Higgs physics at the Future Circular Collider

Speaker: Suyu Xiao

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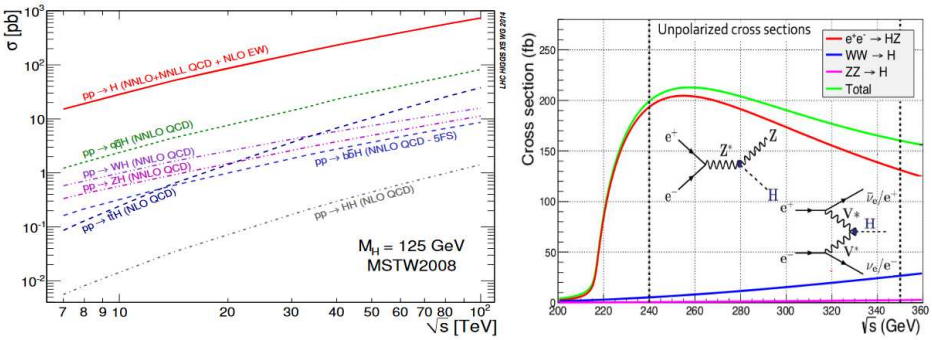
1 Introduction

Some basic information of this meeting:

- **Speaker**: Suyu Xiao
- **Article**: Higgs physics at the Future Circular collider, arXiv Link
- **Time:** 20170224

2 Discussions

2.1 Question on page 3



Suyu Xiao: Why there's a peak around 240 GeV on the right plot?
Shi Xin and Liu Kai:

- For an e^+e^- Higgs factory, its center-of-mass energy should be optimized to produce Higgs particles as more as possible.

- In a e^+e^- collider, the Higgs production is dominated by the Higgsstrahlung process(red line), we get the largest cross section around 250 GeV.
- Here's a paper for more details : Physics cross section and events generation on CEPC

2.2 Comments on the left plot

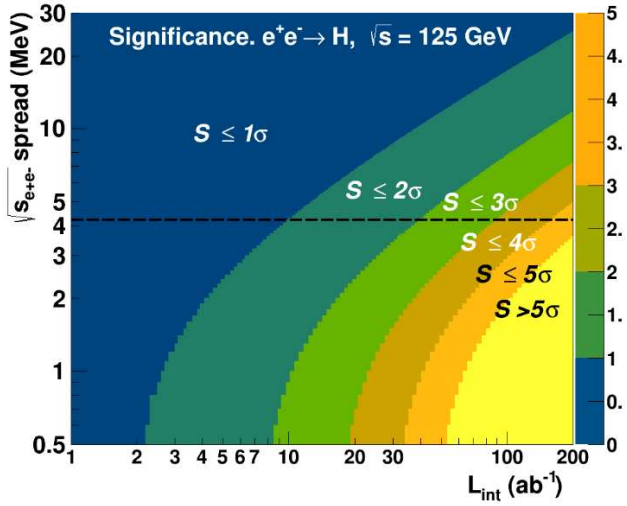
Shi Xin:

- At the FCC-hh, gluon-gluon fusion process(green line) dominates the production.
- Before building the machine, the theoretical predictions of different subprocesses should be made based on what we already known.
- These processes have different contributions on the total Higgs cross section and event topologies.

2.3 Question on page 3

Liu Kai: For CEPC and FCC, which machine will be built firstly?
Shi Xin: CEPC should be built earlier than FCC; The FCC is more expensive due to the price level in Europe and the geological conditions near Geneva.

2.4 Question on page 4



Suyu Xiao: (Page 4) What's the meaning of 'S' on the plot? Shi Xin and Liu Kai:

- Significance represents the probability that a hypothesis is true. (Try to find 'hypothesis testing' in a statistical text book.)
- In experimental partical physics, 5σ means a discovery and 3σ an evidence.
- Here, I give you a good introduction from Scientific American: https://blogs.scientificamerican.com/observations/five-sigmawhats-that/

2.5 Comments on page 4

- Shi Xin and Liu Kai:
  The first line of section 2 in the paper explains why the lightest fermion processes could not be measured at the LHC:
  The SM Higgs boson couples to the fundamental fermions proportionally to their masses m_f, and thus its decays into the actual constituents of the stable visible matter in the Universe —formed by first generation fermions ($u\bar{u}$, $d\bar{d}$, $e^{\pm}$) with light masses $\mathcal{O}(0.5 - 10$ MeV)– have extremely reduced branching ratios and cannot be directly measured at the LHC.
  The background level at the LHC is very high, the signals of rare processes will be submerged in the background and hard to observe.
- Shi Xin: The sterile netrino is used to explain the neutrino mass hierarchy. The 'sterile' means do not interact with others.

2.6 Question on page 5

Suyu Xiao: What's the motivation of studying double and triple Higgs final-states processes?
Shi Xin: The double and triple Higgs processes is used to study the Higgs triple and quartic self-coupling effects, respectively.

2.7 Question on page 7

- Shi Xin: On the left plot, the dark matter contributes about 20%, and others are the dark energy.(This plot has been updated by Suyu.)
- Shi Xin: The reason that $\phi < m_H/2$ and $m_Z/2$, how to explain the parameter 1/2?
  Ryuta and Shi Xin: For the $H \to \phi\phi$ process, m_ϕ should less than $m_H/2$; and $m_\phi < m_Z/2$ for $Z \to \phi\phi$. In addition, the spin of the dark matter particle should be taken into account since the spins of Higgs(J=0) and Z(J=1) are different.