

do first-rate research in experimental areas and attempts were made to seek financial assistance from the Department of Atomic Energy (DAE), with the final goal being to go under the DAE umbrella. Thanks to the efforts of Pradhan and others, IOP joined the DAE family in 1985 as an aided institution like TIFR, SINP, etc.

Pradhan superannuated from IOP in January 1989. In the same year he was appointed as Vice Chancellor of Utkal University, Bhubaneswar, and occupied that position till 1991. In 1990 at the invitation of Pradhan, the Indian Academy of Sciences (IAS), Bengaluru, held its annual meeting in Bhubaneswar. It was jointly organized by Utkal University and IoP, and under the joint leadership of Pradhan and V. S. Ramamurthy, the then Director of IOP. The Academy meeting was a great success. Late Anna Mani wrote to Ramamurthy mentioning that this was the best meeting ever of IAS.

One of Pradhan's profound insights was about the magneto-electric effect. Unfortunately, he was ahead of his time. One might recall that in recent years multiferroics and magneto-electric materials have received wide attention both theoretically and experimentally. Pradhan got interested in magneto-electric materials in the early

eighties. His work on the magneto-electric effect and its connection with axial anomaly and PT symmetry is a forerunner to the present-day topological insulators. In one paper, Pradhan and I showed that the vacuum of the $2+1$ -dimensional quantum electrodynamics with Chern–Simons term shows magneto-electric effect. In 2006, in a paper in *Physica Scripta*, Pradhan looked at the Raman spectra of magneto-electric crystals. He was naturally attracted to symmetries and had made subtle use of them in several of his papers. Few years ago, he told me that he was looking at $SU(2)$ and $SU(3)$ symmetries and their violation in the periodic table. His study of photon confinement in an appropriate refractive index profile, viewed in the context of optical fibres, reveals his deep foresight. Pradhan's recent work on L-charge atoms and its relevance for the three-body problem, leading to an estimation of the ground state energy of helium atom and H^- ion shows his insight in connecting the classical and quantum domains.

Pradhan has authored two books. The first one entitled *The Photon* was published by Nova Science Publishers, New York, USA, while the second book entitled *Quantum Mechanics* was published by University Press, Hyderabad. He has also

edited a book based on the proceedings of the symposium on Current Trends in Physics held in IOP in 1986, and published by World Scientific, Singapore. Pradhan has chaired many committees tasked with academic evaluation of several academic institutions and has suggested a road map for their excellence.

Pradhan's contribution to scientific research and institution-building has been well recognized in the country. He became a fellow of IAS in 1974. He got the Meghnad Saha Award for Theoretical Sciences hosted by Hari Om Ashram (UGC) in 1980. In 1990, the Government of India conferred him with the Padma Bhushan. He received the Kalinga Samman in 2014 and Kalinga Ratna in 2018. He was President of Indian Physics Association (IPA) from 1983–85.

Pradhan's death is a huge loss not only to his friends, family and the IOP community, but personally to me as well since I was closely associated with him for the past 54 years.

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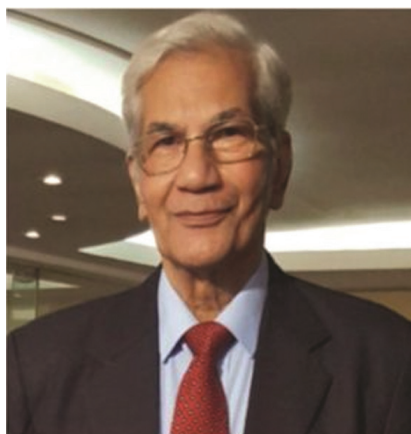
I. B. S. Passi (1939–2021)

Eminent Indian mathematician Prof. I. B. S. Passi passed away on 2 October 2021 in Mohali, Punjab. He was born on 20 August 1939 in Bilaspur, Jagadhari district, Haryana and lived mostly in Punjab.

The journey of Passi, especially as an academician, is noteworthy, being decorated with several achievements, including the Shanti Swaroop Bhatnagar (SSB) prize, the highest science award in India, in the Mathematical Sciences category.

Passi graduated from D. M. College, Moga, Punjab in 1958, and moved to Panjab University, Chandigarh, where he completed M.A. in mathematics in 1960. His first appointment was at the National College, Sirsa, Haryana as a Lecturer in 1960. In 1961, he joined the Department of Mathematics, Kurukshetra University, Haryana. In 1963, Passi was awarded the Commonwealth Scholarship to work at the University of Exeter, England, UK, with Professor David Rees, who was popular

amongst algebraists for the Artin–Rees lemma. After receiving his doctoral degree at Exeter, he returned to Kurukshetra University in July 1966, where he became a Reader in 1967 and eventually a full Professor in 1975. In 1979, Passi joined the



Centre for Advanced Study in Mathematics, Panjab University where he served as a Professor until his retirement in 2000. During this tenure, he served in the administration as well. He was Chairman, Department of Mathematics during 1984–87; Dean Alumni Relations (1990–91), Dean Foreign Students (1991–92), Dean Faculty of Science (1995–96), Dean University Instruction (1997–99) and Convener of University Programs Committee National Board for Higher Mathematics (1992–2002). Along with administrative responsibilities, he was also doing exceptionally well academically, receiving several prestigious awards and fellowships. The most prominent ones being the SSB Prize (1983) and Meghnad Saha Award for Research in Theoretical Sciences (1988). In 1986, he became Fellow of the Indian Academy of Sciences as well as the National Academy of Sciences. In 1989, he was elected fellow of the Indian National

