

GEP-2Gamma (E04-019) & BigCal Status

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For the GEP-2G Collaborations

*The College of William and Mary

- GEP crisis 7 years after: theoretical predictions
- The goals of GEP-2gamma:

TEST OF THE LIMITS OF THE POLARIZATION METHOD:

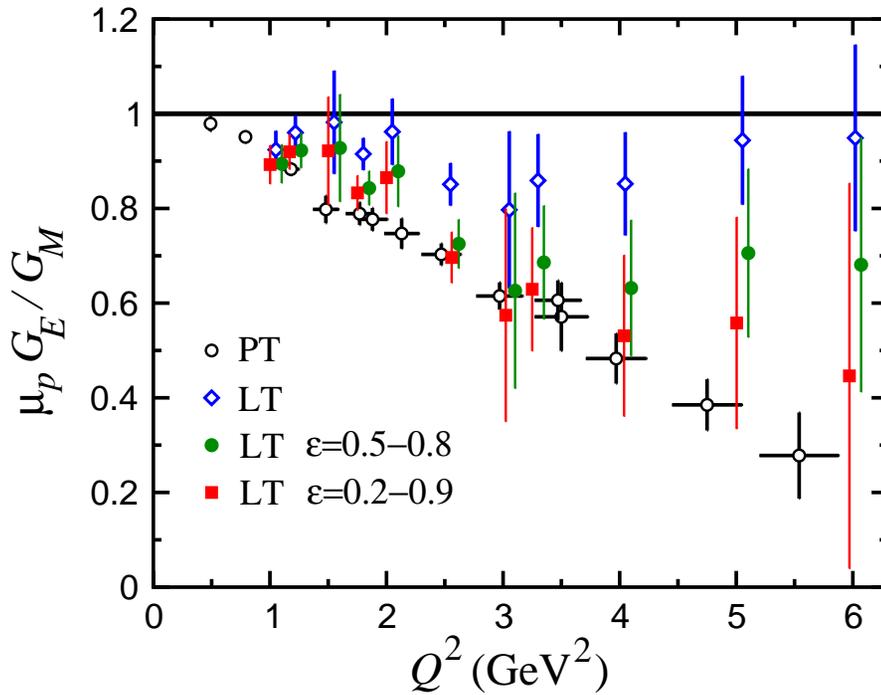
ε dependence of G_E^p / G_M^p , p_l , p_t at fixed Q^2 – NEVER MEASURED BEFORE

Graduate students: Andrew Puckett (MIT), Mehdi Meziane (W&M), Wei Luo (Lanzhuo U. Chiana)

- Big Calorimeter: activities in 2006, summary of the problems/ experience during its construction and testing, experimental requirements

Five approved and three proposed experiments intend to use BigCal:

GEP-III (E04-108), GEP-2G(E04-019), SANE(E03-109), semi-SANE(E04-113), helicity correlations WACS (E05-101), polarization transfer WACS(PR07-002), double-spin in SIDIS(PR07-015), deuteron spin-structure (PR07-011)



Hadronic calculations

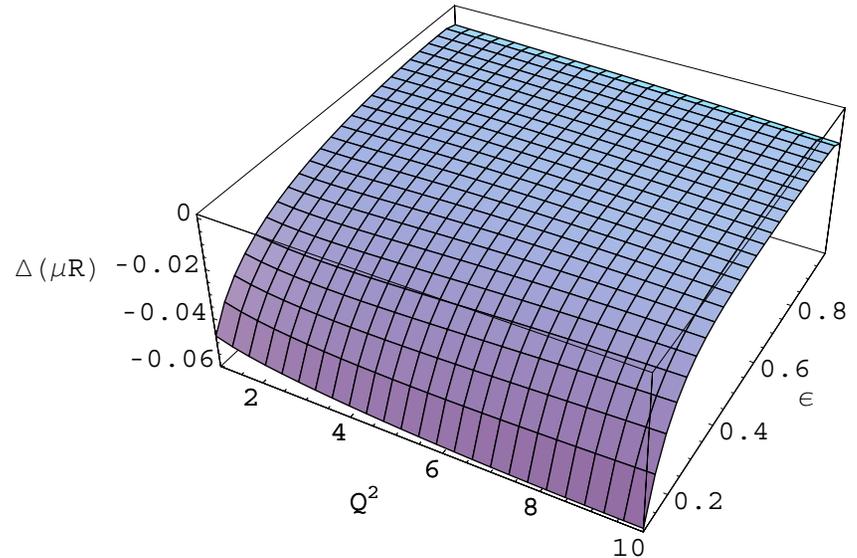
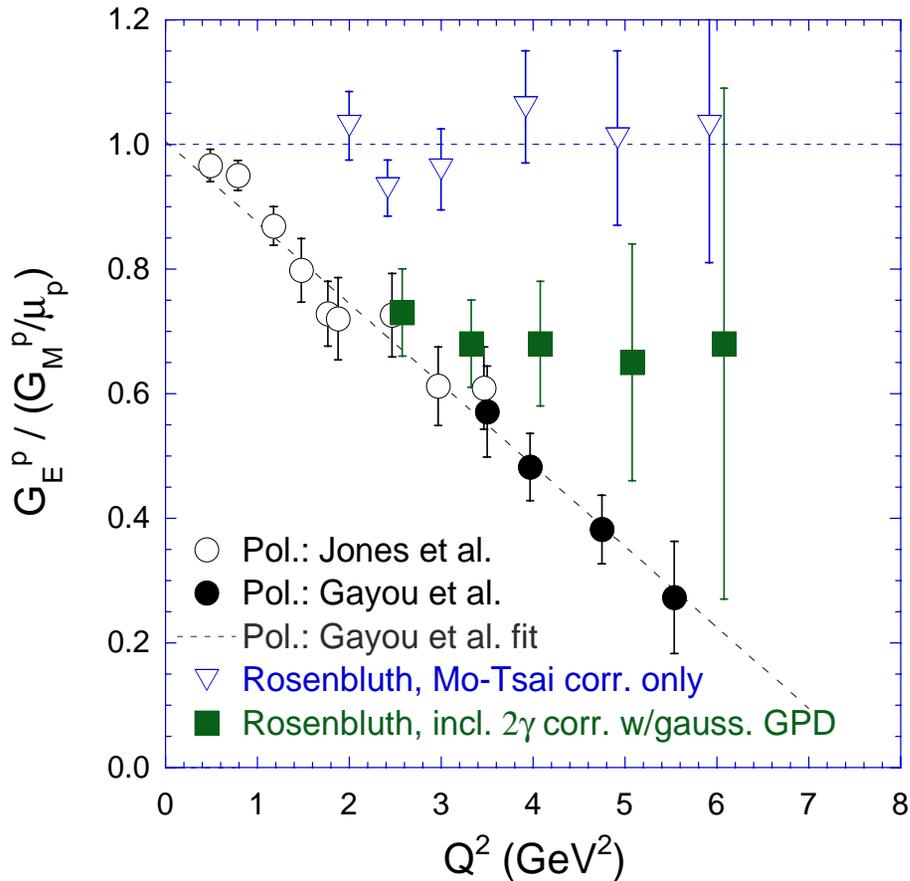
- **P.Blunden et al., Phys.Rev.C72: 034612 (2005)** elastic (Figure)
- **S.Kondratyuk et al., Phys.Rev.Lett. 95: 172503 (2005)** including Delta reduces the effect
- **S.Kondratyuk et al., nucl-th/0701003 (2007)** including 1/2 and 3/2 resonances – no effect

