



14207 - Inventoring Gas in Debris Disks: UV Spectroscopy of Eta Tel

Cycle: 23, 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) -ETA-TEL	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	15-Dec-2015 21:13:39.0	yes
02	(1) -ETA-TEL	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	15-Dec-2015 21:13:42.0	yes

4 Total Orbits Used

ABSTRACT

Debris disks stand between gas-rich protoplanetary disks and mature planetary systems, shedding light on the late stages of planet formation. Their dust component has been extensively studied, yet has provided little information about disk chemical composition. More information can be provided by their gas content, but astonishingly little is known about it. Only two debris disks have measurements of their gas composition, which is shockingly carbon-rich (Beta Pictoris and 49 Ceti). Basic questions remain unanswered. What are the typical gas-to-dust ratios in debris disks? What is the chemical composition of debris gas and its parent material? The answers to these questions have profound implications for terrestrial planet assembly and the origins of planetary atmospheres.

Most detections of debris gas to date were achieved with line of sight UV/optical absorption spectroscopy of edge-on disks, using the central star as the background source. This technique is far more sensitive to small amounts of gas than emission line studies. The UV bandpass is particularly important, since strong transitions of numerous atomic and molecular species lie there. We propose extending our intriguing studies of debris gas with STIS UV spectroscopy of a highly promising debris disk system, Eta Tel. This disk is edge-on and contains circumstellar atomic gas (CII). We will measure column densities of the most important gas species, find the relative elemental gas abundances, and determine the gas mass using a powerful gas disk modeling code. We will also divide our observations into two visits, to search for signs of star-grazing exocomets, which are seen in both Beta Pic and 49 Cet.

OBSERVING DESCRIPTION

1. GENERAL STRATEGY

A high-resolution STIS FUV spectroscopic study of the Eta Tel debris disk system. This disk is ideally suited for a sensitive probe of its gas content, as it is nearly edge-on and known to contain CS gas. Furthermore, the central star is a nearby A0V star, making it bright enough in the FUV to obtain high S/N spectra that can be used to detect superimposed gas absorption lines.

We are targeting strong FUV absorption lines of OI (at 1302 Å), CI (at 1657 Å and 1560 Å), and C II (at 1335 Å). These volatile species are expected to be most abundant after HI, based on our experience with the Beta Pic gas disk. To constrain the molecular fraction in the gas, we will also observe the CO A - X absorption bands at 1419 Å, 1447 Å, 1478 Å, 1510 Å, and 1544 Å. Additionally, we will be sensitive to the lithophile and siderophile species MgII (at 2796 Å), AlIII (at 1671 Å), SiII (at 1304 Å and 1527 Å), and FeII (at 1609 Å). Finally, we are also targeting the highly ionized species CIV (at 1548 Å) and AlIII (at 1855 Å), which highlight high-temperature gas coming from star-grazing planetesimals.

Proposal 14207 (STScI Edit Number: 0, Created: Tuesday, December 15, 2015 9:13:44 PM EST) - Overview

Our goal is to be sensitive to CS gas abundances two orders of magnitude below the Beta Pic abundances of these species. This limit was determined by comparison of the line of sight absorption column densities of CII* towards the two stars. Obtaining identical spectra in two visits separated by several days will ensure that we can separate the stable gas absorption (arising from the bulk of the gas disk) from any variable gas features that might be produced by star-grazing planetesimals.

Basic Data for Eta Tel: A0V, RA = 19:22:51.20620, Dec = -54:25:26.1473, distance = 48 pc, B = 5.035, V = 5.020, E(B-V) = 0.015, F_{IUE}(@ 1600 Å) = 6e-11 erg s⁻¹ cm⁻² Å⁻¹

Eta Tel has a faint M7 or M8 brown dwarf companion located approximately 4" away (~200 AU), which will not pose a problem for any STIS bright limits.

