E07-007 & E08-025 Overview

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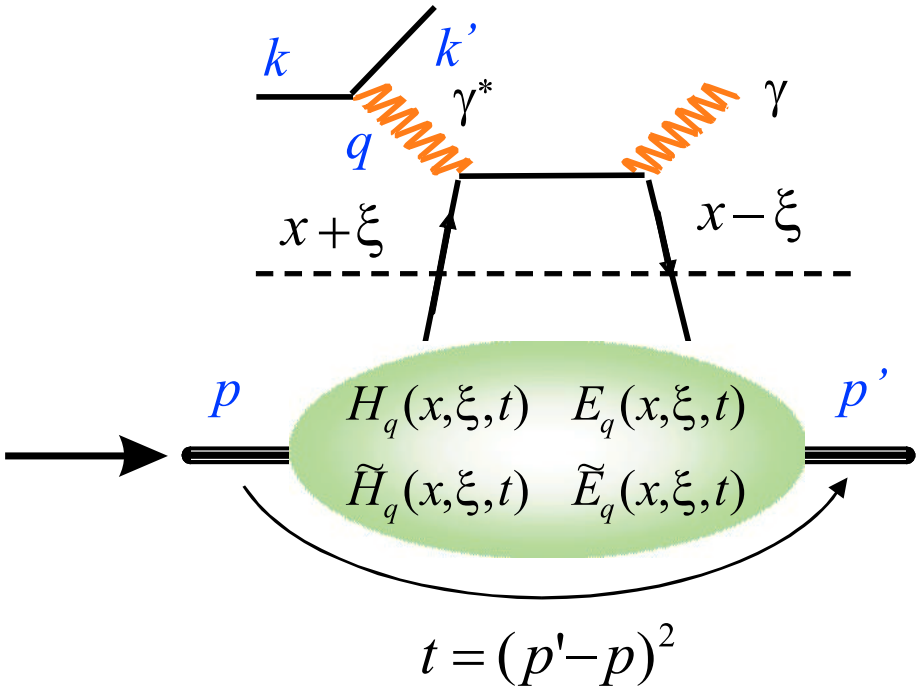
DVCS Collaboration Meeting
November 12, 2012

Hall A DVCS program



Handbag diagram

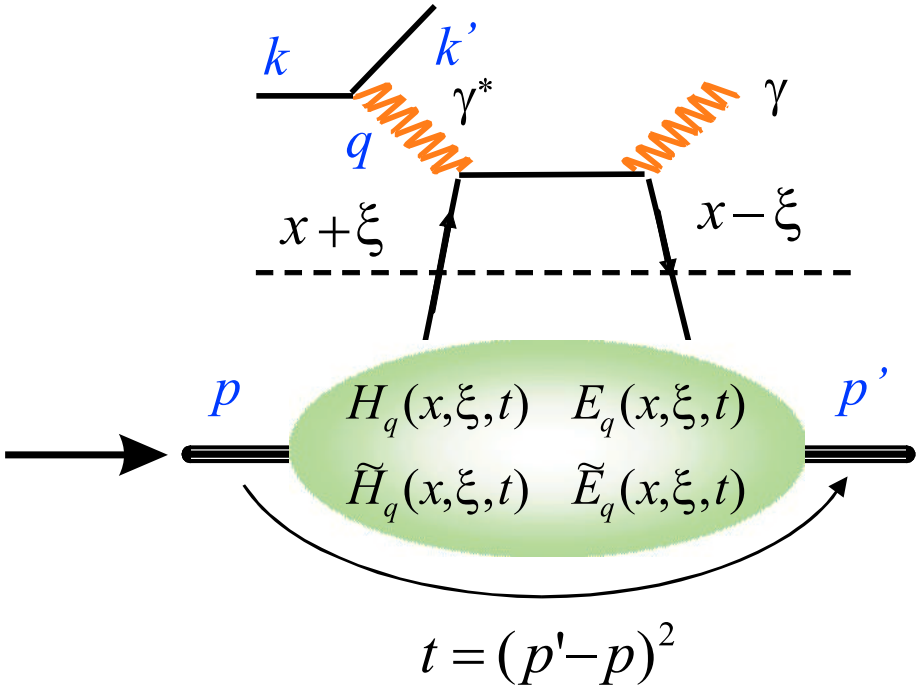
High Q^2
Perturbative QCD

Non-perturbatif
GPDs

Limite de Bjorken :

$$\left.\begin{array}{rcl} Q^2 = & -q^2 \to & \infty \\ & \nu \to & \infty \end{array}\right\} \quad x_B = \frac{Q^2}{2M\nu} \text{ fixed}$$

Hall A DVCS program



Handbag diagram

High Q^2
Perturbative QCD

Non-perturbatif
GPDs

PAC 39 Report, June 2012

"The new data will be of unprecedented statistical precision, but the statistics will go to waste if the data cannot be interpreted with commensurate accuracy. [One] example is the GPD program, where it is pointless to display new asymmetries before scaling has been established in a given channel"

