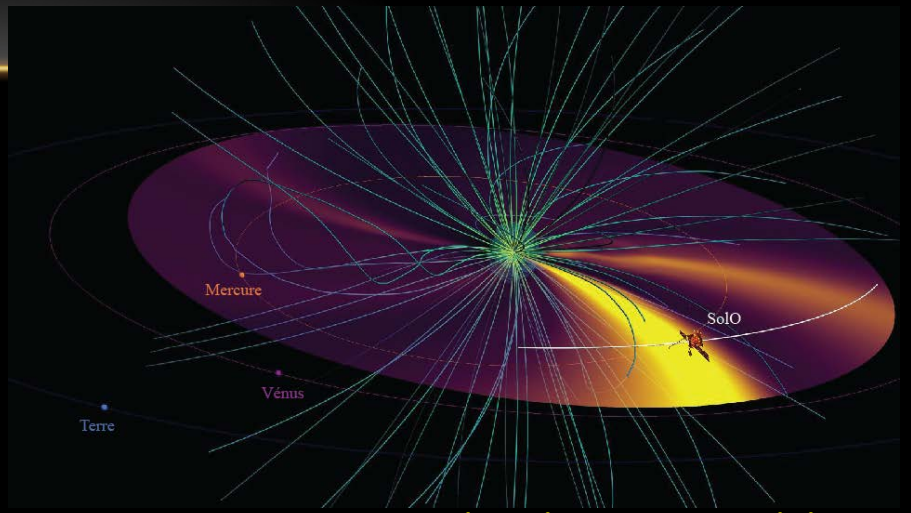
VALIDATION OF A 3D MHD CORONAL-WIND GLOBAL MODEL USING WL AND EUV DATA

S. Parenti[1,2], V. Réville[3], A.S. Brun[2], A. Strugarek[2], R. Pinto[2]

F. Auchère[1], E. Buchlin[1], B. Perri[4], A. Strugarek[2]

(submitted to *ApJ*)

[1]Université Paris-Saclay, CNRS, Institut d'Astrophysique Spatiale, France
[2]Dept. d'Astrophysique/AIM, CEA/IRFU, CNRS/INSU, Université Paris et Paris-Saclay, France
[3]IRAP, Université Toulouse III - Paul Sabatier, CNRS, CNES, Toulouse, France
[4]Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium



WindPredict – AW model

Susanna.parenti@ias.u-psud.fr

THE WINDPREDICT – AW MODEL

3D MHD, heating and solar wind by turbulent Alfvèn waves dissipation (*Réville et al. 2020*)

Réville et al. 2020 :

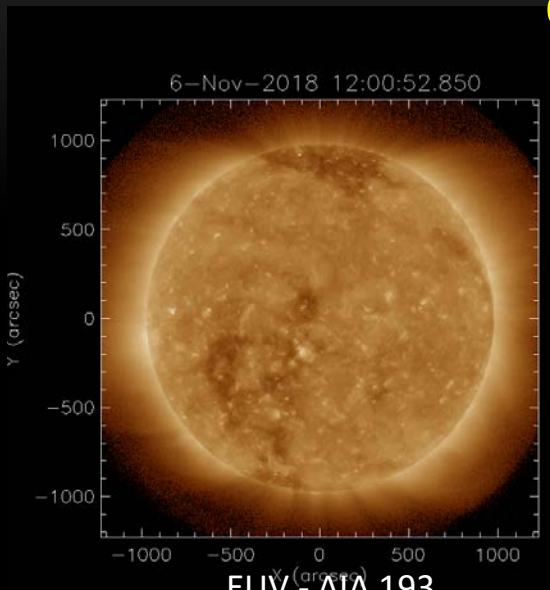
Accurate reproduction of the in-situ Parker Solar Probe data during the first perihelion in November 2018

