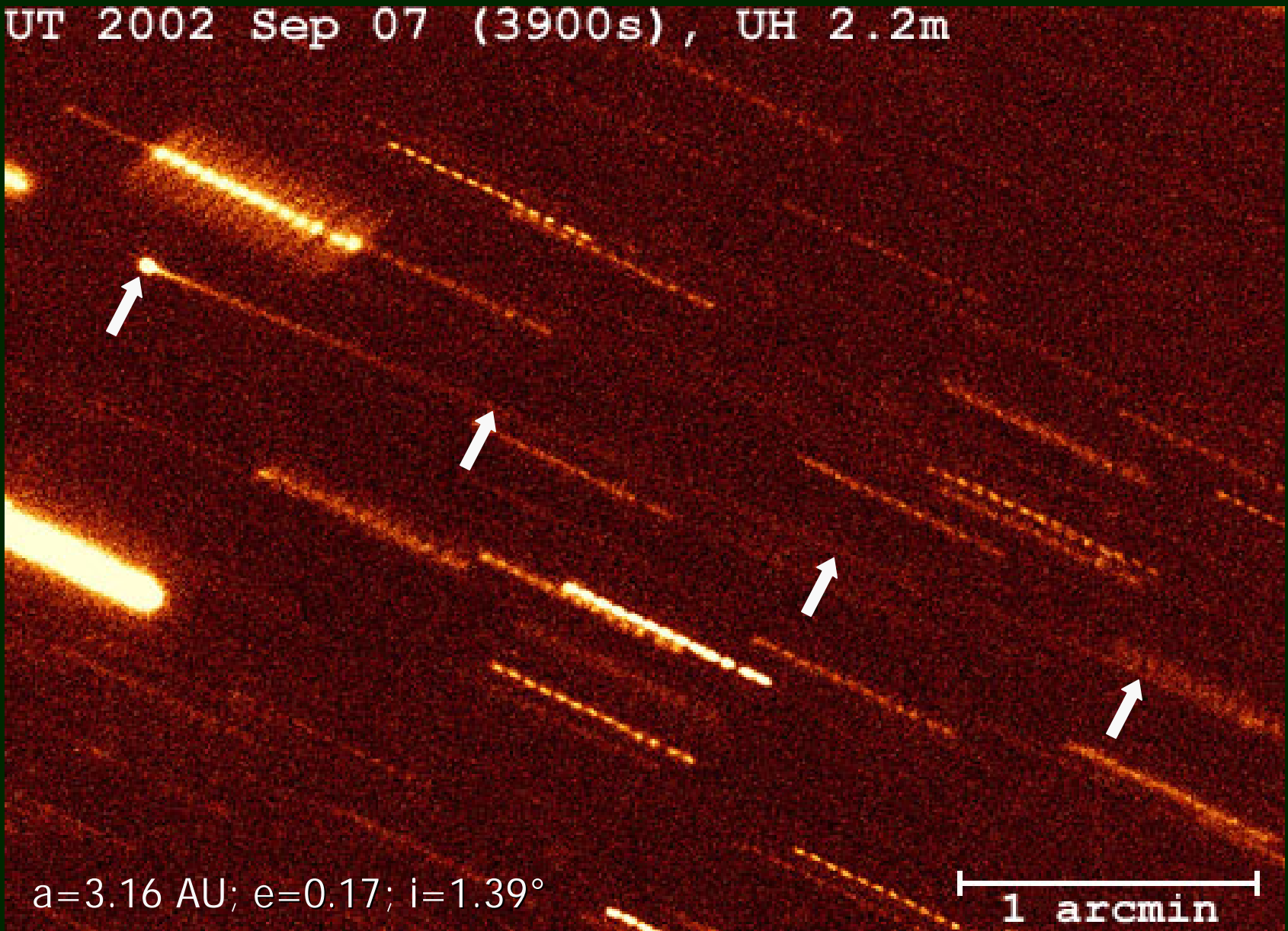

The Search for Active Main Belt Asteroids: The Hawaii Trails Project

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UT 2002 Sep 07 (3900s), UH 2.2m



$a=3.16$ AU; $e=0.17$; $i=1.39^\circ$

1 arcmin

133P/(7968) Elst-Pizarro

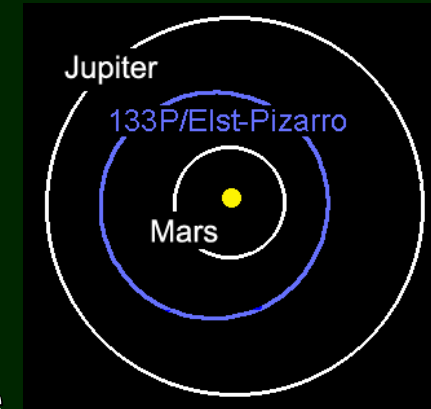
- Dynamically asteroidal but observationally cometary
 - orbits among Themis family
 - dust trail seen in 1996 and 2002

