Using the HBD for a High-pT Charged Pion Trigger in p+p Collisions at PHENIX

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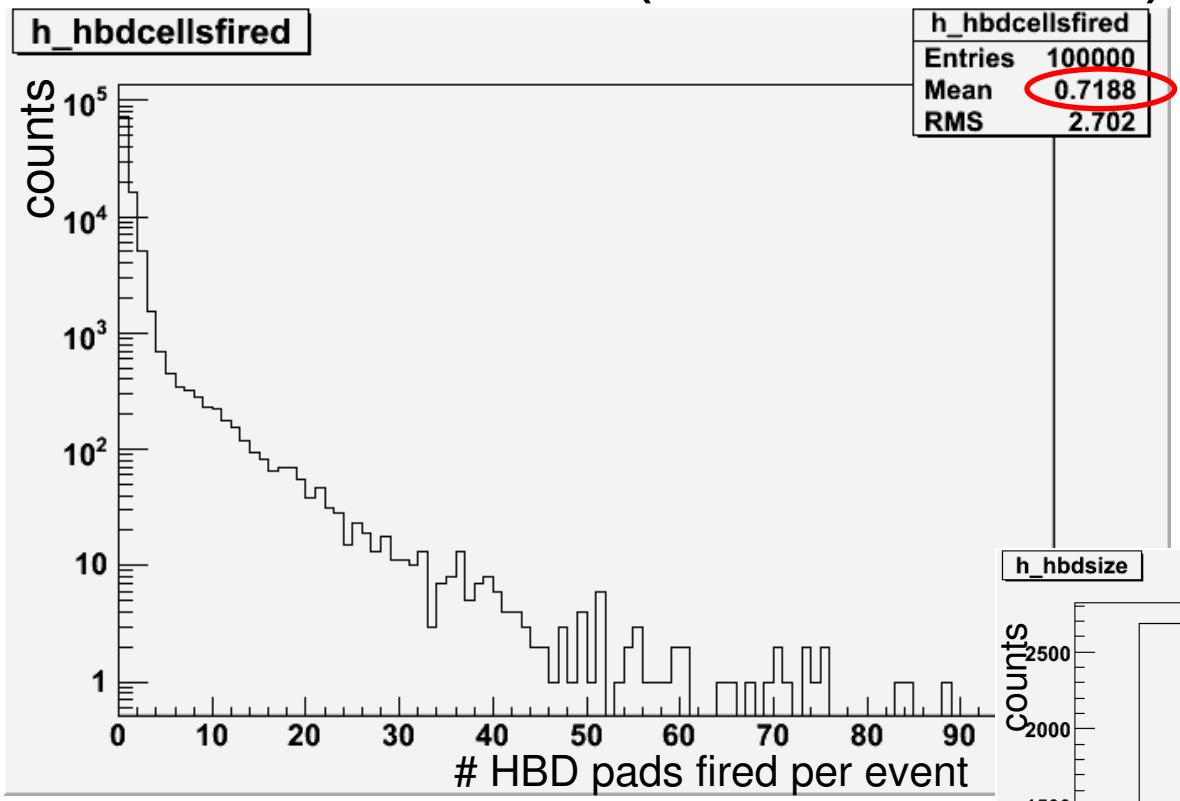
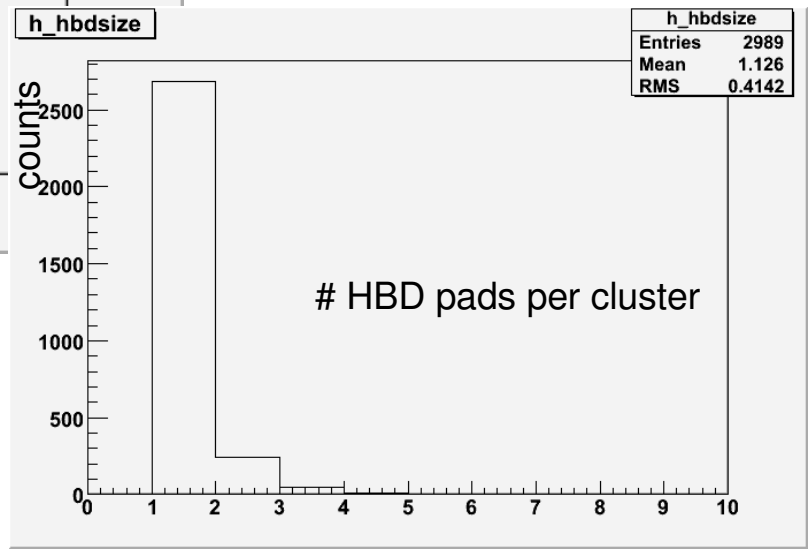
Motivation and Basic Concept

