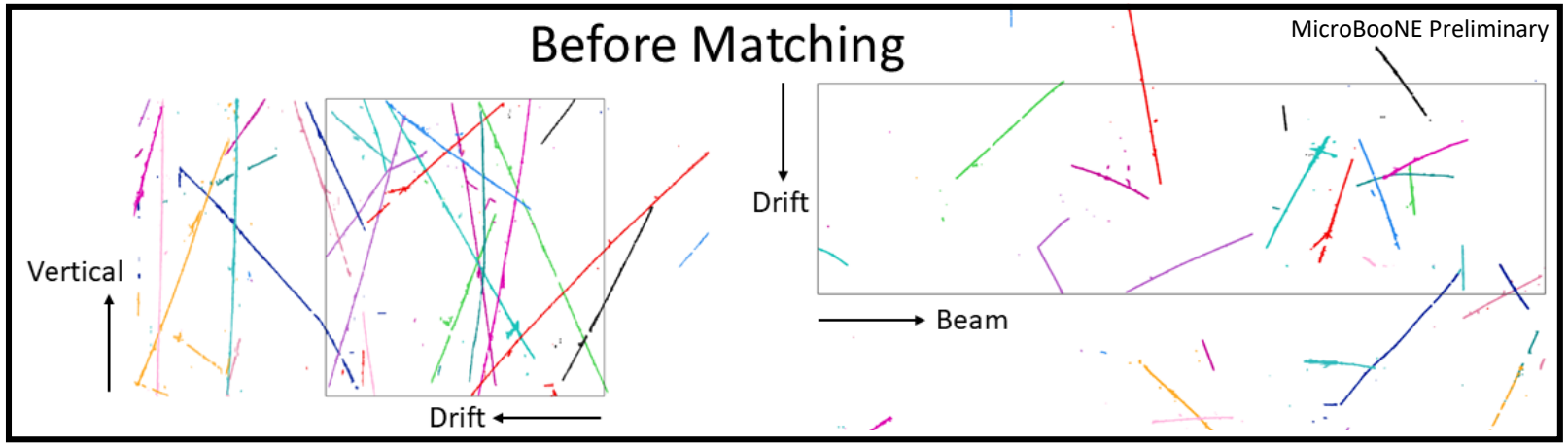
Towards Automated Neutrino Selection at MicroBooNE using Tomographic Event Reconstruction

