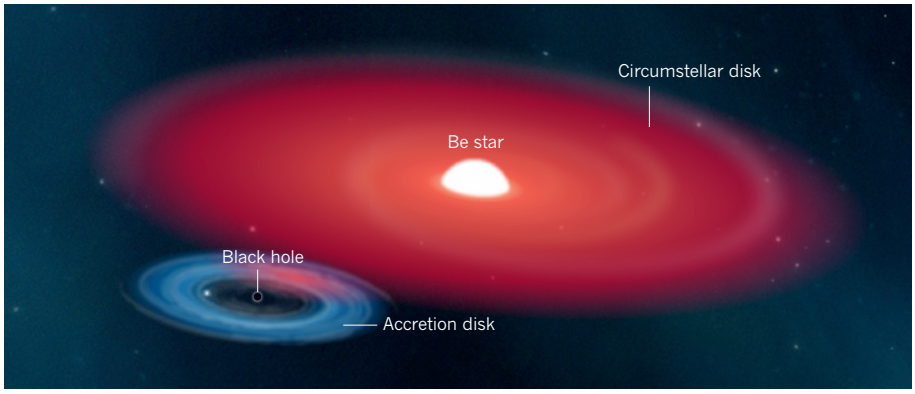

Figure 1 | A Be star with a black-hole companion. Casares *et al.*[1] have detected a quiescent black hole circling a Be star by measuring optical emission from the black hole's accretion disk and from the large disk around the star. As the black hole orbits the star, some material from the circumstellar disk is transferred to the accretion disk. However, the high angular momentum of material in the accretion disk inhibits it from falling into the black hole, so there will be a gap between the accretion disk and the black hole, and the black hole remains quiescent.

measure the line centres, but the authors have taken care to reduce any underlying systematic errors. Taken together with the mass of the Be star, which is about 10–16 solar masses, the measured ratio implies that the black hole has a mass of between 3.8 and 6.9 solar masses.

In studies of stellar evolution, conventional wisdom tells us that stellar-mass black holes form during the collapse of the cores of very massive stars — those with masses more than 25 times that of the Sun[6] — once the stars exhaust their fuel, and that the collapse is possibly accompanied by a supernova. The supernovae that massive stars (8–25 solar masses) undergo are expected to produce neutron star remnants instead. These massive stars tend to form within close groups of stars, so binary star systems are the norm, and triple and quadruple systems are not unusual. The catastrophe of a supernova in a binary has dramatic consequences: if more than half of the total-system mass is lost, or if 'kick' velocity from the explosion propels the newly formed supernova remnant with enough momentum, the remnant and companion star could fly off in opposite directions[7]. But if the companion star does remain gravitationally bound to the remnant, an X-ray binary is formed: the black hole or neutron star remnant interacts with the remaining star to produce X-ray emission.

Theorists predict that stellar-mass black holes are abundant. If this is so, we should find them all over the Milky Way. Many of them ought to be bound in X-ray binaries, whereas others should be freely floating through space. There are probably tens of millions of massive stars in the Milky Way that could potentially collapse into black holes, but there are only about 50 stellar-mass black holes known with good confidence[8]. X-ray studies of young star-forming regions such as the Carina Nebula, which might contain at least a few recent supernovae products, have not found any black holes[9]. Even large sky surveys are coming up with little as they search for the subtle brightness variations of stars whose light bends around a foreground black hole that passes in front of the star (an effect known as microlensing)[10].

MWC 656 presents a rare opportunity to study mass transfer, angular momentum and accretion-disk physics around a quiescent black hole. Casares *et al.* find a hint of a hotspot on the black hole's accretion disk that suggests that mass is pulled away from the Be star's disk, crashing into the accretion disk when the stars make their closest approach during their orbit around one another. The absence of X-ray emission from this system is evidence that material is not channelled into the black hole; rather, it must be retained in a holding pattern within the accretion disk. Gas in the outer regions of the Be star's disk will have high angular momentum, which will be transferred to the accretion disk during the mass transfer. Without an efficient mechanism to remove this angular momentum, accretion will be suppressed and the black hole will remain quiet. If there exists a larger population of Be star–black-hole binaries, such quiescence is probably the rule, not the exception. Casares *et al.* have shown us a way to find them. ■

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50 Years Ago

Space Carrier Vehicles by Oswald H. Lange and Richard J. Stein — The book begins with a useful conspectus of United States space launching missiles from the *Juno* 1 to the *Saturn C*-5: a list of their achievements is included, which shows the *Thor-Agena B* to be well in the lead, with 39 successful launches before the end of 1962 … Further subjects discussed are inertial guidance and control, the fabrication of the missiles (including an informative series of photographs of the Saturn vehicle under construction) … and, finally, the layout and construction of launching sites (with photographs of the Saturn launch complex at Cape Kennedy) … The book shows a bias in favour of German or American achievements: p.1 gives the impression that the first satellite was launched by the United States.
From *Nature* 18 January 1964

100 Years Ago

An article in *Engineering* for January 9 directs attention to the waning supply of petroleum. Although a continually greater supply of petroleum is being placed on the market, this increased output is secured only by sinking more wells and boring to a greater depth, showing that the surface supply is becoming exhausted. At the beginning of this century the wells touched 1100 ft., and to-day the average level of the oil may be placed at 2000 ft. — an ominously rapid rate of sinking … America, by reckless expenditure of her resources, has increased her annual output to 200 million barrels, yet the demand for oil for special purposes has become so great that the rise in price is considerable — so great, indeed, that competition with coal for ordinary purposes has become impossible.
From *Nature* 15 January 1914