

A Powerful Punch by Black Hole

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Why in News?

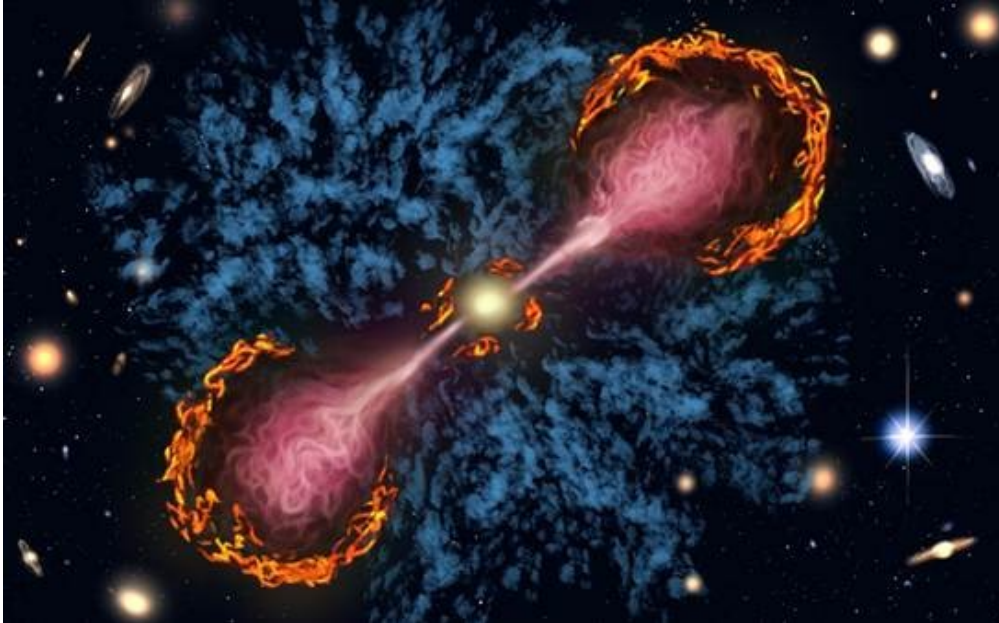
The recent study shows that relativistic jets launched by central supermassive black holes energetically "punch" into the surrounding Circumgalactic Medium (CGM), heating the gas and suppressing star formation.

Circumgalactic Medium (CGM)

- **Definition** - A vast, diffuse halo of gas and dust extending **10 to 20 times** beyond the visible stellar disk of a galaxy.
- **Role in Galactic Evolution** - Serves as the primary gas reservoir that feeds galaxies.
- Under normal conditions, cool gas in the CGM gradually loses thermal energy, collapses, and clumps together under gravity to trigger **star formation**.

Key Scientific Findings

- **Research done by** - Raman Research Institute (RRI), Bengaluru and Arizona State University (ASU).
- **Directional Energy Transfer (The "Punch")**
 - Rather than heating the CGM uniformly in all directions, relativistic jets of hot plasma (charged particles) transfer energy along a focused vector.
 - When a high-velocity jet collides with the CGM, it generates a localized shockwave/jerk that energizes and ionizes the ambient gas.
- **Dual "Braking" Peak Signals** - The team identified that the excitation signal of the energised gas peaks in two primary spatial zones
 - **Inner Edge** - At the boundary of the stellar disk, where the jet first hits the dense interior gas of the CGM.
 - **Outer Boundary** - At the outer fringe of the CGM, where the decelerated jet delivers a final "fist-bump" into the intergalactic medium.
- **Suppressing Star Formation** - The thermal energy deposited by the jet prevents the CGM gas from cooling down.
- Lacking cool gas, the host galaxy cannot synthesize new stars, gradually evolving from an active, star-forming galaxy into a "quiet" or passive elliptical galaxy (AGN Feedback Mechanism).



Significance

- Demonstrates how a central Supermassive Black Hole (SMBH), spatially no larger than our Solar System can shape the evolutionary fate of a host galaxy spanning hundreds of thousands of light-years.
- Provides observational evidence explaining why massive galaxies in the universe do not grow indefinitely into ultra-luminous star monsters, solving a long-standing puzzle in observational cosmology.

Reference

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