



中国科学院国家天文台
NATIONAL ASTRONOMICAL OBSERVATORIES, CAS

Probing Variations in Earth's Ionosphere Using Pulsars

FAST/Future Pulsar Symposium 15

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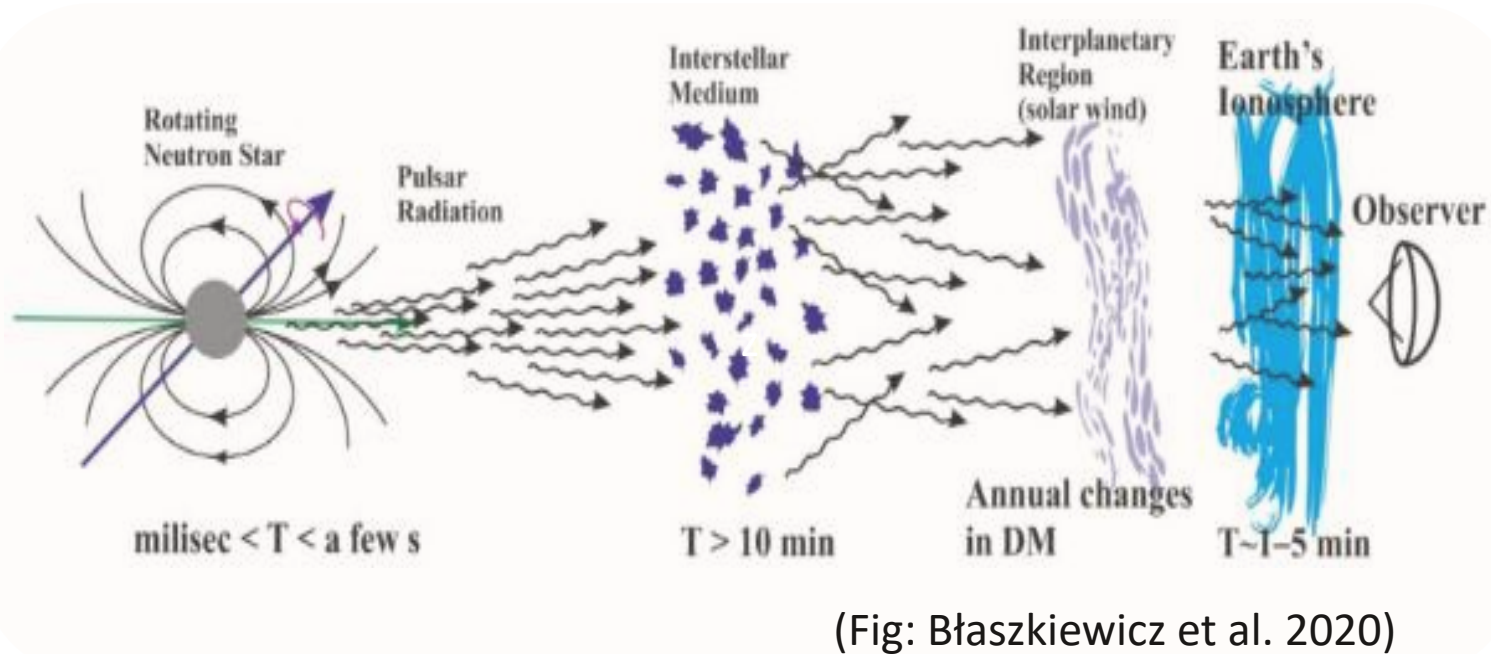
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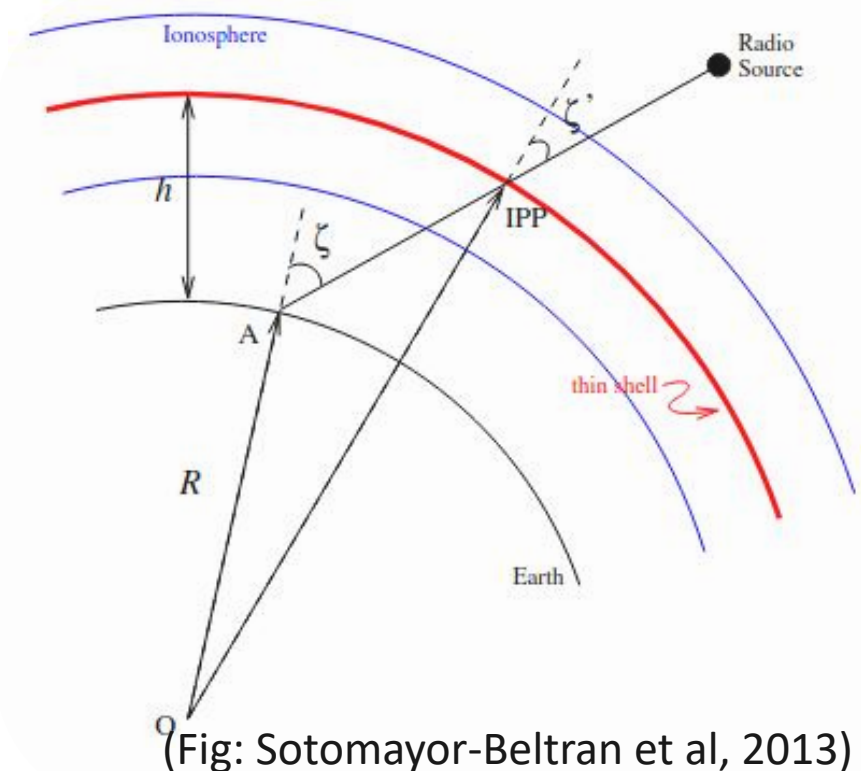


