

Interstellar Scattering and the Einstein Ring PKS1830-211

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The remarkably strong radio source PKS 1830-211 is an Einstein ring gravitational lens, with two bright compact components located on opposite sides of a one arcsecond diameter ring of emission. We have obtained high frequency (22 GHz) VLBI data on this source to determine the intrinsic angular sizes of the two compact radio components. Previous VLBI observations at lower frequencies indicate that the brightness temperatures of these components are lower than $\sim 10^{10}$ K, significantly less than is typical for compact synchrotron radio sources. A possible explanation is that interstellar scattering within our galaxy is broadening the apparent angular size of the source and thereby reducing the observed brightness temperature. This is plausible given the location of PKS 1830-211 only a few degrees away from the galactic center. The effects of interstellar scattering are a strong function of frequency, and should be insignificant at 22 GHz. Our VLBI experiment shows that the angular sizes are indeed smaller at 22 GHz than at lower frequencies, leading to higher intrinsic brightness temperatures and showing that the background radio source in PKS 1830-211 has properties typical of other compact radio sources. Angular size measurements made at lower frequencies need to be corrected for the angular broadening caused by our galaxy's interstellar medium. This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.