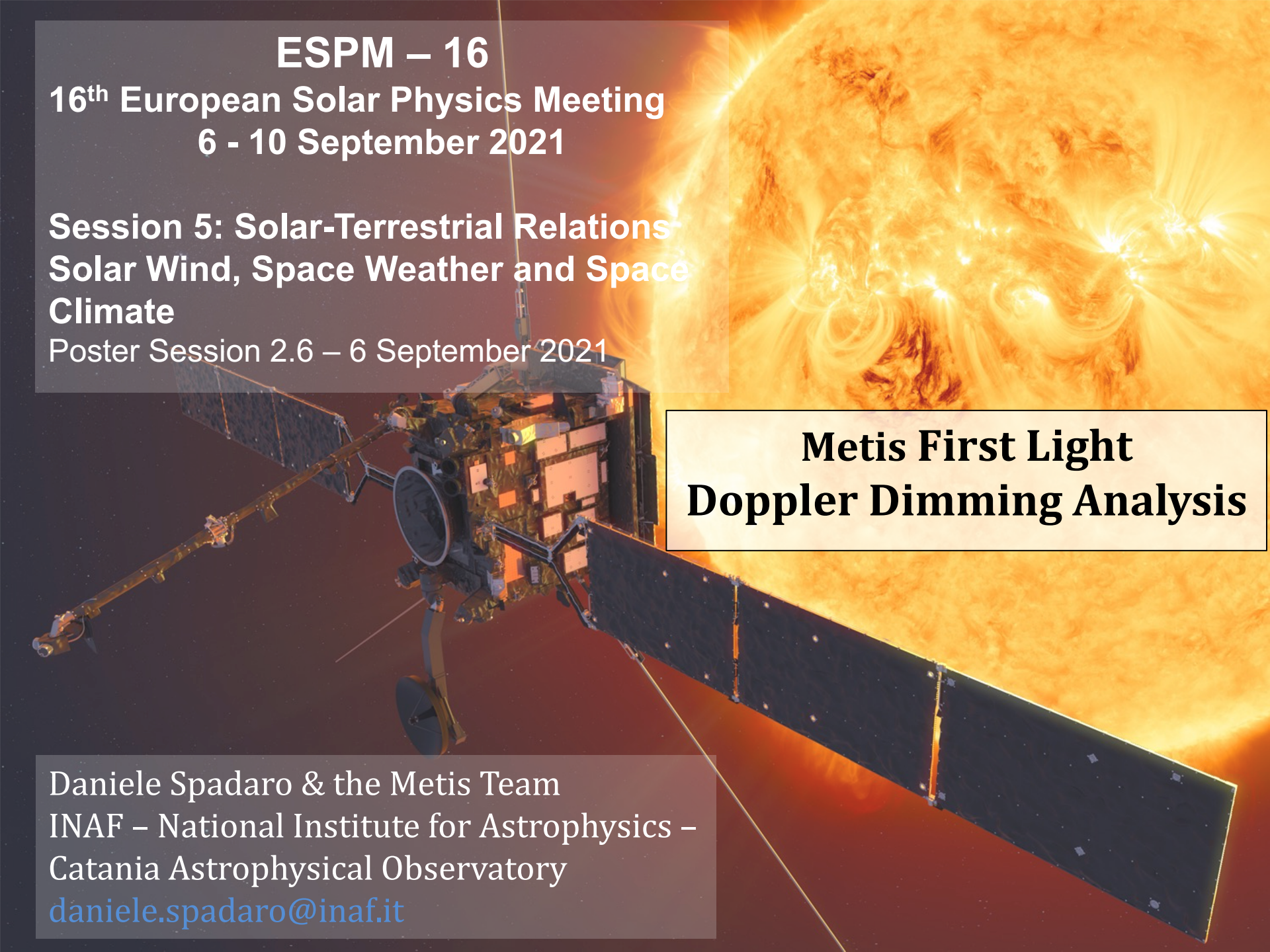
ESPM – 16
16th European Solar Physics Meeting
6 - 10 September 2021

Session 5: Solar-Terrestrial Relations
Solar Wind, Space Weather and Space Climate
Poster Session 2.6 – 6 September 2021



