Measuring the low-energy electron spectrum (20 - 300 MeV) with the AESOP-lite balloon mission

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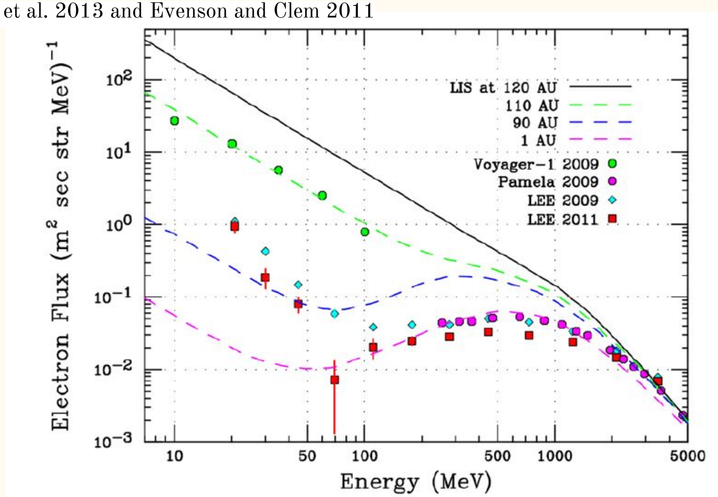
June 13th - International School of Space Science - L'Aquila

Primary Science Goals

Potgieter et al. 2013 and Evenson and Clem 2011



In 2012 at a distance of 121 AU, Voyagers spacecrafts now provides us with the unmodulated Local Interstellar Spectrum (LIS)

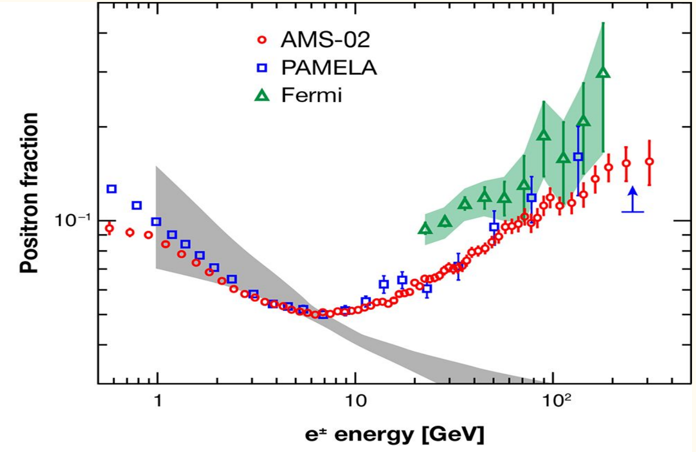
1) Serve as 1AU baseline for Voyager electron measurements

Disagreement between propagation models and observations at below 100 MeV

2) What causes the observed turn-up in the electron spectrum below 200 MeV?

PAMELA, Fermi-LAT, AMS-02 found a positron fraction higher than the one predicted for a purely secondary model for E > 10 GeV ⇒ primary source of positron

3) What is the positron abundance below 200 MeV?



M. Aguilar *et al.* 2013

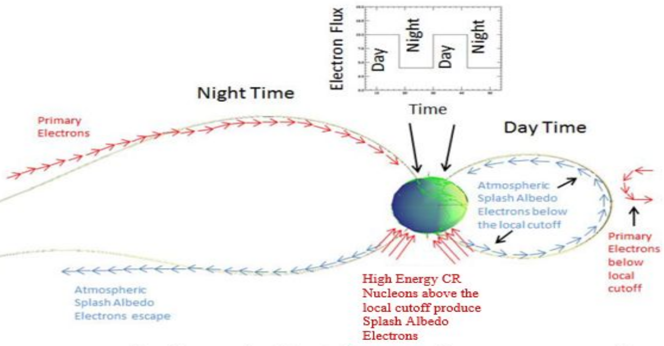
Secondary Science Goals: Geomagnetic Field Studies

Measure the time variation of positrons and electrons magnetically trapped in the geomagnetic field

Time profile of the electron flux clearly reveals diurnal variation and its latitude dependence.

Dirunal variability of the geomagnetic cutoff has been observed, and qualitatively understood, since the 1960's, mainly through observations of electrons.

These transitions are not well predicted by even the best models of today and an improved understanding of what is actually happening is the essence of this proposed measurement.

