



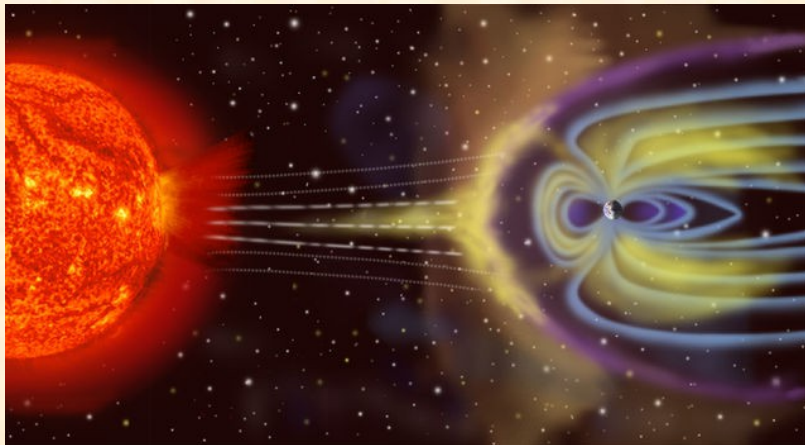
How to test electronics used in the Cosmos ?

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Presentation Plan

- Why ?
- How ? test the electronics used in space !
- Where ?



The Space Radiation Environment



Sun through solar flares: photons, charged particles

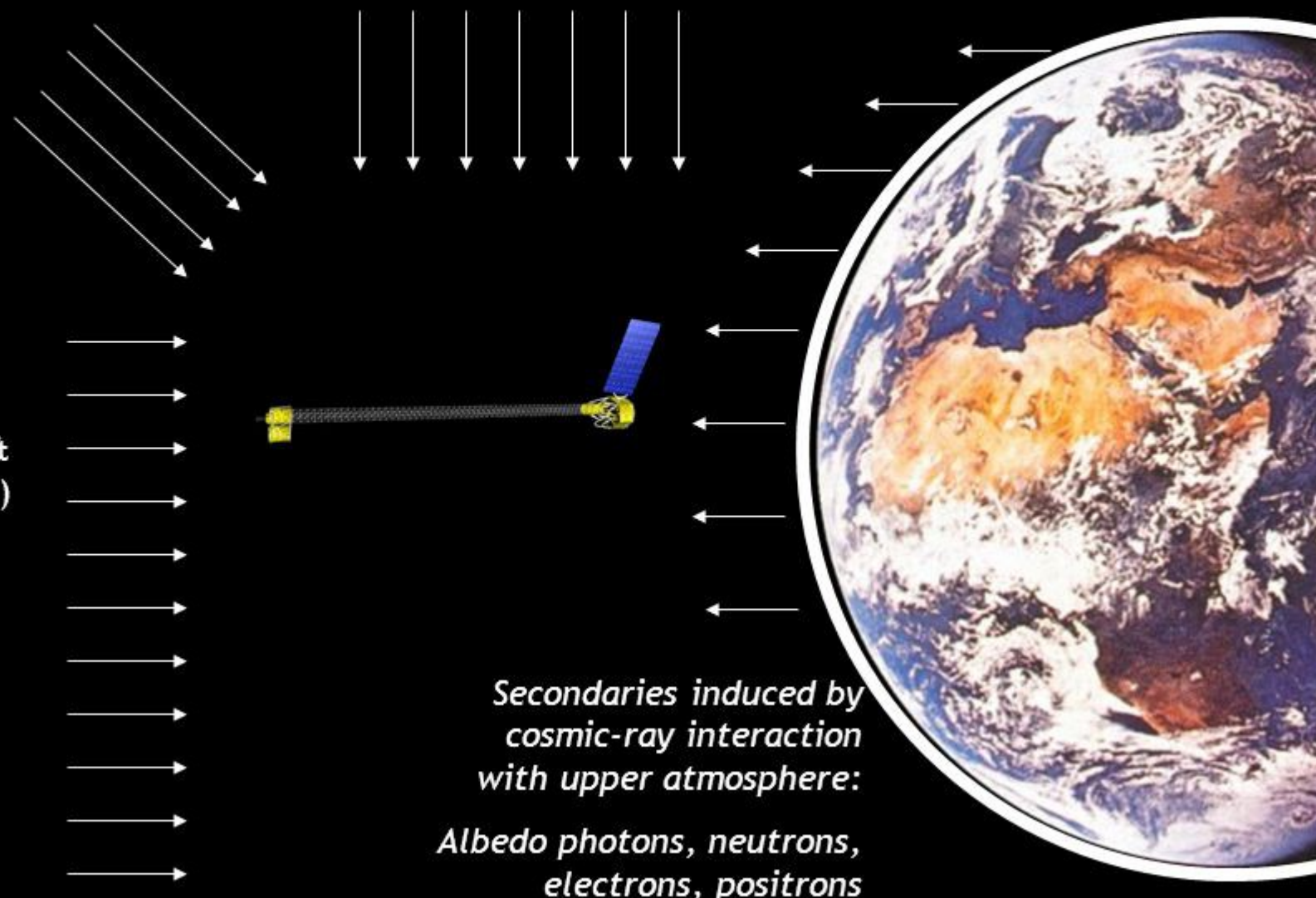
Radiation belts:

Trapped protons (SAA) & resulting activation, electrons

Why ?

