Summary of 2022 requests collected for GIF^{++}
(alphabetic order)

1 ATLAS NSW MM

Contact persons: Alan Peyaud
Ivan Gnesi

The purpose of this experiment is to continue the validation of the Micromegas chambers of the ATLAS New Small Wheel in a close-to HL-LHC conditions. The experiment will provide a **full picture of the behavior** of the NSM MM chambers in terms of tracking and triggering MIPs. The highest estimated background will be 20 kHz/cm2 of low energy highly ionizing particles, that can be provided by the GIF++ Cs source (GIF++ already provided the environment for the validation and test of the HV stability of the MM production chambers).

Data taking is being performed by equipping the chambers with the final Front End electronics and the full DAQ chain, while being exposed at the same time to background and MIPs flux, that will simulate the expected environment at the ATLAS spectrometer.
This continuous effort is therefore of great importance to comprehend the behavior of our quads in near-real conditions with the final elex. and DAQ system.

At the same time, we need to confirm and monitor the chamber performances under **ageing** as they will be already equipped [elex. wise] in the bunker.
Moreover, the experiment shall provide a detailed set of parameters, characterizing the performances of the chamber: tracking efficiencies for the various majorities, MIP and background cluster charges, timing performances in a real environment, dead time for different expected backgrounds etc.
The electronics will be also characterized in terms of baselines, noise jitter, delays. Finally, the conditions for μTPC operation mode will be heavily investigated.

Beam request: 3 x 1 weeks

2 ATLAS NSW sTGC

Contact persons: Margaret Lutz (Tel Aviv University)
Estel Perez Codina (TRIUMF Canada)

The purpose of the experiment is the test of small-strip thin-gap chambers (sTGC) of the ATLAS Muon New Small Wheel (NSW) in Run 3 and close to HL-LHC conditions. The experiment will provide a picture of the NSW sTGC chambers for tracking and triggering in a high-background environment. The highest estimated background will be 20 kHz/cm2 of low energy highly ionizing particles that can be provided by the GIF++ Cs source. The GIF++ is already equipped for the specialized HV and gas system needed by the sTGC, including the CO2-npentane gas mixture used for the mass sTGC tests.
With beam time in 2022, the sTGC team can build on the data taken in the October and

November beam times in 2021, with the opportunity to investigate finer beam tracking for precision studies, and optimization of the electronics configurations, both alone and in conjunction with NSW MicroMegas.

Beam request: 3 x 1 weeks

 # 3 ATLAS RPC

Contact persons: Giulio Aielli (Università e INFN Roma Tor Vergata)
Luca Pizzimento (Università e INFN Roma Tor Vergata)

Setup: ATLAS-BIS78-M0
The module zero of the BIS78 system is installed in the downstream area, close to the wall. It will be used for the following test in 2022:
- performance test at different integrated charges using standard mixture
- standard vs. ecogas characterization test (fluoride concentration in different conditions of source and working point, detector current analysis)

Setup: ATLAS-STD-test
a 50x50 cm^2 ATLAS like RPC will be requested to install in the downstream area, close to the wall, besides ATLAS-BIS78-M0. It will be used for the following test in 2022:
- performance test at different integrated charges using standard mixture
- standard vs. ecogas characterization test (fluoride concentration in different conditions of source and working point, detector current analysis)

Setup: ATLAS-Phase2-proto
a 250 x 70 cm^2 ATLAS phase-2 RPC prototype will be requested to install in the downstream area, close to the wall, in the same trolley holding ATLAS-BIS78-M0. It will be used for the following test in 2022:
- performance test at different integrated charges using standard mixture

Setup: ATLAS-Phase2-production
a trolley will be used to perform the acceptance test of the ATLAS RPC phase-2 gas gap production:
- two different sizes 250x70 cm^2 and 180x110 cm^2
- the duty cycle of one trolley is 1 week (wed to wed)
- the position is downstream but the exact location can be flexible.
- just HV gas and current readout needed.
- this test is starting after the 1st quarter of 2022

Beam request: 3 x 2 Weeks

 # 4 ATLAS sMDT detector prototypes setup

Contact persons: E. Voevodina (Max Planck Institute for Physics in Munich)
H. Kroha
O. Kortner

