



## 15453 - The Most Distant Gravitationally Lensed Quasar at $z=6.5$

Cycle: 25, Proposal Category: GO/DD

(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) J0439	ACS/WFC	1	20-Mar-2018 17:04:18.0	yes
02	(1) J0439	ACS/WFC	1	20-Mar-2018 17:04:19.0	yes

2 Total Orbits Used

### ABSTRACT

We propose to use two-orbit HST/ACS imaging to confirm the highest-redshift gravitationally lensed quasar yet known at  $z=6.5$ . The lack of strongly lensed quasar at high redshift has been a long-standing puzzle. The highest redshift strongly lensed quasar known is only at  $z=4.8$ , and two large HST SNAP surveys yielded no multiply imaged quasars at  $z>4$  among more than 200 targets. Recently, we discovered a ultra-luminous quasar at  $z=6.5$ .

## Proposal 15453 (STScI Edit Number: 3, Created: Tuesday, March 20, 2018 4:04:19 PM EST) - Overview

With  $M_{1450} = -29.5$ , it is the most luminous known object at  $z > 6$ . Close examination of the discovery spectrum shows a faint trace over the wavelength covered by strong IGM absorption, suggesting the presence of a foreground galaxy. Ground-based AO imaging with 0.2" resolution shows that the object is marginally resolved beyond the observed PSF. A model with  $> 2$  components produces a significantly improved fit, suggesting a compact Einstein ring size of 0.2". The presence of a small proximity zone and the implied super-Eddington BH accretion rate further suggest that the intrinsic quasar luminosity is much lower. However, the existing ground-based images are not able to fully resolve the system. HST resolution is needed. The proposed modest ACS observations will definitely resolve the system and characterize the lensing geometry. If confirmed, this would be the first known quasar lens at reionization epoch, providing a unique opportunity to constrain quasar lens model, measure quasar host, and probe the small scale structure of reionization-era IGM through multiple sightlines. The current visibility window for this object ends in early April. A timely observation will allow prompt publication and plan for JWST Cycle-1 followup observations.

### **OBSERVING DESCRIPTION**

We'll perform FR782N and FR853N observations on a lensed quasar at  $z = 6.50$ . Our ground based AO imaging suggests the Einstein ring is about 0.2". In order to get as high resolution possible, we will use the ramp filter FR782N centered at Lyman-beta emission line to detect lens images with sub-pixel dithering. In order to detect the foreground lensing galaxy, we will use FR853N centered at the quasar Gunn-Peterson trough, where quasar has zero flux. In order to balance the cosmic ray rejection and CTE correction, we choose to use 3 points line dither and not include postflash for both filters. The individual exposure is 782s.

Proposal 15453 - FR782N (01) - The Most Distant Gravitationally Lensed Quasar at z=6.5

Tue Mar 20 21:04:19 GMT 2018

<b>Visit</b>	<b>Proposal 15453, FR782N (01), implementation</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: ACS/WFC Special Requirements: (none)
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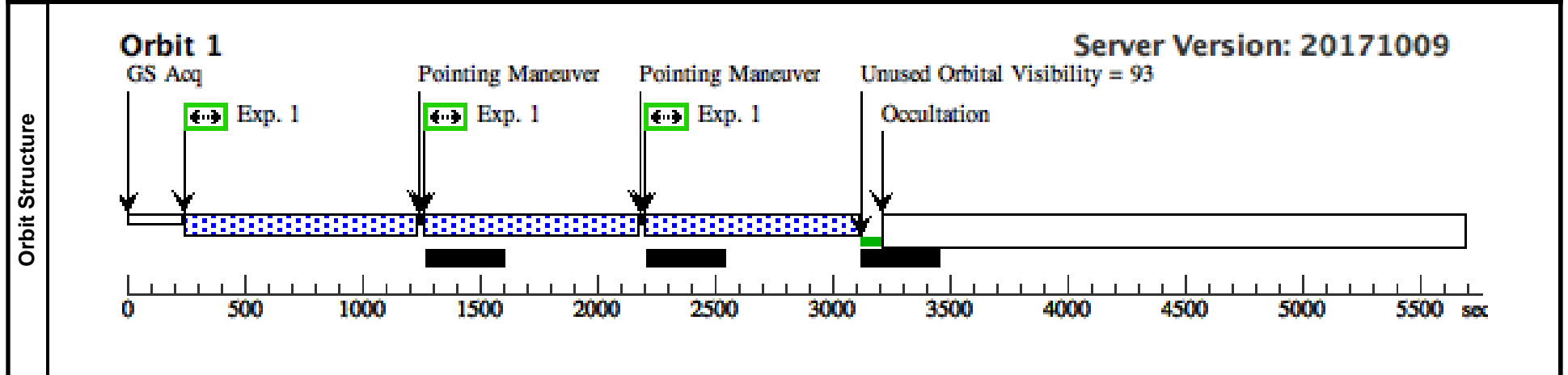
<b>Diagnostics</b>	(Exposure 1 (Pattern 2, Exps 1-1 in FR782N (01))) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp filters as central wavelengths & transmission efficiencies vary within the apertures.
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<b>Patterns</b>	#	<b>Primary Pattern</b>	<b>Secondary Pattern</b>	<b>Exposures</b>
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.170 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(1)

