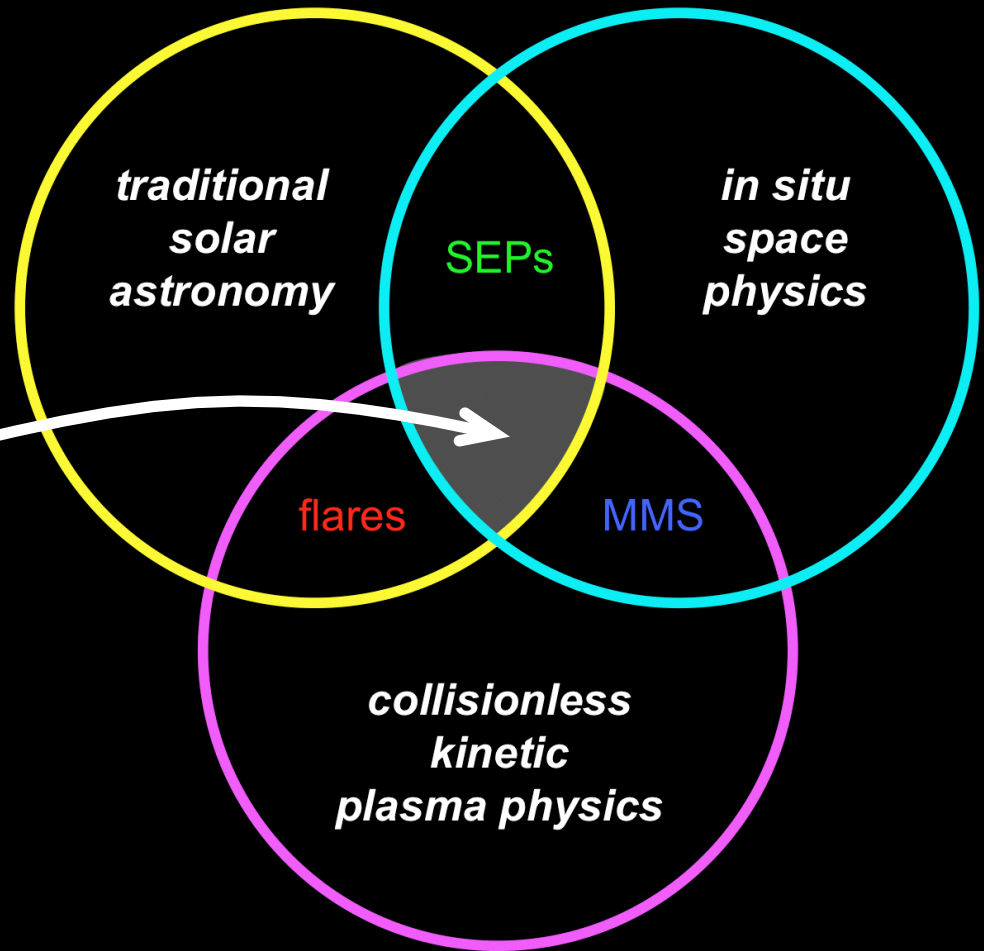
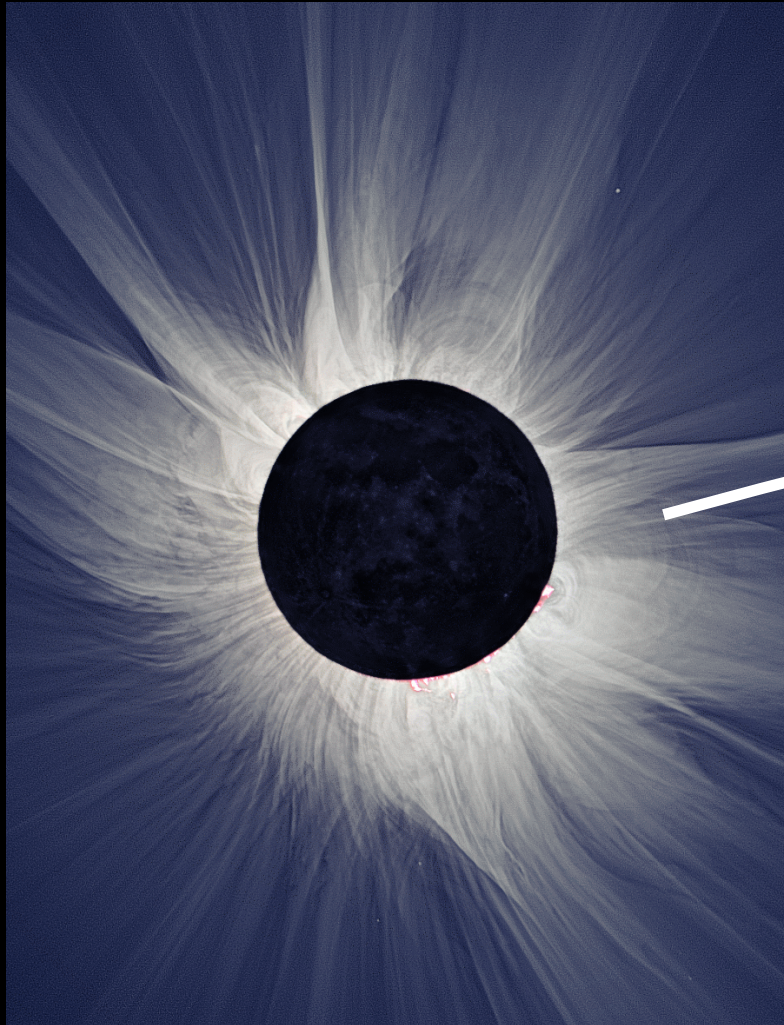




