15872 - Understanding an Extreme QSO: The Curious Case of SDSS 0956+5128

Cycle: 27, 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) VV2006-J095632.5+512824	ACS/WFC	2	23-Jul-2019 17:01:22.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(1) VV2006-J095632.5+512824 WAVE	STIS/CCD STIS/NUV-MAMA	1	23-Jul-2019 17:01:24.0	yes

3 Total Orbits Used

ABSTRACT

SDSS 0956+5128 is an object unlike any other quasar in the SDSS catalog, and challenges our understanding of quasar broad-line regions. There is a wealth of ground-based observations on different instruments and at different wavelengths showing its narrow lines, Balmer lines, and MgII to all lie at substantially different velocities. The most promising of several possible explanations might be an analog of a tidal disruption event during the merger of two supermassive black holes, a stage of the merger process that has never been seen before. HST is uniquely able to shed substantial light on this puzzle in two ways. (1) Imaging with ACS will resolve emission from the host galaxy, determining whether the quasar emission is offset from the galactic bulge, as appears likely from ground-based Subaru IRCS AO observations, and whether the galaxy has undergone a recent merger. (2) STIS spectroscopy will be used to measure the velocity offset and profile of the CIV line, which cannot be seen from the ground. Because CIV is a higher ionization line than HB and MgII and its broad-line region is at ~1/10 the radius, it provides an ideal test of whether SDSS 0956+5128 is undergoing a supermassive black hole merger and a good indicator of the dynamics of the inner broad-line region.

OBSERVING DESCRIPTION

We will acquire high-resolution images of SDSS 0956+5128 with HST using the Advanced Camera for Surveys (ACS) to analyze the internal structure of the host galaxy of a candidate for a unique object most likely to be either a recoiling supermassive black hole or extreme disk emitter. High angular resolution in combination with a stable PSF, such as can only be achieved from space, is required to disentangle the quasar and the host galaxy emission. With a plate scale 0.05" per pixel (0.36 kpc per pixel in our case) that is well matched to the spatial resolution of our NIR imaging (J, H and K) with AO from Subaru, we can not only optimize the detection of the host under the bright emission of the QSO but also reveal the central structure around the AGN.

We will acquire two images using filter bandpasses (F606W and F850LP) that bracket the rest-frame 4000A break in order to accurately determine the stellar mass of the host galaxy. Based on our fit for the broad-band spectral energy distribution of SDSS 0956+5128 combining SDSS, 2MASS, WISE, and GALEX, there is a very high likelihood that HST will detect the host galaxy.

Based analogous decompositions of AGN at similar redshifts in the Extended Chandra Deep Field South using the GEMS survey, one orbit should be sufficient to detect the host galaxy given the expected nucleus to host ratio (N/H 4-6 in F606W and N/H 2-3 in F850LP) in both filter bands. The lower N/H in the F850LP filter will help us determine a precise stellar mass. The total integration time will be split into 6x400 sec exposures in F606W and 2x1200 sec in F850L to avoid saturation given the observed quasar SED. We will dither the individual exposures to minimize the impact of cosmetic defects in the CCD. A total of two orbits is sufficient including overheads due to target acquisition and data readout. The PSF can be well reconstructed because there are at least two nearby stars of similar magnitude.

The existing Subaru NIR K-band data will be complementary to the proposed ACS imaging. There is a clear detection of extended emission from the host galaxy outside the core region of the PSF due to the favorable N/H ratio in the NIR, and this detection will combine with the ACS imaging to further constrain the stellar mass of the host. The nearby PSF star located at a separation of 17 arcsec from the quasar and at the same separation from the laser guide star will also assist in our decomposition the AGN and its host.

Spectroscopy: We plan to acquire a UV spectrum of SDSS 0956+5128 with STIS to cover the rest wavelengths 916-1855 A in order to detect the CIV emission line. Knowledge of the CIV line profile has the potential to aid us in understanding the strong differences between the other lines seen with SDSS, Keck and APO. Using the STIS exposure time calculator, we find that one orbit of integration time is sufficient to detect CIV as well as the continuum at a S/N of 10.0 per pixel. We will use NUV/MAMA with the G230L grating and a slit width of 0.5". A spectral resolution of 450 km/s will be sufficient to characterize the velocity profile of the CIV emission line given the velocity width of the MgII line. The total integration time includes all overheads.

Our plan for the analysis of a deep HST/ACS image and STIS spectra of SDSS 0956+5128 in order to address the science objectives of our program can be summarized as follows:

- From the ACS images, ecompose the QSO and host galaxy with GALFIT. The PSF will be modeled using stars within the ACS/WFC field.

