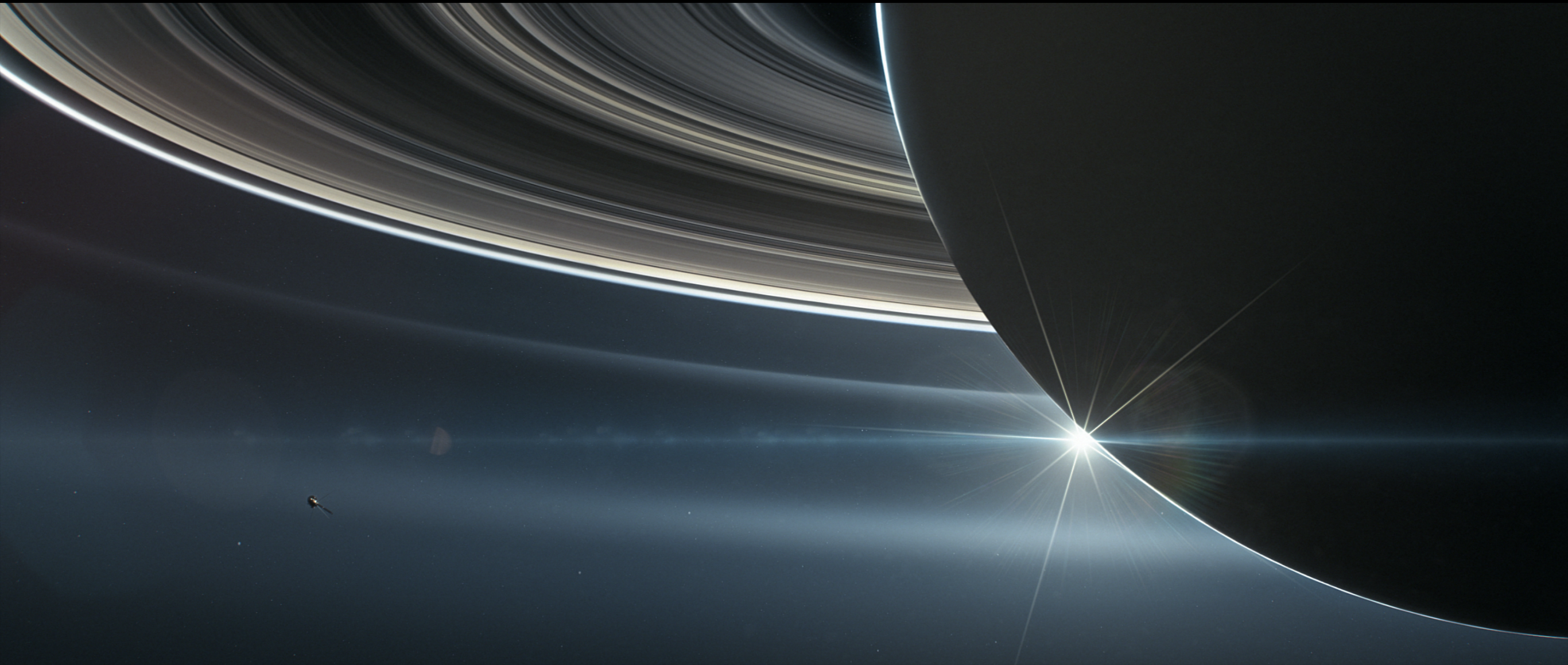


The Composition of Saturn's Upper Atmosphere from Cassini/INMS Measurements



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R.V. Yelle², T.T. Koskinen², S.M. Hörst¹, and the INMS team

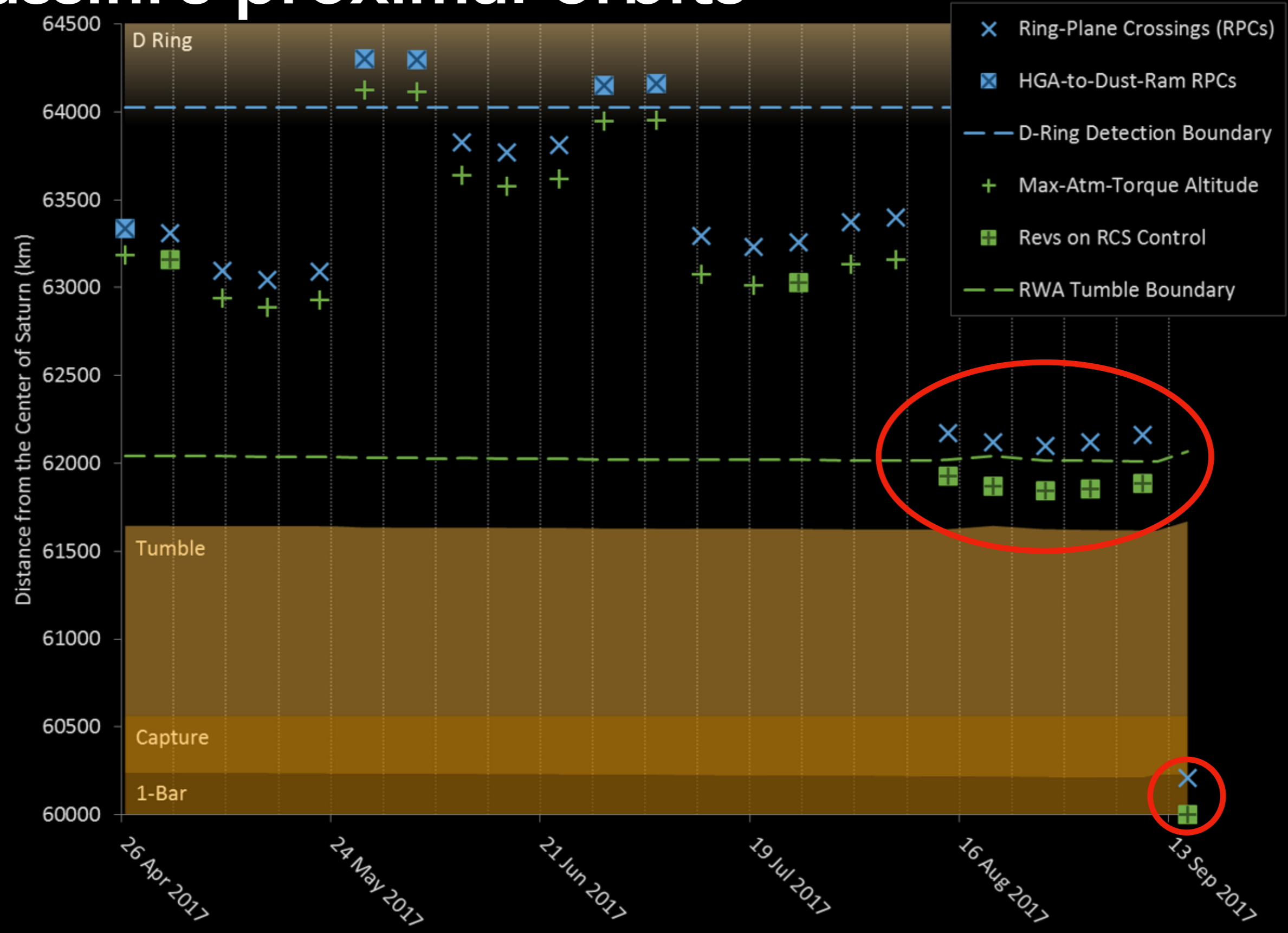
¹Johns Hopkins University, ²University of Arizona

17 August 2018, Cassini Science Symposium



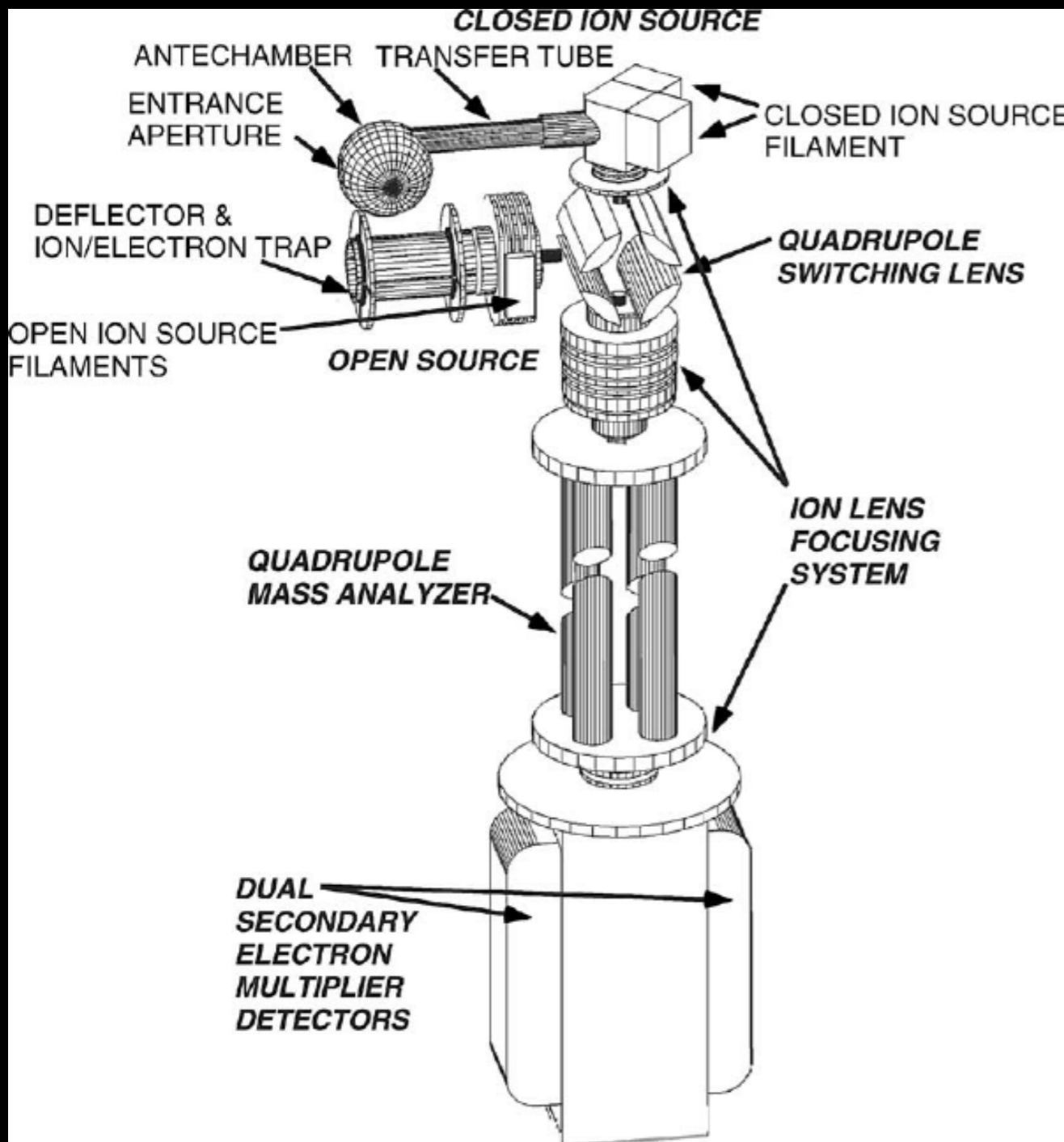
JOHNS HOPKINS
UNIVERSITY

Cassini's proximal orbits



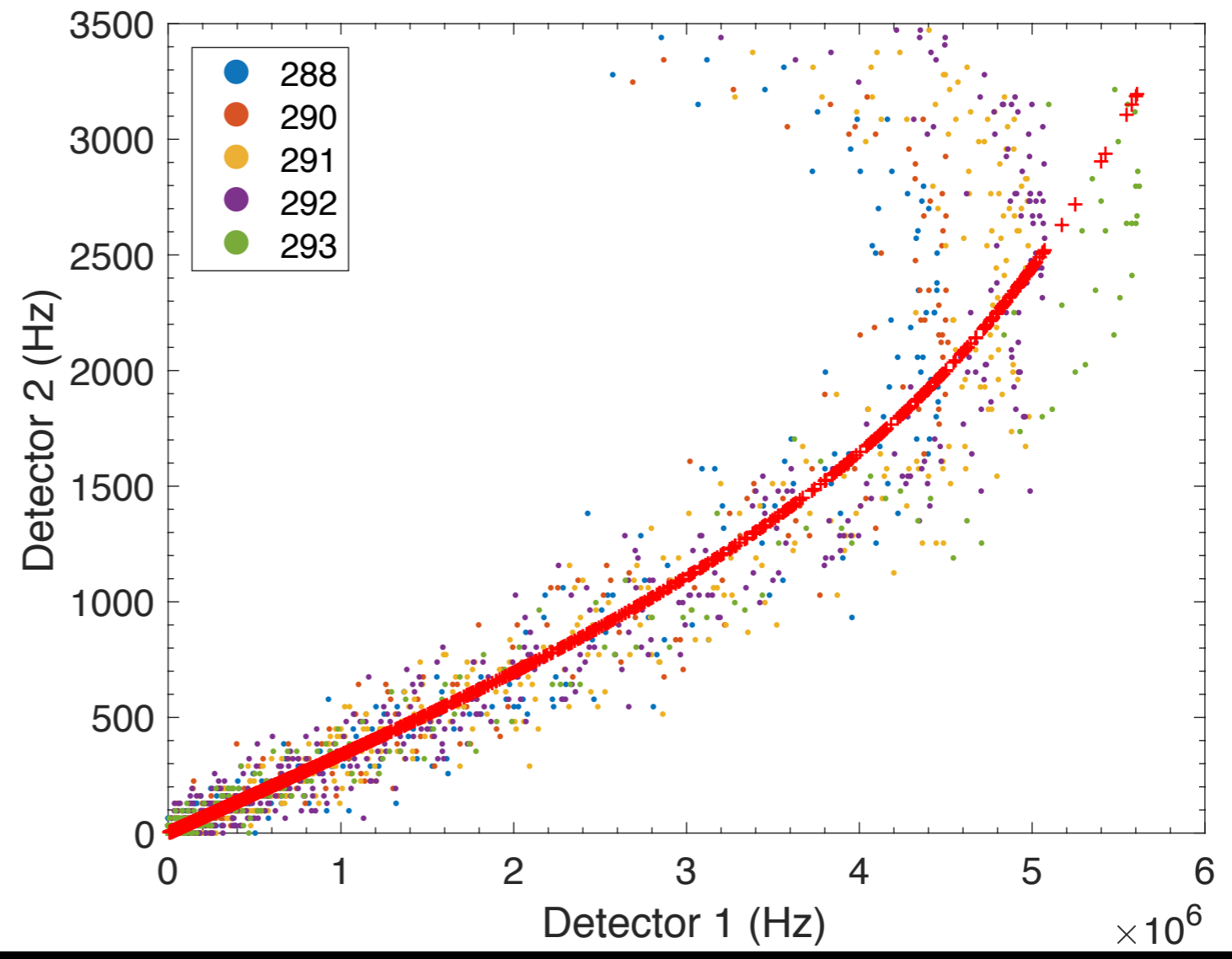
