



12867 - The Wind of Massive Stars in Low-Metallicity Galaxies

Cycle: 20, 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) IC1613-A13	COS/FUV	2	19-Nov-2012 21:01:14.0	yes
02	(1) IC1613-A13	COS/FUV	4	19-Nov-2012 21:01:26.0	yes
03	(2) IC1613-B11	COS/FUV	2	19-Nov-2012 21:01:36.0	yes
04	(2) IC1613-B11	COS/FUV	4	19-Nov-2012 21:01:45.0	yes
05	(3) WLM-A11	COS/FUV	2	19-Nov-2012 21:01:54.0	yes
06	(3) WLM-A11	COS/FUV	4	19-Nov-2012 21:02:04.0	yes

18 Total Orbits Used

ABSTRACT

The ultimate fate of massive stars rests on the mass and angular momentum that they lose during their evolution, hence depends on the properties of their winds. Because of the radiation-driven nature of these winds, we expect the mass loss rates to scale with stellar metallicity. Such a relation has

been established theoretically and empirically with spectroscopic analyses of O stars in the Galaxy ($Z/Z_{\text{sun}}=1$) and in the LMC and SMC ($Z/Z_{\text{sun}} = 1/2$ and $1/5$).

Tramper et al. (2011) derived mass loss rates of 6 O stars in galaxies with low metallicities ($Z/Z_{\text{sun}} \sim 1/7$). Based on the H α line, they derived mass loss rates that are similar to those of LMC stars. This result, if upheld, would have far-reaching consequences beyond our understanding of radiatively-driven winds, and would imply for instance a lower number of collapsars and of SN Ib and Ic in low metallicity environments, hence in the high- z Universe.

We propose to corroborate or refute Tramper et al.'s result by obtaining FUV spectra of 3 O stars in the IC 1613 and WLM galaxies with HST/COS. Because of numerous iron lines and lines sensitive to wind properties, FUV spectroscopy is the adequate tool to fully address and resolve this outstanding issue of the dependence of hot, massive star mass loss rates with metallicity. A comparison of these spectra with extant STIS or COS spectra of LMC and SMC stars will provide a direct, model-independent check of the mass loss - metallicity relation. A quantitative analysis will be carried out using our state-of-the-art NLTE unified model atmospheres calculated with the CMFGEN code to establish robustly the wind properties of low-metallicity massive stars.

OBSERVING DESCRIPTION

We propose to obtain high-resolution ($R=20,000$) COS FUV spectra of the 3 brightest stars from Tramper et al. (2011) study. These stars, namely A13 and B11 in IC 1613 and A11 in WLM, have magnitudes $V = 19.02, 18.68, 18.40$, respectively (Bresolin et al. 2006, 2007). We request to observe each target in a sequence of 6 science exposures with COS, using gratings G130M (1291, 1327) and G160M (1577, 1589, 1611, 1623). This sequence provides coverage without gap of the FUV spectrum between 1132 and 1798 Å. Overlapping segments will be co-added to enhance the final SNR. Thanks to the high efficiency of COS in the FUV and little extinction toward the host galaxies ($E(B-V) = 0.025$ and 0.08 , for IC 1613 and WLM, respectively), we can achieve a sufficient SNR in 6 HST orbits for each target (2 orbits for G130M and 4 orbits for G160M, hence each orbit is dedicated to one grating position). As individual visits should not exceed 5 orbits, we propose two visits to each target (one visit of 2 orbits for the G130M observations with two different FP-SPLIT, and one visit of 4 orbits for the G160M exposures with different FP-SPLIT). Using COS Exposure Time Calculator, assuming Kurucz models for early, or late-O stars, normalized to V and corrected for extinction, we obtain a SNR of about 15 per resolution element for the final spectra (after co-addition of all exposures recorded with each grating).

