Name of research institute or organization:

Institute of Applied Physics, Universität Bern

Title of project:

Solar Sub-Millimeter Flare Observations with KOSMA

Project leader and team:

Dr. Andreas Magun, project leader
Thomas Lüthi, Dr. Andreas Lüdi, Dr. Axel Murk

Project description:

The process of electron acceleration during solar flares is still under debate, and only little information is available that allows its investigation at relativistic energies. With the recent development of sub-millimeter instrumentation and observing sites the synchrotron emission from solar relativistic electrons has become accessible. Our observations are carried out on Gornergrat in collaboration with KOSMA (Köln Observatory for Sub-Millimeter and Millimeter Astronomy). In a recent study [1] with KOSMA we were able to investigate the spectral development of the radio emission and electron distribution during the acceleration and thermal phase with great detail.

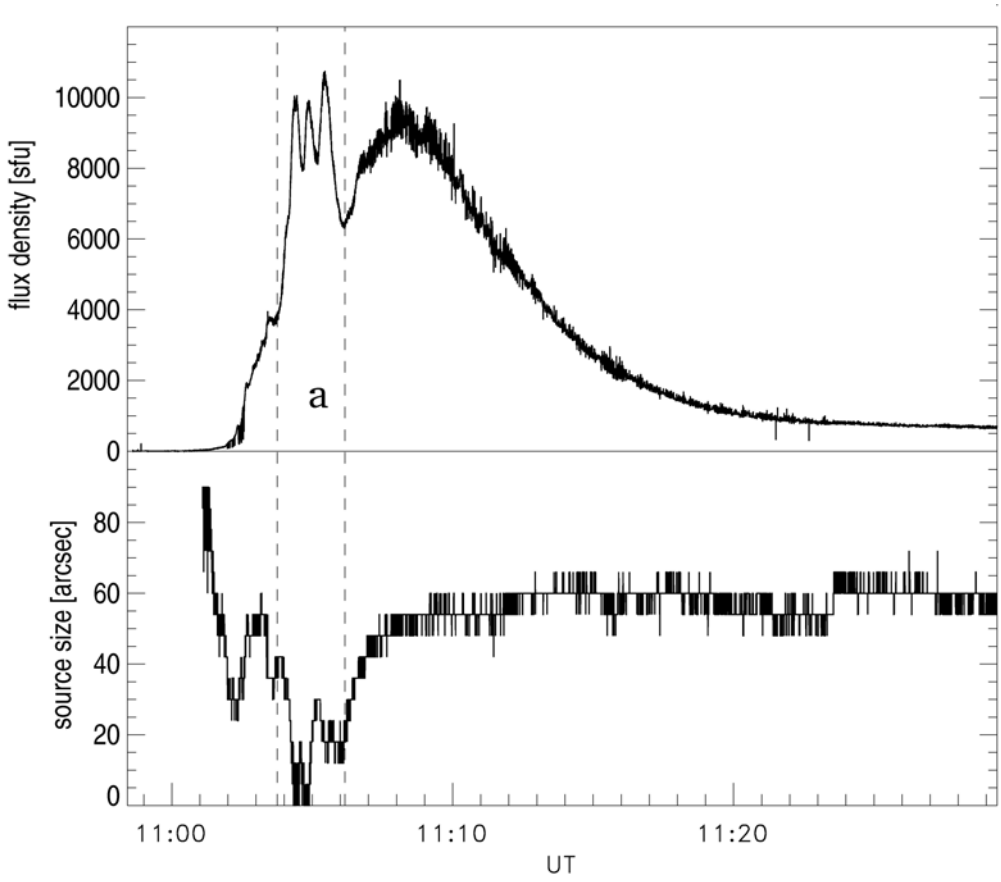

Figure 1 Solar flare at 212 GHz on October 19, 2003. The flux density (top) and radio source diameter time profiles exhibit dynamic changes of source characteristics.

Besides spectral development, also the location and diameter of the radio flare sources provide important clues for the acceleration process. For this reason the multi -beam receiver BEMRAK (BErnese Multi beam Radiometer for KOSMA) has been developed at 212 Ghz. It provides 4 intersecting beams for the reconstruction of source locations with arc-second acuracy at milli second time resolution as well as a good estimate of source diameters [2,3]. A new feature of BEMRAK is the synthesis of a fourth on axis beam from three beams by means of interference. Beam splitting of the received signal allows simultaneous measurements with BEMRAK and the two KOSMA receivers at 220 and 350 Ghz. Thus, also spectral information between 212 and 350 Ghz can be obtained.

