

CoMP and COSMO

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- science problems & an observational approach
- prototype: CoMP
- future: COSMO



NCAR

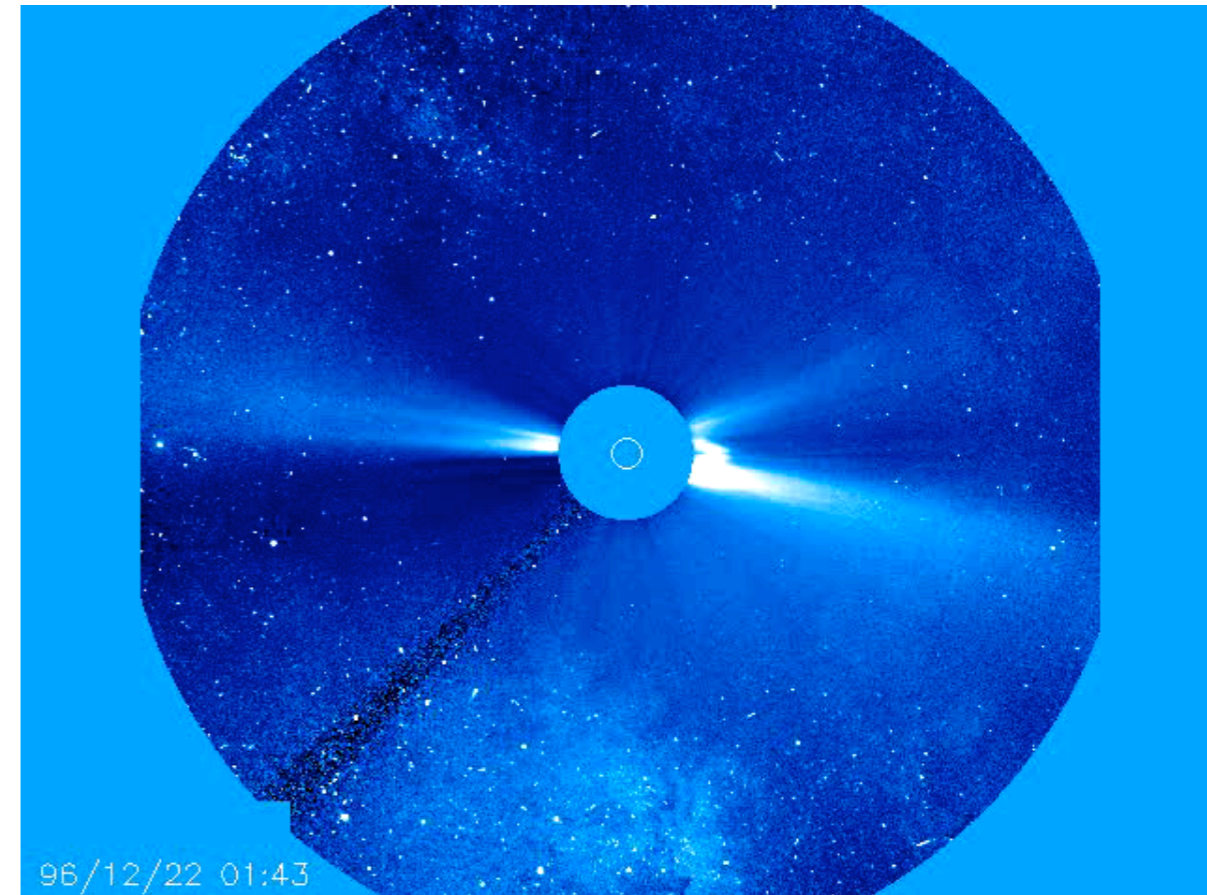
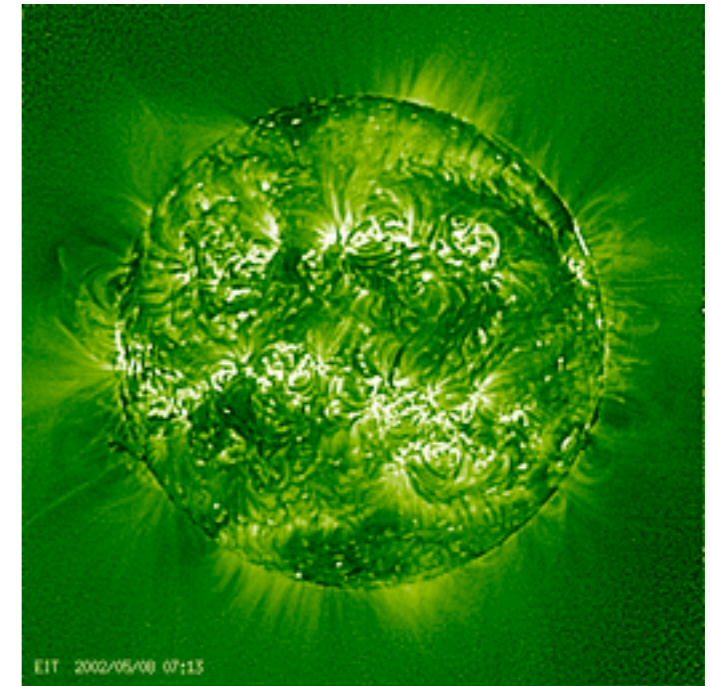
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fundamental problems

