

TPC's working group: from new technologies to new devices to new analysis methods to new physics

RD-51 Collaboration: Development of Micro-Pattern Gas Detector Technologies

FRIB/NSCL new member of the RD-51 Collaboration since June 2020

MPGDs are the most advanced gaseous detector technologies and they have received enormous boost over the last decade

→ Goal: replace wire-based detectors

Large contribution to advance the field provided by the RD-51 Collaboration (since 2008)

MPGDs are used in many scientific domains beyond HEP and NP

MPGD-based tracking system (TPCs) at the forefront of fundamental research

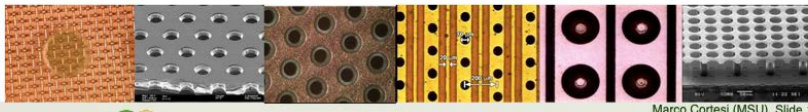
Most of the present instruments/experiments driven by RD-51 collaboration effort

Progress in the field mostly carried by HEP

→ Need effort from the NP community to satisfy future NP experiments' needs

Exciting field for creative new ideas

RD-51 Collaboration is an ideal environment and an attractive opportunity for young scientists!

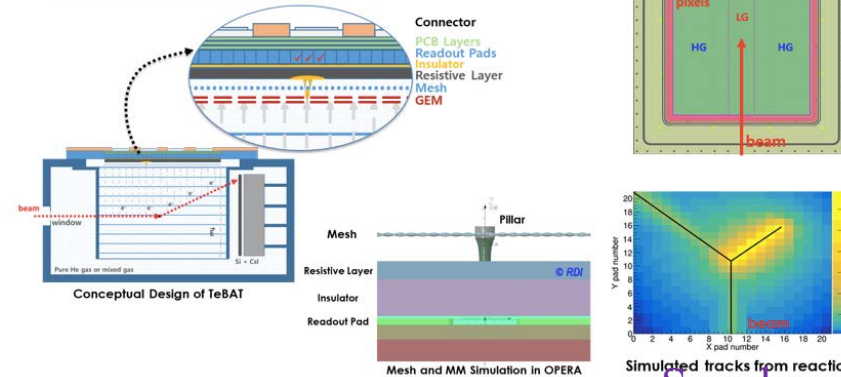


Marco Cortesi (MSU), Slide 1

Marco Cortesi

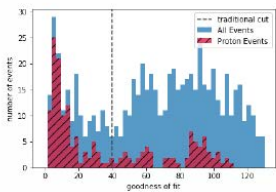
Texas Birmingham Active Target (TeBAT)

- Reactions with high energy beams or heavy radioactive isotopes → boosted forward
- More accurate track measurements and better event identification: **possible with TeBAT!**
- Active area: 252(X) x 135(Y) x 252(Z) mm³
- Resistive layer technique!
- Position Resolution of ~ 200 μm (corresponding to 0.1 deg angle)
- 7056 channels from Micromegas
- GARFIELD simulations and a prototype detector are in progress.
- Collaborations are welcome!



Sunghoon (Tony) Ahn

EVENT SELECTION



Machine Learning Methods for Track Classification in the AT-TPC doi:10.1016/j.nima.2019.05.097

Unsupervised Learning for Identifying Events in Active Target Experiments

<https://arxiv.org/abs/2008.02757>

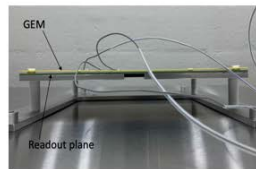
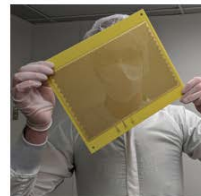
MIXAE

Experiment	Precision	Recall	F1
Experimental → Experimental	0.96	0.90	0.93
Simulated → Simulated	1.00	1.00	1.00
Simulated → Experimental	0.90	0.60	0.72

Data	Accuracy
Simulated	0.96
Cleaned	0.75
Unfiltered	0.71

Michelle Kutchera

ND-Cube components



Tan Ahn

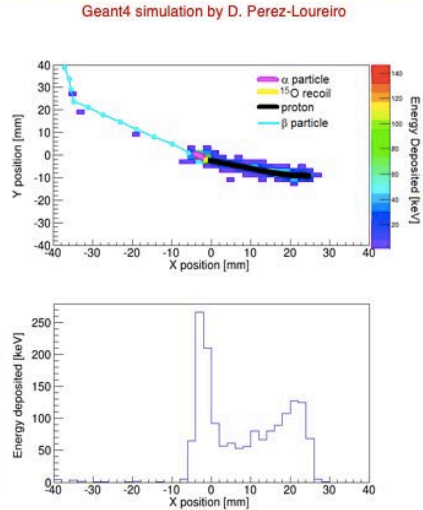
GADGET II: TPC Upgrade

Goal: measure $^{20}\text{Mg}(\beta\alpha)^{15}\text{O}$ through key 4.03-MeV $^{15}\text{O}(\alpha,\gamma)^{19}\text{Ne}$ resonance to determine Γ_α/Γ and accurately model X-ray burst light curves

