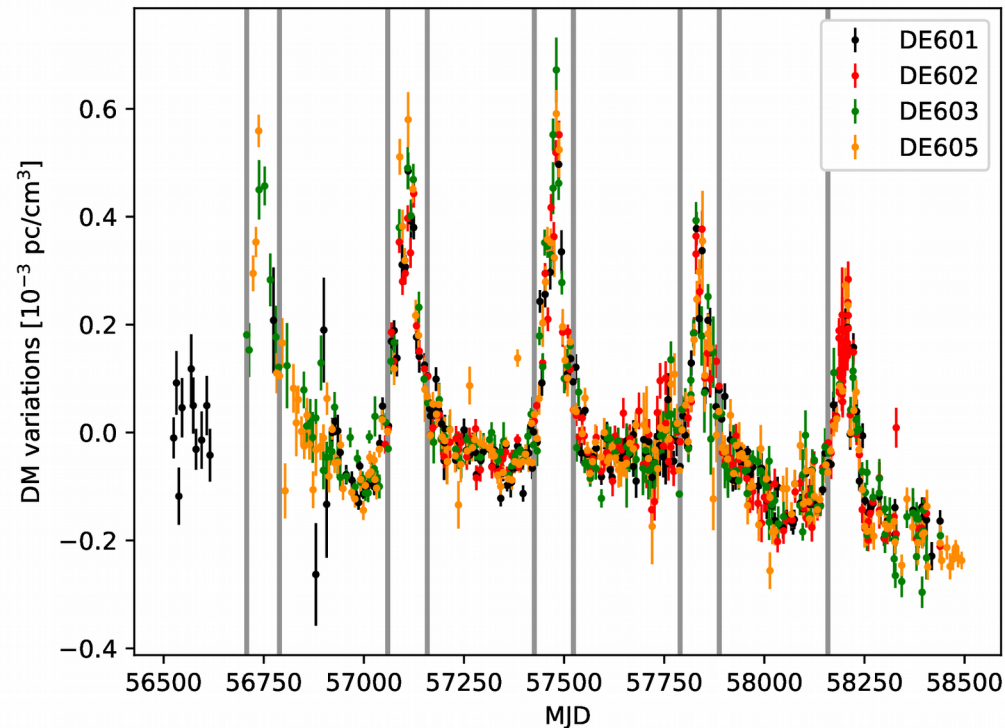


Pulsars track the Solar wind

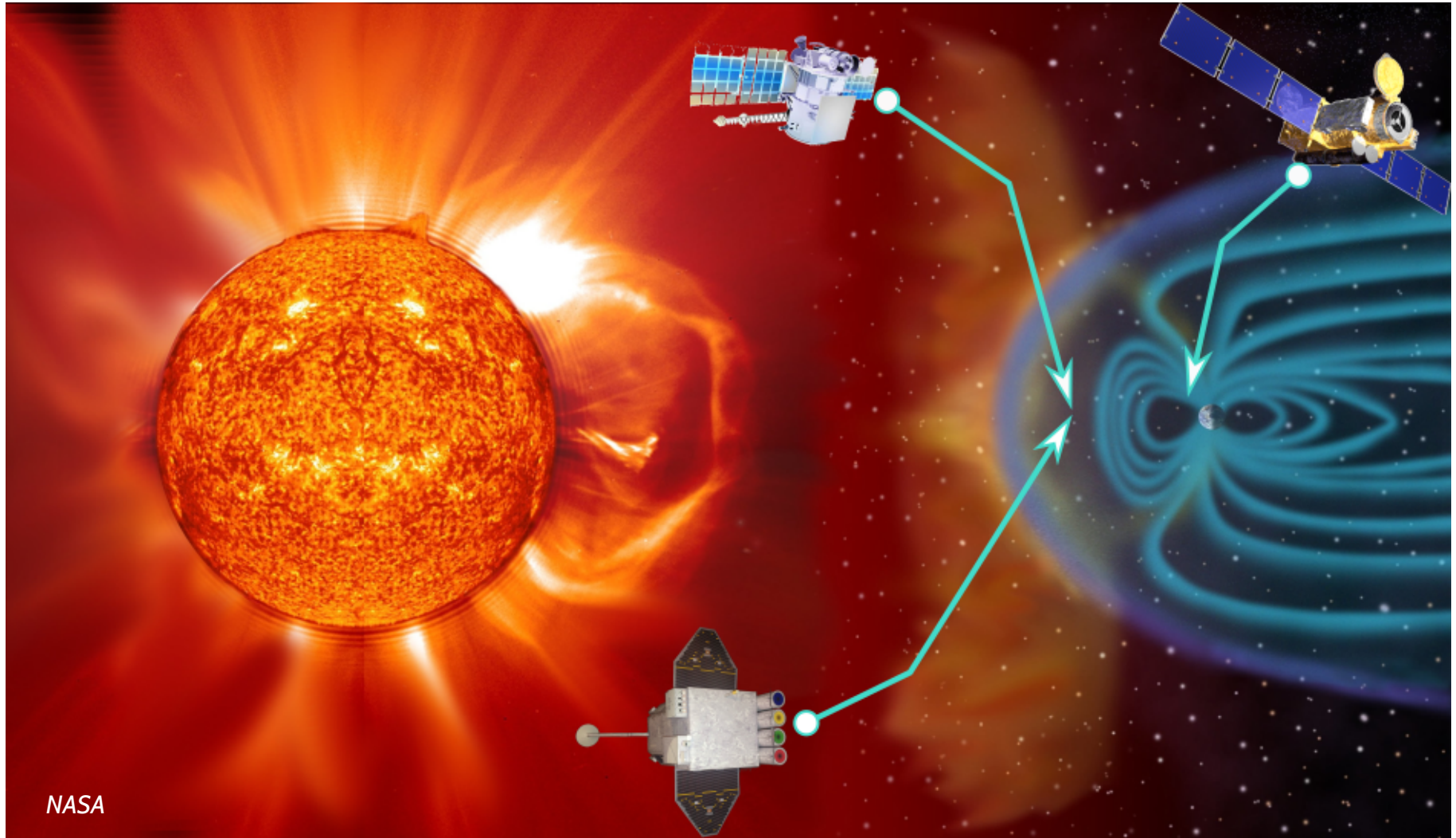


C. Tiburzi – VENI fellow

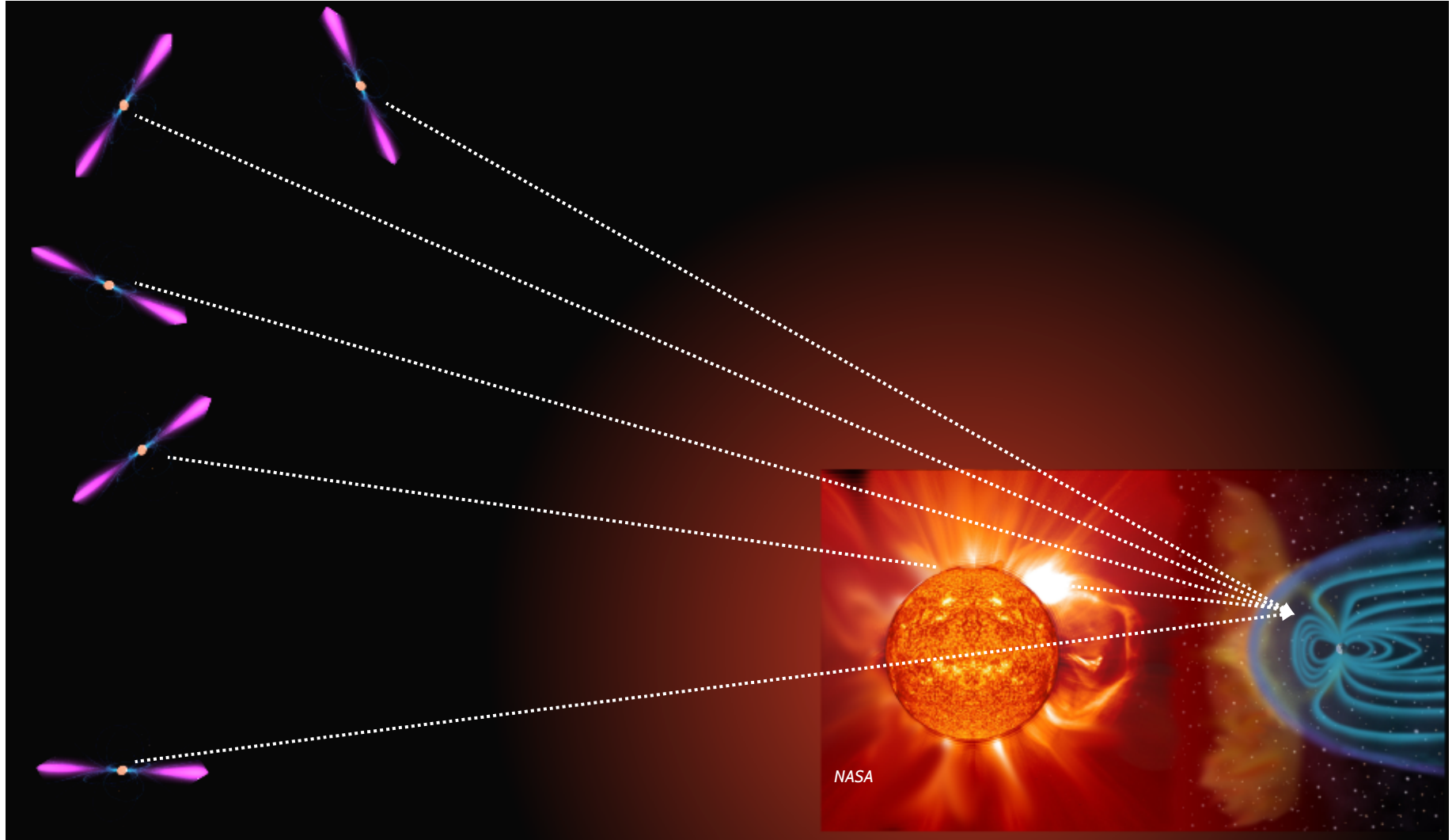
Outline

- Pulsars track the Solar wind
- First milestone – Solar electron content
- Solar magnetic content
- Chasing CMEs
- A glance to the future

