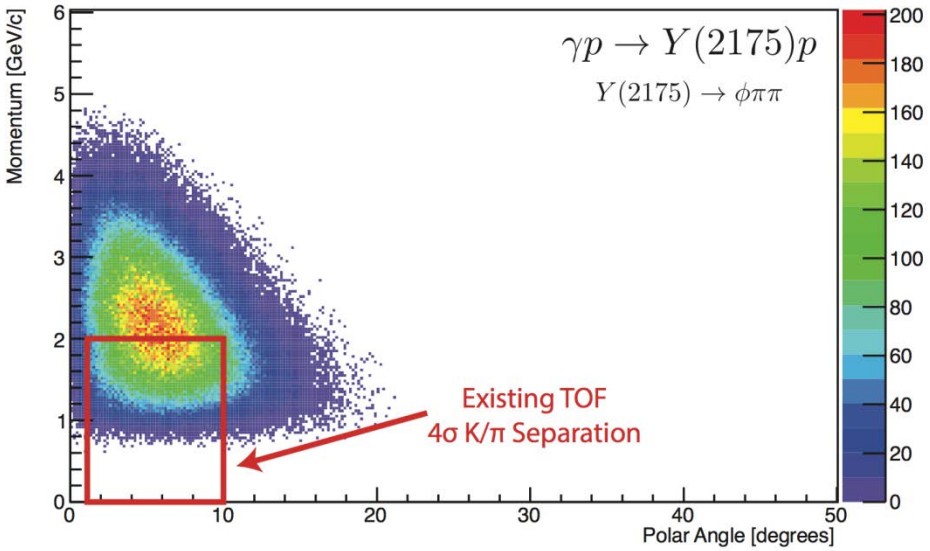
Benchmark channel for calibrating GlueX DIRC (I)

