



# 14844 - Dust to Dust: Monitoring the Evolution of a New Class of Self-Obscured Transients

Cycle: 24, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

| <i>Name</i>                                 | <i>Institution</i>                 | <i>E-Mail</i>                             |
|---------------------------------------------|------------------------------------|-------------------------------------------|
| <b>Dr. Chris S. Kochanek (PI) (Contact)</b> | <b>The Ohio State University</b>   | <b>ckochanek@astronomy.ohio-state.edu</b> |
| Mr. Scott Adams (CoI)                       | California Institute of Technology | smadams@caltech.edu                       |

## 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           | (3) SN-2008S                 | WFC3/IR                             | 1                  | 09-Nov-2016 12:29:46.0        | yes                           |
| 02           | (4) NAME-NGC-300-OT2008-1    | WFC3/IR                             | 1                  | 09-Nov-2016 12:29:47.0        | yes                           |

2 Total Orbits Used

## ABSTRACT

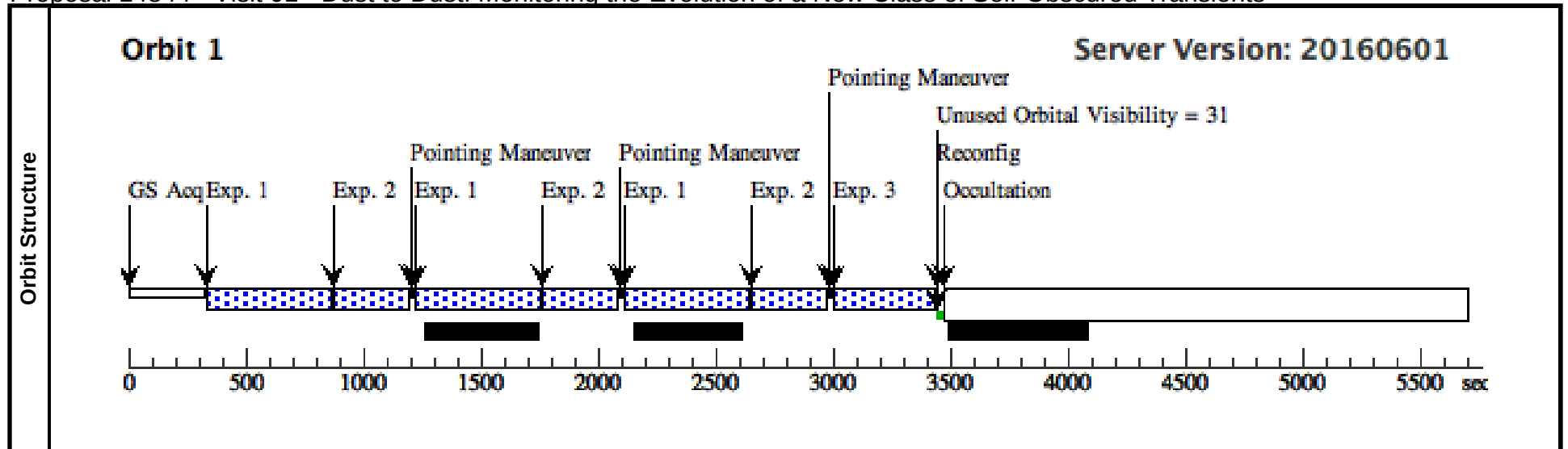
The goal of this proposal is to understand a new class of explosive transients associated with the most massive AGB stars. Today these sources are true creatures of the mid-IR, being optically invisible and very faint in the near-IR. By coarsely monitoring them with Spitzer and HST we can examine the evolution of the luminosity, dust optical depth and dust radius/temperature at a key time when their observed fluxes are approaching those of the two known progenitors. At its very simplest, if they do not stop fading in the mid-IR or start to brighten in the near-IR, then they are almost certainly examples of the theoretically expected but observationally missing electron capture supernovae (ecSNe). The exciting result from the last set of HST/Spitzer observations is that the sources continued to fade and two are clearly substantially fainter than their progenitors. If this continues, the ecSNe interpretation becomes far stronger.

