Modeling Solar Atmospheric Phenomena with AtomDB and PyAtomDB

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August 2, 2017

Abstract

Taking advantage of the modeling tools made available by PyAtomDB Foster(2015), we evaluated the atomic impact of solar phenomena. In particular, the atomic effects of coronal mass ejections (CME). Initially, we perform modifications to the canonical SunNEI code N.A.Murphy et al.(2011) in order to include non-equilibrium ionization (NEI) processes that occur in the CME modeled in SunNEI. The methods used involve the consideration of radiative cooling as well as ion balance calculations produced by PyAtomDB. These calculations were subsequently implemented within the SunNEI simulation. The insertion of aforementioned processes and parameter customization produced quite similar results of the original model aside from the inconsistencies between the Fe charge states, which we found to stem from incongruent data for Argon-like Fe ions between the CHIANTI and AtomDB databases. The key finding was that theoretical models are greatly impacted by the relative atomic database update cycles. We then use the AtomDB database to model the time dependencies of intensity flux spikes produced by a coronal shock wave Ma et al.(2011). Having the data provided allowed us to produce a theoretical representation that interpolated over the intensity data points for each respective Astronomical Imaging Assembly (AIA) wavelength band pass. Specifically, the 171Å(Fe IX), 193Å(Fe XII, Fe XXIV), 211Å(Fe XIV), and 335Å(Fe XVI) wavelengths in order to assess the comparative spectral emissions between AtomDB and the observed data. The results of the theoretical model, in principle, should shine light in regards to the equilibrium conditions related to the precipitant ionic abundances present within the shock front, which will allow for better understanding of energy jumps as well as atomic variabilities at play in the shock wave.

Keywords: Coronal Mass Ejections(CMEs) - Non-Equilibrium Ionization - Spectroscopy

This work supported by the NSF-REU solar physics program at SAO, grant number AGS-1560313.