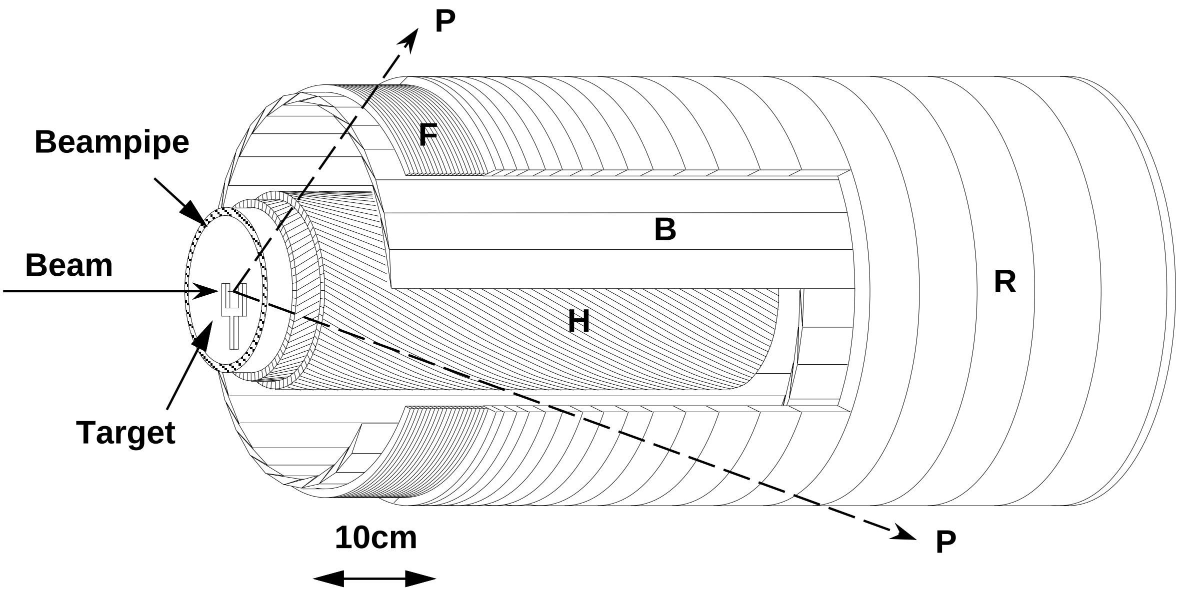
The EDDA Detector



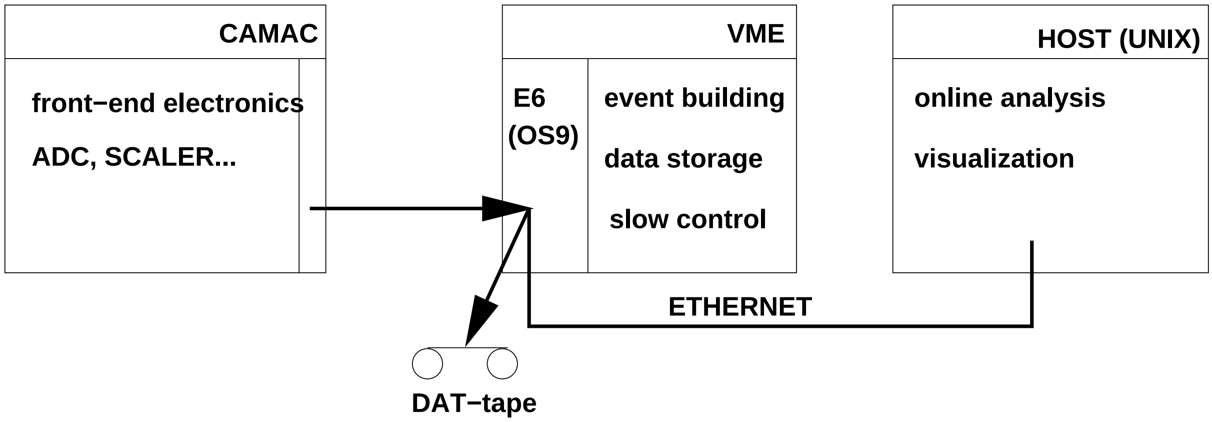
- two-layered cylindrical scintillator structure
  - Outer Layer ($\rightarrow$ trigger!)

