Working group 5

Symmetries and Fundamental Interactions
WG-5 - Symmetries and Fundamental Interaction

NuPECC liaison: Joakim Nystrand, Hans Ströher, Matko Milin

Conveners: Klaus Kirch (PSI Villigen) KKι + Klaus Blaum (MPI Heidelberg) KBι

- Hartmut Abele (TU Wien) HAb
- Kazimierz Bodek (UJ Kraków) KBo
- Dmitry Budker (Mainz) DBu
- Catalina Curceanu (LNF) CCu
- Jozsef Cseh (Debrecen) JCs
- Michael Doser (CERN) MDo
- Jerome Giovinazzo (Bordeaux)
- Etienne Lienard (LPC Caen) ELi
- Krzysztof Pachucki (Warsaw) KPa
- Randolf Pohl (MPQ München) RPo
- Thomas Stöhlker (GSI) TSt
- invited by convenors: Rob Timmermans (Groningen) RTi
- Christian Weinheimer (Münster) CWe
- Lorenz Willmann (Groningen) LWi
WG-5 communications

- Via email, phone conferences
- Via elog
- Via meetings
## WG-5 report contents [responsible, additional input]

- **Introduction (2 pages)** [KBl, KKi, RTi, KPa, all]
  - Standard model SM, fundamental interactions, shortcomings of SM, role of nuclear physics, nuclear theory and experimental methods

- **SM parameters (precision measurements and tests of known interactions as QED, EW, QCD), total 8 pages**
  - Lepton properties (3.5 pages)
    - Neutrinos (masses, mixing angles, ...)[CWe, others?]
    - Charged leptons (e, μ, masses, magnetic moments g-2, lifetime) [KBl, KK, KPa, TSt, others?]
  - Baryon/Nucleon properties (3.5 pages)
    - Quark mixing, masses (incl. gravitational masses), magnetic moments, lifetimes, charge radii, CVC, decay correlations, weak charge $Q_W$ [ELi, RPo, KBo, MDo, RTi, others]
  - Fundamental constants (1 page)
    - Alpha, Ry, G, $G_F$ ... [KBl, KPa, KK, others?]

- **Searches beyond SM, total 8 pages**
  - Symmetry tests (5 pages)
    - (C, P,) T, CP, CPT, Lorentz, Lepton flavor, Lepton number, Baryon number, Spin-statistics [LWi, CCu, RTi, others!]
  - Dark matter & energy, exotic forces (incl. gravity) (2 pages)
    - Direct searches (WIMPs, ...), sterile neutrinos, ALPs, ... [CWe, HAb, DBu, MDo, CCu, others]
  - Time/spatial variation of fundamental constants (<1 page) [DBu, others]

- **Summary & Future directions (1 page)** [KBl, KK, all]
- **Recommendations (1 page)** [KBl, KK, all]
Collection of essential facilities for the fundamental interactions community

Plus a large number of small scale table-top experiments.
Collection of suggested figures for the WG-5 report (not yet complete)

$q/m$ comparison of the proton/antiproton
Collection of suggested figures for the WG-5 report (not yet complete)
Collection of suggested figures for the WG-5 report (not yet complete)

The rms charge radius of the proton determined with muons and electrons along with various analyses of electron scattering data.
Collection of suggested figures for the WG-5 report (not yet complete)

The anomalous magnetic moment of the muon: The uncertainties of the theoretical predictions are dominated by hadronic contributions

![Graph showing the anomalous magnetic moment of the muon with various data points and uncertainties.](image)
Schedule & Timeline

three NuPECC meetings as milestones on the way:

- **11.-12.3.16 NuPECC Meeting Trento**: Status report by NuPECC Liaison (J. Nystrand, H. Ströher)

- **17.-18.06.16 NuPECC Meeting Uppsala**: First draft and presentation by conveners (KBL, KKi)

- **7.-8.10.16 NuPECC Meeting**: Final report, presentation by and discussion with conveners (KBL, KKi)

WG-5 aims at proceeding with the following steps:

- Working Group Input: WG-5 members provide **input until Feb 10, 2016** to convenors

- Convenors meet Feb 23/24, 2016 in Heidelberg and **propose structure** of report to WG-5

- Convenors prepare status report to NuPECC liaison by **end of February 2016**

- WG-5 receives feedback from liaison after Trento meeting

- Convenors meet March 16/17, 2016 at PSI to discuss feedback from liaison and inform WG-5

- **WG-5 Meeting I**: 21.-22.4.2016 at PSI (brief reports about 0th draft fragments)

- First **draft of the report is written** by WG-5 and handed to NuPECC **beginning of June**

- **WG-5 Meeting II for final draft**: date and location tbd, probably be 6/7 or 7/8 Sep 2016

- Convenors meet Sept 21-22, 2016 for final edit. Report ready by the **end of September**
Open questions to NuPECC

- Do you (NuPECC / NuPECC Liaison) agree to the intended content of the WG-5 section of the LRP? Is our assumption of 20 pages length correct?
- Will the LRP again have some explanatory boxes in its sections?
- How many figures will be allowed?
- Will there be a more popular summary of the LRP? Shall we look for suitable figures (addressing less the scientists)?
- When will the 1 page(?) contribution of WG-5 to the executive summary of the LRP be due?
- How will the WG-5 input to the overall recommendations and roadmap of the LRP be considered/implemented? When will it be due?
- How will the WG-5 input to the facility and research infrastructure section of the LRP be considered/implemented? When will it be due?
- Is there any kind of Interconnection diagram between various WGs?

- Which format should be used, is Latex ok, is there a template available?