



11578 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

Cycle: 17, 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) DDO68 ANY	ACS/WFC WFC3/UVIS	3	03-Jul-2008 21:21:06.0	yes
02	(1) DDO68 ANY	ACS/WFC WFC3/UVIS	3	03-Jul-2008 21:21:22.0	yes
03	(1) DDO68 ANY	ACS/WFC WFC3/UVIS	1	03-Jul-2008 21:21:29.0	yes

7 Total Orbits Used

ABSTRACT

A long standing question in astrophysics is the existence of young galaxies, in which stars are now forming for the first time, in the nearby (i.e., present-day) universe. Such galaxies would be the local analogs of primordial galaxies observed at high redshift. The most promising candidates have long been the most metal-poor systems, including dwarf irregulars (dIrrs) and blue compact dwarfs (BCDs). However, in many dIrrs and BCDs studied with HST an old (1 Gyr) underlying stellar population, as traced by red giant branch (RGB) stars, has been unambiguously detected. Even in I Zw 18, which is the most-metal poor prototype of the class and long the most controversial case, our group has recently succeeded in detecting an RGB. Nonetheless, there remains the possibility that the star formation histories of BCDs/dIrrs vary from galaxy to galaxy, and that truly young galaxies do exist in the local universe. A new test of these issues has only recently become possible with the identification of DDO 68 as an extremely metal-poor galaxy with an oxygen abundance equal to that of I Zw 18 ($12+(\text{O}/\text{H})=7.21$). This galaxy is about a factor of 2-3 closer than I Zw 18, which yields the opportunity to avoid the many ambiguities that have plagued studies of I Zw 18. Also, DDO 68 resides in a void, making it more likely that star formation has been suppressed for a very long time. We will observe DDO 68 with ACS/WFC in F606W and F814W, plus F658N (H α) to correct the broad F606W for gas contamination. We will use WFC3 in parallel with the same filters to study radial population gradients. Deep color-magnitude diagrams (CMDs) reaching the depth of one magnitude below the predicted RGB tip will be constructed and interpreted based on synthetic CMD fitting. These data will determine unambiguously whether DDO 68 has an underlying old (RGB) stellar population or is forming stars for the first time. Finding just a single nearby "young" galaxy would have profound cosmological implications.

OBSERVING DESCRIPTION

At a distance of 8.8 Mpc, corresponding to a distance modulus of $(m-M)_0 \sim 29.7$, the tip of the RGB ($M_I = -4.07$ mag at $Z = 1/50 Z_{\text{solar}}$; Bellazzini et al. 2001) in DDO 68 is expected to have a brightness of $I_{\text{TRGB}} \sim 25.7$ mag in the Johnson-Cousins photometric system. The correction to the RGB tip I-band magnitude due to the Galactic extinction is negligible (0.03 mag) and the intrinsic extinction of $E(B-V) < 0.07$, estimated with the Balmer decrement from ground-based spectra (Pustilnik et al. 2005), results in a small correction of less than 0.1 mag to the RGB tip brightness. We want to detect stars at least one magnitude fainter than the RGB tip with a photometric error < 0.1 mag ($S/N > 10$) in both F606W and F814W. This is a conservative request in order to clearly detect or rule out the presence of RGB stars. If an RGB tip is detected, this also gives an estimate of the distance modulus with an uncertainty < 0.05 mag. Driven by these requirements, and based on the ACS ETC, we arrived at the

broad-band exposures adopted in this Phase II proposal. This corresponds to 3 orbits in F814W and 3 orbits in F606W. The exposures for each filter will be executed in a separate visit. The 9 exposures in each broad-band filter (3 per orbit) will be executed with a dithering pattern with both integer and fractional pixel offsets in order to cover the chip gap, get rid of cosmic rays, remove hot/bad pixels, and improve the PSF sampling.

To obtain an H α image we will observe for 1 orbit (3 exposures) in F658N. The small systemic velocity of DDO 68 (504 km/s) places the H α emission line well inside the highest sensitivity region of the filter's response curve. The NII (6584 Å) emission line will also be inside the F658N band, but its flux is practically negligible compared to H α as DDO 68 is a very metal-poor dwarf galaxy. For the H α observations we will use a dither line pattern defined through POSTARs to cover the chip gap.

