The many faces of the shear Alfven wave

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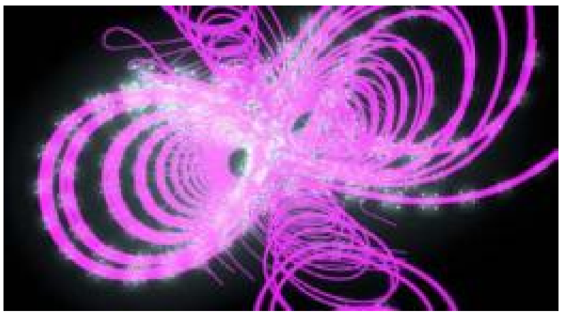

This is a representation of the three-dimensional magnetic field (due to four currents threading the center of each helix) of a shear Alfvén wave. It was acquired at an instant of time throughout the volume of a large (60 cm diameter ,18m long) plasma in the LAPD device at UCLA. The currents and the field topology change in fractions of a millionth of a second. The sparkles are proportional to the electric field in the plasma induced by the wave. Credit: Walter Gekelman, UCLA

Scientists show that 3-D movies are no longer just for Hollywood blockbusters.

When physicists probe the mysteries of plasma, the fourth state of matter, they often discover phenomena of striking beauty. Much as when the Hubble Space Telescope sent back vivid images from space of ionized gas clouds (an interstellar plasma), new 3D images of shear Alfvén waves are delighting both scientists and a new generation of science enthusiasts.

Plasmas support a large variety of waves. Some of these are familiar, such as light and sound waves, but a great many exist nowhere else. One of the fundamental waves in magnetized plasma is the shear Alfvén wave, named after Nobel Prize winning scientist Hannes Alfvén, who predicted their existence.

Shear waves of various forms have been a topic of experimental research for more than 15 years in the Large Plasma Device (LAPD) at the University of California, Los Angeles. When the waves were first studied, it was discovered that their creation gives rise to exotic spatial patterns, such as the one shown in Figure 1, all of them Shear Alfvén waves. Three-dimensional data, such as the magnetic field of the wave shown here, will be presented along with relevant theory. Part of the presentation will be in 3D.

It has become apparent that Alfvén waves are important in a wide variety of physical environments. They play a central role in the stability of the magnetic confinement devices used in fusion research, give rise to aurora formation in planets, and are thought to contribute to heating and ion acceleration in the solar corona. Shear waves can also cause particle acceleration over considerable distances in interstellar space.

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