## **OBSERVING DESCRIPTION**

The newly recognized SN2008S class of transients consists of some form of explosive transient, possibly an electron capture supernova, on heavily self-obscured  $\sim 10 M_{\odot}$  extreme AGB stars. After the transient they again cloak themselves with dust to be almost invisible in the near-IR while remaining very luminous in the mid-IR. The only way to determine their true natures is to continue following their evolution. We have allocated Spitzer time to follow their evolution, but the mid-IR data is not sensitive to the evolution of the dust optical depth. We propose observing 2 of these systems with WFC3/IR in the YJ (F110W) and H (F160W) bands. The near-IR emission comes from the underlying source (an expanding shock and/or a surviving star) and is absorbed by the surrounding dust, so the near-IR fluxes are exponentially sensitive to the evolution of the dust optical depth. For example, the optical depth from the observer through a dusty wind down to an expanding shock drops inversely with time, so we should begin to see these sources become brighter in the near-IR.

# Proposal 14844 - Visit 01 - Dust to Dust: Monitoring the Evolution of a New Class of Self-Obscured Transients

|               |                                                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
|---------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------|-------------------------------|---------------|-------------------------------------|----------------------------------------------------------|------------------------------|-----------|--|
| Visit         | Proposal 14844, Visit 01, implementation                                                                                   |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          | Wed Nov 09 17:29:48 GMT 2016 |           |  |
|               | Diagnostic Status: No Diagnostics                                                                                          |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
|               | Scientific Instruments: WFC3/IR                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
|               | Special Requirements: ORIENT 17.8D TO 74.4 D; ORIENT 107.8D TO 164.4 D; ORIENT 197.8D TO 254.4 D; ORIENT 287.8D TO 344.4 D |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
| Patterns      | #                                                                                                                          | Primary Pattern                                                                                                      |              |                                                                                     |                                                                                                         |                          | Secondary Pattern             |               |                                     |                                                          |                              | Exposures |  |
|               | (1)                                                                                                                        | Pattern Type=WFC3-IR-DITHER-LINE-3PT<br>Purpose=DITHER<br>Number Of Points=3<br>Point Spacing=0.605<br>Line Spacing= |              |                                                                                     | Coordinate Frame=POS-TARG<br>Pattern Orientation=41.788<br>Angle Between Sides=<br>Center Pattern=false |                          |                               |               |                                     |                                                          |                              | (1-2)     |  |
| Fixed Targets | #                                                                                                                          | Name                                                                                                                 |              | Target Coordinates                                                                  |                                                                                                         | Targ. Coord. Corrections |                               | Fluxes        |                                     | Miscellaneous                                            |                              |           |  |
|               | (3)                                                                                                                        | SN-2008S                                                                                                             |              | RA: 20 34 45.3300 (308.6888750d)<br>Dec: +60 05 58.40 (60.09956d)<br>Equinox: J2000 |                                                                                                         |                          |                               | V=26          |                                     | Reference Frame: ICRS                                    |                              |           |  |
|               | Comments: copied from previous HST observation phase 2 APT                                                                 |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
|               |                                                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |           |  |
| Exposures     | #                                                                                                                          | Label                                                                                                                | Target       | Config,Mode,Aperture                                                                |                                                                                                         | Spectral Els.            | Opt. Params.                  | Special Reqs. | Groups                              | Exp. Time (Total)/[Actual Dur.]                          |                              | Orbit     |  |
|               | 1                                                                                                                          |                                                                                                                      | (3) SN-2008S | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F160W                    | NSAMP=11;<br>SAMP-SEQ=STEP100 |               | Pattern 1, Exps 1-2 in Visit 01 (1) | 499.231969 Secs (1497.696 Secs)                          |                              |           |  |
|               |                                                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)] |                              | [1]       |  |
|               | 2                                                                                                                          |                                                                                                                      | (3) SN-2008S | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F110W                    | NSAMP=9;<br>SAMP-SEQ=STEP100  |               | Pattern 1, Exps 1-2 in Visit 01 (1) | 299.231323 Secs (897.694 Secs)                           |                              |           |  |
|               |                                                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)] |                              | [1]       |  |
|               | 3                                                                                                                          |                                                                                                                      | (3) SN-2008S | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F110W                    | NSAMP=10;<br>SAMP-SEQ=STEP100 |               |                                     | 399.231646 Secs (399.232 Secs)                           |                              |           |  |
|               |                                                                                                                            |                                                                                                                      |              |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>]                                                    |                              | [1]       |  |



