

EUHFORIA at CCMC

Christine Verbeke, Jens Pomoell, Stefaan Poedts, Alexey Isavnin, Camilla Scolini

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UNIVERSITY OF HELSINKI

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EUHFORIA

- ▶ **EU**ropean **Heliospheric FOR**ecasting **Information Asset**
- ▶ Science:
 - ▶ Quantify the deformation, deflection and erosion of flux ropes evolving in the inner heliosphere
 - ▶ Characterize the magneto-sheaths of CMEs
 - ▶ Clarify the role of CME-CME interactions in enhanced SEP production
- ▶ Applications:
 - ▶ Space weather forecasts e.g. ROB
 - ▶ Support for space missions e.g. Solar Orbiter



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3D time-dependent MHD model

Solar wind at @ 0.1 AU

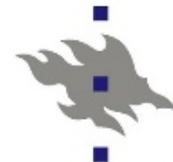
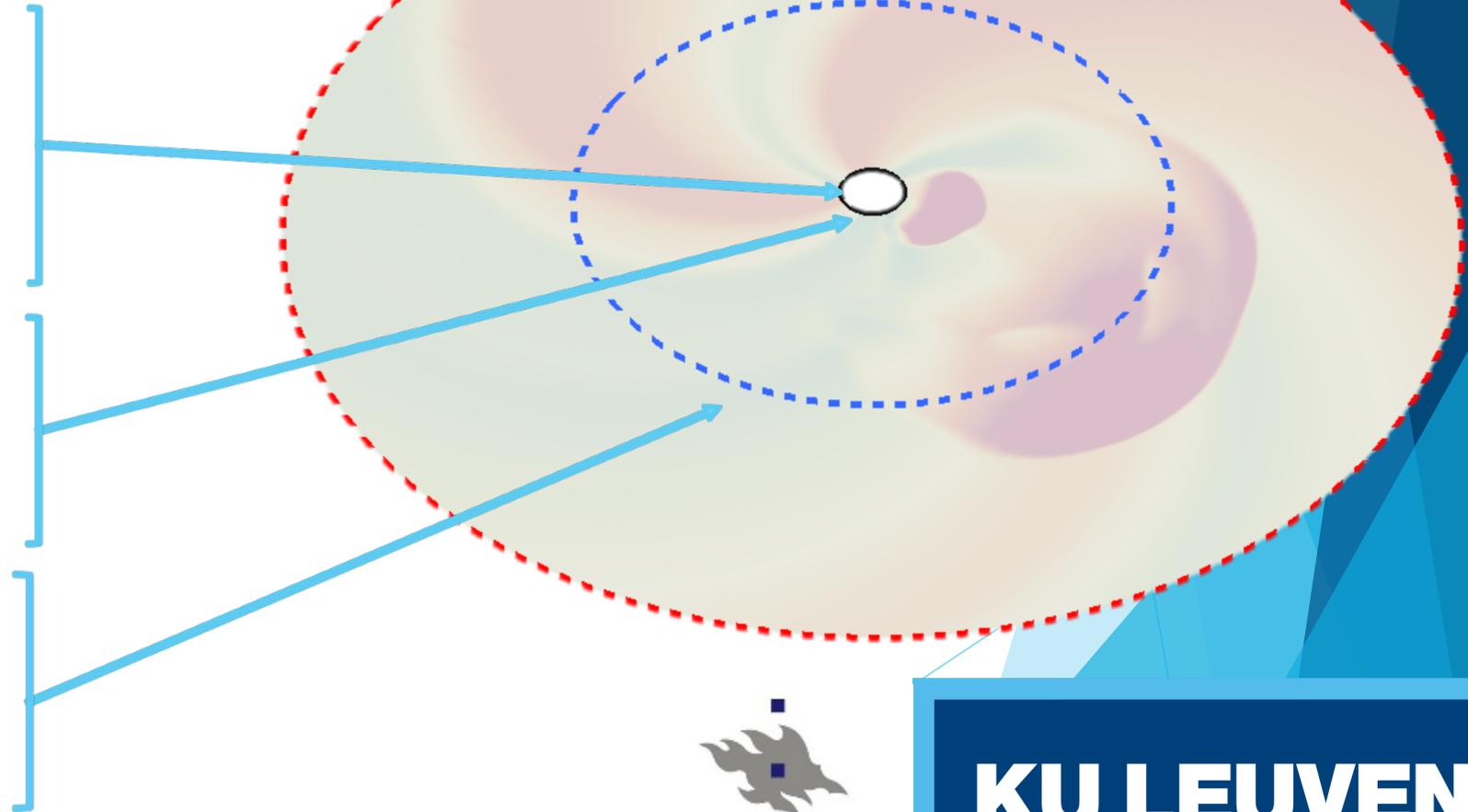
- Semi-empirical:
 - GONG or ADAPT
 - PFSS - SCS - WSA

