Hall C R&D projects@12 GeV

Hall C meeting, January 06, A. Bruell

- **Recall: motivation for Hall C upgrade for 12 GeV**
- **Design parameters for SHMS**
- **R&D projects as presented at Lehman review**
- **Latest ideas (also see talks by Dave and Paul)**

- **R&D projects for detector package**
- **R&D projects for quadrupoles**
- **R&D projetcs for CF magnet**

Motivation for Hall C Upgrade

- Pion and nucleon form factors at high Q^2
- Deep inelastic scattering at high Bjorken x
- Semi-inclusive scattering at high hadron momenta
- Polarised and unpolarised scattering on nuclei

- Highest Luminosity ($L=10^{38}$ nucleons/cm^2/s)
- Pair of magnetic spectrometers
- Detection of charged particles with highest momenta
- Accuracy and reproducibility
- Small angle capability
- Very good particle identification
- Compatibility with all target configurations

Scope of the Hall C Upgrade

Magnetic Spectrometer Pair Capable to Handle Full 11 GeV Energy & Luminosity

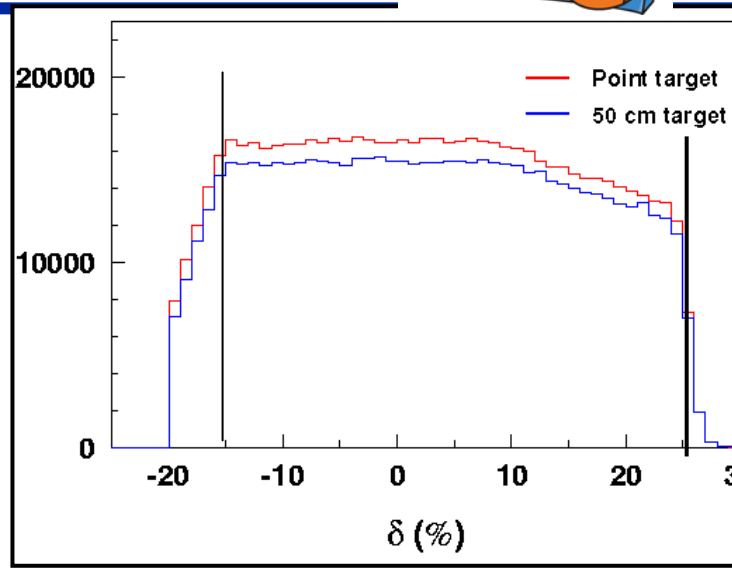
SHMS emulates the essential features of HMS:

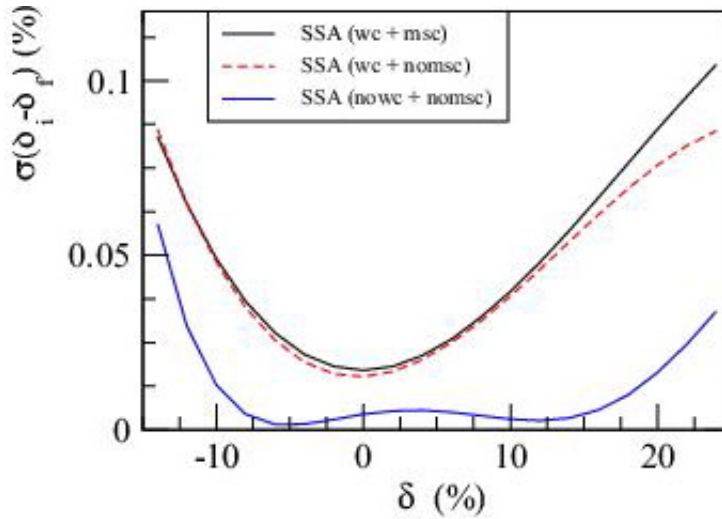
A rigid connection to the pivot, a precision rail system, vacuum, a simple and reproducible point-to-point optics design, a flat and easily understood acceptance and a heavily shielded hut with redundant detectors.

	HMS (existing)	SHMS (new)
Momentum Range	0.4 - 7.3 GeV/c	2 – 11 GeV/c
Angle Range	10.5 – 90 degrees	5.5 – 25 degrees
Solid Angle	~8 msr	2-4 msr
Momentum Acceptance	20%	40%

Design Parameters

Parameter	SHMS Projections (@ 7 GeV/c)
Range of Central Momentum	2 to 11 GeV/c (9 GeV/c for LSA tune)
Momentum Acceptance δ	-15% to 25%
Momentum Resolution	0.02-0.12%
Scattering Angle Range	5.5 to 25 degrees
Vertex Length (as viewed at 90 degrees)	50 cm (35 cm "flat")
Horizontal Angle Acceptance	+/- 24 mrad (LSA tune) +/- 18 mrad (SSA tune)
Vertical Angle Acceptance	+/- 55 mrad (LSA tune) +/- 40 mrad (SSA tune)
Solid Angle Acceptance	4.4 msr (LSA tune) 2.1 msr (SSA tune)
Horizontal Angle Resolution (yptar)	0.6-1.2 mrad
Vertical Angle Resolution (xptar)	0.7-1.3 mrad
Vertex Length Resolution (ytar)	0.1-0.3 cm



