

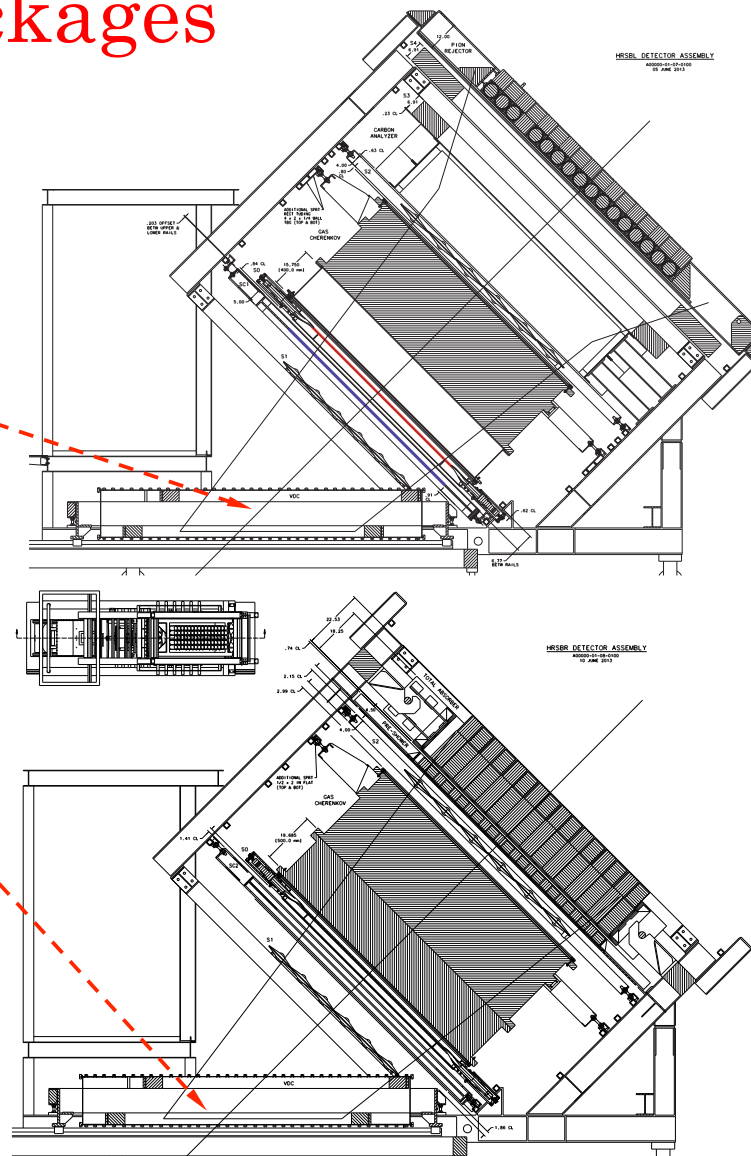
HRS Spectrometers

Bogdan Wojtsekhowski, Jefferson Lab

- HRS parameters: 6 msr; 4 GeV; 3×10^{-4} ; +/- 4.5%
- HRS detector package
 - VDC
 - Plastic counters: S0, S2m, S1m & S1f
 - Shower
 - Cherenkov
- Optics, SciFi counters
- Trigger, electronics
- What else to do with HRS?

Detector Packages

- VDC
- S0 plane
- S1 hodoscope
- S2 hodoscope
- Gas Cherenkov
- Lead-glass calorimeter
- FPP front chambers
- FPP rear chambers
- Aerogel A1, A2 counters
- RICH detector



Detector Packages

VDC

S0 plane

S1 hodoscope

S2 hodoscope

Gas Cherenkov

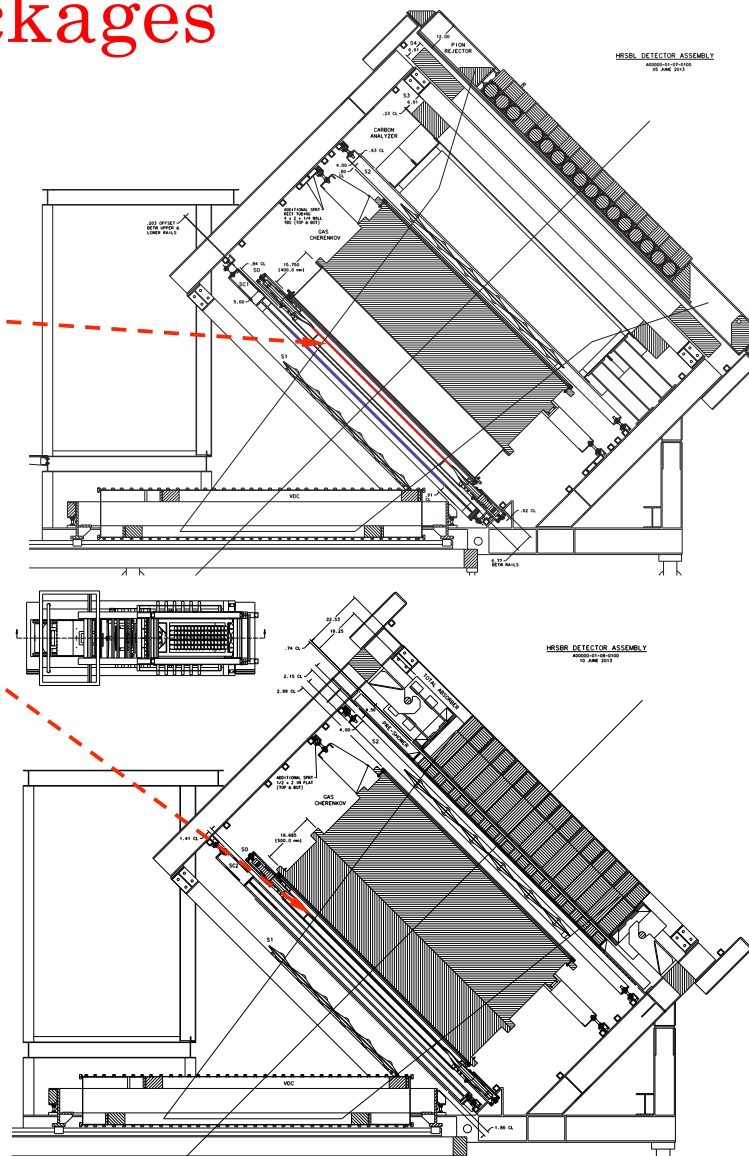
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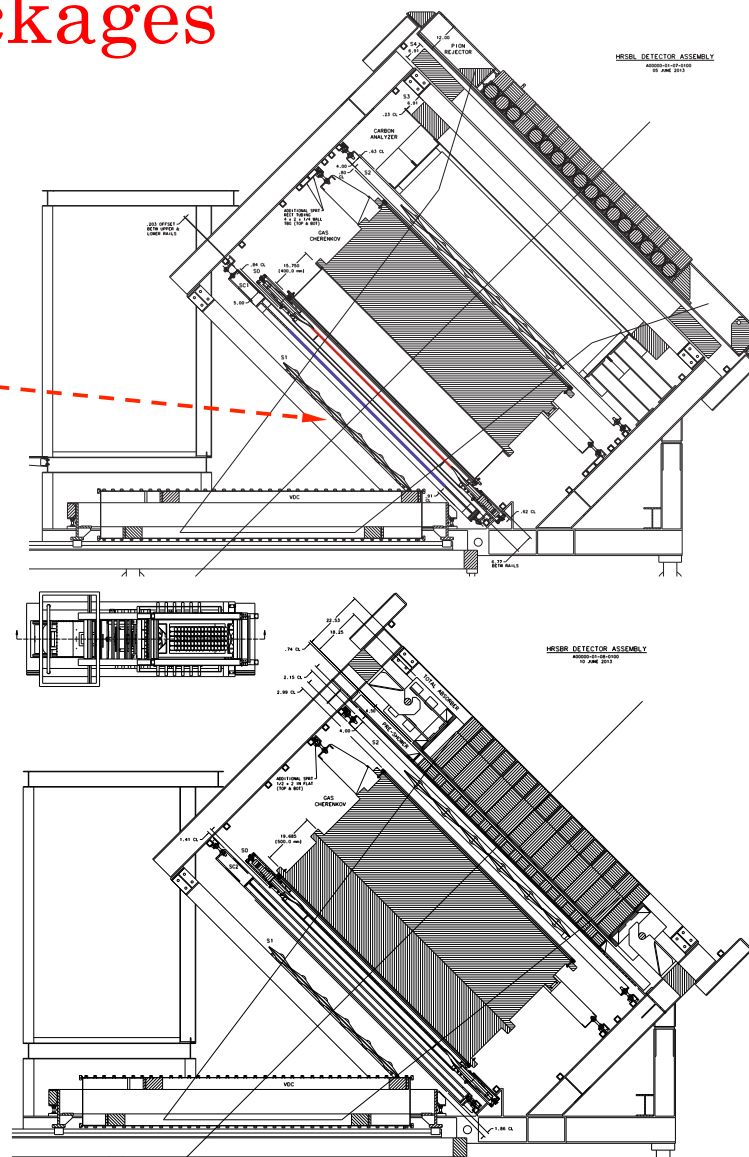
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FPP front chambers

