COMPTON POLARIMETER

RPC Collaboration Meeting, June 3, 2002

P. Bosted

- Physics goals
- Experimntal Method
- Experimntal Strategy
- Layout
- Rates, Asymmtry, Dilution
- Running Time
- Outlook

PHYSICS GOALS

- **Measure photon circular polarization on regular basis for E161 and E159.**
- **One-time check that circular polarization almost same for coherent and incoherent bremsstrahlung (as predicted, but never measured)**
- **Measure flux versus energy: compare to Spent Electron detector in A-line (all 3 experiments)**

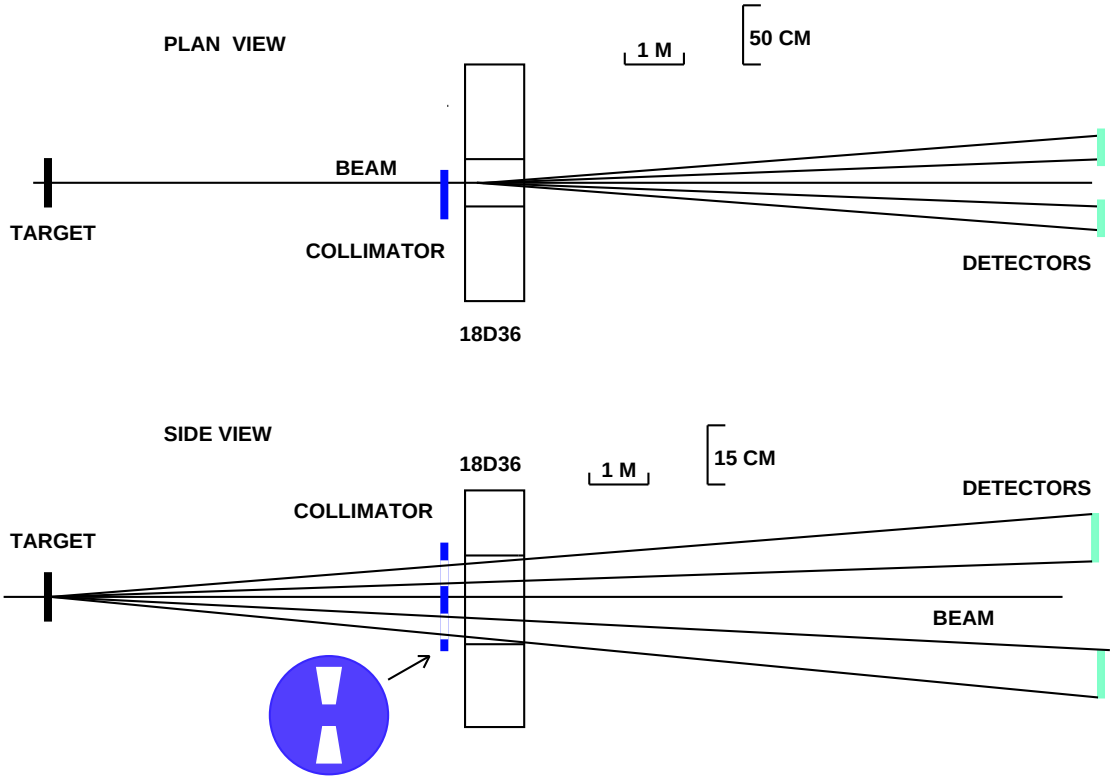
METHOD

- Use Compton scattering from atomic electrons. Typical angles 2 to 10 mr, typical energies 10 to 40 GeV
- Use polarized Fe foil (same as for Moller scattering in previous experiments). About 8% of electrons are highly polarized (near 100%).
- Analyzing power is large: typically > 0.8.
- Detect recoil electron. Possibly reduce backgrounds by detecting scattered photon in coincidence (needs further study).
- Main background with electrons only in wide-angle pair production.

EXPERIMENTAL STRATEGY

- Select ϕ near vertical axis with collimator.
- Bend L/R with magnet. Then x measure p of recoil electron. y measures θ.
- Given P, θ, original photon energy k_0 is determined.
- Use symmetric detector to measure positron spectrum and determine pair-symmetric background.
- Put detectors along lines of constant k_0: determine flux spectrum from rates versus detector number
- Determine beam polarization from double spin asymmetry (flip beam helicity on pulse-to-pulse basis).