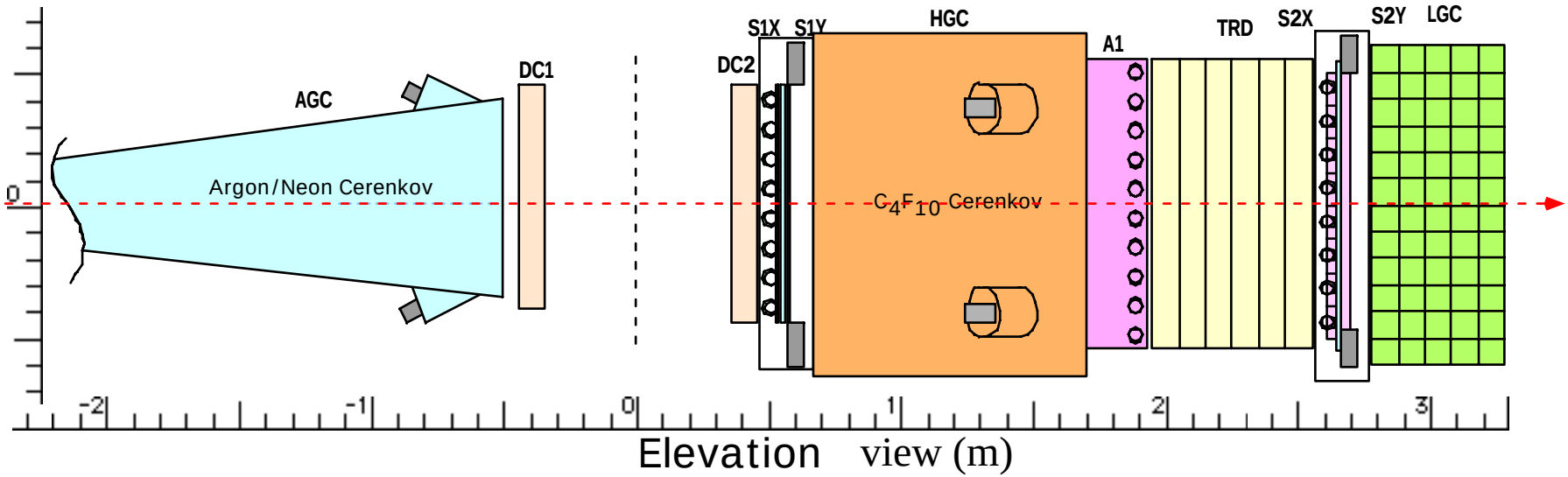


WBS 1.1.4 Hall C R&D

- **Key risks: superconducting magnets**
- **R&D tasks:**
  - **test of existing superconducting cable**
    - **successful**
  - **prototype of burnout proof current lead**
    - **successful**
  - **feasibility study of CF magnet**
    - **no major problems**
  - **force analysis for higher gradient quadrupoles (FY06)**
  - **prototype of support structure for cold mass of CF magnet (FY07)**
- **Hall C R&D budget: $ 382k (5.5% of total R&D budget)**
- **Key risks well addressed by R&D tasks !**

