Method identifies blazar candidates

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An efficient multi-frequency algorithm cross-correlates large radio and x-ray surveys to help identify new sources with blazar-like properties.

Active galactic nuclei are a class of compact and highly variable energy sources associated with supermassive black holes at the center of a host galaxy. They include blazars, objects which exhibit some of the most violent phenomena in the universe. Their emission is dominated by non-thermal processes arising from relativistic particles accelerated in a jet of matter flowing away from the black hole. It covers the entire electromagnetic spectrum, making them ideal sources for multi-frequency observations. Although blazars are not commonplace in the universe, they may be the dominant population of extragalactic sources in the hard x-ray and γ-ray bands and the largest contaminant of cosmic microwave background (CMB) fluctuation maps.1

To date, the number of known blazars does not exceed 2000, but the forthcoming data from the AGILE gamma-ray large area space telescope and Planck space observatories are expected to reveal several thousands of objects of this type. The preparation for these missions, presently underway, requires the identification of new blazar samples to gain insight into their multi-frequency and statistical properties.

At the Science Data Center of the Italian Space Agency (ASDC), we recently compiled a sample of objects with blazar-like properties by cross-correlating large radio and x-ray surveys. The former included data from the National Radio Astronomy Observatory (NRAO) very large array (VLA) Sky Survey (NVSS) and the Australia Telescope Compact Array catalogue of compact Porkes-MIT-NRAO (PMN) sources (ATCAPMN), while the latter used data from the ROSAT All-Sky Survey (RASS). Optical data were taken from the Sloan Digital Sky Survey (SDSS)2 and from the Two Degree Field system surveys to spectroscopically identify likely candidates and test the validity of the selection method. We used a visual inspection procedure to compile the ASDC radio-optical-x-ray catalog (ROXA), a list of 816 objects among which 510 are confirmed blazars (see Figure 1). Only 19% of the candidates

Figure 1. Aitoff projection of the Radio-Optical-X-ray catalog sources plotted in galactic coordinates (top). Purple circles are for BL Lacertae-type objects whereas blue circles are for quasar-type objects. Typical spectra obtained from the Sloan Digital Sky Survey online services2 are shown in the middle and bottom panels, respectively.

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were non-blazar objects, demonstrating the high efficiency of our selection method.³

ROXA also includes 173 new blazar identifications, representing approximately 10% of all presently known blazars. The relatively high flux threshold in the x-ray energy band (provided by the RASS survey) preferentially selects objects with high x-ray to radio flux ratios, leading to the discovery of many new potential targets for GeV-TeV observations.

Our method, based on a multi-frequency selection algorithm, is complementary to previous surveys that used single-band approaches.⁴ ⁵ In principle, our selection method could also be applied to the entire sky to build a much larger sample suitable for the identification of foreground sources in CMB maps and possible γ-ray sources. At present, the most suitable optical data available are from the SDSS project, and we plan to update the ROXA catalog as new SDSS releases become available.

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References