



Construction of an Electrostatic Energy Analyzer for the EQUARS Scientific Satellite



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EQUARS - Equatorial Atmosphere Research Satellite

Orbit: 750km (LEO), equatorial, Inclination 20°, launch scheduled for 2006
Global scale monitoring of the Earth's equatorial low, middle and upper atmosphere and ionosphere, with a special emphasis in dynamical and photochemical energy transport processes.

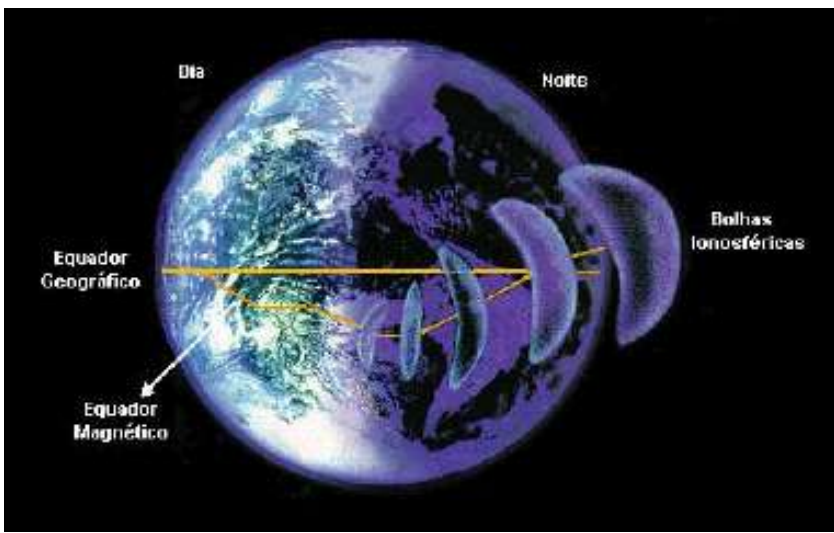
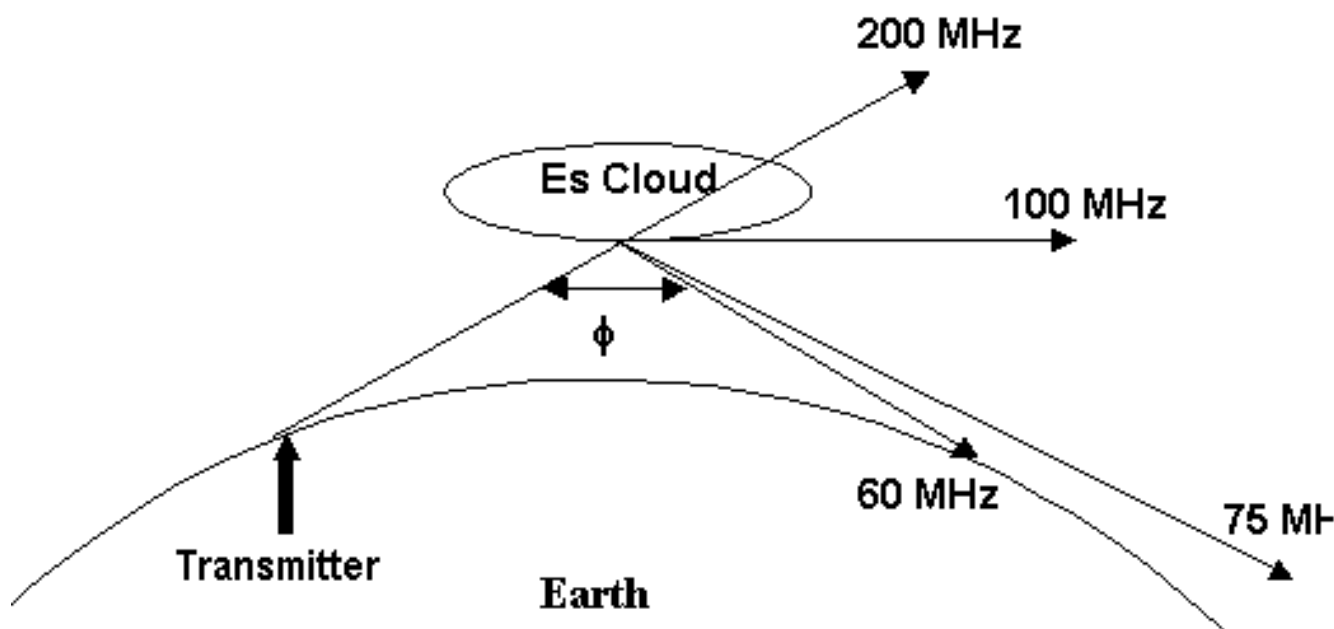
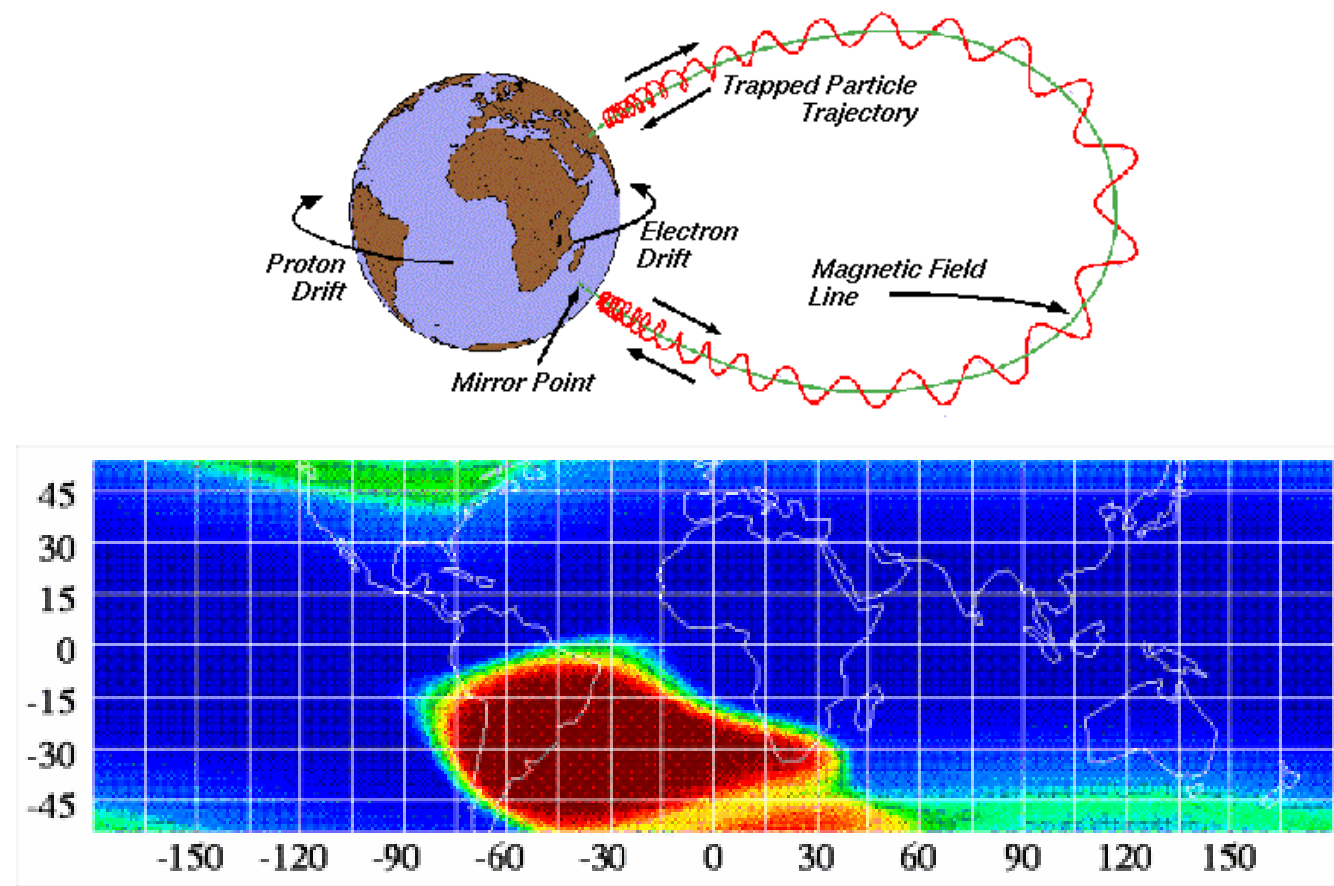
	1	2	3	4	5	6	7	8
Experiment	GPS-DCQUI	GWIM	MLTM	AUS	IONEX	EPM	ELISA	CERTO
Instrument	GPS Receiver	Airglow Imager	Temperature Imager	Sprite Imager	HFC, LP, ETP Sensors	Particle Detector	Electrostatic Energy Analyzer	Beacon Transmitter
PI	Toshitaka Tsuda	Robert Lowe	Michael J. Taylor	Hisao Takahashi	M. A. Abdu	Walter G. Alarcon	Renato S. Dallaqua	Paul A. Bernhardt
Institution	RASC/Univ. Kyoto	UWO/ Canada	USU/ USA	INPE/ Brazil	INPE/ Brazil	INPE/ USP/ Brazil	INPE/ Brazil	NRL/ USA
Observation Parameters	Water Vapor; Temperature; Total Electron Content (TEC)	Odbs Airglow Gravity Waves	Mesopause Temperature	Lightning and Sprites; OH; OHS77; OHS800	Plasma Density; Electron Temperature	High Energy Particle Flux	Low Energy Electron Flux	Ionospheric Irregularities; Electron Content and Scintillations

