# 14047 - Confirming the AGN in a Low-Metallicity Dwarf Galaxy with the HSA and HST

Cycle: 22, Proposal Category: GO

(Availability Mode: SUPPORTED)

**INVESTIGATORS**

| *Name* | *Institution* | *E-Mail* |
|---|---|---|
| **Dr. Amy E. Reines (PI) (Contact)** | **University of Michigan** | **reines@umich.edu** |
| Dr. Adam Travis Deller (CoI) (ESA Member) | Stichting Astronomisch Onderzoek in Nederland (ASTRON) | deller@astron.nl |


**VISITS**

| *Visit* | *Targets used in Visit* | *Configurations used in Visit* | *Orbits Used* | *Last Orbit Planner Run* | *OP Current with Visit?* |
|---|---|---|---|---|---|
| 01 | (1) MRK709 | WFC3/IR<br>WFC3/UVIS | 2 | 27-Feb-2015 21:03:10.0 | yes |

2 Total Orbits Used

**ABSTRACT**

The incidence and properties of present-day dwarf galaxies hosting massive black holes (BHs) can provide important constraints on the origin of high-redshift BH seeds. Reines et al. (2014) have recently identified a candidate AGN in the low-metallicity dwarf galaxy pair Mrk 709. The case for an accreting massive BH is strong (co-spatial central VLA and Chandra point sources), but not watertight. Moreover, very little is known about the environment in which the BH is growing. The primary goal of our proposal is to confirm (or refute) the presence of this candidate AGN by using the HSA (VLBA+VLA+GBT) to detect a compact, high brightness temperature radio core. We also aim to characterize the host galaxy using HST optical and near-IR observations. In particular, we will determine if the AGN lives in a bulge and investigate the star formation in the immediate vicinity of the BH. Confirming the AGN and probing any potential impact on its host galaxy is only possible using deep, high-resolution observations

with the HSA and HST. The results from these observations will have important implications for the birth and growth of the first high-redshift BHs.

**OBSERVING DESCRIPTION**

We will obtain optical and near-IR observations of Mrk 709 with WFC3. The galaxy will be imaged in 3 filters: IR F110W, UVIS F680N, and UVIS F621M. For each filter, we will obtain 4 dithered exposures to facilitate cosmic-ray rejection, avoid bad pixels, and improve the PSF sampling.

According to the WFC3/IR exposure time calculator, we need ~ 7 minutes in F110W to reach a 10-sigma surface-brightness sensitivity of mu_r ~ 23 mag arcsec^2 in a given pixel, which will allow us to adequately decouple bulge and disk components on small scales. We will use the timing sequence STEP25 with NSAMP=9 (~100 s per exposure) and use the IRSUB512 subarray to avoid buffer dumps. Our target galaxy is quite compact so using a subarray will not compromise our science or limit our sky subtraction.

Requisite exposure times in F680N (redshifted H-alpha filter) and F621M (~r-band continuum) are based on the SDSS spectrum of Mrk 709 S. In this 3" aperture, we measure an H-alpha flux of 8.0 x 10^-14 erg/s/cm^2 and a continuum flux density of F6200 = 4.5 x 10^-16 erg/s/cm^2/A. To reach a signal-to-noise ratio of ~20-25 per pixel, the WFC3/UVIS exposure time calculator suggests we need ~25 and ~30 minutes in F680N and F621M, respectively. We will use the 2k x 2k subarray with chip 2 to avoid buffer dumps and reduce readout overhead. We will also use a post-flash to avoid poor charge transfer efficiency.

## Visit

**Proposal 14047, Visit 01** Sat Feb 28 02:03:11 GMT 2015

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR, WFC3/UVIS

Special Requirements: (none)

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFC3-UVIS-DITHER-BOX<br>Purpose=DITHER<br>Number Of Points=4<br>Point Spacing=0.173<br>Line Spacing=0.112 | Coordinate Frame=POS-TARG<br>Pattern Orientation=23.884<br>Angle Between Sides=81.785<br>Center Pattern=false | | (1), (2) |
| (2) | Pattern Type=WFC3-IR-DITHER-BOX-MIN<br>Purpose=DITHER<br>Number Of Points=4<br>Point Spacing=0.572<br>Line Spacing=0.365 | Coordinate Frame=POS-TARG<br>Pattern Orientation=18.528<br>Angle Between Sides=74.653<br>Center Pattern=false | | (3) |