Hall C Detectors

Modular design: optimize for different experiments



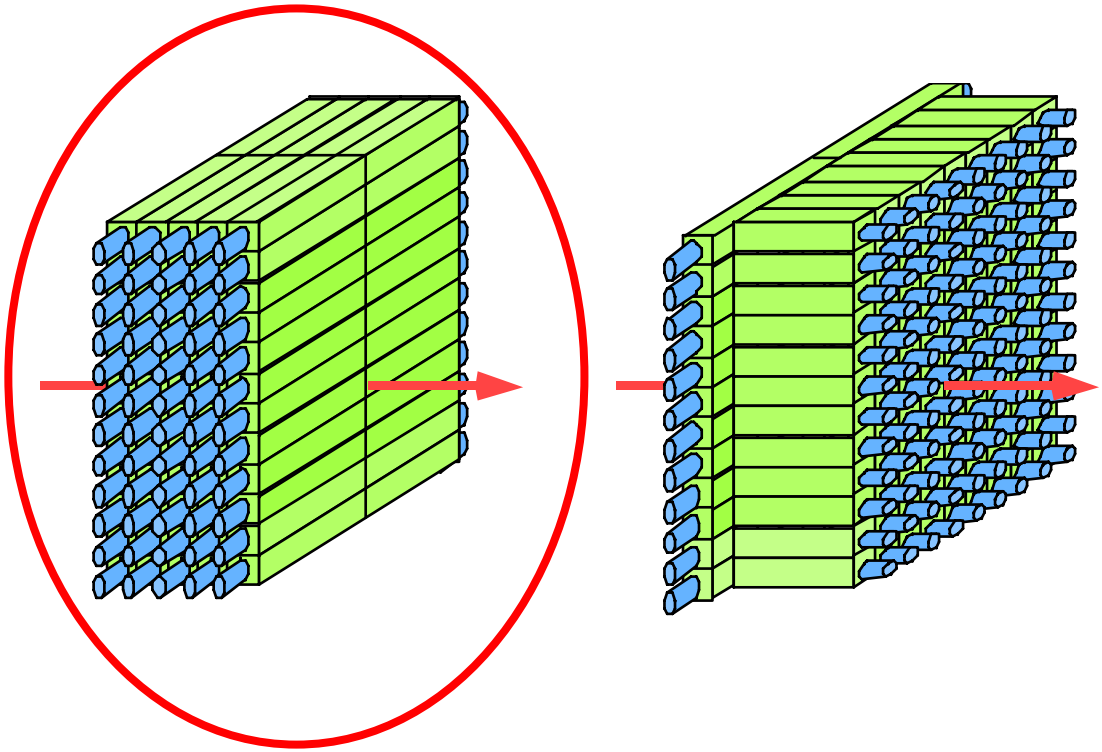
Argon/Neon Cerenkov: e/π (or π/K) separation at high momenta
C_4F_{10} Cerenkov: π/K separation for momenta > 3.4 GeV
Scintillators (time of flight): e/π and π/K separation below 2 GeV
Calorimeter: e/π separation
Space for additional detectors (not included in the project)**:**
Aerogel Cerenkov: π/K separation at low momenta
TRD: improvement of e/π separation

R&D: Shower Counter

Calorimeter design may depend on availability of glass block shapes.

120 Ch. Five-layer Stack -or- 132 Ch. Preshower + Projective

➡ R&D program



Study to be continued this year (as official 12 GeV R&D project)

One person from Yerevan Coming to Jlab

To be finalized in FY07

Cost: $22+57k

R&D: Quartz Detector

Development and test of prototype quartz hodoscope

Present hodoscope design: S1 scintillator
S2 quartz detector

clean trigger !?

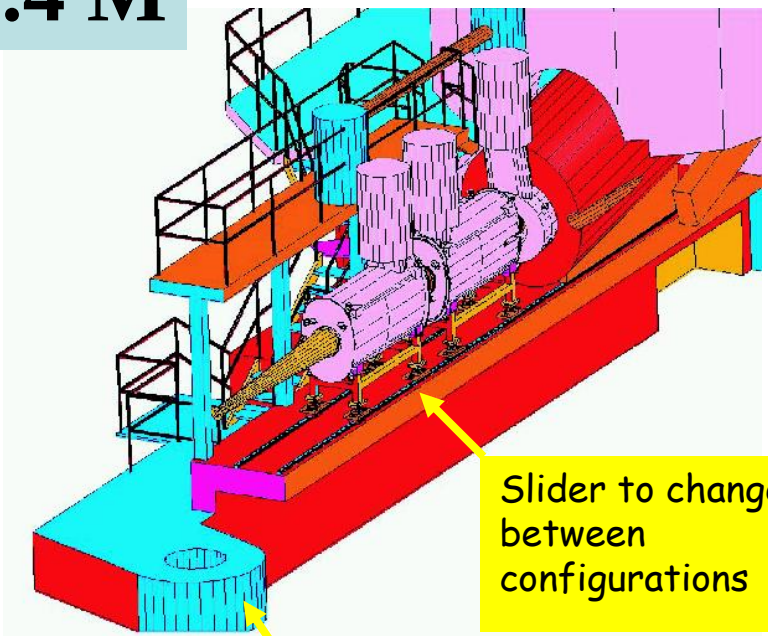
Original plan: build prototype and test at 6 GeV

Problem: no “standard” 6 GeV running in the near future

Decision how to proceed within the next 2 weeks !

Support Structure

$ 2.4 M



Large fraction of cost and design effort for sliding mechanism between different configurations

Budgetary estimates done by same company that engineered & designed HMS carriage & shield house

R&D: Quadrupoles

Original concept: copy HMS Q1 and increase quadrupole strength by about 15% (8.6 T/m instead of 8 T/m).

➡ Small R&D project to verify that increased strength is possible (to be done by space cryomagnetics)

Recently: investigate if two quadrupoles can be combined into one cryostat and length increased by about 15% ? (Paul, Dave)

Also: can we use existing superconductor ?

➡ Larger R&D project (still to be to done by space cryomagnetics)

Estimated cost (Dec 05): additional $67 k

R&D: CF magnet

Design, fabrication and test of a support column for the combined function magnet

- problem: large vertical force between the cold superconducting coils and the warm yoke (600 tons)
- conceptual design for support identified
- prototype to be build
- cost: $90k (FY07)

Also: still investigating if the co-axial design is necessary
(first alternative “simple” QD design available)