Letter of intent: proposal template

**Please specify an acronym, a project title and the name(s) of the project leader(s)**

**Gamma Factory**

**Project leaders: Witold Krasny, Dmitry Budker, Mikhail Gorshteyn**

**In the sections below, please provide details on** *(2 pages max.):*

**1. Research objectives**

The Gamma Factory (GF) [1] is an ambitious proposal, currently explored within the CERN Physics Beyond Colliders program [2], for a source of photons with energies up to ≈ 400 MeV and photon fluxes (up to ≈ 1017 photons per second) exceeding those of the currently available gamma sources by orders of magnitude. The high-energy (secondary) photons are produced via resonant scattering of the primary laser photons by highly relativistic partially-stripped ions (PSI) circulating in a storage ring at ultrarelativistic speeds with a Lorentz factor γ. The electrons bound to these ions interact with a (primary) laser beam and undergo transitions between the atomic shells. The resonance fluorescence photons, as seen in the laboratory frame, are emitted in a narrow cone with opening angle of ≈ 1/γ and form the secondary beam. The photon energy is boosted by a factor of ≈ 4γ2 with respect to the original laser photons used for the electronic excitation. The advent of such an experimental tool will allow for a wide range of applications across atomic, nuclear and particle physics that is not accessible with any other existing γ source. These applications were reviewed in a series of publications [3,4,5], including the Special Issue of Annalen der Physik [3] containing 15 dedicated case studies. The Proof-of-Principle GF experiment at the SPS is planned for 2028. The project is pursued by a group of 90 scientists from 34 institutions from 11 countries and offers a perfect showcase of an activity that INFRASERV aims to promote: a service to an identified key infrastructure (CERN) delivered by a group of European and international scientists. INFRASERV will provide a natural framework to maintain, channel and intensify their cooperation. Application of the GF principle to other heavy-ion facilities (GSI, EIC) should be pursued.

## [1] The Gamma Factory proposal for CERN, M. W. Krasny, arXiv:1511.07794

[2] Summary Report of the Physics beyond Colliders study at CERN, PBC Collaboration, R. Alemany et al, arXiv:2505.00947

[3] Physics opportunities with the Gamma Factory, Special Issue in Annalen Phys. 534 (2022) 3, 2200004

[4] Atomic physics studies at the Gamma Factory at CERN, D. Budker et al, Annalen Phys. 532 (2020) 8, 2000204

[5] Expanding nuclear physics horizons with the Gamma Factory, D. Budker et al, Annalen Phys. (2022) 2100284

1. **Connection to Transnational Access infrastructures (TAs) and/or Virtual Access projects (VAs)**

GF will expand the physics reach of an identified key infrastructure (TA-CERN) delivered by a group of scientists from European, North American and Australian universities.

**3. Estimated budget request**

2 x Workshop (Kick-off and Closing) 30K Euro

Travel budget 25K Euro/ year == 100K Euro

1 x PD Position 2 years at JGU Mainz 150K

**4. Participating and partner institutions**

JGU & Helmholtz-Institut Mainz (Budker, Gorshteyn)

Sorbonne U. (Krasny)

CERN (Dutheil)

IJCLab, Orsay France (Martens)

GSI Darmstadt (Litvinov)

FSU & Helmholtz-Institut Jena (Karbstein)

FAU Erlangen-Nürnberg (Palffy)

PTB Braunschweig (Surzhykov)

LMU München (Thirolf)

MPIK Heidelberg (Weidenmüller, Oreshkina)

Jagellonian U. Krakow, Poland (Placzek)

JLab, Newport News, USA (Wojtsekhovsky)

MSU, East Lancing, USA (Zelevinsky)

U. New South Wales, Sydney, Australia (Flambaum, Berengut)