What Can Fast Radio Bursts Teach Us About Magnetars?

Fast radio bursts (FRBs) are mysterious pulses of radio emission that last only milliseconds, but put out as much energy as our sun produces over several days. Astrophysicists have many reasons to think they originate from magnetars, highly magnetized neutron stars. A magnetar may have a magnetic field of 10^14 Gauss, thousands of times stronger than a typical neutron star (just for comparison, the magnetic field of the sun is about 5 Gauss). What can we learn about magnetars from FRBs, considering the firehose of data expected in the next decade?

As brief as FRB's are, there are features in the radio emission that can be quasi-periodic and may be caused by oscillations of the crust and even core of the magnetar. We find some of these reported "trains" of FRBs are consistent with twisting "torsional" oscillations of magnetars seen in our galaxy. It is possible that FRBs offer opportunities to study the crust and internal structure of magnetars and could help constrain the distance of some of these objects.

If our interpretation is correct, it represents a revolution in our ability to study magnetars. By combining observations from radio, gamma-rays and x-rays, we may be able to test our models of the interiors of some of the most dramatic objects in the universe, providing a laboratory of fundamental physics in extreme conditions. We expect a large amount of data from these objects in the next few years, but we'll particularly require more detailed radio observations to further understand them.

Ref: Zorawar Wadiasingh (663) & Cecilia Chirenti (661) (2020), "Fast Radio Burst Trains from Magnetar Oscillations", published in The Astrophysical Journal Letters, doi: 10.3847/2041-8213/abc562