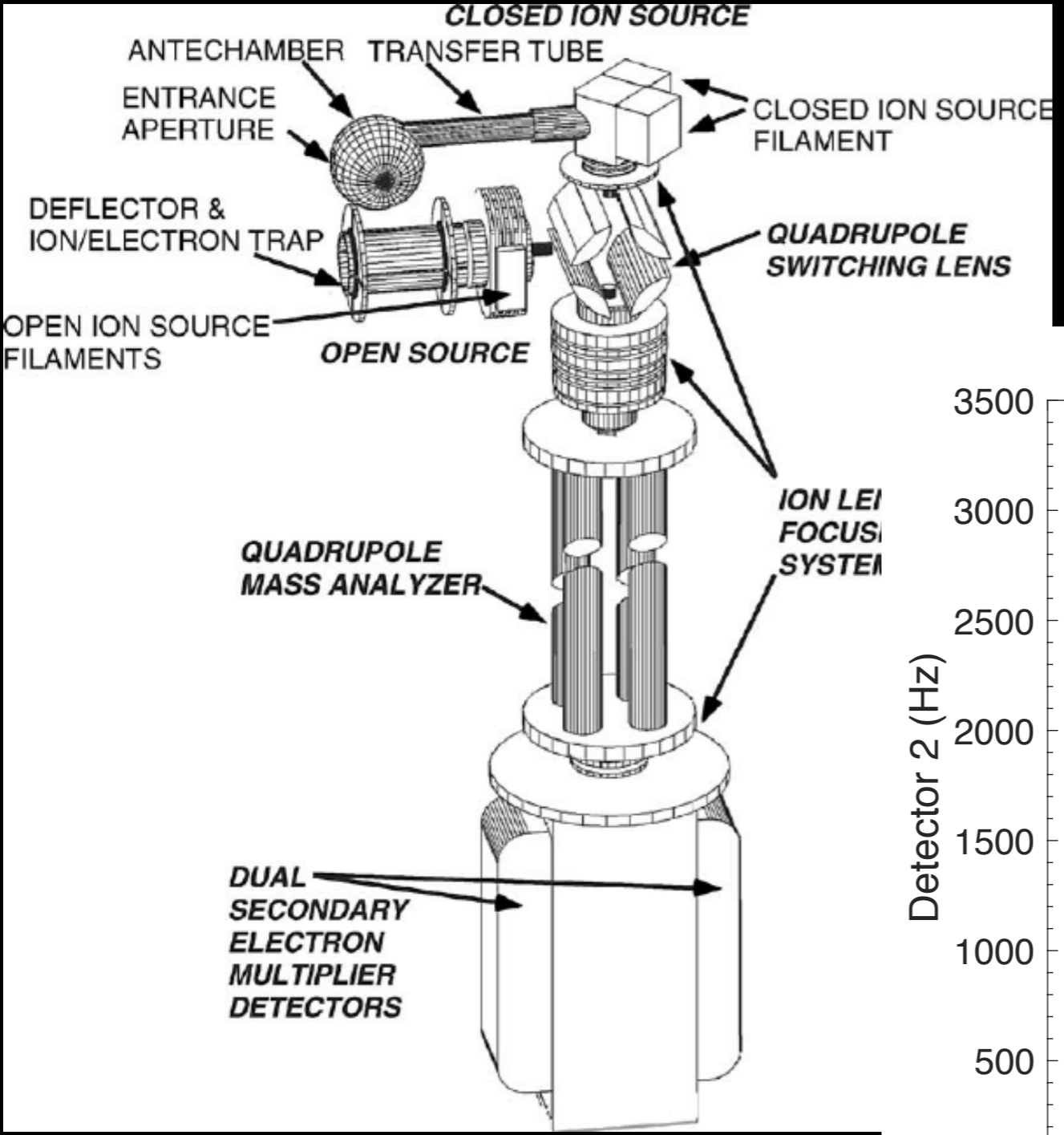
Ion and Neutral Mass Spectrometer

- Operating in closed-source neutral mode.
- Two electron multiplier detectors.



