

Project ELISA

An Electrostatic Energy Analyzer for EQUARS

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Objectives

To measure the energy spectrum of (0.1- 40) keV electrons

Scientific Objectives:

1. Electron Precipitation in the South Atlantic Magnetic Anomaly

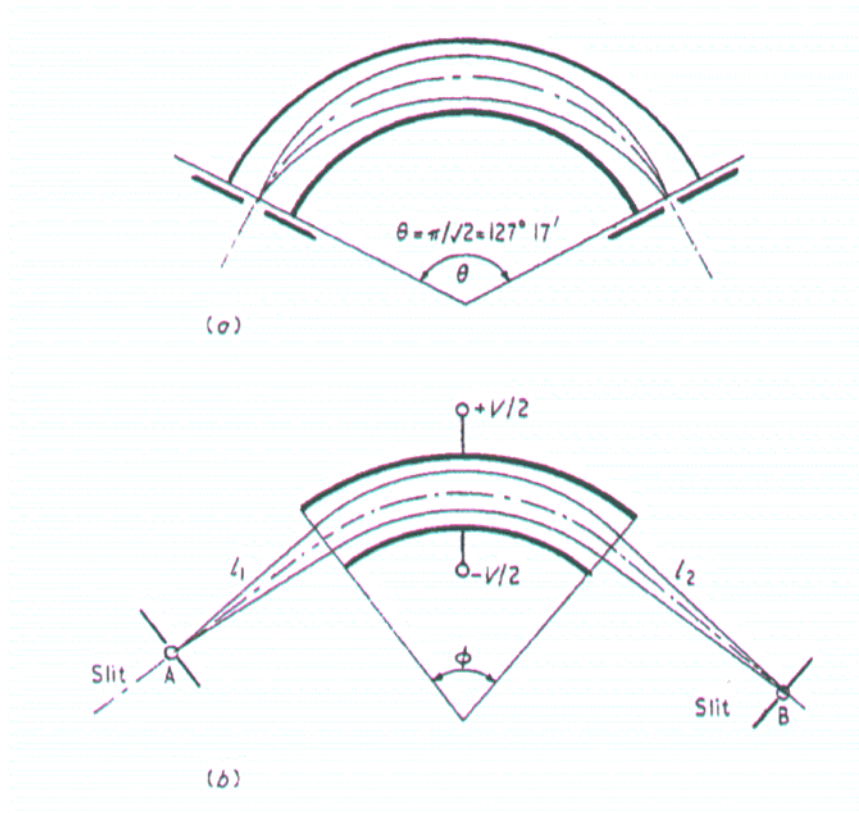
Electrons with $E < 50\text{keV}$ are predicted to explain Sporadic E phenomena observed at SAMA by the CEA-INPE group using VLF, X-rays, and riometer measurements. Direct measurement of the electron beam can corroborate indirect evidences.

2. Study of electron heating by wave-particle interactions in the equatorial plasma

Collaboration with IONEX project

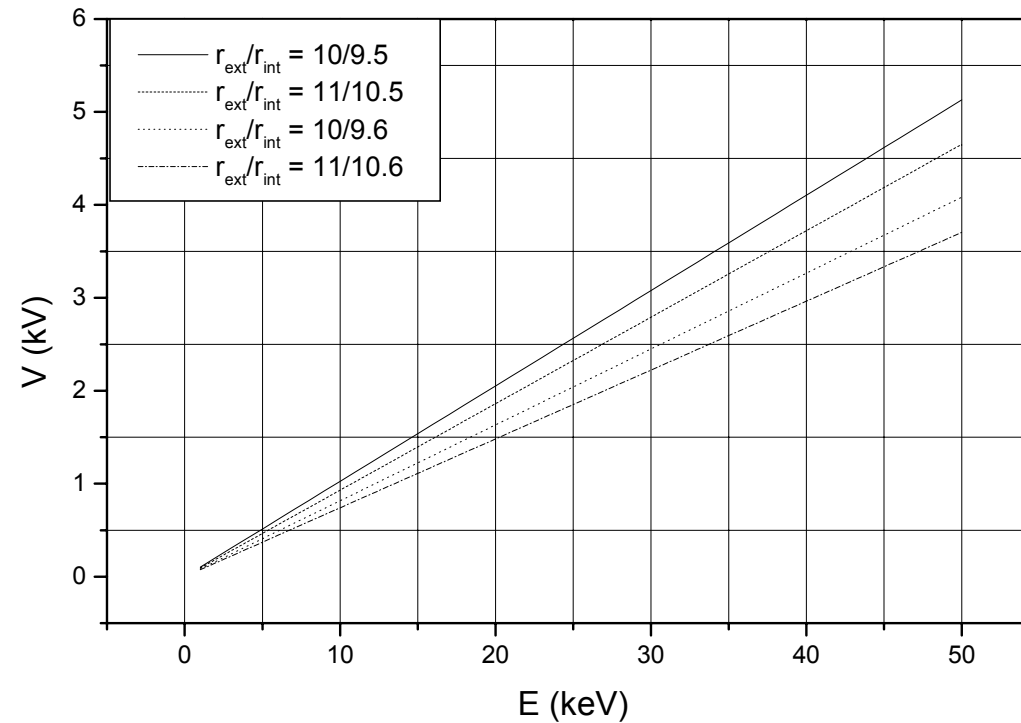
Comparison with the PQUI experiment

The electrostatic Energy Analyzer



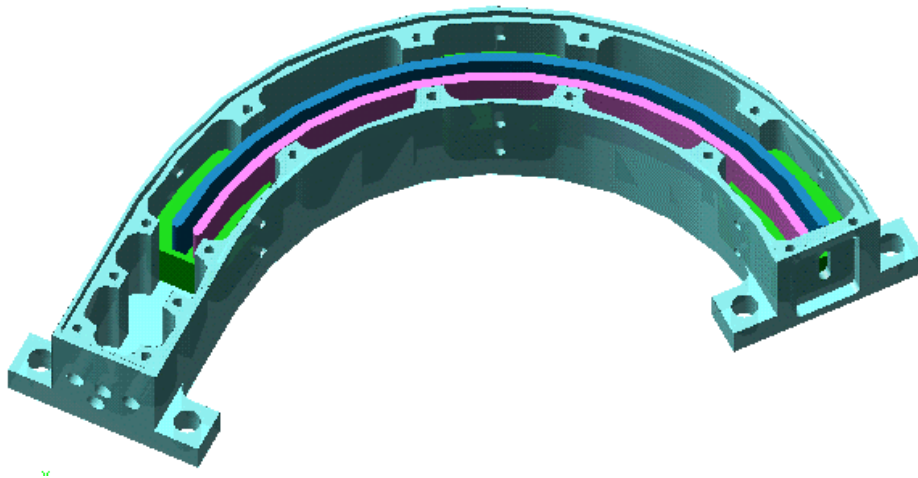
$$E = \frac{qV}{2 \ln \left(\frac{r_{ext}}{r_{int}} \right)}$$