Coronagraphs on the Frontier: Connecting Astronomy, Solar Physics, & Plasma Physics

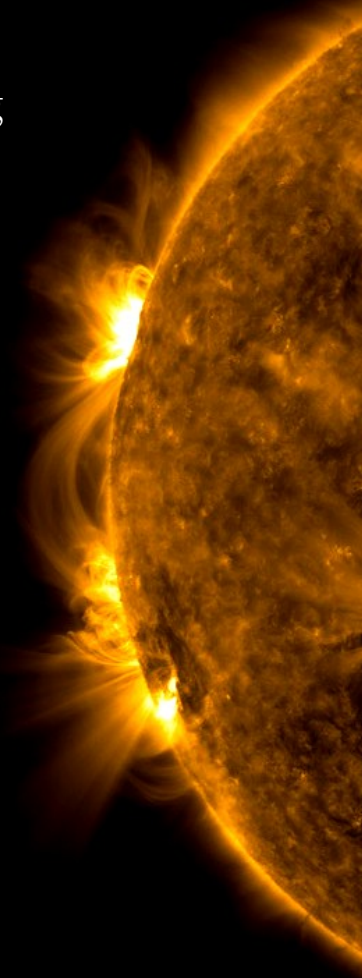


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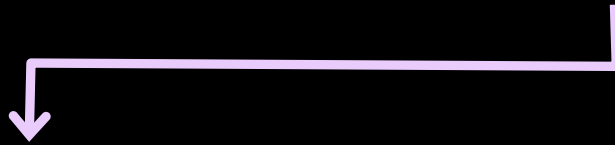
Target: Solar Wind & CMEs

- Global fast & slow solar wind streams
 - CMEs → shocks & magnetic clouds
- } primary carriers (drivers!) of space weather
- The “**coronal heating problem**” sits at the root of our lack of understanding about how the Sun produces the wind & CMEs.
- How do we move forward?
 - improved “theory”
 - improved simulations
 - improved observations



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Dana Longcope, Montana State Univ.
Steve Cranmer, Univ. Colorado
Enrico Landi, Univ. Michigan

magnetic field: “lower boundary?”

... is connected to ...

thermal environment of corona



data assimilation?



What do coronagraphs give us?

- Coronagraphs enable monitoring of the “global” environment of wind/CME production:
 - Solar-pointing telescopes can't see to large radii
(solar-disk glare, PSF wings, detector dynamic range)
 - *In situ* probes can't explore near the Sun's surface
(even Solar Probe won't see main wind acceleration)
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- Coronagraph Diagnostics:

velocity
density
temperature(s)
chemical abundances
MHD wave properties
magnetic topology
shock physics
 $T_p \neq T_e \neq T_{ion}$

Discovery science...

- **High sensitivity/cadence allows fine-grained kinematic feature tracking (e.g., MHD dynamics).**
- **Emission-line spectroscopy allows kinetic, non-equilibrium physics to be probed!**

Quo vadimus, coronagraphia?

Challenges:

- They're complex; probably require more optical design expertise “per square foot” of observatory space than most (?) other types of telescopes.

Ground-based:

- NSO's DKIST (Cryo-NIRSP) will probe off-limb micro-structure (**0.0001 to 0.01 R_{sun}**).
- HAO's next-gen plans (UCoMP, COSMO, K-Cor) would provide huge improvements in our knowledge of dynamics at “coronal flux tube” scales (**0.01 to 0.3 R_{sun}**).
- Exploratory studies of balloon-borne “starshades” may yield new concepts that could simultaneously span scales from **0.001 to $>1 R_{\text{sun}}$** (M. Knölker & W. Cash).

Space-based:

- Going to space is probably needed to explore heights **> 5 to $10 R_{\text{sun}}$**
- It's a sin there's no LASCO replacement in orbit *now*.
- ESA's *Solar Orbiter* will have some interesting coronagraphic capabilities.
- There will be some strong submissions to this summer's NASA SMEX AO.