

Indian researchers spot one of the shortest-period stellar binary system

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In a breakthrough that could reshape astronomers' understanding of how stars evolve, researchers have made the world's first confirmed discovery of a blue straggler star hosting a brown dwarf companion in an extraordinarily compact binary system.

Scientists have long been puzzled by blue straggler stars, which appear brighter and bluer than the main-sequence turn-off in star clusters, defying standard stellar evolution because all cluster stars are expected to be of similar age.

Scientists from Gauhati University supported under INSPIRE programme of the Department of Science and Technology (DST), Indian Institute of Astrophysics, Koramangala (IIA), Bangalore Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, both DST institutes and INAF-Catania Astrophysical Observatory, Italy tried to explore the formation of blue stragglers in open clusters and confirmed discovery of a blue straggler star hosting a substellar (brown dwarf) companion in a very compact binary system.

The team consisting of Ali Hasan Sheikh, Prof. Biman J. Medhi from Gauhati University, Dr. Sergio Messina from INAF-Catania, Prof. Annapurni Subramaniam and Prof. Ram Sagar from IIA, Bangalore, Dr. Neelam Panwar from ARIES, Nainital found that the system has an exceptionally short orbital period of around 5.6 hours (0.234 days) and contains the lightest companion ever detected around a blue straggler, with a mass of approximately 0.056 times the mass of the Sun, placing it firmly below the hydrogen-burning limit.

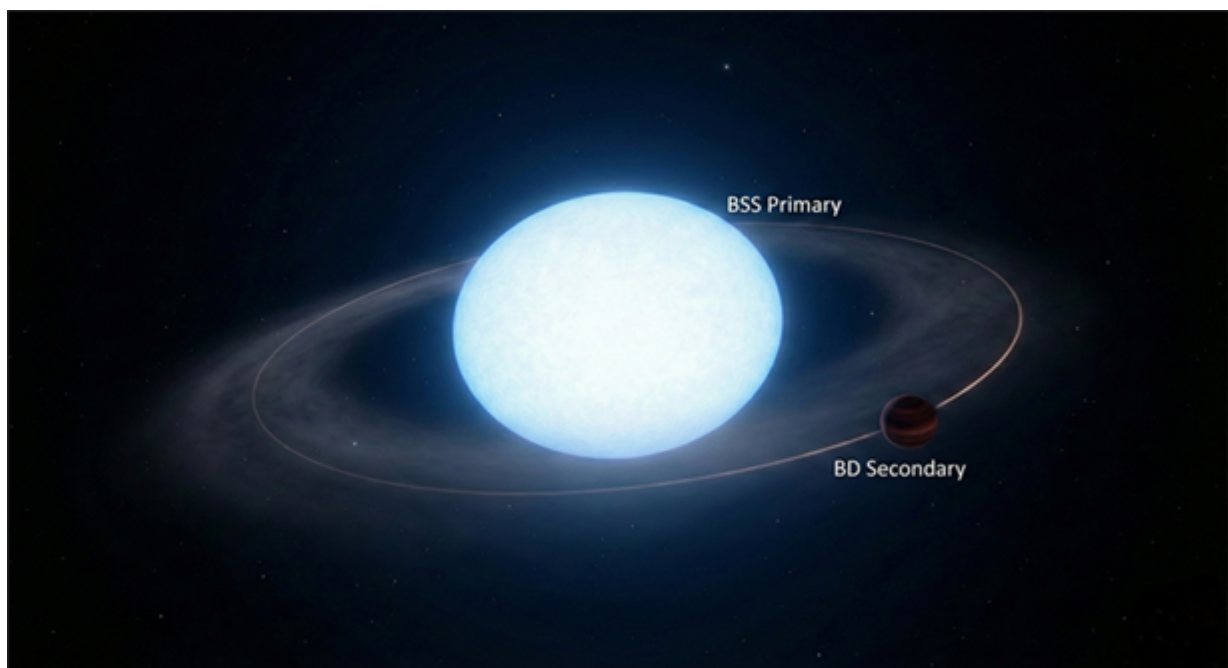


Fig 1: Artistic impression of the discovered compact binary system showing a BSS primary orbited by a BD companion in an ultra-short, nearly circular orbit with a period of about 5.6 hours

The study published in the journal *Monthly Notices of the Royal Astronomical Society: Letters* reveals the shortest-period binary system discovered inside the so-called “brown dwarf desert”, a region where such companions are thought to be extremely rare.

The rapidly rotating blue straggler star accompanied by a substellar brown dwarf the researchers spotted is an object too massive to be a planet but too small to ignite as a true star.

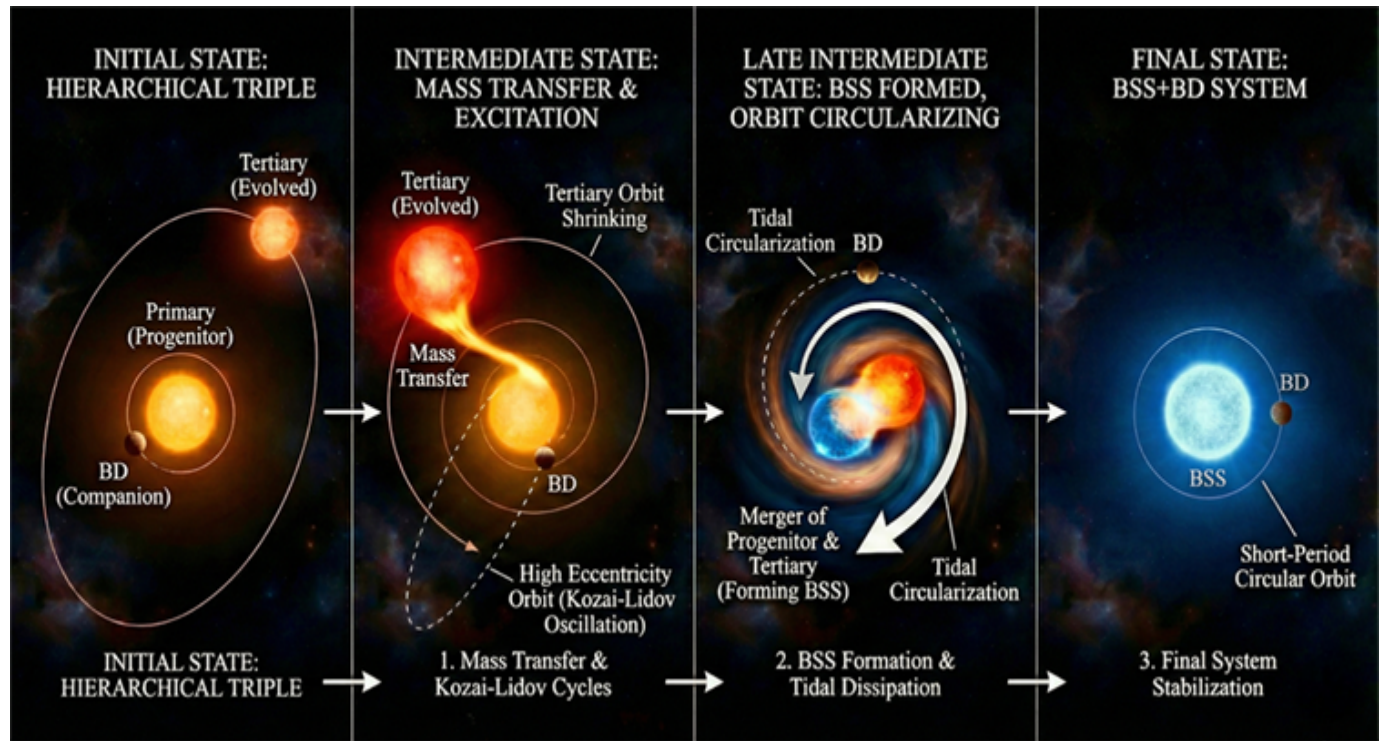


Fig 2: Schematic illustration of the proposed formation pathway of the BSS–BD system through hierarchical triple-star evolution. The system begins as a triple, with an inner binary containing a BD companion and an outer evolved tertiary star. Mass transfer and Kozai–Lidov oscillations induce orbital excitation and merger of the progenitor and tertiary, forming the BSS. Subsequent tidal dissipation circularizes the inner orbit, resulting in the present-day compact BSS–BD binary with a short-period circular orbit

The study advances fundamental scientific knowledge by improving our understanding of how stars evolve, interact, and survive extreme environments, which is essential for building accurate models of stellar and cosmic evolution.

The results help refine theoretical models of stellar evolution, binary interactions, and substellar objects, which are widely used in interpreting data from ground-based observatories and space missions. Additionally, it inspires young researchers by demonstrating how innovative analysis of archival data can lead to major discoveries, encouraging scientific inquiry and exploration without the need for new or expensive observational facilities.

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