- Measure the host galaxy mass based on the SED after AGN/host decomposition, in order to confirm that the host galaxy and quasar point source are consistent with lying in the same system near the black hole mass - stellar luminosity relation.

- Measure asymmetries in the host light distribution that may be indicative of a recent merger.

- Search for an offset between an unresolved point source from the center of the host galaxy that would nail down the nature of SDSS 0956+5128 as a SMBH with a velocity kick.

- Measure the CIV line profile and any offset of CIV with respect to the other broad emission lines.

Visit

Proposal 15872, ACS 850LP (01) Tue Jul 23 21:01:24 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.262 Line Spacing=0.192	Coordinate Frame=POS-TARG Pattern Orientation=18.39 Angle Between Sides=68.14 Center Pattern=false		(1)
(3)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=6 Point Spacing=0.262 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=18.39 Angle Between Sides= Center Pattern=false		(2)

Fixed Targets

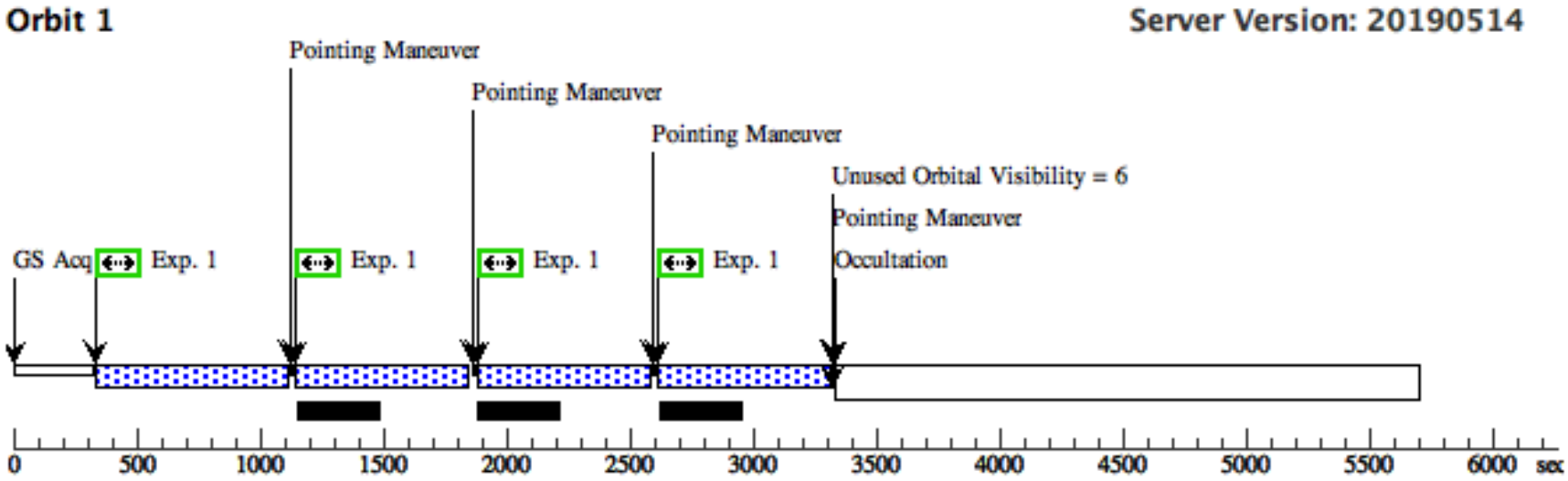
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	VV2006-J095632.5+512824	RA: 09 56 32.4866 (149.1353608d) Dec: +51 28 23.78 (51.47327d) Equinox: J2000		V=19.24	Reference Frame: ICRS

