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Energetic Solar Cosmic Ray surveyor and monitor for EArth-Mars missions (CREAM surveyor and monitor)

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The experiment is conceived in the **plan of activities for the realization of passive and active shielding** systems against ionising radiation in the future manned interplanetary flights and their integration in the project of the spaceship for the first manned mission to Mars.

The knowledge of the SEPs arrival directions as a function of their energy and in correspondence of the different solar phenomena is a basic input for providing an adequate protection and for planning a long duration human presence on Mars.

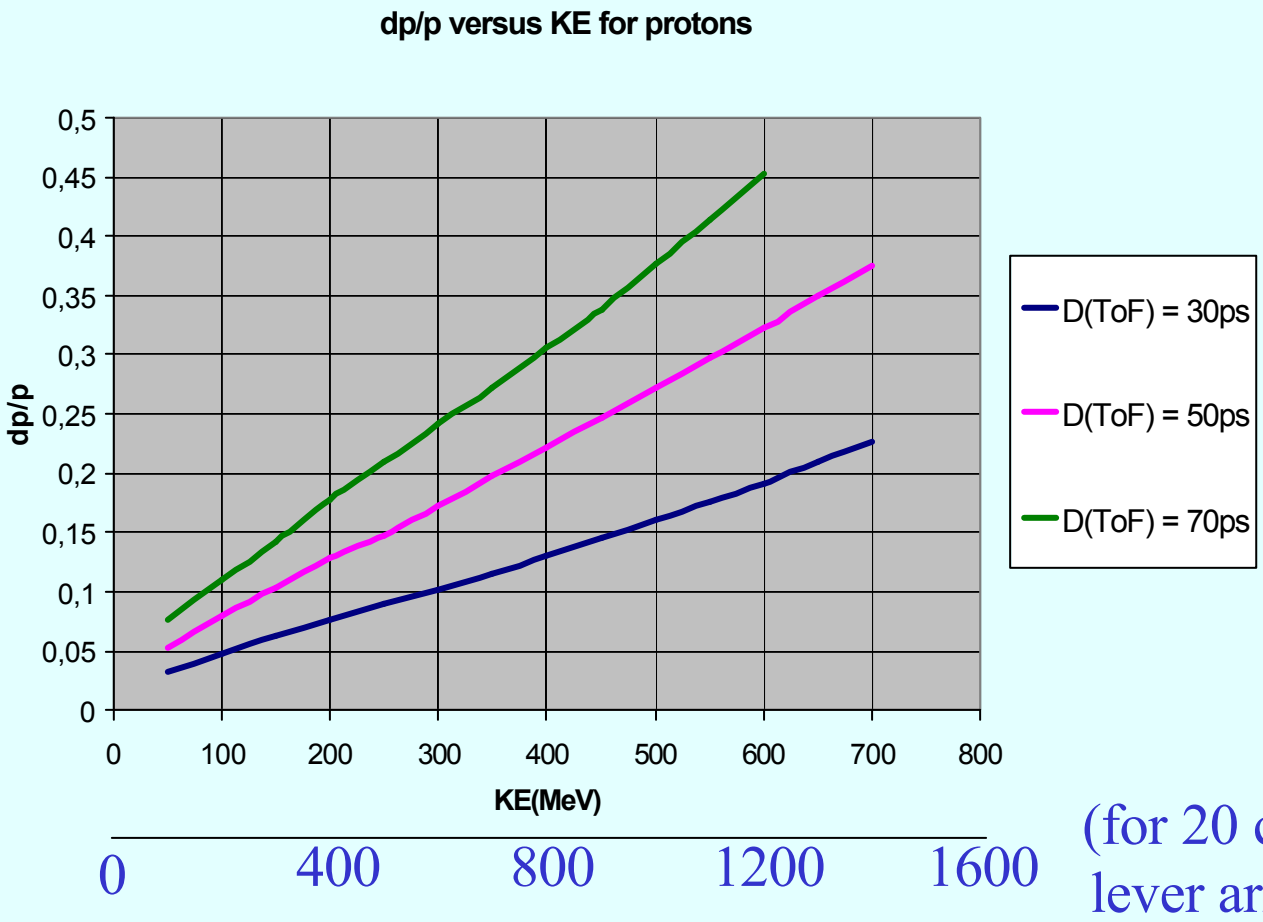
The angular distribution of the most energetic Solar Cosmic Rays strongly depends by their energy and evolves with time.

