16169 - The biological potential of other worlds: comparing the phosphorus content of wet and dry exoplanetary crusts

Cycle: 28, 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) GD-61	COS/FUV COS/NUV	1	22-Jun-2020 12:00:42.0	yes
02	(2) SDSSJ0731+2417	COS/FUV COS/NUV	2	22-Jun-2020 12:00:43.0	yes
03	(3) SDSSJ1043+0855	COS/FUV COS/NUV	2	22-Jun-2020 12:00:43.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
04	(2) SDSSJ0731+2417	COS/FUV COS/NUV	1	22-Jun-2020 12:00:44.0	yes

6 Total Orbits Used

ABSTRACT

Life on Earth as we know it requires water and reliable access to phosphorus to drive basic biological processes. Studies of polluted white dwarf stars are able to detect both water and phosphorus in the accreted material from their extant planetary systems. In this proposal we seek to carefully examine the phosphorus content of a set of polluted white dwarf stars that are accreting the crust and mantle regions (the surface) of massive, differentiated rocky bodies. COS FUV spectroscopic observations of three white dwarf stars -- one water-rich and two relatively water-poor -- along with available data for another water-rich white dwarf will allow us to robustly assess their phosphorus content and compare the biological potential of very wet and more Earth-like worlds.

OBSERVING DESCRIPTION

Our primary goal is to detect or tightly constrain phosphorus for three polluted white dwarf stars: GD 61, SDSSJ0731+2417, and SDSSJ1043+0855. A secondary goal is to measure carbon to a sufficient level in SDSSJ0731+2417 as it cannot be characterized from optical data. Modeling of absorption lines shows that phosphorus has its strongest transitions for the target stars near 1540 Angstroms. Carbon can be measured or sufficiently strongly constrained with observations in the 1130-1433 Angstrom range. We will perform medium spectral resolution ultraviolet spectroscopy with COS and the G160M grating to cover the 1410-1800 Angstrom range for all three targets to measure phosphorus and with the G130M grating to cover the 1130-1433 Angstrom range to measure carbon in SDSSJ0731+2417.

For the measured UV flux of each target (given in their information areas) and based on past COS observations of GD 61 and SDSSJ1043+0855 we expect to obtain near the 1540 Angstrom phosphorus transition S/N~15 for SDSSJ1043+0855 (2 orbits), S/N~22 for SDSSJ0731+2417 (2 orbits), and S/N~22 for GD 61 (1 orbit). Near the 1330 carbon transition for SDSSJ0731+2417 we expect to obtain S/N~15 (1 orbit). These estimates are made using the COS ETC assuming standard background parameters and with a white dwarf spectral energy distribution matched to the parameters and flux level of our targets. These signal-to-noise ratios will enable detection or tight limits on the abundances of phosphorus for all targets and additionally carbon for SDSSJ0731+2417. Our requested time estimates for COS are increased assuming 20 minutes of instrument overhead (including all acquisition and exposure overheads as suggested in the COS manual) per visit and 6 minutes of observatory overhead per orbit

(spacecraft acquisition). In sum, we request a total of 6 orbits for this project.

Observations will be done in the TIME-TAG mode using TAG-FLASH wavelength calibration.

Each white dwarf is an ICRS object (Gaia DR2 position with less than 0.4" positional uncertainty), has a measured UV flux, and is safe for the COS detectors in our desired setups.

Reduced-gyro impact: we do not forsee any significant impact on this program due to reduced-gyro operations. Each visit has a wide range of observing windows, loss of ~50% of these would still leave ample opportunity to obtain each target. There are no orientation restrictions for this program nor does it use spatial scanning.

Visit

Proposal 16169, GD61phos (01) Mon Jun 22 16:00:44 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G160M grating observations of GD 61.