➡ This work: Test the model at the Sun

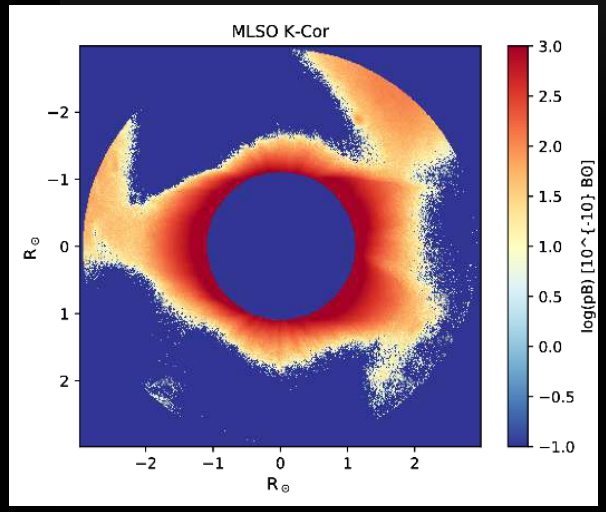
Tests on 3 simulations (at constant energy flux):
Model1: ρ = 10^8 ; **Model2**: 2 10^8; **Model 3**: 3 10^8 cm^{-3}

SYNTHETIC DATA AND OBSERVATIONS

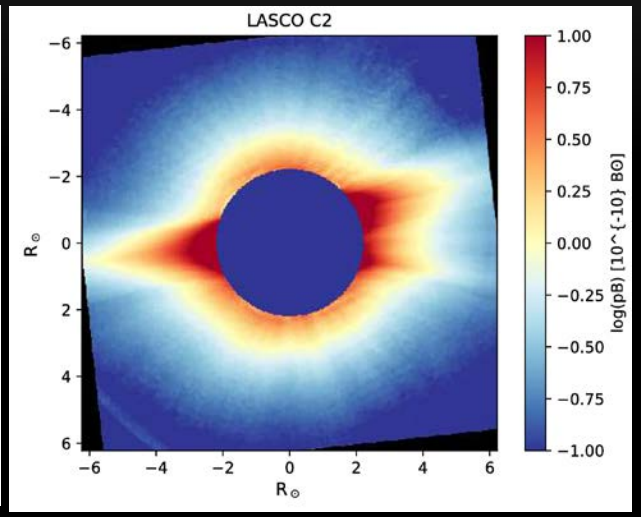
Observations: 6 & 7 November 2018



EUV - AIA 193
R < 1.5



WL pB - MLSO K-Cor
~1.2 < R < ~ 2.2



WL pB LASCO
2.2 < R < ~ 6

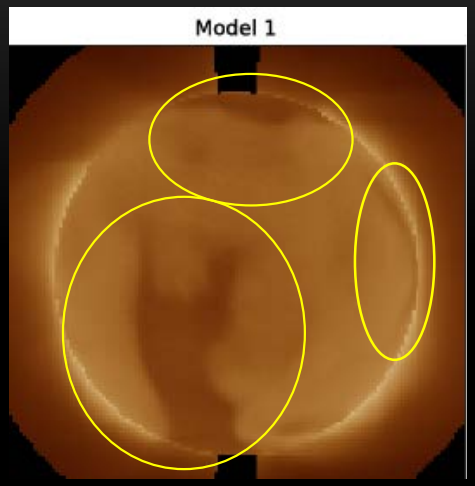
Synthetic images

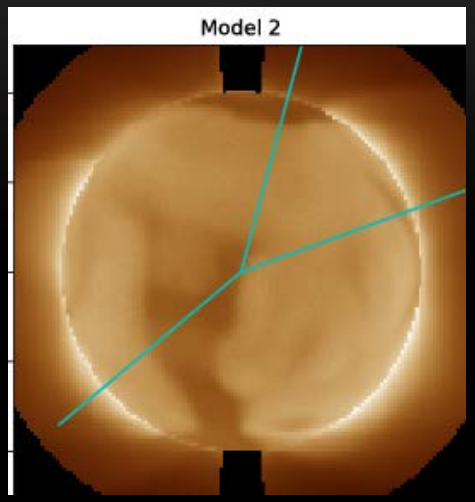
MHD Model Output: 3D N, T ➡ 3D pB and EUV ➡ 2D pB and UV

