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Further searches of the Higgs scalar sector

Recent decades have witnessed remarkable confirmations of the Standard Model (SM) describing the Electro-Weak and Strong Interactions. The experimental discovery of the Higgs boson H_0 at the CERN/LHC has crowned a success of the SM and calls for further studies on this newly observed sector. New and more precise activities are needed in order to extend more precisely this new discovery within Particle Physics. Like for the previous Z_0 studies, additional projects using leptons rather than hadrons should be investigated.

The presently described $(\mu^+ \mu^-)$ initiated cross section is greatly enhanced with respect to the one with $(e^+ e^-)$, since H_0 particle is a scalar and therefore the leptons pair coupling is proportional to the square of the lepton mass. The $\mu^+ \mu^-$ Collider is preferable to the other proposed huge $e^+ e^-$ future options because of its much smaller dimensions and cost and since it may easily fit within one of the already existing European sites. However it requires the success of a substantial R&D in order to convincingly produce the adequate accumulation and cooling in 6D phase space of the muon beams.

High intensity bunches from a negative H^- source are converted into protons, producing secondary particles (mostly π^\pm). The π^\pm 's decay to μ^\pm 's and the μ^\pm 's are captured, bunched, cooled and accelerated in a storage ring to produce an appropriate rate of high energy muon collisions.

The $(\mu^+ \mu^-)$ Collider is primarily concentrated on the optimal scenario offered by further developments of the European Spallation Source (ESS) already under construction in the Lund site as the most intense future source of spallation neutrons.

Two configurations are described: the Higgs mass s-channel resonance at $\sqrt{s} = 125.5$ GeV to study with very small backgrounds the many H_0 decay modes with $L \approx 1032$ cm⁻² s⁻¹ and the higher energy Collider with $L \approx 1034$ cm⁻² s⁻¹ at $\sqrt{s} = 500$ GeV to study the other main H_0 related processes of the scalar sector.

As a preliminary part of the program, cooling should be experimentally studied in the $\mu^+ \mu^-$ ring configuration with the much cheaper and simpler Initial Cooling Experiment. Several European laboratories, like for instance in the UK, Switzerland, France, CERN or Sweden (Lund) could be considered as possible locations of this initial program.

Provided muon cooling has been experimentally verified in its many aspects, the subsequent realization of the full scale $\mu^+ \mu^-$ Collider program may be carried out for instance at the laboratory of the European Spallation Source (ESS) with the help of several conventional accelerator technologies of reasonable dimensions.

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