# Diagnostics & Applications: The He I 5876 Å (D3) Transition in a Solar Prominence

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MSc Astrophysics Presentation
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NASA. Solar prominences. eclipse2017.nasa.gov/solar-prominences, (Last Accessed: 02.07.2020).

## 2. The Project

This project will build off previous results concerning the band-width for a filter on a coronagraph.

We use a 2D cylindrical radiative transfer code developed by Gouttebroze and Labrosse (2009).

The aim is to assess the diagnostic viability of the D3 transition for use on a space-based coronagraph.

P. Gouttebroze and N. Labrosse. "Radiative transfer in cylindrical threads with incident radiation. VI. A hydrogen plus helium system.", *Astronomy & Astrophysics*, **503**:663–671, 2009.

# 3. The Advantages of the D3 Line

- Resides in the visible region of the EM spectrum.
- Is formed in optically thin conditions.
- Has major applications for researchers studying the magnetic structure of a solar prominence.

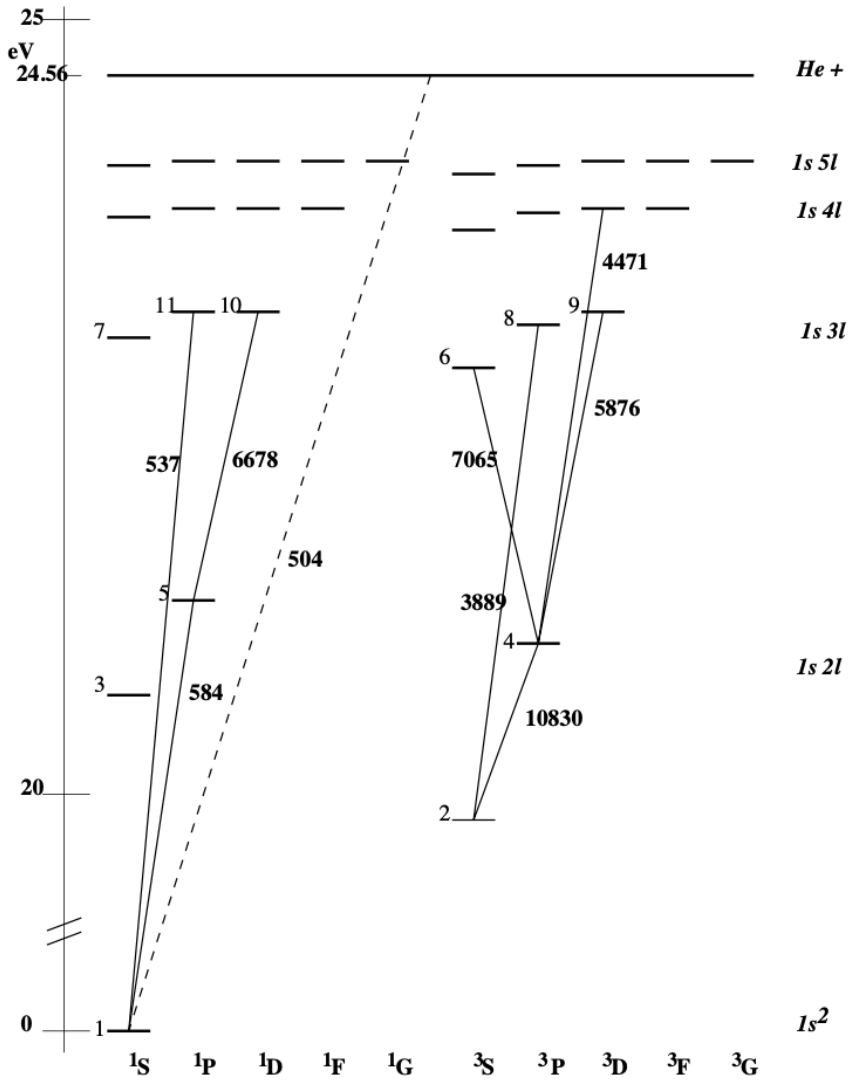


Figure 1: The model helium atom used in the simulations.

N Labrosse and P. Gouttebroze. "Formation of helium spectrum in solar quiescent prominences.", *Astronomy & Astrophysics*, **380**:323–340, 2001.