Fixed Targets

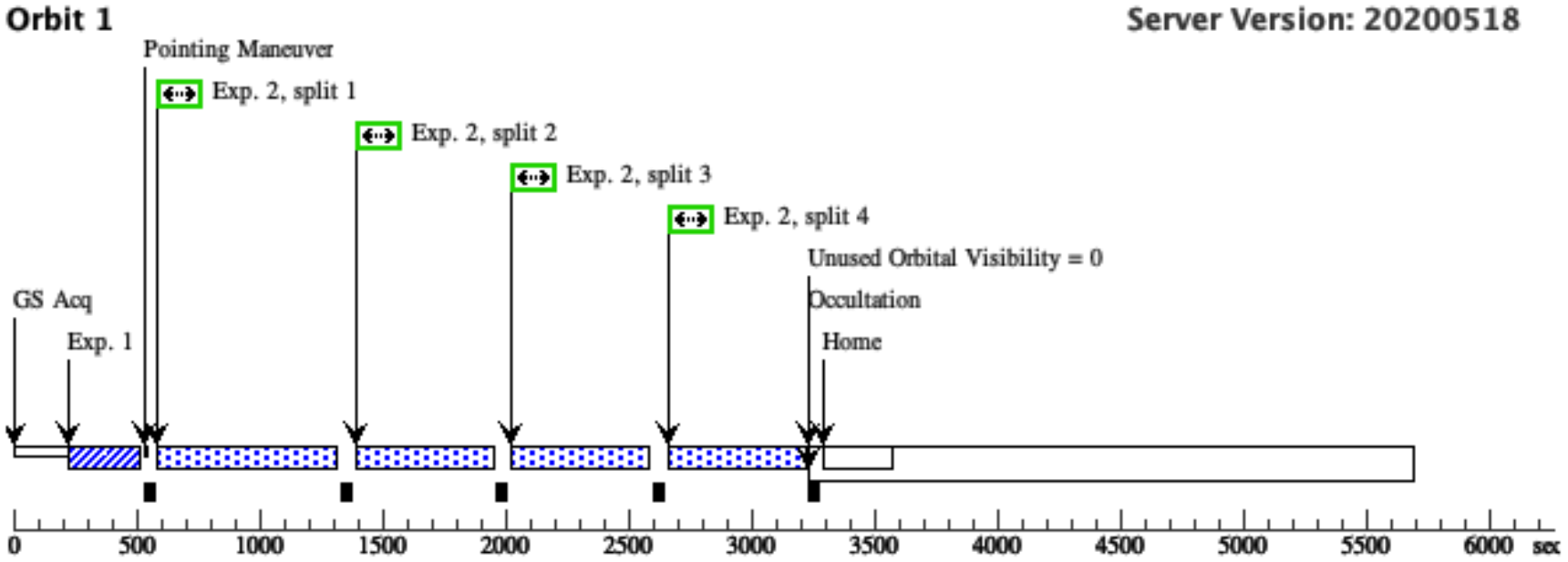
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GD-61	RA: 04 38 39.3810 (69.6640875d) Dec: +41 09 30.65 (41.15851d) Equinox: J2000	Proper Motion RA: 5.3 mas/yr Proper Motion Dec: -109.35 mas/yr Parallax: 0.0186" Epoch of Position: 2015.5	V=14.879+/-0.01 mNUV=14.70+/-0.05	Reference Frame: ICRS

Comments:
Category=STAR
Description=[DB]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GD61acq (COS.ta.1447698)	(1) GD-61	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				32 Secs (32 Secs) *[==>]*	*[1]*
2	GD61G160M (COS.sp.1447699)	(1) GD-61	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=1685; FP-POS=ALL; FLASH=YES			511 Secs (2044 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[1]*

Orbit Structure



Visit

Proposal 16169, SDSS0731PHOS (02) Mon Jun 22 16:00:45 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G160M grating observations of SDSSJ0731+2417.

Fixed Targets

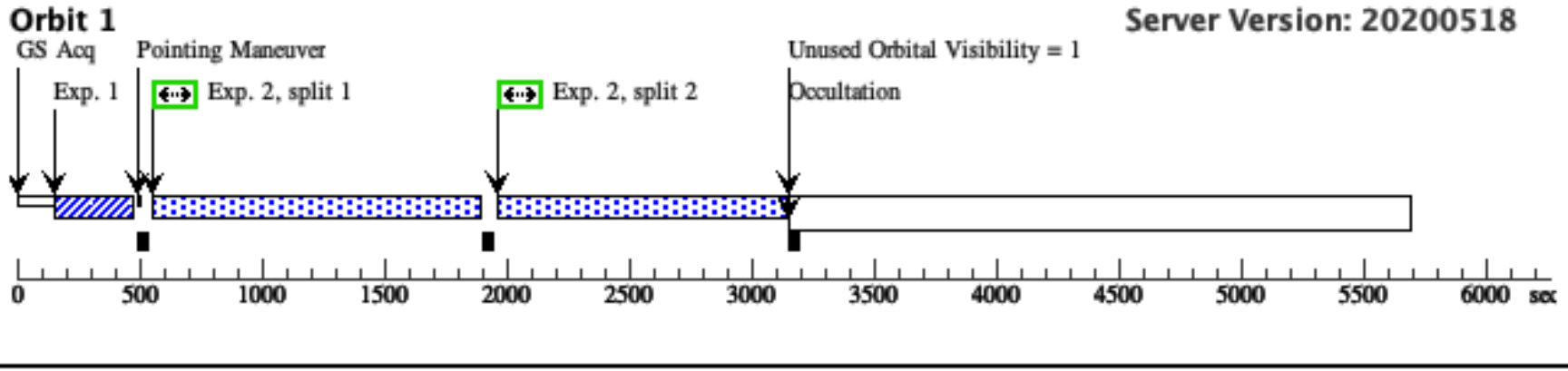
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSSJ0731+2417	RA: 07 31 10.3361 (112.7930671d) Dec: +24 17 3.05 (24.28418d) Equinox: J2000	Proper Motion RA: -19.8 mas/yr Proper Motion Dec: -91.1 mas/yr Parallax: 0.0088" Epoch of Position: 2015.5	V=16.3+/-0.01 mFUV=16.02+/-0.05	Reference Frame: ICRS