- The corona is energized by convection & emerging magnetic fields
- The **free energy** is somehow stored in the **coronal magnetic field**
- This energy is released as
 - radiation from radio to gamma rays (flares, coronal heating)
 - plasmoids (CMEs)
 - energetic particles (Flares, shocks)
- **Why is the Sun obliged to do this?**
- **What are the effects on the heliosphere, & the Earth in particular?**



the basis for an observational approach

- These questions cannot be addressed theoretically
 - turbulent driver
 - nonlinear system
 - highly anisotropic transport
 - credible models for processes spanning wildly different regimes lie far in the future
- direct measurements of the coronal magnetic field are required

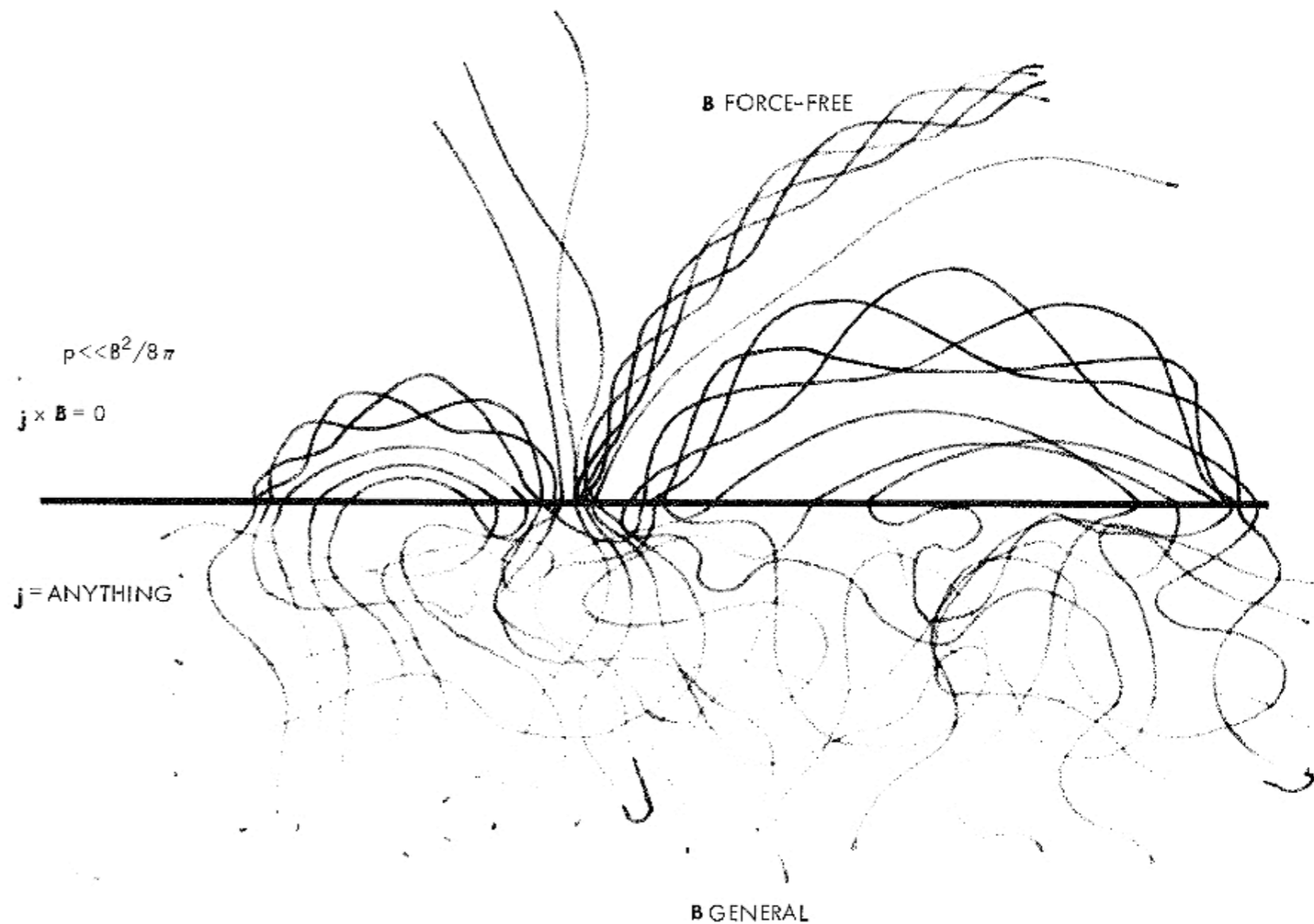
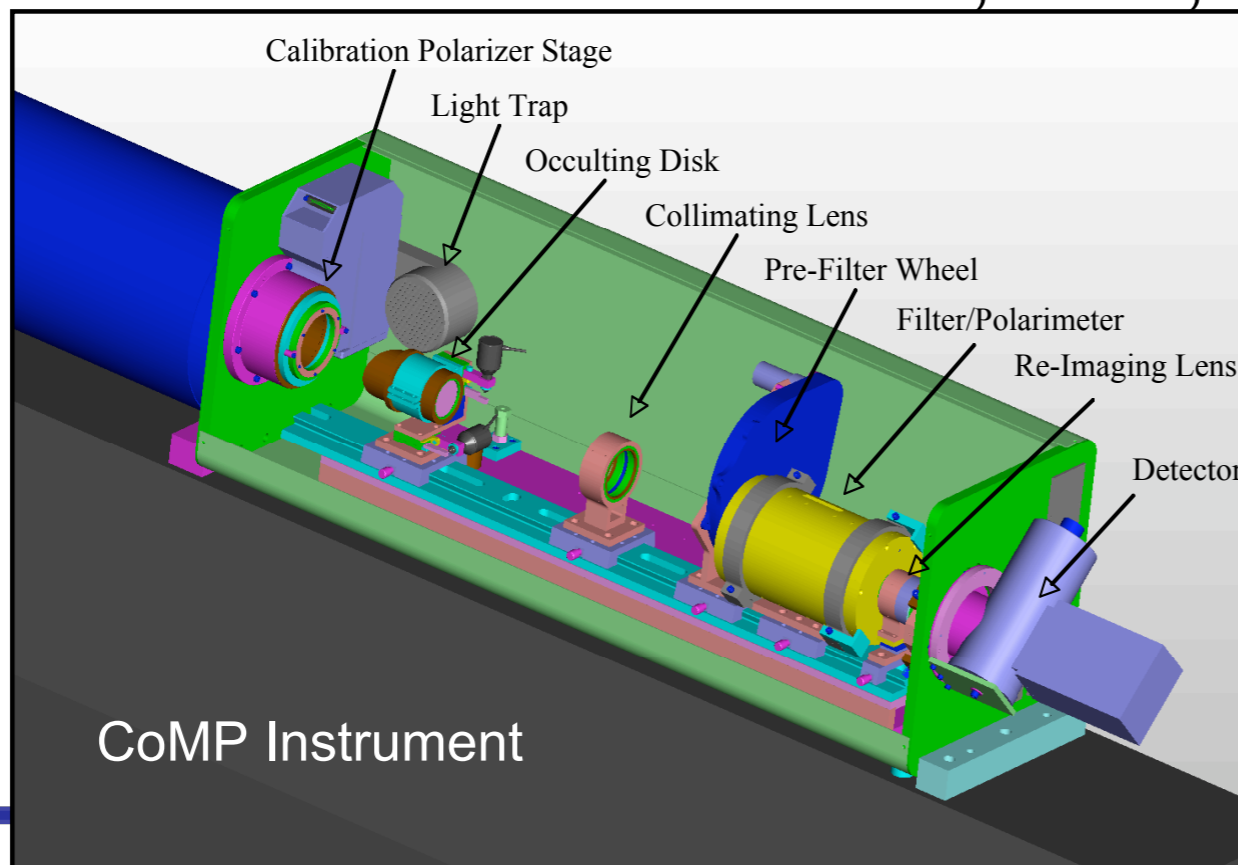


