



# Polarization of Planetary Systems

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Organizers:

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**Abstract.** The meeting “Polarization of Planetary Systems”, sponsored by the EU-COST Action, brought together experts in the study of polarization from the celestial bodies of our solar system and extra-solar planets. Among the main themes under discussion, particular emphasis was given to the diagnostic power offered by the study of the atmospheric properties of planetary systems in the search for life features.

**Keywords.** Polarization, solar system, extra-solar planets, instrumentation

Polarization arises every time there is a mechanism that breaks the symmetry within the radiative source, or between the source and the observer. Examples include the presence of a magnetic field, the presence of collimated beams, or scattering by surfaces or particles. Thus, polarimetry is a very powerful remote sensing tool for the study of a variety of objects of astrophysical interest: from asteroids, planets and other objects in the solar system, to magnetic stars (the spectral lines of which are polarized by the Zeeman effect), asymptotic giant branch (AGB) and post-AGB stars and supernovae (where polarized light may reveal asymmetries of the ejected materials).

From September 23 to 26 Villa Il Gioiello hosted the workshop on “Polarization of Planetary Systems”. Thirty-four participants from 12 different countries took part in the meeting, most of them with the financial support of the COST (European Cooperation in Science and Technology) action MP1104 “Polarimetry as a tool to study the Solar System and beyond”. The workshop was divided into sessions dealing with (i) the small bodies of our solar system, (ii) the atmospheres of the planets (including the Earth), (iii) instruments, and (iv) extra-solar planets.

(i) Polarimetry is routinely used for the study of the atmosphere-less bodies of our solar system. The way the polarisation and the reflectivity depend on the phase-angle (i.e., the angle between the Sun, the object and the observer) may constrain their surface structure. In particular, polarimetric measurements provide an estimate of the object albedo, which, combined with luminosity measu-



Fig. 1. Group picture in the Front Portico of Villa Il Gioiello. (Courtesy of A. Maraviglia)



Fig. 2. The meeting room in the Loggia. (Courtesy of A. Maraviglia)

rements, allows us to estimate the size. This is particularly important for Near Earth Asteroids, that can pose threats to the Earth.

(ii) Polarimetry is also a very useful diagnostic tool for the planet atmospheres, providing unique information on their structure and the scattering properties of particles in the upper atmosphere. A very important aspect of polarimetric studies of the planets of our solar system is that they represent a benchmark for future investigations of the surface structure and the atmospheres of the extra-solar planets. Earth is an important target, as it is the only planet in which we are sure to find life. Polarimetry of the Earth as seen from space has been studied through observations of the Earth-shine and the presence of vegetation identified in the linear polarisation spectra.

(iii) We all know/expect that many current and next-generation astronomical instruments are/will be equipped with polarimetric capabilities. But it is more surprising to learn that even smartphones may turn into spectropolarimeters that can be used by anyone to perform measurements of aerosols in the atmosphere overhead. With iSPEX, a group of scientists from the Netherlands have introduced a new measuring technique for aerosols, as well as a modern measurement philosophy that they call “citizen science”. The users install the iSPEX add-on in front of the camera of their iPhones and point the device at various patches of blue sky. iSPEX measures both the spectrum and the linear polarization of the sunlight that is scattered by molecules and aerosols in the sky. Then the iSPEX app gives the user direct feedback on the air quality and at the same time submits all relevant data to the central database, effectively creating a crowd-sourced map of air pollution.

(iv) Polarimetry has already been applied to the search for and characterization of extra-solar planets. Normally, an extra-solar planet is almost completely hidden in the glare of its parent star. Polarimetric techniques exploit the fact that the light reflected from the planet is polarised, whereas that emitted by the star is not. The use of a polarising filter can make it possible to separate the two sources of light despite the exceptionally close proximity of the planet and the star in the sky.

The full program of the workshop is available at [www.polarisation.eu](http://www.polarisation.eu) (section “Previous meetings”).