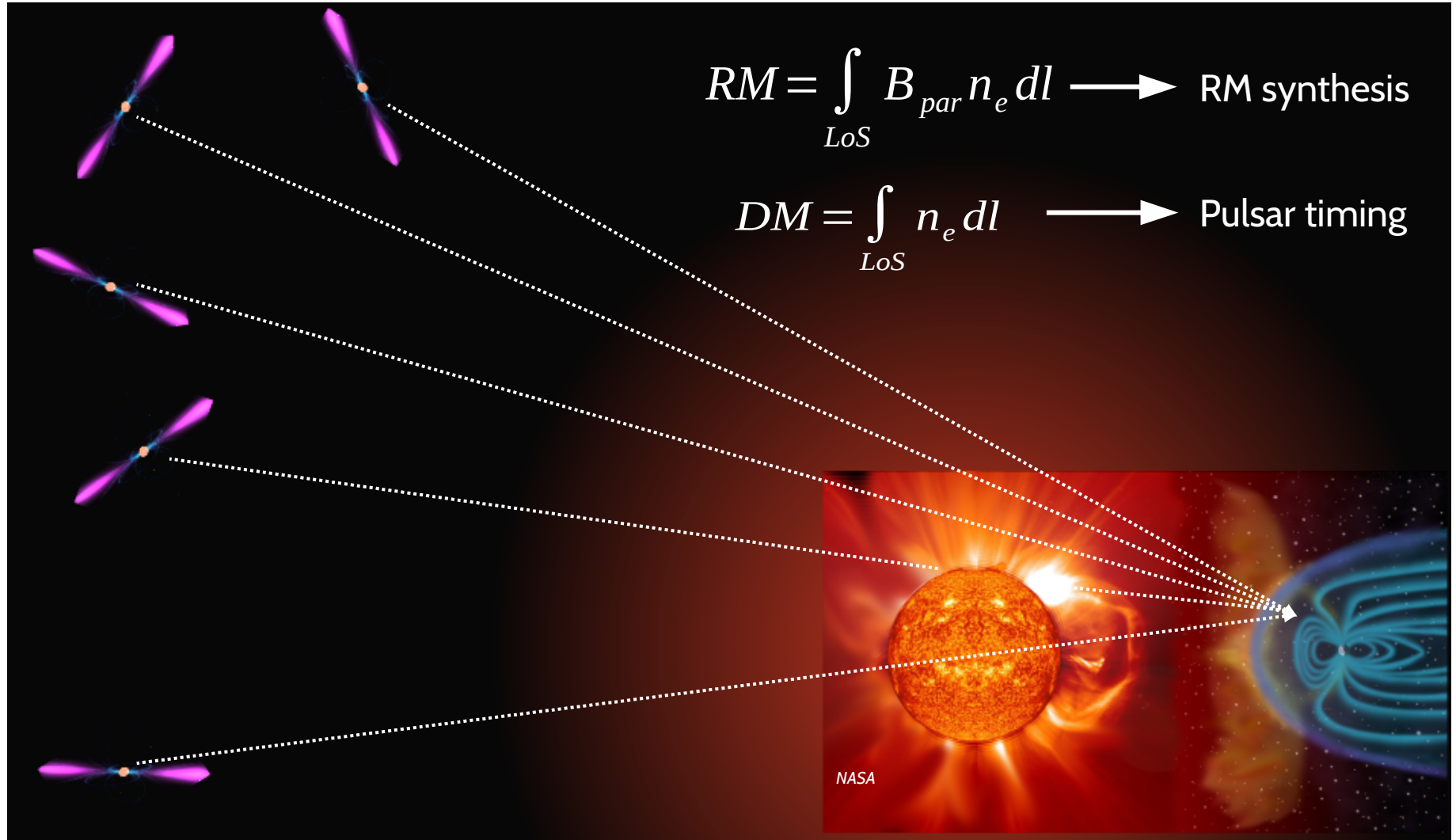
Pulsars track the Solar wind



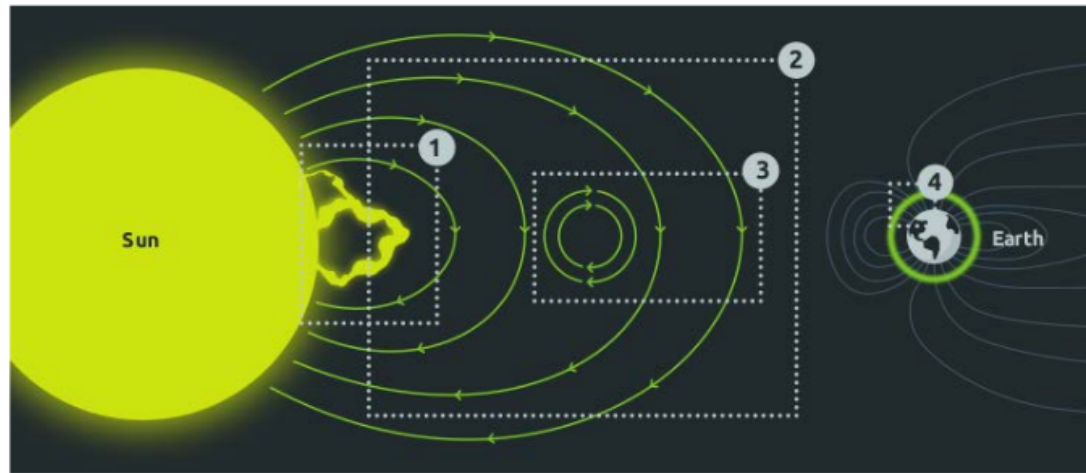
Pulsars track the Solar wind



Pulsars track the Solar wind



Pulsars track the Solar wind



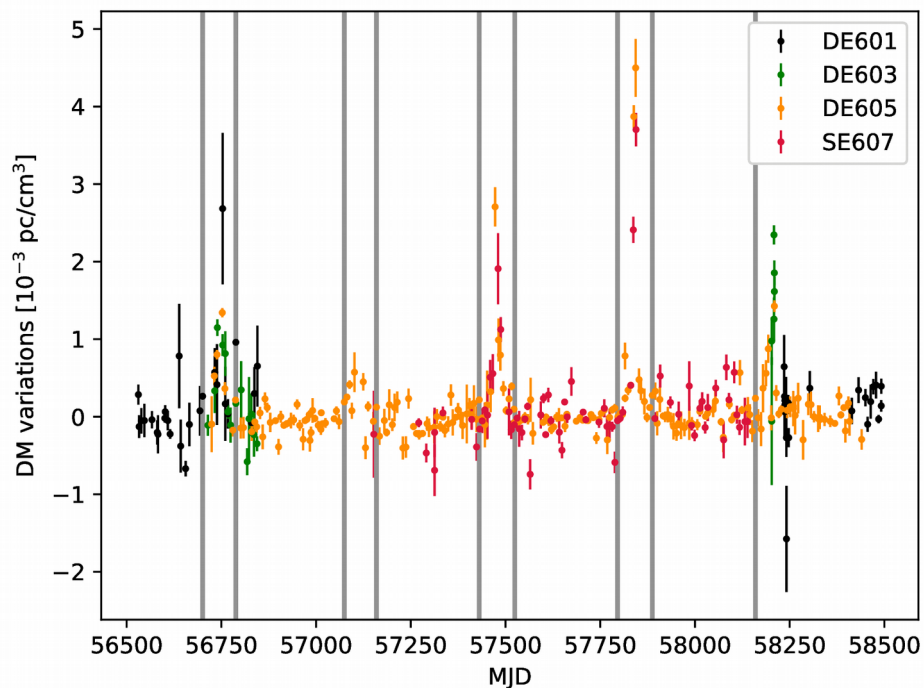
1. Radio emission from Solar bursts
2. Solar wind and CMEs
3. Magnetic field of the Solar wind
4. Ionosphere

