



11569 - Probing the Atomic and Molecular Inventory of a Beta-Pic Analog, the Young, Edge-On Debris Disk of HD32297

Cycle: 17, Proposal Category: GO

(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) HD32297	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	21-Sep-2010 21:01:18.0	yes
02	(2) HD34203	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	1	21-Sep-2010 21:01:31.0	yes
03	(3) HD32304	STIS/CCD STIS/NUV-MAMA	1	21-Sep-2010 21:01:39.0	yes
53	(3) HD32304	STIS/CCD STIS/NUV-MAMA	1	21-Sep-2010 21:01:45.0	yes

8 Total Orbits Used

ABSTRACT

Edge-on, optically thin, debris disks provide unique opportunities to probe physical properties of the disk itself. Using the host star as the background source, trace atomic and molecular disk species can be detected in absorption. Redfield (2007) found that the recently discovered edge-on system, HD32297, has the strongest NaI absorption feature of any known debris disk, 5 times the level observed toward beta Pic, the canonical edge-on debris disk. Roberge et al. (2006) compiled the only comprehensive chemical inventory of a debris disk, using beta Pic, and found that carbon was surprisingly overabundant, which has important implications for the physical structure and support of a stable gas disk. What is severely lacking are comparison observations to determine if such an abundance pattern is typical of debris disk systems. HD32297 represents the best opportunity to make such a comparative study and perform a comprehensive gas inventory of a debris disk, due to its high NaI column density. The UV is critical for this work due to the large number of strong transitions (almost 50 ions and molecules are accessible) that are located in, and often only in, the UV. These observations will provide a much needed comparison dataset for addressing the gas chemistry of debris disk systems that are at the critical stage, near the end of planet formation, and in the process of clearing their interplanetary environments.

OBSERVING DESCRIPTION

Target Selection and Availability: Edge-on debris disk systems are rare, and only a handful of local systems are known. These fortuitously aligned optically thin disks provide an opportunity to search for trace molecules along the long pathlength from the host star through the disk. HD32297, an A0 star, shows the largest NaI atomic absorption of any edge-on debris disk, 5 times that of beta Pic, and therefore is the best target to search for atomic and molecular absorption signatures caused by gas in the debris disk.

Comparison Spectra: The separation of the interstellar and circumstellar absorption components (>4 km/s) is on the order of the resolution of the proposed observations ($R \sim 110,000$, or ~ 2.7 km/s), and therefore if both circumstellar and interstellar components are present for a particular transition, they will be partially resolved by the high resolution gratings of STIS. However, since they are not expected to be fully unblended, we will use two strategies to make an accurate measurement of the circumstellar component: (1) Comparison spectra of nearby stars (HD34203 and HD34204), which are located close to HD32297 in the sky (<5 degrees) and at a comparable distance will be observed in order to identify which transitions in fact do show significant interstellar absorption and at what strength. (2) For those that do show interstellar absorption we will use the velocity structure identified at ultra-high resolution in NaI by Redfield (2007) in order to accurately model the line profile shape by constraining the velocity difference between the two components which will be partially resolved at the high spectral resolution of STIS.

Proposal 11569 (STScI Edit Number: 2, Created: Tuesday, September 21, 2010 8:01:49 PM EST) - Overview

The short comparison observations of nearby stars will be used to reconstruct the interstellar contribution to the full absorption profile observed toward HD32297 for some of the strongest atomic transitions. Two stars are selected, a bright ($V = 5.5$) A0V star (HD34203) which is located only 5.1 degrees from HD32297 and has an identical parallax that places it at ~ 112 pc. The second comparison star (HD34204) is a bright ($V = 6.9$) G5 star only ~ 2.5 arcminutes from HD32297 and located at a comparable distance of ~ 134 pc. Two comparison stars are selected because HD34203, the A0V star, exceeds the brightness limit in the near-UV, and therefore will only be used to obtain spectra in the far-UV settings, while HD34204, the G5 star, can be used to quickly obtain the near-UV comparison spectra. In addition, the two sight lines will provide an indication of any small-scale variations in the interstellar medium along these very similar sight lines. This will enable us to place a more stringent constraint on the strength of the ISM lines observed in the spectra of HD32297. Note that these comparison spectra need not be obtained in the same visit as HD32297. Also note that not all transitions that show circumstellar absorption will also show interstellar absorption (e.g., transitions from an excited level).

