

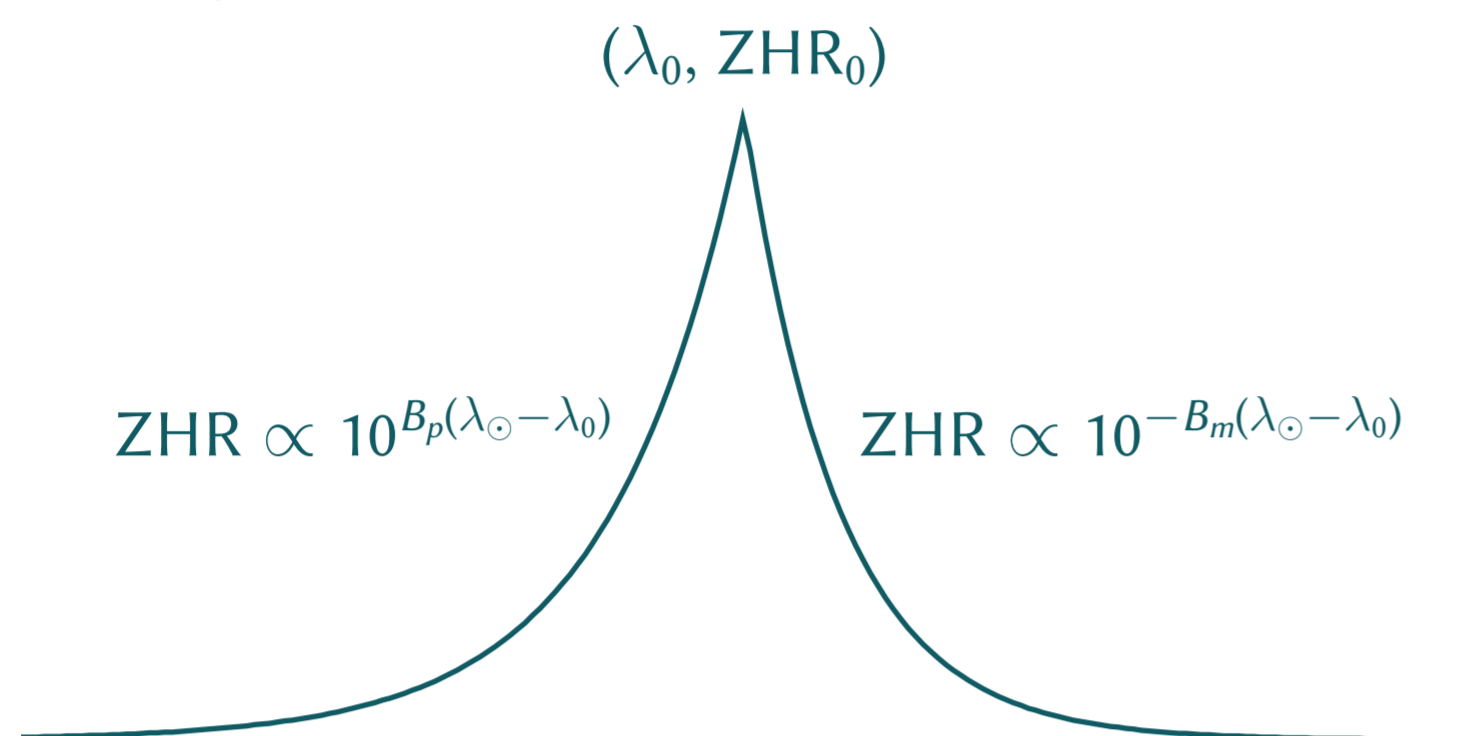
Meteor shower forecasting for spacecraft operations

