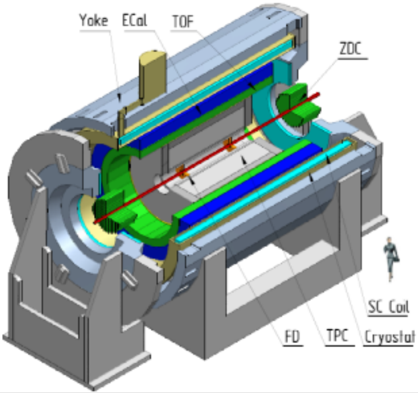
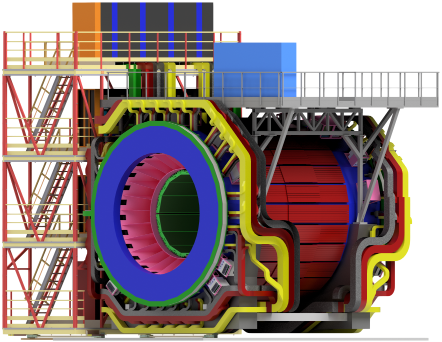
Participation of the University of Warsaw group in the MPD project

Magdalena Kuich

MultiPurpose Detector





- 2π acceptance in azimuth
- 3-D tracking (TPC)
- Low material budget
- High event rate $\sim$ 6 kHz

- Powerful PID (TPC, TOF, ECAL)
  $\rightarrow$ π/K up to 1.5 GeV/c,
  $\rightarrow$ K/p up to 3 GeV/c,
  $\rightarrow$ γ, e : 0.1<p<3 GeV/c

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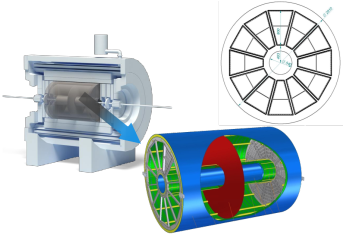
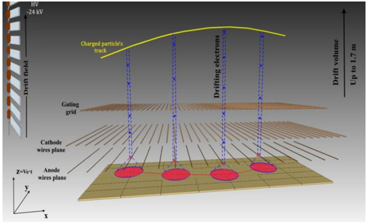
MPD Time Projection chamber

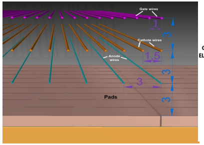


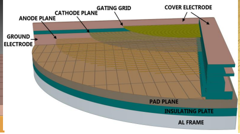
The **T**ime-**P**rojection **C**hamber (TPC) → the main tracking detector allowing for particle track reconstruction in 3D via ionization cluster position measurement in X-Y plane and electron drift time measurement in Z direction

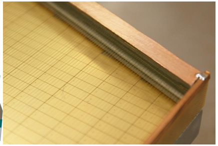
Item	Dimension
Length of the TPC	**340cm**
Outer / Inner radius of vessel	**140cm / 27 cm**
Outer / Inner radius of the drift volume	**133cm / 34cm**
Length of the drift volume	**163 cm (of each half)**
Electric field strength	**~ 140 V/cm**
Drift gas	**90% Ar+10% CH_4 / 80%Ar+20%CO_2**
Gas amplification factor	**~ 10^4**
Drift velocity	**5.45 cm/μs;**
Drift time	**< 30 μs;**
Temperature stability	**< 0.5°C**
Number of readout chambers	**24 (12 on each side)**
Number of pads	**95232**
Maximal event rate	**< 7 кHz (at Lum.= 10^{27})**
Electronics shaping time	**~180 ns**
Signal-to-noise ratio	**30:1**
Signal dynamical range	**10 bits**
Signal sampling	**10 MHz**
Two-track resolution	**~1 cm**



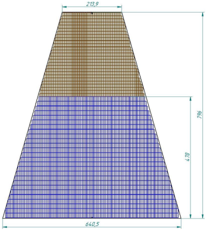
TPC readout system → **M**ulti-**W**ire **P**roportional **C**hambers (MWPC) with cathode pad readout. The end-cap readout plane is covered by 12×30 trapezoidal sectors (bottom=214 mm, top=643 mm and the height - H= 800 mm).







In the ROC chamber next wire planes are used: an anode plane, a cathode plane and a gating grid. The gap between the planes is 3 mm.



Padplane: 27 rows of 5x12 mm pads at inner and 26 rows 5x18 mm pads at outer part of ROC. The total number of pads in the TPC is 95232.

