

GEp status

safety, students and manpower

Evaristo Cisbani for GEp/SBS collaboration
SBS Collaboration Meeting
12 / September / 2024

2024: 62 Registrants from



| | |
|--------------------------------|---------------------------|
| AANL – Yerevan | Old Dominion University |
| Christopher Newport University | Shandong University |
| FIU | Temple University |
| Hampton University | UMass Amherst |
| INFN | University of Connecticut |
| James Madison University | University of Glasgow |
| JLab | University of Salento |
| LLNL | UVa |
| MIT | William & Mary |
| Northern Michigan University | |

GEp (safety oriented) overview

GEp, is the 4th main experiment (after GMn, GEn and GEn-RP/K_{LL}) running with equipment developed for the Super BigBite Spectrometer (SBS) experimental program.

The GEp will run at higher luminosity than the previous SBS experiments.

The equipment does not involve unique or unusual dangers or safety considerations.

The main safety-specific aspects are related to:

- HallA cryogenic Hydrogen target (30 cm thick),
- high current magnet power supplies,
- high voltage to detectors (and high temperature),
- adequate lead shielding
- massive pieces which must be moved with care

GEp Layout

--- Experiment HallA equipment ---

Hall A beamline

Hall A cryo-targets containing LH₂
(and C foils targets)

Hall A scattering chamber

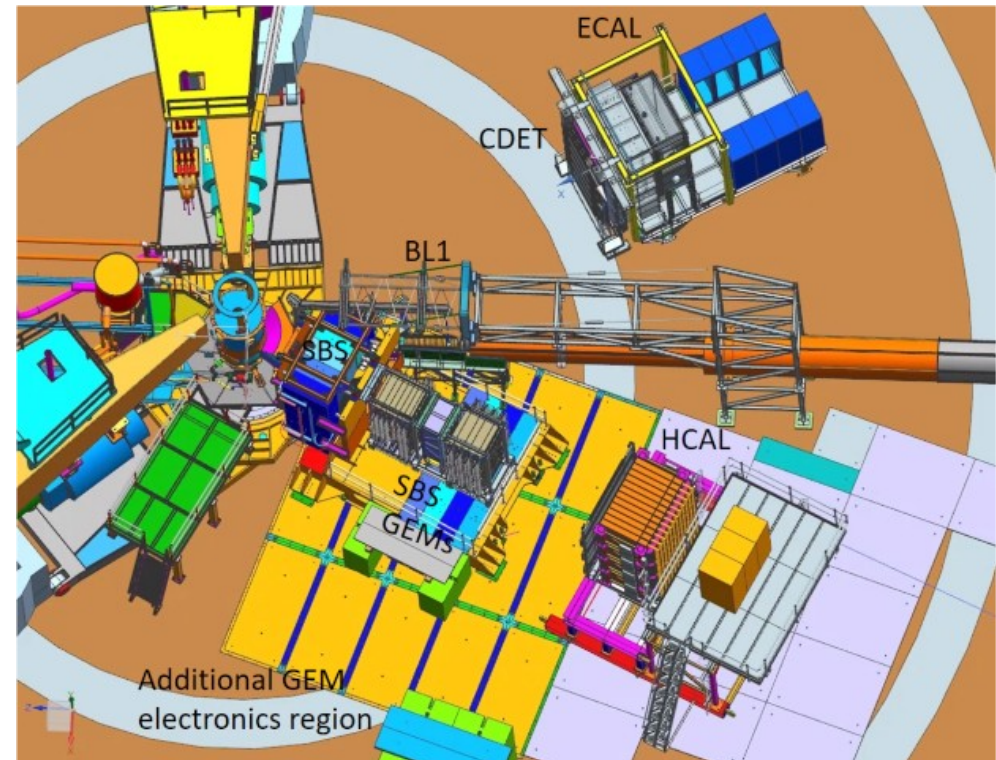
--- Experiment specific equipment ---

Electron Arm:

- Coordinate Detector hodoscope, **CDet**
- Electron Calorimeter, **ECal**

Hadron Arm:

- **SBB** Spectrometer **magnet** (48D48), correctors and power supply
- **GEM** trackers (front and rear)
- CH₂ **analyzer** (polarimeter component)
- Hadron Calorimeter, **HCal**