E07-007/E08-025

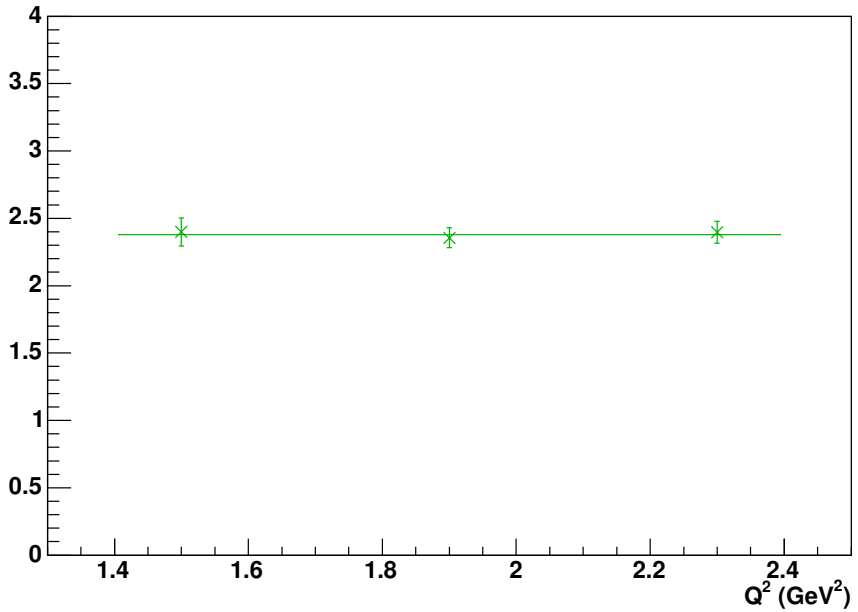
Goal:

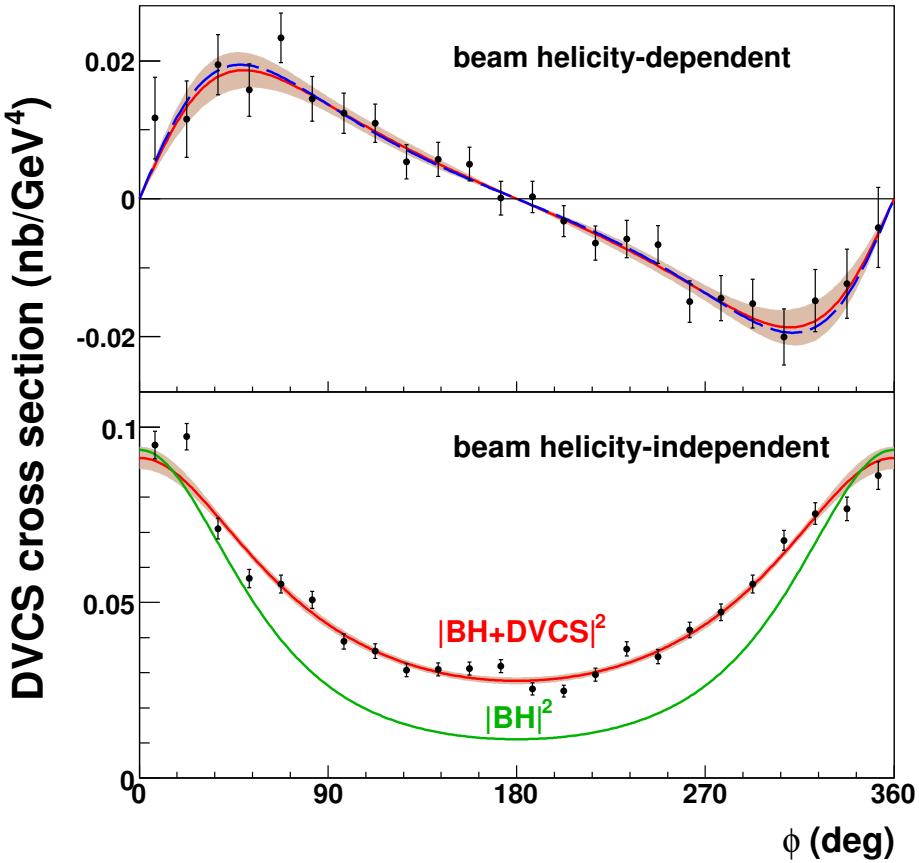
- Measure DVCS cross sections as a function of Q^2 and different beam energies, for both LH2 and LD2.
- Separation of DVCS^2 from interference BH-DVCS interference terms
- Rosenbluth separation of π^0 electroproduction cross section

- Same setup for both experiments
- Only target change from LH2 to LD2
- Data taken: Oct-Dec 2010

Motivation: results from E00-110

Q^2 variation of $\mathcal{I}\mathrm{m}\mathcal{C}^I$





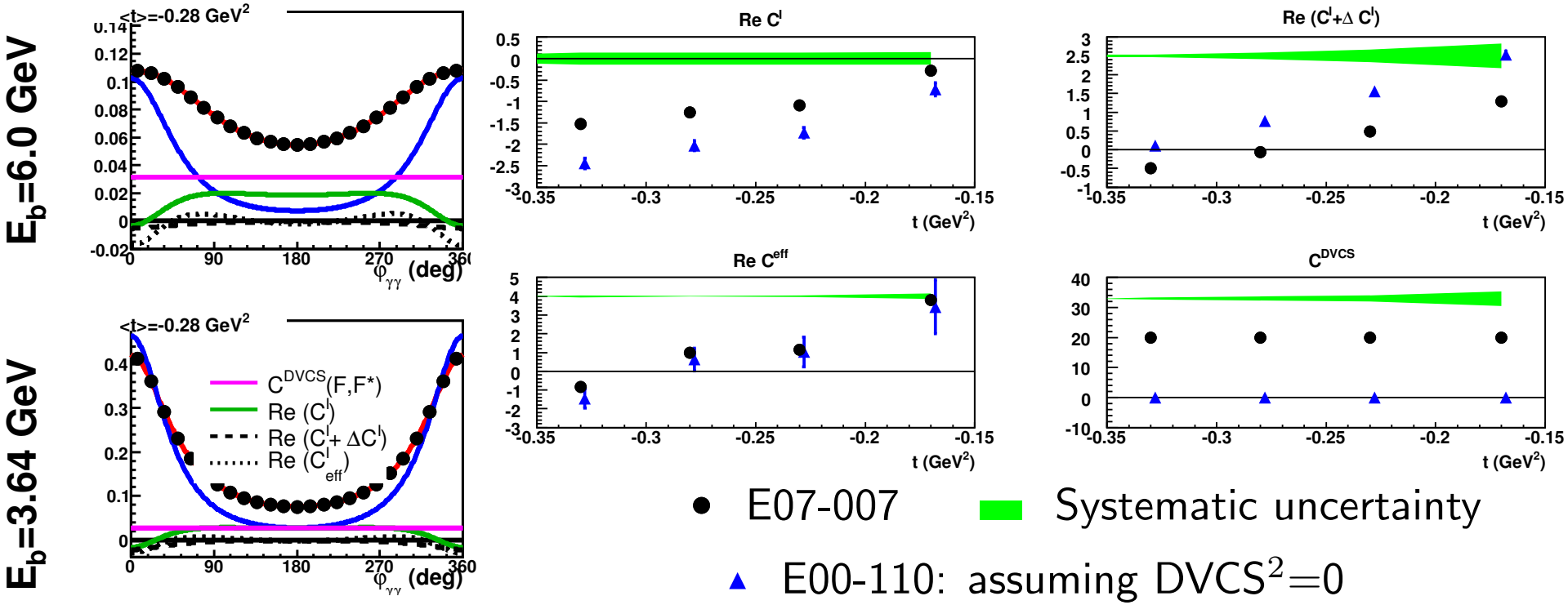
BH much smaller than total cross section $\Rightarrow$ BH·DVCS

