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Wind measurements in Saturn's atmosphere with UVES/VLT ground-based Doppler velocimetry

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We will present preliminary Doppler wind velocity results of Saturn's zonal flow at cloud level. Our aim is help to constrain the characterization of the equatorial jet at cloud level and the latitudinal variation of the zonal winds, to measure its spatial and temporal variability, to contribute to monitor the variability in order to achieve a better understanding of the dynamics of Saturn's zonal winds, whose equatorial jet has a complex vertical structure and temporal variability (Sanchez-Lavega et al., Nature, 423, 623, 3003; Garcia-Melendo et al., Geophys. Res. Lett., 37, L22204. 2010). Finally, the complementarity with Cassini, providing an independent set of observations. The UVES/VLT instrument has been used, which simultaneously achieves high spectral resolving power and high spatial resolution. The field has been derotated in order to have the aperture aligned perpendicularly to Saturn's rotation axis. In this configuration, spatial information in the East-West direction is preserved in a set of spectra in the direction perpendicular to dispersion. The technique of absolute accelerometry (AA, Connes, 1985, ApSS 110, 211) has been applied to the backscattered solar spectrum in order to determine the Doppler shift associated with the zonal circulation. Our measurements have been made in the wavelength range of 480-680 nm. Previously we successfully adapted this Doppler velocimetry technique for measuring winds at Venus cloud tops (Machado et al. 2012). In the present study we will show the adaptation of this method for Saturn's case. Since the AA technique only allows to compare spectra where the line shifts are within the line width, in fast rotating atmospheres (as is the case of Saturn) the spectra must be compared by pairs from adjacent areas of the disk (adjacent pixels in the slit). We will use coordinated observations from the Cassini's Visible and Infrared Mapping Spectrometer (VIMS), in order to compare with the Doppler winds obtained from the UVES/VLT high-resolution spectra. The observations consisted of 4 blocks of 15 exposures of 90 sec, plus two shorter blocks of 9 exposures, totalling 7.3 hours of telescope time. In order to cover the whole disk the aperture has been offset by 1 arcsec in the North-South direction between consecutive exposures. Most of the northern hemisphere was covered by the rings. Saturn's diameter was 17.4 arcsec, and the slit aperture was 0.3x25 arcsec. The aperture offset between consecutive exposures was 1 arcsec. Two shorter observations blocks of 9 exposures only covered the central part of the disk, and four others covered the whole disk. The sub-terrestrial point was at -26.1° S. The presence of the rings lead to severe order superposition. The dark region between the rings and the disk may or may not be present, depending on the slit position. On the other hand, defects in the response of the UVES slit in the upper part preclude its use for accurate Doppler measurements such as these. For these reasons only the central part of the aperture has been considered for the measurements.