



12022 - The chemical composition of AGN outflows

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Jelle Kaastra (PI) (ESA Member)	Space Research Organization Netherlands	j.kaastra@sron.nl
Dr. Nahum Arav (CoI)	Virginia Polytechnic Institute and State University	arav@vt.edu
Dr. Stefano Bianchi (CoI)	University of Rome	bianchi@fis.uniroma3.it
Dr. Alex Blustin (CoI)	University of Cambridge	ajb@ast.cam.ac.uk
Dr. Graziella Branduardi-Raymont (CoI) (ESA Member)	University College London	gbr@star.ucl.ac.uk
Dr. Massimo Cappi (CoI) (ESA Member)	OSSERVATORIO ASTRONOMICCO DI BOLOGNA	cappi@bo.iasf.cnr.it
Dr. Elisa Costantini (CoI) (ESA Member)	Space Research Organization Netherlands	E.Costantini@sron.nl
Dr. Mauro Dadina (CoI)	OSSERVATORIO ASTRONOMICCO DI BOLOGNA	dadina@bo.iasf.cnr.it
Dr. Rob Detmers (CoI)	Space Research Organization Netherlands	r.g.detmers@sron.nl
Dr. Gerard A. Kriss (CoI) (AdminUSPI)	Space Telescope Science Institute	gak@stsci.edu
Dr. Gabrielle Ponti (CoI)	OSSERVATORIO ASTRONOMICCO DI BOLOGNA	ponti@iasfbo.inaf.it
Dr. Rebecca Smith (CoI)	MSSL	rans@mssl.ucl.ac.uk
Dr. Katrien Steenbrugge (CoI) (ESA Member)	University of Oxford	kcs@astro.ox.ac.uk
Dr. Cor de Vries (CoI)	Space Research Organization Netherlands	c.p.de.vries@sron.nl

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) MARK509	COS/FUV	5	16-Oct-2009 21:02:21.0	yes

<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>
02	(1) MARK509	COS/FUV	5	16-Oct-2009 21:02:43.0	yes

10 Total Orbits Used

ABSTRACT

We propose a simultaneous Chandra LETGS - HST/COS observation of the bright Seyfert 1 galaxy Mrk 509, within half a year from an approved large XMM-Newton monitoring campaign. Combining 180 ks LETGS time and 10 orbits of COS time with the XMM-Newton RGS spectrum, we will obtain accurate abundances of C, N, O, Ne, Si, S, and Fe over a broad range of ionisation parameter. This allows us to determine directly the contributions from various supernova types and intermediate mass stars to the chemical enrichment processes in galaxy cores. It also will reveal directly the chemical composition of the outflow that enriches the surrounding diffuse medium. Our team has successfully executed a similar abundances campaign on Mrk 279.

OBSERVING DESCRIPTION

We will observe the Seyfert 1 galaxy Mrk 509 using COS gratings G130M and G160M in a pair of visits, each 5 orbits, coordinated with a 180 ks Chandra observation tentatively scheduled for 3-6 December 2009. The HST observations should be scheduled within 4 days of the Chandra observations. If it would facilitate scheduling, we would consider splitting these observations into 4 visits of 2-3 orbits each.

Our S/N requirements are driven by the troughs of the CIII* 1176 (G130M) and CIV 1549 (G160M) absorption lines. An exposure that will satisfy the needed Ciii* and Civ S/N will be more than adequate to analyse the other troughs. This is due to the fact that the Civ troughs are both at a lower throughput spectral region in the G160M grating compared with the other lines and the doublets residual intensities are closer in value, which indicates a high degree of non-black saturation. Previous STIS echelle observations of Mrk 509 showed that the bottom of the Civ line is at a flux level of 0.46×10^{-14} erg cm⁻² s⁻¹. Due to the similar residual intensity values for the two doublet components, we need a S/N of 20 to derive an accurate solution for the column density as a function of velocity. Our experience shows that in this situation a S/N of 15 produces unacceptably large errors. For the Civ trough at 1603 Å, S/N=20 for $F=0.46 \times 10^{-14}$ erg cm⁻² s⁻¹ is achieved in 14300 seconds. For the Ciii*