Setup: ATL-sMDT

The ATLAS sMDT detector prototypes setup has been installed in the upstream area γ - field upstream at about 2m from the source point (position U2) exposed to a photons flux up to 10^7 Hz/cm^2. It consists of a versatile stand in aluminum bosh-profiles, that allows the installation of several sMDT detectors at the same time. An external trigger has been set up to test sMDT detectors in conjunction with prototype electronics. The trigger consisted of organic scintillators, each fitted with a photomultiplier tube and shielded by lead plates/bricks in order to be protected by the gamma irradiation. ATLAS sMDT setup overall dimensions: 1m x 2m x 2.8m [length x width x height]. All the services (gas line, HV and LV power systems, cables ant etc.) needed to run the sMDT experimental setup are already in place. The operating gas mixture is Ar/CO2 (93/7) – NO flammable gas will be used.

The main goal is to validate the performance of the new on- and off- detector electronics components and as well as the chamber read-out system together with the small-diameter Muon Drift Tube (sMDT) detector technology for the Phase-II upgrade of the ATLAS muon spectrometer. Moreover, a detailed study of the adjustment of the operating voltage at high background hit flux will be performed.

In addition, the real size of the BIS RPC detector prototype produced by the MPI MDT group is planned to be installed in the CERN GIF++ facility. The BIS RPC prototype will have a 1.2 m x 1.8 m x 0.6 m [length x height x width] dimension and consist of three 1mm-gas gap RPCs. The detector will be operated with the ATLAS standard gas mixture as 94.5% of R134a (C2H2F4), 5% of iC4H10, 0.5% of SF6. Water vapour is added to the gas mixture in order to maintain a relative humidity of about 45 % (i.e. 8000–12000 ppmV) and avoid any changes of the High-Pressure Laminates (HPLs) resistivity. The RPC chamber can be easily hosted in the same ATL-sMDT experimental setup by modifying the current trolley accordingly. All services to successfully operate the BIS RPC detector are needed to be installed in advance inside the GIF ++. Additional gas line, HV/LV, LEMO cables must be properly routed from the Gas / Electronics rack to the irradiation area where the ATL-sMDT is located. An extra electronics rack is required to accommodate HV/LV power supplies and a PC with the detector control and data acquisition systems.
The motivation for the RPC test is the precision study of the performance of the new ATLAS RPCs detector developed by the MPI MDT group, their readout and trigger electronics, with a realistic HL-LHC background.

Beam request: 4 x 4 weeks

5 CMS-CSC

Contact persons: E. Kuznetsova (NRC Kurchatov Institute PNPI)
V. Perelygin (Joint Institute for Nuclear Research - JINR)

Setups: CMS-DT-MB2ME1
Trolly 2
Trolly 3

The CSC will be operated with different gas mixtures ($Ar/CO_2/CF_4$ and Ar/CO_2/HFO1234ze), optionally two different chambers measured one by one.

Goals: - longevity studies: chamber performance monitoring during the ongoing long-term irradiation at GIF^{++}
- performance studies: performance of a CSC operated with ecological gas (Ar/CO_2/HFO1234ze)

Beam request: 3 x 2 weeks

 # 6 CMS-DT

Contact persons: Lisa Borgonovi (INFN, Bologna)
Domenico Dattola (Università degli Studi di Torino)

Setups: CMS-DT-MB2

We plan to continue the irradiation on our CMS-DT MB2 chamber in the current position of the setup in the upstream area, to get another ~1 HL-LHC equivalent integrated dose. For that we aim to have an irradiation of few months (~3 months full time) at the beginning of 2022, with source attenuation of 2.2. After the irradiation, the plan is to have a test beam to measure the muon hit efficiency as a function of the dose rate and as a function of different HV conditions, and then compare those results with the ones obtained in the previous test beams performed in 2018 and 2021. This will be fundamental to understand the different hit efficiency trend as a function of the integrated charge observed in some wires replaced in 2018 wrt the older wires, and to evaluate the overall performance of the CMS-DT MB2 chamber after a total of ~ 3 x HL-LHC equivalent integrated dose in the wires irradiated since 2017. After this program we would like to test the performance of the chamber with different gas flows, exploiting the test beam data to evaluate the muon hit efficiency in these different conditions.

