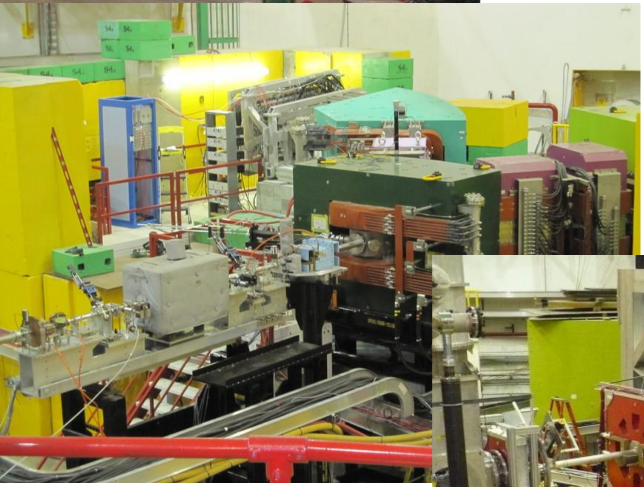
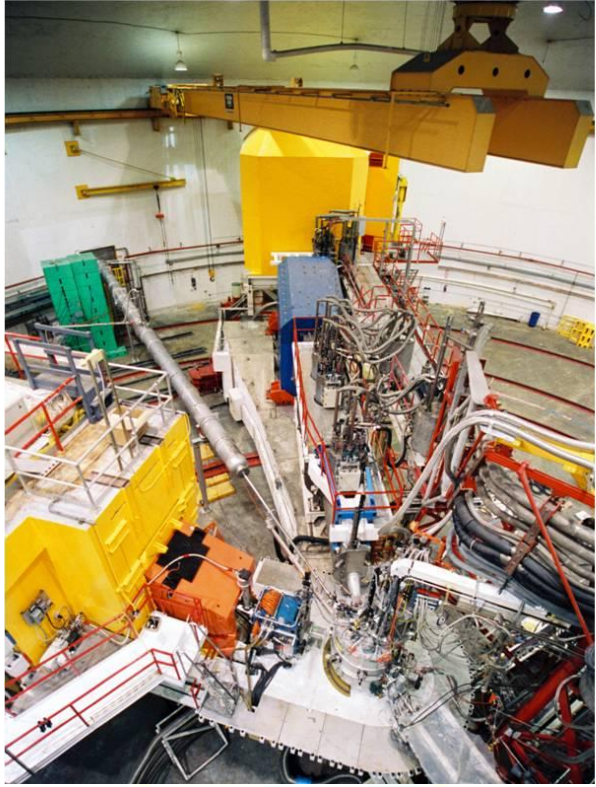
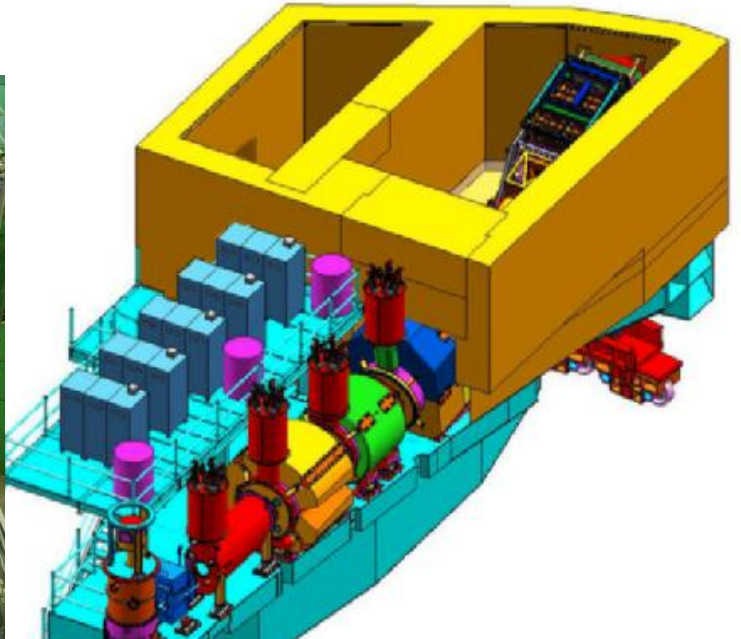


