

COMMITTEE ON THE FACULTY RESEARCH LECTURE
Annual Report, 2006-07

To the Academic Senate, Santa Cruz Division:

The Senate Committee on the Faculty Research Lecture enthusiastically nominates Stanford Woosley, Professor of Astronomy and Astrophysics, to deliver the 2007-2008 lecture. As one of the world's leading astronomers, Professor Woosley is widely known for his pioneering work in understanding the end-stage evolution of massive stars.

Stanford Woosley began his scientific career at Rice University, completing a B.S. in physics 1966 and a Ph.D. in Astrophysics in 1971. He came to UCSC as an assistant professor in 1975 after holding research positions at Rice and Cal Tech. In addition to his ground-breaking research, Professor Woosley has been generous with his service obligations to UCSC. He served several times as chair of the Astronomy Department, for instance: a two-year stint in 1989-91, a five-year term from 1998-2003, and a short interim appointment for a quarter in 2006. His contributions to his profession have been widely acknowledged nationally. In 2001 he was elected to the American Academy of Arts and Sciences and in 2005 he received two prestigious awards: the Hans Bethe Prize in Nuclear Astrophysics from the American Physical Society and the Bruno Rossi Prize in High Energy Astrophysics from the American Astronomical Society. Both awards cited his fundamental contributions to stellar evolution theory, particularly noting his highly influential collapsar model of gamma-ray bursts in supernovae. In 2006 Professor Woosley was elected to the National Academy of Sciences in recognition of his singular influence in the international astronomical community.

Professor Woosley's work involves the mathematical modeling of the multifaceted mechanisms involved in stellar death. Woosley and his team study supernovae explosions of various types: Type Ia explosions, which correspond to a highly predictable model and whose brightnesses provide our firmest evidence that the expansion of the universe is accelerating, as well as explosions that are accompanied by gamma-ray bursts—the most luminous events in the universe. He develops theoretical models to simulate these explosions. Such models mimic the behavior of the gaseous fluid elements of a star from center to edge—a highly complex task that requires the incorporation of multiple factors (such as ordinary turbulence, magneto-hydrodynamic turbulence, nuclear reaction heating, etc.). Since the structure of the star is changing on the time-scale of microseconds, developing realistic models is a daunting task indeed. Woosley and his group have made extraordinary strides in this area. For example, his collapsar model of gamma-ray bursts, developed in 1998 with his graduate student Andrew MacFadyen, has become the standard tool in the field. It envisions that the central regions of the star collapse (rather than exploding), creating black holes. To quote Woosley's colleague Sandy Faber:

In progress [now] is what will amount to the first comprehensive study of the life histories of massive stars as a function of stellar mass and composition. Hundreds of explosion models illustrating the systematics of massive-star evolution have been

calculated. The entire library will be published on the web, eclipsing the dozens of papers now in the literature that have focused on stellar evolution one model at a time.

Woosley's most recent bio-bib lists 358 published articles with eleven more submitted and under review. Citations of his work currently exceed 16,000, his most influential paper having been cited nearly 1200 times. The department letter supporting his most recent personnel action notes that "as far as we can tell, Woosley is now the most-cited stellar evolution theorist in history." Not surprisingly, he has brought numerous large external grants to UCSC, including several from the Department of Energy. The most recent is a DOE SciDAC (Department of Energy Scientific Discovery through Advanced Computing) award for the "Computational Astrophysics Consortium." UCSC's portion of that \$9 million, five-year grant was \$1.2 million.

Woosley has proven to be a wonderful mentor for graduate students in astronomy, and many of his students are themselves emerging as leaders in the field. Students find him sympathetic and caring. In the area of service, he recently acted in the role of PI for an NSF Major Research Instrumentation Grant, which garnered \$1.1 million in funding to purchase and run a state-of-the-art supercomputer at UCSC. Twelve faculty from various departments were involved in this massive project, which required Woosley to collaborate closely with the administration to secure resources for housing the machine.

In summary, then, the committee finds Stan Woosley an outstanding member of the UCSC faculty and heartily endorses his selection as the Faculty Research Lecturer for 2007-8.

Respectfully submitted,

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