

Mass Loss From Hot Jupiters

Principal Investigator: Dr. Eugene Chiang

Institution: University of California - Berkeley

Electronic Mail: echiang@astron.berkeley.edu

Scientific Category: STAR FORMATION

Scientific Keywords: EXTRA-SOLAR PLANETS, GIANT PLANETS, PLANETARY ATMOSPHERES,
WINDS/OUTFLOWS/MASS-LOSS

Total Budget Amount: \$82,000 (1 year for PI and student salary/tuition)

Theory: Yes

Abstract

Photoionization heating from UV radiation incident on the atmospheres of hot Jupiters drives planetary mass loss in the form of hydrodynamic winds. HST STIS observations of HD 209458b, the first hot Jupiter discovered to transit its host star, have confirmed that the planet is losing atomic hydrogen (Vidal-Madjar et al. 2003) and have suggested that it may be losing OI and CII (Vidal-Madjar et al. 2004). These observations, which can be repeated with the advent of the HST Cosmic Origins Spectrograph (COS), do not necessarily imply loss of gas at a rate large enough to significantly reduce the mass of the planet. HST STIS observations indicating a population of hydrogen in the $n=2$ state constrain the structure of the planet's escaping atmosphere (Ballester et al. ~2007). We propose to construct a model of mass loss from hot Jupiter atmospheres, including realistic heating and cooling, ionization balance, tidal gravity, and pressure-confinement by the stellar wind. We have already constructed a model that resolves the atmosphere's transition from atomic to ionized hydrogen.

In our proposed work, we plan to also resolve the transition from molecular to atomic hydrogen. We will employ ray-tracing through our model to explain the HST STIS detections of Lyman alpha and Balmer continuum absorption by neutral hydrogen in an extended atmosphere around HD 209458b, and we will experiment with metal chemistry and vertical mixing in an attempt to reproduce the HST STIS measurement of OI and CII. Our work will provide predictions for future COS measurements. We will infer the correct mass loss rate implied by the Vidal-Madjar et al. (2003) observation and search for new observational diagnostics of hot Jupiter atmospheres.

Investigators:

	Investigator	Institution	Country
PI	Dr. Eugene Chiang	University of California - Berkeley	USA/CA
CoI&	Ms. Ruth A. Murray-Clay	University of California - Berkeley	USA/CA

Number of investigators: 2

& Contact CoI: Ms. Ruth A. Murray-Clay

Dataset Summary:

Instrument	No. of Datasets	Retrieval Method	Retrieval Plan
------------	-----------------	------------------	----------------