The Sensitivity of AIA Observations to Coronal Heating Parameters

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Abstract

We explore the effects of changing heating parameters in closed coronal loops on the intensity of Atmospheric Imaging Assembly (AIA) observations. Using EBTEL (Enthalpy-Based Thermal Evolution of Loops) hydrodynamic simulations, we produce realizations of coronal loops with a series of heating events randomly drawn from a power law distribution. We repeat this procedure for multiple loop lengths, heating intensities, and characteristic heating frequencies to investigate how each of these parameters individually and in combination influences observable loop properties. We generate AIA intensities from the corona and transition region for each realization. The variations within and between models generated with these different parameters illustrate the sensitivity of narrowband imaging to the details of coronal heating. Using insights from this analysis, we generate images of observed coronal active regions using the GX Simulator SSW IDL package and interpret the causes of discrepancies between the models and observations.

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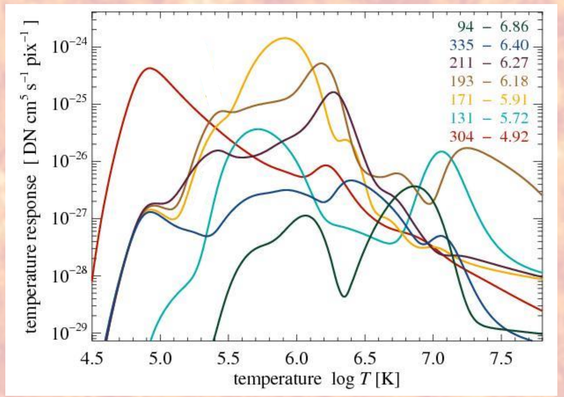
Introduction

- The magnetically closed **corona** has **temperatures > 10^6 K**
  - Caused by conversion of **magnetic energy** into plasma thermal energy
  - The specific **heating mechanism** is still **undetermined**
- One way to study this heating is by modeling extreme ultraviolet (**EUV**) emission from **active regions**
  - Each heating parameterization produces a **unique emission signature**
- Many **studies struggle** to simultaneously match the morphology and amplitude of **coronal** emission **across multiple channels**
  - We investigate **transition region emission** in Atmospheric Imaging Assembly (**AIA**) data to explain this