- **Y.Bystritskiy et al., hep-ph/0603132 (2006)** 2γ effects small, bigger RC than Mo & Tsai
- **D.Borisyuk et al., nucl-th/0612104 (2006)** valid for very low Q^2

GEP crisis 7 years after

GPD calculations

Rosenbluth w/2- γ corrections vs. Polarization data

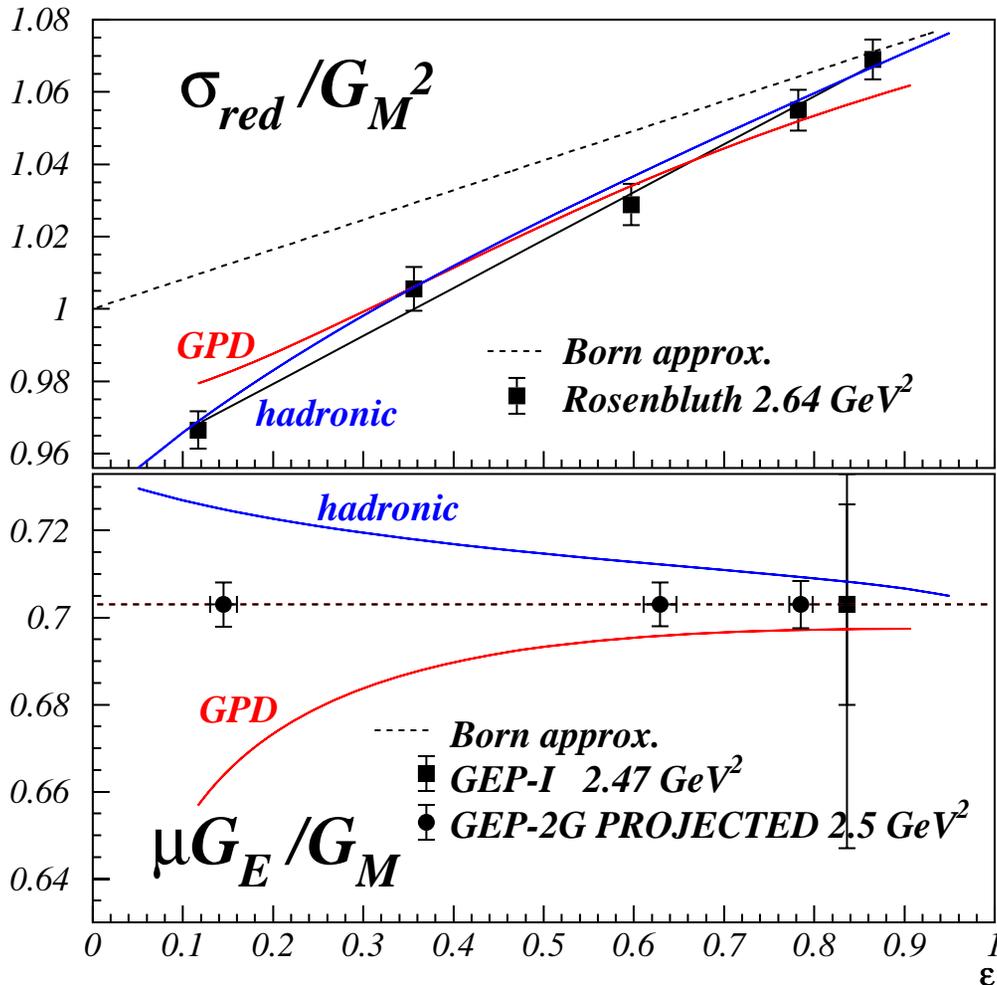


Absolute correction to FF ratio:

slow Q^2 variation, strong effects at low ϵ
(valid for high Q^2 or ϵ)

•A.Afanasev et al., Phys.Rev.D72:013008 (2005) – GPD models: Gauss on Fig., smaller effect with Regge, or non-zero quark mass

GEP-2G goals: ε dependence of R at 2.5 GeV²



hadronic (elastic): dominated by correction to G_M

GPD (includes inelastic): dominated by F_3 and correction to G_E

Both theories describe Rosenbluth data but have opposite predictions for $\mu G_E/G_M$

precision limited only by statistics

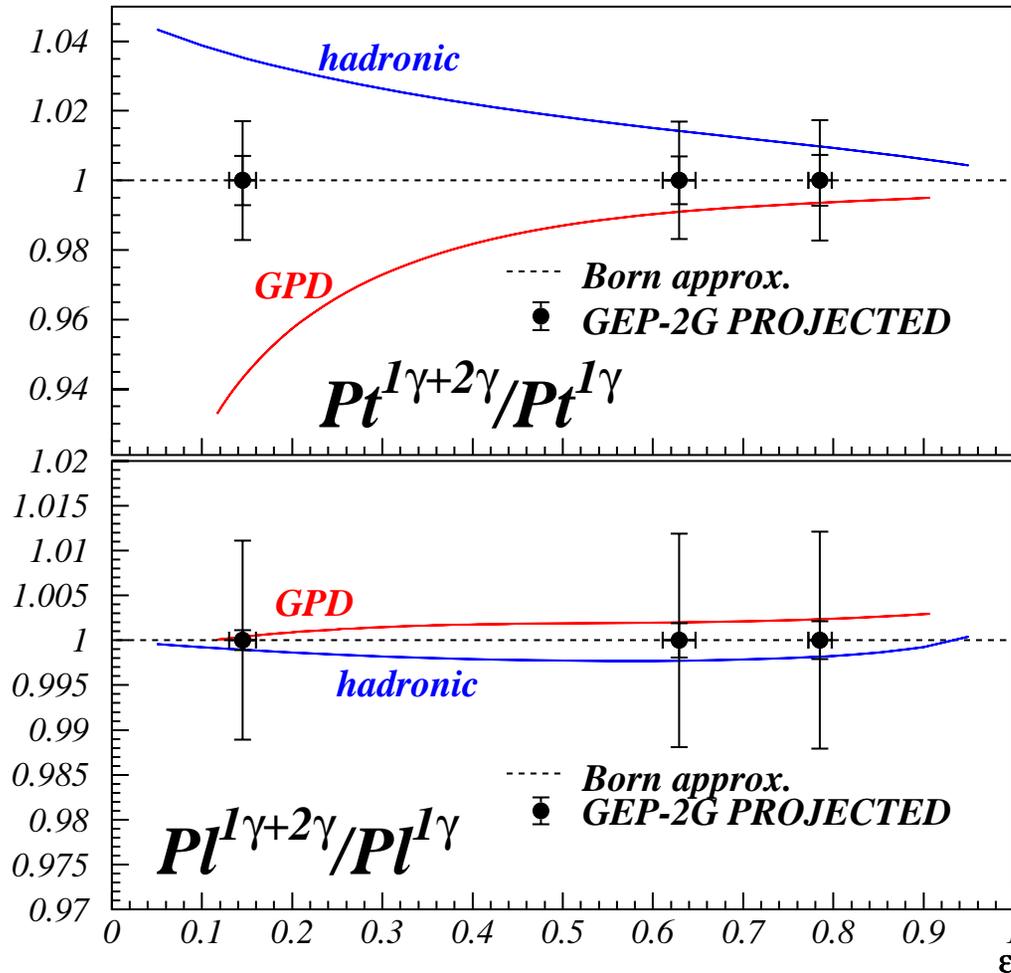
(~ 0.7%), unlike Rosenbluth,

very small p.t.p. systematics:

- A_y , h cancel out in the p_t/p_l ratio

- Q^2 fixed, p_p fixed, χ fixed

GEP-2G goals: ε dependence of p_t , p_l at $Q^2=2.5 \text{ GeV}^2$



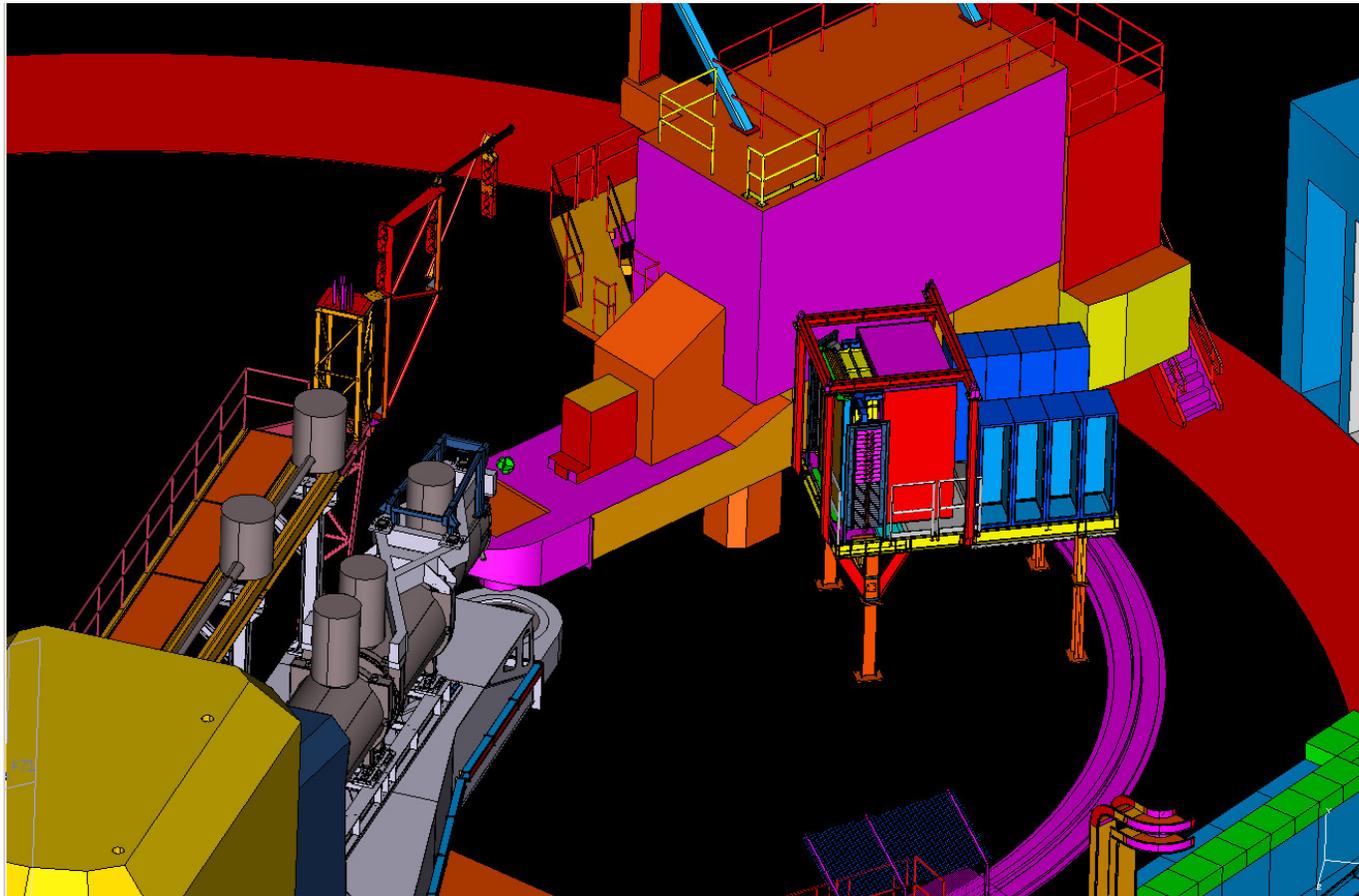
p.t.p. systematic uncertainties:

- 1% beam polarization
- 0% analyzing power :

Q^2 fixed, p_p fixed, A_y fixed

0.75% absolute systematic error: (0.45% non-dispersive bend angle, 0% dispersive (108° prec. angle), 0.3% FPP chambers misalignment)