CMEs at @ 0.1 AU

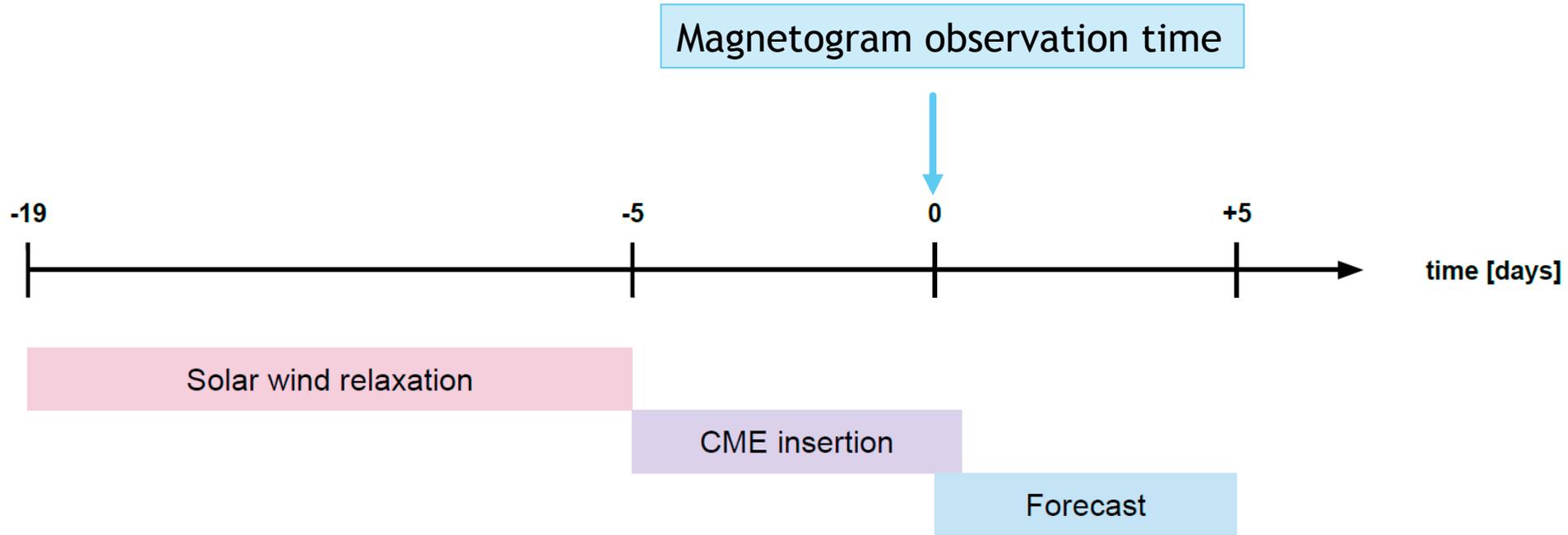
- Cone model
- Spheromak model

Inner Heliosphere

- 0.1 AU \rightarrow 2 AU
- Time-dependent
3D MHD



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