FPP rear chambers

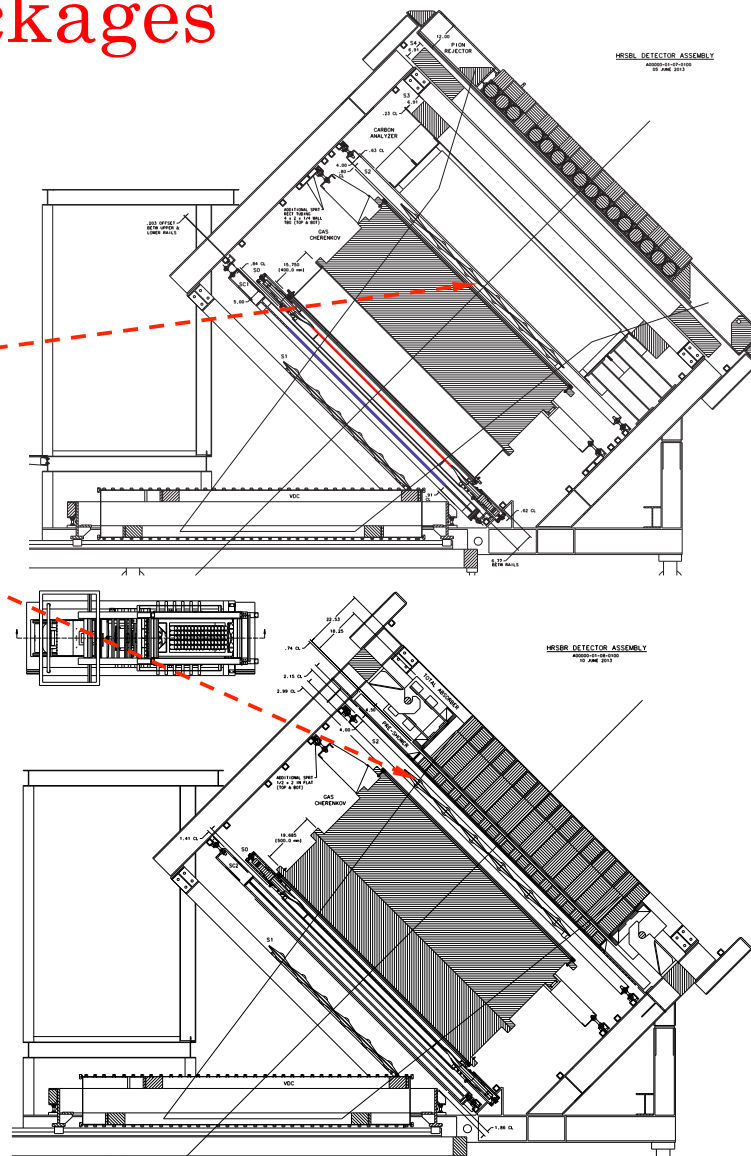
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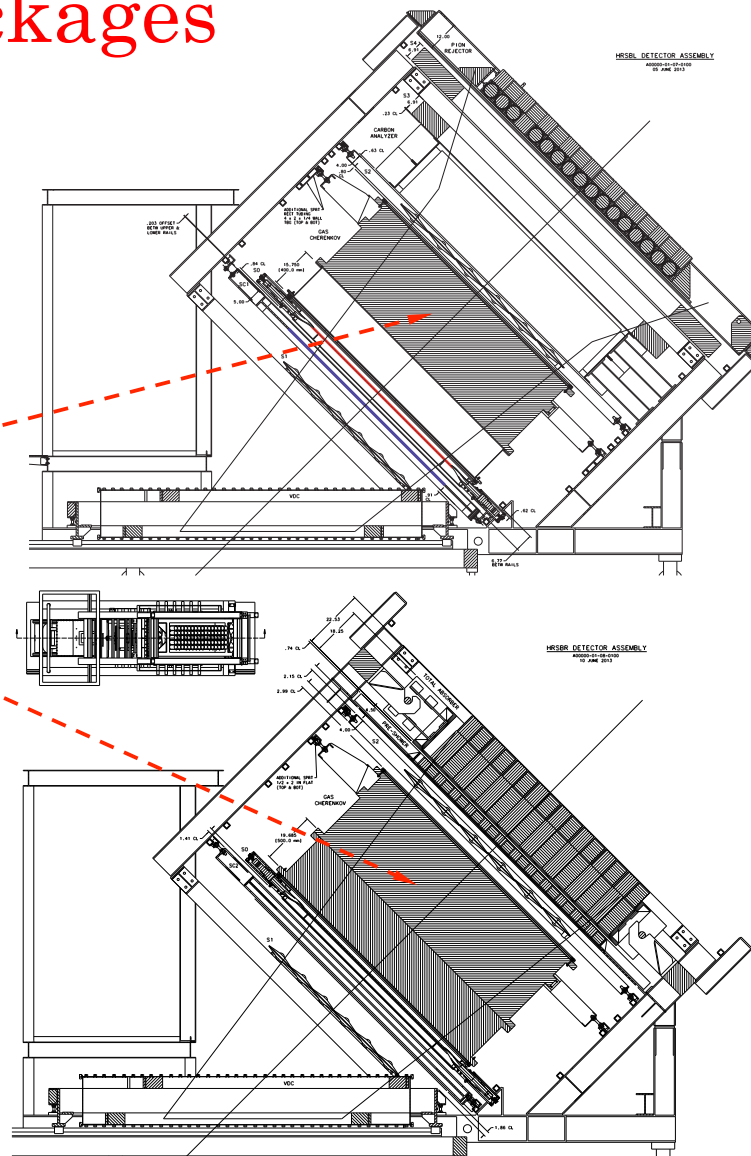
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