FIGURE 44-2. Magnetic field in a turbulent conducting medium. The fluid pressure is assumed large compared with magnetic forces below the dividing plane and small above it.

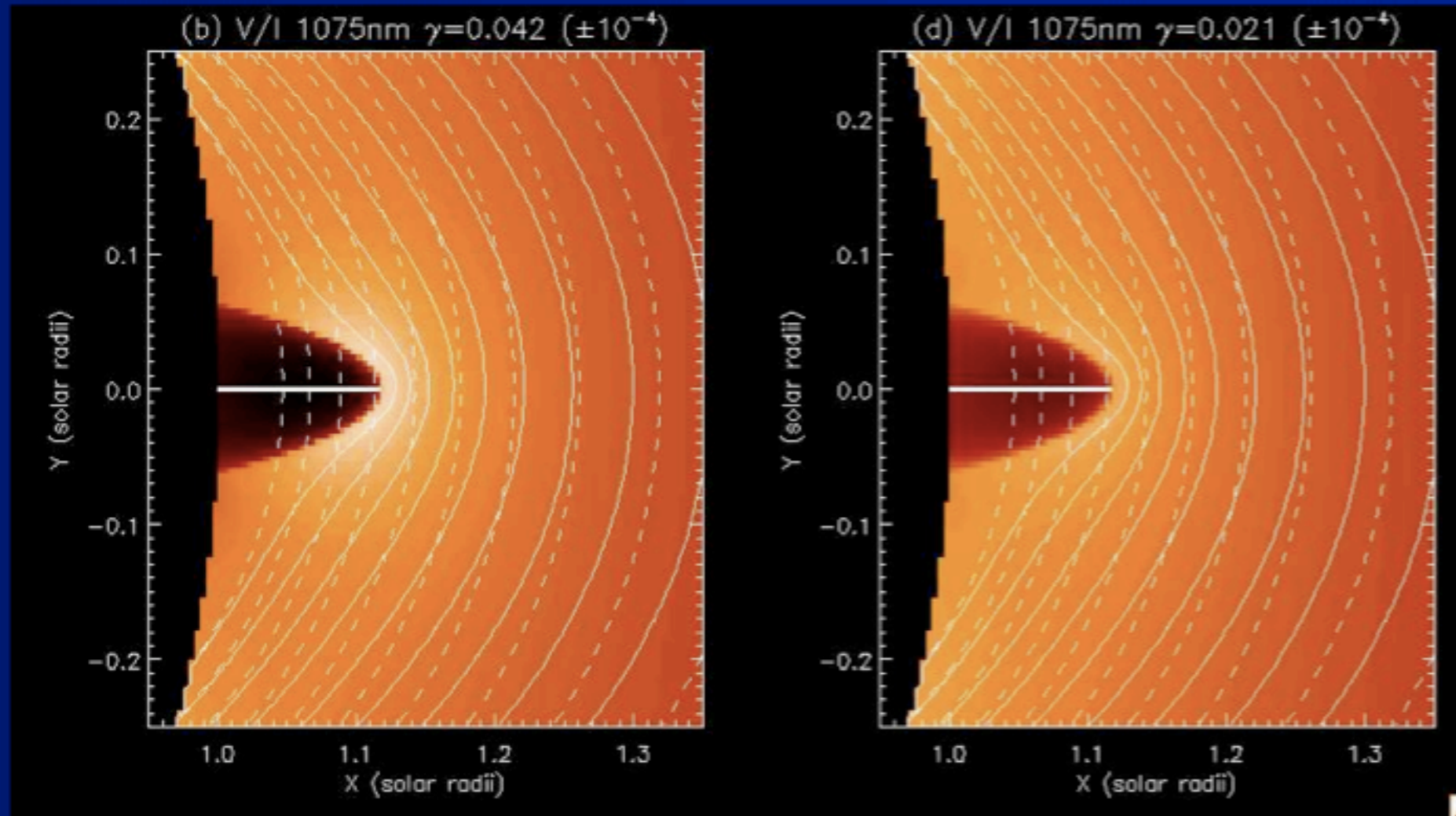
Instrument prototype: CoMP

Tomczyk S., Card G., Darnell T., Elmore D., Lull R., Nelson P., Streater K, Burkepile J., Casini R., Judge P., (2008), Sol. Phys.

- “Coronal Multichannel Polarimeter”
- Exploits forbidden coronal lines
 - Fe¹²⁺ 1.0747 1.0798 microns
 - **polarization** contains direct information on coronal magnetic fields
- ingenious design using birefringent “Lyot” filters (Tomczyk)
- implemented at NSO/Sac Peak, NM, moving to Haleakala HI