- Currently no lvl1 charged trigger in the central arms
  - Offline charged analyses only obtain ~30% of pi0's found in same data set
- Trigger for charged pions with pT>~5 GeV/c could be formed using coincidences between the HBD and RICH
  - Take advantage of current RICH trigger implementation in ERT
  - Current RICH-EMCal coincidence for the electron trigger requires shower in EMCal → PbSc only 0.85 interaction length
  - Recover charged pions that only produce MIP in EMCal by using HBD instead

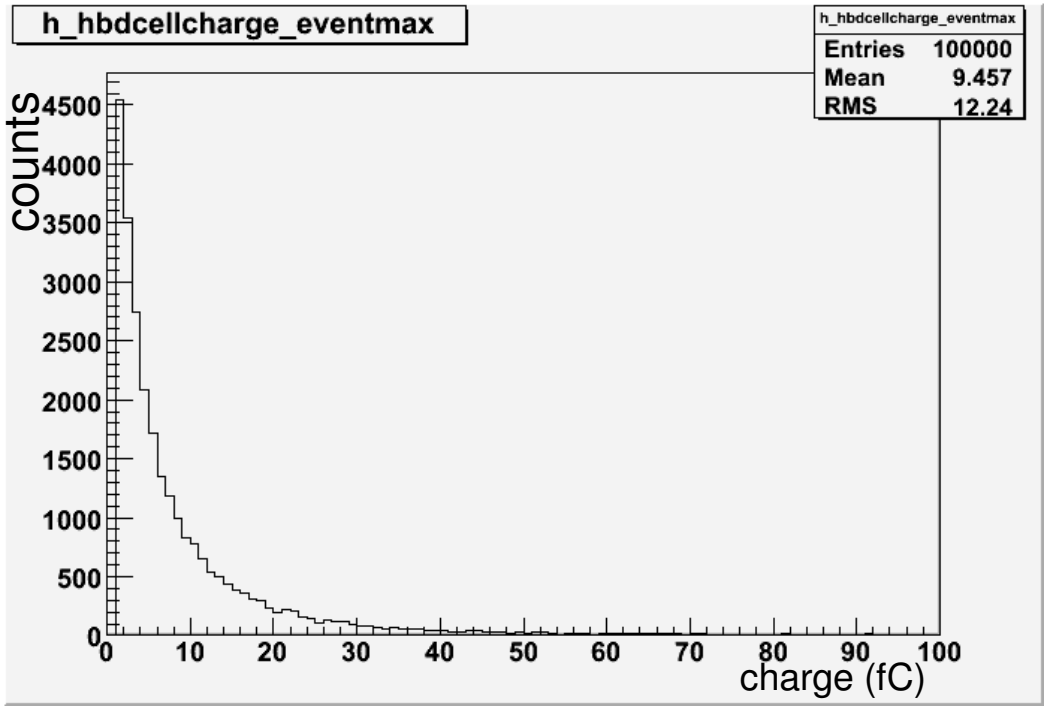
HBD pads fired per event (PYTHIA MB)



In p+p simulation, see on average less than 1 pad firing per event.