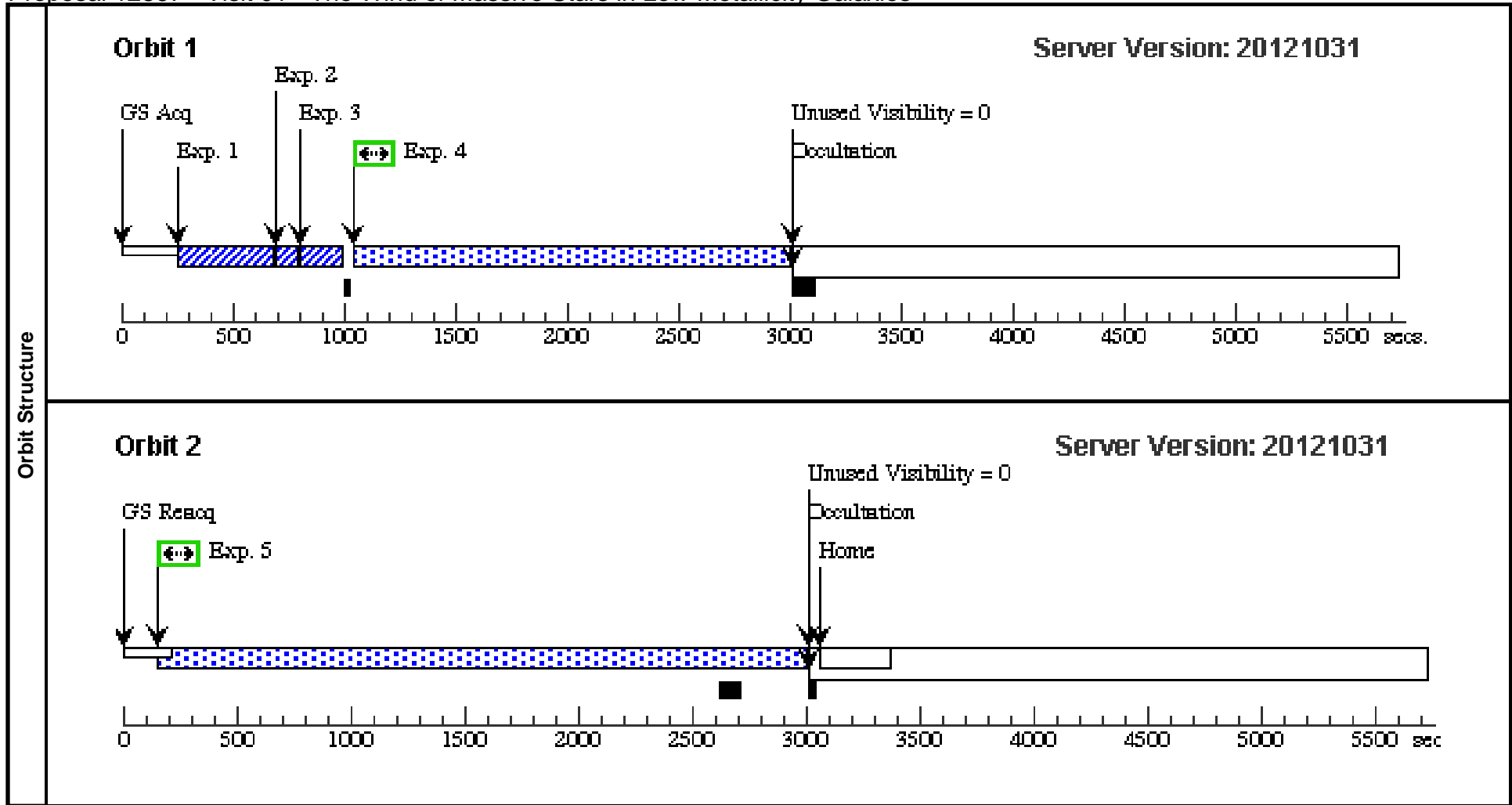
The global count rate on the detector ranges is always less than 500 ct/s with G130M and less than 200 ct/s with G160M. Count rates for the brightest

pixel ranges never exceed 0.1 ct/s for G130M and is always less than 0.01 ct/s for G160M. None of the targets is known or expected to exhibit significant photometric variability. COS exposures are therefore safe in the TTAG mode. Finally, we run the BOT tool for all targets and inspect the stellar fields with Aladin. There are no bright stars at proximity of our targets that may be a safety concern for COS.

Proposal 12867 - Visit 01 - The Wind of Massive Stars in Low-Metallicity Galaxies

Tue Nov 20 02:02:12 GMT 2012

Visit	Proposal 12867, Visit 01, implementation Diagnostic Status: Warning Scientific Instruments: COS/FUV Special Requirements: SCHED 100% <i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 & 5) would benefit of using any possible additional time.</i>									
	(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	IC1613-A13	RA: 01 05 6.2500 (16.2760417d) Dec: +02 10 43.00 (2.17861d) Equinox: J2000		V=19.02 E(B-V)=0.025, Teff=47500K	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.sa.415 001)	(1) IC1613-A13	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=3; CENTER=FLUX-W T-FLR			7 Secs [==>]	[1]
	2	(COS.sa.415 002)	(1) IC1613-A13	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				7 Secs [==>]	[1]
	3	(COS.sa.415 001)	(1) IC1613-A13	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	STEP-SIZE=0.9; CENTER=FLUX-W T-FLR; NUM-POS=5			7 Secs [==>]	[1]
	4	(COS.sp.415 003)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=19 11; EXTENDED=NO; FLASH=YES; FP-POS=3			1911 Secs [==>]	[1]
	5	(COS.sp.414 998)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=23 71; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[2]



