TCS Trigger

TCS signals from calorimeters Beam background hits

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Physics goal









- TCS attained in interference with Bethe-Heitler (BH) process
- Asymmetries sensitive to GPDs
- BH cancels in asymmetries
- Transverse Target Spin Asymmetry sensitive to angular momenta J_u, J_d and GPD E

Proposed TCS setup

$\gamma + p \rightarrow \gamma^* (e^+ + e^-) + p'$



- Detect e⁺, e⁻, recoil p' in coincidence
- Detectors arranged in 4 quarters, oriented to target
- Triple-GEMs for e⁺, e⁻, p tracking
- Hodoscopes for recoil proton detection/PID
- *PbWO*₄ calorimeters for *e*⁺, *e*⁻ detection/PID

TCS event sampling and analysis

TCS event generation:

- From DEEPGen generator
- Sampling phase space:
 - 1) 5.5 GeV < E_v < 11 GeV (Bremsstrahlung spectrum)
 - 2) 4 GeV² < Q² < 9 GeV²
 - 3) $0 \text{ GeV}^2 < -t < 1 \text{ GeV}^2$

Analysis algorithm for TCS events:

- Check kinematic cuts above, + -t/Q² < 0.3;
- Request e- prong hitting at least 2 GEM-s in a quadrant;
- Request e+ prong hitting at least 2 GEM-s in a quadrant;
- Request recoil proton hitting at least 2 GEM-s in a quadrant;
- Project e-, e+ tracks to the face of calorimeter (using X & Y of GEM hits);
- Request the e-, e+ track projections inside calorimeter acceptance (inside of the outer rim of 1 module width (~20mm, 1 Moliere radius));
- Calculate deposited in the calorimeters energies from e+, e-.

Beam background simulations

CPS beam

- •_2 mm rastered collinear bremsstrahlung photon beam , $E_{MAX} = 11 \text{ GeV}$
- Energy range: 10 MeV -- 11 GeV
- Intensity: $2x10^{13} \gamma/s$

Target assembly

- 3 cm target cell
- Ammonia in LHe, 0.6 packing fraction
- Scattering Chamber with thin Al windows
- •Magnet coils, LHe and LN Shields
- Chamber & magnet rotated 90°
- Transverse magnetic field, 5T at center









TCS events



Beam background



Backup slides



e- and e+ hit patterns at the face of calorimeters



Background events, UVA trans. pol. target, Edep > 0 MeV, rates [MHz]



Beam background hit pattern in the calorimeters.

Material before the calorimeters

Item	Material	Density[g/cm ³]	Rad.Length[cm]	Thickness[cm]	Thick./RadL[%]
Half of target	NH ₃ , Lhe	0.5482	78.685	1.5	1.906
Target end cap	Al	2.7	8.893	0.001778	0.020
LHe shield	Al	2.7	8.893	0.00381	0.043
LN2 scr. Window	Al	2.7	8.893	0.00381	0.043
Scat. Cham. window	Al	2.7	8.893	0.0508	0.571
GEMs (3 layers)					
Hodoscope	Polystyrene	1.06	41.313	5.	12.103
Case window	Al	2.7	8.893	0.1	1.124
Air		0.00129	28511.3	~100.	~0.351
Total					16.161

GEMs thick./RL is expected to be small.

What was done since last meeting:

- Weighted TCS events (according to Marie's prescriptions)
- Took into account singularity flag FlagSing in the TCS events analysis
- Added statistics in TCS events (x4)
- Estimated beam background hit rates in the calorimeters