Metis First Light
Doppler Dimming Analysis

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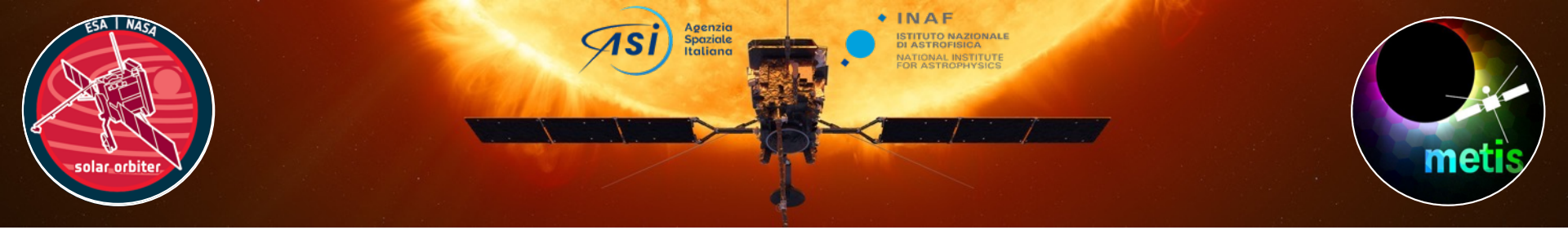


Metis:

the Solar Orbiter visible light and ultraviolet coronal imager

Designed to simultaneously detect both the

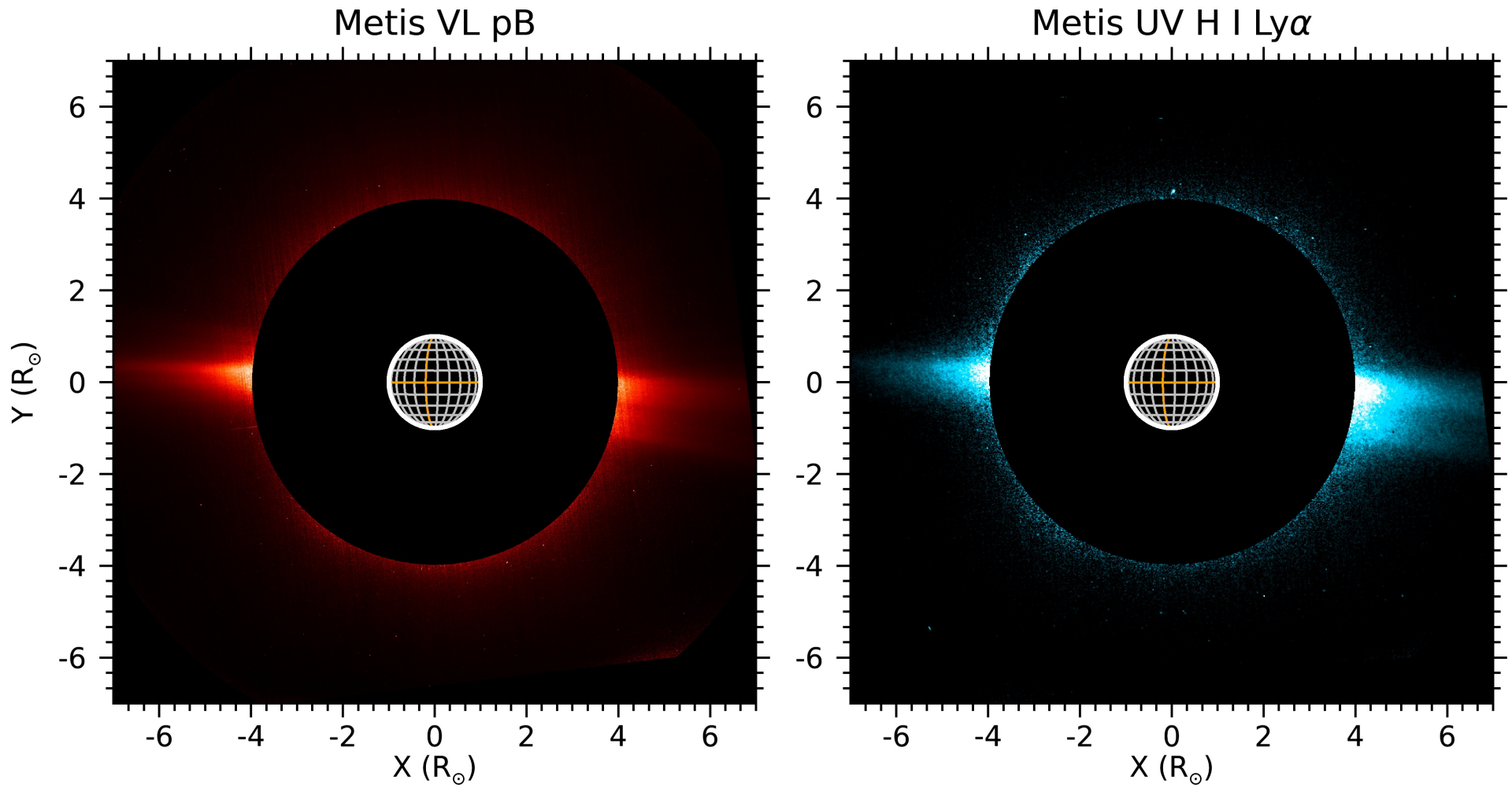
- **polarised visible light (580-640 nm)**
- **HI Lyman-α line (121.6 ± 10 nm) coronal emission**

- **Imaging the full off-limb corona and inner heliosphere**

- **Widening the knowledge previously acquired with UVCS on SOHO**

Antonucci et al., 2020,
A&A special issue on the Solar Orbiter mission

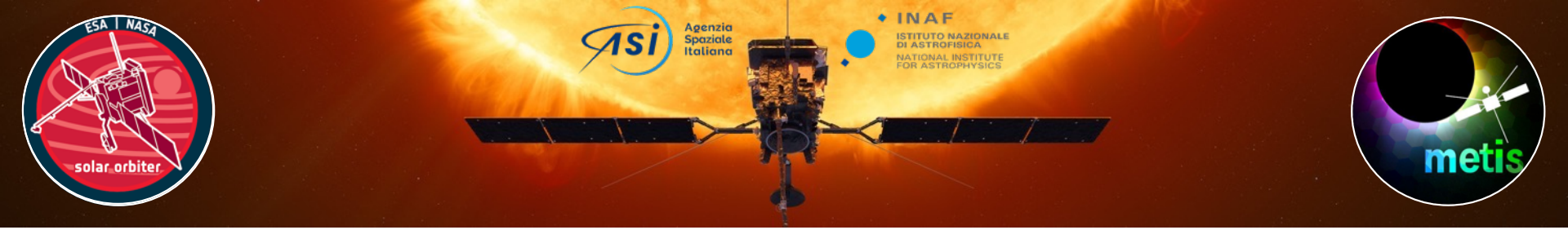
2020/05/15 11:39 UT - 11:41 UT



First simultaneous VL and UV images of the solar corona

Solar Orbiter @ 0.64 AU from the Sun – Metis FoV: 3.8 – 7.0 R⊙

Romoli et al. 2021, A&A special issue on the Solar Orbiter first results

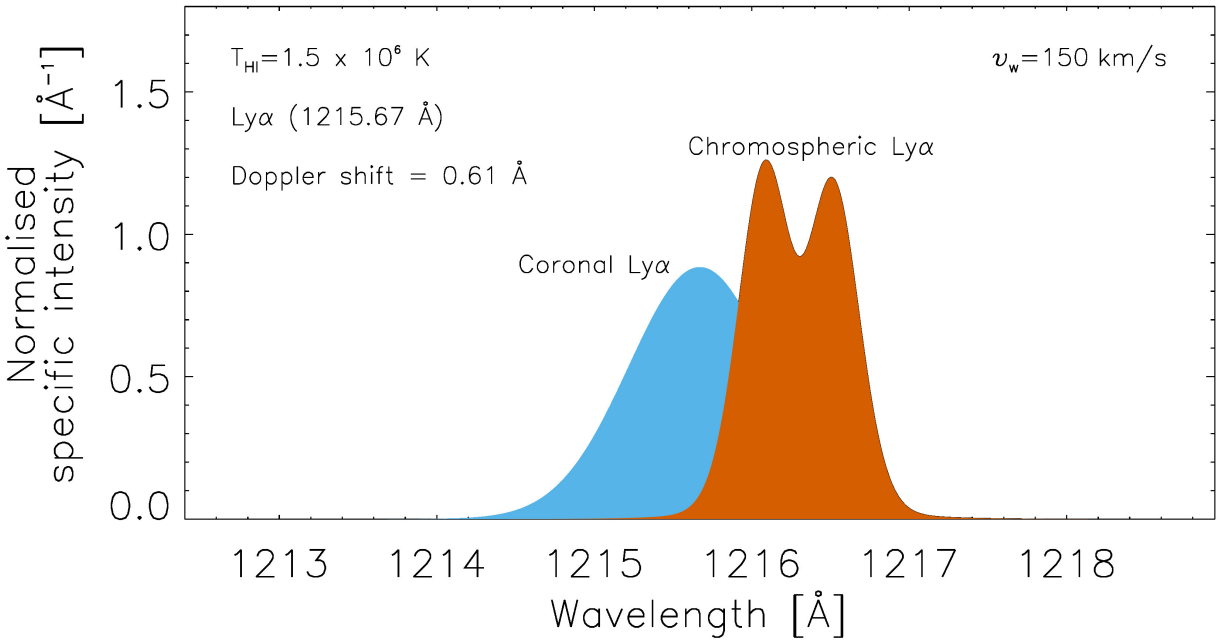


Mapping the speed of the solar wind in the corona over an extended field of view

(see Dolei+ 2018, 2019, Capuano+ 2021, A&A)

Doppler dimming of the UV HI Lyman-α line emission:

this effect is caused by the outward motion of the coronal plasma along the direction of incidence of the chromospheric photons on the coronal neutral hydrogen



Withbroe et al., 1982, Space Sci. Rev.;
Noci et al., 1987, ApJ

Synthesis of resonantly scattered Lyα line intensity

$$\mathcal{I}(\boldsymbol{n}) = \frac{0.833\, h\, B_{12}}{4\pi\lambda_0} \int_{-\infty}^{+\infty} n_e\, R_i(T_e)\, dx \int_{\Omega} \frac{11 + 3(\boldsymbol{n}\cdot\boldsymbol{n}')^2}{12}\, d\Omega$$
$$\times \int_{-\infty}^{+\infty} \mathcal{J}(\lambda', \boldsymbol{n}')\, d\lambda' \int_{-\infty}^{+\infty} \Psi\left(\lambda' - \lambda_0 - \frac{\lambda_0}{c}\boldsymbol{v}\cdot\boldsymbol{n}'\right) d\boldsymbol{v}$$

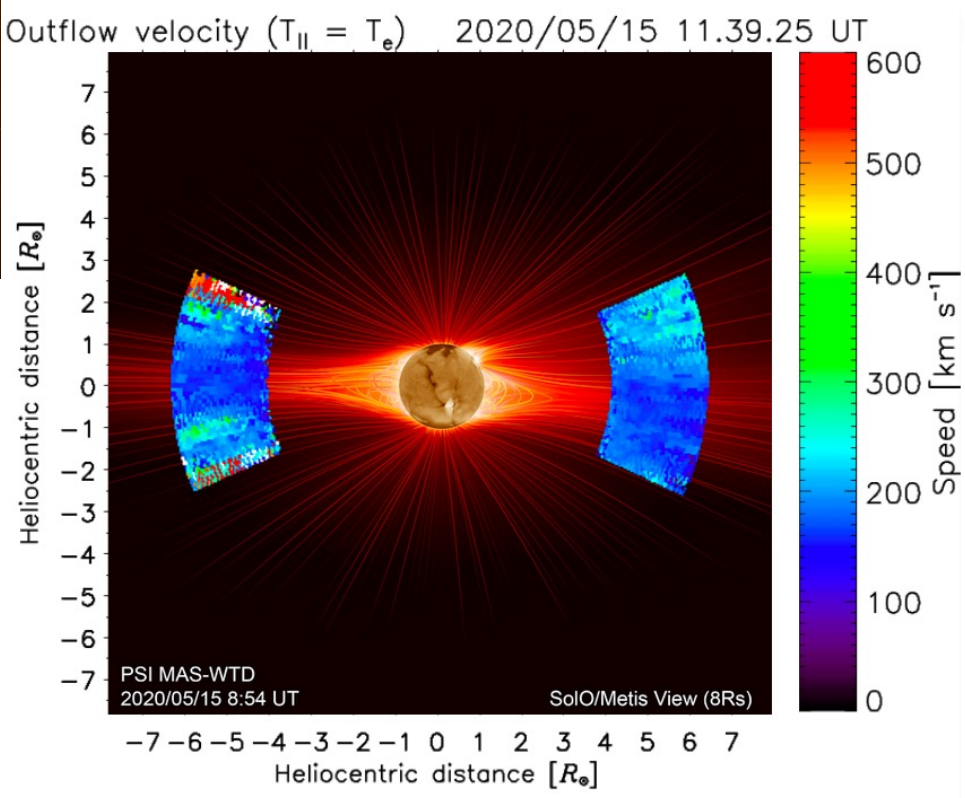
(Noci et al., 1987)