Coordinated parallel WFC3/UVIS observations will also be taken in the F606W and F814W filters. These observations will allow us to characterize the stellar populations in the outskirts of DDO 68 to slightly lower depth than the ACS/WFC observations.

The core of DDO 68 covers an area of ~ 103 arcsec \times 38 arcsec. We request a specific telescope orientation so as to have the elongated part of the target parallel to the gap between the two WFC detectors. By placing DDO 68 on the ACS/WFC1 detector rather than ACS/WFC2, we move our parallel WFC3/UVIS observations closer to the core of the galaxy, increasing the likelihood of finding significant numbers of stars in the outskirts of DDO 68.

We require that all 7 orbits are taken within 2 weeks of each other. Carbon stars are an important component of color-magnitude diagrams, and many of these stars are long-period variables. Having all observations made within a two week window will reduce the effect of the long-term variability of the carbon stars on their inferred positions in the color-magnitude diagrams.

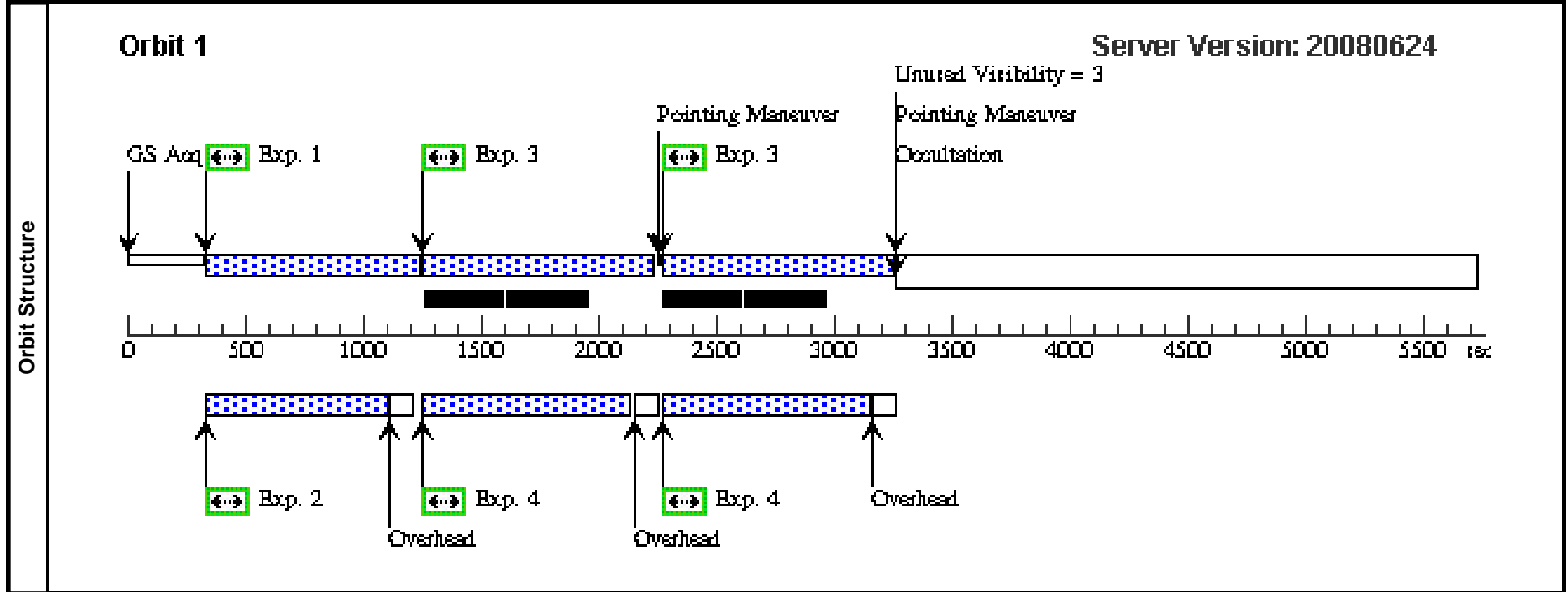
Proposal 11578 - Visit 01 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

