

### CASSINI ORBITER ION AND NEUTRAL GAS MASS SPECTROMETER (INMS) RESULTS.

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**Introduction:** The Cassini Orbiter Ion and Neutral Gas Mass Spectrometer [1,2] was built by NASA Goddard Space Flight Center. After the spacecraft's launch, data analysis and operations are being conducted by a facility science team. The instrument measures in-situ neutral gas and positive thermal energy ions in the upper atmosphere of Titan, in the vicinity of the icy satellites and rings, and in the magnetosphere of Saturn, wherever the signal is above the detection threshold. The instrument was opened to the environment of Saturn immediately after the completion of the Saturn orbit capture burn.

**Ions in Saturn's Ring System:** The INMS detected ions  $H^+$ ,  $O^+$  and  $O_2^+$  just prior to the ring plane crossing [3].  $O_2^+$  suggests a tenuous atmosphere of neutral  $O_2$  created by dissociation of water with the atomic O forming  $O_2$  by ion chemistry or icy surface reactions and loss of  $H_2$  into Saturn's environment.

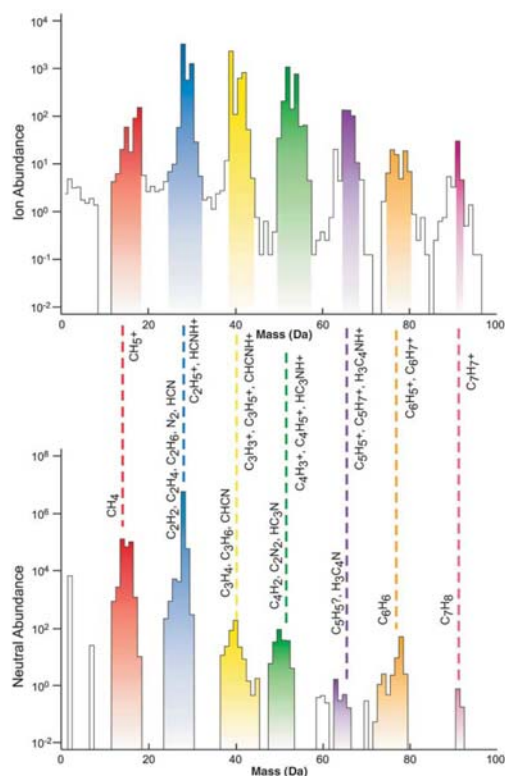
**Enceladus:** On a close flyby of this icy satellite INMS [4] found the main atmosphere to be primarily  $H_2O$  with traces of  $N_2$  and/or  $CO$ ,  $CH_4$  and  $CO_2$ . The source of the gas are jets issuing from the higher temperature fractures in the south polar region crust plus a sputtered source.

**Titan:** The primary goal of the INMS during flybys of Titan is a determination of the neutral gas and thermal ion abundance. The INMS verified the neutral atmosphere model prior to the Huygens probe entry and verified that the upper atmosphere consists of mainly  $CH_4$  and  $N_2$  with traces of other hydrocarbons (including the cyclic hydrocarbon benzene, Fig. 1) and nitriles [5]. Isotopic  $^{40}Ar$  has been detected along with  $H_2$ . The neutral density altitude structure shows variability with latitude, longitude and Titan's orbital position. Wave-like structures are observed in the neutral composition.

The ionosphere composition has a complex carbon-nitrile chemistry that includes hydrocarbons up to at least  $C_7$  that have been detected. Comparison with Plasma Spectrometer data suggests much larger molecular weight ions are also present [6]. The ionospheric peak detected by INMS consists mainly of  $H_2CN^+$  and  $C_2H_5^+$ . The INMS data have also been used to determine the abundance of a number of nitrile

species using both ion and neutral composition [7]. The mass 18 ion has is most likely  $NH_4^+$  derived from  $NH_3$ .

A "hot" component of the neutral atmosphere has been detected [8, 9] due to plasma-ion induced heating.



**Figure 1:** Correspondence of ions (upper) and neutral gas (lower) during pass T19 between 950 and 1000 km [7].

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