Rotational mass lofting on near-Earth asteroid (1917) Cuyo

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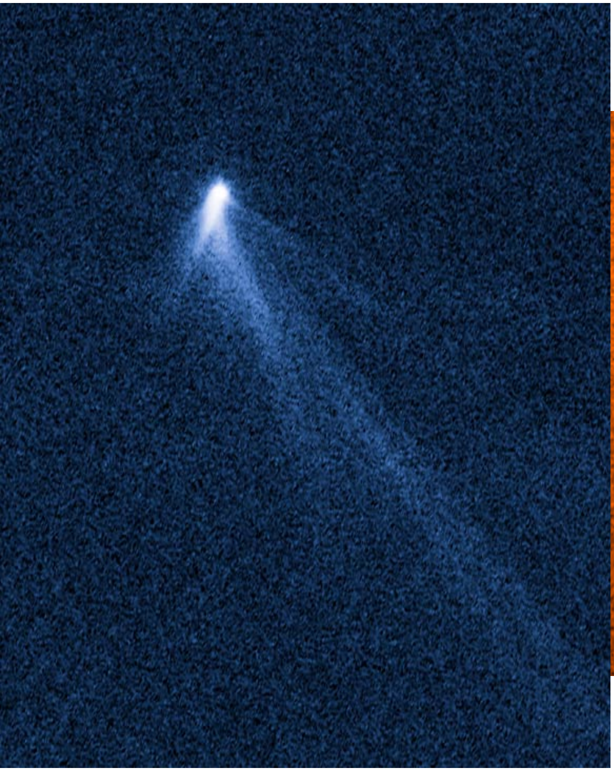
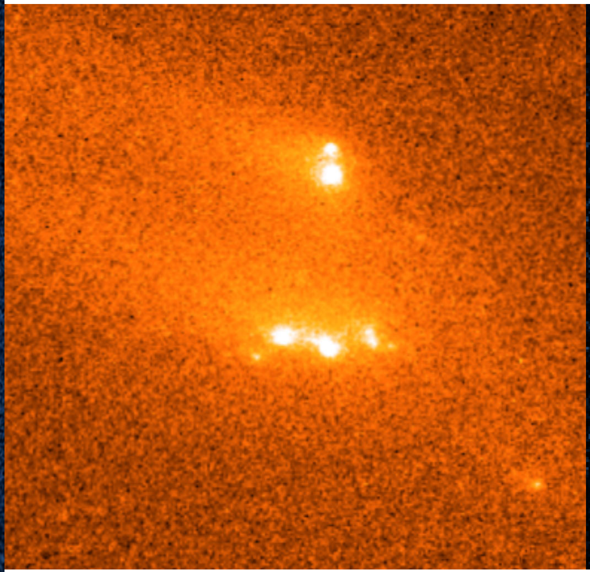
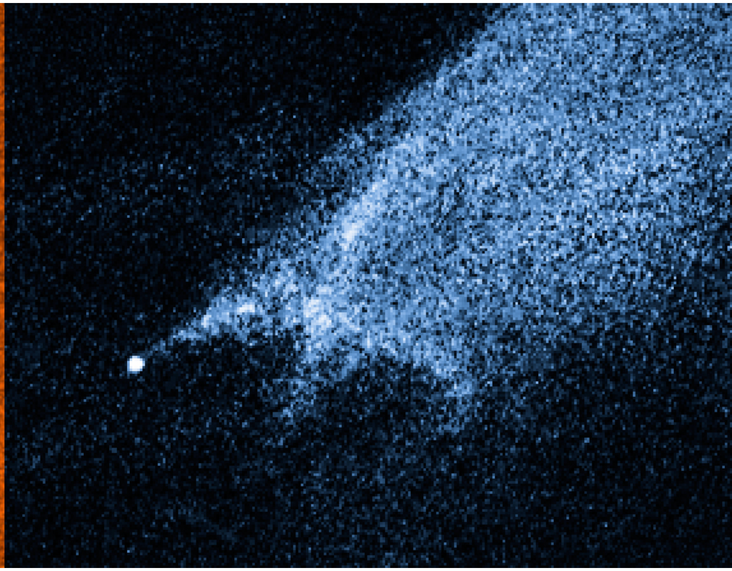
Mass loss detections





