National Aeronautics and Space Administration

Observing strategies for focused, faint orbital debris surveys using the Magellan telescope

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Magellan Baade Telescope

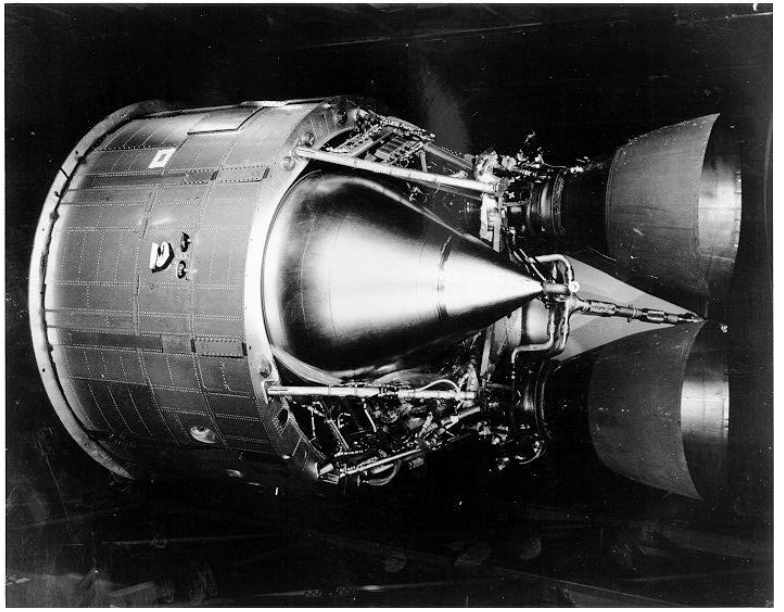
- 6.5 Meter Telescope located at Las Campanas Observatory

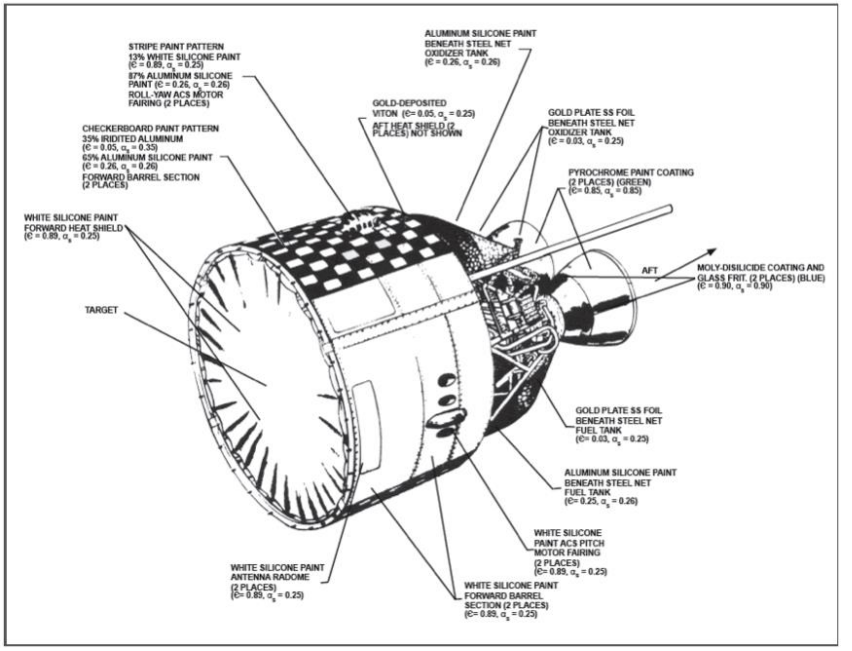
- 2 half nights granted for orbital debris studies
- Attempted a more focus debris search than previously

→ Searching specifically for small debris (<10cm) that may have come about from recent Titan Transtage breakup

