



## 15422 - Anchoring C/O with an Extremely Metal Deficient Galaxy

Cycle: 25, Proposal Category: GO

(UV Initiative, JWST Initiative)

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Dr. Danielle Berg (PI) (Contact)</b>	<b>The Ohio State University</b>	<b>berg.249@osu.edu</b>
Prof. Dawn K. Erb (CoI)	University of Wisconsin - Milwaukee	erbd@uwm.edu
Prof. Max Pettini (CoI) (ESA Member)	University of Cambridge	pettini@ast.cam.ac.uk

### 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) J1044+6303	COS/FUV COS/NUV	3	20-Apr-2018 17:04:19.0	yes
02	(1) J1044+6303	COS/FUV COS/NUV	3	20-Apr-2018 17:04:22.0	yes

6 Total Orbits Used

### ABSTRACT

Carbon has no strong collisionally excited emission lines in the optical, so that carbon abundances from HII regions are relatively sparse. However, by observing CIII] 1907,1909 and OIII] 1661,1666 in the ultraviolet, we can obtain a very secure measurement of the C/O ratio in HII regions. We have been using HST/COS to measure C/O in HII regions in dwarf galaxies from the SDSS which cover a range of roughly one dex in O/H. However, extremely metal poor galaxies are notoriously rare in the SDSS, and our sample lacks targets below  $12 + \log(\text{O}/\text{H}) = 7.25$ .

## Proposal 15422 (STScI Edit Number: 1, Created: Friday, April 20, 2018 4:04:23 PM EST) - Overview

The recent discovery of the nearby dwarf galaxy, Little Cub, with an oxygen abundance of  $12 + \log(\text{O}/\text{H}) = 7.13$ , hosts a sufficiently high surface brightness HII region to allow a C/O measurement in just a few HST orbits. Adding Little Cub to our sample will allow us to extend the metallicity baseline, explore the potential continuity in C/O versus O/H from dwarf galaxies to DLAs, and constrain rest-frame UV emission-line diagnostics in preparation for JWST.

### **OBSERVING DESCRIPTION**

#### Goal:

We will obtain NUV target acquisition images and FUV COS spectroscopy of the recently discovered, nearby, metal-poor, compact "Little Cub" dwarf galaxy in order to anchor the C/O relationship with O/H at the low-metallicity end.

#### Target:

Recently, Hsyu et al. (2017) reported the discovery of the Little Cub, the only extremely metal-poor ( $12 + \log(\text{O}/\text{H}) < 7.3$ ) star-forming galaxy suitable for UV emission-line studies with HST. Little Cub has large optical [OIII] emission line surface brightness, is high ionization, is low metallicity ( $12 + \log(\text{O}/\text{H}) < 7.3$ ), and has a compact morphology which allows maximum flux through the 2.5" COS aperture. We use coordinates centered on the maximum surface brightness from the PanSTARRS1 g-band image, which are in the ICRS reference frame.

#### Target Acquisition:

Since Little Cub has PanSTARRS imaging, which has excellent astrometry, we do not do an ACQ/SEARCH routine. Further, the peak surface brightness coordinates from the PanSTARRS imaging are within 0.1" of the SDSS imaging. With such precise input coordinates from the PanSTARRS, we acquire our target using the ACQ/IMAGE mode with the PSA aperture and MirrorA for the COS/NUV configuration. For this acquisition, we have determined integration times necessary to reach a S/N = 25, which has been demonstrated as sufficient by the execution of very similar programs (HST-GO14168 by PI: Dan Stark and our previous C/O programs: HST-GO13312 and HST-GO14628). We assume a flat spectral distribution normalized by the GALEX FUV surface brightnesses. Each galaxy is compact in the SDSS imaging with a FWHM PSF diameter of ~2". We then divide the GALEX FUV fluxes by the area of the 2" PSF to determine the FUV surface brightnesses.

#### Science Exposures:

We will use COS with the G140L grating with a central wavelength of 1280 angstroms in TIMETAG mode in order to obtain simultaneous measurements of the CIV 1548,1550, HeII 1640, OIII] 1661,1666, SiIII] 1883,1892, and CIII] 1907,1909 emission lines in Detector segment A. We

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will observe Little Cub for 3 orbits through the PSA aperture with the COS/FUV configuration. After target acquisition, all remaining time was allocated to science exposures for the first orbit. The resulting total science integration time is sufficient to reach S/N  $\sim 5$  per resolution element in the CIII] 1909 line, which our experience has shown to be the weakest / limiting line due to the rapid fall off in sensitivity at the red end of the G140L grating. This will provide enough signal to measure the equivalent widths of the relevant emission lines. For the FUV G140L configuration, no flats are available and so we use FP-POS=ALL, which takes 4 images offset from one another in the dispersion direction and increases S/N. These 4 positions allow a flat to be created and cosmic rays to be eliminated.