The electrostatic Energy Analyzer



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

The electrostatic Energy Analyzer



Material: Al 6061-T651

Macor or Teflon

plates height 25mm

inner surfaces darkened

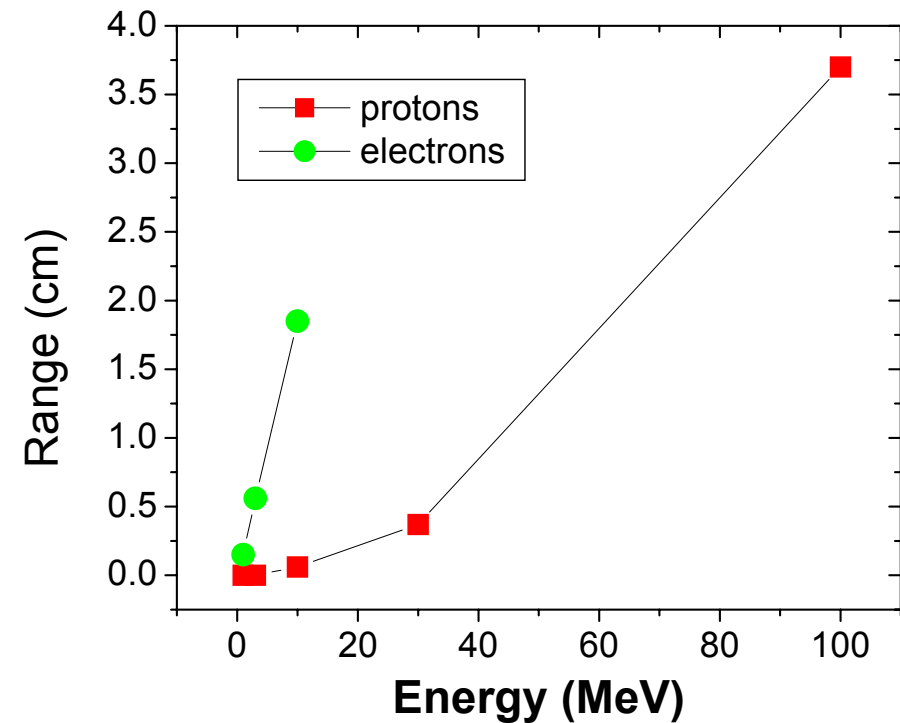
Mass:	Analyzer parallel to B	~ 1300g
	Analyzer perpendicular to B	~ 1300g
	Electronics Box	~ 2500g
	Total	~ 5100g

Volume	30cmx17cmx5cm	
	2 X	(2500 cm ³)
	electronics box ~	2000 cm ³
	Total	~7000 cm³

Radiation Shielding

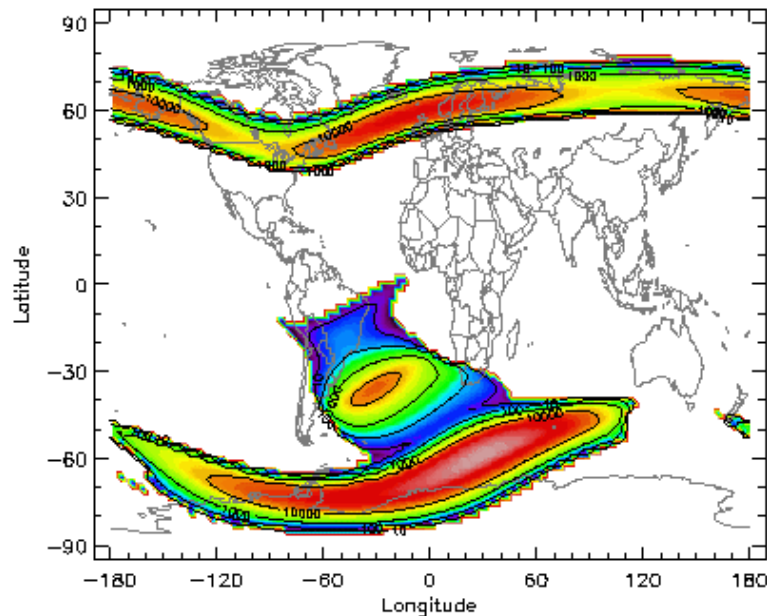
Penetration Range in Aluminum [cm]

Energy [MeV]	electrons	protons
1	0.15	~ nil
3	0.56	~ nil
10	1.85	0.06
30	no flux	0.37
100	no flux	3.7

