Changing the heliocentric orbit of the Didymos system with DART

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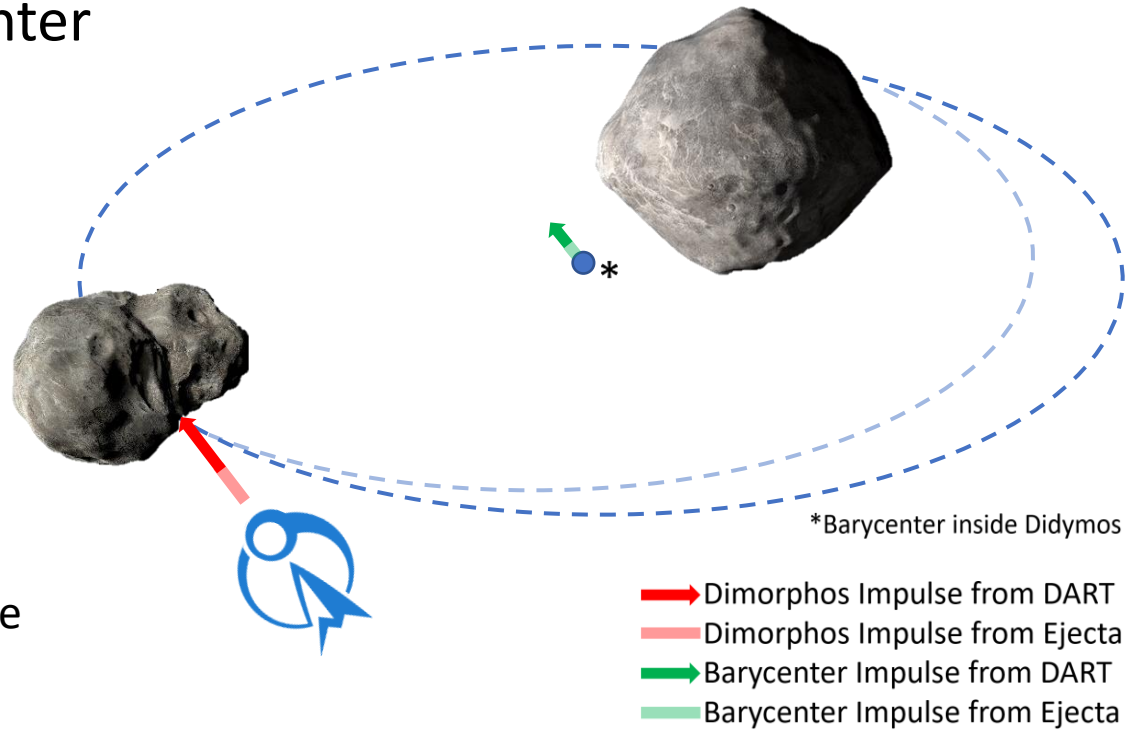
Introduction

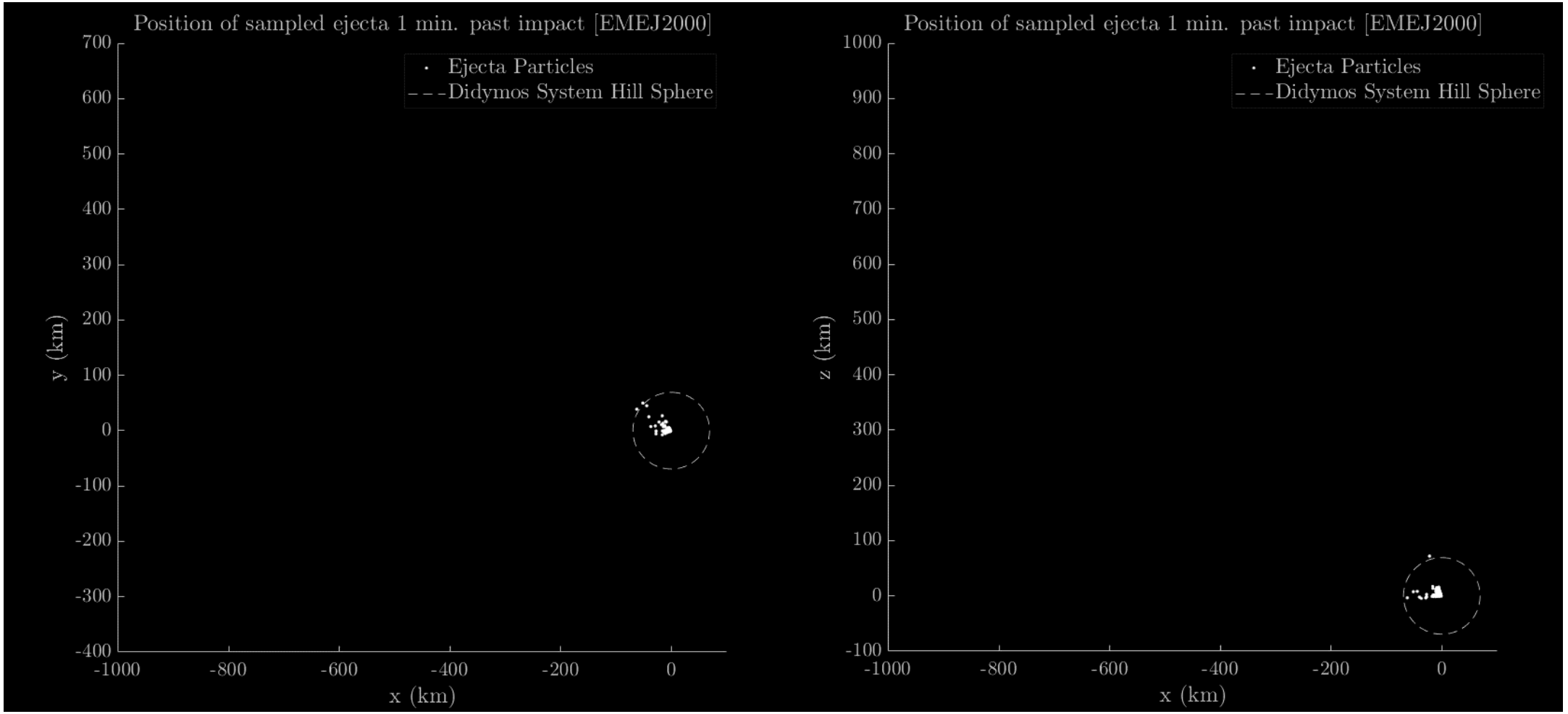
- DART impact can be considered to deliver momentum to Didymos system barycenter
- Ejecta modeled as additional effective impulses when crossing Hill sphere

$$\beta_{helio} = 1 + \frac{\|m_{ejecta}\vec{v}_{ejecta}\|}{\|m_{DART}\vec{v}_{DART}\|} = 1.84$$

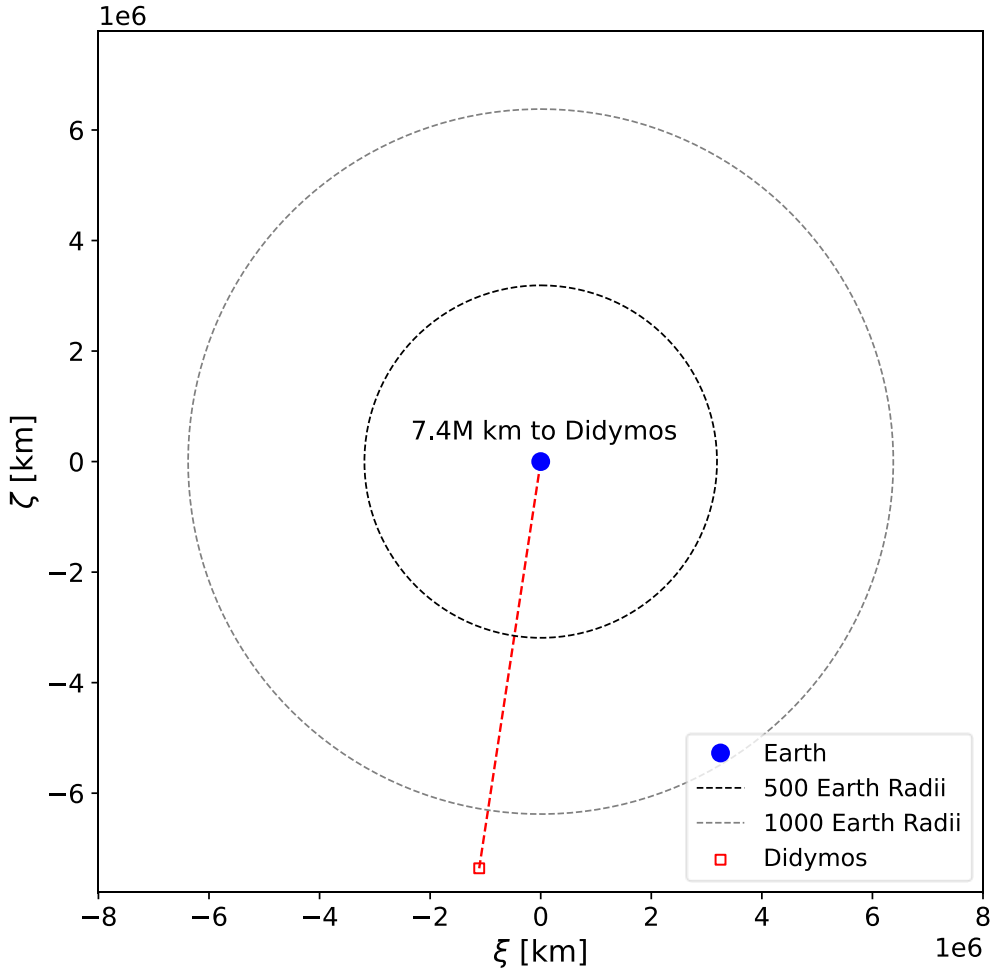
(from one JPL ejecta dynamics simulation over wide parameter space)

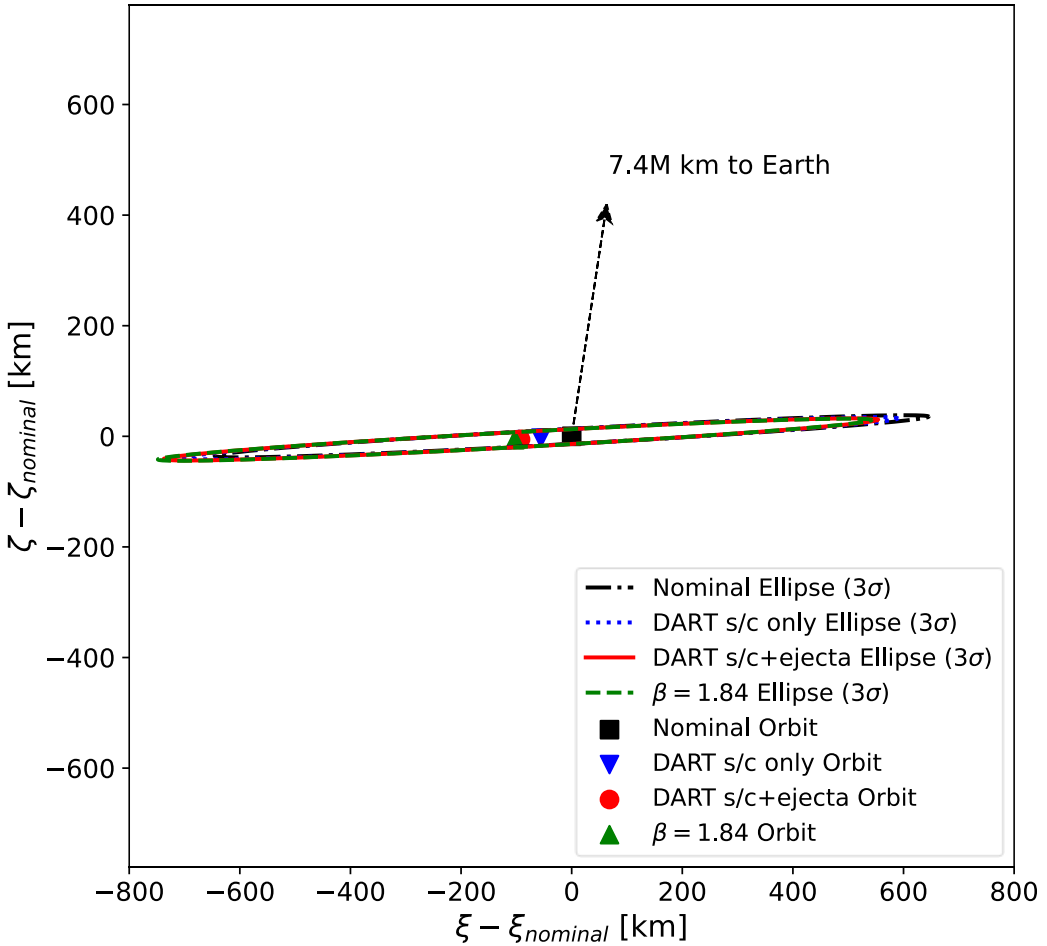


Ejecta Overview



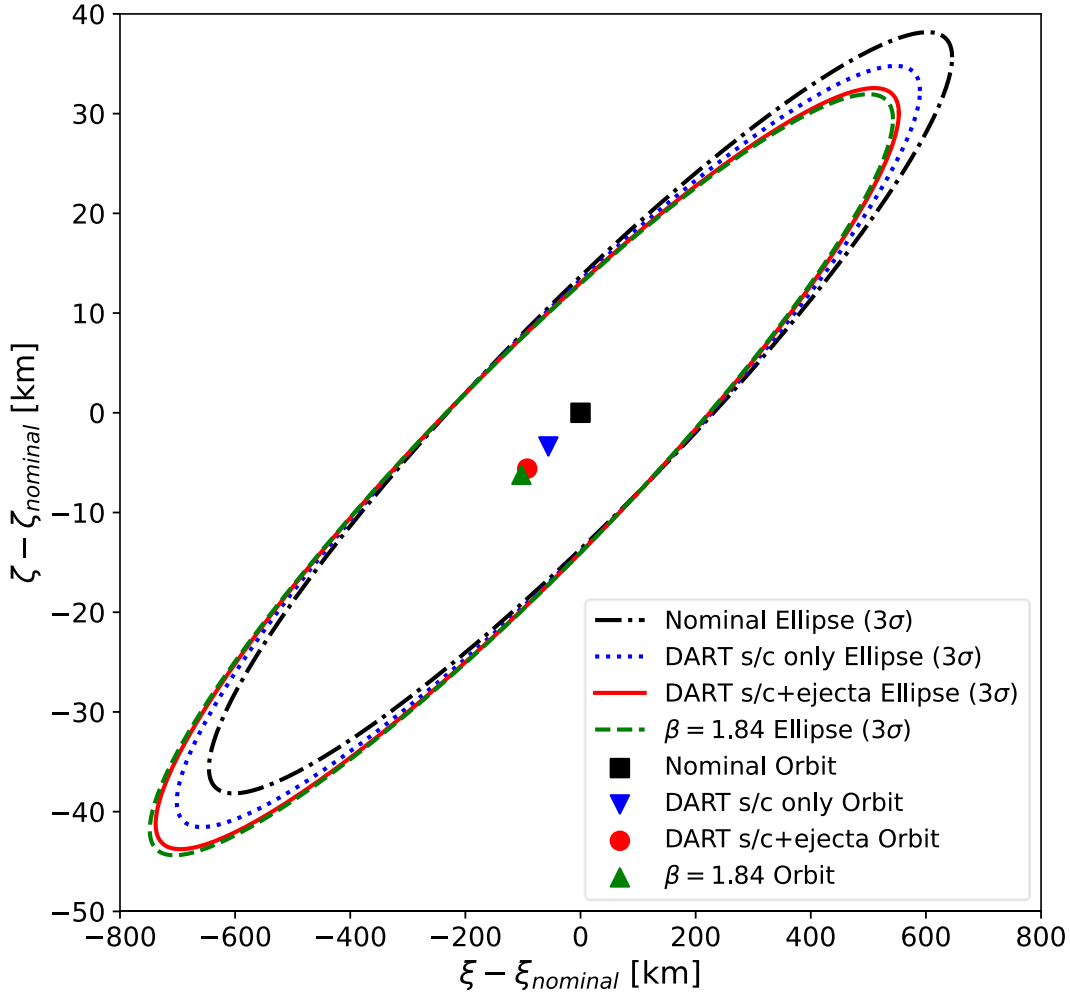
