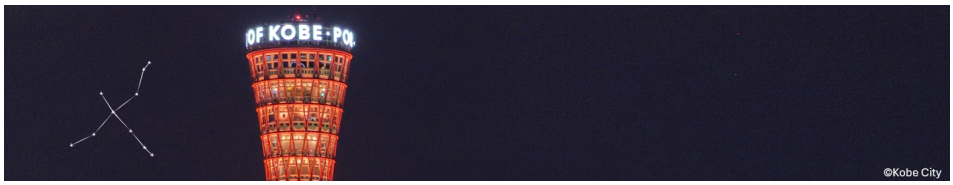

Contribution ID: **31** Type: **not specified**

Searching for and characterizing the Migdal effect with real data-trained deep learning

Wednesday, 25 February 2026 16:10 (25 minutes)

Directly detecting and characterizing the Migdal effect signature in gas time projection chambers (TPCs) remains challenging due to the overlapping nature of its electron recoil (ER) and nuclear recoil (NR) components. This talk will present two complementary machine learning frameworks developed and deployed within the MIGDAL collaboration that together enable real-time detection and precision reconstruction of Migdal candidate event topologies in the experiment's low-pressure optical gas TPC. The first framework, migYOLO, is a YOLOv8-based object-detection pipeline –trained exclusively on real images recorded by the detector's CMOS camera readout –to simultaneously classify and localize ERs and NRs, including those that overlap. Using simulation, we demonstrate that the proximity between detected ER and NR bounding boxes provides a highly effective discriminator for selecting Migdal candidates while rejecting backgrounds. Our second framework, Overlap Aware Segmentation of ImageS (OASIS), is a new segmentation-regression framework designed to fully disentangle the ER and NR components of Migdal candidates, enabling accurate energy and directional reconstructions of both species. OASIS introduces a novel region-weighted loss function that prioritizes reconstruction in areas of object overlap and significantly outperforms unweighted training in both energy and angular reconstruction across all ER energy scales. Crucially, OASIS reconstructs Migdal electrons even in regimes previously considered diffusion-limited, opening new opportunities to measure the Migdal spectrum with current generation detectors.

Presenter: SCHUELER, Jeffrey (University of New Mexico)

Session Classification: Migdal search