



## 12176 - Long term observations of Saturn's northern auroras

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Dr. Jonathan D. Nichols (PI) (ESA Member)</b>	<b>University of Leicester</b>	<b>jdn@ion.le.ac.uk</b>
Prof. John T. Clarke (CoI) (AdminUSPI)	Boston University	jclarke@bu.edu
Prof. Jean-Claude M. Gerard (CoI) (ESA Member)	Universite de Liege	jc.gerard@ulg.ac.be
Dr. Denis Grodent (CoI) (ESA Member)	Universite de Liege	d.grodent@ulg.ac.be
Prof. Stanley W.H. Cowley (CoI) (ESA Member)	University of Leicester	swhc1@ion.le.ac.uk
Dr. Emma J. Bunce (CoI) (ESA Member)	University of Leicester	ejb10@ion.le.ac.uk
Dr. Sarah V. Badman (CoI)	Institute of Space & Astronautical Science	svb4@ion.le.ac.uk
Dr. Dean L. Talboys (CoI) (ESA Member)	University of Leicester	dean.talboys@star.le.ac.uk
Dr. Tom Stallard (CoI) (ESA Member)	University of Leicester	tss@ion.le.ac.uk
Dr. Henrik Melin (CoI) (ESA Member)	University of Leicester	h.melin@ion.le.ac.uk
Prof. Michele Dougherty (CoI) (ESA Member)	Imperial College of Science Technology and Medicine	mdougherty@ic.ac.uk
Dr. Donald G. Mitchell (CoI)	The Johns Hopkins University Applied Physics Laboratory	donald.g.mitchell@jhuapl.edu
Dr. William S. Kurth (CoI)	University of Iowa	wsk@space.physics.uiowa.edu
Dr. Wayne R. Pryor (CoI)	Central Arizona College	Wayne_Pryor@centralaz.edu
Dr. Frank J. Crary (CoI)	Southwest Research Institute	fcrary@swri.edu
Dr. Robert H. Brown (CoI)	University of Arizona	rhb@lpl.arizona.edu
Dr. Kevin H. Baines (CoI)	Jet Propulsion Laboratory	kbaines@aloha.jpl.nasa.gov

### 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>
H1	(1) SATURN	ACS/SBC	1	11-Feb-2011 21:14:03.0	yes
H2	(1) SATURN	ACS/SBC	1	11-Feb-2011 21:14:10.0	yes
H3	(1) SATURN	ACS/SBC	1	11-Feb-2011 21:14:15.0	yes
H4	(1) SATURN	ACS/SBC	1	11-Feb-2011 21:14:21.0	yes
H5	(1) SATURN	ACS/SBC	1	11-Feb-2011 21:14:28.0	yes

5 Total Orbits Used

### **ABSTRACT**

Auroral emissions are a vital tool in diagnosing the dynamics of planetary magnetospheres. While Saturn's southern UV auroras have been observed with high-sensitivity cameras onboard the Hubble Space Telescope (HST), the northern auroras have only been observed at very oblique angles. Our understanding of Saturn's auroral emissions is thus only half complete. However, Saturn has now passed equinox and is moving toward summer in the northern hemisphere, such that the northern auroras are now visible from Earth, and recent results from HST have indicated that Saturn's northern auroras are not simply mirror images of the southern. The changing seasons are also expected to result in significant changes in magnetospheric phenomena related to the auroras. Observing these changes is a specific goal of the Cassini Solstice Mission (CSM) and, since joint HST-Cassini observations have repeatedly proved to be invaluable, CSM operations are currently being planned specifically with joint HST observations in mind. The observations proposed here will thus execute over Cycles 18-20, and will address the following science questions:

What is the morphology of Saturn's northern auroras?

Do Saturn's auroras change with the planet's season?

How are the auroral emissions of different wavelengths related?

