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DISSERTATION SUMMARY

The Origin and Evolution of the White-Dwarf Stars

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The secret of how white-dwarf stars form and evolve is hidden in their interiors. There, gravity separates the constituent elements into layers; the lighter elements float to the top and the heavier ones sink. Consequently, a white dwarf's structure depends on the quantity of the elements present. Measuring that structure can tell us about the processes which formed white dwarfs and allow us to calculate how fast they cool. The latter is indispensable for measuring the age of our galaxy using the oldest white dwarfs as chronometers.

Because some white dwarfs pulsate, we can exploit the resulting luminosity variations to measure their internal structure using "asteroseismology," a procedure analogous to terrestrial seismology. Exploring white-dwarf structure via asteroseismology poses a difficult observational task: acquiring essentially uninterrupted time series measurements of the brightness changes of pulsating white dwarf stars. We have accomplished this task using an instrument we developed for this purpose, the Whole Earth Telescope.

By combining data from the Whole Earth Telescope with published measurements, we have detected a common pattern in the pulsation spectra of all the variable, hydrogen spectra white dwarfs (DAVs), implying that they have similar surface hydrogen layer masses. Because we have identified the degree (l) and the radial overtone (k) of the modes in the pattern detected, we have been able to compare their periods to published pulsation models to find the mass of the hydrogen layer; it is about 10^{-4} times the total stellar mass. This result will require adjustments to published estimates of the age of the galaxy which use theoretical cooling times of the oldest white dwarfs as a time standard; the theoretical models typically assume much thinner hydrogen layers.

We have also investigated the two classes of pulsating helium spectra white dwarfs (DOVs and DBVs). From their pulsation properties, and the mass of the hydrogen layer measured for the DAVs, we have concluded that the helium surface white dwarfs do not form via the same process as the hydrogen surface stars. There must be at least two separate channels for white dwarf formation.