Comparative studies of geomagnetic storms driven by coronal mass ejections (CMEs) and high speed solar wind streams/corotating interaction regions (HSS/CIRs) using measurements from geosynchronous orbit have demonstrated differences in the ion temperature evolution for each type of storm [Denton et al., 2006; Borovsky and Denton, 2006]. While the ion temperature increases for each type of storm, the increase is greater and persists longer for HSS/CIR-driven storms and the MLT location of heated ions differs. The energetic neutral atom (ENA) instruments of the TWINS Mission provide a global view of the magnetosphere with continuous temporal coverage. A technique to calculate ion temperatures from the ENA measurements provides a method to study global ion temperature evolution throughout the evolution of geomagnetic storms.

**TWINS Measurements and Ion Temperature Calculation**

The measured ENA intensity, $j_{ENA}$ (with units of (cm$^2$ sr s eV)$^{-1}$), is related to the ion intensity, $j_{ion}$, by

$$j_{ENA}(z) = \int_{E_{min}}^{E_{max}} \sigma_{cx}(E) j_{ion}(z) \exp\left(-\frac{E}{T(z)}\right) \frac{E}{T(z)} \sin \theta dE,$$

where $z$ is along the LOS, $a$ is the spacecraft location, $\sigma_{cx}$ is the energy-dependent charge exchange cross-section [Freeman and Jones, 1974], $n_a$ is the neutral density. The integral over $\theta$ accounts for the attenuation of ENAs due to additional collisions or ionization along the path from the origin of the ENA to the instrument. This integral is approximately zero for geometry thin regions such as the plasma sheet. The contribution to the high energy portion of the spectrum (energies much greater than the ion temperature) is dominated by emission from the hottest region along the LOS [Hubel et al., 1987]. Thus, we approximate the integral by the peak value at location $z^*$ of the integrand multiplied by a characteristic width, $\xi$ [Scime and Hokin, 1992], to obtain

$$j_{ENA} \approx \sigma_{cx}(E) \frac{\dot{n}_{a}(z^*)}{\dot{E}} j_{ion}(z^*),$$

If we assume the ions are Maxwellian, then

$$\frac{j_{ENA}}{\sigma_{cx}(E) \frac{\dot{n}_{a}(z^*)}{\dot{E}}} \approx \exp\left(-\frac{E}{T(z^*)}\right),$$

and an exponential fit to the scaled measurements yields an effective ion temperature for the hottest region along the LOS.

**Conclusions and Future Work**

- In several cases independent of storm driver, the dawn-dusk ion temperature asymmetry appears opposite to the typical quiet-time structure discussed in Keesee et al., [2011].
- Regions of hot ions on the day side appear in both types of storms, though they are typically closer to dusk for HSS/CIR storms. Day side heating is consistent with superposed epoch analysis of ion temperatures performed with MENA data [Zaniewski et al., 2006].
- Future work: Analysis of additional storms
- Future work: Superposed epoch analyses of ion temperature maps by storm driver.