# 15409 - Characterization of Distant Comet C/2017 K2 - One-orbit DD

Cycle: 25, Proposal Category: GO/DD

(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) C2017K2 | WFC3/UVIS | 1 | 15-Nov-2017 15:02:20.0 | yes |

1 Total Orbits Used

## ABSTRACT


C/2017 K2 is a newly-discovered, in-bound, long-period comet with perihelion at 1.8 AU, currently remarkably far away at 16 AU from the Sun (between the orbits of Saturn and Uranus). No active, pre-perihelion comet has ever been seen before at such large distances. The fact that it is active at such large distance on the inbound leg of the orbit is scientifically special because a) at 16 AU the comet is too cold (~70 K) for water ice (the normal driver of cometary activity) to sublimate b) temperatures are also too low for the leading alternate activity mechanism (the crystallization of amorphous ice) to occur and c) there is no possibility that heat from a previous perihelion is driving the activity. Either another volatile or another mechanism must be responsible. We obtained 1 DD orbit in late June to set the baseline characterization of this unique object and have written a paper about the results (Jewitt et al. 2017, ApJLett, in press). Based on the DD orbit we seek mid-cycle time to determine the effects of K2 crossing

the crystallization zone and to characterize the dust from a perspective above the orbit plane. We seek to bridge the gap before Cycle 26. These observations will provide important context for subsequent studies with HST and JWST as K2 moves towards perihelion in 2022.

**OBSERVING DESCRIPTION**

We request 4 mid-cycle orbits with WFC3-UVIS and the F350LP filter to image C/2017 K2. The F350LP provides maximum sensitivity to faint emission. In each orbit, we will obtain 6 images each of 285s duration, with a dither between groups of three in order to provide protection from chip and flat-field defects. Combination of the images allows the elimination of essential all cosmic ray tracks that otherwise would compromise the measurements. Our science objectives:

Objective 1) Determine the photometric and morphological changes in K2. Initial observations from the DDT proposal establish the status at 16 AU, when the out-of-plane angle was zero degrees. We propose two additional orbits at zero degrees (2017 Dec 20 and 2018 Jun 20) in order to identify changes free from the effects of observing geometry (the changing geocentric distance only affects the scale-factor). We want to know to what extent the changes in K2 represent the loss of interstellar frosting as opposed to other physical processes in the nucleus. Our first-look HST observations show a coma surface brightness gradient p = -1.00+/-0.01, indicating steady-state outflow. We infer (but did not measure) a very low coma expansion speed v ~ 1 m/s. Observations at the next plane-crossings will be used to assess the photometric and morphological stability of K2 at HST resolution, in particular providing measurements of the near-nucleus coma where evidence for changing mass loss rates are most evident in the coma surface brightness profile (p < -1 for activity ramping up, p > -1 for activity decreasing). As the activity ramps up, we expect to find the evidence first in the innermost coma, where HST resolution is essential. Sampling in 2017 December and 2018 June will give us ~6 month (1 AU) resolution and three points across the critical 13 to 16 AU zone where crystallization should occur, if the ice is amorphous. We will also be able to measure the expansion speed (a significant constraint on the mass loss mechanism) directly.

Objective 2) Determine the morphology of K2 from an out-of-plane perspective and use it to derive key dust parameters. Two orbits are requested to image K2 from the maximum (+4 and -4 degrees) out-of-plane perspectives, above (2017 October 1) and below (2018 March 28) the plane, respectively. High resolution images at both epochs will allow us to measure changes in the distribution of dust particles induced by radiation pressure. Deflection of the dust by radiation pressure allows us to make comparison with dust dynamics models to estimate dust parameters. Maximum elevation of the Earth above the orbital plane of K2 occurs on 2017 October and 2018 March, when the angle is +/- 4 degrees. This geometry will provide the best separation of syndyne and synchrone (Finson and Probstein 1968) type dust trajectories and hence the best constraints on the particle size (note: radiation pressure induces size-dependent spatial separation of particles in the orbital plane, which cannot be observed when the out-of-plane angle is small). Although the projection factor is still large (cosec(4) ~ 14), experience with HST on other comet-like bodies shows that we are still able to fit useful syndyne/synchrone models (e.g. Jewitt et al. 2015) by virtue of HSTs high spatial resolution. The phase angle changes slowly near the extrema in October and March, allowing a wider range of useful dates than in December and June.

Objective 3) Isolate the nucleus from the adjacent dust coma to estimate its size. This must be done using a convolution coma model to interpret the innermost surface brightness profile and to subtract off the effects of the coma. This is an extremely challenging measurement; our attempts with the data from 2017 June 27 hint at a nucleus detection but, out of caution, we only claim in Jewitt et al. (2017) an upper limit radius 9km. We would like to repeat the measurement using independent data to gain (or lose!) confidence in the result: a real nucleus should not change in cross-section between the repeated measurements. Knowing the nucleus radius will be important for understanding the relation between size and activity level, and may also impact the evolution and survival of the nucleus. Small nuclei, for instance, are much more susceptible to non-gravitational acceleration and spin-up torques than are large nuclei. No additional orbits are required for this objective: we will use the images acquired for Objectives 2 and 3.

We request the following four visits:
Visit 1: 2017 October 1 +/- 1 month *
Visit 2: 2017 December 20 +/- 3 weeks
Visit 3: 2018 March 28 +/- 1 month
Visit 4: 2018 June 20 +/- 3 weeks

* This program will execute the first visit (a bit later than optimal, but still good), and a separate program will execute the other 3 visits.

