

Japanese Aerospace Literature

This month: *Spaceborne Astronomy*

A93-20504 Global restructuring of the coronal magnetic fields observed with the Yohkoh Soft X-ray Telescope. SAKU TSUNETA, TETSUO TAKAHASHI, LOREN W. ACTON, MARILYN E. BRUNER, KAREN L. HARVEY, and YOSHIKI OGAWARA, *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L211-L214. 2 Refs.

We present an example of the large-scale 'restructuring' of a polar coronal magnetic structure taking place over a time period of 20 hr. A large-scale closed-loop arcade appears to be created from an open field structure formed in association with the disappearance of a polar crown filament. The loops increase their height with time. The loop formation propagates westward, and a cusp structure, inside of which is bright in X-rays, is seen on the west limb. This global structural change of the coronal magnetic field appears to take place only through a non-explosive, quasi-steady magnetic reconnection. The Yohkoh soft X-ray images show that the solar corona is full of such global restructuring, suggesting that magnetic reconnection is a primary device for the general coronal magnetic evolution.

A93-20503 The structure of the coronal soft X-ray source associated with the dark filament disappearance of 1991 September 28 using the Yohkoh Soft X-ray Telescope. ALAN MCALLISTER, YUTAKA UCHIDA, SAKU TSUNETA, KEITH T. STRONG, LOREN W. ACTON, EIJIRO HIEI, MARILYN E. BRUNER, TAKASHI WATANABE, and KAZUNARI SHIBATA, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L205-L210. 8 Refs.

The structure of the coronal soft X-ray source associated with the dark filament disappearance on September 28, 1991, observed with the Soft X-ray Telescope, is examined as a possible example of the 'eruption-reconnection' model of filament disappearance. The results suggest, however, that this model may not fit. There is a strong possibility that much of the dark filament mass remains in the heated unwinding axial field.

A93-20502 Coronal/interplanetary disturbances associated with disappearing solar filaments. TAKASHI WATANABE, YUKIO KOZUKA, MASAMITSU OHYAMA, MASAYOSHI KOJIMA, KISUKE YAMAGUCHI, SHIN-ICHI WATARI, SAKU TSUNETA, JO A. JOSELYN, KAREN L. HARVEY, LOREN W. ACTON et al., *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L199-L204. 16 Refs.

Two examples of coronal events associated with two erupting-filament events observed from different angles are discussed. These are coronal/interplanetary disturbances associated with the disappearance of a 35-deg-long quiescent filament occurring near the solar disk center, observed on September 28, 1991, and with a 25 deg long eruptive prominence at the eastern solar limb, which took place on November 7, 1991. In both cases, bright soft X-ray arcades were observed with the Yohkoh Soft X-ray Telescope about 2-3 hr after the onset of H-alpha events. A transient coronal hole was formed in the immediate vicinity of the disappearing filament on September 28, suggesting that the formation of the new coronal hole was a cause of the filament disappearance.

A93-20501 Comparison between H-alpha and Yohkoh soft X-ray images of emerging flux regions. GORO KAWAI, HIROKI KUROKAWA, SAKU TSUNETA, TOSHIFUMI SHIMIZU, KAZUNARI SHIBATA, LOREN W. ACTON, KEITH T. STRONG, and NARIAKI NITTA, *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L193-L198. 8 Refs.

Results are presented of a detailed comparison between H-alpha and Yohkoh soft X-ray (SXR) images of three emerging flux regions. It is shown that in general the soft X-ray bright features coincide well in space with H-alpha arch filament systems (AFSs) in the emerging flux regions (EFRs). Some young and active parts of EFRs are especially bright in SXR. The SXR structures related to EFRs showed fairly rapid changes in both brightness and shape. The observation that SXR was bright above H-alpha AFSs is consistent with the concept that H-alpha loops of AFSs evolve into coronal loops. The other results suggest that H-alpha loops of AFSs are strongly heated by a fast reconnection in some young and rapidly growing EFRs.