20-Oct-2062 Close Approach



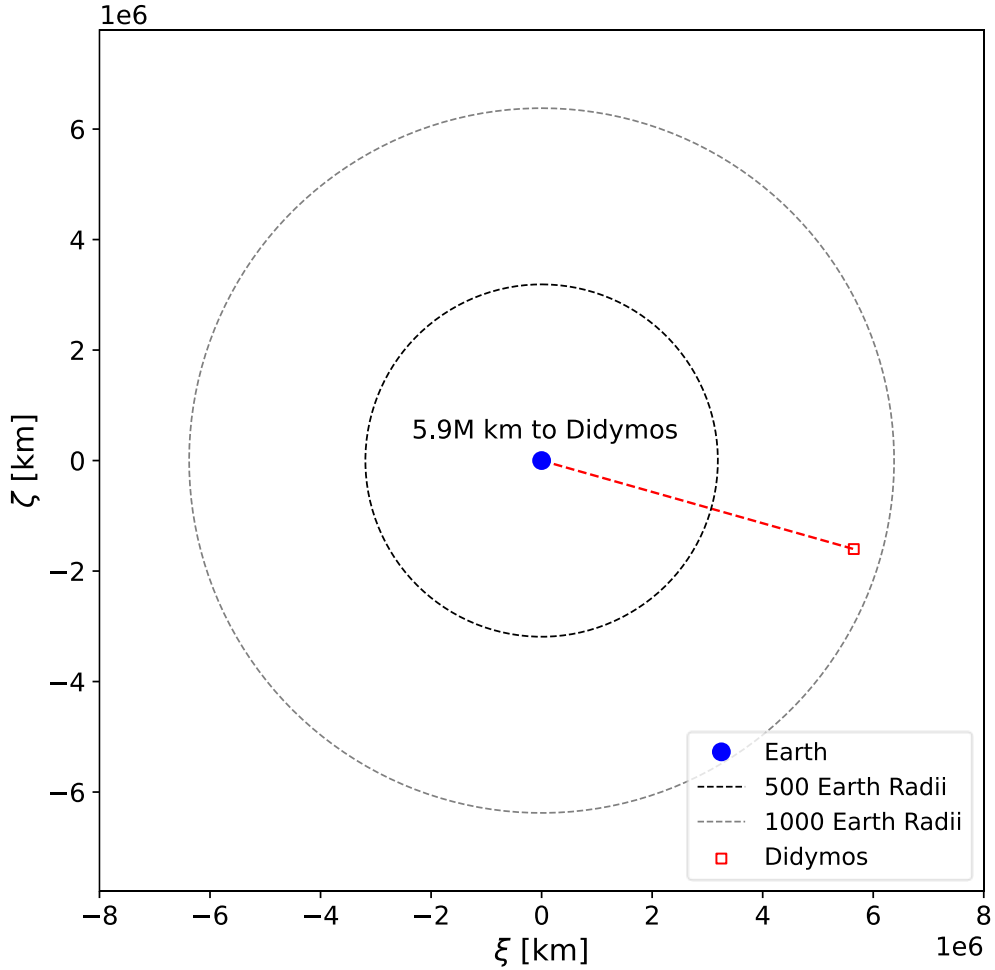


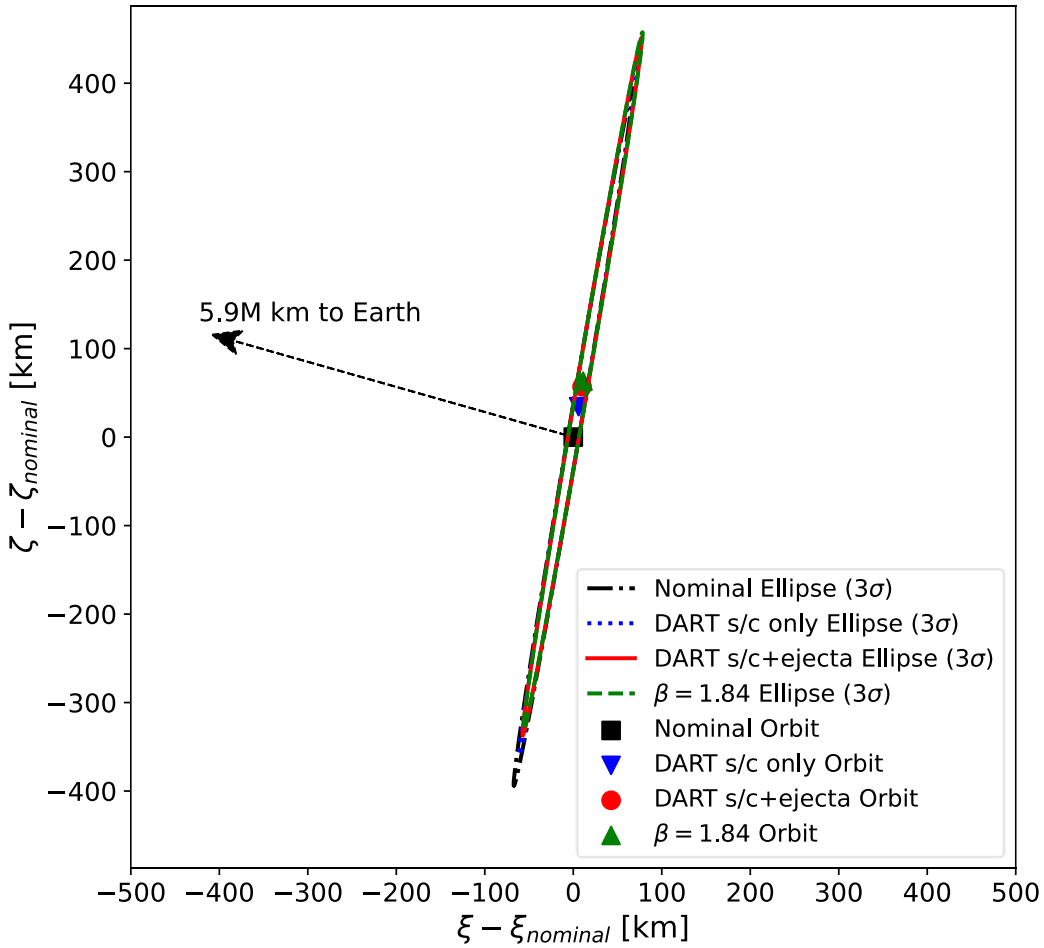
20-Oct-2062 Close Approach

Case	Total Deflection w.r.t Nominal (km)
DART s/c only	56
DART s/c + ejecta	93
$\beta_{helio} = 1.84$	103



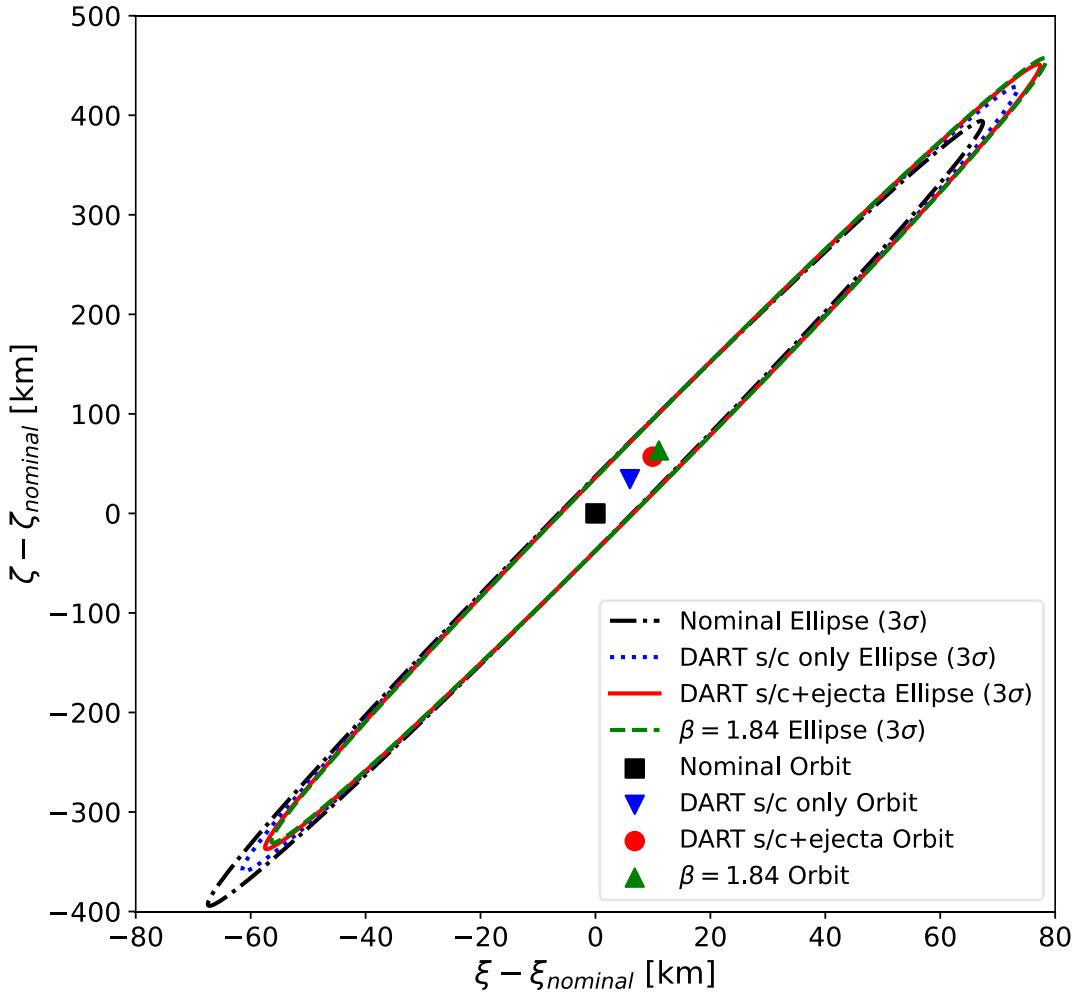
04-Nov-2123 Close Approach





04-Nov-2123 Close Approach

Case	Total Deflection w.r.t Nominal (km)
DART s/c only	35
DART s/c + ejecta	58
$\beta_{helio} = 1.84$	64



Conclusion

- DART changes Didymos close approach distances to Earth
  - October 2062 - approx. 90 km
  - November 2123 - approx. 60 km
- Modeling DART with multiple ejecta impulses differs from a single impulse
  - Ejecta keep leaving the Didymos system for up to 60 days after DART impact
  - Difference in the B-plane of 6-10 km
- This difference could be significant for modeling of future deflection missions
  - On the order of keyhole sizes for other potentially hazardous asteroids (e.g., Bennu)