Refer to M. Mevius, E. Carley and R. Fallows

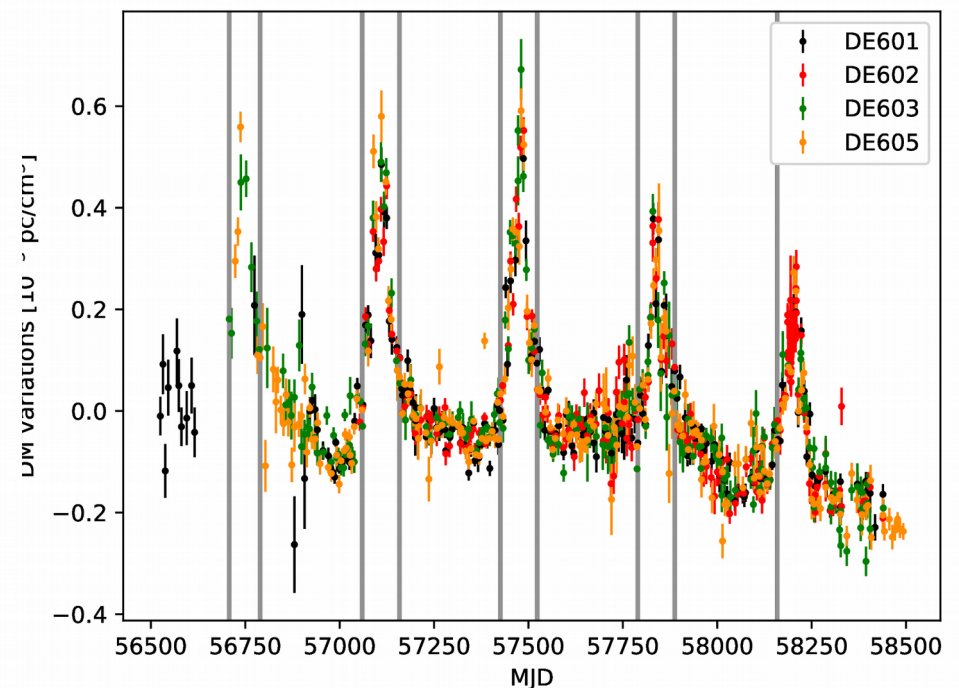
Webpage: <http://lofar4sw.eu/wp/>

Solar-induced DM variations in ecliptic pulsars

PSR J0030+0451 (Elat $\sim 1.45^\circ$)



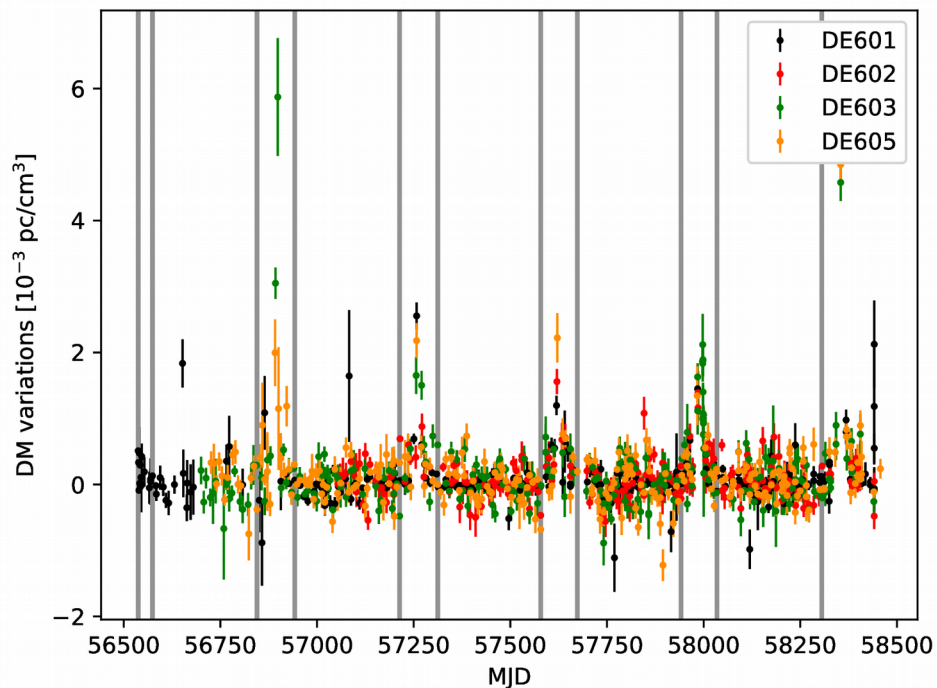
PSR J0034-0534 (Elat $\sim -8.53^\circ$)



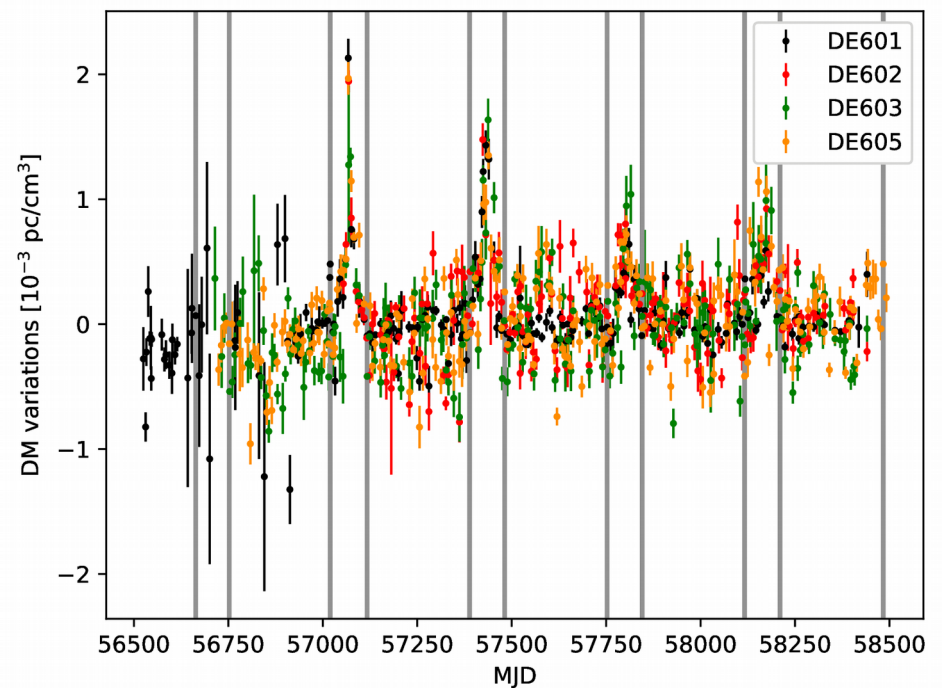
(more in Tiburzi & Verbiest 2018)

Solar-induced DM variations in ecliptic pulsars

PSR J1022+1001 (Elat $\sim -0.06^\circ$)



PSR J2145-0750 (Elat $\sim 5.31^\circ$)

