



Intermediate-Mass Black Holes

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Why in News

Scientists from Chennai Mathematical Institute and Ors. have analysed data from the **LIGO-VIRGO observatories** and estimated the fraction of the **binary Black Hole mergers** detected so far that show potential to **form Intermediate-Mass Black Holes**.

Key Notes

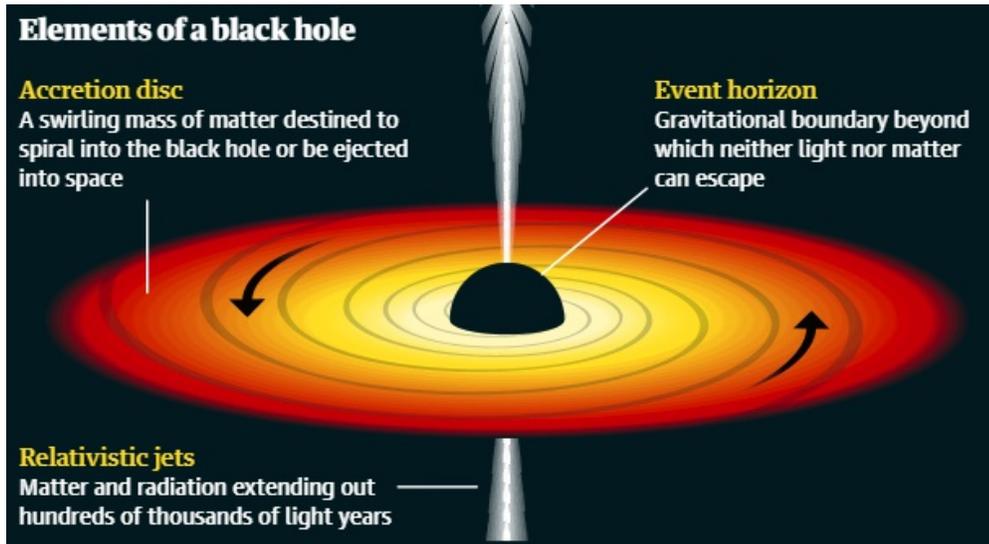
- **About Black Hole Mergers:**
 - It is the phenomenon of **merging of two or more** black holes.
 - Indian scientists have already observed **merger of three supermassive black holes**.
 - Merging of two or more black holes results in different types of black holes. For eg, **Intermediate-Mass Black Holes** and **Binary Black Holes**.
 - **Intermediate-Mass black hole (IMBH)** is a class of black hole with mass in the range 10^2-10^5 solar masses: significantly **more than stellar black holes but less than supermassive black holes**.
 - One of the **theories of intermediate mass black hole formation** has to do with '**hierarchical growth**'.
 - That is, if the black holes exist among a dense cluster of stars, the remnant (black hole) of a merger can pair up with another black hole close by to form a binary. This can eventually merge to form a second remnant which is more massive. This process, happening in a hierarchical manner, **can explain intermediate mass black hole formation**.
 - **Gravitational Waves (GW)** are created when **two black holes orbit each other and merge**.

- **Kicks in Mergers:**

- “Kicks” is the **opposite momentum acquired by a remnant black hole during mergers**. It is a **reaction to Gravitational Waves taking away energy and linear momentum** during mergers.
- These kicks can be quite large, giving it a **velocity of up to 1000 kilometres per second**.
- If this **kick velocity is above the escape velocity of the star cluster in which the black hole is formed, it escapes from the environment and moves out**. This hinders further hierarchical mergers.
- The **extent of the kick received** by the remnant can be calculated from the **masses of the merging black holes and their spin**. The kick estimates help understand **which mergers have the possibility of forming Intermediate-Mass black holes**.

Black Hole

- It refers to a **point in space** where the **matter is so compressed** as to create a **gravity field** from which **even light cannot escape**.
- The **concept was theorized by Albert Einstein** in 1915 and the term ‘**black hole**’ was **coined by John Archibald Wheeler**.
- Black holes **form** when a **massive star undergoes a supernova explosion** towards the end of its lifetime. The black hole forms from the remnants of the explosion.
It is not necessary that a star at the end of its lifetime will become a black hole. As stars reach the ends of their lives, most will inflate, lose mass, and then cool to form **white dwarfs**. But the largest of them, those **at least 10 to 20 times as massive as our own sun**, are destined to **become either super-dense neutron stars** or so-called **stellar-mass black holes**.
- Usually, the black holes belong to **two categories**:
 - One category is of **Stellar black holes** ranges **between a few solar masses and tens of solar masses**. These are thought to **form when massive stars die**.
 - The other category is of **supermassive black holes**. These range from **hundreds of thousands to billions of times that of the Sun** from our Solar system. These are thought to form when two or more black holes merge.
- In April 2019, the scientists at the Event Horizon Telescope Project released the **first-ever image of a Black Hole** (more precisely, **of its shadow**).



Source: TH