LAYOUT

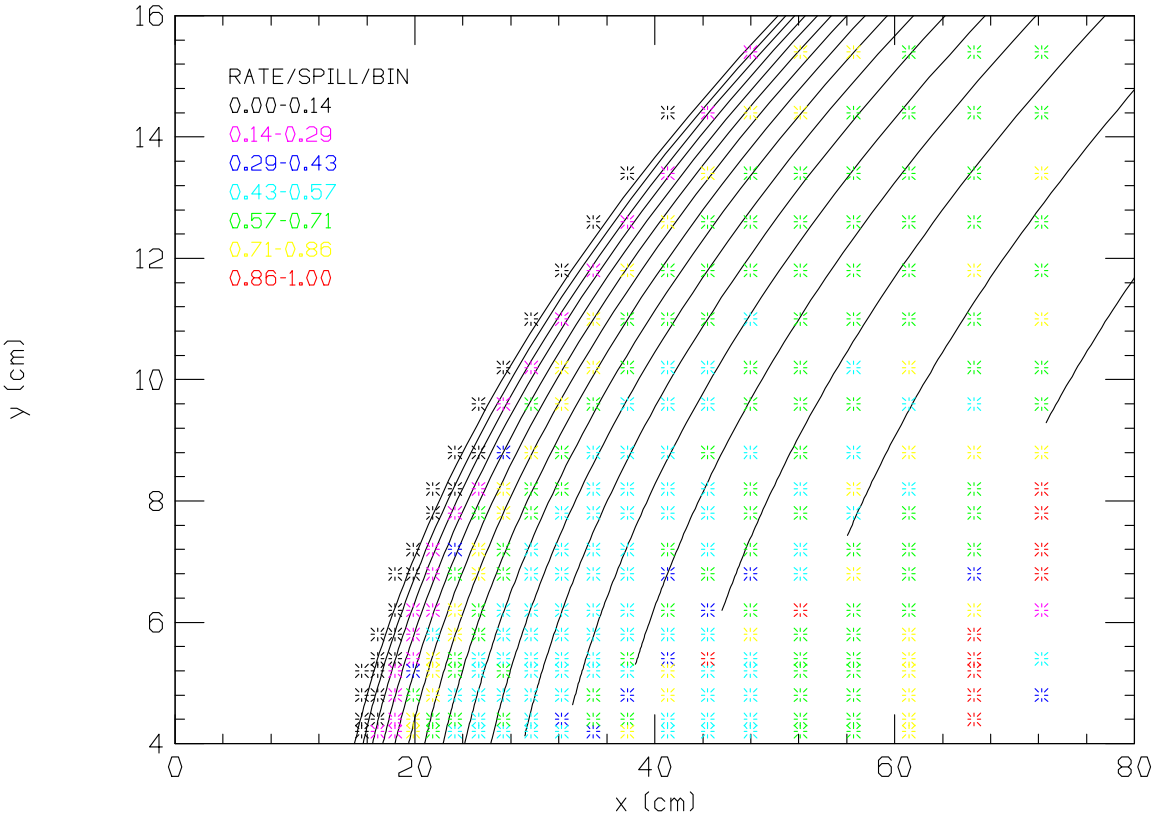

PLAN VIEW
1 M
50 CM
BEAM
TARGET
COLLIMATOR
DETECTORS
18D36
SIDE VIEW
18D36
1 M
15 CM
DETECTORS
COLLIMATOR
TARGET
BEAM

RATES

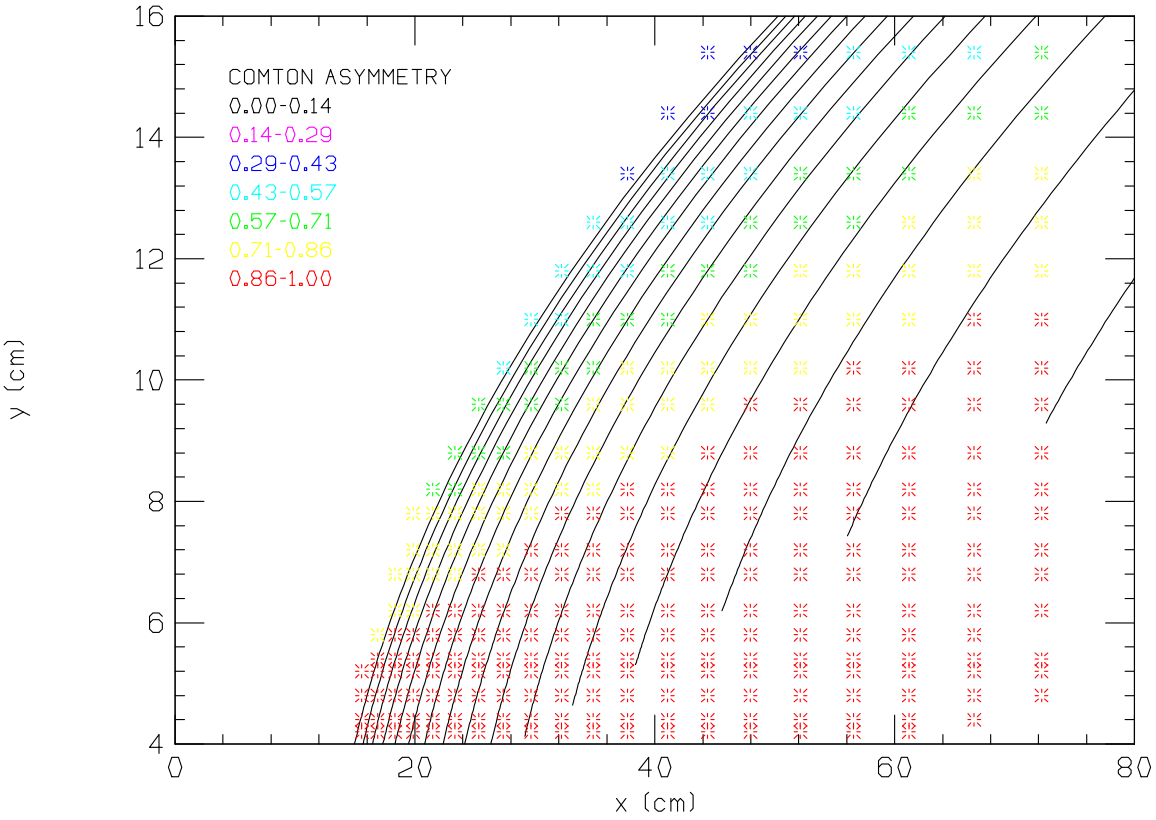
- Calculated for E161-like photon spectrum with a coherent peak at 40 GeV.
- Used highest intensity beam possible (5×10^{10} e/spill on 1.5% r.l. diamond, 50% passing C37 collimator).
- Used thickest Fe target possible (about 1% r.l.) for k_0 resolution of about 2 GeV (thicker makes too much multiple scattering).
- Assumed ϕ range is 10% of 2π.
- Assuming detectors are scintillating fibers following constant k_0 in (x, y) plane, rates are a few/pulse/detector.

RATES AT DETECTORS

Lines show constant k_0 values of 47.5 GeV, 45.0 GeV, ... 7.5 GeV from left to right. Detectors will follow these lines.

