



The first direct measurement of the saturnian stratospheric winds

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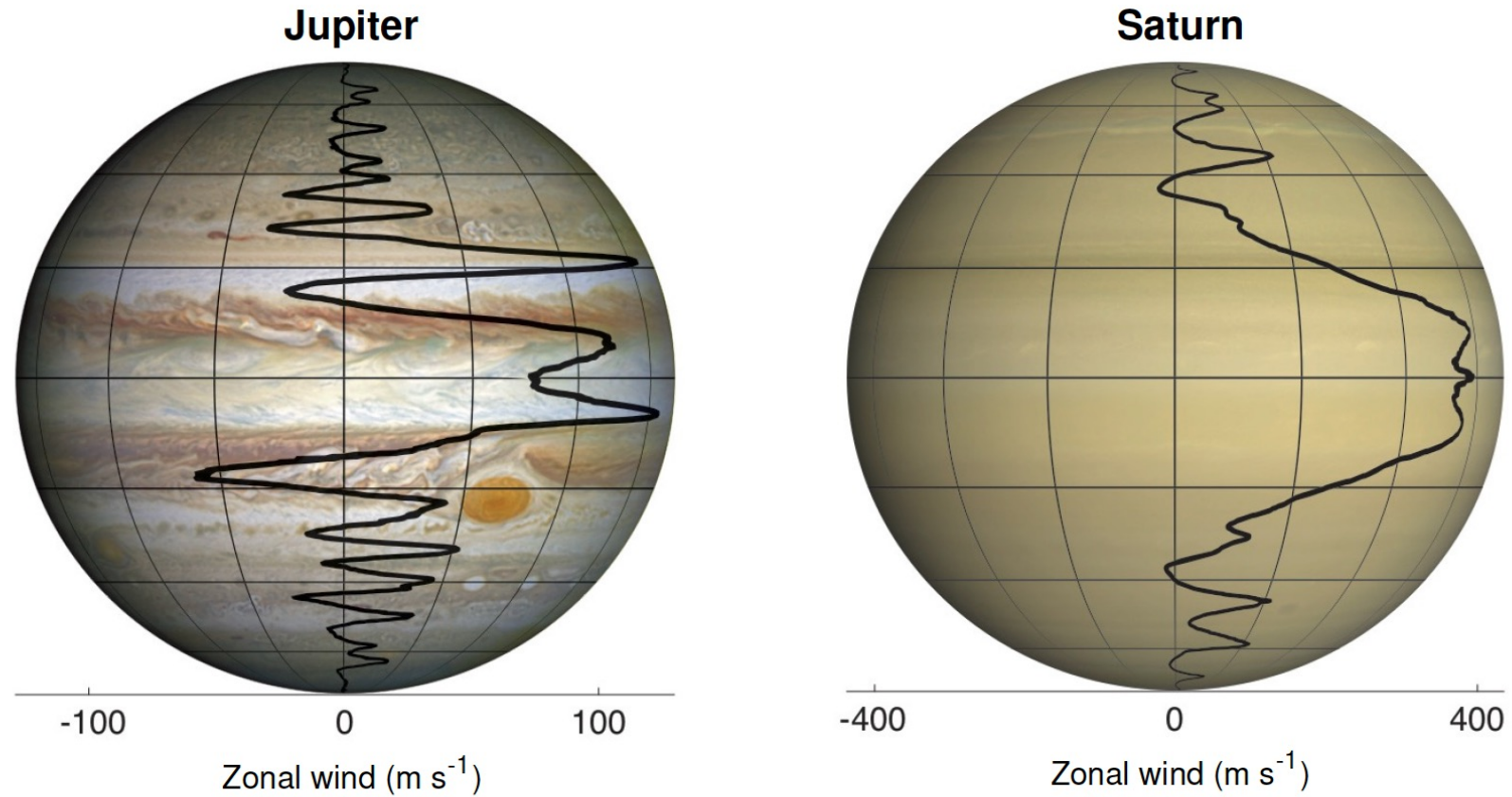
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Introduction



Hubble Wide Field Camera in 2014

Cassini and Voyager
images and removing the rings

Figure from Kaspi et al. (2020)