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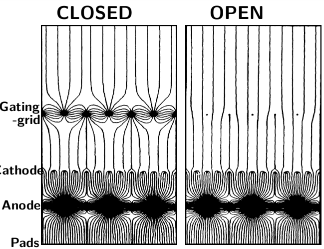
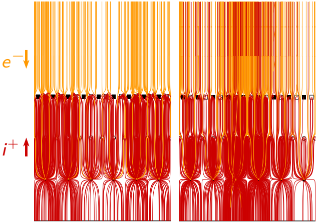
Gating-grid

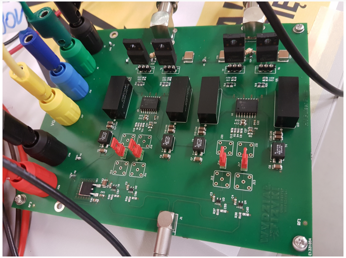
- **24(+2) gating-grid pulser modules**
- **Design follows the well-known solutions (NA61/SHINE, ALICE)**
  - → gating electrode control
  - → communication with DCS
  - → synchronization with (pre-)trigger
- **Compatibility with MWPC geometry**
  - → properly adjusted HV settings
  - → electron transparency (open mode)
  - → efficient charge blockade (closed mode)
  - → fast and efficient ion neutralization

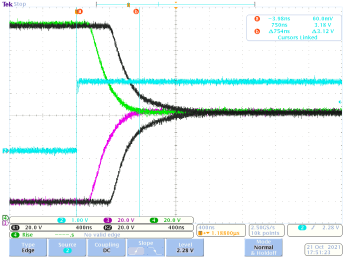
Field lines

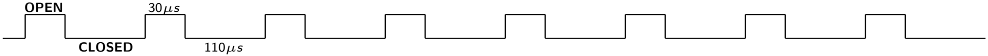


Charge transport









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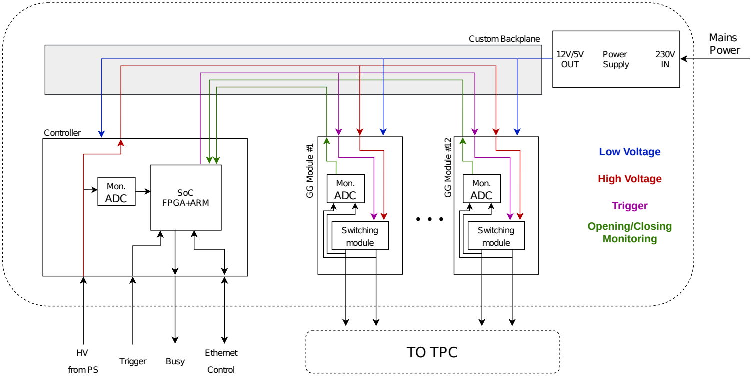
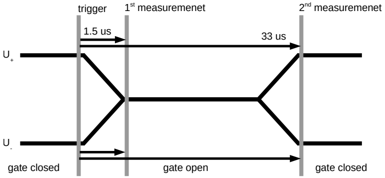
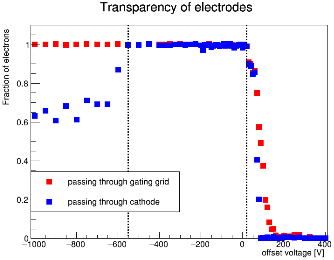
Control unit

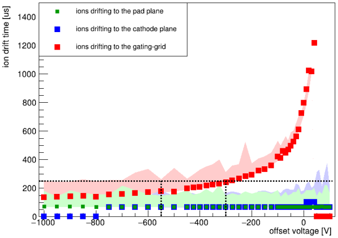


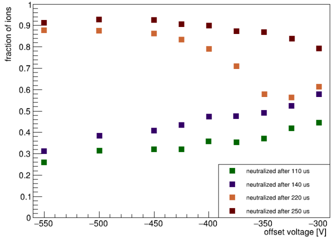


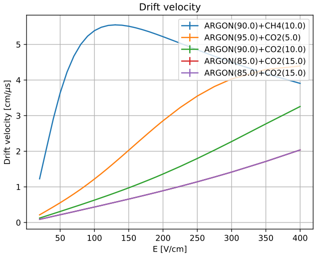
- Distribution of HV and monitoring of HV and LV
- Trigger interface: receive and distribute trigger signals, generate BUSY (special overlay board able to translate various types of trigger)
- Monitor gate opening and closing of each module
- Control interface: SoC running Linux and communicating via Ethernet

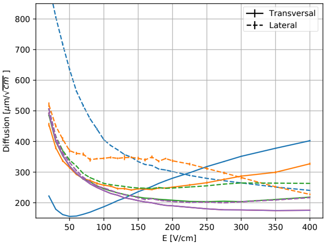
Simulations











- Establishing optimal gating-grid voltages
- Study efficiency of ion neutralization
- Consideration of other gas mixtures

Tasks

- Simulation of the charge transport and drift velocity (UW)
- Simulation of the gate operation for selected operating conditions (UW)
- Determination of optimal working conditions for ROC and gating-grid (UW, LHEP)
- Development of the project of gating-grid modules (UW, Minsk)
- Development of the control unit with trigger and DCS interfaces (UW)
- Production of gating modules and laboratory tests (UW, LHEP, Minsk)
- Production of HV power supplies for the gating-grid pulsers (Minsk)
- Functional test of gating modules with ROCs (LHEP, Minsk, UW)
- Integration of the gating-grid in MPD, i.e. hardware-wise & software-wise (LHEP, UW, Minsk)
- Possible adaptation of transmission lines to ensure the correct operation of the system (LHEP, UW)