Desired Spectral Resolution: This program benefits from the high spectral resolution ($R \sim 110,000$) available with STIS, and therefore will utilize the E140H and E230H gratings with the narrow slit (0.2×0.09). Redfield (2007) observed the NaI transition in the optical at ultra-high spectra resolution ($R \sim 240,000$) and was able to resolve the circumstellar and interstellar absorption profiles. The velocity separation was >4 km/s, which is slightly larger than the the highest resolution available with STIS (~ 2.7 km/s) indicating that the circumstellar and interstellar absorption components should still be partially resolved. Note that not all transitions will show interstellar transitions (e.g., molecular transitions and atomic transitions from an excited level). Indeed several ions (e.g., CI, AlI, SiII, SI, FeII) showed gas disk absorption in excited transitions toward beta Pic, with no contaminating interstellar feature (Lagrange et al. 1998).

Desired Spectral Coverage: In order to observe the strongest transitions of almost 50 different ions and molecules, observations of almost the entire UV spectral range are required. Using the highest resolution gratings (i.e., E140H and E230H), this can be achieved using only 7 different settings. We propose to use the E140H grating centered at 1271 and 1526 Angstroms, in order to cover the far-UV spectral region, and the E230H grating centered at 1763, 2013, 2413, 2713, and 2962 Angstroms, in order to cover the near-UV spectral region. All critical transitions are covered by these settings, along with many more supporting transitions of the same ions and molecules but different opacities. All transitions of a given ion or molecule can be fit simultaneously in order to increase the dynamic range of the observed column density, as well as reduce the impact of systematic errors, such as continuum placement.

Desired Signal-to-Noise: In order to detect a wide range of absorption features, a moderately high S/N is required. Lagrange et al. (1998) measured ~ 65 circumstellar absorption lines toward beta Pic from only ~ 180 Angstroms using spectra with a S/N of approximately 25. Likewise, CO and CI gas features in the beta Pic disk were analyzed by Roberge et al. (2000) with spectra taken with a S/N ~ 10 . Although fainter than beta Pic, HD32297

Proposal 11569 (STScI Edit Number: 2, Created: Tuesday, September 21, 2010 8:01:49 PM EST) - Overview

is a significantly early spectral type (A0, as opposed to A6), and therefore has a strong UV continuum that extends well into the far-UV. We use the STIS Exposure Time Calculator, with (1) an A0V spectral model scaled to the brightness of HD32297 and (2) the well calibrated Vega spectrum, also an A0V star, scaled to the brightness of HD32297, in order to estimate the exposure time needed to achieve a S/N ~ 25 for each setting. The three shortest wavelength settings require roughly a full orbit in order to obtain the desired S/N, while the four longest wavelength settings can be paired, and the S/N for each setting can be obtained in roughly half an orbit. A single orbit is sufficient to obtain high S/N spectra of the comparison star spectra (three settings for HD34203, and two settings for HD34204).

Brightness Limits: Our primary target, HD32297, will not violate the brightness limits of STIS, given we are observing in the highest resolution modes (E140H and E120H) and in a narrow slit (0.2x0.09). One of our comparison objects, HD34203, an even brighter A0 star, will only be observed at the shortest wavelengths (E140H centered at 1271 and 1526 Angstroms, and E230H only at the 1763 Angstrom setting) and through a very narrow slit (0.1x0.03). Our second comparison star, with a G5 spectral type, will not violate the brightness limit and will be used to cover the longer wavelength settings (E230H centered at 2713 and 2962 Angstroms), observed through the nominal slit (0.2x0.09).

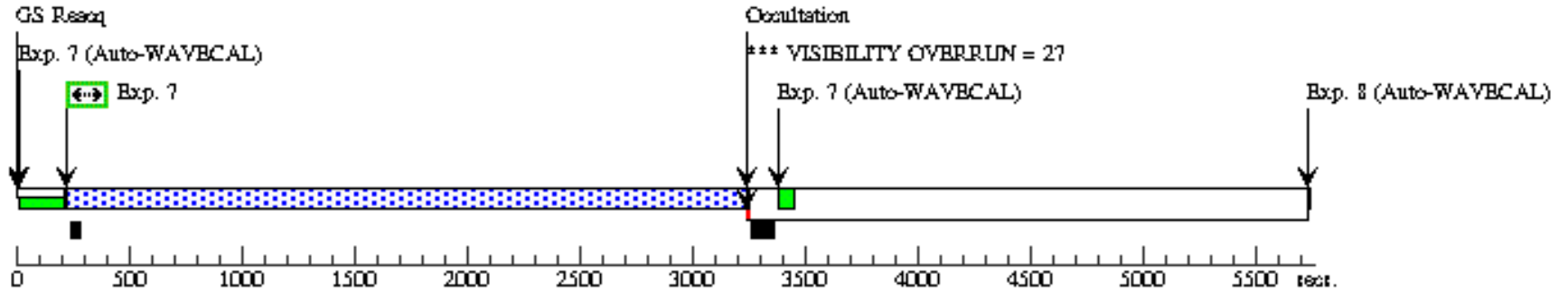
Visit	Proposal 11569, Visit 01, completed Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/CCD, STIS/NUV-MAMA Special Requirements: (none)																							
	Diagnosics (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN																							
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>HD32297</td> <td>RA: 05 02 27.4327 (75.6143029d)</td> <td>Proper Motion RA: +0.00044s/yr</td> <td>V=8.146+/-0.014</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td></td> <td>Alt Name1: BD+07D777</td> <td>Dec: +07 27 39.89 (7.46108d) Equinox: J2000</td> <td>Proper Motion Dec: -0.02332"/yr Parallax: .00892" Epoch of Position: 1991.25 Radial Velocity: +20 km/sec</td> <td>Type=A0, B-V=0.199 +/- 0.014, E(B-V)=0.0, F-CONT(1271) = 1.4 +/- 0.4 E-14, F-CONT(1526) = 2.5 +/- 0.9 E-12, F-CONT(1763) = 4.3 +/- 1.1 E-12, F-CONT(2013) = 3.5 +/- 0.5 E-12, F-CONT(2413) = 2.4 +/- 0.2 E-12, F-CONT(2713) = 2.3 +/- 0.2 E-12, F-CONT(2962) = 2.3 +/- 0.2 E-12</td> <td></td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	HD32297	RA: 05 02 27.4327 (75.6143029d)	Proper Motion RA: +0.00044s/yr	V=8.146+/-0.014	Reference Frame: ICRS		Alt Name1: BD+07D777	Dec: +07 27 39.89 (7.46108d) Equinox: J2000	Proper Motion Dec: -0.02332"/yr Parallax: .00892" Epoch of Position: 1991.25 Radial Velocity: +20 km/sec	Type=A0, B-V=0.199 +/- 0.014, E(B-V)=0.0, F-CONT(1271) = 1.4 +/- 0.4 E-14, F-CONT(1526) = 2.5 +/- 0.9 E-12, F-CONT(1763) = 4.3 +/- 1.1 E-12, F-CONT(2013) = 3.5 +/- 0.5 E-12, F-CONT(2413) = 2.4 +/- 0.2 E-12, F-CONT(2713) = 2.3 +/- 0.2 E-12, F-CONT(2962) = 2.3 +/- 0.2 E-12		<i>Comments: Coordinates and proper motion are from the Hipparcos Output Catalog. Fluxes derived from HST observations of stars of similar spectral type.</i>				
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous																		
(1)	HD32297	RA: 05 02 27.4327 (75.6143029d)	Proper Motion RA: +0.00044s/yr	V=8.146+/-0.014	Reference Frame: ICRS																			
	Alt Name1: BD+07D777	Dec: +07 27 39.89 (7.46108d) Equinox: J2000	Proper Motion Dec: -0.02332"/yr Parallax: .00892" Epoch of Position: 1991.25 Radial Velocity: +20 km/sec	Type=A0, B-V=0.199 +/- 0.014, E(B-V)=0.0, F-CONT(1271) = 1.4 +/- 0.4 E-14, F-CONT(1526) = 2.5 +/- 0.9 E-12, F-CONT(1763) = 4.3 +/- 1.1 E-12, F-CONT(2013) = 3.5 +/- 0.5 E-12, F-CONT(2413) = 2.4 +/- 0.2 E-12, F-CONT(2713) = 2.3 +/- 0.2 E-12, F-CONT(2962) = 2.3 +/- 0.2 E-12																				

Proposal 11569 (STScI Edit Number: 2, Created: Tuesday, September 21, 2010 8:01:49 PM EST) - Overview