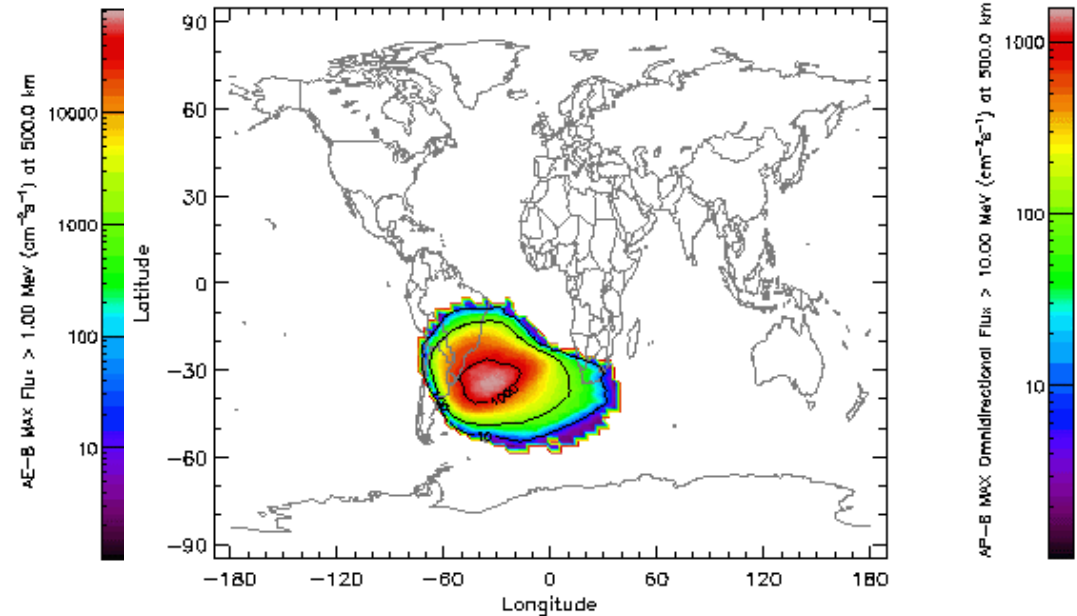


Electron flux < 7 MeV negligible
at any altitude (< 1/cm².s)

