ton luminosity (Kawaler, 1986) — we still are not able to model correctly the way the overall frequency pattern changes with time as the star cools, although we seem to have the timescale about right.

We still have a lot to learn from the white dwarf stars, particularly about the history of nucleosynthesis in our galaxy. That record is written there, and we now have the tools with which we can examine it. We might even be able to understand, at long last, the mysterious process by which a red giant becomes a white dwarf — a problem "solved" long ago.

SEISMOLOGICAL RESULTS ON INDIVIDUAL STARS

	PG-1159	PG-2131	GD 358
Mass	0.59 ± 0.01	0.593 ± 0.006	0.61 ± 0.03
He layer	4×10^{-3}	6×10^{-3}	2×10^{-6}
Rot. per.	1.38 ± 0.01 d	0.42d	0.89-1.6d
Rot. type	solid body	differential	differential
Mag. Field	< 200 G	$\sim$5,000 G	1300 G
Abs. Lum.	200 ± 5	$\sim$30.5	0.05 ± 0.01
Seis. Dist.	440 ± 40 pc	$\sim$1200 pc	42 ± 3 pc

15. Seismology of δ Scuti stars in stellar clusters (Y. Lebreton, E. Michel)

Several δ Scuti stars (A/F stars) have been observed during multi-site campaigns of observations and have been found to be multiperiodic pulsators. They are thus good candidates for asteroseismology from ground based observations. Observations provide the position of the star in the H-R diagram and some frequencies (about 5 for the STEPHI campaigns). Comparisons with models should then allow to identify the oscillation modes of the star and then give information on the unknown parameters of the star (mass, age, chemical composition). However the situation is complicated, since stellar models are based on a physical description of the stellar material, which is not well known in many respects. In particular A/F stars have convective cores, the extent of which depends on the amount of overshooting considered and on the description of this process.

The observation of several δ Scuti stars in the *same* stellar cluster in principle simplifies the problem. All the stars have, in that case, the same chemical composition and their age is the age of the cluster which can be determined by means of comparison with theoretical isochrones. Then, when one more star is observed in the same cluster, this brings several new observable quantities but only one more unknown quantity, the mass of that particular star.

https://doi.org/10.1017/S1539299600011485 Published online by Cambridge University Press

To illustrate the method, we consider a δ Scuti star for which several frequencies are observed, for instance $\nu_{0,1}$, $\nu_{0,2}$, $\nu_{0,3}$ (fundamental radial mode and first and second radial overtones) and the frequency of a "mixed mode" ν_{G1} (see Unno *et al.*, 1989). The accuracy on the frequency measurements is high ($0.1\,\mu$Hz), but the uncertainty on the position of the star in the H-R diagram (luminosity and effective temperature) can be important.

By means of theoretical models it is possible to estimate the unknown parameters of the star (mass, age, composition, physics) provided a sufficient number of observables (frequencies) is available. However as shown by Brown *et al.* (1994) and by Lebreton *et al.* (1994), some of the observables are not independent and the set of observables has to be carefully chosen. By choosing as independent observables $\nu_{0,1}$, $\nu_{0,3}/\nu_{0,1}$ and ν_{G1} we try to solve for the most important physical unknown, the overshooting parameter O_v. We find that, with the actual precision on the measured frequencies, O_v could be determined with a precision of 20 % (0.03 H_p, where H_p is the pressure scale-height) which is quite good since presently O_v is estimated to be 0.15 ± 0.15 H_p.

Unfortunately, the uncertainty on the helium abundance of those stars is high since it cannot be obtained by observations. So, in order to get estimates of both the overshooting distance and the helium abundance, it will be necessary either to observe more frequencies for a given star, or to observe several stars in the same cluster in order to increase the number of independent observables with respect to the number of unknown parameters. We have found that disregarding effects of fast rotation, for these stars, would lead to a misidentification of the modes.

Finally, we consider the effect of fast rotation. Fast rotation induces a frequency shift in the oscillation spectrum (Saio, 1981; Dziembowski & Goode, 1993; Soufi *et al.*, 1994). If this shift was neglected in the previous example, this would lead to erroneous values of the overshooting parameter. Rotation also modifies the position of a star in the H-R diagram with respect to a non-rotating star. The displacement in the H-R diagram has been estimated by Maeder and Peytremann (1970, 1972).

16. Observations of deep-seated structure in the stellar winds of OB stars (R. K. Prinja)

High-resolution, time-resolved spectroscopy in both optical and UV wavebands has shown that the outer layers of luminous OB stars vary on time scales of hours-days. Spectroscopic monitoring with the IUE satellite provides evidence that the stellar winds of luminous, hot stars are not smooth and steady, but are frequently disrupted by the presence of time-dependent structures. In addition, variability is often present in optical photospheric