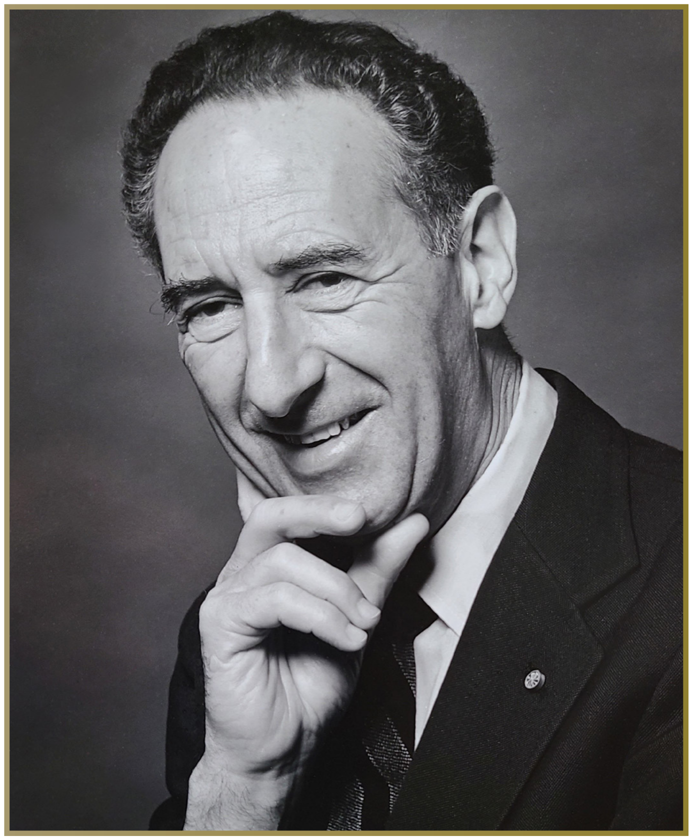
BIOGRAPHICAL
MEMOIRS

Ivan Robert King

June 25, 1927–August 31, 2021
Elected to NAS, 1982

A Biographical Memoir by Jay Anderson, S. George Djorgovski, and Christopher F. McKee



Ivan Robert King was one of the preeminent astronomers of his generation. His work led to a deeper understanding of globular star clusters, their structure, dynamics, and evolution, and their stellar content. He developed the first physically motivated dynamical models of globular clusters, which are nearly spherical clusters of ancient stars, typically of order a million in number and with densities of up to a million times that of stars in the solar neighborhood. These so-called King models served as a standard in the field, and to a large extent still do. Subsequently he also participated in the observational discovery of so-called post-core-collapse globular clusters, which deviate from the canonical King models and were theoretically predicted to result from a dynamical instability.

He also played an important early role in the development of the Hubble Space Telescope (HST) and the Faint Object Camera instrument in particular. With his students and collaborators, he conducted a number of projects using the HST that greatly expanded our knowledge about the complex stellar populations in globular clusters and their origins.

He also served in a number of community leadership roles, including the presidency of the American Astronomical Society. Among his colleagues he was known for his encyclopedic knowledge, deep scientific insights, a sharp intelligence, and an even sharper wit. He maintained the highest standards of scholarship and scientific integrity and instilled them in his students and collaborators.

Early Years and Family

Ivan King was born on June 25, 1927, in the Far Rockaway neighborhood of Queens in New York City to father Myram and mother Anne (Franzblau) King. His intellectual gifts were apparent from an early age, winning him a scholarship to Lawrence Woodmere Academy for his elementary and secondary studies.

He enrolled in Hamilton College in upstate New York at the age of sixteen, graduating with high honors at the age of nineteen with a bachelor's degree in physics, mathematics, and German. He then entered the astrophysics graduate program at Harvard University, working under the supervision of famous astronomers Harlow Shapley and Bart

Bok, receiving his Ph.D. in 1952. While at Harvard, he was awarded a prestigious fellowship in the Harvard Society of Fellows (1947–51) and served as an instructor in astronomy (1951–52).

His Ph.D. thesis at Harvard was devoted to establishing stellar photometric standards, using what was then a state-of-the-art photoelectric photometer. He spent a year at Harvard's Boyden Observatory in South Africa optimizing the use of the photometer for this purpose. King maintained a strong interest in exquisitely precise and accurate photometry for his entire life. This formed the basis for his many important contributions in the field of stellar populations in globular clusters.

Also while at Harvard, he worked on one of the first electronic computers, the Mark I, becoming a skilled programmer while nominally employed as a mathematician for the Perkin-Elmer Corporation. Thus began his lifelong interest in computers, which served him well throughout his career.

He subsequently served with United States Naval Reserve (1952–54) and with the Department of Defense (1954–56), using his expertise in computing and cryptanalysis.