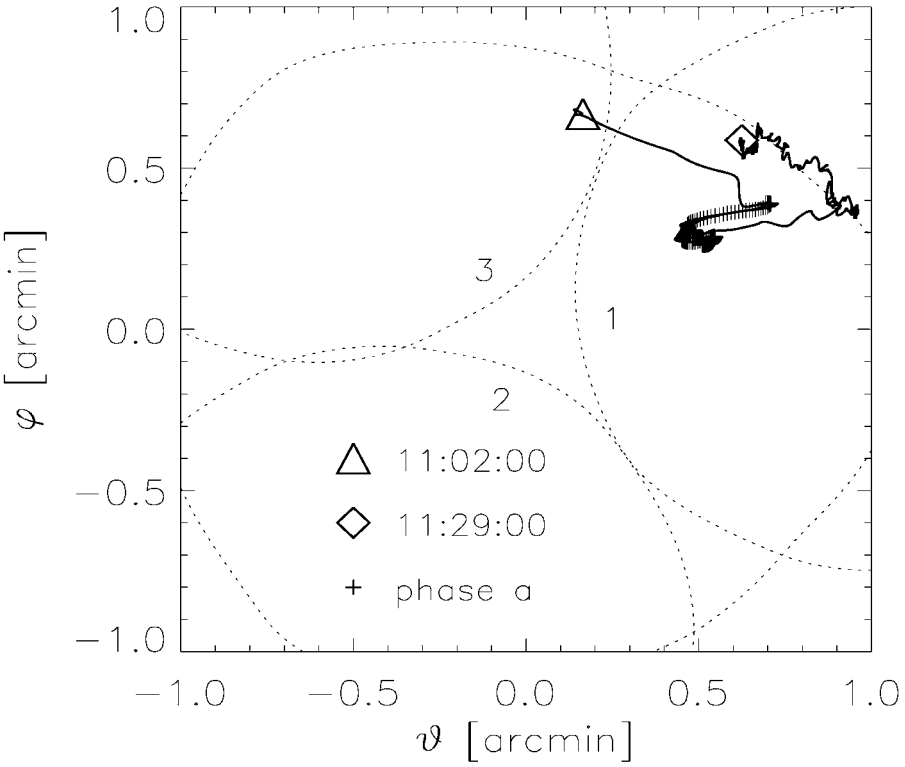

Figure 2 Measured source position changes at 212 GHz for the October 19, 2003, flare. The dotted curves represent the halfpower beamwidths of 3 beams. Phase a is marked in Fig. 1.

Only shortly after completion of the new receiver the 'mega' flare on October 19, 2003 could be observed with KOSMA. During the impulsive phase, that was charcterized by a complex temporal evolution of the millimeter flux (Fig. 1), a significant shift of the source position (Fig. 2), correlated with a dramatic change in source diameter, was observed for the first time. The results have been recently submitted to Astronomy and Astrophysics for publication.

Key words:

Sun, flare, millimeter/sub-millimeter emission

Collaborating partners/networks:

I. Physik. Institut, University of Cologne, Germany

Scientific publications and public outreach 2003:

Refereed journal articles

[1] Th. Lüthi, A. Magun and M. Miller, "First observation of a solar X-class flare in the submillimeter range with KOSMA", Astron. & Astrophys., in press 2003.

Conference paper

[2] Th. Lüthi , A. Murk , A. Magun , A. Lüdi , V. Vasic, "A Multibeam Instrument for Solar Flare Observations at Millimeter Wavelengths - Quasioptical Design and First Antenna Pattern Measurements", 28th International Conference on Infrared and Millimeter Waves, ed.: N. Hiromoto, Japan, pp.: 219-220, 2003

Data books and reports

[3] Th. Lüthi , A. Lüdi , A. Murk , A. Duric , A. Magun, "The Bernese Multibeam Radiometer for KOSMA (BEMRAK) - Instrument Design and First Antenna Measurements, IAP Research Report, No. 2003-05, Institut für angewandte Physik, Universität Bern (2003)

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