Project Name GEM based Transition radiation detector and tracker (eRD22)
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Identification of secondary electrons plays a very important role for physics at the Electron-Ion Collider (EIC). A high granularity tracker combined with a transition radiation option for particle identification could provide additional information necessary for electron identification or hadron suppression.

The transition radiation detector readout is based on well established GEM technology. For the generic R&D activity our group used a small-size (ca 10x10 cm^2) to validate the GEM-based TRD concept. The drift region has been increased from ∼3 mm to 20-30 mm in order to increase the detection length for TR photons. We redesigned the gas-box to minimize the gas gap between the TR-radiator and the cathod. Finally, the standard GEM readout (originally based on the APV25) was replaced with one based on the relatively faster, JLAB developed, flash ADC (FADC125) with GAS-II pre-amplifiers.

The first beam test measurements using the GEM-TRD/T prototype have been performed at Jefferson Lab (CEBAF, Hall-D) using 3-6 GeV electrons (pair-spectrometer) and also hadrons comming from target collisions. We used likelihood and artificial neural network (ANN) algorithms to determine the electron identification efficiency and pion rejection power. An e/π rejection of 9 has been achived for a single layer with 15cm thick fleece radiator and 2.1cm Xe-filled drift volume, which is in a good agreement with the MC/Geant4-based predictions.

Future generic R&D plans:

- Test of different readout architecture (strips, pad,zig-zag) to minimize the noise level, number of readout channels, and spatial resolution. This would require use to build several small (10x10 cm^2) prototypes with different readouts options and test them at JLAB and Fermilab.
- Tests of a new streaming readout architecture hardware (SRO125) and ML-FPGA -based data reduction concepts.
- Test of different TR-radiators.

Future targeted R&D plans (for TDR):

- Build and test large-size modules in order be able to workout possible issues: like noise, gain-uniformity, drift-time issues, HV stability, etc. A field/gas-cage needs to be developed and optimized for TRD applications.
- Test beams at Fermilab with electron and pion beams (once per year)
- Design and development of a recirculation gas system to purify, distribute, circulate, and recover the gas (in collaboration with other labs/universities.
- Development of final design specifications for the streaming readout architecture as input to a coordinated ASIC design program.

Table 1: **A preliminary estimates for eRD22 R&D**

	FY22	**FY23**	**FY24**
Prototyping	SRD $25k		LRD $30k
Readout electronics	$20k	$ 20k	
Gas, gas system	$20k		
Travel Testbeam	$5k	$10k	$10
Total	**$70**	**$ 30**	**$60**