GIF++ Status and Plans

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http://gif-irrad.web.cern.ch/

6th Annual User Meeting
01.12.2022
Irradiation Bunker

Introduction:

- Unique place, combining a high energy muon beam with a 12 TBq$^{137}$Cs gamma source
- Joint EP & BE facility, operated by EP-DT
- Designed for testing real size detectors
- $\approx$100 m² irradiation fields, 2 irradiation zones with independent attenuation systems
- Central Control System, wide range of available gases (+ custom gases), common DCS...

Current R&D Program:

- Detector validation tests in presence of high radiation background & muon beam
- Ageing studies under HL-LHC radiation conditions
- Search for eco-friendly gas mixtures
- Mass-production test of muon chambers
- Radiation tests of electronics and optical components
Joined Facility BE/EP

- EHN1 infrastructure
- Beam line H4
- General GIF infrastructure
  - Electricity, cooling & ventilation, gas primary system...
- Access system (contact to)
- General safety EHN1 (incl. GIF)

- Cs Irradiator
- Local gas distribution
- User operation
  - Irradiation requests, beam request, space management
- User installations
- User contact
- Safety (setups & users)
**GIF EP TEAM 2022**

- **GIF Physics Coordinator**
  - Overall GIF coordination.
  - Deputy to SPS Physics Coordinator for the GIF with authority to optimise the user schedule for all modes (beam, stand alone...), within the constrains of the SPS schedule
  - Future development of the facility

- **GIF User Coordinator**
  - Space management of the bunker & preparation zone
  - Supervising user installation, installation of cables & electronics, rack space distribution, gas requests

- **EXSO**
  - Gas system - First level support
  - Deputy EXSO

- **One EXperimental Safety Officer (EXSO) for all EP irradiation facilities**
  - Department RSO (Radiation Safety Officer)

**Contact to EN/BE services**
GIF++ EP TEAM 2022

Overall GIF coordination.

Deputy to SPS Physics Coordinator for the GIF with authority to optimise the user schedule for all modes (beam, stand alone…), within the constrains of the SPS schedule

Future development of the facility

Space management of the bunker & preparation zone

Supervising user installation, installation of cables & electronics, rack space distribution, gas requests

Contact to EN/BE services

Gas system - First level support

Deputy EXSO

One Experimental Safety Officer (EXSO) for all EP irradiation facilities

Department RSO (Radiation Safety Officer)
GIF++ Irradiator & Attenuation Filters

One $^{137}$Cs source, two identical attenuation systems, each consisting of one angular correction filter (Fe) and 6 absorption filters - a total of 14 custom shaped filters

14 TBq $^{137}$Cs
(as of 2014)
$\approx$ 12 TBq now

Angular correction filter provides uniform photon distribution for large area detectors

Filter System:

<table>
<thead>
<tr>
<th>Absorption factor</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.47</td>
<td>2.15</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>4.64</td>
<td></td>
</tr>
</tbody>
</table>

24 possible attenuation factors:

- 1
- 1.47
- 2.15
- 3.16
- 4.64
- 6.81
- 10
- 14.68
- 21.54
- 31.62
- 46.42
- 68.12
- 100
- 146.8
- 215.4
- 316.2
- 464.2
- 681.3
- 1000
- 2154
- 4642
- 10000
- 21544
- 46415

(calculated values for un-scattered gammas)
GIF++ Infrastructure & Safety

Mixture distribution
Monitoring of pressure, O2/H2O, temperature, atmospheric pressure
Additional software controlled pressure regulation for very low flow regimes
Gas mixing unit

