEC, Noordwijk, the Netherlands

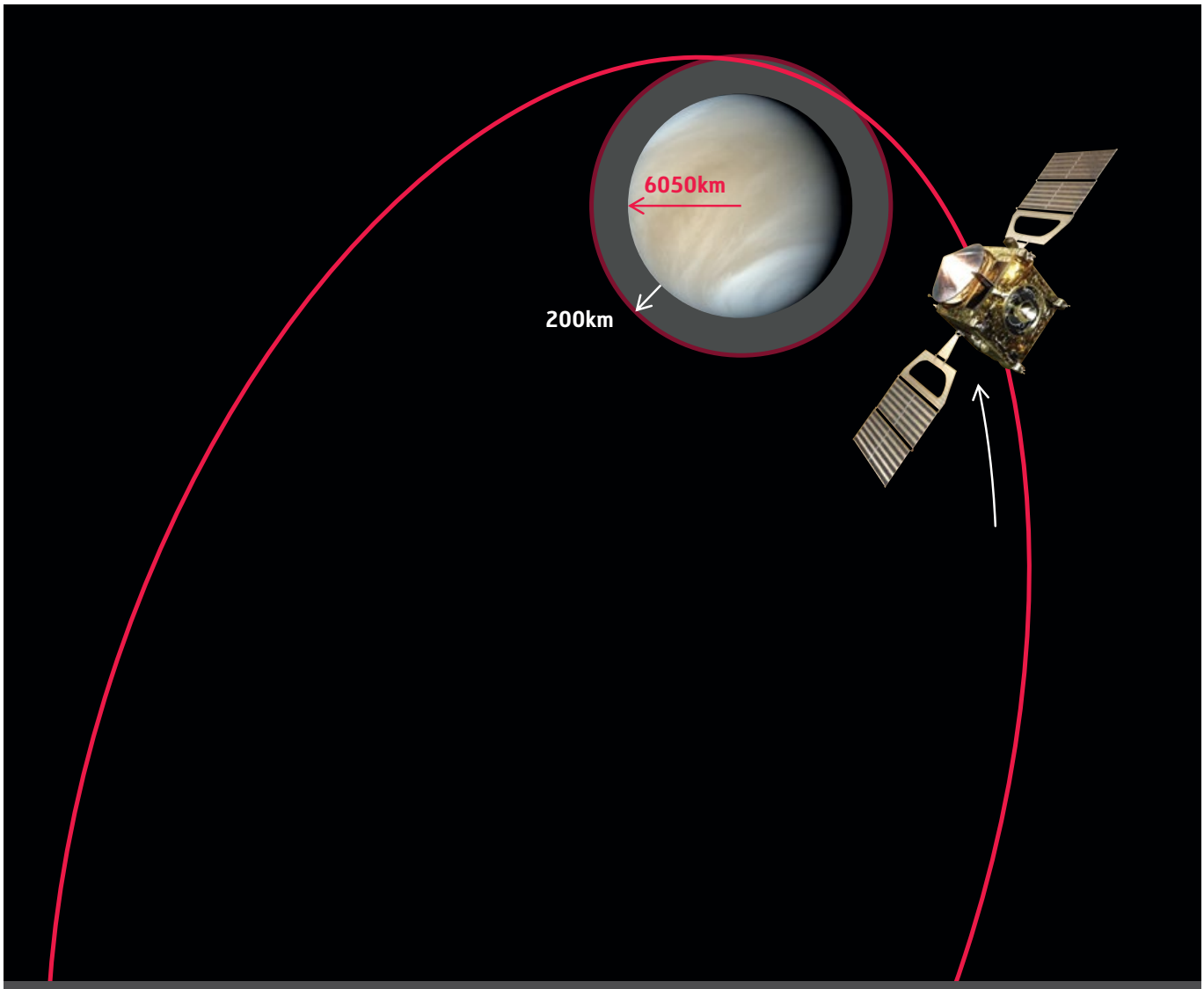
ESA's Venus Express has completed routine science observations but its work isn't over yet. Over the last few months, the spacecraft has made daring plunges into the planet's hostile atmosphere, giving ESA valuable experience in 'aerobraking'.

Currently the only spacecraft orbiting our nearest planetary neighbour, Venus Express was launched from the Baikonur Cosmodrome in Kazakhstan on 9 November 2005 and arrived at Venus on 11 April 2006.

Since then, the spacecraft has carried out observations of Venus and gathered a wealth of information over eight years from its elliptical 24-hour polar orbit. The mission has dramatically enhanced our knowledge about Venus and has sent back to Earth more data than all previous missions to this planet added together.

Over this time, maintenance of the spacecraft's orbit has required a large amount of fuel to be used and Venus Express's tanks are now almost depleted. The natural drift of the orbit is such that the 'pericentre' altitude (i.e. the lowest part of its orbit) is gradually reducing and, in order to make scientific and technical use of this behaviour, it was decided to let the spacecraft dip down into the upper layers of the atmosphere and carry out a series of experimental 'aerobraking' manoeuvres.

Aerobraking is where the aerodynamic drag of an atmosphere against the body of a spacecraft body and its



↑ The orbit of Venus Express, with the spacecraft shown approaching its pericentre (lowest point of the orbit) at 130 km altitude

solar panels reduces the velocity in the lower part of the orbit, which in turn reduces the orbital period and also the 'apocentre' altitude, or highest point of the orbit.

By using aerobraking, a spacecraft in an initial high orbit around a planet with an atmosphere can reduce its orbital period without using a significant amount of fuel. Saving fuel will allow lighter spacecraft and smaller launchers, thus saving significant amounts of money. Alternatively, more and heavier kinds of instruments can be carried to the planet.

In this way, missions that are not feasible using conventional rocket-based techniques of orbit reduction can be made possible. Aerobraking has been used operationally and experimentally by other space agencies but Venus Express is the first ESA spacecraft that has been

"Venus Express has provided useful knowledge both for understanding Venus and for future missions to Venus and other planets with atmospheres."

allowed to dip this deep into a planetary atmosphere and then rise to continue operations.

Venus Express is particularly well suited for such an experiment because, together with its sister spacecraft Mars Express, it was designed for aerobraking just in case the orbit insertion did not work as planned. Fortunately, this back-up procedure was never needed. Now, near the end of the Venus Express mission, the spacecraft design and operational procedures could be tested and verified without risking the mission in its early stages.

New and unique opportunities

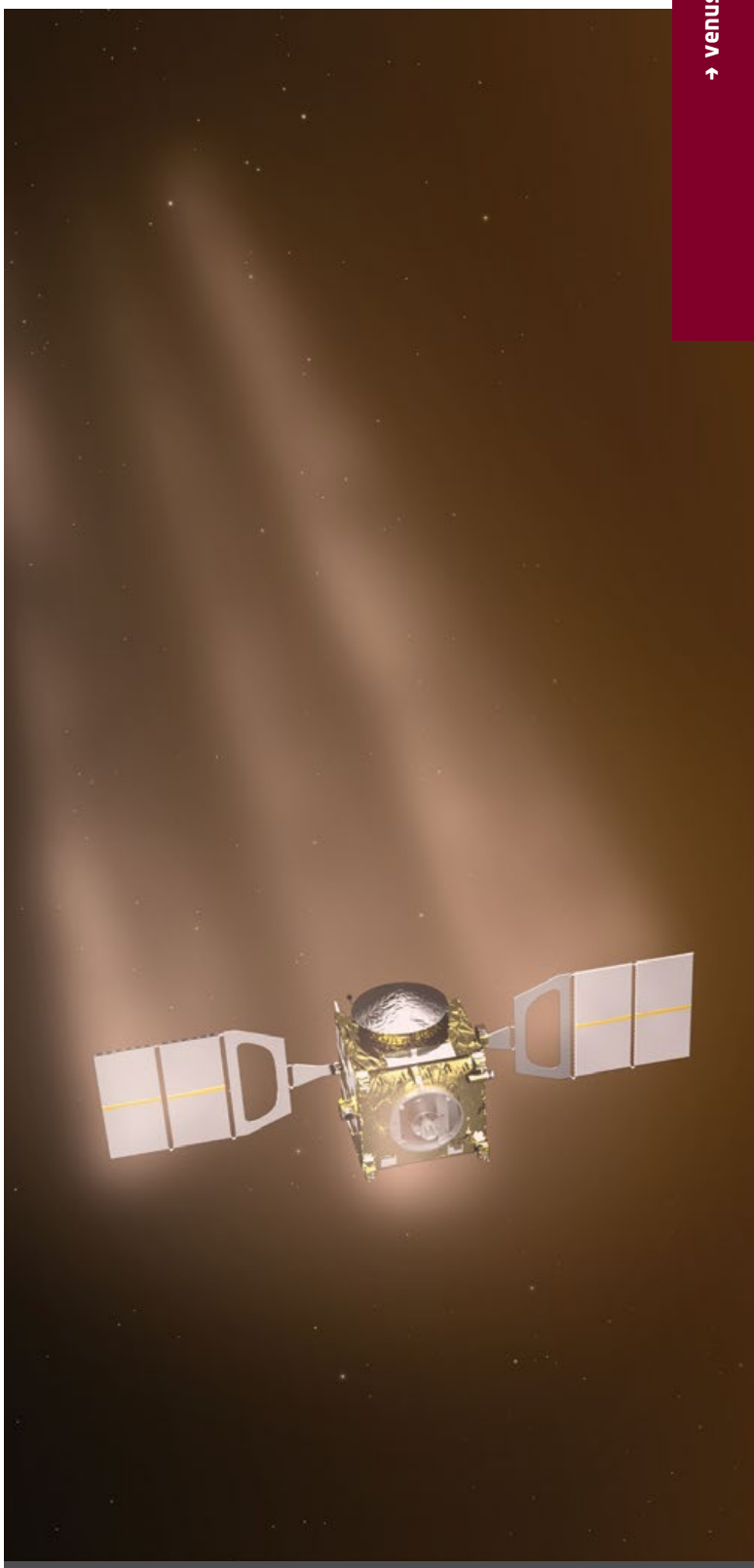
At the same time, valuable scientific data on the atmosphere can be collected that is difficult or impossible to obtain by other methods. Low-altitude operation offers new and unique opportunities for collecting data in the atmosphere throughout the orbital arc. Atmospheric profiles can be collected for each pericentre pass, as well as measurements of magnetic fields and detection and characterisation of energetic particles. These measurements are a major objective of this experimental phase of the mission.

The aerobraking is performed near the lowest point of the orbit by turning the lower end of the spacecraft in the direction of travel, in other words 'against the wind', and by turning the solar panels so that they create the most drag. In its 24-hour orbit around Venus, the 'braking' is only effective for about 100 seconds when Venus Express dips to around 130 km altitude. One pericentre pass slows its speed by about 1 m/s. This amount only has a minor effect on the orbit, so many passes are needed to get a significant change. Missions that have used aerobraking operationally in the past have spent several months repeating these low-altitude passes in order to achieve their desired orbits.

Challenges and risks

There are several major challenges and risks related to these operations. First, the surfaces that are exposed to the airflow will heat up significantly, up to 100 °C or more. Second, if the spacecraft has large solar panels for example, the forces on the joints connecting the panels to the spacecraft can be large. Third, operational procedures must be robust and fail-safe, so that the spacecraft will always enter the atmosphere in the correct attitude and that no emergency 'safe-mode' transitions could endanger the low passes. Finally, uncertainties in the atmospheric density, especially in the variability of the density, need to be considered carefully.

During the experimental campaign between 17 May and 12 July, Venus Express was behaving as expected. During the 'walk in' phase, between 17 May and 18 June, the pericentre altitude was allowed to slowly decrease naturally from 190 km to 137 km. The orbital change was monitored in order to estimate the density of the atmosphere and the effect it would have on the spacecraft. Below 155 km, the onboard accelerometers were providing a direct measure of the deceleration, which is directly proportional to the atmospheric density.



↑ Venus Express during one of its 100-second dives into the venusian atmosphere (ESA/C. Carreau)

A record in aerobraking

The active phase of the aerobraking took place between 18 June and 12 July, when the spacecraft was below an altitude of 137 km. During the first few days of this period, the altitude continued to sink naturally forces and eventually stabilised at about 132 km. The altitude was lowered a few times by activating the spacecraft's thrusters to compensate for changes in the atmospheric density. The lowest altitude reached in this phase was 129.2 km, a record in aerobraking at Venus.

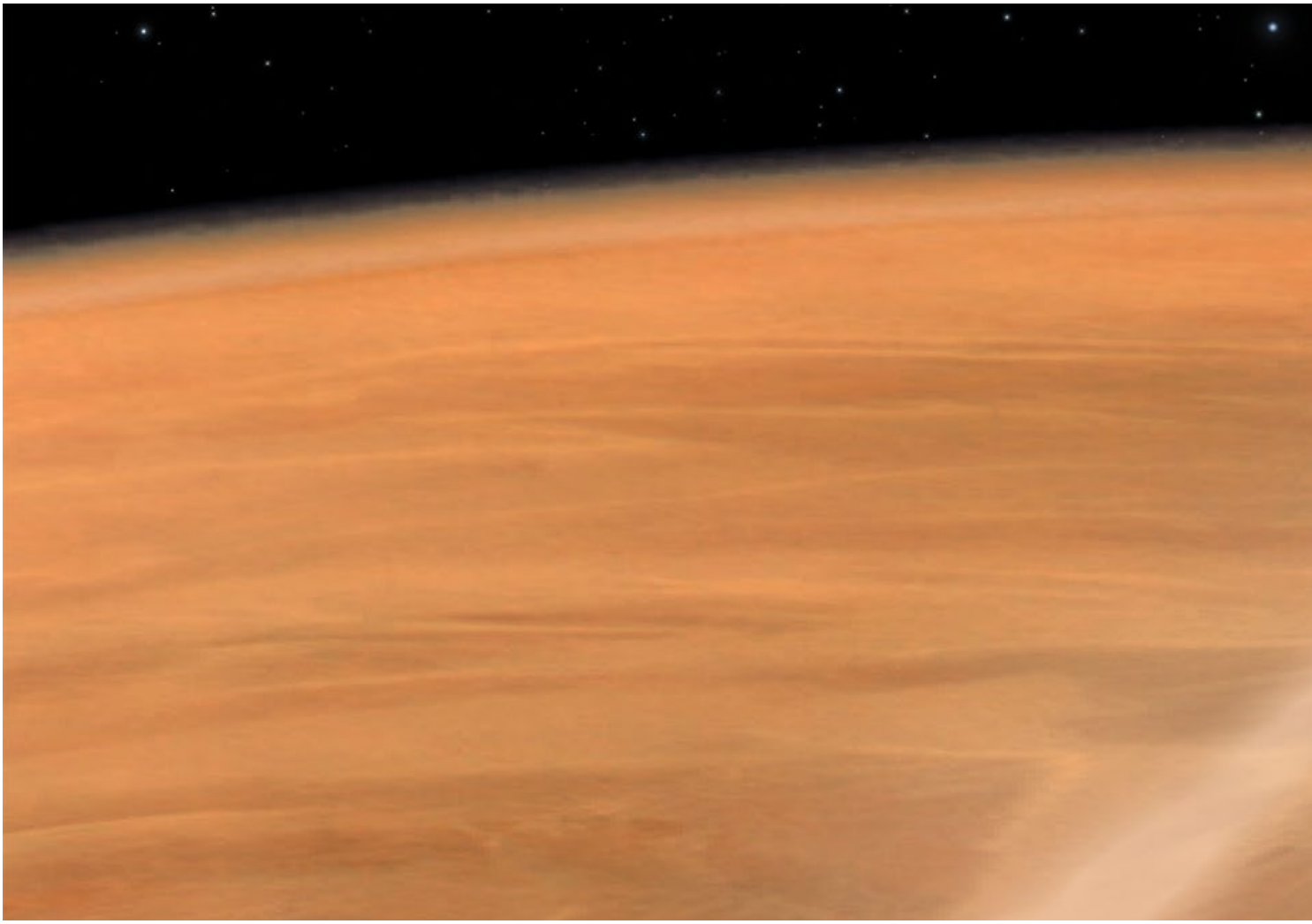
After the end of the aerobraking, the thrusters were fired again to lift the orbit's pericentre out of the atmosphere, increasing the altitude to above 400 km. Reduced science operations by all instruments were started again and, if the fuel lasts, the spacecraft could continue operating until the end of November or possibly even longer.

