Use of space-born coronagraph METIS for study of eruptive prominences and CME's

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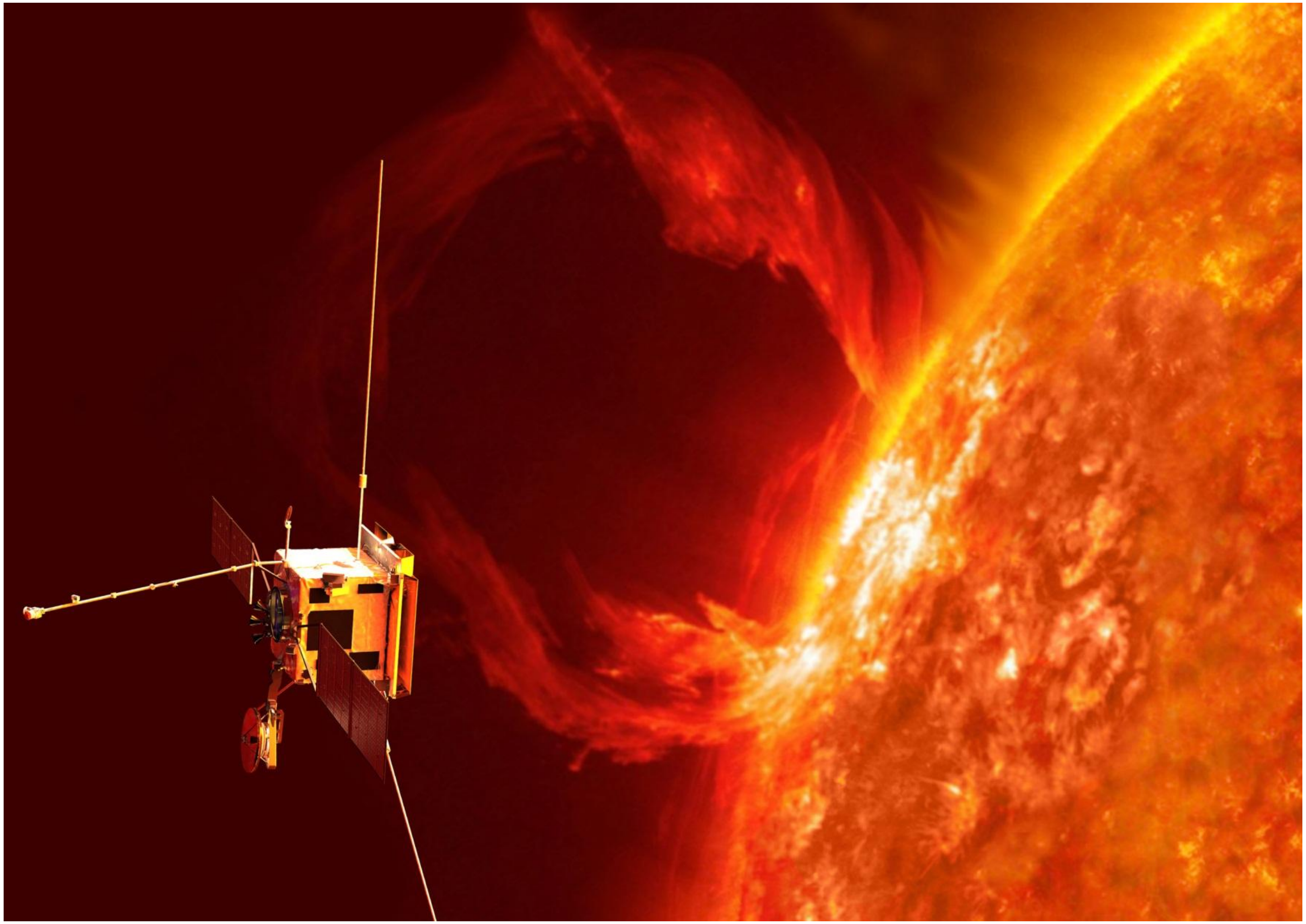
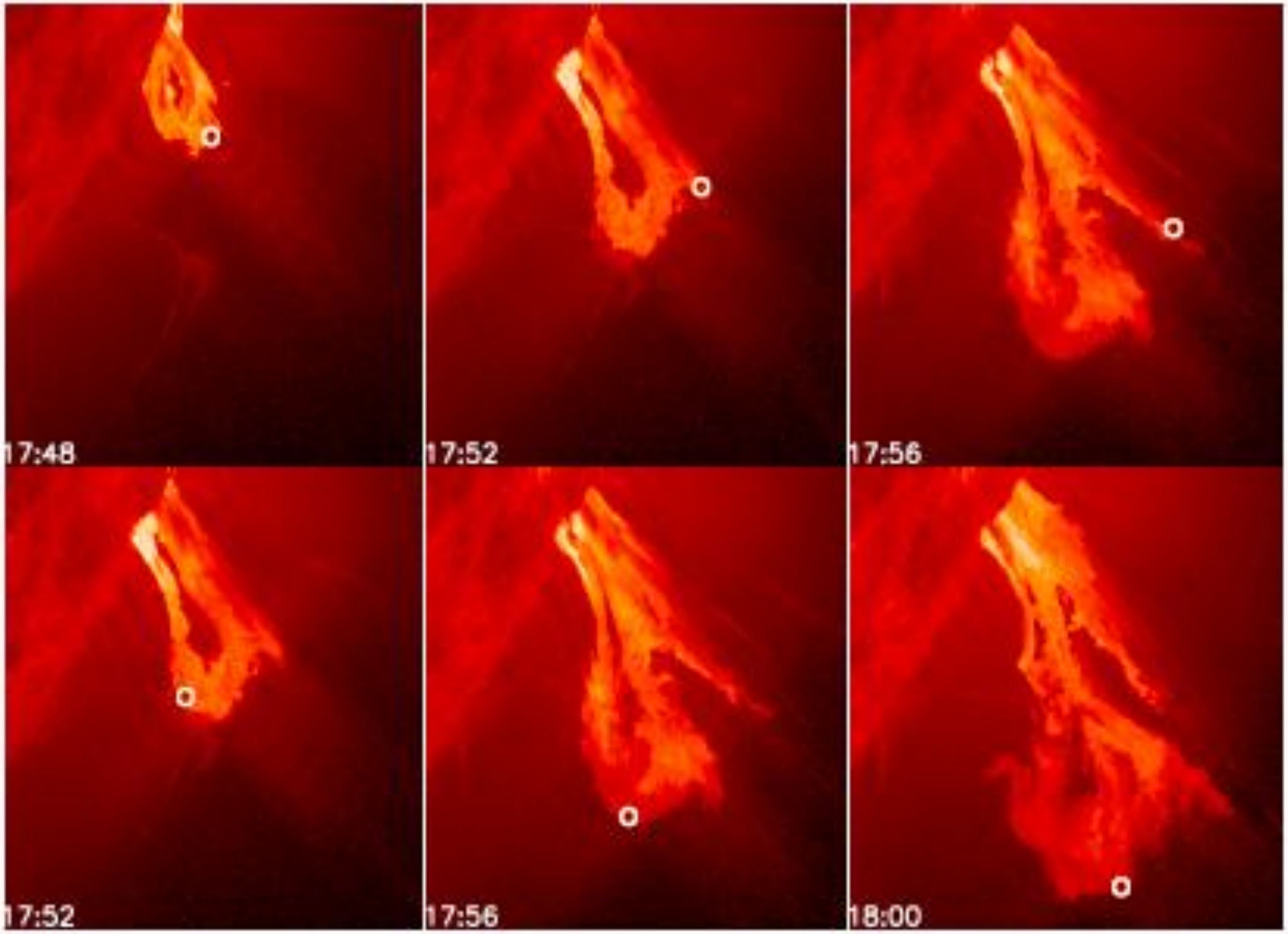