Proposal 15409 - Visit 01 - Characterization of Distant Comet C/2017 K2 - One-orbit DD

## Visit

**Proposal 15409, Visit 01, implementation**

Wed Nov 15 20:02:21 GMT 2017

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 28-NOV-2017:11:00:00 AND 29-NOV-2017:17:00:00

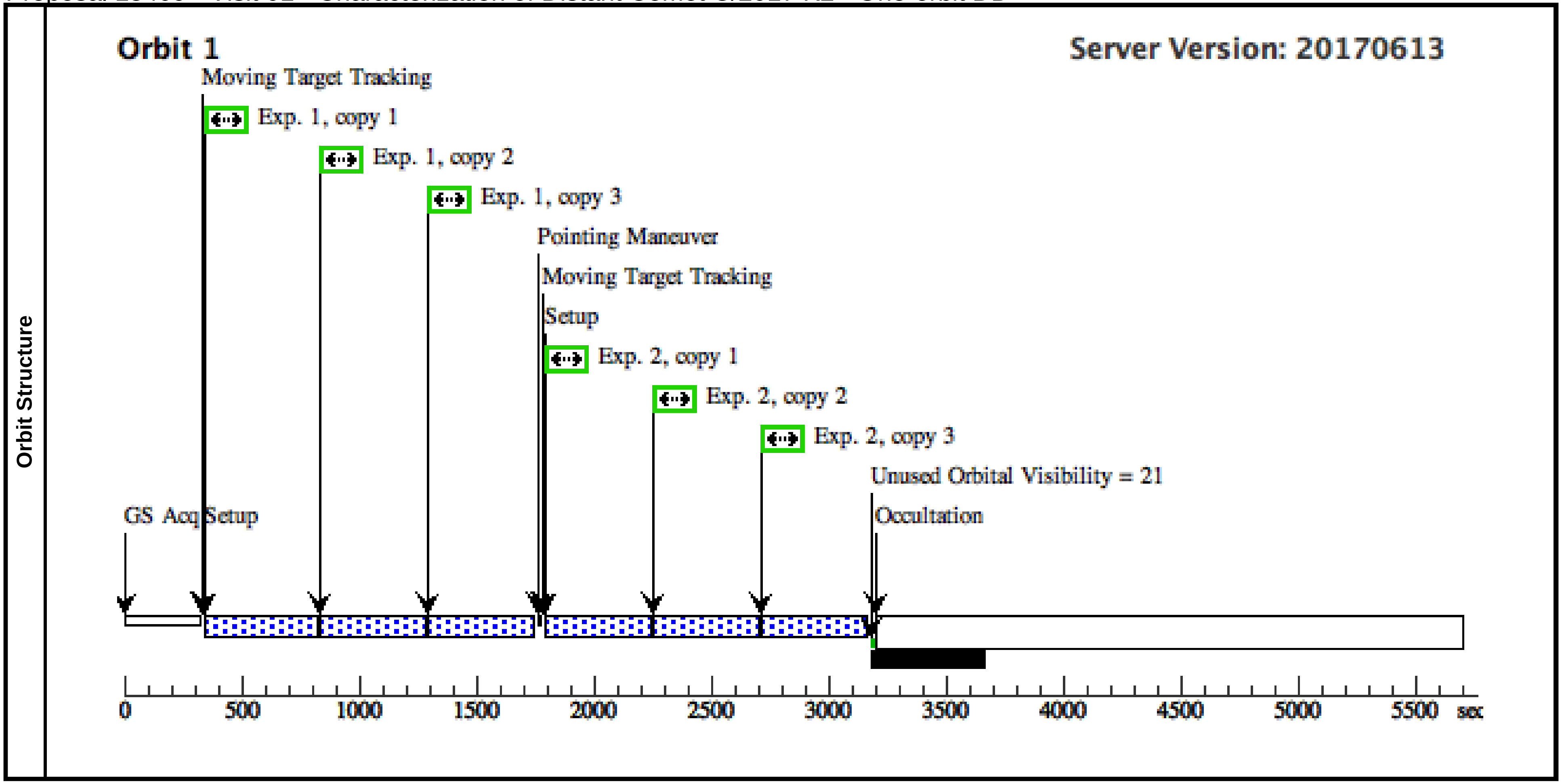
## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 | Window | Ephem Center |
|---|---|---|---|---|---|---|
| (1) | C2017K2 | TYPE=COMET,Q=1.811030889546204,E=1.000346103332712,I=87.55400232142784,O=88.17852322151948,W=236.0175806995972,T=21-DEC-2022:08:28:25,TTimeScale=TDB,EQUINOX=J2000,EPOCH=20-JUN-2017:00:00:00,EpochTimeScale=TDB | | | | EARTH |

*Comments: Extended=YES*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (1) C2017K2 | WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB | F350LP | CR-SPLIT=NO | | | 285 Secs X 3 (855 Secs) | |
| | | | | | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]* | ***[1]*** |
| 2 | | (1) C2017K2 | WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB | F350LP | CR-SPLIT=NO | POS TARG 0.4,0.4 | | 285 Secs X 3 (855 Secs) | |
| | | | | | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]* | ***[1]*** |


Orbit Structure
Orbit 1
Server Version: 20170613
Moving Target Tracking
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Pointing Maneuver
Moving Target Tracking
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Unused Orbital Visibility = 21
GS Acq
Setup
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec