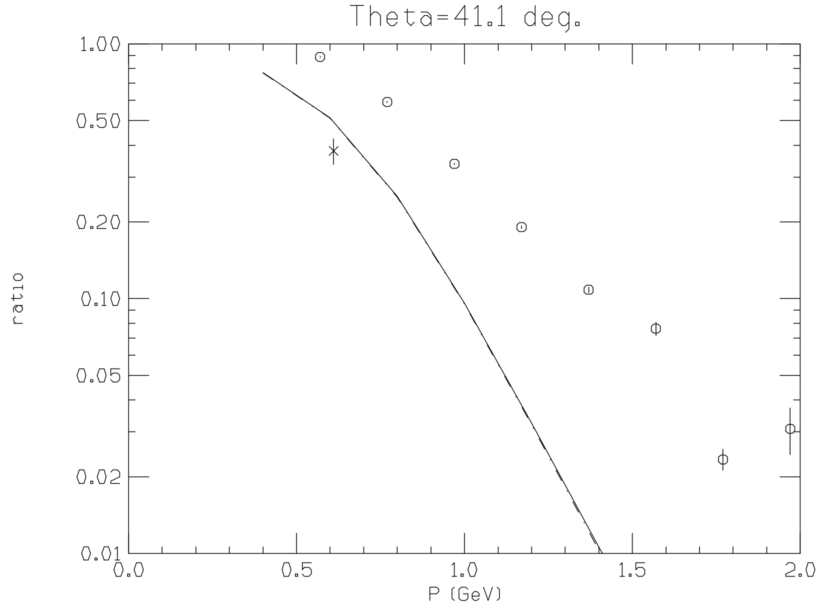
HODOSCOPE FOR SANE (AND SEMI-SANE)

P. Bosted November 11, 2004

- Main purpose of hodoscope is "to provide redundant and efficient electron detection and limited tracking to suppress background".
- Propose to put hodoscope in front of Cherenkov (at about 40 cm from target), instead of afterward (at 240 cm).
- Target position resolution improved from 9.5 cm to better than 0.5 cm.
- Ability to reject non-target background improved by about factor of 500.
- To this after Cherenkov would require < 0.6 cm wide bars instead of proposed 12.5 cm wide bars: need 1000 PMTs assuming double-ended to have chance to get enough light.
- Additional goal: determine sign of low momentum particles: only possible if detector close to target.

e^+/e^- RATIO



- Ratios from Hall B EG2000 show rapid increase at low E'.
- SANE would like to go from $E' = 1$ GeV ($x = 0.3$) where ratio is about 0.4, to $E' = 1.7$ GeV ($x = 0.6$) where ratio is about 0.05.
- Ratios expected to be about 50% larger for SANE due to thicker target.
- e^+ asymmetry was well measured for long. pol. in Hall B, but only transverse measurements are at 29 GeV from SLAC, with limited statistics.

