IMEX – Interplanetary Meteoroid Environment for eXploration:

Modeling meteor showers anywhere, anytime

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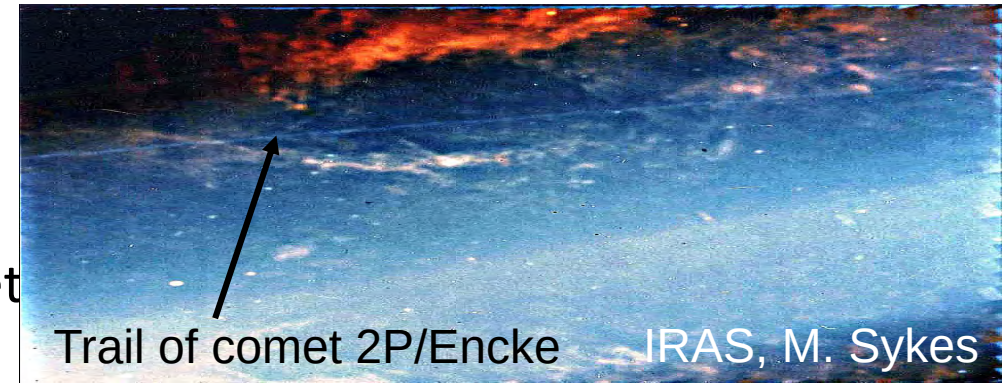
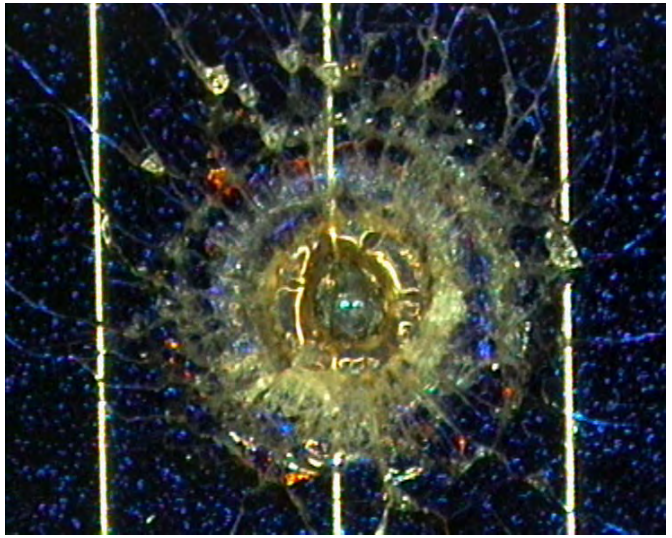
Goal:

Model of the fine structure in the Solar System dust cloud from cometary trails/streams (>100µm)

To study:

- meteor showers at Earth
- meteor showers at other planet locations
- comet dust emission
- planetary perturbations, scattering
- the impact hazard to spacecraft

