Nobel Prize Intro Lectures Part 1: Medicine and Physics

Nobel Prize in Physiology or Medicine

In the field of physiology or medicine, the 2025 Nobel Prize was awarded to Mary E. Brunkow, Fred Ramsdell and Shimon Sakaguchi for their groundbreaking discovery of the mechanisms underlying peripheral immune tolerance. Their work revealed how the immune system restrains self-reactive T cells outside the thymus, thereby preventing autoimmune damage. Sakaguchi's seminal experiments in the mid-1990s identified a distinct population of CD4^+CD25^+ T cells that function as immune-system "brakes." Subsequently, Brunkow and Ramsdell uncovered the forkhead-box gene FOXP3 by studying the scurfy mouse strain (which develops lethal autoimmunity) and then demonstrated its human equivalent in IPEX syndrome. Collectively, these findings launched an entirely new field of peripheral tolerance, beyond the previously acknowledged central tolerance within the thymus. The practical relevance of their work is immense: by defining how Tregs enforce immune self-restraint, they opened novel therapeutic opportunities in autoimmunity, transplantation and cancer immunotherapy. Their discovery explains why most people do not develop devastating autoimmune disease and provides the scientific foundation for modulating immune responses in disease.

Nobel Prize in Physics

Turning to physics, the 2025 Nobel Prize in Physics was awarded jointly to John Clarke, Michel H. Devoret and John M. Martinis "for the discovery of macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit." Their experiments in the 1980s revealed that quantum phenomena can manifest in macroscopic electrical circuits built from superconductors (Josephson junctions). By constructing circuits in which a phase difference across a Josephson junction acts like a quantum variable, they demonstrated that such a "macroscopic quantum system" could tunnel through classically forbidden barriers and absorb/emit quantised energy in discrete packets. These insights provided a crucial step toward superconducting quantum circuits, which form the backbone of modern quantum computing, sensing and other emerging quantum technologies. In other words, their work made the bizarre and counter-intuitive realm of quantum mechanics tangible and engineerable, bridging fundamental physics and future technological application.

The two prizes highlight the power of fundamental discovery: in medicine, unravelling how the body's immune "security guards" operate; in physics, showing that quantum behaviour can be harnessed in human-scale devices. Both arenas underscore how deep insights into nature's mechanisms enable new frontiers, whether therapeutic or technological.