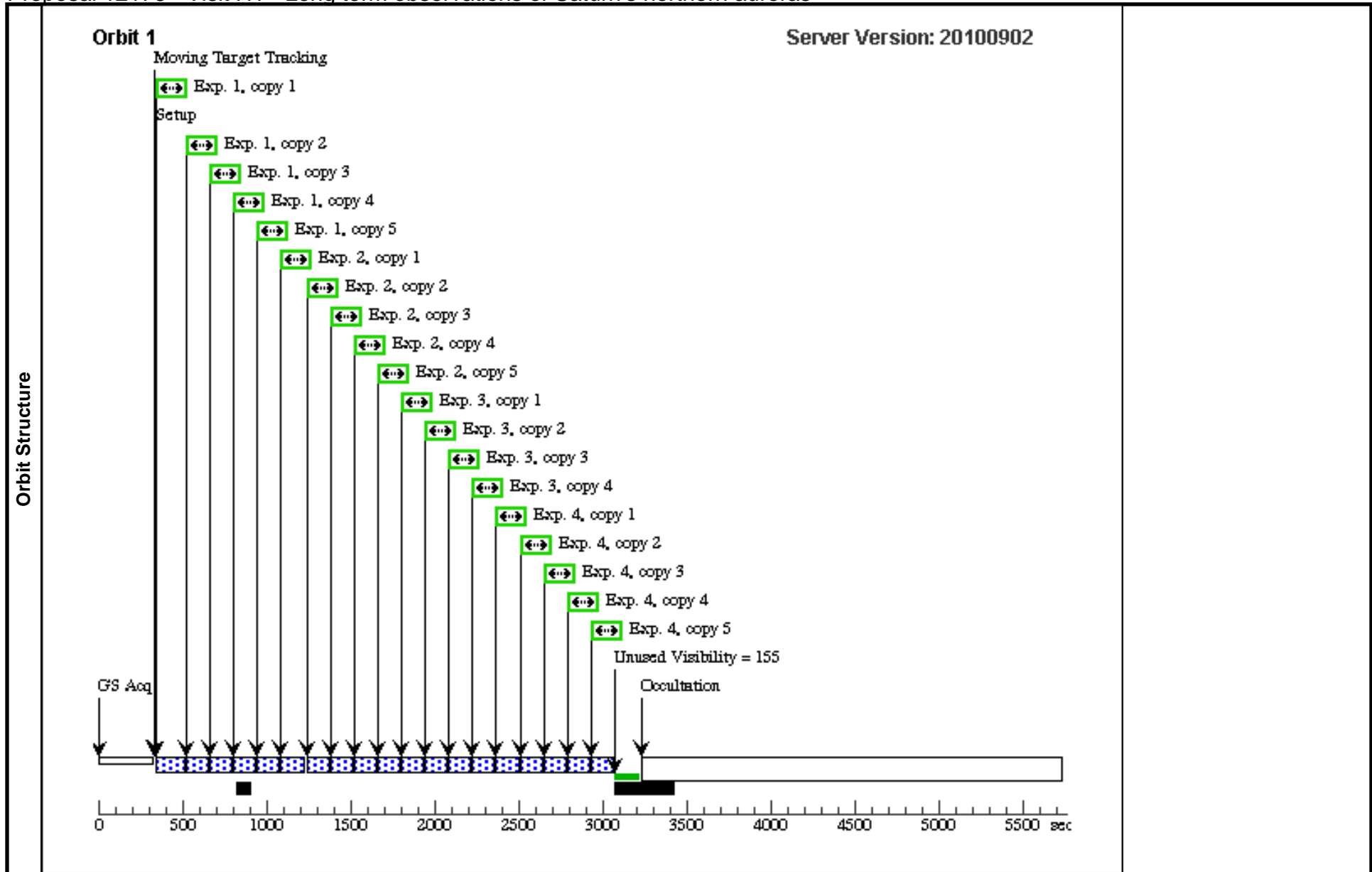
The importance of long term HST observations of Saturn's northern auroras are highlighted by the fact that recent key discoveries would have been missed without the multiyear archive of observations of the planet's southern auroras. The opportunity to obtain HST images while Cassini makes specifically-tailored supporting observations is an extremely valuable opportunity, and HST is the only instrument capable of providing sustained, high time resolution observations of Saturn's auroral emission.