(G130M exposure) we need a $S/N=50$ in order to detect and measure a trough with $\tau \sim 0.05$. This is because the Ciii* 977 trough in the FUSE spectrum has $\tau \sim 1$, and we expect Ciii* to be $\sim 5\%$ of this value. For the appropriate flux level at Ciii* 1176 (2×10^{-14} erg cm^{-2} s^{-1} at 1201 Å), a $S/N=50$ is achieved in 8200 seconds. Adding the two gratings exposures (plus necessary overheads) yields the requested 10 orbits HST COS observations.

We will do the observations in 2 visits of 5 orbits each, with 3 orbits of each visit devoted to G160M, and the remaining 2 orbits to G130M. Recent observations with the UV/Optical monitor on SWIFT as part of our coordinated observing campaign show Mrk 509 to have a UV flux of 5.6×10^{-14} at 2246 Å. This is near the historical mean, and using an average historical spectrum from low-resolution archival HST observations, we predict a flux at 1401 Å of 1.0×10^{-13} . This is too bright for an imaging targeting acq, so we will do a spectroscopic target acq using G130M.

We note that the current flux level of 1.0×10^{-13} at 1401 Å produces a bright object warning for G130M segment B, with 7046 cts/s, which exceeds the limit of 6000 cts/s for an irregularly variable object (see ETC ID COS172433). However, we note that the maximum historical flux for Mrk 509 was observed in 1984 using IUE at a level of 1.36×10^{-13} (see <http://joy.chara.gsu.edu/PEGA/IUE/ObjectTbl.cgi>). The next most recent high value was 1.1×10^{-13} in 1992. Thus, we do not expect that our observations would even come close to this value. Being conservative, and taking a normalization of 2.0×10^{-13} , 50% higher than the historical maximum observed flux, gives a G130M Segment B count rate of 13,735 counts per second (ETC ID COS172824). We would argue that using a value this high (half a magnitude above the brightest flux ever observed) qualifies as "predictable", and thus satisfies the corresponding screening limit of 15,000 cts/s.

Doing the BOT check in APT gives 3 alerts for the target, which is due to the galaxy surrounding the active nucleus. The galaxy itself is not an issue. See above for the nucleus itself.

There is a final alert for an "Unknown" object in the BOA. The unknown is a barely visible faint smudge, which we judge not to be an issue.