interference alone **cannot** explain the difference

E07-007: Rosenbluth-like DVCS^2–$\mathcal{I}$ separation in Hall A

- Clean separation of BH-DVCS intereference term from pure DVCS^2
- Scaling test on the real part of the DVCS amplitude
- Rosenbluth separation of σ_L/σ_T for $ep \to ep\pi^0$

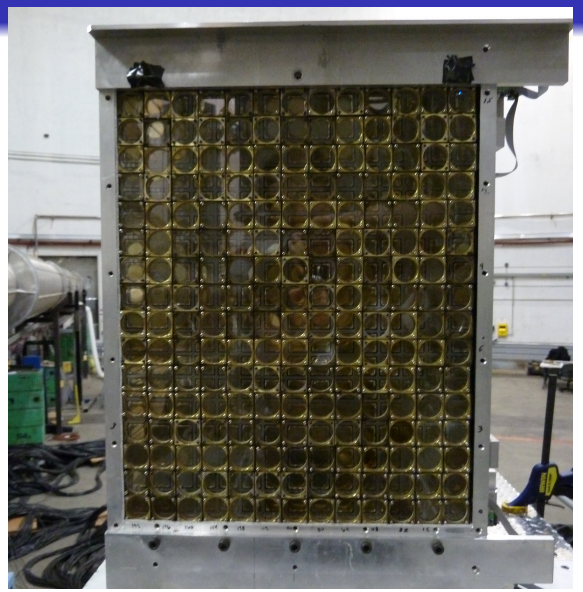
$d^4\sigma$ (nb/GeV^4)



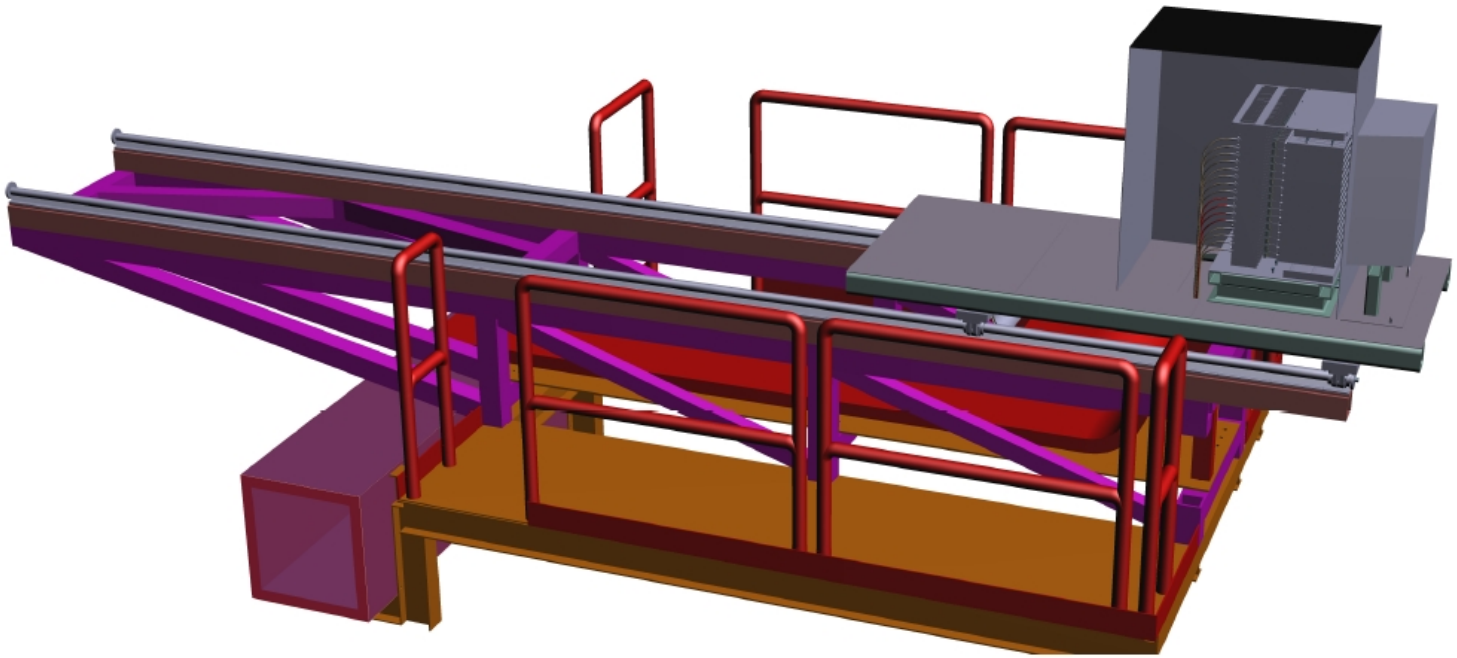
● E07-007 ▬ Systematic uncertainty

▲ E00-110: assuming DVCS^2=0

DVCS detector package



- 208-channel PbF_2 electromagnetic calorimeter
- DVCS stand of top of BigBite stand
  (moving cart: 1.1 m $\rightarrow$ 5.5 m from target)
- CH shielding in front of calorimeter