2. OBSERVATION DETAILS

The four orbits of this program will be divided into two identical visits of two orbits each, separated by 3 to 7 days. Since we do not require time resolution on minute scales, the STIS FUV spectra will be obtained in ACCUM mode. We have verified that the total program can be scheduled using the APT Visit Planner.

2.1 Science Exposures

High spectral resolution is desirable for resolving multiple absorption components, allowing us to separate IS from CS gas in absorption lines arising from ground energy levels. Therefore, each visit will contain three tilts of the STIS E140H grating (i1271, c1416, and c1598) and two tilts of the E230H grating (i1813 and i2713), providing 2.6 km/s resolution. These spectra will cover 1170 Å to 1951 Å and 2574 Å to 2851 Å.

Further, we wish to get the highest spectral resolution while maintaining good throughput and to minimize terrestrial airglow contamination. Therefore, we will use the narrow spectroscopic slit recommended for the high-resolution echelle gratings (0.2 arcsec x 0.09 arcsec) for the E140H tilts. No bright limits are violated for these observations (ETC Request IDs: STIS.sp.757582, STIS.sp.757581, STIS.sp.757579).

For the E230H i1813 tilt, we will also use the 0.2 arcsec x 0.09 arcsec slit. Using this slit, the total count rate for the observation is below the 200,000 counts/s bright limit, but exceeds the limit for irregularly-variable sources (40% of the bright limit). However, Eta Tel is a non-variable main

Proposal 14207 (STScI Edit Number: 0, Created: Tuesday, December 15, 2015 9:13:44 PM EST) - Overview

sequence A star, with measured FUV fluxes, so this is acceptable (ETC Request ID: STIS.sp.757584). For the E230H i2713 tilt, to avoid the total count rate limit, we will use the narrower 0.1 arcsec x 0.03 arcsec slit. With this slit, the total count rate exceeds the limit for irregularly-variable sources, but as stated above, this is acceptable (ETC Request ID: STIS.sp.757586).

2.2 Target Acquisitions (ACQ)

Eta Tel is a bright, isolated point-source, so we will perform ACQs using the target star itself. With the F28X50LP filter, Eta Tel saturates the CCD in less than 0.1 sec. Therefore, we will use the F28X50OII filter for the ACQ observations. With this setup, the time to saturation for the ACQs is 0.52 sec and $S/N = 200$ is achieved in 0.1 sec (ETC Request ID: STIS.ta.757587).

2.3 Peak-Up Observations (ACQ/PEAK)

Since we are using slits narrower than 0.1 arcsec, we have also included peak-up (ACQ/PEAK) observations. Eta Tel saturates the CCD in less than 0.1 sec when performing an imaging peak-up using the 0.2 arcsec x 0.09 arcsec science aperture. Therefore, we will perform a dispersed light peak-up with this slit and the G430L grating. With this setup, the time to saturation for the ACQ/PEAK in the 0.2 arcsec x 0.09 arcsec slit is 2.43 sec (Gain 4) and 238,587 total source counts ($S/N = 487$) are collected in 1 sec (ETC Request ID: STIS.sp.757561).

For our science exposures in the 0.1 arcsec x 0.03 arcsec aperture (E230H i2713), we require a second peak-up with that slit. Eta Tel saturates the CCD in less than 0.1 sec when performing an imaging peak-up using the 0.1 arcsec x 0.03 arcsec science aperture. Therefore, we will perform a dispersed light peak-up with this slit and the G430L grating. With this setup, the time to saturation for the ACQ/PEAK in the 0.1 arcsec x 0.03 arcsec slit is 5.01 sec (Gain 4) and 237,697 total source counts ($S/N = 486$) are collected in 2.1 sec (ETC Request ID: STIS.sp.757590).

