The First Dark Spot Detection in the Atmosphere of Uranus: Properties and Comparison with Dark Spots in Neptune

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October 27, 2010

1 Abstract

In late January 1986, the spacecraft Voyager 2 made its closest approach to Uranus. During the several months that followed this event, the spacecraft acquired more than 7000 images revealing new ringlike features, nine new small satellites orbiting between Uranus rings and Miranda, and the complete absence of detections of dark spots in the atmosphere (Smith et al. 1986). Three years later, the Voyager 2 visited Neptune, and in contrast to the lack of atmospheric features found in Uranus, the spacecraft made the first detection in the system of a great dark spot (GDS) in the northern hemisphere that we know today as GDS 1989 (Smith et al. 1989). After the revealing observations provided by the Voyager 2, the spatial resolution and time coverage in the study of atmospheric features has been significantly improved thanks to the combined work of the Hubble Space Telescope (HST) and ground based facilities. In the case of Neptune, Sromovsky et al. (2002) analyzed the dynamics of several northern dark spots detected between 1993 and 2000. Their observations confirmed the presence of at least two great dark spots (NGDS) located at latitudes of 32.3 ± 0.7^o N (NGDS 32) and 14.2 ± 0.8^o N (NGDS 15). Surprisingly, these NGDS were very stable in latitude and drift rate. While NGDS 32 showed no reasonable drift in latitude during its 6 years lifespan, NGDS 15 drifted only 1.7 ± 1.7^o towards the equator between 1996 and 1997. In the case of Uranus, combined observations using HST and Keck II 10-m telescope began in 1993, however, the first confirmed Uranus dark spot (UDS) detection did not occur until August 2006 (Hammel et al. 2006). The latitude of the observed UDS was 27 ± 0.8^o N with an extension of 2.4^o in latitude and 5.7^o in longitude (approximately 1600 by 3000 km). The average zonal velocity was 43.12 ± 0.09 m s^{-1}, value that is higher than all the other velocities measured to date near that latitude. Hammel et al. (2009) also detected bright structures spatially associated to the UDS. These bright features exhibited considerable variability compared to the relatively stable dark spot, which was observed at least from June through October. None of the numerical simulation results trying to reproduce the UDS were able to survive more than a month. This suggest that structure in the zonal wind profile may be a critical factor in the emergence of large sustained vortices (Hammel et al. 2009).

In this talk we will describe the properties of the first confirmed dark spot detected in Uranus, comparing these observations with fluid dynamic simulated vortices and dark spot features observed in the atmosphere of Neptune.

2 References

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