## **OBSERVING DESCRIPTION**

These observations will be obtained with the Solar Blind Channel (SBC) of the ACS. The field of view of the ACS/SBC is large enough to encompass the whole disc of the planet plus a significant portion of the rings. The observations could, however, also be obtained with the STIS/FUV-MAMA instrument if the ACS is not functioning, but in practice we prefer to use the ACS, since the sensitivity using e.g. the F125LP filter is  $1.5 \times 10^3$  counts pixel<sup>-1</sup> s<sup>-1</sup> for 1 kiloRayleigh of H<sub>2</sub> plus Lyman- emission, versus  $0.5 \times 10^3$  counts pixel<sup>-1</sup> s<sup>-1</sup> for the STIS using the equivalent F25-SrF2 filter. Higher count rates are desirable since planetary rotation introduces 1/100 s of blurring of features near the central meridian longitude. Previously measured count rates are 25,000 counts s<sup>-1</sup>, well below the limit of 200,000 counts s<sup>-1</sup>. We will use the F115LP filter during the Low Sky portion of the orbit and the F125LP filter outside of this in order to reduce the Ly- background contamination from the geocorona. For each set of observations, we will also obtain a set of images using the F140LP filter in order to provide the background reflected sunlight for subtraction. We will obtain 100 s exposures, a length experience shows is sufficient to obtain a good signal-to-noise ratio. We request 30 orbits over 3 cycles divided as follows: 5 orbits in Cycle 18, 10 orbits in Cycle 19 and 15 orbits in Cycle 20. This increasing number of orbits per year reflects the increasing view of the northern auroral region as shown in Fig. 1. Observations will be obtained near opposition each year, with pre-opposition providing the best viewing angles due to the Earth's orbital motion. In the past, Saturn observations have been successfully obtained in both 2-gyro and 3-gyro mode.

