The Gamma Factory project for CERN: physics highlights and technical challenges

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The ongoing discussions on the future CERN scientific program reflect the vision of its mission to be the particle-physics energy-frontier centre. They are focused mainly on CERNs very high energy collider projects: FCC and CLIC. What, if the present and the future LHC hints for new physics at the FCC/CLIC energy scales will turn out to be not strong enough to assure the funding of the new, high-cost, energy frontier collider, …or if its R&D and construction time will be longer than the life-time of the ongoing LHC research program? Should we not consider, already now, complementary research proposals broadening the use of the already existing CERN accelerator infrastructure to new research and technological application domains?

In this seminar an example of such a research proposal will be discussed. At heart of the Gamma Factory project is a new concept of the high intensity gamma source which could be realised at CERN by mastering the storage of beams of highly ionised atoms and by profiting from the recent progress in laser technologies. The increase of the intensity limit of the present gamma sources by at least 6-7 orders of magnitude, in the energy domain which is inaccessible for the FEL based technologies, could provide new research tools resulting in new research opportunities in the domains of:

- particle physics (studies of the basic symmetries of the universe, dark matter searches, precision-support measurements for the LHC),
- nuclear physics (confinement phenomena, link between the quark-gluon and nucleonic degrees of freedom, photo-fission research program),
- accelerator physics (beam cooling techniques, low emittance hadronic beams, high intensity photon beams, plasma wakefield acceleration, high intensity polarized positron and muon sources for the neutrino factory and muon collider, secondary beams of radioactive ions and neutrons),
- atomic physics (electronic and muonic atoms) - applied physics (AdS, transmutation of nuclear waste, fusion research, medical applications).