18101 - A New Approach to Determine the Ionizing Fluxes of Rapidly Rotating Oe Stars at Low Metallicity

Cycle: 33, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Prof. Aida Wofford (PI) (Contact)	**National Autonomous University of Mexico**
Prof. Paul A. Crowther (CoI) (ESA Member)	University of Sheffield
Prof. Sally Oey (CoI) (AdminUSPI)	University of Michigan
Dr. Grace Telford (CoI)	University of Utah
Dr. Jorick Vink (CoI) (ESA Member)	Armagh Observatory and Planetarium
Gautham Sabhahit (CoI) (ESA Member)	Armagh Observatory and Planetarium
Oskar Francisco Arangure-Chong (CoI)	National Autonomous University of Mexico
Dr. Cristophe Morisset (CoI)	National Autonomous University of Mexico
Dr. Daniel Pauli (CoI) (ESA Member)	Institute of Astronomy, KU Leuven

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) LHA-115-S-31	COS/FUV COS/NUV	2	05-Nov-2025 15:00:24.0	yes
02	(2) OGLE-SMC725.11.009683 (3) N80A-OFFSET	COS/FUV COS/NUV	2	05-Nov-2025 15:00:25.0	yes

4 Total Orbits Used

ABSTRACT

Oe rapidly-rotating main-sequence emission-line stars can dominate the ionization of H II regions, particularly at low metallicity, where they are relatively common and reach earlier (hotter) types. When line emission fills-in their key optical absorption lines, it is extremely challenging to infer their spectral type, effective temperature/Teff, and ionizing spectrum using conventional optical analysis. FUV spectra offer the only route for constraining these fundamental stellar properties. However, few FUV spectra of Oe stars are available, and most of them are of stars in complex regions that prevent us from using their associated nebulae to validate their ionizing fluxes. We have used data from the integral field spectroscopic survey, SDSS-V Local Volume Mapper, to identify two SMC-field Oe stars with relatively isolated H II regions. The stars have high-quality optical spectra from 6-8 m class telescopes and are likely to sample different temperature regimes (one early- and one late-type). We request HST/COS G130M+G160M observations of these stars in order to cover the crucial 1160-1190 and 1550 Ang spectral regions. The FUV spectra will enable us to assess the impact of rapid rotation on their ionizing fluxes and to infer stellar wind properties. Due to their isolation, the Oe star H II regions can be used to validate the stellar ionizing fluxes predicted from models fit to the HST/COS spectra. Our study will be the first that combines stellar and nebular spectra to constrain the highly uncertain contribution of Oe stars, known to be more common at low metallicity, to the ionizing fluxes/feedback of their host galaxies.

OBSERVING DESCRIPTION

We will observe two rapidly-rotating O-type main sequence stars in the SMC, AzV 255 or LHA-115-S-31 (~O7V) and N80A or OGLE-SMC725.11.009683 (~O3V).

We will use COS G130M (cenwave=1291) + G160M (cenwave=1611) for the first target (AzV 255), which has fluxes of 4.2e-13 erg/s/cm2 at 1300 A and 3.0e-13 at 1500 A, Gaia G=13.54 mag, and E(B-V)~0.04 mag.

We will use COS G140L and cenwave = 800 for the second star, which is fainter (1.1e-14 erg/s/cm2 at 1300 Ang, Gaia G=17.84 mag) and more reddened (E(B-V)~0.3 mag).

To avoid going over the brightness limits during the TA of N80A, which is located near a bright star, we will acquire instead an offset star (Gaia DR3 4687529716356335360, renamed N80A-OFFSET), which is a B1V star that has a V-band magnitude of 15.56 and E(B-V)~0.04 mag.

For all exposure time calculations we will use Castelli and Kurucz Models models of the stars and the Milky Way extinction law to redden the models prior to their renormalization to the above observed reddened fluxes or magnitudes.

For the TA of AzV 255, we use the BOA, MIRROB, the ACQ/IMAGE mode, and the recommended SNR=30 when using the BOA. For the TA of N80A-OFFSET, we use the PSA, MIRRORB, the ACQ/IMAGE mode, and the recommended SNR=20 (5s) when using the PSA.

Guided by O-star observations from ULLYSES, we need spectroscopic observations to have a minimum SNR=20/six-pixel resel (G130M/1291 at 1150 Ang and G160M/1611 at 1590 Ang). For N80A we require a similar SNR=20 with G140L/800 at 1169 Ang. For this, the G130M and G160M science exposure times for AzV 255 need to be 276 s and 434 s, respectively; and for N80A, 1,369 s.

For AzV 255, the overhead times (in s) for the guide star acquisition and TA, G130M, and G160M exposures are 420, 206 and 1706, and 1706+117 s, respectively.

Thus, overall, we will use 2 (2) orbits for observing N80A (AzV 255) with COS.

