



## 12230 - The effect of radiation forcing on an exoplanet atmosphere

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
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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) WASP-12 (2) HD-258439	WFC3/IR	7	10-Jul-2010 01:13:07.0	yes
02	(1) WASP-12 (2) HD-258439	WFC3/IR	7	10-Jul-2010 01:28:12.0	yes
03	(1) WASP-12 (2) HD-258439	WFC3/IR	4	10-Jul-2010 01:37:55.0	yes

18 Total Orbits Used

### ABSTRACT

We propose to determine the effects of radiation forcing by the stellar primary on the atmosphere of the hot-Jupiter exoplanet WASP-12b using WFC3 near-IR spectroscopy. We will accomplish this by obtaining a completely unique data set consisting of the emission spectra sequence from the dayside, terminator, and nightside regions of the exoplanet's atmosphere. In addition we will obtain the terminator region transmission spectrum; the combination of emission and transmission spectra will be used to help resolve the temperature/composition ambiguity present in interpreting

emission spectra. The wavelength range we have selected, 1.1 to 1.7 microns, includes features from H<sub>2</sub>O, CH<sub>4</sub>, and CO<sub>2</sub> – all of which have been detected in this wavelength range in the hot-Jupiter XO-1b with Hubble. The molecules H<sub>2</sub>O, CH<sub>4</sub>, and CO<sub>2</sub> have been detected in three hot-Jupiter exoplanets to date; we expect to use these molecules as probes of the temperature and composition of the atmosphere of WASP-12b in the dayside, terminator, and nightside regions and thus determine the role of powerful radiation forcing on this exoplanet.

## **OBSERVING DESCRIPTION**

Visits = 3

The visits have an individual science objective and a combined one.

- (1) For the combined science objective, we include the observation of a calibrator source (HD 258439) at the end of each exoplanet host system observation (WASP-12). The science and calibrator observations should be executed as a continuous series of either 7 or 4 orbits in total. The objective is to obtain the best possible spectro-photometric calibration of the exoplanet host system in respect to the calibrator source which will enable a completely unique "following around the orbit" of an exoplanet and thus deriving the longitudinal spectroscopic changes of the atmosphere.
- (2) for the individual science case, the exoplanet host system is followed continuously over 5 or 2 orbits at different orbital phases in three visits. The visits are scheduled such that the third orbit is covering the secondary or primary eclipse event for the visits consisting in total of 7 orbits (5 on the exoplanet system). The visit covering 4 orbits is scheduled such that the 2 exoplanet orbits cover the epoch in between transit and secondary eclipse.

The observations always start with the exoplanet orbits and in the first orbit, a direct image is taken to establish wavelength calibration for the later G141 GRISM observations with WFC3. All remaining time on the exoplanet host system is filled with 7.6 s exposures using the G141 grism on NICMOS (SPARS10 sequence; NSAMPLE = 2). The immediately following orbits on the calibrator start also with a direct image followed by the same fast sequence of spectra taking (over two orbits) with G141.

To optimize the ability to decorrelate the observed flux for instrument changes, all observations need to be conducted at the same role angle.

Additionally, there should be no role angle moves during a visit (also not in the repointing to the calibrator source). Visits = 3

The visits have an individual science objective and a combined one.

- (1) For the combined science objective, we include the observation of a calibrator source (HD 258439) at the end of each exoplanet host system observation (WASP-12). The science and calibrator observations should be executed as a continuous series of either 7 or 4 orbits in total. The objective is to obtain the best possible spectro-photometric calibration of the exoplanet host system in respect to the calibrator source which will

enable the extraction of the nightside and terminator region exoplanet emission spectrum.

(2) for the individual science case, the exoplanet host system is followed continuously over 5 or 2 orbits at different orbital phases in three visits. The visits are scheduled such that the third orbit is covering the secondary or primary eclipse event for the visits consisting in total of 7 orbits (5 on the exoplanet system). The visit covering 4 orbits is scheduled such that the 2 exoplanet orbits cover the 90/270 degree orbital phase angle position (epoch in between transit and secondary eclipse).

The observations always start with the exoplanet orbits and in the first orbit, a direct image is taken to establish wavelength calibration for the later G141 GRISM observations with WFC3. All remaining time on the exoplanet host system is filled with 7.6 s exposures using the G141 grism on NICMOS (SPARS10 sequence; NSAMPLE = 2). The immediately following orbits on the calibrator start also with a direct image followed by the 8 RAPID G141 exposures.

We request no roll angle moves during a visit (also not in the repointing to the calibrator source), to optimize the stability.

Proposal 12230 (STScI Edit Number: 0, Created: Saturday, July 10, 2010 12:38:20 AM EST) - Overview

Visit	<p><b>Proposal 12230, Visit 01</b> <span style="float: right;">Sat Jul 10 05:38:21 GMT 2010</span></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: WFC3/IR</p> <p>Special Requirements: Period 1.0914240 D AND ZERO-PHASE HJD2454508.97608; GROUP 01,02,03 WITHIN 5D</p> <p><i>Comments: Primary Eclipse sequence for WASP-12 (5 orbits), which will be immediately followed by the calibrator source HD 258439 (2 orbits; no interrupt - 7 orbits in total).</i></p>					
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
(1)		WASP-12	RA: 06 30 32.7940 (97.6366417d) Dec: +29 40 20.29 (29.67230d) Equinox: J2000	Proper Motion RA: -5.370955053604048E-5s/yr Proper Motion Dec: -0.0078"/yr Epoch of Position: 2000	V=11.567+/-0.01 H = 10.227; J = 10.477; K = 10.188	Reference Frame: ICRS
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						
(2)	HD-258439	RA: 06 30 53.8035 (97.7241812d) Dec: +29 25 23.61 (29.42323d) Equinox: J2000	Proper Motion RA: 9.184689463082216E-5s/yr Proper Motion Dec: -0.0044"/yr Epoch of Position: 2000	V=9.43 H = 9.114; J = 9.114; K = 9.104	Reference Frame: ICRS	
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

Proposal 12230 (STScI Edit Number: 0, Created: Saturday, July 10, 2010 12:38:20 AM EST) - Overview

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158; PHASE 0.815 TO 0. 85		[==>]	[1]
2	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158		[==>(Copy 1)] [==>(Copy 2)]	[1]

Exposures

Proposal 12230 (STScI Edit Number: 0, Created: Saturday, July 10, 2010 12:38:20 AM EST) - Overview

3	GRISM_W (1) WASP-12 ASP-12	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=2; SAMP-SEQ=SPAR S10	POS TARG -15.172, +1.158
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4	GRISM_W (1) WASP-12 ASP-12	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=2; SAMP-SEQ=SPAR S10	POS TARG -15.172, +1.158; NEW OBSET
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<p>5</p>	<p>WAVE_CA (2) HD-258439 WFC3/IR, MULTIACCUM, F132N SAMP-SEQ=RAPID POS TARG -15.172,                  L_HD25843 IRSUB256 ; +1.158                  9 NSAMP=3</p>	<p>[==&gt;(Copy 1)]                  [==&gt;(Copy 2)]                  [==&gt;(Copy 3)]</p>	<p>[6]</p>

Proposal 12230 (STScI Edit Number: 0, Created: Saturday, July 10, 2010 12:38:20 AM EST) - Overview