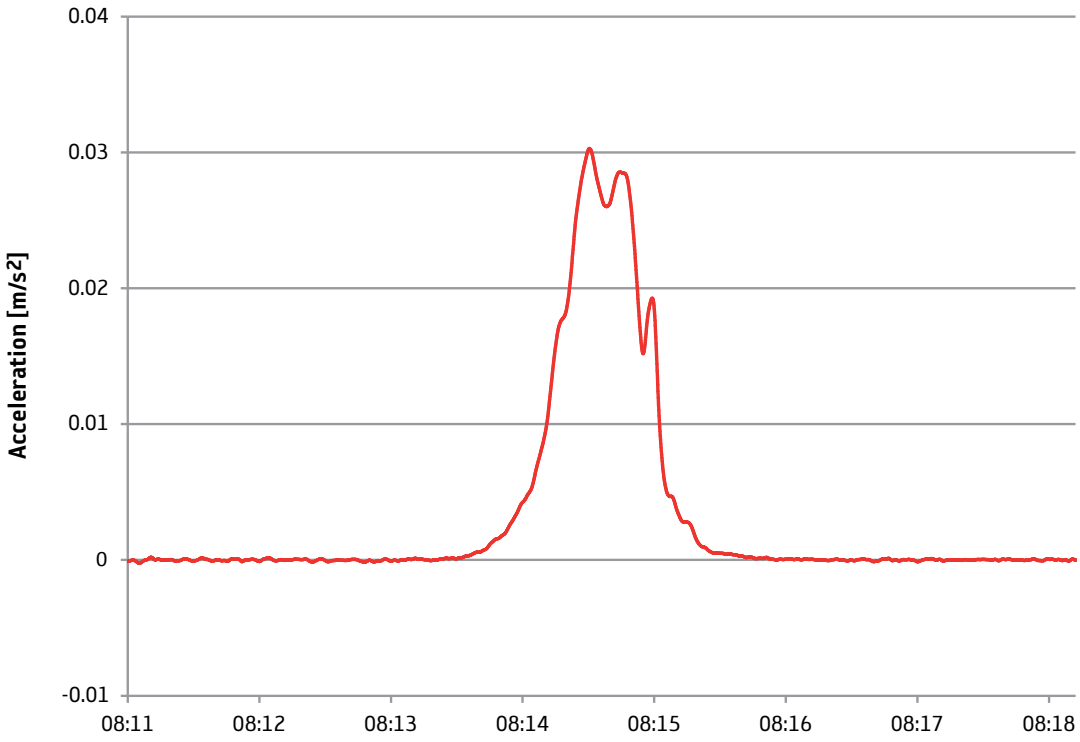
Over the eight weeks of aerobraking, the orbital period was reduced from 24 hours to less than 22.5 hours, corresponding to a total velocity reduction of more than 20 m/s. The efficiency of the aerobraking has been clearly demonstrated.

The spacecraft has not shown any degradation, despite at times experiencing very high heat loads, and operations have been very smooth throughout the whole campaign. During this period, atmospheric density was sampled 55 times and more than 30 atmospheric profiles were gathered.

During each pericentre pass, Venus Express's Magnetometer and Aspera instruments continuously monitored several particle and magnetic field parameters in this new environment. Initial analysis has shown that the atmosphere is much more variable than expected, both along the orbital arcs near the lowest points and from day to day. These data will be analysed in the coming months and will certainly lead to new and improved models and a better understanding of the Venusian atmosphere.

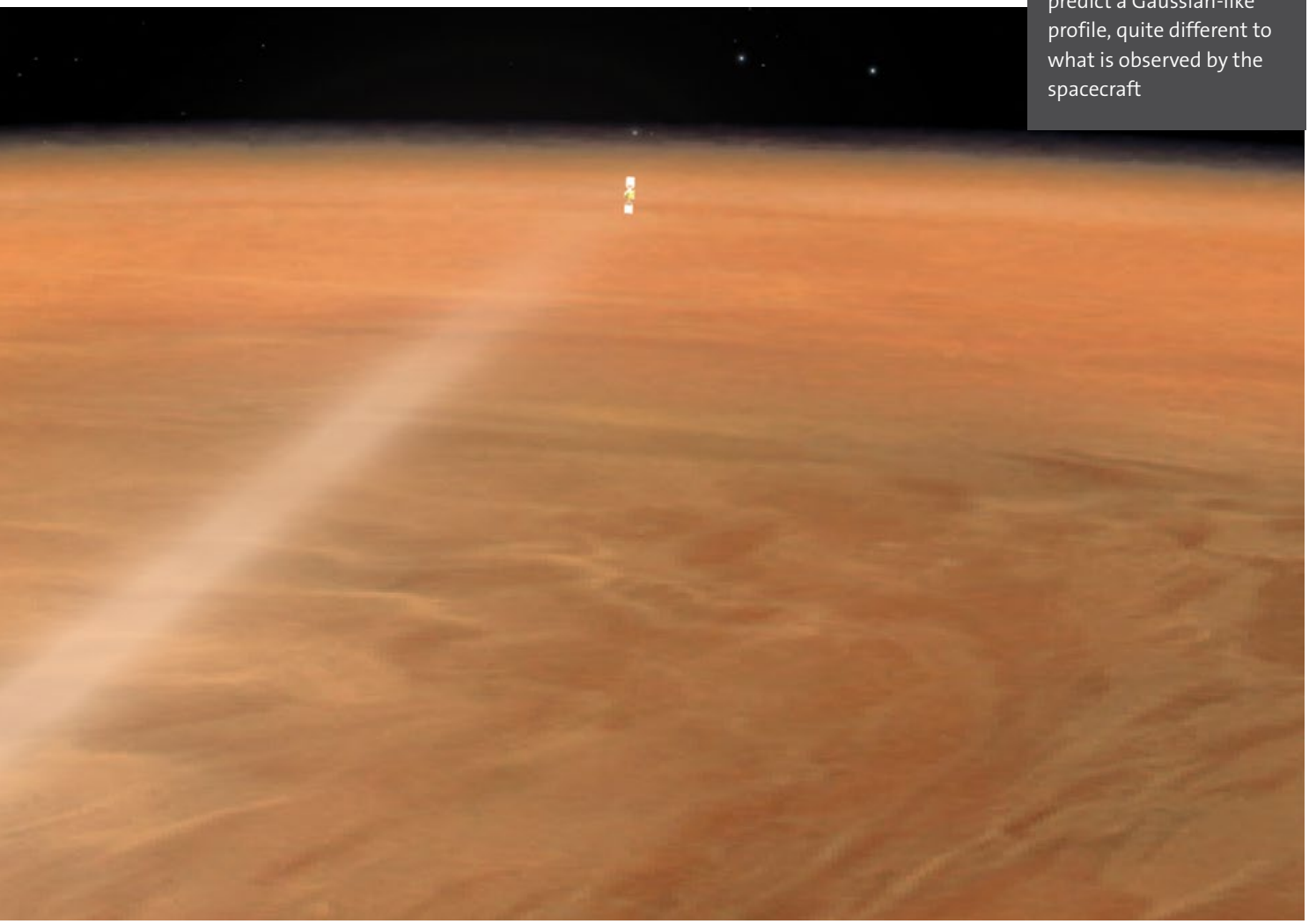
Near the end of its life, after more than eight years in orbit, Venus Express has provided a completely new and unique data set from these low-altitude measurements. It has demonstrated an efficient method to reduce orbital periods without using fuel, very useful knowledge both for understanding Venus and for future missions to Venus and other planets with atmospheres. ■





←

The acceleration of the spacecraft shown as a function of time near the pericentre on 9 July. The pericentre was passed at 08:14:36 and the maximum acceleration was 0.03 m/s² which corresponds to a dynamic pressure of 0.75 N/m² . As can be seen, there seems to be a layered structure or possibly a wave activity going on along the flight path. Several pericentre passes show similar features. This unexpected behaviour is now being characterised and investigated. The atmospheric models used predict a Gaussian-like profile, quite different to what is observed by the spacecraft

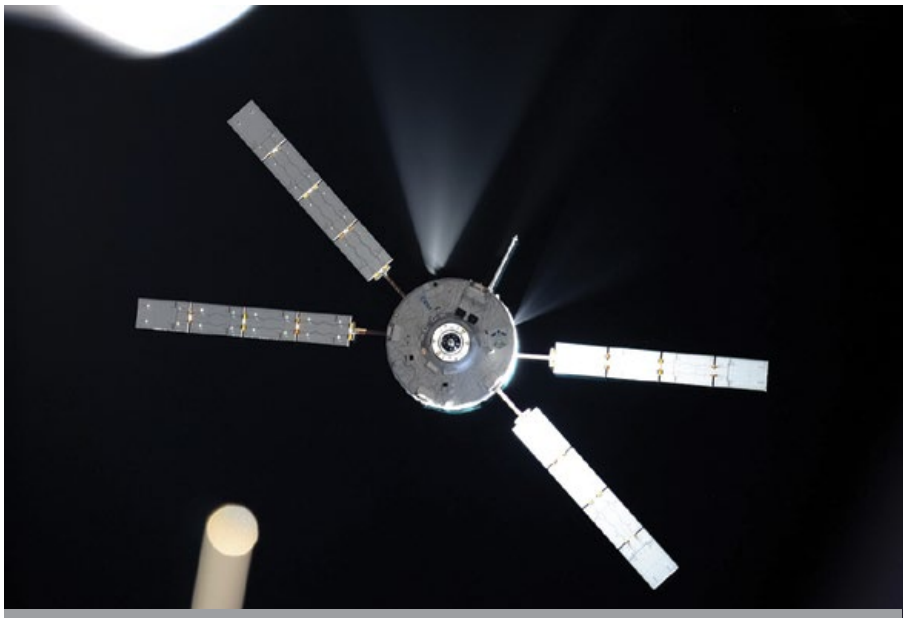


→ NEWS IN BRIEF

Liftoff of Ariane 5 flight VA219 from Europe's Spaceport in French Guiana on 30 July, carrying ESA's last Automated Transfer Vehicle, ATV *Georges Lemaître*, to the International Space Station

Last ATV visits Station

ESA's fifth and final Automated Transfer Vehicle, ATV *Georges Lemaître*, docked flawlessly with the International Space Station on 12 August, for its six-month resupply and reboost mission.



↑ ATV *Georges Lemaître* seen approaching the ISS on 12 August (Roscosmos/O. Artemyev)

The cargo vessel made its successful automated docking with Russia's Zvezda module while being carefully monitored by the ground team, ESA astronaut Alexander Gerst and cosmonaut Sasha Skvortsov on the Station.

Named after the Belgian scientist who formulated the Big Bang Theory, ATV *Georges Lemaître* lifted off on 30 July on an Ariane 5 rocket from Europe's Spaceport in Kourou, French Guiana. With a total launch mass of 20 245 kg, this was the heaviest spacecraft launched by Ariane 5 to date. The vehicle is carrying a record amount of freight, 6602 kg, including 2680 kg of dry cargo and 3922 kg of water, propellants and gases.

This cargo includes complex scientific hardware, such as the Electromagnetic Levitator for experiments to improve industrial casting processes. The unit will allow finer metal castings and more precise measurements than can be obtained on Earth, where readings are affected by gravity. It is also carrying a new pump to recycle urine into drinkable water, a reentry camera to record ATV's eventual controlled destruction after undocking.

The ATV will remain attached until early next year before leaving with waste material for destruction along with the spacecraft during atmospheric reentry.

ESOC presidential visit

↑ ESA Director General Dordain briefs President Gauck on Rosetta at ESOC in May

President Joachim Gauck of Germany made the first-ever visit by a Head of State to ESA's European Space Operations Centre in Darmstadt, Germany, in May.

President Gauck and his party were welcomed by ESA Director General Jean-Jacques Dordain and by Thomas Reiter, ESA Director of Human Spaceflight and Operations, for a guided visit through the centre's mission control facilities.

The visitors were briefed by Director Reiter on the current high pace of ESA activities, including astronaut Alexander Gerst's 'Blue Dot' mission to the International Space Station and the operations of exploration and Earth monitoring satellites. The briefing highlighted Rosetta, which is operated from ESOC and arriving at its comet destination in August.

Rosetta has arrived

After a decade-long journey chasing its target, ESA's Rosetta has today become the first spacecraft to rendezvous with a comet, opening a new chapter in Solar System exploration.

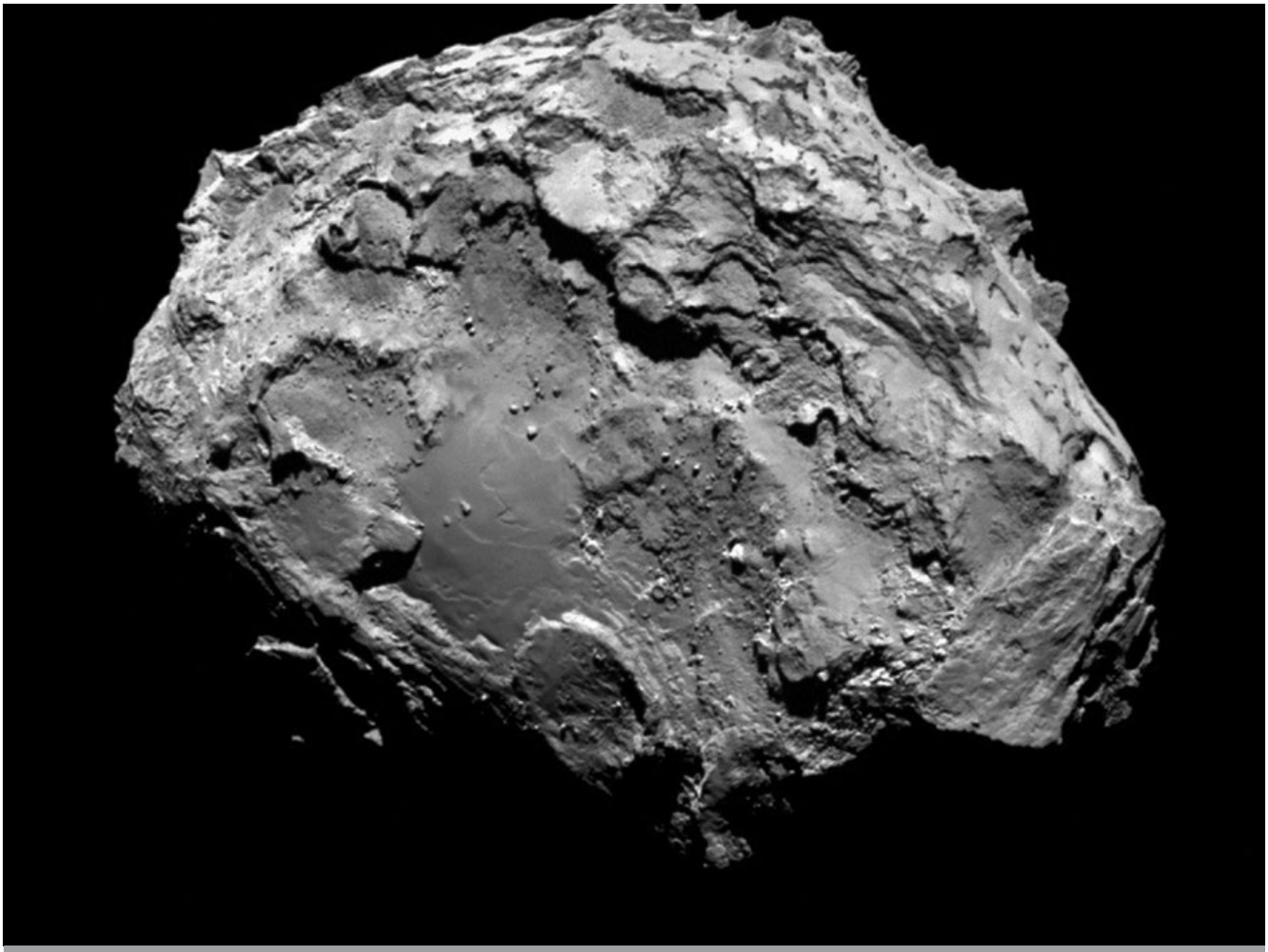
On 6 August, Rosetta completed the last of a series of ten rendezvous manoeuvres that began in May to adjust the spacecraft's speed and trajectory gradually to match those of Comet 67P/Churyumov-Gerasimenko.

ESA Director General Jean-Jacques Dordain said, "After ten years, five months and four days travelling towards our destination, looping around the Sun five times and clocking up 6.4 billion kilometres, we are delighted to announce finally 'we are here'. Europe's Rosetta is now the first spacecraft in history to rendezvous with a comet, a major highlight in exploring our origins. Discoveries can start."

The comet had begun to reveal its personality even earlier, while Rosetta was on its approach. Images taken by the Osiris camera in April and June showed that its activity was variable. The comet's 'coma' – an extended envelope of gas and dust – became rapidly brighter and then died down.

Meanwhile, the Visible and Infrared Thermal Imaging Spectrometer measured the comet's average temperature to be about –70°C, indicating that the surface is mainly dark and dusty rather than clean and icy. Then, stunning images taken from a distance of about 12 000 km began to reveal that the nucleus comprises two distinct segments joined by a 'neck', giving it a duck-like appearance.

As many as five possible landing sites will be identified by late August, before the primary site is identified in mid-September. The timeline for the sequence of events for deploying Philae, planned for 11 November, will be confirmed by the middle of October.



