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Can we build up second generation stars in GCs directly from the ejecta of AGBs?

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Abstract. My contribution to the round table on chemistry and selfpollution mechanisms examines the consequences behind the hypothesis of globular clusters are made up by a first stellar generation plus a second, long stage of star formation, lasting some 200Myr, directly from the ejecta of AGB stars.

Key words. Star formation and Initial Mass function in Globular Cluster stars

I have been discussing that many hints point towards the idea that a second generation of stars is born continuously in Globular Clusters, from the ejecta of massive AGB stars, and that this is the easiest explanation for the chemical anomalies among GC stars (D'Antona 2004; D'Antona et al. 2002). As these anomalies generally concern 30 - 50% of the clusters stars, about this fraction must be made up in the second generation. It is very easy to be convinced that the mass budget requirements can be met *only*if the original Initial Mass Function of the cluster stars is not too steep (that is: if many AGBs indeed form). This is illustrated in Figure 1. So we need a *flat* IMF, that is, for a power law IMF dN/dM $\propto M^{-(1+x)}$, we need x$\sim$ 0. But is there any evidence for a flat IMF in the mass range of massive AGBs, that is stars of 4-8$M_{\odot}$? Kroupa (2001) compilation of the IMF —made for many stellar populations and different mass ranges— shows that the typical IMF index is $\simeq$1.3, that is Salpeter's index –apart than for masses $< 1M_{\odot}$, which have indeed x$\simeq$0.

A possible solution is that the IMF slope in the central parts of clusters is indeed different than in the field. Panagia et al. (2000), in a systematic study of the young stellar population around the Supernova 1987A, show that the number ratio of low mass (1-2Msun) stars to massive stars is very low, $\sim$1.4, within 130" from the supernova, corresponding to about 30pc, while it is $\sim$8.9 in the general field: this translates in IMF slope x=0.5, to be compared with x=1.5 for the entire field. An IMF of mild slope is therefore not to be ruled out: it may well be that in compact stellar systems the IMF slope is mild, while it is much steeper in the general field, reflecting different processes of star formation, as Panagia et al. (2000) suggest.

Other hints came some years ago based on the possible interpretation of MACHO halo objects in terms of halo white dwarfs (Adams & Laughlin 1996; Chabrier et al. 1996). The same Kroupa (2001) paper suggests a systematically varying IMF, which, in the past, had a characteristic fragmentation mass around 1–2$M_{\odot}$, while today it is about 0.1$M_{\odot}$. Finally, the pro-

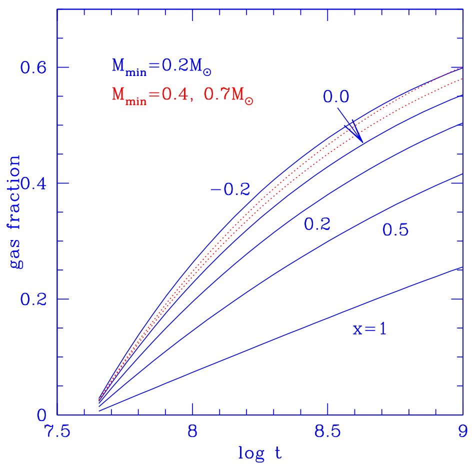

Fig. 1. As function of time, we show the cumulative mass in the ejecta from the first generation of AGB stars which are contained in the initial population having an IMF of index x, and the minimum mass as labeled. We can suppose that the second star forming phase lasts for a time of 2–3$\times10^8$yr, so that we need a very flat IMF (low values of x) if there has to be a considerable fraction of mass in the second generation stars.

cess of formation of a second generation of stars can not be decoupled from the dynamical evolution of the GC: it is indeed possible that the GCs we see today are much smaller than the initial ones. During the first phases of evolution, the intermediate mass stars had time to segregate into the cluster central parts, where, for this reason, indeed the local IMF would look flattish. The ejecta of these stars gave birth to the second generation, but the external parts of the cluster, containing a good fraction of the first generation low mass stars, was lost, leaving the present proportion of first and second generation stars.

In summary, there are several reasons why the fact that there can be so many second generation stars should not be regarded as a problem in the selfpollution picture we are proposing.

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