



AMELIA EARHART FELLOWSHIP

Globally, women make up around 25 percent of the workforce in the aerospace industry. In an

effort to carry out its mission that women have access to all resources and are represented in decision-making positions on an equal basis with men, Zonta International offers the Amelia Earhart Fellowship.

The Amelia Earhart Fellowship was established in 1938 in honor of famed pilot and Zontian, Amelia Earhart. The US\$10,000 Fellowship is awarded annually to

up to 30 women pursuing Ph.D./doctoral degrees in aerospace engineering and space sciences. It may be used at any university or college offering accredited post-graduate courses and degrees in these fields.

Since the program's inception in 1938, Zonta has awarded 1,794 Amelia Earhart Fellowships, totaling more than US\$12.2

million, to 1,365 women from 80 countries.

Our Fellows have gone on to become astronauts, aerospace engineers, astronomers, professors, geologists, business owners, heads of companies, even Secretary of the US Air Force.

SHARON LANGENBECK
AMELIA EARHART FELLOW

In 2025, Past International President and two-time Amelia Earhart Fellow (1977 and 1978) Sharon Langenbeck, Ph.D., showed her dedication to the fellowship with an extraordinary donation to the Amelia Earhart Endowment Fund. In recognition of this incredible gift and Sharon's unwavering impact to the Amelia Earhart Fellowship Program, one fellow will be

officially recognized as the
"Sharon Langenbeck Amelia
Earhart Fellow" every year. The
Sharon Langenbeck Amelia
Earhart Fellow is designated from
the 30 Fellows already selected
by the Zonta International Amelia
Earhart Committee each year
based on pre-established criteria.



Assessment of He I triplet absorption at 10830 Å in escaping atmospheres of hot gaseous exoplanets

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Introduction

Understanding escape is crucial for exoplanets:

- Demographics and habitability
- Chemical/physical atmospheric processes
- Host star interactions [1]

He I 10830 Å line has been detected on many hot Jupiters

- Lower level is He metastable (2¹S) state
- Half-life of ~7800 seconds [2]
- Can be observed from the ground
- Proven difficult to interpret

Parker wind models used to interpret transit depths [3,4]

- Models are typically 1D/2D/3D
- Sub-solar He/H ratios used in the past [3]

Many models in the literature are using outdated rate coefficients that are updated in this work

We present an updated model of He I (2¹S) transit depth:

- Investigate HD209458b - will apply to other systems
- Updated rate coefficients: excitation, reaction rates
- Include photoelectrons which are the major ionization production rate in Earth's atmosphere
- Using escape model that is multi-species [5]
- Including modeling for the H I Balmer lines

We successfully fit the He I 10830 Å transit depth with solar He/H ratios, a solar minimum spectrum and updated excitation chemistry which we compare to previous excitation chemistry [3, 9, 10]

Model

Lower/Middle Atmosphere Model

- Use established lower-mid-atmosphere model [6]
- Assume that lower boundary conditions in upper atmosphere are consistent with lower-mid-atmosphere model

Transit Spectra Radiative Transfer Model

- Line fit T₁ and p profile from the lower/mid-atmosphere model
- Atomic line properties from NIST database
- Assume high profile of He

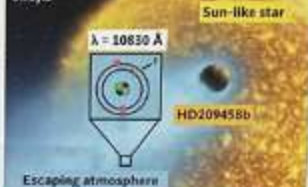
3D Upper Atmosphere Escape Model

- Solves time-dependent coupled equations of continuity, momentum and energy self-consistently [5]
- Multi-species
- Includes photoionization, thermal ionization, recombination, and charge exchange
- Use a solar minimum spectrum

Hydrogen Scattering Model

- The H-atom level population is determined by detailed balance between production and loss [7]
- Includes:
 - Radiative de-excitation
 - e⁻ collisional de-excitation, ionization, and P-radiation
 - p⁺ collisional de-excitation
 - Three-body recombination
 - Photoionization

In a galaxy far, far (153 ly) away...