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
	1		(1) HD32297	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.3 Secs [==>]	[1]	
	<i>Comments: SNR = 59 Brightest pixel = 1,812 e- ETC# = STIS77309</i>										
	2		(1) HD32297	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 3165 A				.8 Secs [==>]	[1]	
	<i>Comments: Brightest pixel = 42 e- Total counts = 1.8e5 e- ETC# = STIS77315</i>										
	3		(1) HD32297	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2962 A				818 Secs [==>]	[1]	
	4		(1) HD32297	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				682 Secs [==>]	[1]	
	5		(1) HD32297	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2413 A				880 Secs [==>]	[2]	
	6		(1) HD32297	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2013 A				1780 Secs [==>]	[2]	
	7		(1) HD32297	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1763 A				3017 Secs [==>]	[3]	
8		(1) HD32297	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1526 A				3017 Secs [==>]	[4]		
9		(1) HD32297	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A				3017 Secs [==>]	[5]		

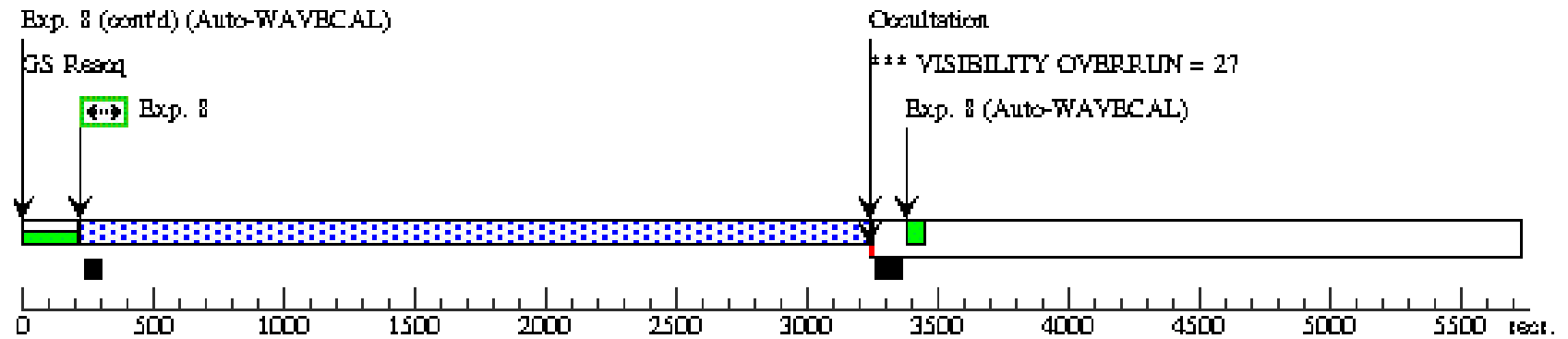
Orbit 3

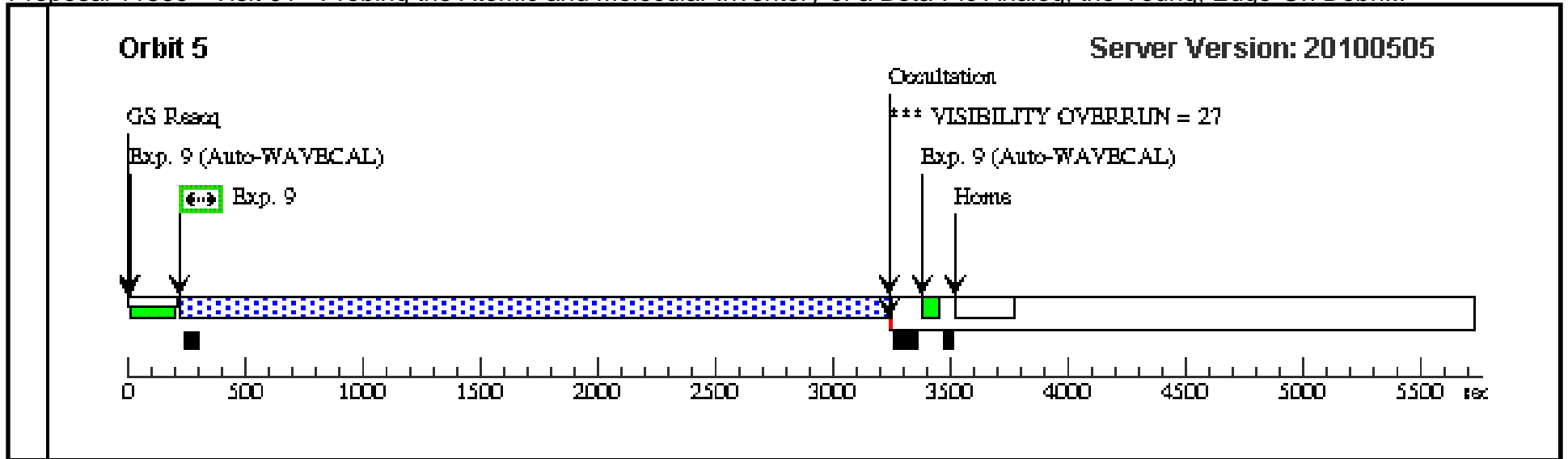
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Orbit 4

Server Version: 20100505

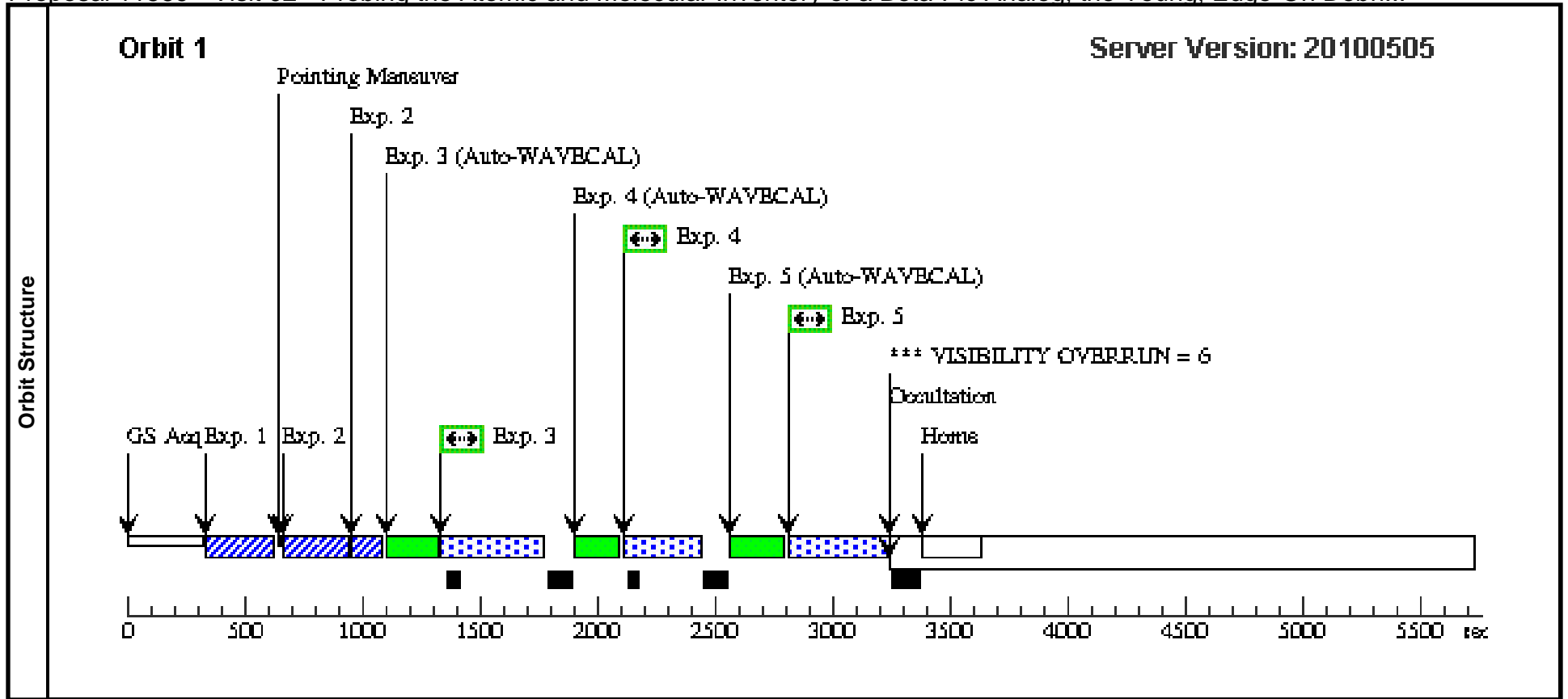




Proposal 11569 - Visit 01 - Probing the Atomic and Molecular Inventory of a Beta-Pic Analog, the Young, Edge-On Debr...