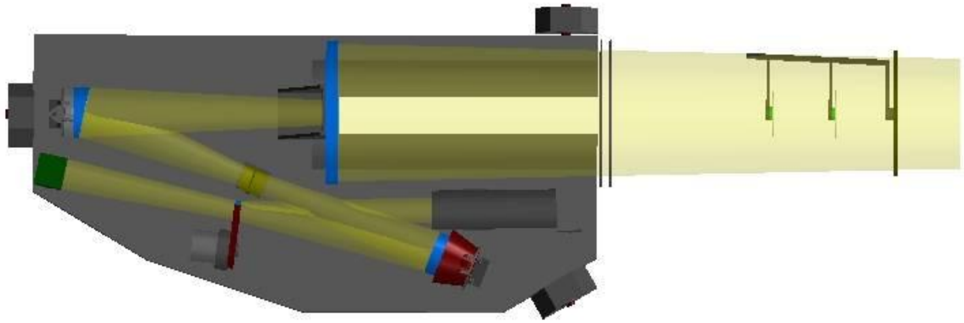
Solar Orbiter will observe the Sun at 0.28 AU

Labrosse and McGlinchey (2012)



Eruptive prominence seen by SDO/AIA in HeII 304

METIS



White-light imager/polarimeter: 500 – 650 nm
UV imager: 121.6 ± 10 nm (HI Lα)

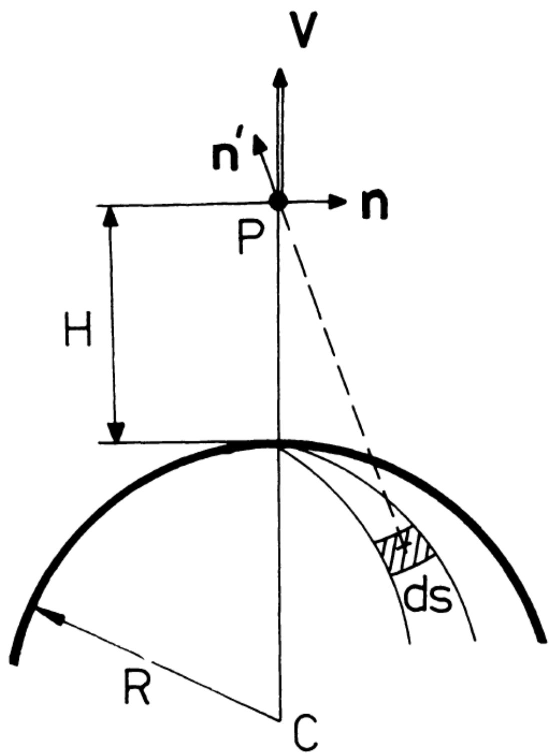
Czech contribution:
Design and manufacturing of the telescope mirrors M1 and M2 (TOPTEC Turnov)

Scientific objectives

Origins and acceleration of the solar wind streams

Sources of solar energetic particles

Origin and early propagation of CMEs:
UV detection of cool (10 000 K) plasma in the outer corona



Resonant scattering of incident solar radiation:

