

# Advancing High-Voltage Technologies for Large-Scale Liquid Xenon Detectors with the MOTION experiment

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Next-generation liquid xenon (LXe) Time Projection Chambers (TPCs) for WIMP dark matter searches aim to double their drift length compared to current detectors. This scale-up introduces not only mechanical and production challenges but also pushes into largely unexplored territory: the interplay between conductors, LXe, and high voltage (HV) in ultra-pure environments.

MOTION, a 70 kg LXe TPC at the Karlsruhe Institute of Technology, serves as a dedicated platform to probe these frontiers. Designed to operate at voltages up to  $-200$  kV, MOTION enables systematic studies of dielectric breakdown in LXe under controlled conditions, identifying factors that trigger and propagate discharges. Beyond breakdown physics, the detector facilitates investigations of spurious electrode emissions after surface treatments and supports the development of HV feedthroughs constructed exclusively from radiopure materials. These insights are critical for ensuring the stability and scalability of next-generation dark matter detectors.

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