Beam request: 2 test beams of two weeks each

 # 7 CMS-GEM

Contact Persons: F. Fallavollita (CERN)
D. Fiorina (University of Pavia)
M. Bianco (CERN)

Description of the Setup:

Small trolley about 60x60 cm footprint 2m high. 1 ME0 module (Triple GEM Detector) during the non-beam time, 1 ME0 Module + tracking system based on GEM chambers during the beam periods. Standard configuration (for irradiation phase) foreseen the RO electronics placed directly in the base of trolley, the control PC and the HV Power System (CAEN Mainframe) to be located in the Racks zone.

During the beam periods, dedicated RO electronics will be installed, need to extend the setup to add tracking chambers, foot print will become about 60 x 1,2 m (along the

beam line), Back-end and, NIM Crate and additional power system to be installed in the Racks zone. Overall the needs of rack space is about 35 Rack Unit.

Scientific goal:

The ME0 GEM Chambers are expected to be operated with background particle fluxes ranging between 3 and 150 kHz/cm^2 on the chamber surface. Both the maximum background rate and the large range in particle rate set a new challenge for particle detector technologies. Rate capability of GEM detectors is limited by voltage drops on the chamber electrodes due to avalanche induced currents flowing through the resistive protection circuits (acting as discharge quenchers). The CMS GEM group proved the possibility to restore the amplification gain adjusting the HV settings as a function of the amplification currents which flow on each electrode. So far the "gain compensation tests" have been carried out by means of X-Ray guns able to irradiate uniformly only 10x10 cm chambers or fraction of the ME0 module. The goal of the tests at the GIF++ area would be to validate the compensation method irradiating at rate comparable, or higher than CMS-ME0 condition, an entire ME0 module, to verify the detection efficiency stability with beam while the detector is heavily irradiate, to develop and test automatic compensation method, able to follow online the background evolution (in CMS function of the beam luminosity, is GIF++ to be simulated with filter scans). We would also plan to test new HV filters, for the triple GEM detectors powered through A1515TG boards, such to minimize the gain reduction due to the HV drop at the level of the HV filter.

Beam request: 2 x 2 Weeks

8 CMS-RPC

Contact persons: Nikolaos ZAGANIDIS, (Universidad Iberoamericana)
Mehar Ali Shah (National Centre for Physics - NCP)

Setups: CMS-RPC-1

Consolidation studies of the present CMS-RPC System in GIF^{++}: A trolley hosting 4 RPC chambers identical to the ones installed in CMS has to be installed in the beam line in order to measure the performances of the detectors as their muon efficiency and cluster size after 1 Coulomb / cm^2 of accumulated charge during four years of irradiation in the GIF^{++} facility started in 2016. These measurements are essential to assess the present system for the HL-LHC

Setups : CMS-RPC-3

QC of the new RPC's for the CMS-Upgrade equipped with the new Front-end board. Study the performance of the new electronics in terms of minimal threshold, cross-talk.

Efficiency and spacial resolution measurements with Muon beam in presence of gamma background.

Aging studies of the new iRPC detectors : Performance measurements with muon beam versus integrated charge

Beam request : 4 x 2 weeks

 # 9 - EP-DT-FS Gas System

Contact persons: Gianluca Rigoletti (CERN)
Beatrice Mandelli (CERN)

Setups: EPDT-2

Description of the setup and motivation for the muon beam request:
The EPDT2 setup consists in a set of 3 single-gap Resistive Plate Chambers (RPCs) with a multi channel readout system made using a CAEN VME digitizer. The detectors are operated with a gas recirculation system with new environmentally friendly gas mixture.
In general, RPCs are employed at ATLAS, CMS, ALICE
experiments and are operated in avalanche mode thanks to the gas mixture composed of ~95% C2H2F4, ~4% iC4H10, ~1% SF6.
The goal of EPDT2 is to study the performance of RPC detectors operated with new environmentally friendly gas mixture in the presence of LHC-like background radiation.