E04-019 kinematics, requirements



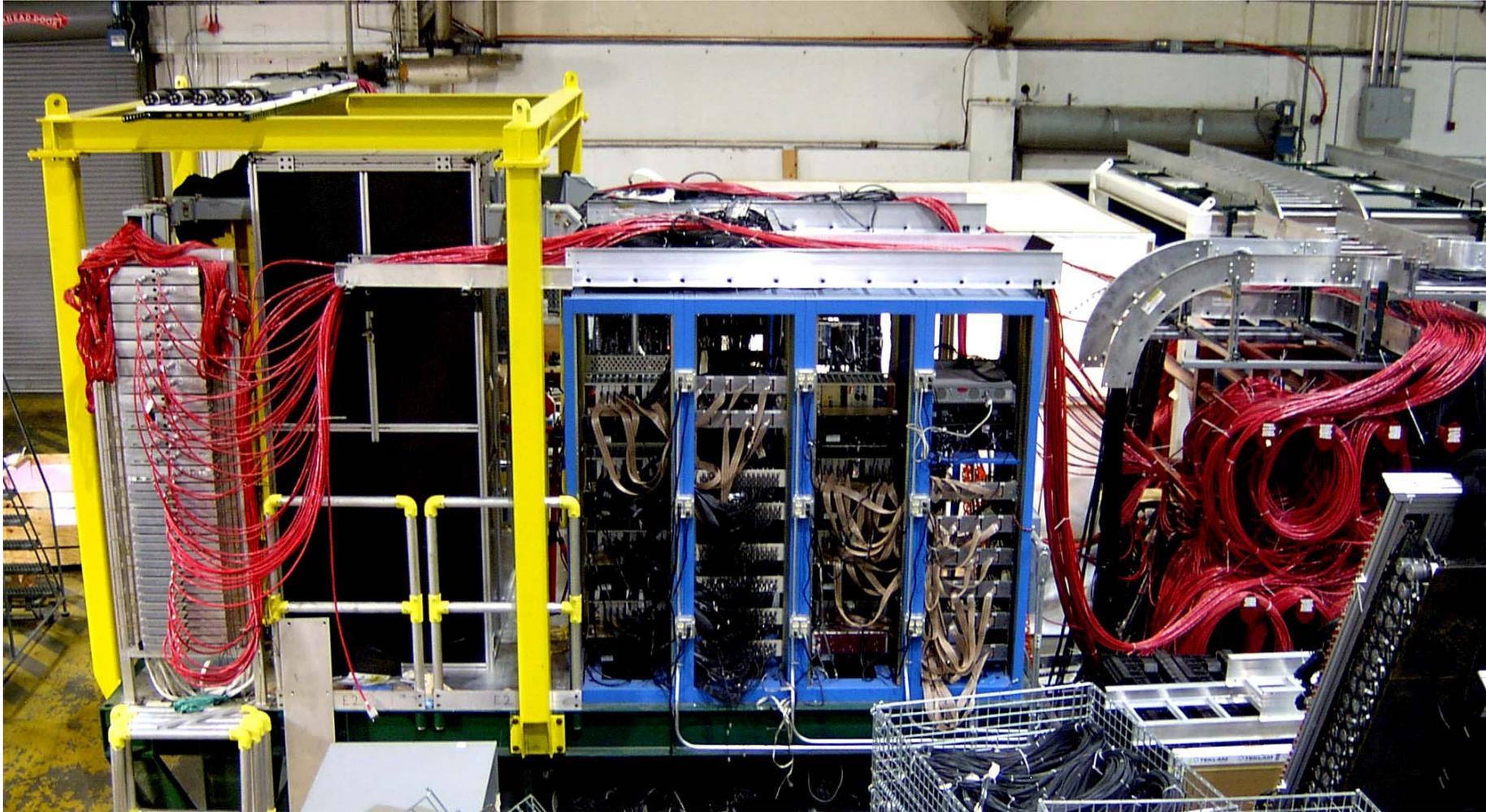
BigCal at 106°

Andrew Puckett, Wei Luo will estimate the trigger rates using simulations

75 μA , 0.80% pol., 20cm LH, FOM from HallA FPP, 50% accelerator eff.

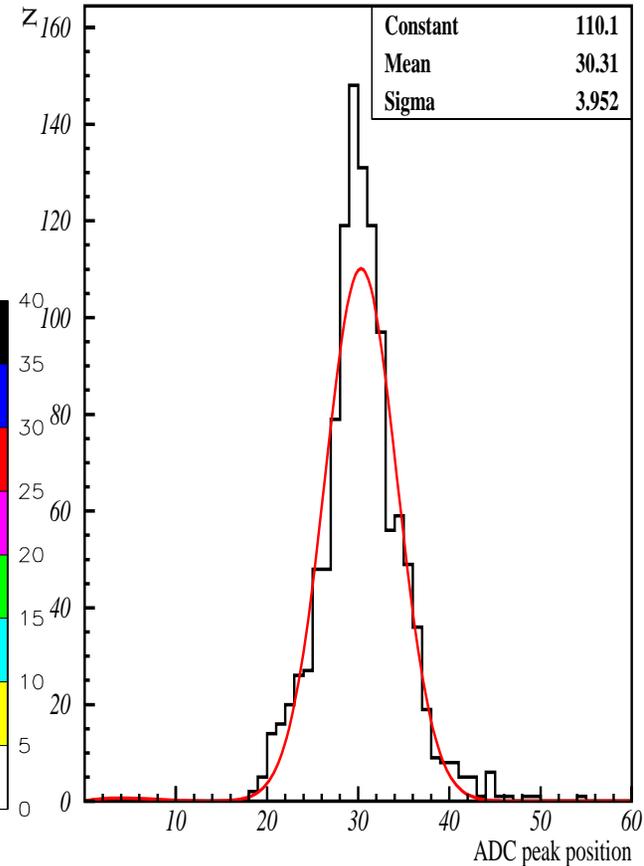
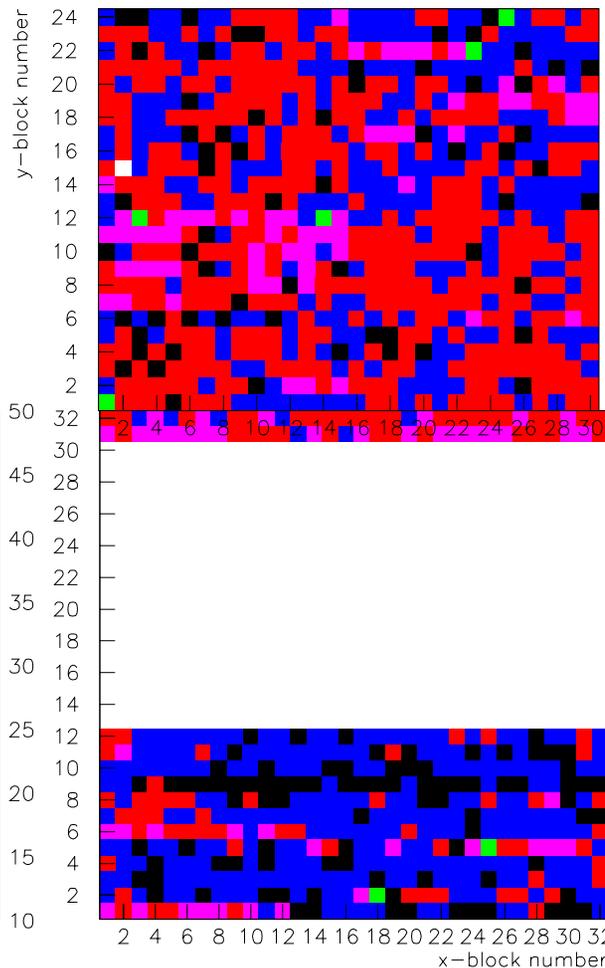
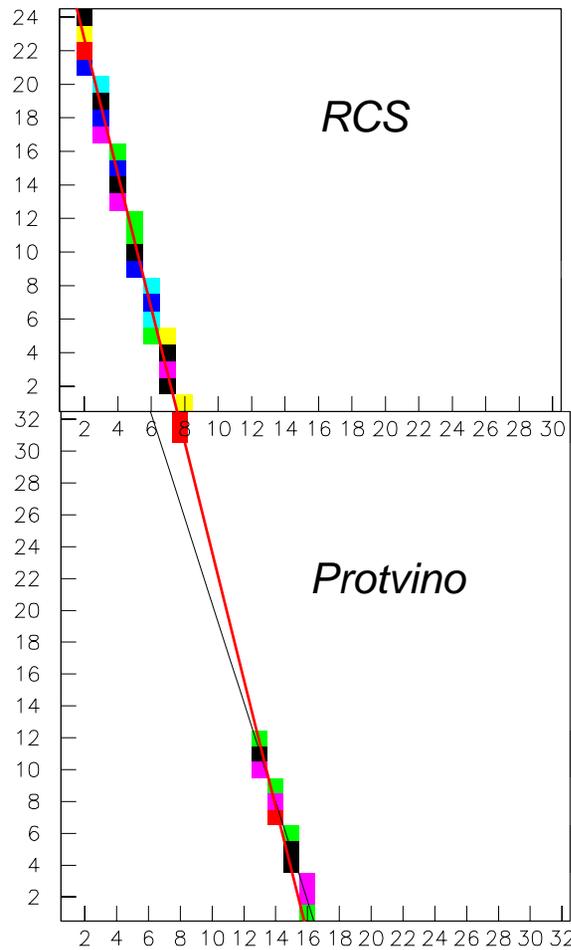
E_e , GeV	p_p	E_e'	Θ_p , deg	θ_e	hours	$\Delta(\mu\text{R})$	ε range	$\langle Q^2 \rangle$	Q^2 range	Rate, Hz
1.867	2.075	0.527	14.13	106	204	0.0051	.130-.160	2.507	2.476-2.538	662
2.839	2.075	1.496	30.76	45.3	108	0.0050	.611-.647	2.507	2.434-2.580	769
3.650	2.075	2.307	35.72	31.7	120	0.0054	.772-.798	2.507	2.418-2.596	859