The ELISA project will measure the energy spectrum of (0.1- 40) keV electrons

Scientific Objectives

Electron Precipitation in the South Atlantic Magnetic Anomaly

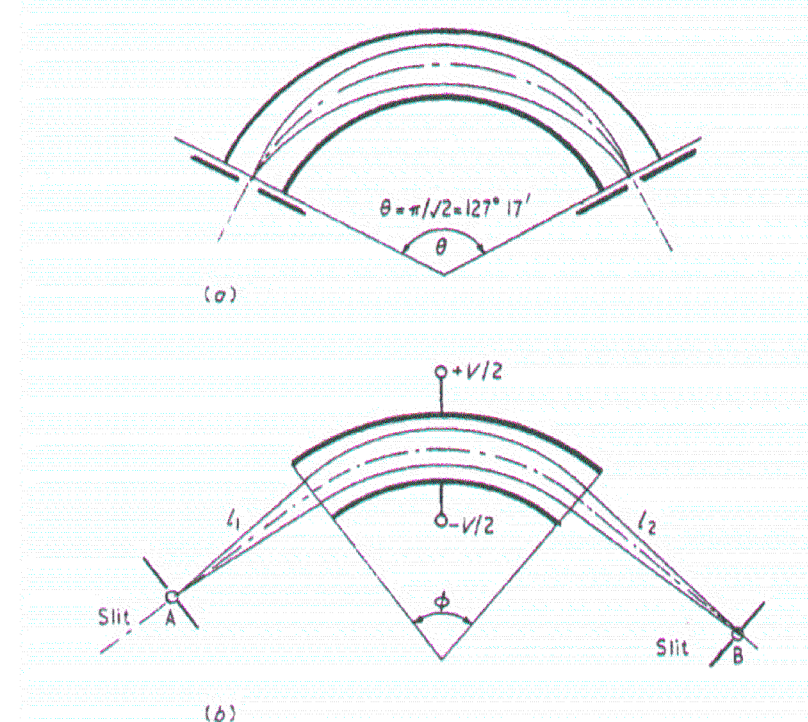
Electrons with E< 50keV are predicted to explain Sporadic E phenomena observed at SAMA by the CEA-INPE group using VLF, X-rays, and riometer measurements. Direct measurement of the electron beam can corroborate indirect evidences.



