Übungen zu Physik an Hadron-Collider SS 2013
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Übungsblatt Nr. 9

Die Lösungen müssen bis 11 Uhr am Mittwoch den 3.7.2013 in die Briefkästen im Erdgeschoss des Gustav-Mie-Hauses eingeworfen werden!

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1. **Top quark decay**

   The muon decay width Γ_μ can be very roughly estimated using dimensional arguments. The Feynman diagram involves two weak vertices, which means the width will be proportional to G^2 (G being the Fermi constant).

   - Based ONLY on dimensional arguments, write down an expression for Γ_μ as a function of G and the muon mass m_μ **[2 points]**

   Note that the estimate is quite wrong, as in the exact calculation there is a large, dimensionless factor$1/192\pi^3$ which is involved in the expression.

   With similar arguments, one can compute the width Γ_t of a top quark decaying into a Wb.

   - Why is the $t \to Wb$ decay in practice the only decay channel of the top quark? **[1 point]**
   - Based ONLY on dimensional arguments, write down an expression for Γ_t as a function of G and the top mass m_t **[2 points]**
   - The result of the exact LO calculation is that a factor $1/8\pi\sqrt{2}$ has to multiply the expression obtained at the previous point. Write down the numerical estimate for Γ_t. **[2 points]**

   On `http://wwwhep.physik.uni-freiburg.de/~fungaro/hadronCollider/Top` you find the ntuple Top.root containing 7 TeV $pp \to t\bar{t} \to l\nu qqbb$ events at truth level (you have the b and light quarks, and the lepton 4-vector).

   - Make a plot of the top mass by explicitly reconstructing the decay (note there is some ambiguity in the association of the two b quarks). How accurate is the calculation of Γ_t made before? **[2 points]**