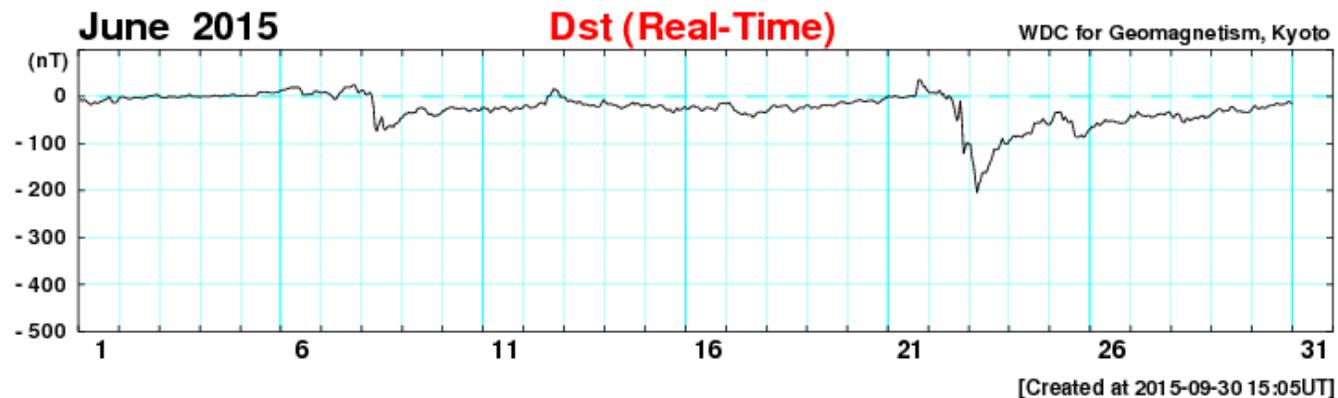
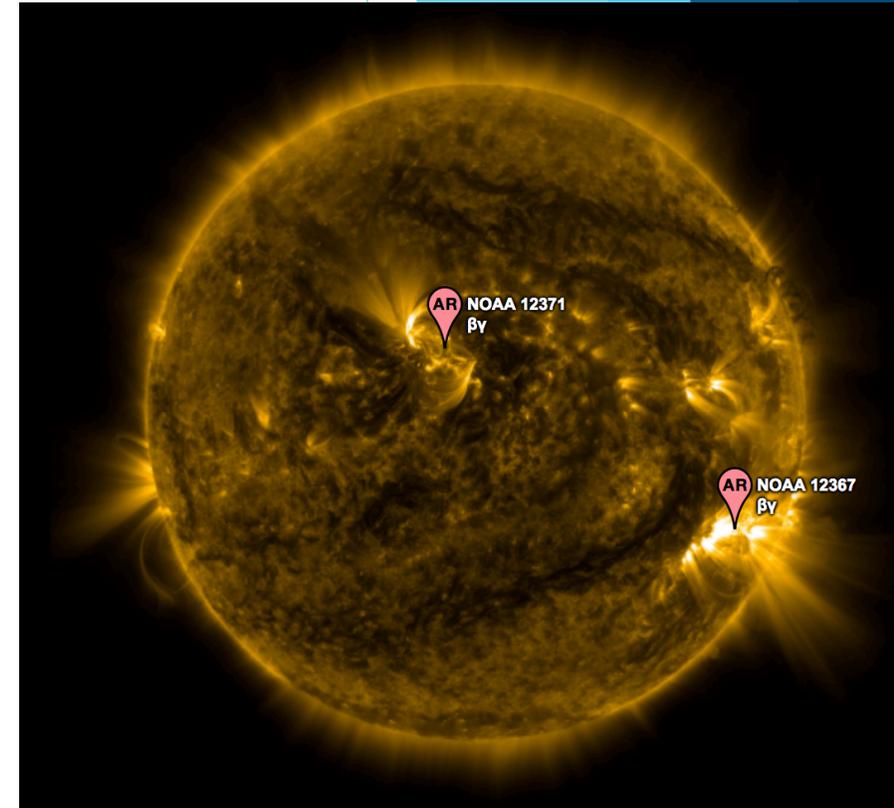


CMEs before the event significantly modify plasma in IP space. Typically, significant CMEs from 5 days prior to event are inserted.