ADDITIONAL COMMENTS

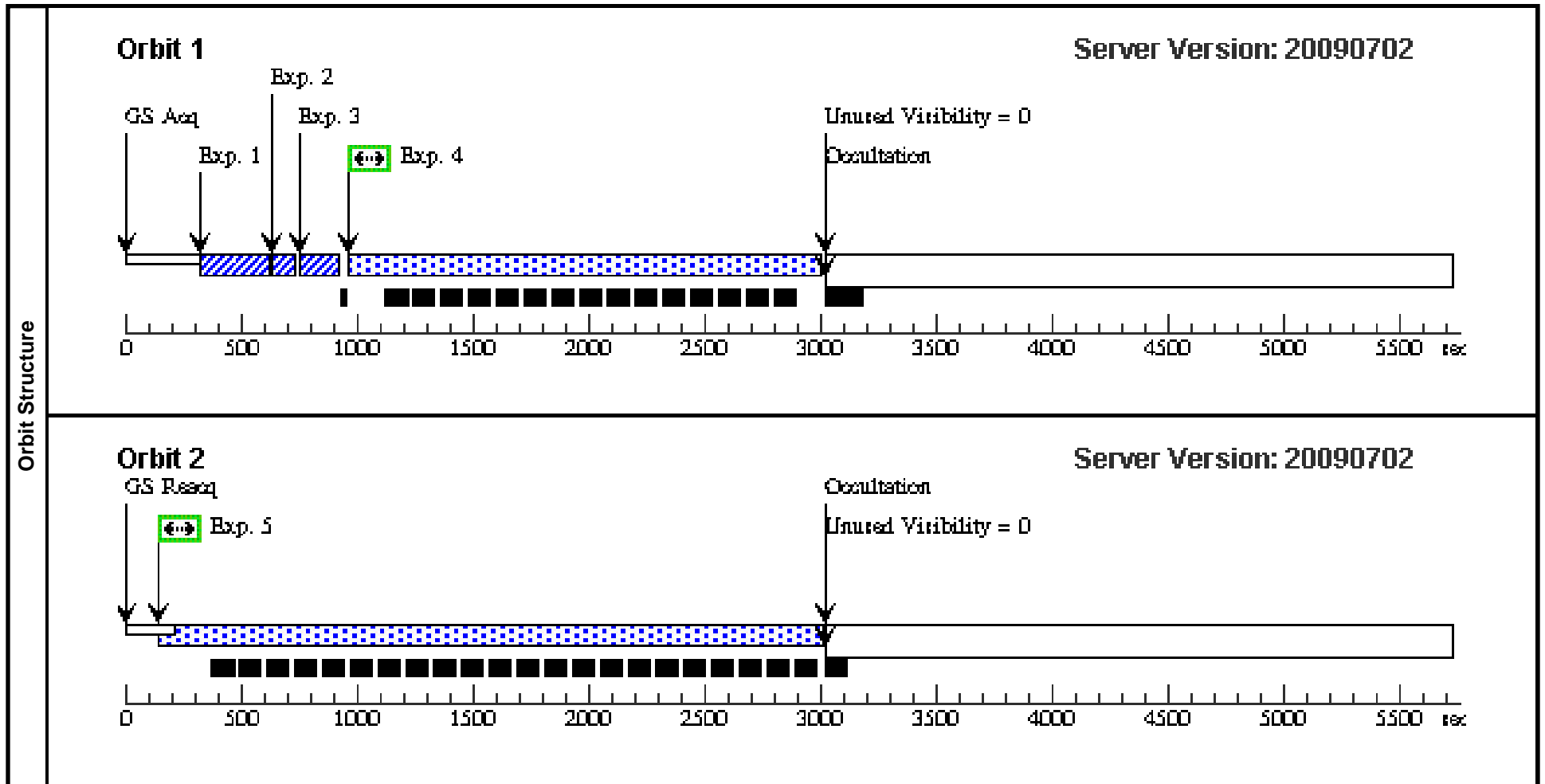
These observations are to be coordinated (within 4 days) with a 180 ks Chandra observation, tentatively scheduled for December 3-6, 2009. Thus, the two 5-orbit HST visits described here should be scheduled between November 30, 2009, and December 10, 2009. If it would aid scheduling, we would be willing to consider splitting these two visits into four visits of 2-3 orbits each, but would prefer not to in order to avoid the additional target