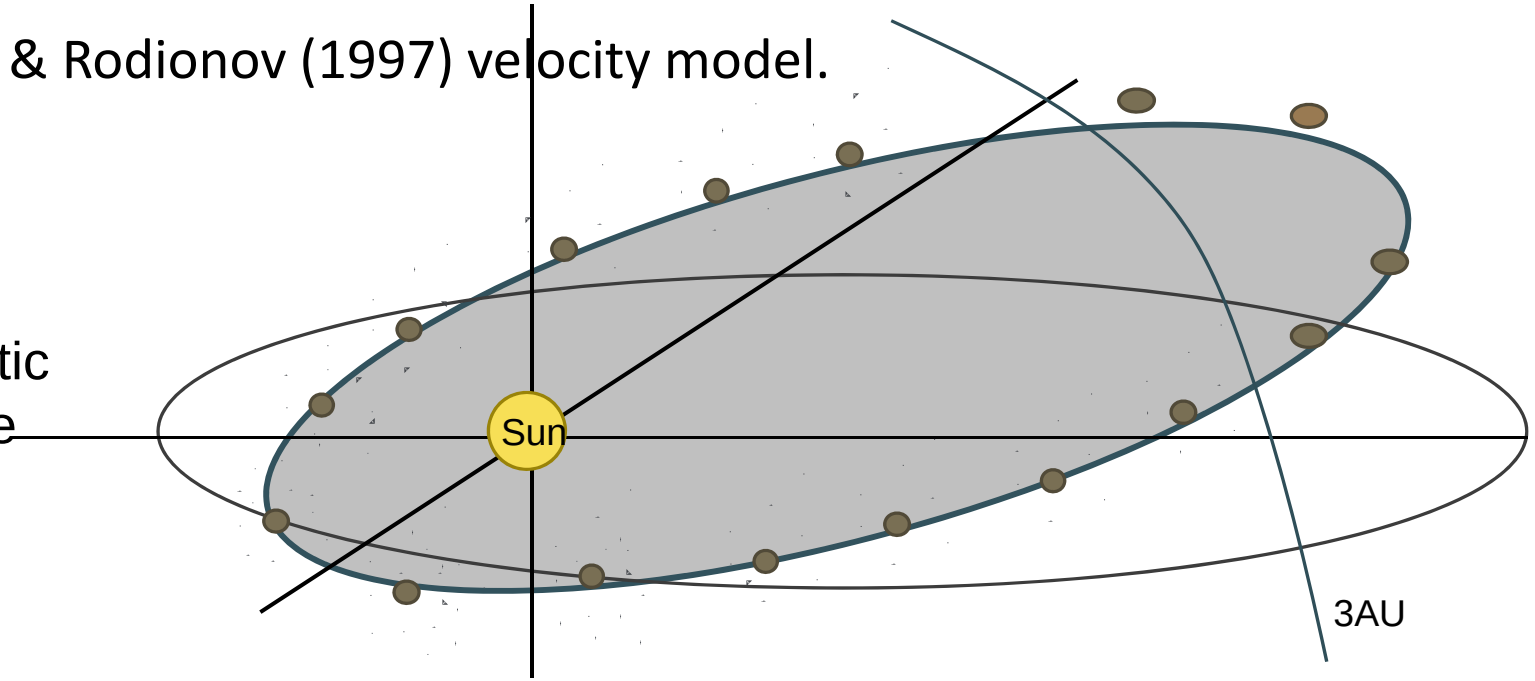




Impact on to Hubble Space Telescope solar cells ESA, Drolshagen, 2008

(1) Emitting particles

- **Emit** dust:
  - from 428 short comets
  - for 200-400 years
  - inwards of 3AU from sunlight hemisphere
  - around 0.33 million particles/ comet/ mass
  - 8 masses 100microns to 1cm.
  - Crifo & Rodionov (1997) velocity model.



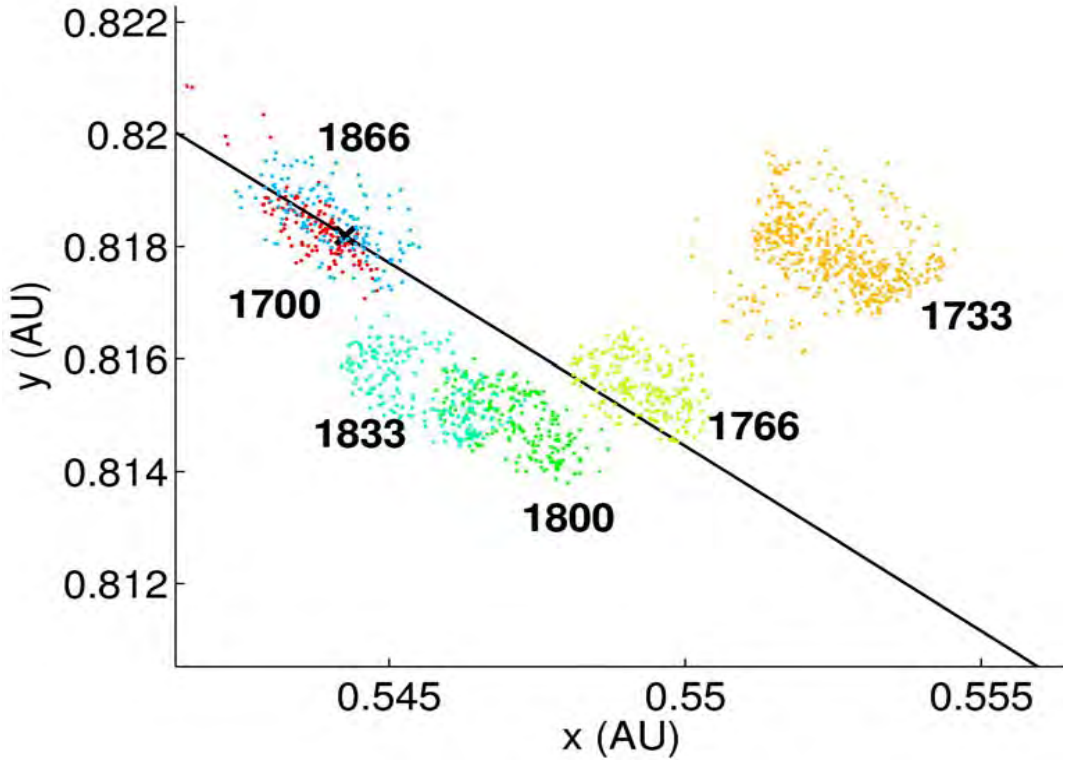
(2) Creating the meteoroid stream database