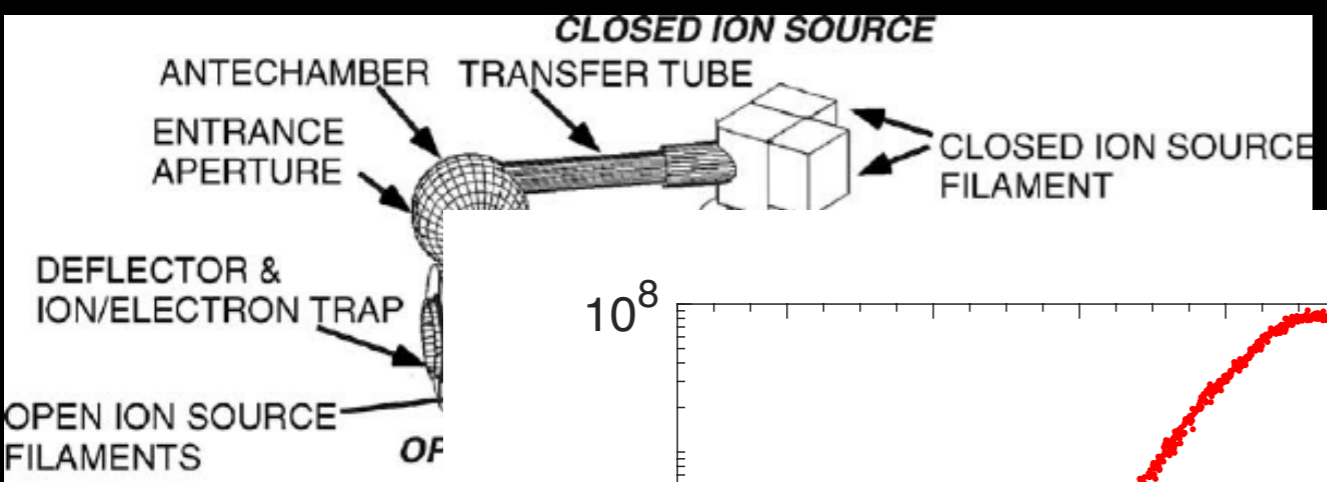
Ion and Neutral Mass Spectrometer

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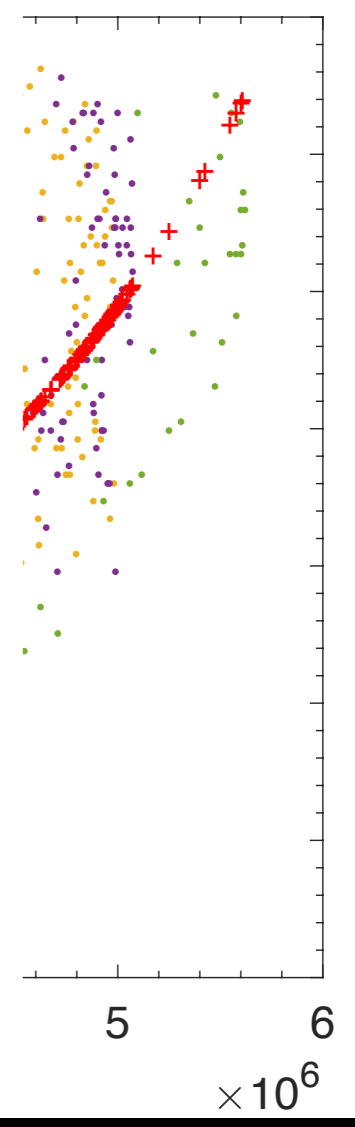
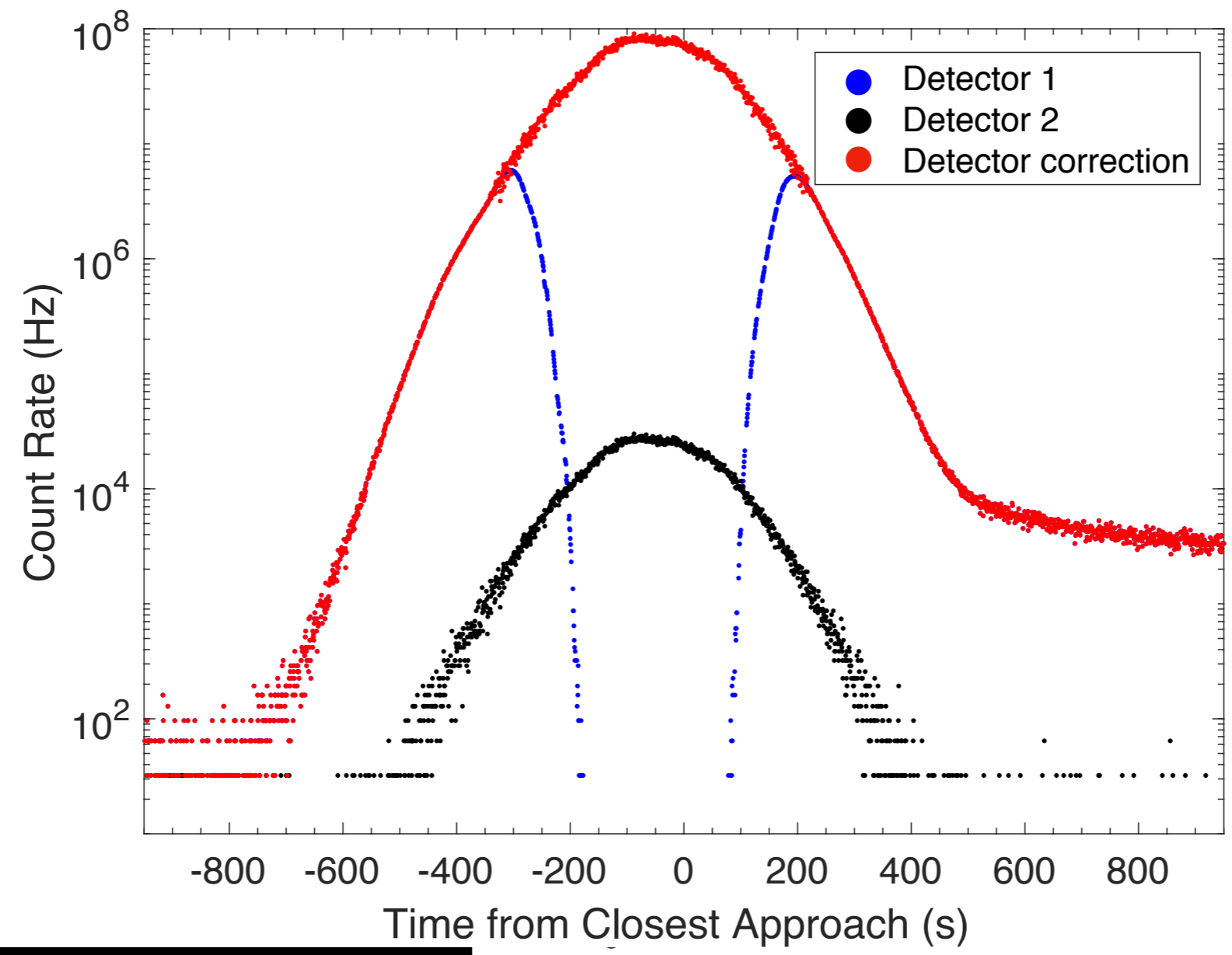
Ion and Neutral Mass Spectrometer