    D: 32 overlapping slabs of triangular cross-section ($\Delta\phi = 11.25^o$)

    F,R: 2x29 semirings ($\Delta\theta_{\mathrm{lab}} = 2.5^o$)
    left semirings $\phi \in [-90^o, 90^o]$
    right semirings $\phi \in [90^o, 270^o]$

  - Inner Layer (H): 640 scintillating fibers
    $\rightarrow$ vertex reconstruction ($\sigma \approx 1\mathrm{mm}$)
- Acceptance: $\theta_{\mathrm{lab}} \in [10^o, 72^o]$
- Targets: CH_2 and C fiber targets, polarized H and D atomic beam target.

EDDA DAQ



DAQ-Modes: (use one or both)

READOUT: readout all ADC, TDC, fiber hit pattern

− low DAQ rate (< 1kHz) (limited by CAMAC)
− online analysis on subsample (bottleneck ethernet)
+ full event reconstruction
  vertex cuts (with ABT mandatory)
  exclusive channels

SCALER: count hardware coincidences (outer layer only)

+ hight count rates (> 10kHz)
+ online analysis on full sample
− only inclusive measurements
− only useful with fiber targets

Rates and Luminosities

Fiber Target $L \approx 5 \cdot 10^{29} \frac{1}{\mathrm{cm}^2\mathrm{s}}$

Tolerate up to $2 \cdot 10^8$ stored protons (CH_2, C sturdier)

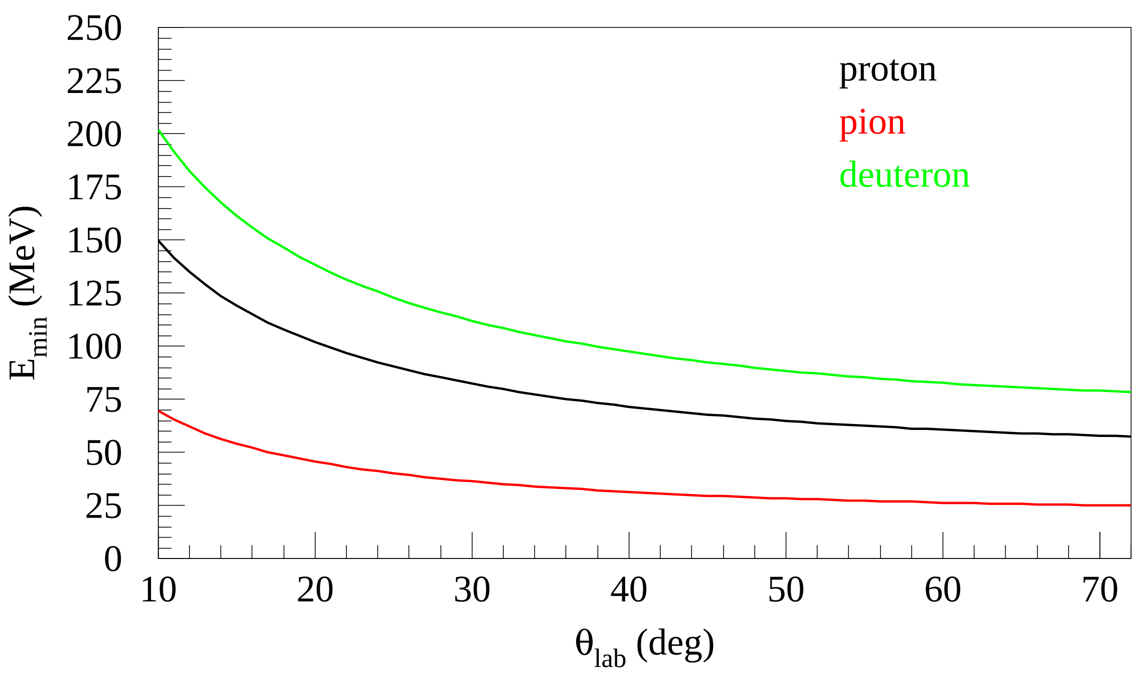
Atomic Beam Target Density $\rho \approx 2 \cdot 10^{11} \frac{1}{\mathrm{cm}^2}$