A92-53648 Perspectives on the use of star sensors for commercial geosynchronous satellites—Applications to the three axis stabilized Italsat platform. LEONARDO MAZZINI, *Proceedings of the International Symposium on Space Technology and Science*, Vol. 2, Tokyo, Japan, May 20-25, 1990, (A92-53451 23-12). Tokyo, AGNE Publishing, Inc., 1990, pp. 1427-1432. 12 Refs.

The present multipurpose pattern recognition system (MPRS) for the Italsat spacecraft controls ion-propulsion firing, continuous yaw sensing, attitude control in transfer orbit, and fast recovery of earth-pointing attitude after emergency sun acquisition. The MPRS design uses passive control to maintain its CCD matrix below 20 C; it has on this basis been possible to detect stars of up to 2.8 visual magnitude. Readout error is minimized through correlated double sampling, and is of the order of 0.2 mV/pixel.

A93-20500 Spatial power-spectra from Yohkoh soft X-ray images. PETRUS C. H. MARTENS and DANIEL O. GOMEZ, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L187-L191. 13 Refs.

We analyze three sequences of images from active regions, and a full disk image obtained by Yohkoh's Soft X-ray Telescope. Two sequences are from a region at center disk observed through different filters, and one sequence is from the limb. After Fourier-transforming the X-ray intensity of the images we find nearly isotropic power-spectra with an azimuthally integrated slope of -2.1 for the center disk, and -2.8 for the limb images. The full-disk picture yields a spectrum of -2.4. These results are different from the active region spectra obtained with the Normal Incidence X-ray Telescope which have a slope of the order of -3.0, and we ascribe this to the difference in temperature response between the instruments. However, both the SXT and NIXT results are consistent with coronal heating as the end result of a downward quasistatic cascade (in lengthscales) of free magnetic energy in the corona, driven by footpoint motions in the photosphere.

A93-20499 Thickness variations along coronal loops observed by the Soft X-ray Telescope on Yohkoh. JAMES A. KLIMCHUK, JAMES R. LEMEN, URI FELDMAN, SAKU TSUNETA, and YUTAKA UCHIDA, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L181-L185. Research supported by Lockheed Corp., 11 Refs.

The paper presents preliminary results of an investigation of thickness variations along coronal loops observed with the Yohkoh Soft X-ray Telescope (SXT), using observations from ten loops selected from the SXT data. The quantitative results indicate that coronal X-ray loops do not expand. This contradicts the expectation that, if plasma loops coincide with magnetic loops, many loops must be significantly broader at their tops than at their foot points. Possible interpretations of the obtained results are proposed.

A93-20498 Observations of X-ray jets with the Yohkoh Soft X-ray Telescope. KAZUNARI SHIBATA, YOSHINORI ISHIDO, LOREN W. ACTON, KEITH T. STRONG, TADASHI HIRAYAMA, YUTAKA UCHIDA, ALAN H. MCALLISTER, RYOJI MATSUMOTO, SAKU TSUNETA, TOSHIFUMI SHIMIZU et al., National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L173-L179. Research supported by Lockheed Corp., 23 Refs.

The features of the multiple X-ray jets in the solar corona, revealed by the time series of the Yohkoh Soft X-ray Telescope images are described. The typical size of a jet was from 5 x 10 exp 3 to 4 x 10 exp 5 km, the translational velocity was 30-300 km/s, and the corresponding kinetic energy was estimated to be from 10 exp 25 to 10 exp 28 erg. Many of the jets were found to be associated with flares in X-ray bright points, emerging flux regions, or active regions, and they sometimes occurred several times from the same X-ray feature. One of the jets associated with a flaring bright point was identified as being an H-alpha surge.

A93-20493 Helium-like sulphur emission lines in solar active regions and their sub-C class variability. TETSUYA WATANABE, EIJIRO HIEI, JAMES LANG, J. L. CULHANE, ROBERT D. BENTLEY, GEORGE A. DOSCHEK, J. I. BROMAGE, CHARLES M. BROWN, URI FELDMAN, ANDRZEJ FLUDRA et al., *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L141-L145. Research supported by SERC, British National Space Centre, British Council, and U.S. Navy. 17 Refs.