Visit

Proposal 18101, Visit 01, implementation

Wed Nov 05 20:00:25 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LHA-115-S-31	RA: 01 00 42.0781 (15.1753254d) Dec: -71 31 12.27 (-71.52008d) Equinox: J2000	Proper Motion RA: 0.795 mas/yr Proper Motion Dec: -1.2019999076073873 mas/yr Epoch of Position: 2000	V=12.74	Reference Frame: ICRS

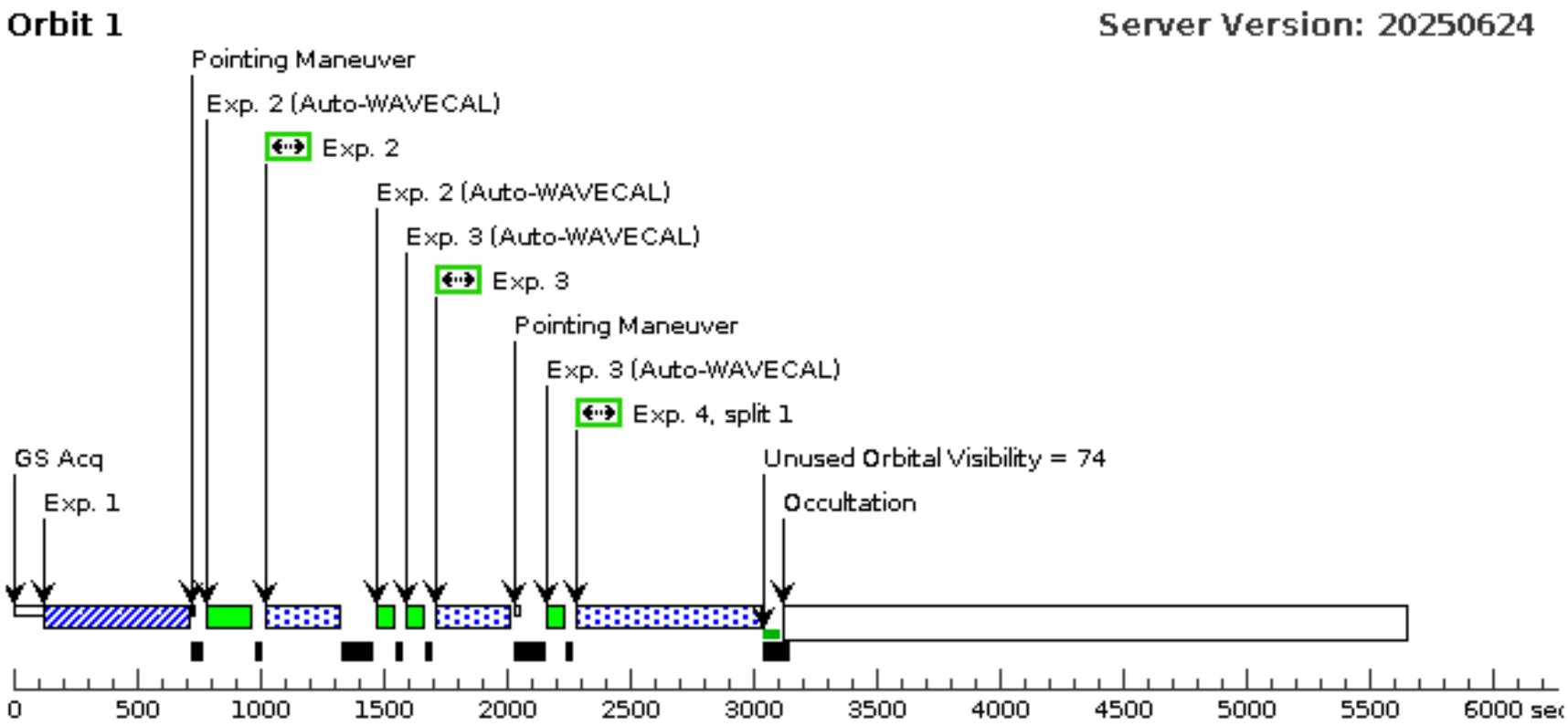
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

