14177 - Identifying Ionization Mechanisms through Spatially-Resolved Neon Emission in the Jets of Sz 102

Cycle: 23, 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) V-V1190-SCO	STIS/CCD	2	25-Jul-2015 21:26:31.0	yes

2 Total Orbits Used

ABSTRACT

Understanding how jet and wind are launched from the disk is essential in understanding how gas accretes through the disk and onto the star in a young stellar system. Studying the jet launch region requires sub-AU resolution which is unresolvable with current facilities but emission from the jet helps to probe the physical conditions close to the launch region. Line diagnostic studies of jets from low-mass young stars suggest most of them are partially ionized, yet the origin of ionization is not fully understood. To investigate the relation between the jet and its ionization sources, we propose to obtain spatially-resolved HST/STIS [Ne III] 3869 spectra along the jet of the T Tauri star Sz 102. Neon has high photoionization thresholds and

high valence ionization potentials that are most sensitive to high-energy processes in low-mass star formation, especially hard (keV) X-rays and strong (100 km/s) shocks. Its high-density forbidden transition [Ne III] 3869 provides probe close to the jet-driving region. Sz 102 drives bright bipolar jets that emit [Ne III] 3869, and has an edge-on oriented disk which blocks most of the stellar light and permit analysis at high spatial resolution. Hard X-ray irradiation is expected to occur close to the star while strong jet shocks occur further away as the flow propagates outward. By resolving the spatial distribution of the [Ne III] line, we aim to identify the major ionizing source of the Sz 102 jet. The study will help to infer the overall structure of ionization sources and be linked to magnetic structure in the star-disk system, which is responsible for launching the jet, potentially producing jet shocks, and emitting X-ray photons.

OBSERVING DESCRIPTION

- Instrumental Configurations

We will use STIS spectroscopic mode to obtain first-order spatially resolved long-slit spectra of [Ne III] 3869. We propose to use G430M grating with the 52X0.2 slit and achieve medium spectral resolution of ~50 km/s. The line widths obtained by VLT/UVES are ~150 to 200 km/s for both the blueshifted and redshifted microjets (Liu et al. 2014). We will spectrally separate the two sides of the microjet, should there be any spatial confusion. With the 52X0.2 slit, it is possible to mitigate slit lost such that the variations of the line flux due to instrumental origins can be avoided.

To obtain the required [Ne III] signal-to-noise of 20 in the brighter redshifted microjet, we request 2 orbits of STIS observation. We will use the two wavelength settings 3843 A (covering 3700 - 3986 A) and 3936 A (3793 - 4079 A) for each orbit, both of which include the [Ne III] emission. The use of two different maximizes the wavelength coverage, including serendipitous observations of the jet in [O II]3726, 3729 lines in the short wavelength setting and the [S II] 4068, 4076 lines in the long wavelength setting. We will dither along the slit by 0".525 (10.5 pixels) to overcome the undulation caused by undersampling of the central source, in order to have better spatial resolution of ~ 0".1. We will set CR-SPLIT = NO for each dither position since the background will dominate the noise.

- Slit Orientations

The slit will be placed along the jet of Sz 102, with a position angle of 98 degrees (Krautter 1986; Wang & Henning 2009). The VLT/UVES spectra of [Ne III] 3869 show that the emission traces both the blueshifted and redshifted jets from Sz 102. Spectroastrometric analysis suggests that the emission peaks of the blueshifted and redshifted jets are separated by ~0."3 (Liu et al. 2014). It is crucial for our study to trace the spatial distribution of jet emission in order to discriminate between ionization mechanisms. Therefore, the slit orientation needs to be kept along the nominal position angle. The proposed value for ORIENT is 45.35 + 180.0 + 98.0 = 323.35 in order to have schedulability. A ~2.5 degrees flexibility is allowed to increase scheduling possibility. The total variation of the angle, 5 degrees, produces < 0."05 transverse deviation (~1 pixel) at the distance of 0."5.

- Exposure Time Estimates

The exposure time estimates for G430M are based on flux-calibrated high resolution VLT/UVES spectra (Liu et al. 2014) and on flux-calibrated low resolution Keck/LRIS spectra (Herczeg & Hillenbrand 2014). The high resolution spectra have been spectrally decomposed into blueshifted and redshifted components, each traces one side of the microjet of Sz 102. We estimate the exposure times mainly based on the brighter redshifted emission. For the brighter redshifted microjet, the total flux is 5 x 10E-15 erg/s/cm2. Assuming the emission is extended over region of 0."2 x 0."5, the average brightness of the emission is thus 5 x 10E-14 erg/s/cm2/arcsec2. The continuum level at 3869 A is 3 x 10E-16 erg/s/cm2/A. With an average airglow condition, and default CR-SPLIT=2 and CCDGAIN=1 options, the ETC predicted a exposure time of ~5000 s for reaching S/N = 23 at the peak of the line emission and S/N = 3 at the continuum. This sets up the required exposure time for the observation in order to have both the line and the continuum with reasonable signal-to-noise ratios. The visibility for Sz 102 would be limited to 50 minutes due to restricted ORIENT. To assure target position accuracy, we propose both ACQ and ACQ/PEAK acquisition procedures for Sz 102.

