

## LA-UR-14-25306

Approved for public release; distribution is unlimited.

Title: IGPPS Space Focus Area

Author(s): Reeves, Geoffrey D.

Intended for: IGPPS External Advisory Committee meeting

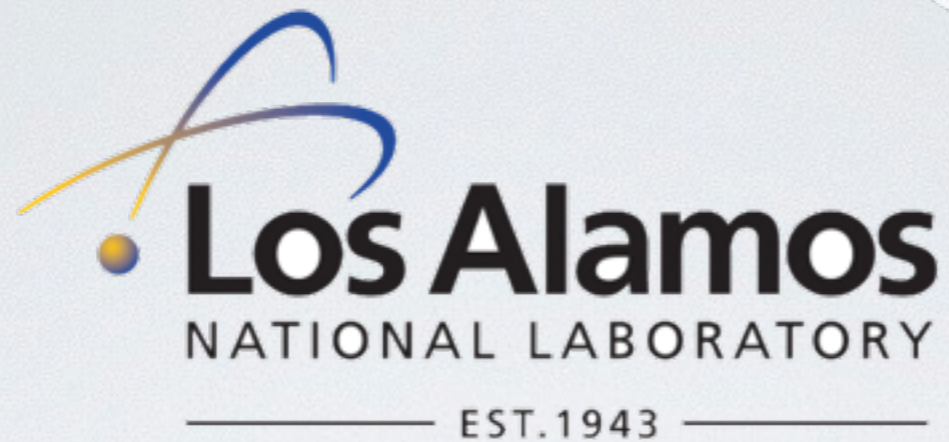
  

Issued: 2014-07-15

---

**Disclaimer:**

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the Los Alamos National Security, LLC for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.



# IGPPS Space Focus Area

Geoffrey Reeves  
Space Science and Applications Group

# FY 2014 Projects

**Experimental Test of Carbon Monoxide Self-Shielding Model and It's Implications for the early Solar System's Oxygen Isotope**

**Roger Wiens (ISR-2)  
Qing-Zhu Yin (UC Davis)**

**Investigating Mass Loading from the Enceladus Plume by Observations and Simulations**

**Misa Cowee (ISR-1)  
Hanying Wei (UCLA)**

**Wave-Particle Interaction-Radiation Belt**

**Gian Luca Delzanno (T-5)  
Lei Zhao (UCSD now T-5 postdoc)**

**Data-Based Model of the Earth's Magnetosphere Magnetic Field**

**~~Serin Zaharia~~, Michael Henderson (ISR-1)  
Chao Yue, Chih-Ping Wang (UCLA)**

**Infrasonic Ionosphere Variations Originated From Mesoscale Thunderstorms**

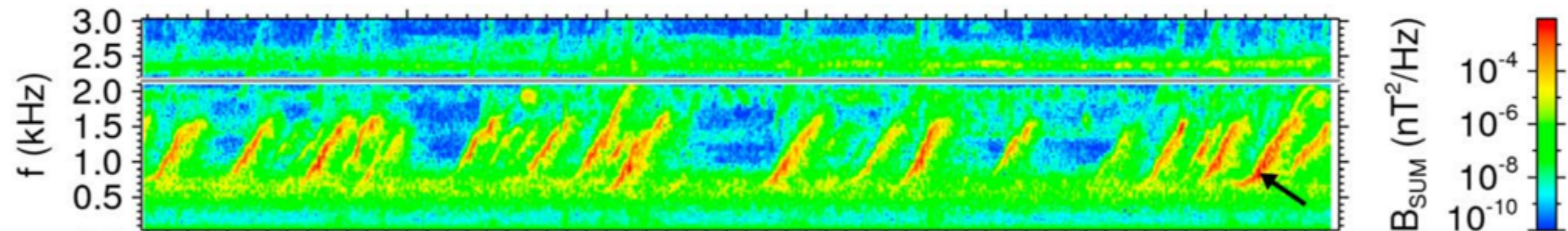
**Xuan-Min Shao, Erin Lay (ISR-2)  
Abe Jacobson (U. Washington)  
C. S. Carrano (Boston College)**

# Wave-Particle Interaction- Radiation Belt

- **Objective:** Understand whether or not quasi-linear diffusion is sufficient to describe wave-particle interactions
- **Technique:** Test particle and Particle in Cell simulations
- **Results to Date:**
  - For a flat wave spectrum (i.e. not Gaussian) very little deviation from QL theory has been seen so far
  - wave-wave interactions appear to be unimportant
  - the role of phase bunching and phase trapping has not yet been fully investigated