Proposal 12176 - Visit H1 - Long term observations of Saturn's northern auroras

Visit	<b>Proposal 12176, Visit H1, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: BETWEEN 01-APR-2011:00:00:00 AND 01-APR-2011:23:59:59 <i>Comments: This visit initiates the sequence of observations near the apoapsis of the orbit of the Cassini spacecraft.</i>							Sat Feb 12 02:14:33 GMT 2011																																																				
Solar System Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Level 1</th> <th>Level 2</th> <th>Level 3</th> <th>Window</th> <th>Ephem Center</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>SATURN</td> <td>STD=SATURN</td> <td></td> <td></td> <td>SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"</td> <td>EARTH</td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center	(1)	SATURN	STD=SATURN			SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"	EARTH																																													
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Exposures	<table border="1"> <thead> <tr> <th>#</th> <th>Label</th> <th>Target</th> <th>Config,Mode,Aperture</th> <th>Spectral Els.</th> <th>Opt. Params.</th> <th>Special Reqs.</th> <th>Groups</th> <th>Exp. Time/[Actual Dur.]</th> <th>Orbit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>(1) SATURN</td> <td>ACS/SBC, ACCUM, SBC-FIX</td> <td>F125LP</td> <td></td> <td>GS ACQ SCENARI O BASE1B3</td> <td></td> <td>100 Secs X 5 [=&gt;(Copy 1)] [=&gt;(Copy 2)] [=&gt;(Copy 3)] [=&gt;(Copy 4)] [=&gt;(Copy 5)]</td> <td>[1]</td> </tr> <tr> <td>2</td> <td></td> <td>(1) SATURN</td> <td>ACS/SBC, ACCUM, SBC-FIX</td> <td>F115LP</td> <td></td> <td></td> <td></td> <td>100 Secs X 5 [=&gt;(Copy 1)] [=&gt;(Copy 2)] [=&gt;(Copy 3)] [=&gt;(Copy 4)] [=&gt;(Copy 5)]</td> <td>[1]</td> </tr> <tr> <td>3</td> <td></td> <td>(1) SATURN</td> <td>ACS/SBC, ACCUM, SBC-FIX</td> <td>F115LP</td> <td></td> <td></td> <td></td> <td>100 Secs X 4 [=&gt;(Copy 1)] [=&gt;(Copy 2)] [=&gt;(Copy 3)] [=&gt;(Copy 4)]</td> <td>[1]</td> </tr> <tr> <td>4</td> <td></td> <td>(1) SATURN</td> <td>ACS/SBC, ACCUM, SBC-FIX</td> <td>F125LP</td> <td></td> <td></td> <td></td> <td>100 Secs X 5 [=&gt;(Copy 1)] [=&gt;(Copy 2)] [=&gt;(Copy 3)] [=&gt;(Copy 4)] [=&gt;(Copy 5)]</td> <td>[1]</td> </tr> </tbody> </table>										#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	1		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP		GS ACQ SCENARI O BASE1B3		100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]	2		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]	3		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 4 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)]	[1]	4		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]
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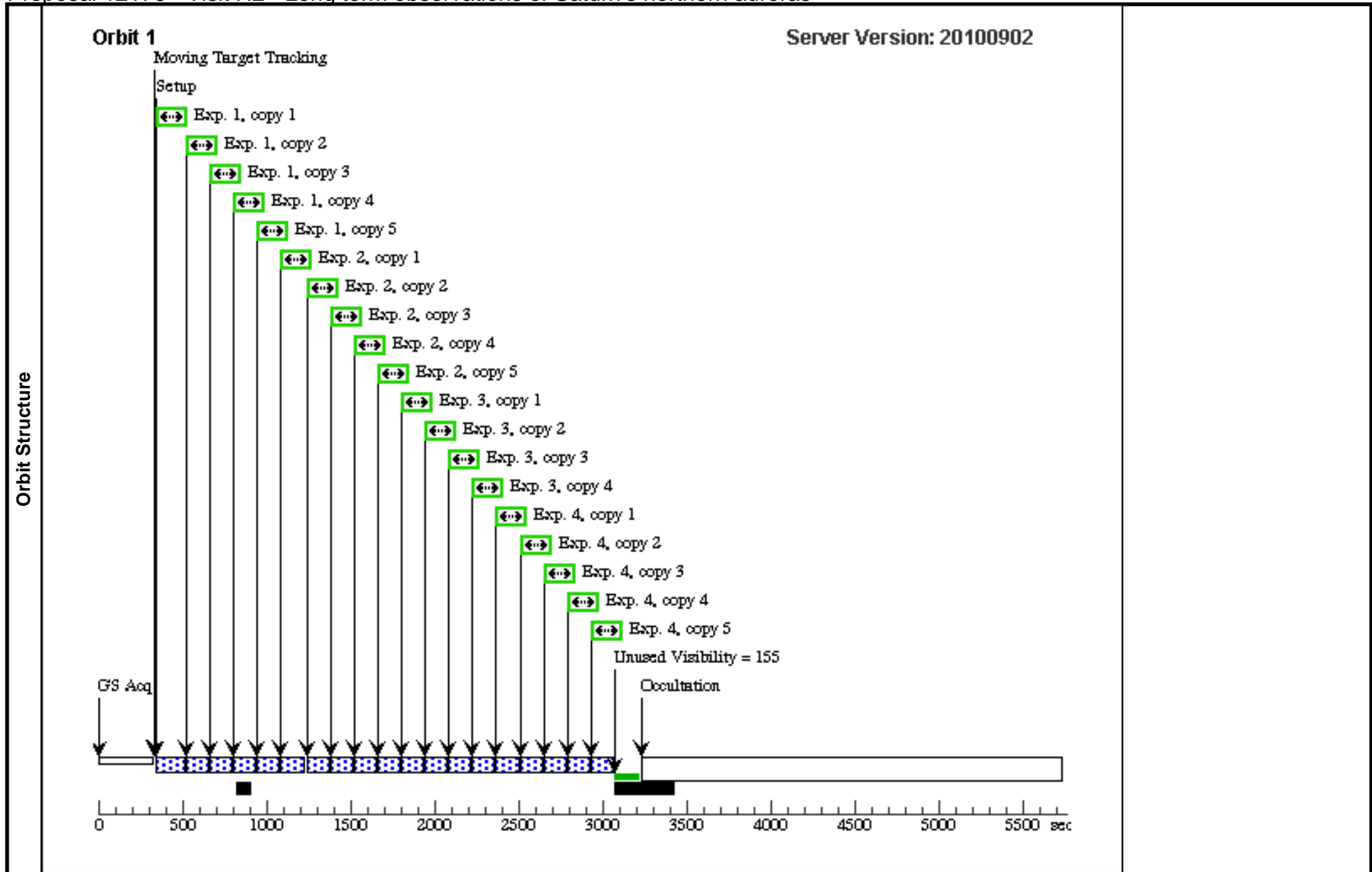
Proposal 12176 - Visit H2 - Long term observations of Saturn's northern auroras