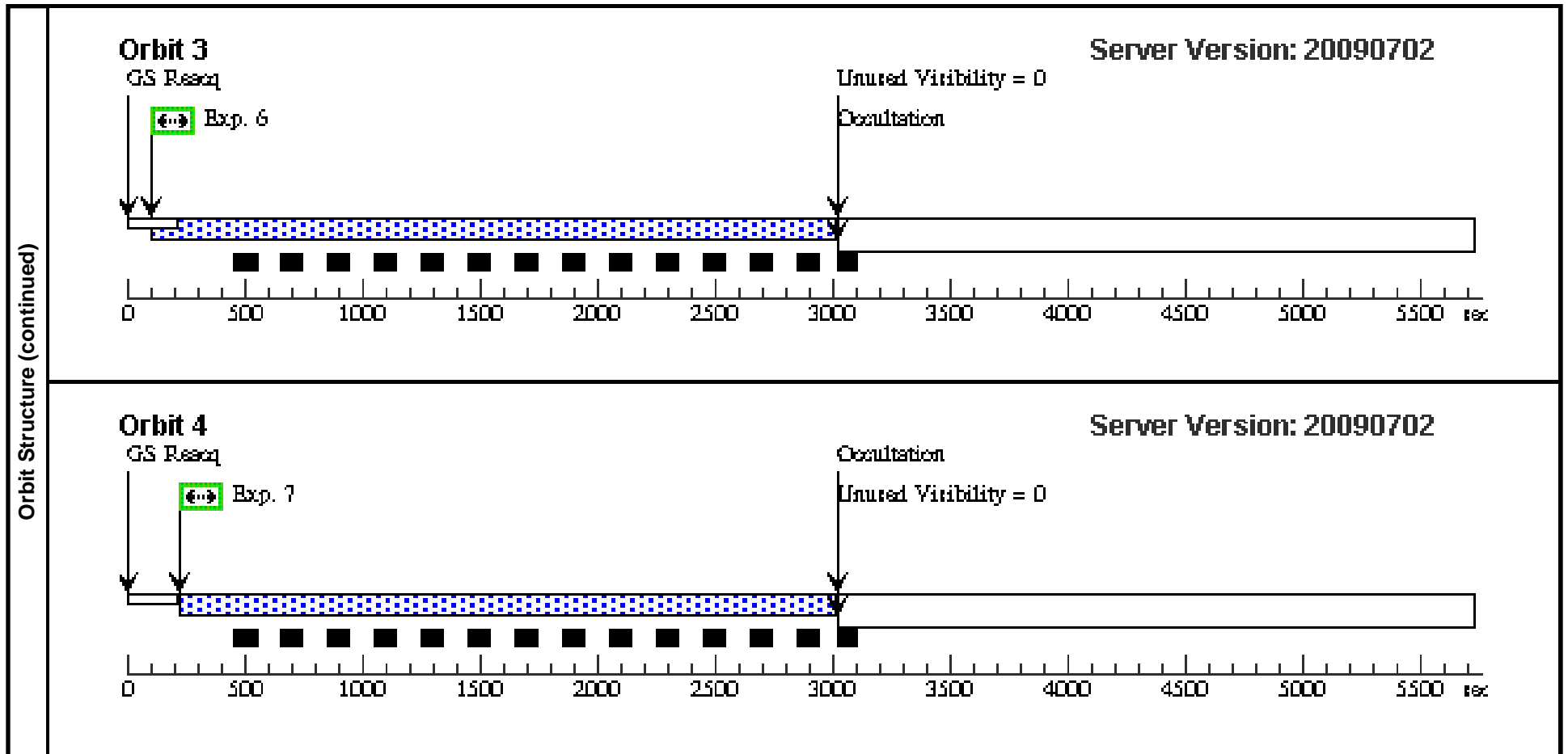
acquisition overheads.

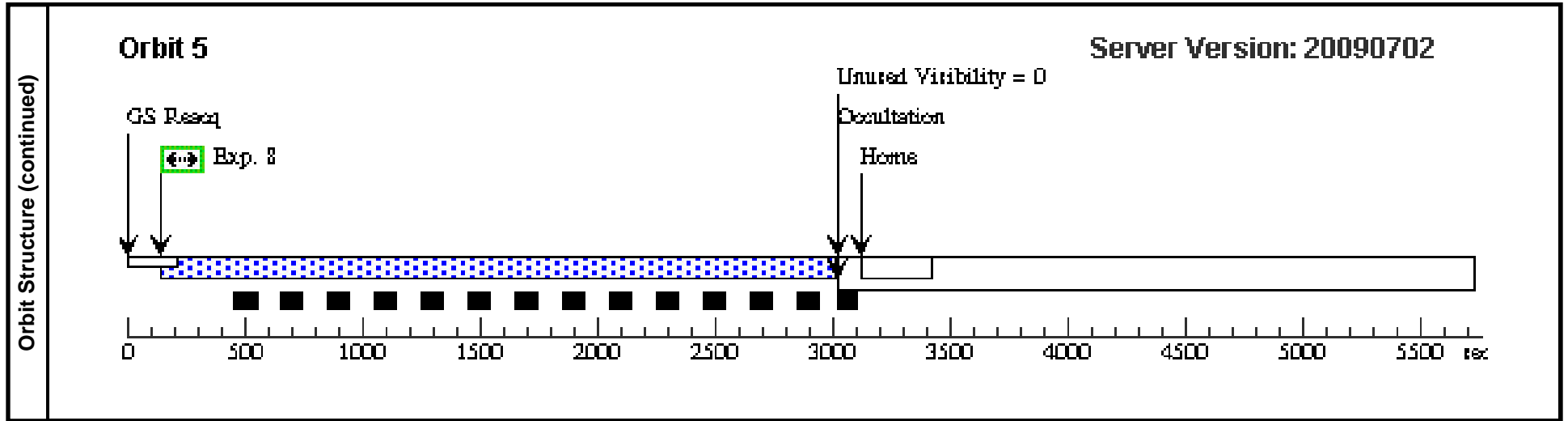
Proposal 12022 - Visit 01 - The chemical composition of AGN outflows

