A THEORETICAL MODEL OF NGC 7027

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It is demonstrated that ionization structure of NGC 7027 cannot be explained by static models based on the standard photoionization theory unless some complementary physical process is included. The main discrepancies are successfully eliminated by including charge transfer reactions with hydrogen for the following ions: C^{+}, C^{+3}, N^{+2}, O^{+2}, Ne^{+2}, S^{+} and S^{+3}, the rate coefficients being probably of the order of or larger than $10^{-9}cm^{+3}s^{-1}$ except for C^{+} and Ne^{+2}; in addition the charge exchange rate for N^{+} is probably $\sim$200 times smaller than the value proposed by Steigman et al. (1971).

An excellent fit to the observations is obtained with a model consisting of a high excitation component at $N_H = 2.5 \times 10^{5}cm^{-3}$ and a lower excitation one at $N_H = 6 \times 10^{4}cm^{-3}$. The high density component may result from the interaction of a strong stellar wind with the nebula. The elemental abundances by number are H, He, C, N, O, Ne, Mg, S = 1.0, 0.10, 3.0(-3), 2.0(-4), 7.3(-4), 2.2(-4), 3.5(-5), 1.7(-5), the nitrogen value depending critically on the assumed charge transfer rate for N^{+2}. The large carbon overabundance confirms the independent determination of Torres-Peimbert and Peimbert (1977).

The last moderate discrepancies concerning [NeIV] λ4724 and [NI] λ5200 are discussed and some observational tests are proposed in order to check the consistency of the whole picture. References: Steigman, G., Werner, M.W., Geldon, F.M., 1971, Astrophys. J. 168, 373; Torres-Peimbert, S., Peimbert, M., 1977, preprint. (Paper will appear in Astronomy and Astrophysics, by Péquignot, Aldrovandi, and Stasinska.)

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