Visit

Proposal 14177, G430M (01) Sun Jul 26 01:26:33 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 320.85D TO 325.85 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=2 Point Spacing=0.525 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(3), (4)

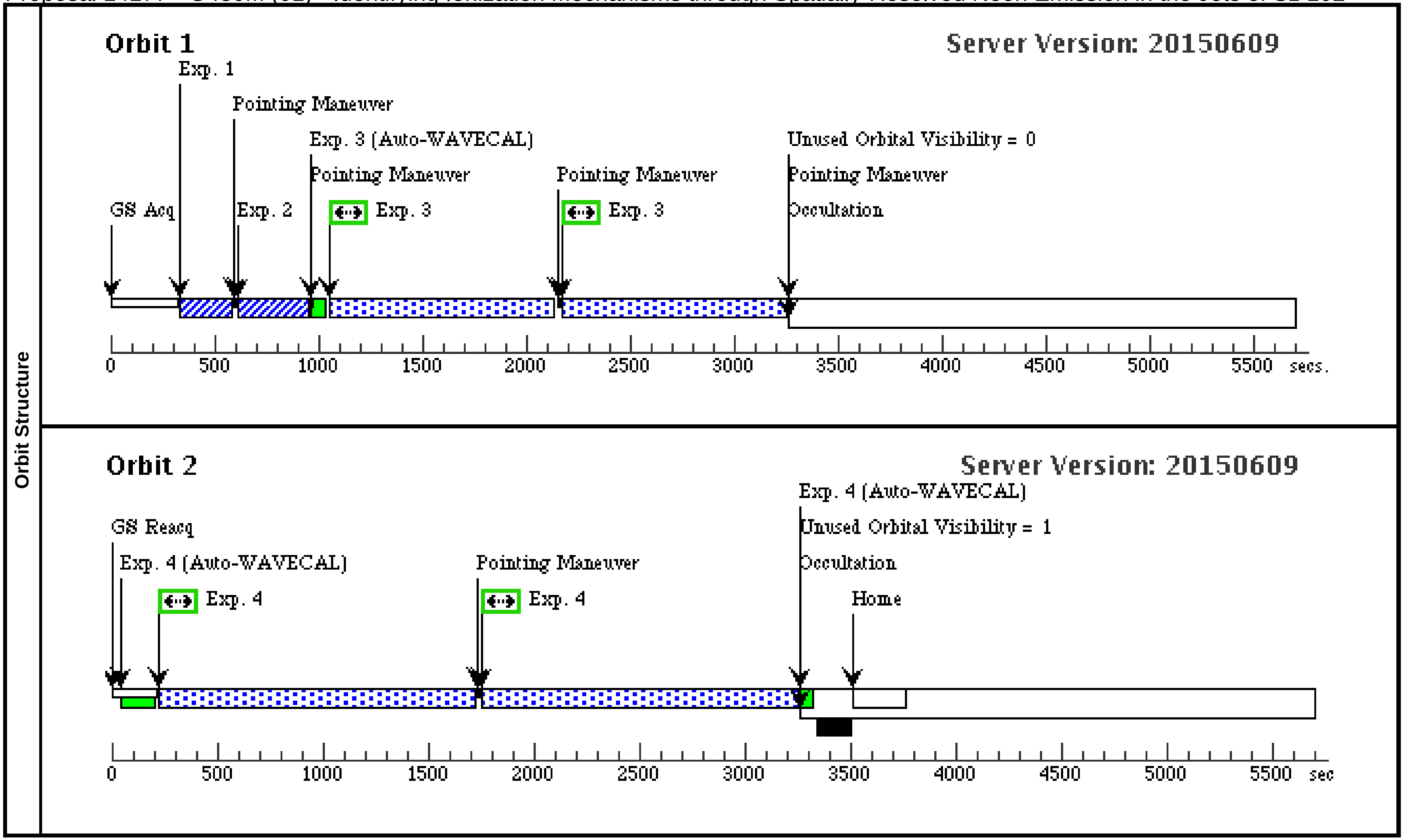
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-V1190-SCO Alt Name1: SZ-102 Alt Name2: TH-28	RA: 16 08 29.7290 (242.1238708d) Dec: -39 03 11.01 (-39.05306d) Equinox: J2000	Proper Motion RA: 4.6 mas/yr Proper Motion Dec: -31.0 mas/yr Epoch of Position: 2000	V=15.91+/-0.05 B = 16.26	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates are based on 2MASS point source catalog. ACQ and ACQ/Peakup are proposed and required to determine the peak position of the continuum source.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Sz 102 ACQ	(1) V-V1190-SCO	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			5.0 Secs (5 Secs) *[==>]*	*[1]*
2	Sz 102 ACQ-Peak (CENTWAVE=3936)	(1) V-V1190-SCO	STIS/CCD, ACQ/PEAK, 52X0.1	G430M 3936 A				5.0 Secs (5 Secs) *[==>]*	*[1]*
3	Sz 102 ACCUM (CENTWAVE=3936)	(1) V-V1190-SCO	STIS/CCD, ACCUM, 52X0.2	G430M 3936 A	CR-SPLIT=NO		Pattern 1, Exps 3-3 in G430M (01) (1)	2100 Secs (2088 Secs) *[==>1044.0 Secs (Pattern 1)]* *[==>1044.0 Secs (Pattern 2)]*	*[1]*
4	Sz 102 ACCUM (CENTWAVE=3843)	(1) V-V1190-SCO	STIS/CCD, ACCUM, 52X0.2	G430M 3843 A	CR-SPLIT=NO		Pattern 1, Exps 4-4 in G430M (01) (1)	2900 Secs (2924 Secs) *[==>1462 Secs (Pattern 1)]* *[==>1462 Secs (Pattern 2)]*	*[2]*


Orbit Structure
Orbit 1
Server Version: 20150609
Exp. 1
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 0
Pointing Maneuver
GS Acq
Exp. 2
Exp. 3
Exp. 3
Occultation
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.
Orbit 2
Server Version: 20150609
Exp. 4 (Auto-WAVECAL)
GS Reacq
Unused Orbital Visibility = 1
Exp. 4 (Auto-WAVECAL)
Pointing Maneuver
Occultation
Exp. 4
Exp. 4
Home
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec