

Herschel Calibration Workshop

Madrid, Feb 2008

Planetary Models Splinter Summary

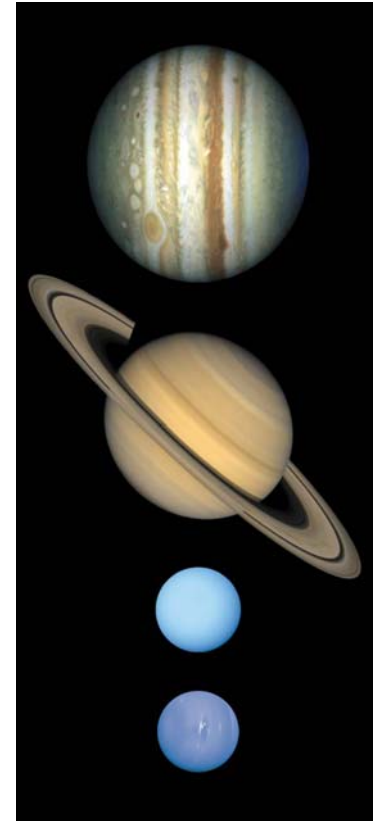
Matt Griffin

Objectives

- **Define baseline list of planets to be used for Herschel calibration**
- **Define the models to be adopted**
 - **Initially for planning purposes**
- **Plan to complete, improve, extend the models**
- **Comment on requirements for calibration observations with Herschel**

Sources

- **Mars**
 - HIFI, PACS spectrometer
- **Uranus and Neptune**
 - HIFI, PACS, SPIRE
- **Jupiter**
 - HIFI – possible interim calibrator
- **Saturn**
 - HIFI – possible interim calibrator
- **Satellites**
 - Titan
 - Galilean satellites