133P/(7968) Elst-Pizarro	
$a = 3.16 \text{ AU}$	$P = 5.61 \text{ yr}$
$i = 1.39^\circ$	$e = 0.17$
$T_J = 3.16$	

- Activity best explained by volatile sublimation (Hsieh et al, 2004, AJ)

- EP could be a lost comet, driven onto current orbit via NG outgassing forces
→ JFC-MB transition unlikely; EP could be alone

- EP could be an icy asteroid, native to the main belt but with recently exposed volatiles → **more EPs should exist!**



Icy Asteroid?

- Ice accretion possible in primordial inner SS
 - icy grains drifting inward, e.g. Cyr et al. 1998
- Aq. alteration seen in meteorites & asteroids
 - CI/CM carbonaceous chondrites; linked to C-types
 - spectroscopic evidence ($0.7\mu\text{m}$ & $3\mu\text{m}$) for hydrated minerals
- Unaltered asteroids/meteorites also seen
 - given aq. alt. evidence, pristine material suggests extant ice supply
 - models also suggest persistent ice, e.g. Grimm & McSween 1989
- Ceres may have surface and subsurface ice
 - Lebofsky et al. 1981: water of hydration ($3\mu\text{m}$), water ice ($3.1\mu\text{m}$)
 - A'Hearn & Feldman 1992: OH emission (photodissociated H_2O)
 - Fanale & Salvail 1989: moderate-depth subsurface ice stable for Gyrs

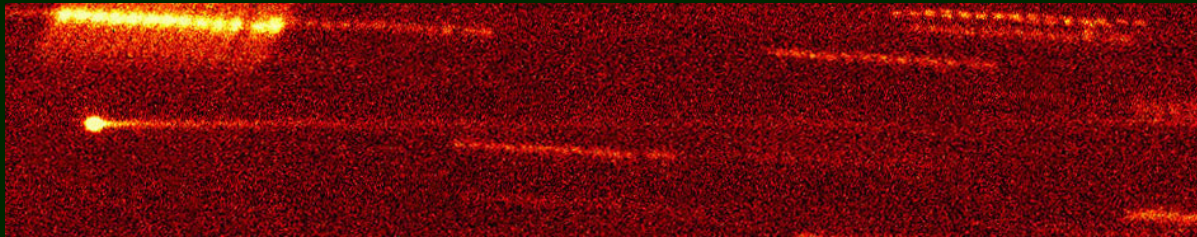
Why No Other Active Asteroids Seen?

- Activity is likely weak and transient
 - Discovery & recovery images typically not deep enough
 - Few small (km-scale) asteroids studied very intensely
- Collisional activation may be necessary
 - Larger cross-sections preferred
 - suggests larger asts more likely to become activated
- Ejection velocity must exceed escape velocity
 - Significant because for EP, $v_{\text{esc}} \sim v_{\text{dust}} \sim 1$ m/s
 - suggests smaller asts more likely to show observable activity
- EP could be bona fide comet