# Proposal 14844 - Visit 02 - Dust to Dust: Monitoring the Evolution of a New Class of Self-Obscured Transients

|               |                                                            |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |       |
|---------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------|-------------------------------|---------------|-------------------------------------|----------------------------------------------------------|------------------------------|-------|
| Visit         | Proposal 14844, Visit 02, implementation                   |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          | Wed Nov 09 17:29:48 GMT 2016 |       |
|               | Diagnostic Status: No Diagnostics                          |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |       |
|               | Scientific Instruments: WFC3/IR                            |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |       |
|               | Special Requirements: (none)                               |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |       |
| Patterns      | #                                                          | Primary Pattern                                                                                                      |                           |                                                                                     |                                                                                                         |                          | Secondary Pattern             |               |                                     |                                                          | Exposures                    |       |
|               | (1)                                                        | Pattern Type=WFC3-IR-DITHER-LINE-3PT<br>Purpose=DITHER<br>Number Of Points=3<br>Point Spacing=0.605<br>Line Spacing= |                           |                                                                                     | Coordinate Frame=POS-TARG<br>Pattern Orientation=41.788<br>Angle Between Sides=<br>Center Pattern=false |                          |                               |               |                                     |                                                          | (1-2)                        |       |
| Fixed Targets | #                                                          | Name                                                                                                                 |                           | Target Coordinates                                                                  |                                                                                                         | Targ. Coord. Corrections |                               | Fluxes        |                                     | Miscellaneous                                            |                              |       |
|               | (4)                                                        | NAME-NGC-300-OT2008-1                                                                                                |                           | RA: 00 54 34.1600 (13.6423333d)<br>Dec: -37 38 28.60 (-37.64128d)<br>Equinox: J2000 |                                                                                                         |                          |                               | V=28          |                                     | Reference Frame: ICRS                                    |                              |       |
|               | Comments: copied from previous HST observation phase 2 APT |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     |                                                          |                              |       |
| Exposures     | #                                                          | Label                                                                                                                | Target                    | Config,Mode,Aperture                                                                |                                                                                                         | Spectral Els.            | Opt. Params.                  | Special Reqs. | Groups                              | Exp. Time (Total)/[Actual Dur.]                          |                              | Orbit |
|               | 1                                                          |                                                                                                                      | (4) NAME-NGC-300-OT2008-1 | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F160W                    | NSAMP=11;<br>SAMP-SEQ=STEP100 |               | Pattern 1, Exps 1-2 in Visit 02 (1) | 499.231969 Secs (1497.696 Secs)                          |                              |       |
|               |                                                            |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)] |                              | [1]   |
|               | 2                                                          |                                                                                                                      | (4) NAME-NGC-300-OT2008-1 | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F110W                    | NSAMP=9;<br>SAMP-SEQ=STEP100  |               | Pattern 1, Exps 1-2 in Visit 02 (1) | 299.231323 Secs (897.694 Secs)                           |                              |       |
|               |                                                            |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)] |                              | [1]   |
|               | 3                                                          |                                                                                                                      | (4) NAME-NGC-300-OT2008-1 | WFC3/IR, MULTIACCUM, IR                                                             |                                                                                                         | F110W                    | NSAMP=8;<br>SAMP-SEQ=STEP100  |               |                                     | 199.231 Secs (199.231 Secs)                              |                              |       |
|               |                                                            |                                                                                                                      |                           |                                                                                     |                                                                                                         |                          |                               |               |                                     | [==>]                                                    |                              | [1]   |