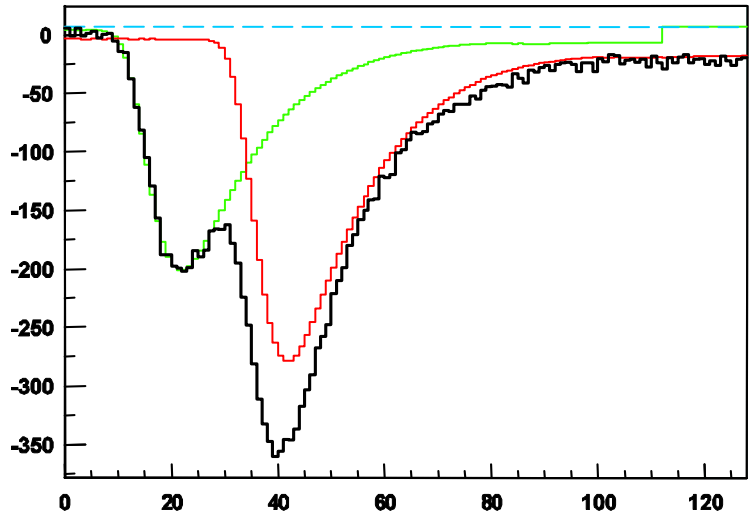


DVCS electronics and DAQ

1 GHz sampling based on the **Analog Ring Sampler (ARS)**

Chip developed by IRFU/CEA-Saclay

Front-end electronics by LPC/Clermont-Ferrand



Calorimeter trigger:

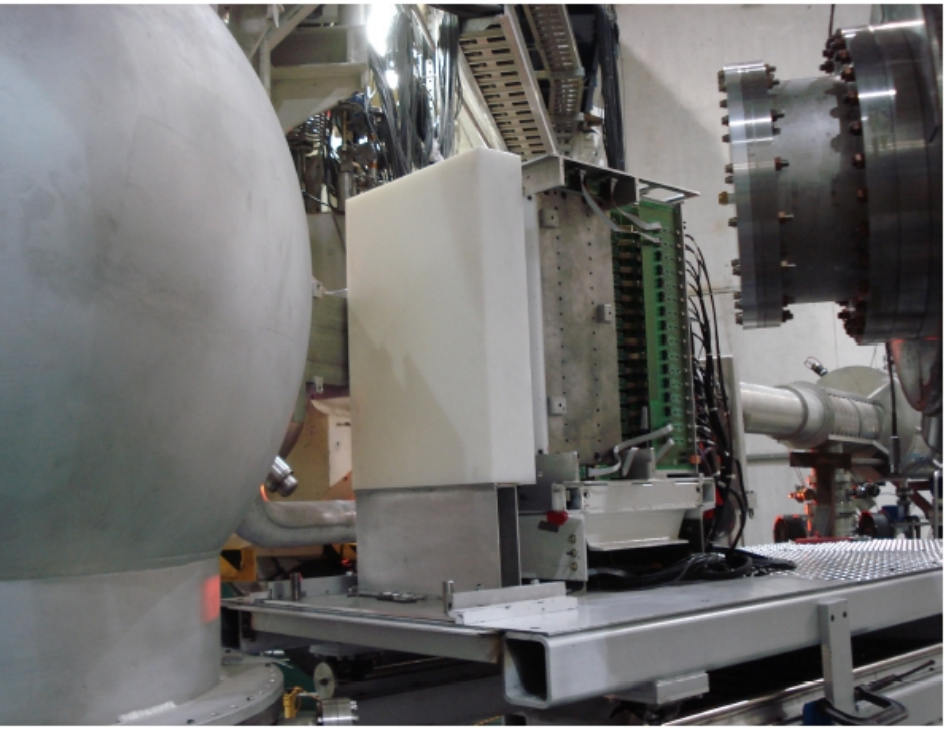
- VALIDATES if 1 set of 2×2 blocks over threshold (~ 500 ns).

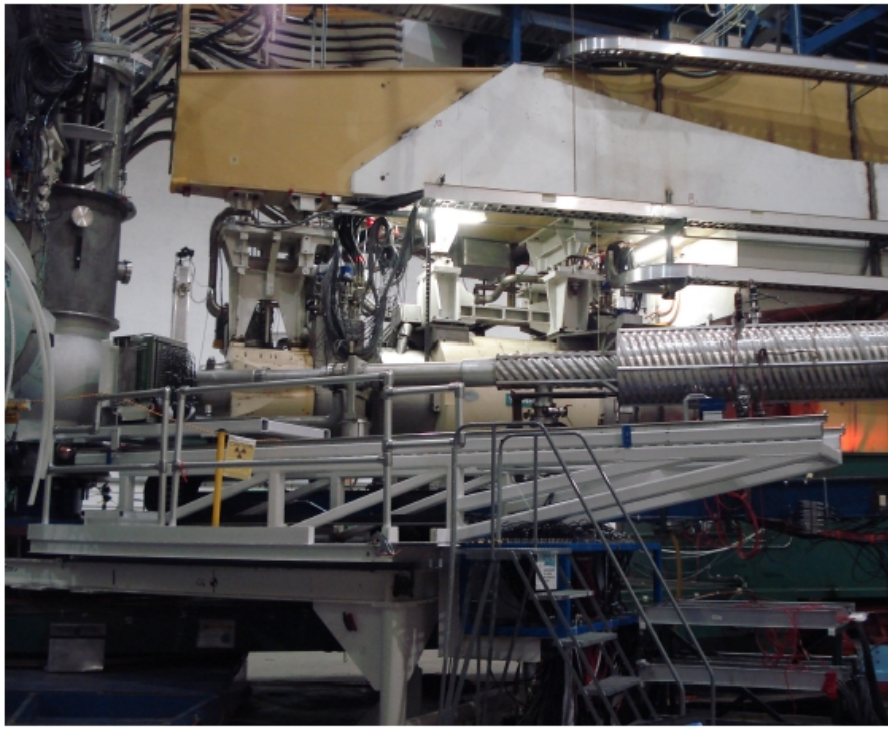
1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121
122	123	124	125	126	127	128	129	130	131	132

