Preface

Red giants are cool, highly luminous stars, covering a rather wide domain in mass, age, chemical composition, and evolutionary state. They have an extended convective envelope which can, as in solar-like stars, stochastically excite p-modes of oscillation. During its first long run (150 days) of observation, the CoRoT satellite launched in December 2006 has observed a large number of red giants and has detected these oscillations in about 900 of them. Not only radial but also nonradial modes of oscillation were detected. It was indeed the first clear detection of nonradial modes in such stars. Moreover, for the very first time, the large number of observed stars (it amounts now to thousands and many more to come) allows the statistical analysis of red giants based on their pulsation properties.

- The first striking result of this statistical analysis has shown that the distribution of frequency at maximum power ($\nu_{\max}$) among all the observed red giants presents a rather narrow peak centered on about 35 μHz. This has to bear the print of the evolution of our Galaxy since these red giants of different masses and ages are representative of all the successive generations of stars in the Galaxy. A first theoretical study made using synthetic stellar population models shows that the actual distribution of red giants in the CoRoT field is indeed highly dominated by stars in a narrow range of stellar masses from 0.8 to 2.5 $M_{\odot}$. The computed distribution of the frequency at maximum power for such stars, which is determined by their mass, radius, and effective temperature does indeed present a peak near 35 μHz, excitingly close to the observed value. These stars (0.8–2.5 $M_{\odot}$) are "red clump" stars. They have undergone a helium flash, with a common critical mass of their helium core of about 0.5 $M_{\odot}$; their luminosities and their radii are thus almost the same. Observations of red giants in clusters show indeed an accumulation of stars in this region of the HR diagram. Moreover, as shown by Hipparcos data, the bulk of giant stars in the solar neighborhood consist indeed of red clump stars.
- This can have a very important impact on our vision of the Galaxy. If $\nu_{\max}$ of a red giant, whose parallax is unknown, is derived from asteroseismic observations together with the so-called large frequency separation, its radius can be estimated

and its distance derived. Solar-like oscillating red giants can thus become new distance indicators.
- A spectroscopic analysis of these stars coupled with this new distance indicator could provide an unprecedented tool to measure the radial and vertical metallicity gradient in our Galaxy. These gradients would be representative of the metallicity distribution at an early phase of the galactic evolution, typical of the time of birth of clump stars. Moreover, thanks to the estimate of stellar mass through seismic constraints, we can potentially characterize the age distributions and age-metallicity relations of the observed populations of giants.

These results are so promising that further analyses are urgently needed. Future CoRoT long runs pointed on different galactic longitudes will bring new red giant asteroseismic data. The *Kepler* mission will also observe red giants at a higher galactic latitude compared to that of CoRoT's fields. The PLATO mission will hopefully add some important data to this harvest. This could indeed reveal secondary peaks in the distribution of the frequency at maximum power, indicative of different stellar populations or different stellar formation episodes. The pulsation properties now available for thousands of red giants promise to add valuable and independent constraints to current models of structure and evolution of our Galaxy. Such a close connection between stellar evolution, galactic evolution, and asteroseismology opens a new very promising gate in our understanding of stars and galaxies. It needs, however, a collaboration between researchers of different expertise. The aim of this workshop was thus to put together for a 3-day meeting,

- Expert researchers in galactic evolution
- Expert researchers in stellar structure
- Asteroseismologists from the Red Giant Team of the CoRoT and *Kepler* missions

in order to allow a broad discussion on the physical aspects involved in red giant modeling such as convection, rotation, conditions prevailing at the onset and during the helium flash, as well as on the parameters involved in galactic evolution and stellar population synthesis, e.g., Stellar Formation Rate, Age-Metallicity Relation, Initial Mass Function.

We are happy to say that due to the dedication and the enthusiasm of the participants, this workshop was a great success. All of us learned a lot, discussed a lot, ate a lot, drank a lot, and went back to their home university with their head full of new ideas and plans for future collaborations.

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