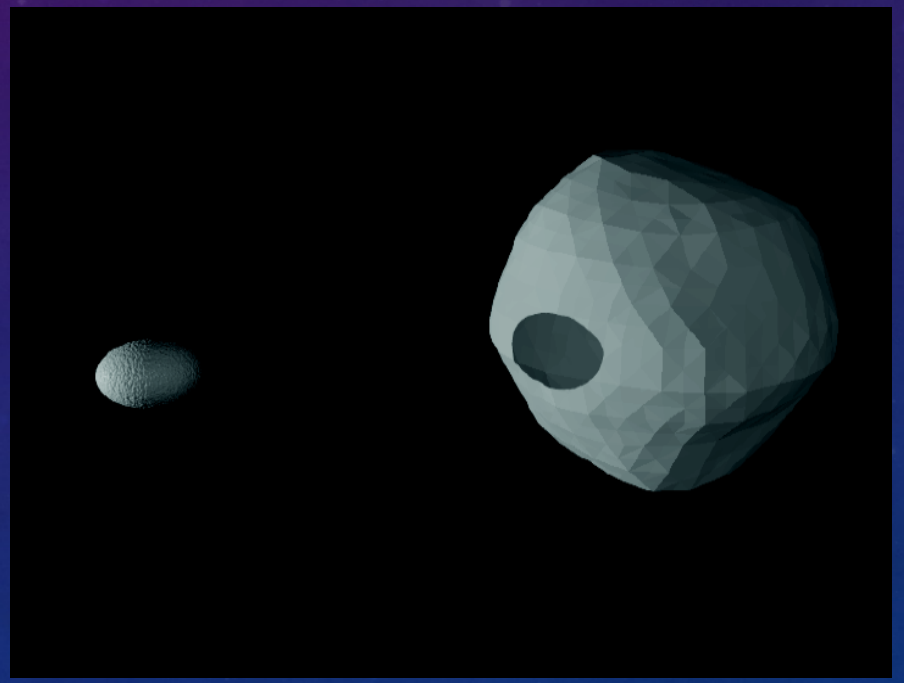
WG3: Dynamical and Physical Properties

Results and Future Work



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HERA Workshop, Berlin 16-17/11/2018

WG3 GROUP

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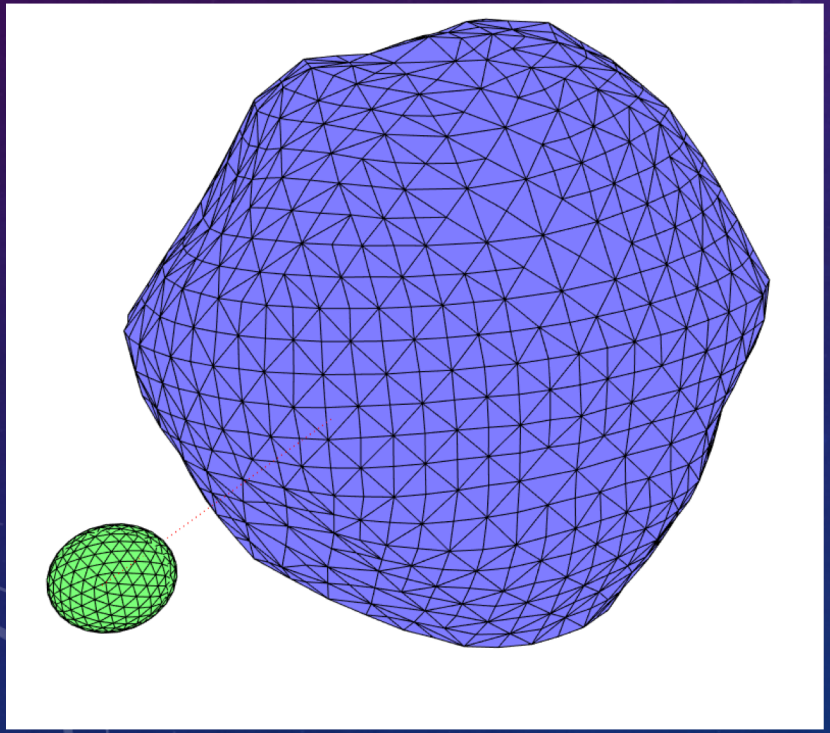
WG3 in AIM: Didymos Reference Model (DRM)

