JOINT DISCUSSIONS

JD1

Abundance Ratios in the Oldest Stars

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JOINT DISCUSSION 1: ABUNDANCE RATIOS IN THE OLDEST STARS

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1. Introduction

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The inspiration for this meeting was the growing overlap and connections between previously separate areas of astrophysical research, namely, studies of stellar abundances, the bulges of galaxies, the gaseous components of nearby galaxies and the clouds (some of which may be primordial) responsible for the narrow absorption lines in quasars.

The signature of the early chemical evolution of our Galaxy is imprinted in the abundance ratios of the oldest stars. We recall that element ratios are determined by a mix of the relative rates of different types of supernovae, the stellar IMF, and the relative histories of star formation rates and gaseous flows, and thus encapsulate much of the history of star formation and ISM evolution in galaxies. Hence, abundance ratios in stars are a primary probe for testing theories of galaxy formation and evolution.

We do not know how the Galaxy formed: both the Eggen, Lynden-Bell & Sandage (1962) and the Searle & Zinn (1978) scenarios may be accommodated in the recent proposal of van den Bergh (1993) where the inner Galaxy follows ELS, whereas the outer Galaxy formation conforms to the Searle-Zinn proposition. A combination of abundance ratios, ages derived from colour-magnitude diagrams, and kinematical properties, can give us the required information to trace the past history of our Galaxy. We note here, that although stellar evolution and model atmospheres are not discussed in the proceedings both topics are of fundamental underlying importance. Model atmospheres are used to derive temperatures, colors and bolometric corrections of stars that are used not only in abundance analyses but also in deriving the ages of stars by comparing CM diagrams with HR diagrams. This process is under close scrutiny because of the apparent difference between the ages of the oldest stars and the expansion age of the universe.

In the present JD, abundance ratios in the halo and bulge, which are the oldest components of our Galaxy, are reviewed. In particular, the abundances of CNO, α-elements, r- and s-elements relative to Fe in the halo and bulge as compared to the disk. Let us note that, due to improved model atmospheres on the one hand, and selections of stellar samples based on kinematical properties on the other, the most recent abundance results, such as that of Nissen & Schuster (1997), show unexpected features.

A comparison between the abundances found in elliptical galaxies and from QSO absorption lines and those predicted by chemical evolution models could help us understand the early chemical evolution of ellipticals and the intergalactic gas.

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Elliptical galaxies are currently interpreted in essentially three ways with regard to their stellar populations: (i) an old stellar population, (ii) a combination of an old plus a young stellar component, (iii) an originally old stellar population, strongly modified by merging processes with other galaxies - the main post-merger characteristic is an intermediate age stellar population formed during the merging process. Despite the different evolutionary scenarios suggested by these interpretations, it is important to note how homogeneous most of these objects are, a large percentage of them following tight relations in the fundamental plane (Burstein et al. 1986; Djorgovski & Davis 1987). In particular, how does one explain the tight correlation between the metallicity indicator Mg_2 versus velocity dispersion and other quantities, in view of a possible variation of [Mg/Fe] in those galaxies ?

The determination of abundances in intergalactic clouds at increasing distances in the line-of-sight of quasars enables the direct study of the chemical evolution with time towards the past. A comparison between these abundances and those found in Galactic metal-poor stars of similar metallicities may lead to a better understanding of chemical evolution as a whole in different parts of our Universe.

Finally, it is important to point out that this is the last General Assembly which will precede the general availability of telescopes of 8-12m class. As analysis of the elemental abundances in the oldest stars, quasar absorption lines and abundances deduced from population synthesis in the bulges of ellipticals/spirals are stated goals of essentially all these telescopes, 1997 is a particularly important time to take stock of our current knowledge in these fields. Future GAs will discuss the progress made by the years 2000 or 2003 following the technological leaps in faint object spectroscopy.

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