12162 - A Definitive Gas-Dynamical Measurement of the Black Hole Mass in M87

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) M-87	STIS/CCD	5	08-Jul-2010 21:31:45.0	yes

5 Total Orbits Used

ABSTRACT

M87 contains the most massive black hole that has been detected dynamically in any nearby galaxy, and it provides a crucial anchor for the uppermost end of the correlations between black hole mass and host galaxy properties. However, the best current measurements of the black hole mass from stellar dynamics and from the dynamics of the circumnuclear ionized gas disk disagree by a factor of 2, and the discrepancy is significant at the 3-sigma level. Since M87 provides crucial information on the top of the M-sigma relation, it is important to determine the cause of this disagreement and to resolve this discrepancy.

Our goal is to improve the gas-dynamical measurement of the central mass of M87. This work will improve on the past measurements by (a) fully mapping out the kinematic structure of the nuclear emission-line disk, and (b) carrying out comprehensive dynamical modeling, including the

possible effects of pressure support or asymmetric drift, which were not considered in past measurements for M87. To accomplish this, we propose to obtain new STIS G750M spectra with the 52X0.1 slit, at five parallel and contiguous positions covering the inner portion of the nuclear disk. Our kinematic measurements and dynamical modeling will provide one of the best comparison tests between gas and stellar dynamical measurements of black hole masses, and an important new constraint on the upper end of the M-sigma relation.

OBSERVING DESCRIPTION

Our goal is to map out the kinematic structure of the nuclear disk in M87 using 5 parallel slit positions with STIS. We will use the 52X0.1E1 aperture, and the G750M grating with wavelength setting 6581 to cover the H-alpha and [NII] emission lines. In order to have the slit PA close to the disk's kinematic major axis at PA=38deg (within + or - 15deg of this PA), we require the ORIENT parameter for our visit to be between 68-98deg or between 248-278deg. We will do a standard point source acquisition and peakup, since the central AGN in M87 is very compact and pointlike. Using the previous STIS acquisition image from program GO-8666 as a reference, we find that 10 sec is a good exposure time for the acquisition image, and we will use 15 sec for the peakup exposure time in the 0.1 arcsec slit. We aim to obtain approximately 1 orbit of exposure time at each of the 5 parallel slit positions, and at each position we will use a STIS-ALONG-SLIT pattern to dither for cosmic-ray and bad pixel cleaning. Following the peakup in the first orbit, we will obtain 3 dithered exposures with the slit at the nucleus, and then in orbit 2 we will obtain 2 additional dithered exposures at the nuclear position in order to improve the S/N at the important central slit position covering the nucleus. After that, during orbit 2 we will then offset by +0.2 arcsec in x using a POS-TARG move and obtain 3 exposures at the +0.2 offset position. For orbits 3, 4, and 5, we will begin each orbit with a POS-TARG offset to move to a new slit position (+0.1, -0.1, and -0.2 arcsec in x), and then use a 4-point STIS-ALONG-SLIT dither pattern at each offset position, obtaining a full orbit of integration at each of these 3 positions. Each orbit will include an auto-wavecal.

Visit

Proposal 12162, Visit 01 Fri Jul 09 01:31:54 GMT 2010

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 68D TO 98 D; ORIENT 248D TO 278 D

Diagnostics

(Visit 01) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE
(Visit 01) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE
(Visit 01) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE
(Visit 01) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=3 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(3), (5)
(2)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=2 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(4)
(3)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=4 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(6), (7), (8)