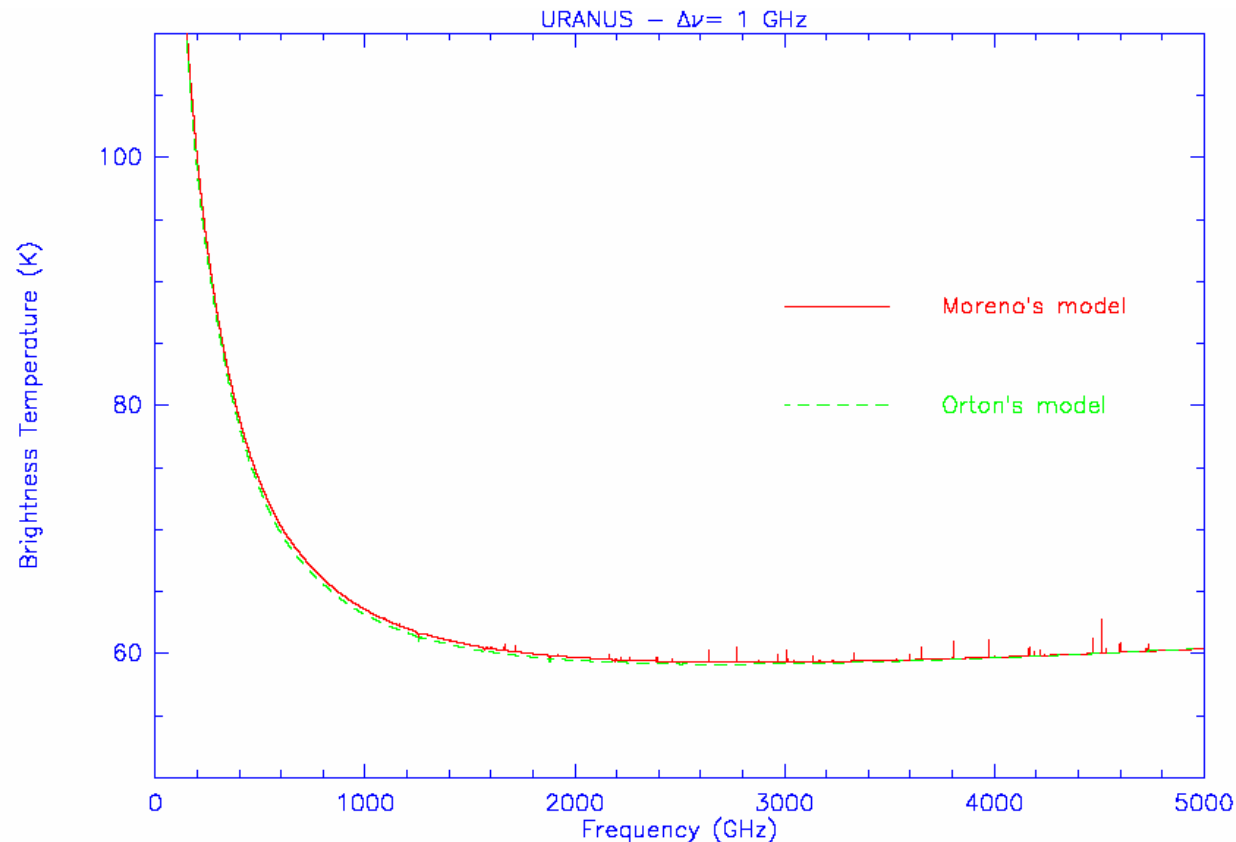


Conventions

- **Standard format for provision of model data**
 - **Disc-averaged T_B vs. frequency (GHz)**
with 1 MHz steps
- **Geometrical parameters to allow solid angle computation**
 - **Equatorial radius (1-bar level)**
 - **Ellipticity**
 - **Polar inclination angle**
- **Models can generate surface brightness distribution for convolution with beam profiles**

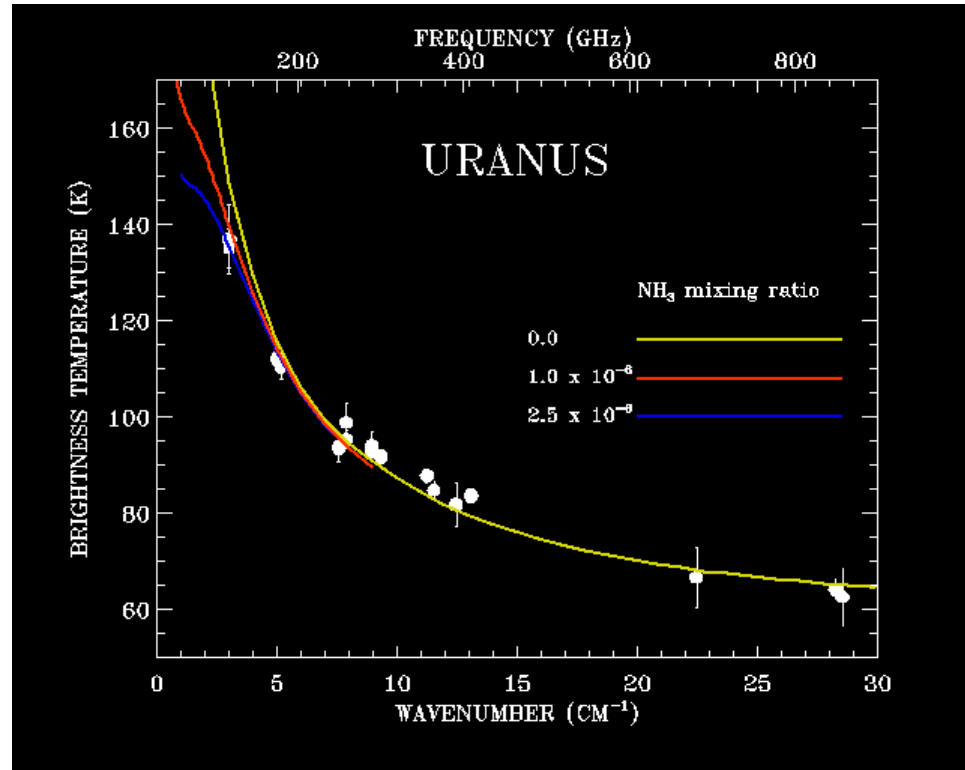
Uranus

- Glenn's and Raphael's models agree to ~ 1%
 - Est. 5% absolute accuracy
 - Work needed to establish compatibility with all available data



