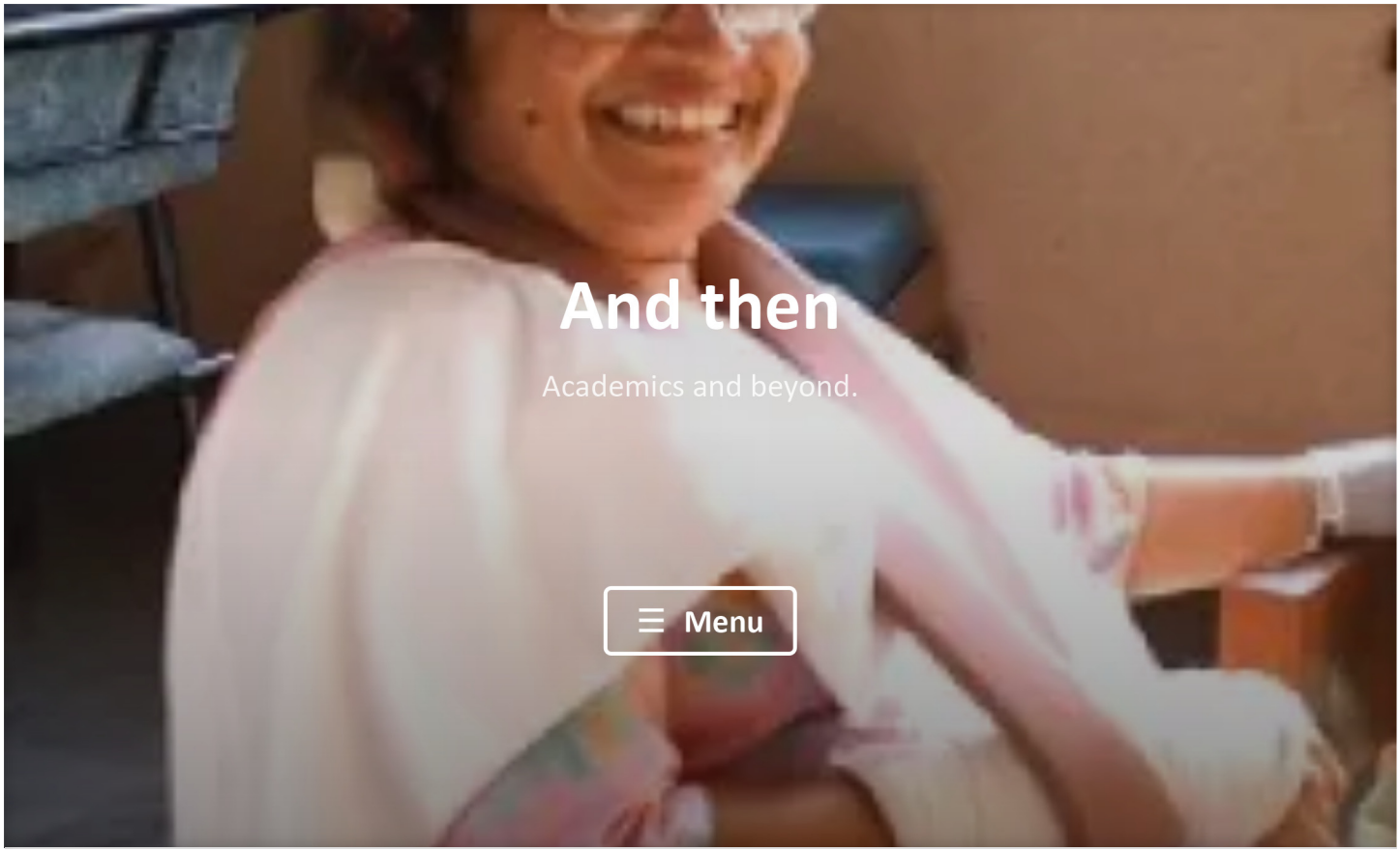

Rohini Godbole (1952-2024)

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9 Minutes

https://ramramaswamy.wordpress.com/2025/01/27/rohini-godbole-1952-2024/

With Rohini Godbole's passing in the early hours of October 25, 2024, not only did India lose a prominent particle physicist, but the movement for gender equality in science in the country lost a vocal and passionate champion, and many of us lost a good friend, colleague, and mentor. Hers was a life cut tragically short: Rohini was a month short of seventy-two, and almost to the end she had remained deeply involved in her academic work.