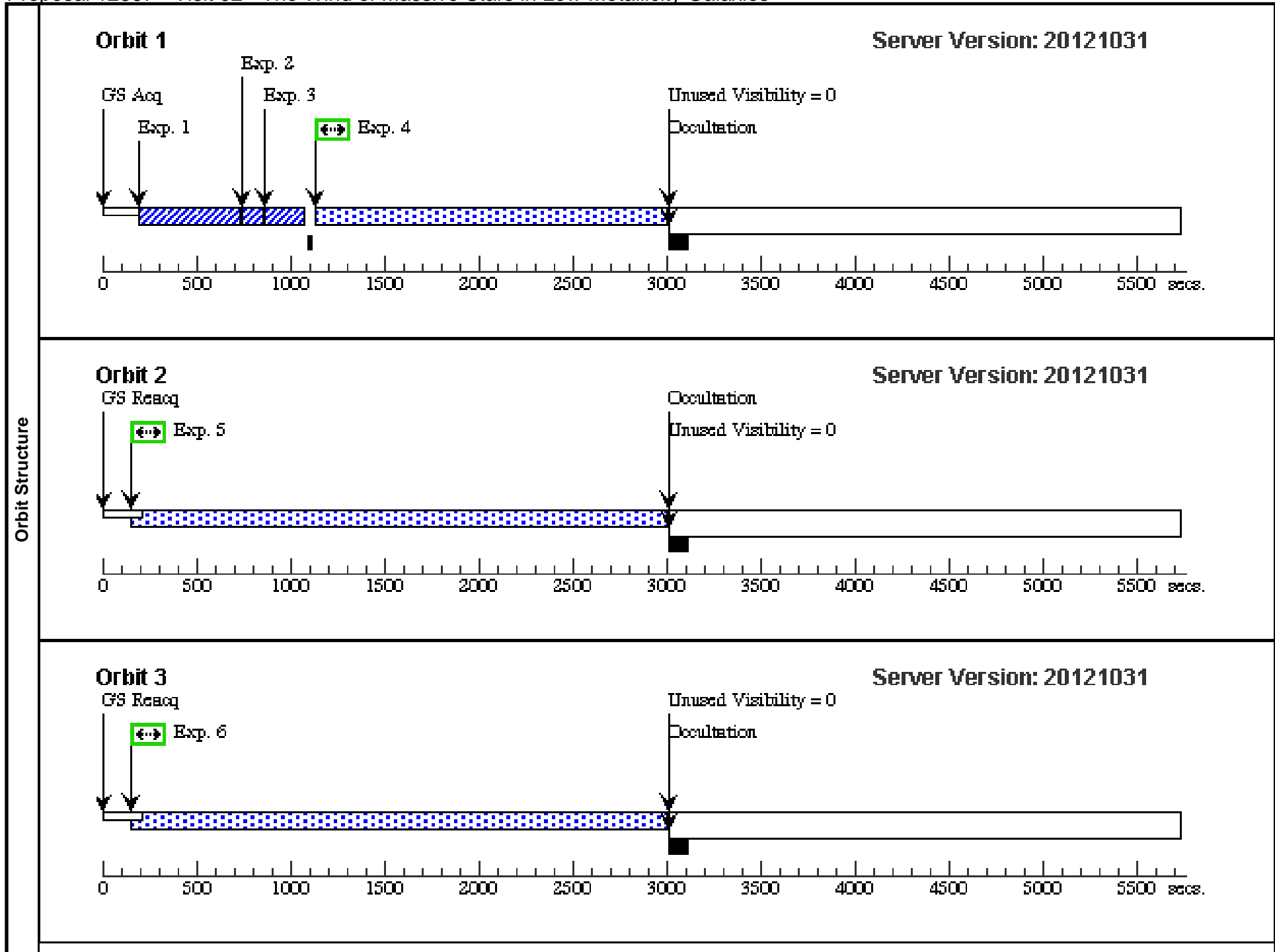
Proposal 12867 - Visit 02 - The Wind of Massive Stars in Low-Metallicity Galaxies

