15309 - Does the Relativistic X-Ray Outflow Quasar PDS 456 Have the Fastest-Ever UV BAL at ~0.3c?

Cycle: 25, Proposal Category: GO

(UV Initiative)

(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) PDS456	COS/FUV COS/NUV	3	13-Aug-2019 17:01:18.0	yes
02	(1) PDS456	COS/FUV COS/NUV	3	13-Aug-2019 17:01:19.0	yes

6 Total Orbits Used

ABSTRACT

The quasar PDS 456 (z~0.184) is a prototype for relativistic accretion-disk outflows measured in X-rays. The X-ray features are highly-variable, revealing speeds up to 0.25-0.3c, total column densities N_H > 10^23 cm-2, a high degree of ionization (FeXXVI), and large outflow kinetic energies that could drive feedback to the host galaxy. This powerful outflow presents a challenge for theoretical models to understand its acceleration, origins, and spatial structure. It has attracted 19.3 days(!!) of observing time on X-ray telescopes. In contrast, there have been only 2 HST observations

totaling 3 orbits to measure the broad UV outflow lines in this quasar. An HST-STIS spectrum revealed a single broad absorption line (BAL) at ~1350A (observed) that was identified as Ly-alpha at a pedestrian speed of ~0.05c, which is typical of BALs in other quasars. However, the Ly-alpha ID is problematic because it is not accompanied by metal lines at the same speed; this would be unique among BAL outflows requiring extremely low column densities, N_H < 10^19 cm-2, a low degree of ionization, and possibly large distances from the quasar. We argue that the UV BAL is, instead, CIV at velocity ~0.3c. This would be the fastest UV outflow ever reported, the first direct link of UV BALs to relativistic X-ray outflows, and the first evidence supporting models where UV BALs drive X-ray outflow accelerations. We propose two 3-orbit observation of PDS 456 with COS G140L to test the Ly-alpha versus CIV BAL identification, study the BAL variability, confirm/search for other broad outflow lines in the UV spectrum, and obtain better constraints on the UV outflow location and physical conditions.

OBSERVING DESCRIPTION

We propose to observe PDS 456 with COS G140L-1280 in 2 visits of 3 orbits each separated by >8 months during Cycle 25. These spectra will cover observed wavelengths from ~1000A to ~2200A corresponding to 845-1860A in the quasar rest frame.

This wavelength range will overlap with the previous 1-orbit STIS G140L + G230L spectrum obtained in 2000 and reach higher SNRs that the 2-orbit G140L-1280 spectrum obtained in 2014 (Figure 1). Our estimates for required exposure times are based on new calculations with the COS ETC as well as the existing G140L-1280 spectrum from 2014, which had a total integration time of 5186 sec. For input to the ETC, we use the FOS-based QSO spectrum with a redshift and Galactic reddening (E(B-V) = 0.47) to match PDS 456 and a flux to match the 2014 COS G140L observation. This input spectrum is very similar to the observed 2014 spectrum in Figure 1. We use G140L-1280 with standard backgrounds. We first adopt an exposure time equaling the 2014 observation to calibrate the ETC results against the actual data. We find that the predicted SNRs per resolution element predicted are larger than observed. It is not obvious why this is so, but we aim to improve the SNRs from the existing spectrum, and so we adopt a total exposure time of 7800 seconds (in 3 orbits). Figure 3 shows the predicted SNR per R ~ 2000 resolution element across short wavelengths that cover important lines at observed wavelengths ~1150A and 1350A (see also Figure 1).

From these predictions and by extrapolation from the existing 2014 COS G140L spectrum, we estimate that our proposed 3-orbit 7800 sec exposure times will be sufficient to measure or place firm upper limits on important features at these wavelengths. We will obtain two spectra like this in two visits that we request to be scheduled >8 months apart during Cycle 25. These 2 observations will probe short-term variabilities in the broad outflow absorption lines. For features or spectral regions that do not vary between observations, we will combine the two spectra to provide higher SNRs and even better measurements/upper limits.

Visit

Proposal 15309, Visit 01, completed Tue Aug 13 21:01:20 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

