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304.12D – A Report of Clouds on Titan

We present in this work a detailed analysis of many of the clouds in the Cassini Visual and Infrared Mapping Spectrometer (VIMS) dataset in order to understand their global and seasonal properties. Clouds are one of the few direct observables in Titan's atmosphere (Griffith et al 2009, Rodriguez et al 2009, Adamkovics et al 2010), and so determining their characteristics allows for a better understanding of surface atmosphere interactions, winds, transport of volatile material, and general circulation.

We find the clouds on Titan generally reside in at 5-15km altitude, which agrees with previous modelling efforts (Rafkin et al. 2015), as well as a power law distribution for cloud optical depth. We assume an average cloud droplet size of 100um. No seasonal dependence is observed with either cloud altitude or optical depth, suggesting there is no preferred seasonal formation mechanisms. Combining these characteristics with cloud size (Kelland et al 2017) can trace the transport of volatiles in Titan's atmosphere, which can be compared against general circulation models (GCMs) (Lora et al 2015).

We also present some specific analysis of interesting cloud systems including hypothesized surface fogs (Brown et al 2009) and orographic cloud formation (Barth et al 2010, Corlies et al

305 – Comet Physical Characteristics: Comae

305.01 – Isotopic Ratios in a Peculiar Outbursting Comet

Isotopic ratios in comets provide keys for the understanding of the origin of cometary material, and the physical and chemical conditions in the early Solar Nebula. A newly discovered peculiar comet, C/2015 ER61, underwent an outburst with a total brightness increase of 2 magnitudes on the night of April 4th, 2017. The sharp increase in brightness offers a rare opportunity to measure the isotopic ratios of the light elements of this comet. We obtained two high-resolution spectra of C/2015 ER61 with UVES on Apr. 13 and Apr. 17 respectively. At the time of our observations, the comet was fading gradually since the outburst. We measured the ¹²C/¹³C and ¹⁴N/¹⁵N isotopic ratios from the CN Violet (0,0) band. In addition, we determined the ¹⁴N/¹⁵N ratio in NH₂ for C/2015 ER61 from four pairs of NH₂ isotopologue lines. Some 18OH lines were detected but the S/N of these lines is too low to derive a reliable 18O/16O estimate. We will present our UVES spectra of C/2015 ER61, obtained shortly after the outburst. We will also present the comparison of the isotopic ratios of C/2015 ER61 with those of other comets.

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305.02 – The Volatile Composition of newly-discovered C/2017 E4 (Lovejoy) before its dissolution

as revealed by iSHELL at NASA/IRTF

In April 2017, we acquired comprehensive high-resolution spectra of newly-discovered comet C/2017 E4 (Lovejoy) as it approached perihelion, and before its disintegration. We detected many cometary emission lines across 4 customized instrument settings (L1-b, L3, Lp1-b and M1) in the (1 – 5) μm range, using iSHELL – the new near-IR high resolution immersion echelle spectrograph on NASA/IRTF (Mauna Kea, Hawaii).

In M1, near 5μm, we detected multiple ro-vibrational lines of H₂O, CO and the (X-X) system of CN; the latter data constitute a

complete survey of CN at these wavelengths. We derived quantitative abundances for CN and addressed its origin by comparing with quantitative production rates for HCN. The ability to quantify both primary and product species eliminates systematic error that may be introduced when measurements are acquired with different astronomical techniques and instruments.

In L1, around 3 μm, we detected fluorescence emission from HCN, C₂H₂, and water, prompt emission from OH, and many other features. Methane, ethane and methanol were detected both in L3 and Lp1 settings. These species are relevant to astrobiology, owing to questions regarding the origin of pre-biotic organics and water on terrestrial planets.

The many water emission lines detected in L1-b (and M1)

provided an opportunity to retrieve independent measures of rotational temperature for ortho- and para-H₂O, thereby reducing systematic uncertainty in the derived ortho-para ratio and nuclear spin temperature. Deuterated species were also sought and results will be presented.

The bright Oort cloud comet E4 Lovejoy combined with the new capabilities of iSHELL provided unique results. The individual iSHELL settings cover very wide spectral range with very high accuracy, eliminating many sources of systematic errors when retrieving molecular abundances; future comparisons amongst comets will clarify the nature and meaning of cosmogonic indicators based on composition.

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305.03 – Opportunities for in-depth compositional studies of comets: Summary from semester 2017A observations and prospects for a 2018 observing campaign

The period from late 2016 to mid 2017 provided unusually rich observational opportunities for compositional studies of comets using ground-based IR and optical spectroscopy. Three ecliptic comets – Jupiter-family comet (JFC) 45P/Honda-Mrkos-Pajdusakova, JFC 41P/Tuttle-Giacobini-Kresak, and 2P/Encke – as well as two moderately bright nearly isotropic comets from the