Brooke Russell (Yale University)
for the MicroBooNE Collaboration

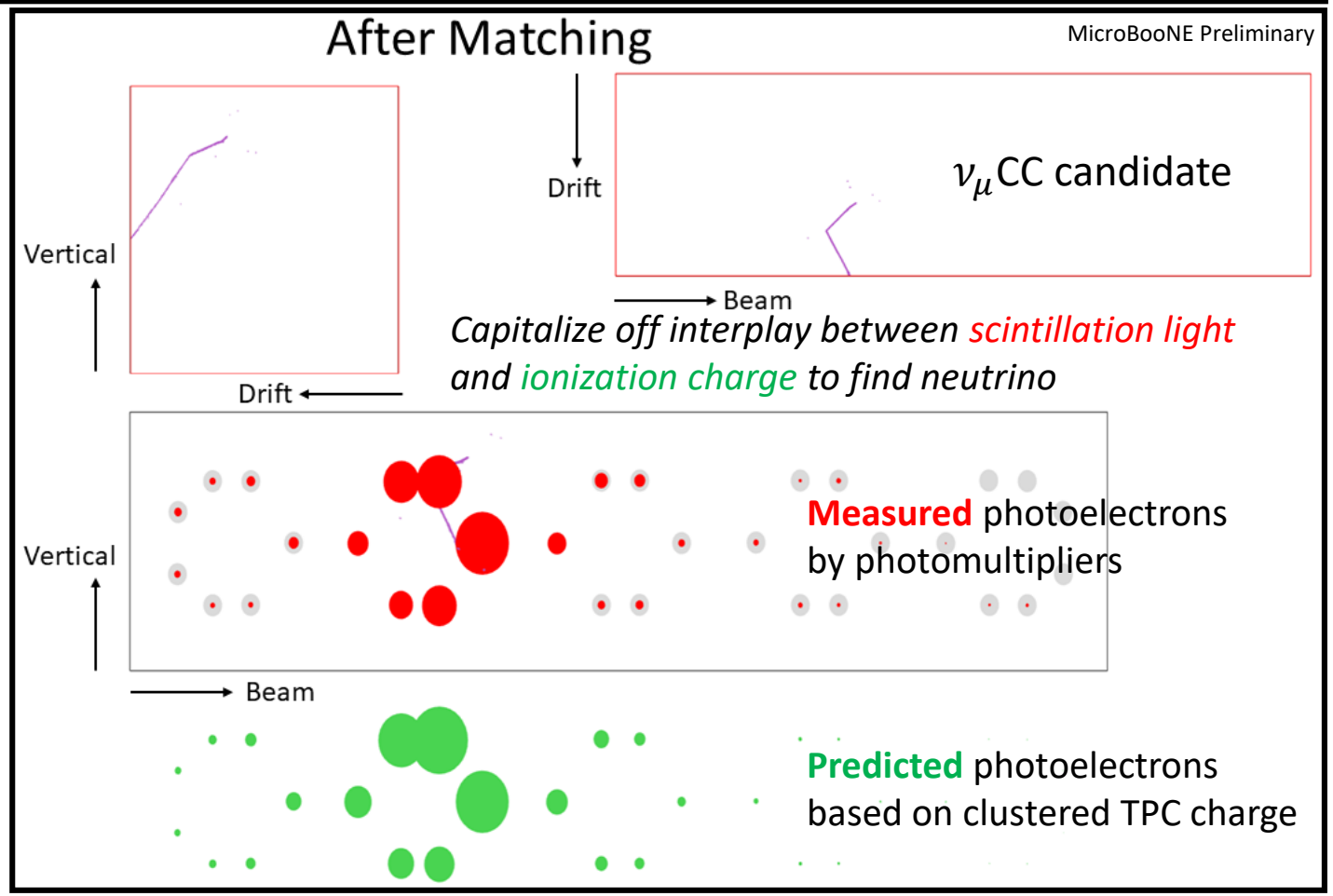


MicroBooNE is a single-phase liquid argon time projection chamber (LArTPC) operating on the surface in the Booster neutrino beam at Fermilab.

Using *tomographic imaging*, new tools have been developed to vastly simplify downstream event reconstruction and neutrino selection.

Many-to-many *matching* of *TPC clusters* to *PMT flashes* is one such newly developed tool to facilitate high performance neutrino selection.

- Pairing of O(10) clusters to O(10) flashes in an event
  - A difficult combinatorial problem
  - Solving made accessible by *compressed sensing*
- A *topology agnostic* method to identify neutrino candidates and disambiguate neutrino candidate activity from cosmic activity



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To evaluate the efficacy of our newly developed tools, we performed a hand scan of O(1k) events

- Matching permits classification of *singular TPC objects*
- Used a web-based interactive 3D display with full *3D clustered charge* representation

With clean cosmic rejection, we show a step towards *high performance* neutrino selection for a surface single-phase LArTPC

Novel technique enabled by *improved understanding* of detector response & effective detector boundary

For more information please see
MICROBOONE-NOTE-1040-PUB
http://microboone.fnal.gov/public-notes

Semi-Automated Scan Results MicroBooNE Preliminary

	ν_μCC	Light Mismatch	Through going μ	Stopping μ	Other	Total
Beam off	0	187	415	95	40	737
Beam on	113	356	560	171	54	1254

- The overall passing rate (ratio of selected ν_μCC candidates over initial software triggers) is **2.85%**
- 14 out of the 113 ν_μCC candidates were determined to be backgrounds by a second round examination using calorimetry; these are likely "dirt" or ν NC interactions
- Fully-automated tools are being developed to mitigate identified background for ν_μCC; we're also pivoting to fully-automated ν_eCC selection for ν_e appearance

Cosmic Rejection Power MicroBooNE Preliminary

Procedure	Absolute (Relative)
Hardware Trigger	1
Software Trigger	0.041
PMT Filter	9.6×10^{-3} (0.238)
Many-to-Many Matching	3.7×10^{-4} (0.038)
Hand Scan	$<3.7\times10^{-6}$ (<0.01)

Cosmic contamination is *significantly* reduced by many-to-many matching