Ellipsoidal Didymoon

$a_s > b_s > c_s$

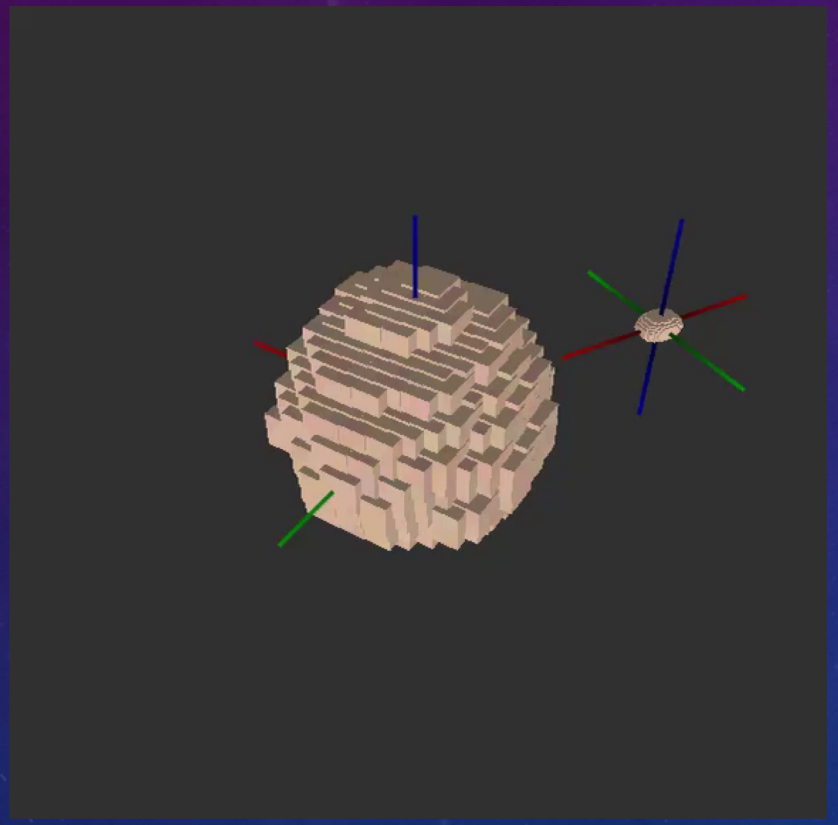
$a_s/b_s = 1.3 \pm 0.2; b_s/c_s = 1.2 \pm 0.2$