He I (2¹S) Chemistry

Name	Formula
Recombination	$He^+ + e^- \rightarrow He(2^1S)$
Photoelectron Collisions	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$
Electron Collisions	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$
Penning Ionization	$He(2^1S) + M \rightarrow He(2^1S) + M^+ + e^-$
Electron Collisions	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$
Photoionization	$He(2^1S) + h\nu \rightarrow He^+ + e^-$
Radiative Decay	$He(2^1S) \rightarrow He(1^1S)$
Electron Collisions	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$
Electron De-excitation	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$
Electron Collisions	$He(2^1S) + e^- \rightarrow He(2^1S) + e^-$

• Not included in other exoplanet studies • Updated

Excitation/de-excitation reaction rates in previous models need revisions



Photoionization Cross Section

- Previous works use fits to Fano cross (1971) which only has ~20 points and ignores resonances
- We include high resolution cross section calculated at LCT



Penning Ionization Rates

- Other works use a constant rate (5 X 10¹¹)
- We use available cross sections to derive a temperature-dependent rate

These changes to the reaction rates significantly reduce the He I (2¹S) population

Results

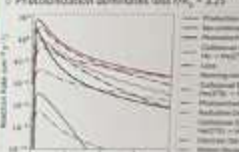
Temperature and Bulk Velocity vs. radius

- Temperature peaks at ~9000 K at 0.1 R_p - 1.2 R_p
- Velocity is ~10,000 m/s at top of atmosphere



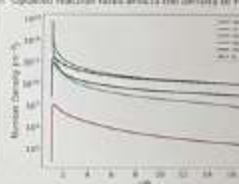
Reaction Rates vs. radius

- Recombination dominates production as expected
- Penning ionization dominates loss (1% - 1.5%)
- Collisional excitation dominates loss (1.5% - 10%)
- Photoionization dominates loss (10% - 3.2%)



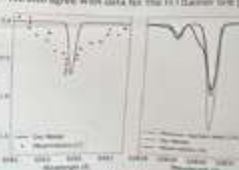
Number Density of major species vs. radius

- Updated reaction rates affect the density of He



Transit depths

- We agree with the (2¹S) observations with a solar He/H ratio, solar minimum spectrum, including H₂ and H₂O in the atmosphere, and updated excitation chemistry
- Some models have agreed with the data but with nonthermal and H/He ratio assumptions [3, 4, 10]
- We also agree with data for the H I Balmer lines [3]



References

- [1] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [2] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [3] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [4] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [5] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [6] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [7] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [8] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [9] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.
- [10] Fortney, J. J. et al. 2013. Evidence for atmospheric escape from the exoplanet HD 209458b. *Nature*, 485, 63-66.

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ELIGIBILITY

Women of any nationality pursuing a Ph.D./doctoral degree who demonstrate a superior academic record conducting research applied to aerospace engineering or space sciences are eligible. It is imperative that students be registered in a full-time Ph.D./doctoral program and have completed at least one year of that program or have received a master's degree in an

aerospace-applied field at the time the application is submitted.

Applicants must not graduate from their Ph.D. or doctoral program before April 2027.

Please note that post-doctoral research programs are not eligible for the Fellowship.

Club members and individuals with direct membership with Zonta International and employees of Zonta International

and Zonta Foundation for Women are not eligible to apply for the Awards. Committee or jury members or any member involved in the selection process should follow the Zonta International Conflict of Interest Policy in the selection of awardees.

Note that previous Amelia Earhart Fellows are not eligible to

apply to renew the Fellowship for a second year.

APPLICATION PROCESS

The Zonta International Amelia Earhart Fellowship Committee reviews the applications and recommends recipients to the Zonta International Board. All applicants are evaluated on the criteria stated in the requirements section of the application. All details of the

evaluations are kept confidential; evaluations are not disclosed to applicants. All applicants will be notified of their status by the end of April.

DEADLINE

The 2026 Amelia Earhart Fellowship application must be submitted in full by 15 November 2025 to be considered.

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FUNDING

Amelia Earhart Fellowships are made possible by generous contributions to the Zonta Foundation for Women Amelia Earhart Fellowship Fund.