Interim Performance Report

Grant #
Contract Number
Title
Investigator
Institution
Institution ID
Start Date
End Date
Request Date
Submitter
Reporting Period

Summary Of Project Activities

1. Brief description of the primary objectives and scope of the project

The T6.5 brown dwarf 2MASS J1237+6526, in the following abbreviated as 2M-1237, displays exceptionally bright H-alpha emission among late Land T-dwarfs. It also exhibits circularly polarised radio emission indicating that 2M-1237 possesses a very strong surface magnetic field of at least 2.9 kG. Here we propose to observe the spectrum of 2M-1237 through the UV to test whether the radio and H-alpha emission is due to auroral processes similar to those known from the massive magnetized planets of the solar system or if the cool T6.5 dwarf has UV properties similar to those of low mass stars. Based on observed UV spectra of Jupiter and a very late M-dwarf, both scenarios are detectable with sufficient signal to noise. First observations of UV aurora outside of the solar system would be highly exciting. Detection of auroral emission would provide a new means to detect or provide constraints on a close-in planet or gas torus around the dwarf 2M-1237. The proposed observations also serve as a benchmark study whether UV emission from other brown dwarfs with less intense H-alpha and radio emission can be detected in the future.

2. Brief description of the findings

We show that brown dwarfs due to their typically strong surface magnetic fields and fast rotation can produce auroral UV powers on the order of 10^{19} Watt or more. Considering their negligible thermal UV emission, their potentially powerful auroral emissions make brown dwarfs ideal candidates to detect extrasolar aurorae. We find time-variable low signal-to-noise emission from the dwarf 2MASS J1237+6526, which should be considered tentative due to SNR values in the range of 2 to 3 only and non-systematic trends in the background fluxes. The emission would correspond to a UV luminosity of 1×10^{19} Watt, which lies in the range of the theoretically expected values. Conclusions. The possible auroral emission from the dwarf could be produced by a close in companion and/or magnetospheric transport processes.

The signal in the NUV is generally very faint. Integrating between 2200 and 3000 Å, we find a flux with a SNR of 2.4. Only within 3065 - 3110 Å do we find distinct feature(s) with a net flux of 2.0 × 10-15 erg s-1 cm-2 with a SNR of 4.8. The origin of this net emission is not clear, but it could stem from emission of TiO possibly excited by auroral electrons (Palmer & Hsu 1972; Phatak & Palmer 1970; Miliordos & Mavridis 2010). Small SNR emission in the same wavelength range was also observed in the spectra of the ultracool M8.5 dwarf LSR J1835+3259 (Saur et al. 2018a).

3. Name and date (or anticipated date) of the publication of results

[Redacted]

4. Suggestions and additional comments

Final Performance Report

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2. Brief description of the findings

We developed a theoretical framework of the plasma and magnetic field environment around brown dwarfs, planets, and low mass stars to derive scaling models for their potential auroral luminosities in order to analyze HST observations of the brown dwarf 2MASS J1237+6526. We show that brown dwarfs, due to their typically strong surface magnetic fields and fast rotation, can produce auroral UV powers on the order of 10^{19} watt or more. Considering their negligible thermal UV emission, their potentially powerful auroral emissions make brown dwarfs ideal candidates for detecting extrasolar aurorae. We find possible emission from 2MASS 1237+6526 but cannot conclusively attribute it to the brown dwarf due to low signal-to-noise values in combination with nonsystematic trends in the background fluxes. The observations provide upper limits for the emission at various UV wavelength bands (near-UV, FUV, Lyman). Their upper limits for the emission correspond to a total UV luminosity of 1×10^{19} watt, which lies in the range of the theoretically expected values. Our conclusion is possible auroral emission from the dwarf could be produced by a close-in companion and/or magnetospheric transport processes. Despite the tentativeness of our observational results, brown dwarfs are ideal objects to search for UV aurora outside of the Solar System, and further UV observations might prove greatly helpful in understanding the space plasma environment around brown dwarfs and extrasolar planets.

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