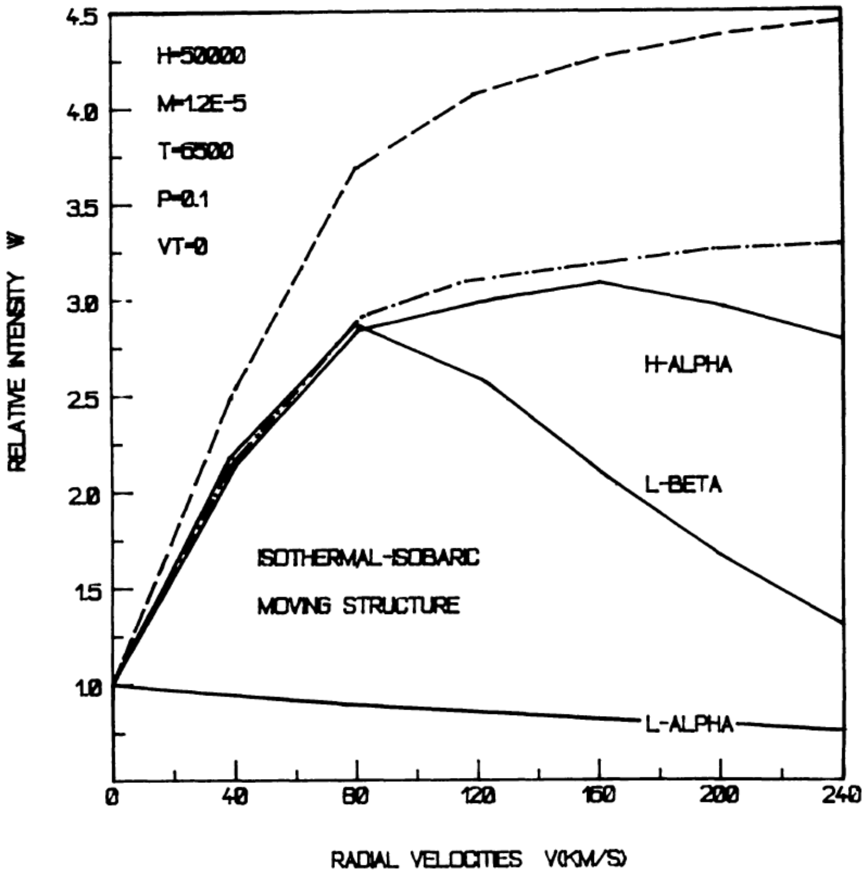
Cool plasmas (eruptive prominences, CMEs)

Neutrals and low ions in the hot corona

Lα emission due to scattering (DDE) + thermal emission due to heating ?

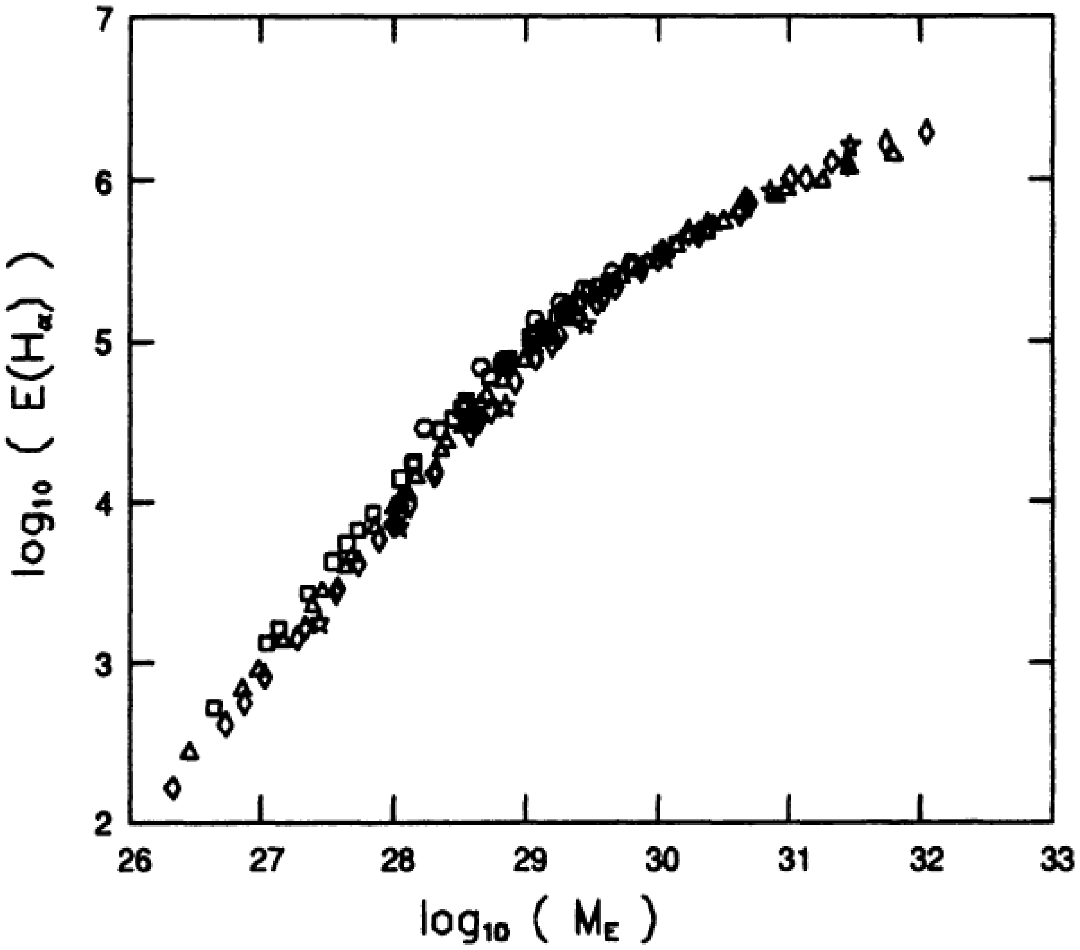
What is the ionization degree of hydrogen within the CME ?

