SOPA Corrections to the MPA Measurements

Particle distribution functions in the plasma sheet have suprathermal tails.
- **Multiple simultaneous ion populations with multiple origins.**
- **Multiple simultaneous electron populations with multiple origins.**

The MPA plasma instruments at geosyncrhouns orbit measure particles from 1 eV - 40 keV.
- **This energy range misses a lot of the ion pressure.**
  (Electrons, no problem.)

SOPA measurements (46 keV – 1.5 MeV) can be used to correct the MPA ion moments.

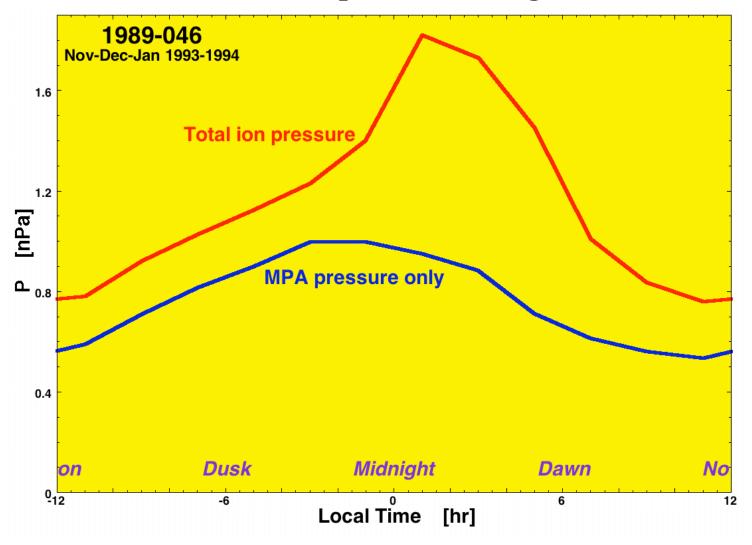**Corrections work as follows:**

$$n_{total} = n_{MPA} + n_{SOPA}$$

$$P_{total} = P_{MPA} + P_{SOPA}$$

$$T_{total} = P_{total} / n_{total}$$

Some typical values.

Quantity	MPA value	SOPA value	Total
n	0.76 cm^{-3}	0.08 cm^{-3}	0.84 cm^{-3}
T	6900 eV	25,900 eV	8500 eV
P	0.83 nPa	0.33 nPa	1.16 nPa

SOPA Corrections to the MPA Measurements

- **Correcting the pressure is more important than the density.**
- **The corrections are most important on the nightside.**
- **The corrections are more important during storms.**

What the Corrections Involve

$$n_{total} = n_{MPA} + n_{SOPA}$$

$$P_{total} = P_{MPA} + P_{SOPA}$$

The quantities n_{SOPA} and P_{SOPA} are obtained from the "Cayton fits" to SOPA measurements.

The Cayton fits are relativistic bi-Maxwellian fits to the count rates of the electrons and to the count rates of the ions. Each Maxwellian has a density and a temperature:

Cayton Fit	n	T	Population
Electron - Low	3×10^{-3} cm^{-3}	35 keV	Tail of electron plasma sheet
Electron - High	2×10^{-4} cm^{-3}	170 keV	Outer electron radiation belt
Proton - Low	7×10^{-2} cm^{-3}	32 keV	Tail of ion plasma sheet
Proton - High	3×10^{-6} cm^{-3}	3 MeV	Ion radiation belt

Problem:

For ions, the lowest-energy channels of SOPA are contaminated by electron counts.

To obtain good Proton-Low fits
1. The Cayton fitting code must be modified to better subtract the electron background.
2. The results must be inspected by eye.

If SOPA corrections are of strong interest for these GEM Events, Tom Cayton will make the Proton-Low fits to SOPA.