# Breakdown of quasi-linear theory

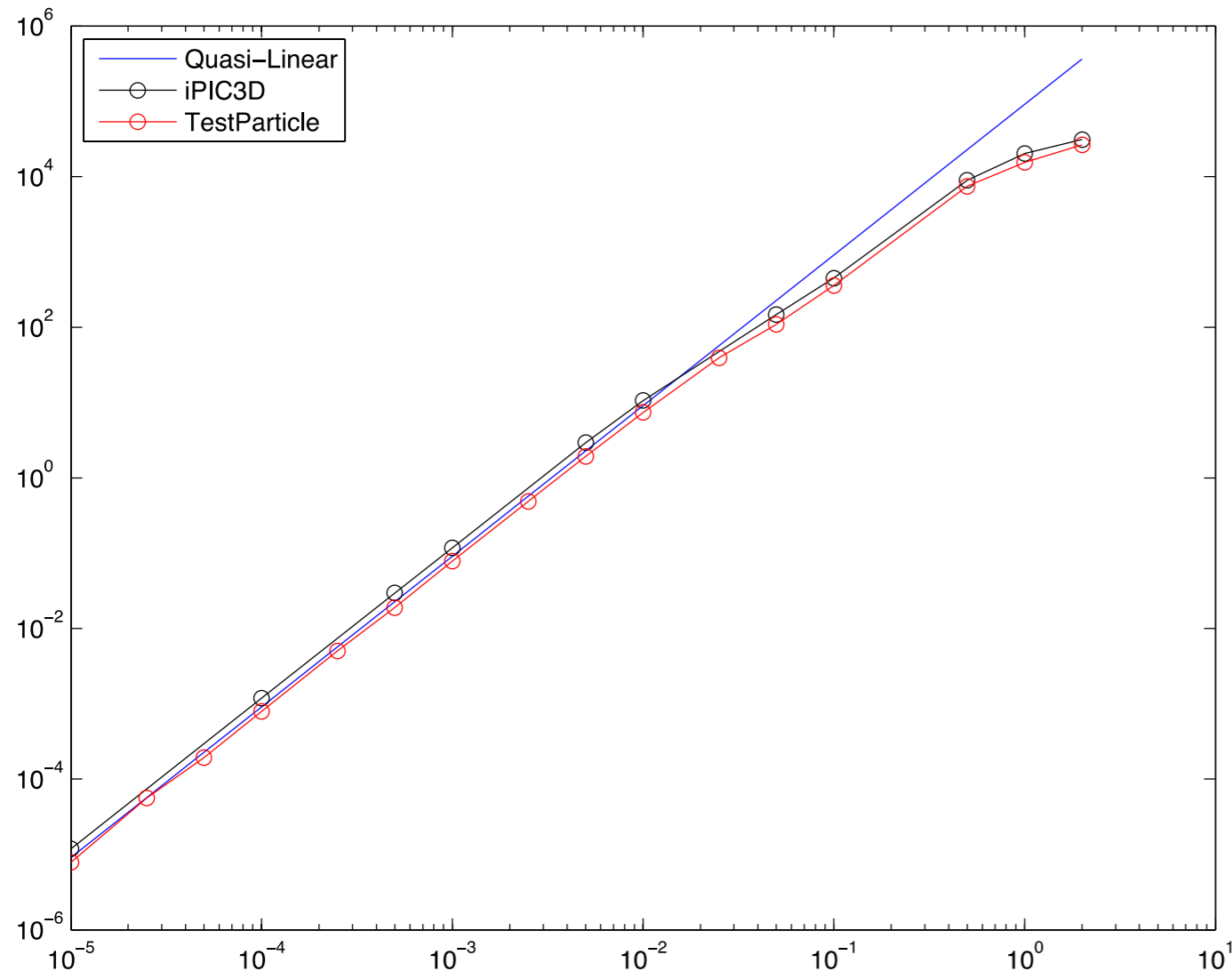
- Conditions for QL theory
  - Small amplitude waves
  - Broadband continuous spectrum, incoherent
- Chorus waves in the inner magnetosphere
  - Excited by storms/substorms, L=[5-7]
  - Large amplitude waves:  $\frac{B_w}{B_0} \approx 10^{-2}$
  - Discrete
- Chorus waves challenge QL theory



