HYDROGEN CORONA OBSERVATIONS AND ANALYSIS USING EMM/EMUS

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The Emirates Mars Mission [Amiri+2021] Emirates Ultraviolet Spectrometer [Holsclaw+2021] (EMM/EMUS) experiment makes observations of the Martian disk and inner corona from all phase angles as part of its routine science observations. A key objective of the mission is to use these observations to constrain the 3D distribution of atomic hydrogen around the planet and the present-day escape rate of H to space. For this purpose, we isolate H emissions at 121.6 nm (Lyman alpha) and 102.6 nm (Lyman beta) so that we can fit the EMUS observations with a 3D H corona model and retrieve H density, temperature, and escape rates. We will present limb scan observations from the EMM insertion orbit which demonstrate that the contribution of spectrally indistinguishable O 102.6 nm emissions is limited to altitudes below 500 km, so that fitting emission above this altitude with an H-only model is appropriate. We will also present examples of simultaneous model fits to H Lyman alpha and beta, using both spherically symmetric and fully 3D models of the H density distribution around the planet. An example of such a fit for two orbits of EMUS observations is shown in Figure 1. There remain substantial discrepancies between the modeled emissions and the data, indicating that there is still a great deal to learn about the H distribution around the planet, the interplanetary hydrogen distribution, and the long term water-loss history of Mars from this dataset.

References:

Amiri+2021:
https://doi.org/10.1007/s11214-021-00868-x

Holsclaw+2021:
https://doi.org/10.1007/s11214-021-00854-3

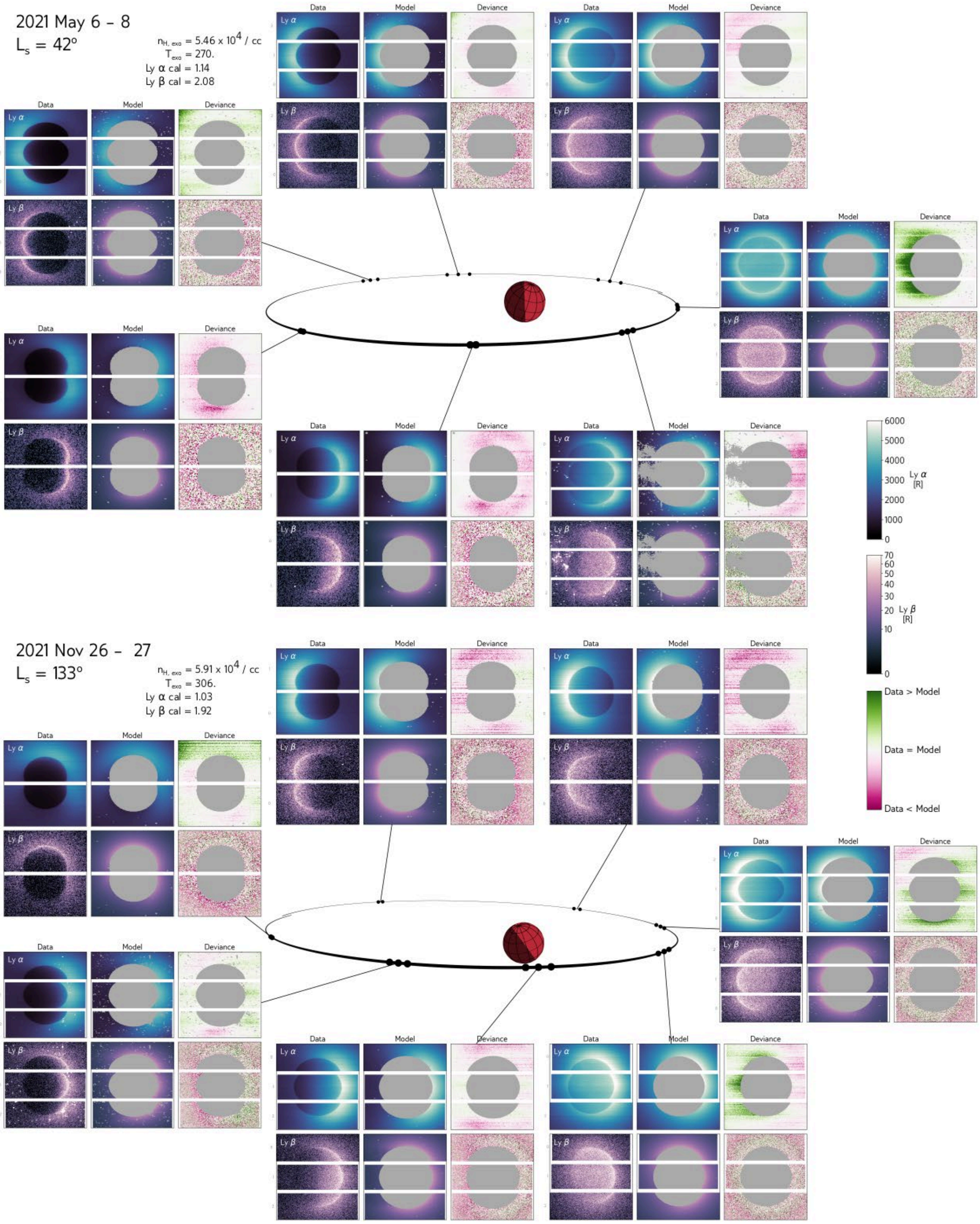

Figure 1. Examples of EMM/EMUS data, spherically symmetric model best fits, and deviance of the model and data. Top/bottom show different collections of EMUS OS2 data and fits for the times indicated. Each set of six panels shows a collection of EMUS Lyman alpha and Lyman beta brightness and model fits using two or three slews of the spectrograph slit across the planet. Spherically symmetric density + radiative transfer model best fits to the data are shown in the middle column of each set. All of the data from each orbit is used to perform a model best fit for all tangent altitudes above 500 km, below which O 102.6 nm contributions become important. Best fit parameters, including a model scale factor for each emission, are given adjacent to each plot. Model/data deviations usually indicate the presence of more or less H in reality than is present in the spherically symmetric model, but occasionally indicate flat field issues or discrepancies between the data and the adopted interplanetary hydrogen model.