10 **ProTOV-RPC**

Contact persons: Barbara Liberti (barbara.liberti@roma2.infn.it)
Alessandro Rocchi (alessandro.rocchi@roma2.infn.it)
Luigi Di Stante luigi.distante@roma2.infn.it
Roberto Cardarelli roberto.cardarelli@roma2.infn.it

The setup consists of a small trolley with dimensions 70 cm x 70 cm x 180 cm. The trolley contains several small detectors (mainly RPC detectors and scintillators). All detectors will be contained within the trolley envelop.
Two gas supplies:

- 95% R134A-4,5%C4H10-0,5% SF6 with standard humidification
- 95% R134A-4,5%C4H10-0,5%SF6 with no humidification

The setup for which we request the beam time will be also proposed as an R&D project at the Gif++, if the project will be still approved it will not be necessary to install for the test beam additional structures or connections other than those that we have already installed in 2021.
The position of the setup should be close to the source (1,5 meters), possibly in the upstream area.
Motivation for the muon beam request: The test will aim to characterize new detectors prototypes like small RPC with different gas gap thicknesses and electrodes material and RCC detectors with cylindrical geometry. We would like to measure the rate capability of the detectors as a function of the constructive parameters, such as gap thickness, electrode thickness, electrode resistivity and geometric quenching factor. We would also like to evaluate the aging effects of already installed detectors. We would like to exploit the background radiation to carry out resistivity measurements of the material used for the construction of the prototypes. Another measure that we would like to carry out consists in evaluating the maximum rate capability for RPCs equipped with a new signal readout system developed to obtain a spatial resolution of the order of 0.5 cm by reducing the number of channels down to about 10 ch/m^2.

Beam request: 2x2 weeks

 # 11 RPC EcoGas

Contact persons: Barbara Liberti
Gianluca Rigoletti

Setup description and motivation:
The ECOGAS collaboration setup consists in a set of Resistive Plate Chambers (RPCs) detectors employed in ALICE, ATLAS, CMS, SHiP experiments. The detectors are made from
different manufacturers and includes RPCs of different shapes, sizes and gap thickness.
RPCs at LHC are operated in avalanche mode using a high Global Warming Potential gas mixture composed of ~95% C2H2F4, ~4% iC4H10, ~1% SF6.
The goal of the ECOGAS collaboration is to study the performance of eco-friendly gas mixture in the presence of background radiation.
The detectors in the setup are operated in open mode with HFO-based, eco-friendly gas mixtures. The setup is controlled by a DCS and a CAEN mainframe power supply with the addition of CERN live monitoring tools.
The motivation for the use of beam time is to evaluate the working point of the chambers with beam particles.

Beam request : 2 x 2

 # 12 RE21/CBM

Contact persons: Subhasis Chattopadhyay (Variable Energy Cyclotron, India)
Zubayer Ahammed (Variable Energy Cyclotron, India)

GEM and Bakelite based Resistive Plate Chamber (RPC) will be used at CBM Muon Chamber (MUCH), at FAIR Germany. The expected maximum particle rate at these stations is very high**.** For this purpose, low resistivity bakelite RPCs are being developed. We plan to test one such RPC module and one GEM module to test the rate capability and efficiency using muon beam in presence of high intensity gamma flux at GIF++ facility at CERN SPS. A self triggered CRI based electronics will be used for readout. We will measure muon detection efficiency of the detector using two finger scintillators as a measure of detector performance with muon only and in presence of photon flux.

Beam request: 1 x 2 weeks

Summary :

ATL - NSW MM :	3 x 1 Week
ATL - NSW sTGC :	3 x 1 Week
ATL - RPC :	3 x 2 Weeks
ATL - sMDT :	4 x 2 Weeks
CMS - CSC :	3 x 2 Weeks
CMS - DT :	2 x 2 Weeks
CMS - GEM :	2 x 2 Weeks
CMS - RPC :	4 x 2 Weeks
EP-DT-2	3 x 2 Weeks
RPC Ecogas :	2 x 2 Weeks
ProTov-RPC :	2 x 2 Weeks
RE21/CBM :	1 x 2 Weeks