Doppler brightening and dimming in hydrogen lines

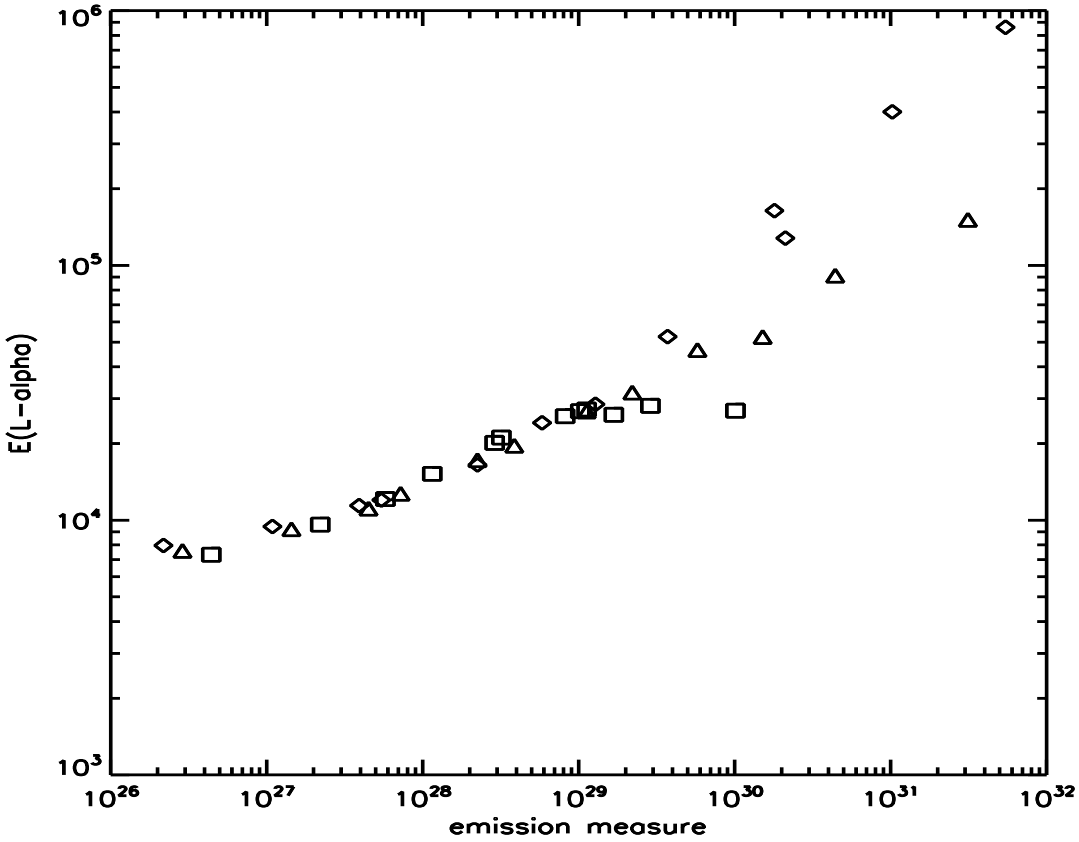


Full line: 3-level atom with continuum – full solution
Dot-dash: approximate solution
Dashed line: 2-level atom without continuum