6	GRISM_HD (2) HD-258439 258439	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=8; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158
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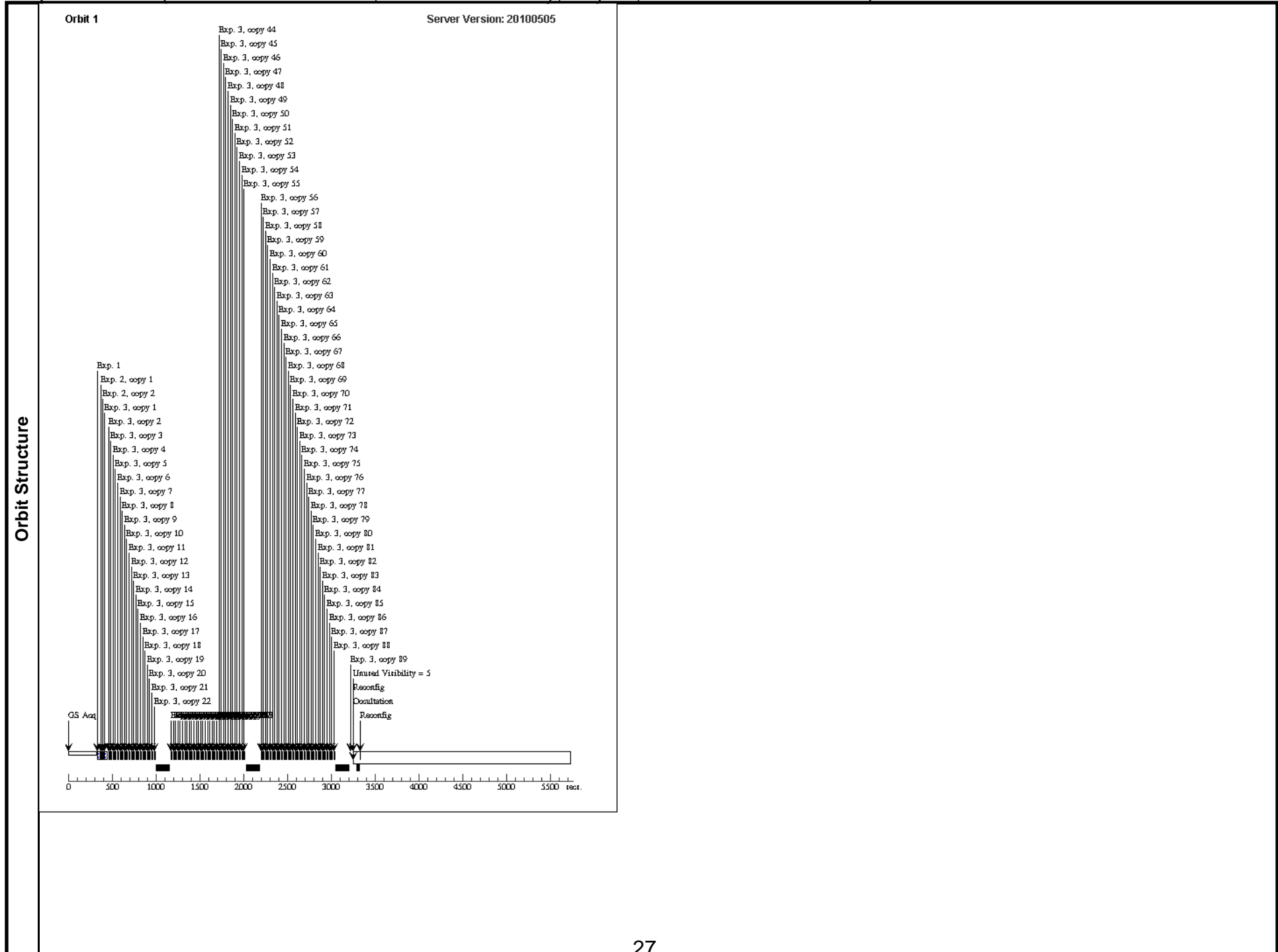
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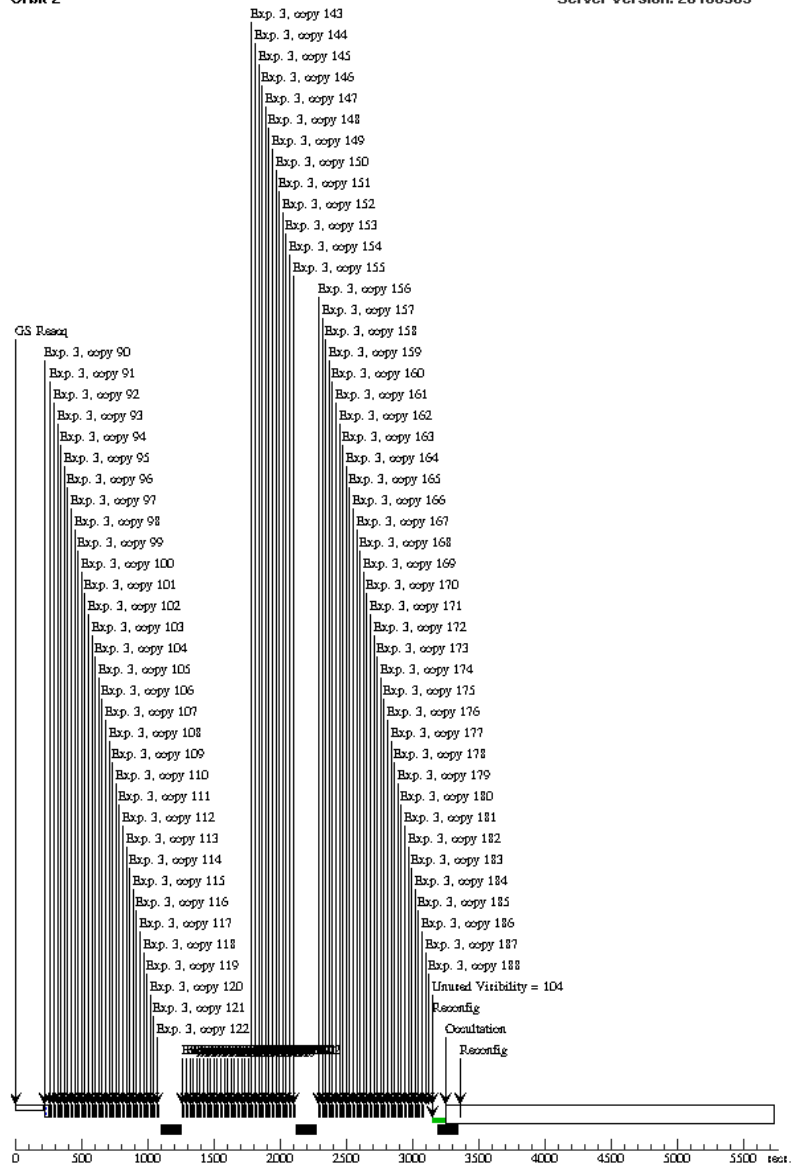
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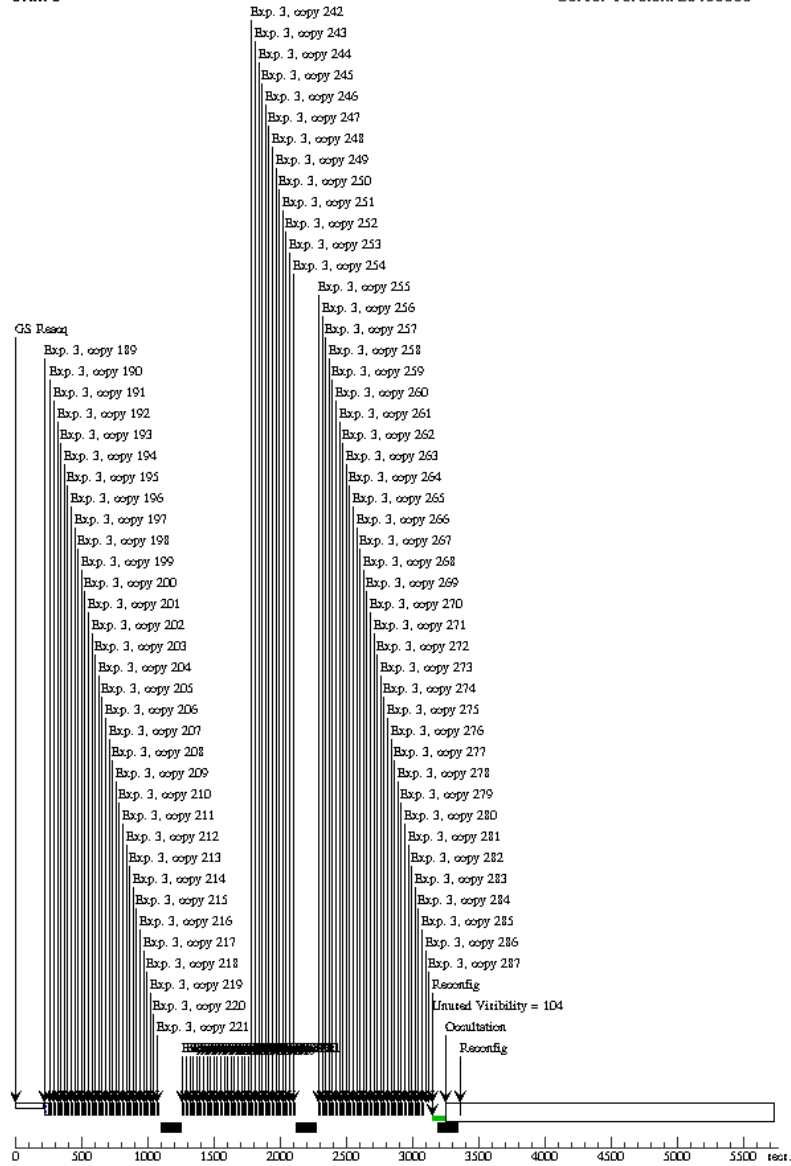
Orbit 2

