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## Meandering into astrophysics

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I was born a year after Sputnik. I grew up in the mofussil town of Mangalore. One of my sweetest childhood memories is that of lying on a mat in our garden watching the night sky: the Milky Way (visible those days (nights!)), meteors streaking across, and human-made satellites slowly winding their way “between” the stars. Also a comet, which I watched for hours, and painted, with our mango tree in the foreground. The cosmos fascinated me and I recall my disappointment at about age seven that humans had not yet landed on the moon. Nevertheless, Yuri Gagarin became my childhood hero and Valentina Tereshkova was a household name. I often dreamt of becoming a scientist working on a spaceship.

My rationalist parents bought me several enchanting childrens’ science books. One called Atoms, had a lovely illustration of Rutherford’s experiment wherein a gold leaf was bombarded with alpha-particles, of which a few “bounced back”. So most of the atom was in a small volume and the atom was mostly empty space! The beauty of that experiment made a deep impression on me.

When I was eleven, my father had me read *Andromeda*, a science-fiction novel by Ivan Yefremov. It is a fascinating tale of space exploration, inter-planetary contact and different life forms, but also of a new “sociology”: of deep and open relationships between people regardless of gender, and with the unmistakable underlying belief in the liberating capacity of science and technology on the one hand and in the inevitability of equity for all peoples on the other. *Andromeda* built for me my utopia.

As I entered my teens, my mother had me read Eve Curie’s biography of Maria Sklodowska Curie, – of her solid intellectual as well as tenderly emotional partnership with Pierre Curie. I cannot say whether the book influenced my career choice. But the vision of Marie sticking out as a female in her science class was stark, perhaps my first eye-opener to the gender inequities of the scientific world.

School had many teachers who in their own instinctive and committed way transmitted the joys of learning, whether in the enchantment of a history narrative, the nuanced puzzles of Kannada grammar, or the fun in mathematical logic. College brought the need for choice: Science and Mathematics versus History and Political Science. I wanted to study both. The clinching argument to choose the former was simply that I could switch later, but not the other way around!

Each of my college teachers was passionate about what they taught, and instinctively emphasised process over outcome, whether it was puzzling out a maths problem, classifying a plant, measuring the Sodium doublet or dissecting a cockroach. A love for empirical work, in fact not seeing it as inferior to or even disparate from theoretical work, is an ethos I certainly imbibed in my mofussil-town college; an ethos I distinctly missed in my more prestigious later institutions.

By then it was clearly Physics for me – the foundational science, spoken in the language of mathematics which I loved, and testable in the ‘oh-so-fun place’ the laboratory. Of course my naive childhood dream of becoming a scientist on a spaceship had long faded. For one, we were barely launching vehicles into space! For another, becoming a cosmonaut appeared to involve passing

through the air force, a military link that I found unpalatable.

Entering the Masters' physics programme at the Indian Institute of Technology, Bombay was exciting. Lodged in the only womens' hostel, it was a thrill to find so many there who shared my passion for physics or sciences in general. Flowing with the IIT "physics mob", Ph.D. seemed the automatic next step. I entered the Tata Institute of Fundamental Research wanting to do experimental nuclear physics, mostly inspired by my favourite IIT teacher P.P. Kane. While teaching that subdiscipline, he opened up for me the world of research. The idea that realisations of equations in the laboratory were not merely fun, but could actually be used to discover something hitherto unknown, fascinated me. Encounters in TIFR, however, had me seeing astrophysics as standing tallest as my choice. Little had I imagined that a hobby would actually turn into a vocation! On the one hand it used cutting-edge technology to probe the universe – adding so many dimensions to the skyscape seen by lying on a mat in the garden. On the other hand, that skyscape was enormously complex, but yet enchantingly amenable to the laws of physics. I was simply floored by it all.

Having the late Vijay Kapahi as a mentor was among the best things that happened to me. He sparked my interest in the workings of active galaxies, the most powerful objects in the universe, driven by the gravity of extremely massive black holes. Vijay treated the puzzles at the centres of galaxies (indeed anything he took up) with both passion and playfulness, an approach which was truly inspiring. He was also completely gender-blind in relating to students and colleagues, a rarity then and now.

Meeting my spouse, an engineer turned environmental scientist, brought a shared growth and exploration that led me to a far more critical understanding of practiced science than my childhood dreams had built. An old college friend recently recalled my excitement in 1974 at India's first nuclear "implosion" – reminding me as to how naive a believer I was then in "peaceful uses of the atom", indeed in the religion that science and scientists would lead humanity up the path to abundance and equity. But ultimately, science is a human endeavour, shaped by social processes,

and embedded in its practice are all the human failings. The outrageously low numbers of women scientists, in a pursuit that prides itself on being “objective”, is a classic illustration of this fact. For me, how natural and unremarkable it is that other women are passionate about physics! But how equally naturally do colleagues see a woman wanting to do physics as doing it primarily for “time-pass” until succeed in finding a spouse!! I await the day when my (or anybody’s) gender would be only as important as, say, my taste in fiction. No wonder I get wistful about the utopia of Andromeda, for the healthy and openly warm relationships between people regardless of gender.

Nevertheless, the dances of matter around massive black holes at the centres of galaxies, with embedded magnetic fields forming fiery hoses that squirt at near-light speeds, continue to fascinate me. These processes manifest at every wavelength of the spectrum, which means physical principles from several sub-disciplines play out, making astrophysics “the last bastion of the generalist”, as Ter Haar put it. It also means working with telescopes on the ground and in space, bringing international involvements and making one part of a global but close-knit community. The challenge of not having controlled experiments to test hypotheses adds to the excitement. The icing on the cake is the use of cutting-edge instrumentation as well as complex mathematical techniques to tease out secrets from the depths of the universe. The beautiful images catch the public imagination, making astrophysics a great tool to perpetuate a scientific temper. Astrophysics is also a delightful vehicle in which to traverse life – a continual reminder that we are scientists because we are lovers of nature who seek to understand her beauty. Ultimately, the enchantment of watching the night sky on a mat in the garden is only enhanced by understanding its overlying workings.