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Saturn atmospheric dynamics after Cassini from ground-based observations in the visible punctuated by HST/OPAL yearly observations

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Abstract

The Cassini Mission observed the Saturn system over half a Saturn year obtaining detailed information of the atmosphere of the planet. Saturn's seasons produce changes in the Polar Regions and the bands of the planet. Like Jupiter, Saturn is a dynamic planet with variable phenomena that cannot be predicted. Winds have been observed to vary in the equatorial latitudes and small and large-scale storms and other non-convective perturbations have also been observed. We explore the capability to study atmosphere dynamics of Saturn with new data obtained from ground-based telescopes including amateur observations, observations at the 1-m planetary telescope at the Pic du Midi observatory and our own observations with the PlanetCam instrument on the 2.2m telescope at the Calar Alto observatory in Spain. Saturn images will be acquired by the HST as part of its OPAL program in June this year. The comparison of HST data with ground-based images obtained several times per week permit to study the history of several atmospheric features including a long-lived polar perturbation (months) and a very long-lived equatorial storm (years). The drift rates of some of these features and their lifetimes allow identification of the features in Cassini ISS images obtained in 2016-2017.

1. Amateur observations of Saturn

Amateur observations of Solar System planets are contributing to a time-resolved vision of the atmosphere dynamics of Jupiter and Saturn. For Saturn current observations show a display of activity not present at the time of the Cassini mission. The main new feature is a polar disturbance at 60ºN (see Figure 1) and an equatorial bright feature active at least since 2014 [1]. Analysis of ground-based data shows that several features can be identified repeatedly (see Figure 2).

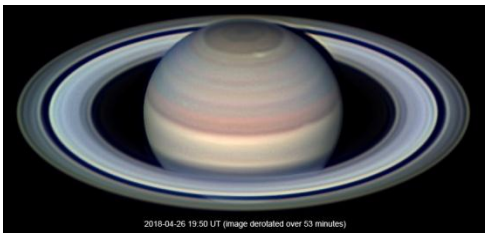

Figure 1: Saturn image obtained by C. Go (Philippines) in April 2017.

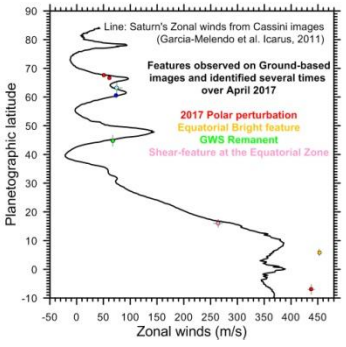

Figure 2:Saturn zonal winds from Cassini ISS compared with tracking of cloud features over April 2017 from amateur images far from opposition.

2. Ground-based Pic du Midi and PlanetCam data

Since 2013 we perform yearly observations of Saturn with the PlanetCam instrument on the 2.2 m

telescope at Calar Alto Observatory. We also analyze images obtained at the 1-m planetary telescope at the Pic du Midi Observatory. Typically, 1-3 campaigns with Saturn data are possible in each telescope each year. Figures 3-4 show examples of past observations but new observations are planned this year and we will present their analysis in comparison with the time-resolved amateur data (several observations per week).

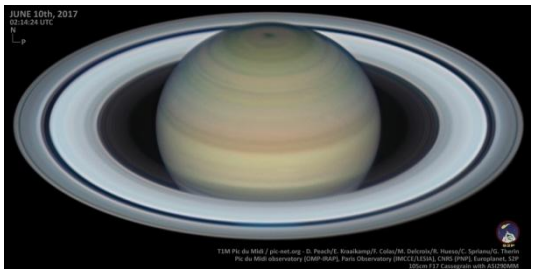

Figure 3: Saturn in the visible observed at the Pic du Midi with the 1.05m planetary telescope in July 2017 at a low elevation of the planet but with good seeing. This image was part of the Pic-Net collaboration and was processed by D. Peach.

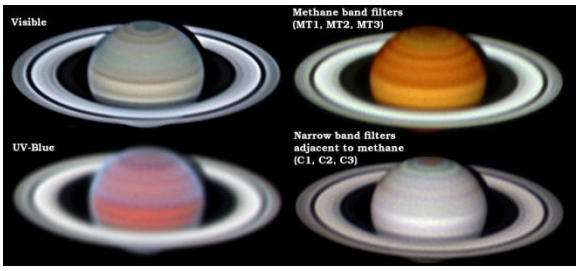

Figure 4: Multi-wavelength images in the visible range (0.4-1.0 μm) with PlanetCam UPV/EHU. The dual camera allows to observe simultaneously also in the 1.0-1.7 microns range (not shown). PlanetCam images can be absolutely calibrated studying photometric variations of the bands in the planet.

3. HST/OPAL

The Outer Planets Atmospheres Legacy HST program observes the giant planets once per year [3]. First observations of Saturn from this program will be obtained on June 6 2017. Saturn was observed by HST on 2015 due to the onset of a polar perturbation [1,2] and observations in 2015 show a variety of atmospheric features at other latitudes that are identified in the ground-based amateur record over the last 4 years. We will show the correspondence of ground-based time-resolved observations and HST features observed close to Saturn's opposition.

Figure 5: Saturn observed by the HST in 2015 showing a variety of atmospheric features and disturbances [1, 2]. New HST observations will be acquired in June 2018 as part of the OPAL program.

4. Summary and Conclusions

The combined analysis of temporally resolved ground-based and HST images of Saturn in the visible range show changes in the planet and new meteorological activity not observed at the time of the Cassini mission. We will present this activity and the comparison of the different datasets.

Acknowledgements

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References

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