

# Mechanical strength of Geminid meteoroids from detailed modeling

Asteroids,  
comets,  
meteors  
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# Motivation

- shower meteors/bolides with a known parent body carry information about a specific asteroid or comet
  - detailed modeling of bright fireballs yields physical and mechanical properties of the meteoroid
  - we constrain the nature of Geminids material
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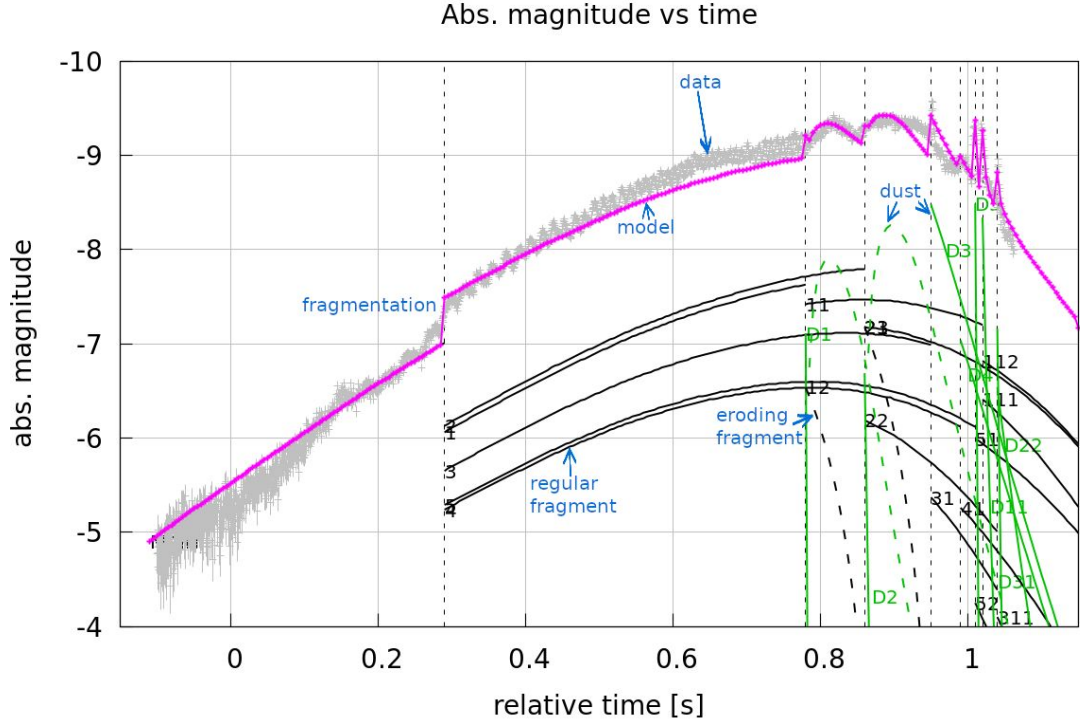
# Geminids modeling

- we modeled 8 Geminids and 9 asteroidal fireballs of comparable entry mass
- data from the European Fireball Network (we fitted radiometric and photometric light curves, foremost fragment dynamics)
- we compared Geminids to ast. fireballs, to Taurids (Borovička et al. 2020) and to the Winchcombe fireball (McMullan et al. 2023, modeling results from Denis Vida)

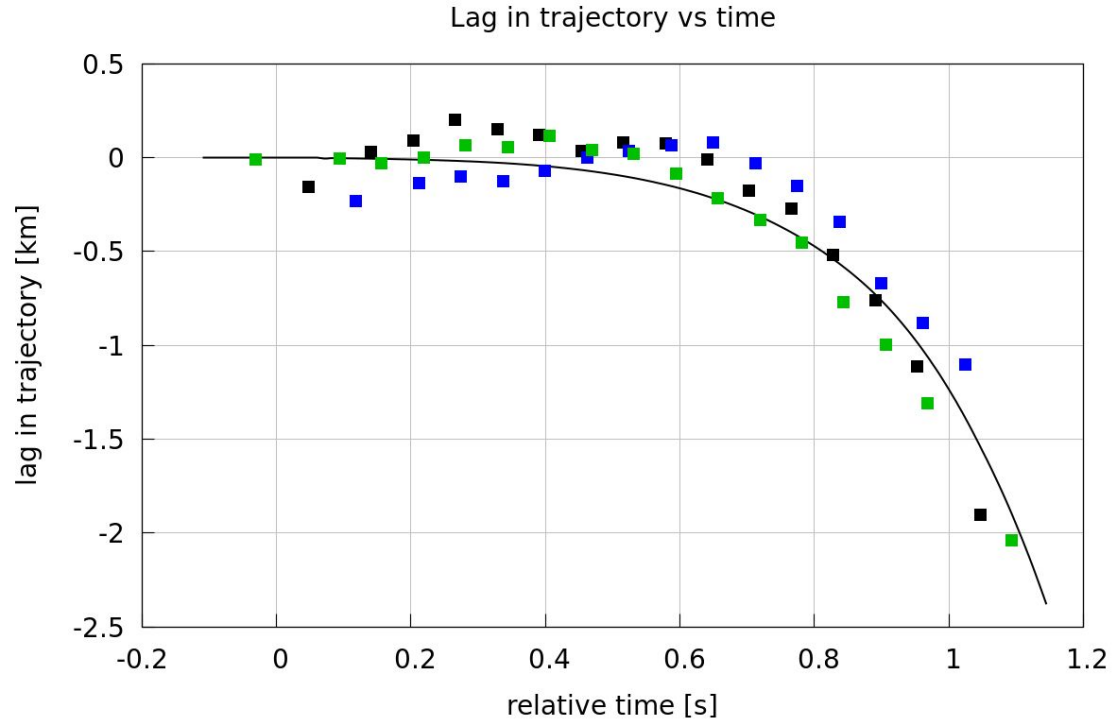
# Geminids modeling

- semi-empirical fragmentation model of Borovička et al. (2020) connected with a genetic algorithm optimizer (Henych et al. 2023)
- we derived dynamic pressure exerted on the meteoroid and its fragments
- at fragmentation points it serves as a proxy for a tensile strength of the fragmenting meteoroid

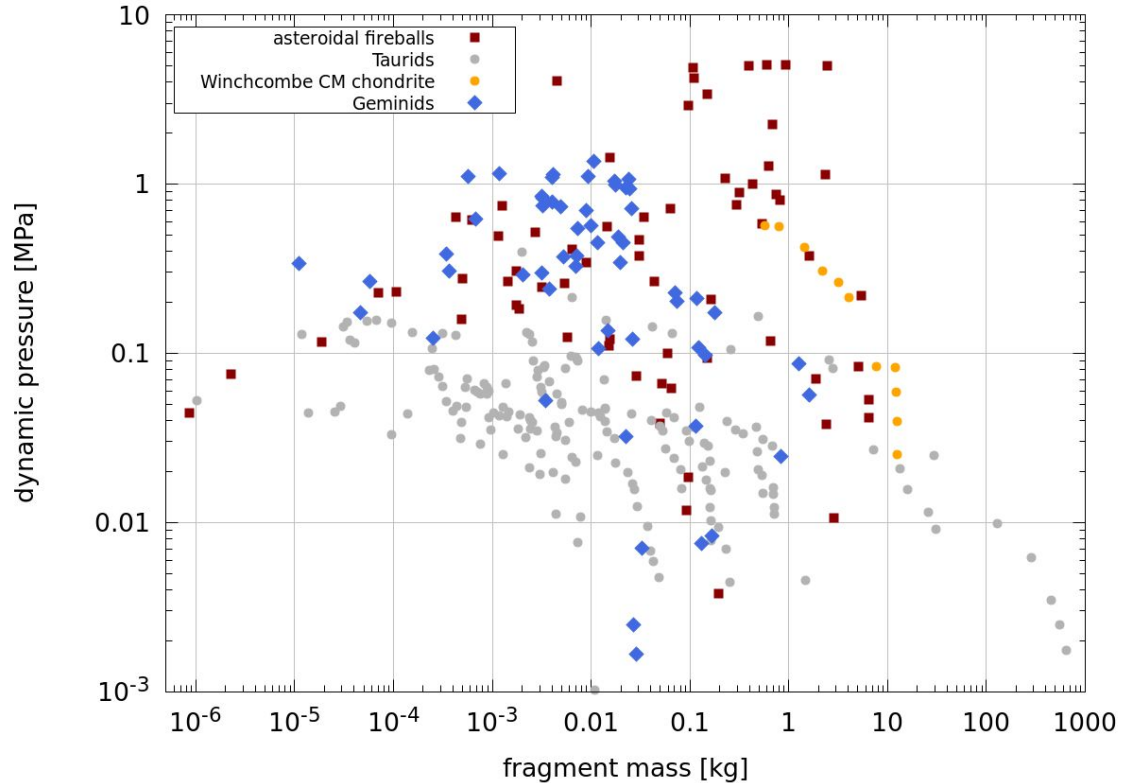
# Radiometric curve



# Dynamics

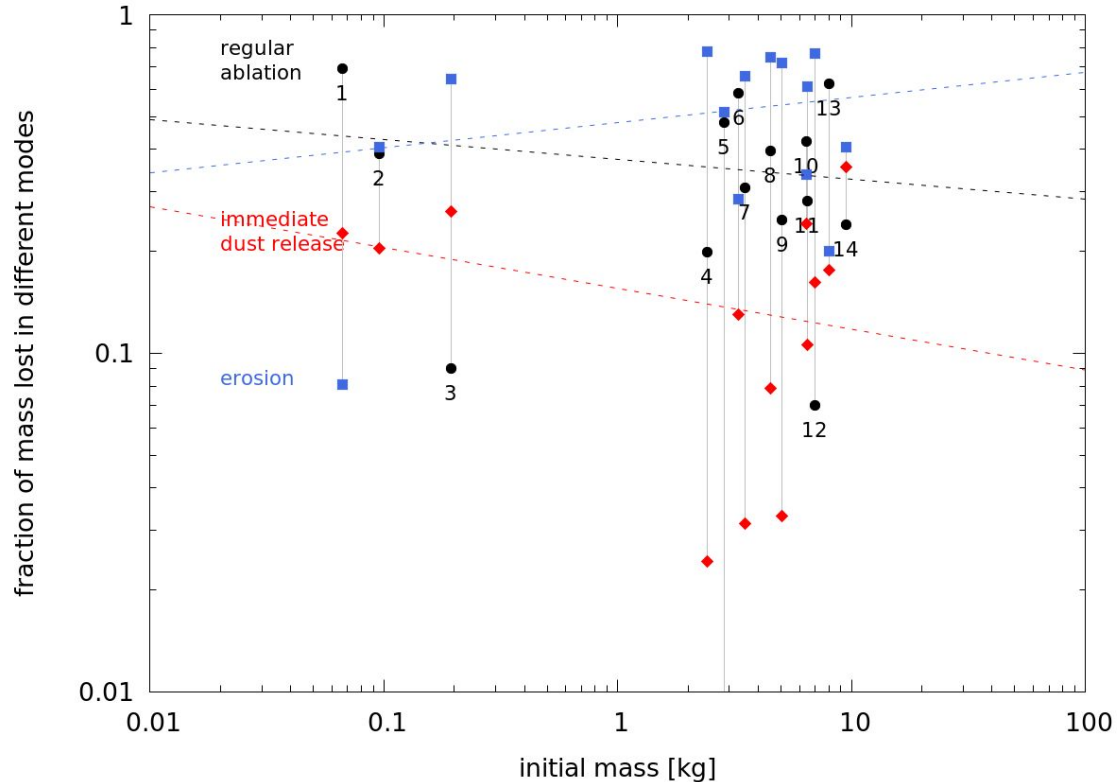


# Dynamic pressure vs fragment mass

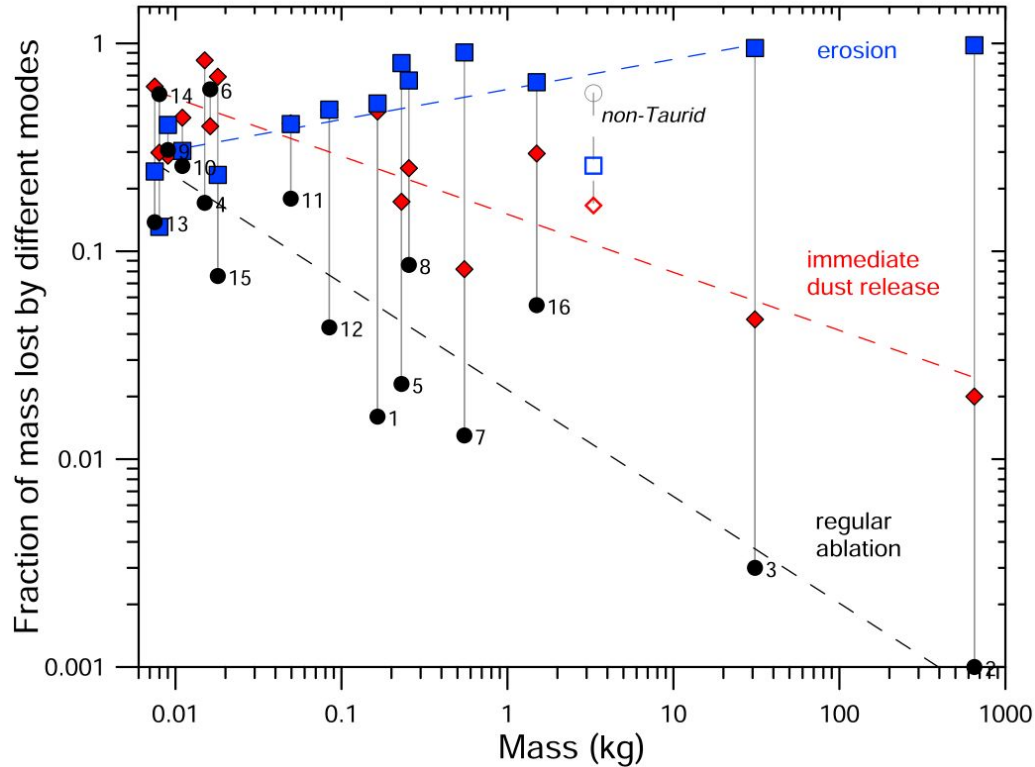




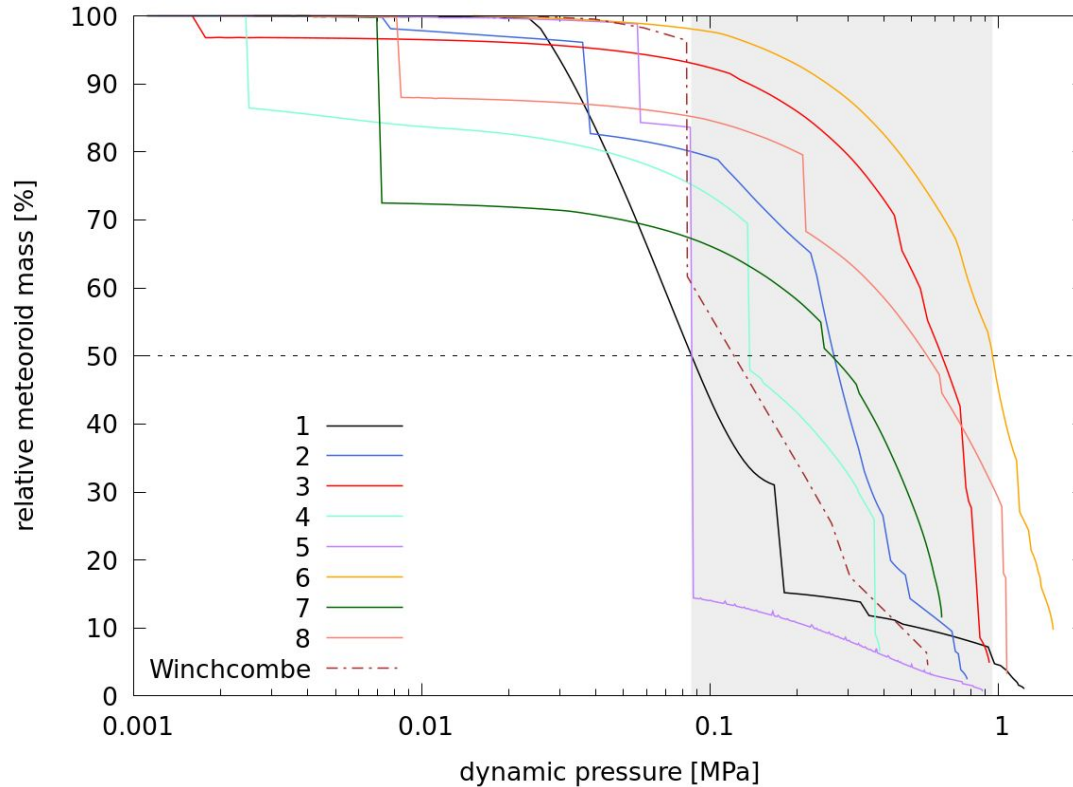
# Mass loss modes in asteroidal fireballs



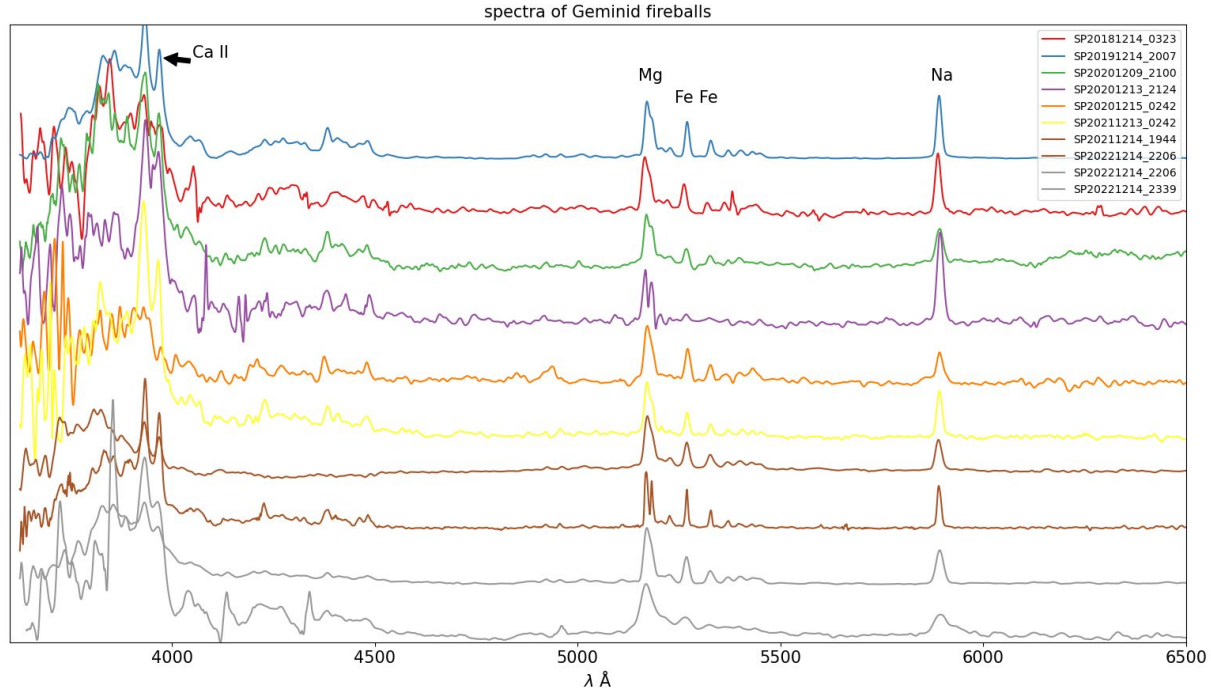
# Mass loss modes in Taurids



# Mass evolution in Geminids



# Spectra of Geminids



# Take away messages

- modeled Geminids 4x weaker than comparable asteroidal fireballs
- 2.5x stronger than the Winchcombe fireball (CM2 carbonaceous chondrite)
- probably formed by compact carbonaceous material
- erosion of dust grains more important for larger meteoroids
- regular ablation more important than immediate dust release, in contrast with Taurids (Geminids are more cohesive)