BigCal activities in 2006: cabling



- 960 signal, 296 TDC, and 88 HV long cables were installed and tested after GeN; **BigCal fully equipped.** Thanks to: Amit Awasthi, Andrew Puckett, Christopher Silkworth, Joseph McClure, Joshua Hoskins, Kirill Pavlovskiy, Mehdi Meziane, Andrei Davidenko, Mark Jones
- Finished installation of the PMs and bases of the top half of RCS part (Andrei Davidenko)
- Interlock system installed and tested: door and 4 thermo probes (Andrei Davidenko)

BigCal activities in 2006: testing with cosmics



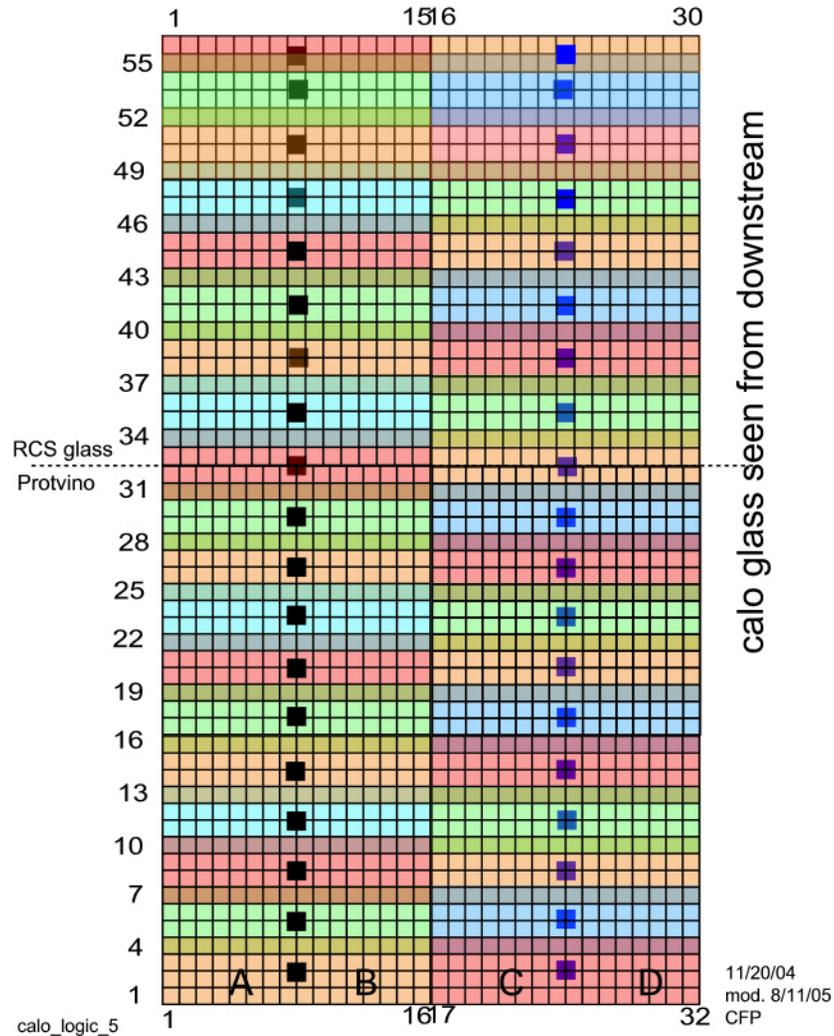
one muon track; color: ADC amplitude

color: ADC peak position from one run

Rows from 13 to 32 (640 channels) not powered; in the hall will have HV from G0. Using temporary HV supply for two rows (31,32 at the Fig.) to test successively the missing part

BigCal activities in 2006: calorimeter trigger

- **Calorimeter Trigger built** (Andrew Puckett, Joshua Hoskins, Kirill Pavlovskiy): $\text{sum of } 64 > \text{discr.} > \text{OR}$
- Partially tested, some problems fixed: second trigger pulse
- Needs further tests using ADC and TDC of the sums
- Roman Pomatsalyuk will set up system for remote adjustment of thresholds



BigCal activities in 2006: LED monitoring system

Prototype monitoring system installed:

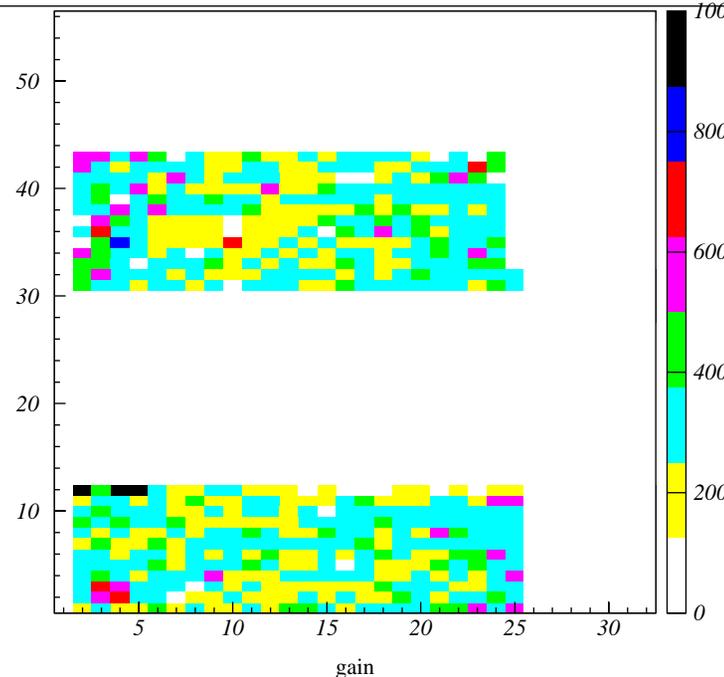
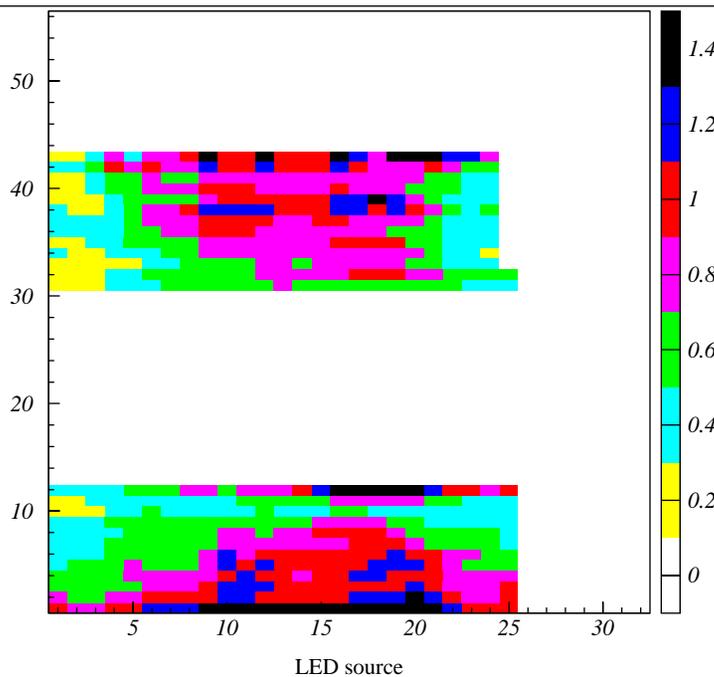
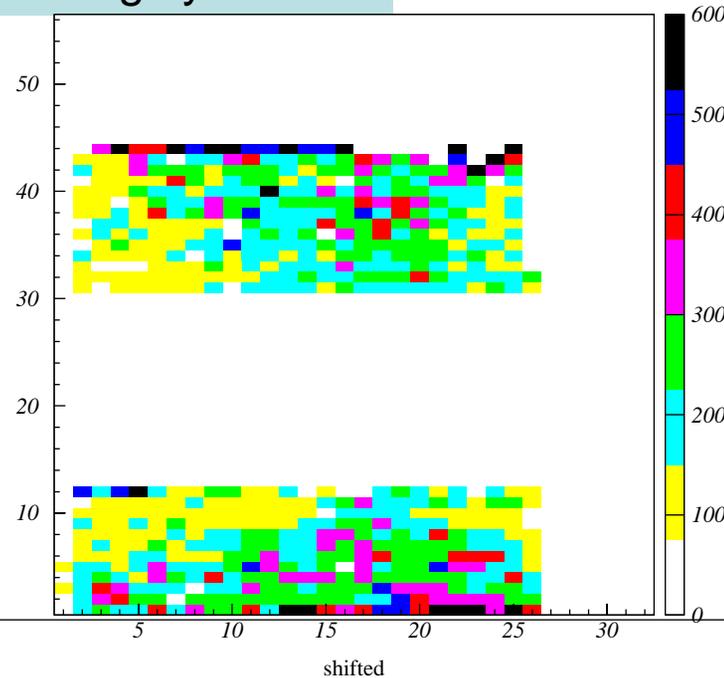
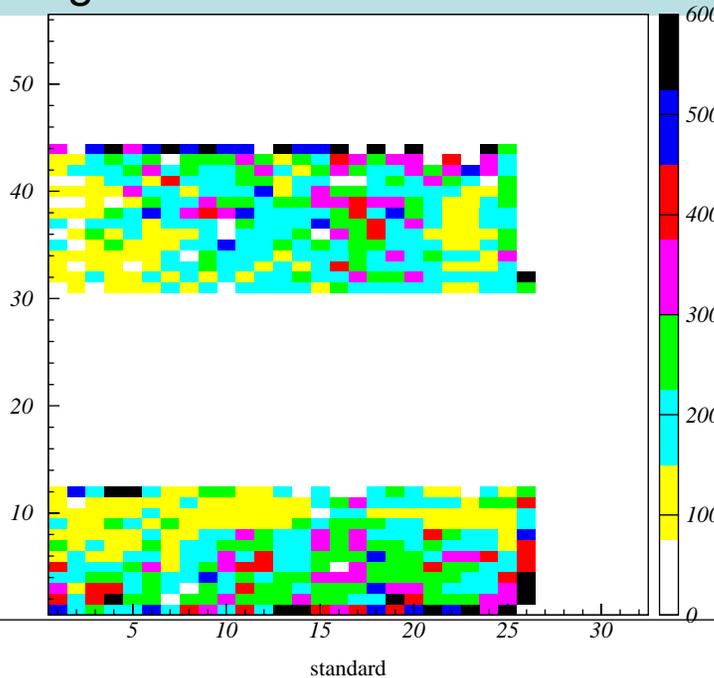
40 x 70" Lucite plate with 24 fibers from LED source on the top

Using HV from cosmics calibration results in non-uniform gain:

suspect bad optics in some glasses

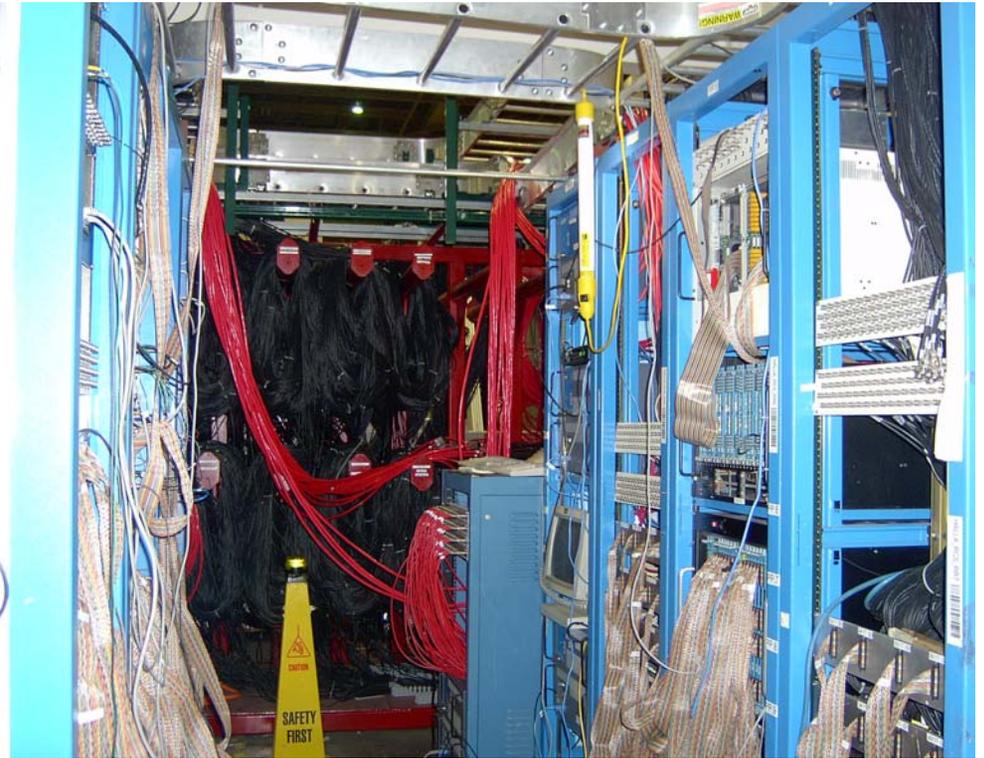
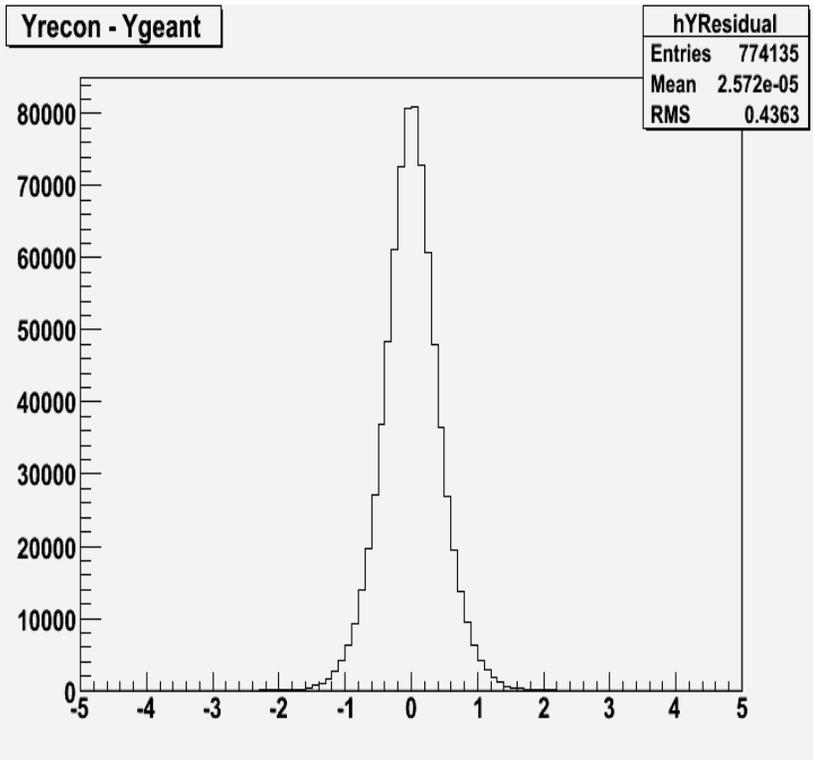
Final monitoring system designed (Bert Metzger), planning to use Hamlet's laser system in the Hall