Helium-like sulphur spectra (formation temperature, T_m about 18 x 10 exp 6 K) from coronal active regions are being obtained by the Bragg Crystal Spectrometer onboard the Yohkoh mission. The average electron temperatures of the quiescent active regions deduced from the full-disk integrated sulphur spectra are 3.5-4 x 10 exp 6 K. The temporal behavior of the emission lines in the sub-C level events shows that hot plasmas (T greater than 10 exp 7 K) can be produced in these weak events.

A93-20489 Effective geometrical thickness and electron density of a flare of 1991 December 2 observed with the Soft X-ray Telescope of Yohkoh and coronagraph. KIYOSHI ICHIMOTO, TADASHI HIRAYAMA, ASAMI YAMAGUCHI, KAZUYOSHI KUMAGAI, SAKU TSUNETA, HIROHISA HARA, LOREN W. ACTON, and MARILYN E. BRUNER, *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L117-L122. 10 Refs.

The effective geometrical thickness and electron density of a M3.7 flare of December 2, 1991 were determined from observations by the Yohkoh Soft X-ray Telescope and a newly built Lyot-type coronagraph at the Norikura Solar Observatory, respectively. A very small geometrical thickness of 1000 km was found for the flare, which occurred beyond the limb. The electron density was determined to be 4 x 10 exp 10/cu cm. The implication of the results, related to the mass balance and to the energy-releasing region, is discussed.

A93-20497 Simultaneous observations of coronal bright points in X-ray and radio wavelengths. NARIAKI NITTA, TIMOTHY S. BASTIAN, MARKUS J. ASCHWANDEN, KAREN L. HARVEY, KEITH T. STRONG, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L167-L172. Research supported by Lockheed Corp., 14 Refs.

We present a first explicit comparison of coronal bright points in soft X-ray and radio wavelengths, using the Soft X-ray Telescope aboard the Yohkoh spacecraft and the Very Large Array. About half of the 33 compact sources identified in a 20-cm full-disk map appear as X-ray bright points in the X-ray data. The other half apparently corresponds to unipolar regions with enhanced magnetic fields. Thus, the identification of radio bright points alone cannot reliably serve as a proxy for X-ray bright points. A preliminary analysis reveals that bright points commonly observed at 20 cm and in X-rays have temperatures of $(1.4-2.9) \times 10^6$ K and emission measures of $(0.4-2.5) \times 10^{26}$ cm⁻³. The observed brightness temperatures at 20 cm $(1-2.5) \times 10^5$ K can be explained in terms of optically thin free-free emission from a plasma with these parameters.

A93-20496 Observations of the variability of coronal bright points by the Soft X-ray Telescope on Yohkoh. KEITH T. STRONG, KAREN HARVEY, TADASHI HIRAYAMA, NARIAKI NITTA, TOSHIFUMI SHIMIZU, and SAKU TSUNETAKA, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L161-L166. Research supported by Inst. of Space and Astronautical Science, SERC, and Lockheed Corp., 16 Refs.

We present the initial results of a study of X-ray bright points (XBPs) made with data from the Yohkoh Soft X-ray Telescope. High temporal and spatial resolution observations of several XBPs illustrate their intensity variability over a wide variety of time scales from a few minutes to hours, as well as rapid changes in their morphology. Several XBPs produced flares during their lifetime. These XBP flares often involve magnetic loops, which are considerably larger than the XBP itself, and which brighten along their lengths at speeds of up to 1100 km/s.

A93-20488 The X flare of 1991 November 15—Coordinated Mees/Yohkoh observations. RICHARD C. CANFIELD, HUGH S. HUDSON, K. D. LEKA, DONALD L. MICKEY, THOMAS R. METCALF, JEAN-PIERRE WUELSE, LOREN W. ACTON, KEITH T. STRONG, TAKEO KOSUGI, and TARO SAKAO et al., National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL. *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L111-L115. 14 Refs.

