# **PRELIMINARY RESULTS OF TCD PRE-R&D BEAM TEST**



For SoLID Telescope Cherenkov Detector working group SoLID Collaboration Meeting, 10/09/2020







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# OUTLINE

- Recent Beam Tests
  - Data from the tests
  - Detector setup
- Data Analysis
  - Raw waveform analysis
  - Event selection
  - Signal Sums
- Preliminary results
  - MaPMT
  - LAPPD

# **RECENT BEAM TEST DATA**

- High rates test
  - Small angle
  - MaPMTs (June-August, 2020), rates from scalers > 4 MHz/PMT
- Low rates tests
  - Large angle
  - MaPMTs (March 2020), rates from scalers ~ 320 kHz/PMT
  - LAPPD (August-September, 2020)
- Raw waveform data taken with JLab FADC250 modules
- Refer to Simona's talk for more details about the tests

# **TRIGGER CHANNELS LAYOUT**





S11 S1

| Top left |         | 6-1 6-4 | 7-1 7-4 |
|----------|---------|---------|---------|
|          | 4       | 6-2 6-3 | 7-2 7-3 |
|          | 5-1 5-4 | 9-1 9-2 | 8-2 8-3 |
|          | 5-2 5-3 | 9-4 9-3 | 8-1 8-4 |
|          | 1       | 2       | 3       |
|          |         |         |         |

### **PHOTODETECTOR CHANNELS LAYOUT**





#### **RAW WAVEFORM SAMPLES – CALORIMETER @ HIGH RATES**



#### **RAW WAVEFORM SAMPLES – SCINTILLATOR @ HIGH RATES**



#### **RAW WAVEFORM SAMPLES – MAPMT @ HIGH RATES**



Sample Number

### **EVENT SELECTION – CALORIMETER TIMING CUTS**



**Calorimeter Peak Time (t-cut)** 

• 20 ns timing window



# **EVENT SELECTION – COINCIDENCE CUTS**



- 20 ns timing window
- The maximum peak is selected for each channel



MaPMT Sums Time (tcut)

Cer14\_5

Cer24 5

Cer34\_5

Cer44 5

#### **SINGLE PHOTO-ELECTRON SIGNALS FOR MAPMT**

- Amplitude is about 10 mV
- Used to normalize each channels' signals for sum



### **SIGNAL SUMS – MAPMT SUM CHANNELS**

- Regular signals: N\_PMT = 4,
  N.p.e = 17
- Pair production signals:N\_PMT = 8, N.p.e = 35
- Identical results as low rates test



#### WAVEFORM SAMPLES – LAPPD



Sample Number

# WAVEFORM SAMPLES – LAPPD

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#### Zoomed-in samples

- Threshold at 8~10 ADC channel
  - About 3~5 sigma of pedestal
- Sharp and small peaks
  - May due to long cables
  - Followed by a negative bump

### **SIGNAL DISTRIBUTIONS – LAPPD**



**ADC Value** 

# SIGNAL SUM COMPARISON – LAPPD

Signal Sums Total



# **SIGNAL SUM GROUPS – LAPPD**



LAPPD Pixels Signal Sums

Peak Height (ADC Channel)

### **COMPARISON – SIGNAL SUM GROUPS**

#### MAPMT Range 0 – 8000 ADC Channels

#### LAPPD Range 0 – 1000 ADC Channels



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# **SUMMARY**

- MAPMT works well at high rates environment (~ 4 MHz/PMT)
  - It shows identical results as in low rates test (320 kHz/PMT)
- LAPPD shows similar results as MaPMT
  - Small signal amplitude and difficulty in extracting SPE for each pixel
  - Expected difference observed for light gas and heavy gas
  - Similar signal sum distributions
- Work for ring-shape pattern recognition with quadrants/pixels data is ongoing