Tracking Waves from Sunspots Provides New Solar Insight

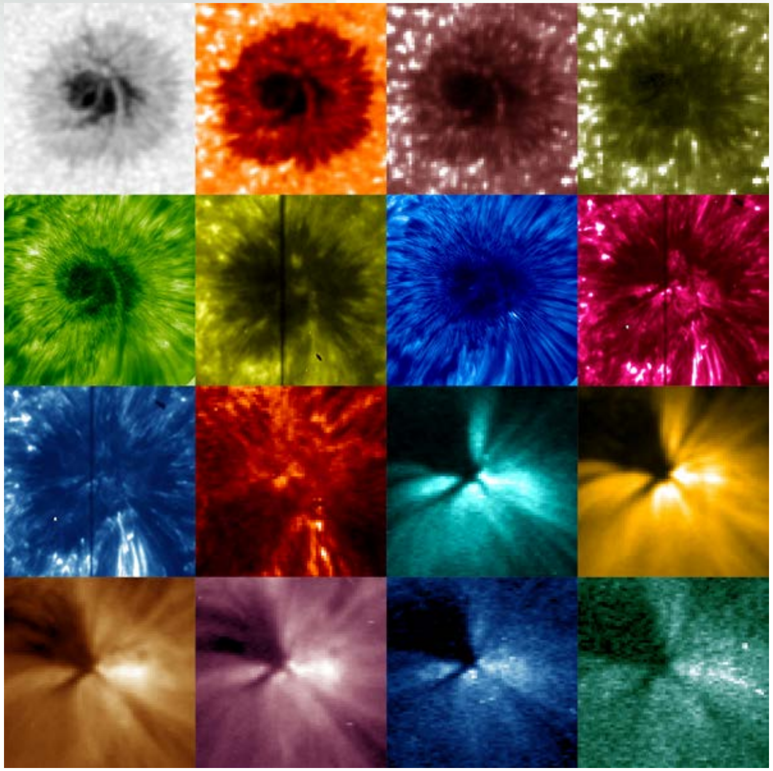
Zhau, J et. al. (2016) TRACING p-MODE WAVES FROM THE PHOTOSPHERE TO THE CORONA IN ACTIVE REGIONS. *The Astrophysical Journal Letters, 830:L17 (7pp). doi:10.3847/2041-8205/830/1/L17*

Combining data returned from NASA's SDO and IRIS heliophysics spaceflight missions and ground based observations from the Big Bear Solar Observatory, researchers have – for the first time – tracked magneto-acoustic seismic waves emerging from a sunspot traveling up through the solar atmosphere.

The sun and its atmosphere are continuously churning and waves have been found to be a ubiquitous phenomenon throughout. However, it has been extremely difficult to determine the relationship between the waves emerging at the surface of the sun, known as the photosphere, and those in the atmosphere because of the tremendous drop in density (density change by a factor of a trillion) over the very short distance between the visible surface of the sun and its corona. Recent efforts to "pipeline" access to data from two NASA solar missions (SDO and IRIS) and the ground-based Big Bear Solar Observatory (BBSO) have produced a research resource that opens the door to a scientific breakthrough relating waves observed at different layers of the sun and its atmosphere. This combined data allows observation of the propagation of waves from the solar surface to the solar atmosphere.

A study using this publicly available data resource was recently published in *The Astrophysical Journal Letters* doing just this – following a solar wave as it propagated out from a sunspot into the solar atmosphere. This study considered acoustic (p-mode or compression) seismic waves emerging in sunspots. Since a significant fraction of all solar material is ionized and the sun has a strong magnetic field, magnetic forces play an important role in any motion of this material; the waves in this study are known as magneto-acoustic waves.

This study provides new information about the temperature, pressure, density, and magnetic field within the layers of solar atmosphere traversed. It also addresses the role of solar seismic waves in coronal heating. The relative importance of the acoustic and magnetic energy changes dramatically with the change in material density with altitude, providing an important diagnostic capability in the technique used in this research.



These are the 16 different wavelengths used to observe the propagation of a magneto-acoustic wave as it emerges and ascends in altitude through the solar atmosphere.

Credits: SDO/IRIS/BBSO