Its knowledge is nowadays very important in view of the programs of exploration of the Solar System for:

-the planning of the **distribution of shielding** systems,
-the project of the **interplanetary spacecraft structure**,
-the radiation **protection of possible orbiters or landers**.

For a reliable forecasting it must be systematically studied, with correlated information on energies, evolution with the time, etc… in correspondence of the different topologies of energetic solar events and of their frequency.

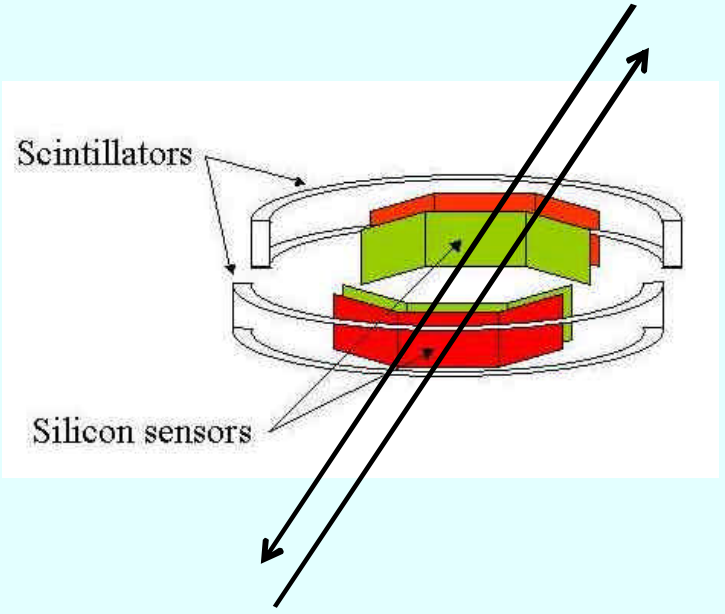
A small mass (<5 kg) and low consumption (<5 W) instrument, based on the two well established techniques of tracking by multistrip silicon detectors and precise charge and timing measurements by scintillation counters, can supply enough precise data up to about 500 MeV/nucleon.

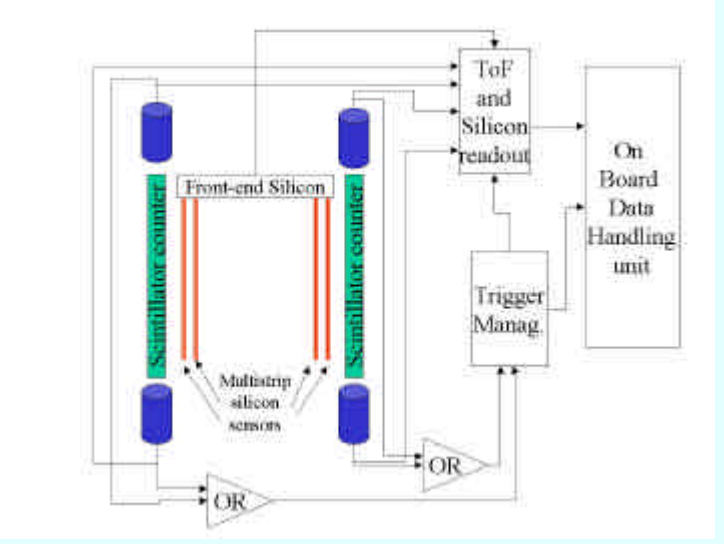


Relative momentum error for protons for different ToF resolutions on a 10 cm lever arm

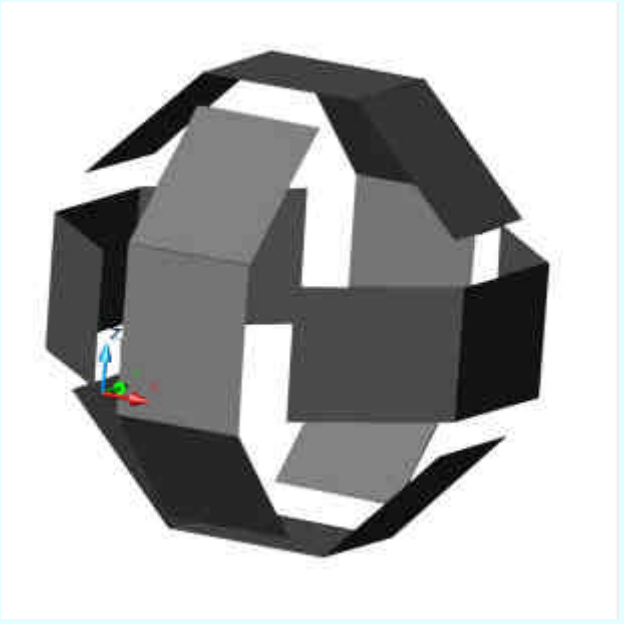
Napoli ToF board – time Resolution

Time resolution of the ToF electronics realized for the PAMELA experiment.