# 4. The PROBA-3 Mission

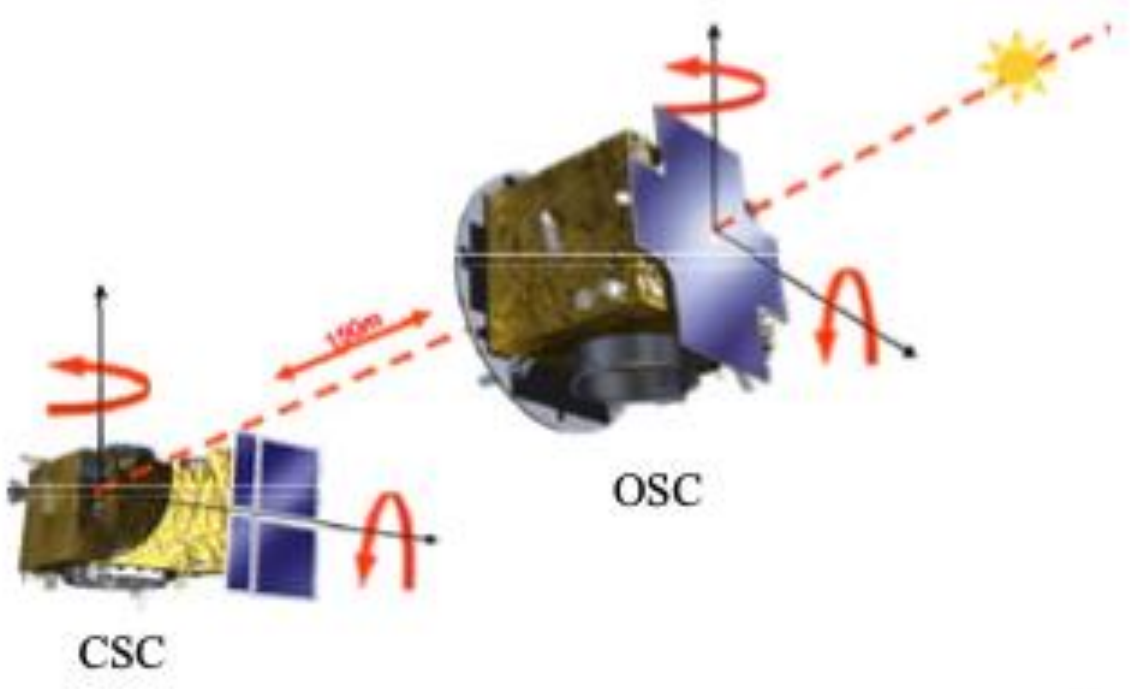


Figure 2: The PROBA-3 satellites

- First simultaneous flying mission attempted.
- They will provide comprehensive, continuous data from a prominence.
- This project aims to provide diagnostic information on the D3 line for use in the ASPIICS coronagraph on board.

E. Renotte et al. "Design status of ASPIICS, an externally occulted coronagraph for proba-3.", *SPIE Proceedings Conference*, 9604, 2015.

# 5. Previous Research

The D3 line and 10830 Å emission were linked.

A prominence to corona transition region (PCTR) was required.

A flat or 20 Å filter would be sufficient in detecting fast-moving prominence structures.

# 5.1 - The D3 and 10830 Å transitions are linked

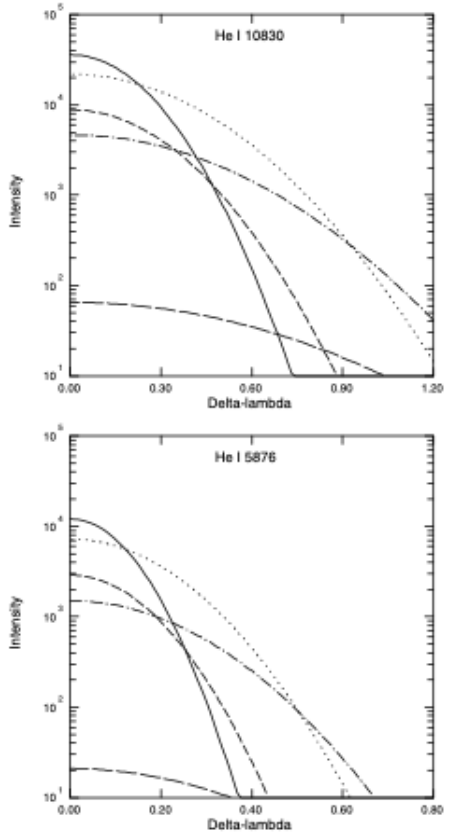


Figure 3.