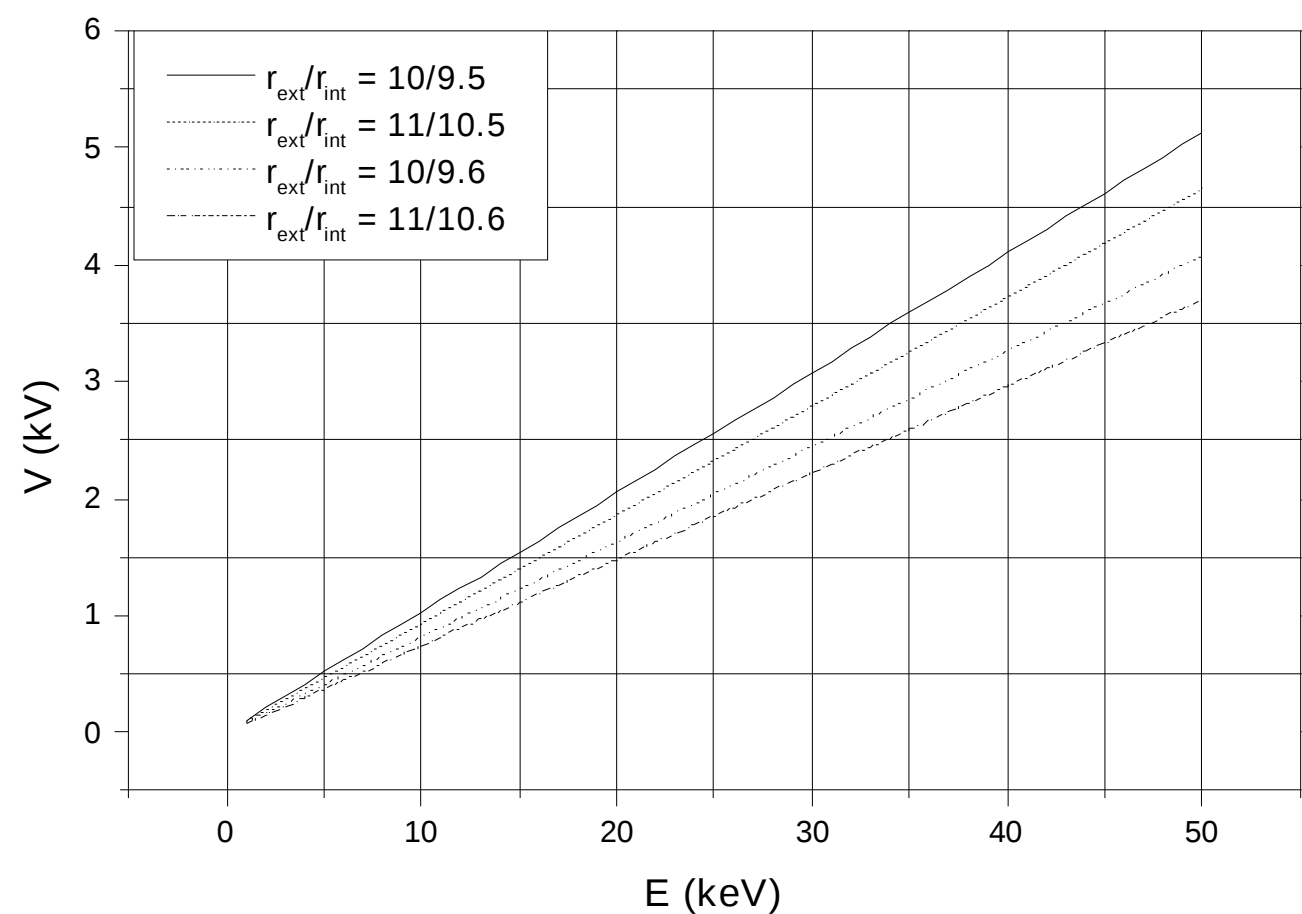
Study of electron heating by wave-particle Interactions in the equatorial plasma

Electron beams in plasma bubbles can interact and heat electrons
Comparison with laboratory experiments (PQUI project)
Collaboration with IONEX project (fluctuations)