Radiation Shielding



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

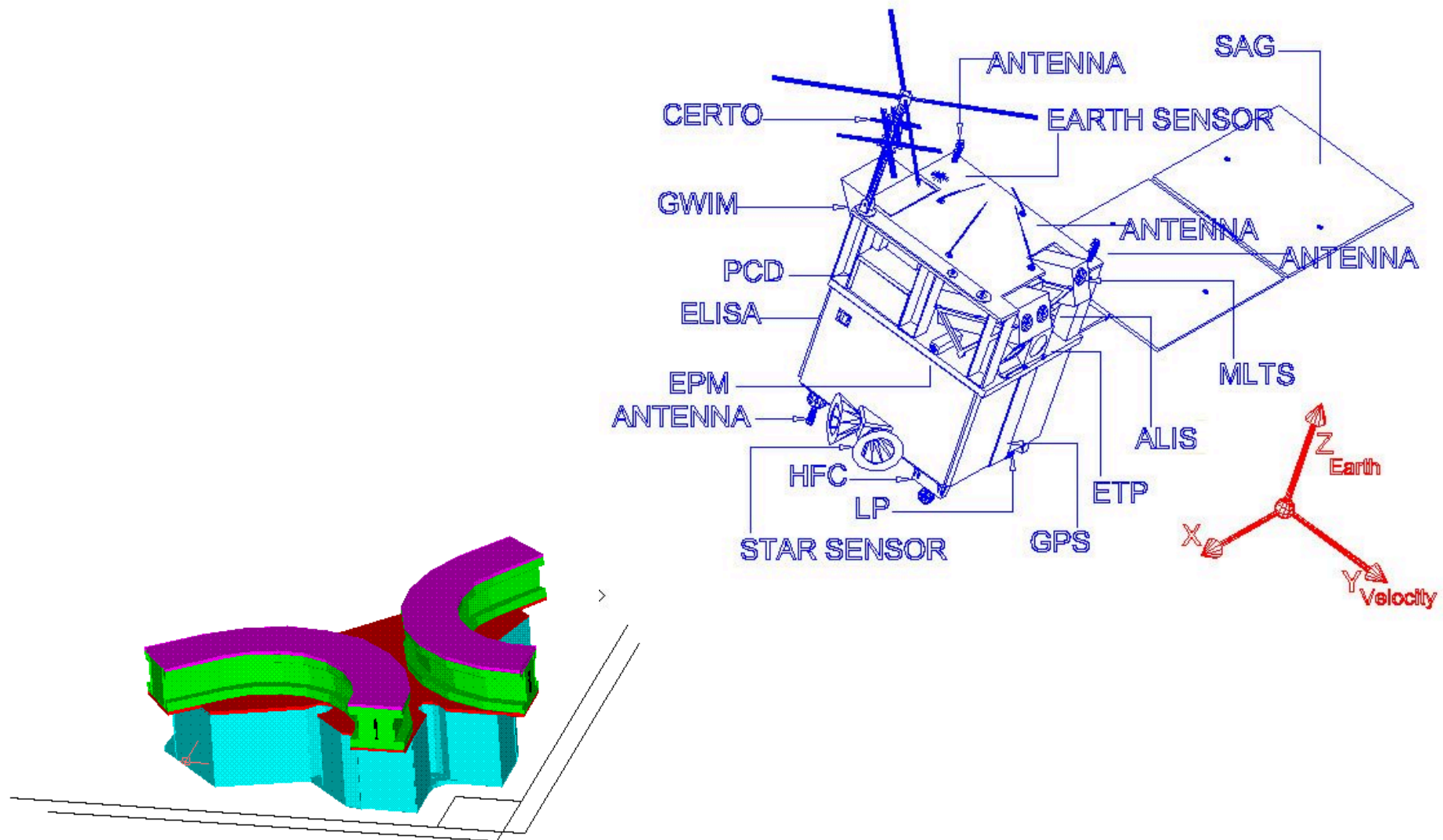


World map of the AP-8 MAX integral proton flux >10 MeV at 500 km altitude.

Estimates by Abdu et al. : electron flux $\sim 8 \times 10^5 \text{ cm}^{-2} \text{ sec}^{-1}$ at $\sim 20 \text{ keV}$