10 cm Al absorber frame constructed



BigCal activities in 2006: DAQ, software

- DAQ set up with two FASTBUS/ROCs and TS (Mark Jones, Ed Brash, Andrew Puckett)
- Max. rate of ~2KHz with pedestal subtraction, using generator
- Not fully tested
- Slow control system to be set up by Roman Pomatsalyuk



- Off-line software (Andrew Puckett, Vladimir Kravtsov, Amit Awashti, Mark Jones), to be interfaced to ENGINE (Andrew Puckett, Mark Jones)
- Comprehensive GEANT studies by Andrew Puckett: for GEP-III and GEP-2G coordinate resolution varies depending on energy, absorber thickness, incident angle from 0.4cm to 0.9cm

BigCal activities in 2006: data base

Phil Carter (CNU)

http://hallcweb.jlab.org/experiments/GEp-III/bigcal_frames/sql/

GEp-III: Jlab Experiment E-04-108 - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://hallcweb.jlab.org/experiments/GEp-III/

Customize Links Free Hotmail Windows Marketplace Windows Media Windows

Jlab Experiment E-04-108: GEp-III
Measurement of G_{EP} / G_{MP} to $Q^2 = 9 \text{ GeV}^2$ via Recoil Polarization in Hall C

[return to Main Menu](#)

BigCal Calorimeter

[Overview](#)

Hardware
[Access to Detector Database](#)

Modeling
[GEANT Simulation](#)

Documents & Write-Ups
[Instructions](#) (from A. Puckett) on how to use the *High Voltage / Gain Matching* program (by Y. Matulenko)

GEp-III BigCal Database

How to enter dates and times: Some text fields allow you to enter a date and/or time. For the best results, use a format like "Jan 2, 2007 12:42 pm". After entering a date and time, click outside the text field or move to the next field. The server will then attempt to parse the date and replace the text you entered. Check to make sure that this date and time are what you intended. You can also leave the field blank to use the current date and time.

General search | **Upload voltages** | **Change data** | **Display logbook**

How to fill in ranges to search: You can specify a range using x..y, or one of the following operators: .. and && or || * / % = () + - inf. To get $x > 3$, type 3..inf. Another example: (15..20 or 30 or 90..inf) and (% 30 = 2). The last part (% 30 = 2) means that the modulus of the column you are searching equals two, so this would be translated into "Y % 30 = 2", for example. [Show more information about operators.](#)

Let me know if there are any features you need that are not implemented. [Display a list of some of the limitations in searching.](#)

Display: <input checked="" type="checkbox"/> Physical Y, X <input checked="" type="checkbox"/> Physical channel <input type="checkbox"/> Logical channel <input type="checkbox"/> Logical Y, X <input type="checkbox"/> Name <input type="checkbox"/> Glass <input type="checkbox"/> PMT number <input type="checkbox"/> Base number <input type="checkbox"/> Multiplexer label <input type="checkbox"/> Multiplexer part # <input type="checkbox"/> ADC module <input type="checkbox"/> ADC slot <input type="checkbox"/> ADC channel <input type="checkbox"/> FASTBUS crate <input type="checkbox"/> HV crate <input type="checkbox"/> HV module <input type="checkbox"/> HV channel <input type="checkbox"/> HV cable number <input type="checkbox"/> Voltage Check all Clear all	For these ranges: All of the following: Physical channel = <input type="text"/> Logical channel = <input type="text"/> Y = <input type="text"/> Physical X = <input type="text"/> Logical X = <input type="text"/> Glass = <input type="text"/> PMT number = <input type="text"/> Base number = <input type="text"/> Multiplexer label = <input type="text"/> Multiplexer part # = <input type="text"/> ADC module = <input type="text"/> ADC slot = <input type="text"/> ADC channel = <input type="text"/> HV crate = <input type="text"/> HV module = <input type="text"/> HV channel = <input type="text"/> HV cable number = <input type="text"/>	Display options: <input checked="" type="checkbox"/> Print output to a web page <input type="checkbox"/> Print output to a CSV file (for spreadsheets) <input checked="" type="radio"/> Don't show dates of last change <input type="radio"/> Show dates of last change <input type="radio"/> Show dates of last change and any associated comments Sort by: Channel number <input checked="" type="radio"/> Ascending order <input type="radio"/> Descending order Date and time for voltages: If displaying voltages, show voltages that were valid for this date and time: <input type="text"/> Leave blank to display current voltages. Entering a date and time has no effect if "Voltage" is not checked in the left column.
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If you have any questions or comments, contact [Phil Carter](#). To add feature requests, visit the [Database design guide](#) on the GepWiki.