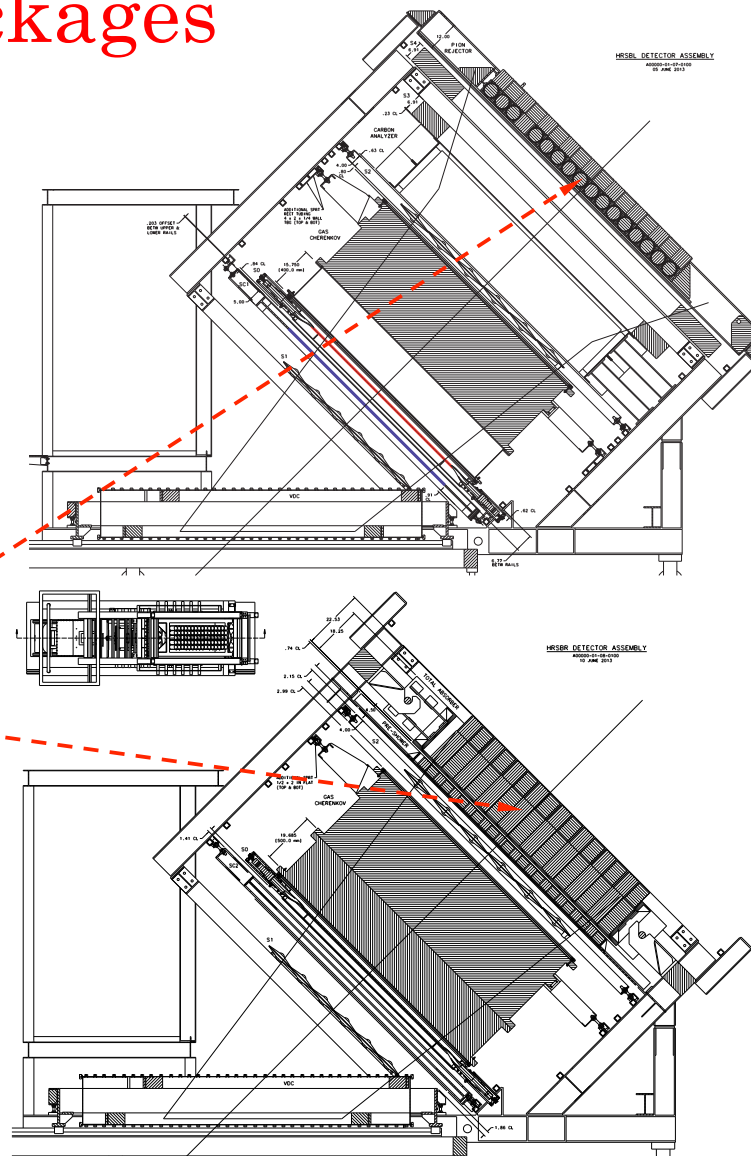
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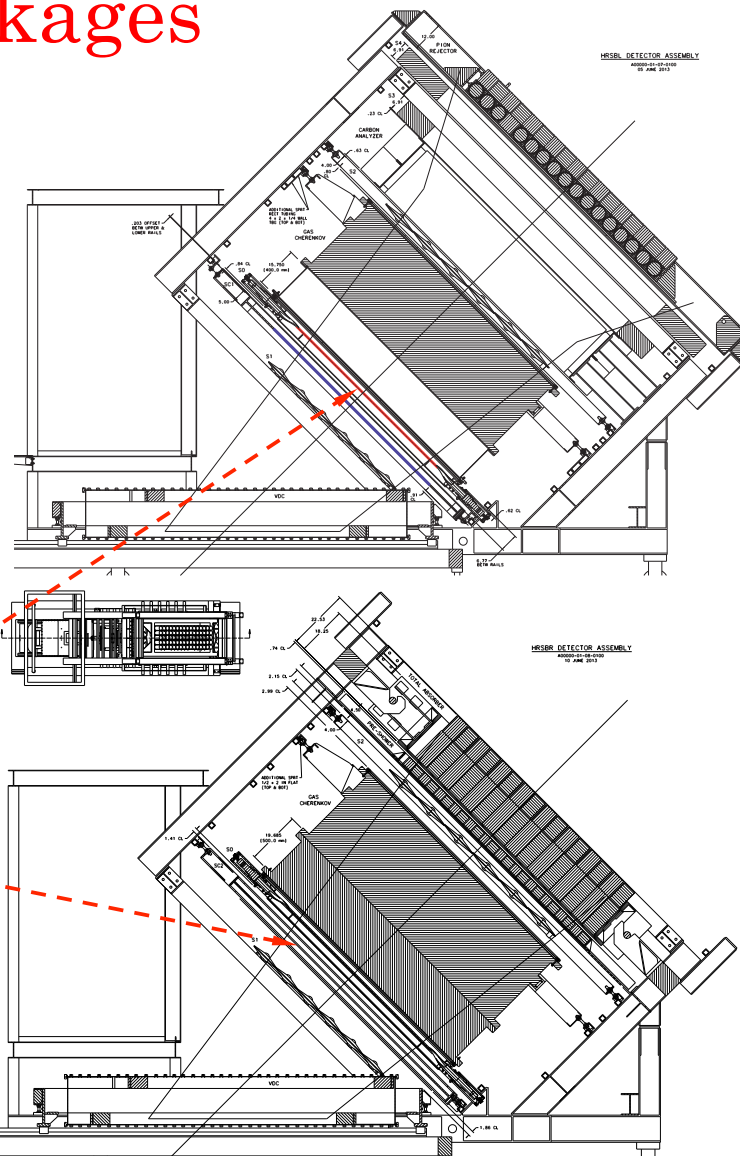
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Status of Detectors

VDC: upgrade of front electronics, 1877S

S0 plane: in good shape

S1 hodoscope: ready for S1m

S2m operates with 0.25 ns timing

Gas Cherenkov: old mirrors,
replacement of PMTs, WLS paint

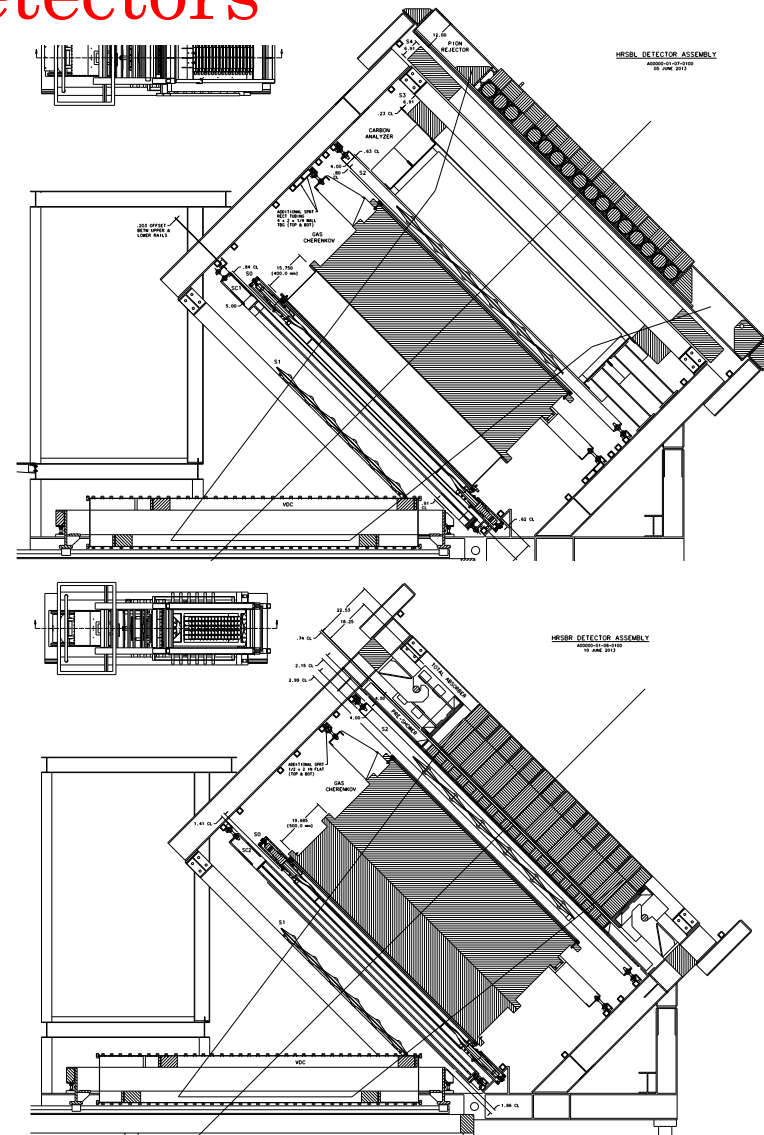
Lead-glass: in good shape, delay lines, HV

FPP (front): almost full repair

FPP rear ----- \ status is experiment

Aerogel A1, A2 ----- > driven: currently

RICH ----- / none of approved
experiments need it



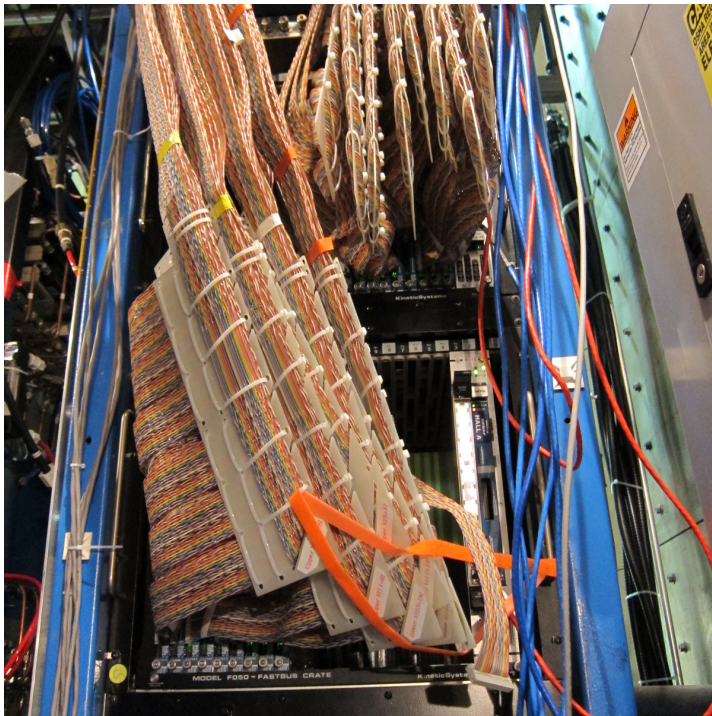
VDC status

STATUS: VDCs (all six) are in good shape

Upgrade of the front-end electronics - completed

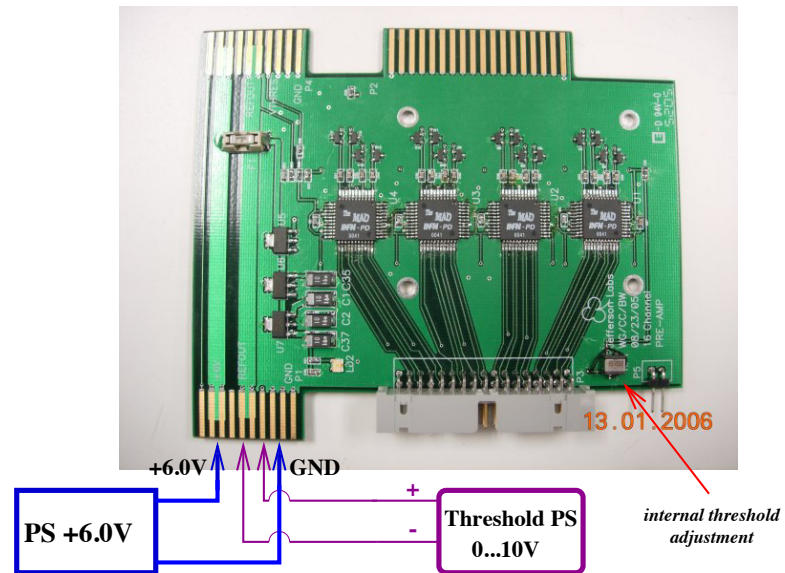
Very good stability against oscillation

Rate capability of 8 MHz (in the whole chamber) was demonstrated



June 13, 2013

slide 10



Bogdan Wojtsekhowski, Hall A collaboration, 2013

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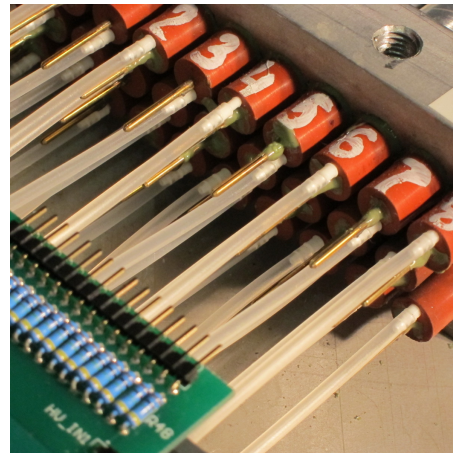
June 13, 2013

slide 11

Bogdan Wojtsekhowski, Hall A collaboration, 2013

Front FPP chambers

- New gas distribution hardware
- New HV distribution board
- Repair of the readout front-end cards
- New crates for the level translator



