

## John Norris Bahcall (1934–2005)

John Norris Bahcall passed away on 17 August 2005 after a rare illness, leaving a void in the world of physics and astrophysics. He is survived by his wife Neta, and his children Safi, Dan and Orli.

Bahcall was born in Shreveport, Louisiana, USA. His original plan was to study philosophy, but he soon found himself more suited to physics. He received his Ph D degree from Harvard University in 1961, after getting his Bachelor's degree from University of California at Berkeley and Master's degree from University of Chicago. He was on the faculty of Caltech till 1968, when he joined the Institute for Advanced Study in Princeton. Bahcall had a long and prolific career in astronomy and astrophysics, spanning five decades and the publication of more than five hundred technical papers, books, and popular articles. He received numerous awards and prizes, including the 1998 US National Medal of Science; the Hans Bethe Prize of the American Physical Society; the Dan David Prize of Israel; the Gold Medal of the Royal Astronomical Society; the Fermi Award (with Raymond Davis); and the Benjamin Franklin Medal in Physics (with Raymond Davis and Masatoshi Koshiba).

Bahcall is best known for his contribution in the field of solar neutrinos. In 1964, together with Raymond Davis Jr., he proposed that questions like how the sun shines, how hot it is, etc. could be examined by measuring the number of solar neutrinos that reach the earth. Measuring the properties of these neutrinos would test both our understanding of how stars shine as well as of fundamental particle physics. Observations by Raymond Davis Jr. in the 1960s and 1970s revealed a clear discrepancy between Bahcall's predictions based on the standard solar model and the standard model of particle physics, and what was measured experimentally. This was the famous 'solar neutrino puzzle' which took about three decades to

solve. In the 1990s, helioseismic observations indicated that the standard model of the sun was basically correct, and that the solution of the puzzle may lie with our understanding of particle physics. In



the late 1990s and early 2000s, neutrino observations from SuperKamiokande in Japan and the Sudbury Neutrino Observatory in Canada confirmed that the discrepancy between neutrino predictions and observations requires a modification of the standard model of particle physics in that neutrinos must have mass and therefore can oscillate between different states.

In addition to the field of neutrino physics, Bahcall contributed to many areas of astrophysics such as galactic structure, quasars and dark matter. He was also an early proponent of the Hubble Space Telescope and worked tirelessly to gain support from the community for the project. In fact, it is believed that had it not been for him and Lyman Spitzer's work, the Hubble Space Telescope would not have existed today. He was a tireless worker and worked till the last few weeks of his life, even from his hospital bed. He has left behind two unfinished papers, one on neutrino physics and another on solar mod-

els and solar neutrino predictions. His collaborators on the papers are now doing the sad work of completing it without him.

Bahcall's most lasting legacy will be the many promising scientists whom he nurtured and mentored through the astrophysics post-doctoral program at the Institute for Advanced Study. He created an extraordinary group of people around him, selecting them for the potential they showed regardless of their nationality, race and gender. These scientists now have successful careers and the list of former post-doctoral fellows reads like a Who's Who of today's leaders in the field of astrophysics. Among the scientists that passed through Bahcall's group are many of Indian origin. Bahcall's guidance has helped them reach the top of their fields. Scientists such as Shrinivas Kulkarni (now at Caltech), Ramesh Narayan (now at Harvard), Raja Guhathakurta (U.C. Santa Cruz), Pawan Kumar (U. of Texas) worked at the IAS. Many other Indian scientists have passed through IAS on shorter visits.

A memorial symposium held in his honour at the Institute for Advanced Study on 29 October saw his former advisees and colleagues from near and far come to pay tribute to their mentor and colleague. Participants came from as far away as Europe and Japan to celebrate the work of John Bahcall and their association with him. He will be sorely missed by all who had the opportunity to associate with him, and the fields of astrophysics and neutrino physics will be poorer without him.

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