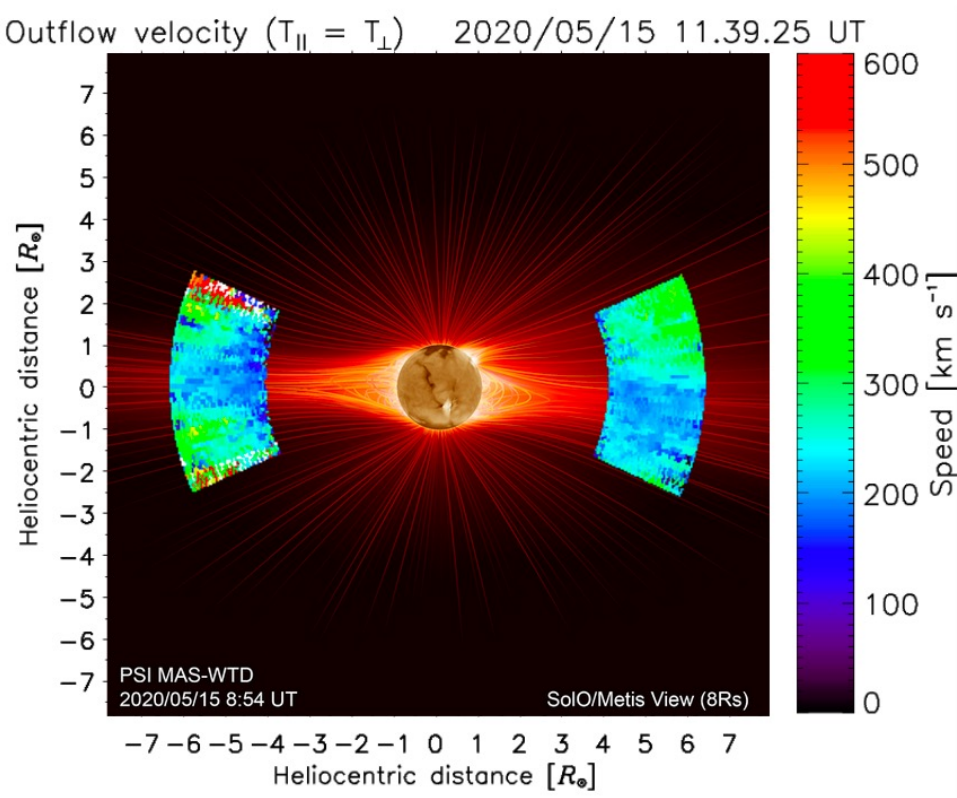
- Electron density by the van de Hulst inversion technique of the VL polarised brightness

- Electron temperature by the interpolation of standard profile reported in literature

- Temperature of the HI atoms by a large collection of UVCS Lyα spectral line data (Dolei+ 2016)
  . Both limits of isotropic and fully anisotropic distribution of T_{HI} are considered

- Uniform intensity distribution of the exciting chromospheric Lyα radiation (derived by Lemaire+ 2015), adopting the analytic line profile proposed by Auchère (2005)
- See Dolei+ 2018, 2019, Antonucci+ 2020, Capuano+ 2021, Romoli+ 2021 A&A