Introduction

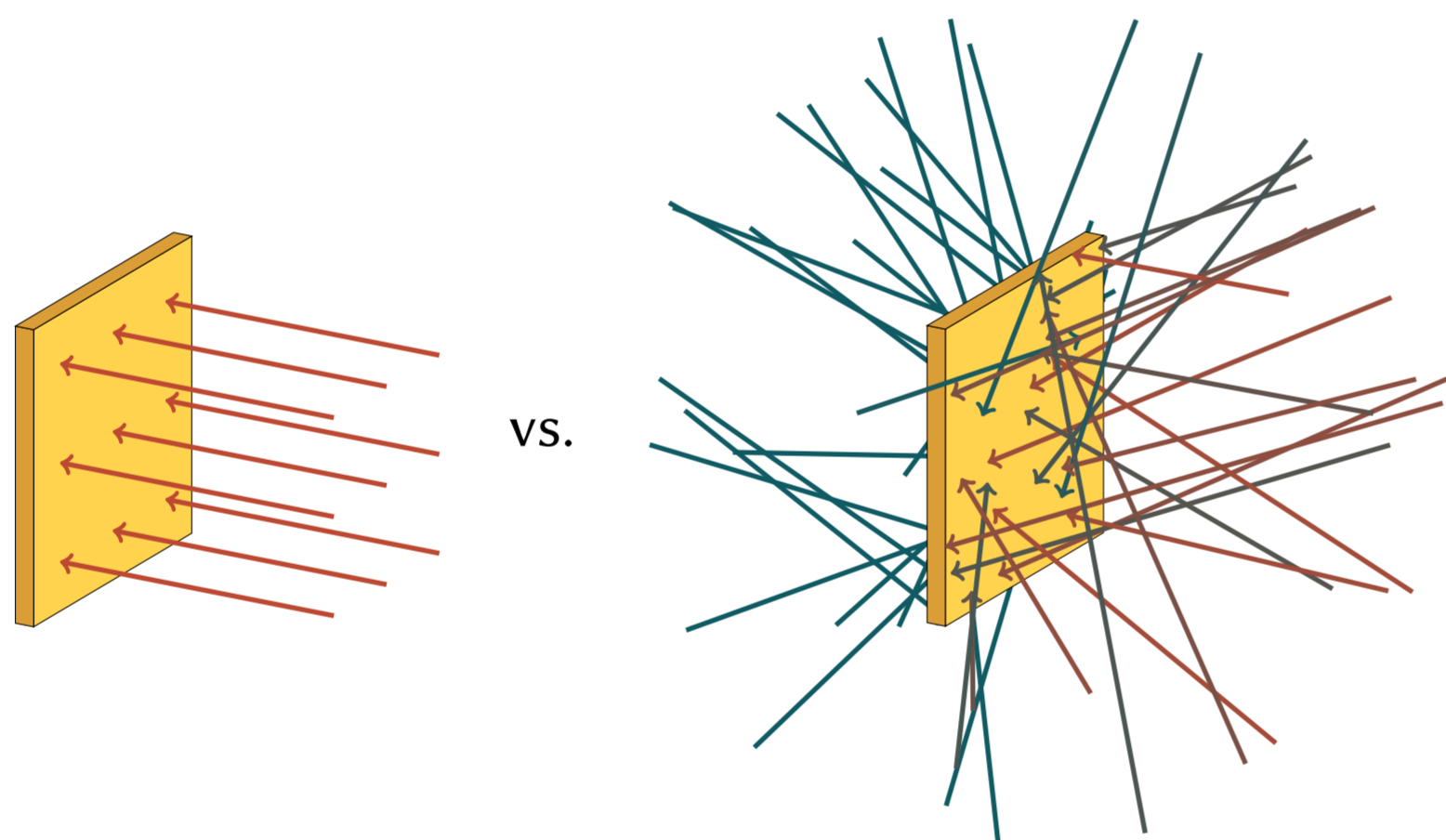
- ▶ Meteoroid impacts are predominantly due to the sporadic background, but meteor showers have higher speeds and occasionally “outburst.”
- ▶ Due to their brief duration, showers can be mitigated operationally.
- ▶ NASA’s Meteoroid Environment Office produces annual forecasts to support meteor shower risk assessments.

Meteor shower data

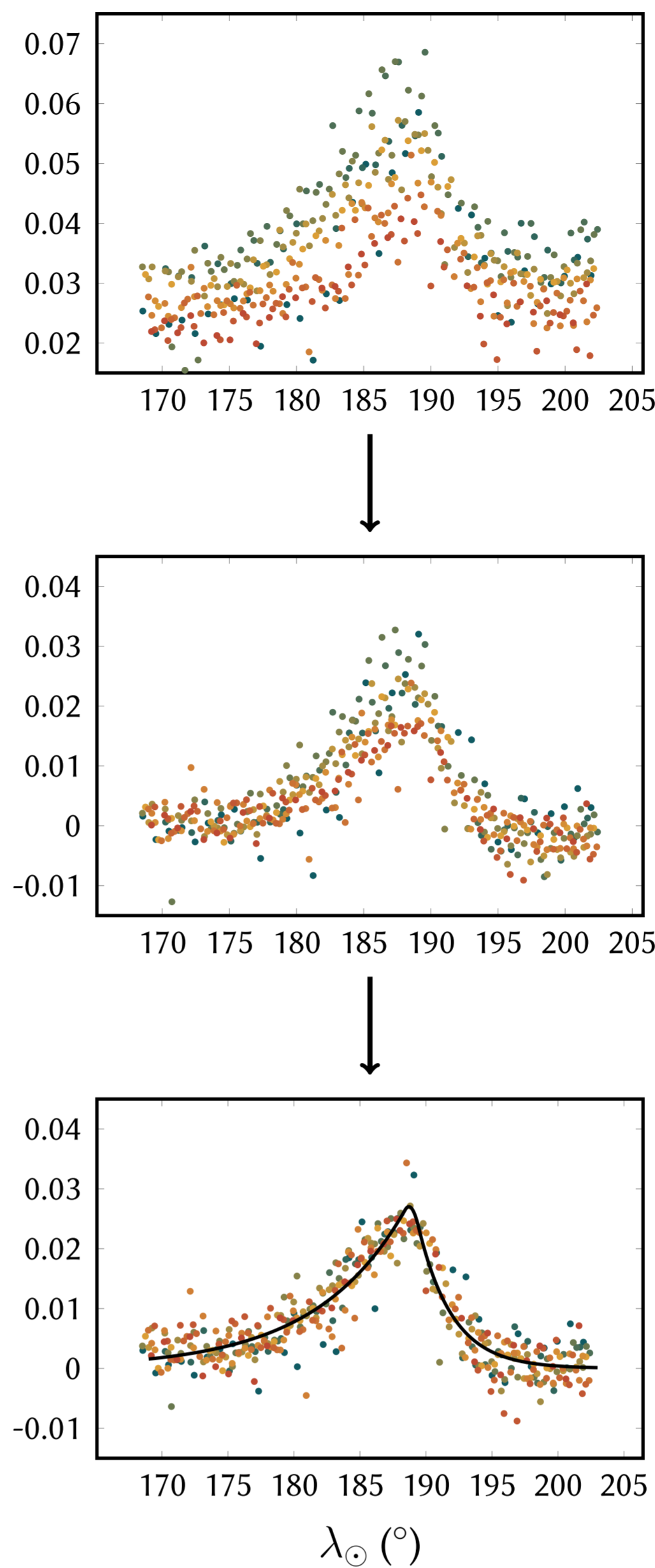
- ▶ Meteor shower activity follows a double exponential function.
- ▶ We convert hourly rates (ZHR) to flux [1] for multiple limiting kinetic energies.



- ▶ We apply gravitational focusing to shower and baseline fluxes, and planetary shielding to the baseline flux [2].
- ▶ Fluxes are calculated for four limiting particle kinetic energies determined by our ISS customer.
- ▶ **Fluxes and flux ratios correspond to a “worst-case” orientation in which a spacecraft surface faces and is fully exposed to the shower radiant.**



New measurements of meteor shower profiles



- ▶ For many years, the forecast used meteor shower profiles derived from naked-eye observations [3].
- ▶ We now have 14 years of flux data from the Canadian Meteor Orbit Radar (CMOR) [4], allowing us to improve many of these profiles.
- ▶ **First**, we de-trend by fitting a linear trend to each year’s flux data (top) and subtracting. We also remove outliers and perform an initial fit (middle).
- ▶ **Second**, we use our initial fit to determine each year’s amplitude. CMOR fluxes tend to be lower in later years.
- ▶ **Third**, we normalize each year to the same amplitude (bottom) and obtain an improved fit.
- ▶ **We were able to obtain improved activity profiles for 11 major meteor showers.**
- ▶ We also removed 24 defunct or inactive showers.

References

- [1] Koschack R., Rendtel J., 1990, *WGN*, **18**, 119-140
- [2] Grün E. et al., 1985, *Icarus*, **62**, 244-272
- [3] Jenniskens P., 1994, *A&A*, **287**, 990-1013
- [4] Campbell-Brown M., Jones J., 2006, *MNRAS*, **367**, 709-716

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