

Hall A collaboration meeting, June 23rd, 2006

Bogdan Wojtsekhowski

SUPER BigBite and related considerations for Hall A

- *12 GeV physics with 4 GeV spectrometers ?*
- *Physics with large x_B at large Q^2*
- *Luminosity of polarized/exotic targets*
- *Large installation for high profile experiments:
(equipment such as Pol.Target + BigBite for A1n/d2, BigCal
for RCS, LH2 Polarimeter for GEP-16, SuperBB and BigHAND for
GEN-6, more for DVCS-5+, CSB - ConeSmallBites - for DISParity)*

Existing instrumentation in Hall A

- HRSs: up to 4.3/3.2 GeV/c, solid angle 6 msr, angle resolution 2 mr, momentum bite of 9%, target length 15 cm ; resolution of 2×10^{-4}
- BigCal: 2.5m² ; energy resolution of 5-7%, angle resolution 1-2 mr (for point target)
- BigBite: 0.3-4.5 GeV/c, $\sim 90 \text{ msr} / (\text{ / } 50)^2$, angle resolution 2 msr, momentum resolution 1% x P[GeV/c], luminosity up to 10^{37}
- BigHand: 5-6 m², 35% efficiency, time resol. 0.3 ns
- Experiment specific detectors - DVCS, RICH, ...

Outline

- Motivation of the new instrumentation
- Gradual development - learn from similar technology in RCS, DVCS, SRC, GEN, ...
- SuperBigBite - very attractive for large x large Q^2 polarized target experiments
- ConeSmallBites - suggestion for DISPar

From experiments requirements

- Why SuperBB is needed for GEN-6 ? • Yes, Large E_{final} is much better for counting rate, selection of the single nucleon knockout require good momentum resolution
- Why SuperBB is needed for DVCS-5+ ? • Yes, Momentum resolution of the BB is 1% for 1.5 GeV/c, and it need to be few times better than calorimeter resolution of 3%.
- Is BigBite good for A_{1n}/d^2 ? • Yes, but SuperBB will provide better rejection/cutof of low momentum background -> needed at max Q^2
- Is BigBite good for u/d (T/He-3) ? • May be, but need full angle-position survey system