Background



➤ Correct ionospheric effects

- ionFR (Sotomayor et al, 2013)
- RMextract (Mevius, M. 2018)



➤ Distort pulsar signal

- Profile、Amplitude
- VLBI: Visibility (Burgin et al. 2024)

Background

➤ Using pulsars to investigate the Ionosphere

- Study the TEC (Zhuravlev et al. 2020)
- Testing the accuracy of the ionospheric models (Porayko et al. 2019)

Here, we will discuss the results of using PSR J0814+7429 to probe the ionosphere TEC. (Under Review at APJL)

Reviewer's Comments:

This is a fine paper, deserving quick publication. The authors have done a fine job in utilizing 'legacy' LOFAR single-station pulsar observation to demonstrate the use and utility of pulsar monitoring for tracking ionospheric phenomena.

I have very few comments:

Data & Method

- Three LOFAR stations (DE604, DE605, DE609)
- 32 observing days (Year 2017)
- Nearly full-day coverage
- Freq range: 120--170 MHz



LOFAR(120-180MHz) (LOFAR官网)

➤ For each day:

- 10-minute cadence
- RM via rmfit

$$RM_{obs} = RM_{ISM} + RM_{ion}$$

$$TEC_{LoS} = 10^7 \times \frac{RM_{obs/ion}}{2.6 \times B_{LoS}}$$

Results1 Diurnal Variations of the Observed RMs

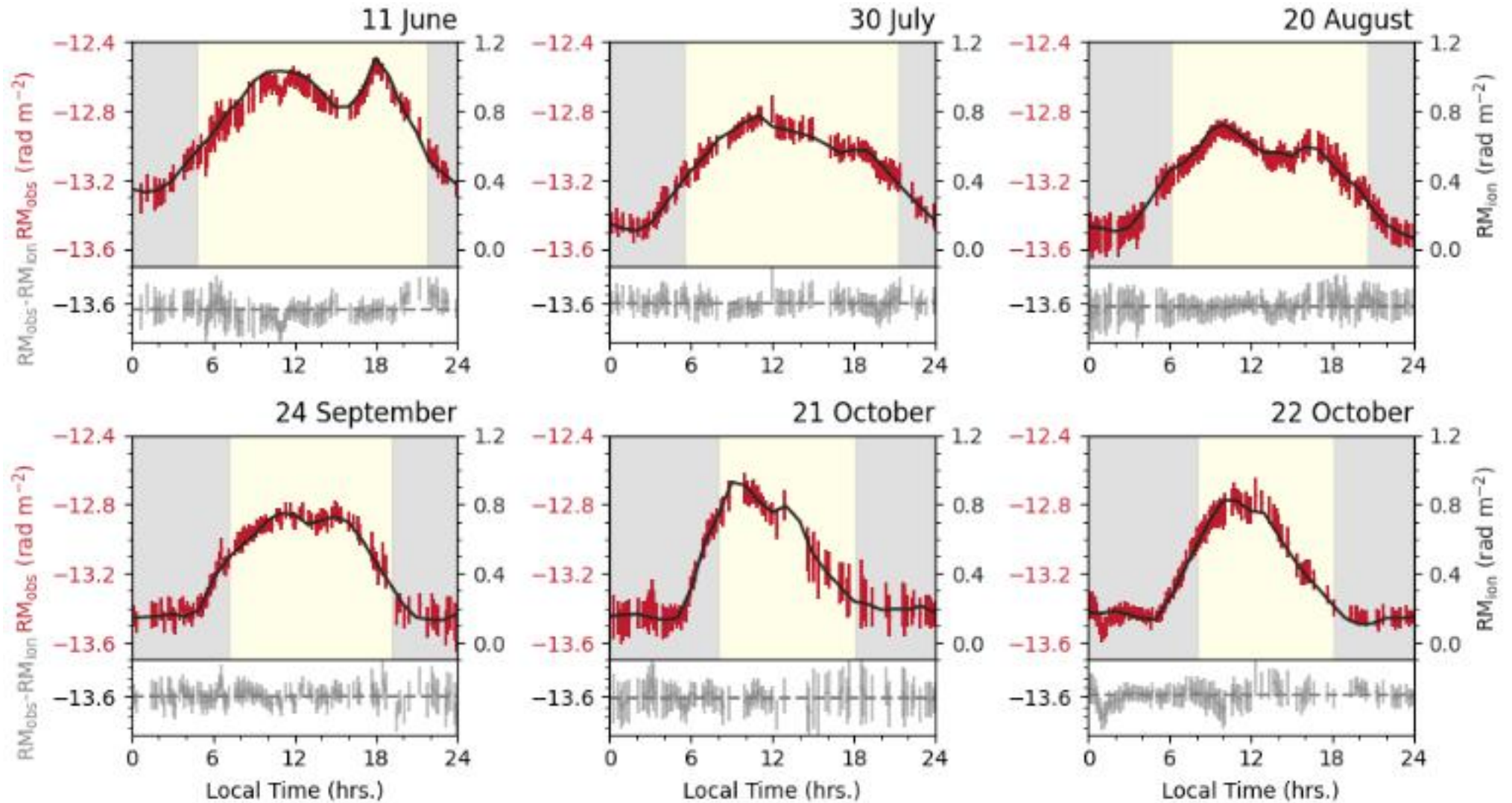
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PSR J0814+7429