Power of spectropolarimetry

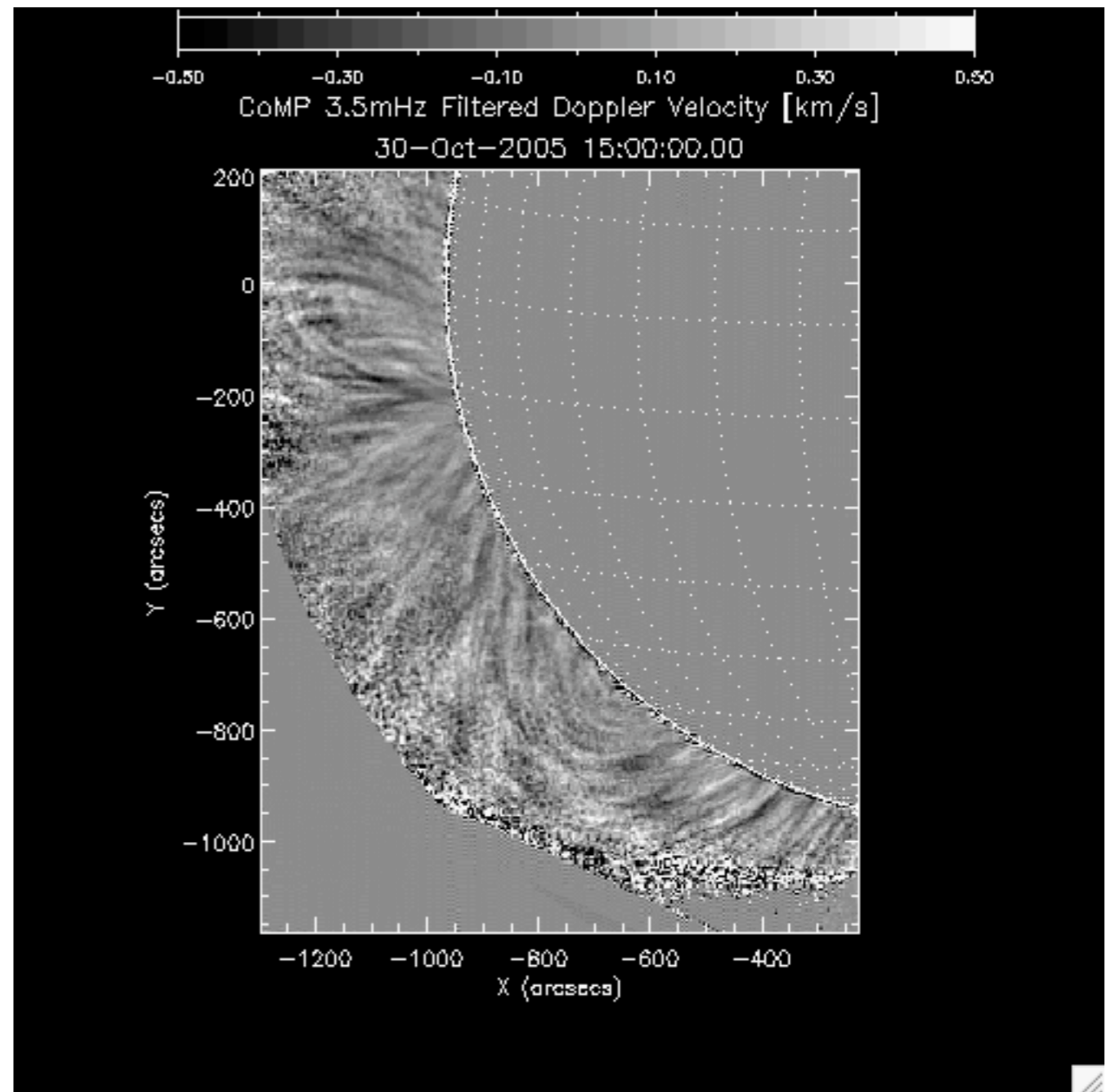


Low, Fong & Fan (2003) analytical current sheet. $\gamma = 0.042$: sufficient energy for opening field and driving CME. $\gamma = 0.021$: insufficient energy.

