Edwin Salpeter

December 3, 1924 — November 26, 2008

Edwin E. Salpeter, among the most influential, prescient and innovative astrophysicists of the last half-century, died in his home on November 26, 2008.

Ed was born in 1924 in Vienna. In 1939, his family fled to Australia after the Nazi takeover of Austria the previous year. After he graduated form the University of Sydney, a prestigious scholarship allowed him to become a doctoral student of Rudolf Peierls in Birmingham. Peierls and his old friend, Hans Bethe, often sent outstanding students to each other for post-doctoral experience, and so Ed came to Cornell in 1949. He stayed at Cornell for almost 60 years, and for most of this time, occupied the same office in Newman Lab assigned to him on his arrival ("the worst of the postdoc offices").

With the publication in 1951 of the Bethe-Salpeter equation, which governs two-particle bound states in quantum field theory, "Salpeter" became a household name in theoretical physics. For most scientists, such an early success would set the trajectory of their career. Not Ed. He soon decided that his own talents and temperament were not well suited to quantum field theory. He started to look for a field that, in his own words, was,

> *"more controversial, more open-ended and new, where quick was useful and sloppy did not matter too much because it would all change soon anyway."*

He found it in astrophysics.

In 1939, Bethe published his Nobel-prizewinning work showing how the conversion of hydrogen to helium powers ordinary stars like the sun. He subsequently received much correspondence on the subject. When Ed became the most junior of Bethe's postdocs, he was often delegated to respond to this correspondence, sparking his interest in nuclear astrophysics. Beginning in 1951, Ed started spending summers at Caltech, working with Bethe's friend, the nuclear experimentalist, Willy Fowler.

His very first astrophysics paper, published in 1952, solved the great puzzle of how giant stars, which have completed their burning of hydrogen into helium, transform helium into carbon. Before this discovery, the origin of the elements beyond helium in the periodic table was a mystery.

The puzzle was that it was already known that there are no stable nuclei of atomic mass number 5 or 8, and so there was no way to fuse hydrogen (mass number 1) with helium (mass number 4), or to fuse two helium nuclei.

Furthermore, the probability of three helium nuclei coming together directly to produce carbon (mass number 12) was much too low to be feasible. Using new data from Fowler's group, Ed realized that beryllium-8, formed by fusion of two helium nuclei was metastable, and would persist in sufficient abundance to lead to carbon-12 by fusion with a third helium nucleus. Fred Hoyle then predicted that there must be a specific energy-level structure in carbon that greatly enhances the probability of this final step. This work led the Royal Swedish Academy to award the Crafoord Prize to Hoyle and Salpeter in 1997.

As the new field of nuclear astrophysics burgeoned, a vital question was how much heavy-element enrichment of the interstellar gas occurs when massive stars die. The answer hinges on how many stars of a given mass have been born – the "initial mass function." In 1955, Ed provided a "sloppy" answer to this crucial question that has turned out to be remarkably good and is still widely used today.

Ed showed his versatility with work in plasma physics, work that was important for understanding white dwarfs and neutron stars, as well as the physics of the ionosphere, which became important when the Arecibo radio telescope was built. Starting in the 1960s, Ed turned from stars to ever-larger scale phenomena: the physical chemistry of interstellar gas; galaxy rotational velocities and dark matter; and the development of galaxy clusters and superclusters.

Ed paid close attention to phenomenology, and while thinking about what might become observable, he often predicted new phenomena. The most famous such prediction, also made independently by Yakov Zel'dovich in the Soviet Union, was that black holes could be revealed by the radiation emitted by accreting gas, which has become one of the standard ways of identifying black holes.

In this and subsequent work, perhaps more than any other single person, Ed brought the full menu of physics into astronomy. This represented a transformative shift: there may have been a few "astrophysicists" before Ed, but he was the one who made astrophysics a real profession.

Ed was virtually unmatched in success in mentoring great students who themselves became leaders in the field. He created a diverse and vibrant "Salpeter school of astrophysics" that continues to energize the field today.

Ed became a tenured faculty member in the Physics Department in 1954 and eventually the J.G. White Distinguished Professor of Physical Sciences. He played a key role in helping to found the "new" Department of Astronomy at Cornell, and was one of its intellectual leaders from the outset. He received many honors, including election to the National Academy of Sciences (1967), the Gold Medal of the Royal Astronomical Society (1973), the Russell

Lectureship of the American Astronomical Society (1974), election to the American Philosophical Society (1977) and as a Foreign Member of the Royal Society (1993), the Crafoord Prize (1997), and the Hans A. Bethe Prize of the American Physical Society (1999).

Late in his career, Ed became increasingly interested in neurobiology, collaborating with his wife, Miriam (Mika, then Professor of Neurobiology and Behavior at Cornell, who died in 2000), on the interactions between nerves and muscle fibers. He also worked on epidemiology and the statistical analysis of clinical trials, both in collaboration with his daughter, Shelley Salpeter, a physician, and recently with his grandson, Nicholas Buckley. Of this work, Ed said,

> *"My switch to epidemiology was not as radical a change as you might think. Humans coughing tuberculosis mycobacteria into the air at different ages required similar mathematical treatment to stars of different lifetimes disbursing heavy elements into the interstellar medium."*

Among his numerous contributions to public service, Ed's most important role was in the rigorous technical studies of anti-ballistic missile defense systems, starting in the 1960s. This impressed on him the limitations of such systems, and in the 1980s, he participated in an influential study by the American Physical Society that debunked the feasibility of the "Star Wars" Strategic Defense Initiative. Ed sparked some controversy by referring to the "dishonesty without outright lies" that pervaded the anti-ballistic missile defense community, then and now. Recently, with his second wife, Antonia (Lhamo) Shouse, he was a fervent opponent of the Bush administration's use of torture.

In addition to his wife, Antonia, Ed is survived by his daughters, Judy and Shelley; his grandsons, Jamie and Caleb Irvine, and Nicholas and Jacob Buckley; and many devoted nieces, nephews, sons-in-law, and other members of this extended family.

Ed had come to Cornell at the age of 24, where Bethe had assembled one of the greatest physics departments in the world, with young members who would become famous in popular culture. Within a few years, Ed demonstrated comparable intellectual powers. But Ed was a modest man who did not display his depth and brilliance at first sight. His amazing productivity always seemed incompatible with his relaxed demeanor, his role as the engaged father of a large extended family, his worldwide friendships, and his endless zest for travel, grand opera and skiing. We count ourselves among the many who had the good luck to be touched by the truly remarkable life of Ed Salpeter.

Saul Teukolsky, Chairperson; Kurt Gottfried, Ira Wasserman