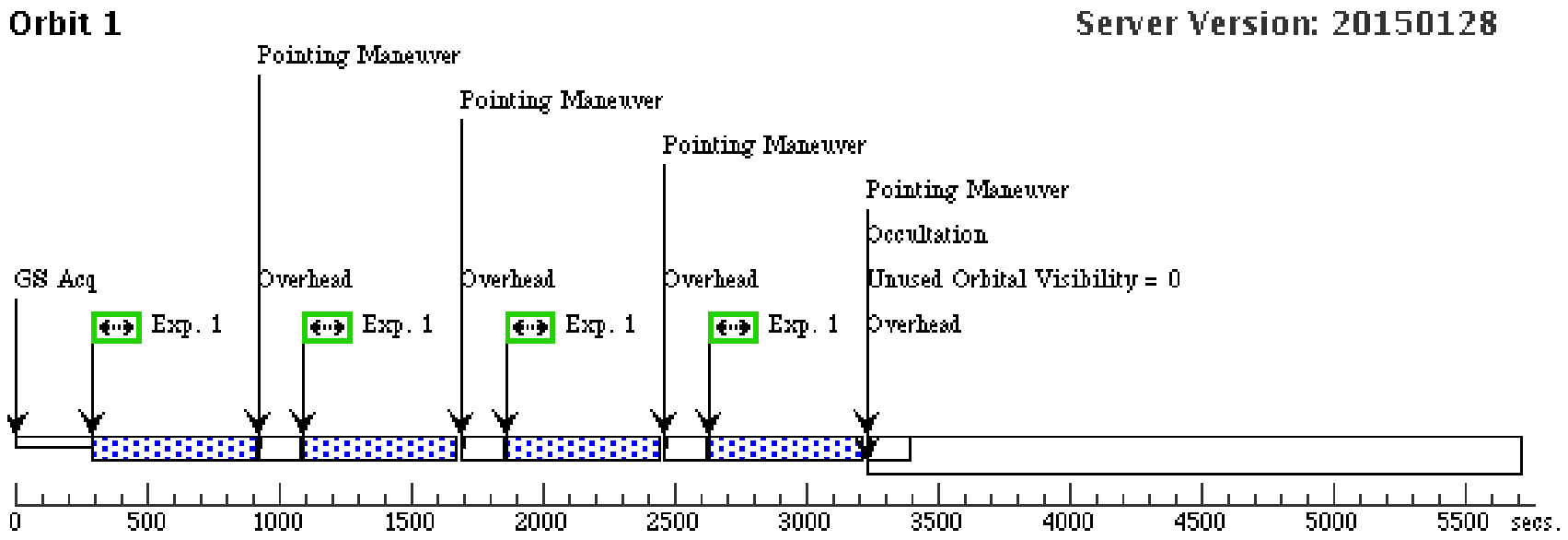
## Fixed Targets

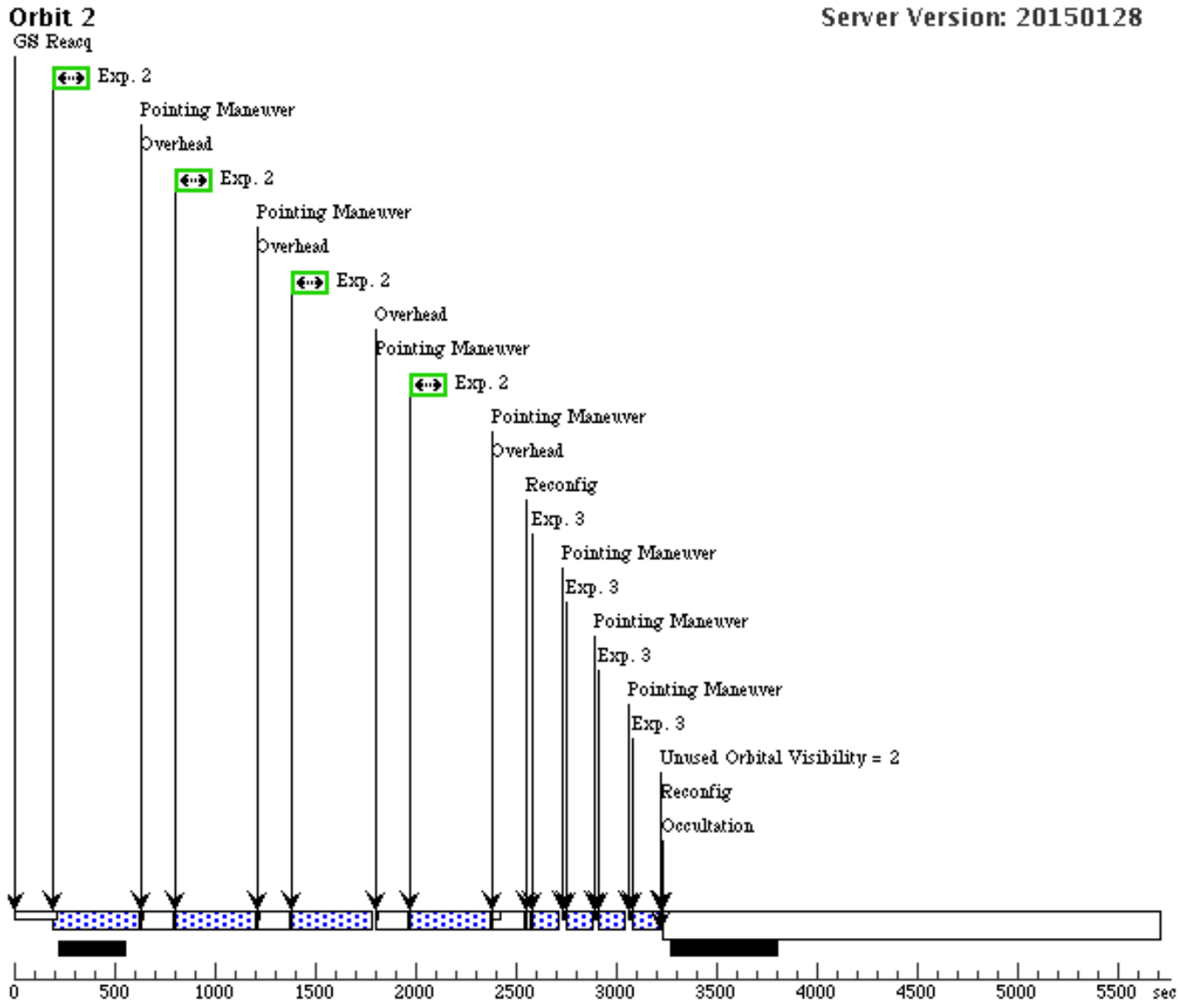
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | MRK709 | RA: 09 49 18.0300 (147.3251250d)<br>Dec: +16 52 44.20 (16.87894d)<br>Equinox: J2000 | Redshift: 0.052 | V=(?)<br>R (Cousins) = 15.65 mag | Reference Frame: ICRS |

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | H-alpha | (1) MRK709 | WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB | F680N | FLASH=7 | | Pattern 1, Exps 1-1 in Visit 01 (1) | 586 Secs (2344 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |
| 2 | F621M | (1) MRK709 | WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB | F621M | FLASH=6 | | Pattern 1, Exps 2-2 in Visit 01 (1) | 403 Secs (1612 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[2]*** |
| 3 | F110W | (1) MRK709 | WFC3/IR, MULTIACCUM, IRSUB512 | F110W | SAMP-SEQ=STEP25;<br>NSAMP=9 | | Pattern 2, Exps 3-3 in Visit 01 (2) | 105.518395 Secs (422.074 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[2]*** |

Orbit Structure




Orbit 2
Server Version: 20150128
GS Reacq
Exp. 2
Pointing Maneuver
Overhead
Exp. 2
Pointing Maneuver
Overhead
Exp. 2
Overhead
Pointing Maneuver
Exp. 2
Pointing Maneuver
Overhead
Reconfig
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Unused Orbital Visibility = 2
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec