

The effect of resonant Ar-lines on metastable densities

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The effect of resonant Ar-lines on metastable densities

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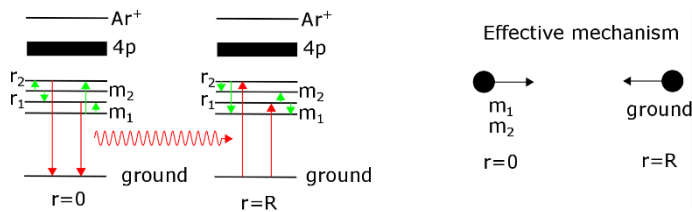


Introduction

Calculations involving radiation are often simplified by using escape factors for the resonance lines. Such a simplification speeds up the calculation, but fails to capture non-local absorption.

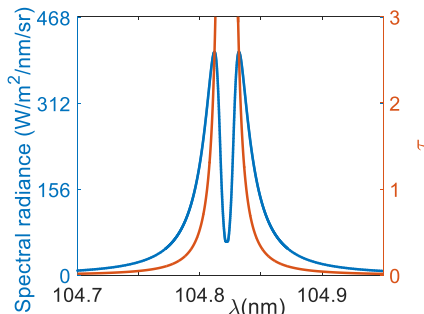
The effects of non-local absorption are investigated by comparing a 1D cylindrically symmetric 7 species Ar model in PLASIMO with the radiation included 1) self-consistently 2) via escape factors derived from the self-consistent simulation.

Additionally, the effect of the impact of absorption from the Ar resonant radiation is investigated on the Ar metastable states. An effective transport mechanism is proposed:

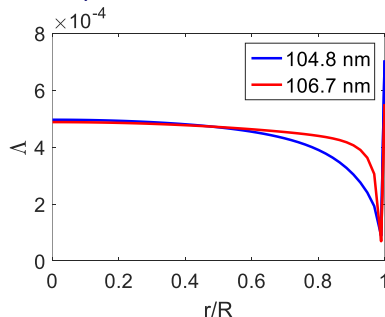


Line broadening

In the self-consistent calculation a Lorentz profile is used to represent the resonance lines. The spectral radiance and the optical depth are shown for one of the resonant lines:

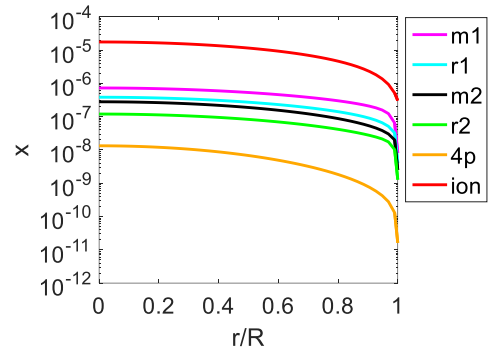


The effective escape factor for the two resonant lines:



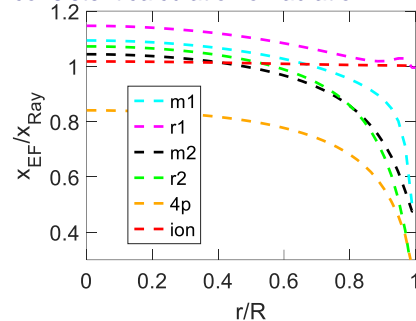
Composition

The plasma composition of the 7 species Ar mixture is shown for an input power of $2 \cdot 10^4 \text{ W/m}^3$ a radius of 25 mm and a pressure of 400 Pa.

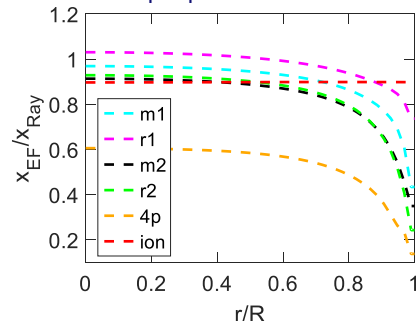


Relative ratios

The calculated densities for the model using constant escape factors are normalized by densities obtained from the self-consistent calculation of radiation.



The results are similar for a radius of 2.5 mm, a pressure of 4000 Pa and an input power of $2 \cdot 10^6 \text{ W/m}^3$



Conclusion/Outlook

The species densities near the wall are strongly affected by using a self-consistent treatment of radiation rather than an escape factor. Additionally, the results confirm that the proposed effective transport mechanism of metastable states exists.