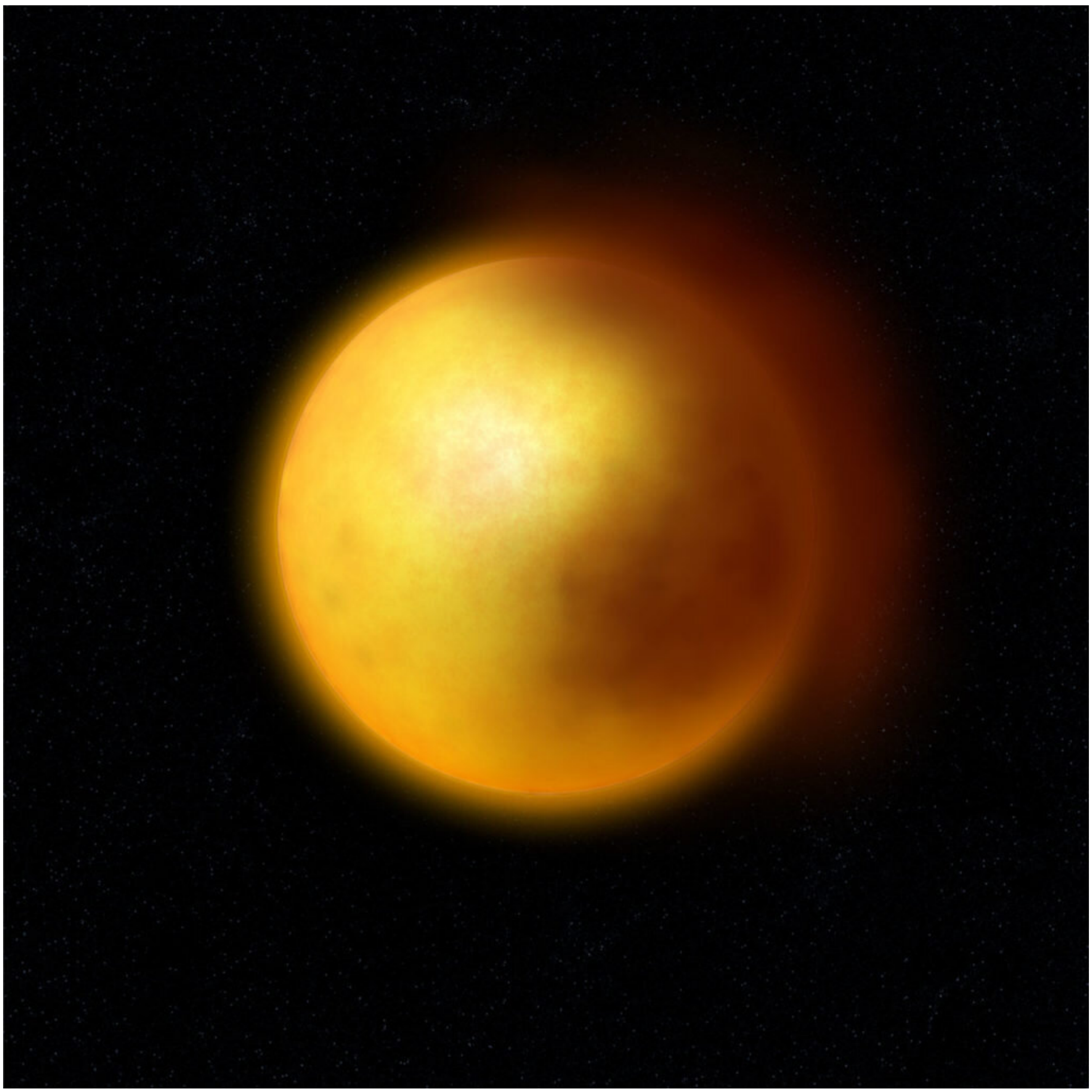
DY Centauri: Stellar evolution while you watch