$L = \rho \nu N_p$ with $\nu \approx 1.5\mathrm{MHz}$

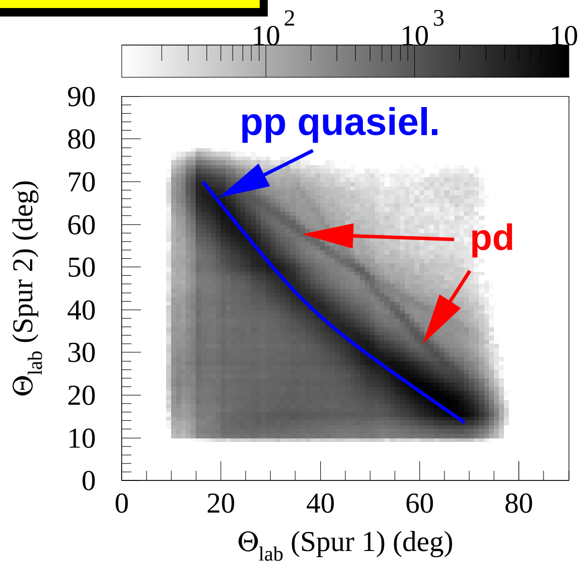
$\rightarrow L = 3 \cdot 10^{27} \frac{1}{\mathrm{cm}^2\mathrm{s}}$ for 10^{10} stored particles.

Detectable Particles

Minimum energy needed to reach EDDA ring layer:



pd elastic scattering

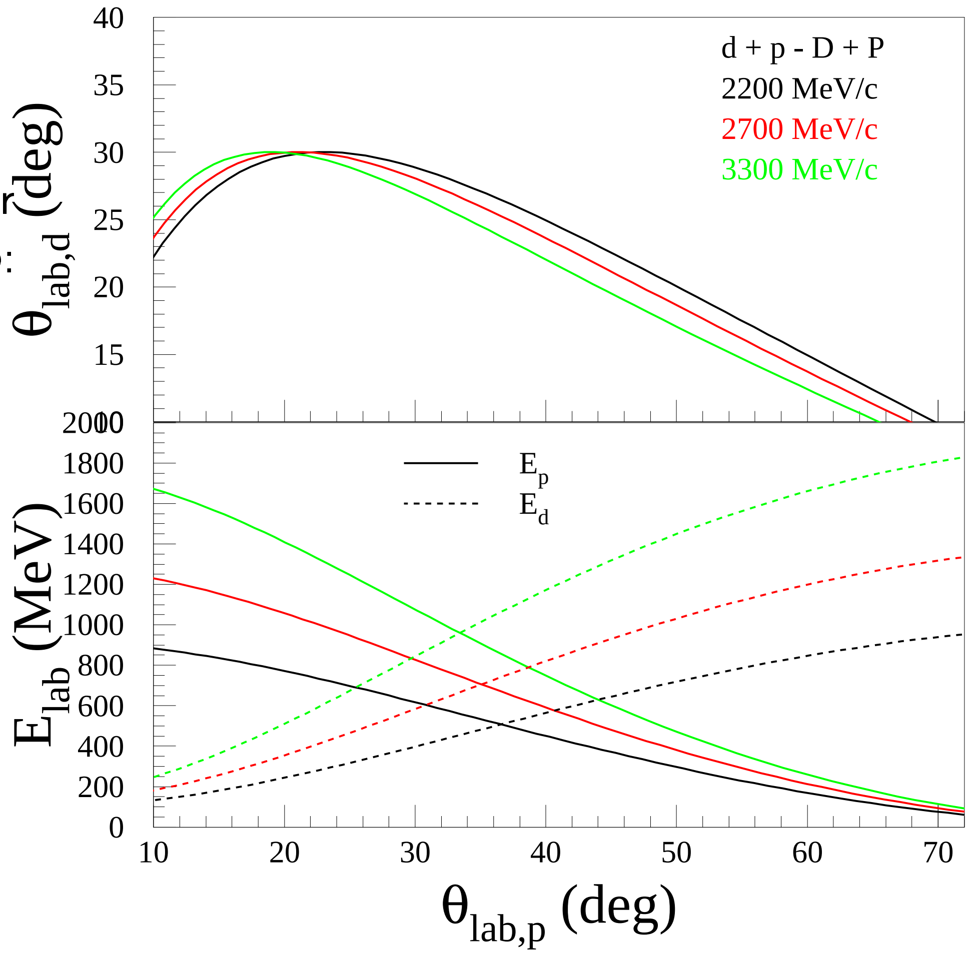


Data from first test of $p+d \rightarrow p+d$ for TRIC

- d atomic beam target
- proton beam energy 800 MeV

$\rightarrow$ dominated by d-breakup!

Some kinematics for $d+p \rightarrow d+p$:



Proton Polarimetry

$$p = \frac{1}{A_N} \cdot \frac{L - R}{L + R} \tag{1}$$

Method: count charged particles in left/right semirings

600-1400 MeV/c singles in forward semirings
1400-3300 MeV/c forward/backward coincidences of semirings

Status: routinely used $\rightarrow$ ready to go !

- fast (10 minutes for standard ramp 25 MeV/c bins)
- calibrated (estimated syst. error 0.05)

Deuteron Polarimetry

Status: never tried, not established

With the stable spin axis in COSY oriented along y and assuming parity conservation, the count rate is expected to vary like

$$I(\theta,\phi) = I_0(\theta) \; \Big(1 \; + \tfrac{3}{2} p_Z A_y(\theta) \cos\phi - \tfrac{1}{4} p_{ZZ} A_{xx-yy}(\theta) \cos 2\phi - \tfrac{1}{4} p_{ZZ} A_{zz}(\theta) \Big) \quad (2)$$

for a deuteron beam with vector (tensor) polarization p_Z (p_{ZZ}).

The count rates at certain ϕ angles look like:

$$\begin{aligned}
I_L = I(0^o) &= I_0(1 + \tfrac{3}{2} p_Z A_y - \tfrac{1}{4} p_{ZZ} A_{xx-yy} - \tfrac{1}{4} p_{ZZ} A_{zz}) \\
I_U = I(90^o) &= I_0(1 + \tfrac{1}{4} p_{ZZ} A_{xx-yy} - \tfrac{1}{4} p_{ZZ} A_{zz}) \\
I_R = I(180^o) &= I_0(1 - \tfrac{3}{2} p_Z A_y - \tfrac{1}{4} p_{ZZ} A_{xx-yy} - \tfrac{1}{4} p_{ZZ} A_{zz}) \\
I_D = I(270^o) &= I_0(1 + \tfrac{1}{4} p_{ZZ} A_{xx-yy} - \tfrac{1}{4} p_{ZZ} A_{zz})
\end{aligned} \quad (3)$$

Availablility:

READOUT-mode: some software needed

SCALER-mode: some additional hardware work needed (hardware coincidences)

With the asymmetries

$$\begin{aligned}
\epsilon_1 &= \frac{L-R}{L+R} = \frac{\frac{3}{2}p_Z A_y}{1-\frac{1}{4}p_{ZZ}A_{zz}} \\
\epsilon_2 &= \frac{L+R-(U+D)}{L+R+U+D} = -\frac{\frac{1}{4}p_{ZZ}A_{xx-yy}}{1-\frac{1}{4}p_{ZZ}A_{zz}} \\
\epsilon_3 &= \frac{8(L-R)}{L+R+U+D} = \frac{\frac{3}{2}p_Z A_y}{1-\frac{1}{4}p_{ZZ}(A_{zz}+A_{xx-yy})}
\end{aligned} \quad (4)$$

(note that $\epsilon_1(1+\epsilon_2)-\epsilon_3=0$) one can not extract the vector and tensor polarizations without additional luminosity measurements.