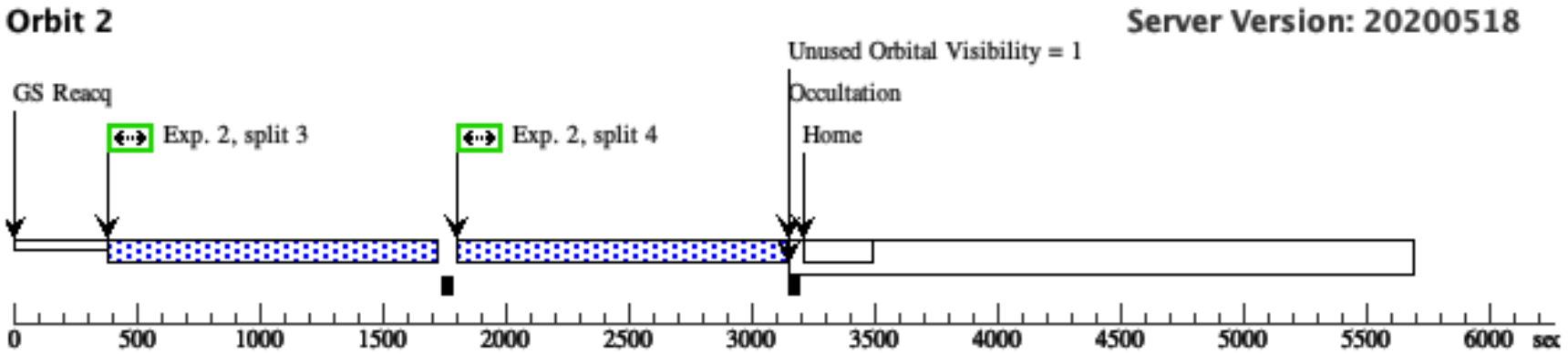
Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J0731acq (COS.ta.1448485)	(2) SDSSJ0731+2417	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				15 Secs (15 Secs) *[==>]*	 ***[1]***
2	J0731G160M (COS.sp.1448487)	(2) SDSSJ0731+2417	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=3885; FP-POS=ALL; FLASH=YES			1000 Secs (4826 Secs) *[==>1125.0 Secs (Split 1)]* *[==>1125.0 Secs (Split 2)]* *[==>1288.0 Secs (Split 3)]* *[==>1288.0 Secs (Split 4)]*	 ***[1]*** ***[2]***

Orbit Structure





Visit

Proposal 16169, SDSS1043PHOS (03) Mon Jun 22 16:00:45 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G160M grating observations of SDSSJ1043+0855.

Fixed Targets

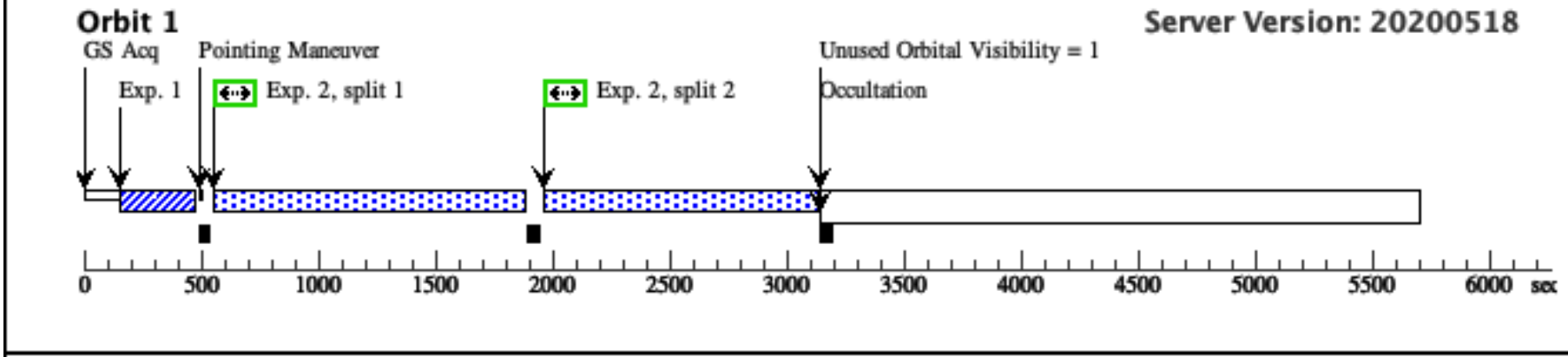
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	SDSSJ1043+0855	RA: 10 43 41.5753 (160.9232304d) Dec: +08 55 57.60 (8.93267d) Equinox: J2000	Proper Motion RA: 42.3 mas/yr Proper Motion Dec: -47.9 mas/yr Parallax: 0.0057" Epoch of Position: 2015.5	V=17+/-0.01 mFUV=16.92+/-0.05	Reference Frame: ICRS

