

Higgs physics at the Future Circular Collider

Speaker: Suyu Xiao

February 24, 2017

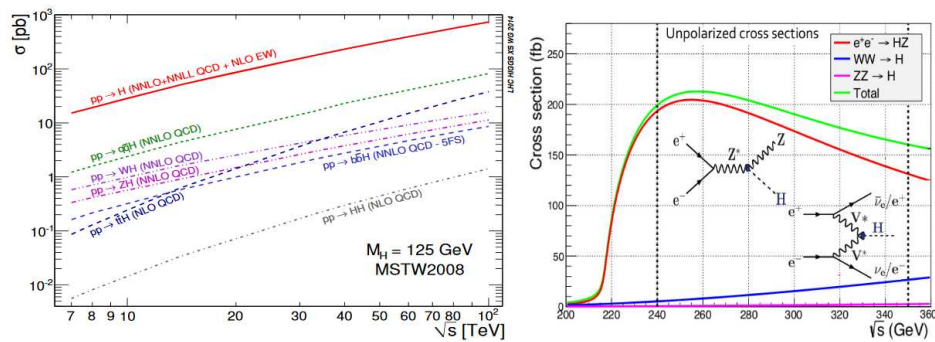
1 Introduction

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.

- 16 • In a e^+e^- collider, the Higgs production is dominated by the Hig-
17 gsstrahlung process(red line), we get the largest cross section around
18 250 GeV.
- 19 • Here's a paper for more details : [Physics cross section and events generation on CEPC](#)
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21 **2.2 Comments on the left plot**

22 **Shi Xin:**

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

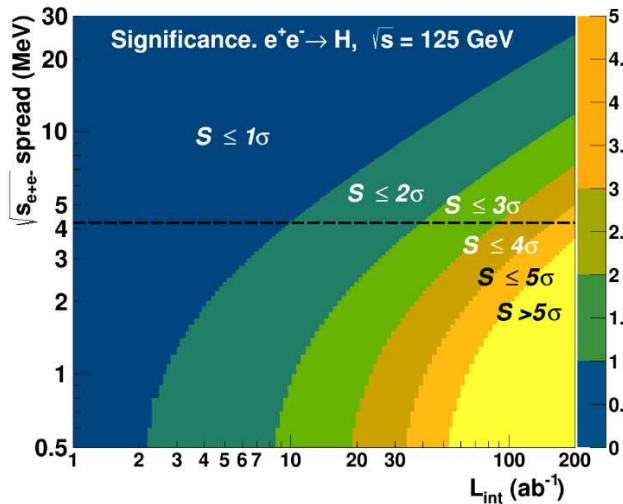
30 **2.3 Question on page 3**

31 **Liu Kai:** For CEPC and FCC, which machine will be built firstly?

32 **Shi Xin:** CEPC should be built earlier than FCC; The FCC is more
33 expensive due to the price level in Europe and the geological conditions
34 near Geneva.

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2.4 Question on page 4



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

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– Significance represents the probability that a hypothesis is true. (Try to find 'hypothesis testing' in a statistical text book.)

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– In experimental particle physics, 5σ means a discovery and 3σ an evidence.

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– Here, I give you a good introduction from Scientific American:

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<https://blogs.scientificamerican.com/observations/five-sigmawhats-that/>

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2.5 Comments on page 4

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– Shi Xin and Liu Kai:

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The first line of section 2 in the paper explains why the lightest fermion processes could not be measured at the LHC:

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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 $\mathcal{O}(0.5 - 10 \text{ MeV})$ —have extremely reduced branching ratios and cannot be directly measured at the LHC.

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The background level at the LHC is very high, the signals of rare processes will be submerged in the background and hard to observe.

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– Shi Xin: The sterile neutrino is used to explain the neutrino mass hierarchy. The 'sterile' means do not interact with others.

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2.6 Question on page 5

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Suyu Xiao: What's the motivation of studying double and triple Higgs final-states processes?

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Shi Xin: The double and triple Higgs processes is used to study the Higgs triple and quartic self-coupling effects, respectively.

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2.7 Question on page 7

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– **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.)

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– **Shi Xin:** The reason that $\phi < m_H/2$ and $m_Z/2$, how to explain the parameter 1/2?

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Ryuta and Shi Xin: For the $H \rightarrow \phi\phi$ process, m_ϕ should less than $m_H/2$; and $m_\phi < m_Z/2$ for $Z \rightarrow \phi\phi$. 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.

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