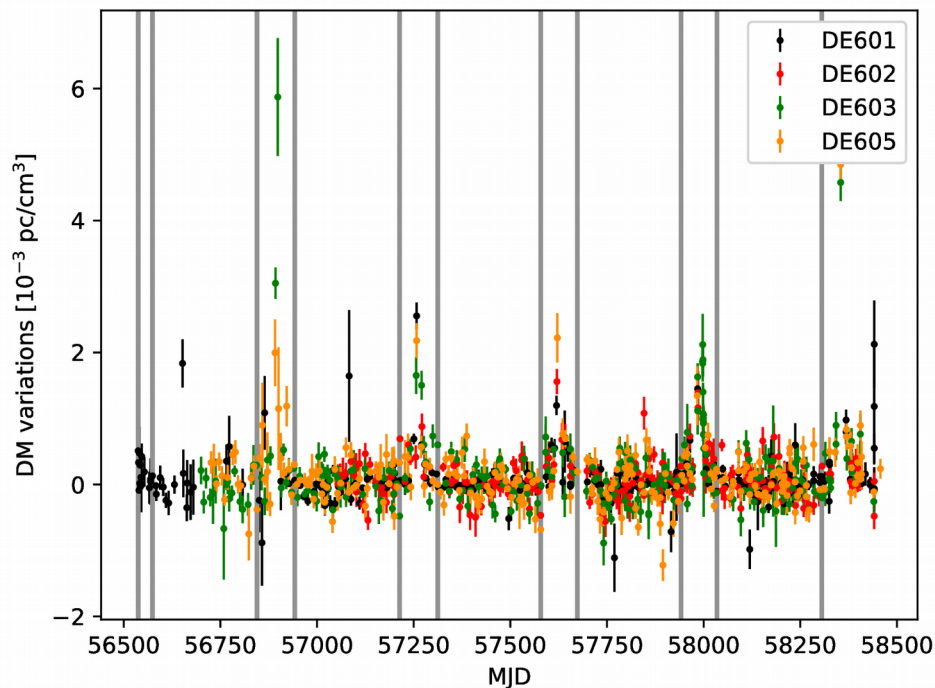


(Wrong beam model implementation)

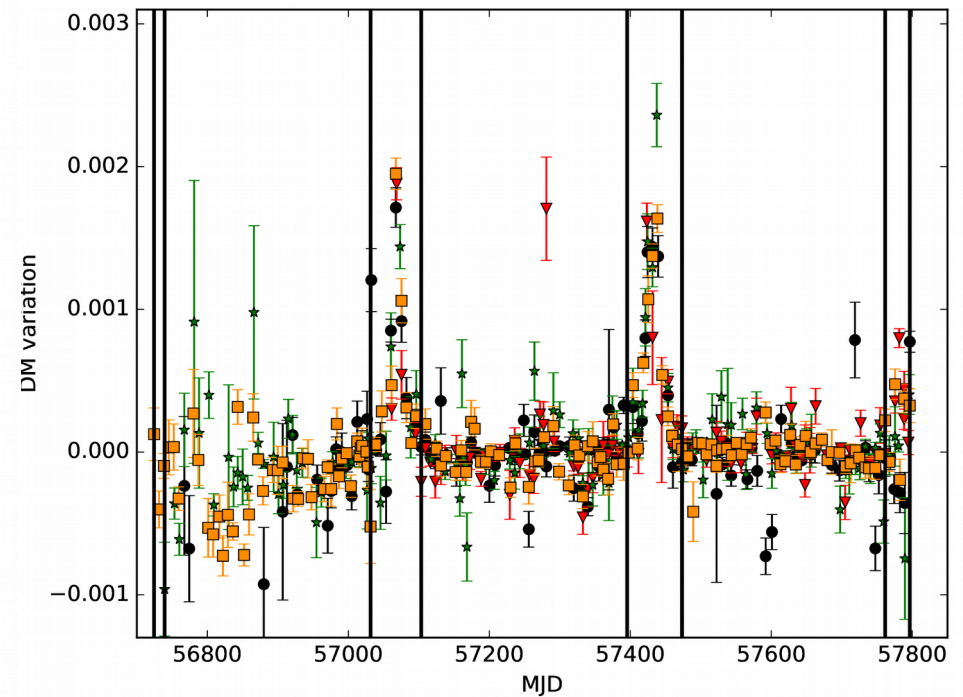
(more in Tiburzi & Verbiest 2018)

Solar-induced DM variations in ecliptic pulsars

PSR J1022+1001 (Elat $\sim -0.06^\circ$)



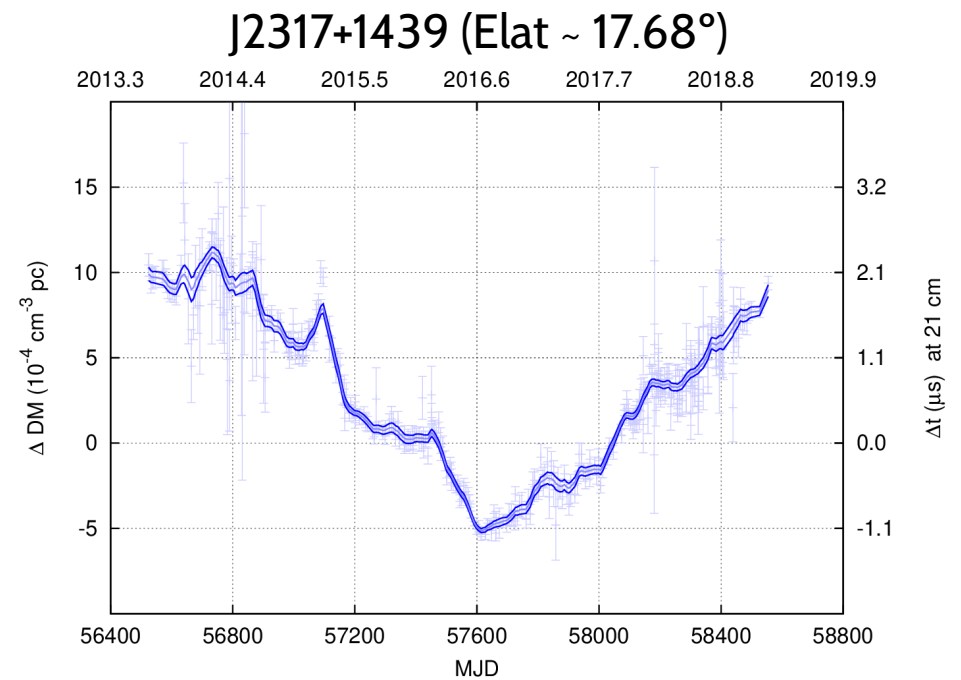
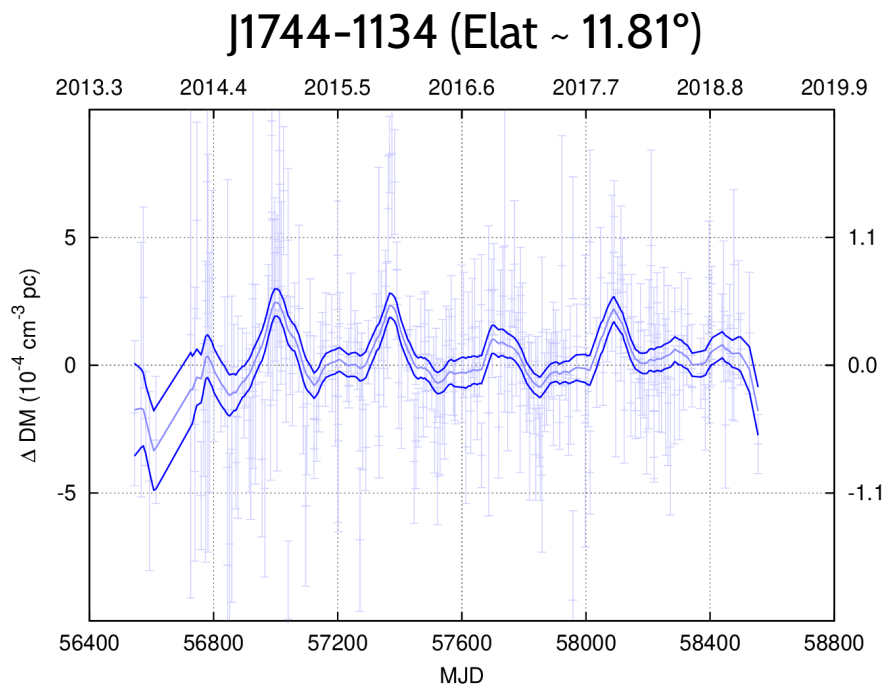
PSR J2145-0750 (Elat $\sim 5.31^\circ$)



(Correct beam model implementation)

(more in Tiburzi & Verbiest 2018)

