1) Conclude the exercises 1-5 as discussed in the lecture.

2)

a) Calculate the spectrum using the data provided by the instructor. Assume 2 full years of data taking ($6.3 * 10^7$ s). Assume 2.5 m^2 of detector surface and the flux to be diffuse from the whole celestial sphere. *Hint: Use a 0.1 logarithmic bin.*

b) How many particles are expected in one second in the bin between $10^{9.3} – 10^{9.4}$ eV?

c)Check the first bin without counts at high energy. What is the 90% FC upper limit on the flux? And the second bin without counts? Why are the estimates different?

d)Fit the data with a simple power law. What is the spectral index? And the normalization at 10^8 eV?

Hint: you can use fitting tools like minuit, the classes of root or various python libraries. However, the spectral shape is very simple: a power law. If you are not familiar with any of those tools, you can try to reproduce the spectral shape "by eye". Change the slope until it matches the one from the data and then do the same for the normalization. You will match the model to the data and obtain so the 2 spectral parameters.

e) How many years of acquisition would you need to have 1 particle (on average) in the $10^{14} – 10^{14.1}$ eV range?

f) Assume that 30% of your detector breaks. How does the estimate of point b) changes?

g) Assume there is a 10% energy overestimation due to calibration issues. (The energies are 10% higher than they really are). How does the estimate of point b) changes?