IRIS Observations of the Transition Region Above Sunspots

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NASA's IRIS mission is providing high-cadence and high-resolution observations of the solar transition region (TR) and chromosphere. We present results from IRIS observation of the transition region above sunspots. The major findings can be summarized as following: (1) Many subarcsec bright dots are present in SJI 1330Å and 1400Å images obtained in high-cadence observations. These bright dots are observed in the penumbrae of all sunspots we inspected, and are occasionally present in the umbrae and light bridges of some sunspots. Some bright dots show apparent movement with a speed of 10-40 km/s (either outward or inward). The lifetime of these penumbral dots is mostly less than 1 min. The most obvious spectral features are the absence of the O IV 1401 line and the broadened Si IV line profiles. Some bright dots appear to be located at the footpoints of coronal loops. Many of them are likely generated by impulsive reconnection in the TR and chromosphere. (2) Strongly nonlinear sunspot oscillations can be clearly identified in both the slit jaw images of 2796Å, 1400Å and 1330Å, and spectra of the bright Mg II, C II and Si IV lines. The temporal evolution of the line core is dominated by the following behavior: a rapid excursion to the blue side, accompanied by an intensity increase, followed by a linear decrease of the velocity to the red side. The maximum intensity slightly lags the maximum blue shift in Si iv, whereas the intensity enhancement slightly precedes the maximum blue shift in Mg ii. We find a positive correlation between the maximum velocity and deceleration, a result that is consistent with numerical simulations of upward propagating magneto-acoustic shock waves. We also demonstrate that the strongly nonlinear line width oscillation, reported both previously and here, is spurious. (3) Persistent supersonic downflows at TR temperatures are clearly detected in many sunspots. Many of them appear to be associated with sunspot plumes. (4) The normally reserved C II and Mg II line profiles are almost Gaussian in the sunspot umbra, suggesting a greatly reduced opacity in the sunspot atmosphere.