+ significant amount of cabling and shielding of control/readout electronics

GEP Kinematics

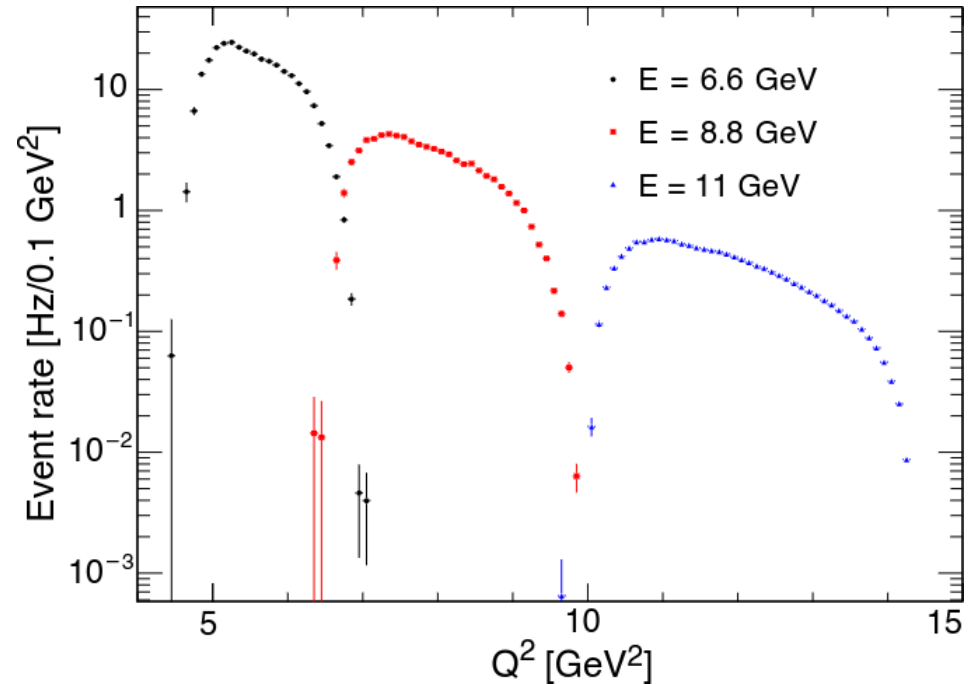
Beam:

- Current: 75 μA ,
- Polarization: 85%

LH₂ Target: 30 cm

45 PAC days of production
+2 PAC days for “GEP+”

From latest PAC-47 update



| Exp. | Setting | Beam | | p-Arm / SBS/HCal | | e-Arm / ECal+CDet | | | Time |
|------|---------|------|----------------|------------------|-------------|-------------------|-------------|--------------|--------|
| | | E | Q ² | P _p | Theta (deg) | E' _e | Theta (deg) | Distance (m) | PACDay |
| GEP+ | 2a | 4.36 | 3.7 | 2.73 | 28.5 | 2.35 | 35.0 | 5 | 2 |
| GEP | 1 | 6.48 | 5.73 | 3.88 | 25.7 | 3.42 | 29.47 | 8 | 2 |
| | 2 | 8.59 | 8.13 | 5.19 | 22.1 | 4.26 | 27.27 | 6.5 | 11 |
| | 3 | 10.7 | 12.1 | 7.29 | 16.9 | 4.27 | 29.7 | 4.7 | 32 |

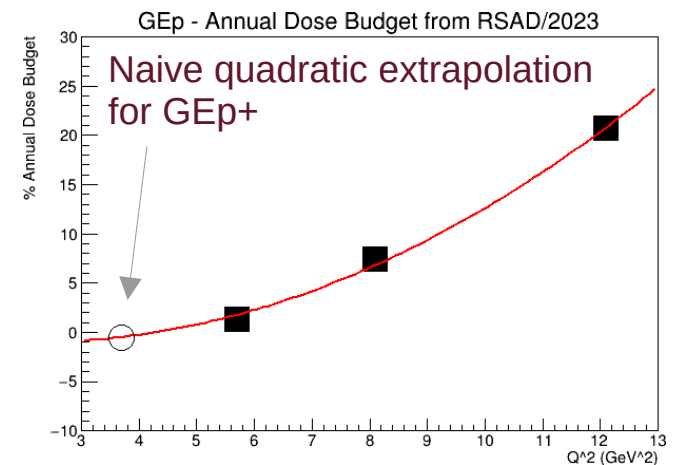
Source: M. Jones et al. July 30 & GEP+ proposal