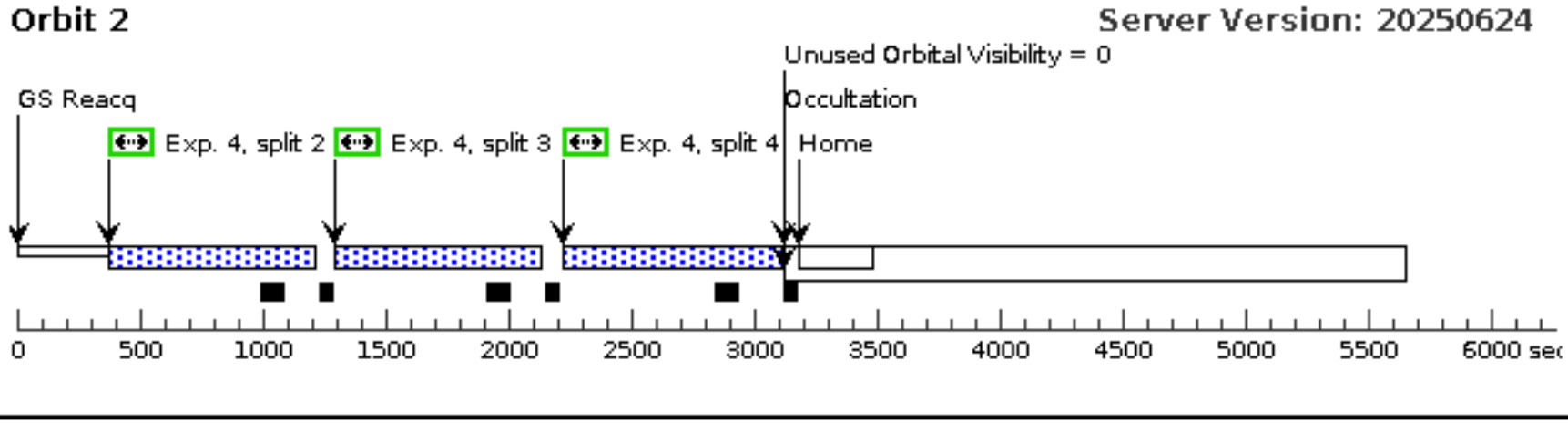
SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.
Category=EXT-STAR
Description=[MAIN SEQUENCE O, OE]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.2225408)	(1) LHA-115-S-31	COS/NUV, ACQ/IMAGE, BOA	MIRRORB				138 Secs (138 Secs) *[==>]*	 ***[1]***
2	(COS.sp.2225411)	(1) LHA-115-S-31	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=211; FP-POS=3			276 Secs (252 Secs) *[==>252 Secs]*	 ***[1]***
3	(COS.sp.2225411)	(1) LHA-115-S-31	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=211; FP-POS=4			276 Secs (252 Secs) *[==>252 Secs]*	 ***[1]***
4	(COS.sp.2225409)	(1) LHA-115-S-31	COS/FUV, TIME-TAG, PSA	G160M 1611 A	SEGMENT=BOTH; BUFFER-TIME=583; FP-POS=ALL			434 Secs (2981 Secs) *[==>572.0 Secs (Split 1)]* *[==>788.0 Secs (Split 2)]* *[==>788.0 Secs (Split 3)]* *[==>833.0 Secs (Split 4)]*	 ***[1]*** ***[2]***

Orbit Structure





Visit

Proposal 18101, Visit 02, implementation

Wed Nov 05 20:00:25 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	OGLE-SMC725.11.009683	RA: 01 08 27.8895 (17.1162062d) Dec: -72 00 10.29 (-72.00286d) Equinox: J2000	Proper Motion RA: 0.542 mas/yr Proper Motion Dec: -1.294 mas/yr Epoch of Position: 2000	V=17.688	Reference Frame: ICRS
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *The equatorial coordinates match those of Gaia DR3* *Category=EXT-STAR* *Description=[MAIN SEQUENCE O, OE]* *Extended=NO*					
(3)	N80A-OFFSET Alt Name1: S0W8275115 Alt Name2: GAIA-DR3-4687529716356335360	RA: 01 08 26.2127 (17.1092196d) Dec: -71 59 54.36 (-71.99843d) Equinox: J2000	Proper Motion RA: 0.811 mas/yr Proper Motion Dec: -1.220 mas/yr Parallax: 0.0000066" Epoch of Position: 2000	V=15.56 G = 15.50	Reference Frame: ICRS
Comments: The equatorial coordinates are from Gaia DR3 *Category=STAR* *Description=[B0-B2 V-IV]* *Extended=NO*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.2225289)	(3) N80A-OFFSET	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				5 Secs (5 Secs) *[==>]*	 ***[1]***
2	(COS.sp.2225369)	(2) OGLE-SMC725.11.009683	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=4139; FP-POS=1			1135 Secs (1129 Secs) *[==>1129.0 Secs]*	 ***[1]***
3	(COS.sp.2225369)	(2) OGLE-SMC725.11.009683	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=4139; FP-POS=2			1135 Secs (1129 Secs) *[==>1129.0 Secs]*	 ***[1]***
4	(COS.sp.2225369)	(2) OGLE-SMC725.11.009683	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=4139; FP-POS=3			1135 Secs (1276 Secs) *[==>1276.0 Secs]*	 ***[2]***
5	(COS.sp.2225369)	(2) OGLE-SMC725.11.009683	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=4139; FP-POS=4			1135 Secs (1276 Secs) *[==>1276.0 Secs]*	 ***[2]***

Orbit Structure