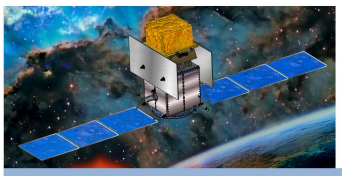

A laser-driven source for radiation damage studies of SiPM in the framework of e-ASTROGAM

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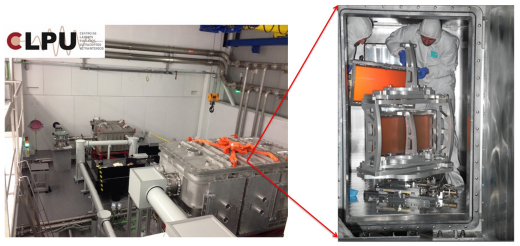
Nowadays, high power lasers, which generate ultra-short pulses and be focused up to ultrahigh intensities, are versatile and powerful sources of radiation and high-energy particles, which might cover the need of affordable and compact accelerators for the space industry. Among other advantages, a laser-driven source can reproduce different aspects of a space environment, tailored to the specific characteristics of a space mission, due to the inherent ability of these sources to produce particle beams with a broad energy distribution that depends on the laser-target parameters (Hidding et al).
In the framework of the e-ASTROGAM collaboration, at the Spanish Pulsed Laser Centre (CLPU), we aim to perform radiation damage studies of silicon photomultipliers (SiPM) detectors, tailored to the low-Earth orbit proposed for the mission. SiPM are of great importance for the Time of Flight (ToF) capability of the anticoincidence system of e-ASTROGAM.

SPANISH PULSED LASERS CENTRE (CLPU)

The Spanish Pulsed Lasers Centre (www.clpu.es) is a scientific and technological infrastructure dedicated to ultra-intense laser research and development.

It is the Spanish reference Users Centre in pulsed femtosecond lasers with **Gigawatt**, **Terawatt** and **Petawatt** peak powers. Its aim is to offer services to the scientific and industrial community by providing access to the cutting-edge high intensity laser systems; consulting and other collaborations.

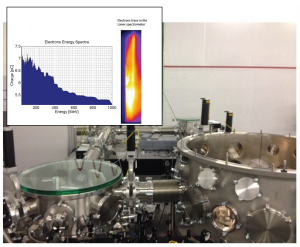
Its main equipment is the **Petawatt laser system called VEGA**, not only unique for its power (30J/30 fs) but its customized design with three synchronized arms.



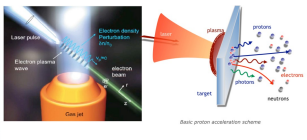
Compression grating of the VEGA laser system at the CLPU

PARTICLE ACCELERATORS BASED ON LASER-PRODUCED PLASMA

The advent of the CPA technique has revolutionized the physics of particle accelerations. Compared to conventional accelerator, lasers can produce ultra short particle beams with high brilliance, low emittance and broad energy spectrum. Moreover Laser technology is in a continuous progress which provide a constant beam quality improvement.



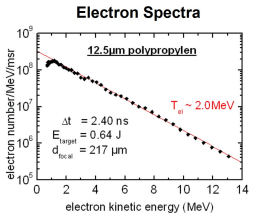
Particle accelerators set-up and electron spectra measured at the CLPU.



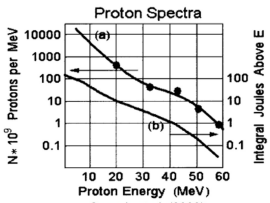
Particle accelerators based on laser-produced plasmas can operate in many different regimes depending upon the characteristics of the laser-target interaction parameters.

LASER-DRIVEN SOURCE TO REPRODUCE NEAR-EARTH SPACE RADIATION ENVIRONMENT

A laser-driven source can reproduce different aspects of a space environment, tailored to the specific characteristics of a space mission, due to the inherent ability of these sources to produce particle beams with exponential energy distribution that depends on the laser-target parameters. This is an outstanding tool to perform radiation hardness testing for space application electronic devices, as well as to study and evaluate the response of materials (e.g., biological shields for the International Space Station –ISS-) or scientific instruments on-board spacecraft, such as in the case of e-ASTROGAM.



ATLAS-Laser system (mpq.mpg.de)

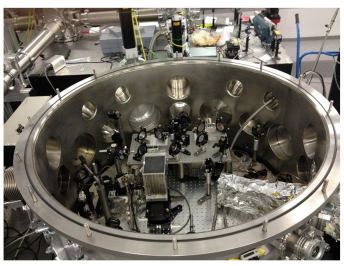


Snavely et al. (2000)

Examples of energy distribution of electron and proton for given parameters of the laser-target interaction in order to illustrate the broad energy band (and shape) of the spectra. Electron energies obtained at CLPU are about 500MeV with the 200TW laser. Energies of a few GeV are achievable with a laser of one PW system like the one at CLPU.

Radiation damage studies of SiPM detectors

At the Spanish Pulsed Laser Centre (CLPU), we aim to perform Radiation damage studies of silicon photomultipliers (SiPM) detectors, tailored to the low-Earth orbit proposed for the e-ASTROGAM.



Experimental setup in the vacuum chamber at the CLPU, where laser-target interaction takes place.

Prototype of a scintillator crystal coupled to a SiPM for testing inside the chamber interaction. The read out is currently being developed at the CLPU based on a NI's Card.

REFERENCES

- Commissioned report, "Study of Space Radiation Effects with Laser-Plasma Accelerators", ESA-ESTEC Darmstadt,(2014).
- Hidding et al. (2013), ESA NPI Activity 4000102854.
- R. A. Snavely et al., Phys. Rev. Lett. 85, 2945 (2000).