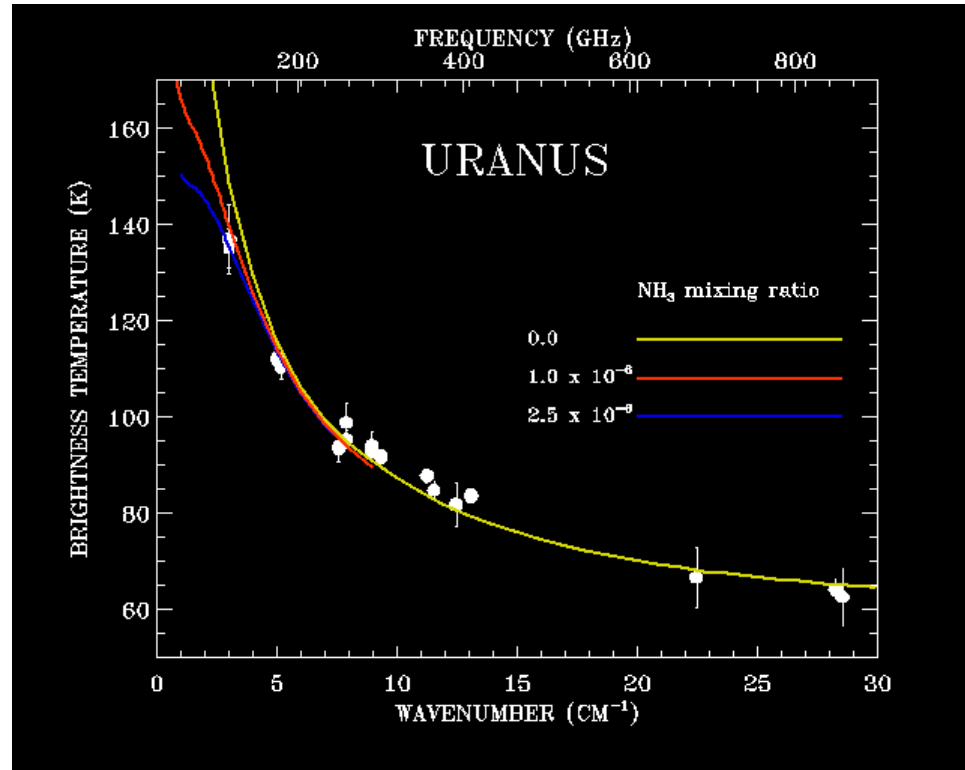
Uranus

- For now, Griffin & Orton (1993) model can be used as interim model
 - But 4% cooler
- Updated model to be provided before launch
- No variability assumed in the models
 - But maybe we could discern variability over the Herschel lifetime



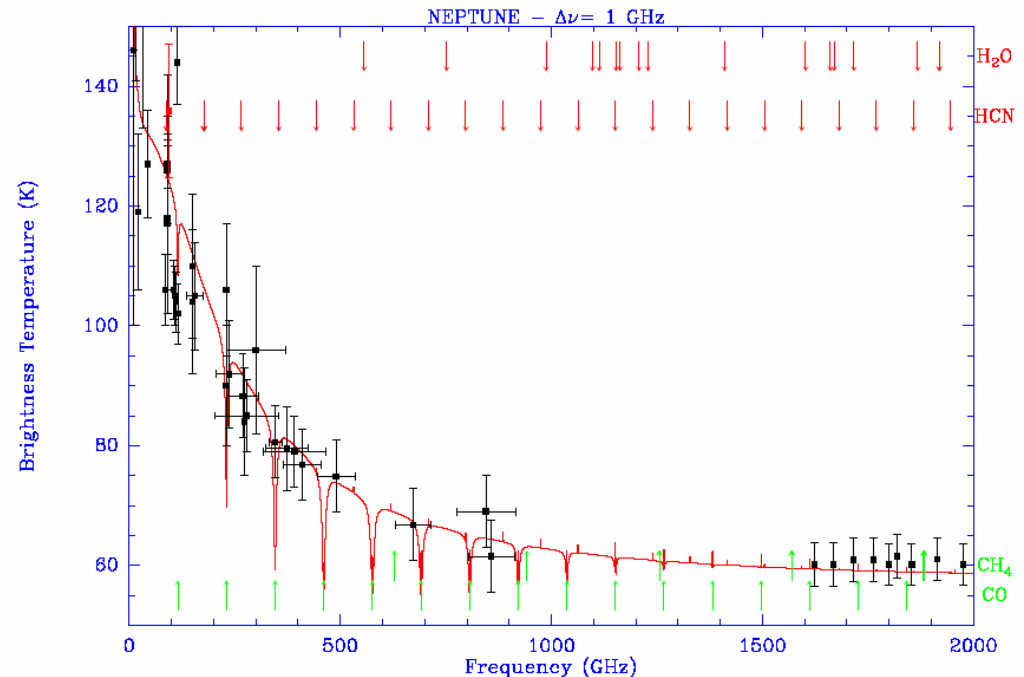
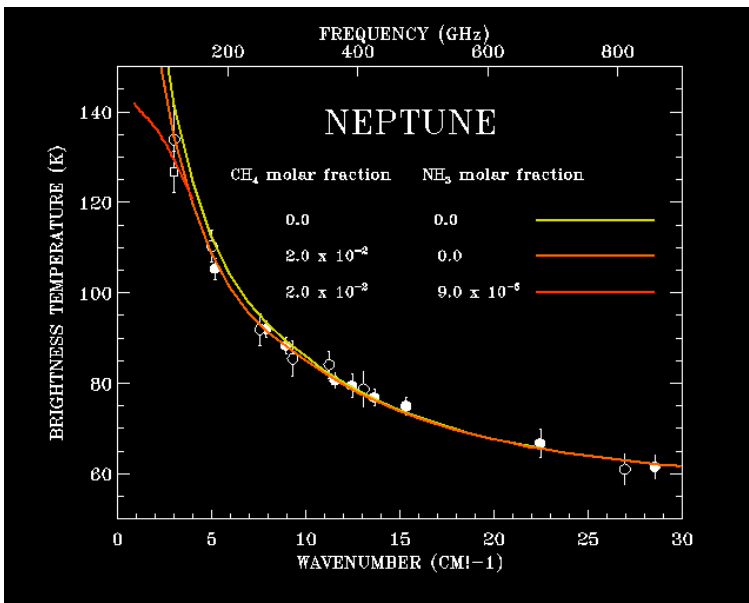
Uranus