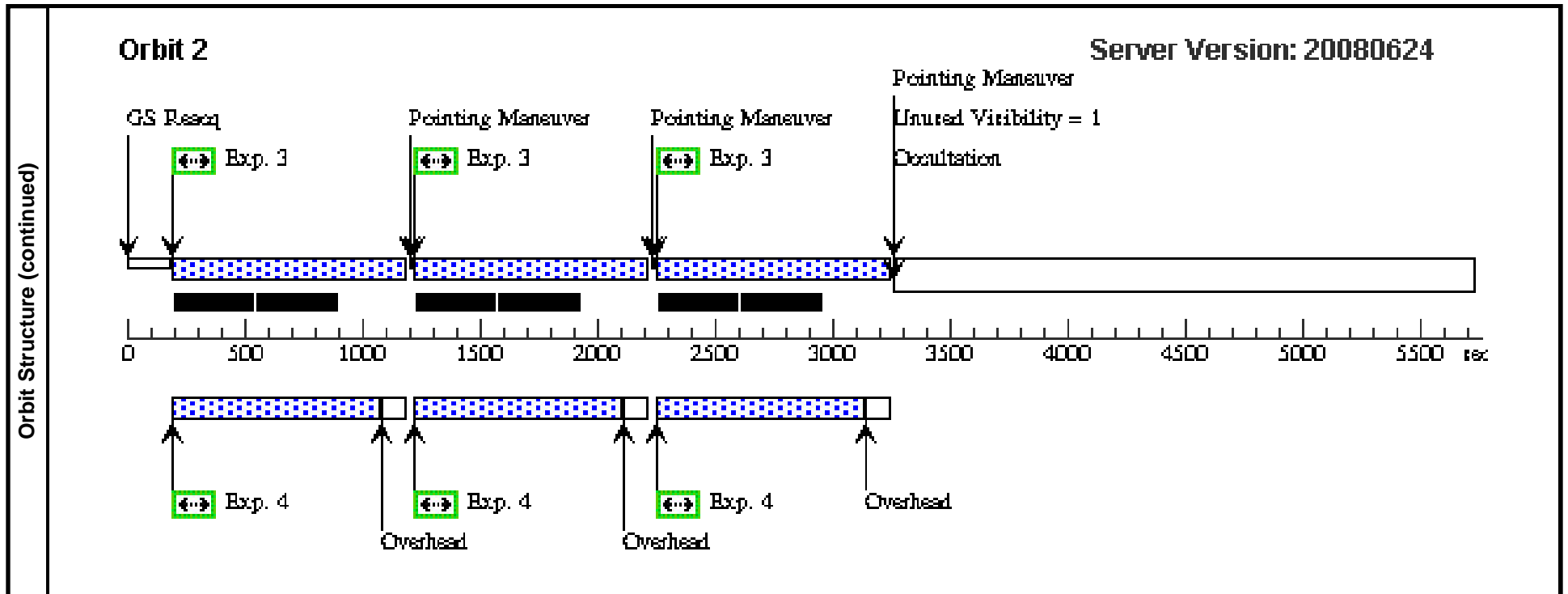
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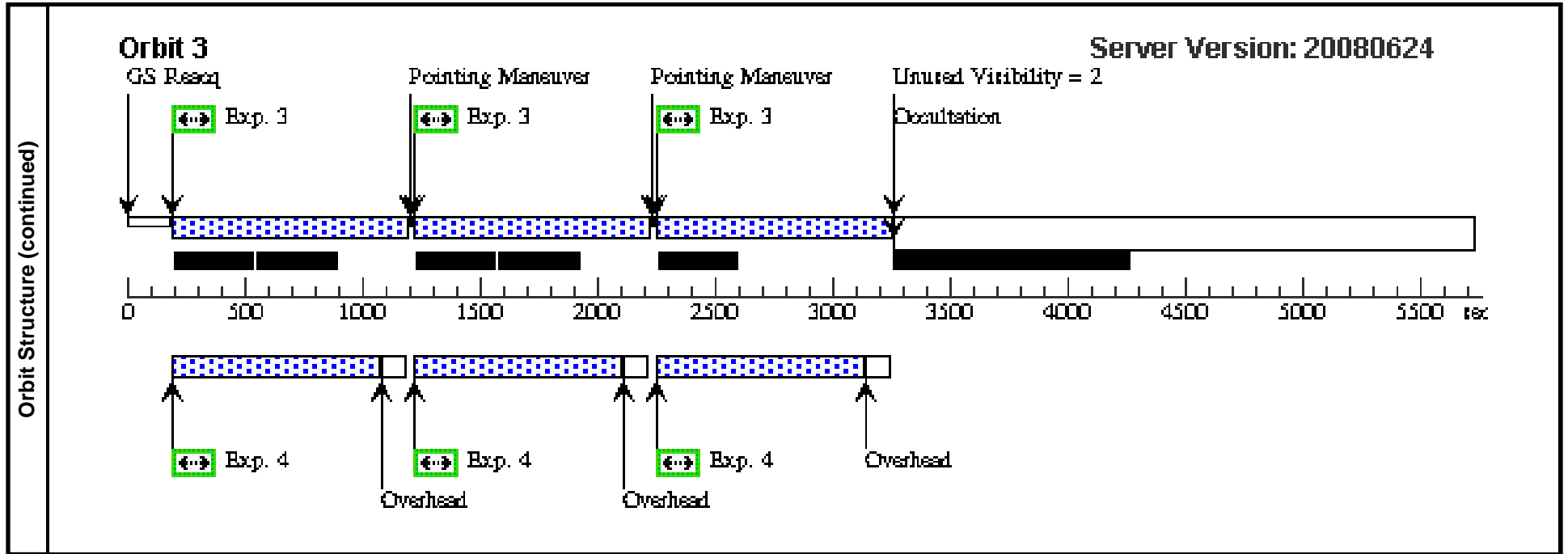
Visit	Proposal 11578, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC, WFC3/UVIS Special Requirements: ORIENT 95D TO 105 D									
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures	
		(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=OTHER Number Of Points=2 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false	(3-4)			
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	DDO68	RA: 09 56 46.2831 (149.1928462d) Dec: +28 49 15.26 (28.82091d) Equinox: J2000		V=14.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) DDO68	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0,0	Prime + Parallel Group 1-2	680 Secs [=>705.0 Secs]	[1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	CR-SPLIT=NO		Prime + Parallel Group 1-2	740 Secs [=>740.0 Secs]	[1]
	3		(1) DDO68	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0,0	Pattern 3-4 (1)	830 Secs	
								Prime + Parallel Group 3-4	[=>855.0 Secs (Pattern 1,1)] [=>855.0 Secs (Pattern 1,2)]	[1]
									[=>871.0 Secs (Pattern 1,3)] [=>871.0 Secs (Pattern 1,4)] [=>871.0 Secs (Pattern 2,1)]	[2]
									[=>872.0 Secs (Pattern 2,2)] [=>872.0 Secs (Pattern 2,3)] [=>872.0 Secs (Pattern 2,4)]	[3]

