14897 - Quantifying the Impact of High-Energy Electrons on Low-Temperature Dwarfs

Cycle: 24, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NLTT33370	ACS/SBC	2	13-Dec-2016 21:12:53.0	yes

2 Total Orbits Used

ABSTRACT

Radio studies show that, despite their low temperatures, very low-mass stars and brown dwarfs can generate strong magnetic fields and accelerate ~MeV electrons. Strikingly, the resulting phenomenology resembles that of a scaled- up planet more than a scaled-down star, with aurorae and radiation belts thousands of times brighter than those of Jupiter. In both Jupiter and the "ultracool dwarfs," radio emission traces energetic magnetospheric electrons. In Jupiter, many of these electrons eventually crash into the upper atmosphere, their energy driving haze production and

vertical mixing. We do not know how efficiently magnetic energy is deposited in ultracool dwarf atmospheres, or the chemistry that this drives. This deposition leads to FUV emission, however, and we have recently calculated that the most radio-active ultracool dwarf, NLTT33370B, should produce enough FUV to be detectable with Hubble. We propose a 4-hour simultaneous VLA/HST observation to measure the impact of this deposition process. Using a novel VLA sub-arraying tactic, we will leverage well-vetted planetary radiation belt models to obtain an unprecendently detailed view of how electrons migrate through this dwarfs's inner magnetosphere. Hubble will probe their ultimate fate.

OBSERVING DESCRIPTION

We propose an HST UV imaging observation aiming to achieve S/N = 5 in our fiducial model of the auroral UV emission of NLTT 33370 B (described in the VLA proposal text). This observation is to be conducted simultaneously with a Very Large Array observation. The Solar Blind Channel of the ACS provides the highest raw sensitivity. Using a realistic model of the auroral emission spectrum (Gustin+, 2013JMoSp.291..108G), we find that observations with the SHADOW constraint provide the most efficient use of HST time. Given the system's known NUV emission (see Williams+, 2015ApJ...799..192W), we propose dithered exposures in both the F115LP and F165LP filters to allow "red leak" subtraction. Using the ACS instrument handbook and the HST exposure time calculator, we find that the desired S/N can be achieved in 2 orbits, with 2470 s (226 s) of on-target exposure in the F115LP (F165LP) filters, after accounting for overheads; the achieved S/N is 6.1 (6.2). [NOTE: these numbers have not been updated to match the precise values derived from use of the orbit planner.] We have checked that the proposed observations do not exceed ACS/SBC count limits, and both the HST Bright Object Tool and GALEX catalogs confirm that there are no sources in a 70" diameter that threaten instrument safety. The SHADOW constraint means that NLTT 33370 B is visible to HST for a relatively brief window, from 2017 Apr 9 to 2017 Jul 5 with some gaps. This window overlaps a VLA configuration change (D -> C; 2017 May 15--25), but the configuration change fortuitously mostly overlaps a gap in HST visit schedulability.

Visit

Proposal 14897, Visit 01 Wed Dec 14 02:12:54 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Comments: This visit is to be conducted simultaneously with an observation on the Very Large Array. It also has a SHADOW constraint which constrains the time of its execution to a few-month window.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2), (3), (4)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NLTT33370 Alt Name1: LSPM-J1314+1320 Alt Name2: 2MASS-J13142039+1320011	RA: 13 14 20.1850 (198.5841042d) Dec: +13 19 58.96 (13.33304d) Equinox: J2000	Proper Motion RA: -247.99 mas/yr Proper Motion Dec: -183.58 mas/yr Parallax: 0.057975" Epoch of Position: 2010.0	V=15.83+/-0.05 spectral type M7, GALEX NUV magnitude 21.0 + - 0.2, not detected in GALEX FUV	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Astrometry has been updated from Dupuy et al 2016. Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(ACS.im.847642)	(1) NLTT33370	ACS/SBC, ACCUM, SBC	F115LP		SHADOW	Pattern 2, Exps 1-1 in Visit 01 (2)	734 Secs (1468 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
2	(ACS.im.847645)	(1) NLTT33370	ACS/SBC, ACCUM, SBC	F165LP		SHADOW	Pattern 2, Exps 2-2 in Visit 01 (2)	74 Secs (148 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
3	(ACS.im.847642)	(1) NLTT33370	ACS/SBC, ACCUM, SBC	F115LP		SHADOW	Pattern 2, Exps 3-3 in Visit 01 (2)	734 Secs (1468 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[2]***
4	(ACS.im.847645)	(1) NLTT33370	ACS/SBC, ACCUM, SBC	F165LP		SHADOW	Pattern 2, Exps 4-4 in Visit 01 (2)	74 Secs (148 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[2]***

Orbit Structure