Bulletin of the AAS • Vol. 54, Issue 1 (Obituaries, News & Commentaries, Community Reports)

James W. Truran (1940–2022)

John J. Cowan[1], Friedrich-Karl Thielemann[2]

[1]University of Oklahoma, [2]University of Basel

Published on: Apr 26, 2022

DOI: 10.3847/25c2cfeb.6fe39daa

James “Jim” W. Truran passed away on Saturday, March 5, 2022. He was 81.

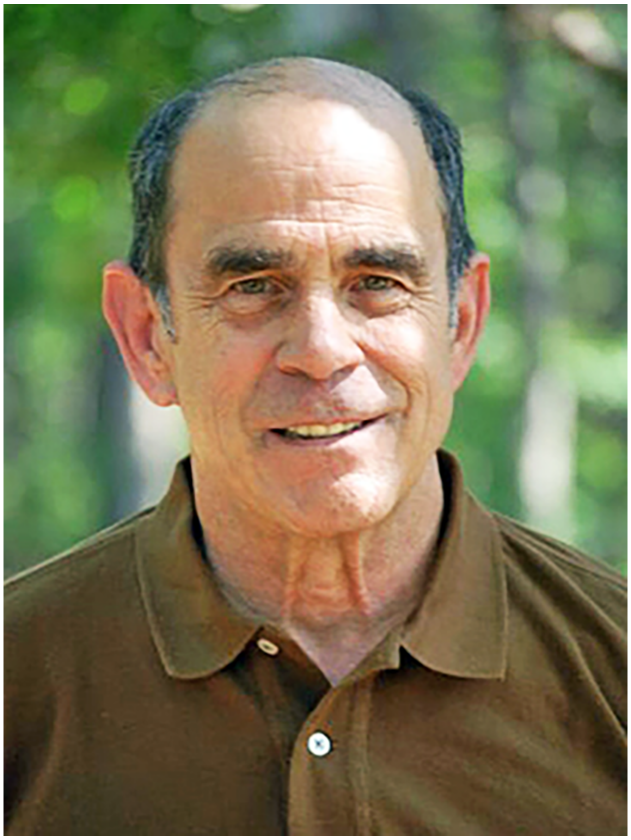

Photo courtesy of the authors.

Professor Truran was Professor of Astronomy, Emeritus, at the University of Chicago. He had a distinguished career in theoretical and nuclear astrophysics and his work has been significant and wide-ranging, including major contributions to the studies of nuclear reactions, stellar nucleosynthesis, big bang nucleosynthesis, stellar abundances, solar system formation, galaxy formation and galactic chemical evolution. He was a world leader in these areas and his work impacted significantly the direction of research in nuclear astrophysics over decades.

Truran was born in Brewster, New York, on July 12, 1940. He attended Cornell University (bachelor’s degree in 1961). He later went to graduate school at Yale University, where he received a master’s and doctorate degree in physics (1966), under the guidance of Alistair Cameron. He worked at the NASA Goddard Institute for Space Studies and was a Research Fellow at Caltech in 1968–1969. He went on for an associate and then full professorship at Yeshiva University before being professor of astronomy at the University of Illinois Urbana-Champaign from 1973–1991 and finally joining the faculty at the University of Chicago.

His achievements include, among others, a Guggenheim Fellowship in 1979–1980 and a Humboldt Research Award at Max Planck Institute for Astrophysics in 1986–1987. He was a Fellow of the American Academy of Arts and Sciences and the American Physical Society. More recently, in 2020 he was awarded the Prize of the Laboratory Astrophysics Division of the American Astronomical Society, and in 2021 the Hans A. Bethe Prize of the American Physical Society for “his distinguished contributions across the breadth of nuclear astrophysics, galactic chemical evolution and cosmochronology”. Throughout his career he served the scientific community, highlights were his membership in the “HST and Beyond Committee” which received the Carl Sagan Memorial Award in 2017 and his time as vice president of the Aspen Center for Physics and his membership on its board of Trustees.

Following the initial development of nuclear astrophysics by Burbidge, Burbidge, Fowler and Hoyle, as well as Al Cameron in 1957, Jim (along with other students of Cameron) led a new generation developing new ideas and techniques in astrophysics. In particular, Jim was the first to provide predictions for nuclear reaction rates that could be utilized in studies of nuclear burning, the big bang and stellar evolution and explosions. In addition, he developed nuclear reaction networks and new computer techniques to use in these nucleosynthesis studies, including pioneering explosive synthesis calculations.

Together with his Illinois colleagues Icko Iben, Susan Lamb and Mike Howard, Jim made important contributions to the understanding of stellar evolution and the *s*-process in stars, including the discovery of the weak *s*-process (which reaches nuclei up to about A=100) and its importance in the evolution of massive stars. Jim’s work on novae (much of it together with Starrfield and Sparks as well as Livio and Webbink, early on also Jean Audouze, and later on with Glasner and colleagues) includes many of the first reactive hydrodynamics simulations of these outbursts, a coupling of microscopic and macroscopic physics that is essential to accurate calculation of the outcomes of these dynamic events and to understanding their origin and onset.

In 1971 his collaboration with Dave Arnett and Stan Woosley led to the first suggestion of carbon detonation models for type Ia supernovae. In more recent time, Jim was deeply involved in the development of the multiphysics FLASH code at Chicago (with a large group of collaborators, including Calder, Fryxell, Townsley, Seitenzahl, Zingale and others) and its application to models of these thermonuclear supernovae. Further extensions of this (together with Ed Brown and Frank Timmes) led to developing an understanding of the variation in the predicted peak luminosity as a function of stellar metallicity. In recent years he has been strongly involved in investigating the possible origins of type Ia supernovae, also addressing He-detonations on white dwarfs.

A topic (similar to type Ia supernovae), which spanned essentially all of Jim’s scientific career, from the late 1970’s and early 1980’s onward, involved a whole series of joint investigations with Cameron and Cowan in order to understand the origin of the *r*-process; eventually extending into joint investigations with Wolfgang Hillebrandt’s group in Garching. This process was initially suggested to occur in explosive He-burning during supernova explosions, based on neutron production via the $^{13}C(\alpha,n)$

reaction. Further studies involved the exploration of the high entropy wind in core-collapse supernovae (e.g. with his postdoc Farouqi). The review by Cowan, Thielemann & Truran of 1991 served for many years as a guide to understand the general nature of the *r*-process. Continued collaboration of Jim with Cowan and Chris Sneden on *r*-process abundance observations in low metallicity stars helped to provide further constraints on *r*-process sources to finally reach a full understanding of all stellar contributions.

With Chris Sneden and Craig Wheeler, his Annual Review article in 1989 provided fundamental contributions to a modern understanding of galactic chemical evolution, relating the origins of e.g. C, N, and *s*-process elements, the alpha-elements, and the Fe-group and *r*-process elements to their nucleosynthesis sites in terms of in low- and intermediate-mass stars, massive stars and their core-collapse supernovae, as well as type Ia supernovae. These types of studies have opened the path to the present understanding of galactic chemical evolution, including the signature of the first stars and the origin of the *r*-process, which is unthinkable without his input.

What is discussed above touches on a number of important subfields of Jim's research, but is not at all a complete overview of his achievements. Professor Truran's impact on nuclear astrophysics was deep and wide. It spans a variety of subfields and a host of techniques. His pioneering early studies spread into many related research areas, his ideas and his collaborative efforts with students and collaborators (all over the world) enriched the whole field of nuclear and computational astrophysics enormously. It was always inspiring to spend any amount of time discussing the entire history of nuclear astrophysics with Jim and learn about fundamental results from that history.

Jim Truran created an enormous scientific oeuvre. But he also stood out with his character and kindness toward his many graduate students, postdocs, and a worldwide network of collaborators. This made him an outstanding mentor, and on the human side, it was always refreshing to hear his progressive views on politics, which would guarantee a peaceful world. In his private life he was a passionate tennis player and always in full support for his family who survived him: his wife Carol, daughters Anastasia, Diana, Elaina, grandchildren Emma, Hunter, Marina, Boden, and great-granddaughter Felicity.