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Neptune

- Discrepancy between Glenn and Raphael
 - Thought to be a software problem
- For now, Griffin & Orton model can be used as interim
- Updated model (inc. CO lines) to be available pre-launch



Mars

- **Web-based models of the continuum made available by Raphael/Emmanuel and Bryan**
 - **Agreement to within ~ 2%**
 - **Different polar cap treatment**
 - **Same penetration length and dielectric const.**
 - **Surface roughness**
 - **Bryan uses effectively zero as default**
 - **Adjustable parameter in French model (12° nominal)**
- **Further discussion to converge on agreed model**
- **Web models can be used for planning purposes**
- **Diurnal variability will require model computation for specific time of observation (to be done when obs. schedule known)**
- **L2 location**
 - **Parallax effect negligible**
 - **Distance effect more significant**
 - **Geocentric distance fine for planning**
- **Dust storms**
 - **Not high probability during first year of Herschel**

Jupiter and Saturn

- **Too bright for SPIRE in any mode**
- **Too bright for PACS photometer**
- **Depending on visibility in the early part of the mission, could be useful at least as interim calibration sources for HIFI (and PACS spectrometer?)**
- **Disks resolved - best to compute the model for a given beam profile**
- **Raphael can generate appropriate models**

Satellites

- If Jupiter and Saturn are the only planets available early in the mission then these can be used
- Titan
 - T_B currently known to a few % - better than asteroids
 - Many lines in Herschel range
- Galilean satellites
 - Voyager-constrained models available
 - Callisto preferable to Ganymede
 - Further out; warmer; T_B not dependent on longitude
 - Possible spectral feature at $120 \mu\text{m}$ from ISO LWS (not in the model)
- Raphael can provide models

Next Steps

- **Matt to write up splinter minutes, inc. detailed conclusions and actions**
- **First-cut models to be defined/clarified and available by end March**
 - **Can be used for calib. observation planning and preliminary population of calibration files**
- **Plan for official updates**
 - **HSC = entity to which information is delivered**
 - **HSC and each ICC to have designated contact point**
 - **Formal update before launch (say Sept. 2008)**
 - **Possible update again before routine obs start**
 - **Can include Herschel results**
 - **Updates at suitable intervals during the mission (six months planned for data proc.)**
 - **Each release to include all information needed for retrospective recalibration whenever significant changes are made**

Some Points for the Herschel Calibration Plan

- **Ambition should be to drive relative and absolute accuracy to the highest levels possible**
- **Planets, stars, asteroids, satellites, secondary sources need to be inter-compared**
- **Repeated measurements needed to build up database, improve statistics, discern variability**
- **Careful, high S/N measurements needed**
- **For planets**
 - **Regular monitoring of Mars, Uranus, Neptune when available with all three instruments (~ weekly)**
 - **High S/N Mars vs. Uranus with HIFI at a predefined set of frequencies**
 - **E.g.: transfer Mars calibration to SPIRE via FTS observations of Uranus**
- **Each instrument to analyse under auspices of its ICC and provide input to cross-calibration group**
- **Calibration data are in public domain**
- **Herschel will dramatically improve calibration of ground-based submillimetre observations**