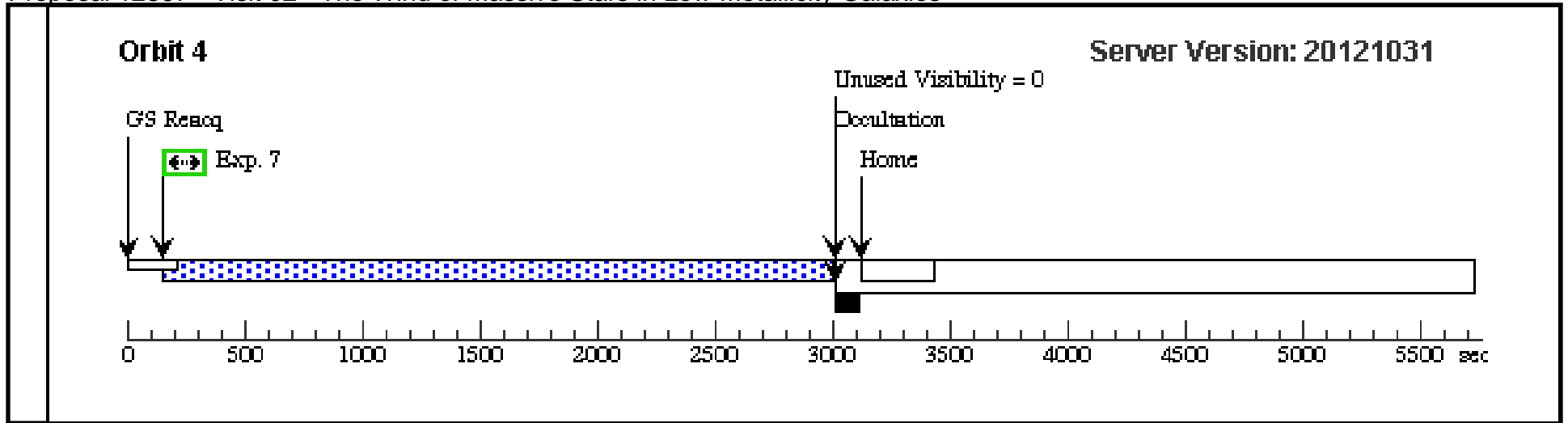
Tue Nov 20 02:02:17 GMT 2012

Visit	<p>Proposal 12867, Visit 02, implementation</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV</p> <p>Special Requirements: SCHED 100%; AFTER 01 BY 0 D TO 21 D</p> <p><i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 to 7) would benefit of using any possible additional time.</i></p>																		
Diagnostics	<p>(Visit 02) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.</p>																		
Fixed Targets	<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>IC1613-A13</td> <td>RA: 01 05 6.2500 (16.2760417d) Dec: +02 10 43.00 (2.17861d) Equinox: J2000</td> <td></td> <td>V=19.02 E(B-V)=0.025, Teff=47500K</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td colspan="6"><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	IC1613-A13	RA: 01 05 6.2500 (16.2760417d) Dec: +02 10 43.00 (2.17861d) Equinox: J2000		V=19.02 E(B-V)=0.025, Teff=47500K	Reference Frame: ICRS	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
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Proposal 12867 - Visit 02 - The Wind of Massive Stars in Low-Metallicity Galaxies

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.sa.415 005)	(1) IC1613-A13	COS/FUV, ACQ/SEARCH, PSA	G160M 1577 A	SCAN-SIZE=3; CENTER=FLUX-W T-FLR			13 Secs [==>]	[1]
	2	(COS.sa.415 006)	(1) IC1613-A13	COS/FUV, ACQ/PEAKXD, PSA	G160M 1577 A				24 Secs [==>]	[1]
	3	(COS.sa.415 007)	(1) IC1613-A13	COS/FUV, ACQ/PEAKD, PSA	G160M 1577 A	CENTER=FLUX-W T-FLR; NUM-POS=5; STEP-SIZE=0.9			13 Secs [==>]	[1]
	4	(COS.sp.415 088)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=18 18; EXTENDED=NO; FLASH=YES; FP-POS=3			1818 Secs [==>]	[1]
	5	(COS.sp.415 046)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G160M 1589 A	EXTENDED=NO; FLASH=YES; FP-POS=3; BUFFER-TIME=27 29			2729 Secs [==>]	[2]
	6	(COS.sp.415 047)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G160M 1611 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[3]
7	(COS.sp.415 048)	(1) IC1613-A13	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[4]	

