Pressure Turns Semiconductor into New State of Matter

Scientific Achievement
Used pressure to transform a semiconductor into a “topological insulator” (TI), a state of matter in which a material’s interior insulates but its edges or surfaces conduct.

Significance and Impact
First case of a pressure-induced TI; results could help scientists find an ideal TI for future electronics applications.

Research Details
– Semiconductor is BiTeI, a compound of bismuth, tellurium & iodine
– Pressure was applied up to 10 gigapascals (GPa) with the structural and electronic changes tracked via x-ray powder diffraction (XRD) and infrared (IR) spectroscopy, which reveal that the TI phase occurs between 2 and 8 GPa
– Both data sets show key features between 2 and 3 GPa that are expected to show up during the transition: respectively, a specific change to the BiTeI crystal unit cell and a maximum in the “plasma frequency,” a quantity closely related to the material’s electronic structure.

Work was performed at Brookhaven National Laboratory.