Proposal 11578 - Visit 01 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	4	ANY	WFC3/UVIS, ACCUM, UVIS	F814W	CR-SPLIT=NO		Pattern 3-4 (1)	880 Secs	
							Prime + Parallel Group 3-4	[==>880.0 Secs (Pattern 1,1)]	[1]
								[==>880.0 Secs (Pattern 1,2)]	
								[==>880.0 Secs (Pattern 1,3)]	
								[==>880.0 Secs (Pattern 1,4)]	[2]
								[==>880.0 Secs (Pattern 2,1)]	
								[==>880.0 Secs (Pattern 2,2)]	
	[==>880.0 Secs (Pattern 2,3)]								
	[==>880.0 Secs (Pattern 2,4)]	[3]							







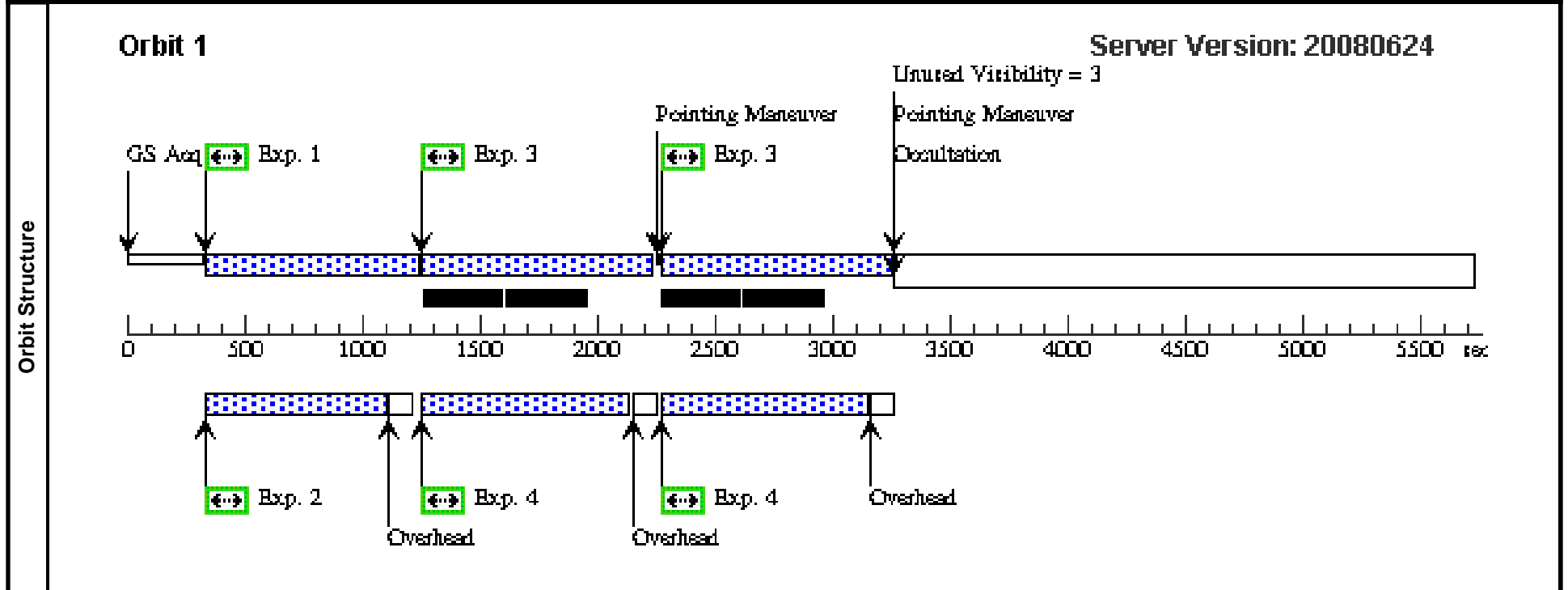
Proposal 11578 - Visit 02 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