Santolik et al, GRL 14

# 1. Diffusion coefficient scanning wave amplitude

$$\alpha(t=0) = 40^\circ \quad E=9.3 \text{ keV}$$



- Agreement TP/IPIC  
-> **no wave-wave interaction**
- Departure from QL  
only at  $\frac{B_w}{B_0} > 5 \cdot 10^{-2}$

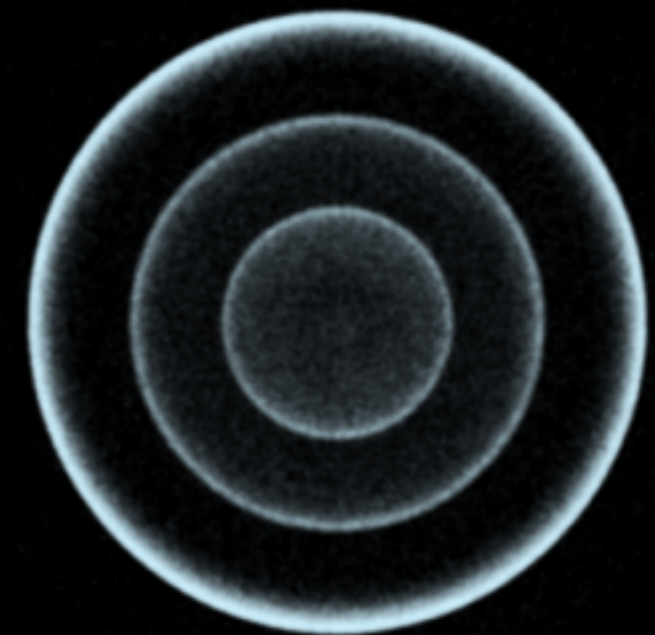
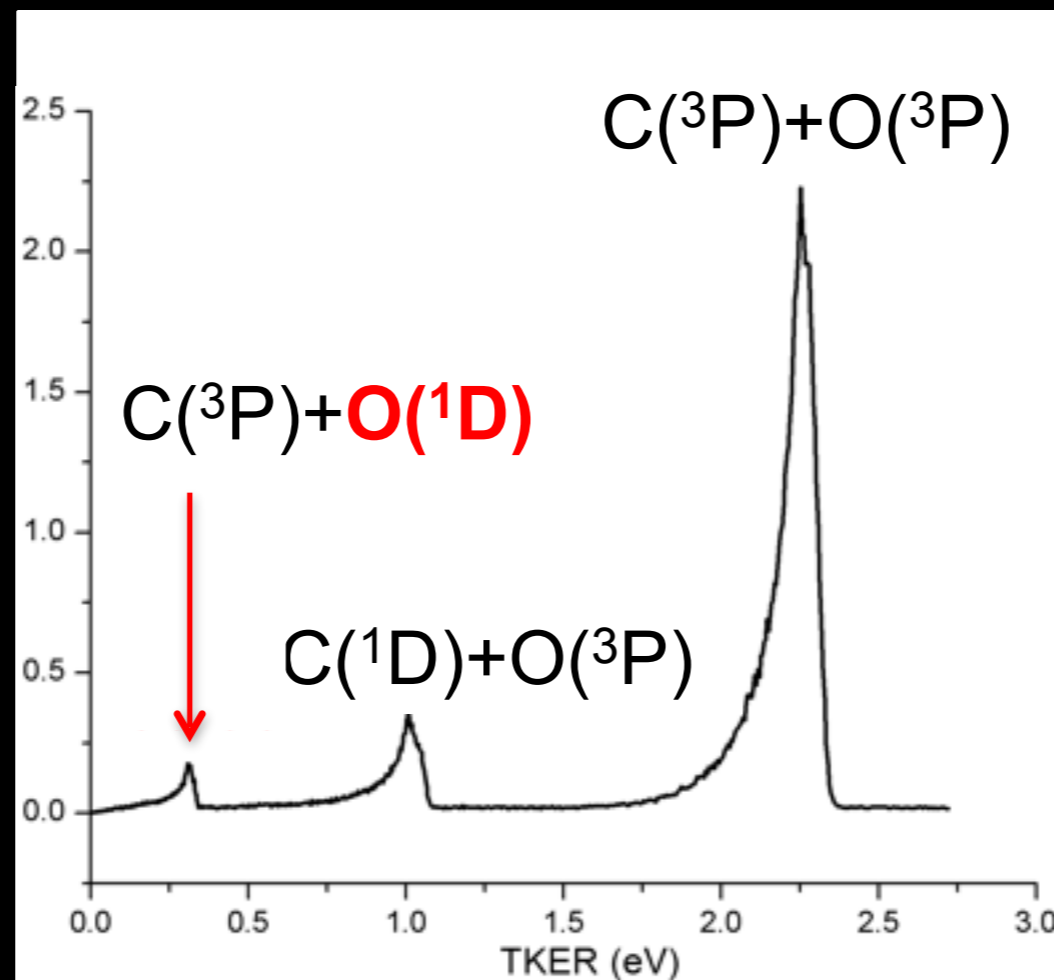
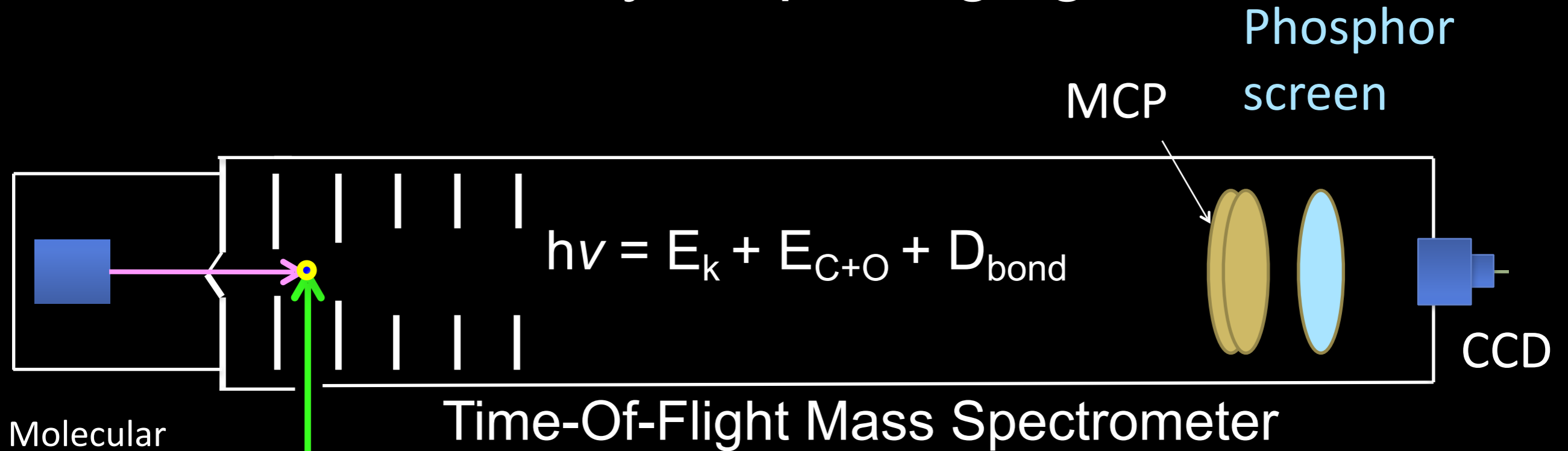
**Is QL theory enough for  
parameters of interest?????**  
Let's dig deeper