A.Ali

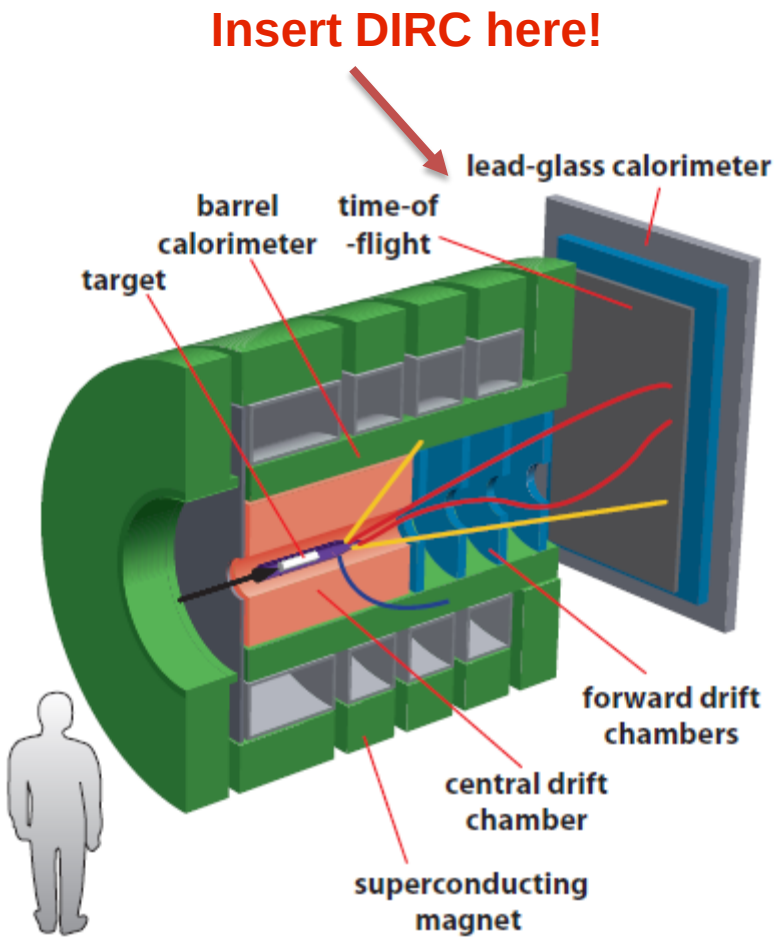
GlueX at Jlab

Y(2175): K± momentum vs polar angle

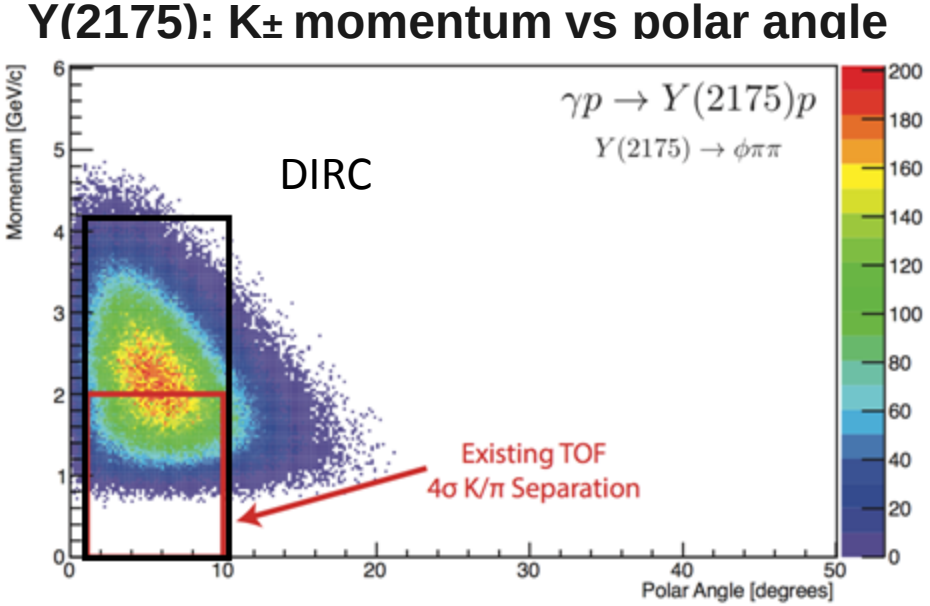


- Designed for light quark
- meson spectroscopy
- 9 GeV linearly-polarized photon
- beam on LH_2 target
- Baseline π/K separation up to
- ~2 GeV provided by time-of-flight