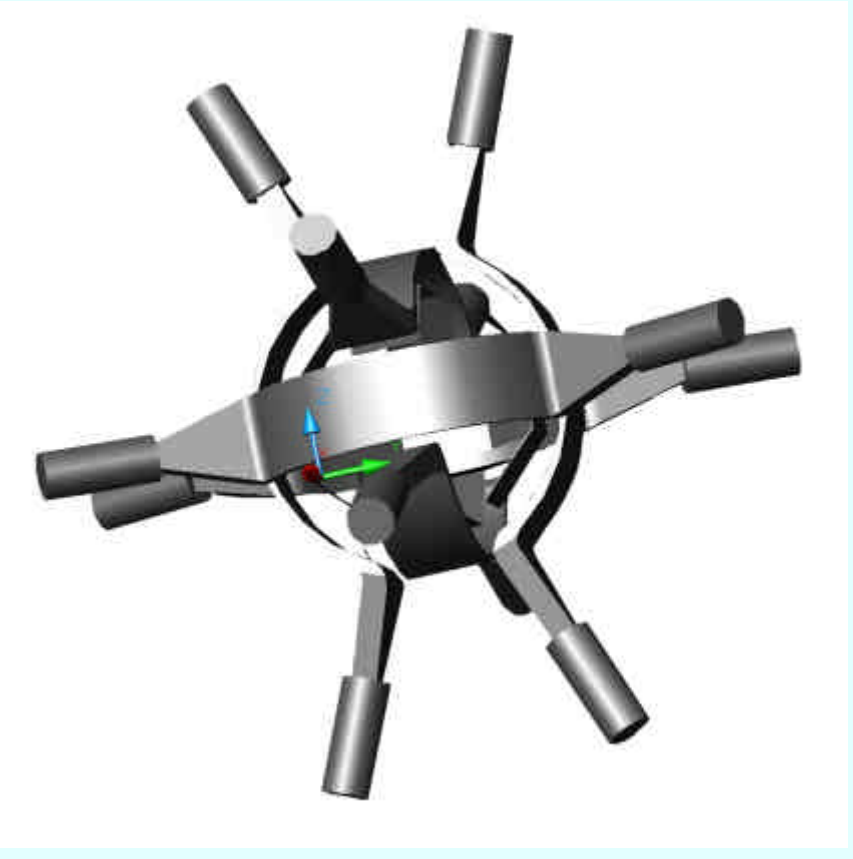




Conceptual scheme of the bi-directional telescope of CREAM and of its electronics (the sign of the ToF gives the versus of the direction)



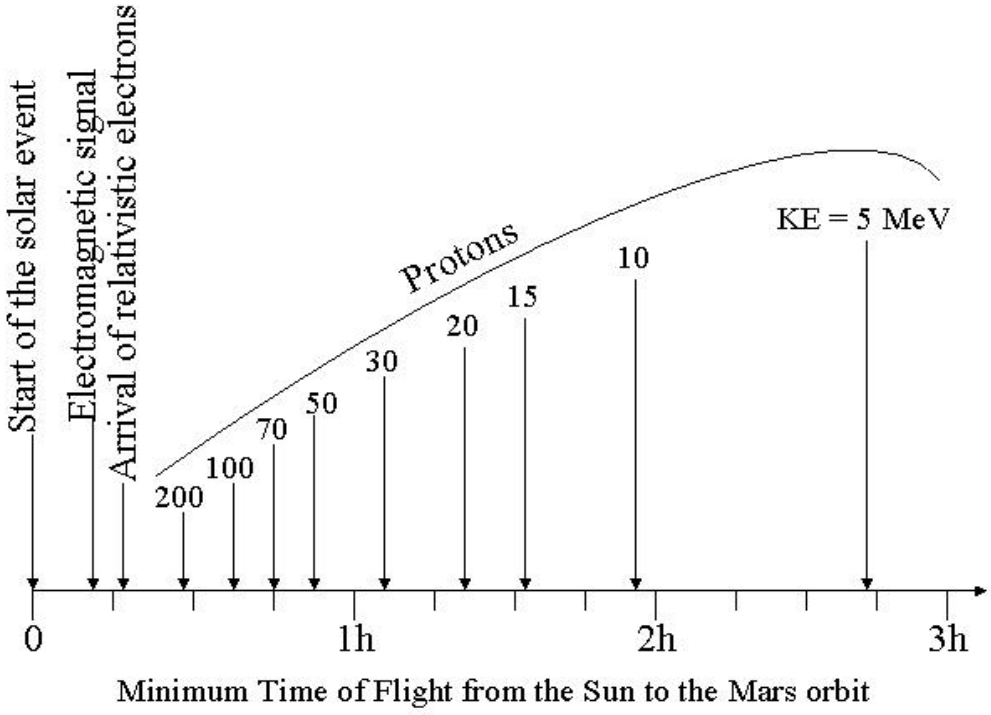
The quasi-spherical structure resulting from the arrangement of three bi-directional telescopes. For sake of simplicity only thesilicon sensors are shown as they are the innermost part of the instrument.