ALMA Observations of Saturn

Observations

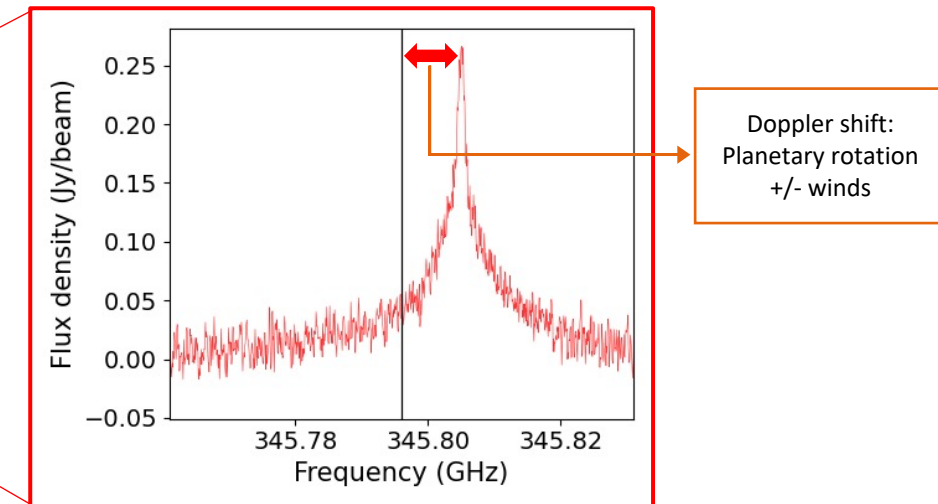
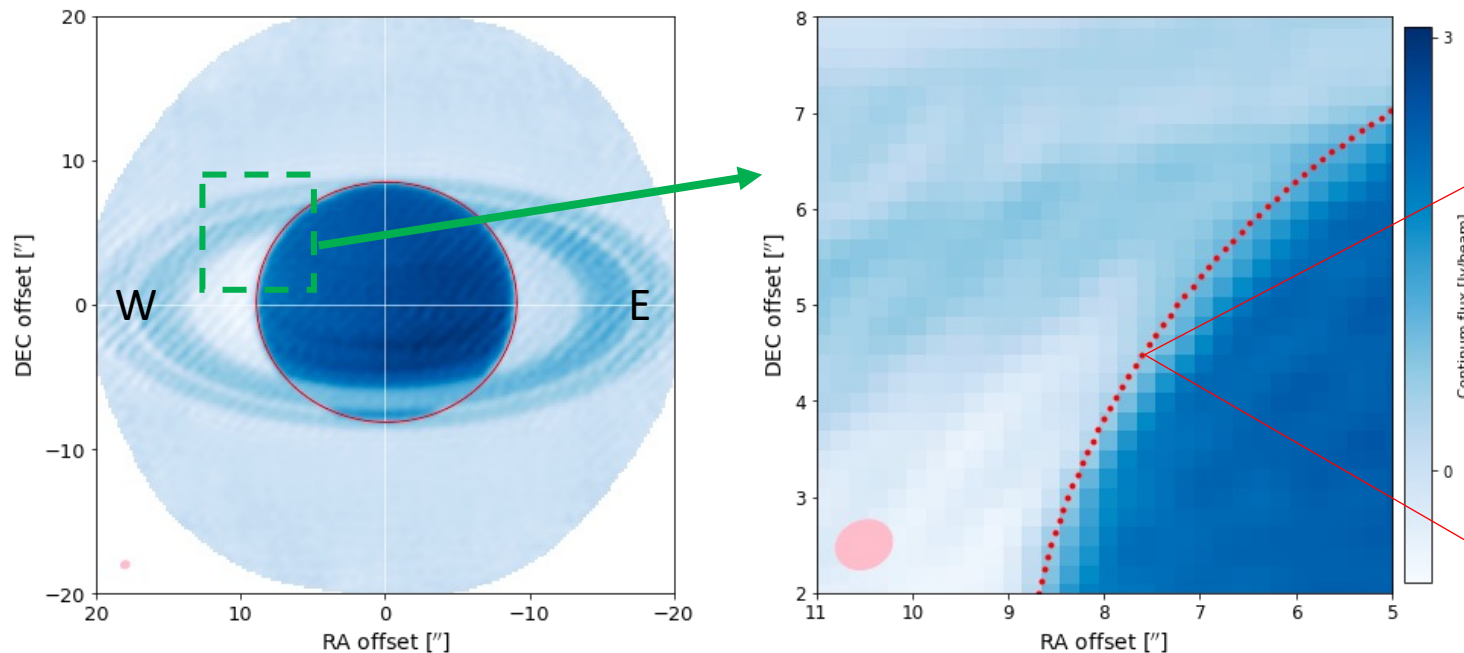
- On May 25th, 2018 we observed Saturn with ALMA (PI T. Fouchet).
- We observed CO (3-2) emissions at 345 GHz and HCN (5-4) at 354 GHz.
- With spectral resolutions of 124kHz and 500 kHz.
- The spatial resolution is 0.63"x0.55" while the apparent size of Saturne is around 18" at the time of observations.

Challenges

We want to measure winds with velocities of about 100 m/s when:

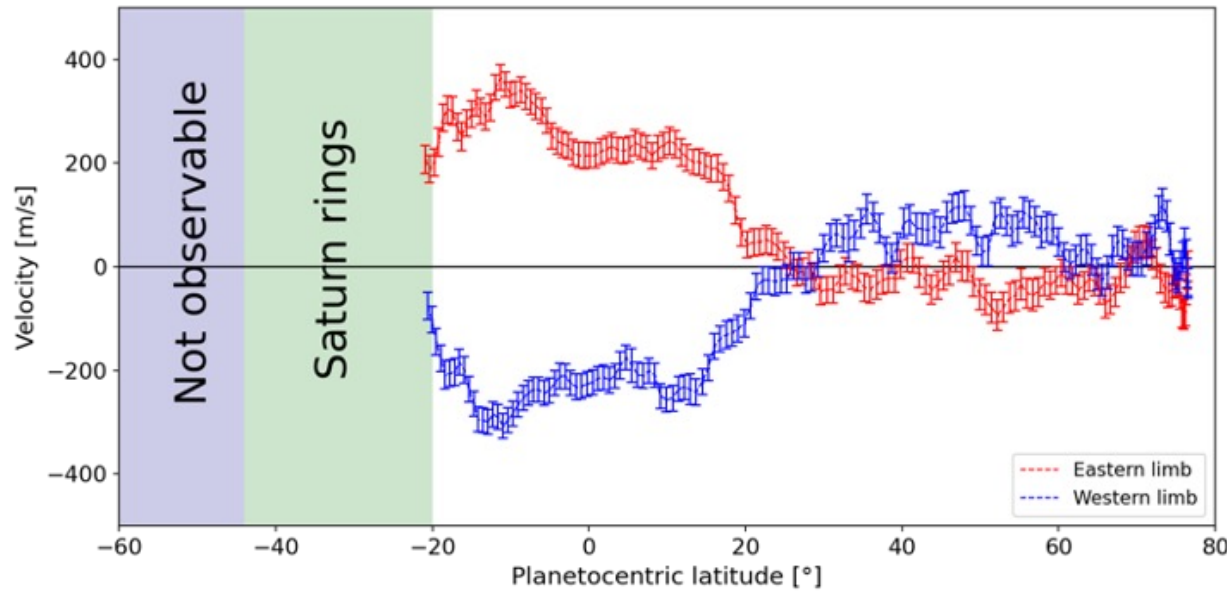
- Saturn's equatorial rotation is ~10 km/s
- The speed resolution is 100 m/s.

- CO previously observed by Cavalié et al. (2009, 2010)
- First detection for HCN (Fouchet et al. in prep)

