

Warmers: Source of Ionization and N Enrichment in AGN

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Abstract. We present a detailed study of the warmers phase in a starburst as a scenario for AGN (Terlevich & Melnick 1985). A numerical code (“ET”) was developed to compute the time evolution of the total spectrum of an ionizing cluster. ET is based in Maeder & Meynet (1988) and Maeder (1990) tracks and in model atmospheres. The ionizing spectra were input into the photoionization code Aangaba (Gruenwald & Viegas 1991) to calculate the nebular emission for a grid of models covering different densities, ionization parameters, metallicities and cluster ages. The emission line spectrum go through an “active phase” beginning at ≈ 3 Myrs, which lasts for about 3 Myrs, when the population of warmers disappears. Metallicities between $1/2$ and $2 Z_{\odot}$ are necessary to generate AGN line ratios. The lower limit is due to the fact that fewer warmers occur in metal poor regions (due to the smaller mass loss rates) and even if some do occur the line ratios would resemble an HII galaxy rather than a Seyfert 2 or a LINER. The upper limit is set by strong line cooling of the emission nebula. The chemical pollution of the gas by the processed stellar winds from the very massive stars produce straightforwardly a N overabundance as that observed in many AGN. In Figure 1a and b, we show the process of heavy element enrichment as a function of time parametrized by γ —a quantity which measures the mass ejected by stars relative to the mass of gas surrounding the stellar association (see Cid Fernandes *et al.* 1991). The chemical yields were taken from Maeder (1990) models.

Key words: Active Galaxies - Photoionization Models - Chemical Evolution

References

- Cid Fernandes, R., Dottori, H. A., Gruenwald, R. B. & Viegas, S. M.: 1991, *Mon. Not. R. astr. Soc.*, in press.
- Gruenwald, R. B. & Viegas, S. M.: 1991, *Astrophys. J. Suppl.*, in press.
- Maeder, A. & Meynet, G.: 1988, *Astr. Astrophys. Suppl.* 76, 411.
- Maeder, A.: 1990, *Astr. Astrophys. Suppl.* 84, 139.
- Terlevich, R. & Melnick, J.: 1985, *Mon. Not. R. astr. Soc.* 213, 841.

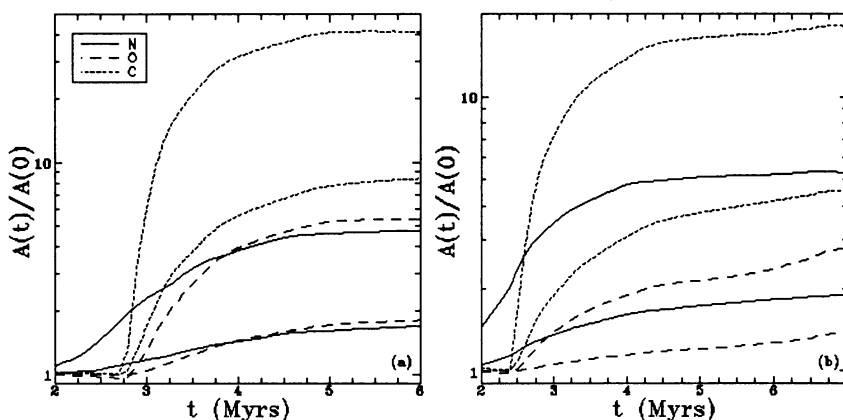


Fig. 1. Evolution of the C, N and O abundances with respect to their initial values for $Z(t = 0) = Z_{\odot}$ (a) and $2Z_{\odot}$ (b). The two sets of curves in each figure correspond to $\gamma = 0.1$ (upper curves) and $\gamma = 1$ (lower curves).