Super BigBite

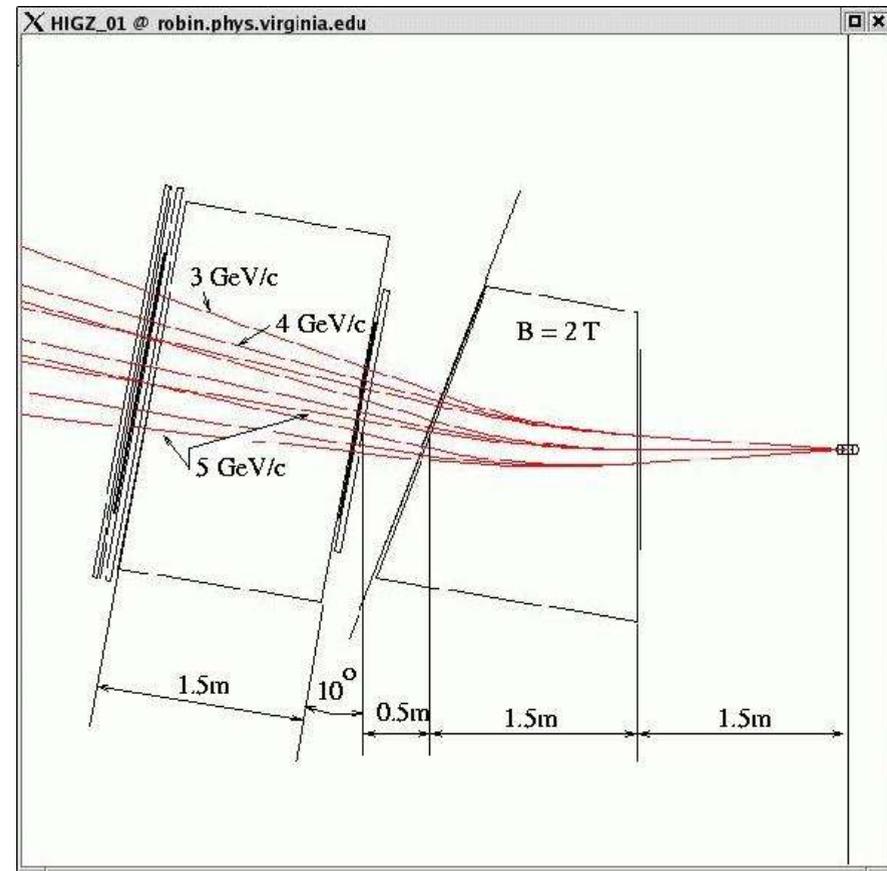
In collaboration with V.Nelyubin

First time in 2002 for GEN > 4 GeV²

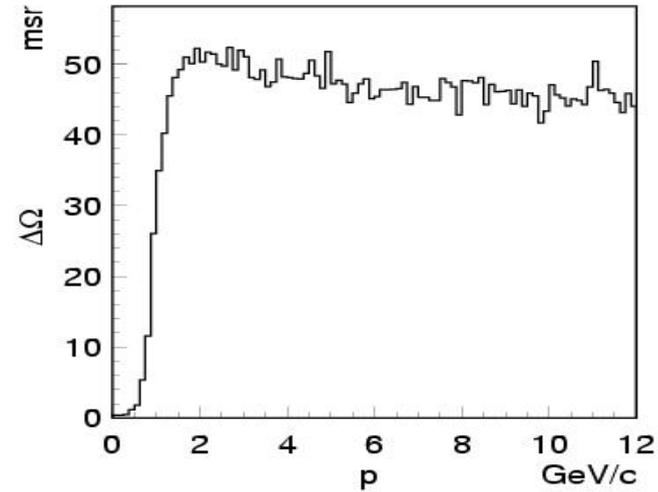
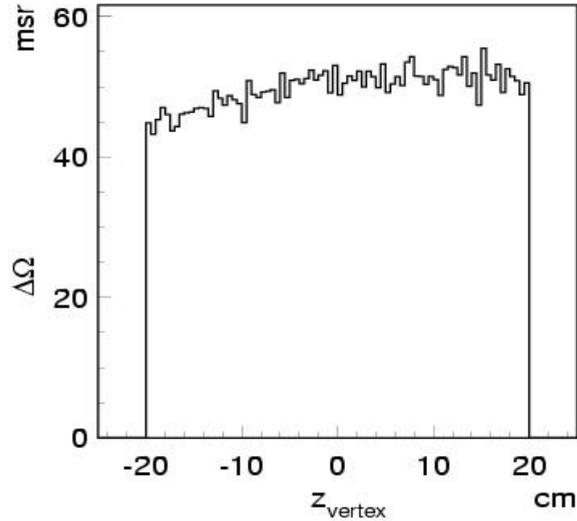
- Simple Dipole - like a BigBite
- Triple H*L = 2 Tesla x 1.5 meter
- Detector package ~ from the BB
- Calculations for 45° position
- MC for the solid angle, momentum
- MC done also for resolutions:

Momentum $p_p/p \sim < 0.2\%$ at 4 GeV/c

- Background, extrapolated from GEN experimental data, allow to use He-3, NH3 pol.targets
- Magnet weight is about 100 ton



MC study of SuperBigBite scheme



- Momentum resolution $\sim 0.15\%$
- Angular resolution < 1 mr
- Vertex resolution of 1 mm

Pictures from Hall A CDR proposal and SuperBB

- Momentum vs x and W^2 vs x
- A_{1p}
- A_{1n}
- Spin duality
- SIDIS
- Transversity
- Pion DIS
- F_{2n}/F_{2p}
- Scattering angle $20-30^\circ$ are most important
- SBB is the best
- SBB is the best
- BB can do it
- SBB is the best electron arm
- SBB is the best
- SBB is the best
- NO, if this need large luminosity

What is SBB could not do ? - a lot, all unpolarized target stuff.
It is parity, u/d, $x > 1$ and exclusive like GEP, RCS, pion ff, nuclei like (e,e'p).

How to arrange *spectrometer for DISParity?*

Considerations for the spectrometers

- Large solid angle -> low luminosity? Large need for multi particle events, Is it a case for DVCS and SIDIS ?
- Large solid angle + large luminosity with BigCal -> low resolution, poor PID.
- Luminosity of 10^{37} require to hide detector behind magnetic field - see in BigBite !
- Luminosity of 10^{38} require to hide detector out of direct view of the target!
- Good momentum resolution require a detector between the target and region of magnetic field or a "vertical" bend as it is in HRS and BigBite.