The Electrostatic Energy Analyzer

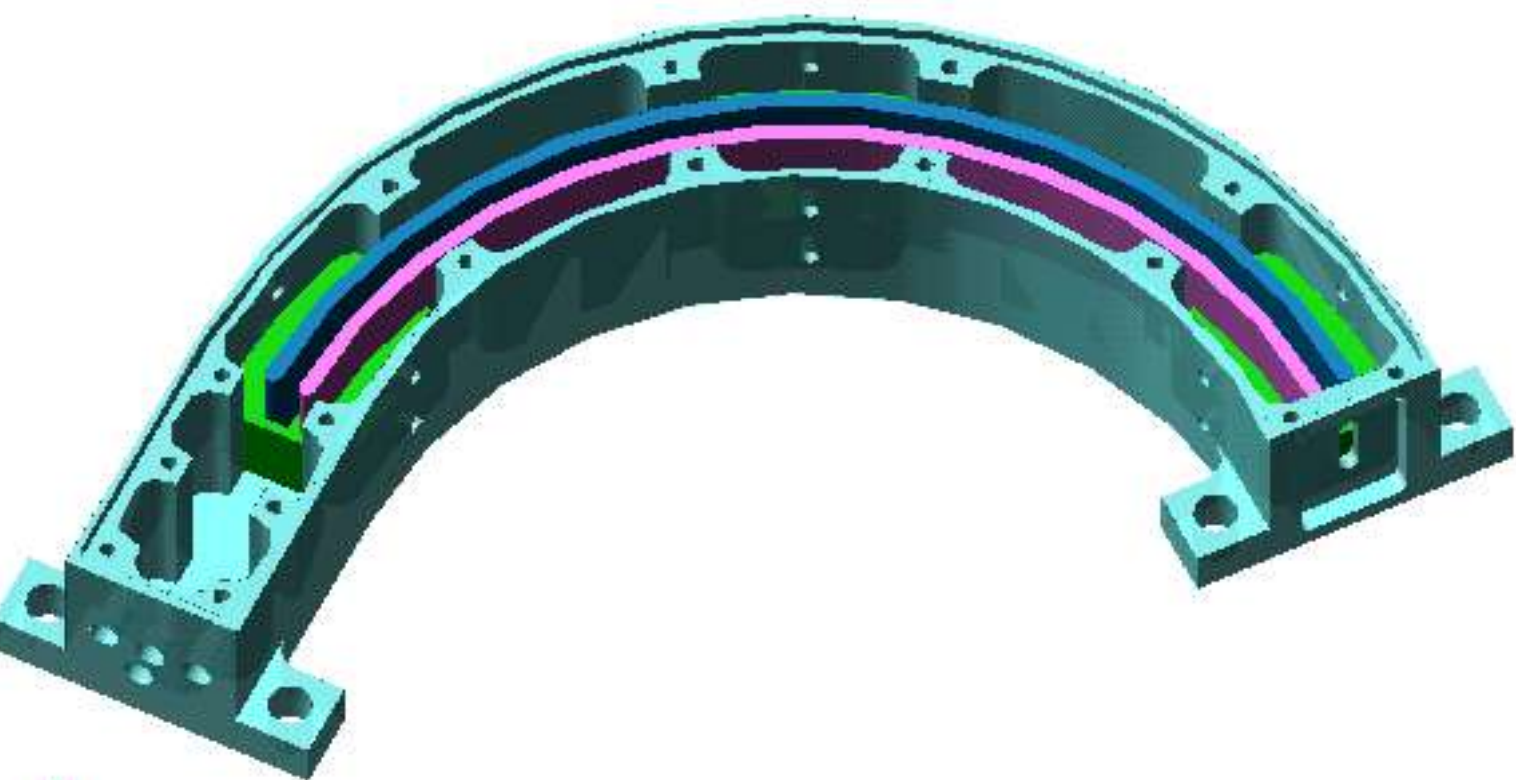


$$E = \frac{qV}{2 \ln \left(\frac{r_{ext}}{r_{int}} \right)}$$



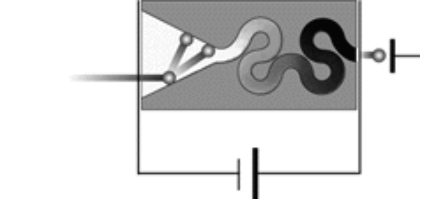
$r_{ext} = 11 \text{ cm}$, $r_{int} = 10,6 \text{ cm}$

Material: Al 6061-T651
Macor or Teflon
plates height 25mm
inner surfaces darkened



Mass:	Analyzer parallel to B	~ 1300g	Volume	30cmx17cmx5cm
	Analyzer perpendicular to B	~ 1300g		2 X (2500 cm³)
	Electronics Box	~ 2500g		electronics box ~ 2000 cm³
	Total	~ 5100g	Total	~7000 cm³