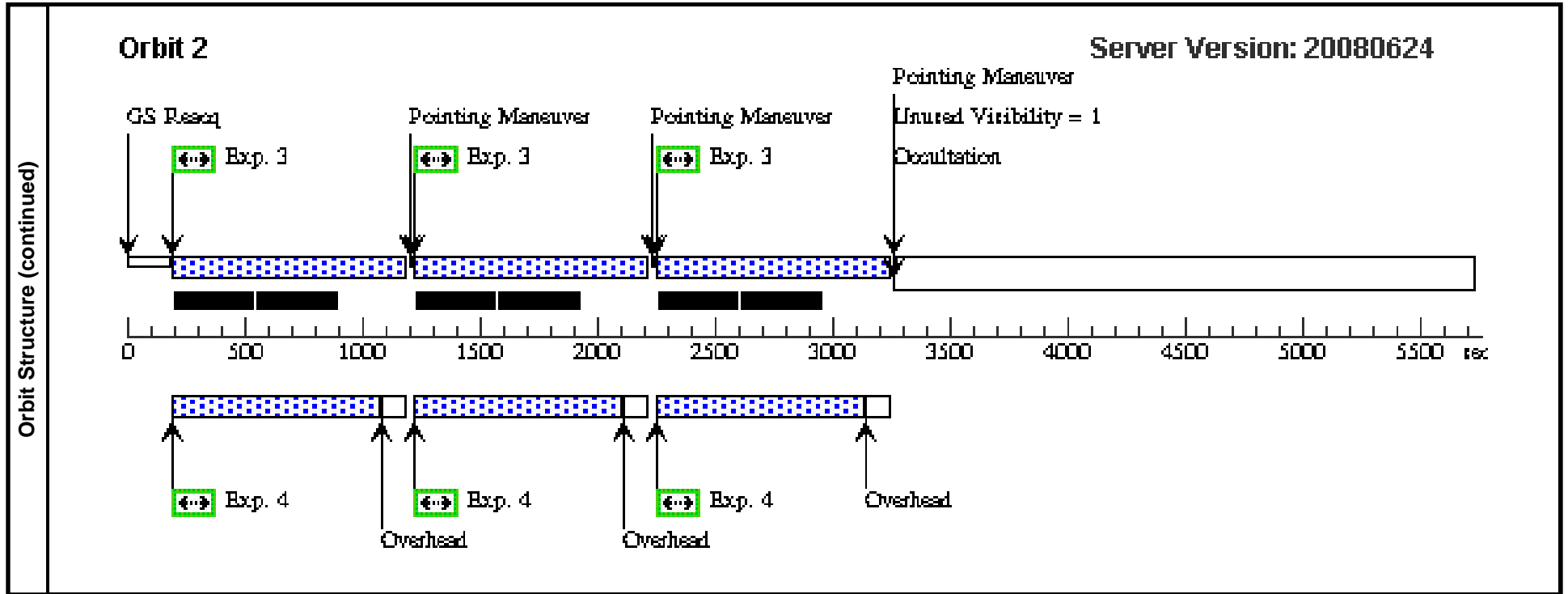
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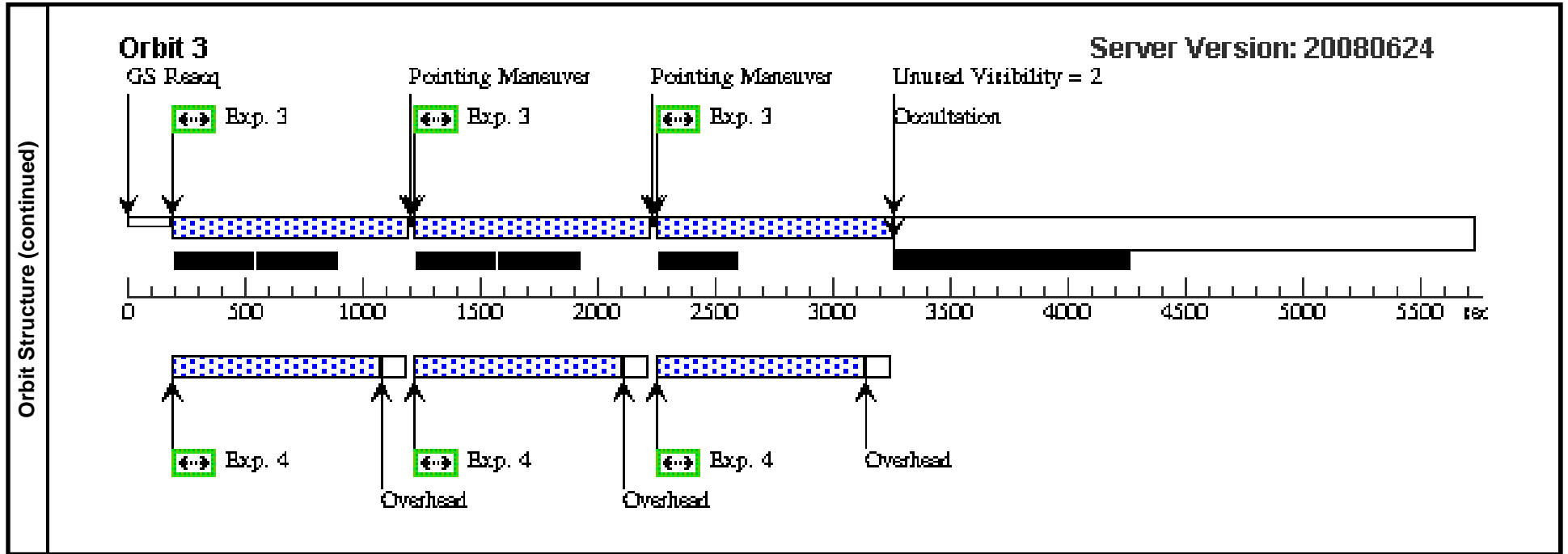
Visit	Proposal 11578, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC, WFC3/UVIS Special Requirements: SAME ORIENT AS 01; AFTER 01 BY 0 D TO 14 D										
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures		
		(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=OTHER Number Of Points=2 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false	(3-4)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes	Miscellaneous				
	(1)	DDO68	RA: 09 56 46.2831 (149.1928462d) Dec: +28 49 15.26 (28.82091d) Equinox: J2000			V=14.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]		Orbit
	1		(1) DDO68	ACS/WFC, ACCUM, WFC1	F606W		POS TARG 0,0	Prime + Parallel Group 1-2	680 Secs		
									[==>705.0 Secs]		[1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W	CR-SPLIT=NO		Prime + Parallel Group 1-2	740 Secs		
									[==>740.0 Secs]		[1]
	3		(1) DDO68	ACS/WFC, ACCUM, WFC1	F606W		POS TARG 0,0	Pattern 3-4 (1)	830 Secs		
								Prime + Parallel Group 3-4	[==>855.0 Secs (Pattern 1,1)]		[1]
								[==>855.0 Secs (Pattern 1,2)]			
								[==>871.0 Secs (Pattern 1,3)]			
								[==>871.0 Secs (Pattern 1,4)]		[2]	
								[==>871.0 Secs (Pattern 2,1)]			
								[==>872.0 Secs (Pattern 2,2)]			
								[==>872.0 Secs (Pattern 2,3)]		[3]	
								[==>872.0 Secs (Pattern 2,4)]			