Server Version: 20100505



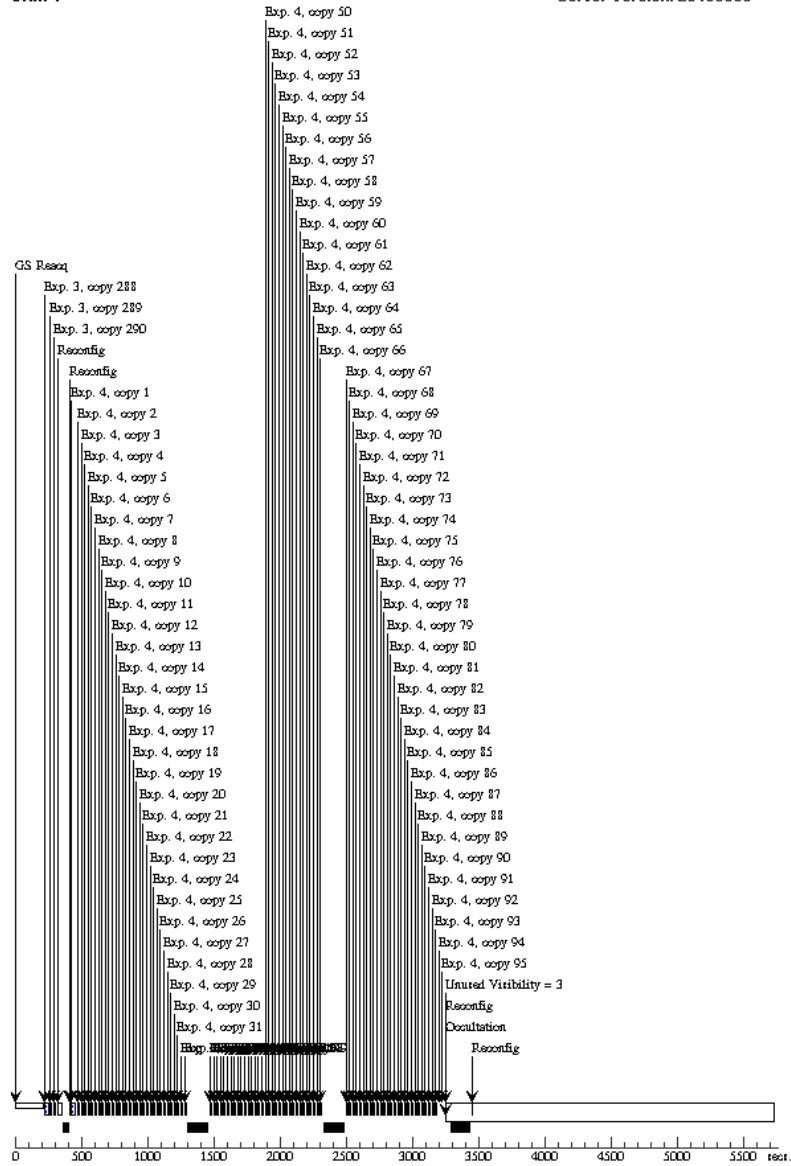
Orbit 3

Server Version: 20100505



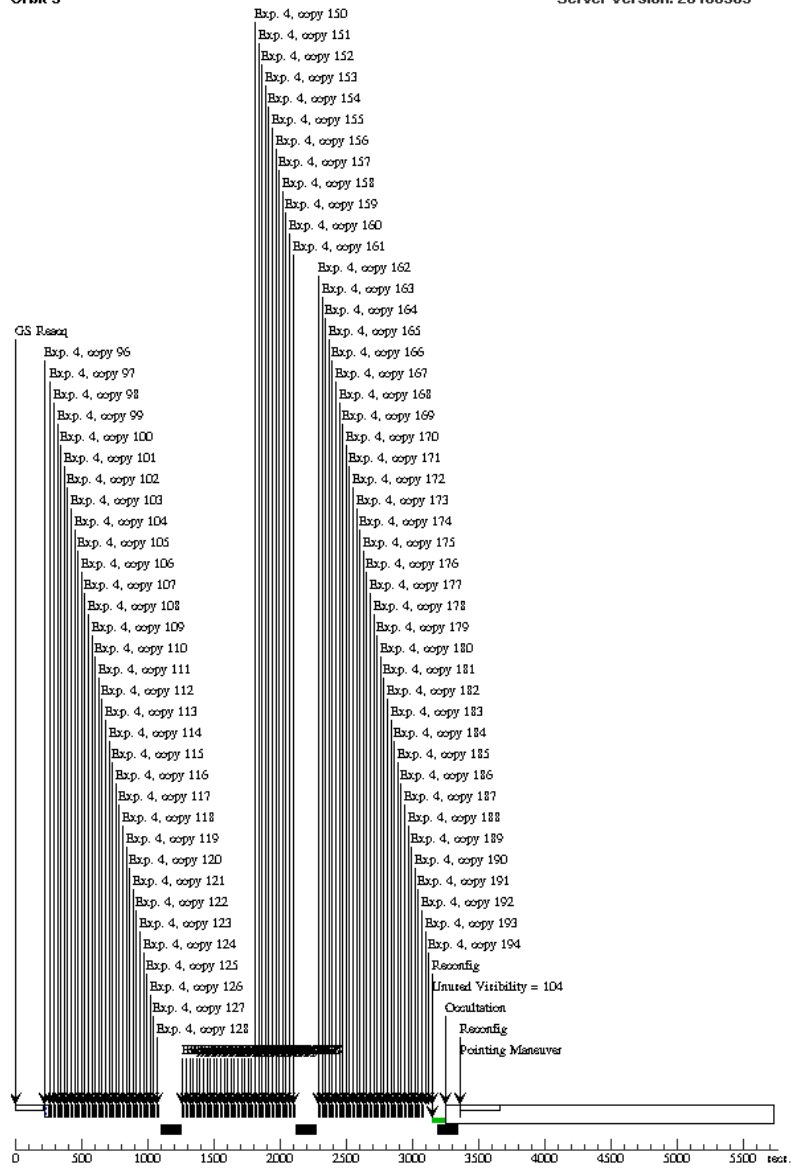
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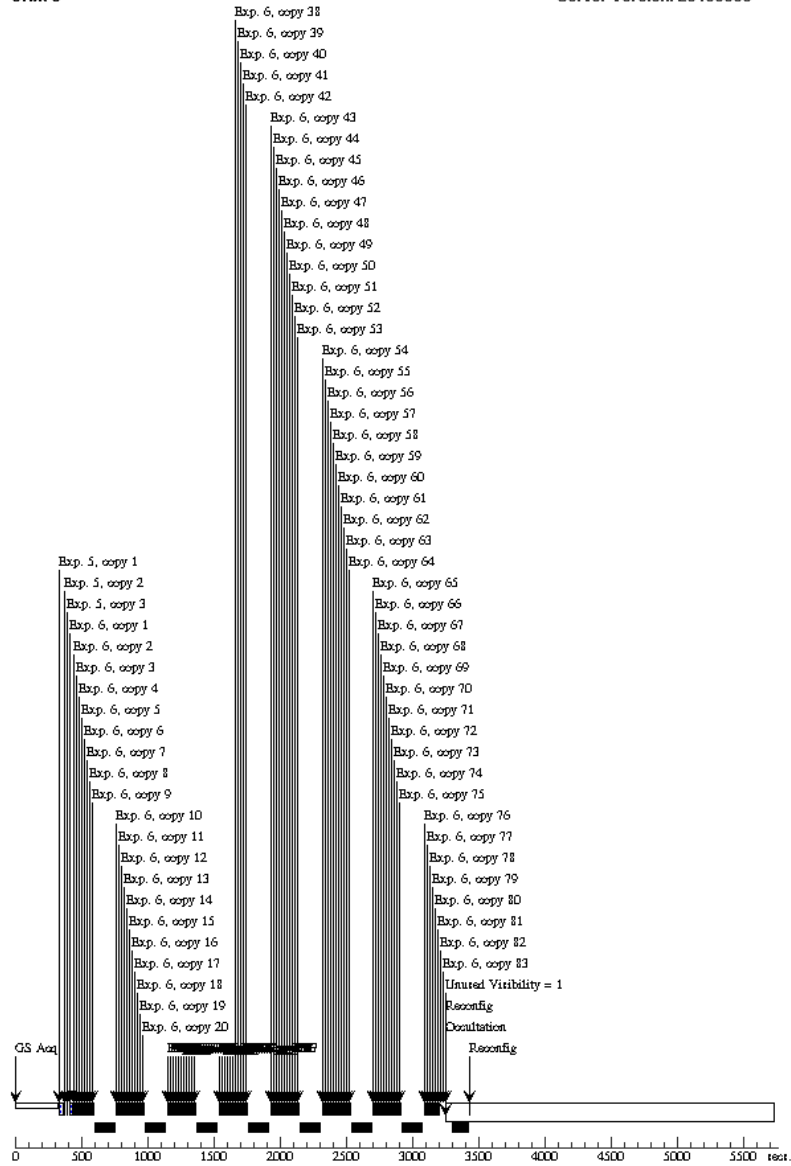
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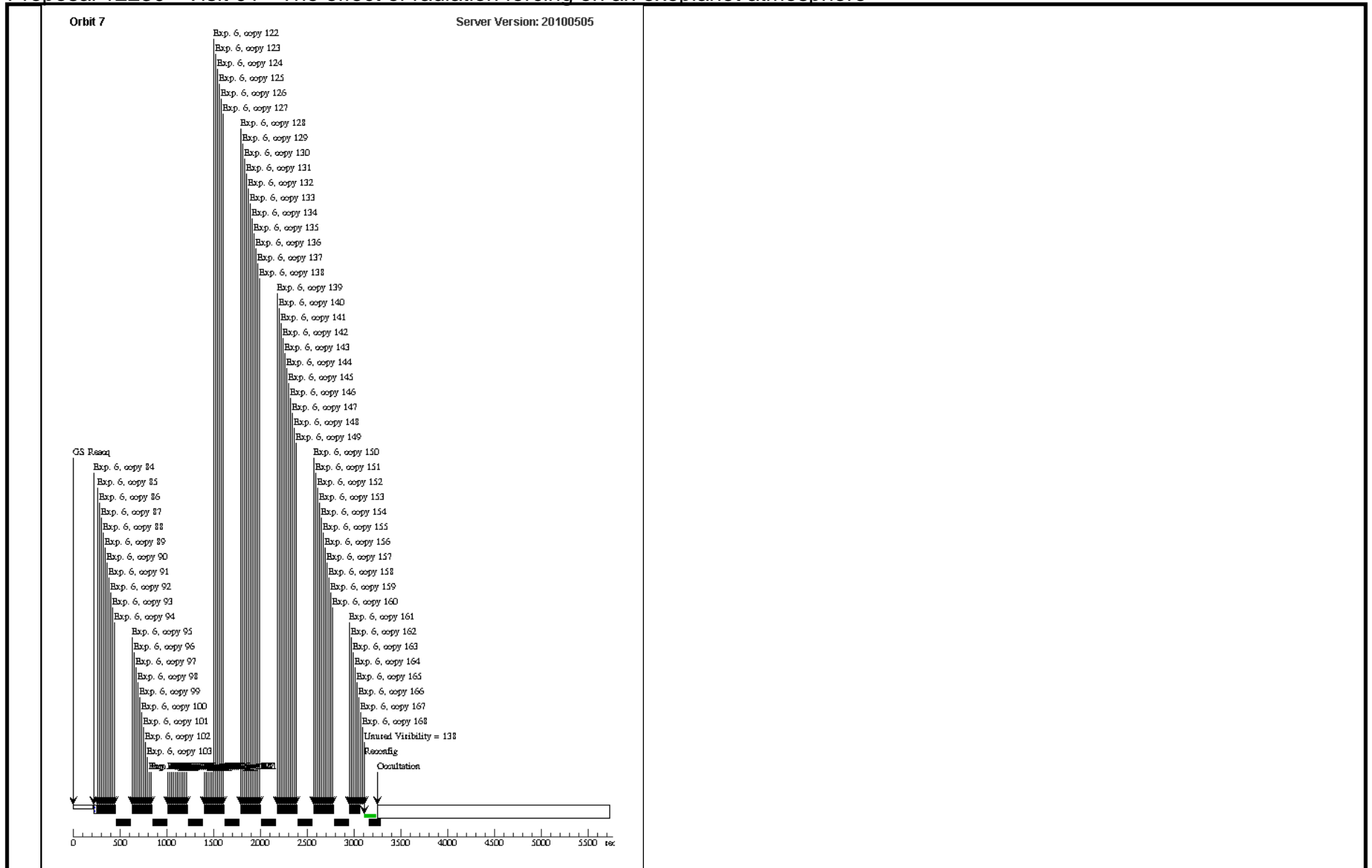


