The Fraunhofer-Gesellschaft

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains more than 80 research units in Germany, including 60 Fraunhofer Institutes. The majority of the more than 20,000 staff are qualified scientists and engineers, who work with an annual research budget of €1.8 billion. Of this sum, more than €1.5 billion is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and region governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

Affiliated international research centers and representative offices provide contact with the regions of greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

The Fraunhofer Institute for Physical Measurement Techniques (IPM)

FHG-IPM (the former Institute for Physical Space Research IPW) was founded in 1973 and has actually about 150 staff members. It develops tailor-made measuring techniques, systems and materials for industry. Many years of experience with optical technologies and functional materials form the basis for high-tech solutions in a wide variety of fields: from laser imaging technology, via optical measuring techniques, spectroscopy and terahertz measuring technology, to thermoelectric and integrated sensor systems. The FhG-IPM infrastructure includes the current laboratory equipment for EUV measurements in ultra-vacuum with several gas discharge lamps and current data archiving system from SolACES mission monitoring and managing. It owns also a well-equipped 400m2 clean room.

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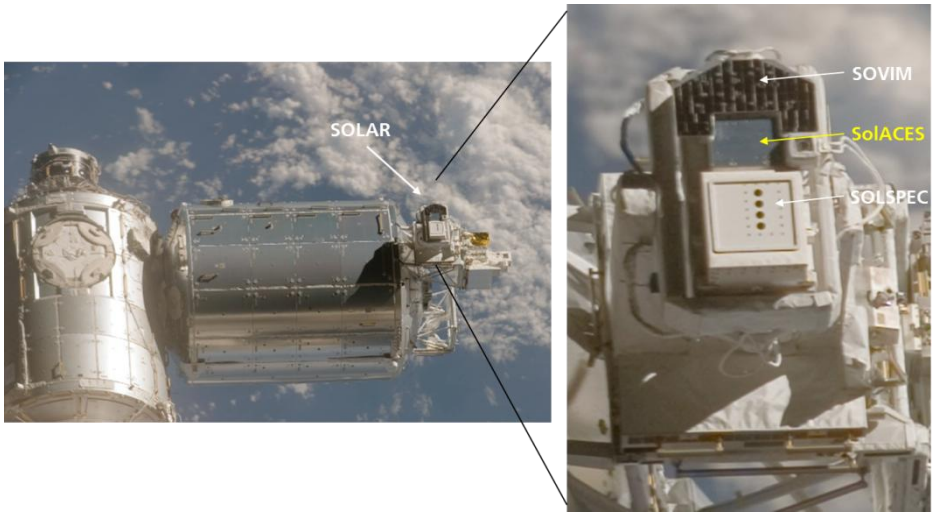
The former institute IPW emerged from the Ionospheric Institute in Breisach founded in 1954 and headed by Prof. Dr. Dr. h.c. Karl Rawer who is one of the German pioneers in space research. Since 1957 EUV spectroscopy for space applications is one of the topics to complement the ionospheric research. Based on more than 40 scientific rocket launches and participation in more than 9 satellite missions IPW/IPM received broad international recognition. The latest project is the Solar Auto-Calibration EUV Spectrometers experiment aboard the International Space Station ISS. A low-cost Spherical EUV and Plasma Spectrometer (SEPS) is under development within the ESA program GSTP. Today Fraunhofer IPM also exploits findings from the analysis of ionospheric plasmas for industrial applications – such as for the characterization of industrial plasmas.