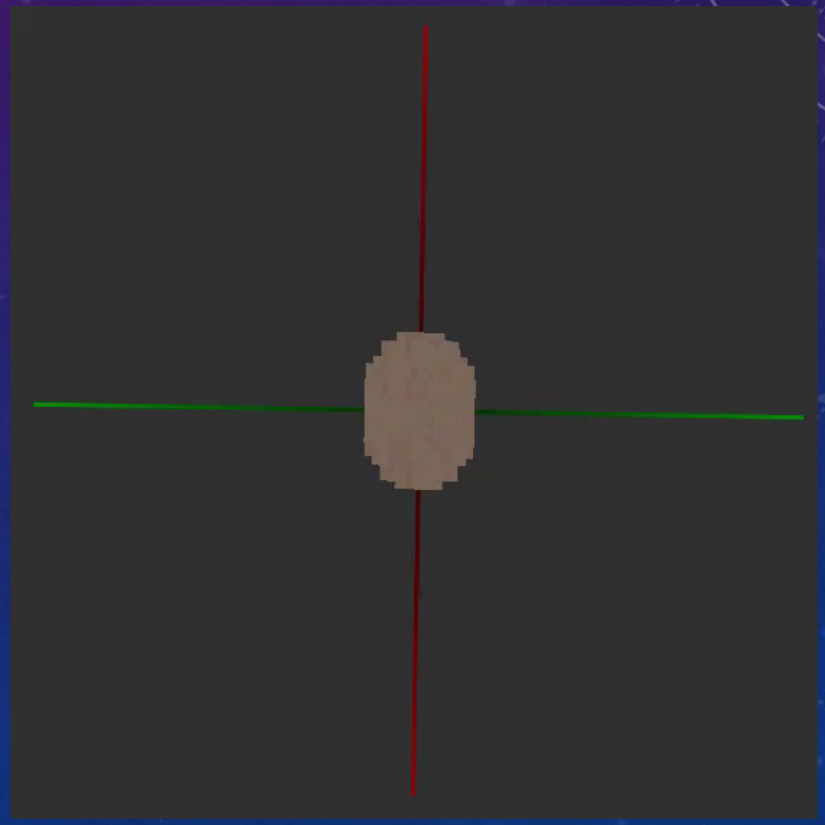


Parameter	Value	Parameter	Value
Primary rotation period	2.2601 ± 0.0001 hr	Bulk density, ρ	2104 kg/m^3 $\pm$ 30%
Mutual orbit period	11.92164 ± 0.00003 hr **	System absolute magnitude, H	18.16 ± 0.04
Mean separation, a_{orb}	$1.18 + 0.04/-0.02$ km	Geometric albedo	0.15 ± 0.04
Total system mass	$5.278e11 \pm 0.54e11$ kg	Radar albedo	$0.27 \pm 25\%$
Diameter ratio, D_S/D_P	0.21 ± 0.01	Mutual orbit eccentricity	$e \leq 0.03$
Primary Diameter, D_P	780 m $\pm$ 10%	Mutual orbit pole (ecliptic lon.)	$\lambda = 270°$
Secondary Diameter, D_S	163 ± 18 m	Mutual orbit pole (ecliptic lat.)	$\beta = -87°$