Orbit 6

Server Version: 20100505



# Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere



Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

Sat Jul 10 05:38:43 GMT 2010

Visit	<b>Proposal 12230, Visit 02</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: Period 1.0914240 D AND ZERO-PHASE HJD2454508.9761 <i>Comments: Secondary Eclipse sequence for WASP-12 (5 orbits), which will be immediately followed by the calibrator source HD 258439 (2 orbits; no interrupt - 7 orbits in total).</i>					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	WASP-12	RA: 06 30 32.7940 (97.6366417d) Dec: +29 40 20.29 (29.67230d) Equinox: J2000	Proper Motion RA: -5.370955053604048E-5s/yr Proper Motion Dec: -0.0078"/yr Epoch of Position: 2000	V=11.567+/-0.01 H = 10.227; J = 10.477; K = 10.188	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	(2)	HD-258439	RA: 06 30 53.8035 (97.7241812d) Dec: +29 25 23.61 (29.42323d) Equinox: J2000	Proper Motion RA: 9.184689463082216E-5s/yr Proper Motion Dec: -0.0044"/yr Epoch of Position: 2000	V=9.43 H = 9.114; J = 9.114; K = 9.104	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					

Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158; PHASE 0.315 TO 0. 35		[==>]	[1]
2	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158		[==>(Copy 1)] [==>(Copy 2)]	[1]

Exposures

Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

3	GRISM_W ASP-12	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=2; SAMP-SEQ=SPAR S10	POS TARG -15.172, +1.158
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Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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5	<p>WAVE_CA (2) HD-258439 WFC3/IR, MULTIACCUM, F132N SAMP-SEQ=RAPID POS TARG -15.172,                  L_HD25843 IRSUB256 ; +1.158                  9 NSAMP=3</p>	<p>[==&gt;(Copy 1)]                  [==&gt;(Copy 2)]                  [==&gt;(Copy 3)]</p>	[6]

Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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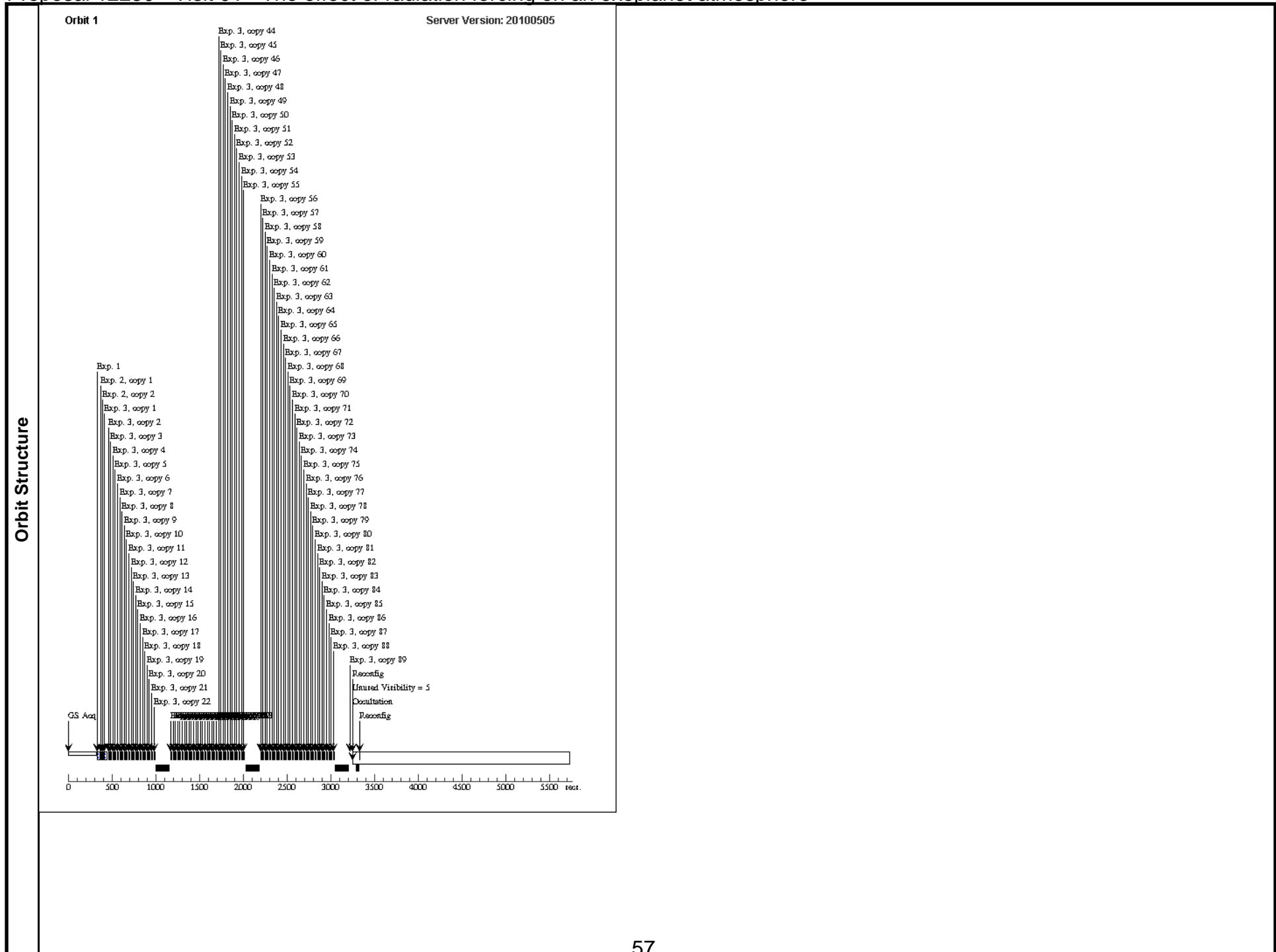
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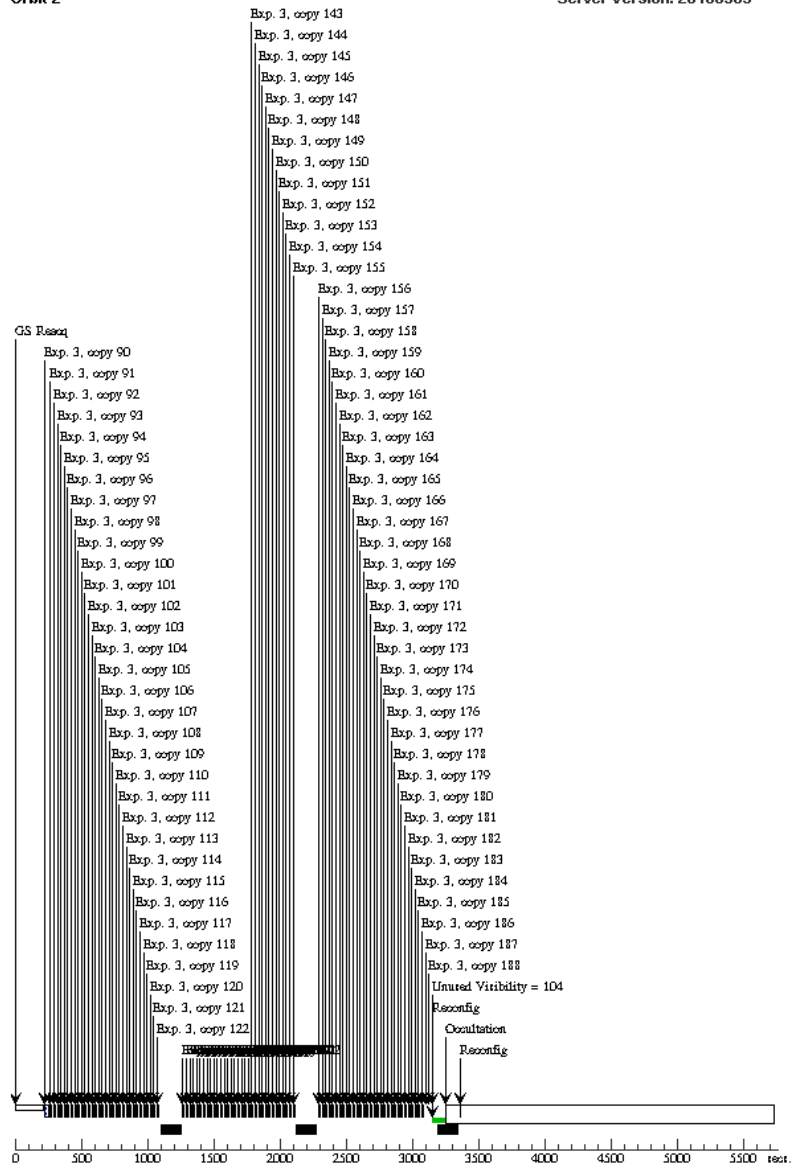
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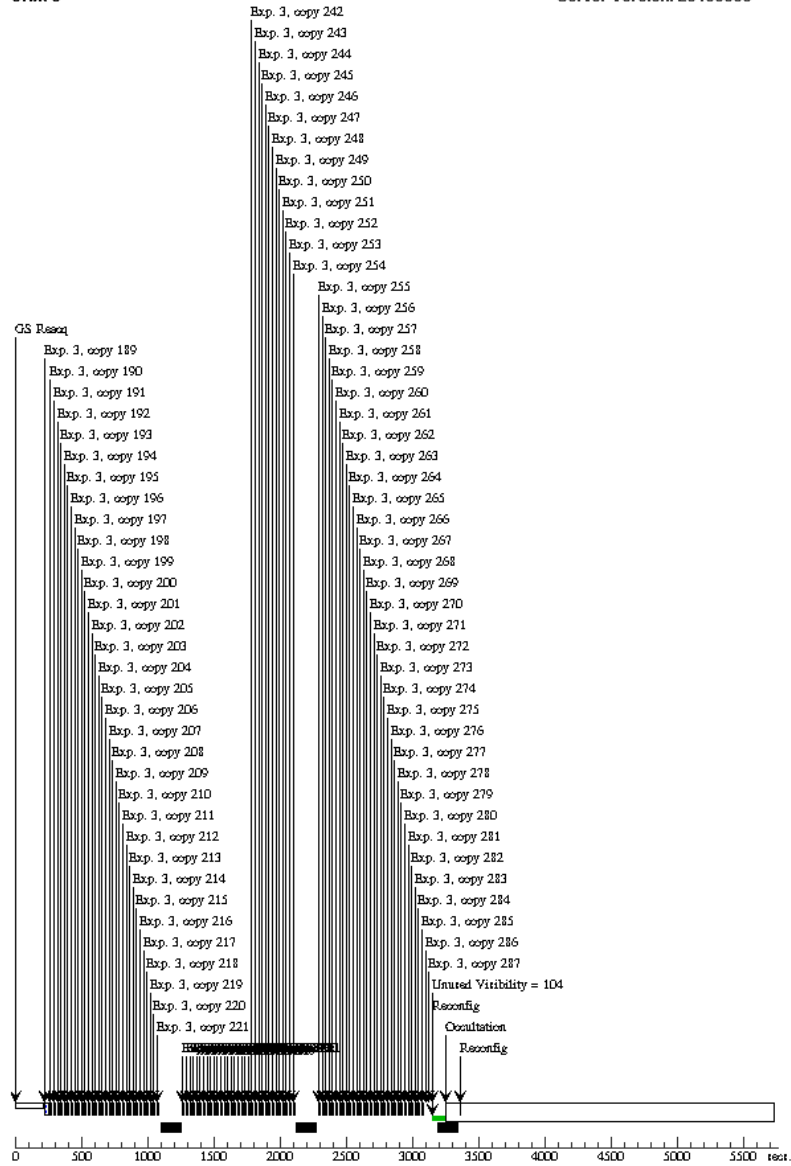
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# Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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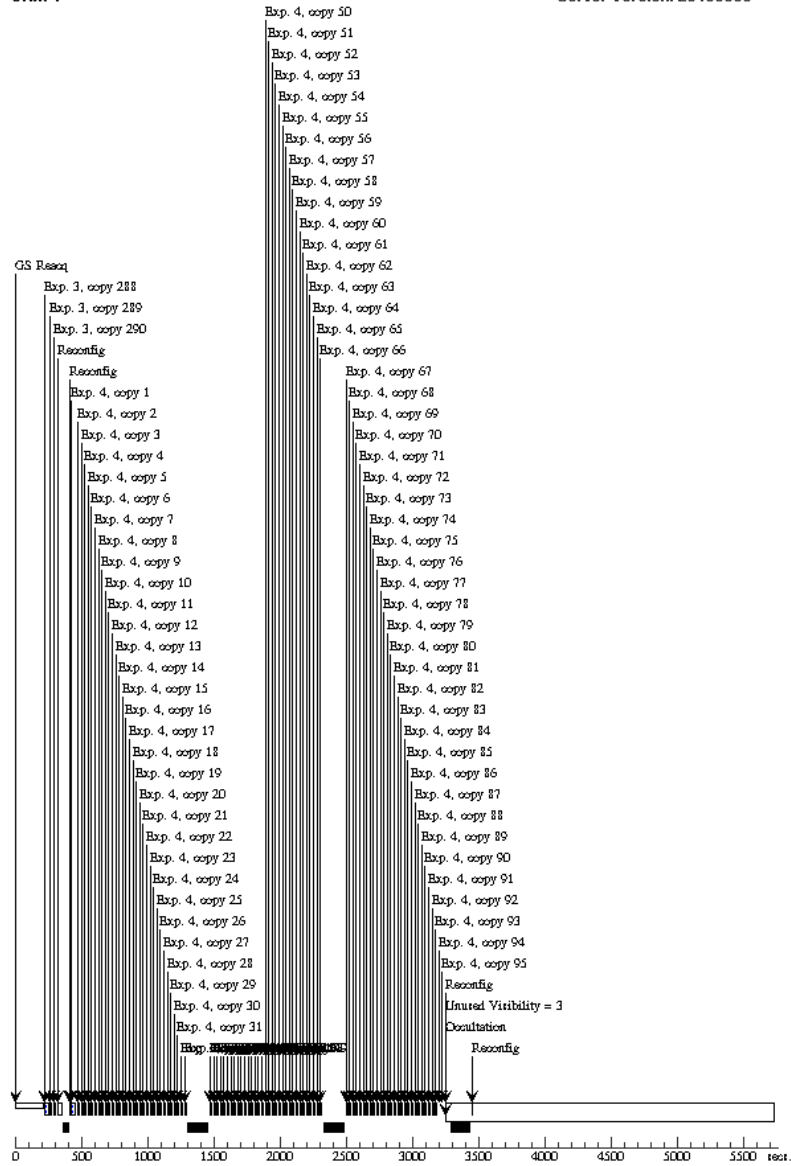
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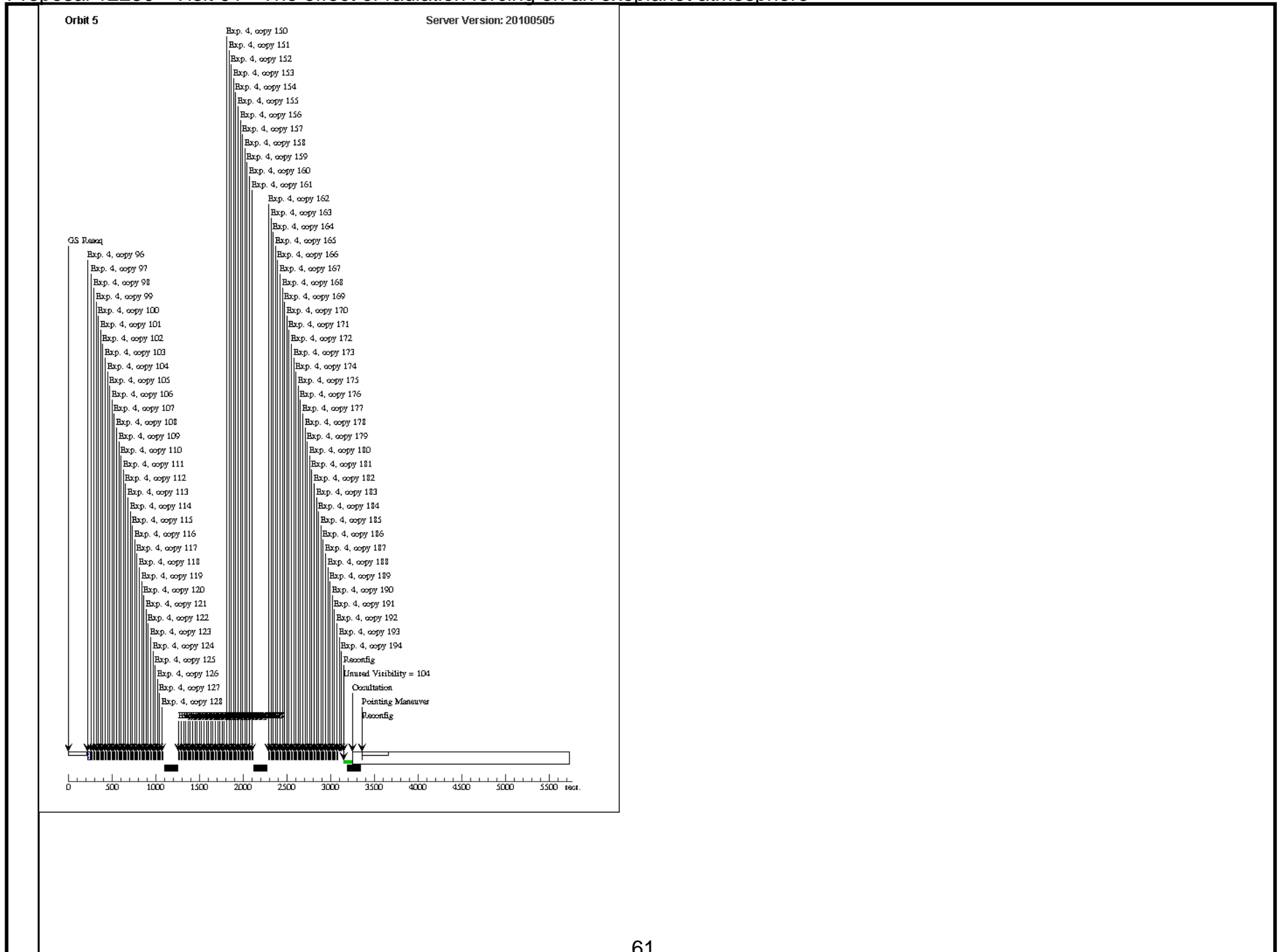
Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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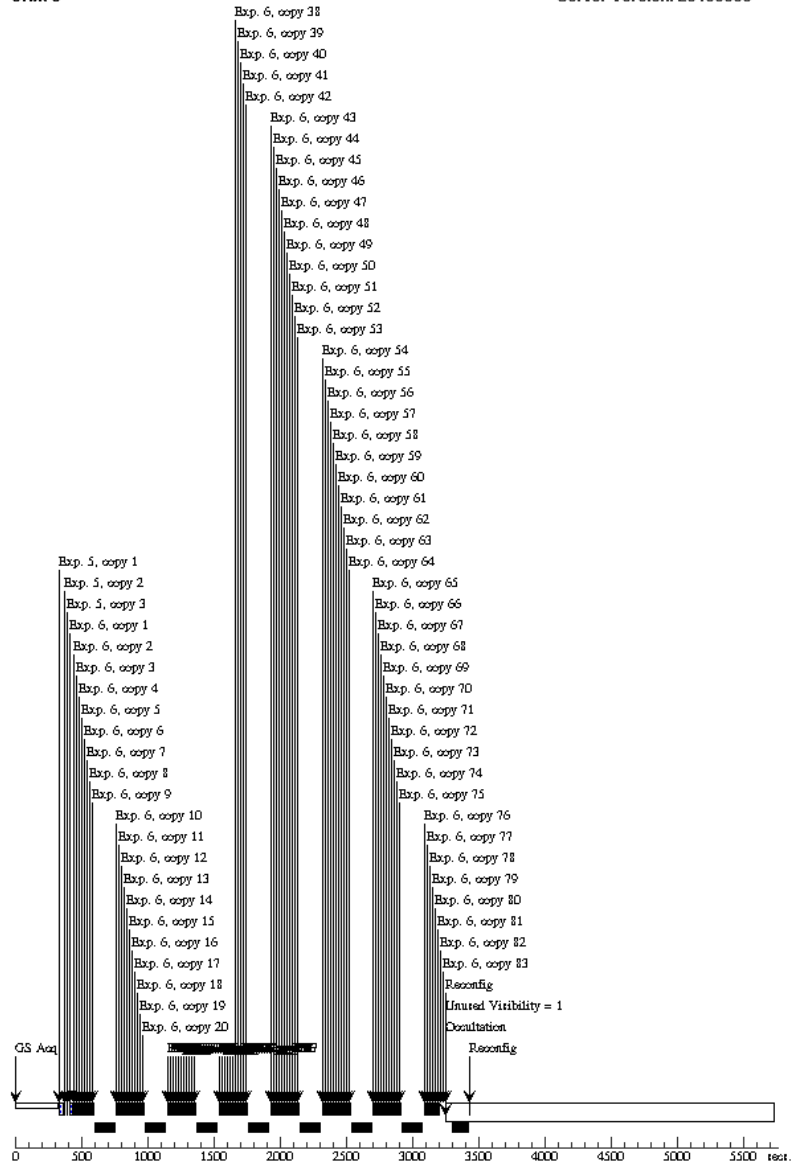
# Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere



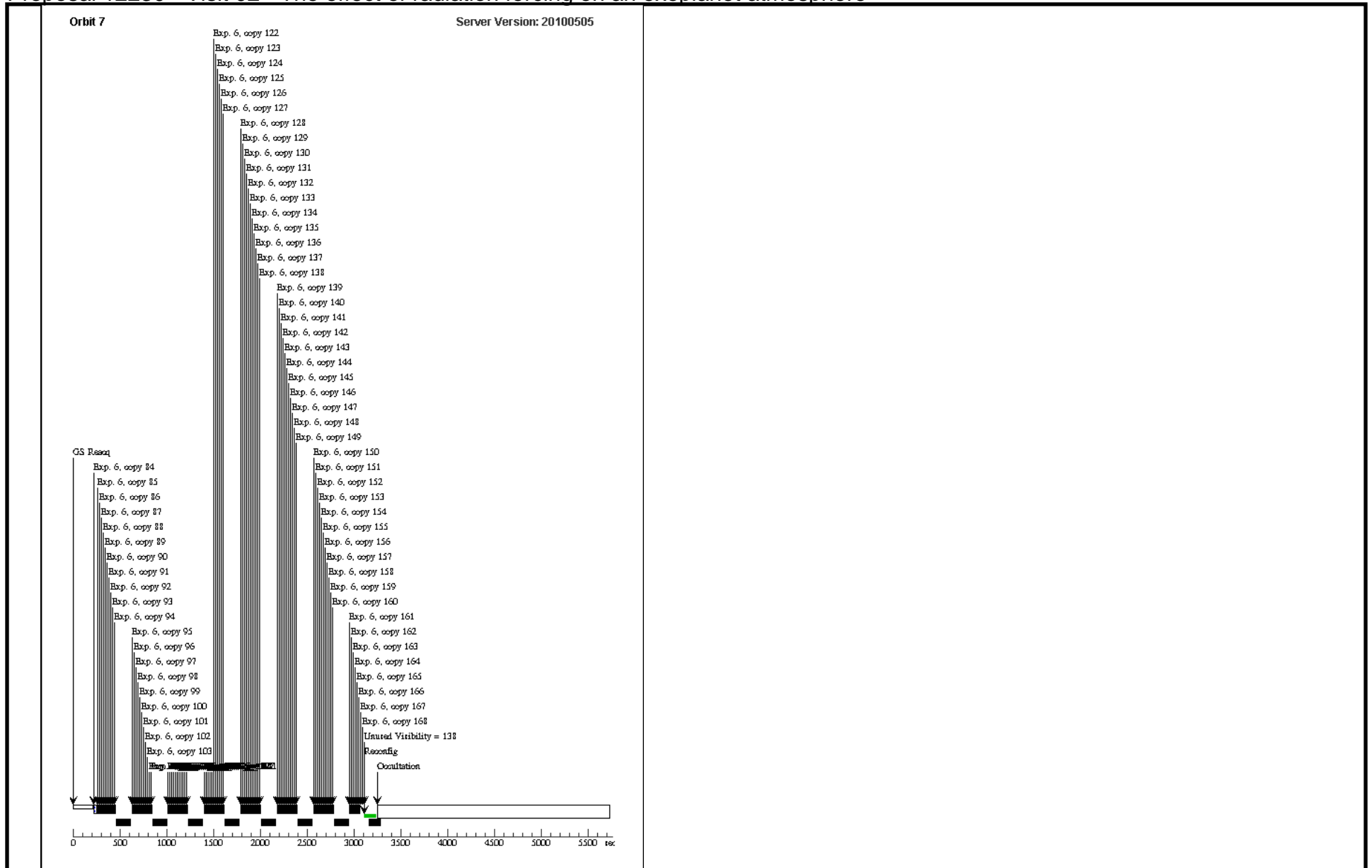
# Proposal 12230 - Visit 01 - The effect of radiation forcing on an exoplanet atmosphere

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Server Version: 20100505



Proposal 12230 - Visit O2 - The effect of radiation forcing on an exoplanet atmosphere



Proposal 12230 - Visit 02 - The effect of radiation forcing on an exoplanet atmosphere

Sat Jul 10 05:39:03 GMT 2010

<b>Visit</b>	<p><b>Proposal 12230, Visit 03</b></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: WFC3/IR</p> <p>Special Requirements: Period 1.0914240 D AND ZERO-PHASE HJD2454508.9761</p> <p><i>Comments: Phase Curve sequence for WASP-12 (2 orbits), which will be immediately followed by the calibrator source HD 258439 (2 orbits; no interrupt - 4 orbits in total).</i></p> <p><i>NOTE: This visit is scheduled to be observed around phase 0.25. An equivalent observation is to observe around 0.75! We could however not give multiple options in the phasing requirements. If necessary, the phasing can be adjusted to be between 0.66 and 0.72 (see first image in WAVE_CAL_WASP-12).</i></p>					
	<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>
(1)		WASP-12	RA: 06 30 32.7940 (97.6366417d) Dec: +29 40 20.29 (29.67230d) Equinox: J2000	Proper Motion RA: -5.370955053604048E-5s/yr Proper Motion Dec: -0.0078"/yr Epoch of Position: 2000	V=11.567+/-0.01 H = 10.227; J = 10.477; K = 10.188	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
(2)	HD-258439	RA: 06 30 53.8035 (97.7241812d) Dec: +29 25 23.61 (29.42323d) Equinox: J2000	Proper Motion RA: 9.184689463082216E-5s/yr Proper Motion Dec: -0.0044"/yr Epoch of Position: 2000	V=9.43 H = 9.114; J = 9.114; K = 9.104	Reference Frame: ICRS	
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					

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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPID	POS TARG -15.172, 1.158; PHASE 0.16 TO 0.2 2		[==>]	[1]
2	WAVE_CA L_WASP-1 2	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	F132N	NSAMP=10; SAMP-SEQ=RAPID	POS TARG -15.172, +1.158		[==>(Copy 1)] [==>(Copy 2)]	[1]

Exposures

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3	GRISM_W ASP-12	(1) WASP-12	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=2; SAMP-SEQ=SPAR S10	POS TARG -15.172, +1.158
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4	<p>WAVE_CA (2) HD-258439 WFC3/IR, MULTIACCUM, F132N SAMP-SEQ=RAPID POS TARG -15.172,                  L_HD25843 IRSUB256 ; +1.158                  9 NSAMP=3</p>	<p>[==&gt;(Copy 1)]                  [==&gt;(Copy 2)]                  [==&gt;(Copy 3)]</p>	[3]

Proposal 12230 - Visit 02 - The effect of radiation forcing on an exoplanet atmosphere

5	GRISM_HD (2) HD-258439 258439	WFC3/IR, MULTIACCUM, IRSUB256	G141	NSAMP=8; SAMP-SEQ=RAPI D	POS TARG -15.172, +1.158
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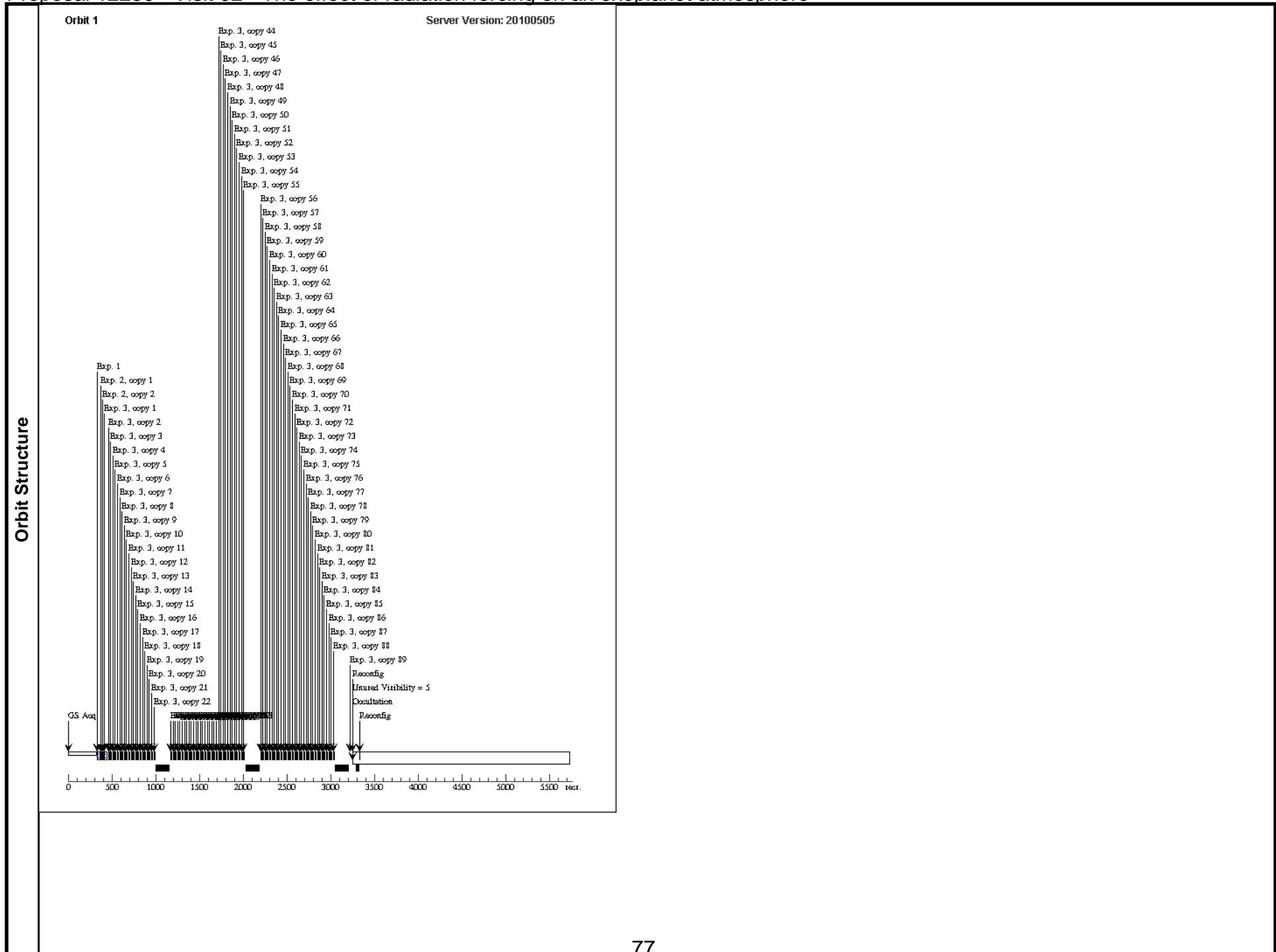
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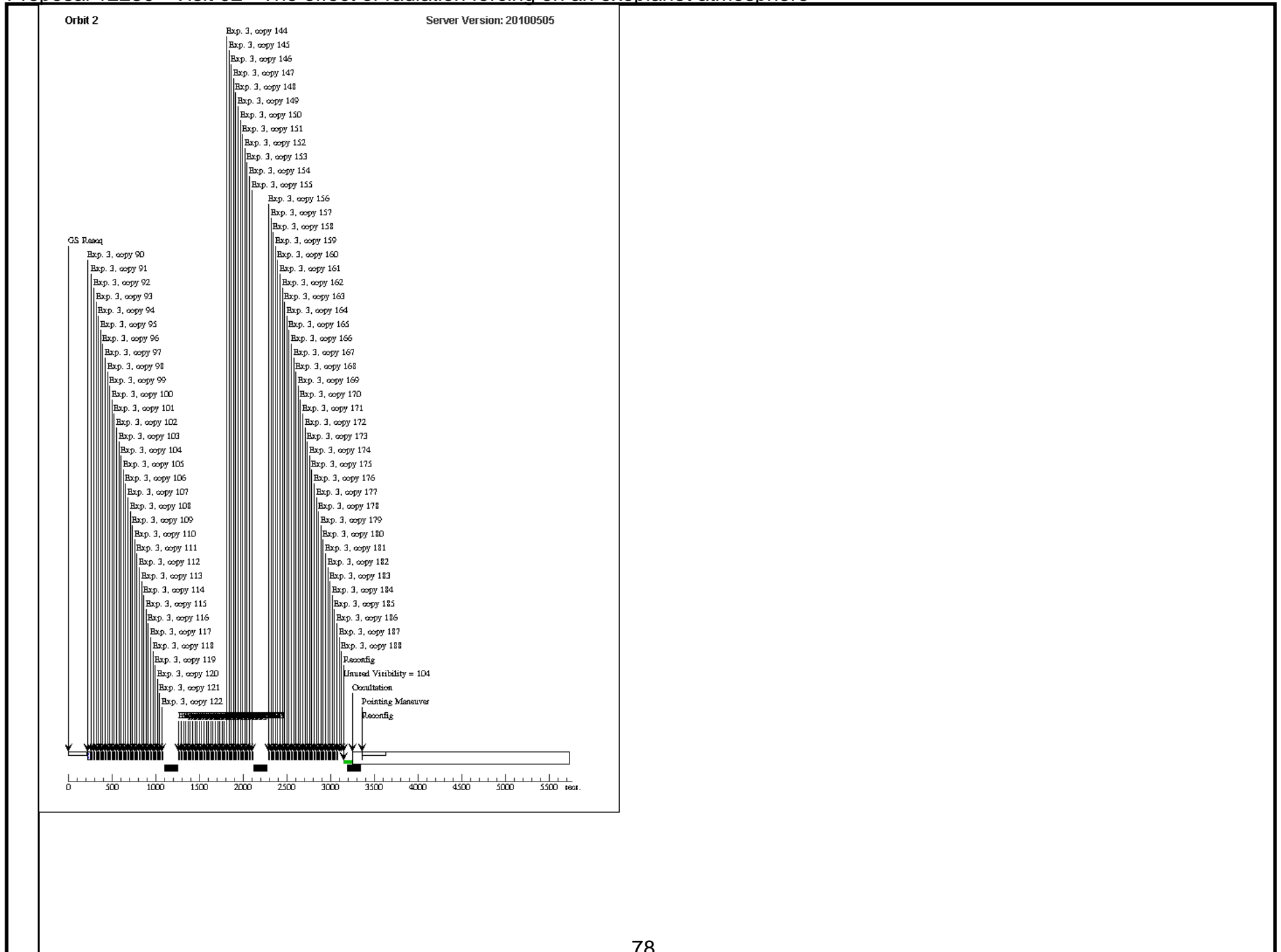
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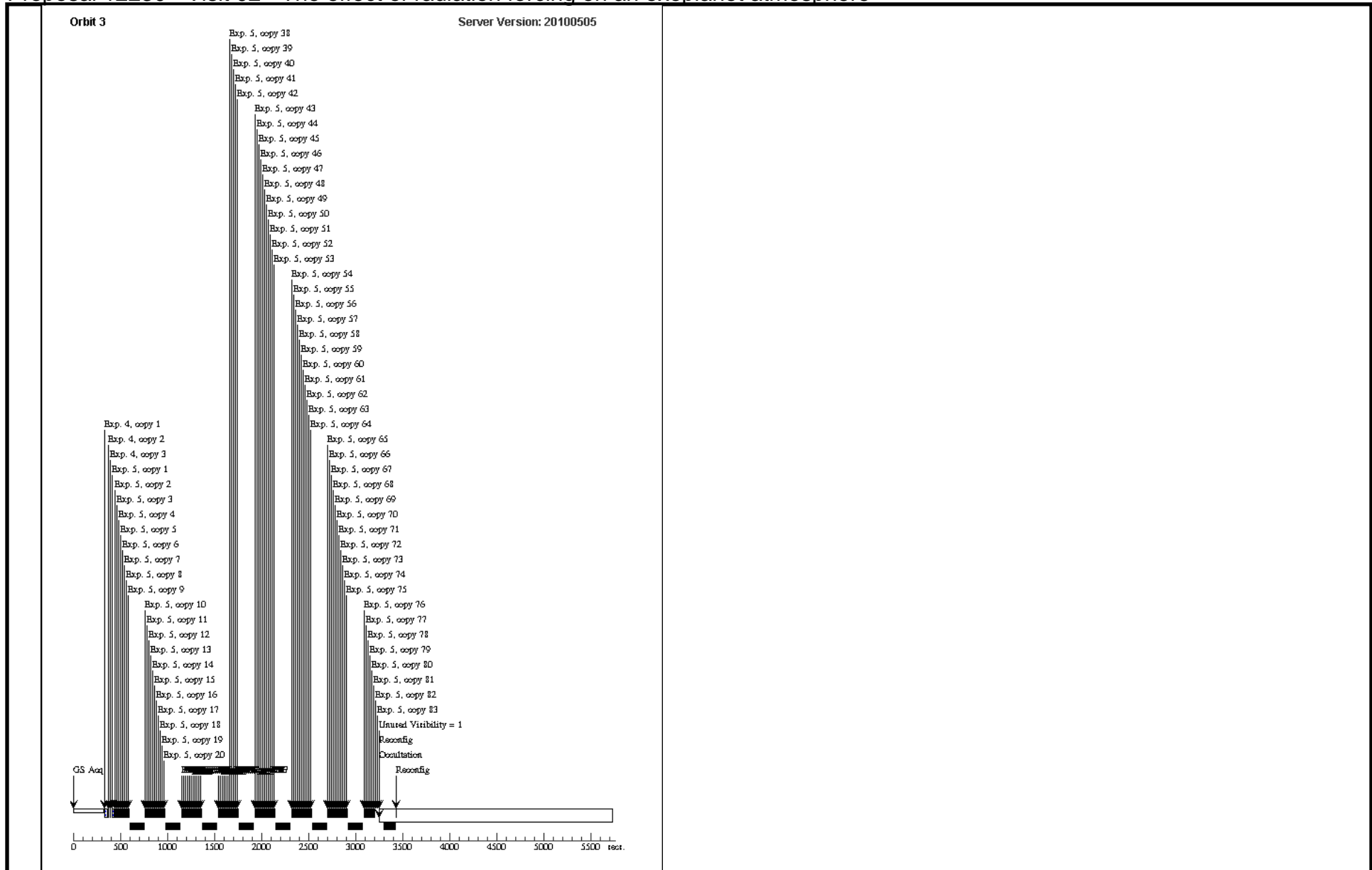
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# Proposal 12230 - Visit O2 - The effect of radiation forcing on an exoplanet atmosphere



Proposal 12230 - Visit O2 - The effect of radiation forcing on an exoplanet atmosphere



# Proposal 12230 - Visit 03 - The effect of radiation forcing on an exoplanet atmosphere