Sat Feb 12 02:14:34 GMT 2011

<b>Visit</b>	<b>Proposal 12176, Visit H2, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: BETWEEN 03-APR-2011:00:00:00 AND 03-APR-2011:23:59:59 Comments: This visit is timed to occur ~2 days after visit H1					

<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
	(1)	SATURN	STD=SATURN				SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]
	2		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]
	3		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 4 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)]	[1]
	4		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]



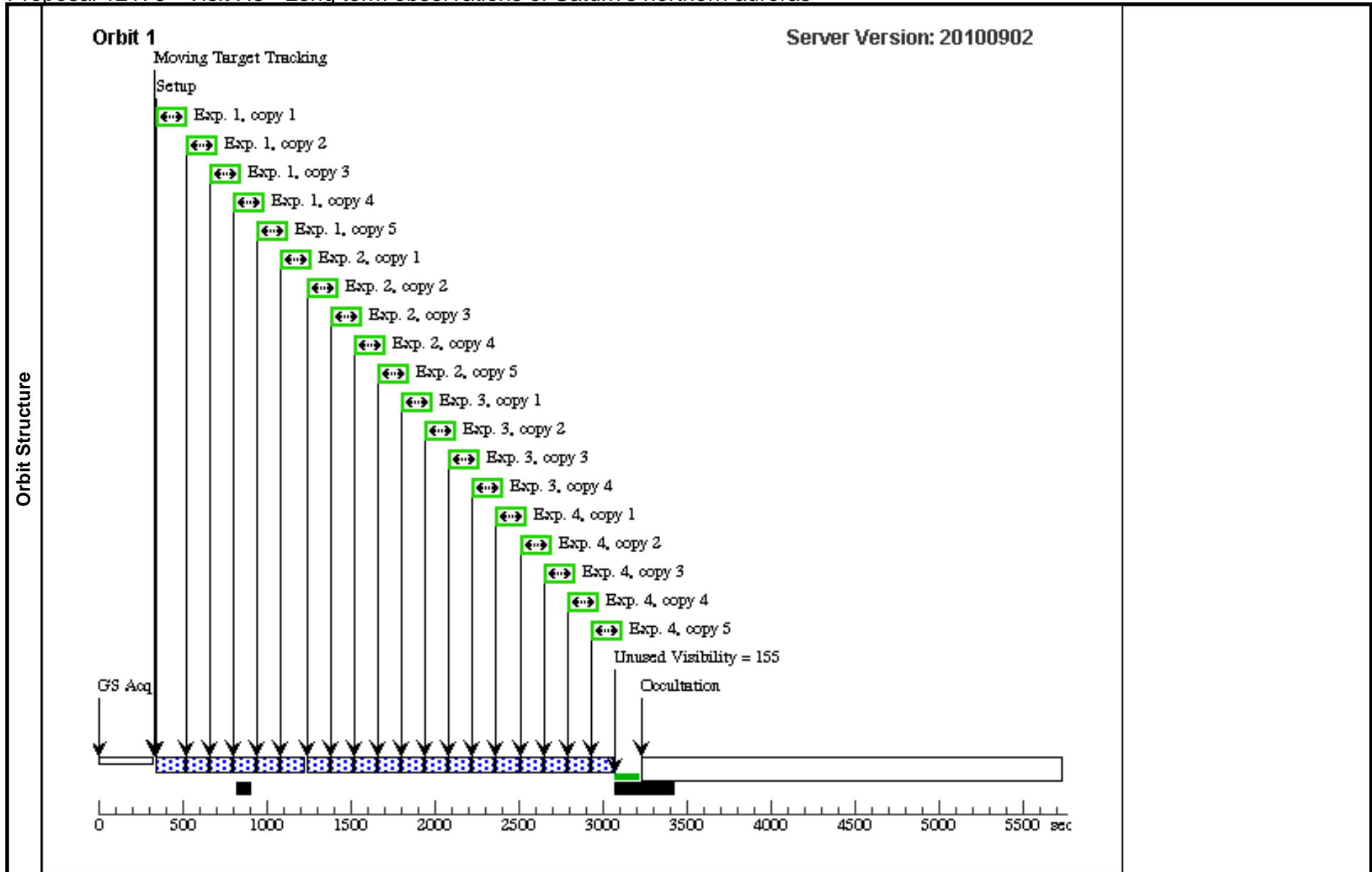
Proposal 12176 - Visit H3 - Long term observations of Saturn's northern auroras

