



16290 - UV Spectroscopy of PDS 70: A T Tauri Star Hosting a Newborn Planetary System

Cycle: 28, Proposal Category: GO

(UV Initiative)

(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) PDS70	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	27-Jun-2020 19:00:13.0	yes

2 Total Orbits Used

ABSTRACT

Observational studies of planet-hosting T Tauri stars (TTS) provide crucial insight into the earliest evolutionary stages of planet formation at ages of a few Myr. In a exciting new discovery, two giant protoplanets have been directly imaged orbiting in the disk gap of the nearby (113 pc) TTS PDS 70. The gap is gas-depleted, directly exposing the protoplanets to UV and X-ray irradiation from the star. PDS 70 is

the closest planet-hosting TTS discovered so far and viewed through very low extinction, making it an exceptional target for UV spectroscopy with HST.

We propose to obtain the first UV spectra of PDS 70 using STIS FUV (G140L) and NUV (G230L) gratings. Our main objectives are to determine the star's accretion rate (which remains controversial) and use the UV spectra, along with existing X-ray spectra, to assess the impact of UV/X-ray irradiation on disk and protoplanet atmosphere ionization and heating. Stellar UV and X-ray emission influence disk dissipation and mass-loss, thus affecting the timescale for planet-formation, a key constraint for planet-formation models.

OBSERVING DESCRIPTION

We propose to obtain STIS/MAMA long-slit (52 x 0.2 arcsec aperture) spectra of the T Tauri star PDS 70 with G140L (1 orbit) and G230L (1 orbit). We prefer that the two spectra be obtained contemporaneously and we have thus packaged them into one Visit (2 orbits) in Phase II. There are no Orient or explicit Timing constraints.

In Phase II, we have used G140L and G230L exposure times of 887 and 739 s respectively with 3 iterations to fill the orbits. We want to use these shorter exposures to check for possible spectral variability across exposures, which may be present in our target since T Tauri stars often vary in the UV. We have requested the G140L exposure to be placed in the second orbit since it provides more usable exposure time and we anticipate lower fluxes in the FUV than in NUV.

For the representative STIS ETC G230L simulation (number entered in APT template) we have assumed a Pickles K7V spectral type normalized to $B = 13.42$ mag (Simbad), and have added a representative Mg II doublet line (2799 Å.) using a line flux

of 1.0×10^{-13} erg/cm²/s (sum of the doublet components) typical of T Tauri stars.

For the G140L ETC simulation we have assumed a faint flat continuum and have added a C IV doublet line (1549 Å.) using a typical T Tauri star doublet line flux of 1.65×10^{-14} erg/cm²/s (sum of the doublet components).

We will perform a target ACQ but since we are using a 0.2 arcsec slit width we have not inserted a PEAK-up in the Phase II observing plan. We have selected the STIS LP filter (F28X50LP) for ACQ. We have set the ACQ exposure time to 0.4 s which ETC simulations indicate will provide SNR = 178 - 289, depending on what input values we use to normalize the target flux for Pickles K7V spectral template, i.e. B=13.42, V = 12.18, R = 11.71, or $F_{\lambda} = 2.2 \times 10^{-15}$ ergs/cm²/s/Å from Swift U-filter (center=3465 Å.) flux density. Using B=13.42 gives SNR=289 in 0.4 s ($t_{\text{sat}} = 1.6$ s), V = 12.18 gives SNR = 270 ($t_{\text{sat}} = 1.83$ s), R=11.71 gives SNR=204 ($t_{\text{sat}} = 3.21$ s), and the Swift U-filter flux density gives SNR=178 ($t_{\text{sat}} = 4.17$ s).

Proposal 16290 - Visit 01 - UV Spectroscopy of PDS 70: A T Tauri Star Hosting a Newborn Planetary System

Sat Jun 27 23:00:13 GMT 2020

Visit	Proposal 16290, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	PDS70 Alt Name1: CD-408434 Alt Name2: GSC07811-01917	RA: 14 08 10.1540 (212.0423083d) Dec: -41 23 52.58 (-41.39794d) Equinox: J2000	Proper Motion RA: -29.661 mas/yr Proper Motion Dec: -23.823 mas/yr Epoch of Position: 2000 Radial Velocity: 3.13 km/sec	V=12.18+/-0.13 B=13.42 (Simbad); Swift uvw2 (1599-2256 A.) = 1.5e-13 ergs/cm ² /s; uvw1 (2253-2946 A.) = 2.7e-13 ergs/cm ² /s (ref. Joyce et al. 2020)	Reference Frame: ICRS			
	<i>Comments: RA, Dec are from Simbad (referenced to Gaia DR2). RA, Dec errors, Proper Motion, Radial Velocity are from Gaia DR2. V mag and uncertainty are from range given in Simbad. Category=STAR Description=[K V-IV, T TAURI STAR]</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	PDS70_AC Q1 (STIS.ta.145 1485)	(1) PDS70	STIS/CCD, ACQ, F28X50LP	MIRROR				0.4 Secs (0.4 Secs) [==>]	[1]
	2	PDS70_G23 0L (STIS.sp.14 51556)	(1) PDS70	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				739 Secs X 3 (2217 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)]	[1]
	3	PDS70_G14 0L (STIS.sp.14 46336)	(1) PDS70	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A				887 Secs X 3 (2661 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)]	[2]