Finding More Active Asteroids

■ Hawaii Trails Project

- survey of km-scale main belt asteroids
- from Mauna Kea, CTIO, and Lulin



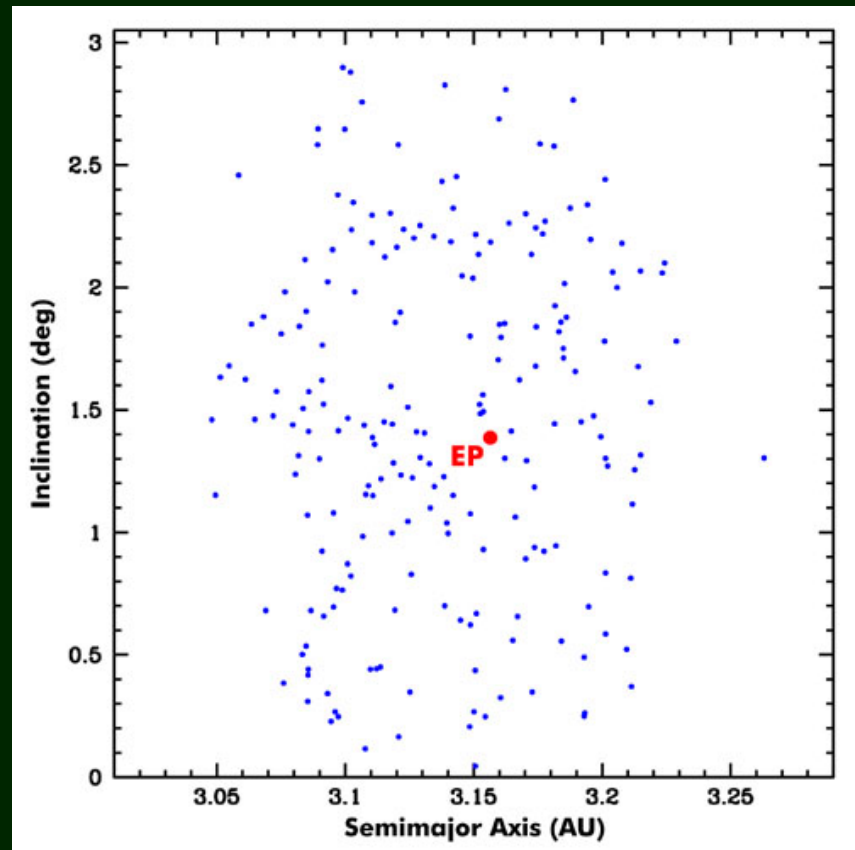
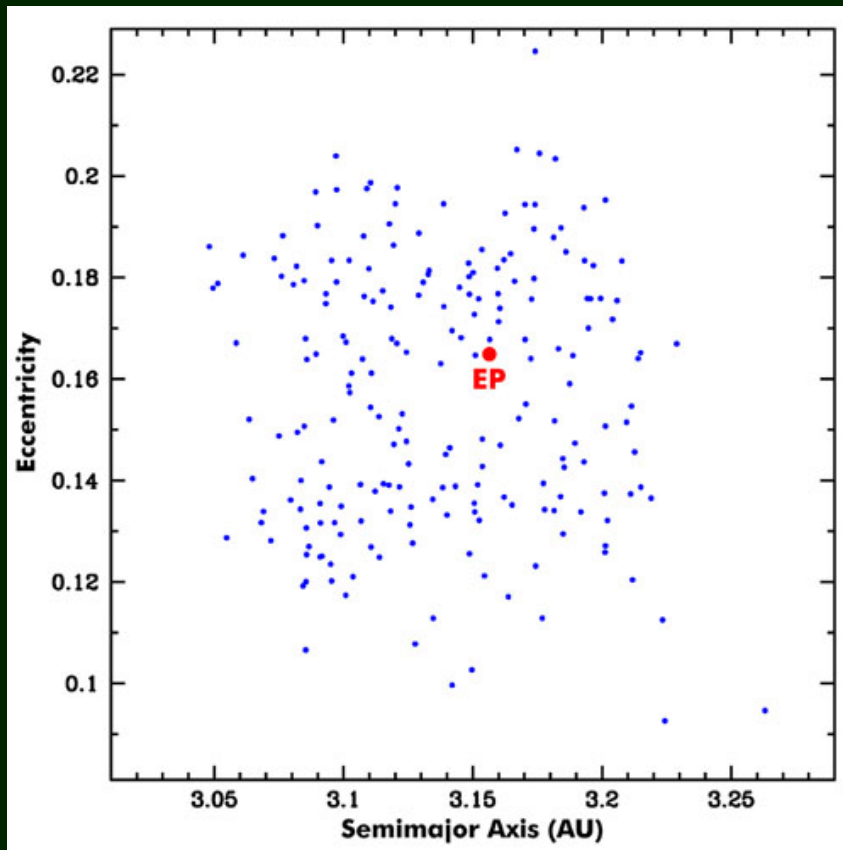
■ Focuses on Themis family (where EP is!)

- Family members compositionally related (e.g. Florczak et al. 1999)
- Known for elevated collision rates (Farinella & Davis 1992)