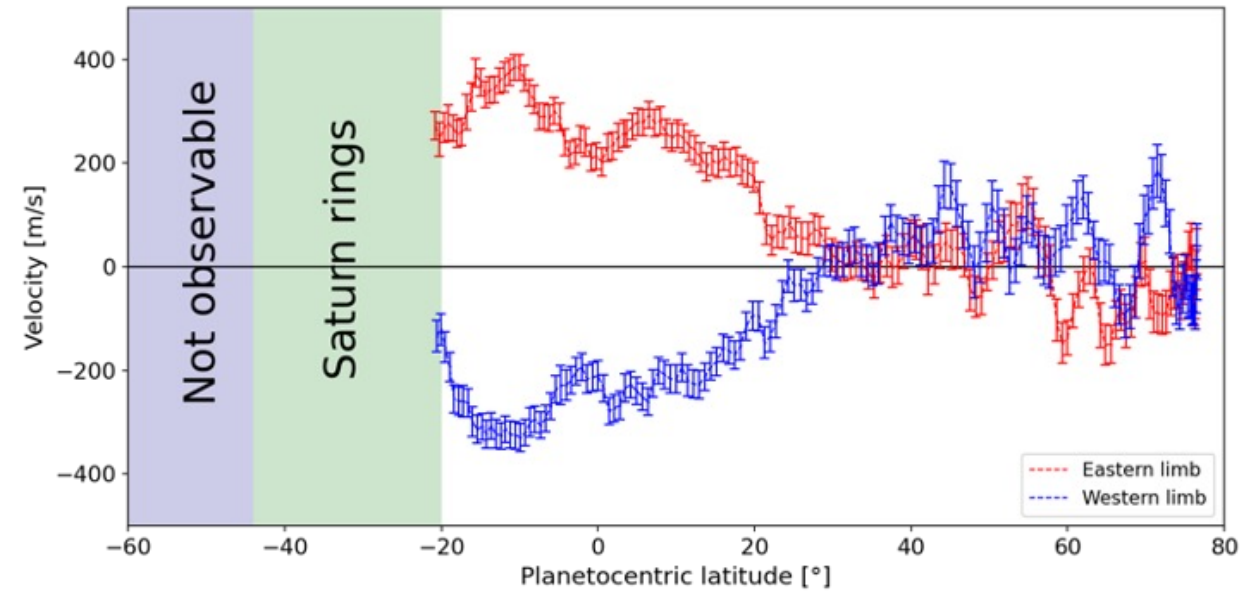


Doppler shift:
Planetary rotation
+/- winds

Saturn line of sight (LOS) winds



Observations CO (3-2)

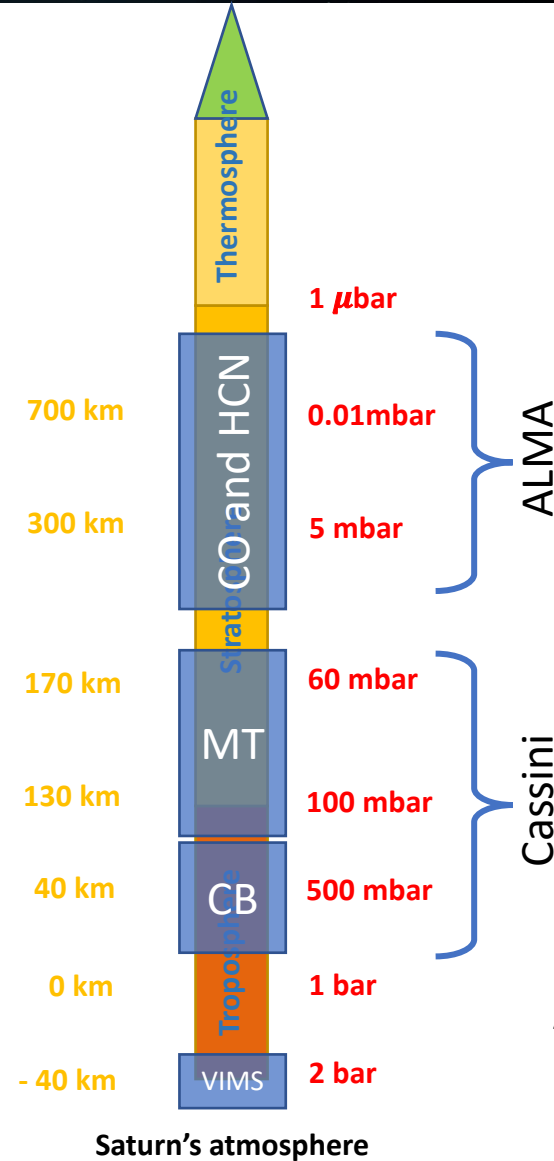
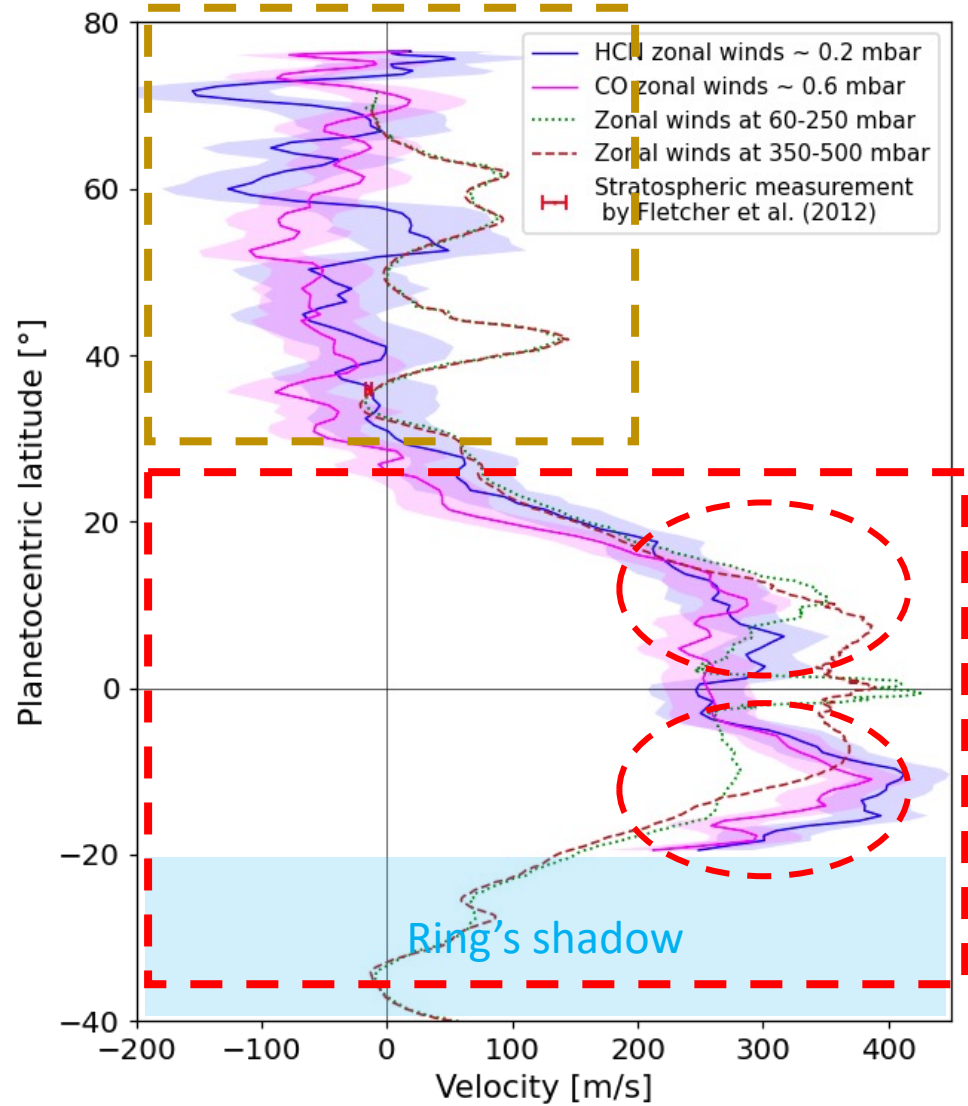


