

## Cometary Science with GROWTH

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## Small-body ~~Cometary~~ Science with GROWTH

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	Stable orbit	Unstable orbit
Coma		Comets
No coma	Asteroids	

	Stable orbit	Unstable orbit
Coma	<b>Active asteroids</b>	Comets
No coma	Asteroids	<b>Dead comets</b>

## Active asteroids & cometary events

(outbursts, splitting, fragmentation)

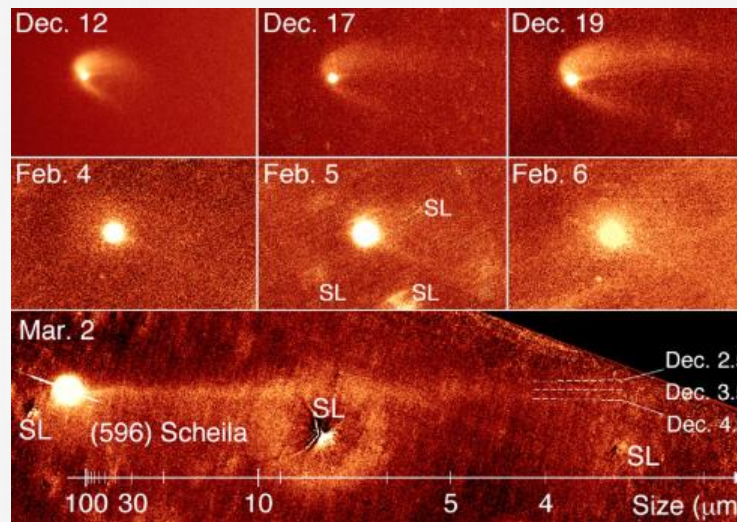
- “Comets are like cats; they have tails, and do whatever they want.” (David H. Levy)
  - Sudden onset of activity
  - No set behaviors
- We know little
  - Activities of most AAs are not well characterized
  - Very few cometary events are well studied

## Active asteroids & cometary events

- Bottlenecks
  - The need of coordinated, rapid-response efforts in following up an event
  - Multidisciplinary approach (time domain multi-wavelength observations, dust modeling, dynamical investigation, meteor data)
- There are lots of room for GROWTH!



## Outburst of (596) Scheila in 2010



Ishiguro et al. (2011)