Detectors



channeltron



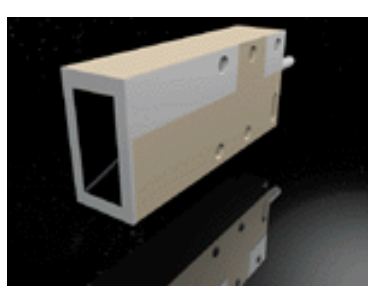
output



amplifier
discriminator

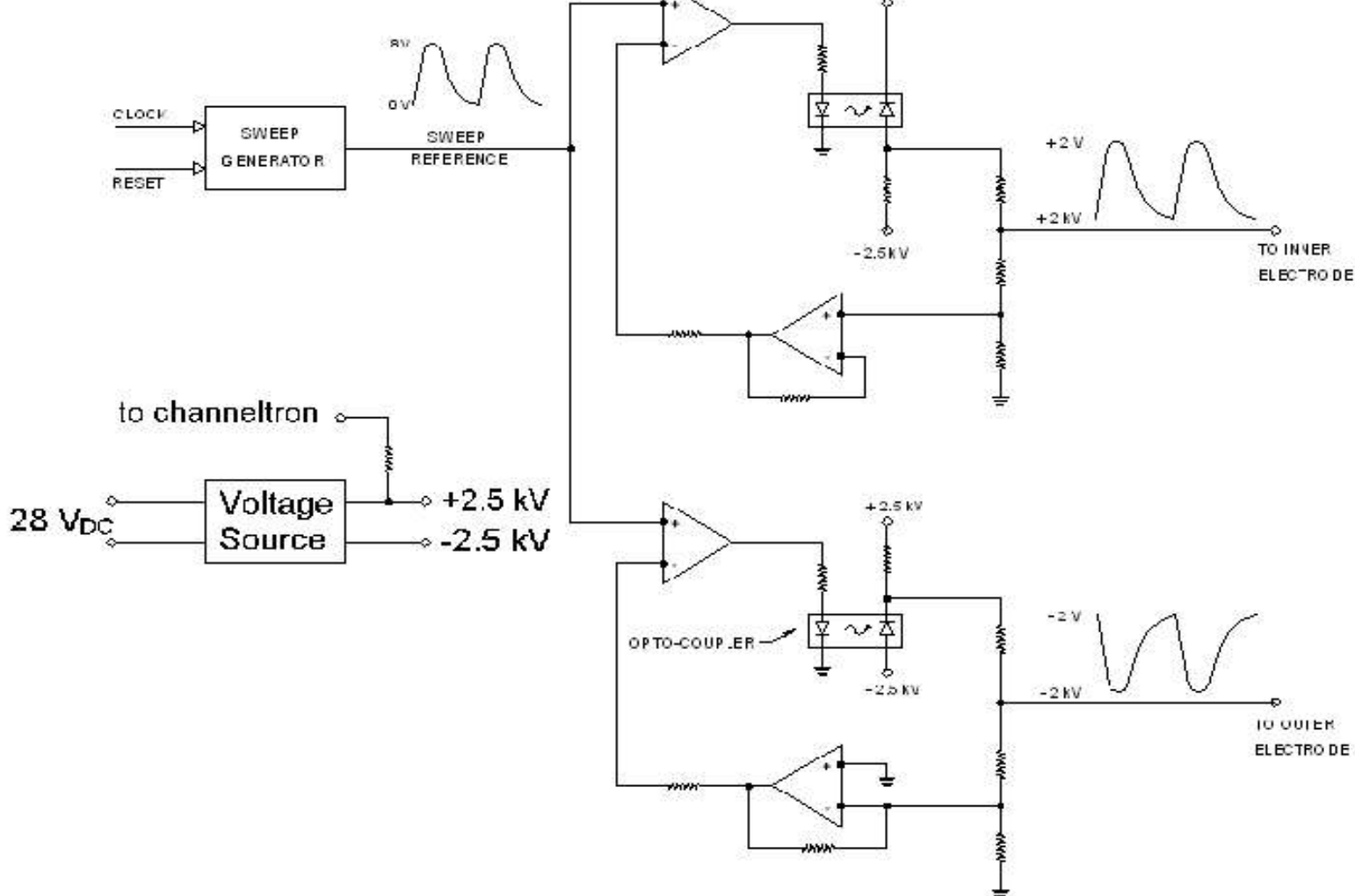


counter



Sjuts model KBL 510

High Voltage Sweeper

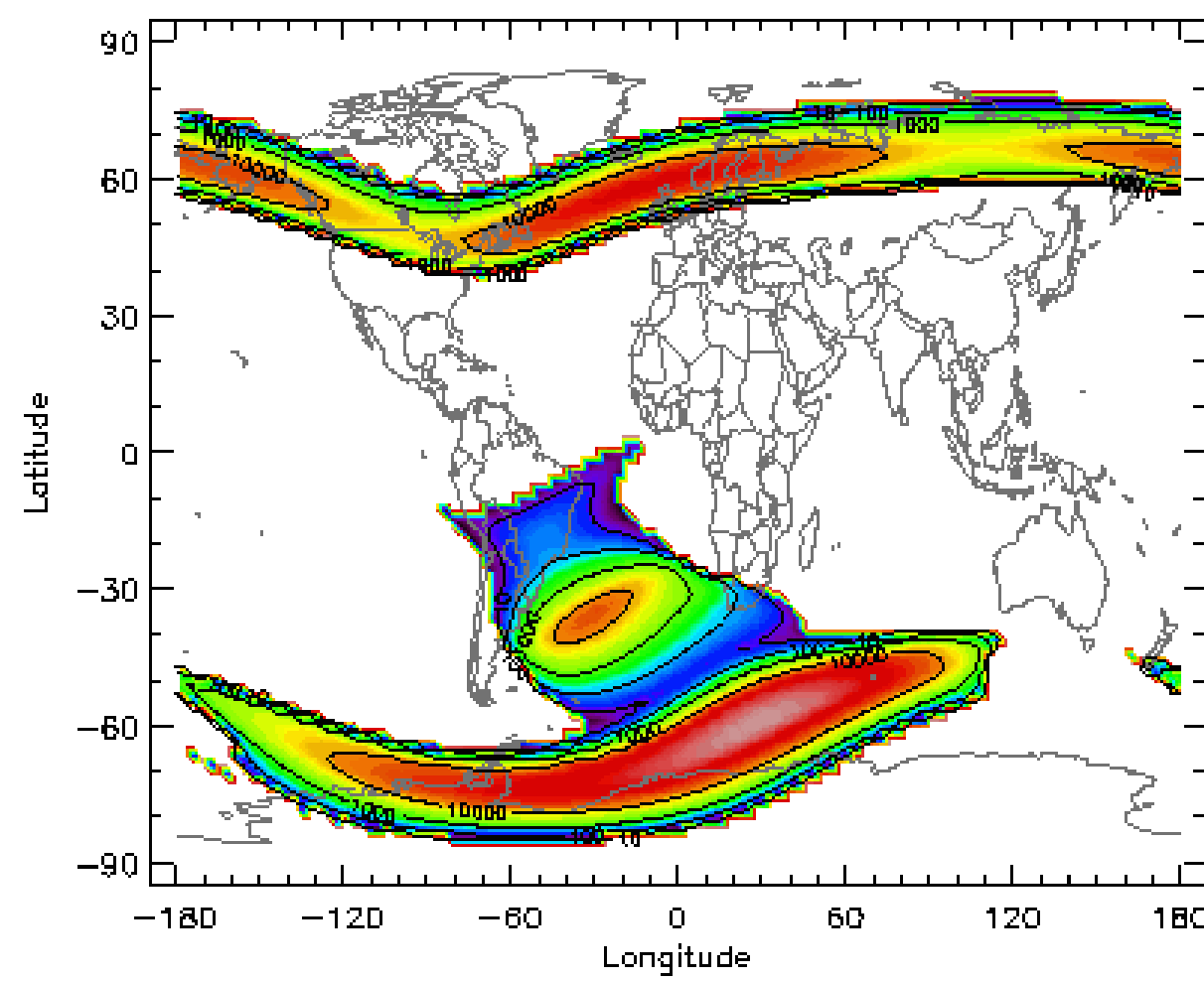


$V_{max} = \pm 2,5 \text{ kV}$

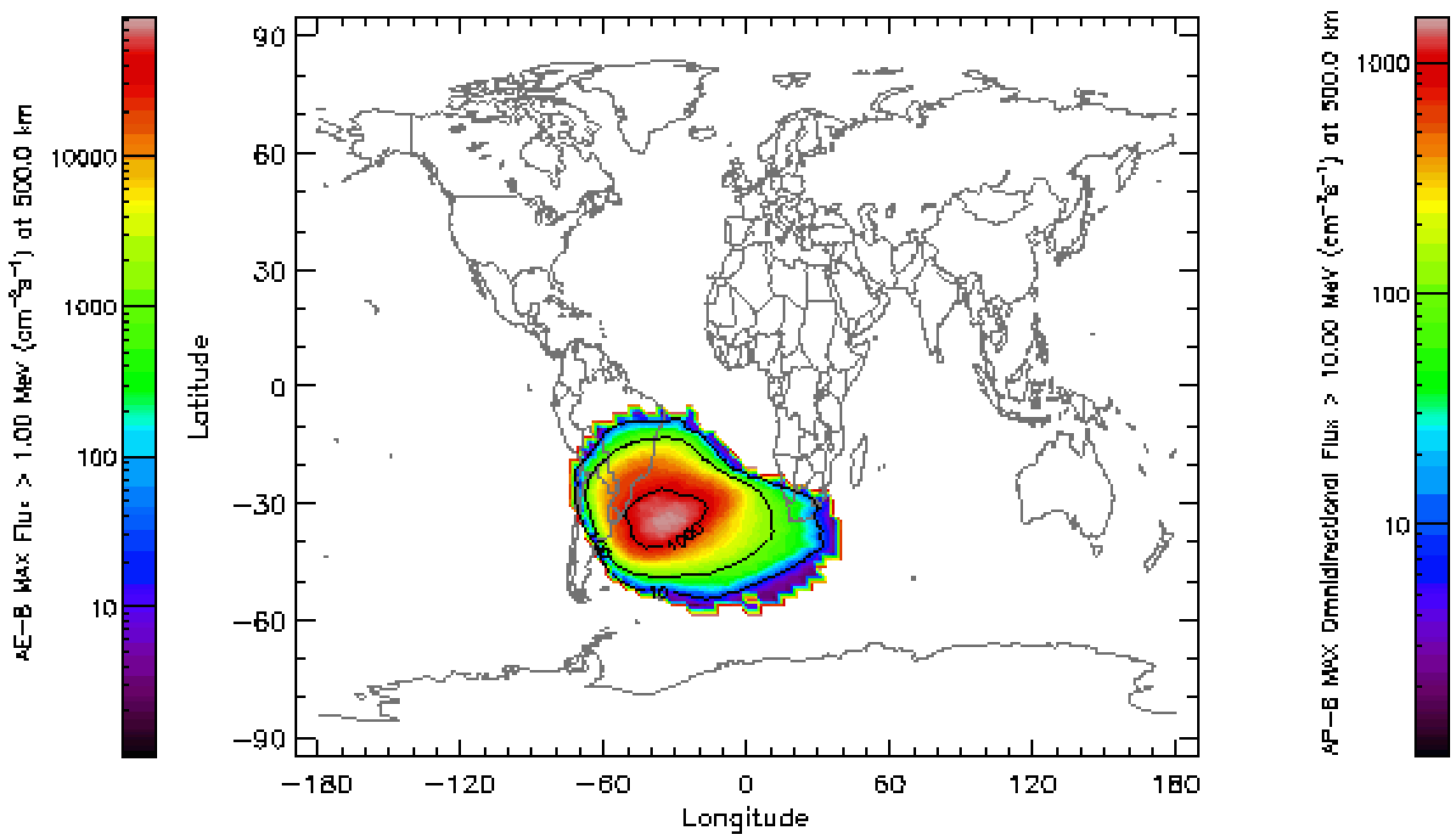
Sweep: 16 or 32 steps
Sweeping rate: 10/s or 1/s