- Each sample in 12-bit flash ADCs

More details: M. Magne's talk (electronics) and A. Camsonne (DAQ)

DVCS setup in Hall A





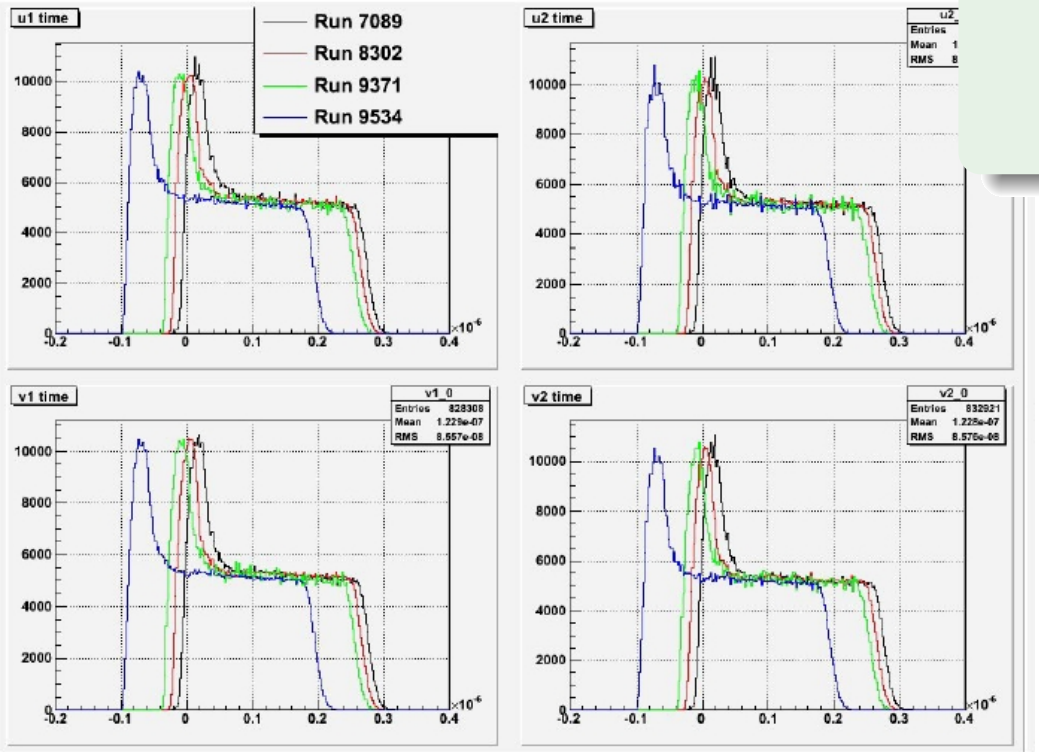
Running conditions for E07-007 & E08-025

Data analysis

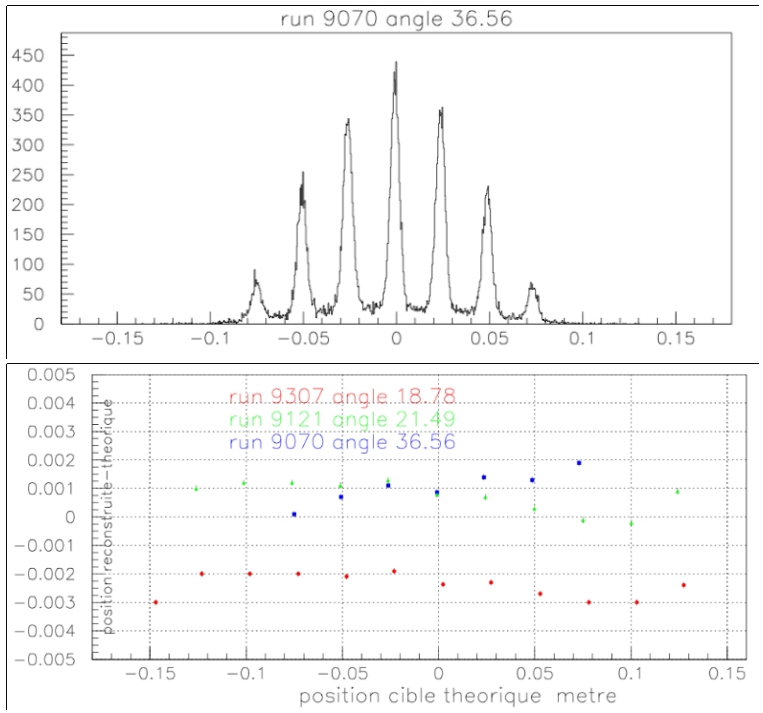
- Beam line
  - Polarimetry (Compton + Møller) data (FINISHED), E. Fuchey
  - Beam charge monitors (BCM) calibration (FINISHED), J. Roche
- HRS
  - Optics and mispointing checks (FINISHED), P. Bertin
  - Drift chambers time offsets (FINISHED), C. Muñoz
- Calorimeter
  - Elastic (energy) calibrations (FINISHED), A. Martí
  - Waveform analysis of PMT pulses (FINISHED), A. Martí
  - Time (calorimeter + HRS) corrections (FINISHED), M. Mazouz
  - Clustering and calibration optimizations (IN PROGRESS...)
- MC simulation, R. Paremuzyan, M. Defurne
  - GEANT4 written from scratch based on previous GEANT3 (FINISHED)
  - Validating results by comparing to old simulation (IN PROGRESS...)

