SBS Coordinate Detector Update

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Overview

- Coordinate Detector ("CDet") in SBS experiments:
  - GEp5: vertical coordinate detector (WBS3 - Proton Form Factor)
  - GMn/GEn: proton tagger (WBS2 - Neutron Form Factor)

- CDet configuration:
  - Two planes w/ sensitive areas of $(102\ \text{cm} \times 294\ \text{cm})$.
  - Each plane includes three 98-cm tall "modules" (possibly four modules for New ECAL configuration).
  - Each module consists of 392 scintillator plates with individual readout.
  - Total of 1,176 scintillator plates per plane, each of cross section $(0.5\ \text{cm} \times 3.0\ \text{cm})$ and 51-cm in length.
  - Light collected by WLS fibers (through 3 mm diameter central hole in each plate) coupled to 16-channel maPMTs.
  - Front-end card produces a logical signal for 1877S TDC.

- CDet performance parameters:

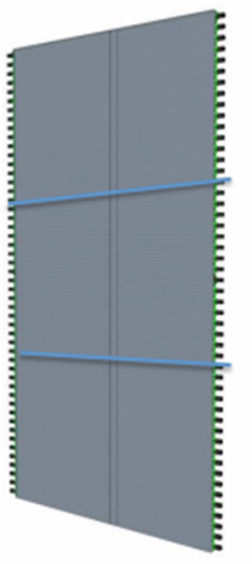
Coordinate resolution per plane	1.8 mm
CDet coordinate resolution	1.3 mm
Time resolution	0.8 ns
Background rates per bar ($E_{\text{thresh}} > 3.5$ MeV)	0.4 MHz
Online occupancy (TDC window of 50 ns)	2 %
Electronic dead time (50 ns per pulse)	2 %

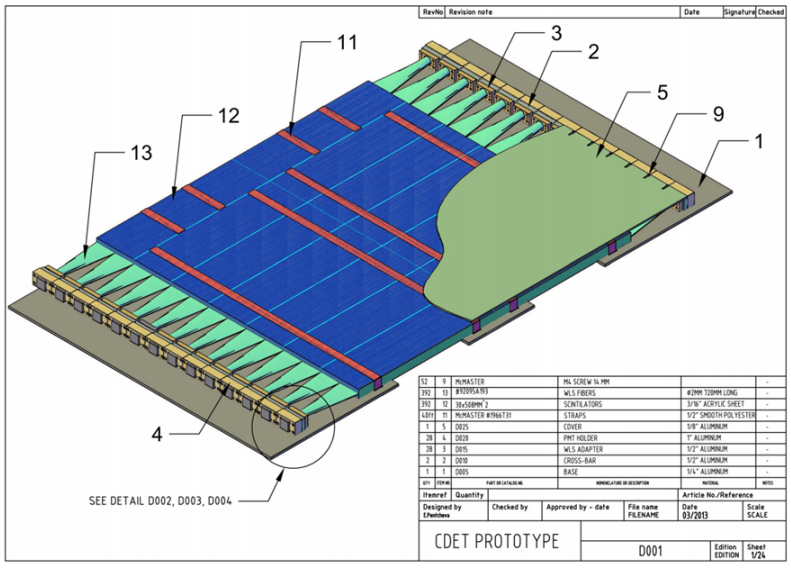
SBS program review and CDet in PMP

- Scintillator-based CDet presented at SBS Program DOE Panel Review on Nov. 4-5, 2013.
  - Panel suggested "modifications to PMP to reflect PMT/scintillator-based scheme".
- Documentation for new CDet scheme in PMP submitted to SBS Management in Dec. 2013.
- JLab CDet Technical Review on February 25, 2014.
  - Main charge: "to confirm the performance parameters of CDet as presented in technical report".
- Technical Review's concerns/recommendations addressed on March 26, 2014.
  - construction and design
  - light-yield
  - PMT pixel gain non-uniformity
  - threshold and rates
  - prototype test
- "Updated PMP with the scintillator-based CDet approved" on April 25, 2014!
- Comprehensive budget (total of $\sim\$386\text{k}$) for CDet construction and timeline submitted on May 5, 2014.

CDet configuration

- CDet placed in front of ECAL ($0.8\ \mathrm{m} \times 3.0\ \mathrm{m}$) and HCAL-J ($1.2\ \mathrm{m} \times 2.7\ \mathrm{m}$).
- Construct six scintillator horizontal-strip "modules".
- Two planes for both sets of experiments.





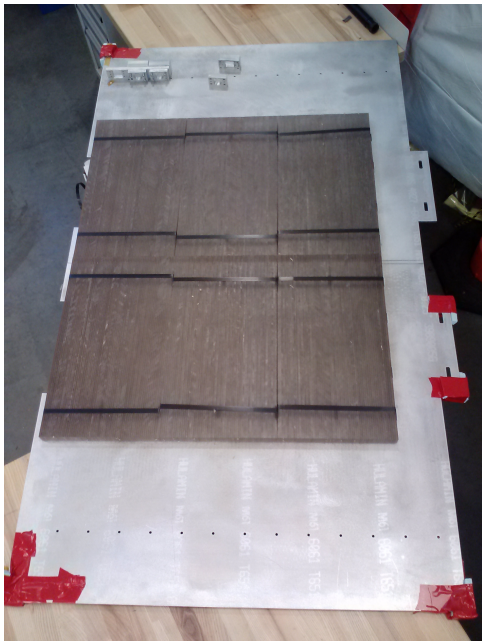
- One plane includes three 98-cm tall segments.
- Each module covers sensitive area of ($102\ \mathrm{cm} \times 98\ \mathrm{cm}$):
  - 392 scintillator bars w/ dimensions ($0.5\ \mathrm{cm} \times 3.0\ \mathrm{cm} \times 51\ \mathrm{cm}$);
  - light collected via WLS fibers and detected by 16-channel maPMT;
  - front-end card produces a logical signal for 1877S TDC.

CDet scintillators

- Fermilab's extrusion facility will produce 3200 scintillator plates.
- Plate geometry: $0.7\ \text{cm} \times 3.0\ \text{cm} \times 51\ \text{cm}$ w/ 3.0 mm diameter central hole along plate.
- Top and bottom surfaces of extruded scintillators will be machined by Eljen Technology to make thickness uniform to $(5.0 \pm 0.05)\ \text{mm}$.
- Updated quotations from Fermilab and Eljen Technology obtained for production.
- Sample extruded scintillators provided to Eljen Technology to test machining process.
- Scintillators will be wrapped in 0.25 mil Mylar for light collection efficiency.
- While stacking plates, pointing of scintillator to target will be adjusted by applying proper shimming using tape.
- Reduce background rates in bars by a factor of 3 by increasing plastic absorber thickness from 15 cm to 20 cm.

CDet prototype and tests

- Construction of prototype CDet at JLab.



- Funds for technical manpower for prototype tests provided by Hall A in January 2014.
- Complete mechanical checkout and light enclosure tests of prototype underway.
- Significant progress in mechanical support frame for scintillators and PMTs.
- R&D to implement the new trigger interface/DAQ idea at SMU.

CDet timeline

- Basic design with budget developed -
  $\Rightarrow$ November 2013.
- Technical design review -
  $\Rightarrow$ February 2014.
- Mechanical checkout and light enclosure tests of prototype completed -
  $\Rightarrow$ July 2014 (4 months float).
- Purchase orders placed for scintillators and WLS fibers -
  $\Rightarrow$ July 2014 (2 months float).
- Fully instrumented detector planes ready -
  $\Rightarrow$ December 2015 (6 months float).