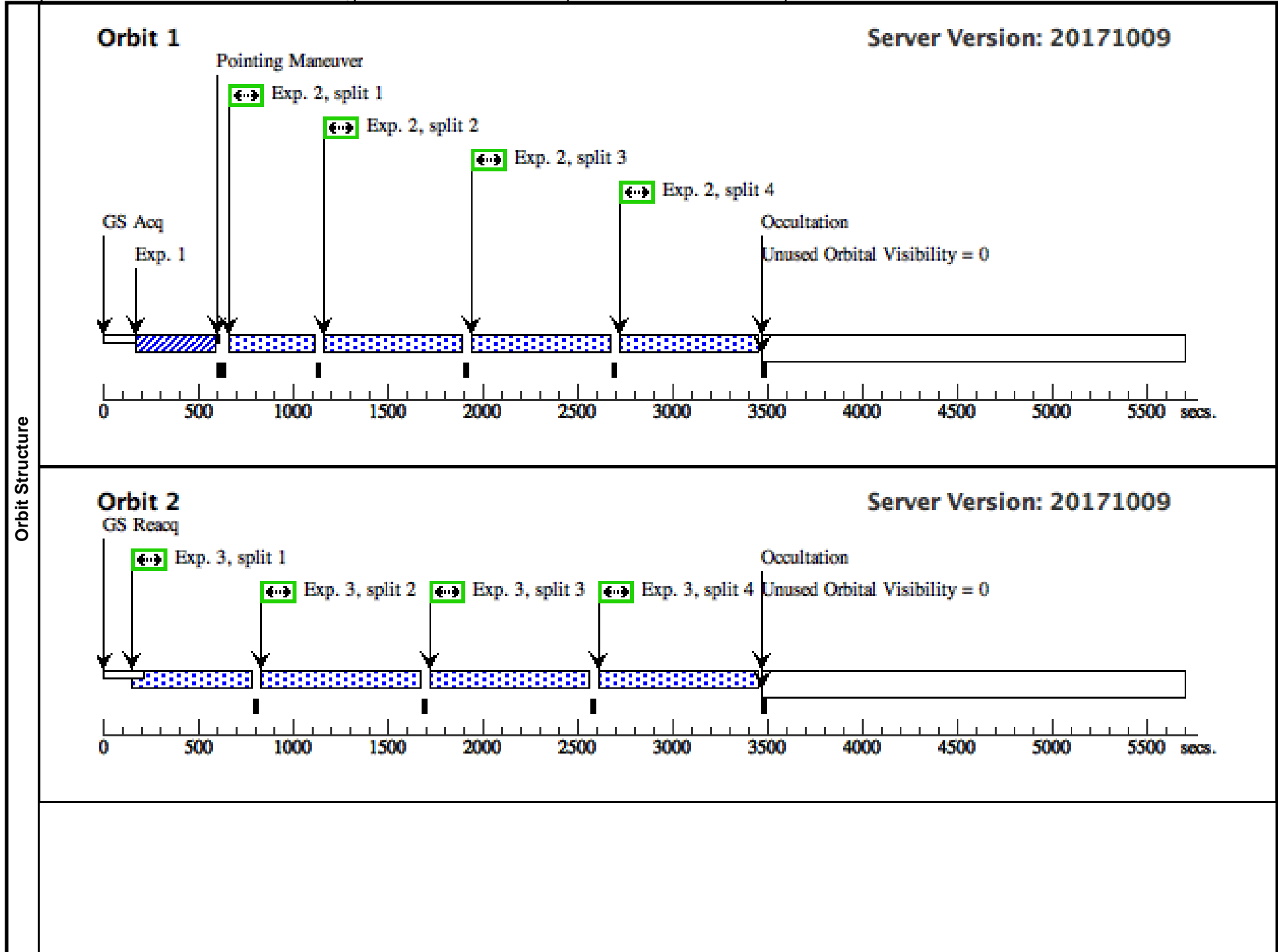
# Proposal 15422 - Visit 01 - Anchoring C/O with an Extremely Metal Deficient Galaxy

