ASTRATION AND PRODUCTION IN CHEMICAL EVOLUTION

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Yokoi et al.[3] introduced a formalism for chemical evolution of the Galaxy which accounts for astration. Malaney et al.[1] used an analogous formalism. In both models however, the astration parameters, respectively χ^a and ξ, are defined only in the instantaneous recycling approximation. We intend to improve the theory by the development of more general equations in the sudden mass loss approximation. Our basic equations are that of Tinsley[2]. We suppose that: in the sudden mass loss approximation, the death of a star of inicial mass M (and lifetime τ_M) is defined only at the instant when all synthesis cease; the distribution of inicial i (any long life r-process radionuclide) is homogeneous at the birth of a star; this homogeneity is locally maintained throughout the life of the star. Our analysis of all depletion trajectories during astration is intended to give the definition of the *depletion reductor of i for the ejected region* (whith mass Q_{ej})

$$\Lambda_i(M) = 1 - \left[\frac{D^i(Q_{ej}(M)) + F^i(Q_{ej}(M))}{Q_{ej}\left[m_i^g(t-\tau_M)/m_g(t-\tau_M)\right]}\right] \quad \text{(that is analogous to } \chi^a \text{ or 1-}\xi\text{)}, \qquad (1)$$

where m_i^g/m_g is the i abundance on the ISM; D^i and F^i are, respectively the inicial i mass depleted and the result of the total "out minus in" inicial i mass in the region throughout the life of the star. Now, let $\mathcal{P}_k^s$ be the total production rate of a k nuclide due to all post main sequence stars with masses above a minimum M_k, and $\theta_M^k(t-t_M)$ the rate of convertion of stellar mass fraction on k, by an M star, $(t-t_M)$ before its birth at t_M. We can write

$$\mathcal{P}_k^s(t) = \int_{M_k}^{M_{max}} \int_{t-\tau_M}^{t-0.9\tau_M} M\,\theta_M^k(t-t_M)\,\psi(t_M)\,dt_M\,\phi(M)\,dM \quad , \qquad (2)$$

where ψ is the star formation rate and ϕ is the inicial mass function. It can be shown that, if: 1)$\psi(t_M) \approx \psi(t-\tau_M)$ in the short time interval $0.1\tau_M$ for each M ; 2)there is no depletion nor production of k in ISM; 3)there is no depletion of inicial k neither of new k during star evolution; 4)k abundance in the infall is negligible; 5)all locked new k is exausted in remnants; then, if k represents metals, from (2) and from a *general* equation of conservation of the nuclides, we can obtain the equation of Tinsley[2] for conservation of metals (however we should see this last one as an approximate equation).

References

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[3]Yokoi,K., Takahashi,K. and Arnould,M. (1983) Astron. Astrophys. **117**, 65-82.