Cosmic rays:

- Photons
- Protons (& activation)
- Alphas
- Ions
- Electrons
- Positrons



Secondaries induced by cosmic-ray interaction with upper atmosphere:

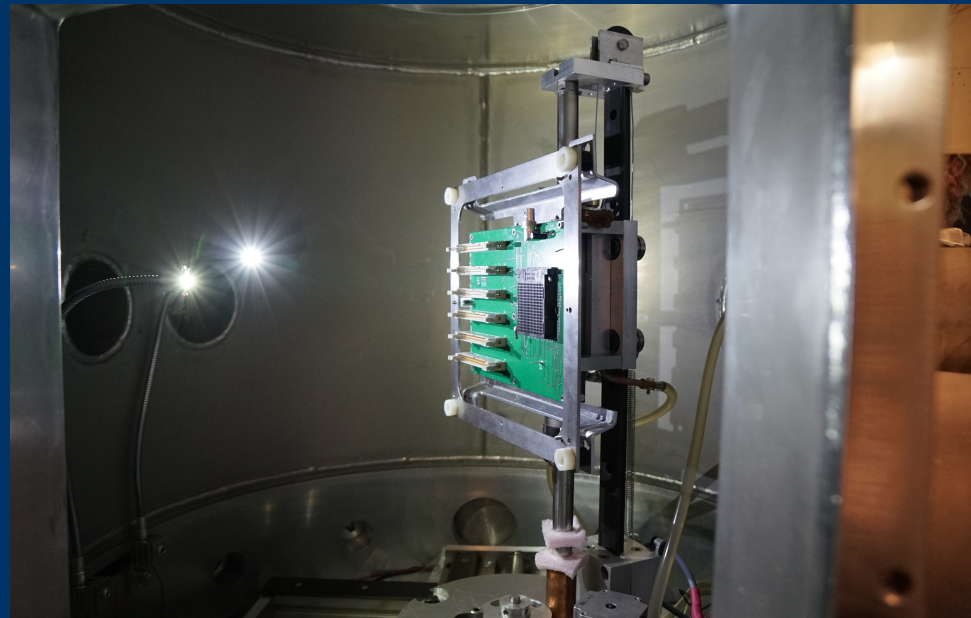
Albedo photons, neutrons, electrons, positrons

How ?

There are two primary ways that radiation can affect electronics: **Total Ionizing Dose (TID)** and **Single Event Effects (SEEs)**.

The heavy ion accelerator shall be capable of delivering ions with a range of at least **40 μm in silicon** with variable flux ranging from a few **10 ions/cm²/s** to at least **10⁵ ions/cm²/s** on the device under test.

The high energy proton accelerator shall be capable of delivering protons in the energy range **20 to 200MeV** with a variable flux ranging from **10⁵p/cm²/s** to at least **10⁸p/cm²/s** on the device under test.



Where ?

The demand for E.E.E. (Electrical, Electronic and Electromechanical) components suitable for space applications is a growing industry within Europe.

There are various numbers of companies that offer testing for space components in Europe recommended from EASA:

ESA Components Laboratory; Alter Technology; Serma Group; IMT srl; TRAD Tests & Radiation; Paul Scherrer Institut (PSI), Villigen, Switzerland; Centre de Recherches du Cyclotron, Louvain-la-Neuve, Belgium, Jyväskylä University, Finland.

Other European SEE & TID IRRADIATION TEST Facilities:

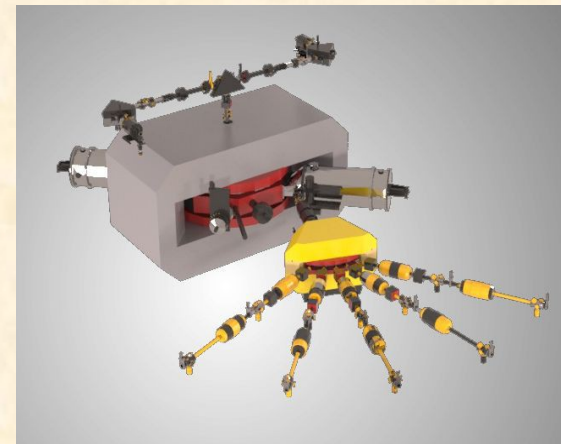
Facility	Town	Country	Source
CALLIOPE	Rome	Italy	Co-60
CNA	Seville	Spain	Co-60, LE Protons
GANIL	Caen	France	Heavy Ions
GSI	Darmstadt	Germany	Heavy Ions
IPN	Orsay	France	Heavy Ions
KVI	Groningen	Netherlands	Heavy Ions & Protons
LNS	Catania	Italy	Heavy Ions & Protons
SIRAD	Legnaro	Italy	Heavy Ions
TSL	Uppsala	Sweden	Protons
USC	Santiago de Compostela	Spain	Co-60

Poland ??



Tested E.E.E. components is used not only in space missions but also in:

- telecommunications satellites;
- satellites conducting research in space;
- nuclear energy devices,
- civil and military aviation;
- medical equipment used in radiotherapy;



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THANK YOU FOR YOUR ATTENTION



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A ROZWÓJ KRAJOWEJ INFRASTRUKTURY BADAWCZEJ
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