Luis
Peña-Moñino
Instituto de Astrofísica de Andalucía (IAA-CSIC)
J.B. Climent, Departament d’Astronomia i Astrofísica, Universitat de València, Burjassot, València, Spain
M.A. Pérez-Torres, Instituto de Astrofísica de Andalucía (CSIC), Granada, Spain; Facultad de Ciencias, Universidad de Zaragoza, Zaragoza, Spain
A.T. Gallego-Calvente, Instituto de Astrofísica de Andalucía (CSIC), Granada, Spain
J.D. Bergasa, Universidad Internacional de Valencia (VIU), Valencia, Spain
J.C. Guirado, Departament d’Astronomia i Astrofísica, Universitat de València, Burjassot, València, Spain; Observatori Astronòmic, Universitat de València, Paterna, València, Spain
J. Moldón, Instituto de Astrofísica de Andalucía (CSIC), Granada, Spain
J. Balmon, Departament d’Astronomia i Astrofísica, Universitat de València, Burjassot, València, Spain
D. Martín, Departament d’Astronomia i Astrofísica, Universitat de València, Burjassot, València, Spain
Oral
We present the results from a quasi-simultaneous, broadband, full-polarization, multi-epoch JVLA observations of the fast-rotating ($P_{\mathrm{rot}} = 2.84~\mathrm{hr}$), ultracool dwarf LSR J1835+3259, aimed at shedding light on the dominant mechanisms behind its radio emission. Our observations covered frequencies from 1 to 50 GHz in a contemporaneous fashion, which allowed us to characterize the temporal and spectral evolution of the radio emission.

We find that circularly polarized radio emission dominates over $\sim 30\%$ of the total rotation phase of LSR J1835+3259, corresponding to approximately $0.84~\mathrm{hr}$ (~ 50~min). In most epochs, we detect two clear peaks in Stokes V, which we identify as auroral emission. The radio emission for the remaining 2.0 hr of the rotation period is dominated by quiescent, non-circularly polarized radio emission. The radio spectrum between 1 and 50 GHz is well described by a self-absorbed synchrotron power-law with $\alpha = -0.62 \pm 0.09$, indicating that the radiation belt of LSR J1835+3259 is fed by an injected population of relativistic electrons with p = 2.24. This result may explain why previous attempts to model the radio emission as gyrosynchrotron radiation have been unsuccessful.

We also present the wideband dynamic radio spectrum of LSR J1835, which exhibits a variety of localized bursts and frequency drifts across multiple frequency bands. We successfully model these features as due to auroral radio emission originating from a single active field line. Our model incorporates explicit frequency dependencies through (i) a frequency-dependent emission height along a dipolar magnetic field and (ii) a frequency-dependent cone opening angle derived from cyclotron-maser emission physics. Our results provide a consistent interpretation of the observed dynamic spectra and place new constraints on the magnetic and emission properties of LSRJ1835.

With temperatures similar to those of giant exoplanets, ultracool dwarfs also share similar atmospheric chemistry and magnetic phenomena. As one of the closest and brightest ultracool dwarfs, LSR J1835+3259 serves as a key laboratory for studying such processes. In particular, the identification and characterization of its radiation belt provide new insight into how large-scale magnetospheric particle populations are formed and sustained. These results have direct relevance for understanding the origin and structure of radiation belts in magnetized bodies more broadly, including planets in our Solar System, and therefore contribute to a deeper understanding of solar-magnetospheric interactions across the planetary system.
Presentation file
pena-monino-luis.pdf
Meeting homepage
NASA 5th Eddy Cross-Disciplinary Symposium
Download to PDF
Abstract category

Solar Infuluence on Earth and Planetary System