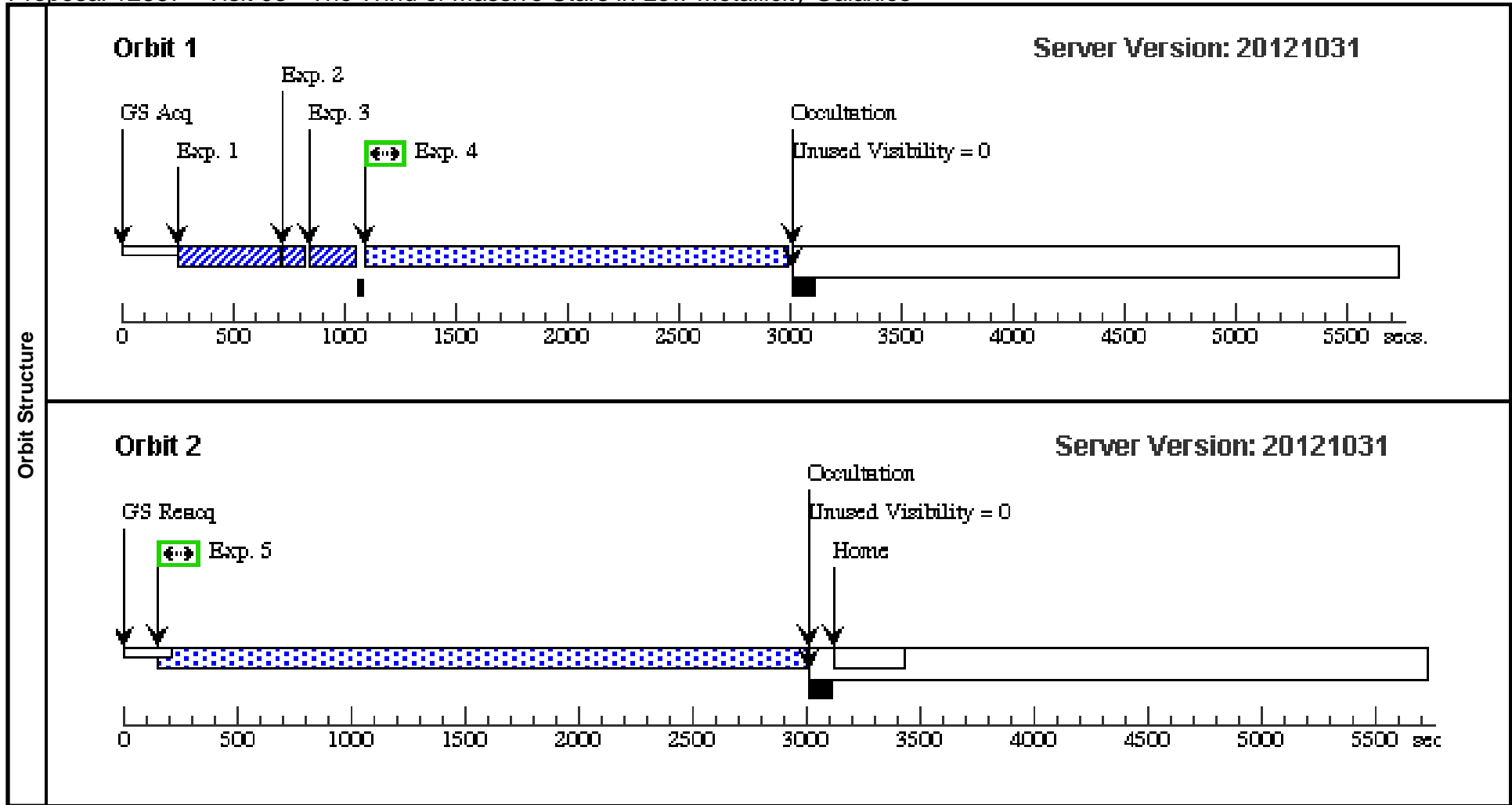




Proposal 12867 - Visit 03 - The Wind of Massive Stars in Low-Metallicity Galaxies

Tue Nov 20 02:02:20 GMT 2012

Visit	Proposal 12867, Visit 03, implementation Diagnostic Status: Warning Scientific Instruments: COS/FUV Special Requirements: SCHED 100% <i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 & 5) would benefit of using any possible additional time.</i>									
	(Visit 03) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2) IC1613-B11 RA: 01 04 43.8000 (16.1825000d) Dec: +02 06 44.75 (2.11243d) Equinox: J2000 Teff=31300K <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.sa.415 054)	(2) IC1613-B11	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=3; CENTER=FLUX-W T-FLR			11 Secs [==>]	[1]
	2	(COS.sa.415 055)	(2) IC1613-B11	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				10 Secs [==>]	[1]
	3	(COS.sa.415 054)	(2) IC1613-B11	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	STEP-SIZE=0.9; CENTER=FLUX-W T-FLR; NUM-POS=5			11 Secs [==>]	[1]
	4	(COS.sp.415 056)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=18 52; EXTENDED=NO; FLASH=YES; FP-POS=3			1852 Secs [==>]	[1]
	5	(COS.sp.415 057)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[2]



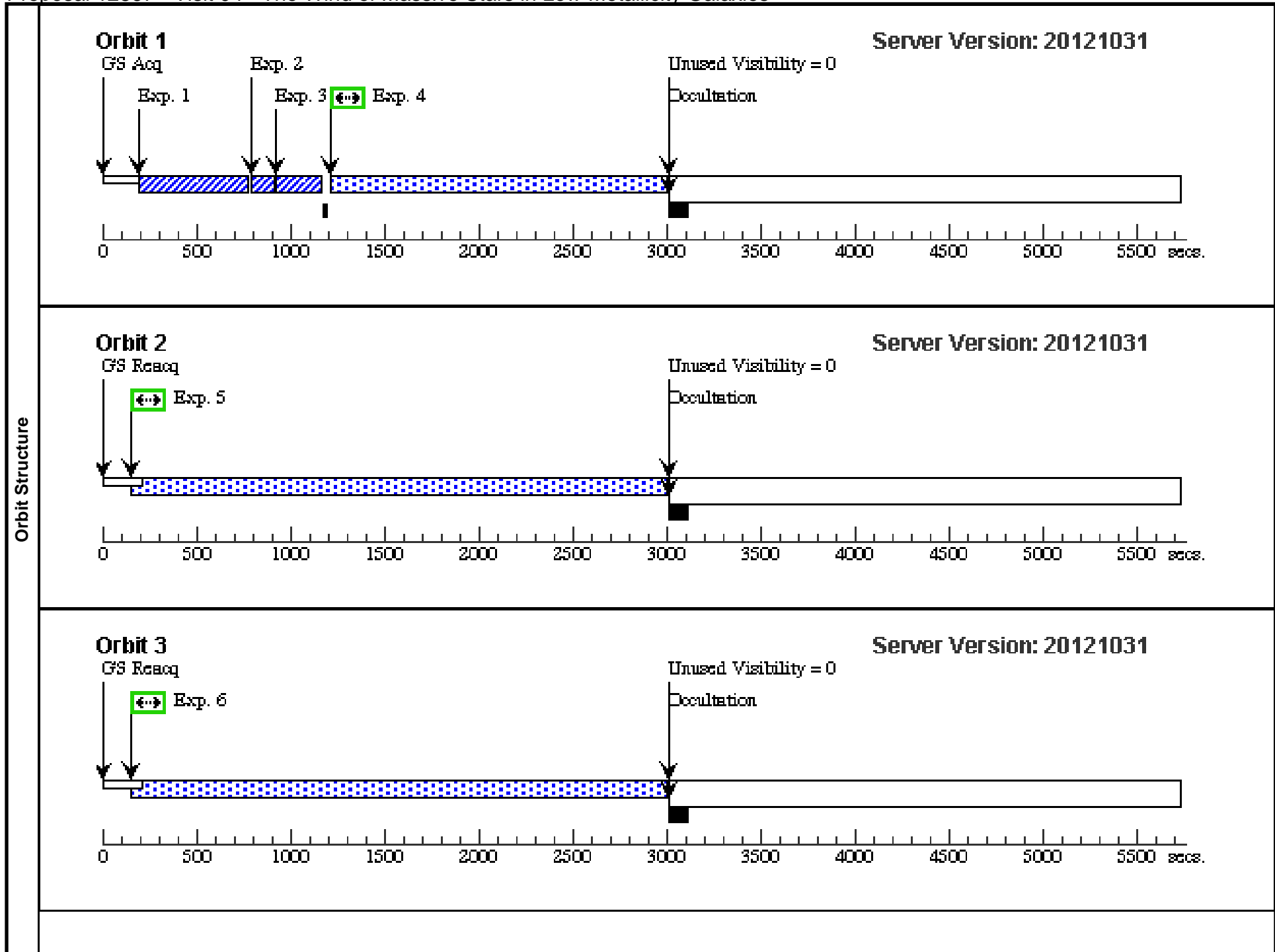
Proposal 12867 - Visit 04 - The Wind of Massive Stars in Low-Metallicity Galaxies

Tue Nov 20 02:02:22 GMT 2012

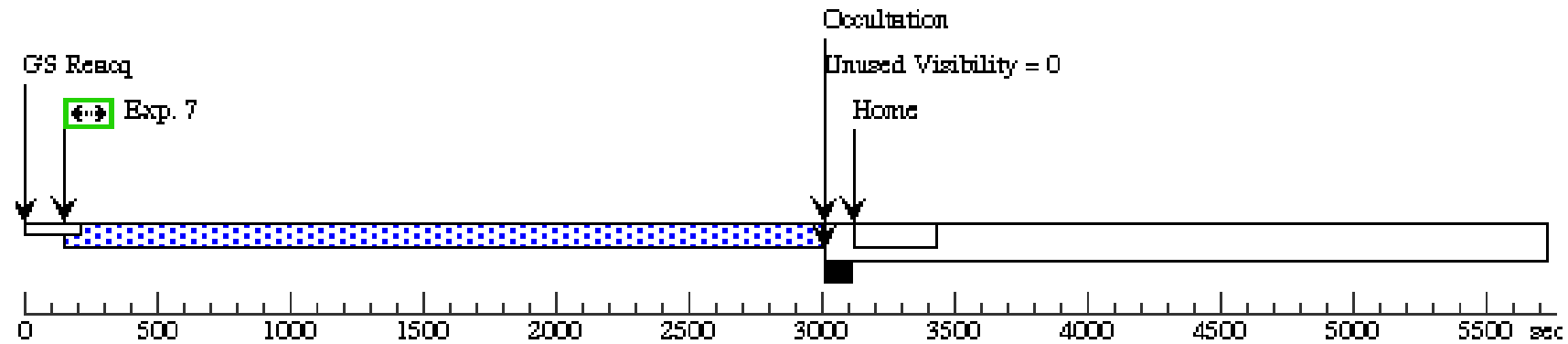
Visit	<p>Proposal 12867, Visit 04, implementation</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV</p> <p>Special Requirements: SCHED 100%; AFTER 03 BY 0 D TO 21 D</p> <p><i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 to 7) would benefit of using any possible additional time.</i></p>																		
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Proposal 12867 - Visit 04 - The Wind of Massive Stars in Low-Metallicity Galaxies

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.sa.415 082)	(2) IC1613-B11	COS/FUV, ACQ/SEARCH, PSA	G160M 1577 A	SCAN-SIZE=3; CENTER=FLUX-W T-FLR			18 Secs [==>]	[1]
	2	(COS.sa.415 084)	(2) IC1613-B11	COS/FUV, ACQ/PEAKXD, PSA	G160M 1577 A				32 Secs [==>]	[1]
	3	(COS.sa.415 082)	(2) IC1613-B11	COS/FUV, ACQ/PEAKD, PSA	G160M 1577 A	CENTER=FLUX-W T-FLR; NUM-POS=5; STEP-SIZE=0.9			18 Secs [==>]	[1]
	4	(COS.sp.415 090)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=17 40; EXTENDED=NO; FLASH=YES; FP-POS=3			1740 Secs [==>]	[1]
	5	(COS.sp.415 092)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G160M 1589 A	EXTENDED=NO; FLASH=YES; FP-POS=3; BUFFER-TIME=27 29			2729 Secs [==>]	[2]
	6	(COS.sp.415 094)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G160M 1611 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[3]
7	(COS.sp.415 096)	(2) IC1613-B11	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[4]	



