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The SupraThermal Electrons, Ions and Neutrals detector for Solar Orbiter

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Solar Orbiter will be launched in 2017 and reach a perihelion of 62 Solar radii (about 0.3 AU). This will allow unprecedented coordinated remote-sensing and in-situ studies of the physics of the Sun, corona, and inner heliosphere. One of the science objectives of Solar Orbiter is to understand how solar eruptions produce the energetic particle radiation that fills the heliosphere.

The Energetic Particle Detector (EPD) will measure charged particles in an energy range from a few keV/nuc up to hundreds of MeV/nuc. It consists of five different sensors to cover this energy range and allows excellent pitch-angle coverage.

The SupraThermal Electrons, Ions and Neutrals (STEIN) detector is part of the Energetic Particle Detector (EPD) suite, and has heritage from the STEREO Suprathermal Electron (STE) instrument. The STEIN telescope itself is located near the end of the boom of the spacecraft, and will measure electrons from 2 keV to 100 keV and protons (ions) from 4 keV to 100 keV. In addition, STEIN also enables the detection of neutral atoms in the same energy range as for ions. STEIN has two viewing directions, one approximately looking along the nominal Parker spiral direction and the other in the opposite direction. Both fields of view come with one array of 32 semiconductor detector (SSD) pixels each.

To distinguish between neutral and oppositely charged particles STEIN uses electrostatic deflection. A collimator in front of the electrostatic deflection unit will prevent scattered light from hitting the SSDs and is an important thermal element. Because STEIN may be directly exposed to sunlight during deep space maneuvers, the shape, material and absorption/reflection characteristics of the collimator are being carefully studied. We are also investigating the use of a coded aperture to increase pitch-angle resolution for charged particles and to improve directional information for neutral atoms.

The layout of the detector pixels and the trajectories of charged particles in the electrostatic deflection unit are being studied. One early result has been the importance of including particle interactions with the housing of the telescope and deflection plates. Both scattering and charge exchange are crucial processes for the overall performance of STEIN. We have used GEANT 4 to take into account most relevant physical interactions of the particles with matter, especially scattering. However, charge exchange is, to our knowledge, not included in GEANT 4 and will require further study.

In this work, we will compare SIMION® and GEANT 4 simulations, initial studies of the collimator, present a preliminary SSD pixel layout of the STEIN instrument, and discuss STEIN's role within EPD and Solar Orbiter.