Slide 1:

Hello,

My name is Marcos Martinez and I are going to speak about the automation of the process of the measure of the tritium levels in water.

Slide 2:

For I can explain you what is the aim of this task I have structured this presentation in this parts:

-First I will introduce the problem.

-Second I will explain this method to level of one channel.

-Finally I will conclude by extending this explanation to several channels. For this one I show you the card, which we pretend use, and I will explain how work this card.

Slide 3:

We need use SiPM in the Tritium Project for several reasons:

-First we need use SiPM because this one have a bigger PDE (50%) than PMTs (30%).

We will want detect low levels of the activity, i mean, we will have few events per second so is very imporatant that our detector which are very efficient.

-Second SiPM need a lower supply, of the order of tens of volts, than PMTs, which need high voltage.

This is important too because the finally place of the detector won't have electricity and we want that this detector are self-sustaining with photovoltaic card or something like this. Therefore we cannot develop a detector which consumes a lot of energy

but we have found new problems with SiPMs which we didn't have with PMTs:

The main problem which we have found is that the gain of the SiPM have a big dependence with the temperature.

If we want use this detector for monitor the level of the tritium in the water we need that the SiPMs have a constant gain.

We have developed a method which allow maintain a constant gain which is fundamental to this project since there's not exist a exaustive control of the temperature in the final location of the detector.

Slide 4:

The model of the SiPM which we have used for do this task is this one. The main reason is that this have a peak in his photo detection efficiency spectrum very near to the peak which have the fibers, which we use in our detector, in his emission spectrum.

In this way we get optimize the efficiency of the detector, which we have already seen that is very important.

The model, which we will use in the final prototipe, is this. This model have the same parameters of this one but this have a bigger active surface.

Slide 5:

Now i am going to show you how we can maintain a constant gain in our detector.

For I do you this task,

* First I will speak about the experimental instrumentation which i have used.
* Second I will explain how you can calculate the gain of you SiPM from it charge spectrum.
* Third and fourth I will show you the dependences which exist:
  + On the one hand between gain and temperature.
  + On the other hand between gain and supply voltage
* Finally I will explain you the method which we have developed for compensating the change in the gain due to a change in the temperature with a change in the operational voltage.

Slide 6:

* First we have used a control system of the temperature which is necessary if we want work with SiPM.
* Second we have used two voltage generator for fed the SiPM and the card.
* Third we have used a diodo LED, which emits photons to 435 nm and this one pretend to simulate the centelleated photons by the fiber. Moreover we used a pulse generator for fed this LED.
* Fourth we have used the SiPM which i have named before
* And Finally we used a card with a gain of one hundred seventy to twenty five degrees which transform the out signal of the SiPM, which was in current, to a signal of voltage, which we need for analyze this pulse with the oscilloscope.

Slide 7:

Now I are going to explain how we can calculate the gain of the SiPM.

The signal which we obtain from this system is like the signal which i show you in the screen where you can see, with the help of the persistence mode, several heights of the pulse which are associated which several number of pixels turn on simultaneously.

Moreover I use the synchronization signal like trigger. In this way i can split the signal of the system and other events which only are going to contribute in the background. Therefore I don't want to use this events in my analysis

Such as I calculate the gain of the SiPM I only have to calculate the gain of the system and extract to this value the gain of the card like you can show in this equation.

Slide 8:

We calculate the gain from it charge spectrum.

I integer the signal in a temporary windows such as I obtain the charge spectrum.

This windows have to be as narrow as you can because, in this way, you reduce the contribution of the events which, as I said before, only are going to contribute in the background. In this case this windows is about five hundred nanoseconds.

Now, you save this result in a histogram. In this histogram, which is a charge spectrum, you can see several Gaussians, which are associated with several height of the pulse. Therefore this Gaussians are associated with several pixels, which have been turn on simultaneously. For instance, in this example, you can see from one until seven pixels, which have been turn on simultaneously.

In this calculate you have to take into account that the first Gaussian is associated with the pedestal of the system

The pedestal is the out signal of the system when the in signal is zero

Slide 9:

Finally we have developed a macro with ROOT for analyzed this spectrum.

Between many things, this macro find the peaks of every Gaussians and plot this one in front of the number of the pixels, which are turn on simultaneously.

Afterward, this macro fit this plot to this equation from which we can obtain the value of the gain. You have to remember that this gain is the gain of the system and you have to extarct the gain of the card.

Finally, in this case, we obtained this value, which if we compared with de valeu provided by Hamamatsu Photonics, we can check that the relative error is less than 6 percent so we can considered that this method is good.

Slide 10:

10-15 minutos.