Radiation Level

- Radiation Budget estimated by Pavel Degtiarenko Mar/2023 based on the GEp setup ($I=75 \mu\text{A}$, 30 cm LH_2) and proposal kinematics from GEp-ERR April 2023
 - The contribution to the boundary dose accumulation expected to be noticeable (2.94 mrem $\sim 30\%$ of the yearly threshold)
 - The average dose during the run is 238.5% of allowed dose, $\sim 20\%$ above the alert threshold (200%) \rightarrow extra limiting measures (such as extra shielding, scheduling coordination with other experiments, etc.), *evaluation to be finalized*

| from RSAD (draft/2023) | | Q^2 | Dose rate at fence post | Dose per setup | % annual dose budget |
|------------------------|---------|----------------|-------------------------|----------------|----------------------|
| Exp. | Setting | GeV^2 | urem/hr | urem | % |
| GEp | 1 | 5.7 | 2.67 | 128 | 1.3 |
| | 2 | 8.1 | 2.79 | 736 | 7.4 |
| | 3 | 12.1 | 2.87 | 2067 | 20.7 |

GEp+ dose should be lower than setting GEp-1



GEP Safety Documentations

Largely overlap with latest GMn/GEN/GEN-RP&K_{LL} safety documentations

Conduct Of Operations

- COO – update (target from ^3He to LH_2); consolidated draft

Emergency Response Guidelines

- ERG (Guidelines and Chart); up-to-date

Equipment Safety Assessment Doc

- ESAD – (target from ^3He to LH_2 , from BigBite to CDet+ECal); consolidated draft

Radiation Safety Analysis Doc

- RSAD – radiation budget table available; countermeasures to take care of ~20% additional average dose during runtime period *under finalization*

OSP's – Operational Safety Procedures

- LH2 Cryotarget: standard Hall A equipment; Silviu Covrig Dusa and Dave Meekins confirmed standard target OSP will cover the GEp target:
 - standard target operates with 3 independent loops and two are typically used for condensed liquid H₂ or D₂
 - GEp requires one target loop condensed – with LH₂ 30 cm
 - cell shape need a change in the target loop volume (ongoing)
- Electron Arm – drafts available in 2023
 - ✓ CDET – Peter Monaghan
 - ✓ ECAL – Donald Jones

Hadron Arm OSP's

Documents are up-to-date (3 need resubmission)

| | GEMs | SBS Corrector Magnets' Power Supplies | SBS Magnet Moving/positioning | HCAL |
|--|--|---|---|--|
| Doc Owner | H. Szumila-Vance | D. Flay, Y. Roblin, J. Benesch | J. Butler | J. Poudel, B. Wojsekhowski, M. Jones |
| Issue Date | 8/Mar/2021 | 28/Aug/2021 | 9/Nov/2021 | 20/Mar/2023 |
| Main Hazards | HV Electrical Shock, compressed gas, ladder work | Missteering of beam, Electrical, Magnetic Field, Fire | Pinch point, stored energy, class 2 electrical hazard, radiation hazard, pressure system, ODH, magnetic field | 160 V for pulsed LED, ladder, fire, use of lifts, hand tools |
| Risk Level without → with mitigations | 3 → 1 | 2 → 1 | 3 → 1 | 3 → 1 |

Summary - safety documents (GEp)

https://hallaweb.jlab.org/experiment/SBS/GEN/GEN_Website.html#gmnsafety

- GEp Conduct of Operations – COO *# minor update of GEN-II document*
- Emergency Response Guidelines – ERG
- Equipment Safety Assessment Document - ESAD
- Radiation Safety Analysis Document – RSAD *# needs some update*
- Safety Procedures (OSP)
 - SBS Monitoring/Positioning *# needs some update*
 - SBS and Corrector Magnet Power Supplies
 - LH2 Target
 - e-arm CDET *finalization*
 - e-arm ECAL *finalization*
 - SBS GEM detectors *(access)*
 - SBS HCAL

Students involved in GEp

Next slides have been assembled from information and pictures provided by the students involved in GEp, contacted by e-mail