June 13, 2013

slide 12

Bogdan Wojtsekhowski, Hall A collaboration, 2013

PID detectors

- Gas Cherenkov
 - box depth: 1.3 m (HRS-R) and 1.2 m (HRS-L)



June 13, 2013

slide 14

Bogdan Wojtsekhowski, Hall A collaboration, 2013

PID detectors

- Time of Flight: Scintillator counters
 - 25 m flight path for Two-arm ToF
 - 2 m in single arm PID between S1 and S2
- Two-layer lead glass detectors
- CO₂ 1 atm Gas Cherenkov (10 5" PMTs)
- Threshold aerogel counters A1 (n =1.015) and A2 (n=1.055)
- RICH MWPC counter

I believe that the RICH detector can still be a resource for Hall A, at marginal maintenance cost; in case an experiment will need it (without upgrade, as-it-is), electronics is in VME standard and therefore supported at JLab, the expected maintenance costs are: 1-CsI evaporation (the evaporator is at Stony Brook); 2-purchase the liquid freon (if the existing one is deteriorated); 3-fix the PCB panel detachment (glue again at least 2 of the 5 PCBs) 4- fix the broken wires of the RICH chamber (not strictly required). Items 1, 3 and 4 require the use of the glove box which is still at JLab. The total cost for that, according to the last transversivity experiment, is on the level of a few \$10k.

Evaristo

HRS Detector Hardening

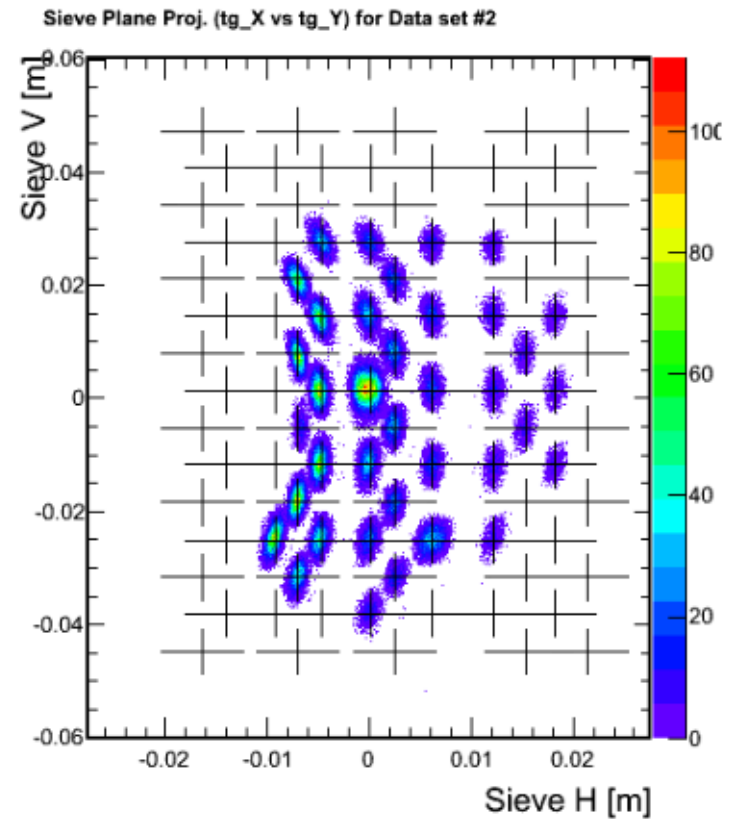
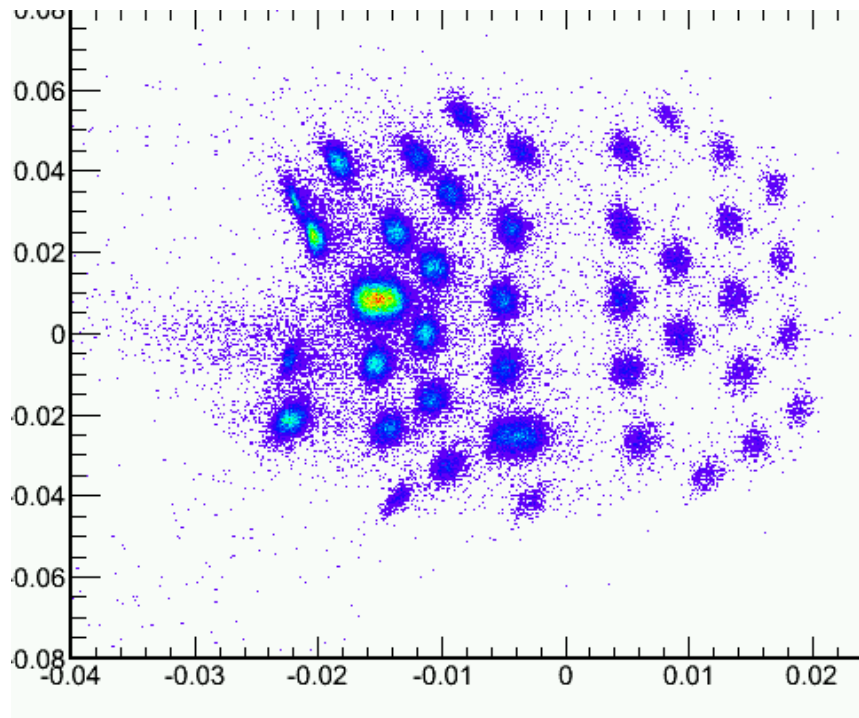
- VDC electronics – replacement of aged A/D cards is completed
- Time of Flight: Scintillator counters – replacement of aging S1: construction of S1m is completed, S1f needs manpower
- ~~▪ Reconditioning of A1 aerogel counter – replacement PMTs&box currently on slow path waiting approved proposal, design manpower, funding allocation~~
- Trigger electronics reconstructed with all NIM, more work is required with the EDTM system based on VME

