Warm-Up 16

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1 Confidence Intervals, Confidence Levels

1. Consider Fig. 1. This is a graph of the number of times the CMS detector at the Large Hadron Collider detected subatomic particles with energy plotted on the x-axis. Scientists were searching for the Higgs boson, a subatomic particle thought to control the mass of all the other particles. In the graph, we see black data points, which are a histogram. The errorbars in the y-direction represent the standard deviation in the mean for the individual data point. Notice the *bump* near $x = 125$. (a) About how many standard deviations above the "background" prediction is teh data point? (Estimate). (b) What is the probability that the central black data point that is farthest from "background" occurred randomly (Estimate based on your answer in part (a)). (c) At what confidence level can you say the black data points in the bump did *not* occur randomly? (The green and yellow bands represent the 1 and 2 sigma confidence intervals for background).

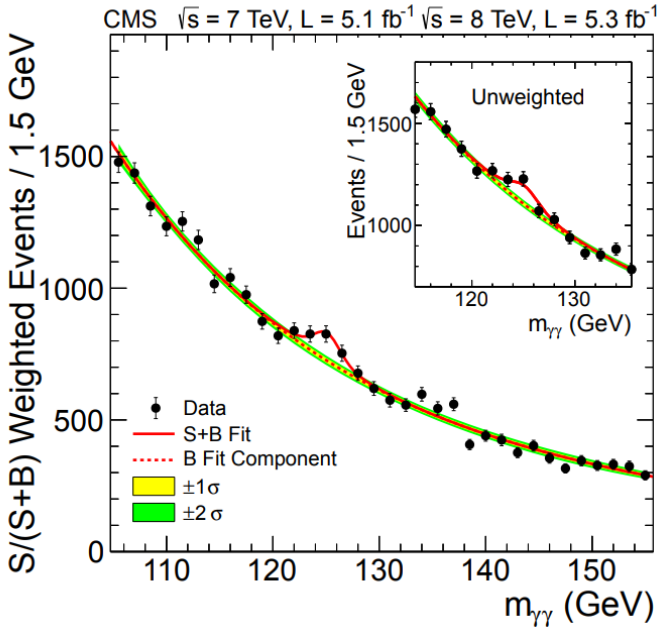

Figure 1: The number of "events" (hits) in the CMS detector at the Large Hadron Collider, versus particle energy, for a particularly special type of particle. The green and yellow bands represent the 68 and 95 percent confidence intervals *versus energy* for **background events.** Background events do not represent the discovery of a brand new subatomic particle.