Sat Feb 12 02:14:34 GMT 2011

<b>Visit</b>	<b>Proposal 12176, Visit H3, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: BETWEEN 05-APR-2011:00:00:00 AND 05-APR-2011:23:59:59 Comments: This visit is timed to occur ~2 days after visit H2.					

<b>Solar System Targets</b>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
	(1)	SATURN	STD=SATURN			SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"	EARTH

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP		GS ACQ SCENARI O BASE1B3		100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]
	2		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]
	3		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 4 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)]	[1]
	4		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [=>(Copy 1)] [=>(Copy 2)] [=>(Copy 3)] [=>(Copy 4)] [=>(Copy 5)]	[1]



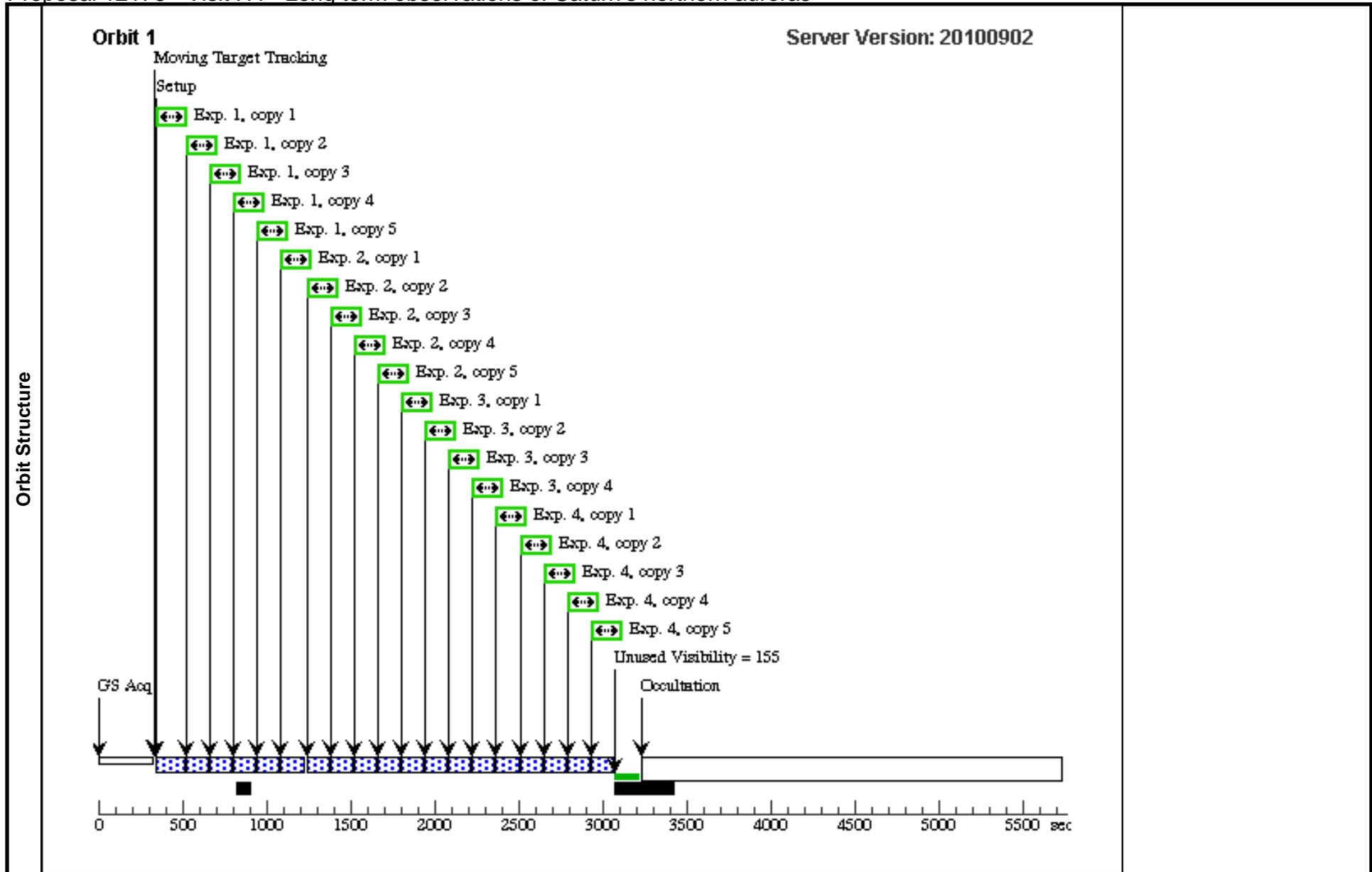
Proposal 12176 - Visit H4 - Long term observations of Saturn's northern auroras

