25th of March 2026 **Quiz number 4**

Phenomenology of Physics Beyond the Standard Model

FS 2026

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1. R-parity phenomenology in MSSM

Consider R-parity in the Minimal Supersymmetric Standard Model (MSSM).

- Define R-parity symmetry. How does this symmetry arise in SUSY?
- What are the values for $R|quark\rangle$ and for $R|\tilde{\chi}_0\rangle$?
- Assume you want to test R-parity conserving SUSY at hadron colliders. What is the requirement on the multiplicity of supersymmetric final states coming from R-parity ?
- Explain why R-parity conserving SUSY gives a natural dark matter candidate. What signature do you expect for the lightest supersymmetric particle (LSP) to produce in the detector ?
- Explain in words how the proton decay can be suppressed requiring R-parity conservation in SUSY.

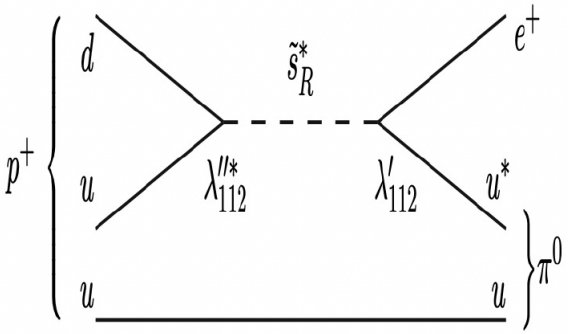


Figure 1: Proton decay in MSSM

2. Radiative corrections to the Higgs boson mass

Consider the light Higgs boson h in the MSSM.

- Explain (without making computations) how the light Higgs boson mass is predicted starting from the Higgs potential V_H.
- What is the upper bound predicted by the MSSM ? At LEP, why could this prediction be considered in tension with the experimental results in Figure 2 ?
- Why was the problem only apparent ? Sketch the main diagrams contributing to raising the Higgs boson mass value. Which new upper bound is obtained ? Why do you need SUSY to be broken to obtain a meaningful result ?

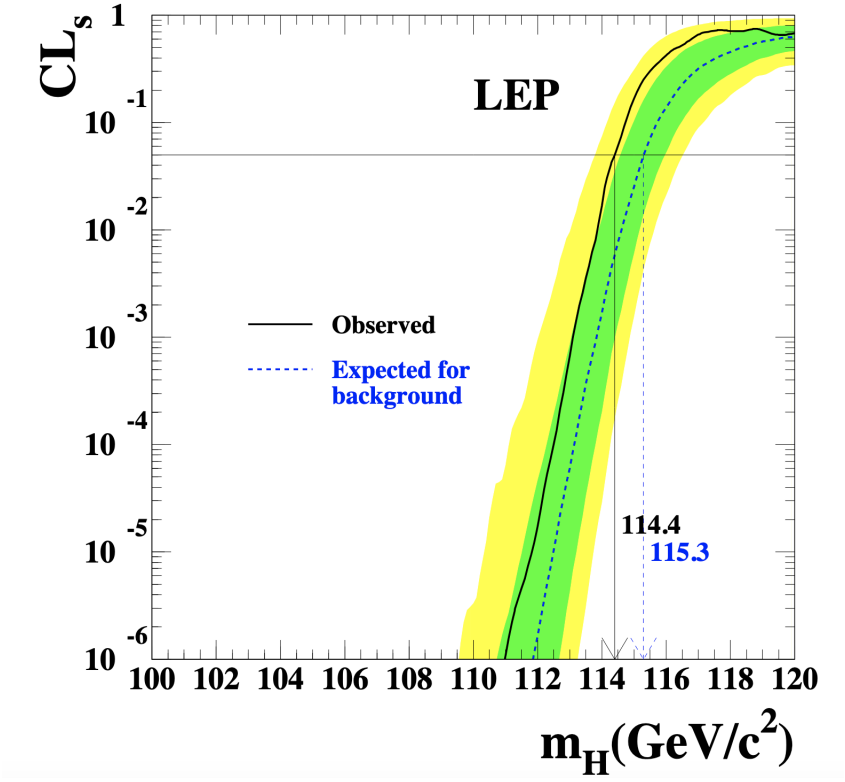


Figure 2: LEP CLs limits on the Higgs boson mass.