Wed Sep 22 01:01:53 GMT 2010

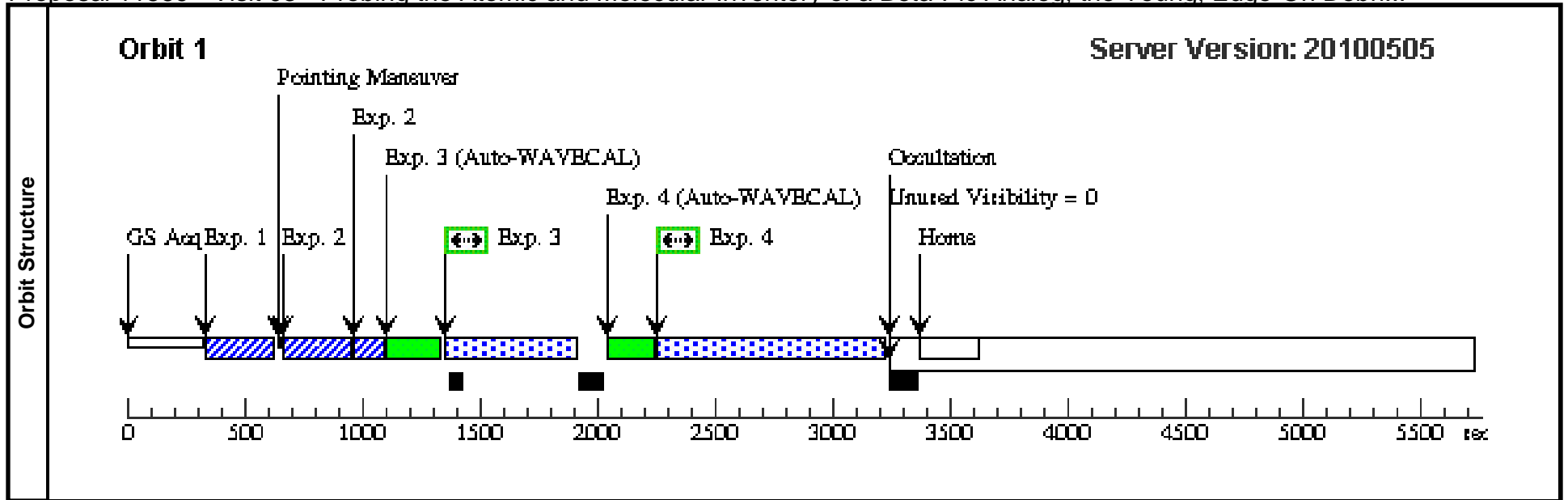
Visit	Proposal 11569, Visit 02, completed Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/CCD, STIS/NUV-MAMA Special Requirements: (none)										
	(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN										
Diagnosics											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous			
	(2)	HD34203 Alt Name1: 18ORI Alt Name2: HR1718	RA: 05 16 4.1392 (79.0172467d) Dec: +11 20 28.93 (11.34137d) Equinox: J2000	Proper Motion RA: -0.00057s/yr Proper Motion Dec: -0.00654"/yr Parallax: 0.00886" Epoch of Position: 1991.25 Radial Velocity: -8.2 km/sec	V=5.52+/-0.01 Type=A0V, B-V=-0.012 +/- 0.005, E(B-V)=0.0, F-CONT(1271) = 1.4 +/- 0.3 E-1 3, F-CONT(1526) = 4.0 +/- 0.4 E-1 1, F-CONT(1763) = 4.8 +/- 1.3 E-1 1	Reference Frame: ICRS					
<i>Comments: Coordinates and proper motion are from the Hipparcos Output Catalog. Fluxes derived from HST observations of stars of similar spectral type.</i> <i>This target leads to a Health and Safety flag for the global count rate when run through the BOT. Hipparcos identifies this star as an A0V (Cowley+ 1969 label it a A0V and Osawa 1959 label it a A0III). The Hipparcos B-V color is consistent with a A0 star and is measured at -0.012 +/- 0.005. Although the BOT has the appropriate B-V color (listed at -0.01), it has an incorrect spectral type of "***O5V**". If the BOT is using the spectral type of an O5V star, then it is grossly overestimating the flux. Using stellar models and Vega (the canonical A0V star) as template spectra in the STIS ETC, there should be little to no risk of approaching the global count rate limit. Indeed, all estimates are <59,000 counts/sec over the entire detector.</i>											
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
	1	(2) HD34203	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT				0.1 Secs [==>]	[1]	
	<i>Comments: SNR = 119 Brightest pixel = 6,683 e- ETC# = STIS77295</i>										
	2	(2) HD34203	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 3165 A					0.1 Secs [==>]	[1]	
	<i>Comments: Brightest pixel = 58 e- Total counts = 2.5e5 e- ETC# = STIS77391</i>										
	3	(2) HD34203	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A					426 Secs [==>]	[1]	
4	(2) HD34203	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1526 A					314 Secs [==>]	[1]		
5	(2) HD34203	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1763 A					410 Secs [==>]	[1]		