He married Alice Greene in 1952, and they had four children: David, Lucy, Adam, and Jane. They divorced in 1982. He married Rev. Judy Schultz of Seattle in 2002.

He had a passion for opera, literature, and the visual arts. Among his many intellectual interests, King had a keen interest in linguistics, and he had at least some abilities in about ten languages, both classical and modern.

Professional Career

In 1956, King joined the faculty at the University of Illinois Urbana-Champaign, first as an assistant professor and then as an associate professor in 1964. That year, he moved to a faculty position at the University of California, Berkeley, where he spent most of his scientific career, achieving full professor in 1966. He served as chair of the Berkeley Department of Astronomy from 1967 to 1970. After retiring from teaching in 1993, he was awarded emeritus status from Berkeley but continued as a professor in the Graduate School and a research astronomer from 1993 to 1998. The final part of his professional career was spent as a research professor at the University of Washington in Seattle, where he remained scientifically active from his arrival in 2002 to nearly the end of his life.

King was well respected by his colleagues and students, both within Berkeley and in the astronomy community at large, owing to his extensive knowledge and the highest scientific and professional standards. He was at the center of the scientific and social life of the Berkeley Department of Astronomy, regularly participating in the informal gatherings and lunches, especially those involving students. He was known for his "Ivanisms," pithy statements often dispensed in reaction to some overblown or hasty scientific claim, such as "If something is impossible, you need much better evidence for it" or "If something is not worth doing at all, it is not worth doing well."

Globular Clusters: Their Structure and Dynamics

Over the course of his more than sixty-year career, King made fundamental contributions to our understanding of globular clusters (GCs), combining both theoretical and observational points of view.

King's interest in star cluster structure, kinematics, and dynamics started during his period at Harvard and continued afterwards. After a series of papers related to star counts and the radial density profiles of GCs, in 1966 he published a set of elegantly simple dynamical models, incorporating the three most important elements governing globular cluster structure: dynamical equilibrium, two-body relaxation, and tidal truncation. These models were based on steady-state solutions of the Fokker-Planck equation and represented the simplest possible static dynamical models using distribution functions based on integrals of motion, wherein the distribution of stars moved within a gravitational potential that was generated by the stars themselves. The deep insight of this study combined with his characteristically clear presentation made this seminal study one of the most highly cited papers in the history of the field, triggering wide embrace of the so-called "King model." Among his many scientific contributions, he considered this to be his most significant one.

In the early 1980s, following up on indications from the King models that the center of the globular cluster M15 is brighter than expected, he initiated a study of the centers of nine high-concentration GCs. This led to the observational discovery of the core-collapse clusters, a phenomenon that had been predicted earlier by theory. Such clusters exhibit a power-law density distribution near their center, in contrast to the constant density cores of the King models. It was then established that about 20 percent of the Galactic globular clusters show such morphology. GCs represent the only kind of dynamical systems in which one can hope to observe this dynamical phenomenon, which is caused by the negative specific heat of self-gravitating systems. The dynamical simulations made clear that the core of a GC would collapse and would then alternate between periods of contraction and expansion, called gravothermal oscillations. This discovery stimulated considerable follow-up work, both observational and theoretical, and renewed interest in stellar dynamics and the evolution of star clusters.

Globular Clusters: Studies with the Hubble Space Telescope

King realized early on that the only way to pursue a deeper study of globular clusters was to observe them from space, where the stars in the dense cores could be observed individually rather than as the blurred-out clump seen through the Earth's atmosphere. For this reason, he involved himself early in development of the HST and was on the instrument team for the FOC, the instrument on HST with the highest spatial resolution and hence the best ability to observe the centers of clusters.

Although King knew that space-based observations could answer longstanding questions, he also realized that innovative approaches would be needed in this new digital regime of data analysis. Turbulent processes in the atmosphere produce a smooth "Gaussian" profile for stars, but stellar profiles from space telescopes are sharper and more complicated to model. King fostered the development of new software to maximize the photometric and astrometric capabilities of all cameras on board HST. King and his students explored a variety of approaches to modeling stars in HST images from the WFPC2 instrument and settled on a purely empirical model called the "effective" point-spread function (PSF). He and his student Jay Anderson wrote a seminal paper describing how to construct such models for stars in space-based images, and these models have become the standard for high-precision analysis of data from all HST detectors installed since then and from subsequent telescopes, including the James Webb Space Telescope.

Developing these high-precision measurement techniques led to the discovery that the cluster stellar main sequences on color-magnitude diagrams were not intrinsically narrow but were often made up of multiple individual sequences. This unexpected discovery challenged the decades-long idea that GCs hosted simple populations of stars having the same age and same chemical composition. In the last two decades of his life, King actively worked to help solve this conundrum, contributing to more than seventy papers, with his last paper appearing in 2020. These improved techniques also enabled other discoveries, including a demonstration that there is indeed a hydrogen-burning limit that sets the faint end of the main sequence, and that there was an end to the white-dwarf cooling sequence in clusters. Finally, they allowed him and his team to measure the proper motions of stars within clusters, allowing the exploration of equipartition and anisotropy, and even a search for intermediate mass black holes.

Other Scientific Work

Most of his scientific work was focused on the studies of globular clusters, including their structure, dynamics, and stellar populations, but King also worked on the open star clusters (younger and less populous star clusters in the Galactic disk), the structure and dynamics of elliptical galaxies, the Coma cluster of galaxies, and the nature of the obscured nearby galaxy Maffei 1, among others. His graduate students Richard Kron and David Koo conducted some of the first studies of galaxy evolution using deep (at that time) galaxy counts and their interpretation using evolution models developed by another Berkeley graduate student, Gustavo Bruzual.

King played an early role in the development of the HST. He was an active member of the team that conceived and built the FOC on board HST, and he participated in a number of studies of various interesting targets with the members of that team. In particular, he used the FOC to study individual stars in the dense cores of globular star clusters and cores of a number of nearby galaxies, including the double nucleus in our sister galaxy, M31. Unfortunately, these FOC observations predated the repair of the HST and were severely affected by the spherical aberration, which limited their scientific utility.

Over his career, King authored or co-authored nearly 300 scientific papers and three books.

Professional Leadership and Service

King was active in the American Astronomical Society, serving as a counsellor, chair of the Dynamical Astronomy Division, and as president from 1978 to 1980. He was an active member of the International Astronomical Union, where he was chair of the Commission on Star Clusters (1973–76). He also served as the chair of the Astronomy Section of the American Association for the Advancement of Science (1973–74). He was a consultant to the Board of Trustees Association of Universities for Research in Astronomy (AURA) from 1976 to 1980 and chaired a workshop on Space Telescope Science Institute, sponsored by AURA and Associated Universities, Inc., in 1979.

He was active in supporting the HST in other ways as well. He was a consulting member of the Phase B High-Resolution Imaging Panel (1973–75), a U.S. member of the FOC Team (1978-95), a member of the Space Telescope Science Working Group (1978–94), and a chair of the Visiting Committee, Space Telescope Science Institute (1985–88).

On the international scene, he also served as a chair of the Review Committee for Netherlands Astronomy in 1985 on behalf of Nederlandse Zuiwer Wetenschaps Organisatie (Netherlands National Science Foundation).

Students and Collaborators

King was known as an outstanding teacher and mentor, helping the professional growth of a number of students and postdocs. He served as a Ph.D. advisor to fifteen graduate students, in chronological order: Elaine Avner and Raymond White, Jr. while at University of Illinois at Urbana-Champaign; Stephen Prata, Christopher Wilson, Charles Peterson, François Schweizer, Liang-Tai George Chiu, Richard Kron, John Retterer, David Koo, Robert Mathieu, Linda Schweizer, Leon Schipper, Craig Sosin, and Jay Anderson, as well as being a co-advisor of S. George Djorgovski while at University of California, Berkeley. He served as a postdoctoral advisor to Georges Meylan, Giampaolo Piotto, Adam Stanford, Tom Statler, and Adrienne Cool, as well as a research supervisor to a number of undergraduate students.

He was also involved in a number of international collaborations, mainly in a series of projects focused on the stellar populations in globular clusters using the HST, which revealed a much greater complexity of their formation histories than heretofore suspected.

Professional Recognitions and Awards

In recognition of his professional contributions, King was elected to the American Academy of Arts and Sciences in 1980 and the National Academy of Sciences in 1982. He was also elected as a fellow of the American Association for Advancement of Science in 1967 and was a George Darwin Lecturer of the Royal Astronomical Society (1979).

He received a Laurea Honoris Causa in Astronomy from the University of Padova, Italy (2002), the Hamilton College Alumni Medal (1990) and an honorary doctorate of science from Hamilton College (2005) and was named honorary professor and member of the Academic Council of the Center for Investigations in Astronomy in Mérida, Venezuela.

He also received a commendation by U.S. Secretary of Navy for his service (1954), and a commendation from NASA for his contributions to the HST program (1992). Asteroid (69159) IvanKing was named in his honor (Minor Planets Circular 82401, 2013) and the Ivan R. King Gateway Gallery at the University of North Carolina's Morehead Planetarium and Science Center, which opened in November 2020, was named in his honor.

Ivan King passed away on August 31, 2021, from complications following surgery. He is survived by his widow, Judy Schultz of Seattle, Washington, and his children David, Lucy, Adam, and Jane, and their families.

Acknowledgments

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