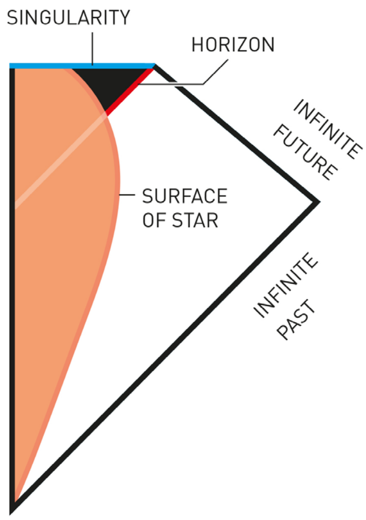

Figure 3. *A Penrose diagram of a star that collapses into a black hole. Time runs upwards and light rays are inclined at 45 degrees.*

Penrose's result is heralded as the first post-Einsteinian result in general relativity. It proves that gravitational collapse cannot be stopped after the trapped surface is formed. One should note that its formation happens at a stage in the collapse when density of matter is not very high. (The supermassive black holes of Michell and Laplace have average densities no higher than those of the Sun or Earth.) A few years later Penrose, together with Stephen Hawking, went further to show that similar results also applied to cosmological singularities (Hawking 1965, Hawking & Penrose 1970). Under reasonable assumptions, a past singularity is inevitable in the Big Bang model. Penrose (1969) wrote a beautiful summary of many of these results. In a review article, Senovilla & Garfinkle (2015) provide a thorough description of the theorem and its historical background.

Penrose's discovery triggered a new era in physics and astronomy. The strange dark objects that Michell and Laplace speculated about were deeply rooted in our modern picture of gravity. It was after Penrose's discoveries that 'black hole' finally stuck as the name for this exotic gravitational anomaly. The American physicist Robert Dicke was the first to use the term during lectures at Princeton in 1960, and Wheeler later helped make it popular (Herdeiro 2018).

Supermassive black holes become the leading model to explain quasars

After the discovery of the extragalactic nature of 3C 273, emission of radiation from accretion of matter onto supermassive black holes became the generally accepted explanation for quasars (Salpeter 1964, Zeldovich & Novikov 1965). This was a plausible extension to the models for X-ray and radio emission from matter falling into (much lighter) stellar-mass black hole candidates, such as the ones observed by the group led by Riccardo Giacconi, the 2002 Nobel Laureate. The gravitational pull must come from an extremely massive object, or else they would exceed the Eddington limiting luminosity, $L = 4\pi G M m_p c/\sigma_T = 1.3 \times 10^{31} \left(\frac{M}{M_\odot}\right) W$ (where m_p is the proton mass, $M_\odot$ the mass of the sun, and σ_T the Thompson cross-section), at which point the radiation pressure would overcome gravity, rendering instabilities, which would blow the object apart. Since the luminosity of 3C 273 is at least 10^{40} W, the enclosed mass must exceed $10^9\, M_\odot$ for the source to achieve equilibrium.

A refined theoretical description of the phenomenon was presented by Donald Lynden-Bell (Lynden-Bell, 1969), who also suggested that many, if not most galaxies, host a heavy black hole at their centre. He asserted that such a supermassive black hole, with a mass as large as 10^6 to $10^9\, M_\odot$, was a quiet remnant of a past active 'quasar phase'. The Milky Way should be no