Sat Oct 17 01:02:50 GMT 2009

Visit	Proposal 12022, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: SCHED 100%; BETWEEN 30-NOV-2009:00:00:00 AND 01-JAN-2010:00:00:00 Comments: Use G130M for target acquisition to minimize overheads. To be conservative, use 50% of historical minimum flux to calculate target acq exposure times: $0.5 \times 4.1e-14 \Rightarrow 2.0e-14$ at 1401 A. For G130M/1309 this gives 0.942 s to get S/N = 40. (ETC ID COS172684). Use 1.0 s exposure times. For ACQ/SEARCH use default step size of 1.767 arc sec with a 3x3 pattern. Follow with PEAKXD, then PEAKD with CENTER=DEFAULT, NUM-POS=5, and STEP-SIZE=1.2 arc sec. For science observations, we want to place gaps to avoid major emission lines and absorption troughs. G130M/1309 and G130M/1327 will place gaps red-ward of N V, and give coverage past the peak of Si IV. The two together will give full wavelength coverage (no gaps) from 1150-1469 A. G160M/1577 and G160M/1589 will cover from the blue wing of Si IV and place gaps in the far blue wing of C IV. (There will be a small gap in the final total from 1568-1577. Don't want to use a redder grating setting for G160M to avoid placing a gap too near the absorption troughs at 1600 A in the C IV profile.)																																																																																										
	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>MARK509</td> <td>RA: 20 44 9.7600 (311.0406667d) Dec: -10 43 24.70 (-10.72353d) Equinox: J2000</td> <td></td> <td>V=13.12+/-0.5 1.0e-13 at 1401 A</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td colspan="6">Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	MARK509	RA: 20 44 9.7600 (311.0406667d) Dec: -10 43 24.70 (-10.72353d) Equinox: J2000		V=13.12+/-0.5 1.0e-13 at 1401 A	Reference Frame: ICRS	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.																																																																												
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Proposal 12022 - Visit 02 - The chemical composition of AGN outflows

Sat Oct 17 01:02:52 GMT 2009

Visit	Proposal 12022, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: SCHED 100%; BETWEEN 30-NOV-2009:00:00:00 AND 01-JAN-2010:00:00:00 <i>Comments: See Visit 1 comments. Overall strategy for Visit 2 is identical.</i>									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	MARK509	RA: 20 44 9.7600 (311.0406667d) Dec: -10 43 24.70 (-10.72353d) Equinox: J2000		V=13.12+/-0.5 1.0e-13 at 1401 A	Reference Frame: ICRS				
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	2	(1) MARK509		COS/FUV, ACQ/PEAKXD, PSA	G130M 1309 A				1.0 Secs [==>]	[1]
	3	(1) MARK509		COS/FUV, ACQ/PEAKD, PSA	G130M 1309 A	NUM-POS=5; STEP-SIZE=1.2			1.0 Secs [==>]	[1]
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