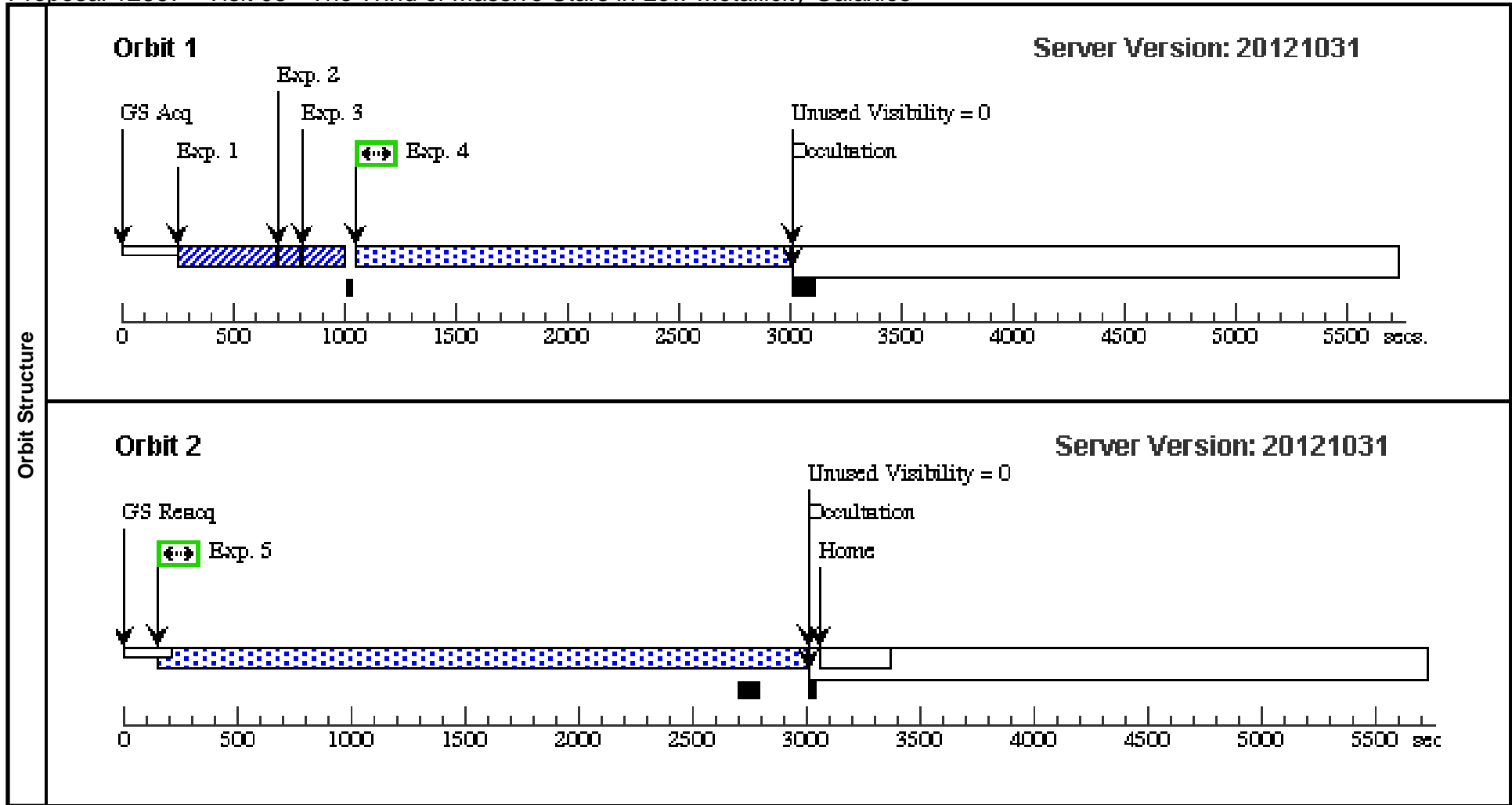
Orbit 4



Proposal 12867 - Visit 05 - The Wind of Massive Stars in Low-Metallicity Galaxies

Tue Nov 20 02:02:26 GMT 2012

Visit	Proposal 12867, Visit 05, scheduling Diagnostic Status: Warning Scientific Instruments: COS/FUV Special Requirements: SCHED 100% <i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 & 5) would benefit of using any possible additional time.</i>																																																																				
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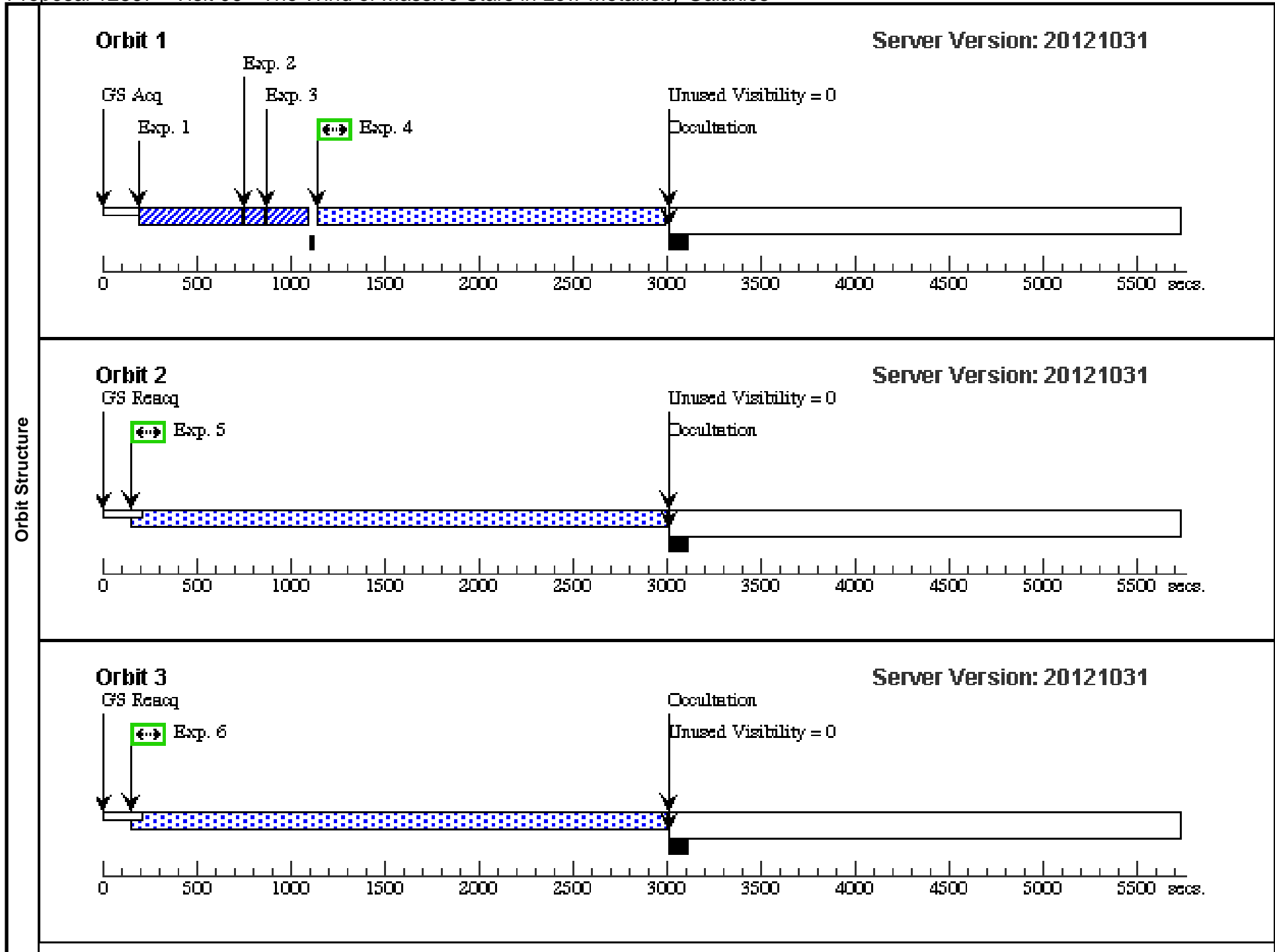
Proposal 12867 - Visit 06 - The Wind of Massive Stars in Low-Metallicity Galaxies

Tue Nov 20 02:02:27 GMT 2012

Visit	<p>Proposal 12867, Visit 06, scheduling</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV</p> <p>Special Requirements: SCHED 100%</p> <p><i>Comments: As required by APT, the visit has been set up with schedulability 100%. If the orbits when the visit is actually scheduled have a longer visibility, the stellar spectrum exposures (exp. 4 to 7) would benefit of using any possible additional time.</i></p>																		
Diagnostics	<p>(Visit 06) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.</p>																		
Fixed Targets	<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>(3)</td> <td>WLM-A11</td> <td>RA: 00 01 59.9700 (.4998750d) Dec: -15 28 19.20 (-15.47200d) Equinox: J2000</td> <td></td> <td>V=18.38 E(B-V)=0.08, Teff=30000K</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td colspan="6"><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(3)	WLM-A11	RA: 00 01 59.9700 (.4998750d) Dec: -15 28 19.20 (-15.47200d) Equinox: J2000		V=18.38 E(B-V)=0.08, Teff=30000K	Reference Frame: ICRS	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
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Proposal 12867 - Visit 06 - The Wind of Massive Stars in Low-Metallicity Galaxies

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.sa.415 121)	(3) WLM-A11	COS/FUV, ACQ/SEARCH, PSA	G160M 1577 A	SCAN-SIZE=3; CENTER=FLUX-W T-FLR			14 Secs [==>]	[1]
	2	(COS.sa.415 122)	(3) WLM-A11	COS/FUV, ACQ/PEAKXD, PSA	G160M 1577 A				23 Secs [==>]	[1]
	3	(COS.sa.415 121)	(3) WLM-A11	COS/FUV, ACQ/PEAKD, PSA	G160M 1577 A	CENTER=FLUX-W T-FLR; NUM-POS=5; STEP-SIZE=0.9			14 Secs [==>]	[1]
	4	(COS.sp.415 123)	(3) WLM-A11	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=18 05; EXTENDED=NO; FLASH=YES; FP-POS=3			1805 Secs [==>]	[1]
	5	(COS.sp.415 124)	(3) WLM-A11	COS/FUV, TIME-TAG, PSA	G160M 1589 A	EXTENDED=NO; FLASH=YES; FP-POS=3; BUFFER-TIME=27 29			2729 Secs [==>]	[2]
	6	(COS.sp.415 125)	(3) WLM-A11	COS/FUV, TIME-TAG, PSA	G160M 1611 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[3]
	7	(COS.sp.415 126)	(3) WLM-A11	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=27 29; EXTENDED=NO; FLASH=YES; FP-POS=3			2729 Secs [==>]	[4]



Orbit Structure

Orbit 4

