16299 - The Nature of a Newly Discovered Wolf-Rayet Binary: Archetype of Stripping?

Cycle: 28, Proposal Category: GO

(UV Initiative)

(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) LMCE055-1	COS/FUV	2	21-Aug-2020 15:00:11.0	yes

2 Total Orbits Used

ABSTRACT

Understanding massive star evolution is important for a variety of astrophysical processes, from the formation of the elements to the generation of gravitational waves as their remnants merge. Wolf-Rayet stars are evolved stars, where the hydrogen has been removed from a massive OB star, and its nuclear burning products revealed at the surface. This stripping can occur either by stellar winds or by interactions in close binaries. Although we expect the latter to be an important mechanism, there are few examples where one can argue which mechanism has been responsible, as even a single WR star may have formed through binary interaction, but merged with its companion. Given the large number of massive stars in binaries, we expect

stripped remnants to be common. Binary models suggest these should look like WR stars, but they are curiously absent where we most expect to find them. However, the recent discovery of a WR binary in the LMC matches many of the properties expected for a stripped binary WR. We have obtained extensive ground-based photometry and spectroscopy of this object, and have carried the analysis as far as it is possible. The WR component is of WN4-type, but with intrinsic hydrogen and helium absorption lines. The companion is an "impossible" star, with a sub-solar mass and radius but a very high temperature. We suggest that this is the result of an Algol-like system, with both components having been donors and recipients at some point. This could be the archetype of binary-produced WRs, but we need UV spectra to determine CNO abundances, stellar wind properties, and better estimates of the bolometric luminosity. HST is the only way to achieve this.

OBSERVING DESCRIPTION

For calculations of exposure times, we used as input our best fluxed CMFGEN model of LMCe055-1, which corresponds to an effective temperature of 65,000 K, reddened by E(B-V) = 0.13 with a combined Galactic and LMC extinction law, and V = 16.2. As a reality check we also compared the exposure times to that of a 65,000 K black body with the same reddening and visual flux.

LMCe055-1 is too bright for acquisition through the Primary Science Aperture with
Mirror A, and so we will perform the acquisition using dispersed light with the G140L/1280
The exposure time needed to reach a S/N of 40 is 3.2 seconds according to the ETC (COS.sa.1422365).
Our coordinates are excellent (Gaia) and so we can skip the ACQ/SEARCH, and instead perform both a
ACQ/PEAKXD and ACQ/PEAKD (NUM-POS=5, STEP-SIZE=0.9)

In order to achieve full wavelength coverage in the FUV we will use the newly supported
G140L/800 setting to provide spectral coverage from 900 to 1950 A, including the critical
OVI 1038, NV 1240, and He II 1640 lines.
This is the recommended wavelength setting with G140L, given that we will not exceed safe count rates at
the longest wavelengths.

We calculate the exposure time needed in order to achieve a S/N of 10 at OVI 1038.This
will require 3300 sec exposure according to the ETC (COS.sp.1422816). At long wavelengths
(such as the Civ 1550 doublet) this will give us excellent S/N (40) according to the ETC

(COS.sp.1422869). However, in order to achieve this (and to obey the COS2025 rules) we must observe with four slightly different central wavelengths as otherwise the flat-field will limit our S/N to 15-20. This is accomplished by FP-POS=all, breaking the exposure into nominally 4 x 825 sec exposures.

Our program requires 2 orbits in total. The first orbit includes the dispersed light acquisition and the first two FPs of the G140L/800 exposures, lengthened from 825 to 1092 sec. The second orbit obtains the 3rd and 4th FPs of G140L/800, with an increase of exposure times to 1438 sec. Thus the total time will be 5150 sec, which should give us a S/N at OVI of 12.

The Bright Object Tool shows thatnNeither the GSC II nor the GALEX catalogs show anything in the area to trigger safety concerns.

Impact of Potential Reduced-gyro Operations: since we do not require a particular orientation, the short answer is "none."

Visit

Proposal 16299, Visit 01, implementation Fri Aug 21 19:00:12 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LMCE055-1	RA: 04 56 48.8116 (74.2033817d) Dec: -69 36 40.61 (-69.61128d) Equinox: J2000	Epoch of Position: 2000.0	V=16.1+/-0.2	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[WOLF RAYET - WN]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition (1422365)	(1) LMCE055-1	COS/FUV, ACQ/PEAKXD, PSA	G140L 1280 A				3.2 Secs (3.2 Secs) *[==>]*	 ***[1]***
2	acquisition (14211721)	(1) LMCE055-1	COS/FUV, ACQ/PEAKD, PSA	G140L 1280 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=DEF			3.2 Secs (3.2 Secs) *[==>]*	 ***[1]***
3	(1422816)	(1) LMCE055-1	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=ALL; BUFFER-TIME=900			900 Secs (5058 Secs) *[==>1091.0 Secs (Split 1)]* *[==>1091.0 Secs (Split 2)]* *[==>1438.0 Secs (Split 3)]* *[==>1438.0 Secs (Split 4)]*	 ***[1]*** ***[2]***

Orbit Structure