This is a preliminary report on two unique new results from coordinated observations at Mees Solar Observatory and Yohkoh of the X1.5 flare of November 15, 1991 using vector magnetograms, H-alpha imaging spectra, X-ray images, and X-ray spectra. First, we find a close spatial relationship between H-alpha redshifts and X-rays from a flare loop and its footpoints at a time of large X-ray blueshifts. Second, we find that impulsive-phase hard X-rays originate in regions that are new, but not coincident with, the peaks of the vertical electrical current density distribution in AR 6919.

A93-20486 Observations of several small flares with the Bragg Crystal Spectrometer on Yohkoh. J. L. CULHANE, ANDRZEJ FLUDRA, ROBERT D. BENTLEY, GEORGE A. DOSCHEK, TETSUYA WATANABE, EIJIRO HIEI, JAMES LANG, MARTIN K. CARTER, JOHN T. MARISKA, ANDREW T. PHILLIPS et al., *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L101-L106. Research supported by SERC, British National Space Centre, British Council, and U.S. Navy. 14 Refs.

We have analyzed data from two flares of GOES class C7.1 and C8.5 observed by the Yohkoh Bragg Crystal Spectrometer. The high sensitivity of the Yohkoh instrument allows us to observe the very early stages of flare development and to study small events with a high signal-to-noise ratio. Spectral fitting programs have been used to derive plasma temperatures, emission measures and velocities from spectra of S XV, Ca XIX and Fe XXV. Large plasma motions indicative of chromospheric evaporation have been found. A more detailed analysis of a flare which occurred on 1991 October 30 is presented.

A93-20477 The Hard X-ray Telescope (HXT) onboard Yohkoh—Its performance and some initial results. TAKEO KOSUGI, TARO SAKAO, SATOSHI MASUDA, KAZUO MAKISHIMA, MIKA INDA, TOSHIO MURAKAMI, YOSHIKI OGAWARA, KENTARO YAJI, and KYOKO MATSUSHITA, *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L45-L49. 10 Refs.

More than two hundred solar flares, including several GOES X-class events, were successfully observed with the Hard X-ray Telescope (HXT) on board Yohkoh during the initial six months of observations since October 1991. Hard X-ray images taken simultaneously in four X-ray energy bands (14-23-33-53-93 keV), with angular and temporal resolutions of about 5 arcsec and 0.5 s, respectively, have been revealing how and where hard X-rays are emitted in flaring magnetic loops, and, further, how and where electrons are accelerated and confined. These HXT observations are briefly reviewed from the viewpoint of the instrument capability and performance, with some new scientific results. (Author)

A93-20492 High-temperature plasmas in active regions observed with the Soft X-ray Telescope aboard Yohkoh. HIROHISA HARA, SAKU TSUNETAKA, JAMES R. LEMEN, LOREN W. ACTON, and JAMES M. MCTIERNAN, *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L135-L140. 10 Refs.

High-temperature plasmas reaching $5-6 \times 10^6$ K in solar active regions have been found with the Soft X-ray Telescope aboard Yohkoh. NOAA region 6919 was investigated in detail using five different X-ray filters. The temperature of a bright loop in the active region is 5.7×10^6 K, with an emission measure of 5.0×10^{26} cm⁻³ exp 5; in a fainter part of the region plasma, we find 5.0×10^6 K and 4.0×10^{26} cm⁻³ exp 5. This indicates that such high-temperature plasmas exist in the active region, irrespective of the brightness. Another observation of the quiet corona was conducted in order to investigate the reliability of a temperature analysis with the same filter pairs which show such high temperatures in active regions. The inferred temperature was 2.7×10^6 K, and the emission measure 1.3×10^{26} cm⁻³ exp 5 which is consistent with the typical results of Skylab. Therefore, the high-temperature plasmas in solar active regions are considered to be real. (Author)

A93-20483 Hard X-ray imaging observations by Yohkoh of the 1991 November 15 solar flare. TARO SAKAO, TAKEO KOSUGI, SATOSHI MASUDA, MIKA INDA, KAZUO MAKISHIMA, RICHARD C. CANFIELD, HUGH S. HUDSON, THOMAS R. METCALF, JEAN-P. WUELSE, LOREN W. ACTON et al., *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L83-L87. 13 Refs.

