Contribution ID: **254** Type: **not specified**

ESPP Contribution - Gravitational Field of Proton Bunches

The Newtonian law describing the gravitational interaction of non-relativistic (slowly moving) gravitating matter, has been tested in many laboratory experiments with very high precision. In contrast, the post Minkowskian predictions for the gravitational field of ultra-relativistic matter, dominated by momentum instead of rest mass, have not been tested directly yet. The intense ultra-relativistic proton beam in the LHC storage ring offers the potential to test general relativity and alternative gravitational theories in this parameter regime for the first time in controlled lab-scale experiments. If successful, this would open the road to a novel use case of the LHC, where non-trivial gravitational physics could be studied likely in a parasitic mode, without the necessity of dedicated filling patterns. While the technical challenges are formidable, they should also lead to the development of ultra-high-sensitive acceleration sensors with abundant applications in other parts of science and technology. The present document summarizes the status of the theoretical studies in this direction, points out the challenges, and possible ways of addressing them.

Authors: Dr PFEIFER, Christian (ZARM University Bremen); Prof. BRAUN, Daniel (University Tübingen); Dr RÄTZEL, Dennis (ZARM University Bremen); Dr MARCHESE, Marta Maria; HERMES, Pascal Dominik (CERN); CAI, Rongrong (CERN); Prof. NIMMRICHTER, Stefan (University Siegen); Dr REDAELLI, Stefano (CERN); Prof. ULBRICHT, Hendrik (University of Southampton)