↑ Comet 67P/Churyumov-Gerasimenko viewed from around 285 km by Rosetta (ESA/Rosetta/MPS for Osiris Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)

Swarm confirms changing magnetic fields

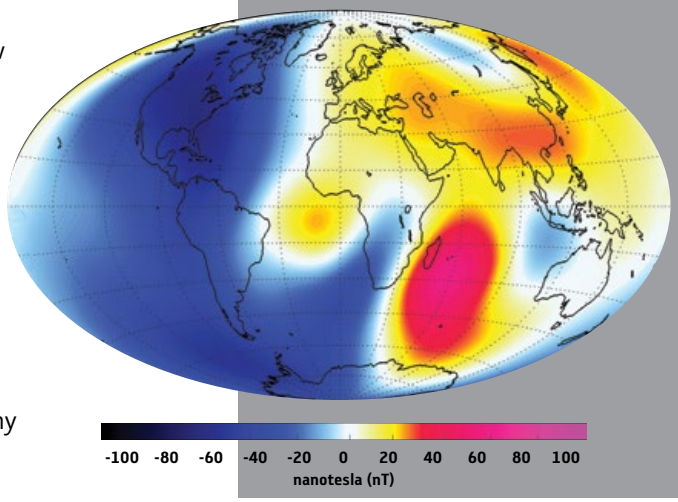
The first set of high-resolution results from ESA's three-satellite Swarm constellation reveals the most recent changes in the magnetic field that protects our planet.

Launched in November 2013, Swarm is providing unprecedented insights into the complex workings of Earth's magnetic field, which safeguards us from the bombarding cosmic radiation and charged particles.

Measurements made over the past six months confirm the general trend of the field's weakening, with the most dramatic declines over the western hemisphere. But in other areas, such as the southern Indian Ocean, the magnetic field has strengthened since January. The latest measurements also confirm the movement of magnetic North towards Siberia.

These changes are based on the magnetic signals stemming from Earth's core. Over the coming months, scientists will analyse the data to unravel the magnetic contributions from other sources, namely the mantle, crust, oceans, ionosphere and magnetosphere.

This will provide new insight into many natural processes, from those occurring deep inside our planet to space weather triggered by solar activity. In turn, this information will yield a better understanding of why the magnetic field is weakening.



↓ Changes in Earth's magnetic field from January to June 2014 as measured by Swarm. Red represents areas of strengthening, while blue shows areas of weakening over six months (ESA/DTU Space)

Mission name for Tim Peake

↑ Tim Peake with winners of the mission-naming competition at the Royal Society, London (UK Space Agency/M. Alexander)

In recognition of the world-changing set of books written by the famous British scientist Sir Isaac Newton, ESA astronaut Tim Peake has chosen 'Principia' as the name of his six-month mission to the ISS in 2015.

The name refers to the *Philosophiæ Naturalis Principia Mathematica*, regarded as one of the most important works in the history of science. Published over 400 years ago, the Principia states Newton's laws of motion, forming the foundation of classical mechanics, and also Newton's law of universal gravitation.

Famously pondering why apples fall from trees, Newton's observations about gravity are now at the heart of spaceflight. Tim Peake will spend six months living without gravity, the first time a British ESA astronaut will visit the International Space Station.

Tim said: "I am delighted with this name that honours one of Britain's most famous scientists. I hope it will also encourage people to observe the world as if for the first time – just as Isaac Newton did. Our planet Earth is a precious and beautiful place and we all need to safeguard it."

More than 4000 people replied to ESA's call for a mission name earlier this year and 20 entries suggested Principia.

ESA on show in the Space Zone

Visitors to the Farnborough International Airshow in the UK were able to enjoy ESA's exhibition highlighting its achievements and plans in a dedicated Space Zone in July.

One of the world's largest aerospace trade shows, Farnborough brings together key players from the international aerospace community, industry, space agencies and trade visitors interested in discovering the latest developments and business opportunities.

Main exhibitors in the Space Zone this year included ESA, Russia's Roscosmos, the UK Space Agency, Airbus Defence & Space, Qinetiq and Surrey Satellite Technology Ltd.

This year, when ESA and its Member States are celebrating 50 years of European cooperation in space, ESA's exhibition underlined the importance of building on past achievements in space science, exploration and applications to shape the future of Europe in this strategic sector.

The exhibition showed the wealth of recent mission results and upcoming launches across all space domains. It also highlighted ESA's new centre in the UK: ECSAT, the European Centre for Space Applications and Telecommunications, which focuses on telecommunications, integrated applications, climate change, technology and science.

→

Left to right: David Parker, Head of UK Space Agency; Robert Goodwill, Parliamentary Under Secretary of State for Transport, UK; Andy Green, Co-Chair of the UK Space Leadership Council; George C. Nield, Associate Administrator for Commercial Space Transportation, FAA; Jean-Jacques Dordain, ESA Director General, and Magali Vaissiere, ESA Director of Telecommunications and Integrated Applications, at Farnborough in July

→

ESA astronaut Tim Peake with UK participants of the Mission-X challenge during Futures Day at the Farnborough International Air Show in July

Spaceplane ready for launch

All eyes are on ESA's Intermediate eXperimental Vehicle (IXV) to showcase reentry technologies after its unconventional launch on a Vega rocket this November.

ESA's IXV spaceplane will flight-test the technologies and critical systems for Europe's future automated reentry vehicles returning from low orbit. The vehicle is now at ESTEC in the Netherlands, where engineers are making final tests, to check that IXV can withstand the extreme conditions from liftoff to separation from Vega.

IXV weighs almost two tonnes, close to Vega's lifting capacity, and will be a tight fit inside the vehicle's fairing. Instead of heading north into a polar orbit – as on previous flights – Vega will head eastwards to release the spaceplane into a suborbital path reaching all the way to the Pacific Ocean.

When IXV splashes down at the end of its mission, it will be recovered by ship and returned to Europe for detailed analysis to assess the performance and condition of the internal and external structures.

The research and industrial community will have the chance to use this information for progress in atmospheric reentry, oriented towards transportation systems with applications in exploration, science, Earth observation and microgravity.

↑ ESA's IXV reentry technologies demonstrator under test at ESTEC, Noordwijk

Signature of ESA/EU delegation agreements for Galileo and EGNOS

←

Jean-Jacques Dordain, ESA Director General, and Daniel Calleja Crespo, Director General for Enterprise and Industry at the European Commission, during the signature of the delegation agreement on the deployment phase of the European satellite radio-navigation programme Galileo, and the signature of the 4th amendment to the delegation agreement on the further implementation of the European satellite navigation programme EGNOS, at ESA headquarters in Paris, on 16 July 2014

ESA science mission selected

The Athena advanced telescope for high-energy astrophysics has been selected as ESA's second 'Large-class' science mission.

The observatory will study the hot and energetic Universe and takes the 'L2' slot in ESA's Cosmic Vision 2015–25 plan, with a launch foreseen in 2028.

By combining a large X-ray telescope with state-of-the-art scientific instruments, Athena will address key questions in astrophysics, including: how and why does ordinary matter assemble into the galaxies and galactic clusters that we see today? How do black holes grow and influence their surroundings?

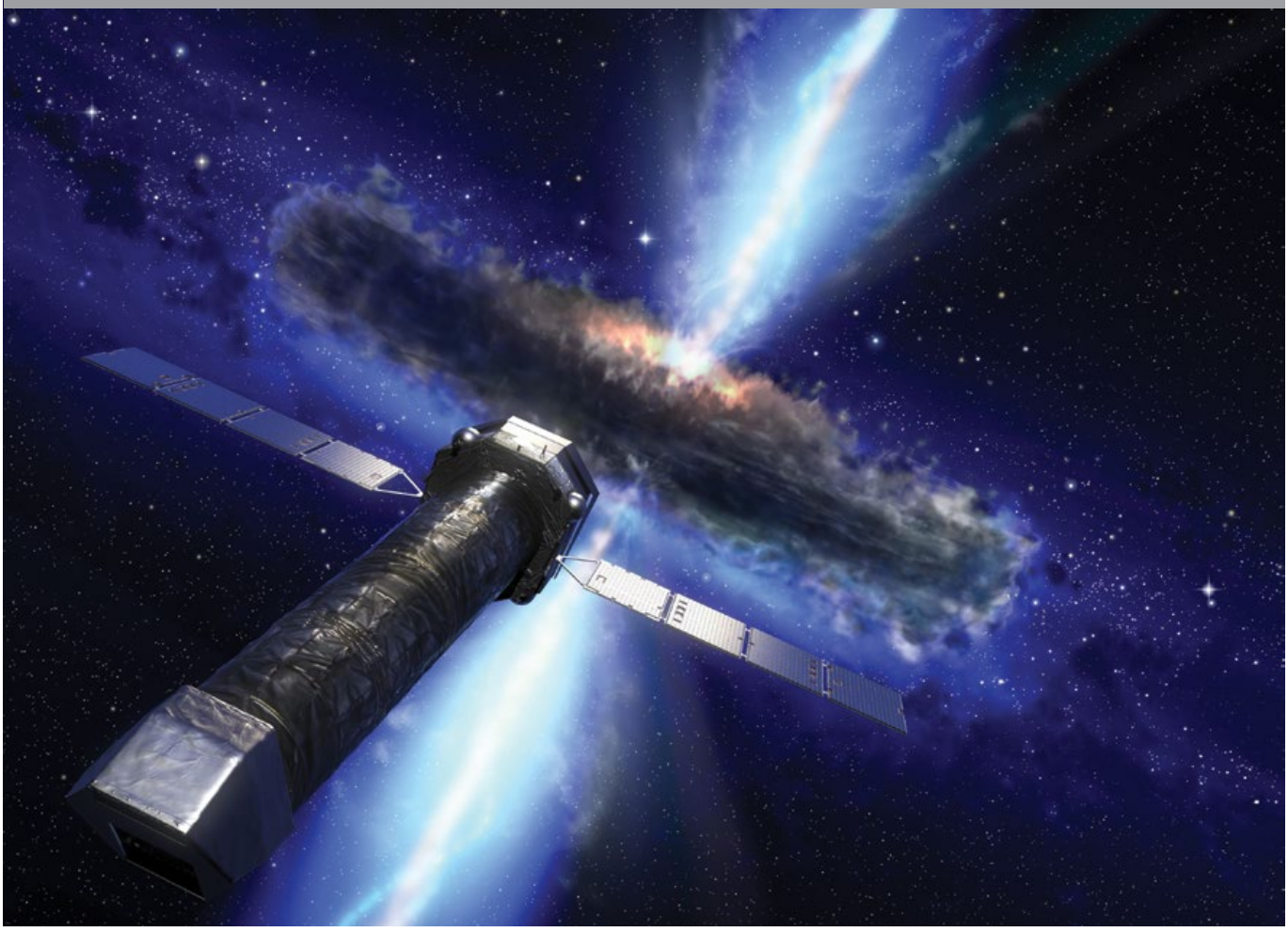
Scientists believe that black holes lurk at the centre of almost all galaxies and that they play a fundamental role in their formation and evolution. To investigate this connection, Athena will observe X-ray emission from very hot material just before it is swallowed by a black hole, measuring distortions due to gravitational light-bending and time-delay effects in this extreme environment.

Athena's powerful instruments will also allow unprecedented studies of a wide range of astronomical phenomena. These include distant gamma-ray bursts, the hot gas found in the space around clusters of galaxies, the magnetic interplay between exoplanets and their parent stars, Jupiter's auroras and comets in our own Solar System.

The Athena observatory that will ensure that Europe's success in the field of X-ray astronomy is maintained beyond the lifetime of ESA's flagship observatory XMM-Newton.

The selection process for L2 began in March 2013, when ESA issued a call to the European science community to suggest the scientific themes to be pursued by the Cosmic Vision programme's second and third Large missions. Athena now moves into a study phase and once mission design and costing have been completed, it will be proposed for 'adoption' in around 2019, before the start of construction.

↓ The Athena observatory

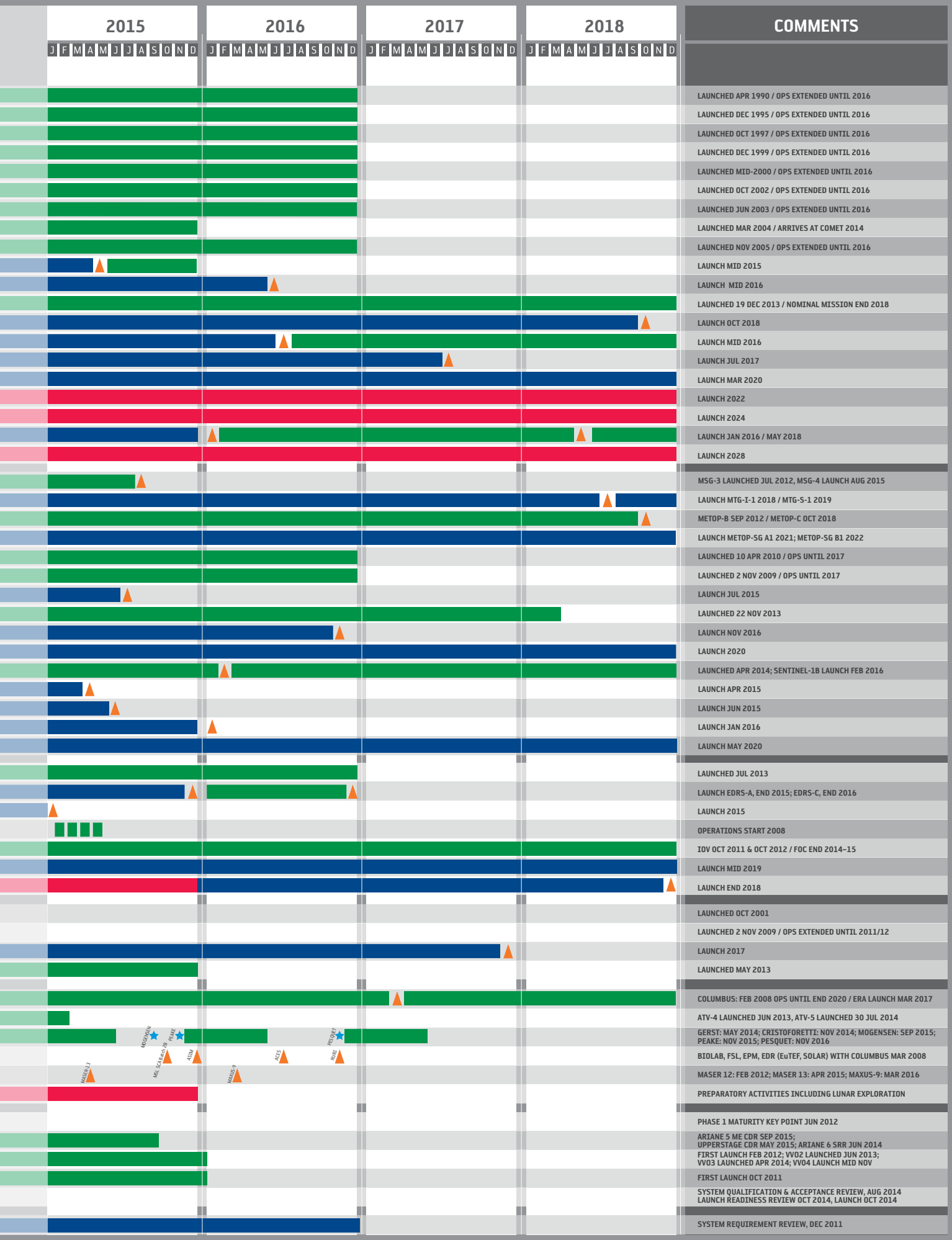


→ PROGRAMMES IN PROGRESS

Status at end July 2014

The prototype of the suborbital IXV Intermediate eXperimental Vehicle is recovered off the coast of Tuscany, Italy, on 23 June 2014, in a practice run for the launch of the real spacecraft in November (Neri/Livorno)


2011
2012
2013
2014
J F M A M J J A S O N D
SCIENCE & ROBOTIC EXPLORATION PROGRAMME
HUBBLE
SOHO
CASSINI-HUYGENS
XMM-NEWTON
CLUSTER
INTEGRAL
MARS EXPRESS
ROSETTA
VENUS EXPRESS
LISA PATHFINDER
MICROSCOPE
GAIA
JWST
BEPICOLOMBO
SOLAR ORBITER (M1)
EUCLID (M2)
JUICE (L1)
PLATO (M3)
EXOMARS
ATHENA (L2)
EARTH OBSERVATION PROGRAMME
MSG
MTG
METOP
METOP-SG
CRYOSAT
SMOS
AEOLUS
SWARM
EARTHCARE
BIOMASS
SENTINEL-1
SENTINEL-2
SENTINEL-3
SENTINEL-5 PRECURSOR
SENTINEL-6
TELECOMMS/NAVIGATION PROGRAMMES
ALPHASAT
EDRS
SMALLGEO
GNSS-1/EGNOS
GALILEO
ELECTRA
NEOSAT
TECHNOLOGY PROGRAMME
PROBA-1
PROBA-2
PROBA-3
PROBA-V
HUMAN SPACEFLIGHT PROGRAMME
COLUMBUS / NODE-2 / NODE-3 / CUPOLA / ERA
ATV
ASTRONAUT FLIGHTS
ELIPS ISS UTILISATION
ELIPS NON-ISS PAYLOADS
TRANSPORTATION & HUMAN EXPLORATION
MASER 1-2
LAUNCHER PROGRAMME
ARIANE 5 POST-ECA
ARIANE 5 ME & ARIANE 6
VEGA
SOYUZ AT CSG
IXV
SSA
PERIOD 2
DEFINITION PHASE
MAIN DEVELOPMENT PHASE
OPERATIONS


2015
J F M A M J J A S O N D
2016
J F M A M J J A S O N D
2017
J F M A M J J A S O N D
2018
J F M A M J J A S O N D
COMMENTS
LAUNCHED APR 1990 / OPS EXTENDED UNTIL 2016
LAUNCHED DEC 1995 / OPS EXTENDED UNTIL 2016
LAUNCHED OCT 1997 / OPS EXTENDED UNTIL 2016
LAUNCHED DEC 1999 / OPS EXTENDED UNTIL 2016
LAUNCHED MID-2000 / OPS EXTENDED UNTIL 2016
LAUNCHED OCT 2002 / OPS EXTENDED UNTIL 2016
LAUNCHED JUN 2003 / OPS EXTENDED UNTIL 2016
LAUNCHED MAR 2004 / ARRIVES AT COMET 2014
LAUNCHED NOV 2005 / OPS EXTENDED UNTIL 2016
LAUNCH MID 2015
LAUNCH MID 2016
LAUNCHED 19 DEC 2013 / NOMINAL MISSION END 2018
LAUNCH OCT 2018
LAUNCH MID 2016
LAUNCH JUL 2017
LAUNCH MAR 2020
LAUNCH 2022
LAUNCH 2024
LAUNCH JAN 2016 / MAY 2018
LAUNCH 2028
MSG-3 LAUNCHED JUL 2012, MSG-4 LAUNCH AUG 2015
LAUNCH MTG-I-1 2018 / MTG-S-1 2019
METOP-B SEP 2012 / METOP-C OCT 2018
LAUNCH METOP-SG A1 2021; METOP-SG B1 2022
LAUNCHED 10 APR 2010 / OPS UNTIL 2017
LAUNCHED 2 NOV 2009 / OPS UNTIL 2017
LAUNCH JUL 2015
LAUNCHED 22 NOV 2013
LAUNCH NOV 2016
LAUNCH 2020
LAUNCHED APR 2014; SENTINEL-1B LAUNCH FEB 2016
LAUNCH APR 2015
LAUNCH JUN 2015
LAUNCH JAN 2016
LAUNCH MAY 2020
LAUNCHED JUL 2013
LAUNCH EDRS-A, END 2015; EDRS-C, END 2016
LAUNCH 2015
OPERATIONS START 2008
IOV OCT 2011 & OCT 2012 / FOC END 2014–15
LAUNCH MID 2019
LAUNCH END 2018
LAUNCHED OCT 2001
LAUNCHED 2 NOV 2009 / OPS EXTENDED UNTIL 2011/12
LAUNCH 2017
LAUNCHED MAY 2013
COLUMBUS: FEB 2008 OPS UNTIL END 2020 / ERA LAUNCH MAR 2017
ATV-4 LAUNCHED JUN 2013, ATV-5 LAUNCHED 30 JUL 2014
GERST: MAY 2014; CRISTOFORETTI: NOV 2014; MOGENSEN: SEP 2015; PEAKE: NOV 2015; PESQUET: NOV 2016
BIOLAB, FSL, EPM, EDR (EuTEF, SOLAR) WITH COLUMBUS MAR 2008
MASER 12: FEB 2012; MASER 13: APR 2015; MAXUS-9: MAR 2016
PREPARATORY ACTIVITIES INCLUDING LUNAR EXPLORATION
PHASE 1 MATURITY KEY POINT JUN 2012
ARIANE 5 ME CDR SEP 2015;
UPPERSTAGE CDR MAY 2015; ARIANE 6 SRR JUN 2014
FIRST LAUNCH FEB 2012; VV02 LAUNCHED JUN 2013;
VV03 LAUNCHED APR 2014; VV04 LAUNCH MID NOV
FIRST LAUNCH OCT 2011
SYSTEM QUALIFICATION & ACCEPTANCE REVIEW, AUG 2014
LAUNCH READINESS REVIEW OCT 2014, LAUNCH OCT 2014
SYSTEM REQUIREMENT REVIEW, DEC 2011
MOGENSEN
PEAKE
PESQUET
ASIM
ACES
MASER 13
MAXUS-9
STORAGE
ADDITIONAL LIFE
LAUNCH/READY FOR LAUNCH
ASTRONAUT FLIGHT

KEY TO ACRONYMS

AM - Avionics Model	ITT - Invitation to Tender
AO - Announcement of Opportunity	LEOP- Launch and Early Orbit Phase
AIT - Assembly, integration and test	MoU- Memorandum of Understanding
AU - Astronomical Unit	PDR - Preliminary Design Review
CDR - Critical Design Review	PFM- Proto-flight Model
CSG - Centre Spatial Guyanais	PLM- Payload Module
EFM - Engineering Functional Model	PRR - Preliminary Requirement Review
ELM - Electrical Model	QM - Qualification Model
EM - Engineering Model	SM - Structural Model
EMC - Electromagnetic compatibility	SRR - System Requirement Review
EQM- Electrical Qualification Model	STM- Structural/Thermal Model
FAR - Flight Acceptance Review	SVM- Service Module
FM - Flight Model	TM - Thermal Model

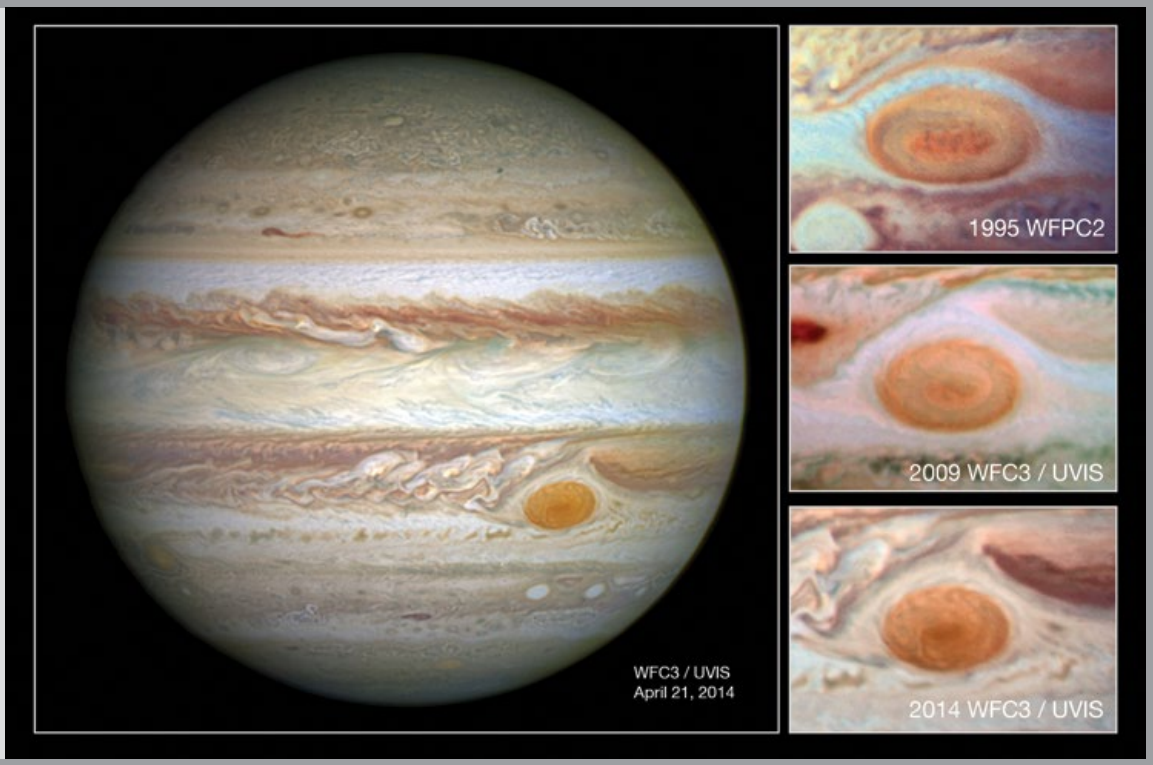
Composite image of the Bullet Group showing galaxies, hot gas (pink) and dark matter (blue) (ESA/F. Gastaldello/ INAF/IASF/CFHTLS)

→ HUBBLE SPACE TELESCOPE

Jupiter's Great Red Spot is shrinking. This downsizing, which is changing the shape of the spot from an oval into a circle, has been known about since the 1930s, but now striking new Hubble images capture the spot at a smaller size than ever before. Historical observations as far back as the late 1800s measured this anticyclonic storm at 41 000 km at its widest point — three times Earth's diameter. In 1979 and 1980, the NASA Voyager flybys measured the spot at 23 335 km across. Recent Hubble observations have confirmed that the spot is now just under 16 500 km across, the smallest diameter ever measured. Amateur observations starting in 2012 revealed a noticeable increase in the spot's shrinkage rate. The spot is getting smaller by about 1000 km per year. The cause of this shrinkage is not yet known.

→ XMM-NEWTON

Galaxies are not as isolated as they may seem at a first glance; on a cosmic scale they congregate into clumps along with dark matter and hot gas. The colourful blob in this new composite image, based on data from several telescopes including ESA's XMM-Newton, is the group of galaxies known as the Bullet Group. Its components appear to be clearly separated, with the hot gas partitioned from the rest of the mass within the group. This is the smallest object ever found to show such an effect, which was probably caused by a merger in the group's past.



Jupiter's Great Red Spot — one of the most iconic and well-known features in the solar system — is shrinking (NASA/ESA/ GSFC/A. Simon)

→ CASSINI

The origin of Titan's atmospheric nitrogen was determined in a recent study and a 'genetic' link established with 'Oort Cloud' comets. Nitrogen exists in different atomic called isotopes, and the relative abundance of each isotope (the isotopic ratio) found within a planetary body or its atmosphere is an important marker of the history of the body's formation. The study showed that the isotopic ratio for atmospheric nitrogen measured over time by Cassini-Huygens at Titan cannot have changed significantly since the formation of the Solar System. Therefore, Titan's current nitrogen isotopic ratio must be representative of the value at the time of its formation.

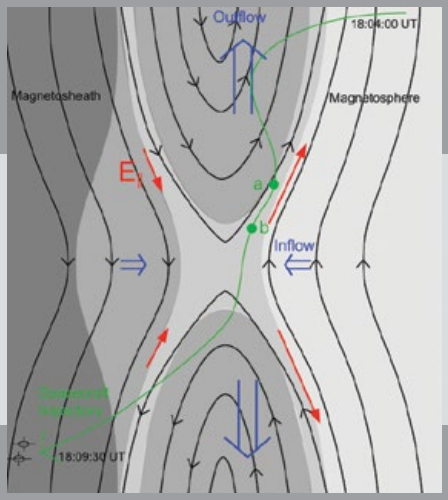
Also, the nitrogen isotopic ratio for Titan appears to be similar to the value found for Oort Cloud comets. These results provide strong evidence that Titan's building blocks originated in the same region of the proto-planetary nebula where these comets also formed.

This study brings an interesting new clue toward understanding the Solar System formation by establishing the compositional similarities between objects expected to have formed under similar physical conditions in the proto-planetary nebula. In this context, similar measurements by Rosetta of the nitrogen isotopic ratio at Comet 67P/Churyumov-Gerasimenko are eagerly expected; there should be differences with Titan, because this comet belongs to a comet family that formed at much greater distances from the Sun, beyond the orbit of Neptune, in the Kuiper Belt.

→ CLUSTER

Magnetic reconnection is a hot topic in plasma physics, both in space and in laboratory experiments on Earth. It is indeed a universal process behind some of the most explosive phenomena in space (for example, neutron star outbursts and solar flares) while perturbing experimental nuclear fusion reactors.

A protoplanetary disc around a young star. The building blocks of comets, and apparently Saturn's largest moon Titan, formed under similar conditions in the disc of gas and dust that formed the Sun (NASA/JPL/Caltech)



The trajectory of the Cluster spacecraft (green) crossing the reconnection region. The spacecraft detected solar wind (60 eV) and magnetospheric electrons (a few keV) outside of the diffusion region (a). When they approached the centre of the reconnection region (b), they observed accelerated solar wind electrons (200 eV). The solid lines represent the magnetic field, light and dark grey represent low and high density (DB Graham/IRF-U Sweden)

In Earth's space environment, magnetic reconnection creates holes in our planet's magnetic shield, enabling solar wind plasma to penetrate and reach Earth. There are two main types of reconnection. One is called symmetric, where the two interacting plasmas have the same properties, such as in the tail of the magnetosphere. The other one, called asymmetric, occurs when the two plasmas have different properties. The symmetric case is simpler and relatively well understood. However, the asymmetric case is more general and less understood; it occurs in the solar atmosphere, the solar wind and the dayside of the magnetosphere.

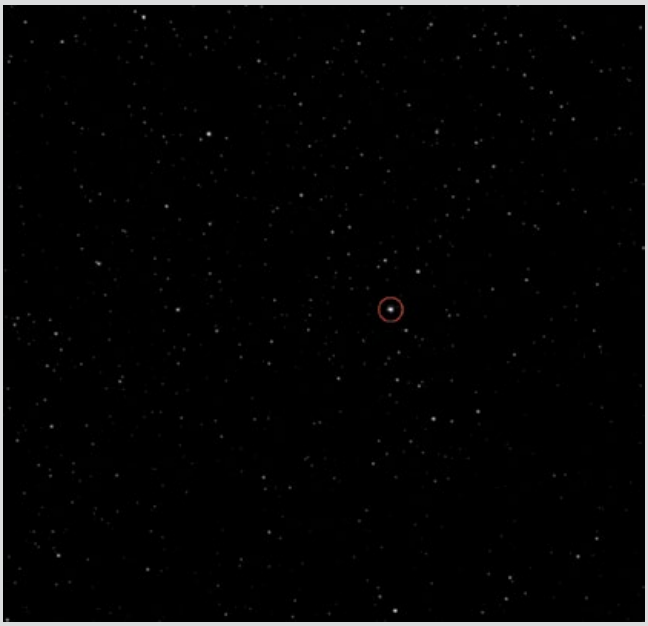
Scientists from the Institute of Space Physics, Uppsala, Sweden, have studied in details an asymmetric reconnection event. They showed that electric fields parallel to the magnetic field are the main process that accelerates and heats electrons. The development of electron acceleration could then be followed as the Cluster spacecraft crossed the centre of the reconnection region (also called diffusion region).

→ INTEGRAL

Ultraluminous X-ray sources (ULXs) are point-like X-ray sources found in nearby galaxies, with luminosities of 10^{39}–10^{41} erg/s. Their nature remains unknown.

Until recently, X-ray observations of ULXs were carried out predominantly at energies below 10 keV. Hard X-ray observations could provide additional valuable information, but were impossible because even the brightest ULXs are faint in X-ray and they are usually located in actively star-forming galaxies with high number density of X-ray sources.

With Integral, it has become possible for the *first* time to overcome these difficulties. Since late 2009, Integral has been performing a series of observations of the M81 group of galaxies, which contains two bright ULXs: Holmberg (Ho) IX X-1 and M82 X-1. As part of the same project, the XMM-Newton observatory performed a series of X-ray observations of Ho IX X-1 and M82 X-1 in 2011.



Two images of Rosetta's target comet, 67P/Churyumov-Gerasimenko, seen on 30 April (left) and 4 June (right) by the Osiris Narrow Angle Camera. The comet's activity has declined since April/May, showing the unpredictable nature of these objects and the excitement in store for Rosetta! (ESA/Rosetta/MPS for Osiris/MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)

It would be impossible for Rosetta to reach its destination without the 'spacecraft navigators' – the Rosetta flight dynamics team at ESOC

The goal of the coordinated observations by Integral and XMM-Newton was to study the spectra of the ULXs in a broad energy range. The deep Integral observations resulted in just a weak detection of M82 X-1 and non-detection of Ho IX X-1. However, comparison of these observations with the data obtained at lower energies by XMM-Newton reveals a clear high-energy cut-off in the spectra of both ULXs. The broadband spectra are unusual for normal X-ray binaries, but can possibly be fulfilled during supercritical accretion onto a stellar-mass black hole.

→ ROSETTA

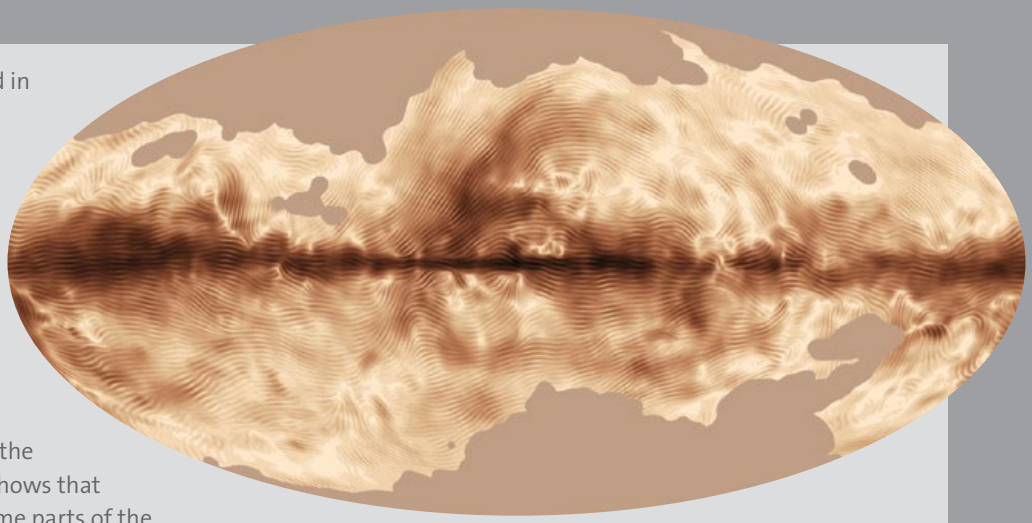
Instruments have been recommissioned and have begun science operations, including the Navigation Camera, from which ESA began to release images in addition to those from the Rosetta's science camera Osiris. During May through to August, the spacecraft is executing a number of thruster burns to facilitate the rendezvous with its target comet 67P/Churyumov-Gerasimenko, one burn every fortnight in May and June and then one per week in July. These burns are necessary to arrest the roughly 800 m/s relative velocity difference between the comet and the spacecraft. During this period, the distance to the comet reduces from nearly 2 million km in early May to about 100 km on 6 August. Observations have shown the target to be behaving like a comet and hinting at the exciting times ahead!

The comet has shown evidence of activity in the form of a dust cloud forming around the nucleus (observed by Osiris) over 1300 km wide, which has subsequently reduced in size, suggesting that we should expect the unexpected! The Microwave Instrument on the Rosetta Orbiter (MIRO), a high-resolution spectrometer, has made the first detection of water vapour coming from the comet. This first estimate of the water production rate is within the range of models being used for the come, and is excellent confirmation that MIRO is on target with its science goals.

→ HERSCHEL

Herschel has passed the milestone of the first 1000 publications in the refereed scientific literature approximately five years after its launch in 2009. Since the end of observing and the 'parking' of the spacecraft in heliocentric orbit in 2013, Herschel is in the post-operations phase, supporting the astronomical community exploiting the Herschel data to do science, and continuously improving the Herschel archive functionality, data-processing software and data products, as well as calibration and documentation.

When stars like our own Sun finally run out of 'fuel' they become unstable, shred off their outer layers into surrounding space, thereby enriching the interstellar environment with elements that will serve as raw material



Our galaxy's magnetic field is revealed in a new Planck image. This whole-sky view was compiled from the first all-sky observations of 'polarised' light emitted by interstellar dust in the Milky Way. Darker regions correspond to stronger polarised emission, and the striations indicate the direction of the magnetic field projected on the plane of the sky. Swirls, loops and arches in this new image trace the structure of the magnetic field in the Milky Way and shows that there is large-scale organisation in some parts of the galactic magnetic field (ESA/Planck Collaboration)

for the next generation of stars. The remaining core will eventually become a white dwarf. This stage in the late life of a star is called a 'planetary nebula'; the name is historical, has nothing to do with planets, and was in fact coined by William Herschel in the 18th century.

Now Herschel has observed a sample of planetary nebulae and, much to the surprise of the observers, has discovered that there is ongoing chemistry in the harsh environments bathed in ultraviolet radiation around the central white dwarfs with temperatures in excess of 100 000 K – almost twenty times the 'surface' temperature of the Sun. Among the molecules observed here, the molecular ion OH+, vital to the formation of water, seems to like this harsh environment and perhaps even depends on it to form, although it remains to be seen whether the conditions would actually allow water formation to proceed.

→ PLANCK

Planck is now in its post-operational phase. The next big milestone will be at the end of October 2014 with the release of all of the data acquired by Planck to the public.

In May, the Planck Collaboration released four scientific papers analysing the polarised light emitted by dust in our home galaxy, the Milky Way. These are the first Planck publications of polarised radiation across most of the sky. The maps presented in the papers were obtained using detectors on Planck that acted as the astronomical equivalent of polarised sunglasses. The amount of polarised emission depends both on the properties of dust and on the direction of the magnetic field in the Milky Way. The results show that dust is much more highly polarised than previously expected, and the spatial patterns of the directions of polarisation indicate that the turbulent component of the galactic magnetic field is very prominent.

→ SOHO

Early on 25 February, the Sun unleashed a powerful X4.9 flare, one of the largest of the current solar cycle, in an active region at the east limb. The flare was accompanied by a large coronal mass ejection (CME), which included an eruptive prominence. The CME shock front reached Earth about 64 hours later and the eruption and caused a moderate (Kp index 6) geomagnetic storm. After the prolonged and deep minimum between cycles 23 and 24 in 2008 and 2009, the Sun is currently going through the maximum of its 11-year solar activity cycle (No. 24). The sunspot counts are cresting and the Sun's magnetic field has flipped. Cycle 24 is a very weak one, though. It ranks among the weakest on record and is expected to start fading in 2015. This, however, does not mean that we will see fewer big flares or geomagnetic storms. Records of solar activity show that most large events, such as strong flares and significant geomagnetic storms, typically occur in the declining phase of solar cycles – even weak ones.

→ GAIA

Commissioning activities are complete and the mission has started. Key spacecraft technologies, namely the phased array antenna and the micropropulsion, work well. On the instrument side, all the detectors of the focal plane and their relevant electronic units have normal performances, as well as the seven video-processing computers, the large mass memory and two rubidium atomic clocks. The spacecraft is being operated in its nominal science mode, i.e. at 45° angle to the Sun, spinning at four revolutions per day controlled by the micropropulsion system, which uses the focal plane itself as attitude and rate detector. The ground segment, composed of the Mission Operation Centre, the Science Operation Centre and the Data

Processing and Analysis Consortium, works well; science telemetry is being received and distributed to the various groups. More than 2.9 terabytes of science data have been received and processed.

The commissioning and science teams are now assessing the expected end-of-mission science performances based on the performance of the spacecraft and the data collected during the first months in orbit.

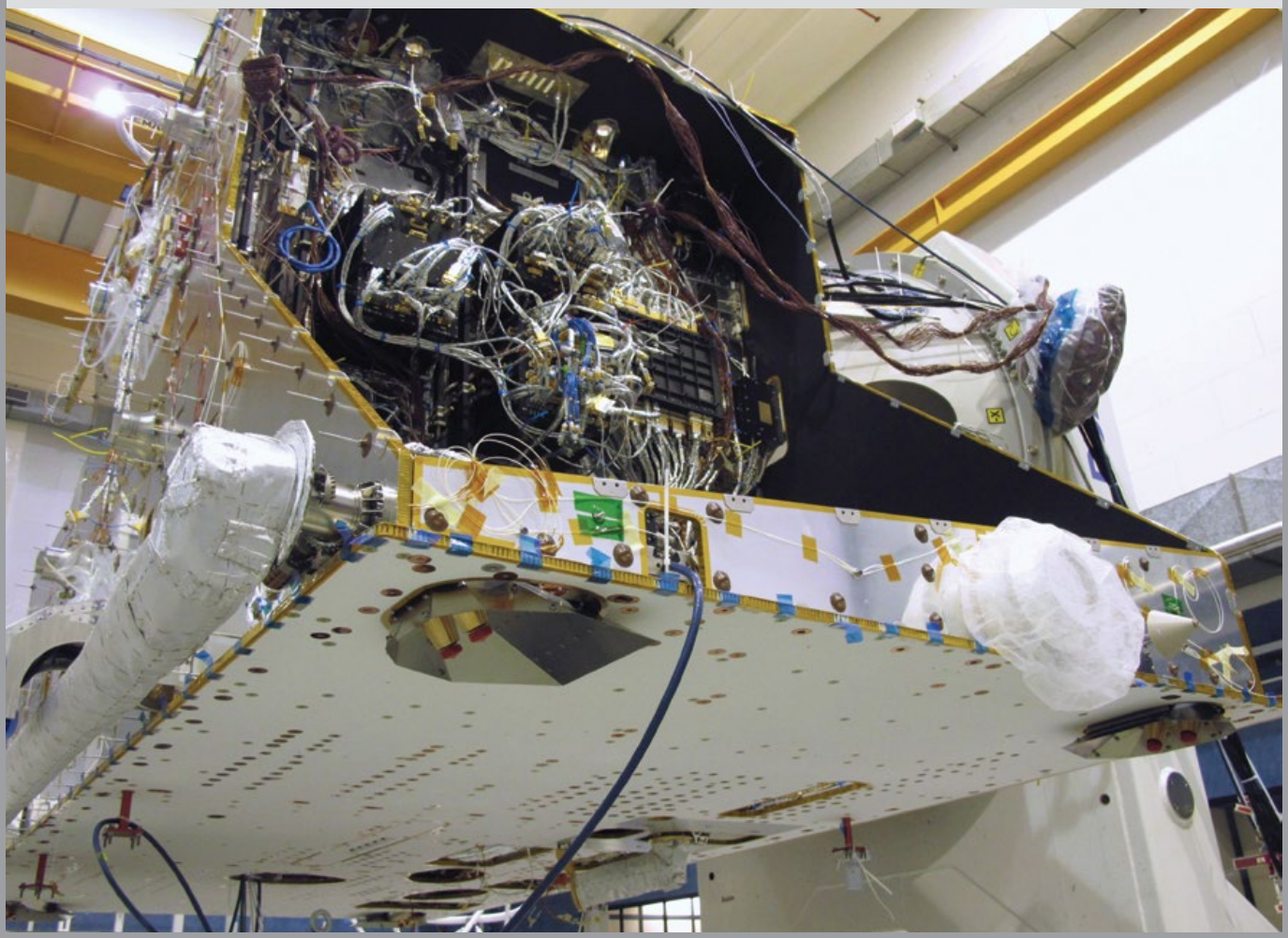
→ LISA PATHFINDER

The Science Module is being retrofitted with three new side-panels onto which the cold-gas micropropulsion equipment has been integrated. The functional verification of the spacecraft is progressing as planned, now with a complete version of the flight software and with using the micro-thruster drive electronics EM. Integration of the two Inertial Sensor Heads (ISH) flight units has been completed and the acceptance testing is starting. The ISH FMs, after acceptance, will be integrated on the LTP Core Assembly (LCA). The LCA includes an optical interferometry ultra-stable bench on its support frame, the two ISH, diagnostics equipment and support equipment. The LCA integration has advanced to the point where the next step is the integration of the ISH. The launch vehicle is Vega, on one of the VERTA launches.

→ BEPICOLOMBO

Mechanical and electrical integration of the Mercury Planetary Orbiter (MPO) FM spacecraft continues as planned. The integrated system tests of the scientific instruments and of the communication subsystem with the radio-science instrument were completed. The central software version needed for the functional test during the MPO thermal vacuum test was loaded into the onboard computer. The system functional tests, covering main and redundant electrical configurations, were de-bugged on the Engineering Test Bench and are now under execution on the FM MPO. A start has been made with the integration of the multi-layer insulation, thereby closing the spacecraft before shipment to ESTEC in August. The integration on the Mercury Transfer Module (MTM) of the spacecraft harness and the power

The BepiColombo Mercury Planetary Orbiter Flight Model spacecraft under integration in Turin



The Schiaparelli Landing Platform wrapped and installed in the oven to reduce bio-burden following COSPAR Planetary Protection procedures (Thales Alenia Space Italy)

control and distribution unit was completed. The thruster floor with pre-integrated thruster pointing mechanisms was delivered and verified with the high-pressure regulator and electronics unit. The MTM is ready for shipment to ESTEC early July, together with the MMO sunshield. The Engineering Test Bench equipment related to MTM was shipped to QinetiQ for an end-to-end coupled test of the electric propulsion system, which was successfully completed.

All payload equipment supporting the MPO spacecraft thermal vacuum test was integrated and verified. Half of the payload consists of flight-representative QMs that will be replaced by FMs after completion of the thermal test.

The scientific instruments of the Japanese Mercury Magnetospheric Orbiter (MMO) demonstrated proper performance after the system environmental acceptance test campaign. Payload reintegration on the spacecraft is ongoing. Ground segment development is ongoing. Acceptance testing of the Mission Data Systems is continuing.

→ MICROSCOPE

The manufacture and testing of the cold-gas micropropulsion system electronic unit QM are completed and integrated testing with two micro-thrusters has started. Once completed, the hardware will be delivered in July to CNES for initial system-level tests.

→ EXOMARS

The 2016 mission system CDR was completed and the Pre-Board level of the 2018 mission Descent Module Design Review led by the Russian team was finalised.

System AIT activities for the 2016 mission Trace Gas Orbiter (TGO) and Schiaparelli continue at Thales Alenia Space France and Italy respectively. The special planetary protection activities for Schiaparelli have been validated with the successful Dry Heat Microbial Reduction process applied to the FM landing platform in Italy. For this activity, special care in wrapping the entire landing platform was necessary followed by baking in an autoclave in order to sterilise and reduce the bio-burden on the platform. The remaining assembly is done in a specialised cleanroom at Thales Alenia Space, purpose-built for the activities. The TGO continues with the integration of the computer, power elements and the electrical harness. Software development continues for both the TGO and Schiaparelli with the first versions running on their respective computers. The avionics test benches are used for verifying software/hardware interactions of the electronic units of the spacecraft and the instrument Experiment Interface Models.

In the 2018 mission, the Rover Analytical Design Laboratory (ALD) Sample Preparation and Distribution Sub-system (SPDS) PDR was completed and manufacture of the EQM units started. These units are the first parts of the overall ALD EQM that will be built through the remainder of the year and tested in early 2015. Procurement activities for the Rover continue along with those for ESA contributions to the Russian Descent Module and the ESA-provided Carrier Module. Overall, 2018 mission progress is good and coordination with the Russian partners for all aspects of the mission continues with intensive contacts at engineering and management levels.

The ExoMars 2016 Ground Segment Implementation Review will be held in September. The Science Ground Segment (SGS) for the 2016 Mission initiated a Requirements/Design Review in June. This combined review has been tailored to address the late start of the SGS as well as the extensive re-use from other missions. An ESA/Roscosmos Working Group began investigating the feasibility of adding a Russian 64 m antenna to the ESTRACK system to augment the science return on the ExoMars 2016 TGO mission.

→ SOLAR ORBITER

The spacecraft Primary Structure STM has been equipped with models of the chemical propulsion subsystem units at prime contractor facilities at Stevenage with STMs of various spacecraft units (including heat pipes and mirrors) and payload units.

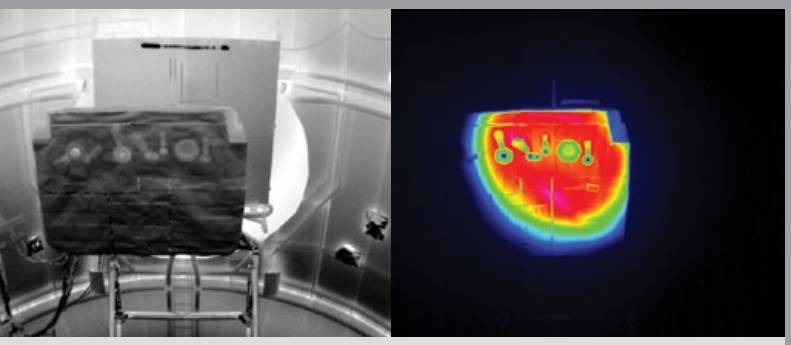
The spacecraft-level Engineering Test Bench integration and testing activities are continuing. The On-board Computer, Solid State Mass Memory, Remote Interface Unit and Fine Sun Sensor EMs have been integrated. After delivery of the first version of the Central Software, version 2.0 passed its PDR and will be delivered by August.

The Heat Shield STM underwent its Thermal Balance test under vacuum and exposed to the 10 Solar Constant flux in the Large Space Simulator at ESTEC. Afterwards it went to IABG for more Thermal Balance tests at lower solar fluxes. Both, hot and cold cases have been tested, which is an important milestone.

Subsystem-level CDRs continuing. To address a serious EMC issue, identified earlier, the Reaction Wheel Assembly is undergoing a broad redefinition/redesign process, including the design of a magnetic shield.

The schedule of the solar generator continues to be a concern. Additional suppliers for various sub-elements are being added to the industrial team to supplement current capacity and also to address obsolescence problems.

Following application of a specifically qualified black surface treatment to the titanium sheets (forming the front layer of the Heat Shield), the use of this black surface treatment on other spacecraft surfaces, including the antennas, is under preparation. This will help to improve the thermal performance of the spacecraft, while moderating undesirable stray light bouncing back towards instrument apertures. In parallel, the development of a white version of this surface treatment is continuing.



The Solar Orbiter Structural and Thermal Model Heat Shield under test in at ESTEC in May

Instrument CDRs are progressing. The SoloHI, MAG, SPICE, EUI, PHI and EPD CDRs have already been run, one (STIX) is being performed, the data package for another (SWA) is being put together. The second METIS coronagraph PDR was re-run as planned, following the restart of the development. Various instrument STM items have been delivered to the prime contractor facilities and will be integrated into the spacecraft STM. Other instruments will be represented by mass and thermal dummies.

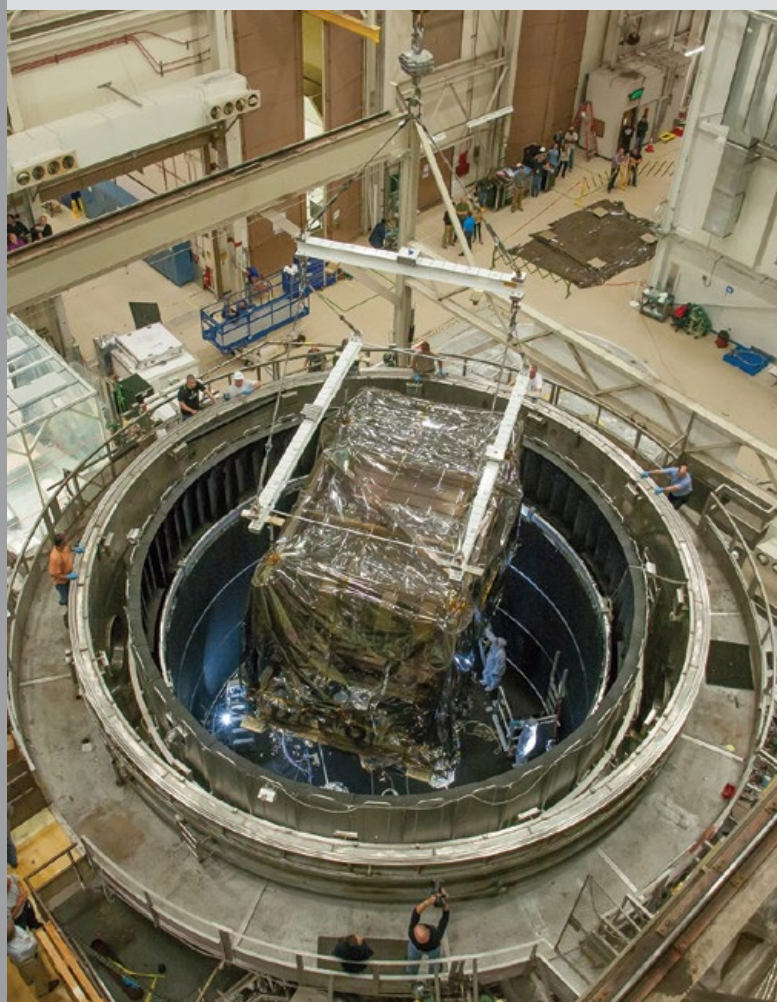
The launch vehicle interface definition with United Launch Alliance, the launch supplier selected by NASA, is proceeding. Umbilical connectors for test purposes have been delivered, a Coupled Load Analysis is under preparation, as well as a separation shock test to be performed with the spacecraft STM at the beginning of 2015.

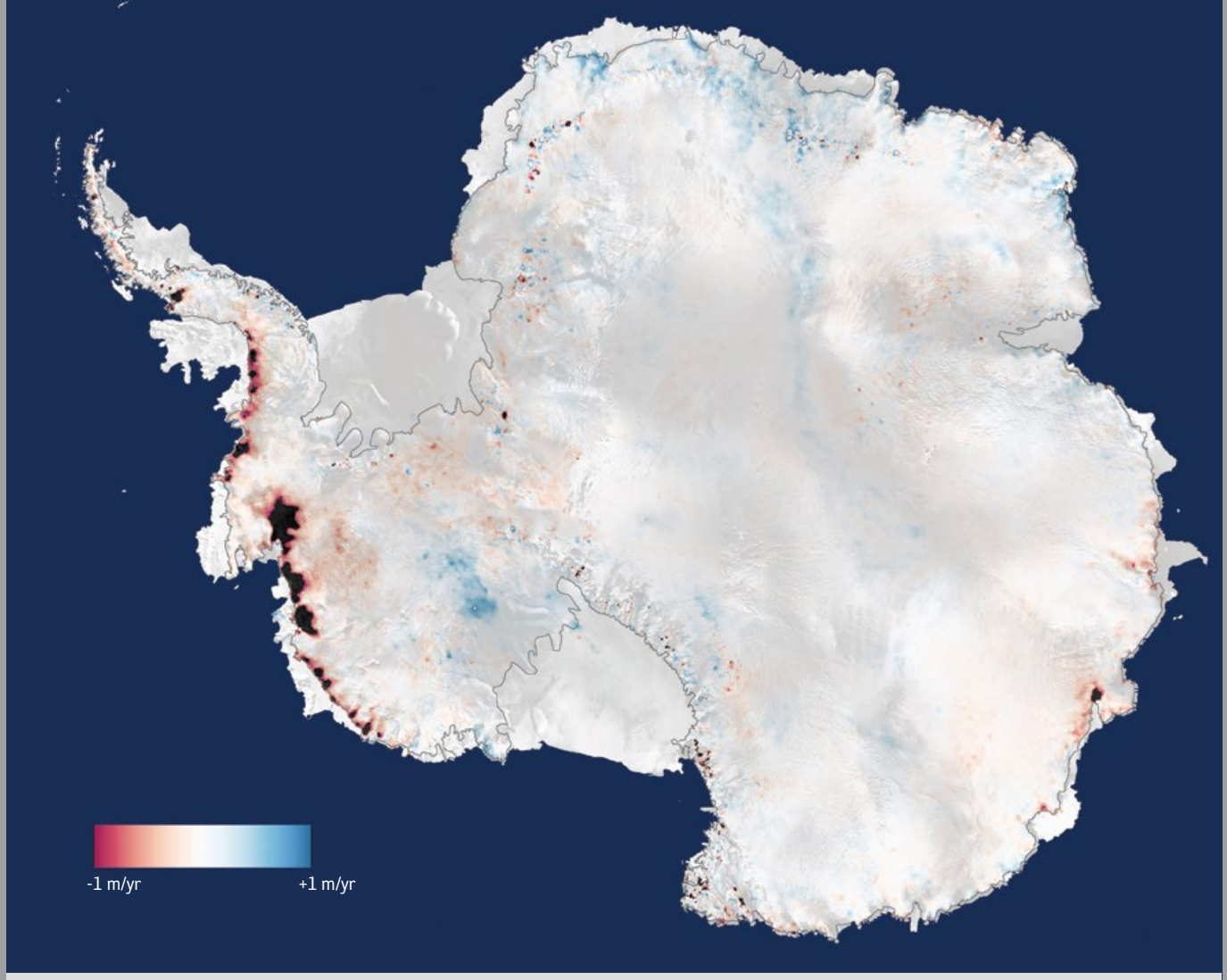
The planned launch date is July 2017.

→ JAMES WEBB SPACE TELESCOPE

The NASA 'System Look Back Review' to review the system changes since the CDR in 2010 was passed. The second cryogenic test of the complete Integrated Science Instrument Module (ISIM) FM started as planned.

The Webb Integrated Science Instrument Module being installed in the NASA Space Environment Simulator thermal vacuum chamber (NASA/Goddard Space Flight Center/D. Stover)





Between 2010 and 2013, west Antarctica, east Antarctica and the Antarctic Peninsula lost 134, 3 and 23 billion tonnes of ice each year, respectively. The average rate of ice thinning in west Antarctica has increased compared to previous measurements, and this area's yearly loss is now one third more than measured over the five years before CryoSat's launch (CPOM/Leeds/ESA)

NASA has completed the manufacturing of the new flight Micro Shutter Assembly for the ESA-developed NIRSpec instrument. It has passed the initial cryogenic verification test and the sine and acoustic tests, and the final cryogenic verification test is ongoing. NASA has completed the build of a new NIRSpec FM detector. The vibration test was passed and cryogenic performance tests are ongoing. The exchange of the Micro Shutter Assembly and the detector is planned by end of the year. This will take place before the ISIM vibration test and the final cryogenic performance test.

→ EUCLID

Implementation continues for Phase-B2 activities. The prime contractor, Thales Alenia Space Italy, and the Payload Module (PLM) contractor Airbus Defence & Space are completing the definition of the subsystem requirements, system design and subsystem and units procurement. The selection of all the subsystems and units for the PLM has been completed. In addition to the long lead items, like the SiC structures and mirrors (which are being manufactured at Boostec) and the dichroic plate element, many contracts for units like the secondary mirror mechanism, the mirror polishing, the external baffle, the OGSEs and others have been awarded. The PLM has completed a PDR, which allows Phase-C/D to begin. On the Service Module (SVM), the activities are proceeding the completion of the SRR in February. Activities on critical elements have started, such as the Reaction Wheel testing and the Fine Guidance Sensor. The subsystem layer procurement is now the main task with many subsystem ITTs being published.

The procurement of the Near Infrared Spectro-Photometer (NISP) detectors is proceeding. The detector system is composed of three units: a HgCdTe hybrid detector, a flex cable and a proximity electronic unit packaged into an ASIC. Teledyne Imaging Sensors of Camarillo (US) has manufactured all the necessary detectors for the Evaluation and Qualification phase, showing very good performance.

The procurement of the detectors (CCDs) of the Visible Imager Instrument (VIS) is also proceeding well with the company e2v (UK). Many STM devices have been delivered and the QM/FM production of the various parts is proceeding according to schedule. The test facility readiness review was held and the test of the first EMs has started.

The two scientific instruments (VIS and NISP) and the Science Ground Segment developed by the Euclid Consortium are also proceeding. The team leading the VIS development at Mullard Space Science Laboratory has passed a PDR and is now proceeding to Phase-C/D. The NISP PDR at system level took also place and the subsystem PDRs are being carried out.

Arianespace, under a contract for the launcher support (Soyuz from CSG), has performed the feasibility assessment required for the mission SRR and is now supporting the next phase leading to the system PDR.

→ SMOS

The spacecraft has been in orbit for more than four years. Thanks to the excellent technical and scientific status of the mission, SMOS continues to operate beyond its planned lifetime. Following a joint mission extension review with CNES, operating the platform, mission operations have been extended to the end of 2017. All data have been available to the science community since 2010. The RFI situation keeps improving, in particular over Europe.

→ CRYOSAT

The mission continues flawlessly, acquiring and generating science data systematically to measure the variation of sea-ice mass floating in the Arctic and trend of land-ice volume over Greenland and Antarctica. Recently, the mission requirements over land ice sheets at global and regional scale were verified by a group of UK scientists. Three years of observations from CryoSat show that the Antarctic ice sheet is now losing 159 billion tonnes of ice each year – twice as much as when it was last surveyed. The polar ice sheets are a major contributor to the rise in global sea levels, and these newly measured losses by CryoSat from Antarctica, alone are enough to raise global sea levels by 0.45 mm each year.

→ SWARM

The commissioning phase is completed and operations Phase-E2 began on 9 April. The final orbital constellation was reached on 17 April, where the lower pair is formed by Swarm 'Alpha' and 'Charlie', and Swarm 'Bravo' is in the upper orbit. It is expected that the difference in the orbital plane orientation (due to the difference in precession) will reach 60 degrees in about three years time. All satellites are healthy and fully equipped to meet the mission requirements. On Swarm Charlie, unfortunately, the redundant unit of the Advanced Scalar Magnetometer is inoperative and has been declared lost. This loss of redundancy on one of the satellites of the lower pair is not expected to impact the mission return.

The Calibration and Validation phase is running, with a highly active community of participants from ESA, industry and world-leading experts in the field. A first review of this phase was held six months after launch, again confirming the excellent performance of the instrument package as well as the platforms. This has led to the first release of data to the larger research community, in line with ESA's free and open data policy. More products will be released soon. The first scientific results from the mission were presented at the Third Swarm Science Meeting, in Copenhagen on 19/20 June, in presence of the Danish Minister for Higher Education and Science. In the near future, the mission will deliver the data that will be used by the community to generate the next generation of the International Geomagnetic Reference Field. This is a model that is updated (by convention) every five years, and is used by practically all communities, applications and services in need of geomagnetic data.

→ ADM-AEOLUS

Airbus Defence & Space executed a high fluency test in Toulouse of the Optical Bench Assembly using the FM A laser delivered in December, during which the transmission and beam quality remained stable. Selex ES has completed the burn-in test of the second FM laser in vacuum. This will be followed by a post-test characterisation under ambient conditions. In the ground segment, the Payload Data Ground Segment team is now in place and is working to consolidate the changes introduced during their restart.

→ EARTHCARE

Following the mechanical integration of most avionics and electrical equipment in the spacecraft PFM Base-Platform, the preparation for its vacuum bake-out campaign at Intespace during the summer is ongoing at Airbus Defence & Space (DE).

The laser transmitter CDR took place and actions are in place to address the issues raised. A CDR is planned for September. In parallel, the laser heads integration and test activities are proceeding at SELEX (IT). Integration of both PFM cameras of the Multi-Spectral Instrument is ongoing at SSTL (UK) and TNO (NL).

The Cloud Profiling Radar interface CDR took place in Japan with the support of Airbus Defence & Space, and the resulting actions are being progressed by JAXA and their contractor NTS. The manufacturing of the CPR electronics units, required as part of the refurbishment of the instrument EQM into PFM, is nearing completion.

→ BIOMASS

Two parallel and competitive mission definition studies are being conducted with consortia led by Airbus Defence & Space and OHB/Thales, respectively. The aim is to establish system concepts that meet the scientific and programmatic constraints to a level of detail that will enable industry to submit robust proposals in the competition to build the Biomass satellite.

Studies to define the requirements for the algorithms to derive final products as 'mass of wood per hectare of forest' are under preparation as well as field campaigns to generate information and data to assist such data processing.
A dedicated campaign in the African tropical forest will start in November, lasting one year. It will use the instrument from a previous campaign in French Guiana.

→ METEOSAT

Meteosat-8/MSG-1
Meteosat-8 operations are normal. Meteosat-8 is now the operational backup for Meteosat-9 and 10.

Meteosat-9/MSG-2
Meteosat-9 provides the Rapid Scan Service (one picture every five minutes of the northernmost third of Earth in 12 spectral channels), complementing the full-disc mission of the operational Meteosat-10.

Meteosat-10/MSG-3
Meteosat-10 is performing the full-disc mission (one image every 15 minutes in 12 spectral channels), as well as the data collection, data distribution and search and rescue missions.

MSG-4
Following the repair of the Scan Drive Unit and of the Calibration Motor, the SEVIRI instrument has been delivered back from Astrium and reintegrated on MSG-4. Integration and test activities, including acoustic vibration tests, were performed and the thermal vacuum test will take place in July. MSG-4 will be ready for launch at the beginning of July 2015, however a launch date has yet to be agreed between Eumetsat and Arianespace.

→ MTG

Following the closure of the MTG-I and MTG-S satellite PDRs, all main element PDRs have also been closed with the exception of the structure and datahandling elements for the platform. More subsystem and unit PDRs have been held or are ongoing, including the PDR for the critical Scan Assembly.

The compliance status of both MTG-I and MTG-S has been revised taking into account some of the lower-level PDRs and early results coming from development units (breadboards and EMs). Overall, the compliance status has been improved from the already promising status presented at PDR.

With respect to satellite mass, significant progress has been achieved in stabilising the baseline design and the project team is confident that compliance with the agreed customer targets of 3600 kg and 3800 kg for MTG-I and MTG-S respectively can be achieved.

Detailed consolidation of the baseline verification approach at both satellite and main element levels has progressed. Verification matrices are complete at satellite level and are well advanced at main element level. An optimised satellites development plan has been agreed in principle with industry, aiming to mitigate technical risk and to secure the protoflight schedule.

For both FCI and IRS, industry has significantly simplified the implementation of the Cooler Support Assembly. The result is a slight increase in microvibration on the one hand, but an improvement in cryogenic performance on the other hand. For FCI and IRS, this new configuration is considered acceptable, while further analyses are ongoing at LI and UVN level.

For the LI, progress is being made. The work is focused on the actions resulting from the PDR, in particular a local adaptation of the instrument electronics to reduce the sensitivity of the instrument to microvibrations and to increase flexibility.

The Flight Acceptance Review for MTG-I-1 remains set for July 2018, while the Flight Acceptance Review for MTG-S-1 was been brought forward to October 2020. The agreement on the optimised development plan should further secure the protoflight schedules.

→ METOP

MetOp-A
The satellite will operate in parallel with MetOp-B until the commissioning of MetOp-C.

MetOp-B
Eumetsat's primary operational polar-orbiting satellite.

MetOp-C
The satellite is in storage. The annual maintenance of the Payload Module and the Solar Arrays were completed in June. Following a review and optimisation of the long-term operational service, the launch window settled by Eumetsat is from October to December 2018.

Sentinel-2A fully integrated and under testing (Airbus Defence & Space GmbH)

MetOp Second Generation

TThe second generation of MetOp satellites (MetOp-SG) will continue and enhance the observations provided by the first-generation satellites. MetOp-SG will consist of two series of satellites (Satellite A and Satellite B) and will provide the operational meteorological observations from polar orbit for the period 2021–45.

Airbus Defence & Space (FR) is prime contractor for Satellite A and Airbus Defence & Space (DE) is prime contractor for Satellite B. The two contracts, including for the relevant Contractor Provided Item instruments started on 28 May. The next main milestone is the SRR, planned for September/October.

→ SENTINEL-1

Sentinel-1A LEOP was completed in just three days after liftoff on 3 April. Then commissioning activities began, covering the in-orbit verification of all satellite subsystems and the interfaces with ground. This also includes the in-flight calibration of the Synthetic Aperture Radar by using a series of known targets, conveniently deployed as transponders and corner reflectors, and natural targets such as tropical rainforest. A detailed and thorough calibration will allow the best performance for mission exploitation during the satellite lifetime.

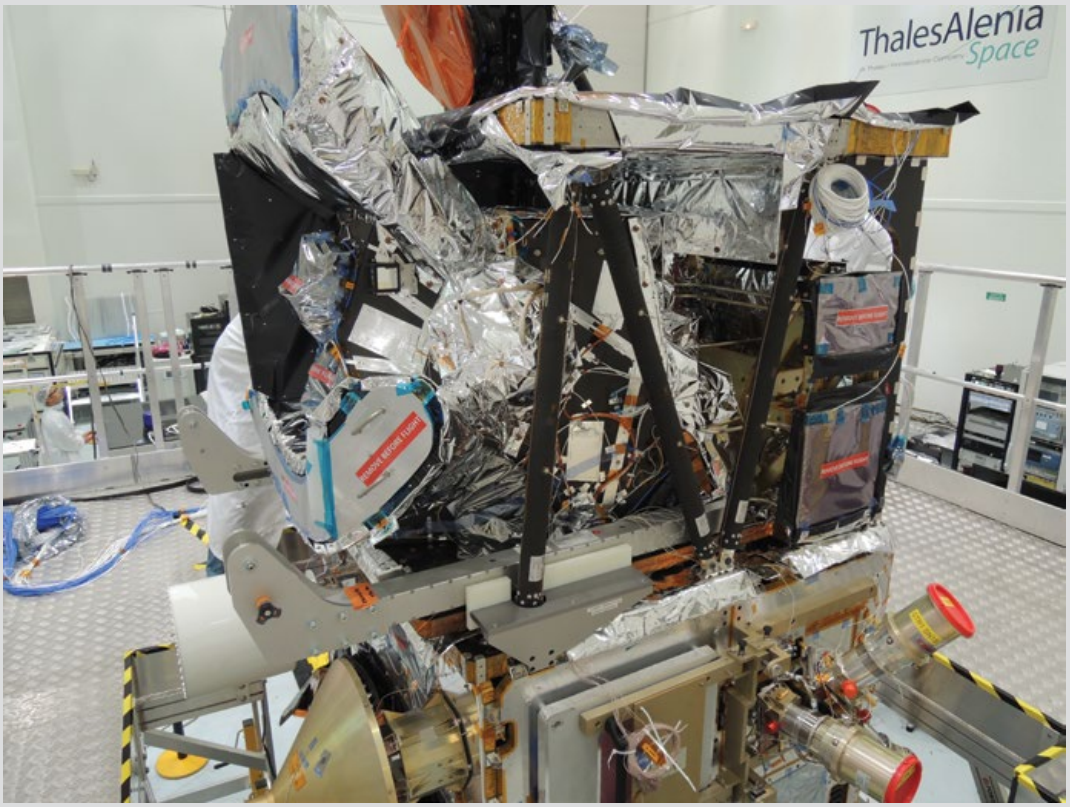
An important activity during this phase is the acquisition of the reference orbit, where the satellite has been designed to work, from the orbit in which the satellite was inserted. This operation is taking several weeks, needing to be carefully executed and closely monitoring the potential interference with other objects that may require extra collision avoidance manoeuvres.

Sentinel-1A sample datasets products are made available online to all users at https://senthub.esa.int. These products are released for familiarisation and support of preparatory user activities. The industrial team are continuing AIT of the identical sister spacecraft Sentinel-1B.

→ SENTINEL-2

The instrument delivered in May to Airbus Defence & Space is now integrated to the platform, and the payload system performance and functional tests are being executed. The satellite will be shipped to IABG in August for an environmental qualification test campaign that will last five months.

The satellite in-orbit commissioning preparations are conducted with close involvement of ESOC and ESRIN Ground Segment teams, and CNES is actively supporting



The Sea and Land Surface Temperature Radiometer Protoflight Model integrated on the Sentinel-3A satellite (Thales Alenia Space)

the preparations for instrument calibration, validation and image quality. Vega final mission analysis is ongoing.

The second 'Sentinel-2 for science' workshop at ESRIN took place in May. The instrument and satellite characterised performance reported was very much appreciated, and on that basis, representatives of the user communities predicted that Sentinel-2 will certainly set a new standard for operational land and vegetation imaging.

→ SENTINEL-3

The Sentinel-3A Platform and the Topography Payload completed their Integrated System Test (IST) 1. The Sea and Land Surface Temperature Radiometer (SLSTR) PFM instrument completed its instrument-level test campaign and was delivered to the prime contractor in May. It is now mechanically integrated on the satellite and electrical and functional tests are ongoing. The Ocean and Land Colour Instrument (OLCI) is undergoing its last functional tests at instrument level before being delivered in July for integration on the satellite.

The Final Mission Analysis Review with the launch service provider Rockot was concluded. At system level, preparation of the Sentinel-3A Commissioning Phase is proceeding, with activities starting related to the scientific expertise support during the payload Cal/Val phase.

In parallel to Sentinel-3A activities, the Sentinel-3B platform activities have been completed and the platform was delivered to the prime contractor in May.

→ SENTINEL-4

The targeted 10% instrument mass reduction exercise has been achieved. The suppliers for all the 42 subsystems procurement items have been selected. Six more subsystems PDRs were completed or are ongoing. The remaining 10 subsystems PDRs will be completed before the end of the year.

All tests on three optical breadboards to demonstrate the achievement of Technology Readiness Level 5 for the opto-mechanical design of the telescope and of the two spectrographs have been completed. The Telescope EM is being manufactured and it will be tested throughout July and August.

The prime contractor plans to submit their Price Conversion for Phase-C/D on 15 July.

→ SENTINEL-5

Most configuration trade-offs have been concluded and a baseline instrument design established. The SRR is

ongoing. The first set of Best Practice procurements, related to the Short-Wave Infrared (SWIR) and CCD detectors, were initiated. The CCD development contract started, and the SWIR detector development contract is being negotiated. To complete the funding of the programme, the subscription of Phase-2 of the Copernicus Space Component Segment 3 was opened from February until May. Additional subscriptions are foreseen by the time of the next Ministerial Council.

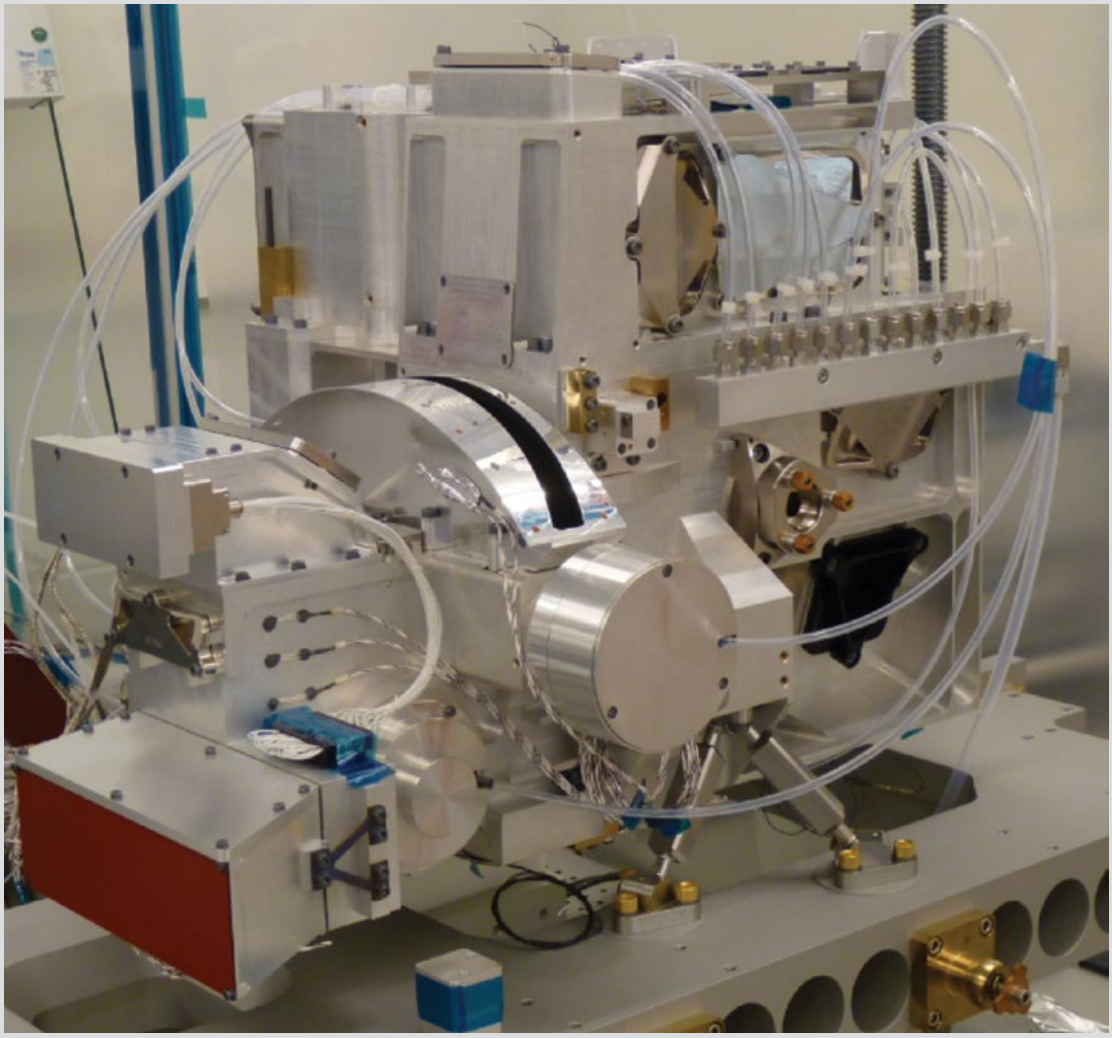
→ SENTINEL-5 PRECURSOR

Platform assembly at Airbus Defence & Space is complete. System Validation Testing in conjunction with the Flight Operations Segment at ESOC was completed in April. EMC testing of the platform was completed in May.

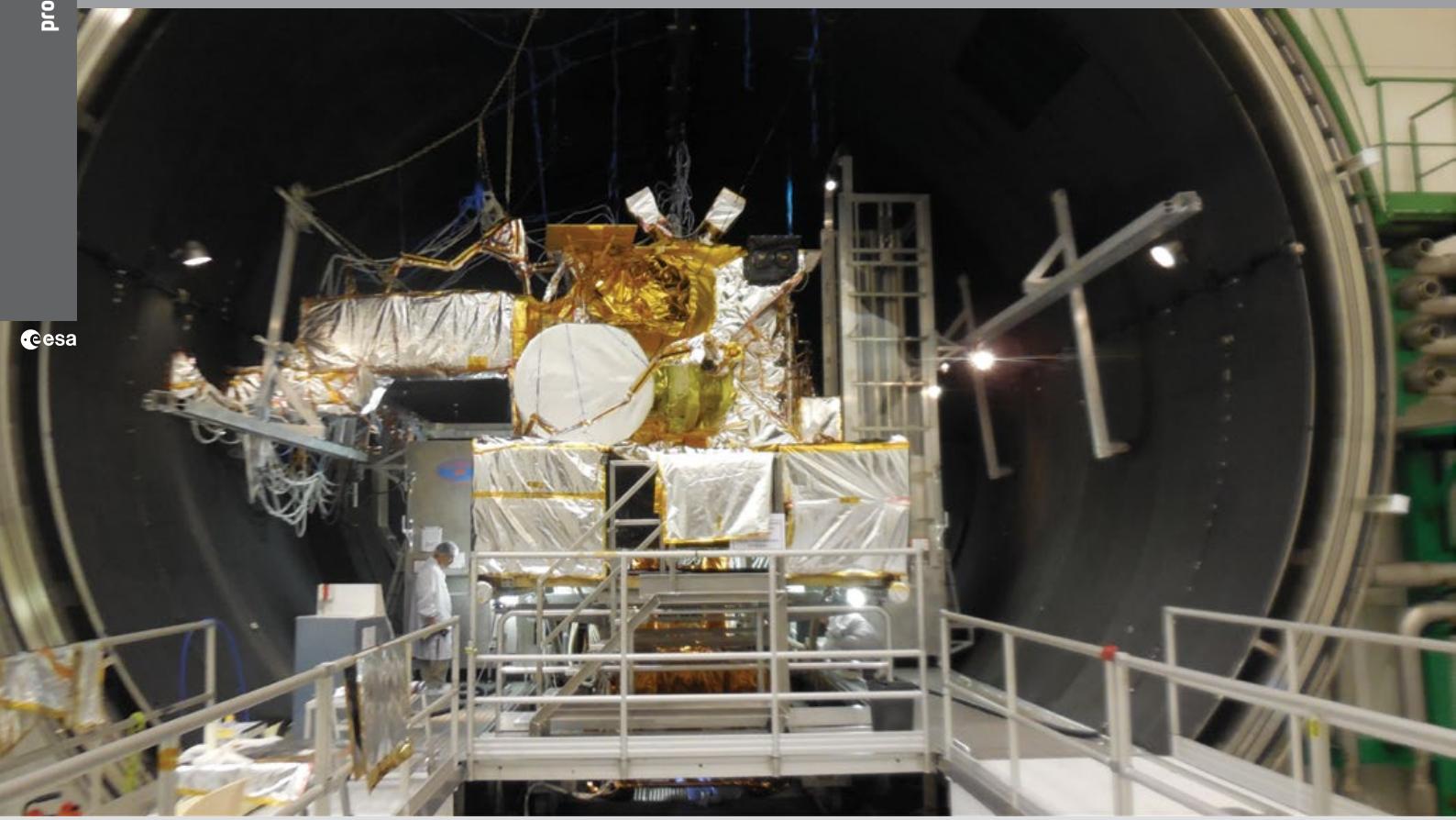
Integration of the TROPOMI payload was completed at Dutch Space by mid July followed by transportation of the payload to CSL Liège for environmental and calibration testing. For the Ground Segment, the CDR was concluded in June. On Rockot launcher procurement, the Preliminary Mission Analysis Review was conducted in July.

→ SENTINEL-6/JASON-CS

A special meeting of ESA's Earth Observation Programme Board, held on 24 June, decided to release the full GMES Space Component 3rd period (GSC-3) programme. This means that Sentinel-6/Jason-CS, as part of this programme, is now in force as an ESA project. The following day, ESA's Industrial Policy Committee, approved the Sentinel-6/Jason-CS Procurement Proposal. This gives ESA the authorisation to release the Request for Quotation to industry, which will be done towards the end of July. The industrial work has focused on completing the design process such that the data-package for the PDR, which marks the end of Phase-B2, can be completed. The PDR will be held from September to November. This phase has also seen the development of some electronic breadboards that have been used to develop designs for the new digital circuitry of the Poseidon-4 radar altimeter.



The TROPOMI UVN Module Protoflight Model (Dutch Space/TNO)



The EB9B satellite in the thermal balance/vacuum chamber

→ EDRS

The EDRS-A mission CDR cycle concluded with the board meeting in January 2014, thereby completing the EDRS-A detailed design phase. All EDRS-A payload flight equipment – except the Laser Communication Terminal (LCT) – has been integrated into the Communication Module (CM) at Airbus Defence & Space, Portsmouth. The integrated CM was shipped from Portsmouth to the EB9B satellite integration site in Toulouse and mating of the CM with the SM (Service Module) was completed in March. Meanwhile, the LCT – the core element of the EDRS mission – was acceptance tested at TESAT, and was delivered and integrated with the satellite in early June. All baseline payload performance tests were completed, including an end-to-end data transmission test involving the full onboard chain from the LCT to the feeder link antenna interface. The satellite has been moved into the thermal vacuum test facility, and thermal vacuum testing started on 26 June.

The EDRS-C satellite CDR began in April. The board meeting in July will mark the formal start of the Phase-C/D. This will be followed by the EDRS-C mission CDR, which will ensure the consistency of the EDRS-C satellite with the ground segment and thereby verify the overall performance of the mission.

All elements of the EDRS Ground Segment required for the operation of EDRS-A have been reviewed as part of the EDRS-A mission CDR. Development of the Ground Segment hardware is in progress.

All Ground Segment hardware is being manufactured, and the stations in Weilheim, Redu and Harwell are being built. The Mission Operation Centre is the heart of EDRS, where the overall data relay link and data flow planning will take place. It provides the link between the EDRS Space Segment and Ground Segment on one side, and the EDRS users on the other. The utilisation of the system capacity and the type of services provided will be planned from here, based on the requests received from users. Located in Ottobrunn, Germany, the Mission Operation Centre is being integrated. Its functionality and interfaces to the EDRS Ground Segment, as well as to the anchor customer Copernicus Sentinel, will be tested later in 2014.

→ NEOSAT

The objective of ARTES 14 element Neosat is to develop and qualify next-generation platform product lines allowing the two European satellite prime integrators, Airbus Space & Defence (FR) and Thales Alenia Space (FR) to deliver

Redu (BFLGS)

competitive satellites (in the 3–6 tonne launch mass range) to the commercial satellite market to address future satellite operators' needs. The programme, implemented by ESA in cooperation with CNES, includes the in-orbit validation of the new platform product lines, with PFM delivery in orbit by end of 2018 or early 2019. Phase-A activities concluded with the architectural design review in March. The ARTES 14 Phase-B contract was signed on 20 February with Airbus Defence & Space and Thales Alenia Space. The system PDRs for the platform product lines are planned for the end of the year.