- **Integrate orbits (gravity and radiation effects)**
  - Constellation distributed computing platform
  - Citizen science project: 12478 users with 57,521 PCs world wide
- **Generate a database of cometary dust**
  - Save each integrated particle several times per orbit between 1980-2080
- **Result: we have a database from which can reconstruct the orbits of all stream particles from 429 comets.**

Andreas Hornig and Lars Bausch:
aerospaceresearch.net

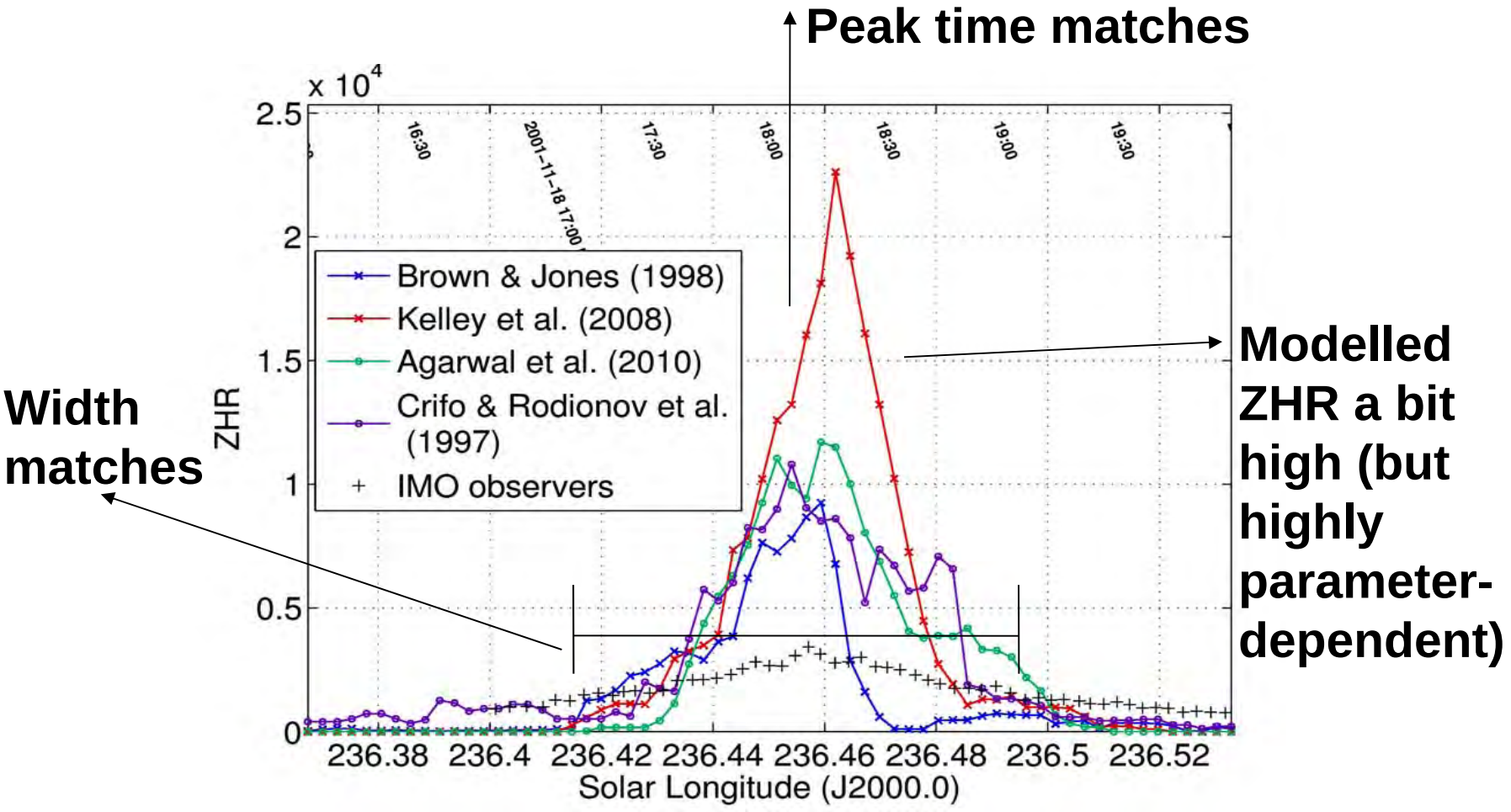
Verifying the model (1): Meteor Storms
Leonids in 2001

- Dust from **55P/Tempel-Tuttle** 1690-1998
  - Leonids at Earth **2001**
  - Compare observed and modeled max times of storms at Earth: **Within 10-30mins.**



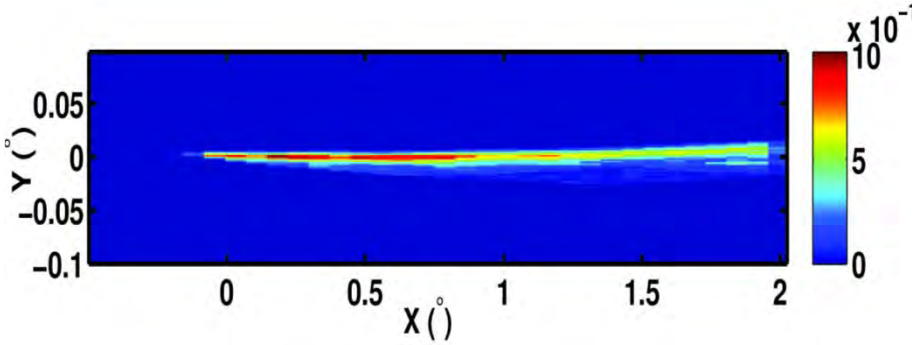
Verifying the model (1): Meteor Storms
Leonids in 2001

- ZHR profiles for different velocity models



Verifying the model (2): Comet Trails
Comparison with IR images

- **67P/Churyumov-Gerasimenko**
  - Spitzer observations in 2004-6
    - Kelley et al 2008
    - Agarwal et al 2010
  - Brightness match factor ~2

