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ABSTRACTS OF ORAL PRESENTATIONS

JUPITER'S IO TORUS VIEWED AS A NEBULA

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Space physics research often involves studies of the behavior of plasma and magnetic field structures on a scale large enough to justify the claim that physical understanding, if generalized, apply to astrophysical processes. The availability of rockets to carry scientific payloads throughout the solar system has done for space physics what the introduction of the telescope did for astronomy. The capability to make *in situ* measurements has made all the difference. We now know what we are looking at.

The plasma torus surrounding Jupiter and associated with its innermost Galilean satellite Io is a good example. The Jupiter flybys by several spacecraft revealed that Io is covered with volcanoes that injected about 1000 kg s^{-1} of sulfur dioxide and its constituents into an Io-like orbit about Jupiter whereupon the gas became ionized to form a relatively dense (10^3 – 10^4 ions cm^{-3}) torus of ionized sulfur and oxygen. The cross-sectional diameter of the torus is about the size of Jupiter, and its overall outer diameter (1×10^{11} cm) makes it almost as large as the Sun (1.5×10^{11} cm).

The torus itself is dynamic. It radiates approximately 3×10^{12} Watts in the extreme UV (mainly 685 Å). The radiation is stimulated by impact from the high-energy tail of a thermalized 3 eV (rms) electron population in the torus. The ion thermal temperature is about 50 eV. The radiative loss rate from the torus is so large that the torus would dim perceptibly in just two hours if the electrons were not resupplied with energy almost continuously. Within the torus there are sharp temperature gradients and an outstanding ribbon-like feature. Finally, the torus and its sharp, dense ribbon oscillate in the plane of the torus with an amplitude of nearly 1 R_J and a period that is synchronized to System III period (the spin period of Jupiter's tilted magnetic dipole. The motion can be explained by the presence of a 30 MV electric potential of 30 MV across Jupiter's magnetospheric tail. Few of these phenomena are well understood.

It must be agreed that unless we can get a firm grip on the physics of the Io torus, it will be even more difficult to understand distant astrophysical nebula that are seen exclusively by remote sensing.

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TEMPERATURE AND DENSITY FLUCTUATIONS IN PLANETARY NEBULAE

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There are several issues in the abundance determinations in gaseous nebulae that have been present now for several years: (a) the T_e derived are systematically different for different line ratios, and (b) the intensity of the λ4267 line of $C^{++}$is systematically larger than expected from the λ1909 line, and the derived abundance of C^{++} is larger for I(4267)/I(Hβ) than for I(1909)/I(Hβ). In recent times the faint recombination lines of O^{++} have become available for some bright PNe and this problem was analyzed by Mathis, Torres-Peimbert, & Peimbert (1998); some of their results are presented here.

Since Peimbert (1967) proposed a scheme to study the temperature inhomogeneities

$$T_0 = \frac{\int T N_e N_i dV}{\int N_e N_i dV} \quad \text{and} \quad t^2 = \frac{\int (T - T_0)^2 N_e N_i dV}{\int T_0^2 N_e N_i dV} ,$$

where assuming a smooth temperature distribution it is possible to obtain T_0 and t^2 from the observed ratio of lines of the same ion that originate in different upper states. This treatment has not been widely accepted given that it is cumbersome, it assumes a smooth temperature distribution, and in general it has yielded larger values for t^2 than predicted by many ionization structure models.

We studied the possibility of a bimodal temperature distribution T_{hi} and T_{low}, and a fraction f_{hi}