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Solar-like oscillations in open cluster stars

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Introduction

Asteroseismology of stellar clusters is potentially a powerful tool. The assumption of a common age, distance, and chemical composition provides constraints on each cluster member, which significantly improves the asteroseismic output. Hence, detecting oscillations in cluster stars in a range of evolutionary stages holds promise of providing more stringent tests of stellar evolution theory. Driven by this great potential, we carried out multi-site observations aimed at detecting solar-like oscillations in the red giant stars in the open cluster M67 (NGC 2682). To obtain these data we observed for 43 days with nine 0.6-m to 2.1-m class telescopes in January and February 2004 (Stello et al. 2006). The photometric time series comprises roughly 18000 data points. The properties of the red giant stars we present here are given in Table 1 and their location in the colour-magnitude diagram is shown in Fig. 1 (left panel).

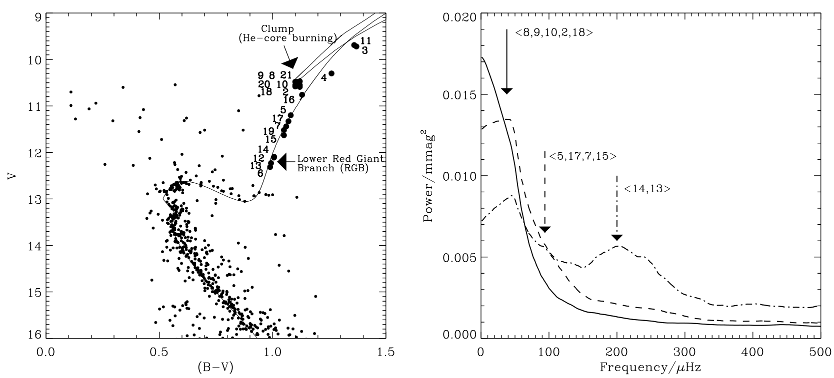

Figure 1: Left Panel: The colour-magnitude diagram of the open cluster M67. The red giant target stars and their ID are indicated. Right Panel: Average power distributions for three groups of stars sorted according to luminosity: most luminous (clump stars), intermediate, and least luminous (lower RGB). Arrows show expected locations of solar-like oscillations (see Table 1). Only stars with a white-noise level lower than 50 μmag have been used.

Table 1: Properties of red giant target stars. Luminosities and temperatures are from photometry (Montgomery et al. 1993). Estimates of oscillation amplitudes, characteristic frequencies and large separations are from known scaling relations in the literature (Kjeldsen & Bedding 1995, Brown et al. 1991). Cross-references are to Sanders (1977) and Gilliland et al. (1991).

ID	$L/L_\odot$	$T_{\rm eff}$ K	$\delta L/L$ μmag	$\nu_{\rm max}$ μHz	$\Delta\nu_0$ μHz	Cross-ref.
8	50.8	4750	287	35.8	4.3	S1010/G2
9	50.2	4772	281	36.8	4.4	S1084/–
10	48.2	4727	275	37.0	4.4	S1279/G7
2	46.4	4727	265	38.4	4.6	S1074/–
18	45.8	4772	256	40.3	4.7	S1316/–
5	25.4	4815	140	74.8	7.6	S1054/G9
17	22.4	4835	122	86.0	8.4	S1288/–
7	20.2	4854	109	96.9	9.2	S989/G12
15	16.9	4873	91	117.3	10.6	S1277/–
14	11.2	4945	58	187.3	15.2	S1293/–
13	9.9	4966	51	213.2	16.8	S1305/–

Results

Mean levels in the Fourier spectra in the frequency interval 300–900 μHz, corresponding to white noise, reach 20 μmag for the stars with the lowest noise. In many stars we see apparently high levels of non-white noise, but the detailed temporal variation of the noise is unknown. We are therefore not able to clearly disentangle the noise and stellar signal in the analysis. However, we do see evidence of excess power in the Fourier spectra, shifting to lower frequencies for more luminous stars, consistent with expectations (Fig. 1; right panel). If the observed power excesses were due to stellar oscillations, this result would show great prospects for asteroseismology in stellar clusters. A more detailed analysis will be given by Stello et al. (2007).

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