Thanks to all of Them

Hope I did not miss other students and relevant information

Mahmoud Gomina

Virginia Tech

Supervisor: Marie Boer

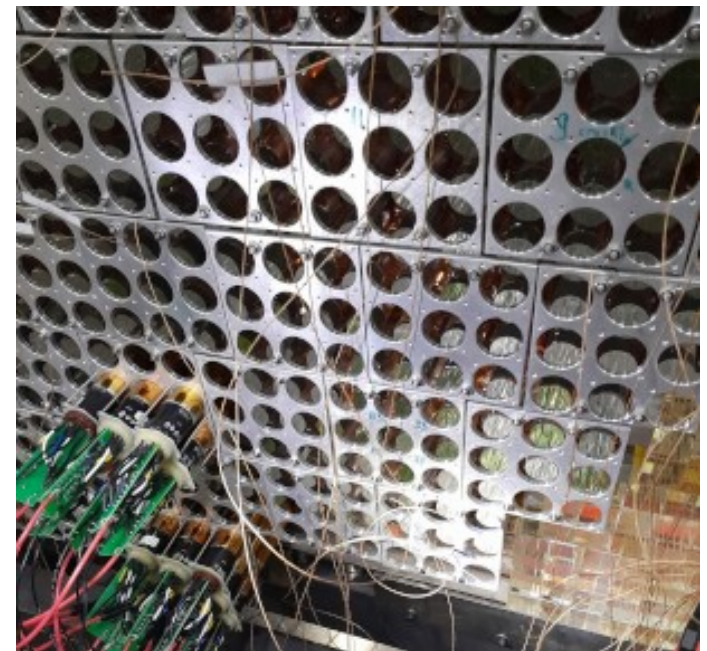
Started in GEp: Summer/2023

End expected: 2027

Activities: ECal installation; assembling dividers, wrapping mu-metals, testing PMTs and installation in Hall A.

Next activity: cabling (running HV and signal cables from the ECal to the DAQ bunker).

Available for additional work from the end of November this year.



Nikolas (Kip) Hunt

UCONN

Supervisor: Andrew Puckett

3rd year grad.



Activities:

working on the ECal installation in Hall A;
point person on Monte Carlo simulations of GEp for
shielding design (GEMs), effects on optics and background,
trigger rate estimates; g4sbs geometry updates.

Will be on site for the duration of the GEp run

Will contribute to the reconstruction software development.

Jacob Thomas McMurtry

University of Virginia

Supervisor: Nilanga Liyanage

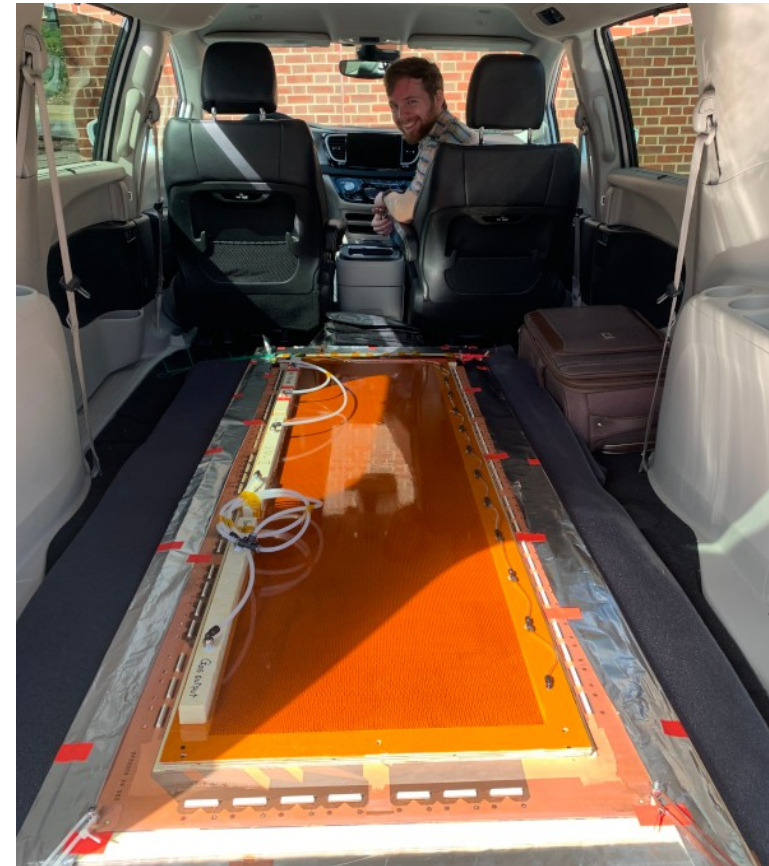
Started in GEp: Summer/2023

End expected: 2027/28

Activities: assist with the
GEM detectors/tracker,
hardware and DAQ set up

Also started with some of the
software/simulation work on
the side

Plan to do analysis for GEp for
his thesis.