2010 Dec 3.4 UT  
First detection by CSS  
(not identified initially)

Dec 11.4  
CSS report

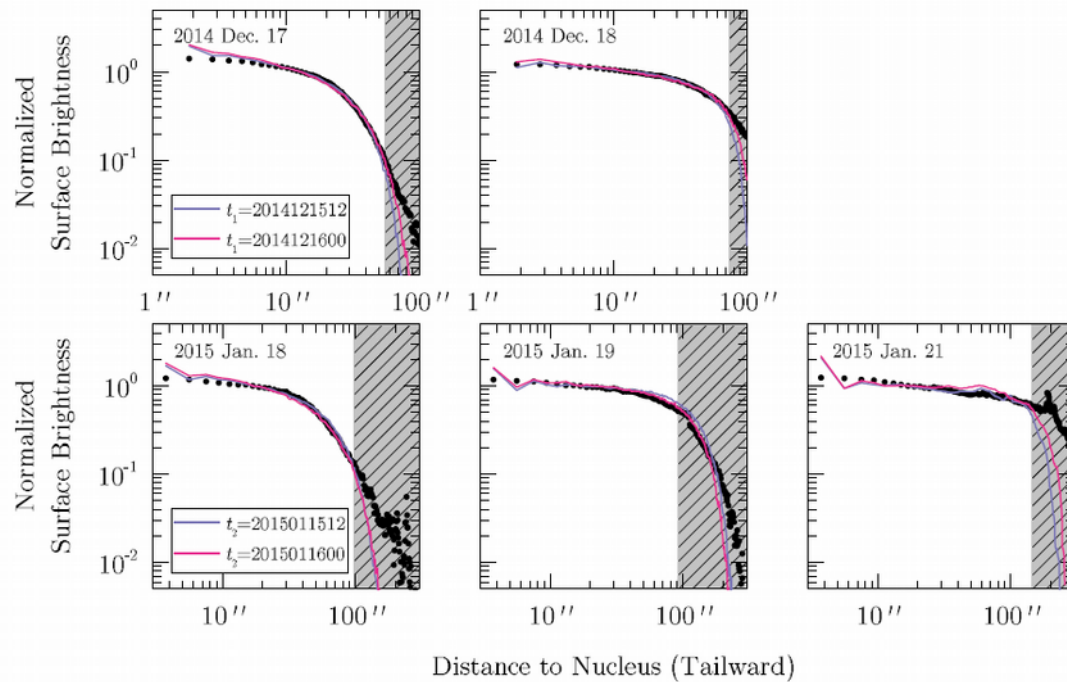
Dec 13.5  
Subaru

Dec 12.8 Dec 14.3  
IAO SWIFT

- “Scheila offered a unique target as we observed it only weeks after its outburst...” (Bodewits et al. 2011)

# GROWTH

Global Relay of Observatories Watching Transients Happen



Ye et al. (2016)

2015 Jan. 17.5 (UT)

2015 Jan. 19.6 (UT)

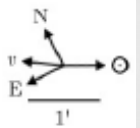
2015 Jan. 20.5 (UT)

2015 Jan. 21.5 (UT)

2015 Jan. 23.6 (UT)

2015 Jan. 27.6 (UT)

2015 Jan. 29.6 (UT)

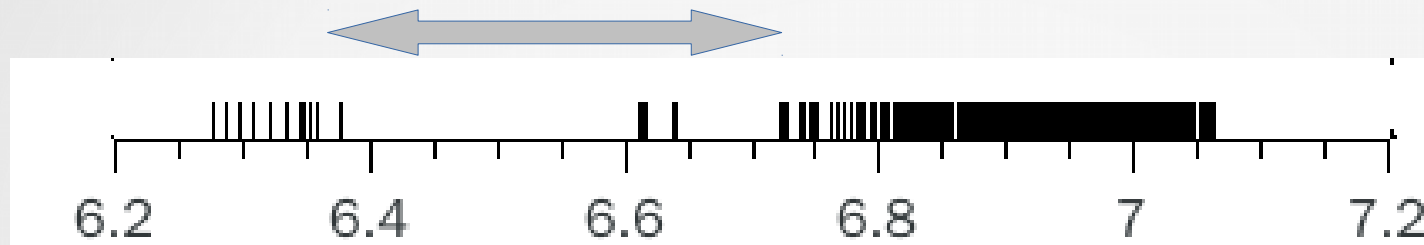




## Near-Earth Asteroids & dead comets

- Rapid follow-up and characterization of sub-km NEOs
  - ~20% NEOs are lost after their initial detections
  - <5% NEOs have been characterized, mostly km-sized NEOs
- Dead comets in the NEO population
  - Dark, faint, short observing window
  - The need of multidisciplinary approach