Initial CoMP Results: **one** example

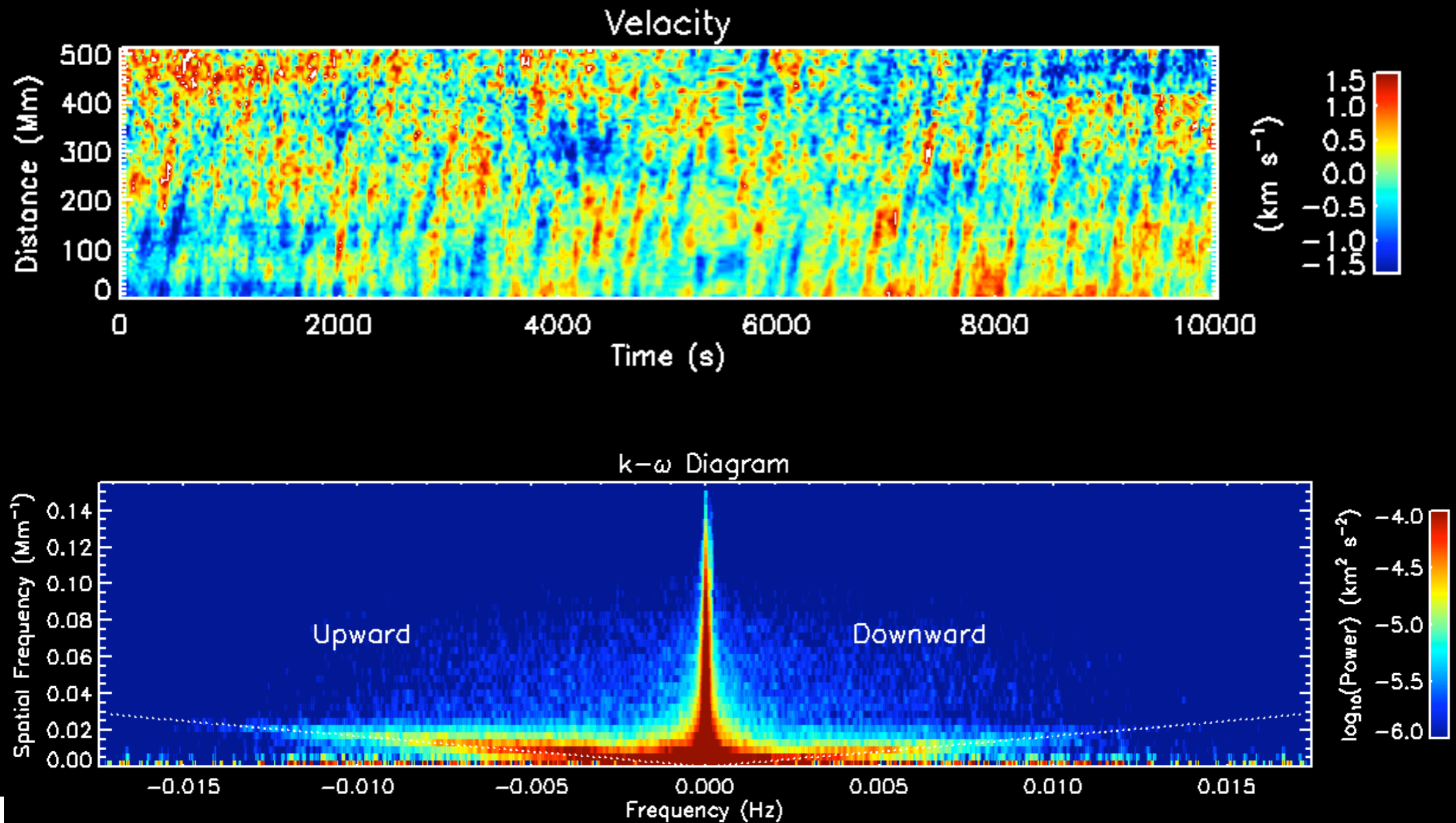
Tomczyk S., McIntosh S., Keil S., Judge, P., Schad, T., Seeley, D., Edmondson J., Science 317, 1192 (2007).

- First credible detection of Alfvénic fluctuations in the corona
- has already stimulated much discussion in the international community
- recognized by some solar physicists as the first major step forward since SKYLAB (1973)



Previously unthinkable results from CoMP

Tomczyk & McIntosh (in prep.)