- Operating in closed-source neutral mode.
- Two electron multiplier



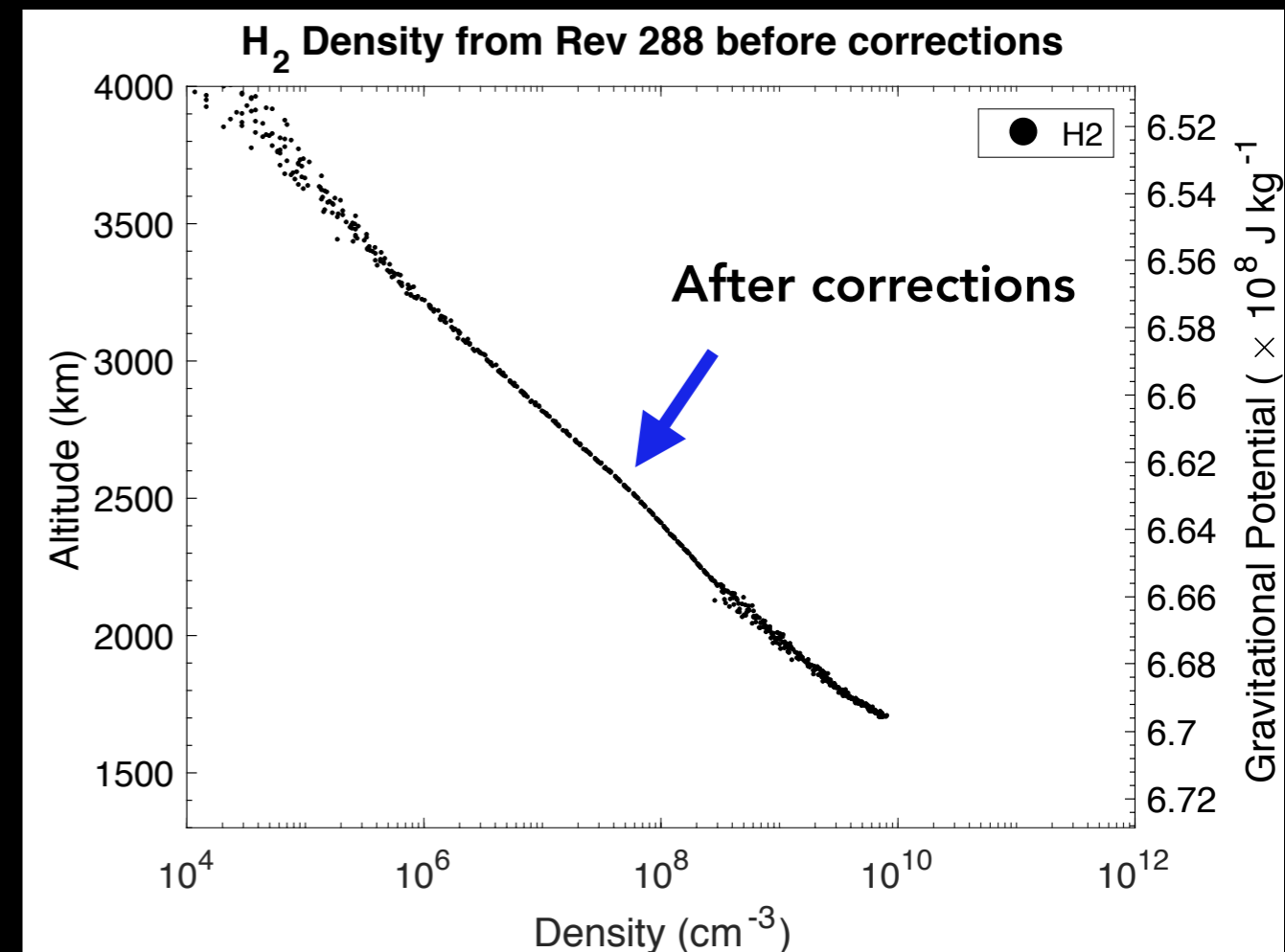
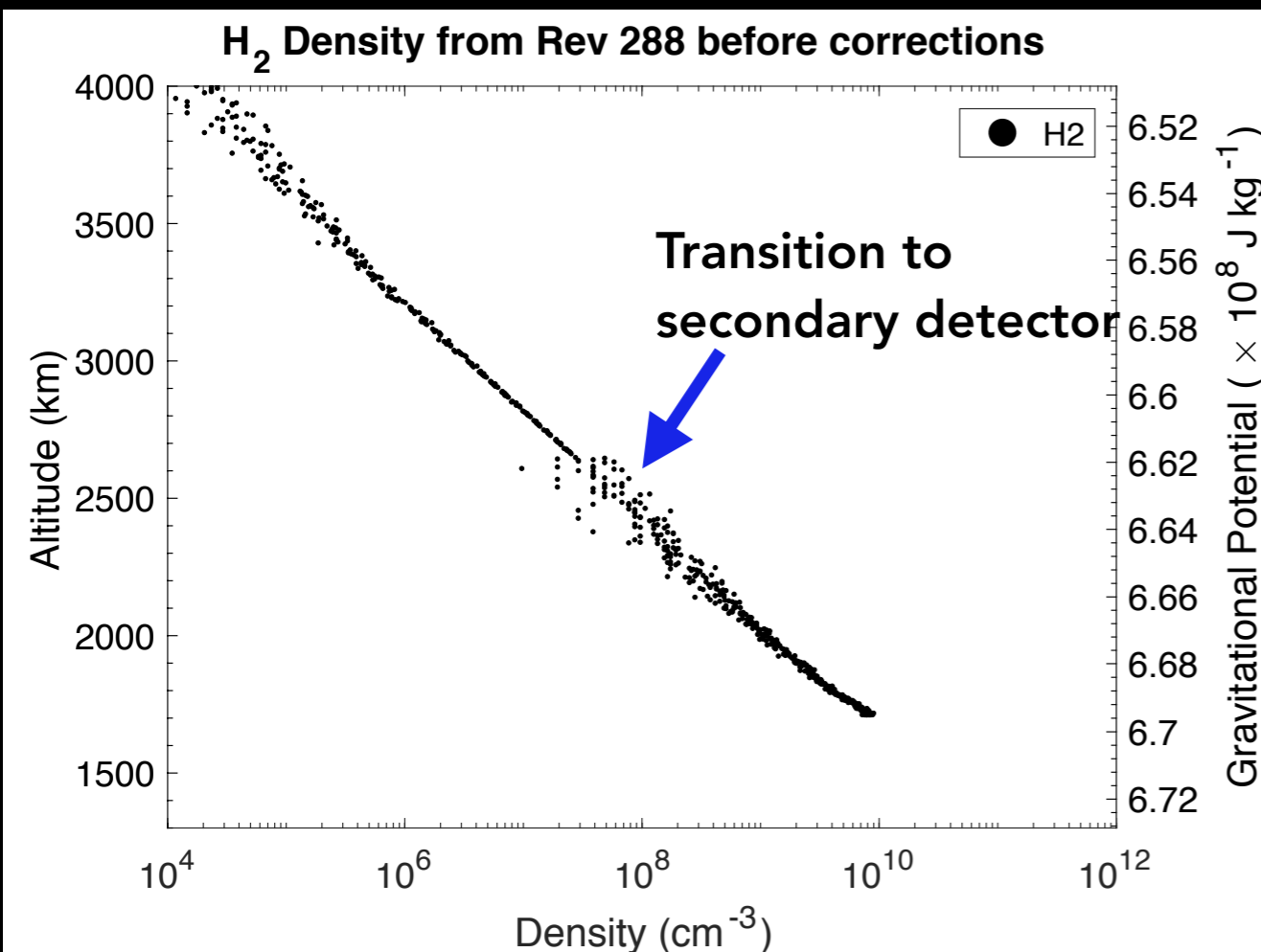
QUADRUPOLE MASS ANALYZER

