



14845 - A Search for Stellar Dust Production in Leo P, a Nearby Analog of High Redshift Galaxies

Cycle: 24, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) NAME-LEO-P	WFC3/IR	1	09-Nov-2016 12:29:57.0	yes

1 Total Orbits Used

ABSTRACT

The origin of dust in the early Universe is a matter of debate. One of the main potential dust contributors are Asymptotic Giant Branch (AGB) stars, and several studies have been devoted to investigating whether and how AGB dust production changes in metal-poor environments. Of particular interest are the most massive AGB stars (8-10 Msun), which can in principle enter the dust-producing phase <50 Myr after they form. However, these stars cannot produce their own condensable material (unlike carbon AGB stars), so the efficiency of dust production decreases with metallicity. Evidence for dust production in massive AGB stars more metal-poor than the Magellanic Clouds is scarce due both to the rarity of chemically-unevolved, star-forming systems reachable in the infrared and to the short lifetimes of these stars. The recently discovered galaxy Leo P provides an irresistible opportunity to search for these massive AGB stars: Leo P is a gas-rich, star-forming galaxy, it is nearby enough for resolved star photometry with Spitzer, and its interstellar medium is 0.4 dex more metal-poor than any other accessible star-forming galaxy. Models predict ~ 3 massive AGB stars may be present in Leo P, and optical HST observations reveal 7 candidates. We propose to use Spitzer to determine whether these stars are dusty, providing valuable constraints to the dust contribution from AGB stars up to at least redshift 3.2, or 11.7 Gyr ago, when massive spheroidals and Galactic globular clusters were still forming. This is a gain of 2.8 Gyr compared to other accessible galaxies. We also request 1 orbit of joint HST time to confirm whether the AGB candidates in Leo P are indeed massive AGB stars belonging to the galaxy. These observations will provide information crucial for potential JWST followup spectroscopy.

OBSERVING DESCRIPTION

Targets:

We will target 1 field in Leo P that overlaps with Spitzer cycle-13 coverage and existing HST optical coverage.

Filters:

To take full advantage of the CN+C2 and water features near 1.4 microns, we require observations with F127M, F139M, and F153M. All three filters are necessary, since combinations with the broad-band optical, near-IR, and IR filters do not successfully isolate the carbon stars.

Required exposure times and photometric depth:

In order to detect all AGB stars, we must achieve full photometric completeness at the tip of the red giant branch (TRGB). The orbit time for our target is 54 min, so we can achieve the necessary photometric depth within a single orbit (as demonstrated by Boyer et al. 2013). This allows for total exposure times of 800-850s in each filter, resulting in $S/N > 7$ in F139M for $m_{F160W} = 23$ mag, using a Bruzual template for an M6III star. The S/N is even better in the F127M and F153M filters, owing to a higher throughput. For reference, the TRGB in the F160W filter corresponds to $m_{F160W} \sim 19$ mag at the distance of Leo P.

Dithering Strategy:

Dithering diminishes errors associated with where a source is placed on a pixel, undersampling of the WFC3/IR channel, and image artifacts such as cosmic rays. We choose a 4-point dithering strategy to achieve Nyquist sampling of the PSF & to simultaneously allow us to fit the three selected filters into a single orbit. We have entered the dither offsets manually into the target offset entries following the WFC3 handbook WFC3-IR-DITHER-BOX-MIN values from table C.3

Avoiding Saturation:

The brightest AGB stars in our sample may reach $m_{F160W} \sim 16.5$ mag (or $M_{F160W} = -8$ mag). Stars brighter than $m_{F160W} \sim 16.7$ mag are in danger of saturating in 460 s exposures in the medium-band filters. Our longest exposures are only 300s, so saturation of our targets will not be an issue. Other bright stars in the field will be recovered by the WFC3/IR MULTIACCUM sampling.

Parallels:

There are no parallel observations for this program.

