Collision model and scaling laws

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tumblers and rotational excitation

- asteroids in excited state of rotation are called tumblers
- rotation about the extremal axis and precession about angular momentum vector (Kaasalainen, 2001)

what caused their excited rotation?

- one of the possible mechanisms are sub-catastrophic collisions

tumblers and rotational excitation

- asteroids in excited state of rotation are called tumblers
- rotation a ut
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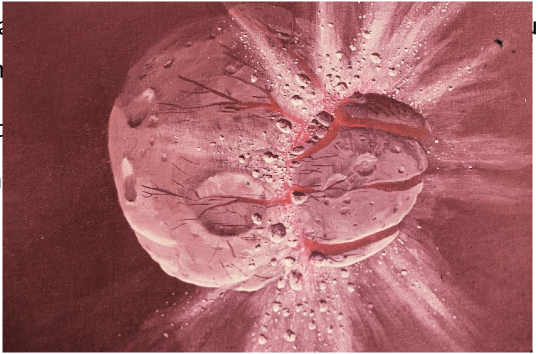
what caused t

- one of th
  collisions



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a simple model

system of two colliding bodies

- the larger one (target) is triaxial ellipsoid, the smaller one is a sphere (impactor, projectile), both are homogeneous
- before the impact the target is rotating in a basic state
- it's diagonal inertia tensor defines the principal axes
- hypervelocity impact gives birth to impact crater on the larger one, the smaller one evaporates completely

a simple model

system

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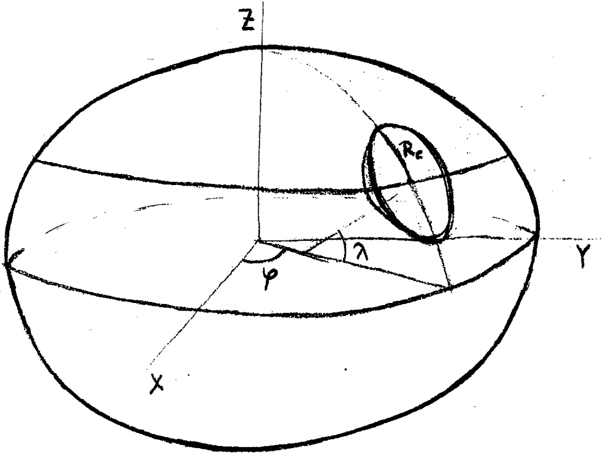

a simple model

angular momentum exchange during the impact occurs

calculate inertia tensor of the ellipsoidal body with the crater

- check if it is diagonal in the same reference frame or not
- inspect its sensitivity to various parameters of the bodies (mass ratio, velocity, impact angle, shape of the bodies)
- test various regimes of crater formation (strength, gravity)

approximations used

- homogeneous bodies with the same density
- impact process only results in simple crater formation, possible ejecta escape in radial direction to infinity, no other processes are taken into account
- projectile trajectory is a straight line (should be hyperbola)
- the shape of the crater is circular paraboloid without any rim

scaling laws

how to calculate the diameter of the crater?

- we only know the properties of the impactor (size, density, velocity)
- scaling laws give us the answer – tell us how to extrapolate small scale impact experiments to much larger scales
- when using point-source approximation of the impact, scaling law has the special form of power law (Holsapple, 1993)

$$D_c \sim aU^{\mu}\delta^{\nu}$$

253 Mathilde

NASA

crater formation mechanism

- craters on 253 Mathilde (tumbler) are very large, close to each other and lack larger ejecta
- Housen *et al.* (1999) proposed the compaction mechanism of cratering on Mathilde
- this explains the problems mentioned better than the classical excavation mechanism
- maybe no need to worry about the ejecta and it's dynamical influence

current state and future

finishing the code and testing its correctness

start to prepare simulations

- plausible ranges of the parameters describing the system
- catch up weak approximations
- think of the illustrative outcome of the simulations

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