Real-time single-proton counting with transmissive perovskite nanocrystal scintillators

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High-sensitivity radiation detectors for energetic particles are essential for advanced applications in particle physics, astronomy and cancer therapy. Current particle detectors use bulk crystals, and thin-film organic scintillators have low light yields and limited radiation tolerance. Here we present transmissive thin scintillators made from $CsPbBr_3$ nanocrystals, designed for real-time single-proton counting. These perovskite scintillators exhibit exceptional sensitivity, with a high light yield (~100,000 photons per MeV) when subjected to proton beams. This enhanced sensitivity is attributed to radiative emission from biexcitons generated through proton-induced upconversion and impact ionization. These scintillators can detect as few as seven protons per second, a sensitivity level far below the rates encountered in clinical settings. The combination of rapid response (~336 ps) and pronounced ionostabilitenables diverse applications, including single-proton tracing, patterned irradiation and super-resolution proton imaging. These advancements have the potential to improve proton dosimetry in proton therapy and radiography.

Short Bio:

Hongyu Bian received her PhD degree in Condensed Physics from Northeast Normal University. She then carried out postdoctoral research work at National University of Singapore. She joined Jilin University in 2024 as a tenure-track professor. Her research is focused on luminescent nanomaterials and nanophotonic devices.