EUHFORIA v1.0.3: June 18-27, 2015

- ▶ NOAA AR 12371 produced 3 GOES M-class flares + numerous C-class flares
- ▶ 7 events marked as partial or full halo, related to the M-class flares
- ▶ Geomagnetic storm as result of events



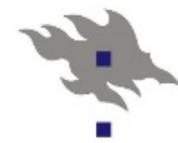
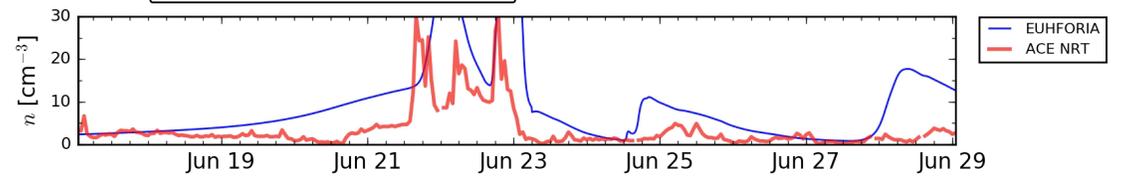
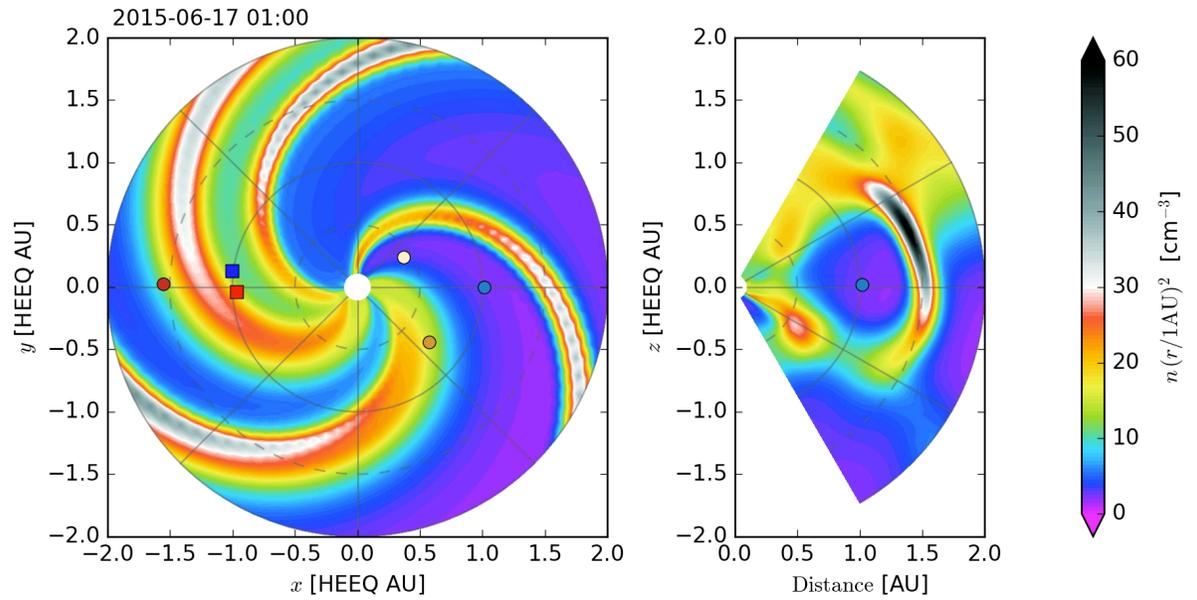
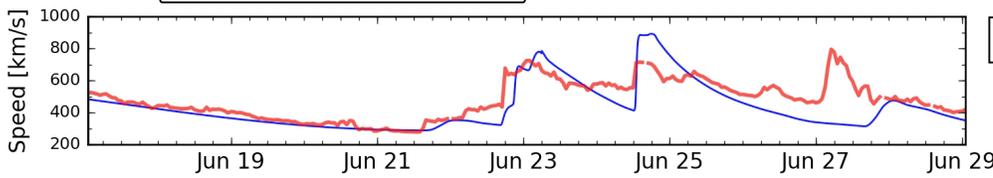
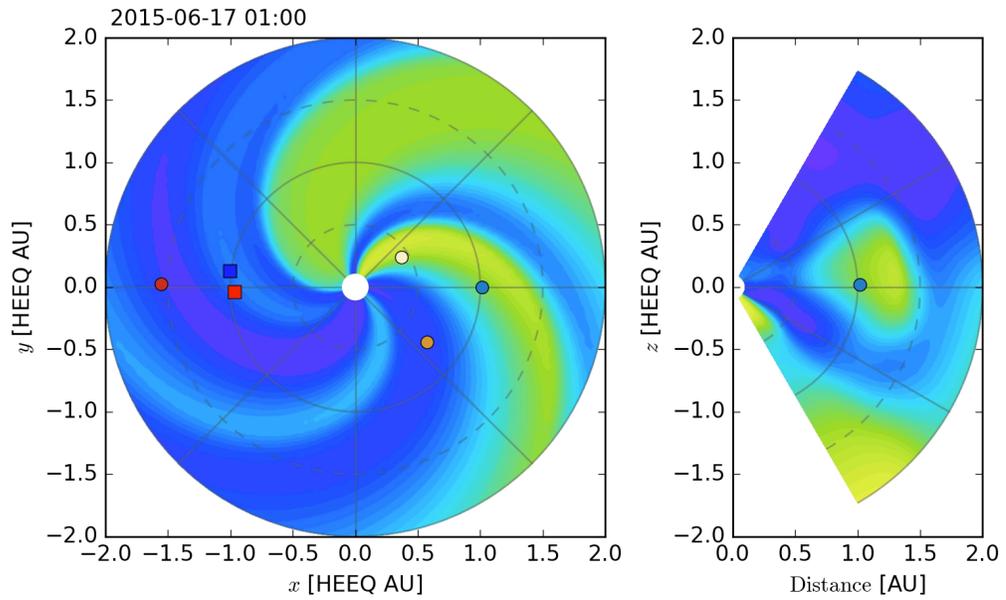
EUHFORIA v1.0.3: June 18-27, 2015