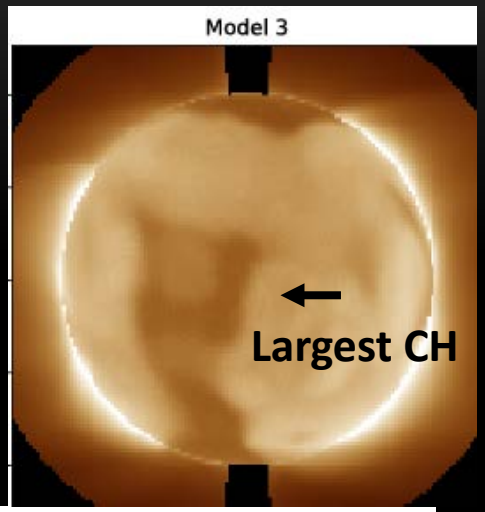
⬇

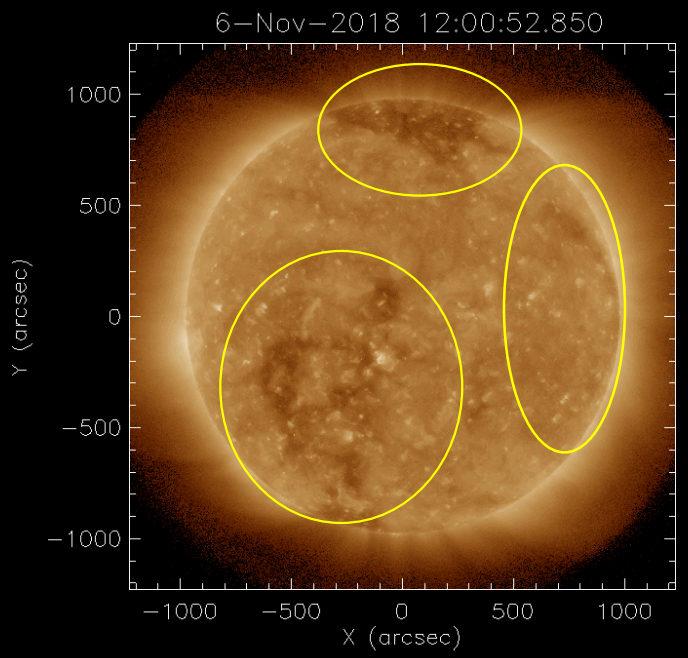
Synthetic images obtained using *Tomograpy* (*Barbay et al. 2013*)

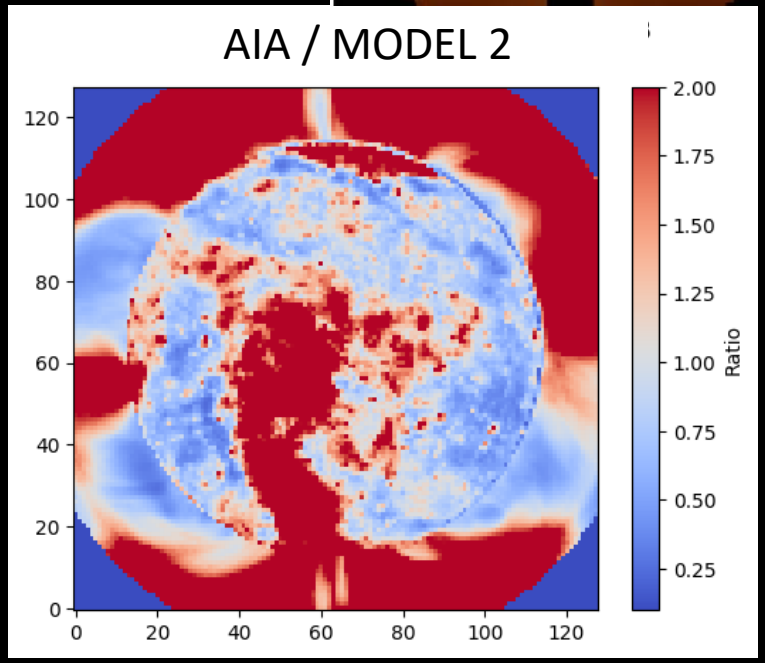
GLOBAL PERFORMANCE OF THE MODEL (EUV)