Sat Feb 12 02:14:35 GMT 2011

<b>Visit</b>	<b>Proposal 12176, Visit H4, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: BETWEEN 07-APR-2011:00:00:00 AND 07-APR-2011:23:59:59 Comments: This visit is timed to occur ~2 days after visit H3. A related Cassini UVIS observation is also scheduled to occur on 7 April.						

<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Window</b>	<b>Ephem Center</b>
	(1)	SATURN	STD=SATURN			SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"	EARTH

<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>	<b>Orbit</b>
	1		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5	
									[==>(Copy 1)]	[1]
									[==>(Copy 2)]	
									[==>(Copy 3)]	
								[==>(Copy 4)]		
								[==>(Copy 5)]		
2		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP					100 Secs X 5	
								[==>(Copy 1)]	[1]	
								[==>(Copy 2)]		
								[==>(Copy 3)]		
								[==>(Copy 4)]		
								[==>(Copy 5)]		
3		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP					100 Secs X 4	
								[==>(Copy 1)]	[1]	
								[==>(Copy 2)]		
								[==>(Copy 3)]		
								[==>(Copy 4)]		
4		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP					100 Secs X 5	
								[==>(Copy 1)]	[1]	
								[==>(Copy 2)]		
								[==>(Copy 3)]		
								[==>(Copy 4)]		
								[==>(Copy 5)]		



Proposal 12176 - Visit H5 - Long term observations of Saturn's northern auroras

Sat Feb 12 02:14:35 GMT 2011

Visit	<b>Proposal 12176, Visit H5, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: BETWEEN 09-APR-2011:00:00:00 AND 09-APR-2011:23:59:59 <i>Comments: This visit is timed to occur ~2 days after visit H4. This visit contains the set of F140 images for this Cycle.</i>									
	Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center		
	(1)	SATURN	STD=SATURN				SEP OF SATURN RHEA FROM EARTH GT 10.0", SEP OF SATURN TITAN FROM EARTH GT 10.0"	EARTH		
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)]	[1]
	2		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F115LP				100 Secs X 5 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)]	[1]
	3		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F140LP				100 Secs X 4 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)]	[1]
	4		(1) SATURN	ACS/SBC, ACCUM, SBC-FIX	F125LP				100 Secs X 5 [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)]	[1]