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Science Academy (INSA). Passi's work gained international recognition and he received the Indo-American Fellowship Award (with affiliation at University of Wisconsin, Madison and University of California, Los Angeles, USA) in 1987. During 1988–1989, he was Visiting Professor at the University of California, Los Angeles. Passi was also part of the INSA–Royal Society Exchange Programme (1988) in affiliation with the University of Manchester, UK; and INSA–Deutsche Forschungsgemeinschaft Exchange Programme (2000) in affiliation with Universität Stuttgart, Germany. He served on the editorial board of the *Journal of the Indian Mathematical Society* (Editor, 1985–91); *Research Bulletin (Science)*, Panjab University (Chief Editor, 1995–96); and *Journal of Group Theory* (Editor, 1998–2001). He also served the Indian Science Congress Association (President, Mathematics Section, 1998–99).

After retirement from Panjab University in 2000, Passi continued to work in an exemplary manner. His publications, collaborations, visits, awards, memberships and honours only grew larger. In addition to Panjab University, where he received Emeritus Professorship in 2005, he has been gratefully acknowledging three institutions that prolonged his career: Harish-Chandra Research Institute, Allahabad, where he was Visiting Professor during 2000–05 and Adjunct Professor during 2014–16; INSA, for designating as INSA Senior Scientist 2005–09 and INSA Honorary Scientist 2017–18; and Indian Institute of Science Education and Research, Mohali, where he also has been a senate member, in addition to being an Honorary Professor, since 2007. He was Visiting Professor at Mathematisches Institut Georg-August Universität, Göttingen, Germany in 2012 and was lately associated with the Central University of Punjab, Bathinda (2015–17) and Ashoka University (2018–2020) as an Adjunct Professor and Visiting Professor respectively.

The awards received by Passi include the Distinguished Service Award (2003) by Mathematical Association of India; Prasanta Chandra Mahalanobis Medal (2011) by INSA and Khosla National Award (2011) by Indian Institute of Technology Roorkee.

In addition, he served as the Member, Editorial Board of the *Indian Journal of Pure & Applied Mathematics* (2004–2011); President, Indian Mathematical Society (2006–07); APEX Committee & Chairman, Selection Committee (Mathematics), DST-INSPIRE Faculty Scheme (2011–2015); Council Member, INSA (2015–17); Vice-President, Society for Promotion of Science and Technology in India (2015 onwards) and Chairman, NASI Chandigarh Chapter (2018 onwards).

Passi was a noted algebraist and educator. He contributed significantly to the study of group rings by investigating this algebraic structure, from various aspects. While some results give information about the structure of these group rings, the others acquaint us with the properties of elements in them. In fact, almost each work initiated by him in this direction created a new line of research. His most prominent work during his early career has been on augmentation ideals and dimension subgroups, which gained him worldwide recognition. Interestingly, his last publication is in the direction of extending some of the results on dimension subgroups to the unit group of an integral group ring. A major part of his research was oriented around studying algebraic elements in group rings, particularly, torsion units, nilpotent and idempotent elements. This includes defining the Jordan decomposition property, which generalized the concept of Jordan decomposition in matrices. Some of the questions on Multiplicative Jordan property are being attempted by people working in group rings till date. He is also credited for HeLP method which stands for **Hertweck–Luthar–Passi**, used to compute conditions on partial augmentations of torsion units in integral group rings, for the verification of Zassenhaus conjecture. The same has been implemented in GAP (Groups, Algorithms, Programming – a System for Computational Discrete Algebra) package HeLP for computational purposes. In recent years, he explored the unit groups of integral group rings, and its centre. One of the works that gained limelight was recognizing a class of groups, for which he coined the term **cut**-groups that refers to groups G for which all central units of the integral group ring $\mathbb{Z}G$ are **trivial**.

Passi had long collaborations with late Professor I. S. Luthar, Professor A. W. Hales and Dr Roman Mikhailov but the list of his collaborators is long, and so is list of his publications, the last being in 2020. In addition to over 100 research publications, he wrote several monographs and books as well.

Passi has lived the life of a celebrated mathematician. Undoubtedly, his contributions and teachings will be useful for generations to come. His enthusiasm, vision, principles, and attitude made him the great man he was. He earned respect from one and all, from the world of mathematics, and outside it as well.

*His presence had charisma & magnetism, that taught us lot more than **isomorphism**, because teaching was not his only virtue, discipline, humility, passion, to name a few.*

*Fellowship or award or any prize, he inspired only to rise and rise. He never **bound limits**, **set** students **free**; to think of **finite**, or **indefinite**, like a sea.*

*To write or to edit or to review, one thing was clear in his view; Work could be **multiplicative** or **trivial**, a note or a book or a research article, Excellence is utmost essential; what else could be, expected as **ideal**!!*

*To his work, he stayed **faithful**, used **primitive** ideas, got them **rational**; his research then, witnessed **augmentation**, this is how, **induced** new **dimensions**.*

*A person who touched the greatest heights, yet the tone of his voice was always light. A great person, inspirational researcher and an **ideal** teacher, of course, none other than our **Passi Sir**.*

We'll always miss you, Sir!

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