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Carl J. Hansen (1933–2011)

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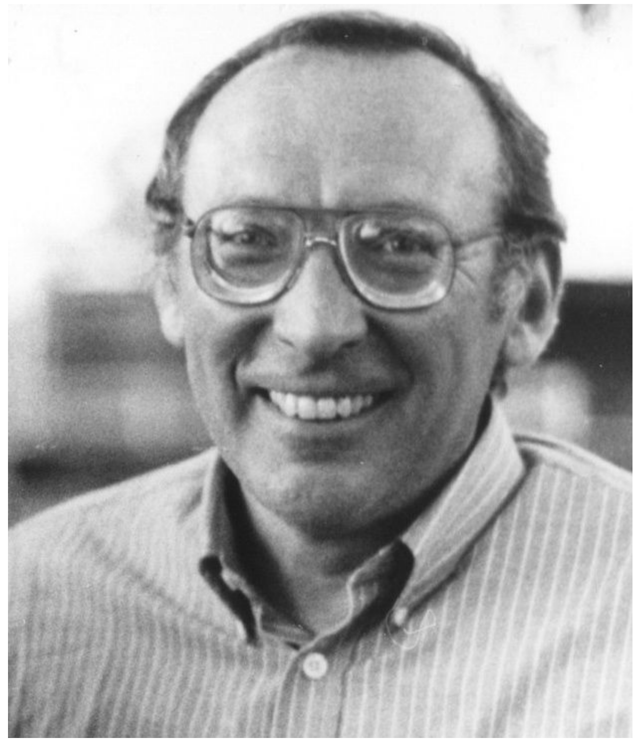
Carl John Hansen died on Sunday the 3rd of July, 2011.



Carl John Hansen, an emeritus professor at the University of Colorado, died at Ocean Beach Hospital in Ilwaco, Washington, from congestive heart failure. He was a well-liked astrophysicist who was a leading expert on the properties of dense stars and the matter of which they are composed and an outstanding stellar-oscillation theorist.

Carl was born in Brooklyn, New York, on December 21, 1933. After graduation from Stuyvesant High School, he obtained a B.Sc. in mathematics from Queens College of the City University of New York. He spent a few years working as a nuclear reactor analyst at Combustion Engineering, Inc. In October, 1957, the Soviet Union launched *Sputnik 1*, the first man-made satellite to orbit the Earth. This awakened the United States to the very real danger of losing technological supremacy to another country and spurred a vigorous federal response to encourage young people into careers in science and technology. Whether or not this had anything to do with Carl's decision to return to academia, in the late 1950s he enrolled as a graduate student at Yale University, where he earned his M.Sc. He joined a research group in the rapidly developing field of nuclear astrophysics and in 1966 completed his dissertation under the supervision of the late A. G. W. Cameron (1925–2005). His Ph.D. thesis was entitled "Neutrino Emission from Dense Stellar Interiors". A paper based on this work was published in 1968 [1]. Carl then accepted a postdoctoral appointment at the Joint Institute for Laboratory Astrophysics (JILA) at the University of Colorado, working with the late John P. Cox (1926–1984).

Carl became a faculty member at Colorado in 1968. He wrote one of the early codes to do explosion hydrodynamics, and in 1969 he and graduate student J. Craig Wheeler, whose research he was supervising, published an important paper on supernova explosions [2]. Carl's research continued to be focused on dense stars and on the properties of the dense matter of which they are composed. In 1972, Carl hosted IAU Symposium No. 53 on the physics of dense matter at the University of Colorado, and he and Lorraine H. Volsky edited the conference proceedings [3].

Carl rose rapidly through the academic ranks, becoming a full professor in 1974. In 1973, Carl and JILA Visiting Fellow Yoji Osaki computed the nonradial pulsation modes of cooling white-dwarf models to show that the oscillation periods are in precisely the period range observed for the ZZ Ceti stars [4]. In 1974, Carl joined a group of nuclear physics experimentalists to begin a series of thick-target measurements of various nuclear reaction rates of astrophysical interest [5]. Carl greatly enjoyed participating in this work, which continued for many years, with publications appearing episodically.

John Cox introduced Carl to Hugh Van Horn, who had been one of John's students at Cornell University before John moved to Colorado. Carl and Hugh hit it off immediately and soon became fast friends and close collaborators. In 1973, Hugh became a Visiting Fellow at JILA, and the collaboration really took off. After a JILA colloquium on accreting neutron stars and transient X-ray sources, Hugh and Carl performed a quick project to study nuclear burning in accreting neutron stars. Carl realized that the thin nuclear-burning shells were likely to be unstable. He estimated the instability timescales, and the two suggested that such models might be relevant to the transient X-ray sources [6]. More detailed models by Paul Joss and Ron Taam led to this becoming the accepted model for such sources.

Carl and Hugh continued to collaborate after Hugh returned to the University of Rochester, and they ultimately supervised two Ph.D. students jointly. In 1979, Hugh hosted IAU Colloquium No. 53 at the University of Rochester. One of the key astrophysical puzzles at the time concerned the nature of the ZZ Ceti pulsations. Motivated by a review talk at the conference by E. L. ("Rob") Robinson on the observational properties of these stars, Carl and Hugh undertook to supervise Donald E. Winget's Ph. D. thesis on this topic. Ultimately, the three found that nonradial *g*-mode pulsations are trapped in the highly stratified surface layers produced by the very high surface gravities of these dense white dwarfs [7]. They also found that the modes are driven in the H-ionization zone in the white-dwarf surface layers [8].

Carl and Hugh also collaborated in supervising the Ph.D. thesis research of Patrick N. McDermott to investigate the nonradial oscillations of neutron stars. This work resulted in the determination of the nonradial oscillation spectra [9][10][11] and in determinations of the different damping mechanisms for various modes [12].

Carl was truly the embodiment of the concept of a mentor. Not only did his students benefit from his personal supervision, but also a number of brilliant scientists had their careers altered for the better after spending time with Carl in Boulder.

One of the most-cited papers by Carl and his colleagues involved using the cooling timescale of the faintest white dwarfs to determine the age of the disk of the Milky Way Galaxy (which with great chutzpah the authors extrapolated to estimate the age of the Universe!). During the 1980s, observers had come to realize that there is a real deficiency of the very faintest white dwarfs, and—realizing that the luminosity of a white dwarf depends in a by-then well-determined way on its age—Carl and his colleagues used this to estimate the age of the galactic disk as 9.3 ± 2.0 Gyr.

Another highly cited paper concerned the development of the "Whole Earth Telescope" (WET), which involved observations of rapidly varying stars coordinated among a group of observatories spread around the world, preferably with identical fast-photometric instrumentation [13]. The brainchild of the late R. Edward Nather (1926–2014), the WET allowed essentially uninterrupted observations of a given celestial object for days or weeks. As one wag put it, "The sun never rises on the Whole Earth Telescope!" This enabled observations of multiperiodic variations to be resolved completely. This approach was applied with tremendous success to obtain 264 hours of essentially continuous data and resolve the period spectrum of the hot, pulsating pre-white dwarf star PG 1159−035. The observations revealed 101 specific individual pulsation modes with periods between 385 and 1000 seconds, enabling the authors to constrain the stellar mass, rotation period, and magnetic-field strength and to confirm that the outer layers of this star are indeed compositionally stratified by its high surface gravity. Carl's work on data analysis and theoretical interpretation, including the asymptotic analysis of rotational splitting of modes, was presented in this paper. His earlier work had laid the foundations for the asteroseismology of compact stars, and this paper brought it to maturity.

In 1994, Carl and Steven D. Kawaler, a former University of Texas Ph.D. student who had been supervised jointly by Carl and Don Winget, wrote a very well-received book on the structure and evolution of the stars [14]. A second edition was published ten years later, with Virginia Trimble added as a co-author. Also in 1994, Carl was part of another WET collaboration that obtained 154 hours of high-speed photometric data for the variable DB (He atmosphere) white dwarf GD 358. From more than 180 significant peaks in the oscillation spectrum, the authors were able to constrain the stellar mass, the mass of the outer He layer, the stellar luminosity and the distance, and to show that it has a 1300 G magnetic field.

In an initiative late in his life, Carl volunteered to write sections on astrobiology for the reviews “Astrophysics in 2005” and “Astrophysics in 2006,” so that these papers became Trimble, Aschwanden, and Hansen [15][16]. He caught perfectly the slightly frivolous style of the first two authors (Markus Aschwanden had been writing the Sun section for a decade or so, and Trimble had done the rest from 1991 on), and he added significant expertise on the subject.

Carl Hansen died on July 3, 2011. He is survived by his second wife, Camille, and his son Ethan from his first marriage. With his death, his colleagues have lost a good friend and a treasured scientific colleague. Many often still find themselves wondering, “What would Carl do (or say)…” when doing science, working with students, dealing with fellow faculty, *etc*. The field of stellar astrophysics will be poorer because Carl is no longer with us.

Citations

1. Hansen, Carl J. (1968). Some Weak Interaction Processes in Highly Evolved Stars. *Ap&SS*, *1*(4), 499–512. https://doi.org/10.1007/BF00658771 ↩
2. Hansen, Carl J., & Wheeler, J. Craig. (1969). A Calculation of a White Dwarf Supernova. *Ap&SS*, *3*(3), 464–474. https://doi.org/10.1007/BF00653366 ↩
3. Hansen, Carl J. (1974). *Physics of dense matter.* ↩
4. Osaki, Y., & Hansen, C. J. (1973). Nonradial oscillations of cooling white dwarfs. *ApJ*, *185*, 277. https://doi.org/10.1086/152415 ↩
5. Roughton, N. A., Fritts, M. J., Peterson, R. J., Zaidins, C. S., & Hansen, C. J. (1974). Thick-Target Measurement of the (p, v) Stellar Reaction Rates on the Nuclides 12C, 29Si 46 Ti , 47 Ti, and 56 Fe. *ApJ*, *188*, 595–602. https://doi.org/10.1086/152752 ↩
6. Hansen, C. J., & van Horn, H. M. (1975). Steady-state nuclear fusion in accreting neutron-star envelopes. *ApJ*, *195*, 735–741. https://doi.org/10.1086/153375 ↩
7. Winget, D. E., van Horn, H. M., & Hansen, C. J. (1981). The nature of the ZZ Ceti oscillations - Trapped modes in compositionally stratified white dwarfs. *ApJL*, *245*, L33–L36. https://doi.org/10.1086/183516 ↩

8. Winget, D. E., van Horn, H. M., Tassoul, M., Fontaine, G., Hansen, C. J., & Carroll, B. W. (1982). Hydrogen-driving and the blue edge of compositionally stratified ZZ Ceti star models. *ApJL*, *252*, L65–L68. https://doi.org/10.1086/183721 ↩

9. McDermott, P. N., Hansen, C. J., van Horn, H. M., & Buland , R. (1985). The nonradial oscillation spectra of neutron stars. *ApJL*, *297*, L37–L40. https://doi.org/10.1086/184553 ↩

10. Carroll, B. W., Zweibel, E. G., Hansen, C. J., McDermott, P. N., Savedoff, M. P., Thomas, J. H., & van Horn, H. M. (1986). Oscillation Spectra of Neutron Stars with Strong Magnetic Fields. *ApJ*, *305*, 767. https://doi.org/10.1086/164290 ↩

11. McDermott, P. N., van Horn, H. M., & Hansen, C. J. (1988). Nonradial Oscillations of Neutron Stars. *ApJ*, *325*, 725. https://doi.org/10.1086/166044 ↩

12. McDermott, P. N., Savedoff, M. P., van Horn, H. M., Zweibel, E. G., & Hansen, C. J. (1984). Electromagnetic damping of neutron star oscillations. *ApJ*, *281*, 746–750. https://doi.org/10.1086/162152 ↩

13. Nather, R. E., Winget, D. E., Clemens, J. C., Hansen, C. J., & Hine, B. P. (1990). The Whole Earth Telescope: A New Astronomical Instrument. *ApJ*, *361*, 309. https://doi.org/10.1086/169196 ↩

14. Hansen, Carl J., & Kawaler, Steven D. (1994). *Stellar Interiors. Physical Principles, Structure, and Evolution.* https://doi.org/10.1007/978-1-4419-9110-2 ↩

15. Trimble, Virginia, Aschwanden, Markus J., & Hansen, Carl J. (2006). Astrophysics in 2005. *PASP*, *118*(845), 947–1047. https://doi.org/10.1086/506157 ↩

16. Trimble, Virginia, Aschwanden, Markus J., & Hansen, Carl J. (2007). Astrophysics in 2006. *SSR*, *132*(1), 1–182. https://doi.org/10.1007/s11214-007-9224-0 ↩