Coronal magnetometry
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The challenge

- we wish to measure coronal magnetic fields, to address problems in storage and release of energy
  1. basic MHD of the corona (structure, stability, causes of dynamics, flares)
  2. the origins of space weather
  3. the role of the corona in the solar magnetic cycle
  4. coronal heating?

- the time is ripe to exploit forbidden coronal lines (1960s: Charvin, Harvey) [permitted lines in prominences- 1970s Leroy]
  1. signatures of the coronal magnetic field are weak
     \((I : P : V \approx 1 : 0.1 : 0.001)\)
  2. ambiguities abound... models needed
Progress- theory

Progress- instrumental


Progress- observational


Tomczyk, S.: 2004, “Magnetic Field Measurements from The Coronal Multi-Channel Polarimeter”, *AGU Fall Meeting Abstracts* B4
The SOLARC off-axis reflecting coronagraph. Gregorian, off-axis, “scatter free”.
SOLARC coronal data: I, V spectra

Feed to IR spectrograph. V changes sign at $h \approx 0.17R_\odot$: loops.
SOLARC coronal data: azimuth
SOLARC coronal data: $B_{\text{LOS}}$

SOLARC (contours of $B_{\text{LOS}}$), EIT (Intensity at 17.1 nm)
COMP (Tomczyk P.I., HAO)

Multi-Channel Polarimeter for Coronal Magnetic Field Measurements.
Lyot filters ($\lambda/\Delta\lambda \approx 10^4$). Implemented at the 20cm “One-Shot” coronagraph on Sacramento Peak.
COMP coronal data: I

FeXIII 1074.7 Intensity 4/21/05
COMP coronal data: Velocity

Fe XIII 1074.7 Line-of-Sight Velocity 4/21/05
COMP coronal data: P/I

FeXIII 1074.7 Linear Polarization 4/21/05
COMP coronal data: azimuth

FeXIII 1074.7 Azimuth of B 4/21/05
COMP coronal data: $B_{\text{LOS}}$

FeXIII 1074.7 Longitudinal B 4/21/05
Low, Fong & Fan (2003) analytical current sheet. $\gamma = 0.042$: sufficient energy for opening field and driving CME. $\gamma = 0.021$: insufficient energy.
Synthetic circ. poln. abs(V)/I

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Summary

- SOLARC spectra show definitive measurements of $V$: $B_{LOS}$ (this is the really difficult measurement)
- COMP filter-based technique shows definitive measurements, is very efficient. Stokes $V$ is being verified
- Synthetic data: COMP-like measurements can distinguish magnetic structures of real physical interest
- $\Rightarrow$ the time is ripe for a concerted effort.
“COronal Solar Magnetic Observatory”

- a new $20M project with Kuhn, Lin (U. Hawaii), Zurbuchen (U. Michigan)
- 1m-class coronagraph, great site
- coronal and prominence magnetic field sensors
- update of existing Mauna Loa facilities
COSMO status

- white paper draft sent to collaborators (7 Feb 2007)
- will be widely distributed to the community
- need science advisory team
- Engineer to be hired soon devoted to COSMO
- proposal to MRI funding agency early 2007?
In preparation

- COMP instrument paper (Tomczyk)
- COMP initial results paper (Tomczyk)
- Synthetic magnetic signatures of current sheets (Judge, Low, Casini)
- ...

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