Total power consumption < 5 W

Radiation Shielding

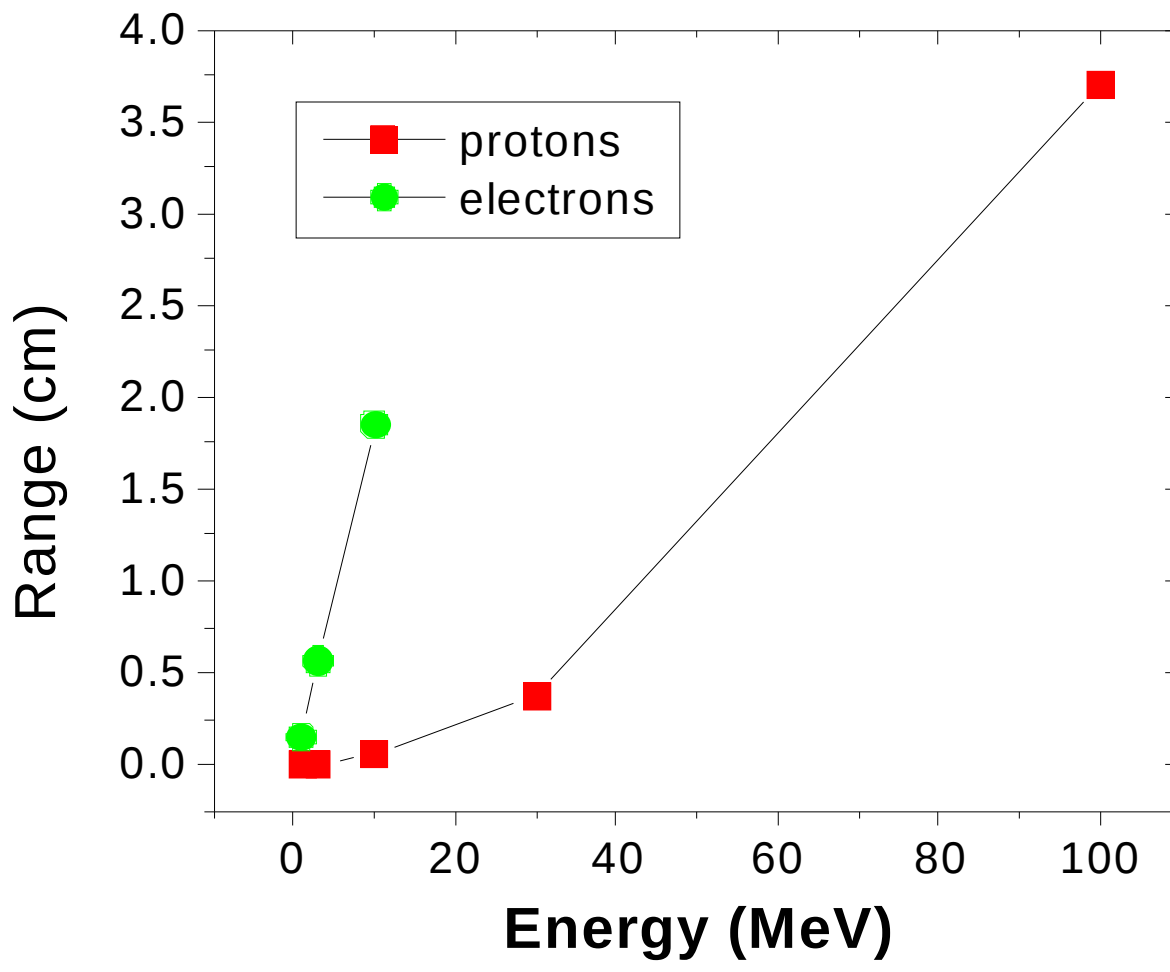


World map of the AE-8 MAX integral electron flux >1 MeV at 500 km altitude.



World map of the AP-8 MAX integral proton flux >10 MeV at 500 km altitude.

Penetration Range in Aluminum (cm)