■ Survey Status

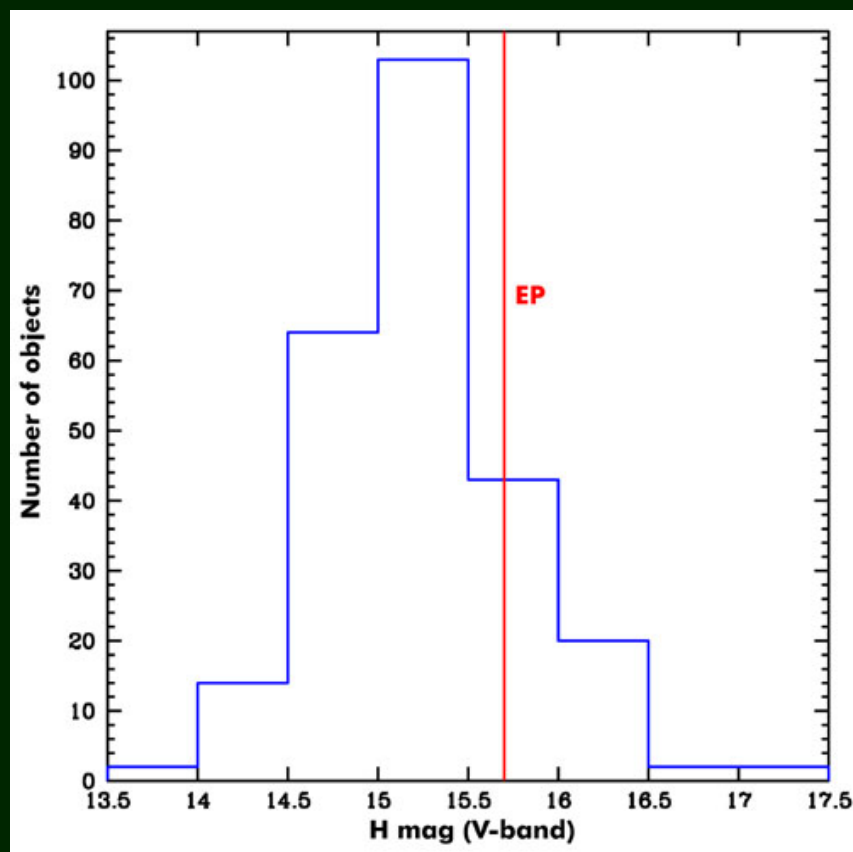
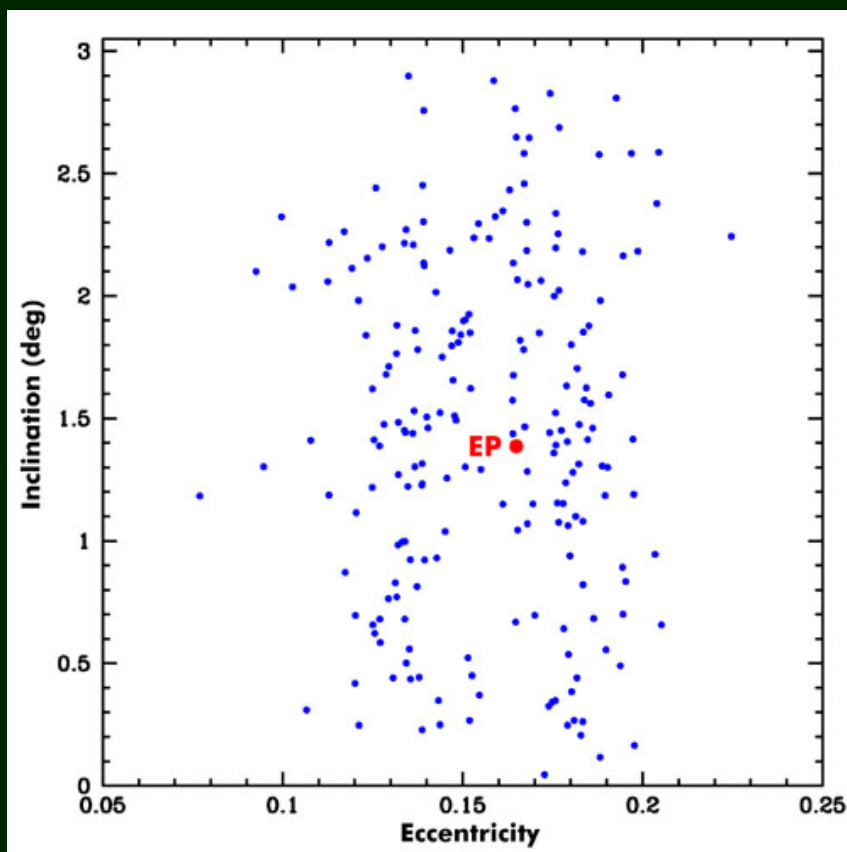
- ~200 objects imaged: $17 > H_v > 14 \rightarrow r \sim 0.5-6 \text{ km} \rightarrow v_{\text{esc}} \sim 0.5-4 \text{ m/s}$
- looking for trails and/or coma (though EP showed no coma)
- no activity found yet (sensitivity $\sim 0.1-0.01 \text{ kg/s}$)

Hawaii Trails - Status



Surveyed so far...