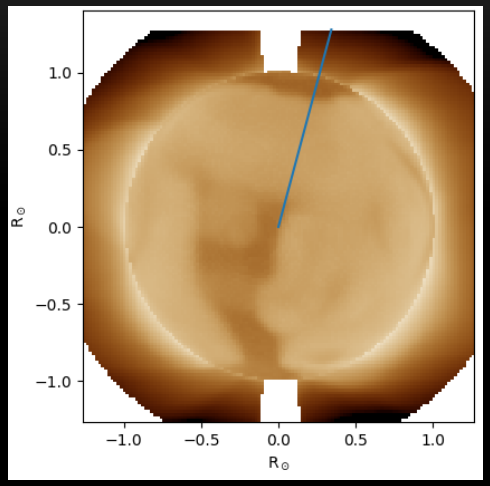


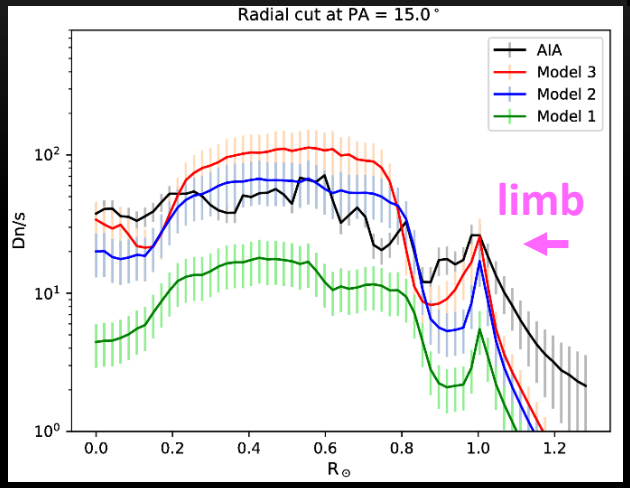


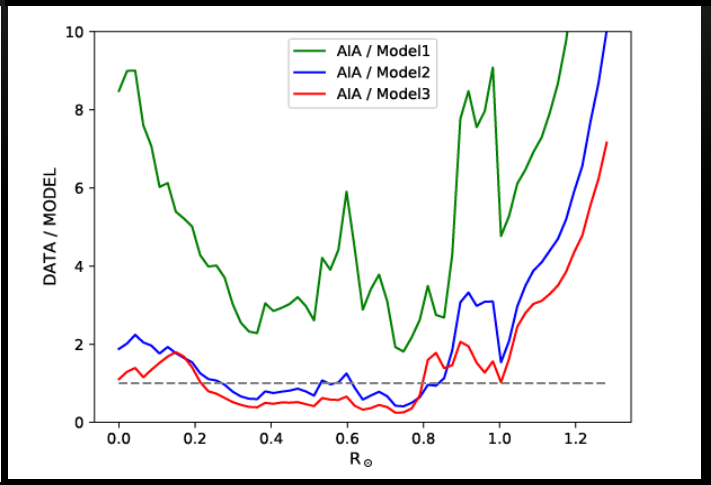




AIA 193 RADIAL CUT: QS AND CH





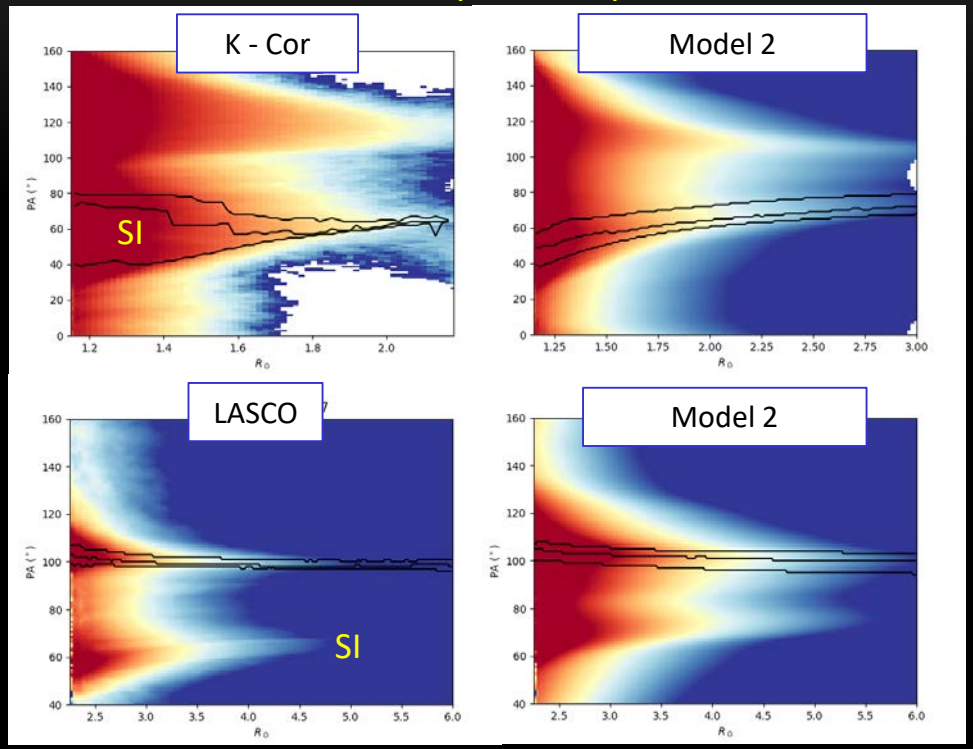


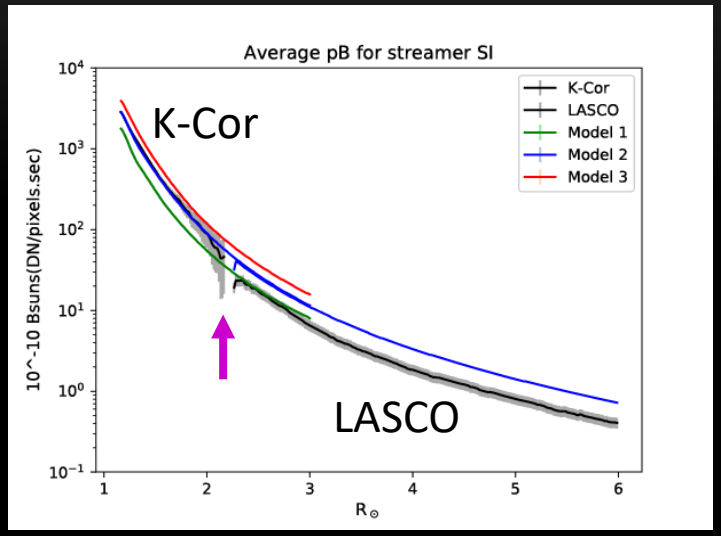
CH QS CH

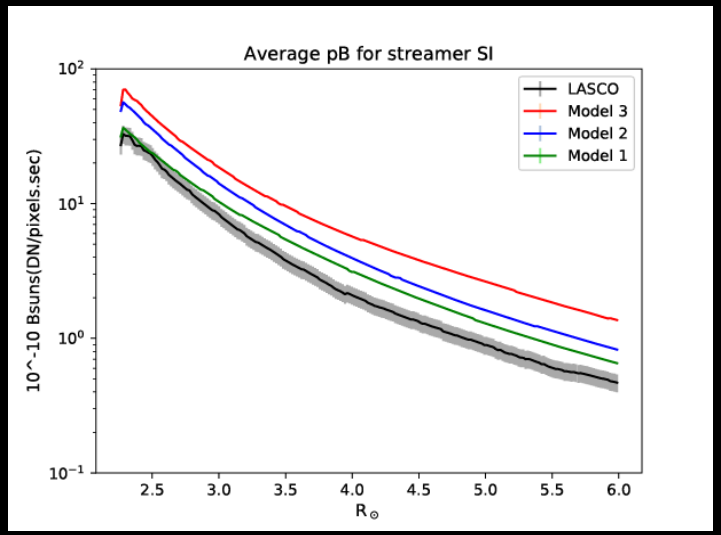
- ✓ QS: Model 2 reproduces quantitatively the observation
- CHs: The intensity is too low in the models.
  - Part of the TR emission emission is missed in the WindPredict-AW;
  - 50% more stray light in AIA 193 (Saqri et al. 2020)

STREAMERS pB INTENSITIES (K-COR & LASCO/C2)