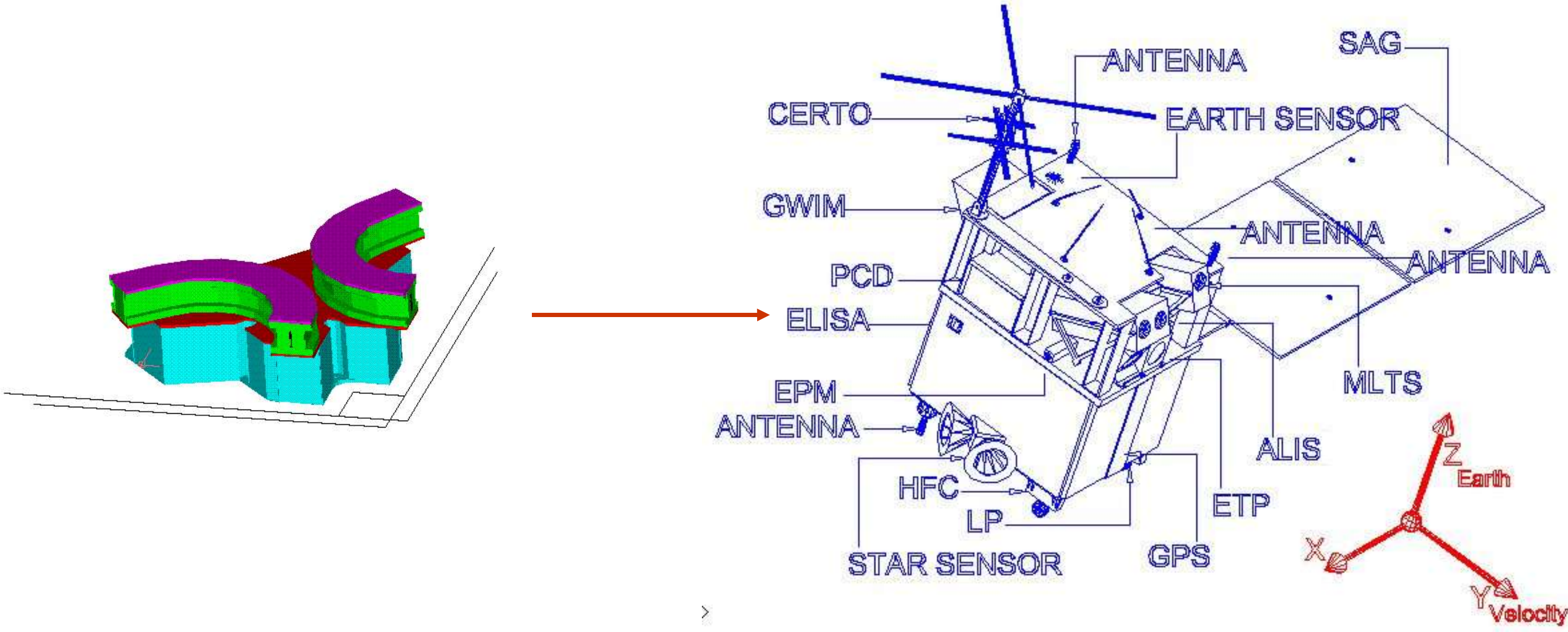


Electron flux > 7 MeV negligible at any altitude (< 1/cm².s)

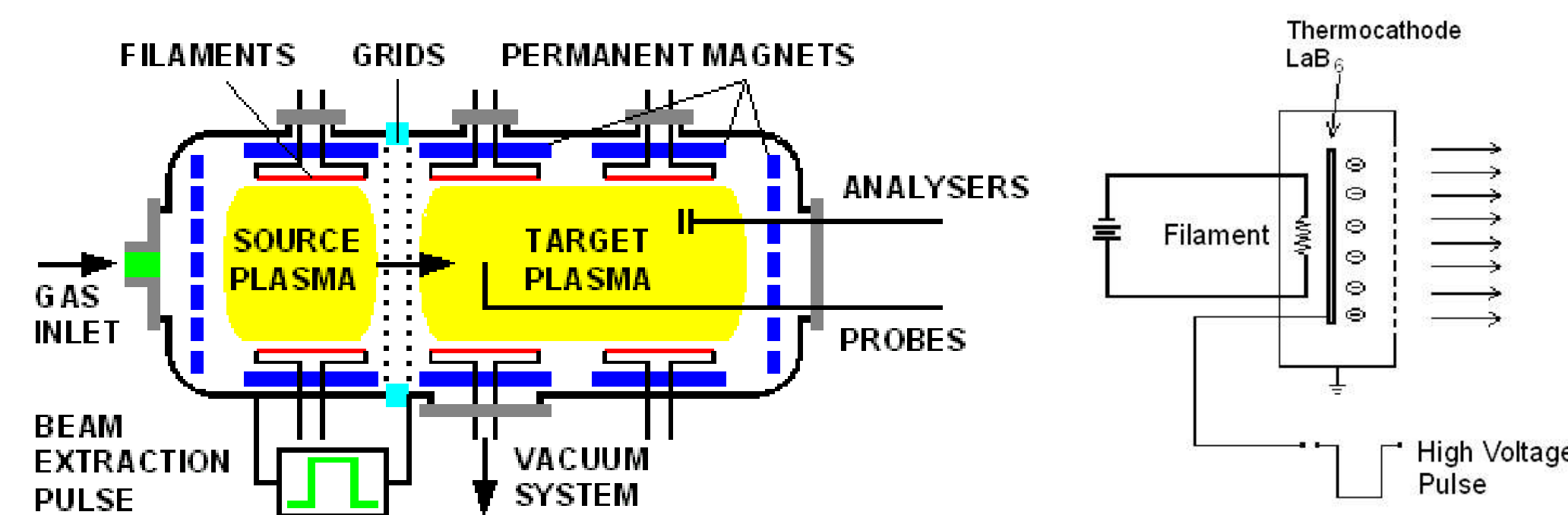
A 1cm thick wall will be added around the detector

Estimates by Abdu et al. :
electron flux ~ $8 \times 10^5 \text{ cm}^{-2} \text{ sec}^{-1}$ at ~ 20 keV
(J. Atm. Terr. Phys. 39 (1977), 723)