FHG (Fraunhofer IPM) activities within the EU project AFFECTS

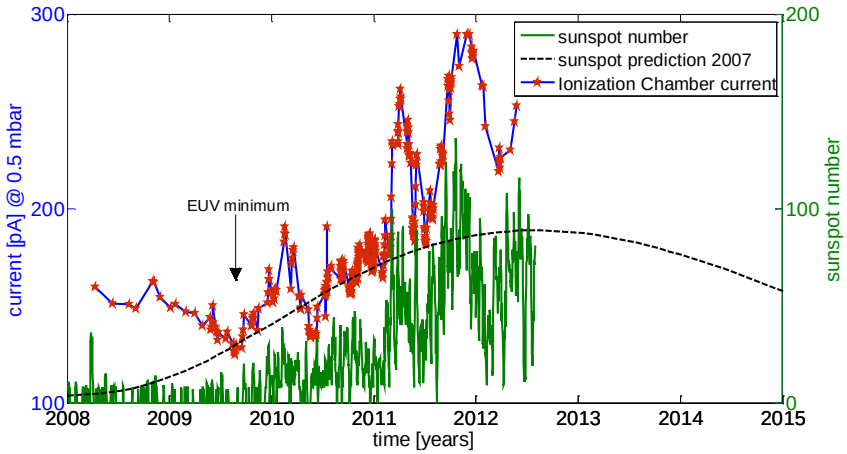
Solar EUV data

The solar Extreme Ultraviolet (EUV) radiation is totally absorbed in the Earth's atmosphere and drives the photo-chemistry of the Earth's (and other planets) upper atmosphere. Even though the EUV is only a small fraction of the total solar irradiance, it is highly variable on many time scales from minutes (solar flares), hours (flares and active region evolution), days (solar rotation modulation) and years (solar cycle, the 22 year magnetic cycle). The amount of Total Solar Irradiance variability depends on the wavelength, at the shorter EUV wavelengths below 50 nm the solar cycle variability is a factor of 10 – 100. As the radiation below 200 nm is absorbed in the atmosphere it drives the temperature structure and ionization state of the upper atmosphere.



The evaluation of the SolACES data set Level 1 (16 nm – 154 nm) can be hopefully be ready by end of 2012. The data set shall be published on the homepage (www.solaces.eu) including the available publications concerning the SolACES instrument and data analysis. One special topic is the analysis of the unusual solar minimum period between the cycles 21 and 24 [1]. Due to the periodically measurement behavior of the SOLAR experiment based on the combination of pointing device capability and IIS orbit behavior the data set cannot provide a continuous sun observation in time.

[1] B. Nikutowski, R. Brunner, Ch. Erhardt, St. Knecht , G. Schmidtke: *Distinct EUV minimum of the solar irradiance (16-40 nm) observed by SolACES spectrometers onboard the International Space Station (ISS) in August/September 2009*, Adv. Space Res. 48, 899-903, 2011.



The first ionisation current of the aluminium/carbon filter I4 as an absolute integral measure of the 16–40 nm EUV irradiance exhibits its minimum in the middle of September 2009. The comparison of spectra at different activity levels shows that at lowest activity the EUV irradiance is always the lowest, too.

Several data pools for EUV data sets of available international EUV missions are currently under development. One of them is a public data pool called LISIRD initialized by the LASP/Boulder organization (http://lasp.colorado.edu/lisird/) in USA. Another data archive

for the SOLAR experiment at ISS is under discussion at ESAs science archive ESAC (Villafranca, Madrid) (http://www.rssd.esa.int/index.php?project=SH).

In addition to the regular TIGER Symposia a EUV Working Group has been established. In this context the Solar EUV Irradiance Inter-Calibration and Validation Workshop was held in October 2011 in Boulder /CO USA in order to collect all EUV data available and validate them to elaborate a common data pool for the science community. The aim of the Working Group is to produce an absolutely calibrated measure of the solar EUV irradiance, and to provide a long-term record of the solar EUV irradiance and its variability. This is accomplished by validating the EUV irradiance products from various instruments, understanding their calibration and degradation. A second workshop concerning these topics was held in Mai 2012 at ROB in Brussels.

SEPS sensor simulation

One of the tasks of the SEPS instrumentation shall be the measurement of EUV irradiance between 15-200 nm.The versatile instrument SEPS enables also the plasma measurements in the altitude regimes of LEO and GEO.

The sensor consists of three metallic spheres/electrodes, the central metallic sphere (MS), a highly transparent inner grid (IG) and an outer grid (OG). In the EUV mode of operation the measured current from the sphere is a mixture of the photoelectrons produced on the sphere as well on the inner and the outer grid. The on-going work is to establish a mathematical tool to model the different contributions to the measured MS current in order to derive the energy distribution of the photoelectrons, hence to determine the incoming EUV spectrum. There are two EUV modes of operation: The total EUV fluxes can be recorded at 10 ms repetition rate while the spectral resolved recording required up to 5 min, each. After activation and reconfiguration of the SolACES test measurement equipment in the lab, some tests are planned to verify the model by spectral measurements with SEPS.