May 20 2020, by Simon Jeffery



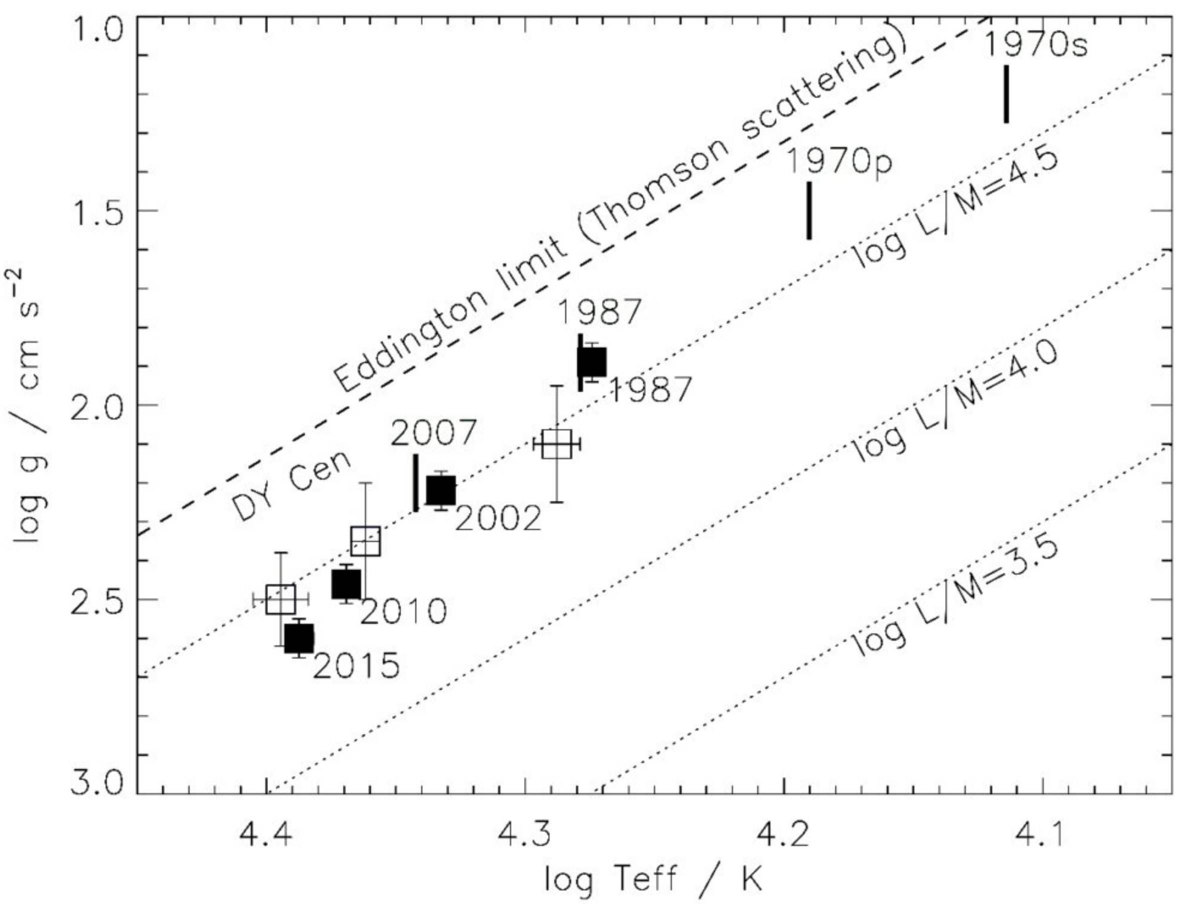
Artist rendering of the surroundings of a R Coronae Borealis star, inferred from observations obtained with ESO's Very Large Telescope. Such stars show erratic variability that is thought to arise from the presence of large clouds of dust in their envelope. Credit: European Southern Observatory

In 1930, Dorrit Hoffleit reported that star number #4749 in the Harvard List of variables had faded four times between 1897 and 1929, and identified it as an R Coronae Borealis (RCB) variable. RCB stars are luminous low-mass stars (red giants) with surfaces around 5,000—7,000 K—not much hotter than the sun. They are remarkable for having little or no hydrogen on their surfaces; this is replaced by helium and carbon. They dim by factors of 100 or more every so often by ejecting clouds of carbon, or "soot." When thrown towards Earth, soot clouds block the starlight, until they expand enough to let the light through once more. Being in the constellation of Centaurus, H.V. 4749 was given the variable star name DY Centauri, or DY Cen for short.

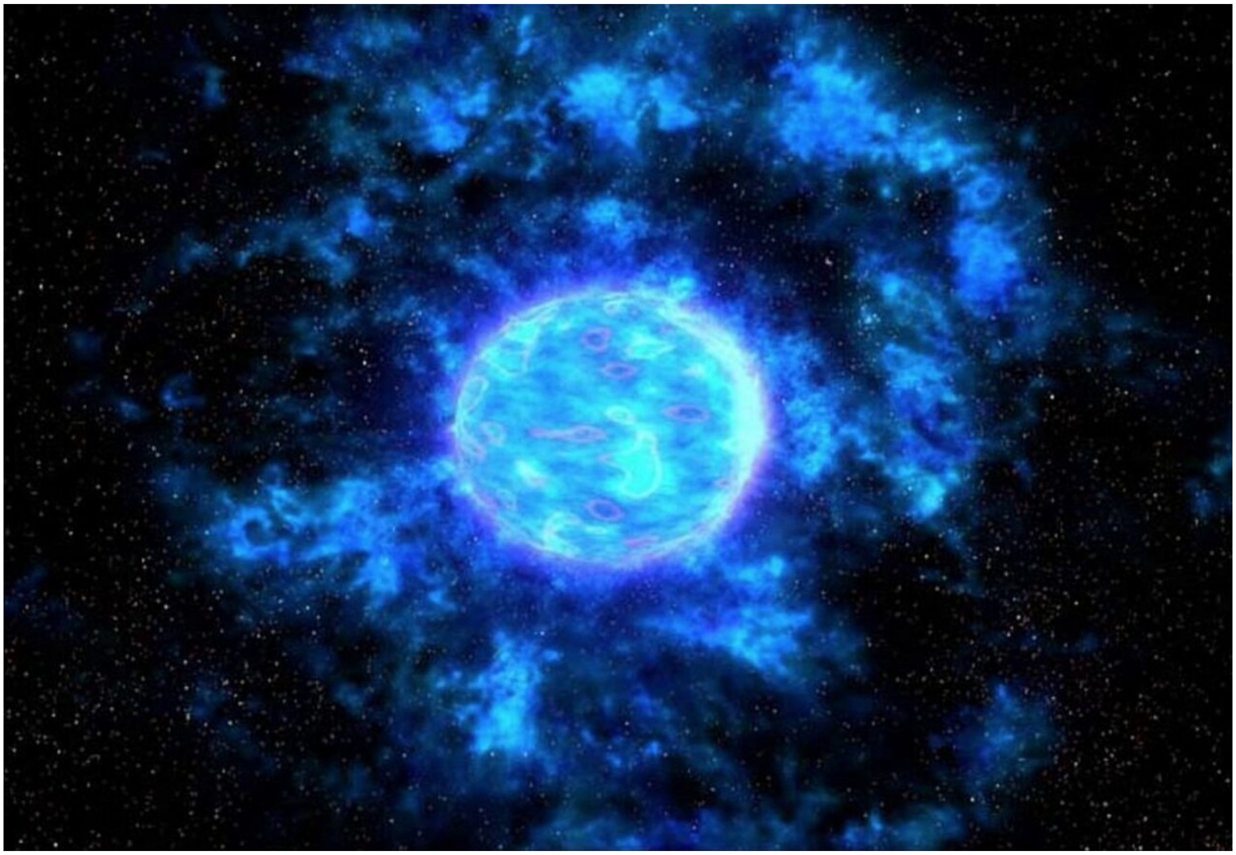
After 1935 or thereabouts, DY Cen stopped showing soot-cloud fading, but its apparent brightness started to fade. In 1980, Kilkenny and Whittet reported DY Cen to be bluer than other RCB stars, with a surface at 10,000 K—so they called it a hot RCB star. Armagh astronomer Simon Jeffery obtained the first high-resolution spectrum in 1987, when the surface was nearly 20,000 K. The overall fading is another sign that the surface is getting hotter and bluer, because light is emitted at ultraviolet instead of visible wavelengths. Additional spectra were obtained in 2002 and 2010—DY Cen was still getting get hotter.

The 2010 data also suggested that DY Cen might be a binary star, with a period of about 40 days. Since this could help to explain how DY Cen was formed, why it has such unusual surface chemistry, and why it is heating up so quickly, Simon returned to DY Cen in 2015. Using the

High Resolution Spectrograph (HRS) on the Southern Africa Large Telescope (SALT), Simon and his collaborators Kameswara Rao and David Lambert, made a series of measurements over a complete orbit. They did not find what they were looking for—DY Cen is a single star after all!



Evolution of DY Cen in surface temperature and surface gravity. Credit: Jeffery et al. 2020, MNRAS



Artist's impression of mass-losing star. Credit: NASA

DY Cen continues to heat up—already 25,000 K. It is heating because it is shrinking, from about 200 times the sun in 1890 to a mere five times the sun today. As it shrinks, it is spinning faster. Simon and colleagues have observed the spin-speed going from 20 km/s in 1987 to 40 km/s in 2015. They have predicted that DY Cen may start to spin so fast that its surface could start to break off within a few decades. The spectrum is starting to show stronger and stronger emission lines, possibly a sign that radiation is winning the surface battle with gravity. The team also made another surprising discovery. Looking back at the 1987 and 2002 observations, they found evidence for a huge excess of strontium on the star's surface. Strontium is formed inside stars when iron is bombarded by neutrons, usually in a very late stage of evolution.

It seems that DY Cen is the remnant of a star that nearly finished its life as a white dwarf. Sometime not long before 1890, in a last burst of helium burning, the white dwarf puffed up to become a red supergiant, the ashes of neutron bombardment were dredged to the surface, and DY Cen became an RCB star. However, the reborn star was already doomed. With no nuclear fuel left to support them, the surface layers are collapsing once again and spinning up—as we watch.

Provided by Armagh Observatory

Citation: DY Centauri: Stellar evolution while you watch (2020, May 20) retrieved 26 April 2024 from https://phys.org/news/2020-05-dy-centauri-stellar-evolution.html