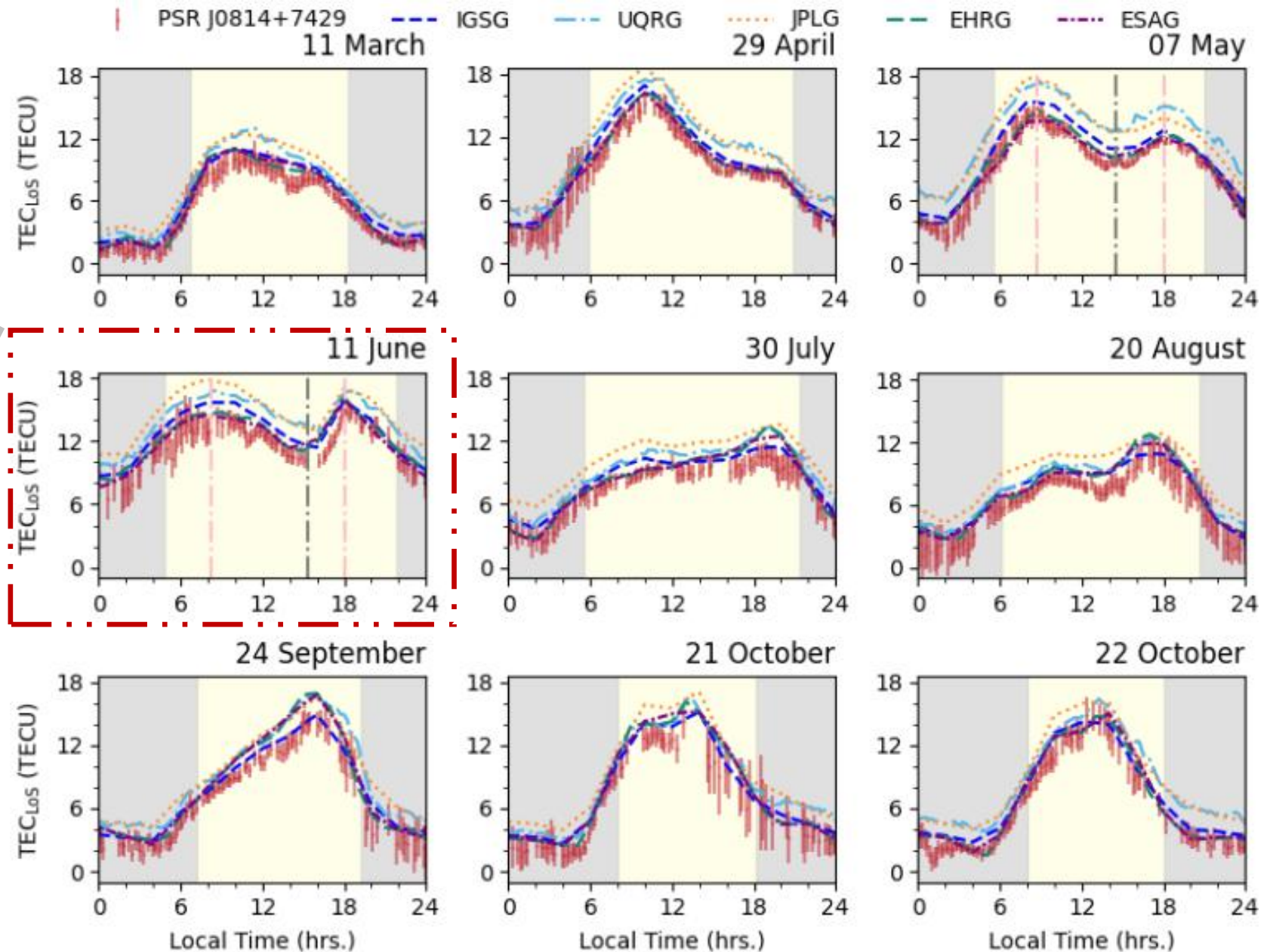
RMextract: RM_{ion}



Results2 Probing the Ionospheric Electron Density

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The ionospheric
noontime Bite-outs
phenomenon



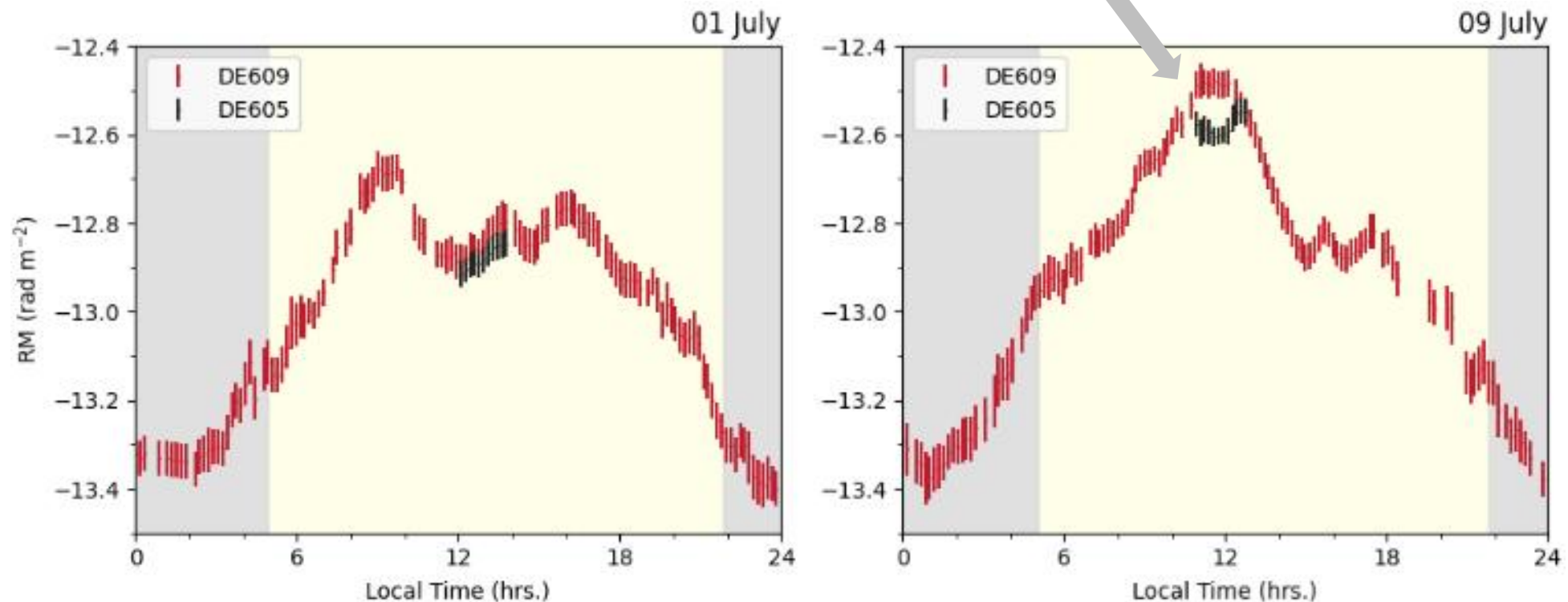
Results3 The Impact of Solar Activity on the Ionosphere

- 11 simultaneous observations by DE605 and DE609



of course, might interfere or might give you an opportunity for some [interesting photos](#).

The storms are expected on July 9, 2017 when the solar wind stream should hit Earth's magnetic field.



Discussions

Pulsar signal

- Encoding ionospheric diurnal variations
- Sensitive to ionospheric anomalies (e.g., noontime bite-out events)
- Sensitive to space weather effects

Pulsars may become powerful probes of the Earth's ionosphere

However, integrating multiple datasets for ionospheric sensing remains an important challenge.

Thanks!