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Study of recurrent activity in radio sources

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Peaked-spectrum (PS) radio sources are widely regarded as tracers of the earliest stages of radio jet evolution. Milliarcsecond VLBI imaging frequently reveals compact double morphologies embedded within kiloparsec-scale cocoons, suggesting that many PS sources have the potential to grow into large FR I or FR II radio galaxies. However, a key open question remains: Do PS sources typically evolve into large-scale radio galaxies, or do they instead undergo short, intermittent bursts of activity separated by long quiescent phases? Over the past three decades, only a handful of PS AGN have been found inside older, faint radio cocoons, leaving the duty cycle of young radio jets poorly constrained. Earlier wide-area surveys lacked the surface-brightness sensitivity and angular resolution to identify these "compact core + relic emission" systems in statistically significant numbers. Recent advances in low-frequency radio interferometry have made it possible to detect faint, low-surface-brightness emission that was previously inaccessible. In this talk, I will first introduce the fundamental concepts of radio astronomy, AGN, radio galaxy morphology, and the evolutionary role of compact peaked-spectrum sources. I will then present the motivation and scientific goals of my PhD research, which aims to probe the duty cycle and restarted activity of radio sources. Using multi-frequency radio surveys, including LoTSS, we search for diffuse, relic emission around compact PS cores providing direct evidence of earlier cycles of jet activity and offering new insights into the episodic nature of young radio galaxies.

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