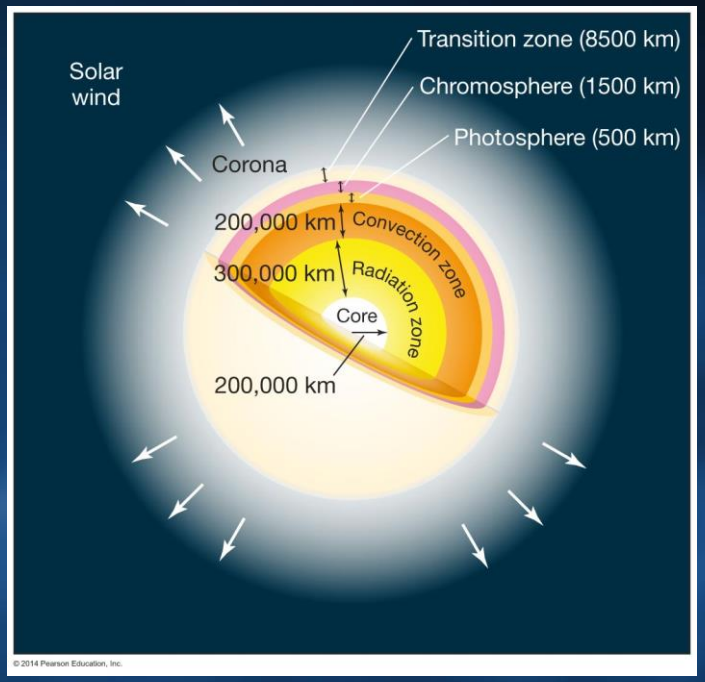
Using a Slitless Spectrograph to View the Transition Zone

The Sun's atmosphere includes a transition zone nestled between the extremely hot corona (1,800,000°F) and the relatively cool chromosphere (40,000°F). The processes inside this thin transition zone with its steep temperature gradient, holds clues to why the corona itself is so much hotter than the solar layers below -- but due to the abundance of ionized hydrogen there, it is difficult to view the zone. Now, using a spectrometer, scientists have recently been able to view the transition zone -- isolated from the corona and chromosphere -- in ultraviolet light.



The transition region is a thin and very irregular layer of the Sun's atmosphere that separates the hot corona from the much cooler chromosphere.

A study published in the Journal of Astronomical Telescopes Instruments and Systems used a slitless spectrometer on NASA's Multi-Order Solar EUV Spectrograph (MOSES) sounding rocket to take snapshots of the Sun. This instrument was able observe a wide area of the transition zone simultaneously, as opposed to most slit-style spectrographs which have a narrow field of view.

Repurposing an algorithm originally designed to analyze horizontal flow on the photosphere, the authors instead applied it to motion along the line-of-sight, deriving a Dopplergram depicting charged particle motion towards and away from the Sun. The analysis used Fourier local correlation tracking to compare the strong Helium II emission line across simultaneous images of the Sun taken with three different diffraction orders.

By studying the Doppler effect in the transition zone, we can begin to piece together the temperature gradient rising up through the transition zone as well as track the flow of the energized particles and explosive events through the region. Getting this insight into this mysterious transition zone will help our overall understanding of the sun, and understanding the connection between the corona and the chromosphere.

Hans T. Courrier, Charles C. Kankelborg, "Using local correlation tracking to recover solar spectral information from a slitless spectrograph," J. Astron. Telesc. Instrum. Syst. 4(1), 018001 (2018), doi: 10.1117/1.JATIS.4.1.018001.