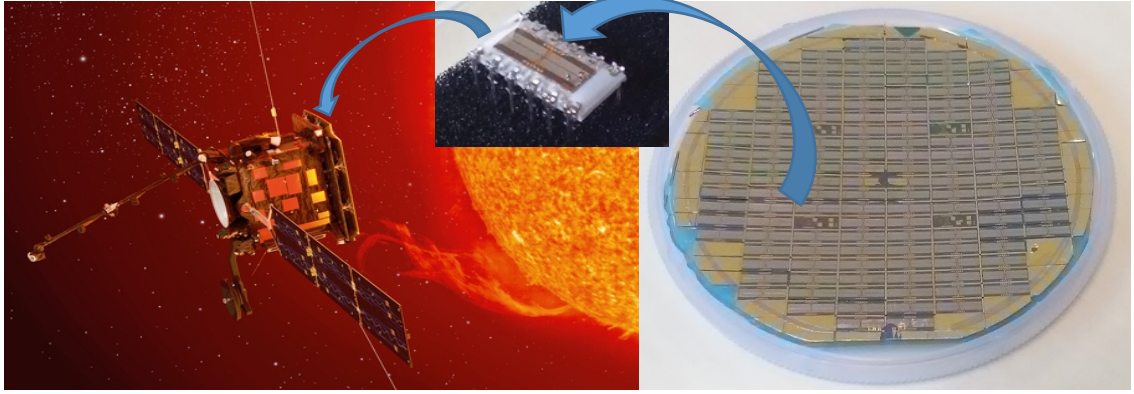

PhD POSITION ON MAGNETIC SENSOR FOR SPACE EXPLORATION

Towards the next generation of space magnetometers: the miniaturized tunneling magnetometer MAROT

Measuring the magnetic field in space is essential to characterize the near-Earth space environment (ionosphere, magnetosphere) and to study the heliosphere and the others planets of our solar system. The state-of-the-art solution to perform these measurements is to use simultaneously two different instruments, which is necessary in order to measure the magnetic field variations with a good sensitivity at all frequencies. The LPC2E and SPINTEC laboratories, which have respectively expertise in space measurements of the magnetic field (TARANIS -CNES-, PARKER SOLAR PROBE -NASA- SOLAR ORBITER -ESA-) and spintronics, are combining their skills to develop a new instrumental concept to measure the magnetic field over a broad range of frequencies with a single, much smaller and lighter instrument. The very small size and extreme lightness of the MAROT magnetometer will make it an excellent candidate for both future standard and nanosatellites space missions designed to explore our solar system.

The MAROT magnetometer is based on an innovative architecture that includes a magnetic tunnel junction as the sensitive element of the sensor, a flux concentrator to amplify the field to measure, and a magnetic field modulation system to reduce the measurement noise.

The PhD work will build on previous patented achievements obtained by our two laboratories. In a first step, the work will focus on the development of an innovative magnetic tunnel junction by studying the impact of both the chosen materials and the junction geometry. This will require numerical simulations as well as experimental work in laboratory including multilayers deposition, micro-manufacturing in clean room (lithography, etching, metal deposition …), characterization with various microscopic imagery methods, and electrical and magnetic characterizations.
In a second step, the work will focus on maximizing the signal to noise ratio of the sensitive element of the sensor either by increasing the size of the junction or by connecting several junctions in a serial/parallel circuit. Finally, the optimization of the modulation system should allow to increase the sensitivity of the new sensor far beyond the usual sensitivity of miniature sensors.
Time permitting, a sensor prototype will be realized by the end of the PhD.

The PhD is co-directed by the two laboratories LCP2E and SPINTEC, and co-funded by the French space agency (CNES); the successful applicant will be based at SPINTEC (CEA-CNRS- UGA) in Grenoble where most of the experimental work will be performed, with regular visits at LPC2E (CNRS, Univ. Orléans) in Orléans during the PhD.

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