North-West polar maps

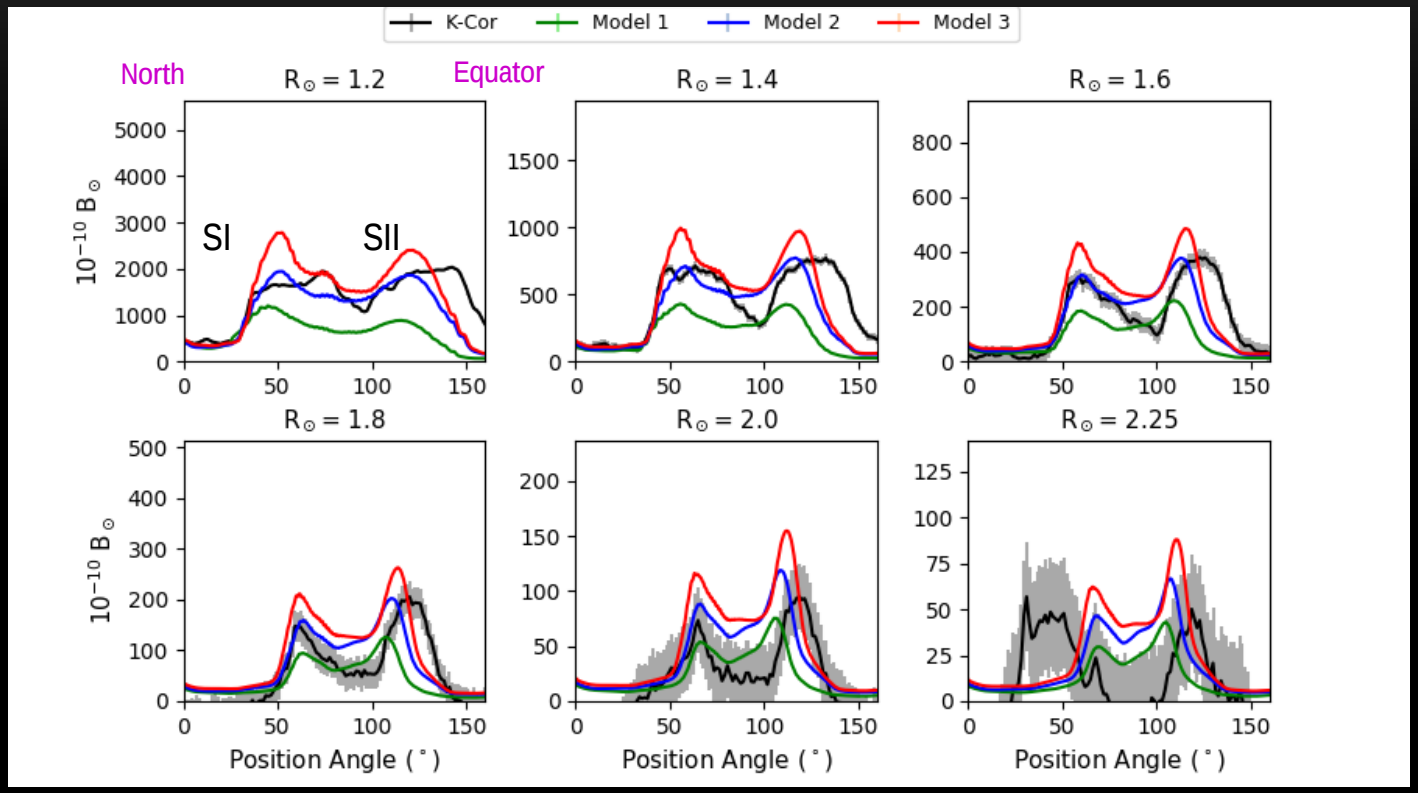






- ✓ K-Cor is quantitatively reproduced by Model 2
- ✓ The radial decay is well reproduced
- ✓ Model 2 within ≤ 30% from the data
- • The synthetic images for LASCO are too bright
  - • Step in the observations at ~2 Ro

THE CORONA: K-COR LATITUDINAL PROFILES



- ✓ K-Cor is quantitatively reproduced by Model 2
- ✓ The streamers latitudinal extension is reproduced by the models:
  - o SI is quantitatively consistent

CONCLUSIONS

- We provided QUANTITATIVE similarities and differences between synthetic EUV and pB images and the observations.
- WindPredict – AW is able to produce synthetic data quantitatively comparable to both EUV and WL pB.
- Model 2 is the best candidate to match the observations.
- Further improvements of the model: active corona, TR.
- Example of aplications: Solar Orbiter perihelia

Parenti et al. submitted to *ApJ*