Ben Spaude

William & Mary

Supervisor: Todd Averett

Start in GEp: end of current
semester

Activities to be defined, as soon as he finish the
semester classes



Jhieh-Ying Su

UMASS – Amherst

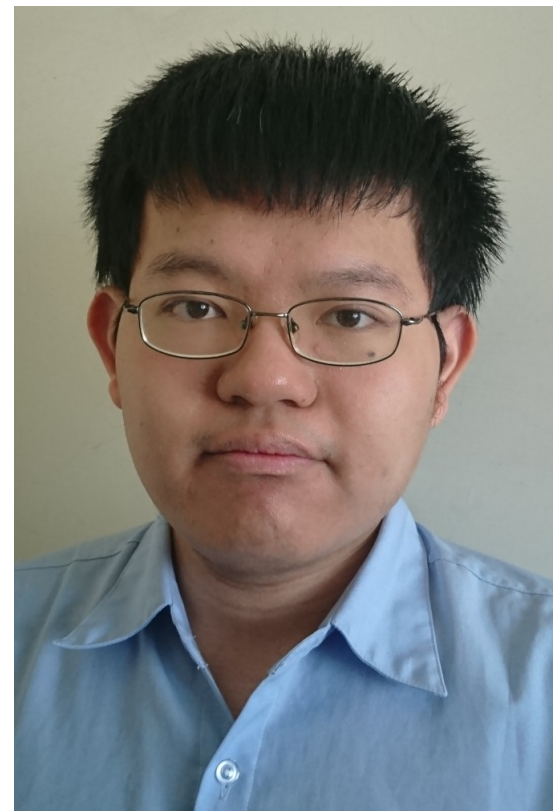
Supervisor: Krishna Kumar

Started in GEp: June/2024

End expected: June/2025 (at least)

Activities:

working on the installation of ECal (PMT testing and cabling), trigger simulation, and the HCal scaler



Run period Manpower some evaluations

- start 3 days before beam expected in Hall A
- total 45 PAC days + 2 PAC days for low Q²
- 3 periods of SBS/ECAL movement - 15 days
→ **total calendar runtime: $3 + 47 \times 2 + 15 = 112$ days**
- run start expected for Feb 1th, 2025 + contingency
- total number of **Run Coordinators: $112 / 7 = 16$**
 - experts could be RC closer to the end of run
 - spokespeople could be RC twice
- **shifts slots to be covered: $109 \times 3 \times 2 = 654$**

List of 16 RCs

Identified and
contacted by Bogdan

Donald Jones

Bill Henry

Arun

Chandan

Evaristo

Bogdan

Arun

Xinzhan

Jiwan

Lubomir

Jimmy

Evaristo (or possibly Roberto Perrino)

Ciprian (before Feb/26)

Ole

Andrew

Silviu

“Contingency”

Mark

Simona

Nathan Heinrich

Nilanga

Eric

Shift Crew composition and needs

- 2 people:
 - Target Operator
 - Shift Leader & Run Conductor
- Total shifts: $109 \times 3 = 327$
- Shift web page maintained by W. Tireman

Components / Contact persons

Draft

| | |
|--|---|
| Physics Division Liaison | D. Jones |
| Hall A beam line, BPMs, BCMs and corrector magnets | Ciprian Gal |
| The LH2 target | D. Meekins |
| The Möller polarimeter | D. Jones |
| SBS Magnet and correctors | B. Wojtsekhowski |
| The e-arm, SBS and beam line equipment | L. Hurt |
| DC power for spectrometers and SBS correctors | Zak |
| The DAQ bunkers | L. Hurt |
| The LeCroy HV crates controls | Jimmy Caylor, R. Michaels |
| CDET | R. Marinaro, P. Monaghan |
| ECAL | D. Jones, Jimmy Caylor, and Simona Malace |
| SBS GEM trackers | N. Liyanage, Ching Him Leung |
| Gas supply for the GEM chambers | Chandan Ghosh |
| HCAL detector | J. Poudel |
| The DAQ electronics and readout software | A. Camsonne |
| The data analysis software | A. Puckett |
| Safety documentation | E. Cisbani |
| SBS web page and shifts schedule | W. Tireman |
| GEp run coordinators | B. Wojtsekhowski |

Consolidation required, link to run plan document in Mark presentation

Summary

- Lots of work ongoing for the preparation of the experiment
- Safety documentation looks in rather good shape (thanks also to previous SBS experiments)
- GEp requires significant amount of manpower
- Students are involved in a stimulating scientific community that will benefit from their work