W3C XHTML 1.0

Best viewed with Firefox
W3C HTML 4.01

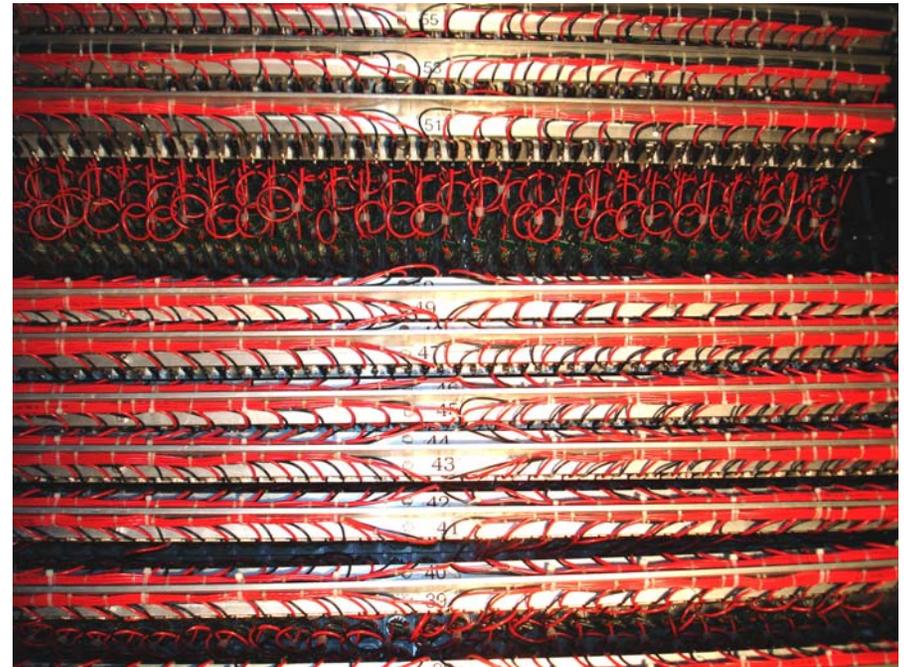
Privacy and Security Notice

(fww) 03-2005

BigCal: experience/problems

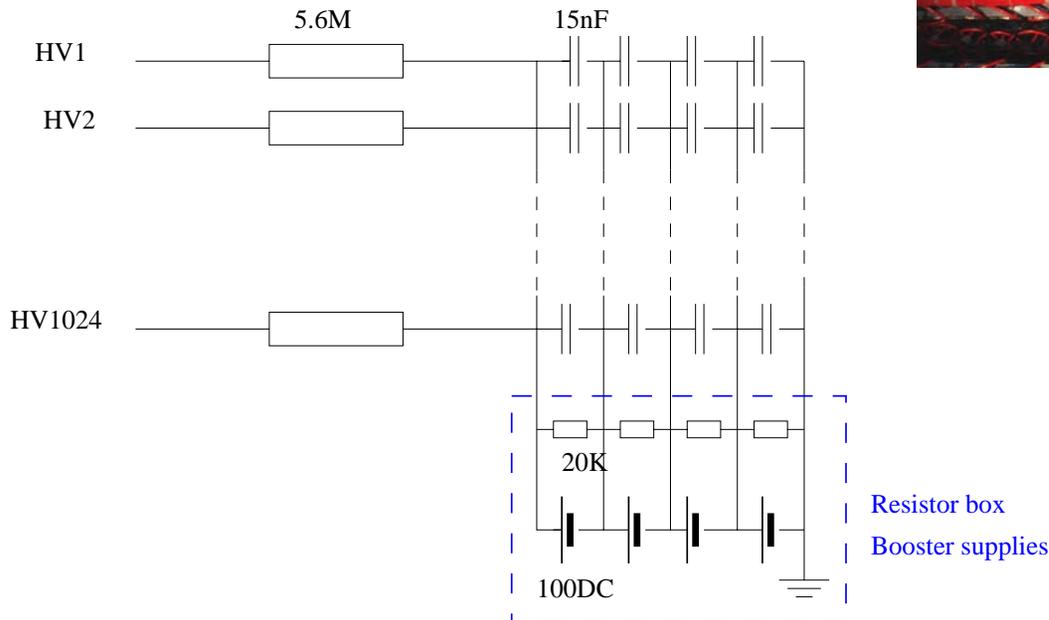
RCS part:

- Moving the patch boards results in disconnecting the bases from the PMs
- High power (~1 Watt/ channel)
- Bad connectors on the long signal cables
- Fragile connectors on the thick (24 channels) HV cables



Protvino part:

- Booster supply takes most of the current outside the detectors, but:
- Bad tracks on the patch boards for the booster; if disconnected results in burning (usually) one base
- Related to that (maybe): HV crate failure (one of the 24V supply on the crate and 9 HV cards)
- Uncorrelated discharge (~1Hz) on the bases



SUMMARY

E04-019

- No proven explanation of the GEP puzzle found yet, seven years after
- GEP-2Gamma can identify deviations from Born approximation of the order of 1%:
 - ▶ *Test of the limits of the polarization method*
 - ▶ *Sensitive to different amplitudes than Rosenbluth and e^+/e^- experiments*

BigCal: status

- Detector in testlab fully equipped (except HV supplies for 640 channels from G0)
- Tests with cosmics demonstrate all channels are working
- DAQ with two ROCs, calorimeter trigger, prototype monitoring system were set up

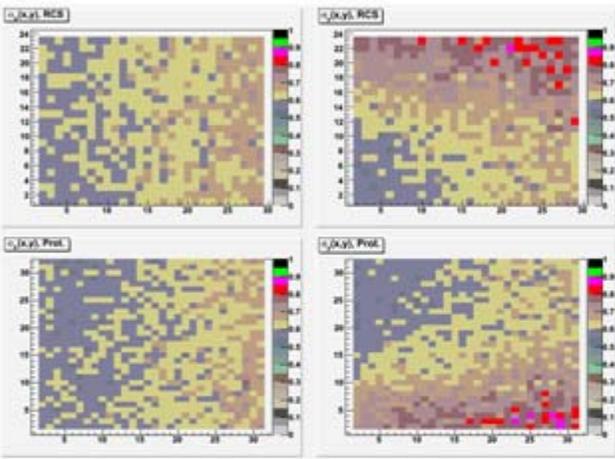
BigCal: plans for the next 3 months in the testlab

- Connecting and testing TDCs (long cables installed already)
- Connecting the calorimeter trigger sums to TDC and ADC, and testing the trigger
- Working on the on-line, off-line software, and slow control system

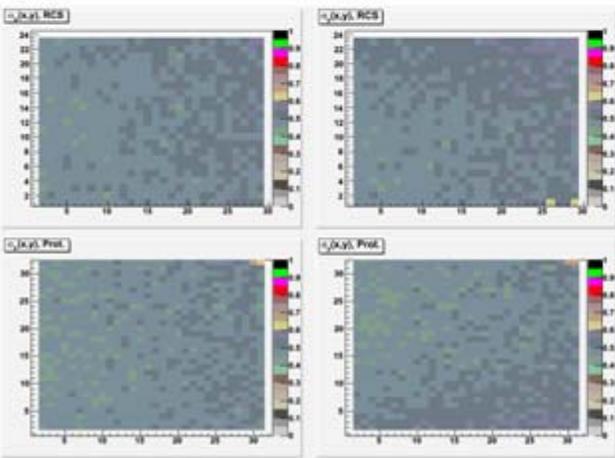
Bottom line

BigCal ready to be disconnected and moved to the Hall at the end of April

BigCal Resolution



a) Resolution of ep elastic electrons at $Q^2=8.5 \text{ GeV}^2$, $E' \approx 1.2 \text{ GeV}$, $R=4.4 \text{ m}$, 10 cm Al absorber. Left is x-coordinate, right is y-coordinate



b) Resolution of ep elastic electrons at $Q^2=7.1 \text{ GeV}^2$, $E' \approx 2.0 \text{ GeV}$, $R \approx 8.1 \text{ m}$, 10 cm Al absorber. Left is x-coordinate, right is y-coordinate

- Coordinate resolution depends on energy, angle of incidence, and presence/thickness of absorber (to reduce rad. damage to lead-glass)
- Comprehensive GEANT studies determine shower shape parametrization
- For GEp-III and GEp-2g, resolution varies from 0.4 cm at highest E and R to .9 cm at low E, R.