PHY 5669: Quantum Field Theory B, Spring 2017

April 26^{th}, 2017

Final Exam

(due May 5^{th}, 2017)

This Final Exam consists of the Final Project on p. 775-777 of Peskin and Schroeder's book. Complete as many points as you can.

In completing the project you will need to have full control of the Lagrangian of the Standard Model (SM), whose components are discussed in Chapter 20 of Peskin and Schroeder's book. Make sure you understand the form of all components of the Standard Model Lagrangian, write them explicitely, write the Feynman rules for propagators and interaction vertices, and use them in working through this exam. Please show full work.

In point **(b)** of this project consider that, in the case of a SM Higgs ($M_H \approx 125$ GeV), $M_H < 2M_W$ and $M_H < 2M_Z$. In Fig. 1 you can see that $\mathrm{Br}(H \to WW)$ and $\mathrm{Br}(H \to ZZ)$ are given also for $M_H \approx 125$ GeV and lower. What do they correspond to? Explain how you could calculate the corresponding rates.

Once you have formal results for the various Higgs-boson branching ratios, evaluate them for the set of parameters given in this project and $M_H \approx 125$ GeV. Compare them with Fig. 1, where you can see plotted the theoretical predictions for the SM Higgs-boson branching ratios (l.h.s.) and total width (r.h.s.). Remember that $\mathrm{Br}(H \to XX) = \Gamma(H \to XX)/\Gamma_{\mathrm{tot}}$ where Γ_{tot} is the sum of all the rates. How do your results compare to the numbers that you can extract from the plots? Assuming that your results are correct (you can cross check with the literature), they will probably not perfectly agree with the plot on the l.h.s. Can you tell what could cause such difference?

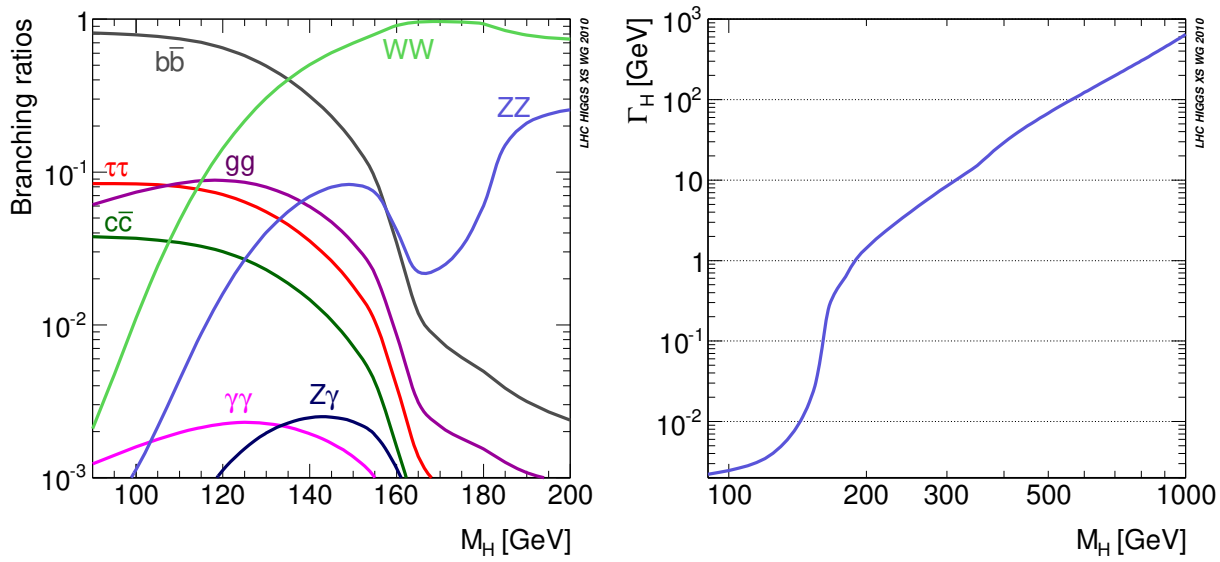

Figure 1: **L.H.S.**: Branching ratios of the SM Higgs boson as a function of its mass. **R.H.S.**: width of the SM Higgs boson as a function of its mass.