We report on hard X-ray imaging observations of the 1991 November 15 flare with the HXT instrument aboard Yohkoh. Distributions of the hard X-ray sources at various stages of the flare, together with an overlay of the white-light flare, are presented. Attention is concentrated on the behavior of hard X-ray sources during the impulsive phase. The hard X-ray source appeared initially as a single source near the magnetic neutral line, then evolved into a double-source shape with the separation increasing with time. We believe that this is evidence for a multiple loop system flaring successively with a rising energy-release site. At the minima between the individual spikes of the time profile, the hard X-rays at 20-30 keV were concentrated near the apex of the flaring loop, whereas the hard X-rays above 30 keV originated from the footpoints. These observations are compared with the existing models.

A93-20476 The status of Yohkoh in orbit—An introduction to the initial scientific results. YOSHIKI OGAWARA, LOREN W. ACTON, ROBERT D. BENTLEY, MARILYN E. BRUNER, J. L. CULHANE, EIJIRO HIEI, TADASHI HIRAYAMA, HUGH S. HUDSON, TAKEO KOSUGI, JAMES R. LEMEN et al., *Publications of the Astronomical Society of Japan* (ISSN 0004-6264), Vol. 44, No. 5, 1992, pp. L41-L44. 7 Refs.

The design and in-orbit function of the Yohkoh spacecraft and its four scientific instruments are described. The instruments include the Hard X-ray Telescope (HXT), the Soft X-ray Telescope (SXT), the Wide-Band Spectrometer (WBS), and the Bragg Crystal Spectrometers (BCS). The key feature of the Yohkoh is the combined use of the coaligned telescopes (HRT and SXT) and spectrometers (WBS and BCS) operating simultaneously, thus constituting a spaceborne solar observatory. The SXT has already taken hundreds of thousands of excellent pictures of active regions and of flares, and the HXT has obtained data concerning more than 200 major flares.

A92-53724 MUSES-B—Japanese space VLBI satellite. TOSHIMITSU NISHIMURA, HARUTO HIROSAWA, HISASHI HIRABAYASHI, KIYOSHI MURATA, TAKESHI ORII, and EIJI NAKAGAWA, *Proceedings of the 17th International Symposium on Space Technology and Science*, Vol. 2, Tokyo, Japan, May 20-25, 1990, (A92-53451 23-12). Tokyo, AGNE Publishing, Inc., 1990, pp. 1941-1945. 2 Refs.

Japan's Institute of Space and Astronautical Sciences has undertaken the development of the MUSES-B radio astronomy satellite, which when launched in 1995 will use space VLBI as well as space observations for simultaneous coordination with ground-based VLBI. The space deployment of an orbiting telescope will require the development of suitable deployment mechanisms, low noise signal reception techniques, and an ultra-stable phase-reference transfer from the ground station to the satellite. An account is given of the development status of the satellite's design and the organization of international cooperation.

A92-53718 Space optics for studying extra-solar planetary systems. ROBERT A. BROWN, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD. *Proceedings of the 17th International Symposium on Space Technology and Science*, Vol. 2, Tokyo, Japan, May 20-25, 1990, (A92-53451 23-12). Tokyo, AGNE Publishing, Inc., 1990, pp. 1901-1905. 10 Refs.

The sharp imaging of telescopes in space will improve the ability to see faint objects near bright ones. One exciting application is the search for planets around other stars. However, because a planet is, at best, 10^9 times fainter than a star in visible light, specialized optical systems are required. Using apodization to remove diffracted light, the limiting source of noise is the intensity of starlight scattered by mirror figure errors. Based on the prelaunch metrology of the HST mirrors, and considering only photon statistics, months of integration would be needed for HST to detect Jupiter next to the sun at a distance of 5 pc. The integration times will be shorter for future telescopes in space with smoother mirrors and/or larger apertures.