Magnetohydrodynamic Seismology of the Corona of the Sun

Valery M Nakariakov
University of Warwick, United Kingdom

Processes operating in the outer layers of the Sun's atmosphere, the fully ionised, magnetically dominated plasma of the corona, remain one of the major unsolved puzzles in solar physics. Intensively debated research topics include the enigmatic problem of coronal heating; the rapid release of enormous amounts of magnetic energy in solar flares and coronal mass ejections; the microphysical mechanisms responsible for the efficient acceleration of charged particles; among others.

The solar physics community is strongly supported by a range of ground-based and spaceborne observational facilities, which provide a wealth of high-precision data across the entire electromagnetic spectrum, from radio waves to gamma-rays. Nevertheless, several key parameters of the solar corona, such as the magnetic field, the heating function, and the effective coefficients of thermal conduction, viscosity, and resistivity remain inaccessible to direct observation.

The method of magnetohydrodynamic (MHD) seismology, which infers plasma parameters from the properties of MHD waves, offers a paradigm-shifting diagnostic tool for probing the coronal plasma. Modern MHD seismology makes use of a range of MHD modes observed in different plasma structures to determine fundamental physical parameters of the corona and to diagnose the processes at work there.

A short biographical introduction:

Professor Valery M Nakariakov graduated from the School of Radiophysics of Lobachevsky's Gorky State University, USSR in 1989, and gained PhD in Plasma Physics at the Applied Physics Institute of the Russian Academy of Sciences in 1994. In 1995-1999, he was a postdoc at St Andrews, United Kingdom, and since 1999 he has a permanent academic position (Full Professor since 2007) at the University of Warwick, United Kingdom. His main research interests relate to the observational study and theoretical modelling of magnetohydrodynamic (MHD) wave process in the corona of the Sun, in particular, coronal plasma diagnostics by MHD waves; and plasma astrophysics and radiophysics. Nakariakov has twice received an ERC Advance Grant, in 2013 and 2025. For the development of the method of MHD seismology Nakariakov was granted the Payne-Gaposchkin Medal and Prize 2015, and the Chapman Medal of the Royal Astronomical Society 2024. In 2011-2014 Nakariakov was President of the Solar Physics Division of the European Physical Society. Presently, Nakariakov is the International Astronomical Union Representative to the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) Council.