Observations HCN (4-3)

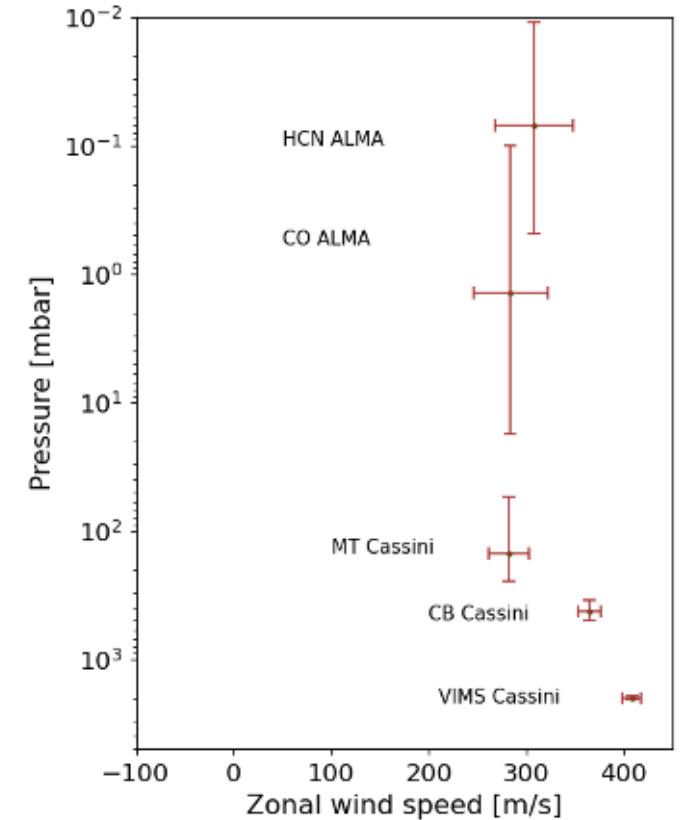
Probed pressures : (by contribution function calculation)

- For HCN → we probe at 0.01-0.4 mbar
- For CO → we probe at 0.1-20 mbar

Saturn's ALMA vs Cassini winds



VIMS 2000 mbar measured more than 400 m/s winds at the equator



Averages of ALMA and Cassini measurements between 10°S and 10°N excluding the latitude interval 3°S-3°N to compare vertically all these observations

Conclusion

- First direct measurement of the stratospheric wind in Saturn
- The great equatorial jet reach in the stratosphere
- Comparison with Cassini measurements show good correlations at the equator
- The large equatorial jet detected seem to be very extended vertically.
- The study will be published (Benmahi et al. In prep)