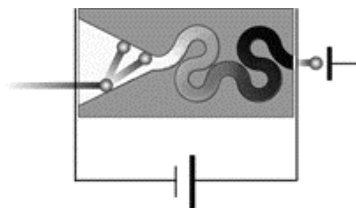
J. Atm. Terr. Phys. 39 (1977), 723

Project ELISA on EQUARS



Detectors

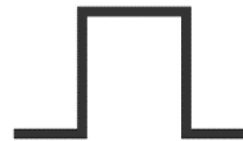
Detectors - Channeltrons



channeltron



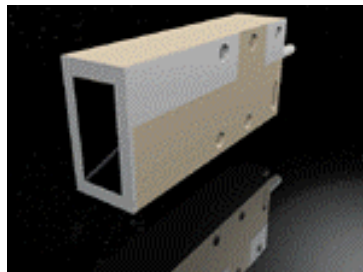
output



pre-amplifier
discriminator



counter



Sjuts model KBL 510

Opening: 5 x 10 mm²

High Voltage Power Supply

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

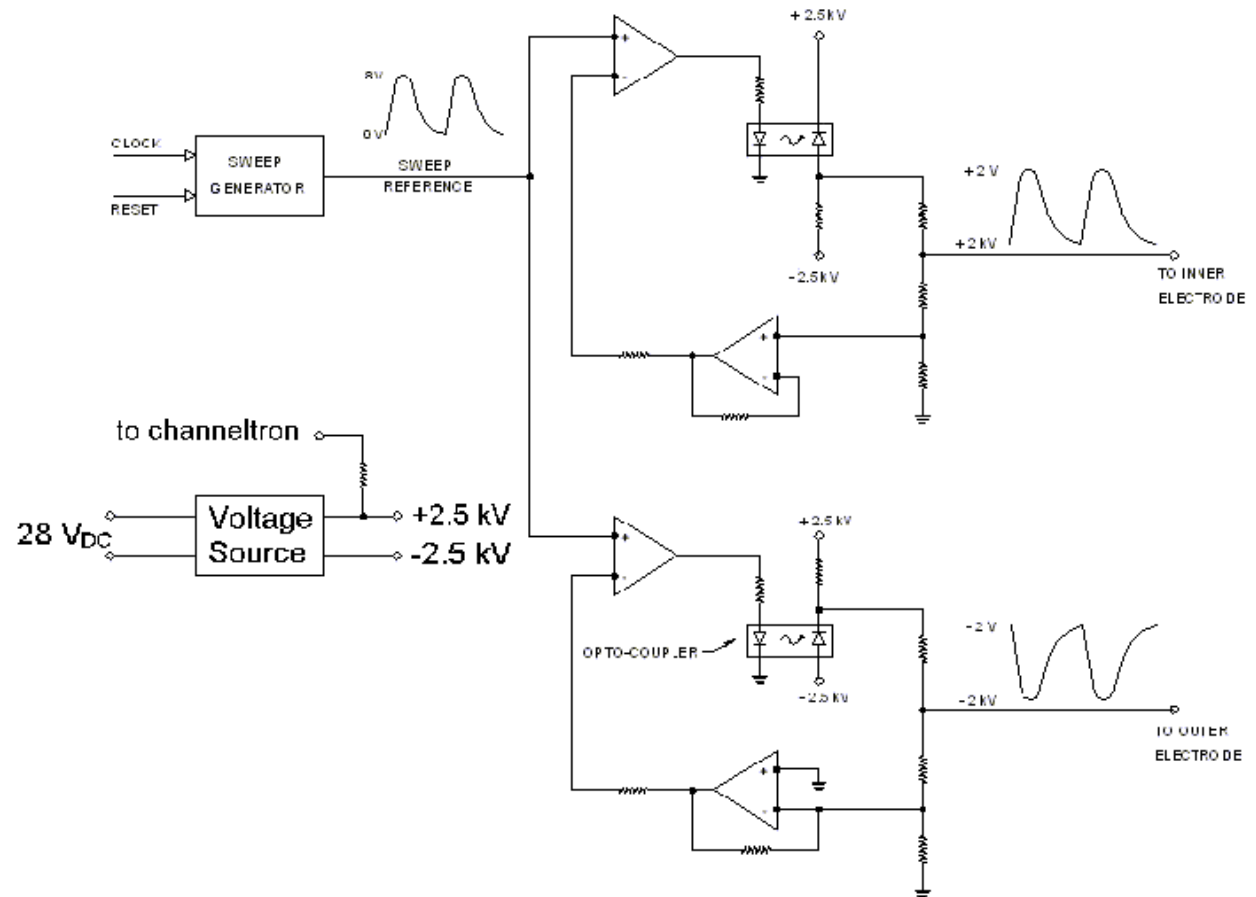
Sweep: 16 or 32 steps

Sweeping rate:

10/s or 1/s

Total power

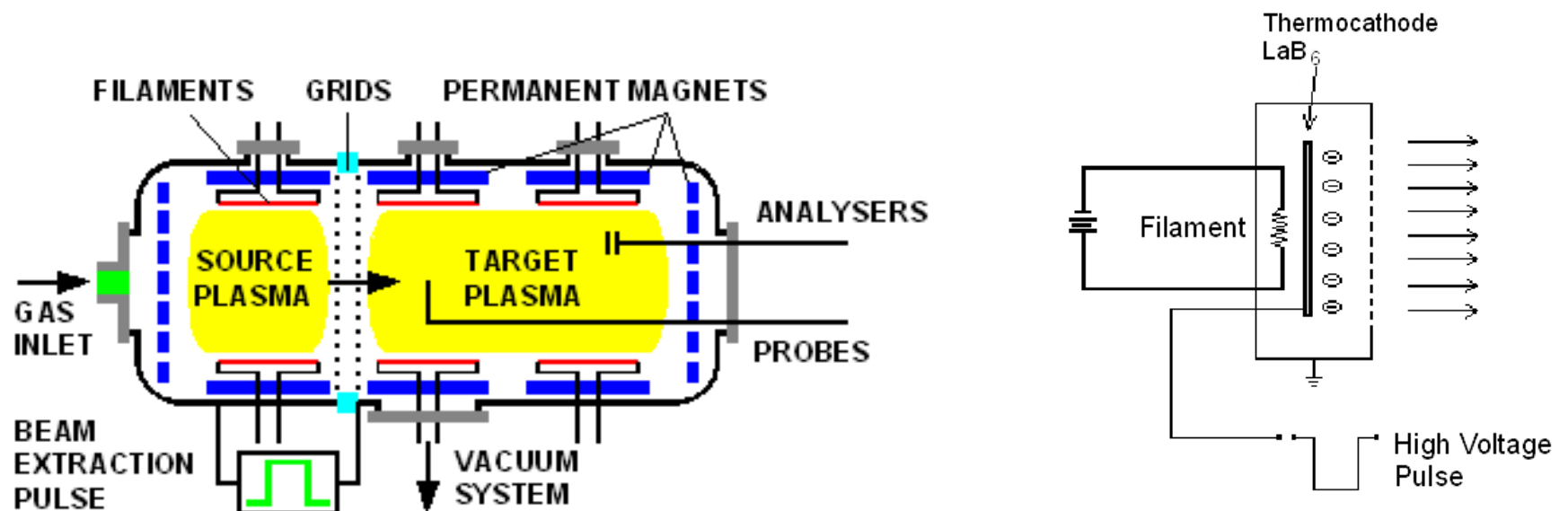
consumption < 5 W



Calibration

The Quiescent Plasma Experiment (PQUI)

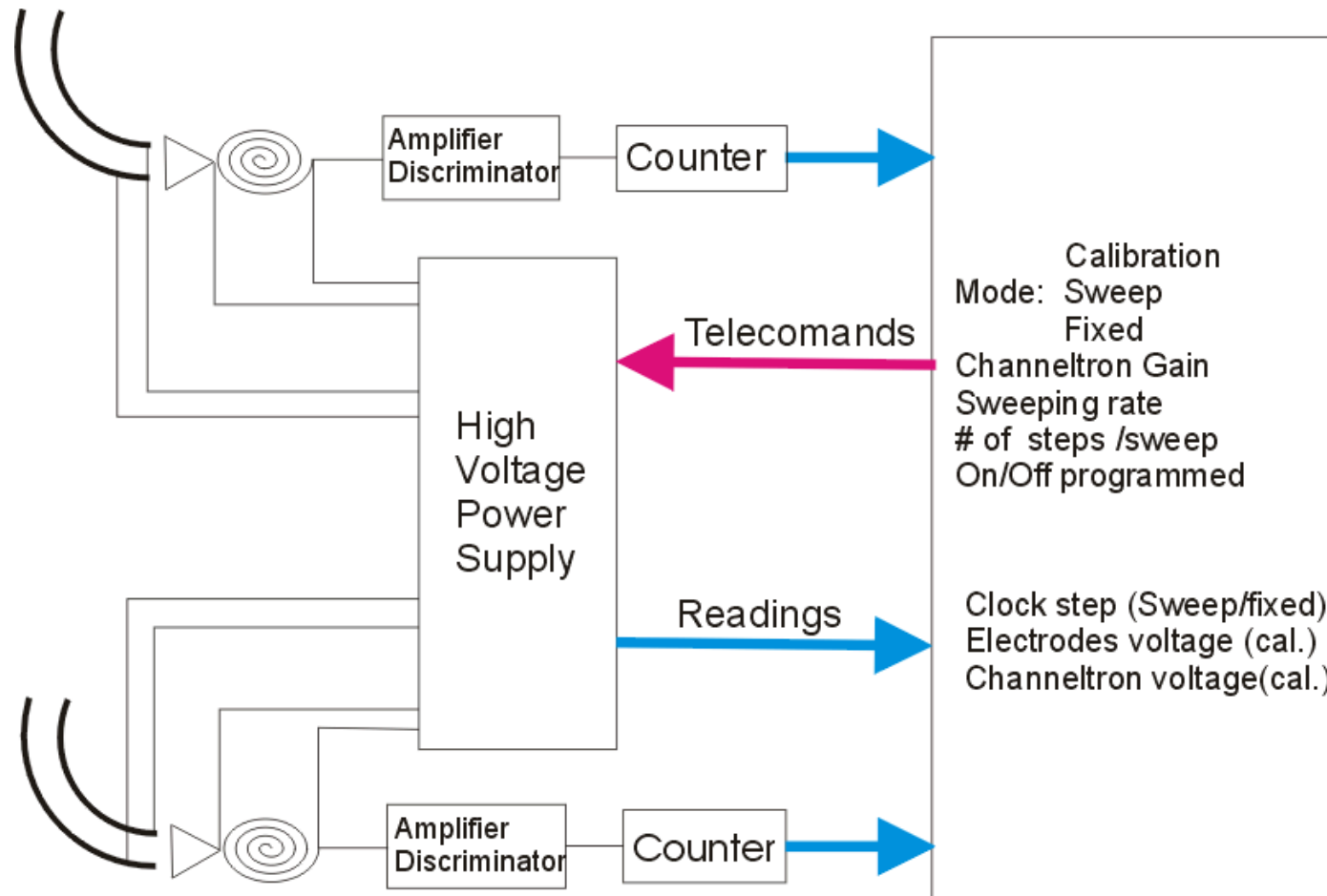
Produces a beam of electrons with $E=20-500$ eV



