Source : www.thehindu.com Date : 2020-10-08

THE HOLE IN THE MIDDLE: THE HINDU EDITORIAL ON 2020 PHYSICS NOBEL

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This year's Nobel prize in physics awards studies that established the existence of black holes. It celebrates theoretical work as much as it does dedicated observation. Andrea Ghez is only its fourth woman recipient. Roger Penrose, now at Oxford, who gets half the prize, ingeniously used mathematics in the 1960s to theorise under what conditions black holes must form. This was a time when the reality of black holes as a solution to Albert Einstein's field equations of the General Theory of Relativity was not accepted by many prominent physicists. Within a couple of months after Einstein proposed his General Theory of Relativity in 1915, Karl Schwarzschild published a solution to the field equations that exhibited singularities, or points where physical quantities grew infinitely large or vanished. Today, this is understood as the event horizon — the point of no return beyond which even light cannot escape the black hole's gravitational attraction. While more solutions were found to Einstein's equations that suggested black holes, they all required special symmetries and their realisation under general astrophysical conditions was doubtful. Penrose, through the singularity theorems, identified the formation of trapped surfaces as the condition for the formation of black holes in a generic manner. In this climate came observational hints of supermassive black holes, through the discovery of what were initially called quasars that were supermassive and found at the centre of galaxies.

The other half of the prize is jointly awarded to Reinhard Genzel, at the Max Planck Institute for Extraterrestrial Physics, Garching, Germany, and Prof. Ghez, of the UCLA, U.S., for showing that the dense region in the centre of our galaxy — the Milky Way — is indeed a black hole. Towards the end of the 1960s it was clear that the region named Sagittarius A* occupies the centre of the Milky Way, which is about 26,000 light years away. Around this, all stars in the galaxy orbit. In the 1990s, when telescopes and equipment were developed that could tackle this distance, Prof. Genzel and Prof. Ghez set up independent groups to explore this region. They built unique instruments and pursued research from Very Large Telescope, in Chile, and the Keck Observatory, Hawaii, respectively. For three decades, the groups tracked nearly 30 stars, in particular one named S-2 (or S-O2). This star's orbit has been nearly completely tracked. These stars followed elliptical, Keplerian, orbits, which can only imply a central concentrated massive object — a supermassive black hole. Thus, the prize strings together theoretical research from the 1960s driven by conviction, and a three-decade long observational study that started in the 1990s. It reiterates that in the pursuit of truth, time is but a twinkle.

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