CME Number	Time at 0.1 AU	Lat (deg HEEQ)	Lon (deg HEEQ)	Half-width (deg)	Speed (km/s)
1	2015-06-18T20:00:00	11	-50	45	1000.0
2	2015-06-19T14:59:00	-33	9	54	603.0
3	2015-06-21T05:01:00	7	-8	47	1250.0
4	2015-06-22T21:10:00	14	3	45	1155.0
5	2015-06-25T10:51:00	23	46	41	1450.0

- ▶ 17 cone model entries in **DONKI**, 9 with little or no impact to Earth
- ▶ Selection of the **5 events most directed to Earth**
- ▶ Events 1, 4 and 5 are related to M-class flares from NOAA AR 12371



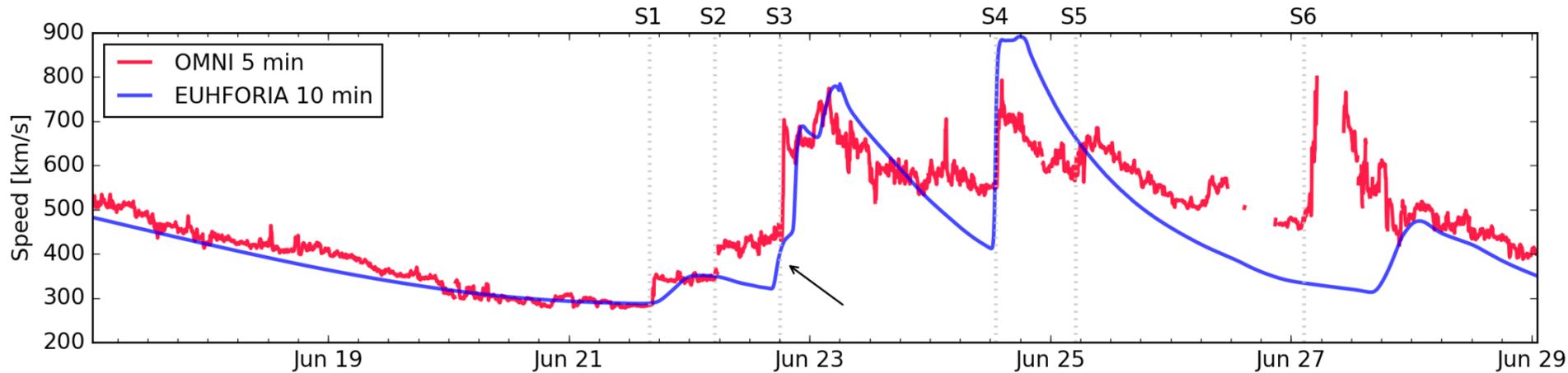
EUHFORIA v1.0.3: June 18-27, 2015



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Blue: simulation data at Earth **Red:** OMNI 5 min data