Figure 3 shows the helium line half profiles from five different temperature models.

Figure 4 shows the integrated intensity of D3 against the integrated intensity of 10830 Å.

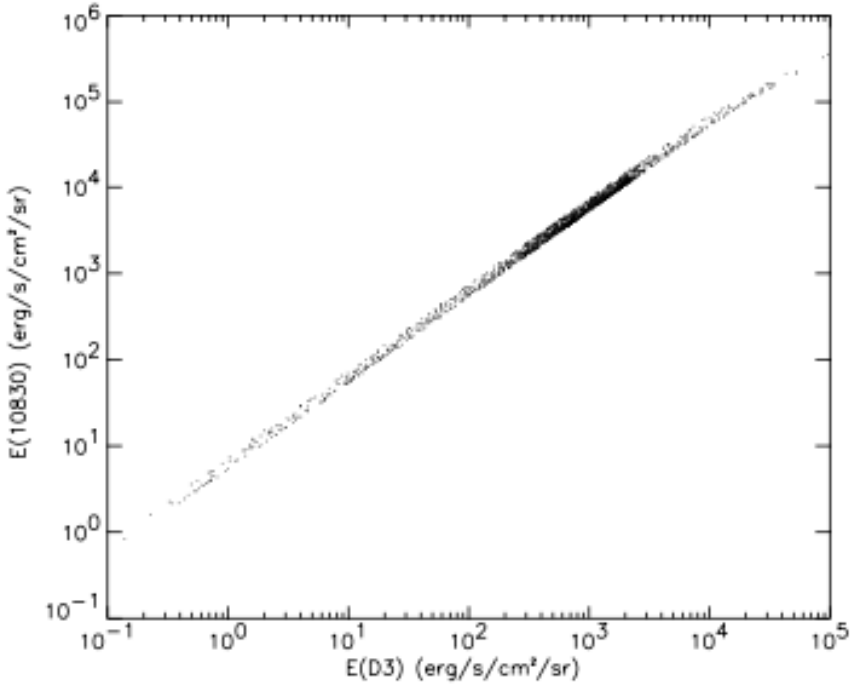


Figure 4.

LHS - P. Gouttebroze and N. Labrosse. "Radiative transfer in cylindrical threads with incident radiation. VI. A hydrogen plus helium system.", *Astronomy & Astrophysics*, **503**:663–671, 2009.
RHS - N. Labrosse and P. Gouttebroze. "Non-LTE radiative transfer in model prominences. I. Integrated intensities of He I triplet lines.", *The Astrophysical Journal*, **617**:614–622, 2004.

# 5.2 - A Prominence to Corona Transition Region was required

Figures 5 and 6 show how the integrated intensity ratio of D3/10830 Å with and without a PCTR for a range of temperatures.

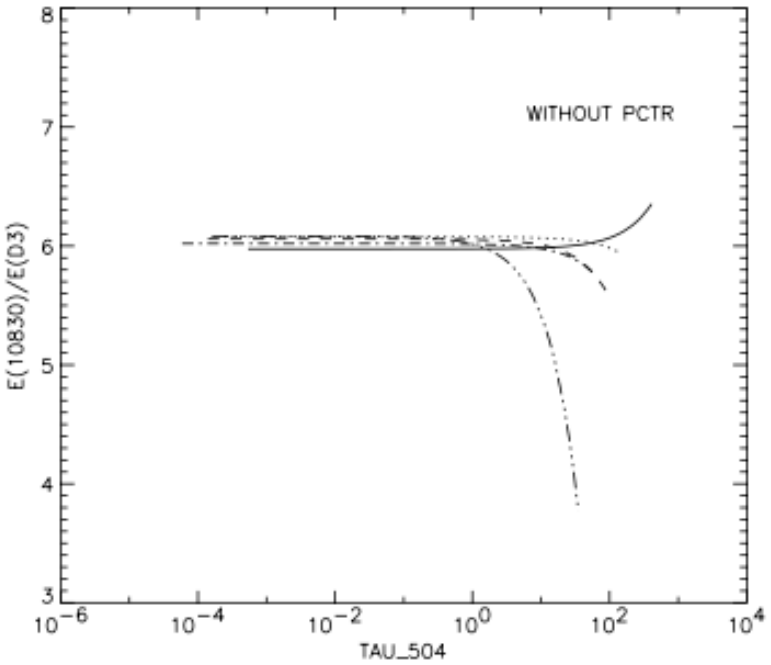


Figure 5.