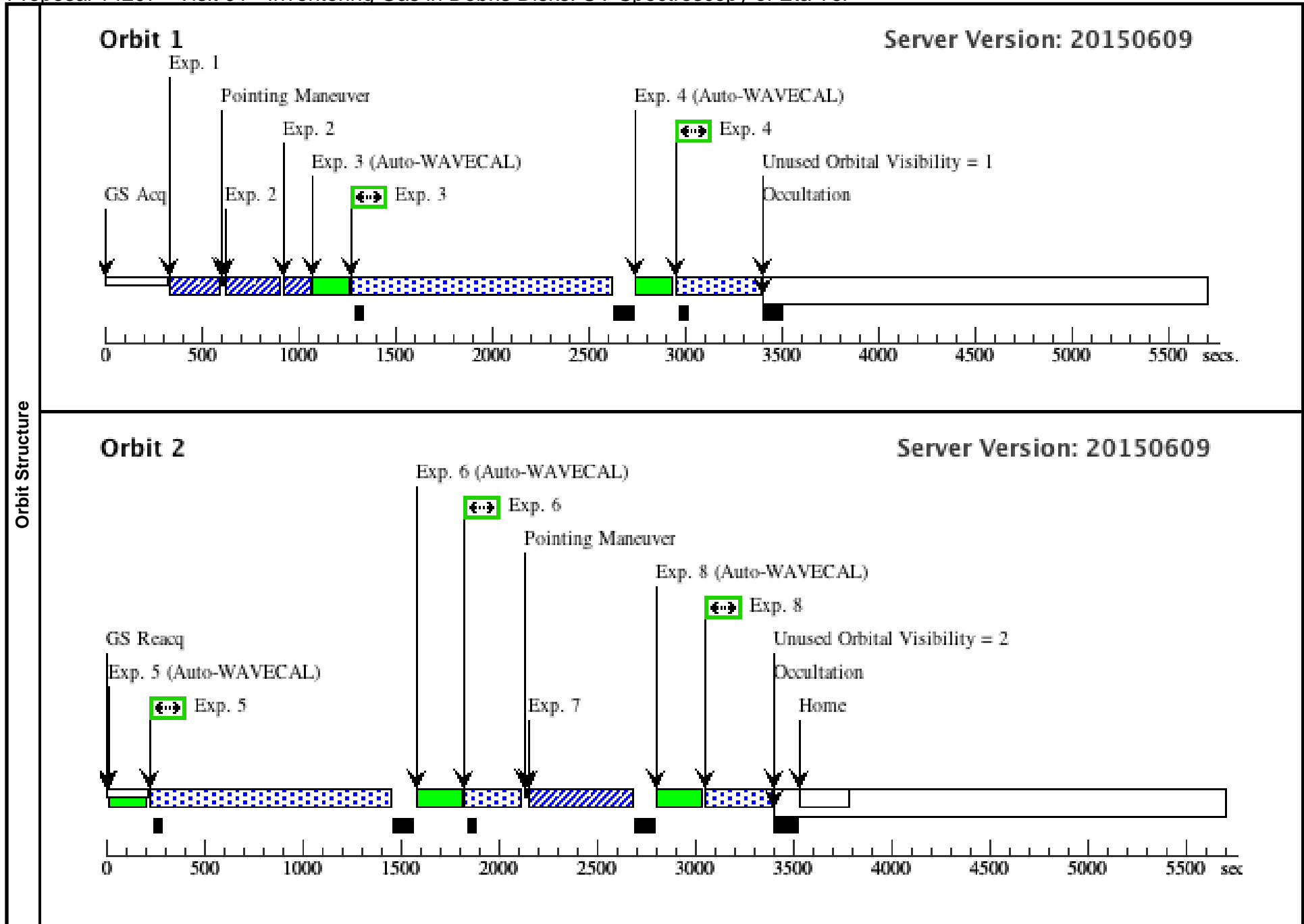
Proposal 14207 - Visit 01 - Inventoring Gas in Debris Disks: UV Spectroscopy of Eta Tel

