A Time Projection Chamber for the Crystal Ball
A Status Report

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Time Projection Chamber
TPC for the Crystal Ball
Karlsruhe Prototype
Outlook

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Time Projection Chamber

Tracking Device

- Gas filled volume
- Incident particle ionizes gas along track
- Electric field moves charges
- Amplification
- Readout

2D charge distribution
+ timing information
+ known drift velocity
→ 3D hit information
A GEM-TPC

- Diffusion depends on gas mixture
- Magnetic field reduces diffusion
- but: no magnetic field inside Crystal Ball
Gas Electron Multiplier

- kapton foil with copper layers
- small holes
- strong field inside holes
- gas amplification
- ions get collected
- suppressed ion drift back
- no gating grid required
- gas gain: $O(100)$
A TPC inside the Crystal Ball?

- more data points
- better resolution compared to MWPC
- track reconstruction
- better rate capabilities
- contribute to Particle Identification: \( \frac{dE}{dx} \) measurement
- state of the art hardware

Collaboration with a group from Bonn
Crystal Ball TPC

- read out on backward end
- space for target & PID
- pad size: $\approx 2\text{mm} \times 5\text{mm}$
Crystal Ball TPC

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Long version:
- $\approx 3.5cm$ effective radius
- only few pad rows
- easier installation
Crystal Ball TPC

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Shorter version:
- $\approx 7\,cm$ effective radius
- more data points!
- end caps cover lowest crystals
- but forward cap very thin
Crystal Ball TPC

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Will this work?
Karlsruhe Prototype

- 20cm diameter, 25cm long
- 320 channels
- designed for studies for the ILC
- electronics from the STAR Detector
- 5 years old

Goals:
- learn how to operate
- get to know signals
- test gas mixtures
- test new electronics
Status

So far:
- set up working space
- cleaned chamber
- 3 GEMs mounted
- flushed with $N_2$
- electronics are working
- gas mixture ordered (Ar, CH$_2$, CO$_2$)

to do:
- understand analysis software
- build gas system
- tests with cosmics
  → decide on electronics
Scalable Readout System

- scalable (0..36 ch / SRU)
- same hardware for different applications
- only special A-Card for each type of chip
- FEC, SRU, Computers, stay the same

CERN RD51, WG5, Hans Mueller
Outlook

Next Steps
- gain experience
- tests with cosmics

Outlook
- develop electronics
- build first prototype chamber
- improve chamber
- integration into A2 System