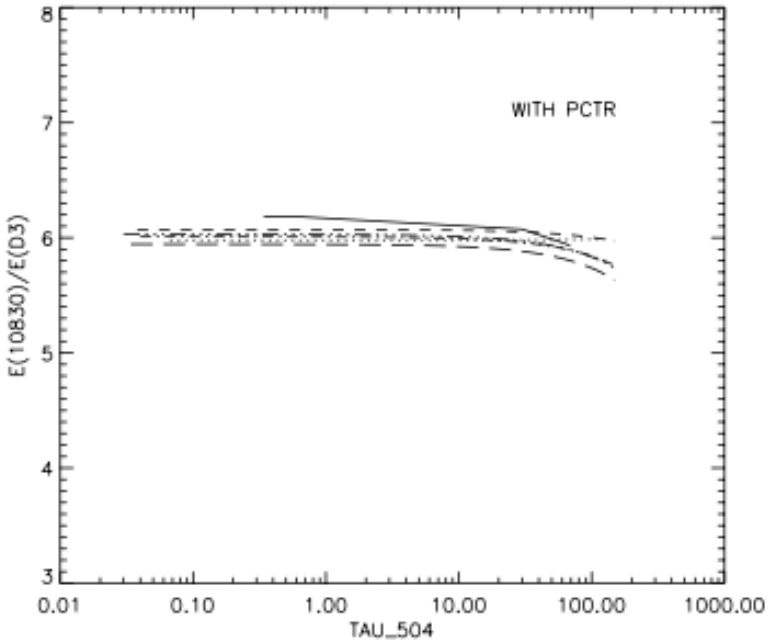


Figure 6.

N. Labrosse and P. Gouttebroze. "Non-LTE radiative transfer in model prominences. I. Integrated intensities of He I triplet lines.", *The Astrophysical Journal*, **617**:614–622, 2004.