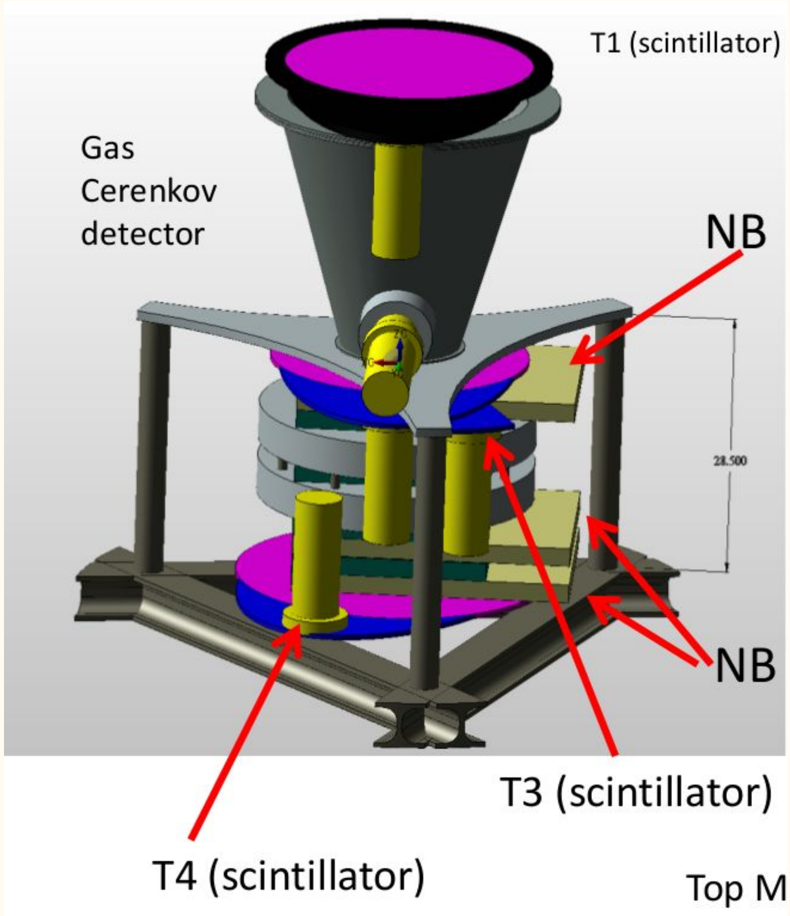


Schematic illustration of the geomagnetic diurnal effect for an observer near the magnetic polar caps. At night magnetic fields lines are drawn out into the geotail, lowering the cutoff. Below approximately 100 MeV the return albedo flux is higher than the primary cosmic ray electron flux, leading to higher observed fluxes during the day. Protons and heavies interacting in the atmosphere are the source of the return albedo electron flux.

AESOP-lite instrument

Main components, heritage from LEE telescope

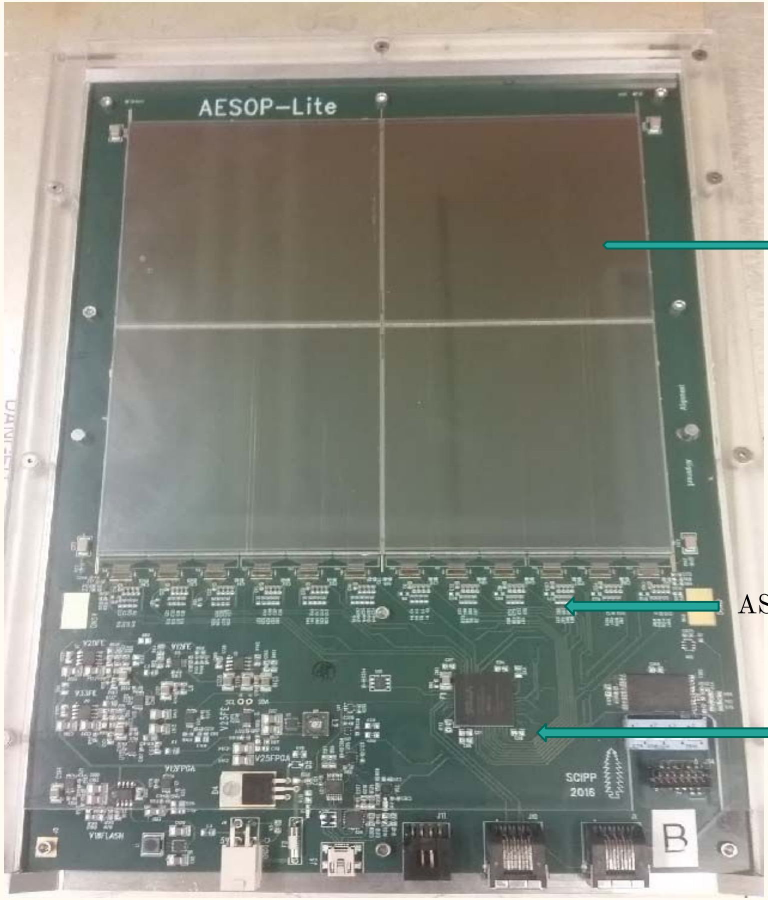
- 4 scintillators (T1, T3 and T4 + Guard) each connected to photomultiplier tube (PMT)
- Cherenkov threshold detector for hadron and backwards particle discrimination
- Magnet spectrometer: dual ring dipole magnet and seven planes of Silicon Strip Detectors (SSD)
- 4 planes in the bending view, 3 in the non-bending view



Tracking system

- Detectors were specially designed for the Fermi/LAT satellite instrument, reused for pCT, and now AESOP-lite

Thickness	400 μm
Length	18 cm
Strip pitch	228 μm
$\sigma_{detector}$	66 μm



SSD wafer

ASIC front-end chip

Spartan-6 FPGA chip

Future Work - 2018 Balloon Campaign

January 2018 - Integration at Columbia Scientific Balloon Facility (CSBF) in Palestine, TX

May 2018- Launch from Esrange, Sweden on 40 MCF, Zero Pressure, Long Duration balloon, for a minimum exposure of 100 hours, at an altitude of ~140 kft (42 km)

Flight path for 2009 LEE flight on a 40 mcf balloon