Solar-induced DM variations in ecliptic pulsars

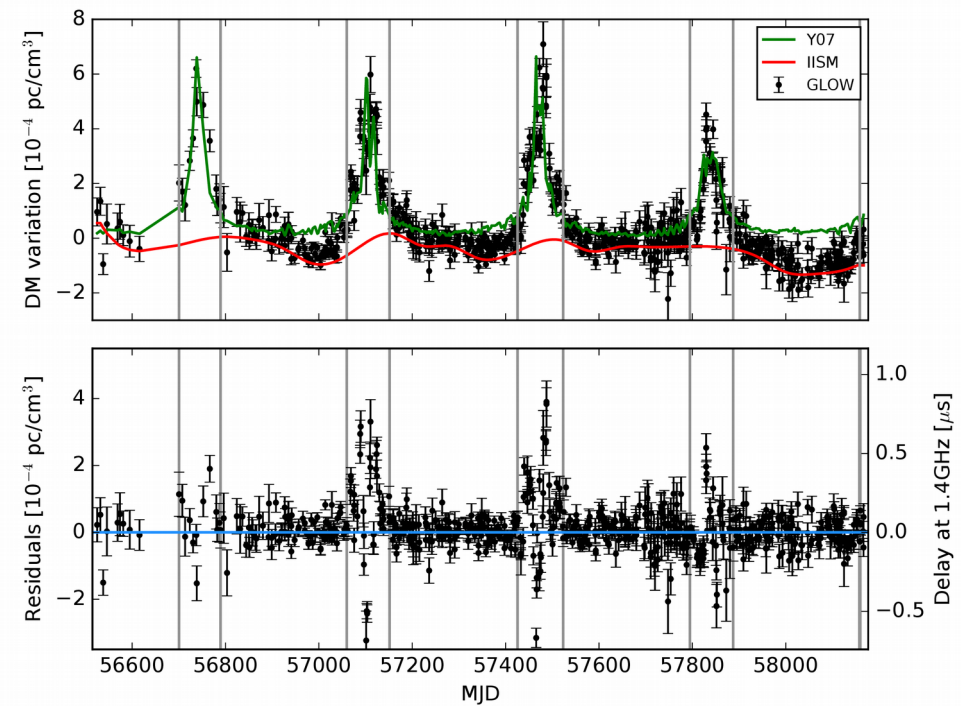
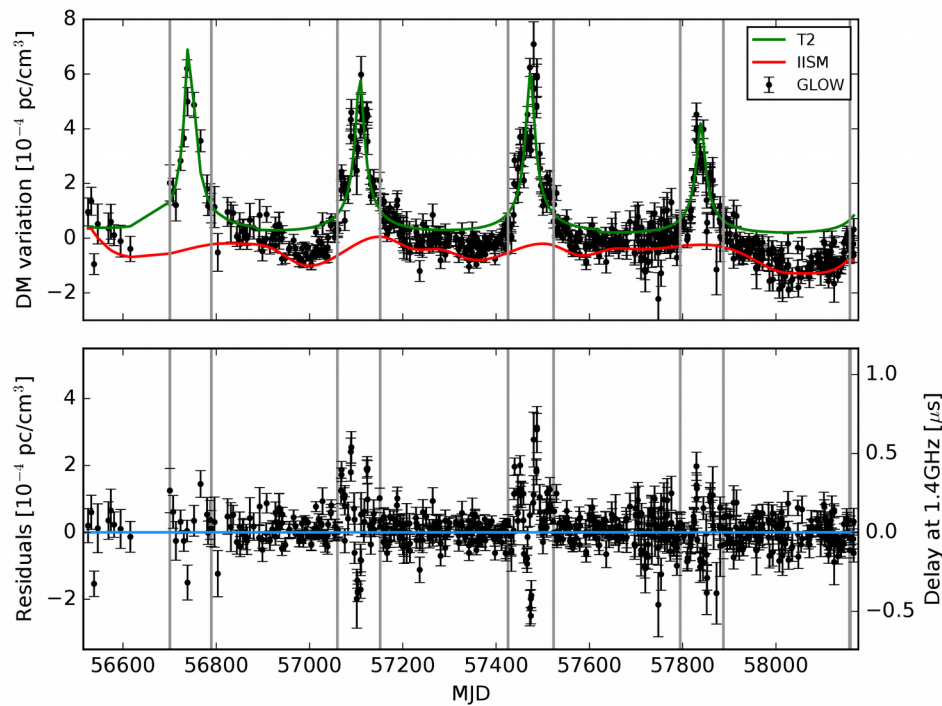