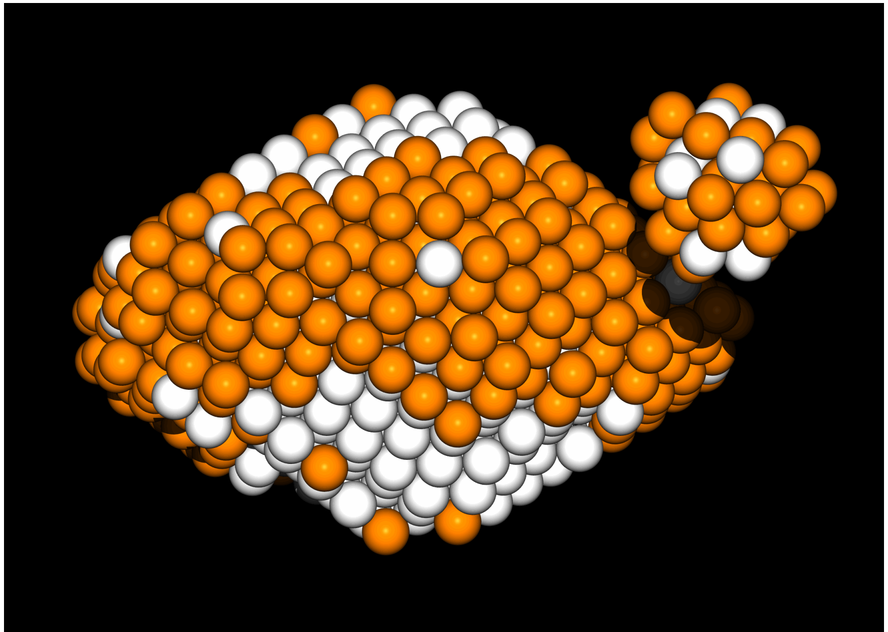


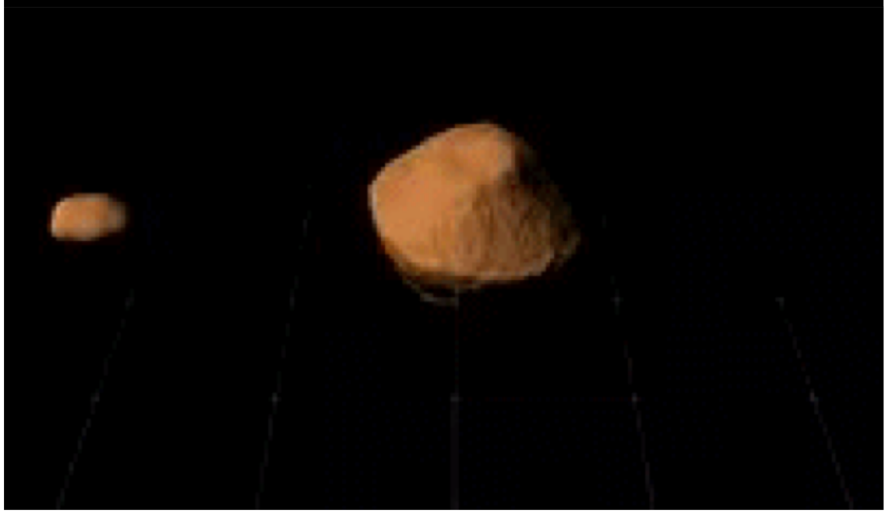
- 311P/PANSTARRS
- Rotational mass shedding

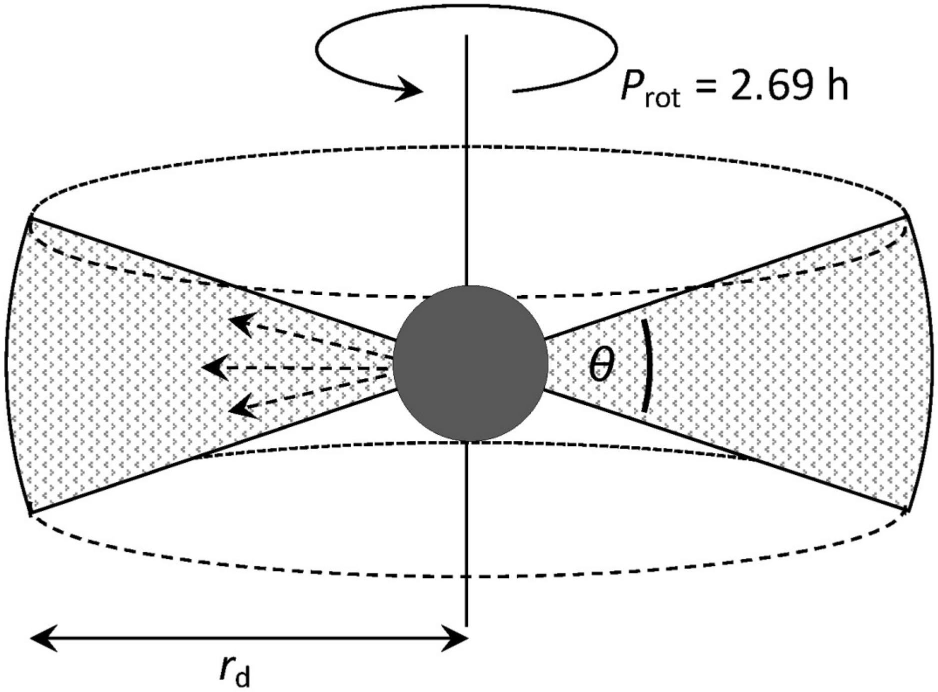
- P/2013 R3
- Rotational breakup or fragmentation

- P/2010 A2
- Asteroid collision

Rotational mass lofting



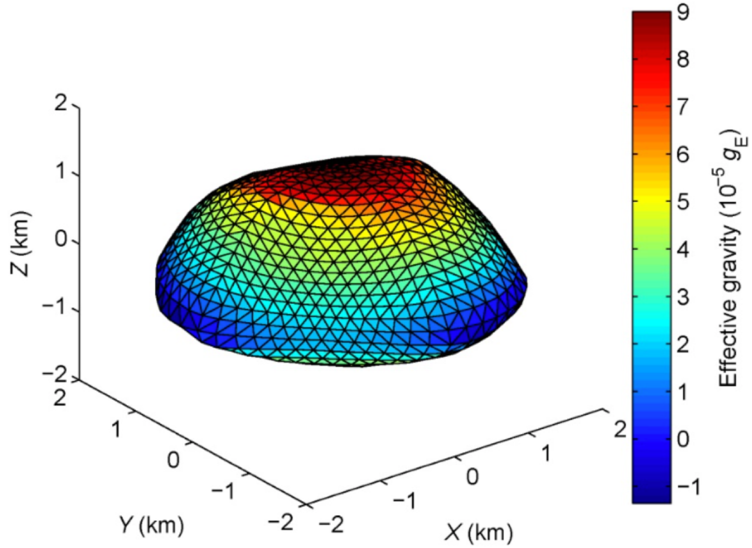




- Continued YORP spin-up can gently loft particles
- Forms a semi-bound particle disc that facilitates binary formation

NEA (1917) Cuyo

- Observed as part of a large campaign to detect the YORP effect in 40 NEAs
- Physical properties:
- 3.15 km in size
- 2.69 hr rotation period
- S-type
- Optical lightcurves constrain its shape and upper limits for YORP
- Thermal IR observations find a low thermal inertia dusty surface
- Gravitational modeling finds regions of negative effective gravity around Cuyo's equator



Mass lofting on Cuyo

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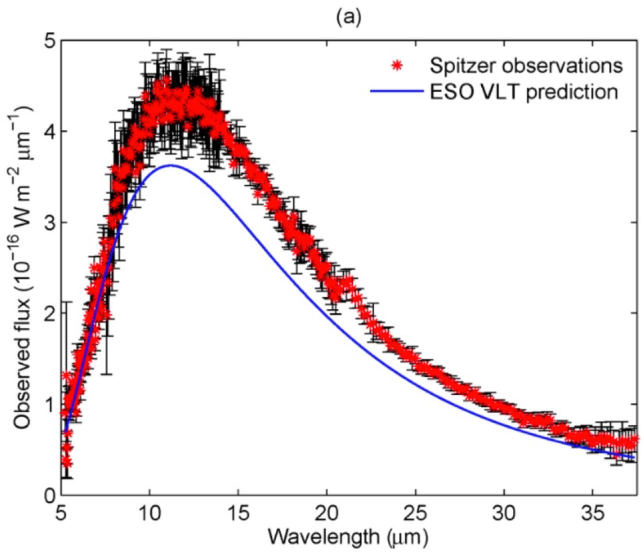
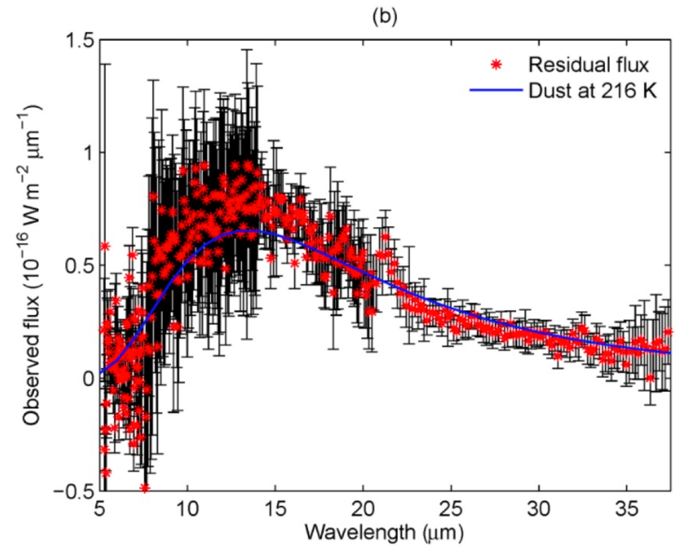
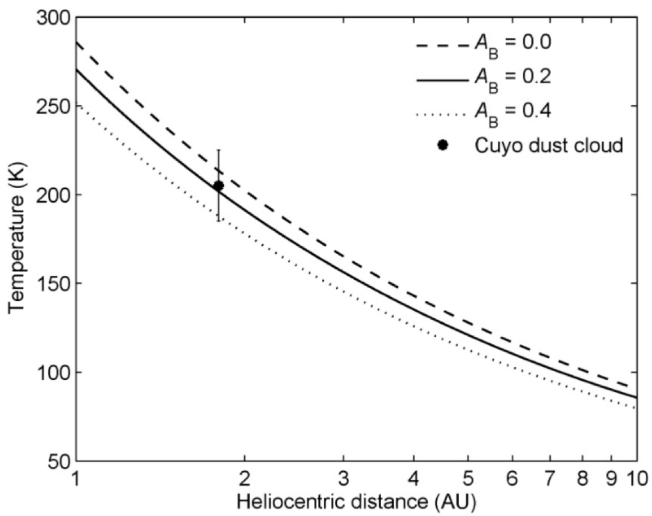
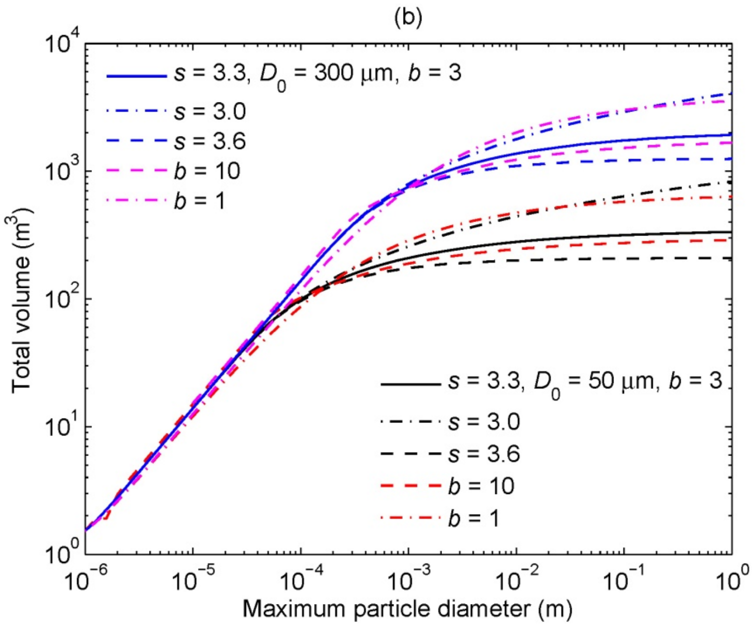


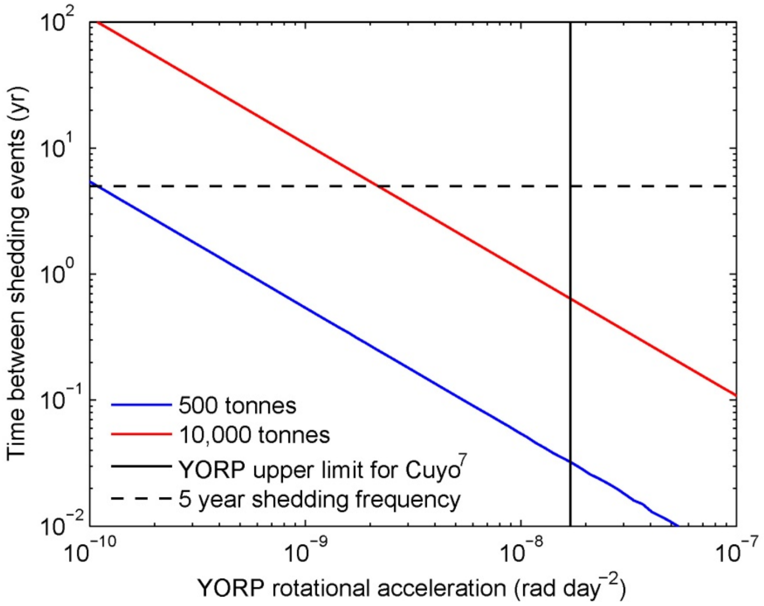




- Detection of thermal flux excess in Spitzer data obtained in December 2005
- Flux residual has a colour temperature that suggests dust in radiative equilibrium

Frequency of mass lofting





- Total mass of observed dust depends on the particle size distribution
- For realistic distribution parameters the total mass is between 500 to 10,000 tonnes

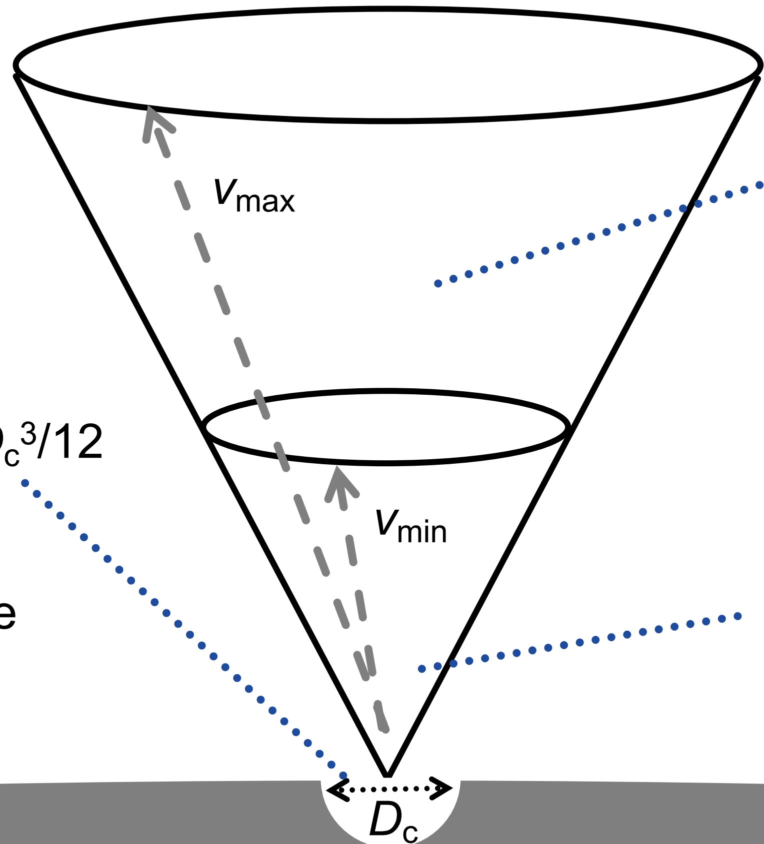
- Frequency of mass lofting events depends on the YORP effect strength
- For realistic values of YORP this mass lofting event can occur every 12 to 233 days

DART impact ejecta plume

Very simple ejecta plume assumptions…

Applies only to first few minutes after impact

Particle size range between D_{min} and D_{max}



Particles uniformly distributed in plume

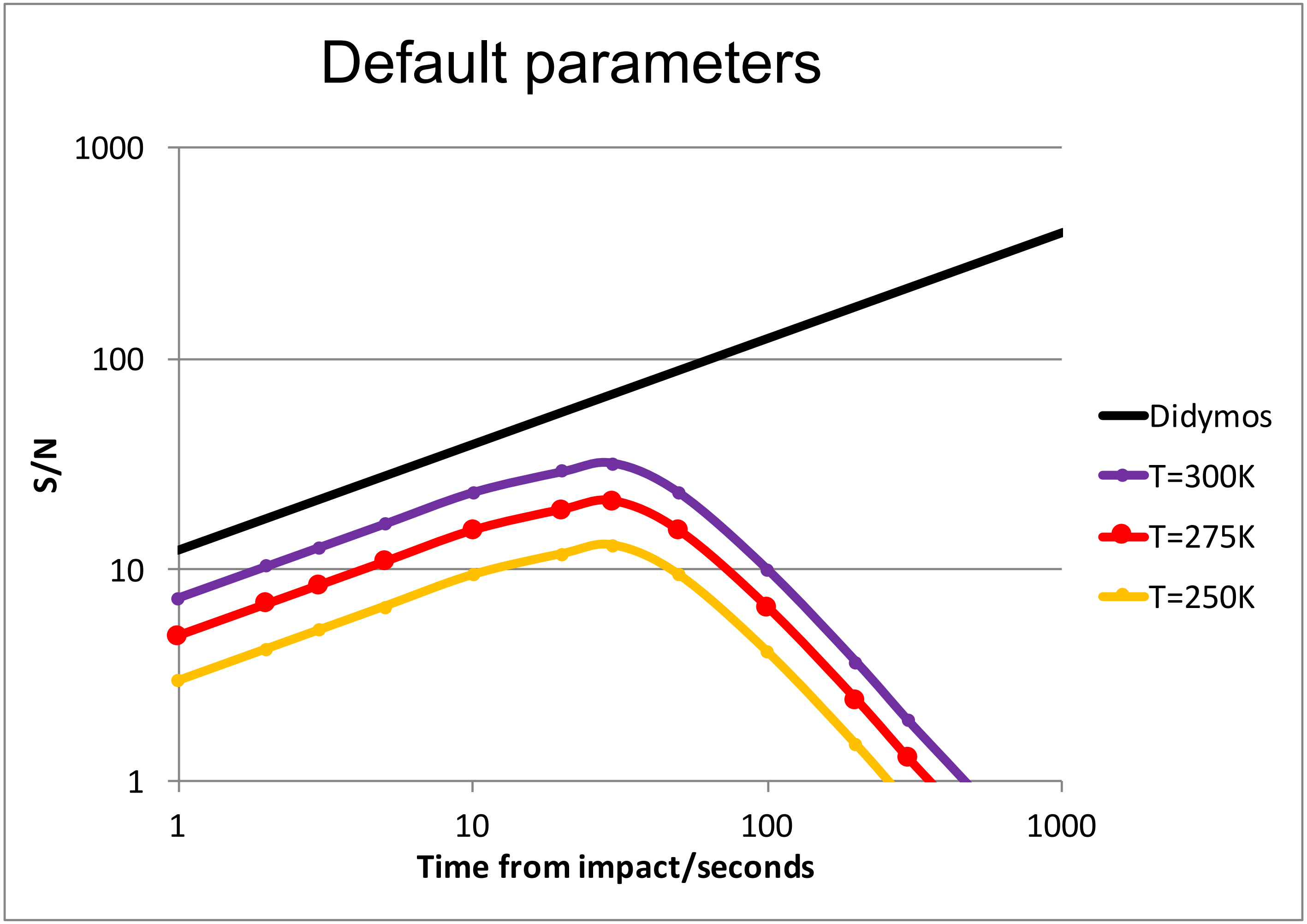
Volume of ejecta = $f \pi D_c^3/12$

f is scaling factor (fraction of crater volume ejected as particulates)

Conical plume subtends half angle θ

Plume IR detectability

Results for 8m VLT VISIR imaging.   Integration = *t*/2



Conclusions

- Rotational mass lofting can be detected by changes in brightness and/or intrinsic thermal emission
- A mass lofting event was detected around NEA (1917) Cuyo with an estimated mass of 500 to 10,000 tonnes
- Such a mass lofting event is predicted to occur as frequently as every 12 to 233 days depending on YORP
- Size of the detected thermal flux excess is similar to that expected from the dust plume caused by the DART impact on Didymoon