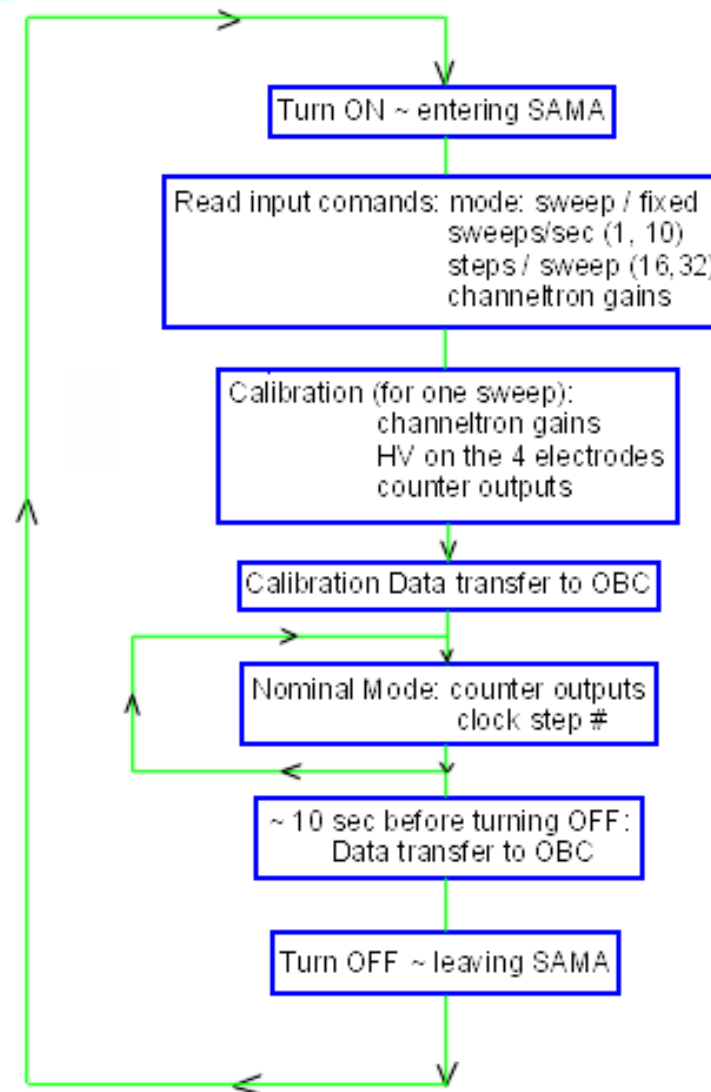
Telemetry

Data sampling rate < 21 kbits/sec

Data volume ~ 167Mbits/day (1/4 of 12 orbits)



Flight Operations Flow



Project ELISA: costs and timetable

Costs:

FAPESP – US\$80,000 a US\$100,000

PPA- INPE – R\$25.000,00 (first prototype – not space qualified)

PPA-INPE (2004-2005) - ~ US\$60,000 (submitted)

Timetable

Date	Task
08/2003	Proposal submission to FAPESP
11/2003	Importation o space qualified components
06/2004	Construction of space qualified prototype Calibration Thermal and vibration tests (LIT)
06/2005	Construction, calibration and mounting the analyzer for EQUARS
06/2006	Launching