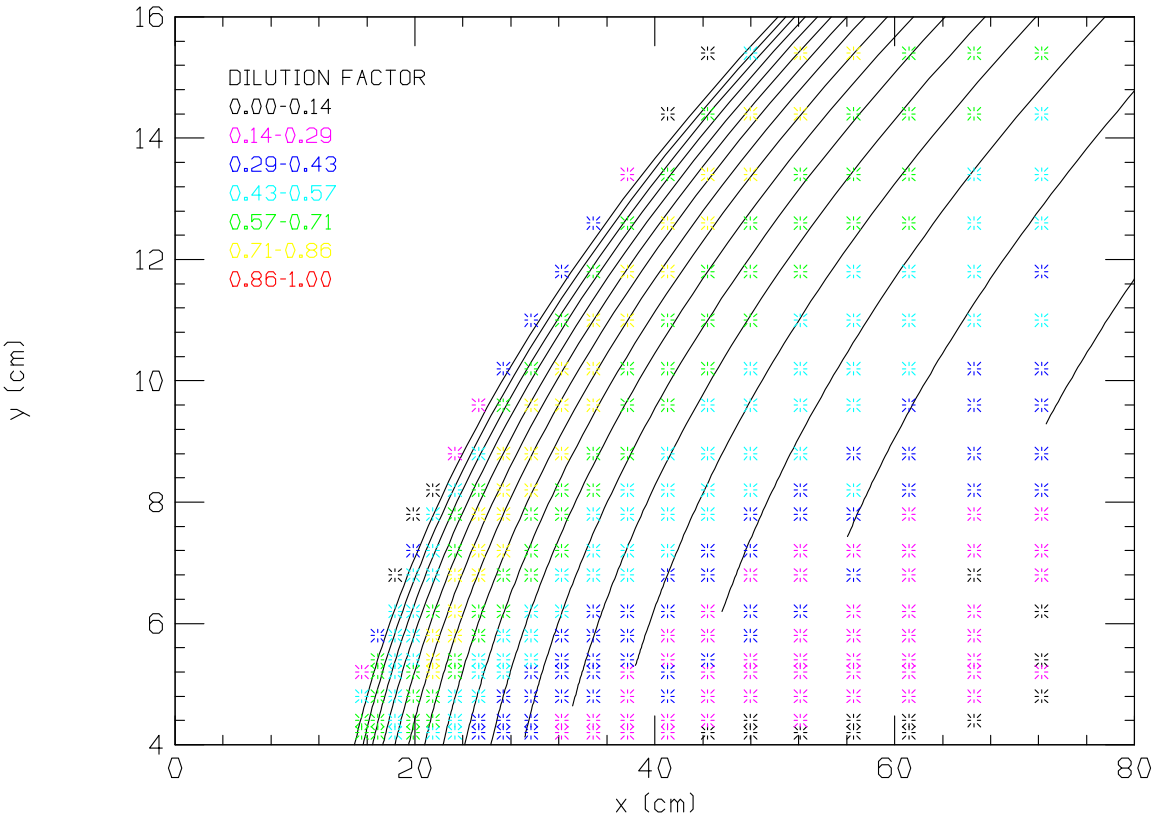


PHYSICS ASYMMETRY AT DETECTORS



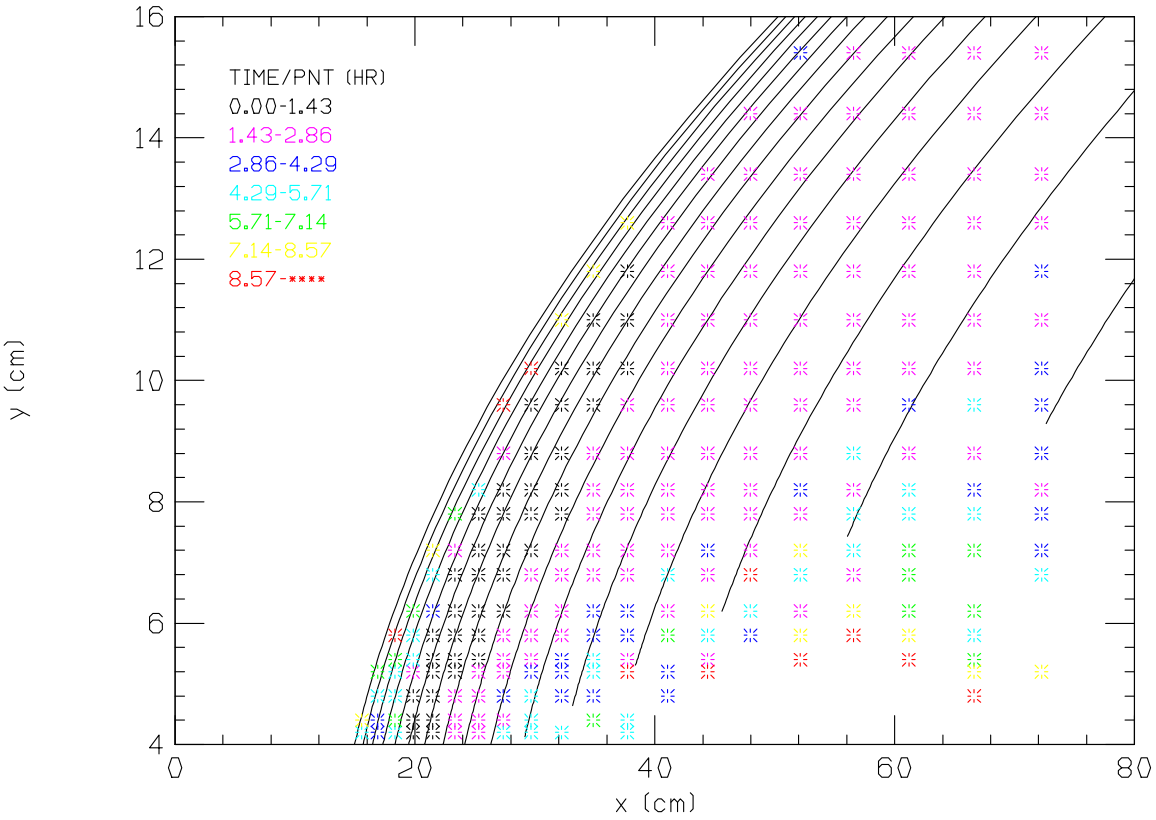
DILUTION FACTOR AT DETECTORS

Dilution defined at Com/(Com+BH). Best at 40 GeV coherent peak.



TIME NEEDED

Values are for each bin, for a 5% error. Can measure average polarization in about 15 minutes. Can measure energy dependence in a several hour run.



OUTLOOK

- Rough simulation shows reasonable performance possible detecting only recoil electrons.
- Need to study resolution, number of scintillating fibers needed, optimize layout
- Need to study if performance better if scattered photons detected also.
- Need to worry about triplet production from atomic electrons.
- Need to study shielding against soft backgrounds.
- Optimize amount of W in front of detectors.
- These studies will be carried out by Yerevan group (recently received grant for this purpose).