Hall C

Off-line Analysis and Simulation in the 12 GeV Era

May 20, 2011





Hall C after 12 GeV Upgrade

- Beam Energy: 2 – 11 GeV/c
- Super High Momentum Spectrometer (SHMS) (NEW)
  - Horizontal Bender, 3 Quads, Dipole
  - P $\rightarrow$ 11 GeV/c
  - dP/P 0.5 – 1.0x10^{-3}
  - Acceptance: 5msr, 30%
  - 5.5° < θ < 40°
- High Momentum Spectrometer (HMS) (EXISTING)
  - P $\rightarrow$ 7.5 GeV/c
  - dP/P 0.5 – 1.0x10^{-3}
  - Acceptance: 6.5msr, 18%
  - 10.5° < θ < 90°

- Minimum opening angle: 17°
- Well shielded detector huts
- Cryotargets

- Compton and Moller beam polarimeters

- Ideal facility for:
  - Rosenbluth (L/T) separations
  - Exclusive reactions
  - Low cross sections (neutrino level)

Simulation

- Most standard equipment experiments use SIMC for experiment planning and analysis:
  - Physics models generate coincidence events in apertures of spectrometers
  - Matrix style transport to trace events through magnets
  - Used to:
    - Model decay, energy loss, multiple scattering, algorithm efficiencies…
    - Make radiative, coulomb, acceptance corrections
  - Iterate physics models by changing event weights
  - Typically <=10% of experiment analysis CPU time
- Large Installation/non-standard equipment experiments use Geant4/Geant3/Custom simulations
  - Large installation experiments have been a major part of 6 GeV Hall C
  - < 1/3 of current 12 GeV lineup uses elements beyond standard equipment
  - Simulations tend to use university or desktop computing resources

Analysis

- Hall C Engine – Fortran/HBOOK:
    - Tracking and PID by ENGINE -> ntuple of reduced size
    - 2 to 4 raw data -> ntuple passes typically done
    - Usually able to keep all ntuples for an experiment on disk

- ROOT based analyzers used for Hall C Parity experiments

- 12 GeV Plans
    - Develop root analyzer using Hall A analyzer as starting point
    - Update Fortran analyzer to support new SHMS – backup and validation of root analyzer.
        - (SHMS detector package very similar to decomissioned SOS).

    - Use of root analyzer will, at least initially, increase per event analysis times and analysis output (“ntuple”) sizes

Resource Estimates

- Current experiment: Qweak (to May 2012) – very different DAQ and Analysis style from future Hall C experiments, but resource needs not to far from future needs:
  - 1kHZ trigger, 4kb/event, ~50 weeks@60% -> 75TB, $2x10^{10}$ events
  - 10ms/event, 2 analysis passes, “ntuple”/raw = 4
  - CPU time $2x10^{8}$sec, 3 farm cores
  - 600TB cooked data, 60TB on live disk

- 2015:
  - 5kHZ trigger, 4kb/event ~30 weeks@60% -> 220TB/year $5x10^{10}$ events
  - 10ms/event, 2 analysis passes, “ntuple”/raw = 2
  - CPU time $5x10^{8}$, 17 farm cores
  - 900TB cooked data, 90TB on live disk (for 2-3 years)
- 2016
  - 10 kHZ trigger, ~30 weeks
  - 34 farm cores, 1.75PB cooked data/year, 175TB on live disk (for 2-3 years)

Comments

- Many experiments will have physics rates << DAQ maximum or have high rates for a fraction of kinematic settings
  - Initial hardware PID cuts will be loose (PID harder at higher energies)
  - Hardware coincidence windows may initially be large
  - Experiments may choose low pre-scale factors for singles in coincidence experiments
  - Flash ADC data may not be well sparsified. High rate experiments will want full waveform to deal with multiple tracks.

- Experience will bring
  - Lower DAQ rates from better use of trigger
  - Smaller root tree/ntuple sizes as understanding of hardware and analyzer improves

- Need to be prepared for worst case to avoid surprises
  - Periodic data challenges

- DB (mysql) access from farm will be important