Along with **Sreerup Raychaudhuri** who is presently at the BHU, I had written a biographical note on Rohini for *Current Science*, the fortnightly science magazine published from Bangalore. This blogpost is largely excerpted from that note.

Rohini will be primarily remembered for her work in particle physics. She worked on both electro-weak and strong interactions, and although it was unusual for an researcher to work on this combination of

energy scales, she made significant contributions in both these areas. Her research output was prodigious. Though she worked on a multitude of topics, there were some that she pioneered and then turned to again and again in different contexts.

Rohini was born in Pune on November 12, 1952, in a cultured and highly educated middle-class family. Her father Madhusudan Godbole had studied Economics at University and made a career in the Defence Accounts. Her mother Malati studied Hindi and Sanskrit. Their four daughters were encouraged to pursue their own paths in academics and as it happened, all four would choose STEM disciplines.

Rohini's schooling was at Pune's iconic Huzurpaga High School. She graduated in the merit list in 1967 and joined the Sir Parashurambhau College where she did the Intermediate examination and subsequently enrolled for the B.Sc. Physics degree of Pune University as a National Science Talent Scheme (NSTS) scholar in 1969. Graduating at the top of the class in the final exam in 1972, she then went on to do her MSc Physics at IIT Bombay, here, too, she was at the top of the class and won the Institute silver medal in 1974. At that time, the number of NSTS scholars in any College or University was very low, and the number of women NSTS scholars was a fraction of that, so early on she realised the isolation that women in STEM face. She would, however, say that she did not encounter discrimination in the IIT; her main worry was being able to speak in English, having been educated till then largely in Marathi.

Her science tutor Bhau Sowani was a major inspiration during her schooldays, and Professor S. H. Patil at IIT Bombay was another major influence on her, inspiring her to a life in research as a theoretical physicist. Rohini went to the State University of New York (SUNY) at Stony Brook for her PhD in 1974. This was a Mecca for aspiring theorists, just down the road from Brookhaven National Laboratories where cutting-edge particle physics experiments were taking place. She took to this world with great gusto: the discovery of the J/psi particle in November 1974, a few months after she got to Stony Brook, gave a further boost to the field and made her graduate studies all the more exciting and current.

Even as a doctoral student, Rohini's versatility was evident. Her very first publication discussed proton structure functions, an exercise in the then-newly minted theory of strong interactions, quantum chromodynamics (QCD), but almost immediately after, she published a work on electroweak corrections to the muon anomalous magnetic moment. In her thesis work, with Stony Brook physicist Jack Smith (a student of Peter Higgs), she studied the possibilities of bremsstrahlung photons as colliding particles at a lepton collider.

On returning to India in 1979 Rohini joined the Tata Institute of Fundamental Research (TIFR) as a Visiting Fellow in the Theoretical Physics Group; and it was here that she produced the first of her

memorable research works. This was in the early 1980s, soon after the discovery of the bottom (*b*) quark in 1977. It was obvious that this must have a partner, dubbed (*t*) the top quark, which immediately became an object of experimental searches. In 1983, together with D.P. Roy and Sandip Pakvasa, Rohini pointed out that experimental data pointed to the *t* quark being much heavier than the *b* quark, in which case, if it were produced at a high energy collider like the upcoming Tevatron at Fermilab, the *t* quark would not be ultra-relativistic. This would lead to a wide angular spread among its decay products, which would lead to a jet and a high-energy lepton isolated from the jet. A decade later, in 1994, it was precisely this signal which was used to discover the t quark at the Tevatron, and it is still used as a trigger for *t* quark events at the currently running at the Linear Hadron Collider (LHC) in Geneva.