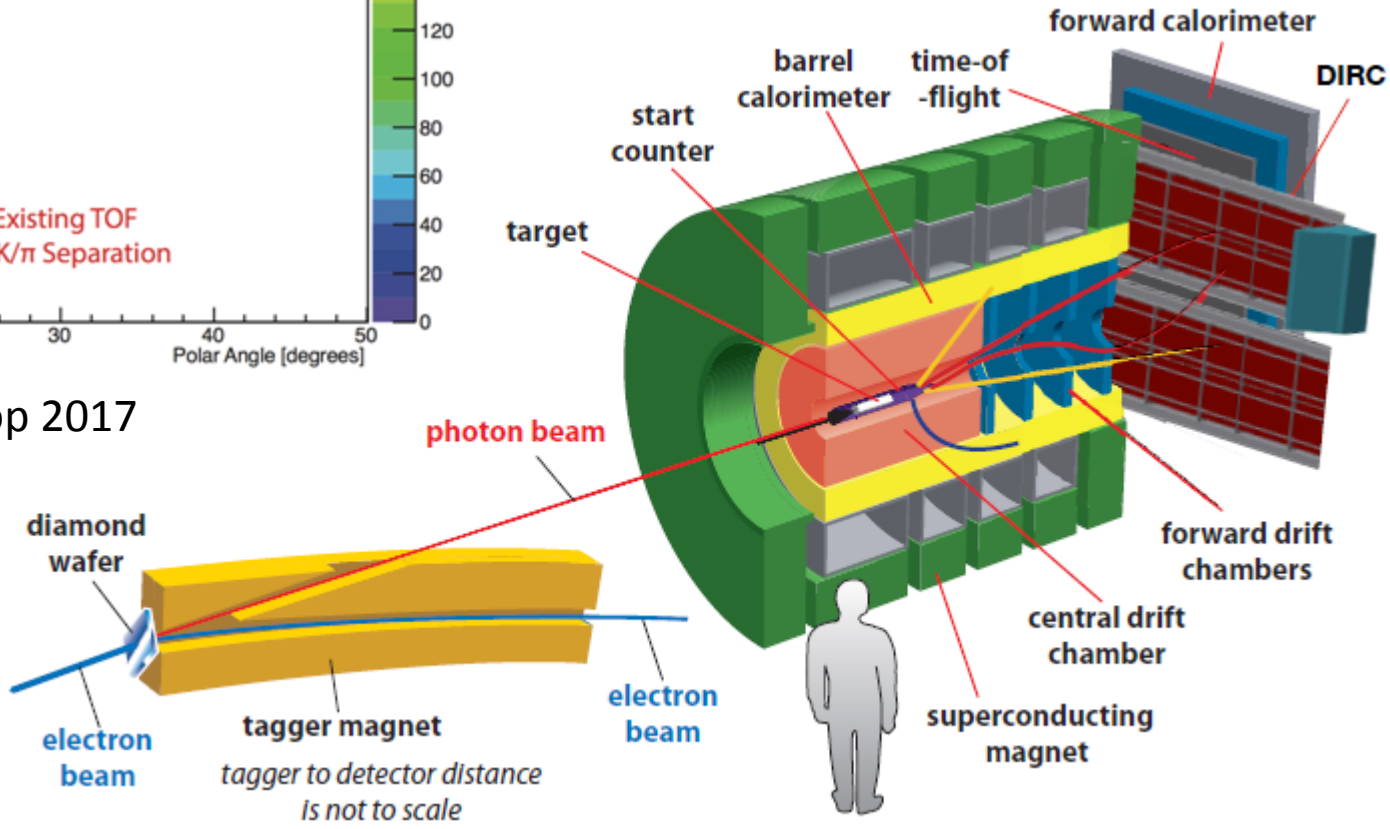
Justen- DIRC workshop 2017



Expected GlueX DIRC performance

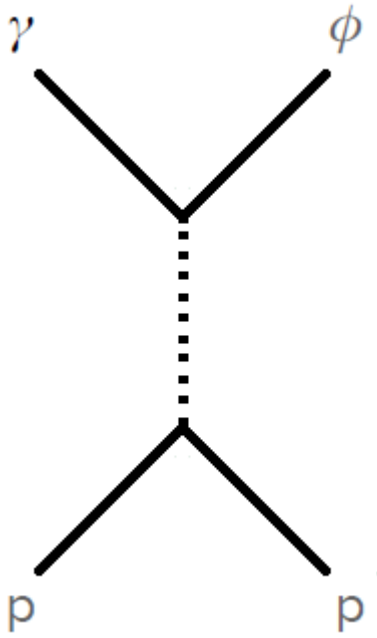


Justen- DIRC workshop 2017



GlueX Physics analysis benchmark channel

- Physics Analysis Motivation
  - Excellent particle identification is crucial to the success of GLueX physics program. The identification of kaons in the final state is mandatory to separate the signal events from the huge pionic background.
  - Since $\phi \rightarrow K^+ K^-$ is a clean channel with 48.9 % branching fraction , such a benchmark physics channel is a good candidate to evaluate the GlueX DIRC detector performance.



- Analyzing decay of $\phi \rightarrow K^+ K^-$
  - M_ϕ = 1.019 GeV
  - Γ = 4.26 MeV
- Spring 2016 Data
  - Golden Period
  - 11366 to 11532

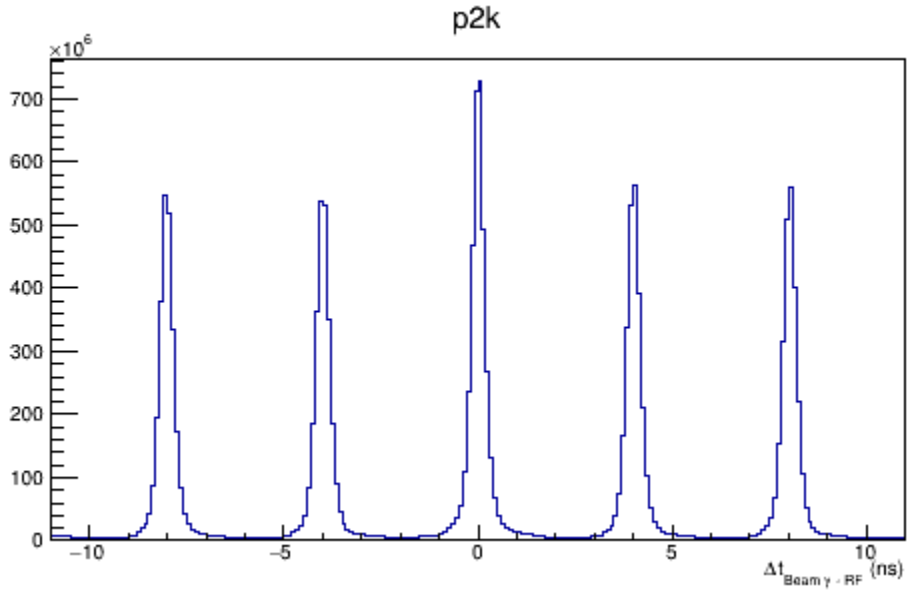
Analysis Cuts

- PID Δt (BCAL/FCAL/TOF) [ns]
  - proton: ±2.5, ±3.0, ±2.0
  - K^+ : ±1.5, ±3.0, ±0.75
  - K^- : ±1.5, ±3.0, ±0.75
- Invariant mass cut for ϕ-meson:
  - Select 0.9 < ϕ-meson mass < 1.1
- Missing mass-squared cut for combinations:
  - Select -0.08< missing mass < 0.08
- Kinematic fit confidence level:
  - 5.73303E-7 equivalent to +/- 5 sigma confidence level