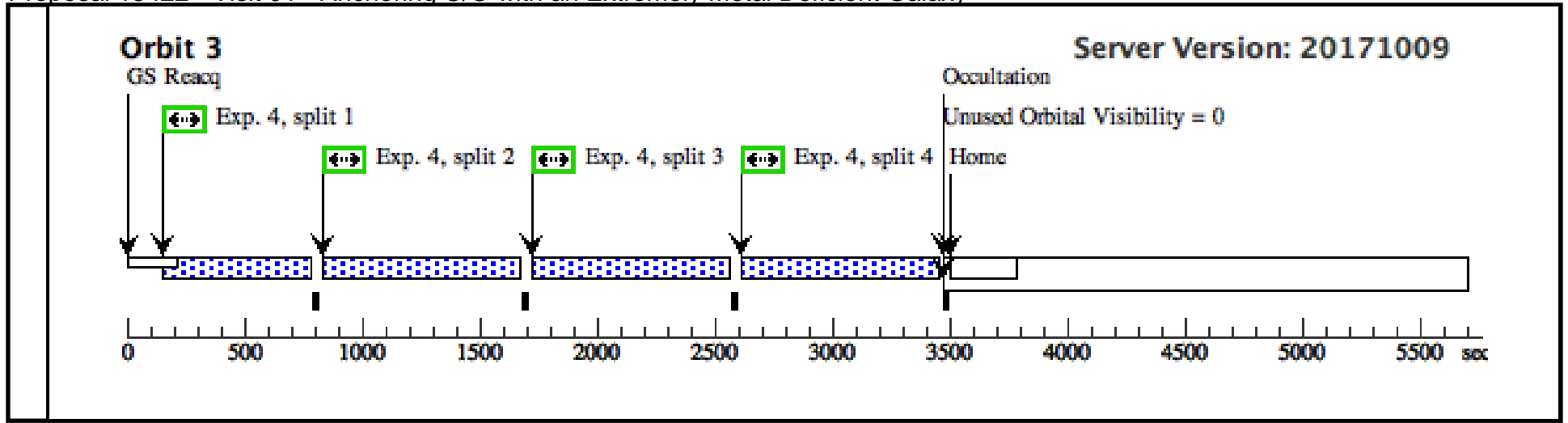
Fri Apr 20 21:04:23 GMT 2018

<b>Visit</b>	<b>Proposal 15422, Visit 01, failed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																
<b>Diagnostics</b>	(Visit 01) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (Visit 01) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (Exposure 2 (Visit 01)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details. (Exposure 3 (Visit 01)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details. (Exposure 4 (Visit 01)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.																
<b>Fixed Targets</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>J1044+6303</td> <td>RA: 10 44 42.6450 (161.1776875d) Dec: +63 06 2.10 (63.10058d) Equinox: J2000</td> <td></td> <td>V=19.87+/-0.05 M_B=-11.4, GALEX NUV = 19.60, FUV = 19.66, SDSS g = 19.56</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table> <p><i>Comments: V band magnitude determined from the SDSS conversions of Jester+05</i>                  Category=GALAXY                  Description=[DWARF COMPACT]                  Extended=YES</p>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	J1044+6303	RA: 10 44 42.6450 (161.1776875d) Dec: +63 06 2.10 (63.10058d) Equinox: J2000		V=19.87+/-0.05 M_B=-11.4, GALEX NUV = 19.60, FUV = 19.66, SDSS g = 19.56	Reference Frame: ICRS				
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Proposal 15422 - Visit 01 - Anchoring C/O with an Extremely Metal Deficient Galaxy

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(1036817)	(1) J1044+6303	COS/NUV, ACQ/IMAGE, PSA	MIRRORA					100 Secs (100 Secs)	
										[==>]	[1]
	<p><i>Comments: The GALEX NUV flux per area was determined by assuming an extended target with an approximately 2.5" diameter and used as an input to the ETC. Our experience has show that similar low-metallicity dwarf galaxies have more compact UV morphologies.</i></p>										
	2	(1036902)	(1) J1044+6303	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=ALL; SEGMENT=BOTH; BUFFER-TIME=19 383; FLASH=YES				850 Secs (2308 Secs)	
									[==>274.0 Secs (Split 1)] [==>678.0 Secs (Split 2)] [==>678.0 Secs (Split 3)] [==>678.0 Secs (Split 4)]	[1]	
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3	(1036902)	(1) J1044+6303	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FLASH=YES; FP-POS=ALL; SEGMENT=BOTH; BUFFER-TIME=19 383				850 Secs (2870 Secs)		
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Proposal 15422 - Visit 02 - Anchoring C/O with an Extremely Metal Deficient Galaxy

Fri Apr 20 21:04:23 GMT 2018

<b>Visit</b>	<p><b>Proposal 15422, Visit 02</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Scientific Instruments: COS/FUV, COS/NUV</p> <p>Special Requirements: (none)</p> <p><i>Comments: HOPR repeat of visit 1.</i></p>																
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