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Foreword

The Liège International Astrophysical Colloquia (LIAC) started in 1949 at the initiative of Pol Swings, and they were continued with the efforts of Paul Ledoux and Marcel Migeotte. They were organized each year except for those when a General Assembly of the IAU took place. About sixty years after the first edition we are now at the 40th edition of the series.

This is not the place to list all the astrophysical discoveries that were presented before publication at a Liège colloquium. Just an example: the first interpretation by Allan Sandage of the HR diagram of a globular cluster in terms of stellar evolution was presented in 1953, but not published until 1957. At that time, even for a major advance in astrophysics such as this, the rush to publish was much, much smaller than it is nowadays.

For the 40th edition of the LIAC we have decided to concentrate on ageing stars. Specifically, we have focused on low-mass red giants, either ascending the red giant branch or in the red clump helium-burning phase, sdB stars and white dwarfs. This choice was justified by the increasing quality of ground-based asteroseismic data and by the enormous amount of splendid asteroseismic observations obtained over the last few years by the space missions CoRoT and *Kepler*.

These stars have very complex internal structures. They are extremely interesting because they bear multiple signatures of their past history. For example, their time as young main sequence stars, still with a growing convective core, left unique observational signatures still visible today. These signatures mainly take the form of chemical discontinuities and anomalies in surface abundances. They are the result of physical processes that are still not fully understood such as rotation, convection, overshooting and diffusion, which are not fully properly implemented in stellar evolution codes.

Fortunately we have a powerful tool: asteroseismology, a sort of scanner. When added to other tools such as photometry, spectroscopy and interferometry, asteroseismology allows us to shed some light on the interior of stars. However, in evolved stars with huge density contrasts, fast rotating cores and chemical discontinuities leading to sharp features in the Brunt-Väisälä frequency, the message sent to us through the frequency spectra is extremely difficult to understand and interpret. It is a real challenge to decipher what such stars are really telling us.

A main goal of this colloquium was first to present and discuss what we know about the structure of low-mass stars at advanced phases of their evolution, and especially to point out the numerous open problems in their structure and their evolution. Asteroseismology then gives a glimpse into the deep interior of these stars. Moreover, we can determine masses, radii and ages with an unprecedented accuracy. Not forgetting all our other tools (in particular spectroscopy for obtaining stellar metallicities), a better understanding of the evolution of stars and of the structure and the chemical evolution of our Galaxy is now within our reach.

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