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Charles Thomas Bolton (1943–2021)

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Charles Thomas (Tom) Bolton died in February 2021 at his home in Richmond Hill, Ontario, a short distance from the David Dunlap Observatory (DDO), which had been his scientific home for his entire career.

Bolton was born in Tennessee and raised in Illinois. He completed his B.Sc. with Honors in Astronomy at the University of Illinois in 1966 and M.Sc. in Astronomy at the University of Michigan in 1968. He continued at Michigan for doctoral studies with Professor Charles R. Cowley, and successfully defended his dissertation on “Spectral Synthesis of Low Dispersion Luminosity Criteria in A and F Type Stars” in December 1970. He began a postdoctoral fellowship at the University of Toronto in September 1970, working with R. F. Garrison on spectral classification and J. F. Heard on the DDO’s radial velocity programs. After serving as adjunct faculty in the Department of Astronomy for several years, Bolton was hired as an Assistant Professor in 1973, became a full Professor in 1980, and was appointed Emeritus faculty upon his retirement in 2008.

Tom Bolton in December 1986. *Photo courtesy A. W. Fullerton.*

Bolton’s most celebrated scientific contribution is certainly his discovery that the bright X-ray source Cygnus X-1 harbors a black hole. Shortly after his arrival in Toronto, the blue supergiant HDE 226868 was identified with Cygnus X-1 through correlated X-ray and radio variability. Bolton started monitoring this star spectroscopically from DDO. By combining his radial velocity measurements with values available in the literature, he concluded that the orbital elements “imply that the secondary is a black hole” ([1]; see also [2] and [3]). Continued monitoring and refined analyses of the inclination of the orbit (with D.R. Gies and by others) has cemented this epochal identification of the unseen companion as a black hole. The

discovery of the first black hole catapulted Bolton to fame, and he never tired of retelling the story as a vehicle for public outreach.

More generally, Bolton's research emphasized the stellar astrophysics of hot massive stars. His particular interests included studies of binary stars, especially X-ray and radio binaries; stellar atmospheres; using variability to probe magnetic and pulsational properties; and connecting all these observable properties to fundamental issues of stellar evolution. Bolton had a special knack for identifying significant problems that could be addressed through the patient collection, detailed analysis, and careful interpretation of high-quality spectra. Highlights include his studies of the chemically peculiar OBN/OBC stars; detailed investigations (with S. N. Shore and others) of the photospheres and magnetospheres of He-strong spectrum variables; studies (especially with the late M. T. Richards) of mass-transfer in the Algol system; and determining (with D. R. Gies) the binary status of massive, high-velocity "runaway" stars to constrain scenarios for their origin. Bolton's initial work often stimulated detailed follow-up investigations by others. For example, his UV-optical analysis of the Be star λ Eridani suggested that these massive stars pulsate, and that the characteristics of these pulsations might be linked to the emission outbursts [4]. Subsequent investigations of line-profile variations due to non-radial pulsations in early-type stars by Bolton (with A. W. Fullerton) and other researchers confirmed and complicated this initial interpretation. The connection between photospheric and circumstellar phenomena remains an active field of investigation.

Throughout his career, Bolton devoted time and energy to scientific organizing committees, working groups, time allocation and scientific advisory committees for the benefit of the astronomical community, especially in Canada. He was a charter member of the Canadian Astronomical Society / Société Canadienne d'Astronomie and was named a Fellow of the Royal Society of Canada in 1985. He was a rigorous, entertaining lecturer for courses that ranged from solar system astrophysics to spherical astronomy at the undergraduate level, and emphasized stellar atmospheres, binary stars, and observational techniques at the graduate level. For his Ph.D. students, Bolton was simultaneously a patient advisor, stern task master, sympathetic mentor, and friend. Because Bolton was himself a superb writer, he set high standards for his students, and wielded his red mark-up pen with relish and ferocity.

Tom Bolton in front of the mirror of the DDO 74" telescope, *Courtesy of the Bolton Family.*

Bolton remained a staunch supporter of DDO as a research facility throughout his career. In the late 1970s he oversaw the installation of a PDS scanner to digitize photographic plates in the basement of the observatory and obtained a series of infrastructure grants to maintain it as an open-use facility. In the 1980s he supervised the retrofitting of the DDO spectrographs to accommodate digital detectors. Starting in 1975, Bolton began a relentless campaign to limit light pollution caused by the rapid development of metropolitan Toronto. By engaging constructively with civic leaders and local developers, he arrived at a “win-win” solution that reduced light pollution at DDO and lighting costs for the municipality. For his efforts, the Town of Richmond Hill

recognized Bolton as an “Outstanding Citizen” in 1987, and in 1995 passed the first municipal Light Pollution Abatement By-Law in Canada, which he helped to draft.

Although the University of Toronto’s decision in 2007 to sell DDO was a bitter pill for Bolton, his continued efforts to preserve its legacy ultimately resulted in the Observatory being designated a Canadian National Historic Site. The Observatory continues to offer public outreach activities of the sort that Bolton championed: public talks and tours, ending with a look through the 74-inch telescope to couple inquisitive minds directly with the universe — a universe that we now know includes black holes.

Citations

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