THE ROLE OF SPECTROSCOPY IN RESEARCH ON THE NEUTRAL ATMOSPHERES OF THE OUTER SOLAR SYSTEM

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Remote-sensing observations of Jupiter, Saturn, Uranus and Neptune, as well as Titan - Saturn's largest satellite, and the spectroscopic information required to interpret these observations play a pivotal role in the exploration of the atmospheres of the outer solar system. We rely on well-mixed constituents to derive temperatures unambiguously, with only the collision-induced absorption and quadrupole transitions of H_2 and CH_4 in Jupiter and Saturn fulfilling that role. Condensate and chemically disequilibrated molecules (e.g. NH_3 and PH_3) act as indirect tracers that inform us of the strength of vertical winds. Higher-order hydrocarbons are present in all these atmospheres and their abundances and distribution acts as a tracer for stratospheric circulation and chemistry. The platforms on which planetary spectroscopy is done include a variety of ground-based facilities that observe the planets from the visible through radio regions. Airborne facilities, such as NASA's SOFIA, together with Earth-proximal facilities in space, allow both increased sensitivity and wider spectral access. Spectrometers on interplanetary missions have allowed us to examine the spatial and temporal variability of atmospheric properties that are not possible from the Earth. Several needs and challenges remain, and a constant dialog between those in the planetary exploration community and laboratory spectroscopists and theorists has been and will continue to be an important component of progress in atmospheric research. -