Scheduling Constraints:

We require observations to be concurrent with Spitzer cycle 13 observations (PI Boyer, GO-13009) to avoid uncertainties that arise in non-contemporaneous observations of large-amplitude variable stars. Spitzer observations are not yet scheduled, but we do know that they will occur in specific known windows. We've designed constraints here to ensure that HST observations will occur within 20 days of Spitzer (we'd prefer <15 days). However, the timing constraints entered here are flexible depending on exactly when the Spitzer observations are finally scheduled. The Spitzer window is entered under "Comments" in the Visit.

Proposal 14845 - LeoP (01) - A Search for Stellar Dust Production in Leo P, a Nearby Analog of High Redshift Galaxies

Wed Nov 09 17:29:59 GMT 2016

Visit	Proposal 14845, LeoP (01) Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: BETWEEN 25-FEB-2017:00:00:00 AND 01-APR-2017:00:00:00 <i>Comments: Timing constraints on this visit ensure the data are obtained within a few weeks of joint Spitzer observations to minimize variability affects (periods > 200 days). The Spitzer observing window is Feb 25, 2017 to Apr 04, 2017. The Spitzer cycle is 2 years long, so its possible the target won't be observed until similar windows in 2018.</i>												
	Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>NAME-LEO-P</td> <td>RA: 10 21 44.8850 (155.4370208d) Dec: +18 05 31.59 (18.09211d) Equinox: J2000</td> <td></td> <td>V=20+/-0.5</td> <td>Reference Frame: SIMBAD</td> </tr> </tbody> </table> <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Extended=NO</i>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	NAME-LEO-P	RA: 10 21 44.8850 (155.4370208d) Dec: +18 05 31.59 (18.09211d) Equinox: J2000		V=20+/-0.5
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous								
(1)	NAME-LEO-P	RA: 10 21 44.8850 (155.4370208d) Dec: +18 05 31.59 (18.09211d) Equinox: J2000		V=20+/-0.5	Reference Frame: SIMBAD								
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit			
	1	F127M	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F127M	NSAMP=8; SAMP-SEQ=STEP1 00			199.231 Secs (199.231 Secs) [==>]	[1]			
	2	F139M	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F139M	NSAMP=8; SAMP-SEQ=STEP1 00			199.231 Secs (199.231 Secs) [==>]	[1]			
	3	F153M	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F153M	NSAMP=8; SAMP-SEQ=STEP1 00			199.231 Secs (199.231 Secs) [==>]	[1]			
	4	F127M - off set1	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F127M	NSAMP=8; SAMP-SEQ=STEP1 00	POS TARG 0.542,0.182		199.231 Secs (199.231 Secs) [==>]	[1]			
	5	F139M - off set1	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F139M	NSAMP=8; SAMP-SEQ=STEP1 00	SAME POS AS 4		199.231 Secs (199.231 Secs) [==>]	[1]			
	6	F153M - off set1	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F153M	NSAMP=8; SAMP-SEQ=STEP1 00	SAME POS AS 4		199.231 Secs (199.231 Secs) [==>]	[1]			
	7	F127M - off set2	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F127M	NSAMP=8; SAMP-SEQ=STEP1 00	POS TARG 0.339,0.485		199.231 Secs (199.231 Secs) [==>]	[1]			
	8	F139M - off set2	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F139M	NSAMP=8; SAMP-SEQ=STEP1 00	SAME POS AS 7		199.231 Secs (199.231 Secs) [==>]	[1]			
	9	F153M - off set2	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F153M	NSAMP=8; SAMP-SEQ=STEP1 00	SAME POS AS 7		199.231 Secs (199.231 Secs) [==>]	[1]			
	10	F127M - off set3	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F127M	NSAMP=8; SAMP-SEQ=STEP1 00	POS TARG -0.203,0.303		199.231 Secs (199.231 Secs) [==>]	[1]			
	11	F139M - off set3	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F139M	NSAMP=10; SAMP-SEQ=STEP5 0	SAME POS AS 10		249.23203 Secs (249.232 Secs) [==>]	[1]			
	12	F153M - off set3	(1) NAME-LEO-P	WFC3/IR, MULTIACCUM, IR	F153M	NSAMP=8; SAMP-SEQ=STEP1 00	SAME POS AS 10		199.231 Secs (199.231 Secs) [==>]	[1]			

