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Origin and Cosmic Ray Acceleration in Fermi Bubbles and Other High Energy Phenomena at the Galactic Center

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The center of our Milky Way galaxy hosts a series of energetic outbursts, including the well-known Fermi and eROSITA bubbles, galactic center lobes, the inner 15-pc X-ray lobes. Are they long-lasting or fast evolving explosive events? What causes these structures? Are they PeVatrons related to ultra high energy gamma ray emissions from the central molecular zone and the Galactic center? The Fermi and eROSITA bubbles may correspond to typical galactic feedback processes occurring in our own Galaxy in the near past. Galactic feedback is one central unsolved problem in contemporary astronomy, and the Fermi and eROSITA bubbles are also galactic-scale accelerators of cosmic rays, whose origin remains a century-long mystery. In this talk, I will describe our long journey to reveal the origin of the Fermi bubbles. Our recent jet-shock model could explain the X-ray, gamma-ray, and microwave observations of the Fermi bubbles, suggesting that they were produced by a pair of powerful jets emanating from the supermassive black hole at the Galactic center about 5 million years ago. We also use a similar jet-shock model to explain the origin of the inner 15-pc X-ray lobes, which may be related to ultra high energy gamma ray emissions from the central molecular zone.

Primary author: GUO, Fulai (Shanghai Astronomical Observatory, Chinese Academy of Sciences)

Presenter: GUO, Fulai (Shanghai Astronomical Observatory, Chinese Academy of Sciences)

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