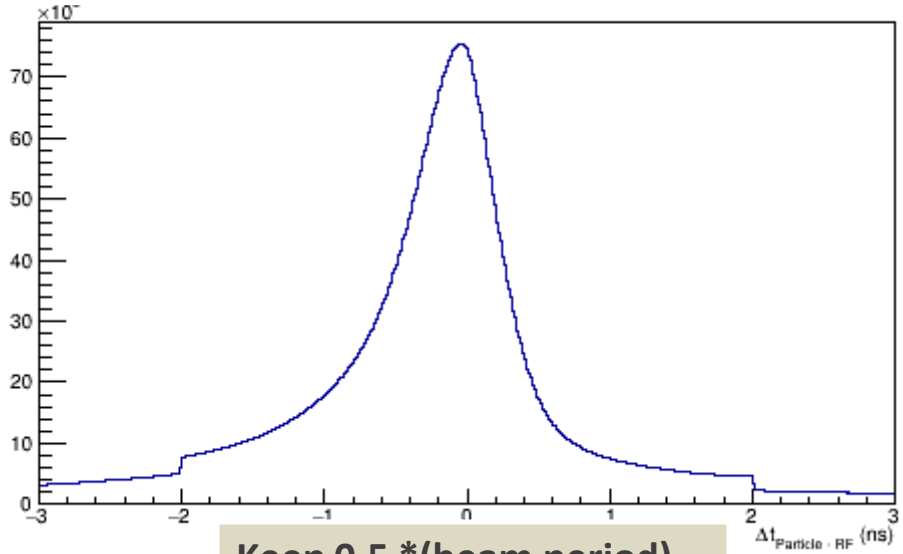
  cut to suppress ρ background
- Keep 0.5*(beam period)
- Proton energy deposition:
  - Customized cut

RF Time

- RF time (signal from the accelerator) corresponds to when beam arrives. Basically there is beam every ~4 ns.



- This high resolution RF time can be used as a reference for selecting the beam photon that matches each event, and for timing PID as well.

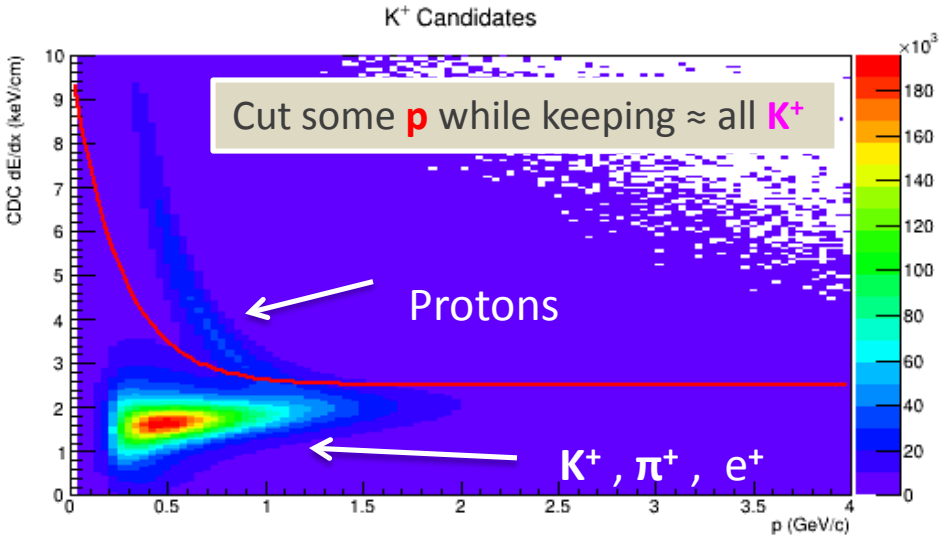


Keep 0.5 *(beam period)