HRS analysis

Frequent timing changes during the experiment

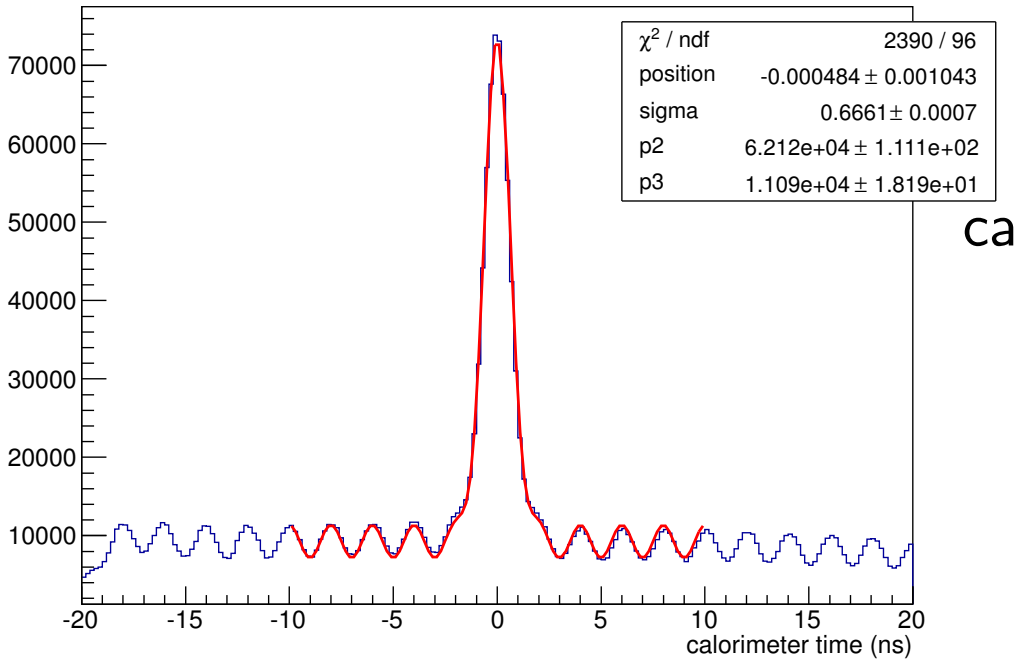


- Survey of HRS pointing at one particular angle
- Multifoil target runs at every kinematics



Careful checks and ajustments of VDC offsets necessary

Coincidence time



Relative time between HRS and calorimeter corrected for:

- S2 paddle time offsets
- x & y position of the track
- Amplitude of the S2 signal

0.67 ns coincidence time resolution

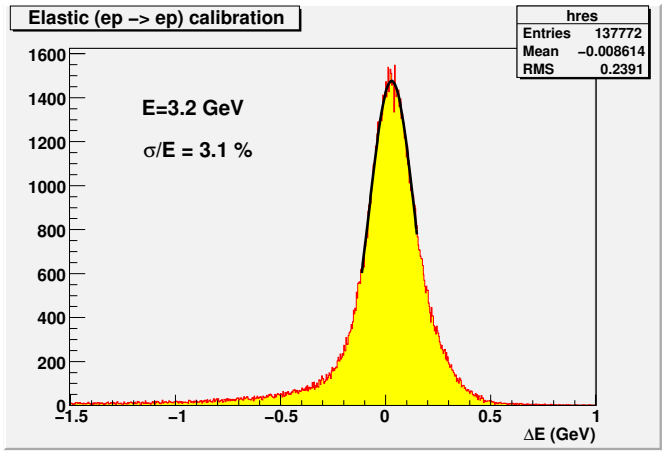
More details: M. Mazouz's talk

Elastic calibrations

$ep \rightarrow ep$

- p in L-HRS
- e in DVCS calorimeter

Date	E (GeV)	σ/E	$\sigma/\sqrt{E}$ (GeV$^{1/2}$)
Oct 26	3.2	3.1%	0.0555
Nov 17	3.2	3.1%	0.0555
Dec 14	3.9	2.8%	0.0553



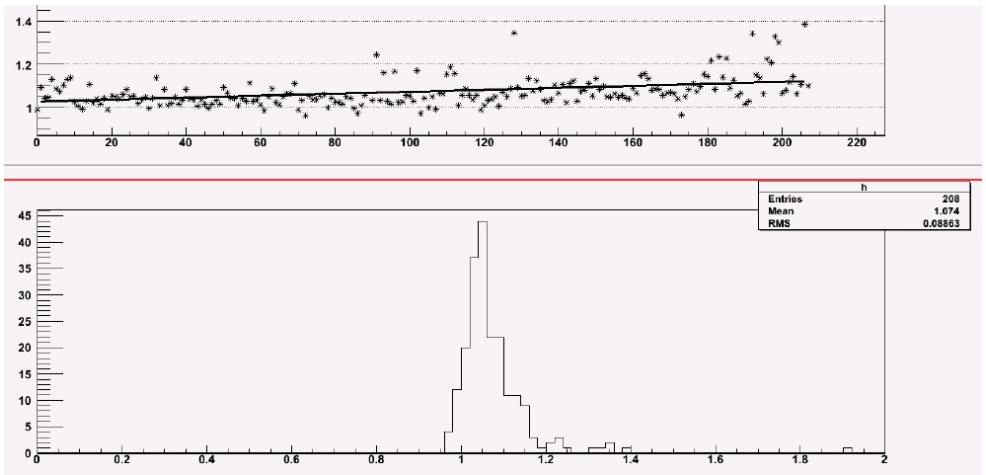
- Absolute calibration points for each block
- Energy resolution and absolute calibration changes $\Rightarrow$ Radiation damage