Plots by J. Donner

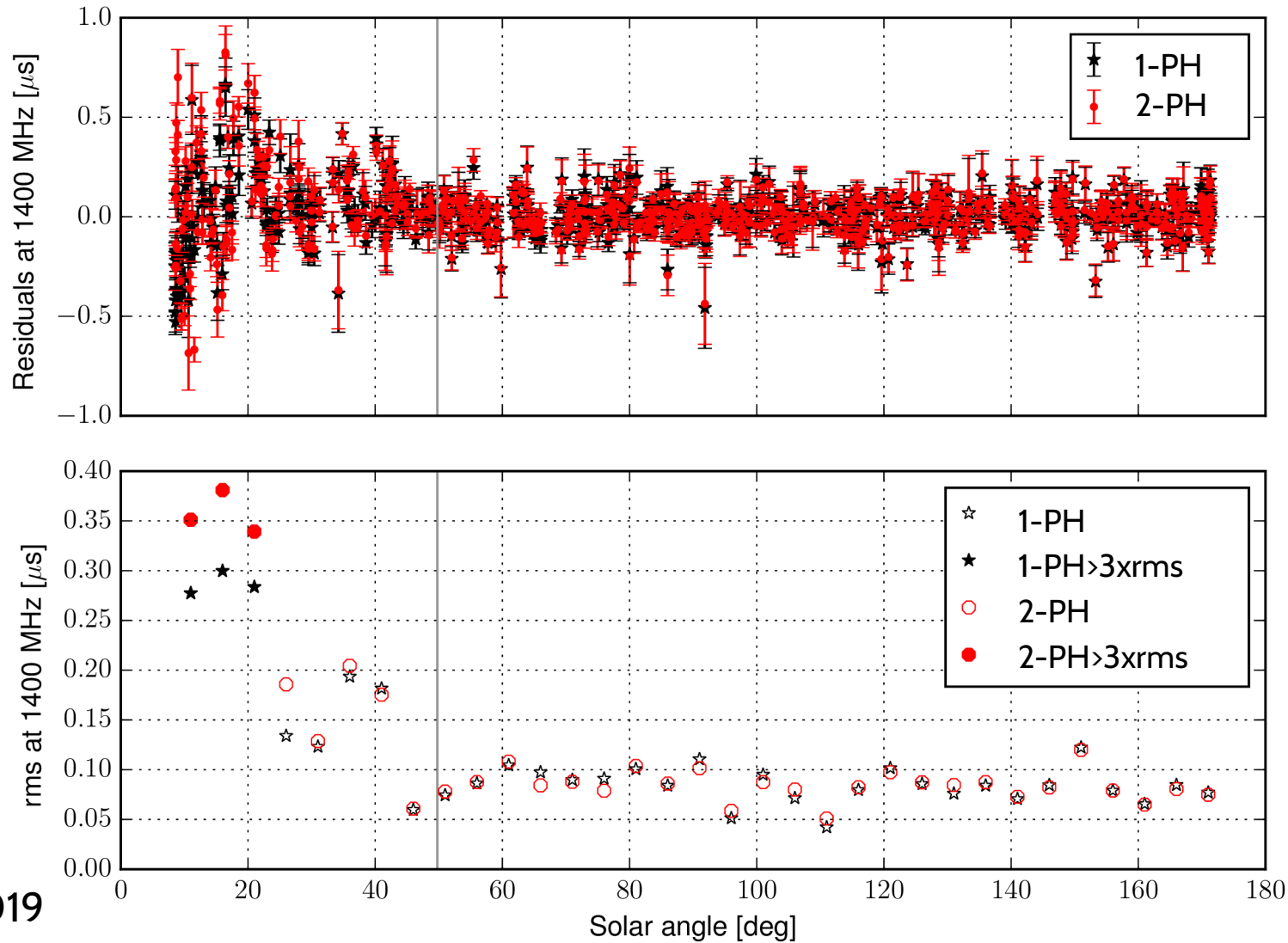
Solar wind models for pulsar timing

One-phase,
spherical model

Two-phase,
radial model

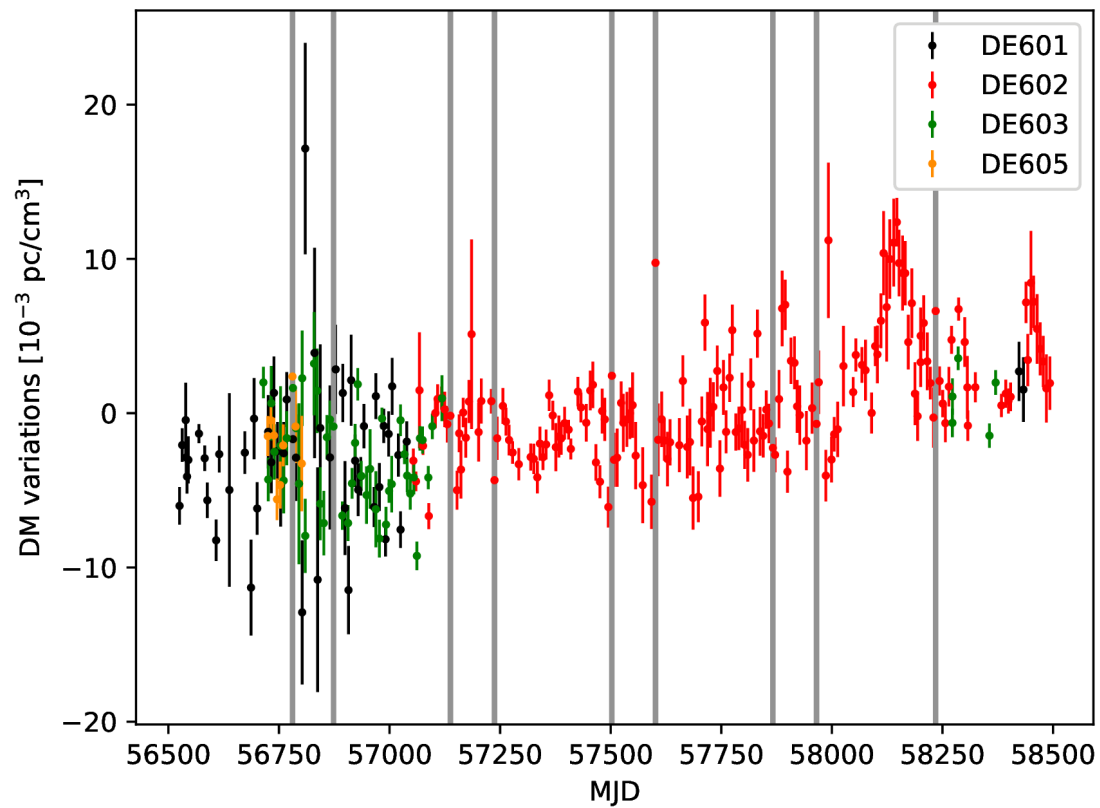


Solar wind models for pulsar timing



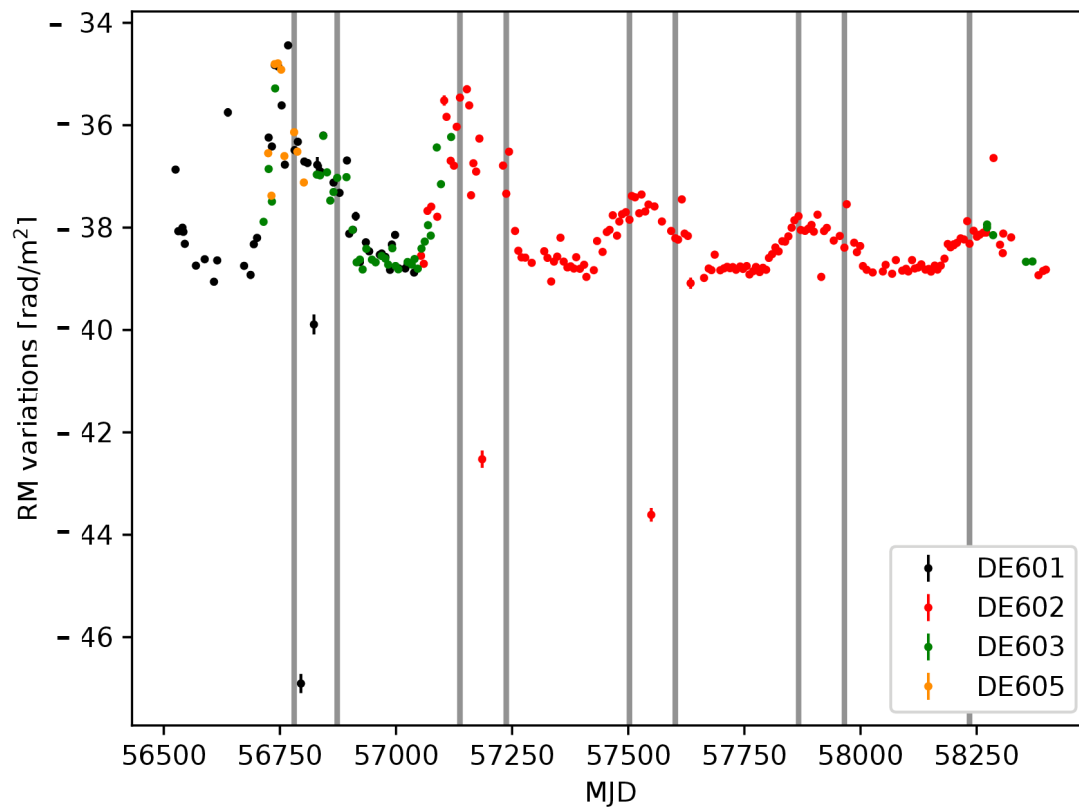
DM variations

Test bed: PSR J0528+2200 (Elat $\sim -1.24^\circ$)



RM variations

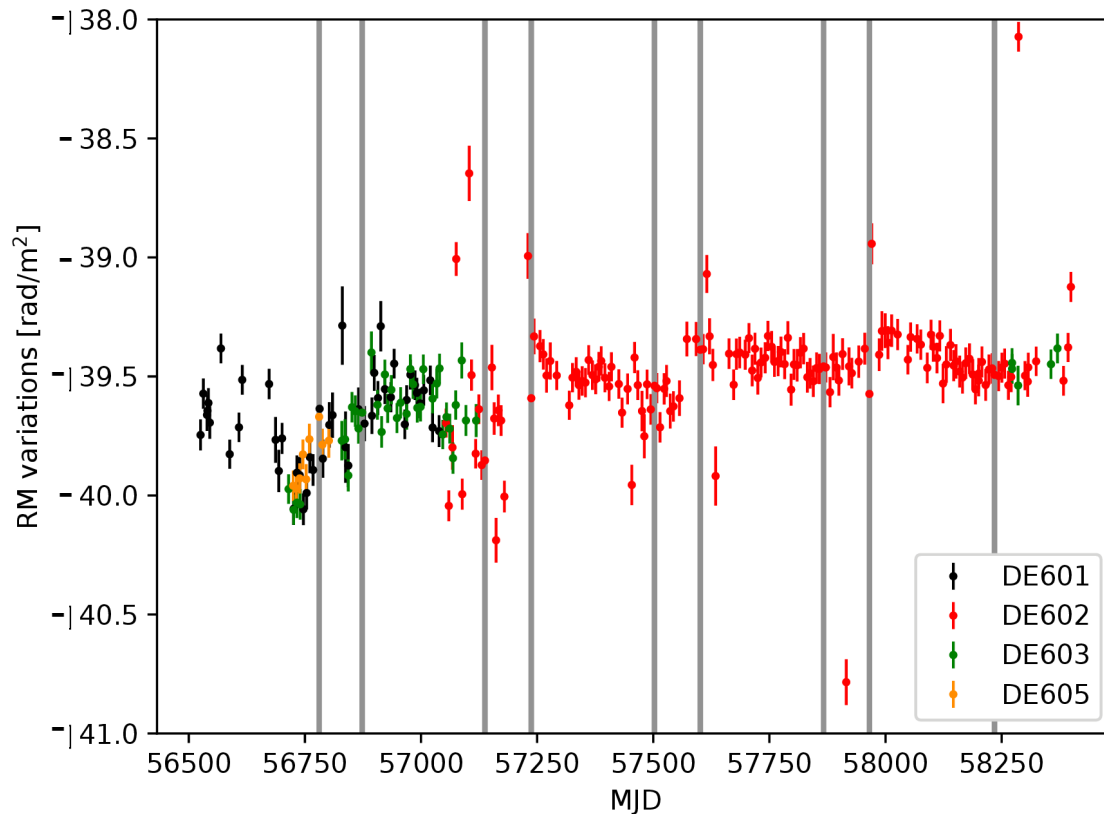
Test bed: PSR J0528+2200 (Elat $\sim -1.24^\circ$)



- Modified RM synthesis based on Bayesian Lomb Scargle periodogram (see **Porayko+2019**)
- Three contributions:
 - ✓ Interstellar medium
 - ✓ Solar wind
 - ✓ Ionosphere

RM variations

Test bed: PSR J0528+2200 (Elat $\sim -1.24^\circ$)

