Thomas Metcalf SPD Travel Award Report

Waves and Instabilities in the Solar Atmosphere Meeting Northumbria University, Newcastle, UK (20-23 June 2023)



Teia Mihăilescu

I am a PhD student at University College London's Mullard Space Science Laboratory (MSSL) in the UK, working under the supervision of Prof. Lucie Green.

My research focuses on spectroscopic observations of plasma composition in the solar corona. I investigate plasma composition patterns in solar active regions and aim to understand how they are linked to magnetic activity such as flaring, flux emergence or flux dispersal. Before starting my PhD, I completed a masters project at UCL on the same topic, under the supervision of Dr. Deborah Baker.

Contributing talk: Wave Driven Evolution of Plasma Composition in an Active Region

Teia Mihailescu, David H. Brooks, J. Martin Laming, Deborah Baker, Lucie M. Green, Alexander W. James, David M. Long, Lidia van Driel-Gesztelyi, Marco Stangalini

One of the major open questions in solar physics is why the elemental abundance of some regions in the solar corona is different from that of the underlying photosphere. Elements that have a low first ionisation potential (FIP) are preferentially transported to the corona and, therefore, show enhanced abundances in the corona compared to the photosphere. This is called the FIP effect and the level of enhancement is measured using the FIP bias parameter.



In this work, we use data from the EUV Imaging Spectrometer (EIS) on Hinode to study the plasma composition in an active region following an episode of significant new flux emergence into the preexisting active region. We use two FIP bias diagnostics: Si X 258.375 A/ S X 264.233 A (temperature of 1.5 MK) and Ca XIV 193.874/ Ar XIV 194.396 (temperature of 4 MK). We observe slightly different FIP bias values in the Ca/Ar diagnostic than Si/S in

the newly emerging loops, and this pattern is much stronger in the preexisting loops (those that had formed before the flux emergence).

This result can be interpreted in the context of the ponderomotive force model, which proposes that the plasma fractionation is generally driven by coronal Alfvén waves. Simulations of the model suggest that, in this case, the fractionation in the emerging loops could be driven by resonant waves, while the fractionation in the preexisting loops could be driven by non-resonant waves, which would result in different fractionation patterns in the two sets of loops. Most notably, fractionation driven by non-resonant waves is predicted to be stronger but also affect S which is otherwise considered a high-FIP element, which could explain the discrepancy between the FIP bias values we observe in the preexisting loops in this study.

I am grateful to the AAS/SPD committee and the WISA Meeting SOC for this award. Attending this meeting gave me the opportunity to expand my knowledge of both theoretical and observational aspects of waves in the solar atmosphere as well as discuss my work with waves experts. This is essential for being able to link my work on spectroscopic observations of plasma composition to fractionation models based on wave activity.