DUAL SECONDARY ELECTRON MULTIPLIER DETECTOR

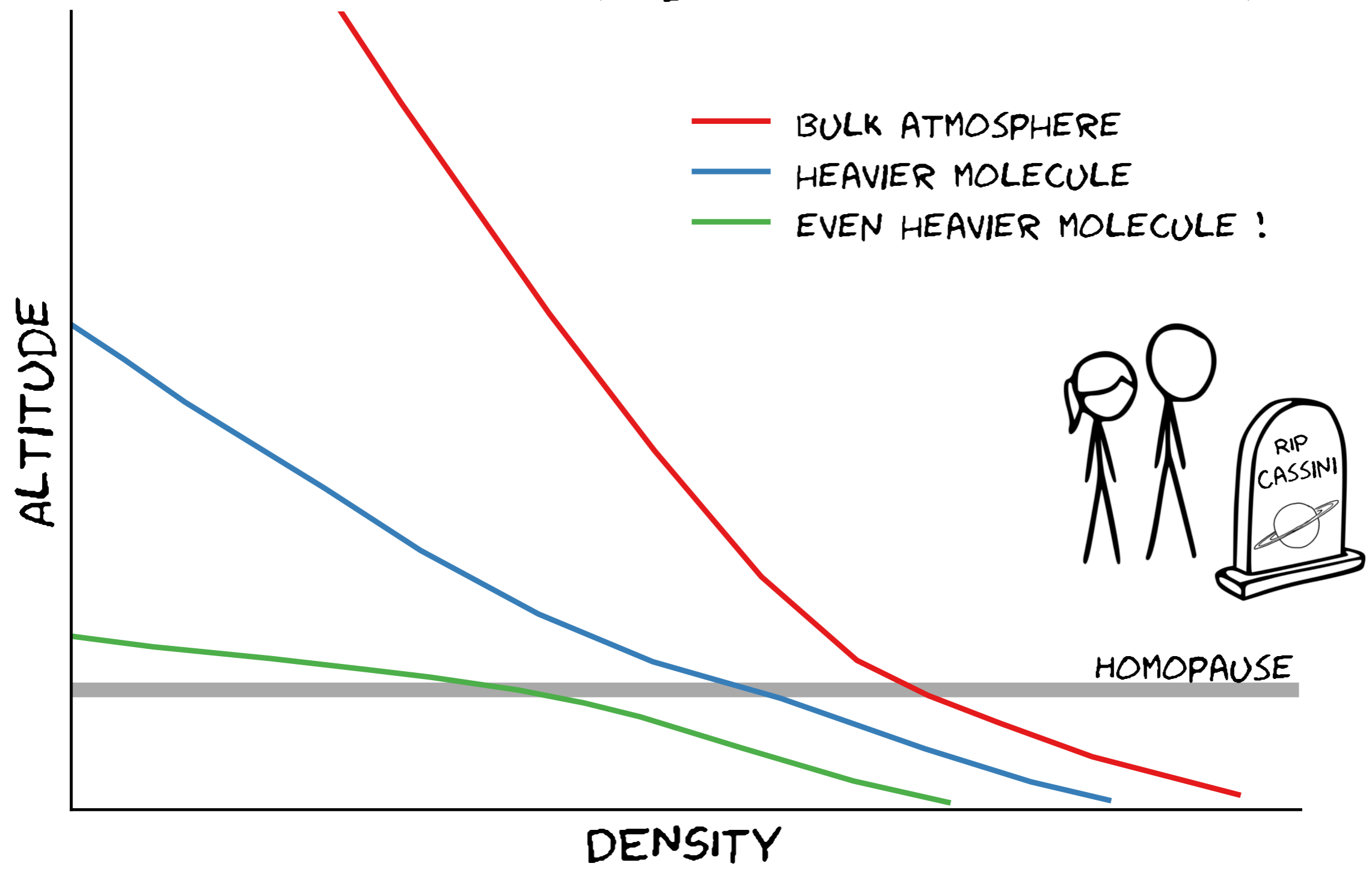


INMS-derived Density Corrections

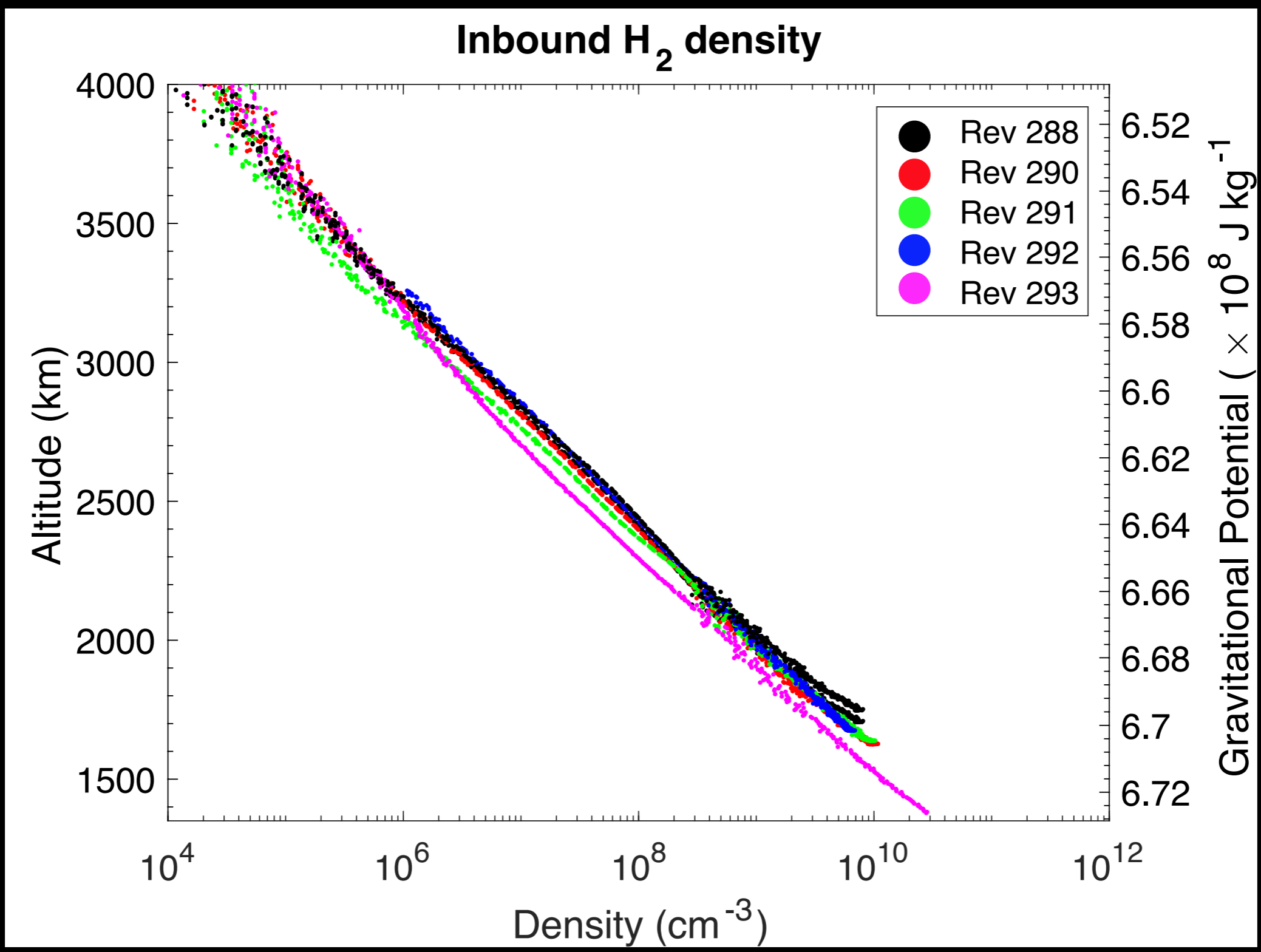
- Detector correction similar to Cui et al. 2012
- Gravitational potential adopted from Anderson & Schubert 2007
- Calibration results from Teolis et al. 2015