HRS trigger electronics

- S2m – as before, but all in NIM
 - S0 – the same
 - Cherenkov – the same
 - Shower – new addition in the trigger
-
- 2/4 majority logic - based on the NIM units
-
- EDTM – controlled by VME, fan-out to the S2m/S0/Cherenkov PMTs and the Shower summing modules – work in progress

HRS optics

Traditional sieve pattern

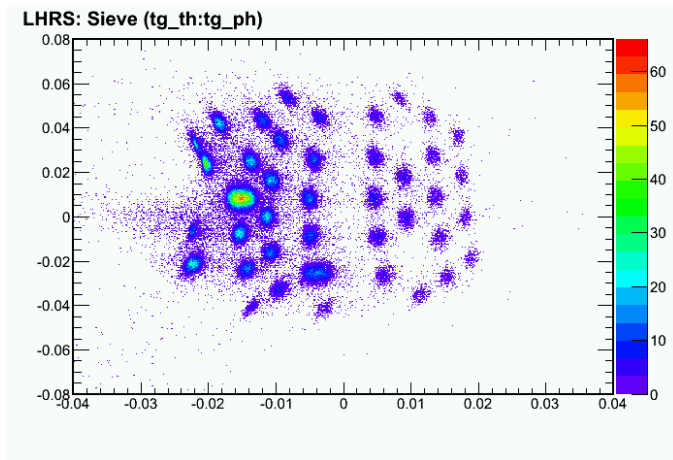


Final optics quality is very good: 0.1 mrad: relative is 0.1/50

Angular resolution is 0.33 mrad (horizontal) – observed!

HRS optics

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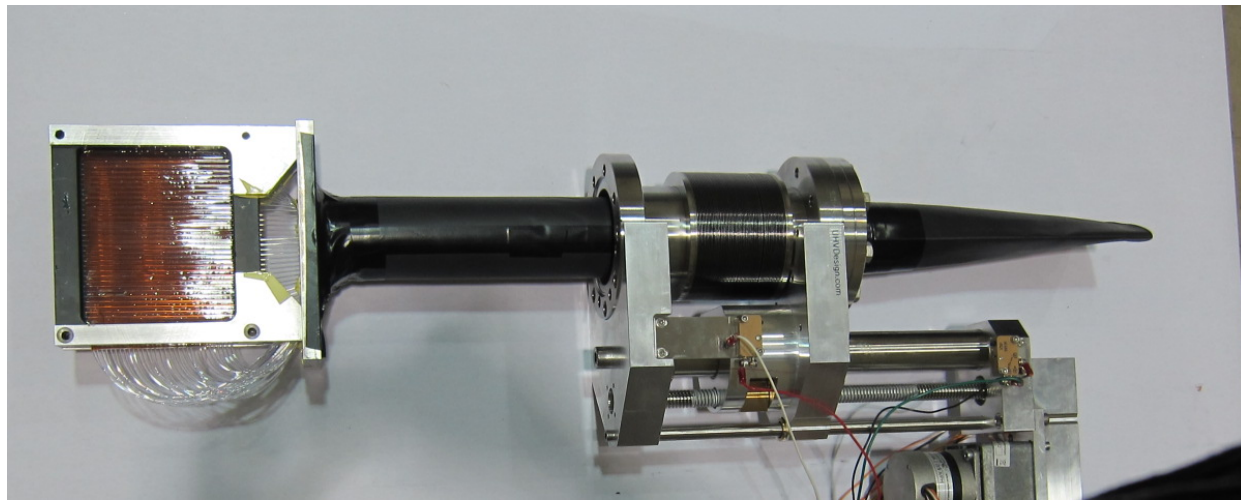


Active “sieve slit”: a Sci Fiber detector with 1 mm fibers with 1/4” pitch connected via a bundle of 1.5 mm clear fibers to a 64-channel PMT.

Readout via 1877S TDC; 1-3 MHz rate per fiber; off-line time window of < 5 ns
All components are constructed.

One arm was assembled in February.

Positively
charged particle
optics needs
the SciFi



HRS spectrometers: the tool for discoveries

- ❖ HRS FPP: GEP
- ❖ Septa magnet: HAPPEX, PREX
- ❖ HRS PID: $e, e'K$
- ❖ Calorimeter: WACS, DVCS
- ❖ HRS VDC rate capability: APEX – has a discovery potential

- ❖ What else could we do with HRS?
 - High Q^2 – GMp – needs a 1% absolute cross section
 - Phi meson in $(e, e'p)$ – interest in the threshold area

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Phi meson photo-production

Cross section vs. photon energy

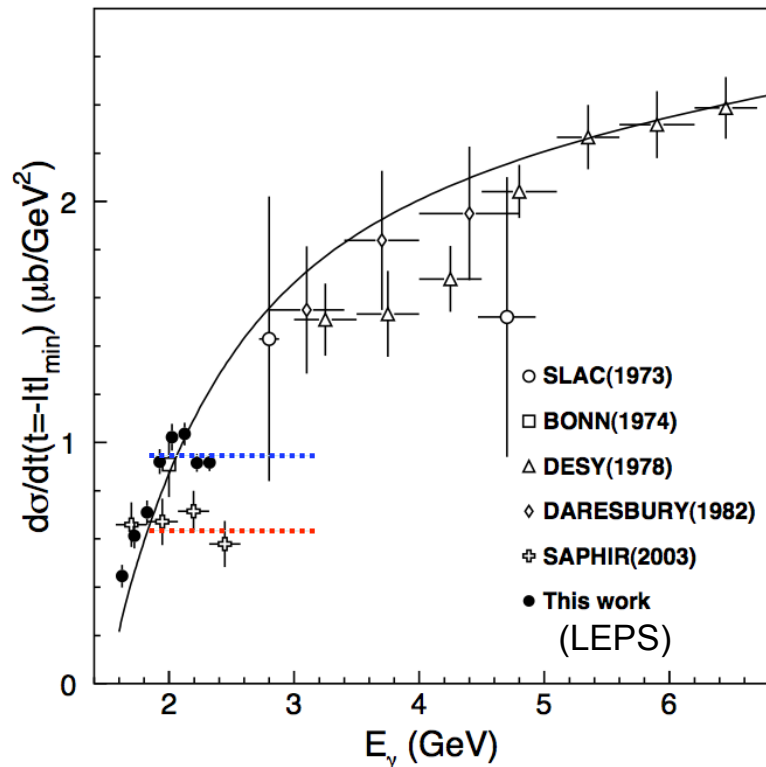
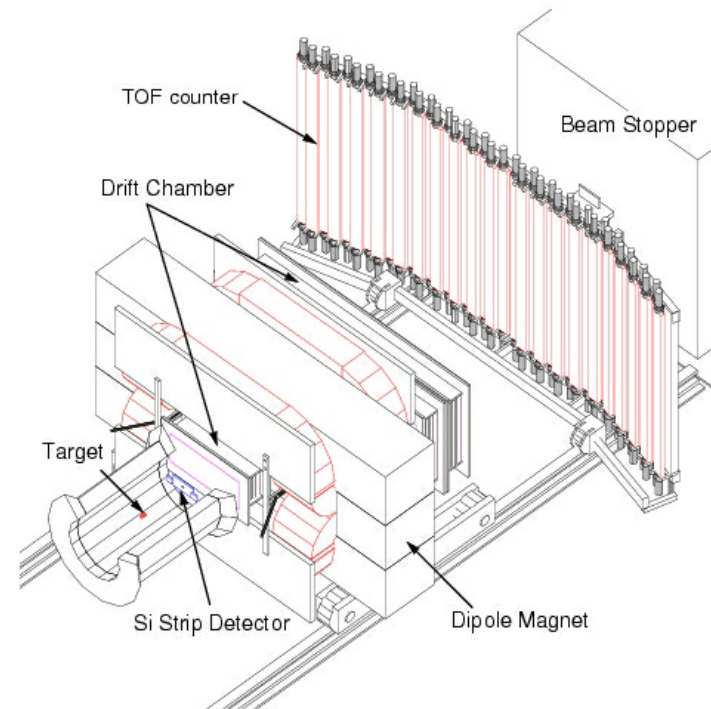


