Summary of the Belgian experimental particle physics landscape and input to the European Strategy Group in view of the European strategy update in particle physics in 2019

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This document summarizes the input of the Belgian scientists to the European Strategy Group (ESG) in the context of the upcoming European strategy update for particle physics research. The Belgian HEP community (permanent researchers from particle and astroparticle physics) met in Brussels on September 12th, 2018. During this meeting we took stock of our current activities, evaluated our current person power and growth potential and discussed our individual and common interest in future collider and non-collider based high energy physics experiments. Our feedback to the ESG consists of a short overview of the Belgian tradition and current involvements in experimental HEP, followed by our opinions and priorities on future large-scale HEP projects. A separate statement from the nuclear physics community in Belgium is added in an addendum.

Belgian HEP landscape:

Belgium is one of the founding member states of CERN, and has been an active user of CERN's research infrastructure ever since. Being a relatively small country, the size of the HEP community in Belgium is significant, with a total person power, as presented to RECFA in April 2017, of 277 FTE, of which 60 FTEs are permanent (experimentalists and theoreticians, from particle and astroparticle physics). The funding bodies for fundamental science in Belgium are split between Flanders and Wallonia, though cross-regional funding schemes are available. A total of eight universities take a long standing active role in experimental HEP: Universiteit Antwerpen (UAntwerpen), Université Libre de Bruxelles (ULB), Vrije Universiteit Brussel (VUB), Universiteit Gent (UGent), Katholieke Universiteit Leuven (KUL), Université de Liège (ULiège), Université Catholique de Louvain (UCLouvain), and Université de Mons (UMons). All these universities also have phenomenology/theory HEP activities as well. Each university has individual research traditions and focus. Presently, besides involvements in CERN based HEP experiments (CMS, NA62, ISOLDE), the Belgian community is also involved in astroparticle experiments (IceCube, Auger, Telescope Array), reactor neutrino experiments (SOLID, JUNO), gravitational wave observatories (Planck, Virgo), and has a legacy of DESY based experiments as well. Many groups also participate in specific detector R&D projects, some of which are coordinated by CERN, and a subset of groups jointly operate two LHC Tier2 centres, of which part of the capacity is also used by non-LHC physicists.

At present the largest fraction of permanent and temporary staff in Belgium is focused on the CMS experiment at the LHC, in particular in data analysis and hardware services related to the tracking, muon and forward calorimetry systems. Currently the Belgian institutes are strongly committed to the tracker end-cap upgrade of the CMS detector for the high-luminosity LHC program, also contribute to the muon RPC and GEM detector upgrade. All commit to co-maintain these systems during the LHC high-luminosity program.

The strategy of our community is to be active at the international forefront of detector development and physics data analysis, for the latter with a strong connection with local and global

phenomenology experts. We always aim to achieve a critical mass in large scale projects, hence our involvement in only one LHC experiment, while maintaining the possibility for diversity and breadth across both collider and non-collider projects. We recognize the leadership role of CERN in the international research community and will continue to actively support CERN programs and initiatives in the near and long future. In view of the upcoming strategy update for particle physics in Europe, we provide the European Strategy group with the following points for consideration.

Belgian Strategy update inputs:

1. The Belgian groups will maintain their support for CERN as a world-leading research laboratory, and will take an active role in the discussion of CERN's policy and strategy via its council and via ECFA;
2. The focus of our experimental HEP activities will remain for the near and midterm future on the LHC program, in particular the successful completion of the LHC run3 and to prepare the HL-LHC by delivering one CMS endcap tracker and new CMS muon chambers for the LHC phase 2;
3. We will continue active detector R&D programs on silicon tracking, gaseous detectors, calorimetry, and trigger/DAQ, to maintain a sustainable technology platform, which can be used for future projects;
4. Complementary to the HL-LHC physics program, we encourage diversification of the CERN research program. This diversification could be also concretized as an expansion of detector construction and physics analysis activities for non CERN-based projects;
5. We encourage the CERN-neutrino platform model to be applied to fundamental interaction research projects outside CERN once these have been firmly established as a sustainable long-term international project. Potential candidates can be found among non-EU based collider experiments, dark matter physics, astroparticle detectors and gravitational wave observatories.
6. In particular, together with our theoretical/phenomenological community, we continue to explore the physics potential of future colliders, both CERN and non-CERN based.
7. We aim to maintain expertise in computing support in function of large scale particle physics projects, and in particular for the HL-LHC program.

Belgian Concerns:

The current strategy update discussions have also revealed a diverse spectra of possible future projects, notably the possibility to increase the beam energy of the LHC after its high luminosity upgrade, the designs for linear or circular e^+e^- collider that will operate as Higgs boson factories in its first phase, and proton-proton colliders that will substantially increase the currently achievable centre-of-mass energy obtained in colliders. In contrast to the technological prospects to realize these facilities, there are no strong guarantees for new physics discovery, as it was the case for the LHC program. We are therefore primarily looking forward to a statement from the Japanese policy makers concerning a reduced energy linear e^+e^- collider. We are keen to investigate the possibility to contribute to its detector construction program, but would surely benefit from a CERN coordinated European activity located at the CERN laboratory sites.