Geophysical Research Abstracts
Vol. 21, EGU2019-18943, 2019
EGU General Assembly 2019

A New Method to Comprehensively Diagnose Shock Waves in the Solar Atmosphere Based on Simultaneous Spectroscopic and Imaging Observations

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Shock waves are believed to play an important role in plasma heating. The shock-like temporal jumps in radiation intensity and Doppler shift have been identifi ed in the solar atmosphere. However, a quantitative diagnosis of the shocks in the solar atmosphere is still lacking, seriously hindering the understanding of shock dissipative heating of the solar atmosphere. Here, we propose a new method to realize the goal of the shock quantitative diagnosis, based on Rankine– Hugoniot equations and taking the advantages of simultaneous imaging and spectroscopic observations from, e.g., IRIS (Interface Region Imaging Spectrograph). This method is called as “Shock-ABIS”, short for “Shock Analysis Based on Imaging Spectrograph”. Because of this “Shock-ABIS” method, the key parameters of shock candidates can be derived, such as the bulk velocity and temperature of the plasma in the upstream and downstream, the propagation speed and direction. The method is applied to the shock candidates observed by IRIS, and the overall characteristics of the shocks are revealed quantitatively for the fi rst time. This method is also tested with the help of forward modeling, i.e. virtual observations of simulated shocks. The parameters obtained from the method are consistent with the parameters of the shock formed in the model and are independent of the viewing direction. Therefore, the method we proposed here is applicable to the quantitative and comprehensive diagnosis of the observed shocks in the solar atmosphere.