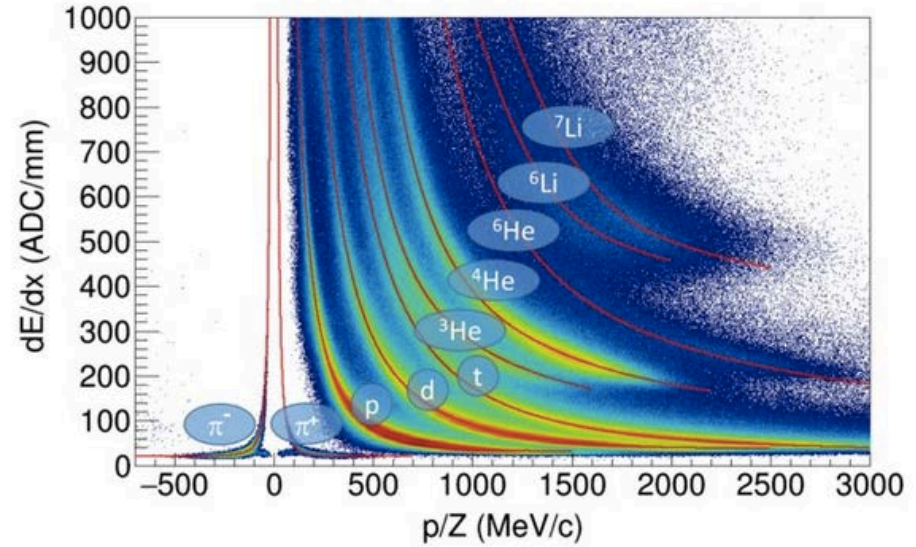
Events will have unique 3D signature

TPC upgrade: new high-granularity Micromegas board & GET electronics

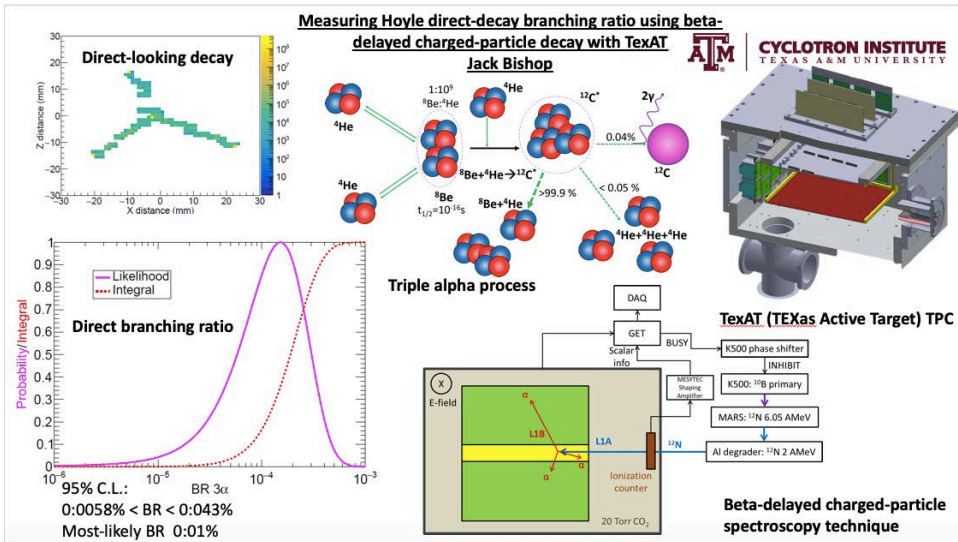
Timeline: final few components arriving within the next month or so; "Day 1" FRIB experiment



Christopher Wrede



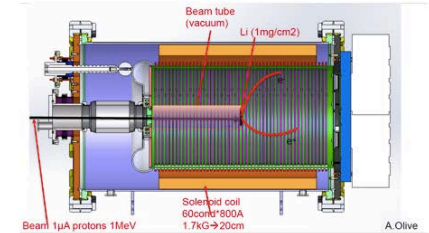
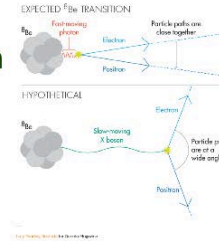
Justin Estee



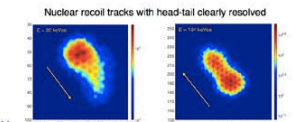
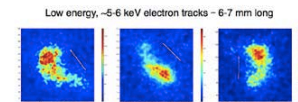
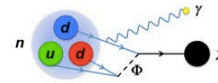
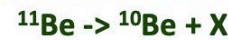
Jack Bishop

Search for Exotic Physics with Time Projection Chambers (Ayyad and Mittig)

X17 boson



Dark neutron decay



D Loomba, UNM

Yassid Ayyad