See dedicated talks in this Session

Access / Safety / Procedures

Access Requirements for GIF Areas:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Access Rights &amp; PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIF/N1</td>
<td>• CERN Card</td>
</tr>
<tr>
<td></td>
<td>• Personal Dosimeter</td>
</tr>
<tr>
<td></td>
<td>• Personal Protection Equipment</td>
</tr>
<tr>
<td>GIF Control Room</td>
<td>• CERN Card</td>
</tr>
<tr>
<td></td>
<td>• Personal Dosimeter</td>
</tr>
<tr>
<td></td>
<td>• “Control Room HPA-48V (DH1-1-0037)”</td>
</tr>
<tr>
<td>GIF Service and Preparatory Area</td>
<td>• CERN Card</td>
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<tr>
<td></td>
<td>• Personal Dosimeter</td>
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<tr>
<td></td>
<td>• Personal Protection Equipment</td>
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<tr>
<td>GIF Radiation Booth</td>
<td>• CERN Card</td>
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<tr>
<td></td>
<td>• Personal Dosimeter</td>
</tr>
<tr>
<td></td>
<td>• Personal Protection Equipment</td>
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<tr>
<td></td>
<td>• Activated (U) Operational Environment</td>
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<tr>
<td></td>
<td>• AUSIA rights - GIF++ Zone Tunnels (EH38-1-4397)</td>
</tr>
<tr>
<td></td>
<td>• Training Req: &quot;10901 / CERN - Beam Facilities&quot;</td>
</tr>
<tr>
<td></td>
<td>• Training Req: &quot;0035 Radiation Protection - Supervised Area&quot;</td>
</tr>
<tr>
<td></td>
<td>• Valid IMPACT request</td>
</tr>
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</table>

The dosimeter service (building 5) will hand out personal- and operational dosimeters to you.
**GIF++ Important Dates**

- **Christmas Closure:**
  - We will stop the Irradiator FRIDAY 16.12.2022
  - Mo-Tue (19-20.12) will be used for maintenance preparations
  - **strictly no access** during CERN closure 22.12.2022 – 04.01.2-23

- **Annual Irradiator maintenance:**
  - First full week of new year to avoid 2 shutdowns: 09-12.01.2023
  - Limited access, with priority given to VF
  - DSO Source Test on 12.01.2023

- **Restart of facility**
  - We expect normal access from Friday 13.01.2023
  - Getting back into normal position of setups
  - Restart of Irradiator on/after Monday 16.01.2023 (depending on previous point)

- **2023 Muon beam request call imminent:**
  - New online tool almost ready (presentation in todays PS/SPS User meeting)
  - Requests for the GIF++ have to be submitted via GIF++ Physics Coordinator
  - More detailed instructions will follow in the next days
Comments on Run 3

- After the turmoil of the pandemic at the end of the LS2 and last year’s start of Run 3, we had a comparable smooth year of running
  - Several primary gas system issues, access system issues…. but no major show stopper

- Many of the improvements made during the last years paid off, and we could host all user requesting irradiation and beam time (!)

- We did profit from a generous allocation of beam time in 2022 (partly caused by cancelation of other H4 users)

- 2022 also showed some of the limitations we currently face, both from the facility and from user (= LHC Experiments) manpower

- Extended life time of the facility beyond Run 3
  - Originally designed for the validation of the LHC Experiments Muon system upgrades in LS2/3 the GIF++ is now recognised as an essential facility for ongoing detector developments, ageing studies with new gas mixtures and the important search for eco friendly gas mixtures
**Successful 2022 with extended muon beam operation:**

  (stop only during CERN Christmas closure and essential maintenance)

- **9 weeks of dedicated muon beam**, up from 7 weeks requested
  (Will be less in 2023 due to shortened beam operation)
  Providing essential muon beam time for critical projects like ECOGAS beyond requests

### Set-ups participating

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Setup / Week</th>
<th>25.04</th>
<th>4.05</th>
<th>11.05</th>
<th>18.05</th>
<th>25.05</th>
<th>1.06</th>
<th>13.07</th>
<th>20.07</th>
<th>19.10</th>
<th>26.10</th>
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<td>ATL NSW MM</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
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<td>D</td>
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<td>3 x 1 week</td>
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<td>2</td>
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<td>D</td>
<td>3 x 2 week</td>
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<tr>
<td>3</td>
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<td>D</td>
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<td>D</td>
<td>D</td>
<td>D</td>
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<tr>
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<tr>
<td>16</td>
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</table>

