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Operating Spacecraft Around Comets: Evaluation of the Near-Nucleus Environment

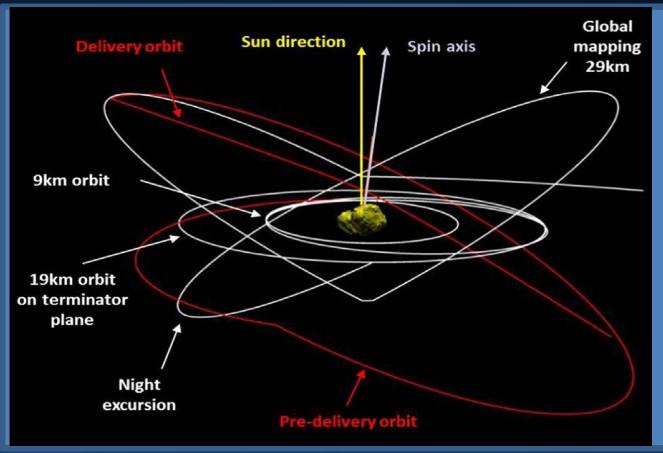

Figure 1. Future comet spacecraft missions will enter into multiple long-term near-nucleus orbits inside the comet's coma atmosphere in order to conduct science operations.

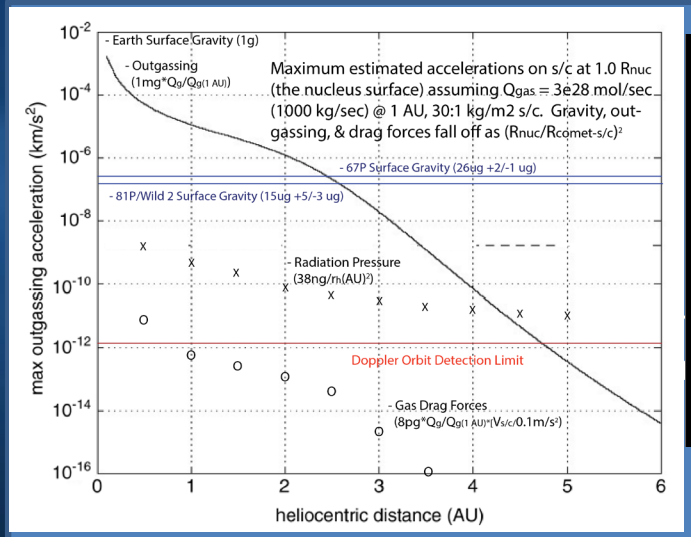

Figure 2. Only small stochastic forces on spacecraft in the ug – ng range will be encountered and controlled.

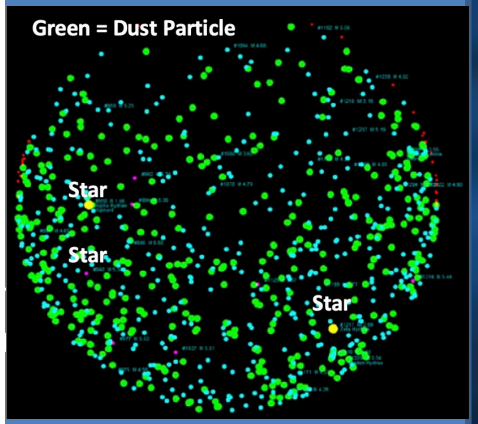

Fig. 3 Smart modern star tracker nav cameras will eliminate confusion by 1000's of emitted dust particles.

With proper design and operations planning, the near-nucleus environment of a comet can be a relatively safe region to operate a spacecraft.

- Combining sophisticated engineering models of spacecraft behavior and recent spacecraft proximity operations experience (e.g., *Rosetta*), we find that **the conditions around a comet are generally more benign than a typical day on Mars.**
  - Gas densities similar to good laboratory vacuums
  - Dust densities similar to Class 100 cleanrooms
  - Dust particle velocities of 10's of m/s
  - Microgravity forces permit slow, deliberate operations
- Lessons-learned:
  - Surface contamination only a concern if spending >months to years within kms of the comet nucleus.
  - Stochastic forces on spacecraft can be accounted for by using modern Attitude Control Systems.
  - Next generation star trackers with improved algorithms will address confusion caused by dust particles.

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