→ ADAPTED ARIANE 5 ME & ARIANE 6

Adapted Ariane 5 ME / Upper Stage and Commonalities

An anomaly arose during a Vinci test (high vibration level at 9 kHz). A steering board held on 13 May considered the level of analysis sufficient to restart testing with a different turbo-pump, although investigation of the anomaly is still ongoing. Regarding Launcher Qualification, and as requested by the Verification Key Point steering board, a task force was set up to propose further actions for an optimised balance between test objectives, risks, costs and schedule targets. On Ground Segment and Operations activities, the Ground/Board Mechanical Coherence Key-Point steering board took place on 30 April.

The Hot Gas Reaction System PDR took place on 7 April. The H_2O_2 HGRS 'green' technology is considered mature for implementation on the Ariane 5 ME launcher, with a demonstration on its maiden flight in mid-2018. ESA handed over the follow-on development and qualification activities to the Ariane 5 ME prime contractor.

On the Ariane 5 ME bare tank, works are continuing for both the equipped and insulated tank manufacturing facilities and the bare tank manufacturing facilities buildings, in Bremen. First Engine Thrust Frame specimen was released on 7 May. It will be integrated in the Thrust Vector Control test bench at Installation de Simulation Fonctionnelle, Les Mureaux.

Ariane 6

A procurement proposal was approved that will enable a Request for Quotation to industry to be issued for Ariane 6 Phase-B2/C/D/E1. The Request for Quotation was issued in early May. The second Design Analysis Cycle is planned for the period March to August. The results of the second Design Analysis Cycle will be gathered in the SRR documents of the Ariane 6 launch system, generating the updated project baseline design. A Key Point has been initiated to review the adaptations of existing facilities in French Guiana for the manufacturing and tests of the first development model of the Solid Rocket Motor. The Board meeting took place in April.

The Intermediate eXperimental Vehicle at ESTEC in July

→ IXV & PRIDE

The six main activities leading to the mission readiness are progressing, namely flight segment and ground segment qualification and acceptance, launch campaign preparations, operations preparation, recovery preparations, the logistics and transportation for the deployment worldwide, and finally safety compliance.

The IXV vehicle was shipped to ESTEC in June to undergo the environmental test campaign concluding the qualification phase, allowing acceptance of the flight and ground segments. The vehicle will be shipped to Kourou in September, with a launch date scheduled in the first half of November.

To maximise the return on the technology investments performed in the ongoing IXV development, the PRIDE programme objectives are being re-assessed to maximise the use of technology developed through IXV with a projection to multiple applications.

→ FUTURE LAUNCHERS PREPARATORY PROGRAMME

The implementation of the Period 3 with the reinforced integration with Ariane and Vega development programmes is now in force, resulting in the participation of Ariane 6 Technology Gate, ELK maturation and Vega avionics and fairing technology maturation. Preparation of Period 3 contract actions are close to an end, with more than 90% of the Ministerial Council subscriptions contracted or under formal contract negotiation with industry. Major milestones have been achieved for the seven integrated demonstrators structuring the FLPP activities.

On System Studies, FLPP materials and processes technology was promoted in a paper presentation at the European Conference on Spacecraft Structures, Materials and Environmental Testing in Germany in April.

In integrated demonstrators, implementation is progressing with the Steering Committee for the Solid Rocket Motor Composite Casing Demonstrator PDR. The Expander Technology Integrated Demonstrator Steering Committee took place in May.

→ VEGA

Vega flight VV03 was carried out on 29 April, marking the third consecutive success for Vega. This was the first flight carried out under the responsibility of the launch service provider, a VERTA flight using an ESA-procured

VERTA launcher. The injection trajectory and final orbital parameters of the DZZ-HR spacecraft were well within specification. The spacecraft is operating well and the first pictures show the perfect health of all systems and optical payload.

The next launch, VV04 (VERTA-2), will carry the IXV technology demonstrator in November. In parallel, the next Vega missions, and particular the VERTA missions LISA Pathfinder and ADM-Aeolus, are being prepared. Work continued on the generic qualification review, closure of anomalies identified during the previous three flights, and exploitation and implementation of improvements on the launch system aimed at reducing costs. The outcomes are being taken into account for the preparation of the next Ministerial Council, in particular for the continuation of the Vega part of the Launchers Exploitation Accompaniment Programme.

The Vega-C launch vehicle requirement review was rescheduled to September in order to perform a single launch SRR that takes into account the emerging programmatic constraints. Phase-A activities were completed with the delivery of the review data package, and some urgent Phase-B activities started while waiting for the completion of the requirements review.

→ HUMAN SPACEFLIGHT

The Expedition 40/41 crew, ESA astronaut Alexander Gerst (DE), NASA astronaut Reid Wiseman and Roscosmos commander Maxim Surayev, was launched from Baikonur Cosmodrome in Kazakhstan on 28 May on Soyuz TMA-13M. Alexander's 'Blue Dot' mission includes a full research programme in life and physical sciences along with additional technology, educational and public relations activities. During his mission, he will also perform one spacewalk as well as taking a key role in procedures for visiting vehicles, including the fifth and final European Automated Transfer Vehicle, ATV *Georges Lemaître*.

→ ISS

In April, the SpaceX CRS-3 Dragon logistics spacecraft (NASA's commercial ISS resupply spacecraft) was launched to ISS, docked and later undocked loaded with experiment samples and payloads. The period also saw the undocking of Progress 53P and 54P, and the launch and docking of Progress 55P. One US-based spacewalk was made in April to replace a failed backup external Multiplexer/Demultiplexer computer. This is one of several units that route computer commands to various systems on the ISS. One Russian-based spacewalk took place in June to install an external antenna and relocate an external boom.

The launch of Vega flight VV03 on 30 April (ESA/CNES/ Arianespace-Optique Video CSG)

The Pharao atomic space clock arrived at Airbus Space & Defence in Friedrichshafen, Germany, in July to be assembled with another atomic clock forming part of the Atomic Clock Ensemble in Space (ACES). The final 375 kg experiment will be installed on a platform outside Europe's Columbus space laboratory on the ISS (CNES)

Two external payloads were delivered by the SpaceX CRS-3. The first, NASA's High Definition Earth Viewing experiment, will be used to stream live video of Earth for viewing online. It was transferred by the Station's principal robotic arm (Canadarm 2) from CRS-3 to the External Payload Facility of Columbus on 30 April. A week later the Optical Payload for Lasercomm Science payload, was installed on the Station truss and will test the potential for using lasers to send data to Earth from space. In July, the Orbital Sciences' Cygnus cargo vehicle arrived at the ISS.

ATV *Georges Lemaître*

An optical sensor demonstration experiment called LIRIS was integrated and tested on ATV-5 in Kourou. Progress was made with partners on the implementation of the ATV-5 shallow reentry experiment, which is intended to collect data for studies on the ISS reentry. The launch of ATV-5 took place on 30 July.

Astronauts

Training of astronauts Samantha Cristoforetti (IT) and Tim Peake (GB) has continued with both astronauts undergoing pre-flight medical testing. At EAC, Samantha took part in payload training, medical activities and baseline data collection (which concluded on 3 April), with more ATV and payload training in June. The Neutral Buoyancy Facility at the European Astronaut Centre in Cologne featured in a PR event with Tim Peake for the BBC.

The Expedition 40/41 crew, ESA astronaut Alexander Gerst, Roscosmos commander Maxim Surayev and NASA astronaut Reid Wiseman (NASA)

The Orbital Sciences' Cygnus cargo vehicle approaches the ISS, July 2014 (NASA)

NASA astronaut Steve Swanson and ESA astronaut Alexander Gerst, in the ISS Cupola during rendezvous and capture operations of the Orbital Sciences' Cygnus cargo craft (NASA)

Expedition 47 crew members, Tim Peake and Tim Kopra, during docking training in a Cupola mockup at NASA's Johnson Space Center in May (NASA/L. Harnett)

Andreas Mogensen, Russian cosmonaut Sergei Volkov and Thomas Pesquet during water survival training near Star City, Russia, on 25 June

Andreas Mogensen (DK) and Thomas Pesquet (FR) trained at JAXA in Japan in April and with Roscosmos in Russia in May and June. They also started payload training at EAC on June. Andreas had Russian language training at EAC in April/May while Thomas followed Mission Robotics Operator training with the Canadian Space Agency in May.

ESA Space Medicine Office representatives visited the Astronaut Centre of China (ACC) in May, as part of the bilateral Medical Working Group activities. The meeting focused on the medical and exercise rehabilitation practices for healthcare in space, with emphasis on ways of supplementing and integrating traditional Chinese medicine with evidence-based medicine. ACC specialists intend to visit EAC in the autumn to familiarise themselves with ESA post-flight rehabilitation practices.

European Robotic Arm (ERA)

Because of an issue with cleanliness of the fuel transfer lines of the Multipurpose Laboratory Module (MLM), launch has been delayed and is planned for November 2015. The MLM was moved back from RSC Energia to Khrunichev at the end of December. Khrunichev is expected to produce a plan for resolution of the problems with the MLM's leaking and contaminated propulsion system by mid-March and RSC Energia should publish an overall schedule, including a launch date, by the end of March. In the meantime, the ERA FM electrical and software integration has been completed.

→ RESEARCH

The International Life Science Research Announcement (ILSRA) in coordination with ASI, CNES, CSA, DLR, JAXA and NASA closed in May with 111 European proposals (plus 58 from NASA, 25 from JAXA and 11 from CSA).

European research on the ISS

Highlights of the European ISS utilisation programme with the assistance of the Expedition 39/40 crew members on orbit in the past three months (until 30 June) are as follows:

Alexander Gerst works with the combustion experiment known as the Burning and Suppression of Solids (BASS) in the Microgravity Science Glovebox in June. He is wearing a Drager Double Sensor on his forehead for the Circadian Rhythms Experiment (NASA)

The Circadian Rhythms experiment was completed by JAXA astronaut Koichi Wakata as a test subject prior to his return to Earth. Alexander Gerst and Reid Wiseman started their monthly sessions of the experiment following their arrival at the ISS. The main objective of the experiment is to get a better basic understanding of any alterations in circadian rhythms in humans during long-duration spaceflight.

The science programme of the Fundamental and Applied Studies of Emulsion Stability (FASES) experiment inside the Fluid Science Laboratory in Columbus continued in June. FASES investigates the effect of surface tension on the stability of emulsions. Results of the experiment are important for applications in oil extraction processes, for the chemical and food industries.

The Facility for Adsorption and Surface Tension (FASTER) experiment started in the European Drawer Rack in Columbus after arriving at the ISS on SpaceX CRS-3 in April. Processing in the first experiment container included formation of a water droplet at the end of a capillary tube inside a bulk fluid (paraffin) with variation of other parameters (temperature, pressure, surfactant concentration, etc.). Research started with the second experiment container towards the end of June where the bulk fluid used was hexane. FASTER is a Capillary Pressure Tensiometer developed for the study of the links between emulsion stability and characteristics of droplet interfaces. This research has applications in industrial domains and is linked to investigations such as foam stability/drainage/rheology.

Monostatic Breadboard Radar for Space Surveillance & Tracking

Non-ISS research in ELIPS
Isolation studies: 10 new project proposals have been selected and approved from the Concordia 2013 Announcement of Opportunity.

Drop towers: the SOUND (Nonlinear Sound Propagation in Granular Media) drop campaign took place in April and a G-DWS (Diffusing Wave Spectroscopy Measurements on Granular Media) experiment campaign took place in June at the Centre of Applied Space Technology and Microgravity (ZARM) at the University of Bremen.

Advanced materials and energy projects: with the recent completion of the Casting of Large Ti Structures (COLTS) project, the other advanced materials research projects with the European Commission (ThermoMag, Accelerated Metallurgy, ExoMet, AMAZE) are progressing well. Close links with ELIPS projects are exploited in terms of science team members and flight experiments.

→ EXPLORATION

Multi-Purpose Crew Vehicle European Service Module
The PDR for the Multi-Purpose Crew Vehicle European Service Module (MPCV-ESM) was held on 15 May. ESA and NASA board members endorsed the project to proceed to the CDR. The industrial Phase-C/D proposal was received and the review started.

International Berthing Docking Mechanism (IBDM)
Work was completed on the preparation of the IBDM model compliant with Revision C of the International Standard approved in 2013. The new system is being assembled for testing in August. The design of the flight hardware, compatible with the standards and applicable to the Sierra Nevada Dream Chaser crew transportation vehicle, has undergone its Mission and System Requirements Review. Information is now being exchanged routinely with Sierra Nevada to ensure the full compatibility of the IBDM with their vehicle.

International Docking Standard System (IDSS)
Technical exchanges among the ISS partners have been restarted in preparation for the Revision D of the IDSS. A technical meeting with the partners took place in June. The main efforts were to establish a rigorous configuration control of the standards and complementing the existing text with further details concerning the docking interface, such as the retractable power umbilicals and separation system.

Operation Avionics Subsystem (OAS)
The third phase of the OAS contract is producing a crew vehicle cockpit mock-up that includes the developments

of the first two phases and is representative of the Dream Chaser vehicle cockpit. A follow-on for the development of software and displays for the Dream Chaser has been approved under General Support Technology Programme funding and representatives of European industry will move to the Sierra Nevada premises in July.

Meteron

The final Experiment Sequence Tests of the OPSCOM-2 experiment, consisting of operating the Eurobot from the ISS, were performed on 10–13 June, with ESTEC, ESOC, the Belgian User Support and Operations Centre and NASA all connected. The experiment is now planned for 7 August.

Lunar exploration

The ESA approach for 'Destination Moon' has been further developed. It focuses on strategic European lunar products, starting in the areas of landing, in situ investigation and communications, with a potential first flight opportunity on the Russian-led Luna missions. A meeting between Russian and European parties took place on 21/23 May. Progress was made on the technical baseline design and a cooperation agreement was proposed. An Industry Workshop about lunar exploration took place on 16 June, where ESA lunar plans were presented and feedback provided by industry.

Strategic Planning on Space Exploration

The role of the Moon in ESA's Strategy for Space Exploration was presented at the NASA Global Exploration Roadmap (GER) community workshop in April in Laurel (USA). An ISECG meeting was held in May in Beijing. The CNSA was introduced to the work of the various ISECG working groups.

→ SSA (SPACE SITUATIONAL AWARENESS)

Architectural Design

The parallel architectural design studies for the Space Surveillance & Tracking (SST) and the Near Earth Objects (NEO) segments, led respectively by Airbus Defence & Space (DE) and by Indra (ES), were completed. The Architectural Design Reviews for those two segments, involving representatives of the various user communities, started in June and will be completed in July.

Space Weather (SWE)

The SWE segment is providing support to the Venus Express mission through daily reports on solar activity. The SWE Coordination Centre (SSCC), located at the Space Pole in Brussels, delivers the reports to the ground controllers of the Venus Express spacecraft. The reports are particularly important as, now that Venus Express has completed its eight-year scientific mission, the mission control team is pacing the satellite through an extraordinary three-month 'aerobraking' campaign. In this campaign, the orbit of the spacecraft is lowered so that, for part of each orbit, it dips down very low and skims through the very uppermost reaches of the Venusian atmosphere. The information about the potential space weather impacts on the atmosphere and particle radiation effects on its electronics are crucial for a successful campaign. The space weather updates will deliver the information from a variety of sources, including ESA's Proba-2 mission and solar-orbiting ESA and NASA spacecraft, to the mission control team as rapidly as possible.

Proba-2

The Proba-2 mission continues with the spacecraft in good health. Data from the SWAP and LYRA instruments are used in daily SSA activities, including the space weather bulletins provided to the Venus Express mission.

Near Earth Objects (NEO)

The NEO Segment discovered two new Near-Earth Asteroids during a regular survey observation using the Tenerife 1-m telescope. The total number of known NEOs now exceeds 11 000. The NEO website (http://neo.ssa.esa.int) was upgraded. New features include greater brightness of NEOs during a close approach to Earth, improved statistical information on NEO discoveries, and the incorporation of NEO historical and milestone information that was previously provided by the International Astronomical Union.

The second meeting of the Space Missions Planning Advisory Group (SMPAG) took place on 12/13 June in Vienna in conjunction with the UN COPUOS meeting. ESA was elected chair of the group for the next two years. SMPAG now has 18 members.

SST radars

The test and validation of the monostatic breadboard radar, delivered by Indra Espacio (ES), is continuing in order to validate the technologies used. The first validation campaign, devoted to the full characterisation of the radar performance in terms of its measurement accuracy, confirmed the proper accuracy in the range measurement, and is now continuing to characterise the radar's angular accuracy. Due to security restrictions, no data is exported outside the radar's secure zone.

The development of the second breadboard radar, which uses bistatic technology, with a consortium of industries led by Onera (FR), is continuing. The first round of testing, witnessed by ESA, has been completed. It focused on the radar's receiving sub-system located in Palaiseau, France. The next test will cover the transmitting sub-system, located in Crucey, France, in early July. The final Site Acceptance Test, involving the full radar chain (transmitting sub-system, receiving sub-system and offline data processing chain) is planned for October.

→ ESA PUBLICATIONS

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How Columbus Learnt to Fly (October 2013)
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Proc. 6th European Conference on Space Debris, 22–25 April 2013, Darmstadt, Germany (August 2013)
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