Dark Matter and Black Holes

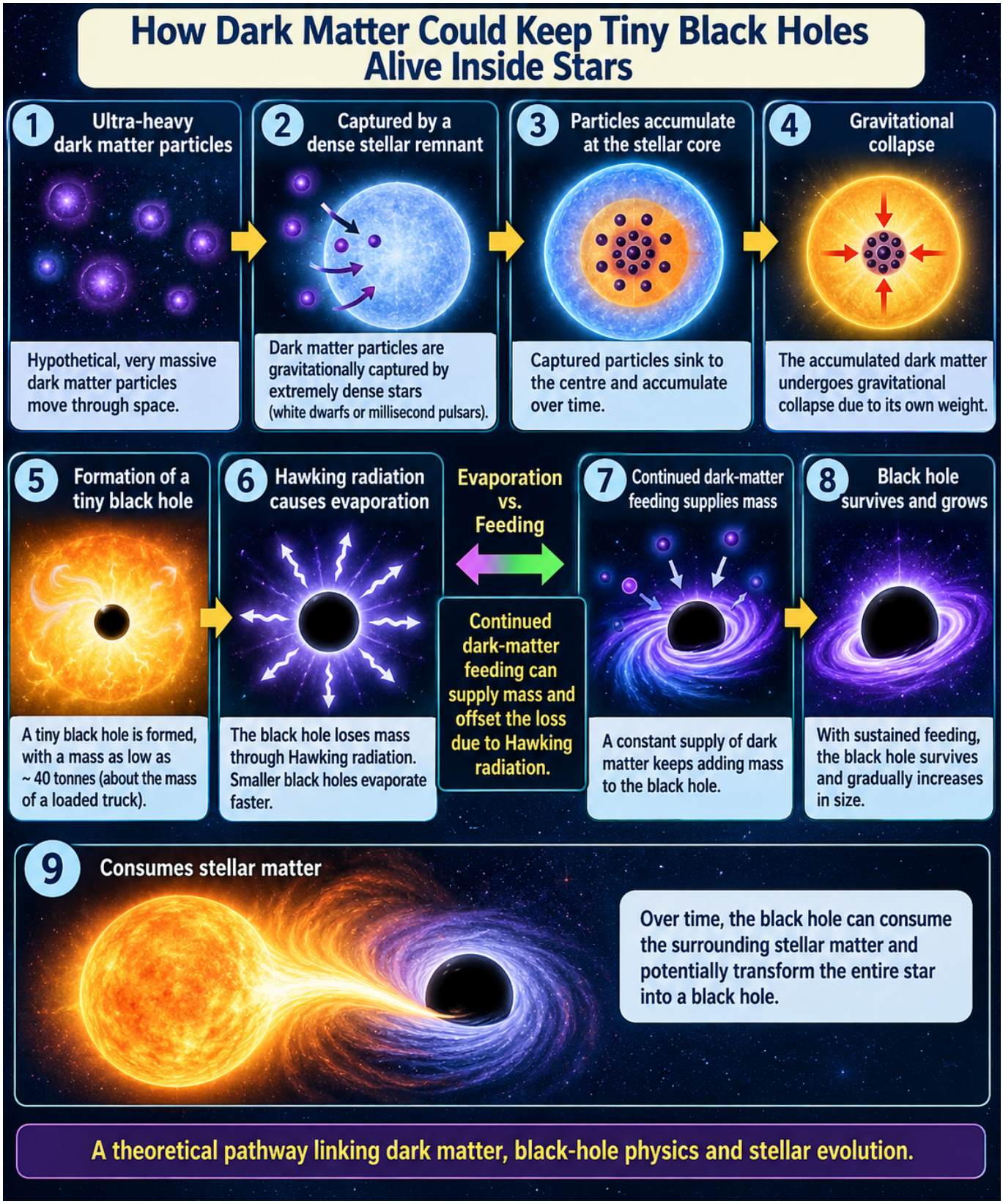
Prelims: *Current events of national and international importance | Science & Technology*

Why in News?

A recent study suggests that ultra-heavy dark matter particles trapped inside dense stellar remnants could accumulate at their centres and collapse into tiny black holes.

Key Highlights of the Study

- **Dark Matter as a Fuel Source -** Ultra-heavy dark matter particles could be captured by extremely dense stars, accumulate at their cores and collapse into a tiny black hole.
- **Tiny Black Holes -** The resulting black holes could initially have masses as low as **about 40 tonnes**, roughly comparable to the mass of a loaded semi-truck.
- **Hawking Evaporation -** Very small black holes are expected to lose mass through **Hawking radiation**.
- The smaller the black hole, the faster it evaporates.
- **Dark-Matter Feeding -** A continuous supply of dark matter could compensate for this mass loss, allowing the tiny black hole to grow rather than disappear.
- **Consumption of the Host Star -** Once the black hole overcomes evaporation, it could gradually consume surrounding stellar matter and potentially transform the entire star into a black hole.
- **Ancient Stellar Laboratories -** The survival of old dense stars for billions of years can help scientists place constraints on the properties of ultra-heavy dark matter.



Considered Stellar Objects

- **Millisecond Pulsars -** Extremely dense, rapidly rotating neutron stars that emit regular pulses of electromagnetic radiation, often with rotation periods of less than 10 milliseconds.
- **White Dwarfs -** Extremely dense remnants of stars that have exhausted their nuclear fuel.
- Researchers considered conservative survival ages of approximately **1 billion years for millisecond pulsars** and **10 billion years for white dwarfs**.

Dark Matter vs. Ordinary Matter

- **Ordinary Matter -** Interacts through electromagnetic, strong and weak nuclear forces and forms stars, planets and living organisms.
- **Dark Matter -** Does not absorb, emit or reflect light in the conventional way; its presence is inferred primarily through **gravitational effects**.
- Dark matter is therefore **not simply invisible ordinary matter**.

Reference

The Hindu | Dark matter could keep tiny black holes alive inside stars