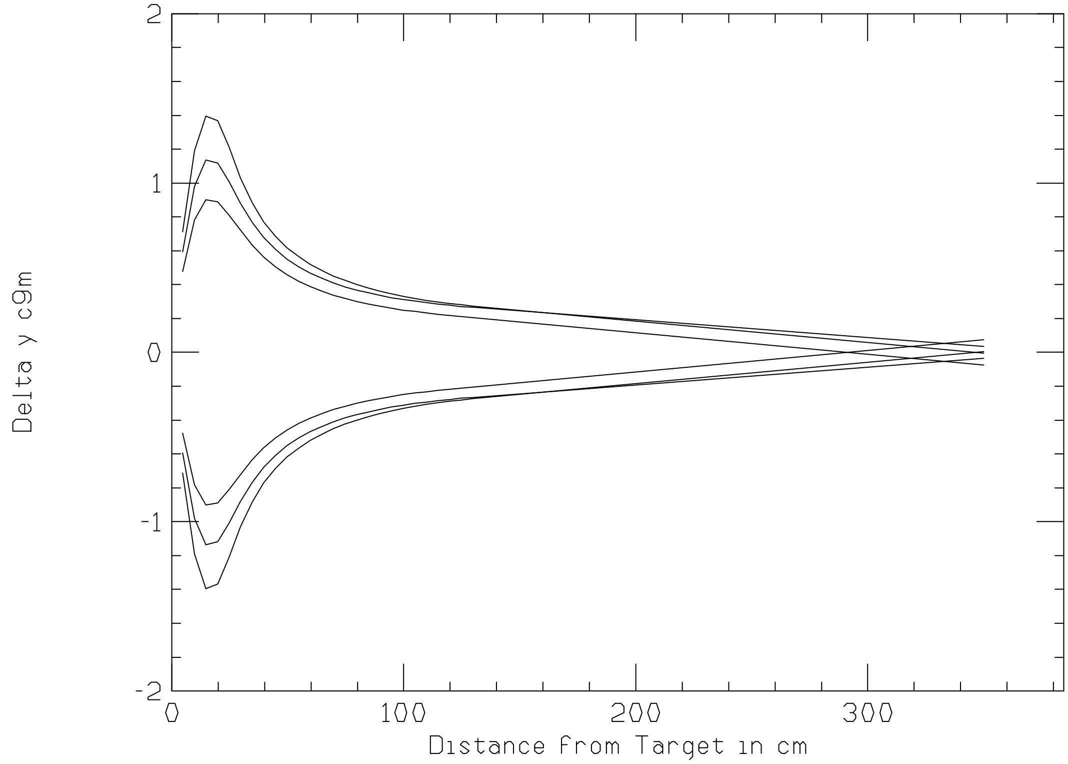
ADVANTAGES

- **Can afford to use quartz instead of Lucite: bigger signals (see talk by Dave Mack at June meeting).**
- **Detectors much shorter: more light, less position dependence.**
- **Can be made on spherical surface so rays on average perpendicular to radiator surface: more light.**
- **Partial ability to discriminate low momentum positrons from electrons: ability to measure positron asymmetry for transverse running (Hall B only measured positron asymmetry for parallel running).**
- **Ability to partially reduce positron contamination of electron sample (trade-off in purity versus efficiency), and also reject low momentum π^+.**

DRAWBACKS

- More knock-ons from pions hence worse pion rejection (see Vipuli's talk). Could be as much as factor two worse rejection, but likely not this bad once Cherenkov optics put in simulation since low momentum knock-ons have large angles relative to pion and Cherenkov angle is also large. Also, partially offset to extent pion charge can be determined, and ability to reject non-target pions much better.
- Want detector as close to target as possible to reduce knock-ons (since will be bent by higher magnetic field). Also, want detector as this as possible.
- Magnetic field of order 10 kG at 40 cm: ordinary PMTs don't work in such high fields.
- For particle sign determination, would like 0.4 cm granularity in vertical direction (80 bars): may be hard to get enough light.

PARTICLE SIGN DETERMINATION



- **Plot shows typical difference in y of $P = 1$ GeV and infinite P for $\theta =$ 33 to 47 deg. (inner to outer)**
- **Need position resolution of about 2 or 3 mm (sigma) to tell positive, negative particles.**
- **Sensitivity maximal at about 20 cm from target**

PROPOSAL: Starting point for discussion

- Put detector as close to target as is easily practical. Make diameter of new OVC as small as possible without compromising acceptance at 47 degrees (38 cm diameter?). Detector at 40 cm from target?
- Size at 40 cm is about 26 cm tall, 13 cm wide.
- Make from 3 mm by 3 mm quartz bars/fibers. Have two layers measuring vertical direction y, with 1.5 mm offset, for redundancy. Have one layer measuring x. Would need 440 channels of readout, assuming double-ended.
- Need readout that can withstand 10 kG field and high radiation levels, is inexpensive, and has reasonable efficiency, signal to background. Likely candidate are the SiPM device Mahbub will talk about.
- Bend bars slightly so follow spherical surface.