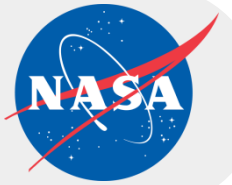
Titan Transtage Breakup

- **4 June at approximately 02:38 UT, a provisional breakup of a Titan 3C Transtage rocket body (SSN# 3692, International Designator 1969-013B) occurred**
- **>45 years after its launch**
- **The breakup has reportedly five observed fragments.**
- **This is the fourth breakup of this class**





Focused Search Strategy



- **Debris cloud produced using models**
- **Fragment orbits were propagated forward in time**
- **Expected debris cloud density was calculated for sky above Magellan over observing window**

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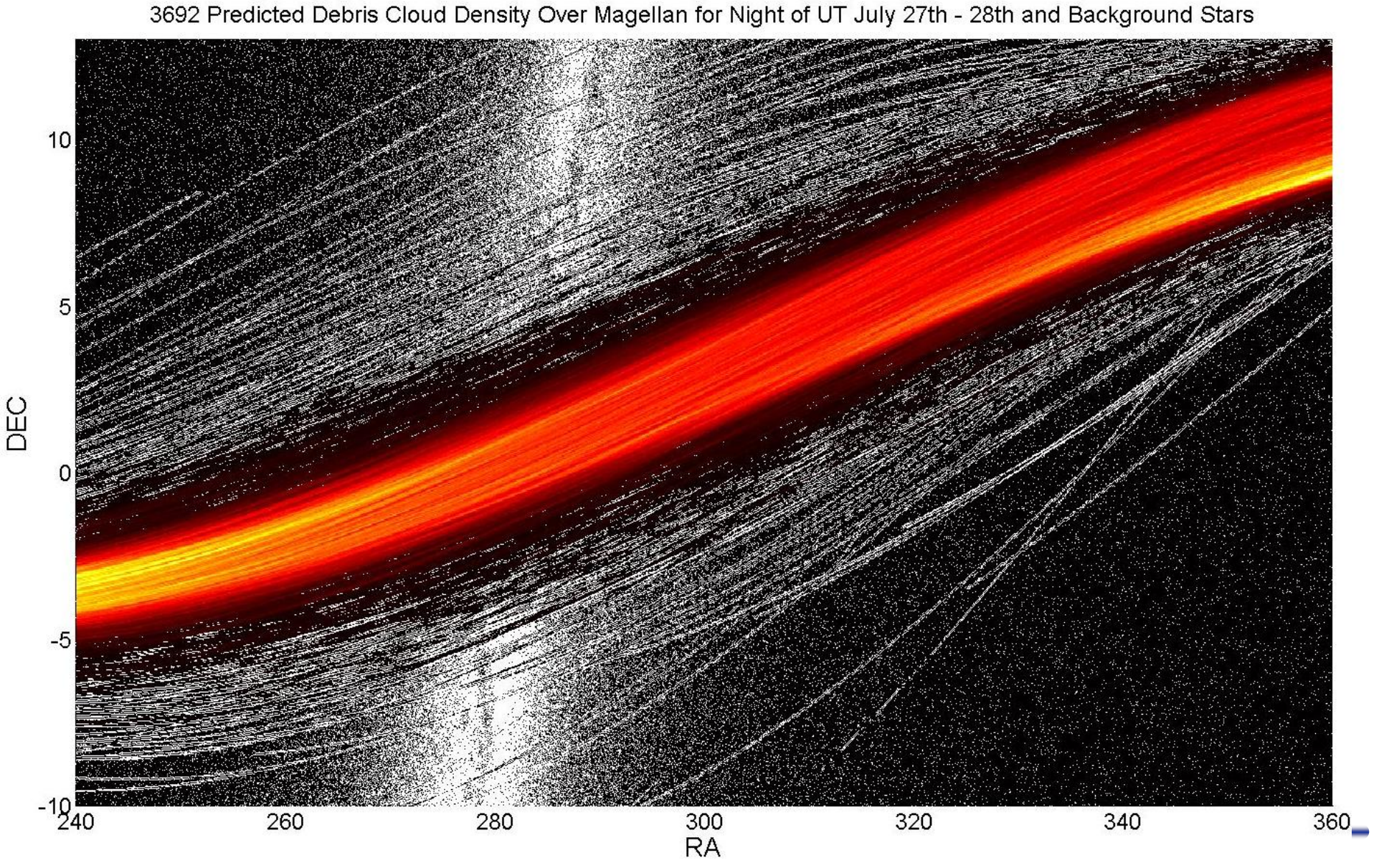
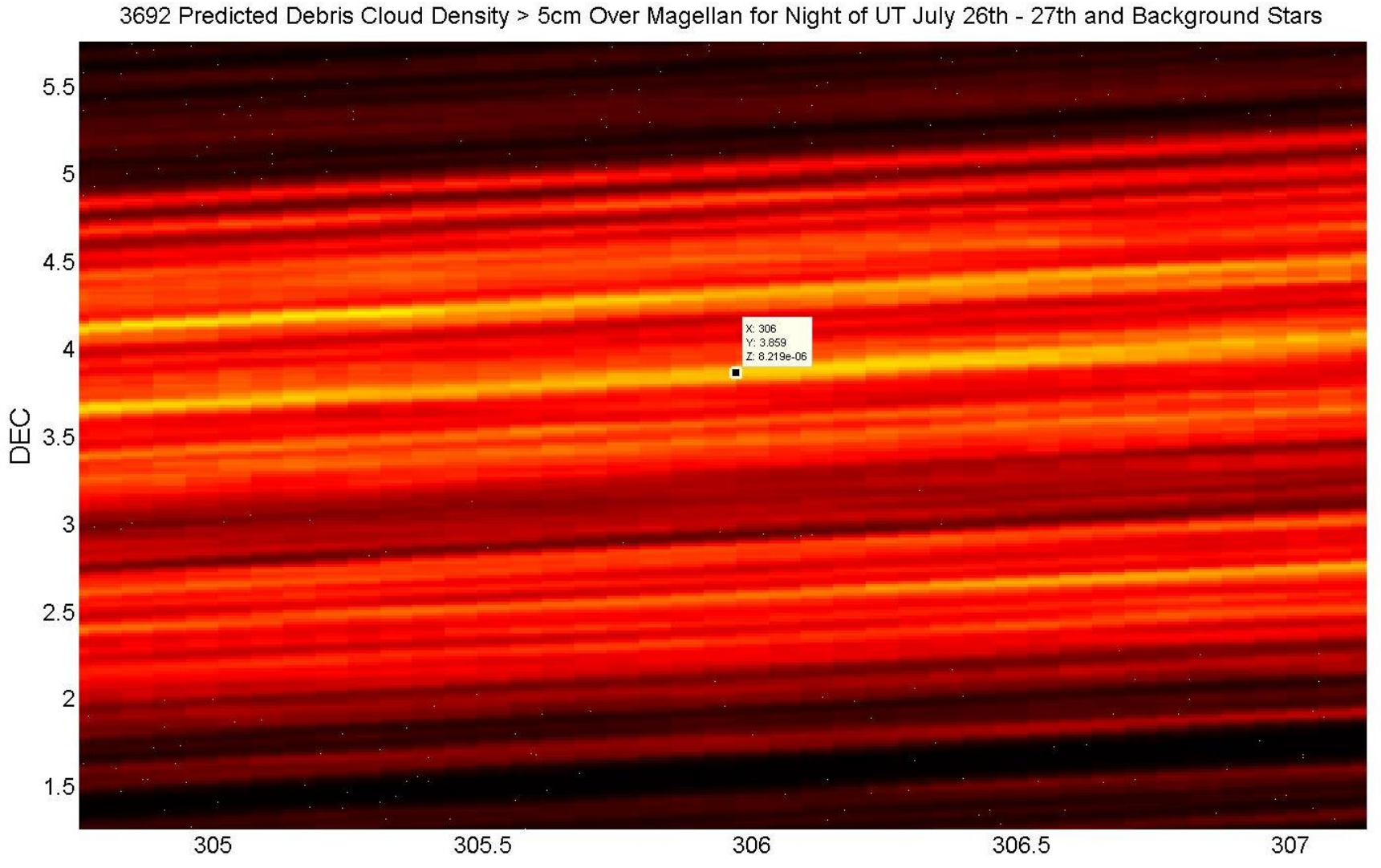
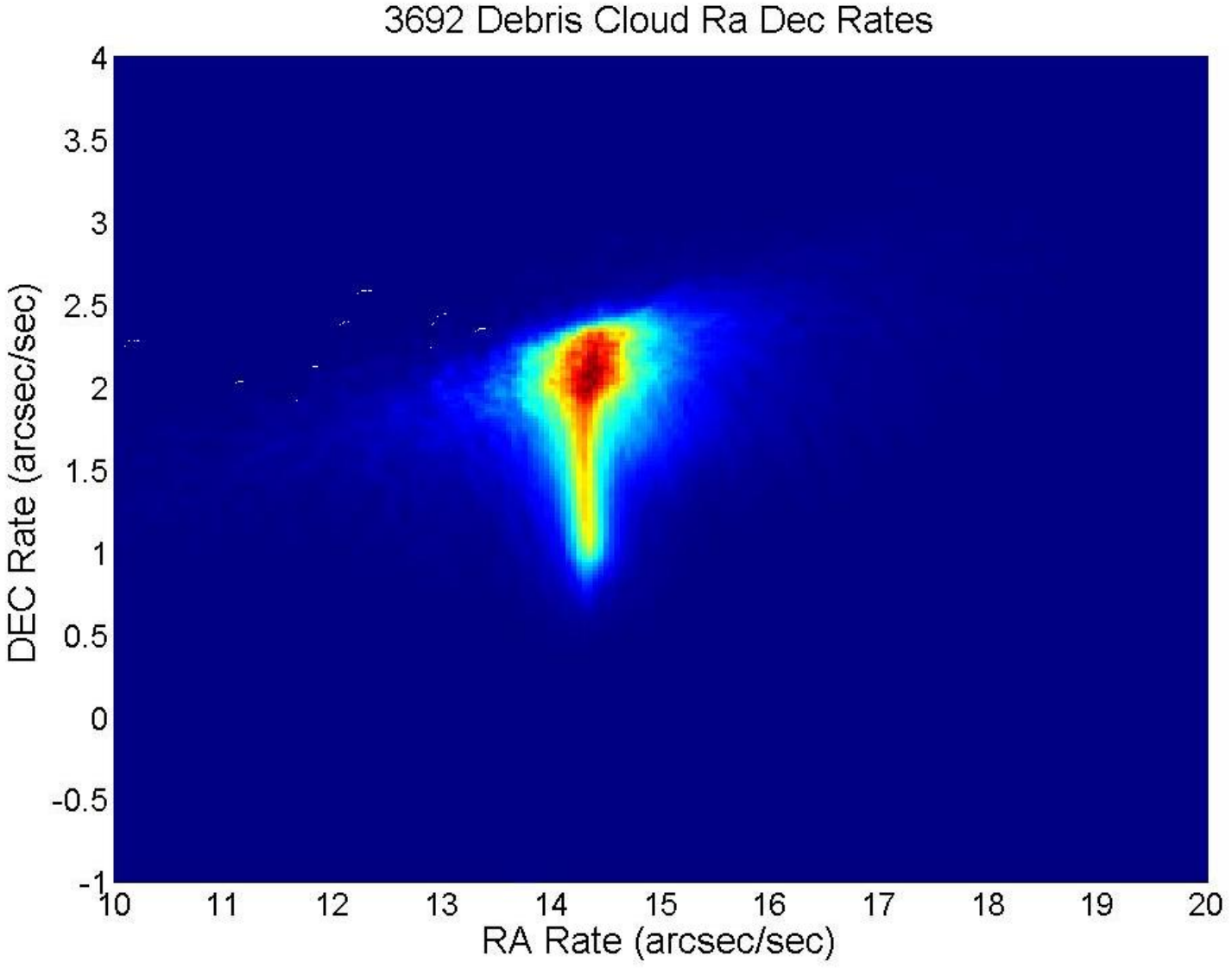
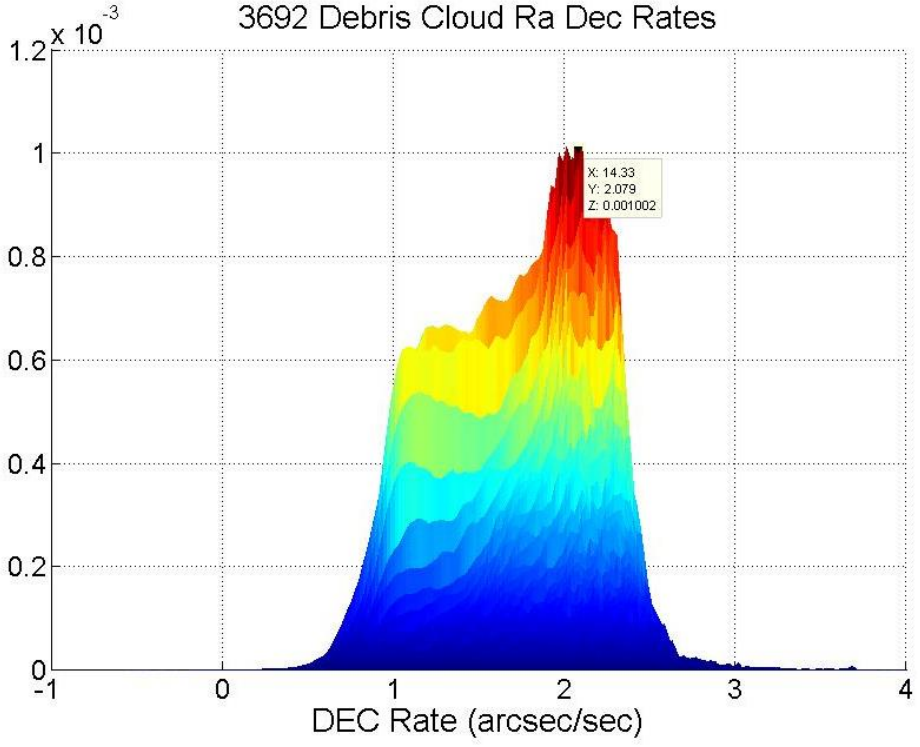
Magellan Tasking Strategy

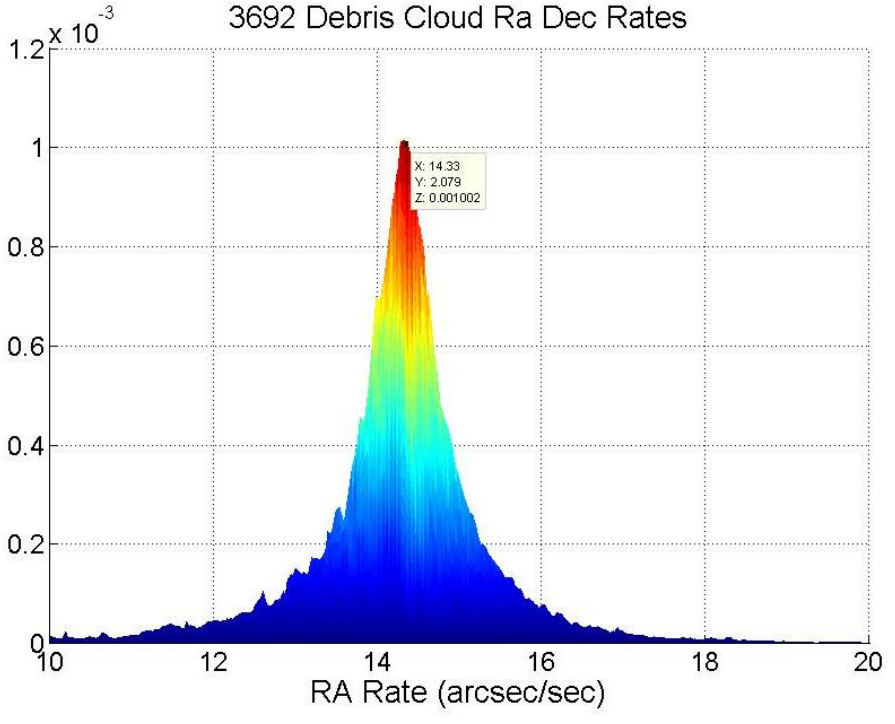



3692 Predicted Debris Cloud Density > 5cm Over Magellan for Night of UT July 26th - 27th and Background Stars
DEC
5.5
5
4.5
4
3.5
3
2.5
2
1.5
305
305.5
306
306.5
307
X: 306
Y: 3.859
Z: 8.219e-06

Magellan Tasking Strategy




3692 Debris Cloud Ra Dec Rates
x 10^-3
1.2
1
0.8
0.6
0.4
0.2
0
-1
0
1
2
3
4
X: 14.33
Y: 2.079
Z: 0.001002
DEC Rate (arcsec/sec)

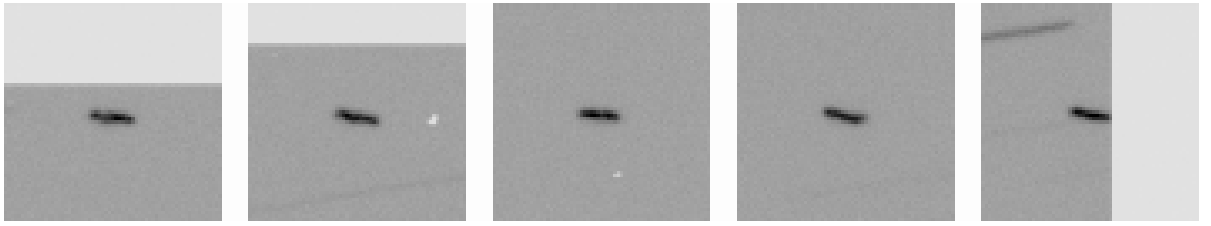

3692 Debris Cloud Ra Dec Rates
x 10^-3
1.2
1
0.8
0.6
0.4
0.2
0
10
12
14
16
18
20
X: 14.33
Y: 2.079
Z: 0.001002
RA Rate (arcsec/sec)

Observations

- **26-28 July**
  - Magellan run very successful. 0.5 night of 3 night run shared with another project
  - Observations - 5 seconds through r filter until moonset then broad 4800-7800 filter using the IMACS f/2 instrument (0.5 degree diameter field)
  - Conditions clear and probably photometric, seeing < 0.8 arcsec FWHM.
  - 20 sequences of 16 images each rate tracked at expected positions and rates of maximum of debris population. Take 2 images while sidereal tracked to establish focus, then 16 at rate track.
  - 15 sequences at first initial RA,DEC; 5 sequences at second initial RA, DEC.
- **30 Oct – 1 Nov**
  - Next observing run using Baade

Eyeball results

- Object ~16-17th mag
- Moving 1 arc-sec/sec in EW direction with respect to predicted debris motion
- Object at upper edge of frame in first two images, at extreme right of frame in last image.
- Visually detected object at telescope in between in-between attempting to set personal paddle ball record.



Rest of processing in progress…