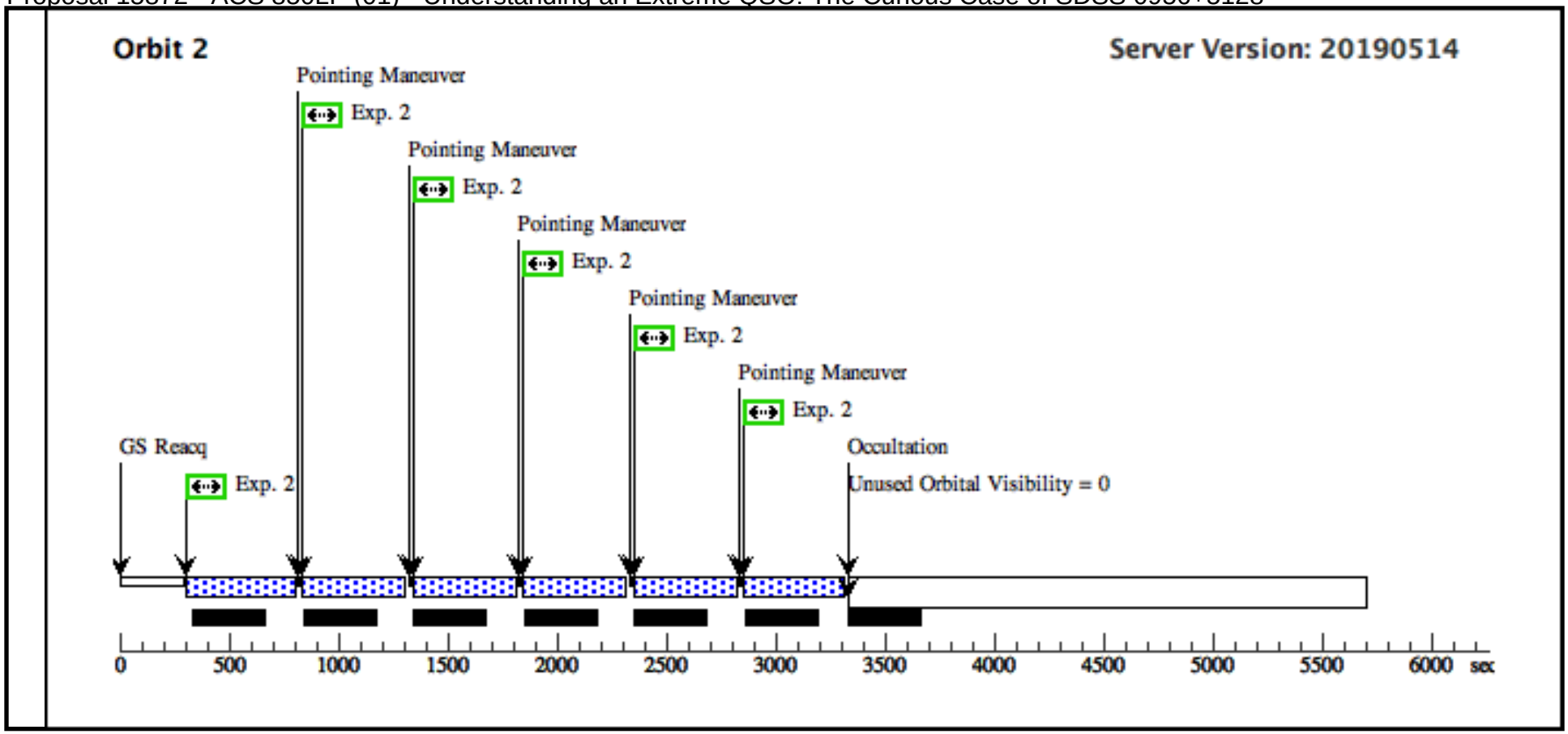
Comments:
Category=GALAXY
Description=[QSO, QUASAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1370708)	(1) VV2006-J095632.5+512824	ACS/WFC, ACCUM, WFC	F850LP			Pattern 2, Exps 1-1 in ACS 850LP (01) (2)	575 Secs (2300 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	(1370707)	(1) VV2006-J095632.5+512824	ACS/WFC, ACCUM, WFC	F606W			Pattern 3, Exps 2-2 in ACS 850LP (01) (3)	347 Secs (2075 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]* *[==>(Pattern 5)]* *[==>340.0 Secs (Pattern 6)]*	***[2]***

Orbit Structure

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Server Version: 20190514
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
GS Reacq
Exp. 2
Occultation
Unused Orbital Visibility = 0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15872, STIS (03) Tue Jul 23 21:01:25 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	VV2006-J095632.5+512824	RA: 09 56 32.4866 (149.1353608d) Dec: +51 28 23.78 (51.47327d) Equinox: J2000		V=19.24	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[QSO, QUASAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1370704)	(1) VV2006-J095632.5+512824	STIS/CCD, ACQ, 50CCD	MIRROR				10 Secs (10 Secs) *[==>]*	*[1]*
2	(1368112)	(1) VV2006-J095632.5+512824	STIS/NUV-MAMA, ACCUM, 52X0.5	G230L 2376 A	WAVECAL=NO			1150 Secs X 2 (2316 Secs) *[==>(Copy 1)]* *[==>1166.0 Secs (Copy 2)]*	*[1]*
3		WAVE	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				*[==>]*	*[1]*

Orbit Structure