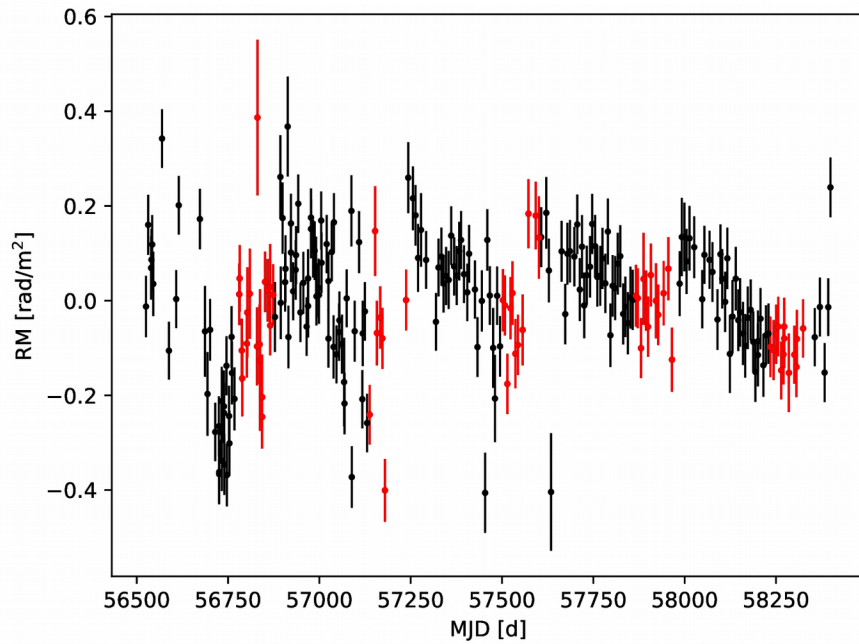


- Modified RM synthesis based on Bayesian Lomb Scargle periodogram (see **Porayko+2019**)
- Three contributions:
 - ✓ ~~Interstellar medium~~
 - ✓ Solar wind
 - ✓ ~~Ionosphere~~(Rmextract by M. Mevius + uqrg TEC map, see **Porayko+2019**)

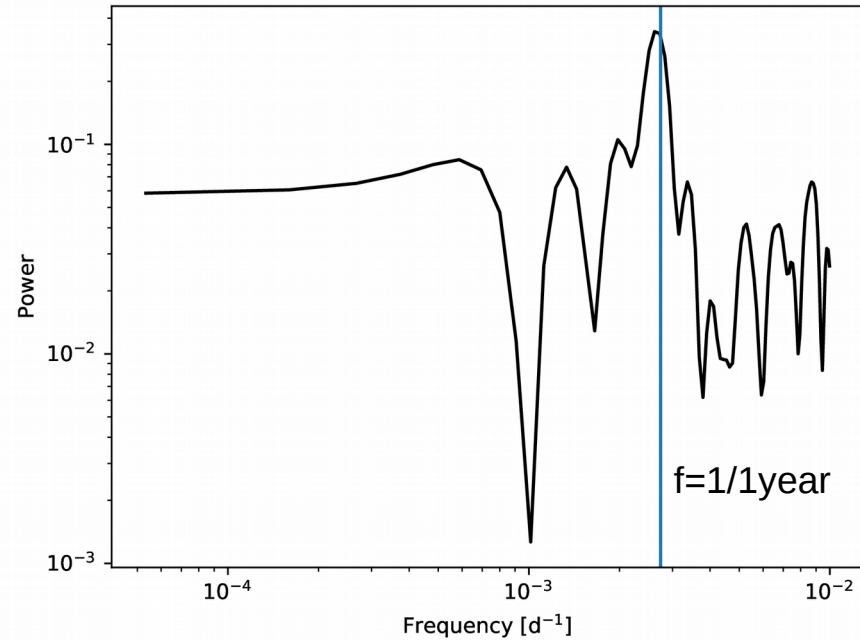
RM variations

Test bed: PSR J0528+2200 (Elat $\sim -1.24^\circ$)

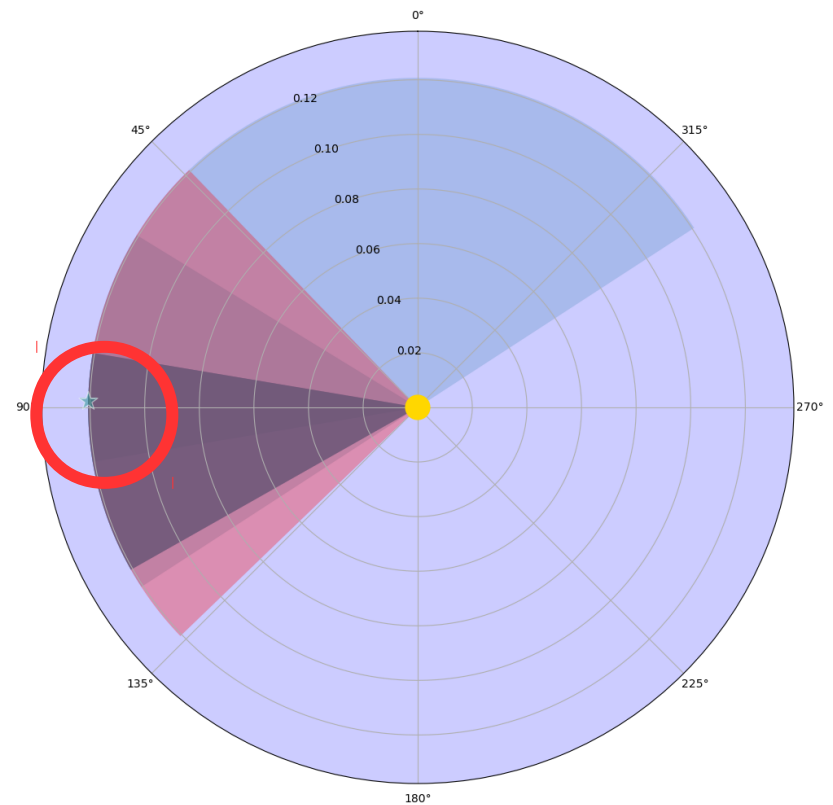
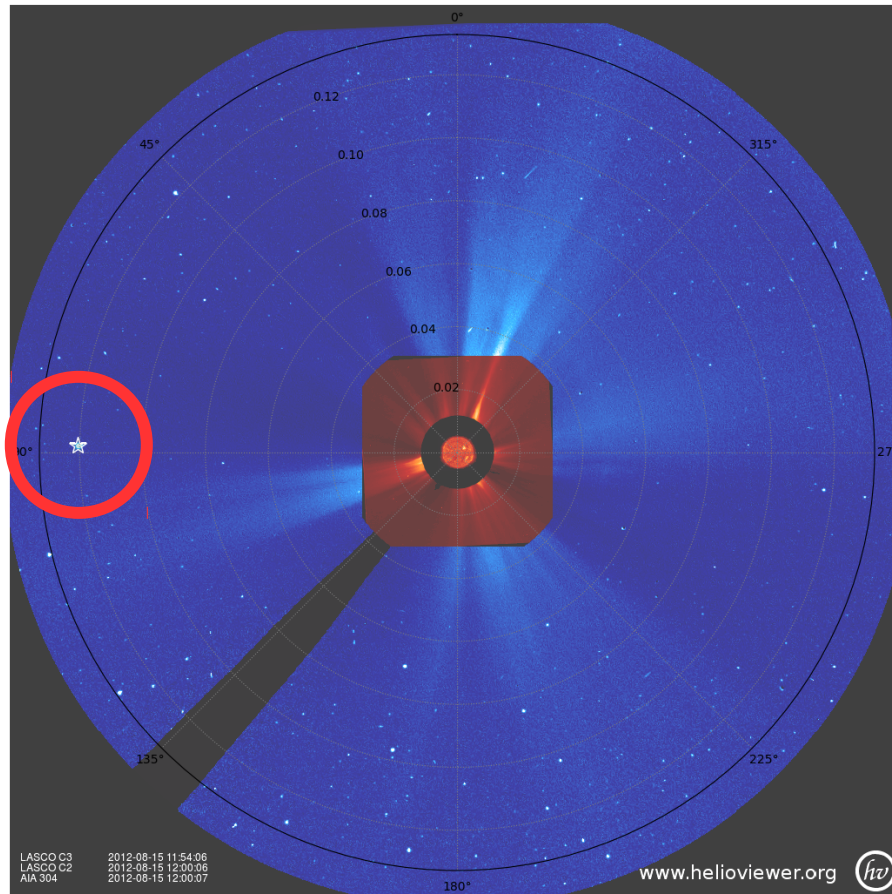
RM time series minus linear trend