# Carbon Monoxide Self-Shielding and the Oxygen Isotope Ratio

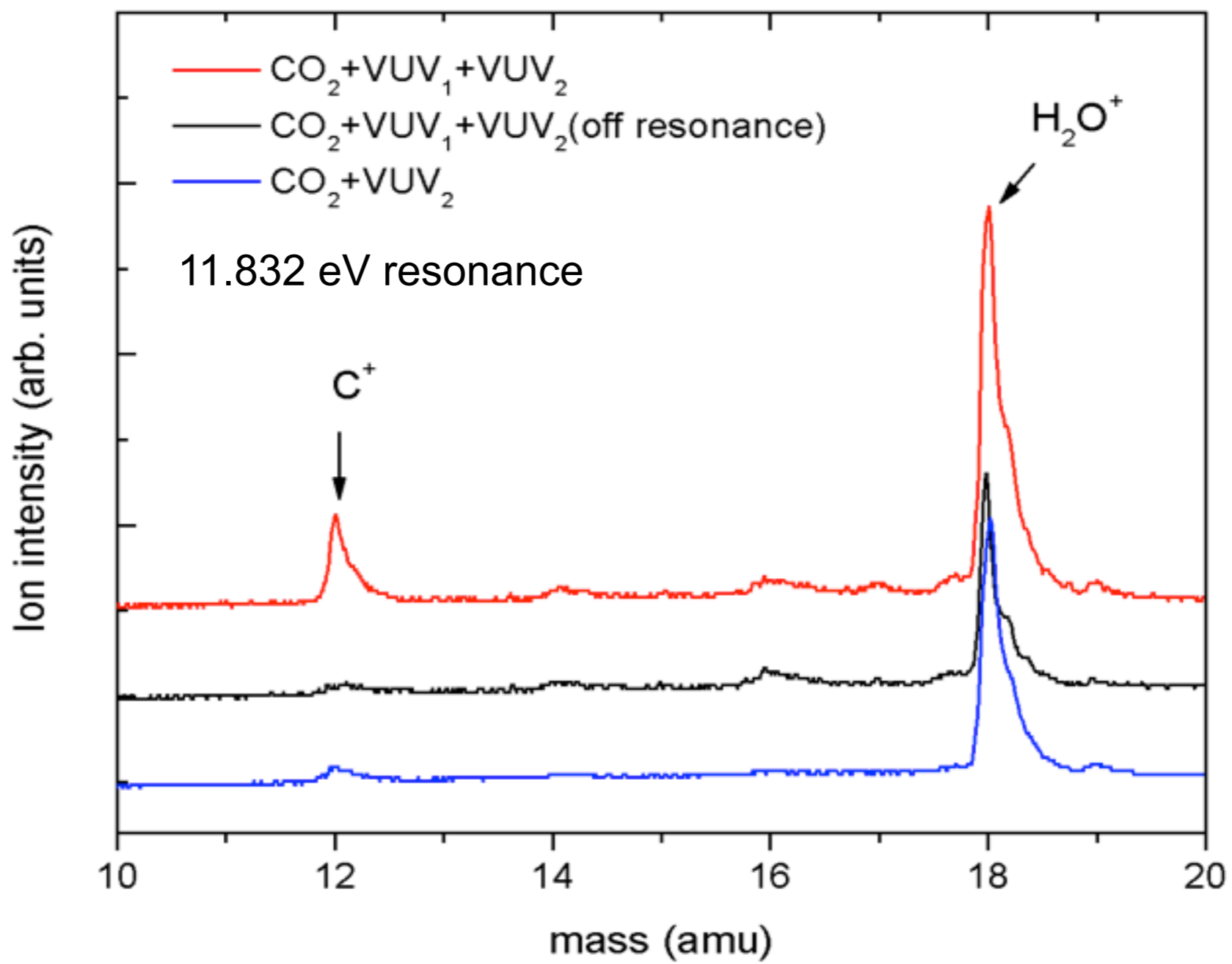
- **Objective:** Understand whether CO photo-dissociation can explain the oxygen isotope ratio in the early solar system
- **Technique:** Use the UCD experimental facility to simulate conditions in the early solar system. Apply UV laser to (1) attenuate and (2) photo-dissociate CO. Analyze O isotopes
- **Results to Date:**
  - $\text{CO}_2 + h\nu \rightarrow \text{CO} + \text{O}$  was considered the only pathway for photodissociation of  $\text{CO}_2$
  - Demonstrated a new chemical pathway to produce  $\text{C} + \text{O}_2$  from  $\text{CO}_2$