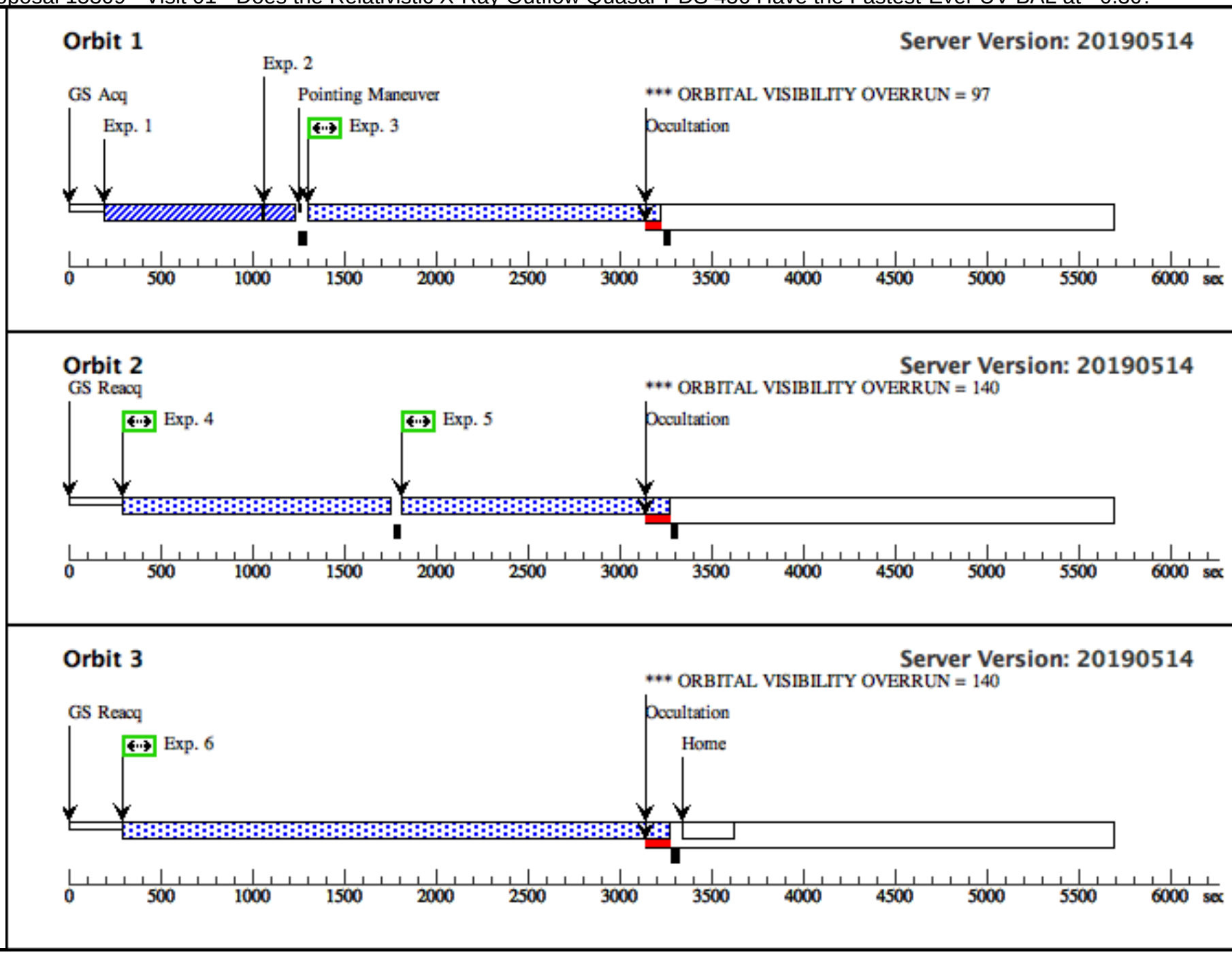
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PDS456	RA: 17 28 19.8000 (262.0825000d) Dec: -14 15 56.06 (-14.26557d) Equinox: J2000	Epoch of Position: 2000	V=14.03	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[QUASAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/SEARCH / NUV / MIRROR B / PSA (COS.ta.1014035)	(1) PDS456	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			128 Secs (128 Secs) *[==>]*	*[1]*
2	ACQ/IMAGE / NUV / MIRROR B / PSA (COS.ta.1014036)	(1) PDS456	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				40 Secs (40 Secs) *[==>]*	*[1]*
3	G140L / 1280 / FP-POS=1 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=1; BUFFER-TIME=9000			1750 Secs (1750 Secs) *[==>]*	*[1]*
4	G140L / 1280 / FP-POS=2 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=2; BUFFER-TIME=9000			1404 Secs (1404 Secs) *[==>]*	*[2]*
5	G140L / 1280 / FP-POS=3 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; BUFFER-TIME=9000			1404 Secs (1404 Secs) *[==>]*	*[2]*
6	G140L / 1280 / FP-POS=4 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=4; BUFFER-TIME=9000			2800 Secs (2923 Secs) *[==>2923.0 Secs]*	*[3]*

Orbit Structure



Visit

Proposal 15309, Visit 02, implementation Tue Aug 13 21:01:20 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: AFTER_01 BY 280 D TO 600 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PDS456	RA: 17 28 19.8000 (262.0825000d) Dec: -14 15 56.06 (-14.26557d) Equinox: J2000	Epoch of Position: 2000	V=14.03	Reference Frame: ICRS

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Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/SEARCH / NUV / MIRROR B / PSA (COS.ta.1014035)	(1) PDS456	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			128 Secs (128 Secs) *[==>]*	***[1]***
2	ACQ/IMAGE / NUV / MIRROR B / PSA (COS.ta.1014036)	(1) PDS456	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				40 Secs (40 Secs) *[==>]*	***[1]***
3	G140L / 1280 / FP-POS=1 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=1; BUFFER-TIME=9000			1653 Secs (1653 Secs) *[==>]*	***[1]***
4	G140L / 1280 / FP-POS=2 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=2; BUFFER-TIME=9000			1334 Secs (1334 Secs) *[==>]*	***[2]***
5	G140L / 1280 / FP-POS=3 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=3; BUFFER-TIME=9000			1334 Secs (1334 Secs) *[==>]*	***[2]***
6	G140L / 1280 / FP-POS=4 (COS.sp.1014037)	(1) PDS456	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=4; BUFFER-TIME=9000			2783 Secs (2783 Secs) *[==>]*	***[3]***

Orbit Structure