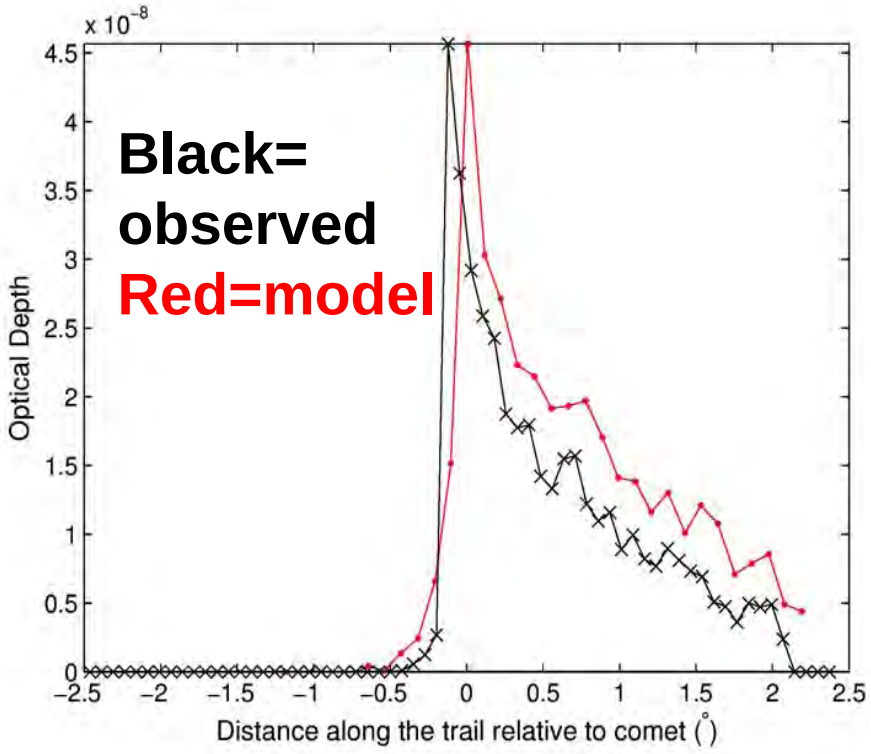


Verifying the model (2): Comet Trails Comparison with IR images

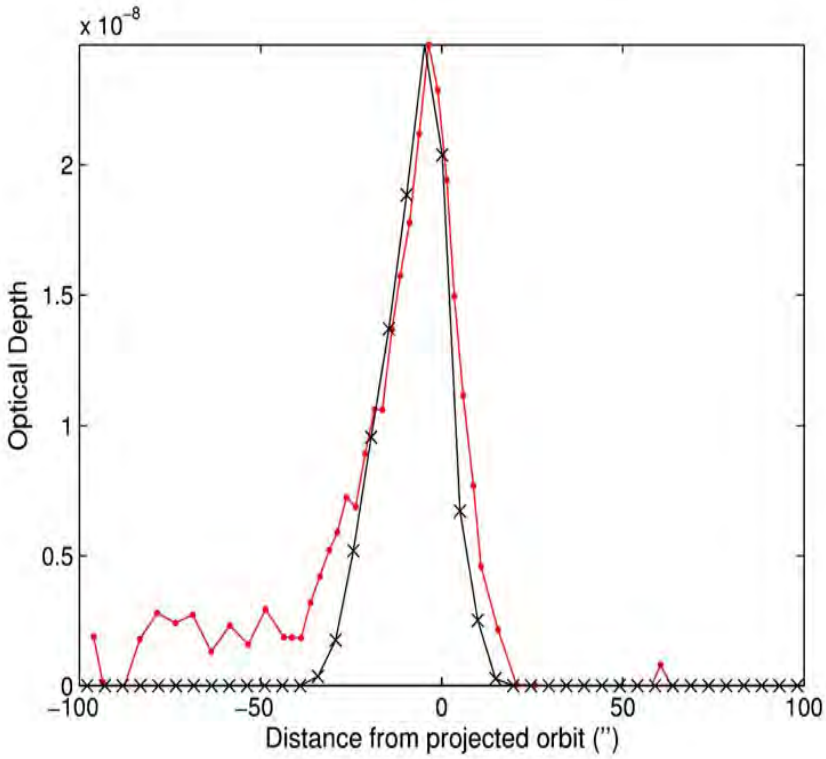
Trail width matches well, but requires low velocities (Agarwal et al. 2010 model)

Kelley et al. 2008 observations: trail profiles

Along the trail



Across the trail



Summary

- **IMEX model now performs well for individual streams**
  - Generation of large volumes of data works well
  - Resulting trails match **IR trail** observations and **meteor storm** observations
- **Ready for the next stage:**
  - mass production of database of streams of 429 short period comets for the period 1950-2100.

The Trail of 67P/Churyumov-Gerasimenko

Dust Streams near an object near 1AU (STEREO-B)