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Detection of an orthogonal alignment between parsec scale AGN jets and their host galaxies

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Abstract

The relationship between galaxies and their supermassive black holes (SMBHs) is an area of active research. One way to investigate this is to compare parsec-scale jets formed by SMBHs with the projected shape of their kiloparsec-scale host galaxies. We analyse Very Long Baseline Interferometry (VLBI) images of Active Galactic Nuclei (AGN) and optical images of their host galaxies. We compare the inner-jet position angle in VLBI-detected radio sources with the optical shapes of galaxies as measured by several large optical surveys. In total 6273 galaxy-AGN pairs were found. We carefully account for the systematics of the cross-matched sources and find that Dark Energy Spectroscopic Instrument Legacy Imaging Surveys data (DESI LS) is significantly less affected by them. Using DESI LS, with which 5853 galaxy-AGN pairs were cross-matched, we find a weak but significant alignment signal (with a p -value ≤ 0.01) between the parsec-scale AGN jet and the kpc projected minor axis of the optical host galaxy in sources with measured spectroscopic redshifts. Our results show that the observed source properties are connected over 3 orders of magnitude in scale. This points towards an intimate connection between the SMBH, their host galaxies and their subsequent evolution.