# 5.3 – A flat or 20 Å filter would be sufficient in detecting fast-moving prominence structures

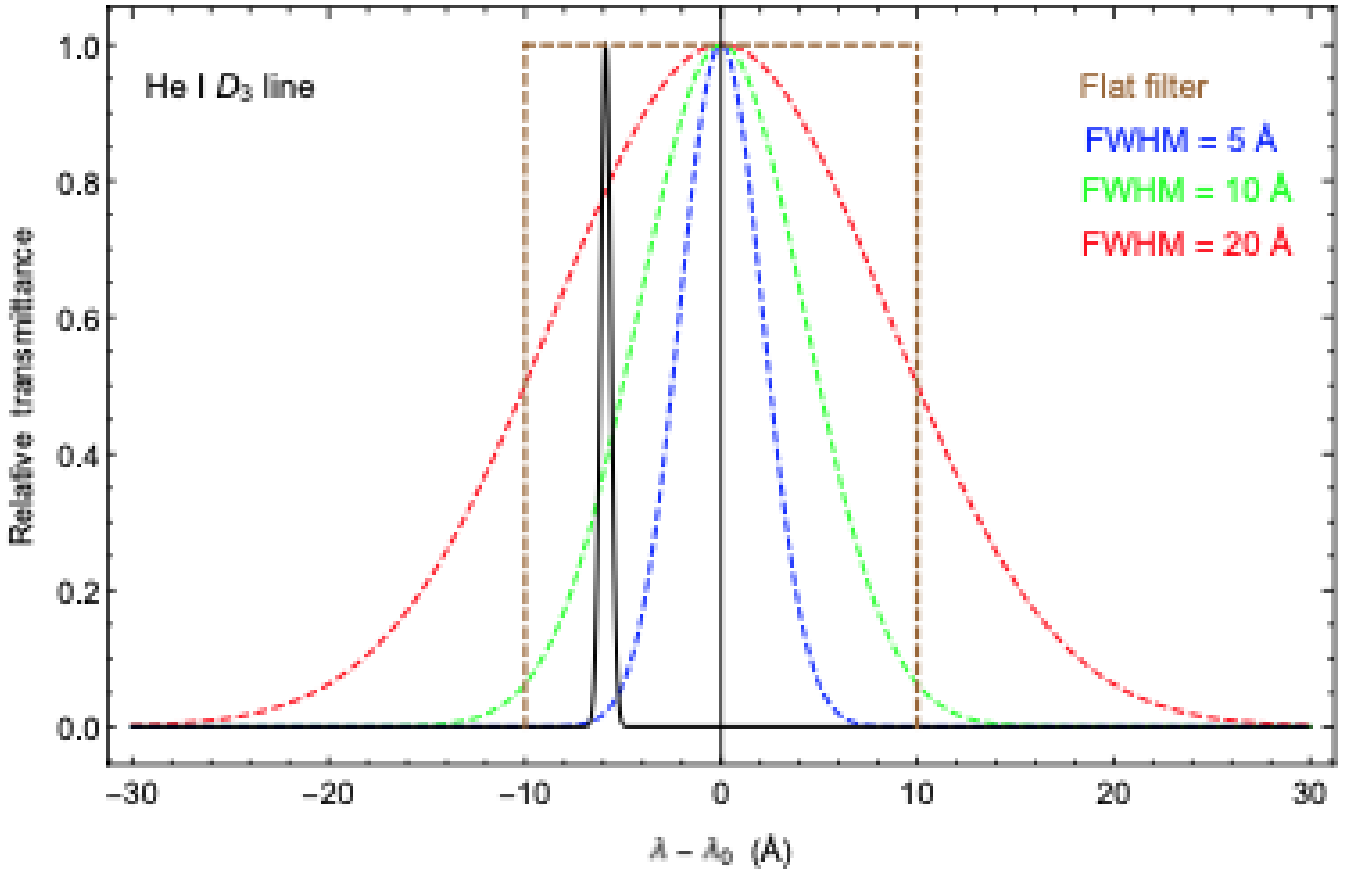


Figure 7: A range of filters centered around a Doppler shifted D3 emission profile.

S. Jejcic, P. Heinzel, N. Labrosse, A. N. Zhukov, A. Bemporad, S. Fineschi, and S. Gunar. "Visibility of prominences using the he I D3 line filter on PROBA-3/ASPIICS coronagraph.", *Solar Physics*, **293**(33), 2018.

## 6. Moving the Project Forward

Run new simulations which confirm or challenge the conclusions reached in 2018.

Explore how altering the radius of the cylinder affects the D3 line emission.

How do these new simulations compare to observational data?

# 7. Questions?


- Slide 1 - NASA. Solar prominences. https://eclipse2017.nasa.gov/solar-prominences, (Last Accessed: 02.07.2020).
- Slide 2/5.1 LHS - P. Gouttebroze and N. Labrosse. “Radiative transfer in cylindrical threads with incident radiation. VI. A hydrogen plus helium system.”, *Astronomy & Astrophysics*, **503**:663–671, 2009.
- Slide 3 - N Labrosse and P. Gouttebroze. “Formation of helium spectrum in solar quiescent prominences.”, *Astronomy & Astrophysics*, **380**:323–340, 2001.
- Slide 4 - E. Renotte et al. “Design status of ASPIICS, an externally occulted coronagraph for proba-3.”, *SPIE Proceedings Conference*, 9604, 2015.
- Slide 5.1 RHS/ 5.2 - N. Labrosse and P. Gouttebroze. “Non-LTE radiative transfer in model prominences. I. Integrated intensities of He I triplet lines.”, *The Astrophysical Journal*, **617**:614–622, 2004.
- Slide 5.3 – S. Jejcic, P. Heinzel, N. Labrosse, A. N. Zhukov, A. Bemporad, S. Fineschi, and S. Gunar. “Visibility of prominences using the he I D3 line filter on PROBA-3/ASPIICS coronagraph.”, *Solar Physics*, **293**(33), 2018.