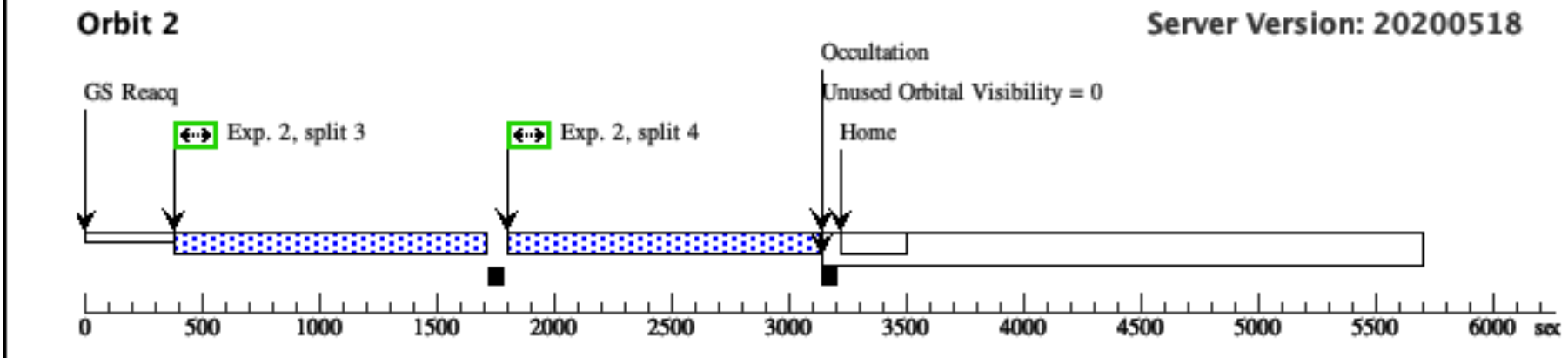
Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J1043acq (COS.ta.1448059)	(3) SDSSJ1043+0855	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				15 Secs (15 Secs) *[==>]*	 ***[1]***
2	J1043G160M (COS.sp.1448061)	(3) SDSSJ1043+0855	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=2520; FP-POS=ALL; FLASH=YES			1000 Secs (4774 Secs) *[==>1114.0 Secs (Split 1)]* *[==>1114.0 Secs (Split 2)]* *[==>1273.0 Secs (Split 3)]* *[==>1273.0 Secs (Split 4)]*	 ***[1]*** ***[2]***

Orbit Structure





Visit

Proposal 16169, SDSS0731C (04) Mon Jun 22 16:00:45 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G130M grating observations of SDSSJ0731+2417.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSSJ0731+2417	RA: 07 31 10.3361 (112.7930671d) Dec: +24 17 3.05 (24.28418d) Equinox: J2000	Proper Motion RA: -19.8 mas/yr Proper Motion Dec: -91.1 mas/yr Parallax: 0.0088" Epoch of Position: 2015.5	V=16.3+/-0.01 mFUV=16.02+/-0.05	Reference Frame: ICRS

Comments:
Category=STAR
Description=[DA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J0731acq2 (COS.ta.1448485)	(2) SDSSJ0731+2417	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				15 Secs (15 Secs) *[==>]*	*[1]*
2	J0731G130MFP3 (COS.sp.1448491)	(2) SDSSJ0731+2417	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=2575; FP-POS=3; FLASH=YES			1144 Secs (1144 Secs) *[==>]*	*[1]*
3	J0731G130MFP4 (COS.sp.1448491)	(2) SDSSJ0731+2417	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=2575; FP-POS=4; FLASH=YES			1144 Secs (1144 Secs) *[==>]*	*[1]*

Orbit Structure