Particle ID

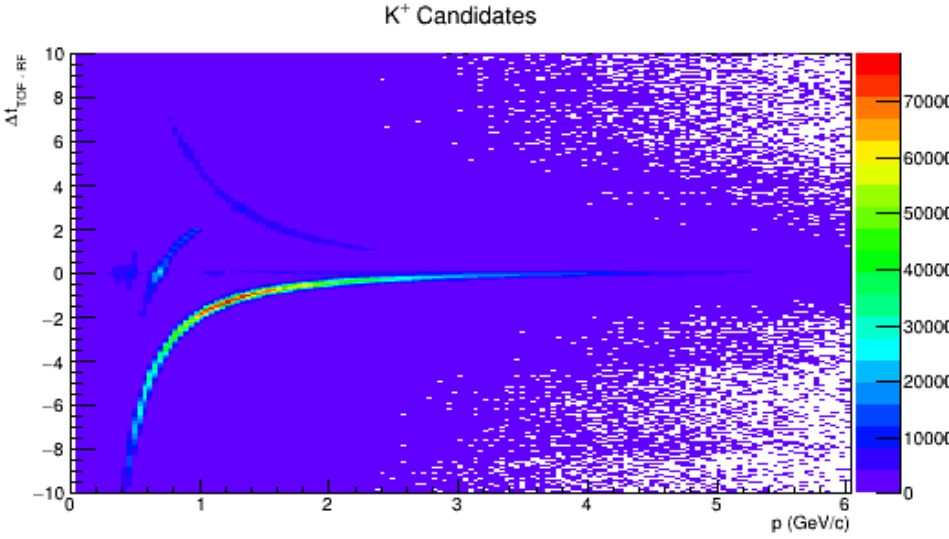
Particle ID: dE/dx :

- Energy loss cut in the drift chambers to perform p/ K^+ separation



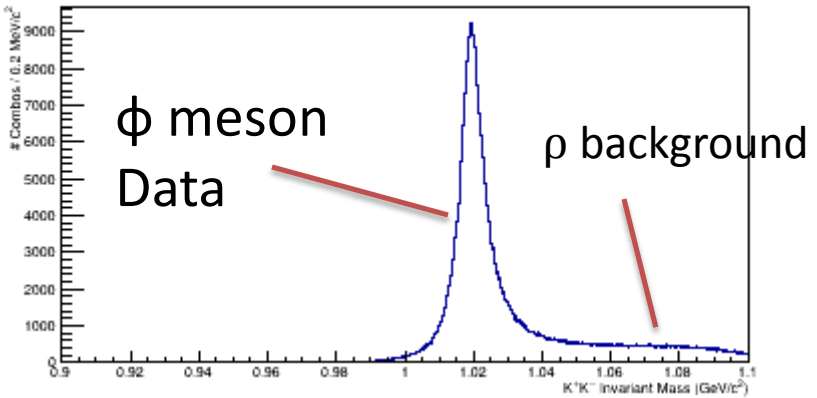
Particle ID: Timing:

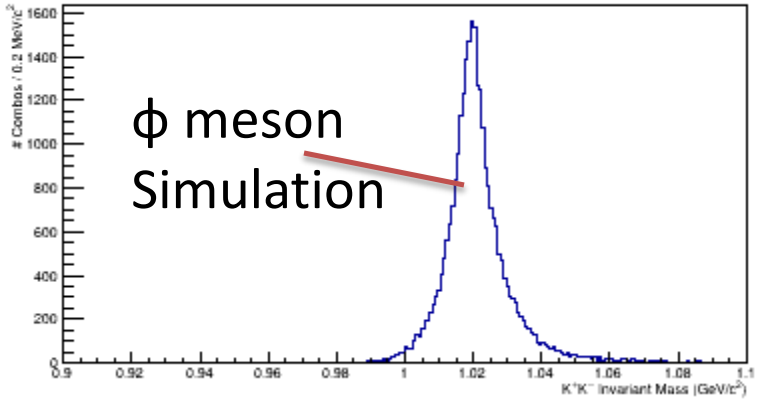
- Assume all positive charged particles as K^+candidate and propagate the time using the time of flight system back to the target and compare it with the RF time



Kinematic Fitting

- Hypothesis test: Was this event the reaction I want?
- There are different types of constrains:
  - Require energy and momentum to be conserved
  - Require mass of K^+ K^- matches ϕ mass
  - Require all of the common come from the same vertices.
- Adjust the measurements to satisfy constraints, then events selection relies on confidence level cut. (these results based on +/- 5 sigma confidence level cut)





Thanks for your attention