

Name of research institute or organization:

Institute of Applied Physics, University of Bern

Title of project:

Solar Flares at mm- and sub-mm Wave Lengths

Project leader and team:

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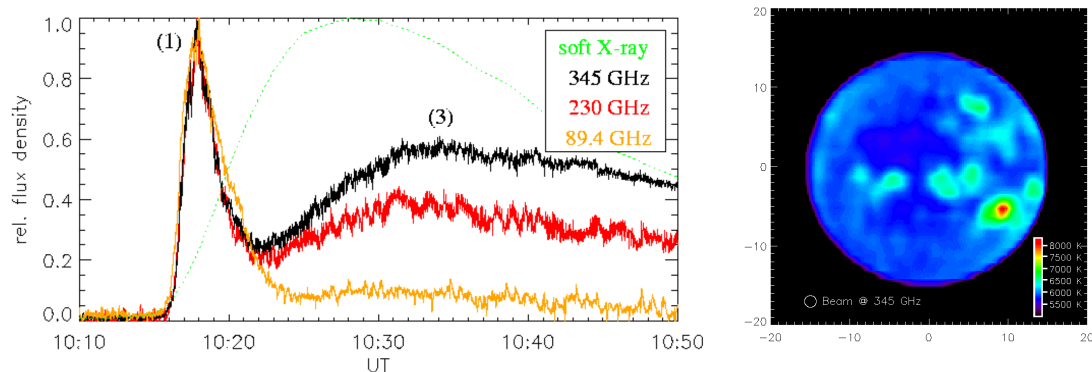
Project description

Introduction

Our research concerns the mechanism that accelerates electrons to relativistic energies during solar flares, the measurement of their gyro/synchrotron emission at mm- and sub-mm wavelengths [2] and the development of mm/submm-techniques for the instrumentation necessary for measurements in this frequency range [1]. The mm/submm-part of the electromagnetic spectrum has been covered only little for solar flare observations. Therefore one of our main goals is to observe and analyze the flare related emission over a wide wavelength range, between 30 and .3 mm (10 - 1000 Ghz), with our own and other instruments, and to compare our results with theoretical models developed elsewhere. Another focal point of our research is the study of atmospheric turbulence at mm- and sub-mm wavelengths.

Observations with KOSMA

For the first time a solar flare could be observed above 300 GHz with KOSMA at Gornergrat [3]. This confirms that electrons are accelerated to relativistic energies during the flash phase and the late formation of a thermal plasma. The intensity profiles of the radio emission between 8 and 345 GHz show the typical signatures expected for gyro/synchrotron (1) and thermal emission (3). The latter becomes visible as a strong source above the active region.



First observation of a sub-mm flare with KOSMA on April 12, 2001

For a detailed interpretation, our radio observations are currently correlated with hard and soft x-ray observations from YOHKOH. For a better understanding of the temporal evolution of the accelerated MeV electrons and the spatial relation of the different spectral components a detailed modelling is planned.

An effort has also been made to measure with KOSMA the elusive mm/sub-mm solar recombination lines for which only theoretical calculations exist. So far, no lines could be detected.

Due to the excellent atmospheric (low water vapour content) conditions at Gornergrat and the excellent infrastructure of KOSMA further observations of flares and recombination lines are planned during next summer, when the telescope can not be used for non-solar work. The new 400 and 800 Ghz receivers of KOSMA will give us a unique opportunity to extend solar observations to even higher frequencies.

Atmospheric Turbulence

For the investigation of radio propagation in a turbulent atmosphere effects of anisotropy were taken into account and our theoretical results compared with angle of arrival measurements (with sub-arcsecond and milli second resolution) carried out in Switzerland and Argentina. From their time spectra outer scale lengths L_0 in vertical and horizontal directions could be simultaneously determined. Our measurements demonstrate that their values vary between a few and approximately 100 m, and that scale length anisotropy strongly depends on meteorological conditions and location. In a stable atmosphere the horizontal scale length can even be 2 orders of magnitude larger than in vertical direction whereas under unstable conditions the vertical scale length dominates [4].

Key words

sun flare radio mm sub-mm radio observation

Collaborating partners/networks:

data exchange and collaboration with several institutions

Scientific publications and public outreach 2001:

[1] A. Murk, A. Magun, N. Kämpfer et al., "Characterisation of various quasii-optical Components for the Submillimeter Limb-Sounder SMILES", 12th Int. Symp. On Space Terahertz Technology, San Diego, USA, 2001.

[2] C.G. Castro, J.P. Raulin, C.H. Mandrini, P. Kaufmann and A. Magun, "Multi-resolution wavelet analysis of high time resolution millimeter wave observations of solar bursts", *Astron. & Astrophys.*, 366, 317-325, 2001.

[3] Th. Lüthi, M. Miller, A. Magun and A. Murk, "First observations of a solar x-class flare in the submillimeter range with KOSMA", CESRA Workshop on Particle Acceleration in the Solar Corona, 2-6 July, Ringberg Castle, Germany, 2001.

[4] A. Luedi and A. Magun, "Near Horizontal Line-of-Sight mm-Wave Propagation Measurements for the Determination of Outer Length Scales and Anisotropy of Turbulent Refractive-Index Fluctuations in the lower Troposphere", accepted for publication in *Radio Science*.

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