- ▶ Shock 1 (due to flank CME1) arrives slightly late in simulation and is smeared out
- ▶ Shock 2 is 12 hrs late (see arrow)
- ▶ Shock 3 slightly late and interacting with late shock 2
- ▶ S4 arrival time OK, but overestimated
- ▶ S5 is too late (flank event)



EUHFORIA: integration at CCMC

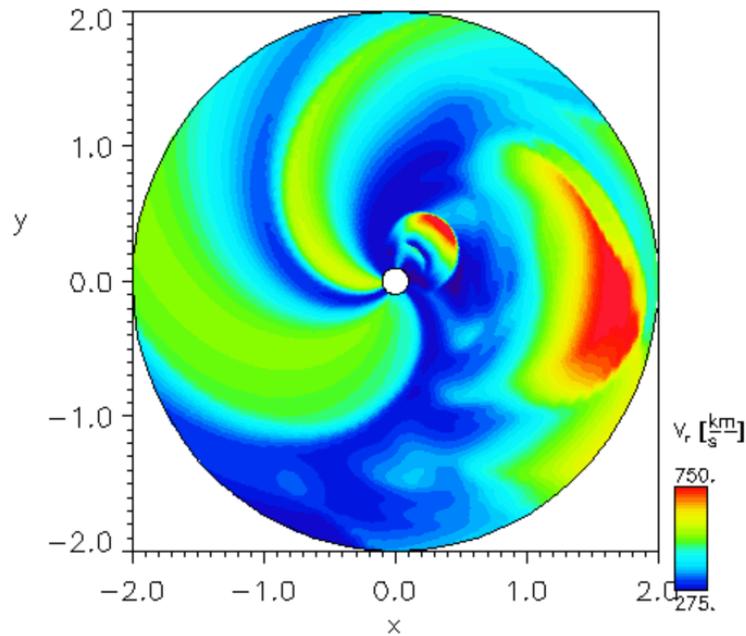


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Please wait - computation is estimated to take 0 minutes and 8 seconds.
A "." will appear for each 5 seconds elapsed.

06/26/2015 Time = 07:02:34 UT lat= 0.00



Model at CCMC: EUHFORIA

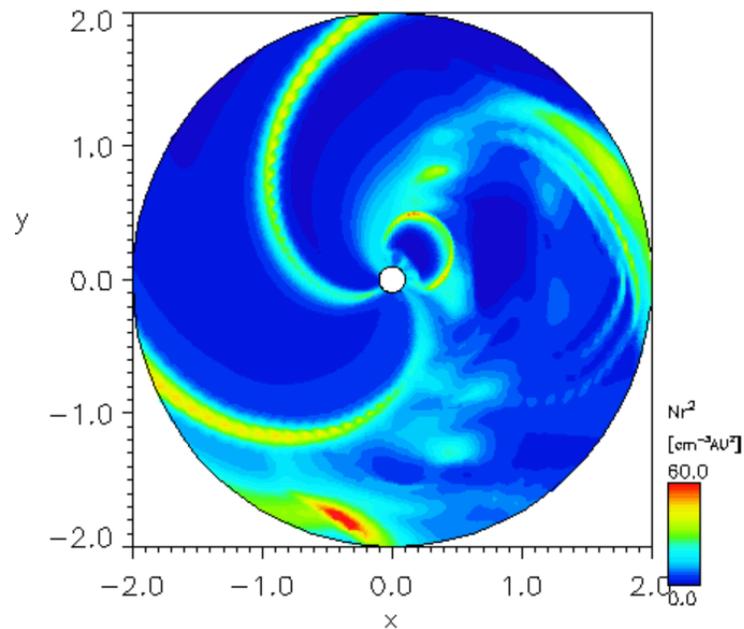


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Model at CCMC: EUHFORIA

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EUHFORIA: integration at CCMC

- ▶ Installation: finished
- ▶ Test run performed and visualized:
 - ▶ https://ccmc.gsfc.nasa.gov/cgi-bin/run_idl3d.cgi?dir=21684
- ▶ Visualization:
 - ▶ Quick-look graphics from EUHFORIA
 - ▶ As shown before
 - ▶ CCMC web interface visualization
- ▶ Release time: TBD