More details: A. Martí's talk

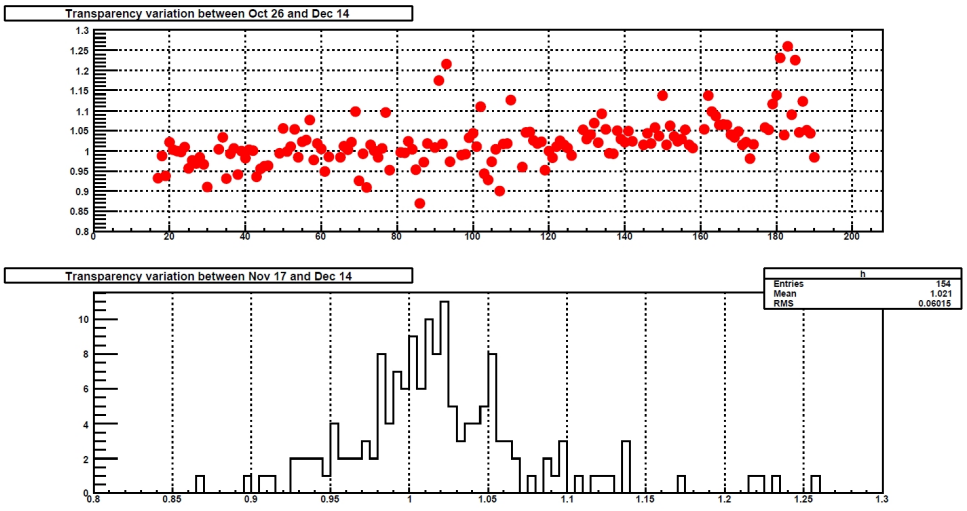
Radiation damage

Calibration coefficient changes between:

Nov 17 / Oct 26
(7% average gain loss)



Dec 14 / Oct 26
(2% average gain loss)

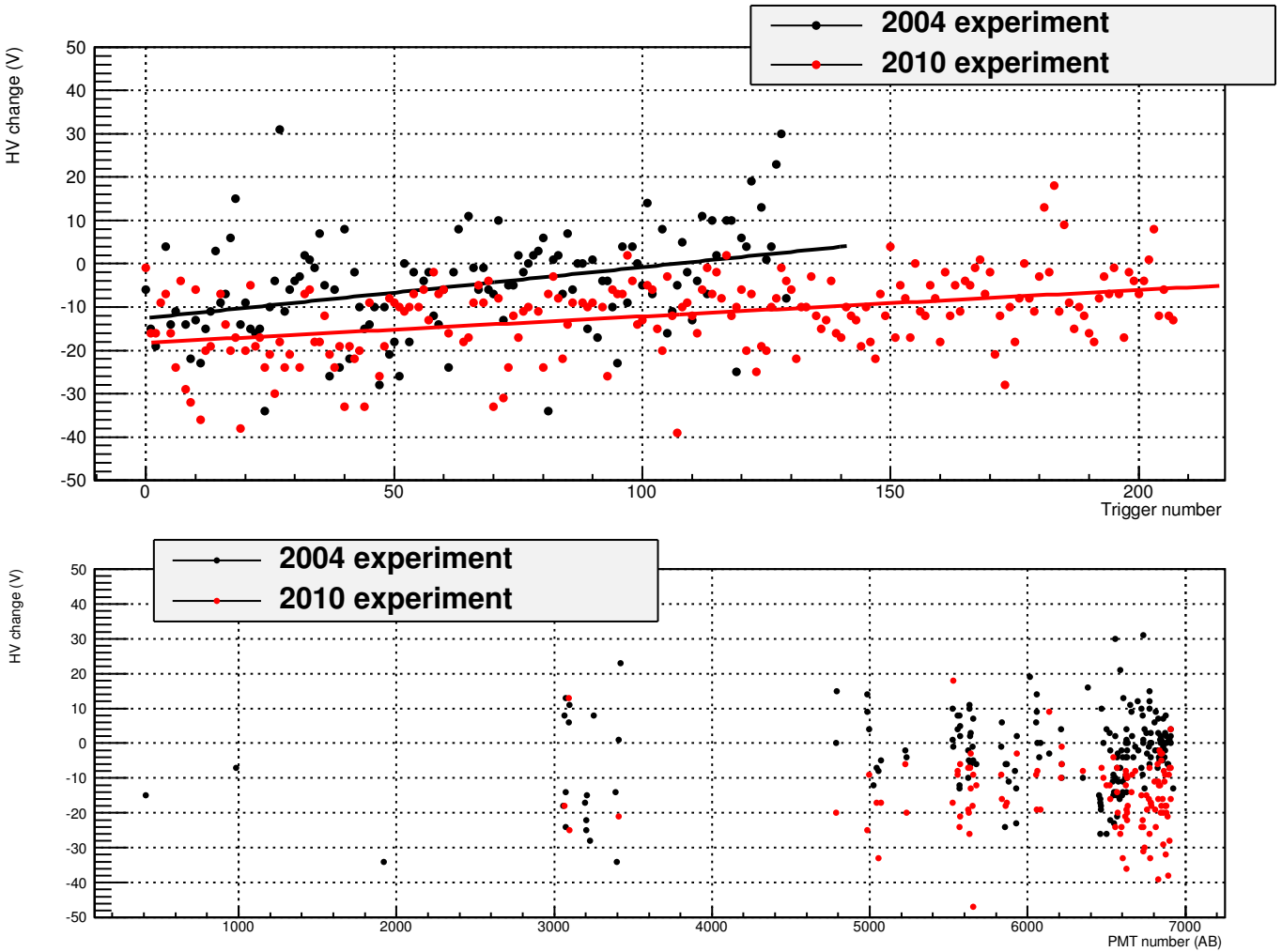


- Radiation damage to PbF_2 blocks
- PMT gain changes

PMTs shipped to Clermont-Fd for testing in Feb 2012...

PMT gain changes measured at LPC-Clermont

$10\,V$ correspond $\sim 15\%$ gain change

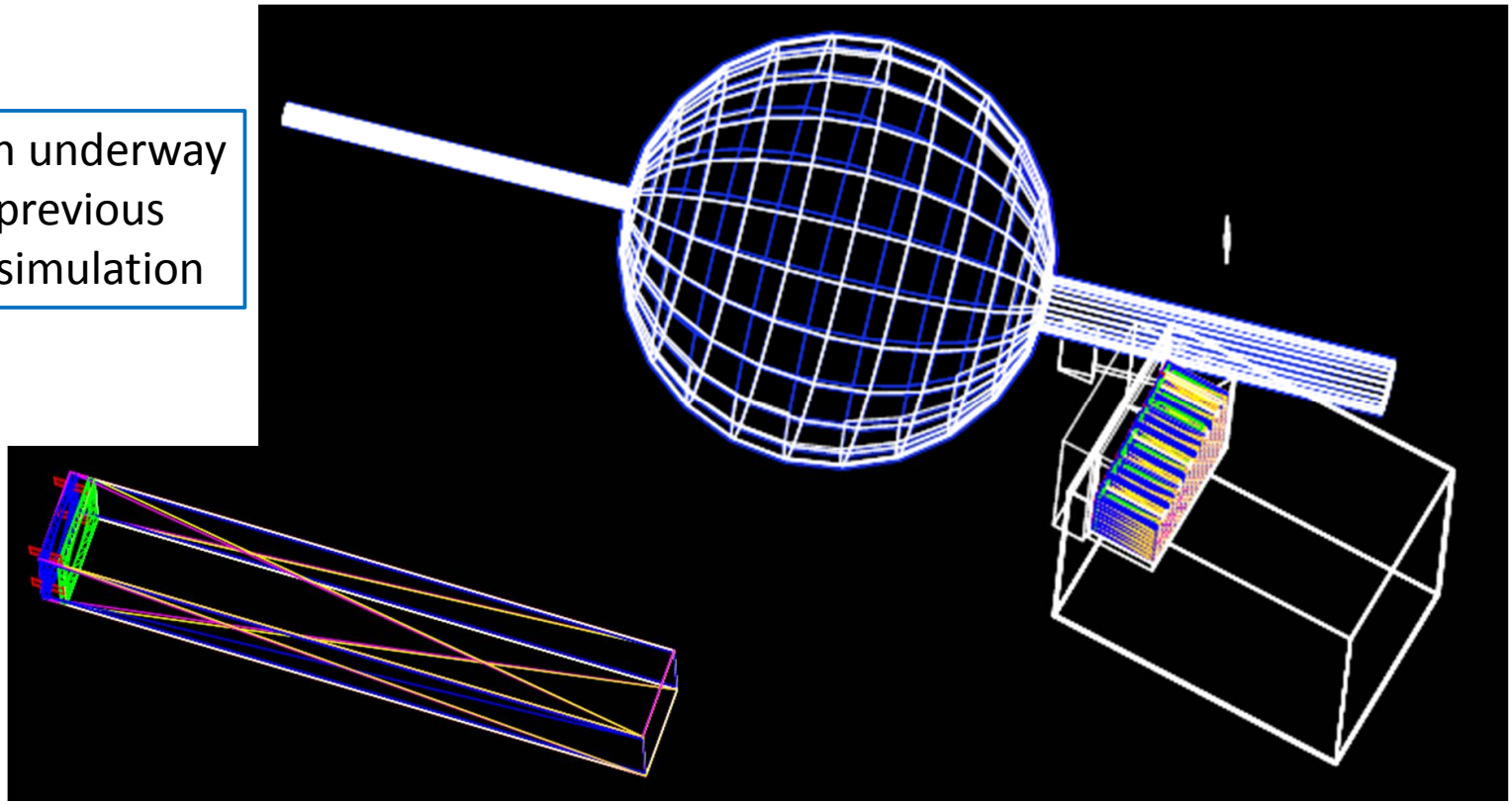


- Moderate gain variation of PMTs after two experiments
- PMTs in good shape for 12 GeV

Geant4 simulation package

- Full geometry implemented:
  - Target and scattering chamber
  - Calorimeter blocks with wrapping and PMT holders, shims, and surveyed positions
  - Calorimeter and beam pipe shielding
- Coupled to C++ DVCS event generator, including RC
- Using same C++ reconstruction software as DVCS data

Validation underway using previous Geant3 simulation



More details: R. Paremuzyan

TODO

- Final checks on waveform analysis results
- Refine calibration between elastic calibrations (using $\pi^0 \to \gamma\gamma$)
- π^0 substraction (for DVCS)
- Cross-section extraction (as a function of Q^2):
  - DVCS L/T separation on proton
  - DVCS L/T separation on neutron
  - π^0 L/T separation

Roughly 6–12 months of analysis left for preliminary results