Proposal 11578 - Visit 02 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	4	ANY	WFC3/UVIS, ACCUM, UVIS	F606W	CR-SPLIT=NO		Pattern 3-4 (1) Prime + Parallel Group 3-4	880 Secs	
								[==>880.0 Secs (Pattern 1,1)]	[1]
								[==>880.0 Secs (Pattern 1,2)]	
								[==>880.0 Secs (Pattern 1,3)]	
								[==>880.0 Secs (Pattern 1,4)]	[2]
								[==>880.0 Secs (Pattern 2,1)]	
[==>880.0 Secs (Pattern 2,2)]									
[==>880.0 Secs (Pattern 2,3)]									
[==>880.0 Secs (Pattern 2,4)]	[3]								







Proposal 11578 - Visit 03 - The Extremely Metal-Poor BCD Galaxy DDO 68: a Young Galaxy in the Local Universe ?

Fri Jul 04 01:21:35 GMT 2008

Visit	Proposal 11578, Visit 03 Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC, WFC3/UVIS Special Requirements: SAME ORIENT AS 01; AFTER 01 BY 0 D TO 14 D									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	DDO68	RA: 09 56 46.2831 (149.1928462d) Dec: +28 49 15.26 (28.82091d) Equinox: J2000		V=14.5	Reference Frame: ICRS				

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
		1		(1) DDO68	ACS/WFC, ACCUM, WFC1	F658N		POS TARG -0.25,-3.0	Prime + Parallel Group 1-2	770 Secs [=>776.0 Secs]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W	CR-SPLIT=NO		Prime + Parallel Group 1-2	820 Secs [=>820.0 Secs]	[1]
	3		(1) DDO68	ACS/WFC, ACCUM, WFC1	F658N			Prime + Parallel Group 3-4	800 Secs [=>806.0 Secs]	[1]
	4		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	CR-SPLIT=NO		Prime + Parallel Group 3-4	800 Secs [=>810.0 Secs]	[1]
	5		(1) DDO68	ACS/WFC, ACCUM, WFC1	F658N		POS TARG 0.25,3	Prime + Parallel Group 5-6	800 Secs [=>806.0 Secs]	[1]
	6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W	CR-SPLIT=NO		Prime + Parallel Group 5-6	800 Secs [=>800.0 Secs]	[1]