Cylindrical coordinate system

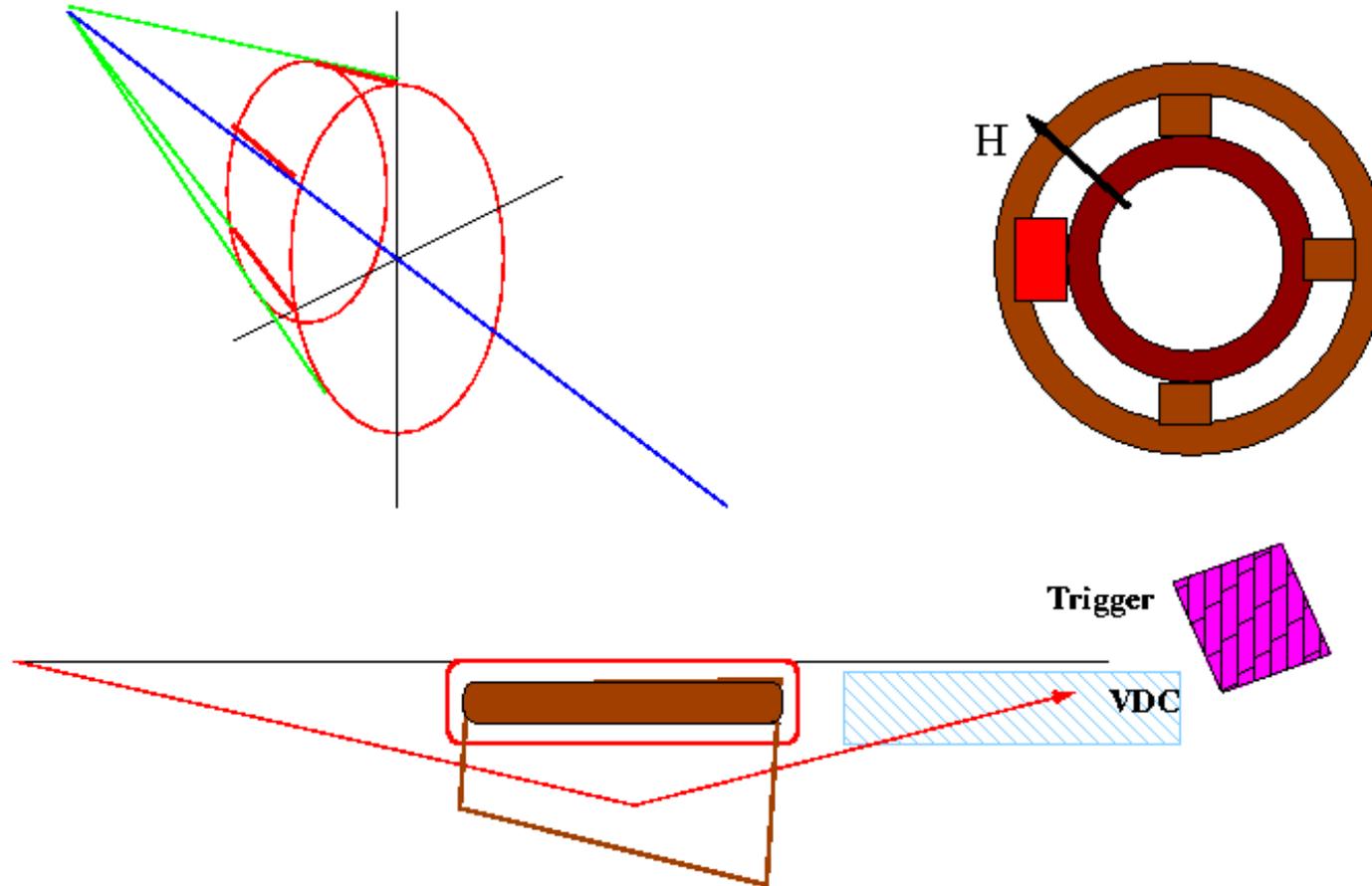
- Toroidal field provide large + low luminosity => CLAS
- Solenoidal field is effective for colliders case and low L
- For small angle of $\sim 20^\circ$ the radial field is an interesting configuration - it is a "vertical" for every element of system and allow to hide the element of detector behind a coil/iron.

Cone of Small Bites (CSB)

logic and estimated parameters

- Bend could is just of 6° for 6 GeV/c \rightarrow 1% resolution need a magnet of 2 T \times m field integral
- Angle opening must be less than Bend !
- Azimuthal cover $360^\circ \times \sin 25^\circ = 150^\circ$
- 50% fraction covering \rightarrow 75° total opening
- Total need 12 magnetic segments -small Bites
- Total solid angle $\sim 0.5 \times 2 \times \sin 25^\circ \times 0.1 = 130$ msr
- Resolution \sim 1%
- Luminosity of 10^{38}

Cone of SmallBites (CSB)



Test could be done by using one of OOPS magnets (Costas's) from Bates

Summary

- Ideas of instrumentation and time scale of implementation vs scientific goal and collaboration interests
- Need balance of advance detector technology, requirements, time of development and cost -
- SuperBigBite is very much adequate to largest group of high profile experiments with 12 GeV beam
- Radial field is a proven way for high luminosity with good momentum resolution - Cone of Small Bites is an effective BigBite for 20-30 degree.