LSP

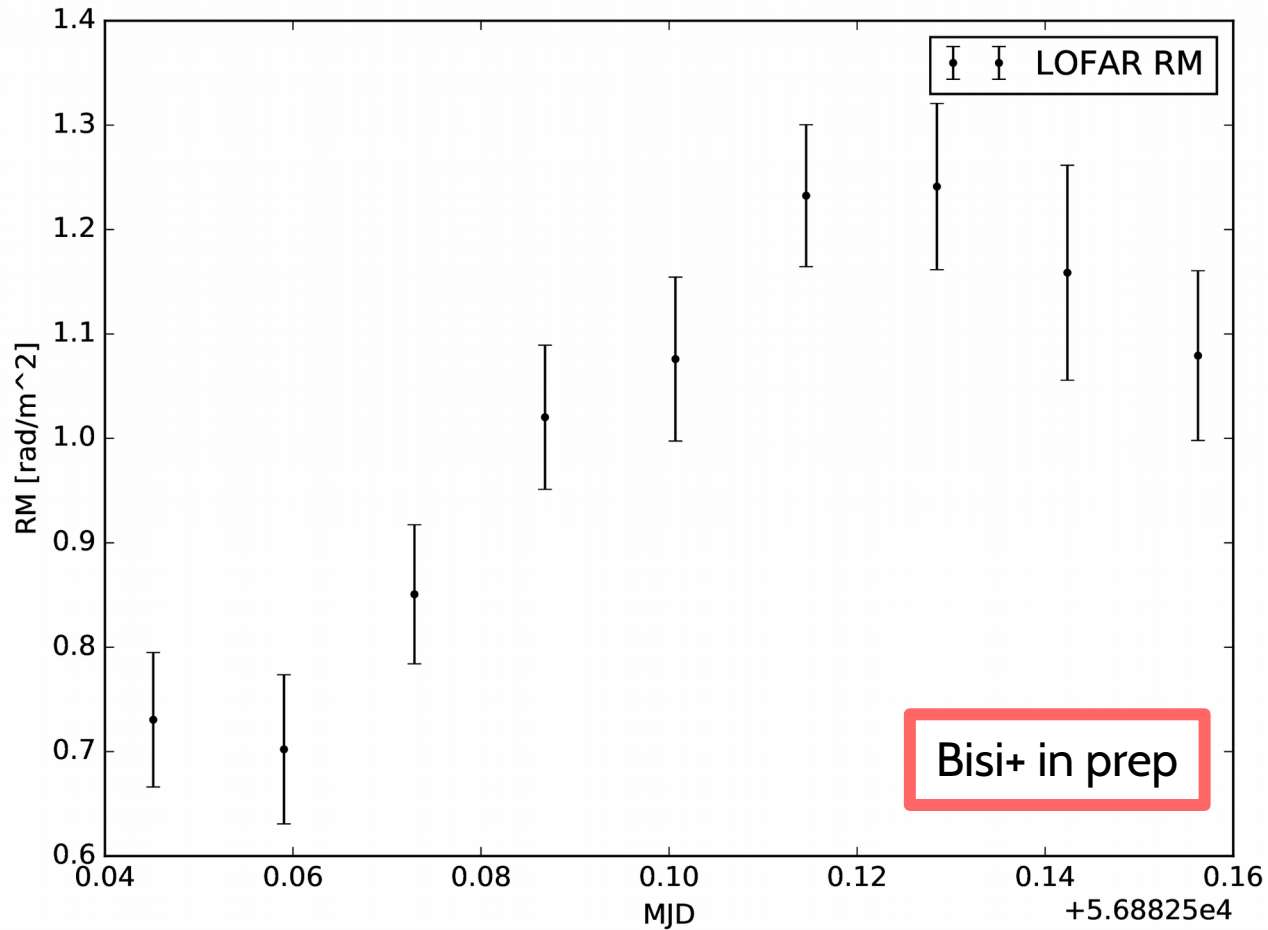


Searching for pulsar occultations



Shaifullah, Tiburzi, Zucca in prep.

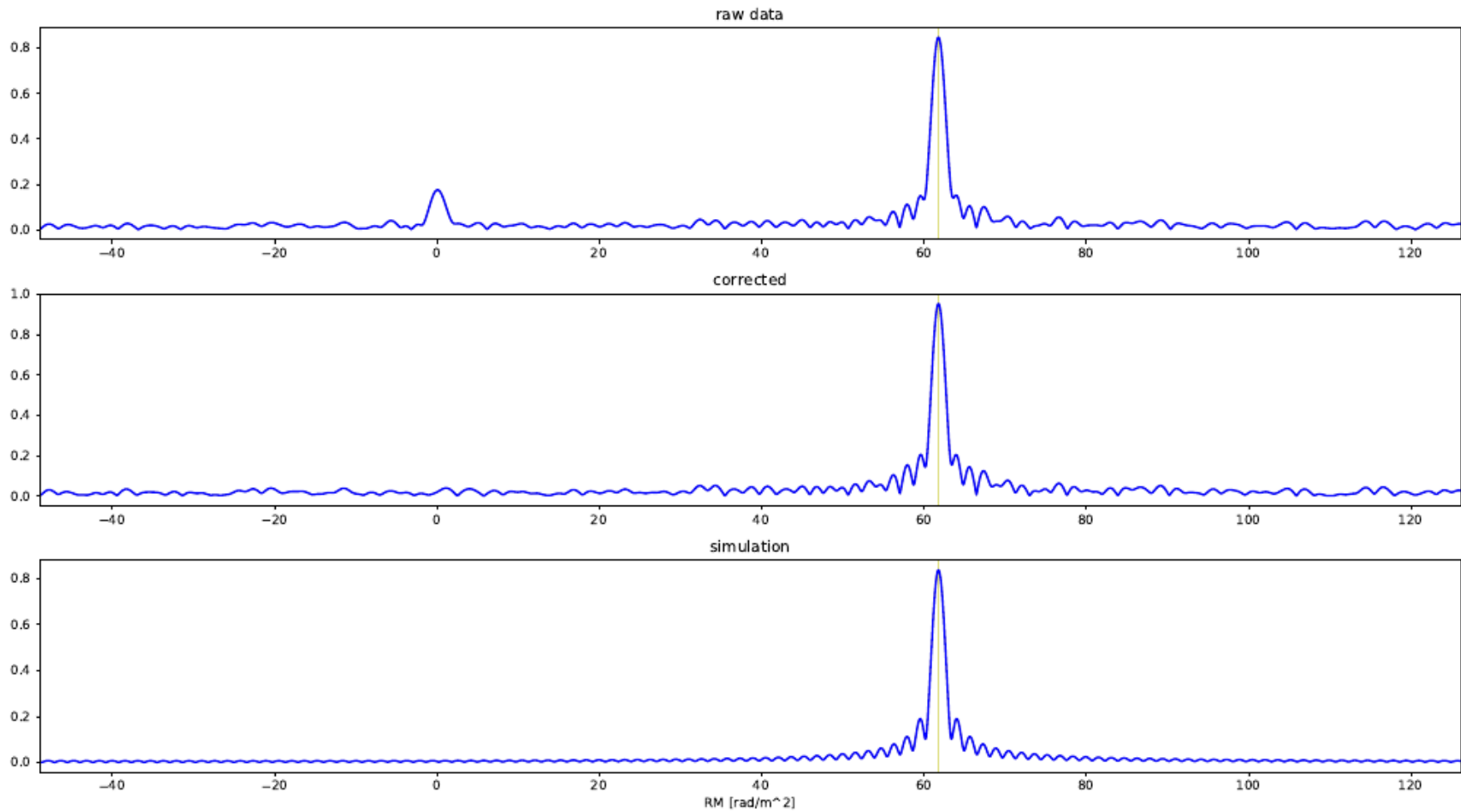
CME's Faraday rotation



- Coronal Mass Ejection in August 2014
- Transit in front of PSR 1022+1001 (Elat ~ 0.2 deg)
- Clear detection of the Faraday rotation induced by the CME

A glance to the future

- **Polarization calibration to recover pulsars with RM close to zero** – with O. Wucnitz, V. Kondratiev, G. Shaifullah, N. Porayko, T. Carozzi and W. van Straten



- **Polarization calibration to recover pulsars with RM close to zero** – with O. Wucnitz, V. Kondratiev, G. Shaifullah, N. Porayko, T. Carozzi and W. van Straten
- **LOFAR core** proposal (Cycle 12) – weekly observations of pulsars during the Solar approach with the HBAs

Parkes Radio Telescope proposal (Apr2019) – quasi-daily (!) observations of 3 pulsars during the Solar approach with the UWL receiver (0.7 – 4 GHz)

- Disentangling the ionosphere
- Searching for CME signatures in archival data
- Searching for new Solar signatures in DM/RM time series

The end!