<b>Fixed Targets</b>	#	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	J0439	RA: 04 39 47.0980 (69.9462417d) Dec: +16 34 15.82 (16.57106d) Equinox: J2000	Redshift: 6.5	V=24 z_AB=19.5	Reference Frame: ICRS

*Comments: This object is undetected in V-band (fainter 24 magnitude).  
 Category=GALAXY  
 Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, QUASAR]  
 Extended=YES*

<b>Exposures</b>	#	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1	(1) J0439	(1) J0439	ACS/WFC, ACCUM, WFC2-ORAMP	FR782N 7700 A		GS ACQ SCENARI O SINGLE	Pattern 2, Exps 1-1 in FR782N (01) (2)	800 Secs (2346 Secs) [==>782.0 Secs (Pattern 1)] [==>782.0 Secs (Pattern 2)] [==>782.0 Secs (Pattern 3)]	[1]



Proposal 15453 - FR853N (02) - The Most Distant Gravitationally Lensed Quasar at z=6.5

Tue Mar 20 21:04:20 GMT 2018

<b>Visit</b>	Proposal 15453, FR853N (02), implementation <b>Diagnostic Status: Warning</b> Scientific Instruments: ACS/WFC Special Requirements: (none)										
	(Exposure 1 (Pattern 2, Exps 1-1 in FR853N (02))) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp filters as central wavelengths & transmission efficiencies vary within the apertures.										
<b>Diagnosics</b>											
<b>Patterns</b>	#	Primary Pattern		Secondary Pattern	Exposures						
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.170 Line Spacing=		Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false	(1)						
<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(1)	J0439	RA: 04 39 47.0980 (69.9462417d) Dec: +16 34 15.82 (16.57106d) Equinox: J2000	Redshift: 6.5	V=24 z_AB=19.5	Reference Frame: ICRS					
Comments: This object is undetected in V-band (fainter 24 magnitude). Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, QUASAR] Extended=YES											
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1		(1) J0439	ACS/WFC, ACCUM, WFC1-IRAMP	FR853N 8750 A		GS ACQ SCENARI O BASE1B3	Pattern 2, Exps 1-1 in FR853N (02) (2)	800 Secs (2346 Secs) [==>782.0 Secs (Pattern 1)] [==>782.0 Secs (Pattern 2)] [==>782.0 Secs (Pattern 3)]	[1]	
<b>Orbit Structure</b>	Server Version: 20171009										
	<p>Orbit 1</p> <p>Timeline (sec): 0, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 5500</p> <p>Events:</p> <ul style="list-style-type: none"> <li>GS Acq Exp. 1 (at ~300s)</li> <li>Pointing Maneuver (at ~1400s)</li> <li>Pointing Maneuver (at ~2300s)</li> <li>Unused Orbital Visibility = 1</li> <li>Occultation (at ~3300s)</li> </ul>										