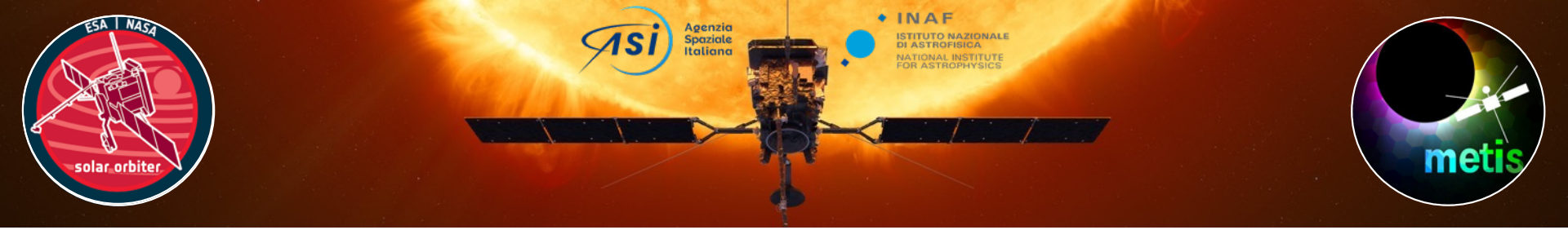


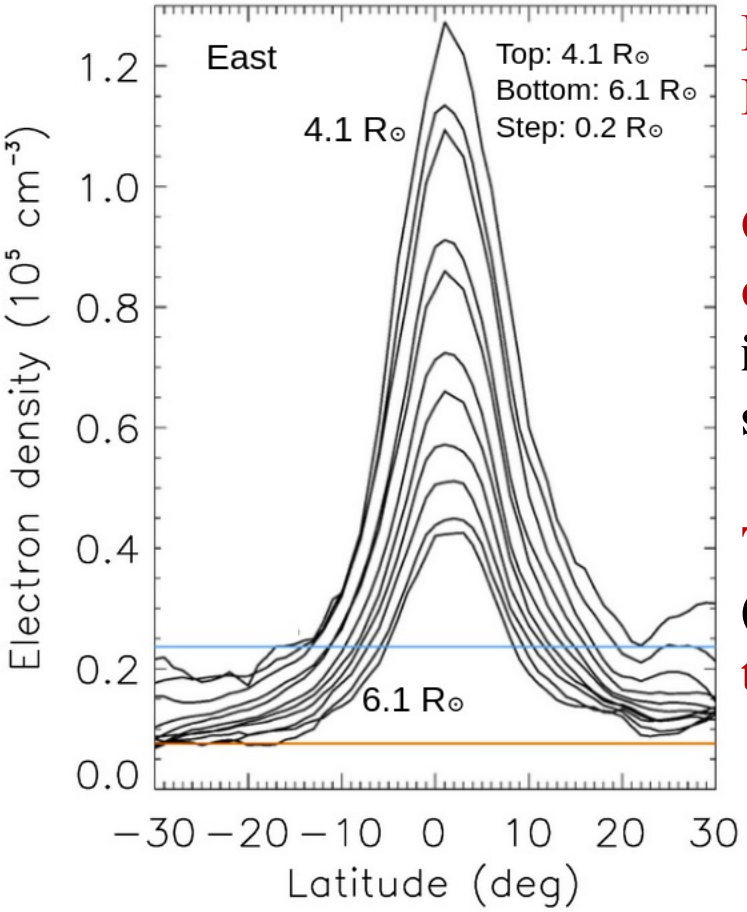


- First instantaneous image of the speed of the plasma outflows during the minimum of solar activity, from 4 $R_\odot$ to 6 $R_\odot$, ±20° wide across the equatorial belt

- Identification of the layer where the slow wind flow is observed

- Transition between slow and fast wind in the corona, beyond the boundaries of the high-density layer (Romoli et al. 2021, A&A)





In the equatorial sheet of enhanced density at the East limb: solar wind flowing at about 160 km/s

Outside the boundaries of the equatorial layer of enhanced density plasma: the wind velocity rapidly increases, to about 185 and 210 km/s (northern and southern border, respectively) at 6 $R_\odot$

The observed high velocity gradient in latitude (on the order of tens of km/s/deg) **is marking the transition between slow and fast wind in the corona**

This latitudinal transition is the subject of further study at present.