HBD Pad Charge—Max per Event (PYTHIA MB)



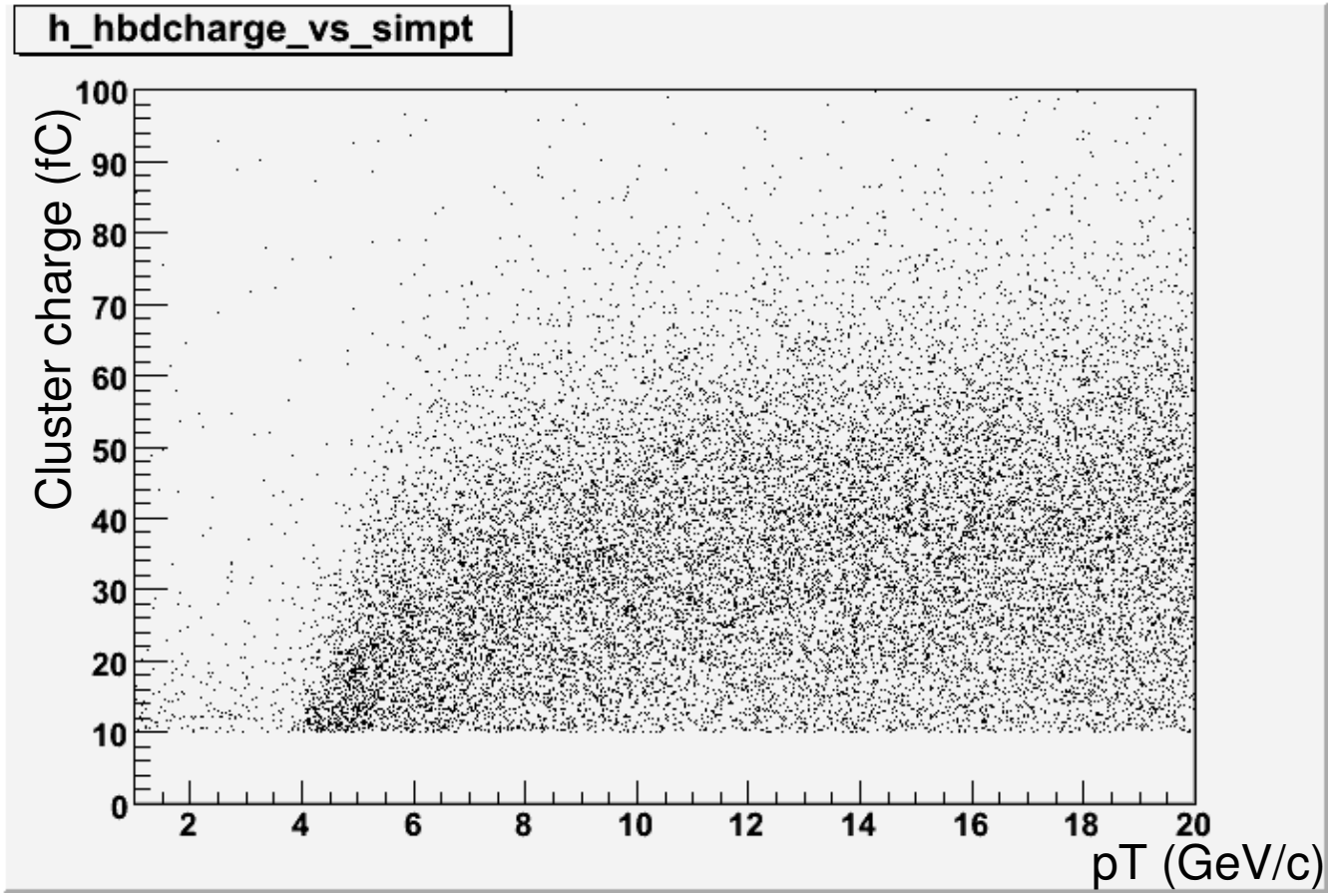
N.B. Gain in simulation is 1×10^4.
Observed gains ~5×10^3.

Sample HBD-only rejection factors
for various charge thresholds per pad

1.0 fC -> RF = 3.7
3.0 fC -> RF = 5.3
5.0 fC -> RF = 7.1
7.0 fC -> RF = 9.1
9.0 fC -> RF = 11.3

Question for HBD group: Does charge distribution in MB look reasonable?
(ignoring "known" factor 2) (1 fC ~ 2/3 photoelectron)

Cluster Charge vs. Simulated pT (single particle simulation)

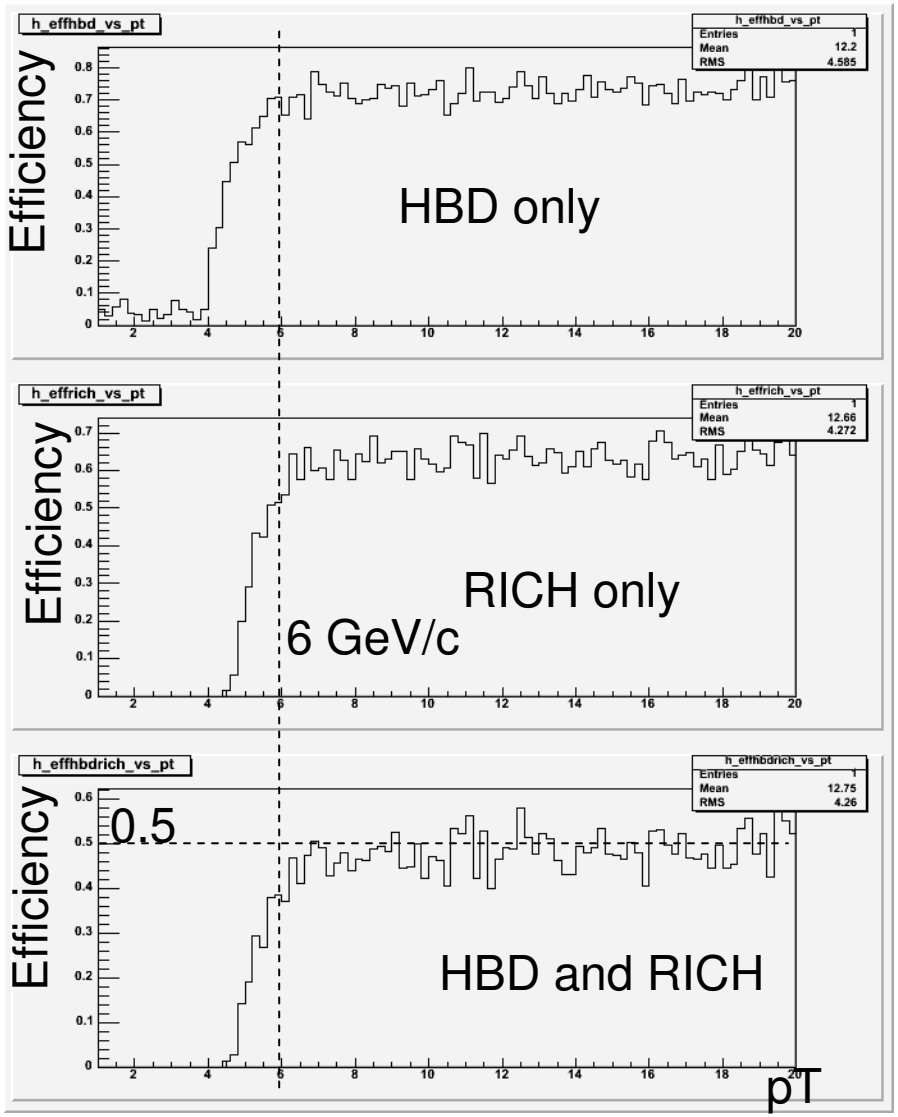


Does cluster charge for particles below threshold (MIPs) look reasonable?

Will Scintillation Be a Problem?

- What is scintillation yield per charged particle in wavelength range of CsI sensitivity?
  - Working assumption: Scintillation not an issue in p+p because so few charged tracks; 1 photon per pad max.
- Do low-energy particles ever spiral around forever?
  - (++ magnetic field config in p+p)

Efficiencies vs. pT (single particle simulation)



Turn-on dominated by RICH, which has higher threshold than HBD.

Efficiency plateaus at or just above ~6 GeV/c.
~50% efficiency from simulation.
(~75% HBD x ~65% RICH)

75% HBD efficiency reasonable?
Where are losses in simulation primarily coming from?
Could we gain efficiency by running with RB off in pp?

How are the pads assigned to the FEMs?

- Perhaps the simplest level-1 output from the HBD would be the OR of 48 pads in a FEM

  - then check to see if RICH hit at same phi

- How are the pads assigned to a FEM? (in strips? rectangles?)

  - ideally we'd like to map RICH elements with HBD elements at the same phi

  - this would be easier if FEMs mostly contain pads at same or similar phi

Extra slides

HBD Cluster Charge (PYTHIA MB)