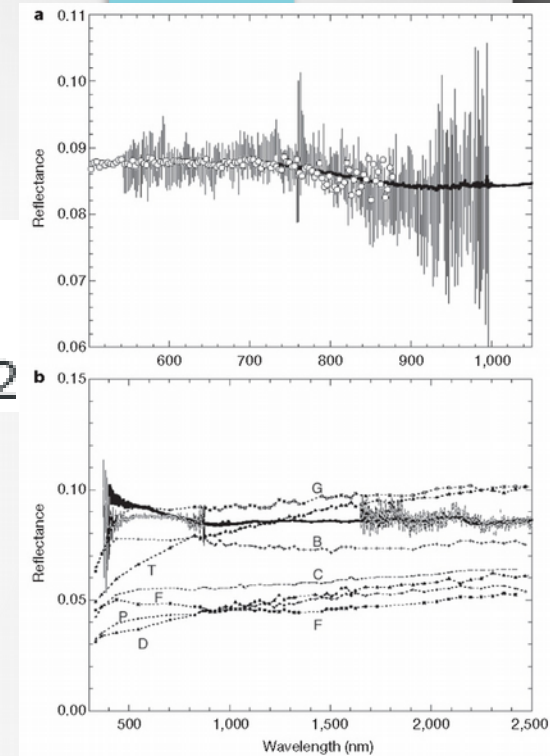
## The impact of 2008 TC<sub>3</sub>



2008 Oct 6  
6:39 UT  
CSS discovery

NASA  
Alert +  
WHT  
Spectrum

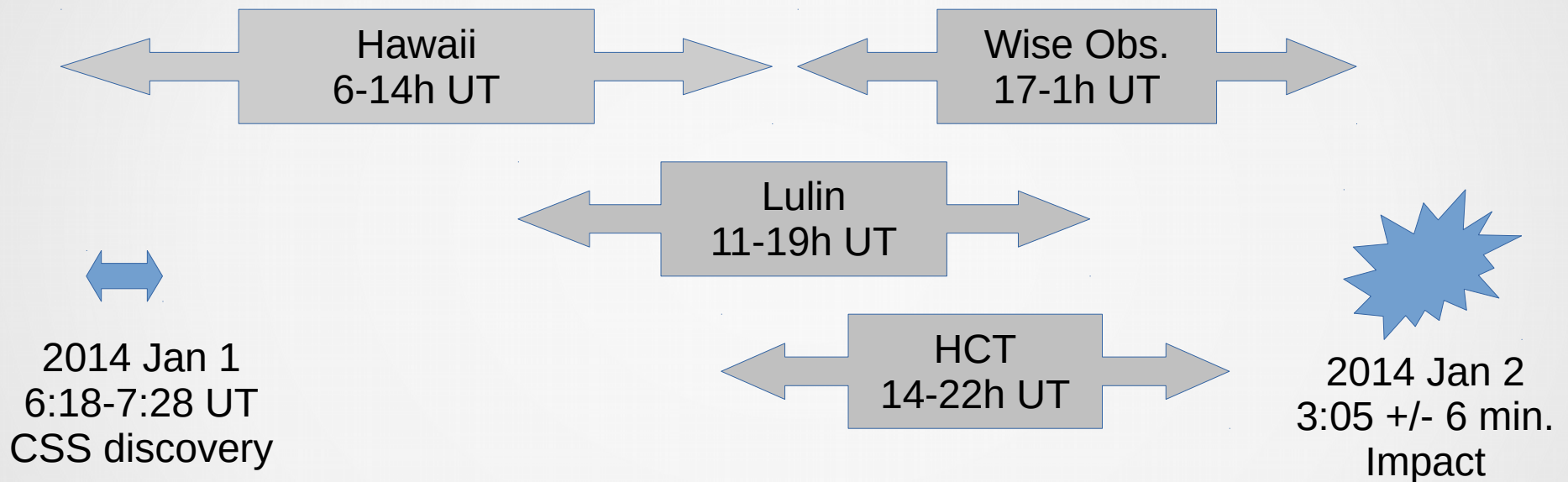
2008 Oct 7  
2:46  
Impact



- Light-curve
- Asteroid spectrum
- Meteorite spectrum



## The impact of 2014 AA



- Lack of Eurasian observers
- It was New Year's Day

## Summary

- Transient science related to small bodies
  - Active asteroids
  - Cometary outbursts, splitting, fragmentation
  - Tracking/characterizing small NEOs before they are lost or hit us!
- Challenges for GROWTH
  - Large candidate rates from ZTF and other surveys
  - Speed-up and automate the follow-up process

**Thank you!**