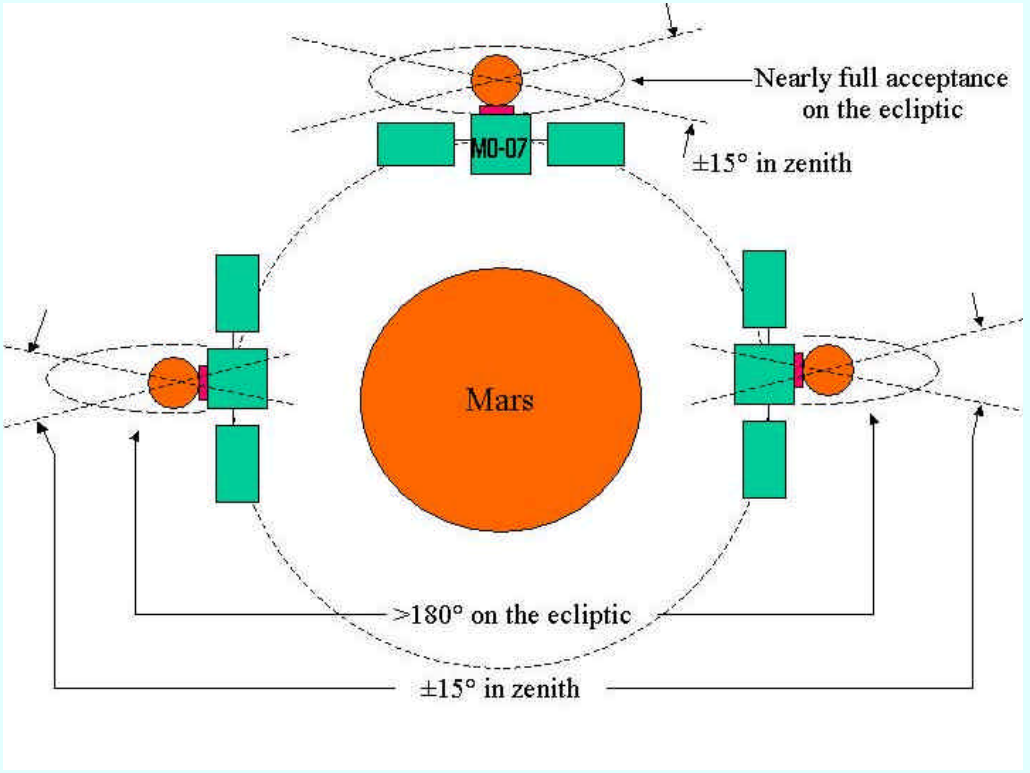
The quasi-spherical structure resulting from the arrangement of three bi-directional telescopes with the scintillation counters outside, in case that they are read by PMs.

The **quasi-spherical layout** of the instrument allows to sample the particles coming from a large fraction of the whole solid angle and to do therefore the measurement **independent from the attitude of the spacecraft**.

It could be part of the payload of a future general-purpose interplanetary probe.
If inserted in a Martian orbit it can register in real time the sudden increase and arrival direction evolution of the early arriving electron component, alarming other devices, such as other Mars orbiters, or landers, of the soon arrival (at least half an hour) from a determined direction of the dangerous proton and nuclei storm, greatly simplifying the countermeasure actions.



Early arriving electron component, alarming other devices, such as other Mars orbiters, or landers, of the soon arrival from a determined direction of the dangerous proton and nuclei storm.



Example of CREAM on board of a Martian polar satellite: field of view on the ecliptic plane for different positions along the Mars orbit.

Owing the tenuous Mars atmosphere and the vulnerability of the landed instruments, this is **extremely important in planning the robotic exploration, also before a possible human exploration of the planet.**