FIG. 3: Energy dependence of $(d\sigma/dt)_{t=-|t|_{min}}$. The closed circles are the results of the present work. Other data points are taken from Ref. [7, 8, 9, 10, 11, 12]. The error bars rep-

LEPS at Spring-8



$$H(\gamma_{\text{tagged}}, K+K^-)X$$

Phi meson photo-production

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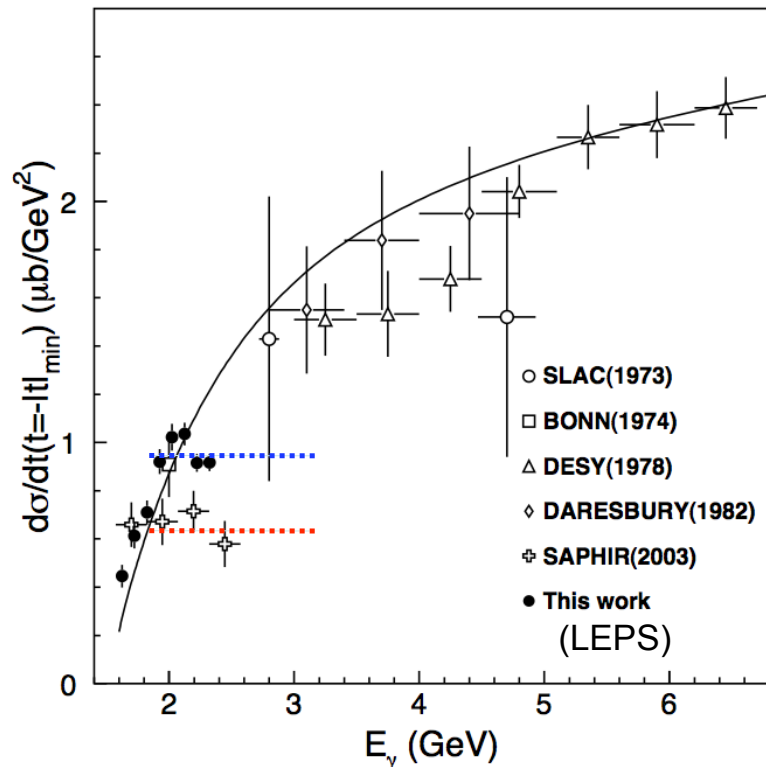
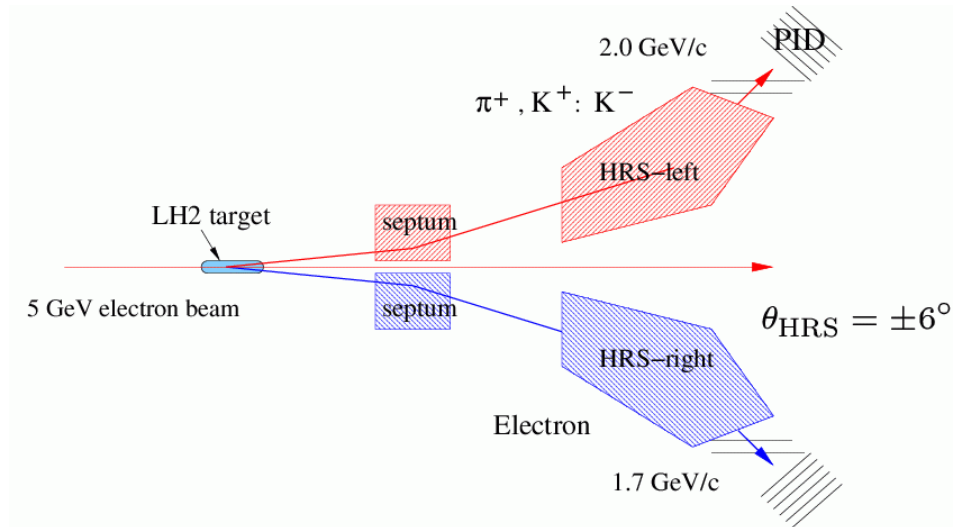


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HRS proposal:



H(e,e'p)X with 3-4 GeV beam

allows us to have a ϕ -meson

in the missing mass spectrum

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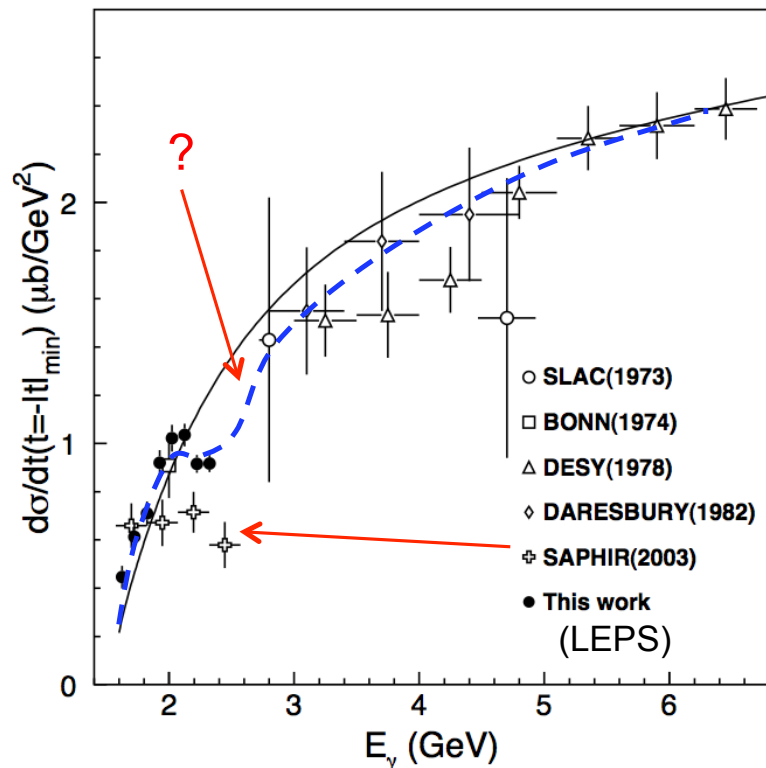
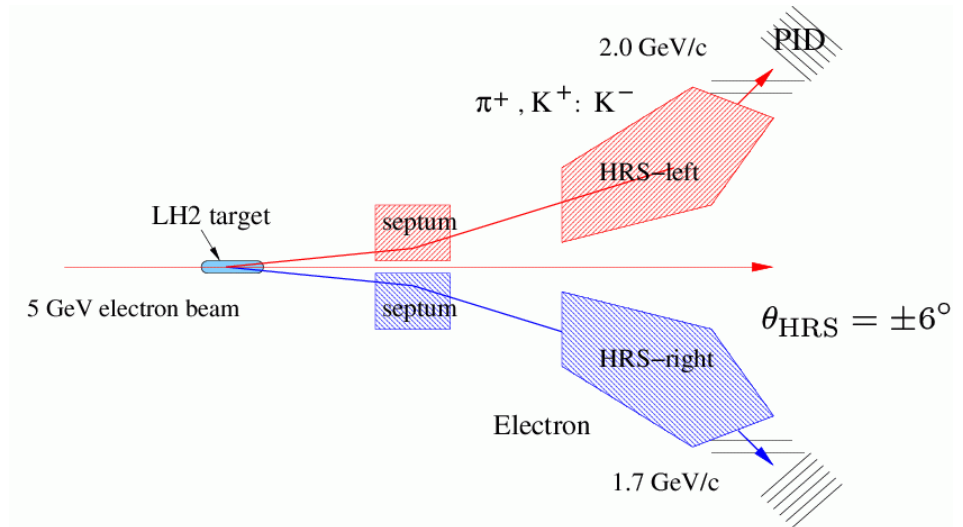


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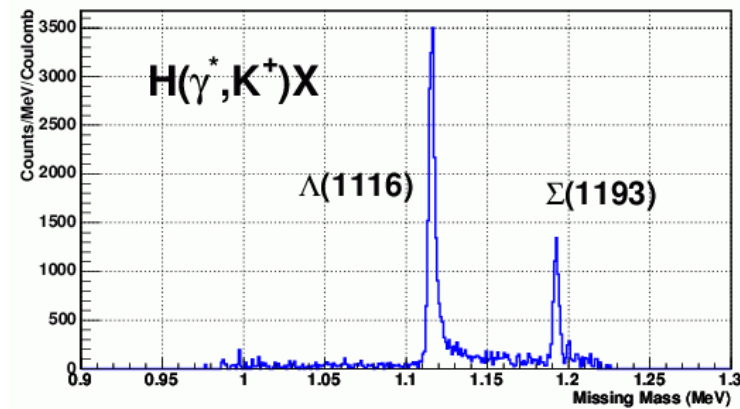
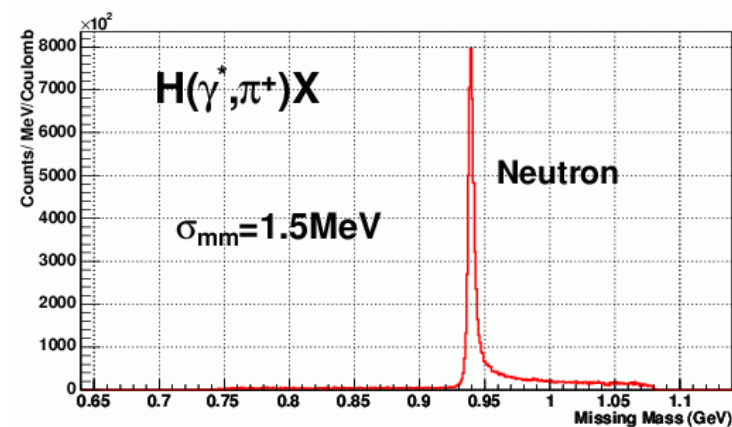
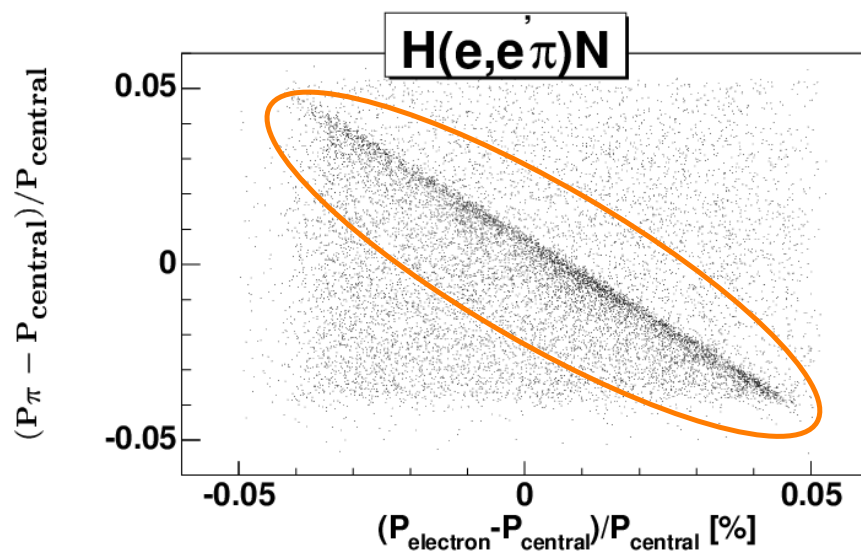
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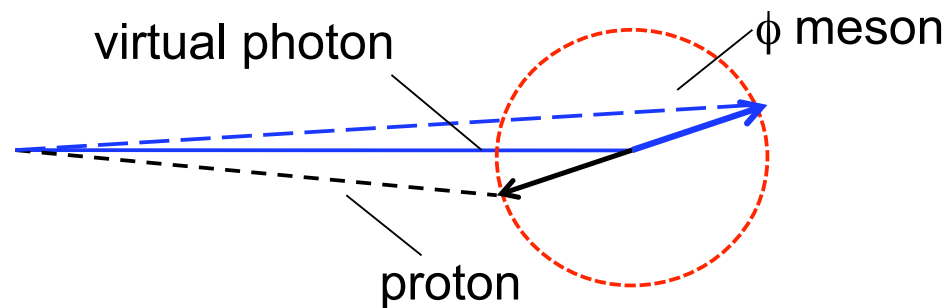
HRS best feature - resolution

Examples of 10-year old data
from the Θ^{++} search run



HRS unique feature – momentum resolution

Kinematical diagram



Small angle between phi and proton => possible binding effect

Let me know if you are interested in collaborating on such a proposal