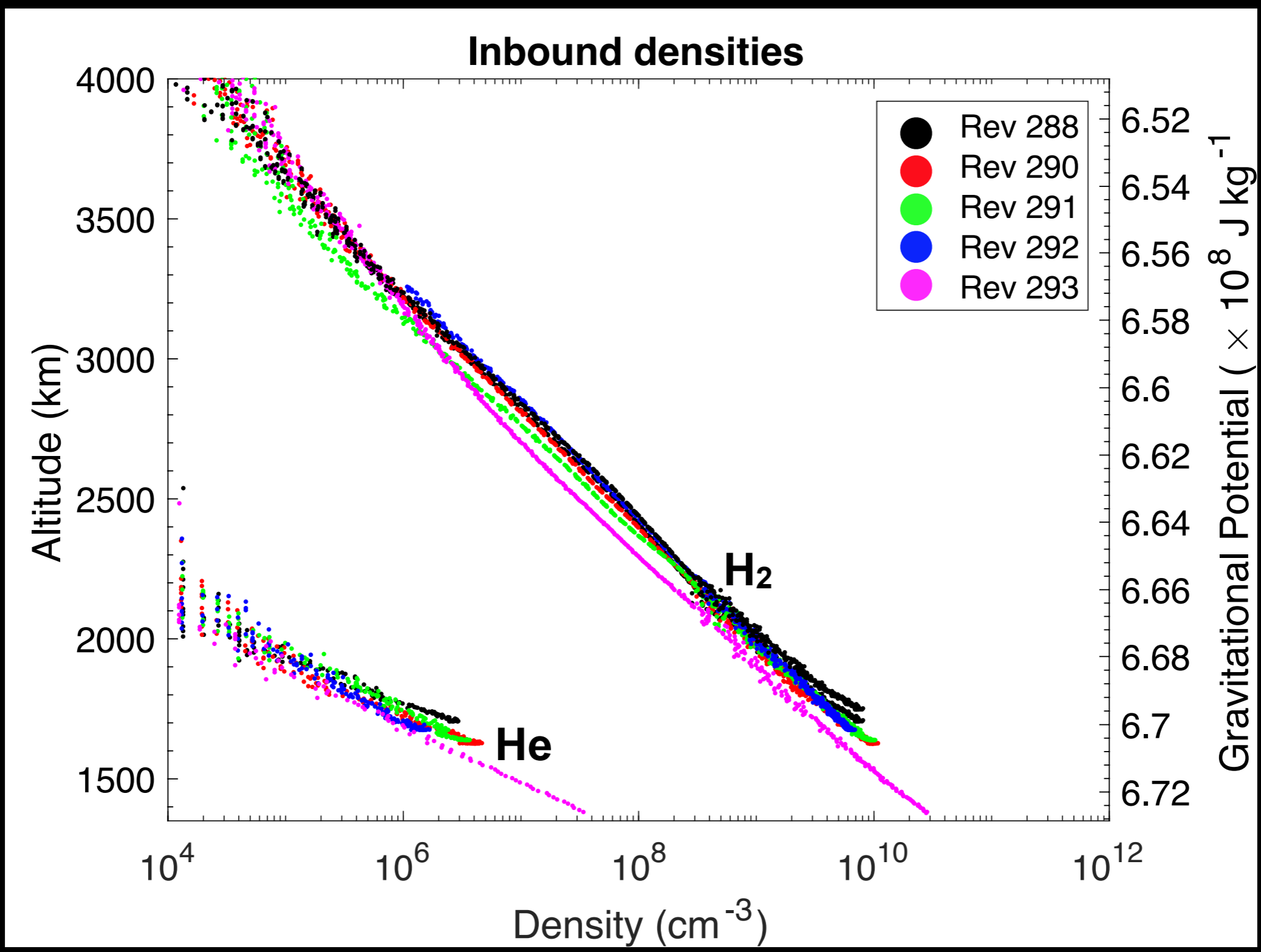
A BRIEF PRIMER ON DIFFUSIVE SEPARATION



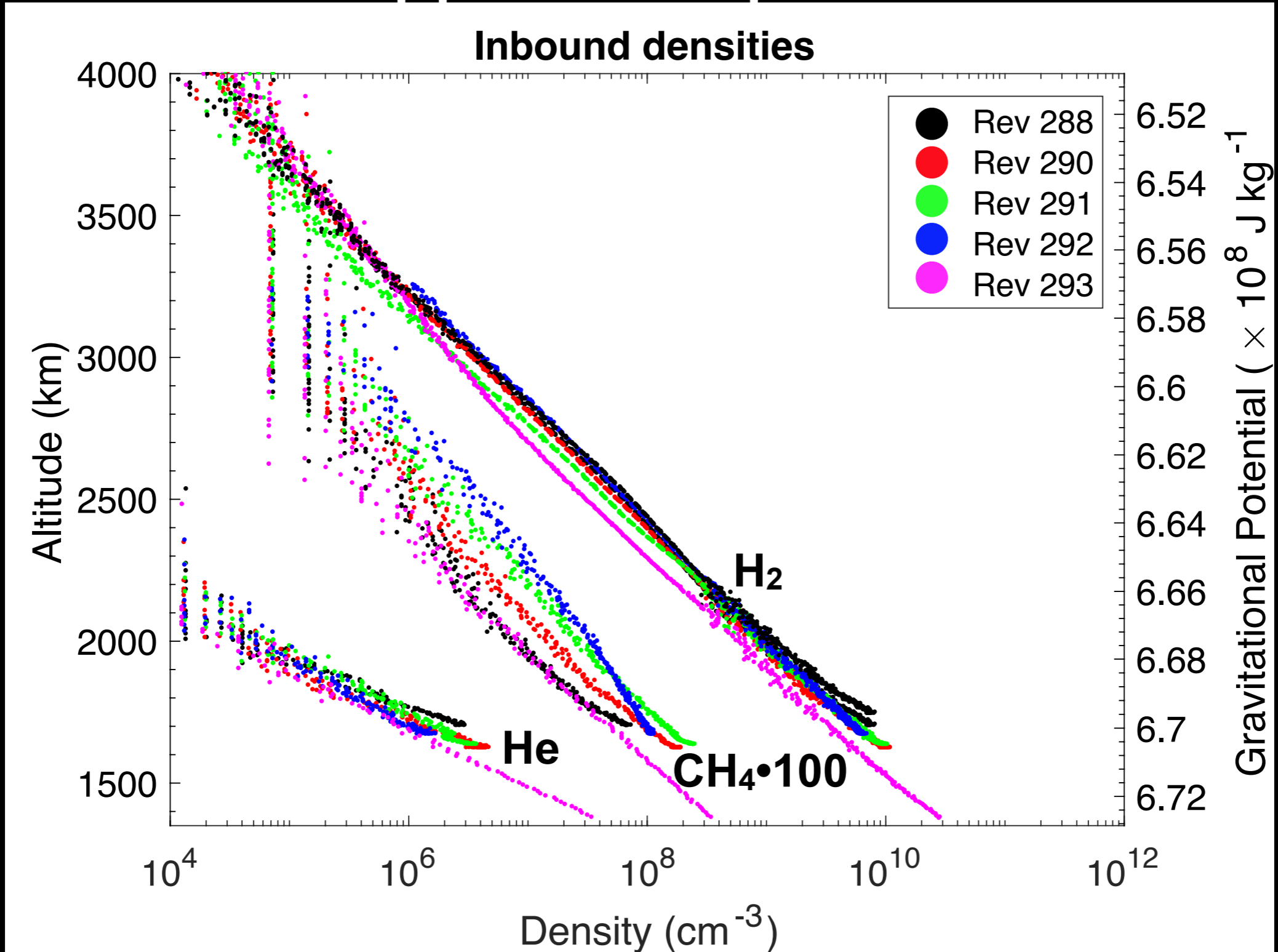
INMS H₂ densities from Cassini's final orbits are as expected