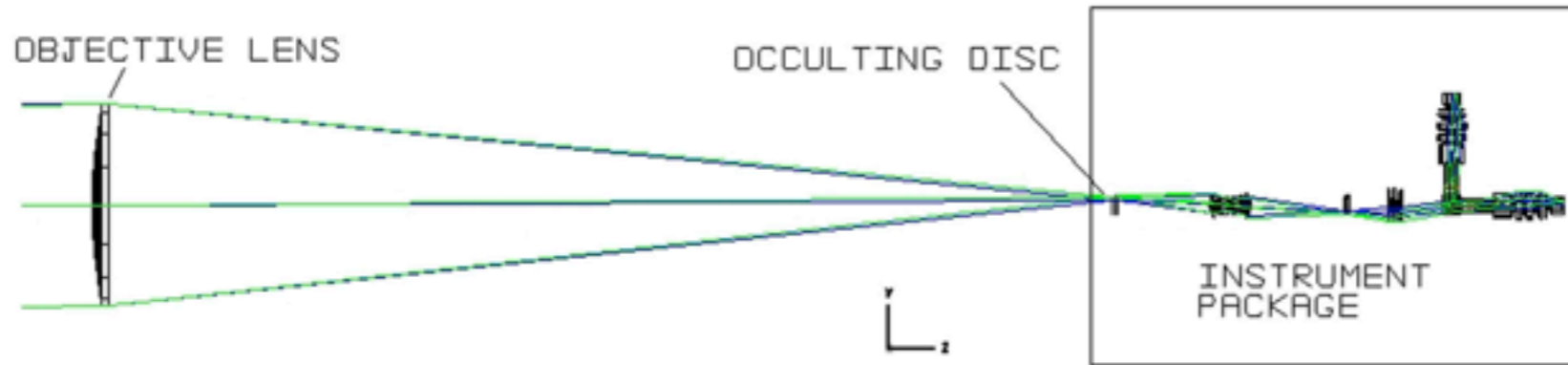
the future: COSMO

(HAO, U. Hawaii, U. Michigan)

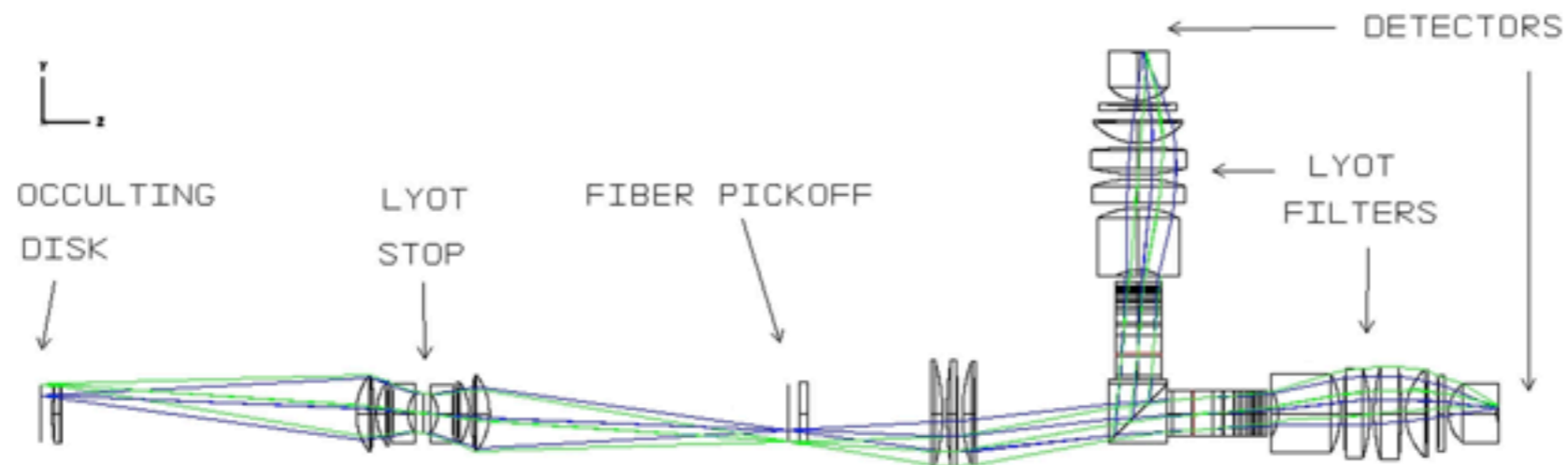
- Complete magnetic field vectors are extremely difficult to measure
- CoMP is photon starved & limited by poor coronal site
- COSMO is designed
 - to optimize measurements of the forbidden lines (& He I)
 - as a synoptic, community observatory
 - to replace MLSO, requiring new **white light** and **chromospheric** instruments (CHROMAG)
- Much work is already done within and outside HAO
 - Advisory group has members from Harvard-Smithsonian CfA, HAO, NRL, NSO, Rice U., U. Michigan, U. Nice
- see <http://www.cosmo.ucar.edu/>



COSMO



Optical design of the COSMO large-aperture coronagraph. An enlargement of the post-focus instrument section is shown in Figure 13



Enlargement of the post focus instrument section of the COSMO large-aperture coronagraph showing the fiber pickoff for the spectro-polarimeter at the center, and the filter polarimeter to the right

(in)Famous TRACE post-flare loops

