

ACES clocks and links

Luigi Cacciapuoti¹, Michele Armano¹, Sophio Patarai¹, Thomas Peignier¹, Simon Weinberg¹, Patrick Crescence², Achim Helm², Johannes Kehrer², Silvio Koller², Remy Lachaud², Thomas Niedermaier², François-Xavier Esnault³, Didier Massonnet³, Didier Goujon⁴, Jacques Pittet⁴, Antonio Perri⁴, Qinghua Wang⁴, Shuo Liu⁵, Wolfgang Schaefer⁵, Theo Schwall⁵, Ivan Prochazka⁶, Anja Schlicht⁷, Ulrich Schreiber⁷, Philippe Laurent⁸, Marc Lilley⁸, Peter Wolf⁸, Christophe Salomon⁹

¹European Space Agency, ESTEC, Noordwijk, The Netherlands

²Airbus Defence and Space, Friedrichshafen, Germany

³CNES, Toulouse, France

⁴Safran Timing Technologies SA, Neuchâtel, Switzerland

⁵Timetech, Stuttgart, Germany

⁶Czech Technical University in Prague, Prague, Czech Republic

⁷Technical University of Munich, Munich, Germany

⁸SYRTE, Observatoire de Paris-PSL, CNRS, Sorbonne Université, LNE, Paris, France

⁹Laboratoire Kastler Brossel, ENS, Paris, France

Email: Luigi.Cacciapuoti@esa.int

The Atomic Clock Ensemble in Space (ACES) mission is developing high performance clocks and links to test Einstein's theory of general relativity. From the International Space Station, the ACES payload will distribute a clock signal with fractional frequency instability and inaccuracy of 1×10^{-16} establishing a worldwide network to compare clocks in space and on ground.

The laser-cooled Cs clock PHARAO, the active H-maser SHM, and the on-board frequency comparator (FCDP) are installed in the ACES payload and are currently under test. The single-photon avalanche detector of the ELT optical link has completed the performance tests, and it is ready to be integrated. The microwave link (MWL) acceptance test campaign is in progress. After the environmental tests (thermal cycles, vibration, and EMC), the end-to-end link performance will be measured and its dependency on temperature and signal dynamics calibrated. After MWL integration, the ACES system tests will follow to confirm the clocks and links performance in the final configuration and under representative environmental conditions before shipment to the launch site.

In this paper, we will present the ACES mission status and the recent test results together with the major milestones that will lead us to the ACES launch.

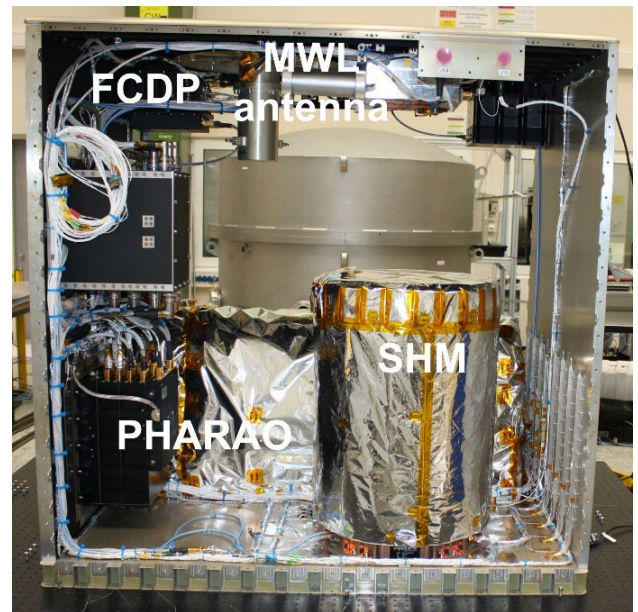


Fig. 1: Flight model of the ACES payload before system tests.