Heinzel and Rompolt (1987)

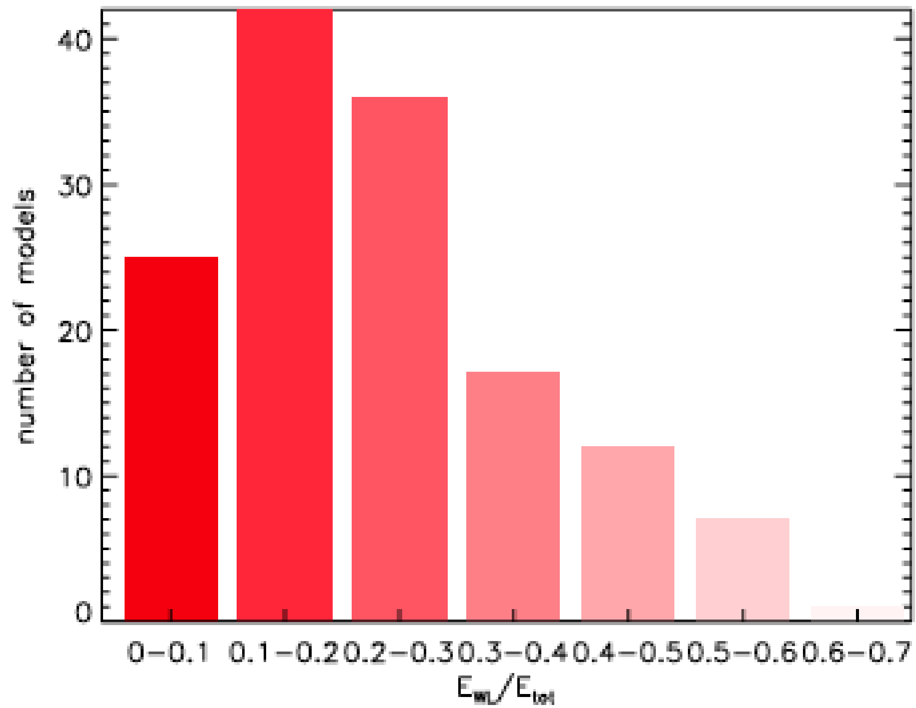


Dependence of the Hα line intensity on the emission measure of isothermal and isobaric prominence models of Gouttebroze et al. (1993). Sensitivity to plasma temperature is indicated by different symbols.



Dependence of the Lα line intensity on the emission measure of isothermal and isobaric prominence models of Gouttebroze et al. (1993). Sensitivity to plasma temperature is indicated by different symbols (unpublished result)

Prominences are pink on broad-band eclipse images



Jejčič and Heinzel (2009)

Eruptive prominences and CMEs

The Doppler brightening/dimming effect was investigated for the case of eruptive prominences (cool plasmas) by Heinzel and Rompolt (1987) and later by Gontikakis et al. (1997) (hydrogen Lyman lines) and by Labrosse et al. (2008) for helium lines. METIS will detect hydrogen Lα, allowing the determination of flow velocities in eruptive events. The amount of cool plasma at Lα line formation temperatures, contained within the CME, will be an indicator of the eruptive-prominence heating. METIS will measure the white-light intensity which is due to the scattering of photospheric radiation on free electrons (Thomson scattering), in the corona, CMEs, and in cool prominence structures (Jejčič and Heinzel, 2009). The intensity is linearly proportional to the electron density and the thickness of the structure. On the other hand, the line intensities are proportional to the emission measure. This allows to separate the electron density and the geometrical LOS extension.

Neutral hydrogen + electron density -> degree of ionization of hydrogen -> heating of eruptive prominence within CME

Neutral hydrogen + electron density -> determination of total mass loading (Schwartz et al., in preparation)

2D/3D non-LTE radiaive-transfer simulations are in progress