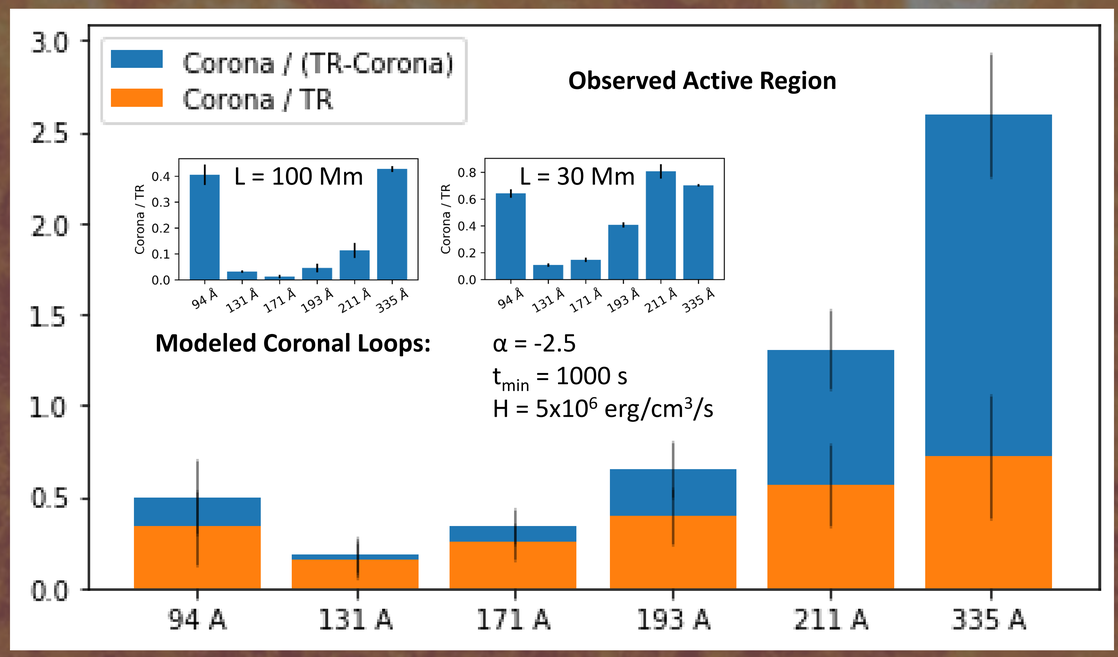


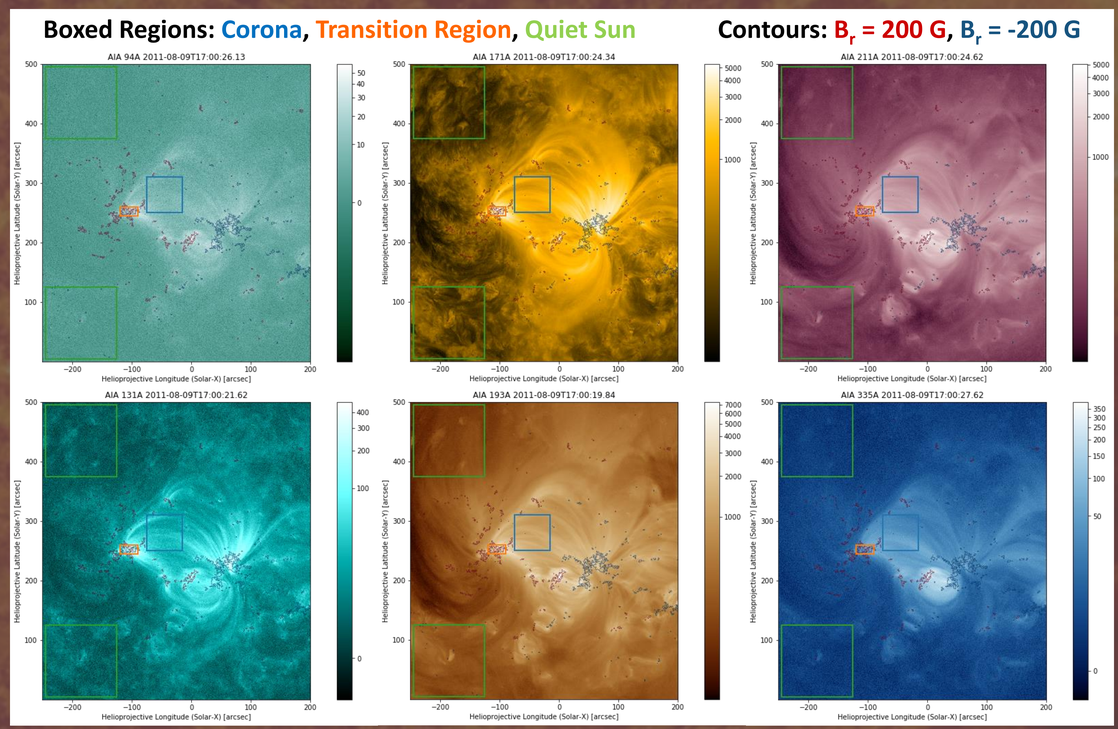
AIA Temperature Response Functions
Peter, Bingert, and Kamio 2010

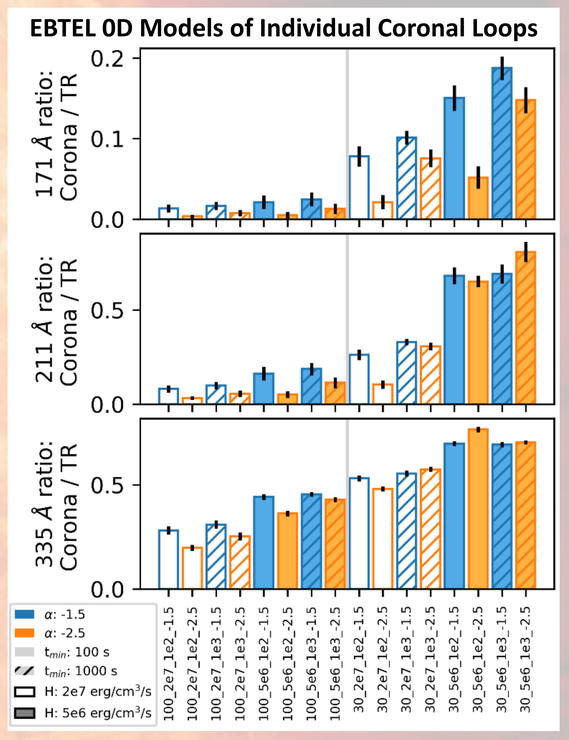
Methodology

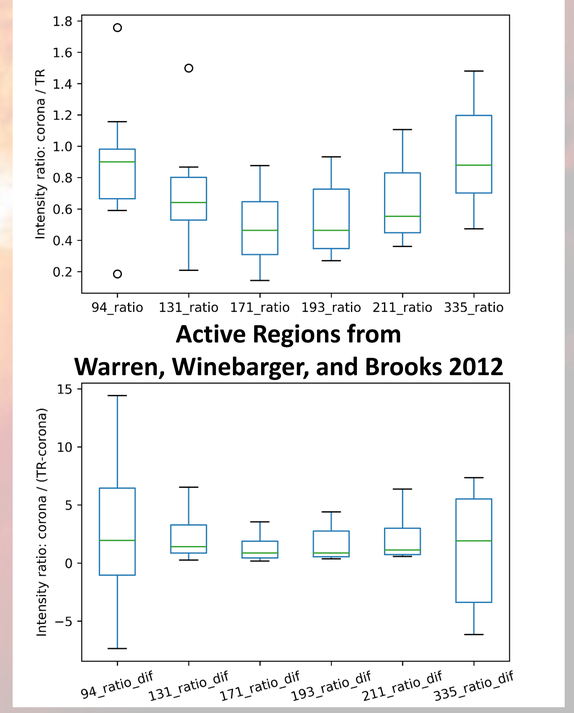
- We identify features in active regions observed by AIA:
  - **Corona**: Distinct loops connecting two regions of opposite magnetic polarity with weak underlying magnetic fields
  - **Transition Region**: Termination of loops in strong ($|B_r| > 200$ G) photospheric fields
- **Compare** the ratio between **observed intensities** in these regions with **EBTEL 0D models** of active region loops

Active region models must include the **transition region** to accurately represent **EUV emission.**









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