Project ELISA on EQUARS

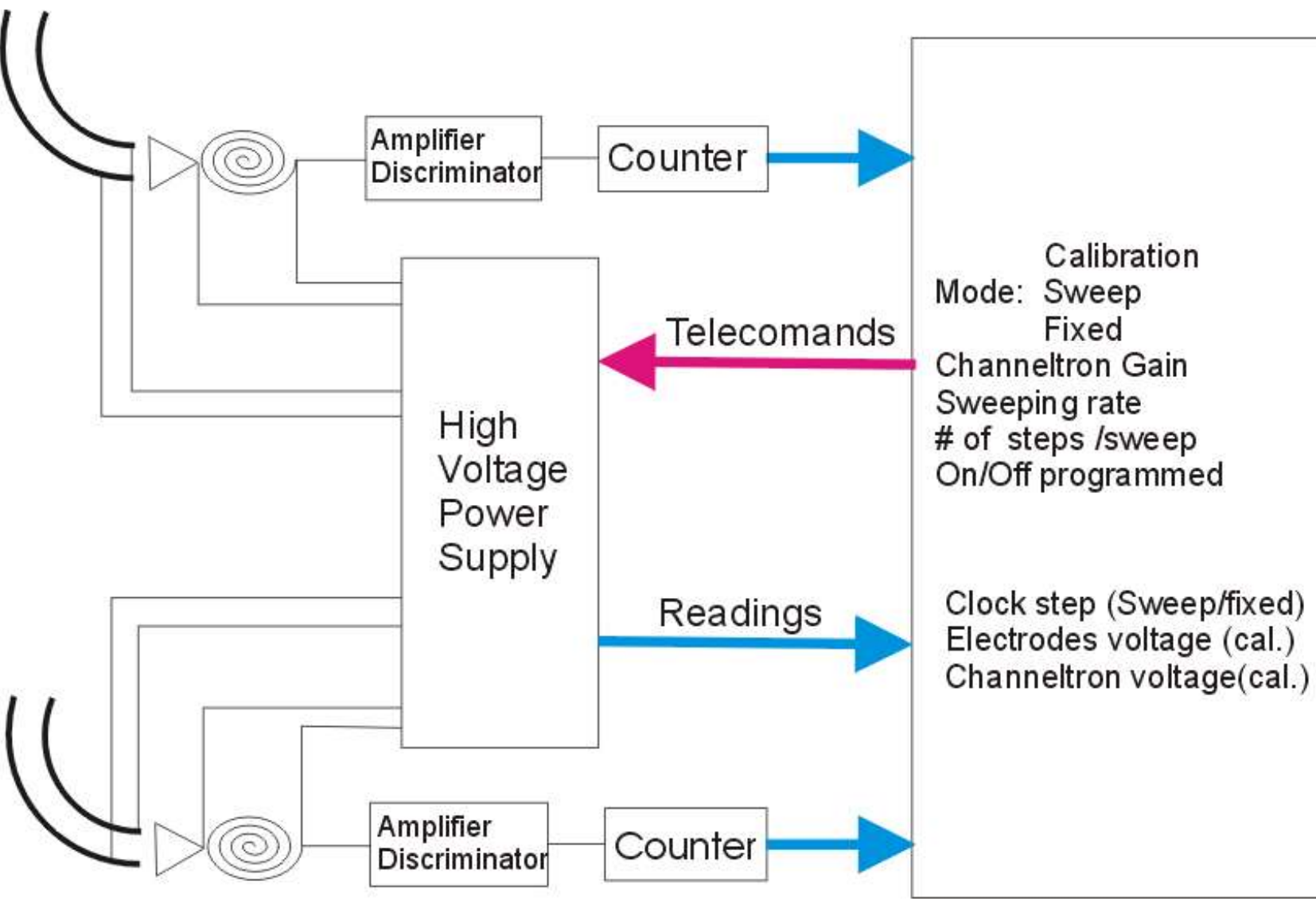


Calibration



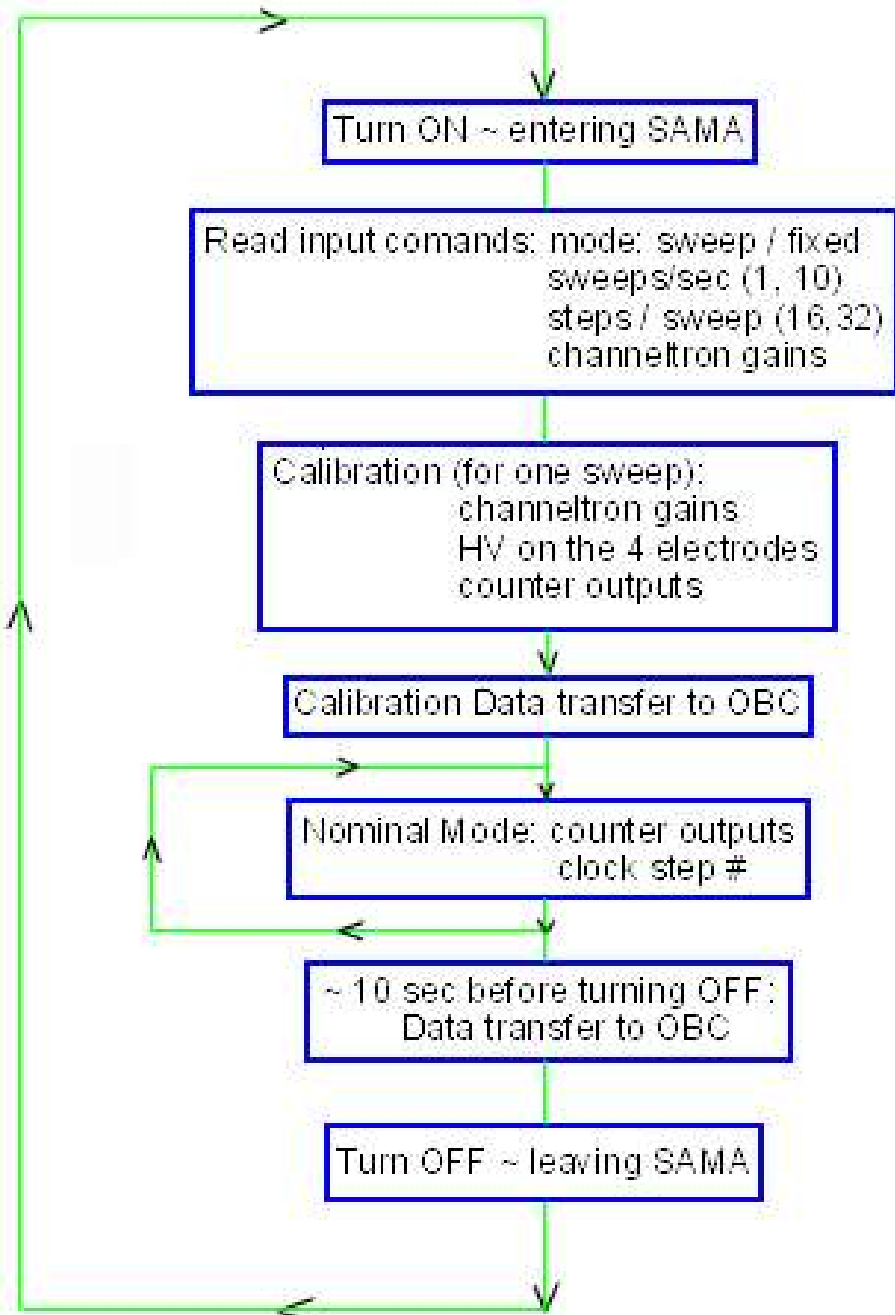
The Quiescent Plasma Experiment (PQUI) produces a beam of electrons with E=20-500 eV.
An electron beam with energies up to 40 keV will be added for calibration.

Telemetry



Data sampling rate < 21 kbits/sec
Data volume ~ 167Mbits/day
(1/4 of 12 orbits)

Flight Operations Flow



Timetable

Date	Task
03/2003	Proposal and project presentation
10/2003	Construction and Tests of Laboratory Prototype
06/2004	Importation of space qualified components
10/2004	Construction of space qualified prototype Calibration Thermal and vibration tests (LIT-INPE)
06/2005	Construction, calibration and mounting of flight model
06/2006	Launch