# Time-Sliced Velocity-Map Imaging

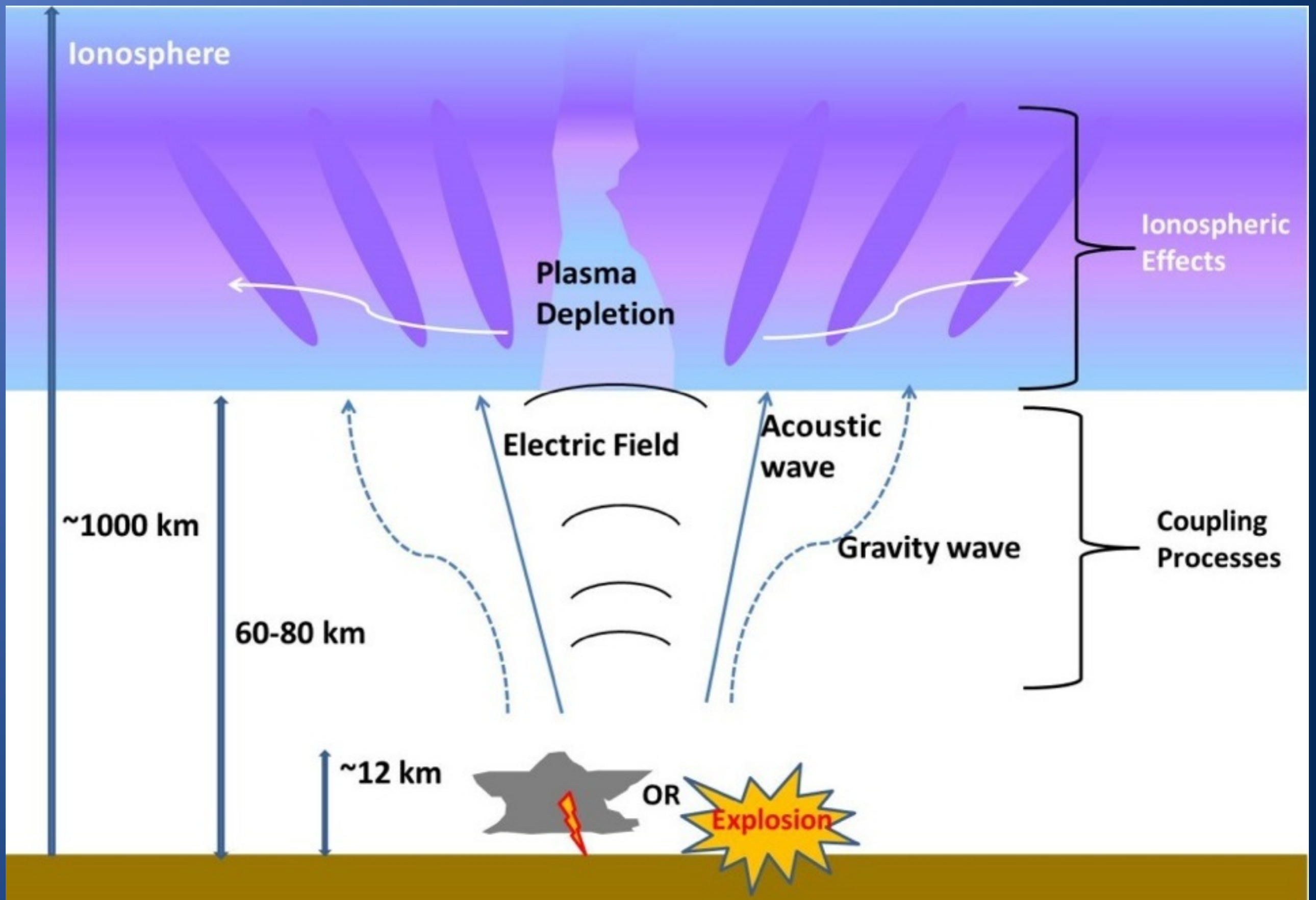


Branching ratio in dissociation



# Infrasonic Ionosphere Variations From Mesoscale Thunderstorms

- **Objective:** Understand atmosphere-ionosphere coupling through perturbations from thunderstorms.
  - Investigate application to remote sensing of disturbances
- **Technique:** Use VLF/ELF observations with very high temporal and spatial resolution to probe D-region electron density changes, TEC disturbances, and gravity waves
- **Results to Date:** (predate start of LDRD reserve funding)
  - D-region electron density variations depend on storm size.
  - Anomalous TEC variations are found to be closely related to storm-produced acoustic and atmospheric gravity waves.



# Mass Loading from the Enceladus Plume

- **Objective:** To provide quantitative constraints on the size and strength of mass loading of Saturn's ring system by Enceladus
- **Technique:** Cassini observations and numerical simulations of newborn plume ions and associated ion cyclotron waves (ICW)
- **Results to Date:**
  - Hybrid simulations of ICW match Cassini observations
  - Identified regions of enhanced ICW only close to Enceladus
  - Implies strong mass loading is very localized to that region
  - Previous studies suggested temporal variability  $>50x$ . They observe variations  $< 2x$

# Data-Based Model of the Earth's Magnetosphere Magnetic Field

Mike Henderson...