Proposal 11569 - Visit 02 - Probing the Atomic and Molecular Inventory of a Beta-Pic Analog, the Young, Edge-On Debris...

Wed Sep 22 01:01:53 GMT 2010

Visit		Proposal 11569, Visit 03, failed Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/NUV-MAMA Special Requirements: (none)									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(3)	HD32304 Alt Name1: BD+07D778	RA: 05 02 31.4873 (75.6311971d) Dec: +07 25 26.66 (7.42407d) Equinox: J2000	Proper Motion RA: -0.00153s/yr Proper Motion Dec: -0.01666"/yr Parallax: 0.00748" Epoch of Position: 1991.25 Radial Velocity: -1.4 km/sec	V=6.86+/-0.01 Type=G5, B-V=0.958 +/- 0.009, E(B-V)=0.0, F-CONT(2713) = 4.7 +/- 0.9 E-13, F-CONT(2962) = 1.2 +/- 0.3 E-12, F-LINE(2796) = 1.4 +/- 0.7 E-12, , W-LINE(2796) = 0.65 +/- 0.07	Reference Frame: ICRS					
<i>Comments: Coordinates and proper motion are from the Hipparcos Output Catalog. Fluxes derived from HST observations of stars of similar spectral type.</i>											
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
	1		(3) HD32304	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.1 Secs [==>]	[1]	
	<i>Comments: SNR = 68 Brightest pixel = 2,067 e- ETC# = STIS77276</i>										
	2		(3) HD32304	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 3165 A				0.5 Secs [==>]	[1]	
<i>Comments: Brightest pixel = 50 e- Total counts = 1.6e5 e- ETC# = STIS77302</i>											
3		(3) HD32304	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2962 A				548 Secs [==>]	[1]		
4		(3) HD32304	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				957 Secs [==>]	[1]		



Proposal 11569 - Visit 03 - Probing the Atomic and Molecular Inventory of a Beta-Pic Analog, the Young, Edge-On Debris...

Wed Sep 22 01:01:54 GMT 2010

Visit	Proposal 11569, Visit 53 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/NUV-MAMA Special Requirements: (none) Comments: HOPR repeat of visit 3.									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(3)	HD32304 Alt Name1: BD+07D778	RA: 05 02 31.4873 (75.6311971d) Dec: +07 25 26.66 (7.42407d) Equinox: J2000	Proper Motion RA: -0.00153s/yr Proper Motion Dec: -0.01666"/yr Parallax: 0.00748" Epoch of Position: 1991.25 Radial Velocity: -1.4 km/sec	V=6.86+/-0.01 Type=G5, B-V=0.958 +/- 0.009, E(B-V)=0.0, F-CONT(2713) = 4.7 +/- 0.9 E-13, F-CONT(2962) = 1.2 +/- 0.3 E-12, F-LINE(2796) = 1.4 +/- 0.7 E-12, , W-LINE(2796) = 0.65 +/- 0.07	Reference Frame: ICRS			
	Comments: Coordinates and proper motion are from the Hipparcos Output Catalog. Fluxes derived from HST observations of stars of similar spectral type.									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(3) HD32304	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.1 Secs [==>]	[1]
	Comments: SNR = 68 Brightest pixel = 2,067 e- ETC# = STIS77276									
	2		(3) HD32304	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 3165 A				0.5 Secs [==>]	[1]
	Comments: Brightest pixel = 50 e- Total counts = 1.6e5 e- ETC# = STIS77302									
3		(3) HD32304	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2962 A				548 Secs [==>]	[1]	
4		(3) HD32304	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				957 Secs [==>]	[1]	