**Date of beam period starting:**

<table>
<thead>
<tr>
<th>Date</th>
<th>25.04</th>
<th>4.05</th>
<th>11.05</th>
<th>18.05</th>
<th>25.05</th>
<th>1.06</th>
<th>13.07</th>
<th>20.07</th>
<th>19.10</th>
<th>26.10</th>
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</thead>
<tbody>
<tr>
<td>Upstream (U)</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
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<td>6</td>
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<tr>
<td>Downstream (D)</td>
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<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

- **2 dedicated weeks for GIF**
- **5 shared weeks with RD51**
- **1 parasitic week**
- **+2 extra weeks due to cancelation of other H4 users**

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- **Up to 15 set-ups scheduled**
- **Up to 11 set-up hosted** in parallel during beam weeks

**Several cancelations (D/U) due to manpower issues** (experts busy with LHC experiments)
**GIF++ Improvements over the last year**

*Extension of the GIF++ Control Room (2022)*

Restrictions of CoVid-19 pandemic in control room occupancy were “challenging”. Satellite control rooms needed to be used.

But even outside of a pandemic, the GIF++ control room could no longer host the increased user base (following the 2019 bunker extension) during beam time with \( \geq 14 \) setups x 1-2 people.

We needed to find a solution! With the help of BE-EA we could add a sparsely used meeting room by removing the separation wall. Significant increase the footprint of the GIF++ control room, allowing again the operation from a single control room.
Upcoming challenges (LS3 and beyond):

- **The increased number of setups** along the beam path leads to significant - and very uneven - shadowing for some experiments
  - Not possible to spread the setups more evenly, especially during beam time when they all need to be aligned to beam path

- **When designing your trolley**, please consider the effect any internal shielding will have on users behind you!

- **If your shielding causes excessive shadowing for other users**, your setup will have to be removed and modified.
  - Possible delay to your irradiation program
Upcoming challenges (LS3 and beyond):

- Caused by last-minute changes\(^1\) during the construction of the GIF++ in 2013-14, the Saleve shielding wall is too close to the beam path to place large setups fully in beam
  - Not possible to place all parts of big chambers inside the beam path due to proximity of Saleve side wall to beam path
  - Space is sometimes further limited by cable trays etc.

\(^1\) Approval of the Neutrino platform and extension of the H2 beamline
Proposed GIF++ Phase II Upgrade
Bunker Extension LS3

While already considered in the 2019 bunker extension, the Saleve wall modifications could not be done in LS2 due to severe manpower shortage, especially with EN-EL

- Main electrical cupboard of GIF++ would need to be relocated
- Gas distribution panels need to be relocated....

After the strong EP endorsement to operated the facility beyond LS3, we now restart the planning of the Phase II upgrade

- Bunker redesign with increased space to allow better distributions of detectors
- Possibility to place the full width of a detector inside the muon beam

Current financial situation (e.g. energy prices, inflation..) makes this proposal more difficult

Requires a strong support from the user side

Significant improvement for “moderate” spending
Upcoming challenges (LS3 and beyond):

- Extension of life time beyond LS3
  - From original 14 TBq (2014), we will be < 11 TBq by LS3

To ensure & improve the efficient operation of the facility beyond LS3, we need to look for a new source!

- Extension of Irradiator maintenance contract
- Market survey for new source. Currently challenging (as one of the main source producers)

- Difficult to plan the replacement of the current Cs source
  - Very few producer of high intensity sources, with biggest manufacturer currently not available

- Current dimensions of Irradiator capsule can limit the reachable activity
  - Housing and bunker designed for ≤ 100 TB, but capsule dimensions could limit us to ≈ 20 TBq

- On site loading of new source appears to be technical possible

- A new Irradiator with increased dimension could be envisaged.
  - Opens the possibility to add multiple sources in one Irradiator via loading carousel
    - Significant higher costs. Might need a redesign of the attenuator system.
Conclusions

GIF++ is a unique facility, not easy to replace.

Proposal to operate the GIF++ beyond 2026 is currently under finalisation.

Strong support from the community needed to be approved.
Questions ?