WG3 in AIDA: Didymos dynamics benchmarking

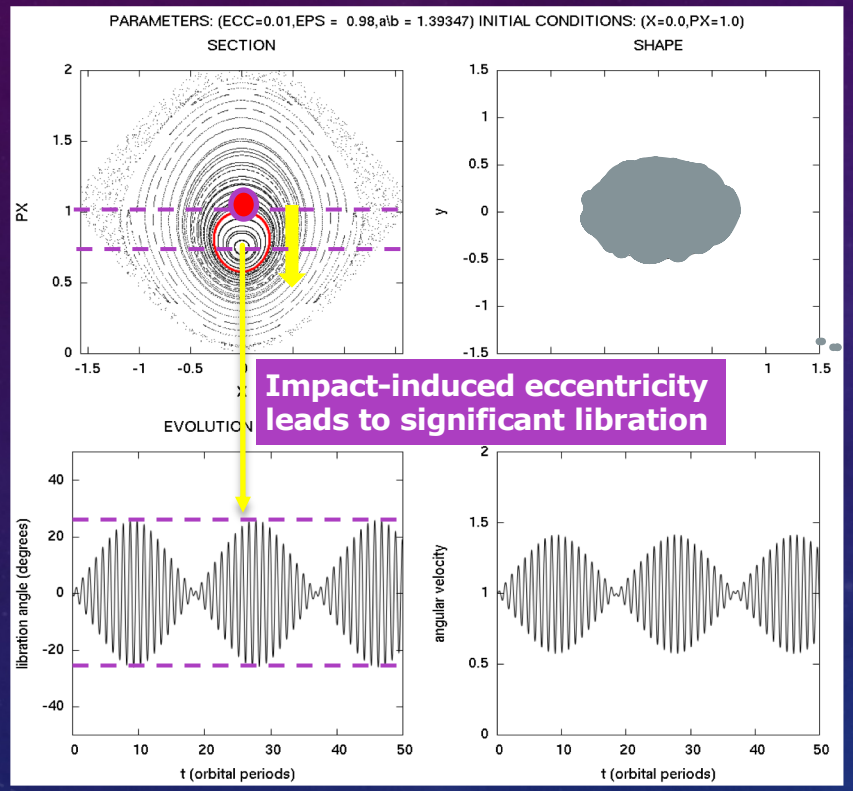
[NxM] direct mascons symplectic code

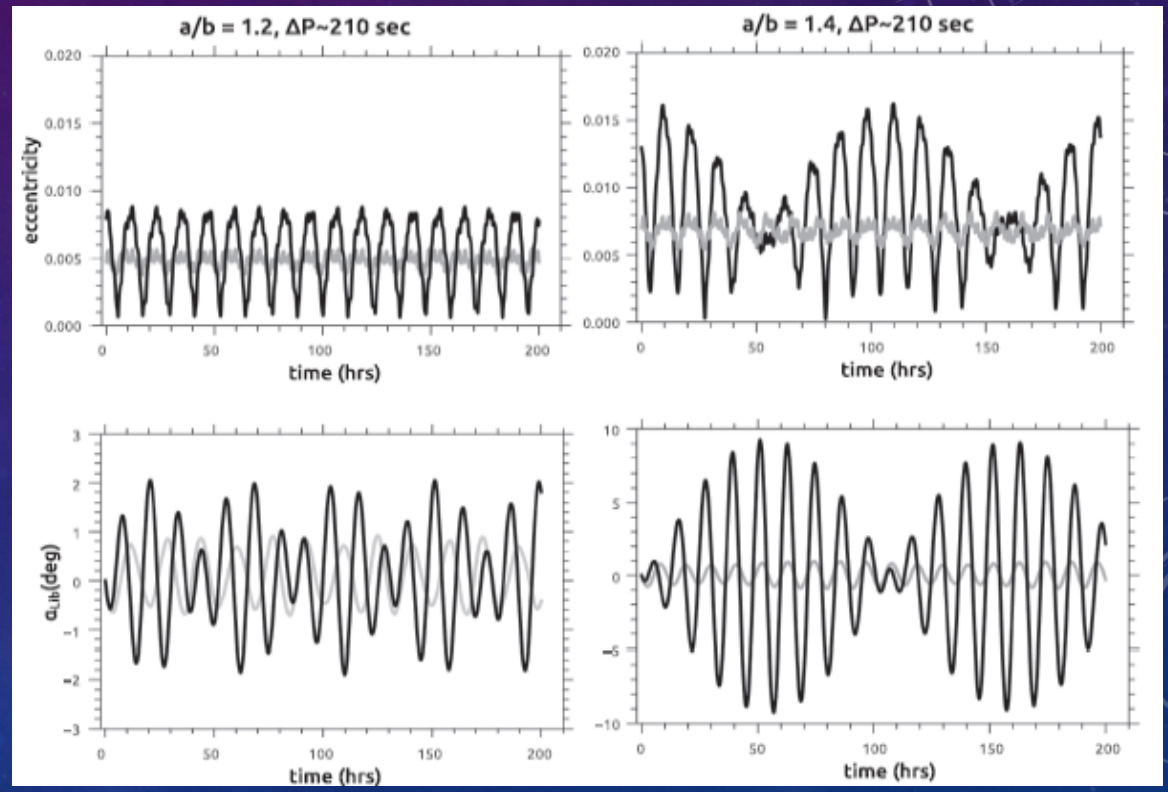




WG3 in AIDA: Didymos dynamics

Understanding the effects of Δv for different values of a/b, μ, etc

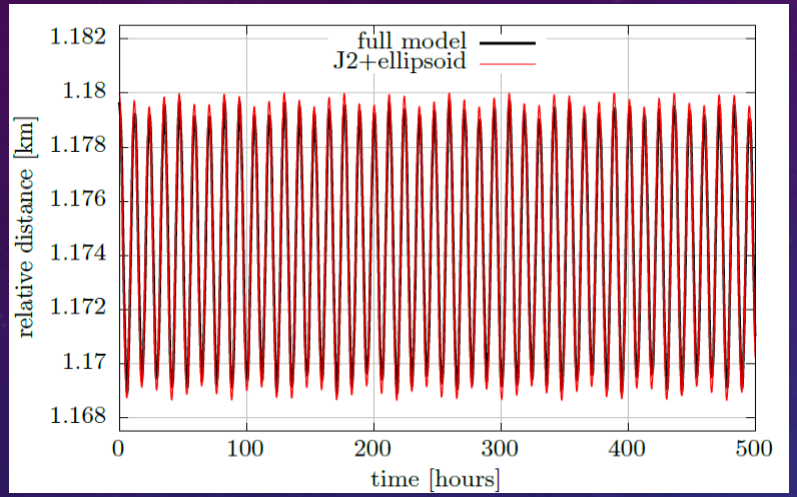


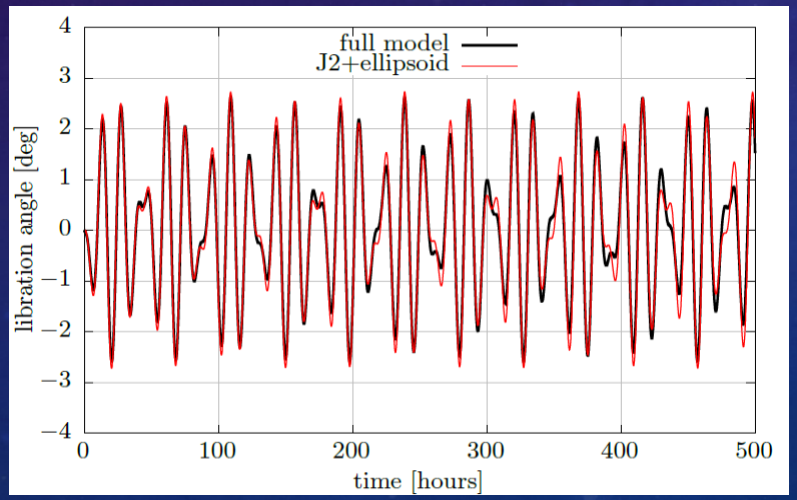


WG3 in HERA: Analytical Modeling

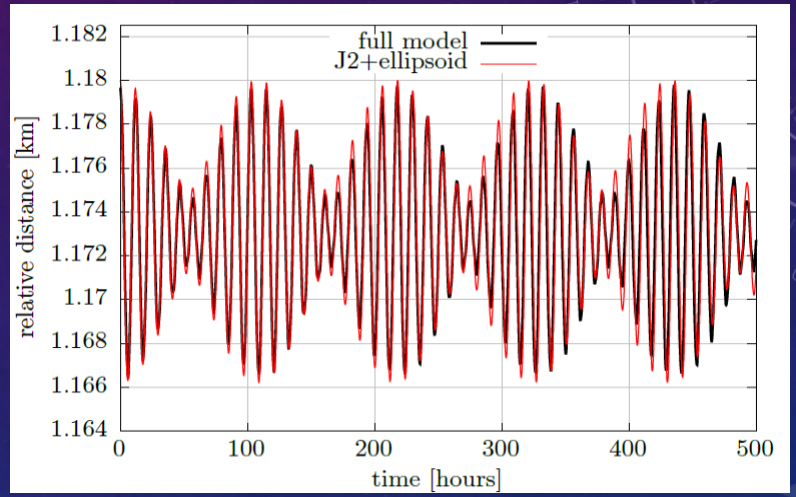
Comparison of Full NxM model with a "J2+ellipsoid" 2-D model

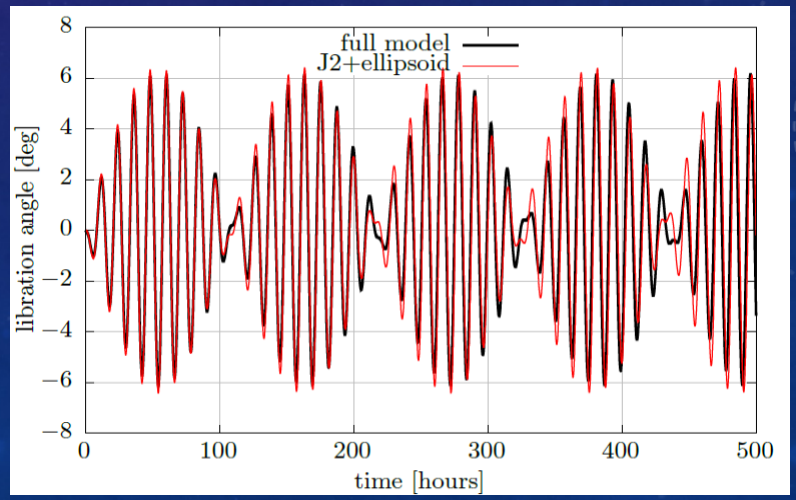
a/b=1.2





a/b=1.4





Final goal for HERA: Compute β !

Requires accurate (post-impact)

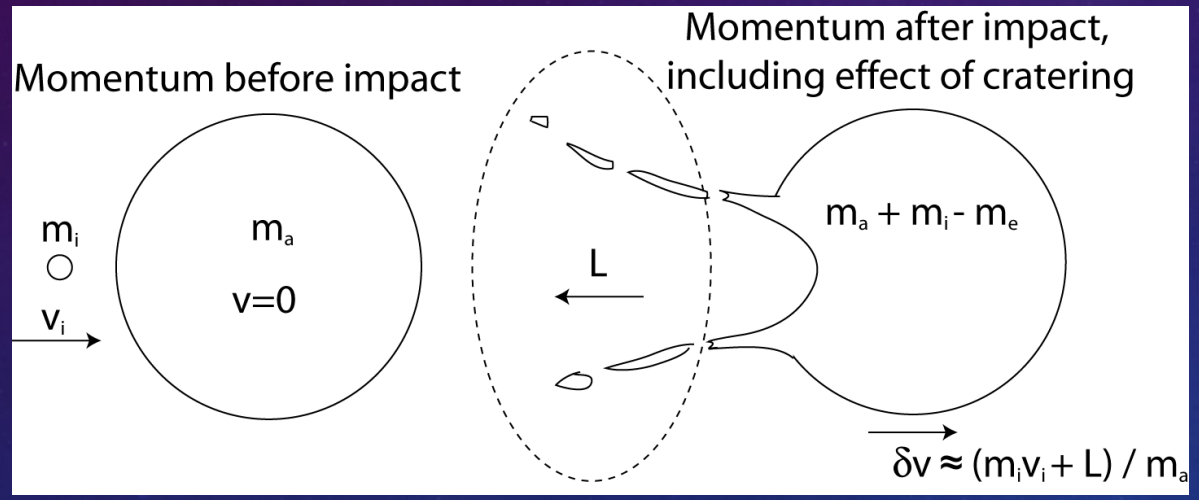
- *orbit/rotation parameters*
- *shapes*
- *mass of Didymoon*

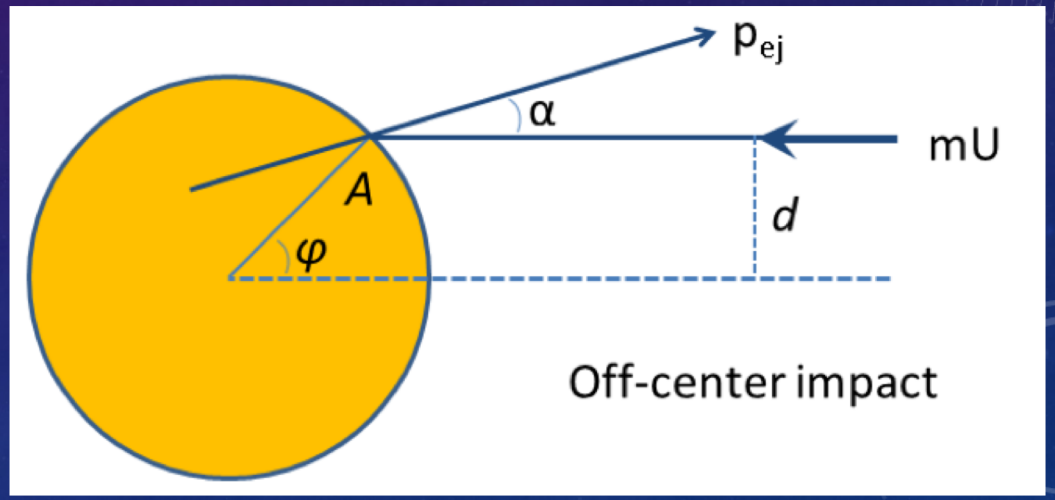
Hera

\+ impact direction/location (DART)

Model

→ β

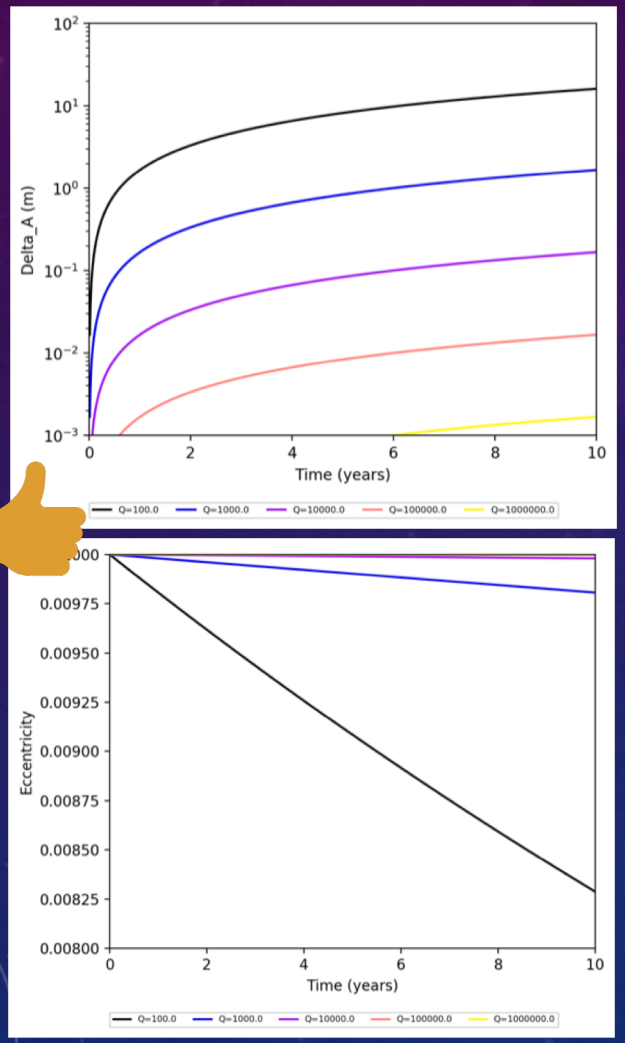


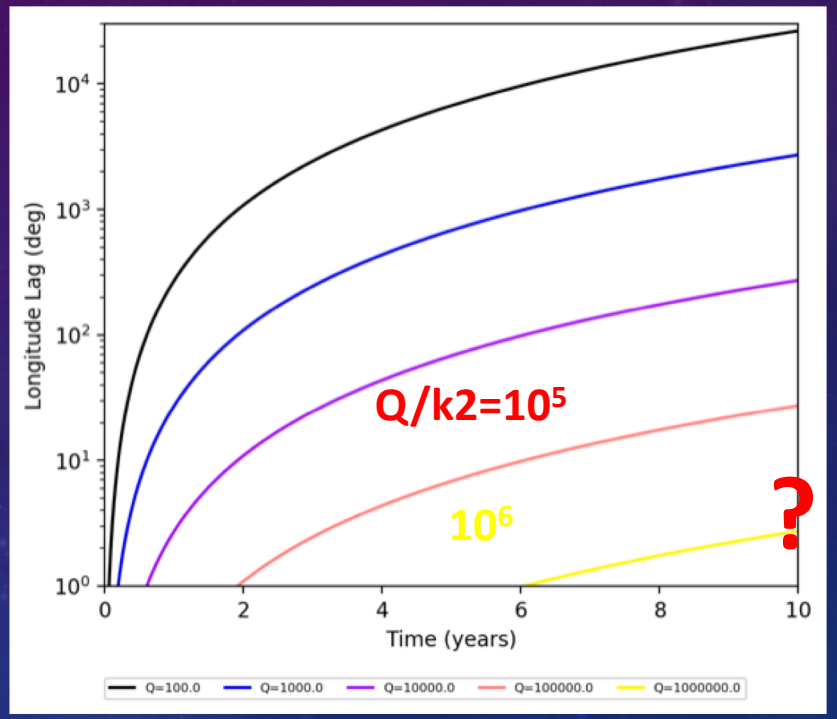


* Disentangle orbit / rotation / shape effects

WG3 in HERA: Tides and late arrival of HERA

Simple tidal models suggest no dissipation of Δa, Δe after ~10yr





? **Observable ?**

$$\frac{da_s}{dt} = \frac{3k_{2p}M_s G^{1/2} R_p^5}{Q_p M_p^{1/2} a_s^{11/2}}\left[1 + \frac{51e_s^2}{4}\right] + \frac{2a_s^{1/2}\Gamma_s}{M_s (GM_p)^{1/2}} - \frac{21k_2^s n_s M r_s^5}{Q_s M_s a_s^4} e_s^2$$

$$\frac{de_s}{dt} = + \frac{57k_{2p}n_s M_s R_p^5}{Q_p M_p a_s^5} e_s - \frac{21k_2^s n_s M_p r_s^5}{2Q_s M_s a_s^5} e_s + F_{me}$$

WG3 in HERA: Dust dynamics and ejecta mass

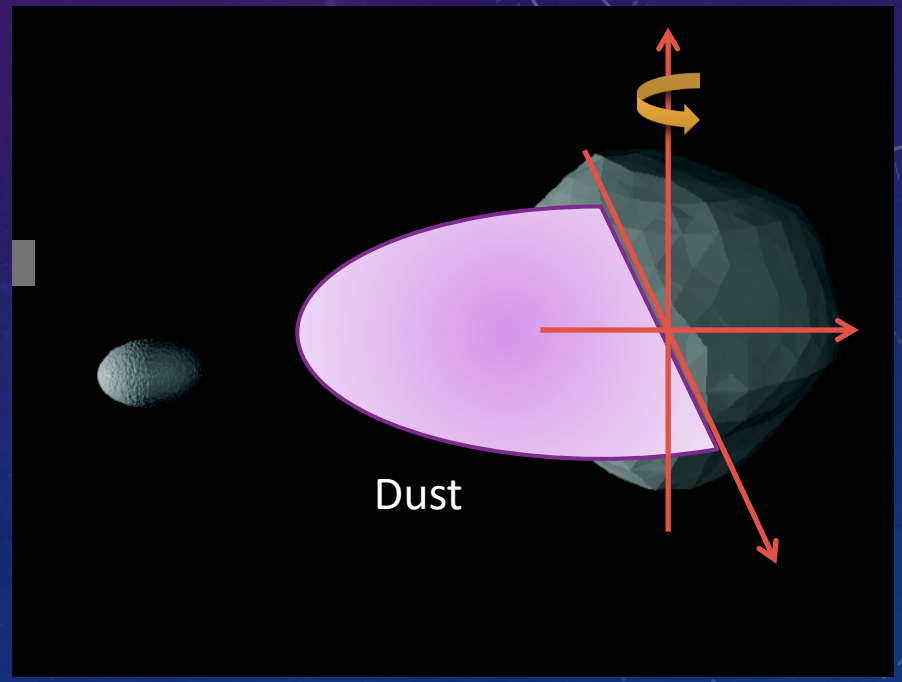
Studies suggest existence of a steady-state dust ring/disk, due to fast primary rotation

DART will disrupt this, but it should be re-built later on

→ now, including Didymoon material (DART-induced ejecta landing on Didymain)

Can we combine models + HERA observations to derive ejecta total mass?

Other ring-like features?



WG3: Summary of future activities

- Continued participation in DART/AIDA benchmarking activities
- Analytical model & full parameters space exploration → beta
- Explore tidal models / predictions → longitude drift ?
- Model steady-state dust environment → ejecta contribution
- Other ?