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Blazar Radio and Optical Survey (BROS): A New Catalog of Blazar Candidates

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By using deep radio source catalogs currently available, we present a new blazar candidate catalog, BROS, which includes 56314 sources located at declination $\delta > -40^\circ$ and outside the Galactic Plane ($|b| > 10^\circ$). We picked up flat-spectrum radio sources of $\alpha > -0.5$ (α is defined as $F_\nu \propto \nu^\alpha$) from 0.15 GHz TGSS and 1.4 GHz NVSS catalogs. Then, we identified their optical counterparts by cross-matching with the Pan-STARRS1 data.

Color-color and color-magnitude plots for the selected flat-spectrum radio sources clearly showed two populations, “quasar-like” and “elliptical-galaxy-like” sequences. We emphasize that the latter population emerged for the first time and is missed by previous CRATES catalog because of the higher radio flux threshold.

We found that the color-magnitude relation of nearby bright elliptical galaxies up to $z=0.3$ follows the “elliptical-galaxy-like” sequence. The index of the logN-logS distribution for this sample is 1.44 ± 0.06 , supporting the interpretation of “nearby” because the measurement is consistent with a value for a static Euclidean universe. This BROS catalog is useful to search for electromagnetic counterparts of ultra-high-energy cosmic rays as well as PeV neutrinos recently detected by IceCube, thus a powerful catalog in the era of multi-messenger astronomy. We also emphasize that this BROS catalog includes nearby ($z \leq 0.3$) BL Lac objects, a fraction of which would be TeV emitters and detectable by future Cherenkov Telescope Array. We will soon make this catalog available once published.

Author: Dr TANAKA, Yasuyuki (Hiroshima University)

Co-authors: Prof. OHTA, Kouji (Kyoto University); Dr INOUE, Yoshiyuki (ISAS/JAXA); Dr UTSUMI, Yousuke (Hiroshima University)

Presenter: Dr TANAKA, Yasuyuki (Hiroshima University)

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