Milind Kunchur is the world leader in the exploration of superconductors under extreme conditions of electric fields (in kV/cm), power densities (in GW/cubic-cm), and vortex velocities (over 10 km/s). He was the first to show the applicability of the Bardeen-Stephen flux flow concept (1965) to high-temperature superconductors [1], a result that is cited in Michael Tinkham’s “Introduction to Superconductivity” textbook. The elusive pair-breaking current, one of the three fundamental critical parameters of the superconducting state, was measured for the first time in any high-temperature superconductor by Kunchur [2], who went on to conduct the most complete test of theories on this topic. Kunchur discovered and provided the theory for a new type of vortex instability that arises from vortex core expansion and condensate softening at high vortex velocities [3]; an effect entirely unanticipated and fundamentally different from the conventional Larkin-Ovchinnikov instability in which the core contracts. Subsequently he conducted the most controlled investigation of the negative-differential conductivity regime, which led to the discovery of quantized steps in the current-voltage response (analogous to the Gunn effect in semiconductors) resulting from elastic fragmentation of the flux lattice [4].

During his 25-year research career, Kunchur has made significant contributions to several topics. His work in metal-insulator transitions was the first to show that the metal-insulator and super-normal transitions don’t have to coincide [5], and he demonstrated a new method to establish the metallic character of the normal state at low temperatures [6]. He published one of the early papers on the Hall effect in high-temperature superconductors that elucidated the controversial sign reversal [7]. He proposed and experimentally confirmed a new memory effect that was key to ruling out the superconducting-glass scenario for magnetic relaxation in high-temperature superconductors. He was the first to demonstrate in a real-time correlated current-voltage measurement the ballistic acceleration of a supercurrent in an electric field [8], as expected from the first London equation. Recently Kunchur turned his expertise with fast pulsed signals to investigate a very different question—the time resolution of human hearing—and set the new standard of 5 microseconds. This revolutionary result is now being cited in college textbooks and discussed in popular magazines.