Fixed Targets

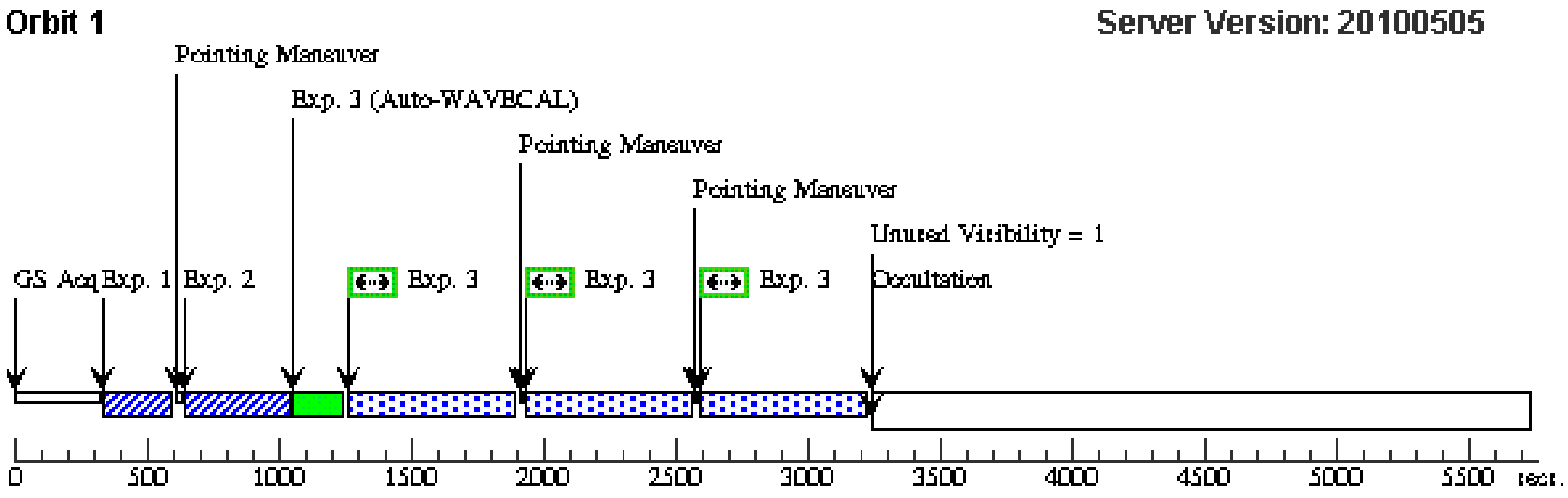
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-87	RA: 12 30 49.4234 (187.7059308d) Dec: +12 23 28.04 (12.39112d) Equinox: J2000	Redshift: 0.004360	V=8.63	Reference Frame: ICRS

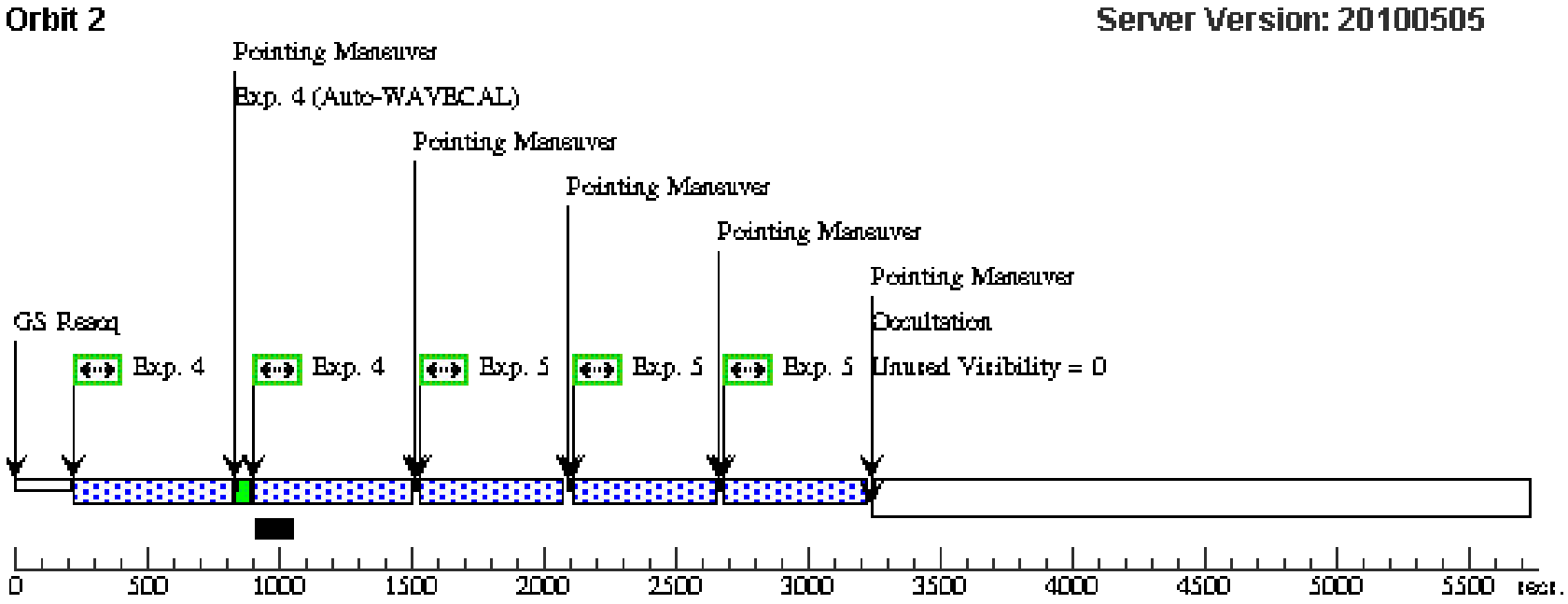
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates confirmed with 2MASS image.

Exposures

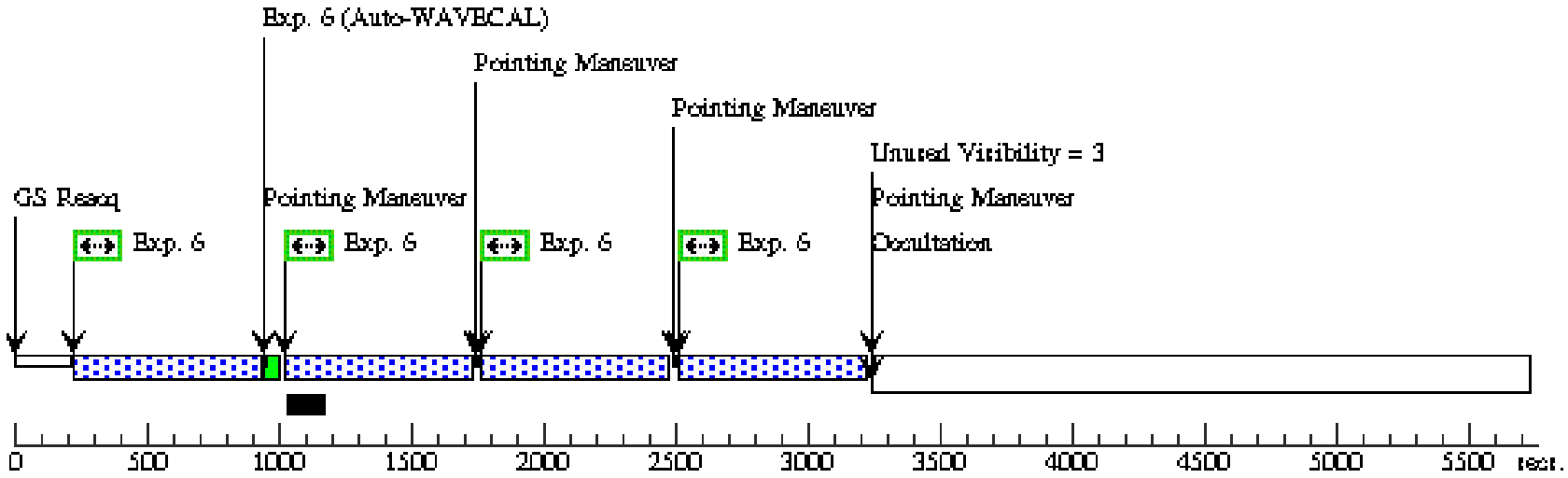
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) M-87	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs	
								[==>]	***[1]***
2		(1) M-87	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				15 Secs	
								[==>]	***[1]***
3	Nuc 1	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG 0,0	Pattern 1, Exps 3-3 (1)	597 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
4	Nuc 2	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG 0,0.3	Pattern 2, Exps 4-4 (2)	560 Secs	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
5	Offset +0.2	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG 0.2,0	Pattern 1, Exps 5-5 (1)	507 Secs	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
6	Offset +0.1	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG 0.1,0	Pattern 3, Exps 6-6 (3)	677 Secs	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
7	Offset -0.1	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG -0.1,0	Pattern 3, Exps 7-7 (3)	677 Secs	
								[==>(Pattern 1)]	***[4]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
8	Offset -0.2	(1) M-87	STIS/CCD, ACCUM, 52X0.1E1	G750M 6581 A	CR-SPLIT=NO	POS TARG -0.2,0	Pattern 3, Exps 8-8 (3)	677 Secs	
								[==>(Pattern 1)]	***[5]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	

