strospheres

lanets

rears

al Cloud

Sun

G Cloud

50

Alpha Centauri

Sirius

Redfield (2012)

NASA/Goddard/Adler/U. Chicago/Wesleyan

### Where the Heliosphere Ends





Zank & Frisch (1999)

Müller (2004)



lanets

rears

#### 600,000 AU

al Cloud

Sun

G Cloud

Alpha Centauri

Sirius

Redfield (2012)

NASA/Goddard/Adler/U. Chicago/Wesleyan

#### **Objectives that Connect to the Big Picture**

- Local ISM shares the same volume as stars (and planets)
  - 62% of known exoplanets reside within 100 pc (80% of Earth-like)
- The screen through which we view the universe and the substance we must travel through to go anywhere
  - Rare opportunity to couple in situ measurements with line-of-sight measurements for a comprehensive understanding of interstellar phenomena that we can apply elsewhere in our galaxy and beyond
  - Building capabilities and acquire the most basic environmental information
- How do the ISM, stars, and planets interact?
  - Shields planetary atmospheres (and occupants) from Galactic cosmic rays
  - Our local example, the heliosphere, is the standard by which all others are understood

### **Kinematics of the LISM**



Redfield (2009)

Frisch, Redfield, & Slavin (2011)

### **Kinematics of the LISM**





- New IBEX measurements in agreement with absorption line spectroscopy regarding the velocity and direction of interstellar gas flow
- Low velocity argues for no heliospheric bow shock (McComas et al. 2012)

# Global LISM Morphology



Redfield & Linsky (in prep)

### **Electron Density**



 Rely on measurements of collisionally excited transitions of ionized carbon

$$\frac{N_{\text{CII}^*}}{N_{\text{CII}}} = \frac{n_{\text{e}}C_{12}(T)}{A_{21}}$$

• Measure a LISM mean electron density of 0.13 cm<sup>-3</sup>

Redfield & Falcon (2008)

## **Electron Density**



## ISM Science Key Questions (>300 AU)

- What is the density structure of the ISM?
  - The issue that plaques all line-of-sight observations
  - Hydrogen density from Lyman- $\alpha$  emission (mean free path only ~10 AU)
- What is the composition and ionization of the ISM?
  - Currently limited to meteoritic and solar (stellar)
- What is the composition and size of interstellar dust?
  - A largely invisible constituent of the local ISM
- Is the ISM in pressure balance?
  - An inventory of magnetic field, temperature, and turbulence
- How do stars (and planets) interact with the ISM?
  - Have yet to probe hydrogen wall where charge exchange reactions occur, or the bow shock (wave) region
  - It is this region that is observed for other stars (astrospheres) and currently limited to models and line-of-sight averaged observations