Hawaii Trails - Status

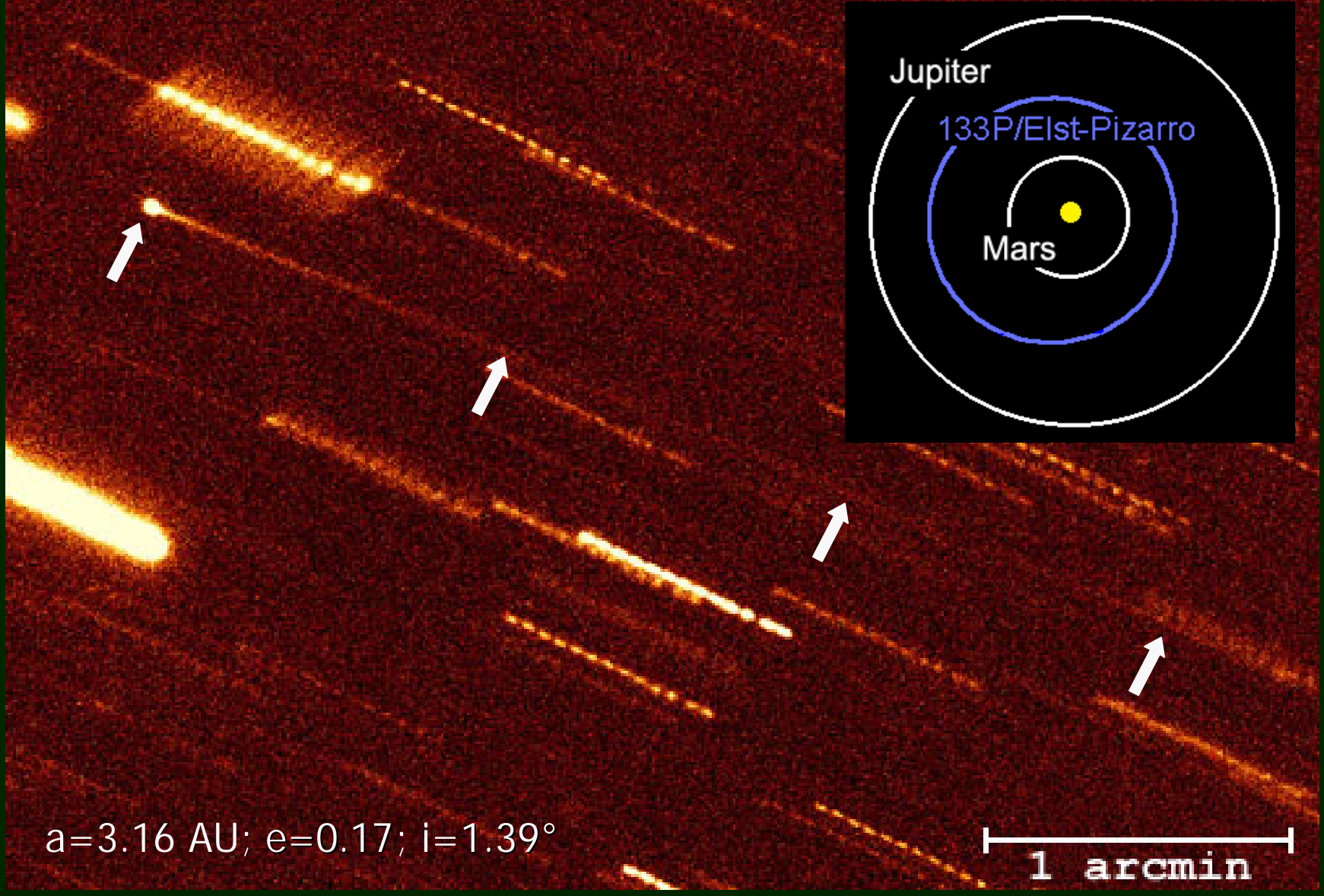


Surveyed so far...

Challenges

- Only one EP known! ... Is it typical?
- Rogue comet hypothesis difficult to assess
 - Could use dynamical assessment of probability of JFC-MB transition
- Activated asteroids possible but likely rare
 - Collisional activation hypothesis involves size preference conflict
 - Not all collisions will necessarily be activations (need to hit icy spots)
 - Activated sites expected to have finite lifetimes
- Lots of possible candidates
 - Need to refine target selection criteria → need to find another EP!

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