Orbit Structure





Orbit 3 **Server Version: 20100505**



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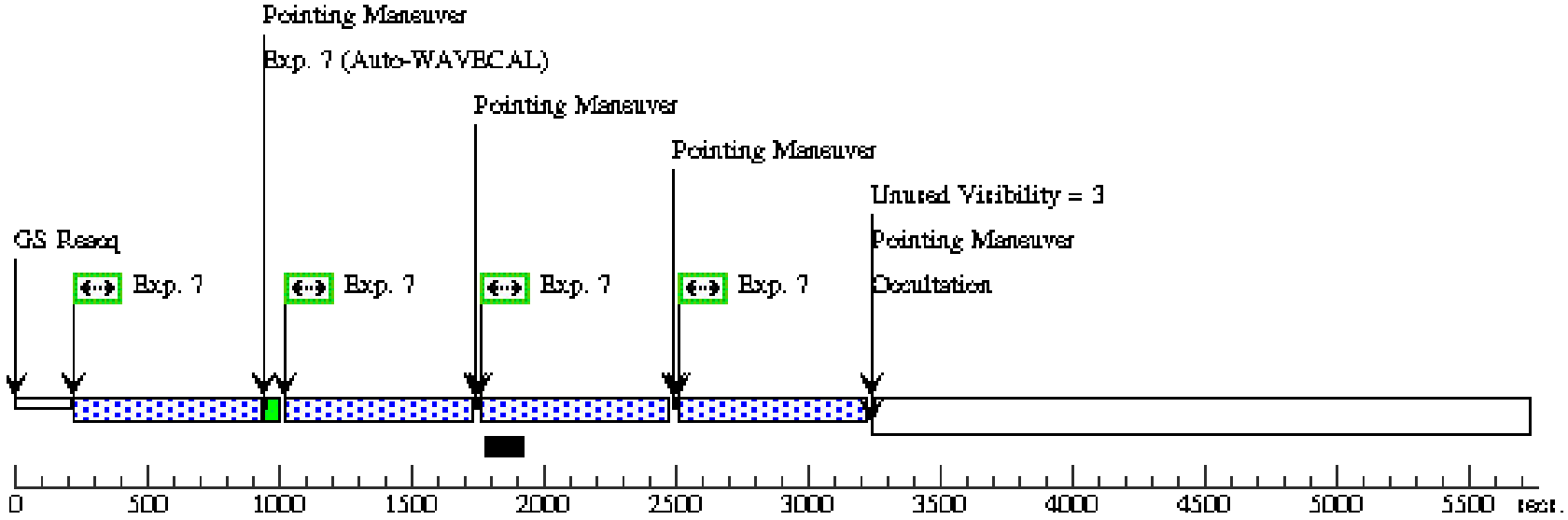

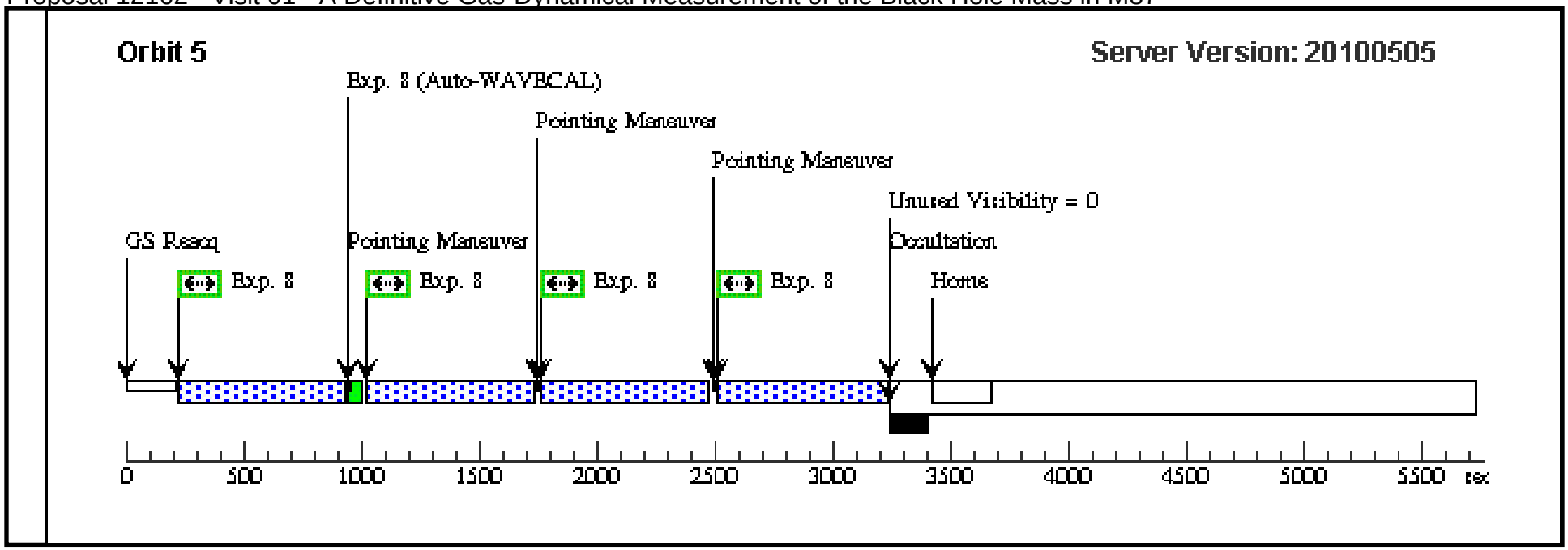
Orbit 5
Server Version: 20100505
Exp. 8 (Auto-WAVECAL)
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 0
GS Reacq
Pointing Maneuver
Occultation
Exp. 8
Exp. 8
Exp. 8
Exp. 8
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec