Spintronics: Giant Rashba semiconductors show unconventional dynamics with potential applications

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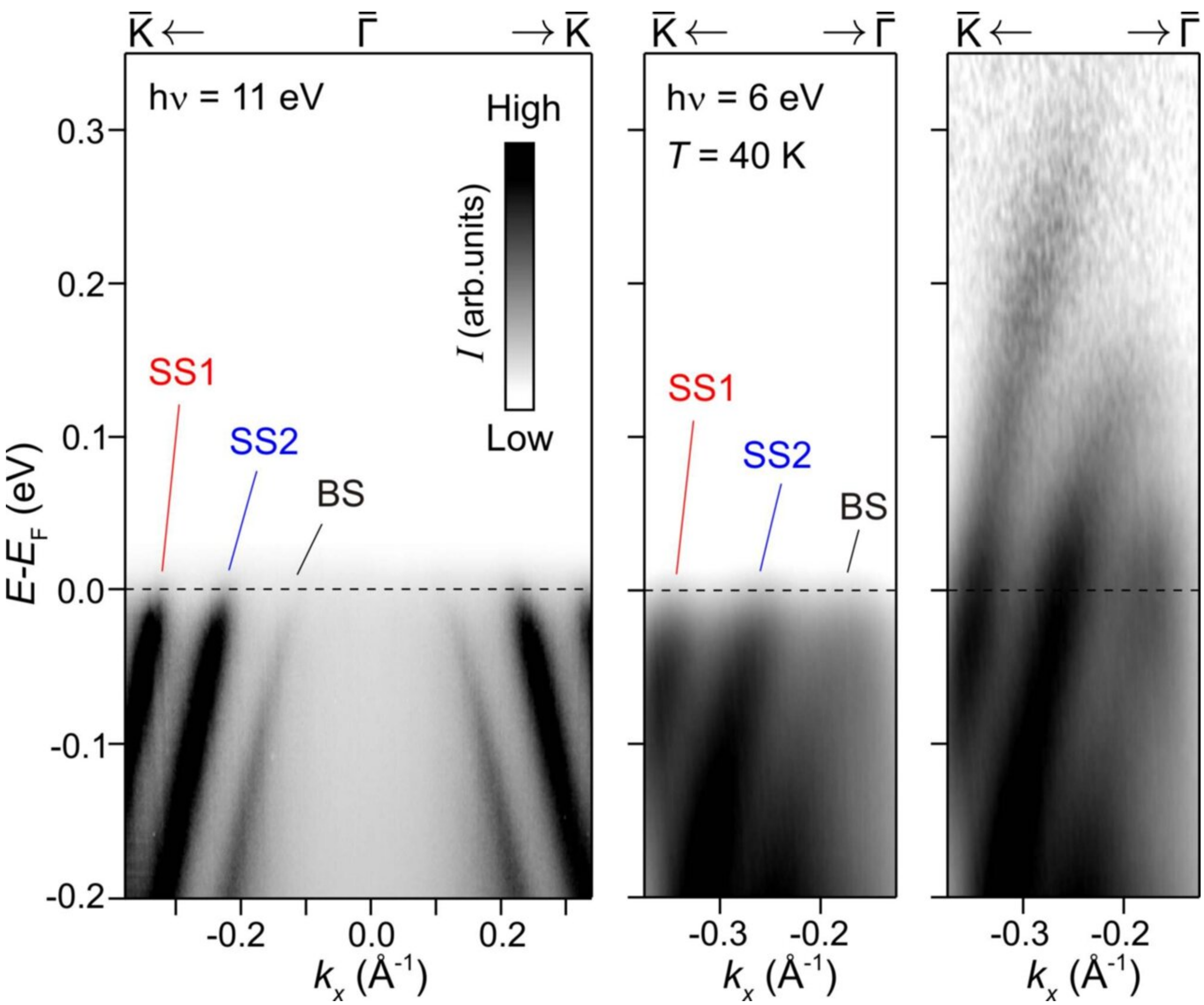

Left: Electronic structure of GeTe taken with 11 eV photons at BESSY-II, showing the band dispersions of bulk (BS) and surface Rashba states (SS1, SS2) in equilibrium. Middle: Zoom-in on the region of the Rashba states measured with fs-laser 6 eV photons. Right: Corresponding out-of-equilibrium dispersions following excitation by the pump pulse. Credit: HZB

Germanium telluride is a strong candidate for use in functional spintronic devices due to its giant Rashba-effect. Now, scientists at HZB have discovered another intriguing phenomenon in GeTe by studying the electronic response to thermal excitation of the samples. To their surprise, the subsequent relaxation proceeded fundamentally different to that of conventional semimetals. By delicately controlling the fine details of the underlying electronic structure, new functionalities of this class of materials could be conceived. They have reported on their results in *Advanced Materials*.

In recent decades, the complexity and functionality of silicon-based technologies has increased exponentially, commensurate with the ever-growing demand for smaller, more capable devices. However, the silicon age is coming to an end. With increasing miniaturization, undesirable quantum effects and thermal losses are becoming an ever-greater obstacle. Further progress requires new materials that harness quantum effects rather than avoid them. Spintronic devices, which use spins of electrons rather than their charge, promise more energy efficient devices with significantly enhanced switching times and entirely new functionalities.

Spintronic devices are coming

Candidates for spintronic devices are semiconductor materials wherein the spins are coupled with the orbital motion of the electrons. This so-called Rashba effect occurs in a number of non-magnetic semiconductors and semi-metallic compounds and allows, among other things, to manipulate the spins in the material by an electric field.

First study in a non equilibrium state

Germanium telluride hosts one of the largest Rashba effects of all semiconducting systems. Until now, however, germanium telluride has only been studied in thermal equilibrium. Now, for the first time, a team led by HZB physicist Jaime-Sanchez-Barriga has specifically accessed a non-equilibrium state in GeTe samples at BESSY II and investigated in detail how equilibrium is restored in the material on ultrafast (

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