



17284 - A young lensed quasar at cosmic dawn

Cycle: 30, 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) PJ170+20	ACS/WFC	1	05-Apr-2023 14:00:35.0	yes
02	(1) PJ170+20	ACS/WFC	1	05-Apr-2023 14:00:36.0	yes

2 Total Orbits Used

ABSTRACT

QSOs at $z > 6$ are among the brightest sources in the Universe and are unparalleled tools to investigate the first billion years of Cosmic History. The origin of the first supermassive black holes, however, is an enduring mystery, since classical Eddington-limited growth has been ruled out as the

formation mechanism for this population. However, to date, only the brightest end of the underlying QSO population has been investigated. New insights into the formation of the first black holes can be obtained by studying intrinsically faint QSOs that are magnified by foreground lensing galaxies. Unfortunately, while a high fraction of QSOs is predicted to be gravitationally lensed at high redshift, only one $z \sim 6$ lensed QSO has been reported to date (J0439+1634 at $z=6.5$).

Recently, the second-ever strongly-lensed QSO at $z > 5$, PJ170+20, was discovered serendipitously. PJ170+20 is not only strongly lensed, but shows promising signs of being young, with an onset of its latest bright phase potentially only ~ 1000 years ago, and exhibits unusual dust emission. These characteristics open the possibility of PJ170+20 being a long-awaited keystone in QSO growth: an intrinsically faint QSO caught during (or right after) a phase of highly-obscured super-Eddington growth. We here propose exploit the unparalleled spatial resolution allowed by ACS/WFC optical and IR imaging to confirm these properties by revealing the so far unresolved multiple lensed images and precisely pin down the location of the foreground galaxy (which are required for lens models). Unleashing PJ170+20 as unique workhorse to explore the origins of super massive black holes at cosmic dawn.

OBSERVING DESCRIPTION

We will gather ACS/WFC observations with the FR931N and F555W bands of a lensed quasar at $z=6.41$. We aim to obtain these data in two visits, one per filter.

FR931N observations:

Goal of this visit is to get as high resolution as possible to identify multiple quasar images. To do so, we will take observations at the shortest wavelength where the quasar emission is detectable (i.e., at the edges of the Ly-Alpha forest) using ACS/WFC with the ramp filter FR931N centered at 9100Å. In order to balance the cosmic ray rejection and CTE correction, we choose to use 3 points line dither and not include postflash. We also made 0.334" dither steps to minimize variation in the wavelength and transmission efficiency within the aperture.

F555W observations:

Goal of this visit is to precisely determine the location of the foreground lensing galaxy using the intergalactic medium as a natural blocking filter to avoid the quasar light. We will observe at wavelengths shorter than the quasar's Lyman limit, i.e., with the F555W filter. We will split the observations into 4 exposures using the ACS-WFC-DITHER-BOX pattern.

Proposal 17284 - FR931N (01) - A young lensed quasar at cosmic dawn

Wed Apr 05 18:00:36 GMT 2023

Visit	Proposal 17284, FR931N (01), implementation	
	Diagnostic Status: Warning	
	Scientific Instruments: ACS/WFC	
	Special Requirements: (none)	

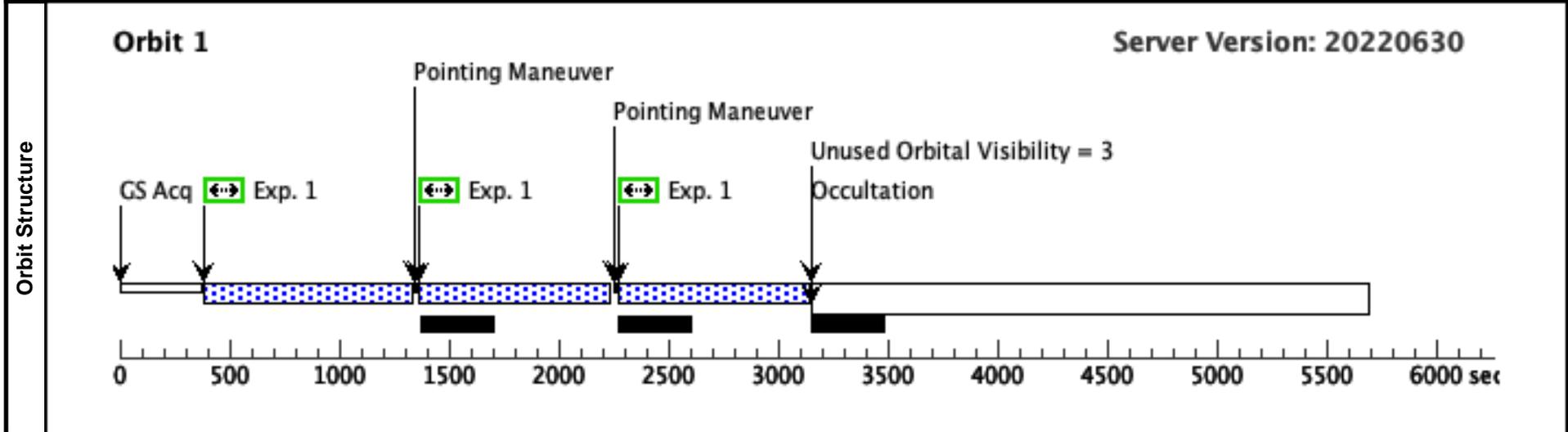
Diagnostics	(Exposure 1 (Pattern 2, Exps 1-1 in FR931N (01))) Warning (Form): POS TARG & PATTERN should be used carefully with ACS ramp filters as central wavelengths & transmission efficiencies vary within the apertures.
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Patterns	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.334 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.29 Angle Between Sides= Center Pattern=false	

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	PJ170+20	RA: 11 23 19.8400 (170.8326667d) Dec: +20 12 29.79 (20.20828d) Equinox: J2000		V=(?) z_AB=20.5mag, y_AB=20.0mag	Reference Frame: ICRS

Comments:
 Category=GALAXY
 Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, QUASAR]
 Extended=YES

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) PJ170+20	ACS/WFC, ACCUM, WFC2-ORAMP	FR931N 9100 A				Pattern 2, Exps 1-1 in FR931N (01) (2)	745 Secs (2235 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]



Proposal 17284 - F555W (02) - A young lensed quasar at cosmic dawn

Wed Apr 05 18:00:37 GMT 2023

Visit	Proposal 17284, F555W (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: (none)		
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Patterns	#	Primary Pattern	Secondary Pattern	Exposures
	(3)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.2637 Line Spacing=0.1856	Coordinate Frame=POS-TARG Pattern Orientation=20.7 Angle Between Sides=69.02 Center Pattern=false	(1)

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	PJ170+20	RA: 11 23 19.8400 (170.8326667d) Dec: +20 12 29.79 (20.20828d) Equinox: J2000		V=(?) z_AB=20.5mag, y_AB=20.0mag	Reference Frame: ICRS

Comments:
 Category=GALAXY
 Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, QUASAR]
 Extended=YES

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) PJ170+20	ACS/WFC, ACCUM, WFC1-CTE	F555W				Pattern 3, Exps 1-1 in F555W (02) (3)	520 Secs (2080 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[1]