INMS H₂ and He densities from Cassini's final orbits are as expected



Evidence of an external source of CH₄ into the upper atmosphere



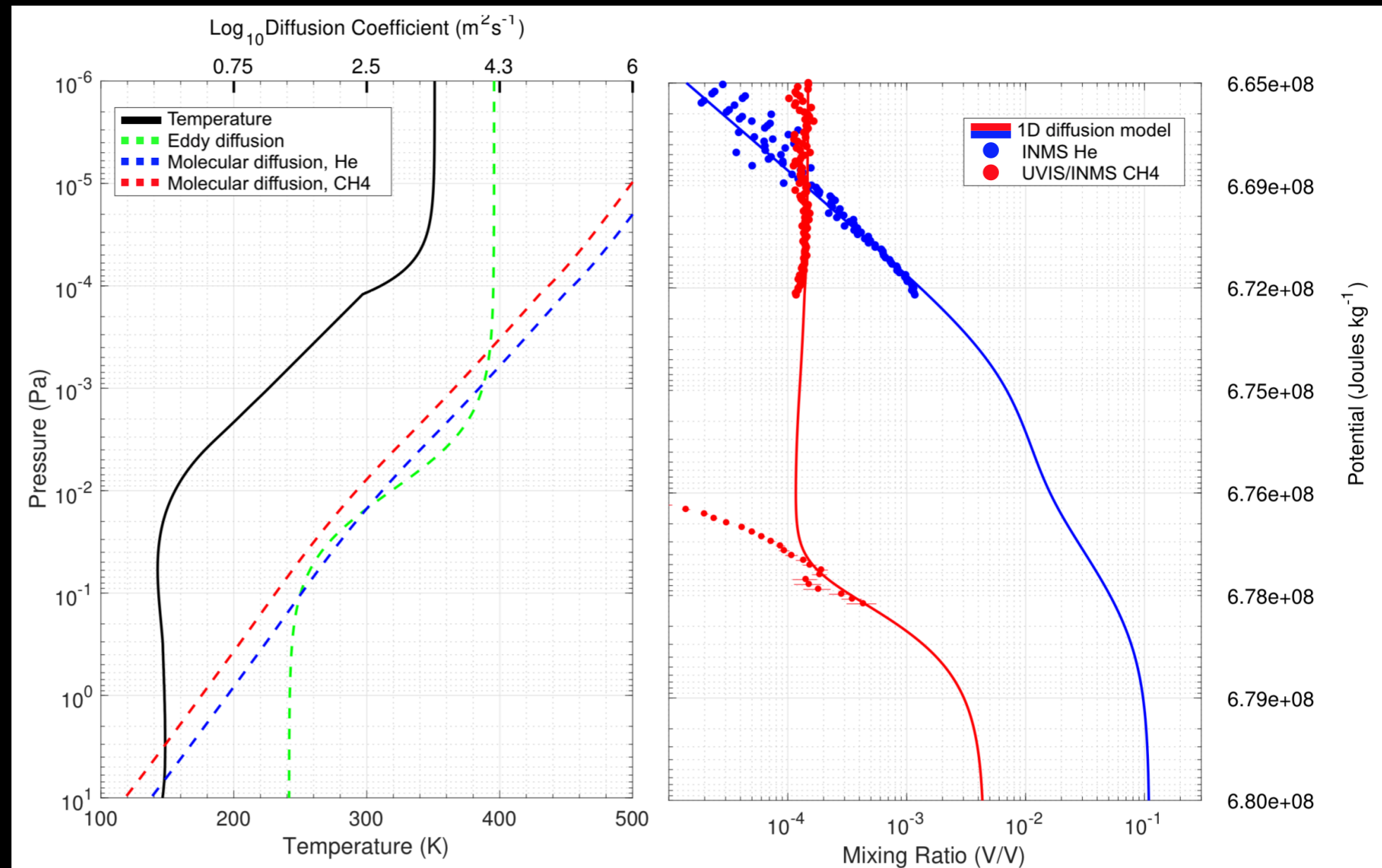
Adapted from Yelle et al. 2018, accepted to GRL

Constructing a 1D model to understand He and CH₄ diffusion processes

- Temperature ranges from 340-370 K (354 K for plunge)
 - Consistent with UVIS occultation measurements from Koskinen and Guerlet, 2018
- Downward flux of CH₄ $\sim 10^{13} \text{ m}^{-2}\text{s}^{-1}$

- Bottom MR boundaries used in model:

- CH₄: CIRS, Fletcher et al. 2010
- He MR: UVIS occultations, Koskinen & Guerlet, 2018



Yelle et al. 2018, accepted to GRL

Major points

- H₂ densities from INMS indicate temperatures in Saturn's thermosphere of 340 - 370 K, consistent with UVIS results (Koskinen & Guerlet, 2018).
- He measurements consistent with diffusive equilibrium.
- Evidence of external source of CH₄ from rings.
 - Downward external flux of $\sim 10^{13} \text{ m}^{-2}\text{s}^{-1}$.
- Unexpectedly complex mass spectrum to be explored in the future.
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