Wed Dec 16 02:13:44 GMT 2015

Visit	Proposal 14207, 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)	-ETA-TEL	RA: 19 22 51.2062 (290.7133592d)	Proper Motion RA: 25.57 mas/yr	V=5.020	Reference Frame: ICRS
		Alt Name1: HD181296	Dec: -54 25 26.15 (-54.42393d)	Proper Motion Dec: -82.71 mas/yr		
		Alt Name2: HR7329	Equinox: J2000	Epoch of Position: 2000		
	<i>Comments: Extended=NO</i>					

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.757 587)	(1) -ETA-TEL	STIS/CCD, ACQ, F28X500II	MIRROR				0.1 Secs (0.1 Secs)	
									[==>]	[1]
	2	(STIS.sp.75 7561)	(1) -ETA-TEL	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				1 Secs (1 Secs)	
									[==>]	[1]
	3	(STIS.sp.75 7579)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1598 A				1330 Secs (1330 Secs)	
									[==>]	[1]
	4	(STIS.sp.75 7581)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1416 A				422 Secs (422 Secs)	
									[==>]	[1]
	5	(STIS.sp.75 7582)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A				1216 Secs (1216 Secs)	
								[==>]	[2]	
6	(STIS.sp.75 7584)	(1) -ETA-TEL	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1813 A				277 Secs (277 Secs)		
								[==>]	[2]	
7	(STIS.sp.75 7590)	(1) -ETA-TEL	STIS/CCD, ACQ/PEAK, 0.1X0.03	G430L 4300 A				2.1 Secs (2.1 Secs)		
								[==>]	[2]	
8	(STIS.sp.75 7586)	(1) -ETA-TEL	STIS/NUV-MAMA, ACCUM, 0.1X0.03	E230H 2713 A				321 Secs (321 Secs)		
								[==>]	[2]	



Proposal 14207 - Visit 02 - Inventoring Gas in Debris Disks: UV Spectroscopy of Eta Tel

Wed Dec 16 02:13:44 GMT 2015

Visit	Proposal 14207, Visit 02				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA				
	Special Requirements: AFTER 01 BY 3 D TO 7 D				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	-ETA-TEL	RA: 19 22 51.2062 (290.7133592d)	Proper Motion RA: 25.57 mas/yr	V=5.020	Reference Frame: ICRS
		Alt Name1: HD181296	Dec: -54 25 26.15 (-54.42393d)	Proper Motion Dec: -82.71 mas/yr		
		Alt Name2: HR7329	Equinox: J2000	Epoch of Position: 2000		
	<i>Comments: Extended=NO</i>					

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.757 587)	(1) -ETA-TEL	STIS/CCD, ACQ, F28X500II	MIRROR				0.1 Secs (0.1 Secs)	
									[==>]	[1]
	2	(STIS.sp.75 7561)	(1) -ETA-TEL	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				1 Secs (1 Secs)	
									[==>]	[1]
	3	(STIS.sp.75 7579)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1598 A				1330 Secs (1330 Secs)	
									[==>]	[1]
	4	(STIS.sp.75 7581)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1416 A				422 Secs (422 Secs)	
									[==>]	[1]
	5	(STIS.sp.75 7582)	(1) -ETA-TEL	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A				1216 Secs (1216 Secs)	
								[==>]	[2]	
6	(STIS.sp.75 7584)	(1) -ETA-TEL	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1813 A				277 Secs (277 Secs)		
								[==>]	[2]	
7	(STIS.sp.75 7590)	(1) -ETA-TEL	STIS/CCD, ACQ/PEAK, 0.1X0.03	G430L 4300 A				2.1 Secs (2.1 Secs)		
								[==>]	[2]	
8	(STIS.sp.75 7586)	(1) -ETA-TEL	STIS/NUV-MAMA, ACCUM, 0.1X0.03	E230H 2713 A				321 Secs (321 Secs)		
								[==>]	[2]	