The Visiting Fellowship at TIFR did not lead to a more permanent appointment. In retrospect, this decision of the Theoretical Physics group was shortsighted – Rohini would have been an excellent addition to the faculty and would have strengthened the Theory group. She had to move to the Institute of Science in 1982, as CSIR Research Associate. Luckily, a few months later she succeeded in getting the position of Lecturer in Physics at the University of Mumbai where she could start her independent research career. She was then 30 years old.

The next thirteen years were spent building up a name for herself as a teacher and researcher at Mumbai University. The physical cost of this was considerable – she would initially commute on an almost daily basis from her home in Prabhadevi to the Kalina campus and then come to the TIFR in Colaba before getting back home. Her teaching world was in Mumbai University, but her research work needed her to come to TIFR. She continued to work on the Standard Model and its testing at collider machines but also started working on physics beyond the Standard Model, particularly in supersymmetric models, which were then coming into vogue and would dominate particle physics research for the next quarter of a century. Her collaborations at TIFR continued, and with Probir Roy and Xerxes Tata, another lifelong friend, Rohini wrote the first Indian paper on an aspect of supersymmetry called R-parity violation, a thread which was later taken up in a bigger way by many younger scientists in the Indian high energy community.

It was during a sabbatical at the University of Dortmund in Germany when Rohini was able to utilize her expertise on structure functions for two ideas which took her name across the globe. The first was pioneering, but simple – a calculation of parton density functions in the proton using net-to-leading order QCD corrections. These became known as the GGR parton densities, after the authors Gluck, Godbole and Reya. At Dortmund she also collaborated with Manuel Drees to develop a theory of photon structure functions. They pointed out that in a quantum field theory, a bare photon is indeed a

point particle, but it will always come 'dressed' in different virtual particle-antiparticle pairs due to the phenomenon of vacuum polarization. They showed that a single photon can be treated in the same way as a composite proton, i.e. a bag of particles, with probabilities given by the parton density functions. This is a result of lasting importance, since the higher the energy, the higher the vacuum polarization. At the next generation of high energy colliders, it will be impossible to get correct results without taking into account the Drees-Godbole structure function.

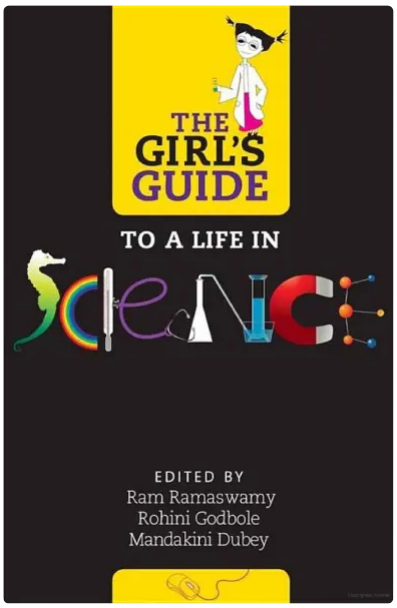
The Higgs boson, which is the cornerstone on which the Standard Model of electroweak interactions is based, never ceased to fascinate Rohini. Again and again, she returned to the topic of discovering the Higgs boson, and then after it was discovered in 2012, she was interested in the precise measurement of its quantum numbers. In the early days, she, along with others across the world, formulated strategies to discover the highly elusive boson, some of which are now in active use by the experimental collaborations. Even before the actual discovery, however, Rohini and colleagues had begun to formulate ways and means to pin down the precise quantum numbers of the Higgs boson, to discover if its couplings matched the Standard Model and if it had an admixture of any other particle.

In 1995, Rohini left Mumbai for Bengaluru to join the Centre for Theoretical Studies (CTS) later renamed Centre for High Energy Physics (CHEP) in the Indian Institute of Science (IISc). She spent the remaining twenty-seven years of her life there and her career blossomed, and in addition to her work in particle physics, she started taking a serious interest in the problems that women in science face.

She was the first Chair of the Women in Science Panel of the Indian Academy of Sciences and among the issues of concern, underrepresentation of women in STEM disciplines was a major one. She became a tireless crusader for the inclusion and encouragement of women to seek careers in STEM subjects.

Around 2005 she and I embarked on a nebulous project, to put together a set of autobiographical essays of contemporary women working in science. Our idea was to hear from them directly of of their motivations and inspirations in pursuing a career, partly as a way of highlighting the major problems that women faced. The book **Lilavati's Daughters: The Women Scientists of India** was finally published in 2008, and it was followed up in 2012 by **The Girl's Guide to a Life in Science**, a shorter book covering similar topics. A second edition of **Lilavati's Daughters** was released in 2024.

Rohini also co-authored the IAS-NIAS Research Report entitled **Trained scientific woman power — how**



much we are losing and why? which brought these issues to the notice of the policy makers. And thus, when the Indian Physics Association (IPA) finally created a Gender in Physics Working Group (GIPWG), Rohini was one of its leading lights, playing an important role in setting up gender groups and panels, which she also did for the Indian science academies.

Peer recognition came along the way -Rohini was elected to the three Science Academies of India – the Indian Academy of Science in 1992, the Indian National Science Academy INSA in 2003 and NASI, the National Academy of Sciences in India in 2007 as well as TWAS, The World Academy of Sciences in 2009. Her scientific contributions as well as her significant work in the cause of women in science brought her two signal recognitions. In 2019, she was awarded the Padma Shri by the Government of India, and in 2021, the Ordre National du Mérite by the French Government, the latter also mentioning her important role in furthering scientific ties between India and France. Apart from these, Rohini held several prestigious chair professorships and honorary doctorates.

Rohini worked tirelessly for the community. She was Editor of Pramana — journal of physics of the Indian Academy of Sciences and served on the Council and was Vice President of the Academy during the past three years. She was instrumental in organizing the series of international Workshops on High Energy Physics (WHEPP), the DST-SERC Schools in Theoretical High Energy Physics, where she chaired the National Committee from 2006–10, and the international Asia-Europe-Pacific Schools in High Energy Physics (AEPSHEP), of which the second school was held in Puri, India in 2014. She was also the Indian scientist of choice on many international panels, including the High Energy Physics Advisory Panel, USA from 2018 to 2020). In India, she played a crucial role in the furtherance of high energy physics, supporting enhanced Indian participation in the planned International Linear Collider (ILC) project in Japan as well as the indigenous India-based Neutrino Observatory (INO) during the time that the latter project was active. She strongly supported the cause of internationalism in science and encouraged young scientists from India to go abroad to hone their skills and return to enrich the scientific scene in India.

Gregarious by nature, her open and frank attitude attracted many students and collaborators across the world. The 14 students that she mentored for the Ph.D. are spread across India and the world; always happy to talk to students, she would guide M.Sc. students and undergraduates with the same care. At conferences, she was easily the most approachable senior scientist and would go out of her way to engage with young participants. It will be difficult for the community to adjust to existence without her

ubiquitous presence, friendliness and patronage. Her efforts have gone a long way in making it easier for young women to choose to have careers in science.

Rohini was a pioneer in the high energy physics community in India through her work as researcher, teacher, champion and mentor, as well as her phenomenal efforts in ensuring gender equity in the academic workplace. She will be missed.

Published by Ram Ramaswamy

From 1986 to 2018 (October, when I retired) I taught at the Jawaharlal Nehru University in New Delhi. From mid 2011 to early 2015 I was Vice Chancellor of the University of Hyderabad (UoH), also known as Hyderabad Central University (HCU). Till October 2023 I was Visiting Professor in the Department of Chemistry at the IIT Delhi. View all posts by Ram Ramaswamy