

In 30 minutes build complete CsI(Tl) detector with great results!

I offered some weeks ago a few 2"x2"CsI(Tl) crystal to you all, and there were some enthusiastic member that wanted one, and maybe already received it or will receive it soon.



CsI(Tl) crystal $\pm 50 \times 50$ mm the start for a simple home made detector.

Because I would like to show you what is possible with this crystal and how to use it for your hobby, I decided to make a simple but still good usable detector with it.

Of course you can design your own version depending on the materials you have available, what I describe here is just one way to make a good working detector with this crystal.

My aim was to spend as little as possible time on it, use materials that are available and let it work as if it is an expensive professional build version.

Normally I try to use pmt's with a high as possible gain so mainly with 10 dynodes but in this case I used a Hamamatsu R6231 pmt (8 dynodes), it is a good pmt you can find them on eBay for a fair price, and I happened to have one in my junk box.

You can also use a smaller or bigger pmt that will work too but results may not be exactly as the test I did, a Hamamatsu pmt will give you the best results.

The R6231 has only 8 dynodes so it will need some extra high voltage to get enough gain, but the good part is that the sensitivity for the green colour light coming from the CsI(Tl) crystal is much better than with an other brand pmt's so that will give a big advantage in spite of the low gain from this pmt.

You have to keep in mind that CsI(Tl) gives only about 40% of the light from a similar NaI(Tl) crystal.



Pmt with base

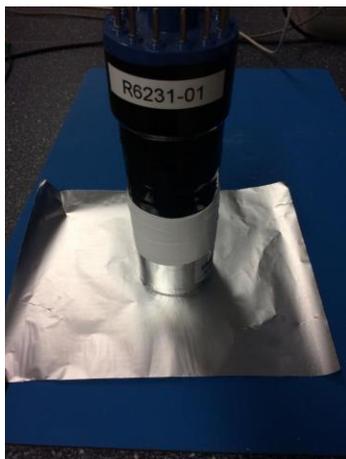


Wrapped in ptfе and tape



With crystal, grease and ptfе

I wrapped the pmt in Teflon ptfе and than cover that with black electrical tape. The crystal is coupled with some coupling compound e.g. silicone grease to the pmt than wrapped with Teflon around it so light can't escape from the joint between the pmt and the crystal and than kept in place with some electrical tape. Because the original crystal wrapping is not 100% light tide I needed something like a can to cover the crystal so I used a basic household aluminium foil, it is cheap and it works great, folded over the crystal and taped to the pmt I needed two layers to get it 100% light tide.



Aluminium foil



Foil wrapped around crystal



Front with aluminium foil

It does not look to very pretty with the aluminium foil lots of wriggles but it is effective!



To make it at least look a little bit better I wrapped an extra aluminium foil around the side of the crystal.

The pmt is shielded with an old solid mu-shield also coming from the same junk box as the pmt, but you can also use a mu-foil around the pmt and then some other metal tube around the pmt that works good too.



The used solid mu-shield.



Complete detector ready to test.

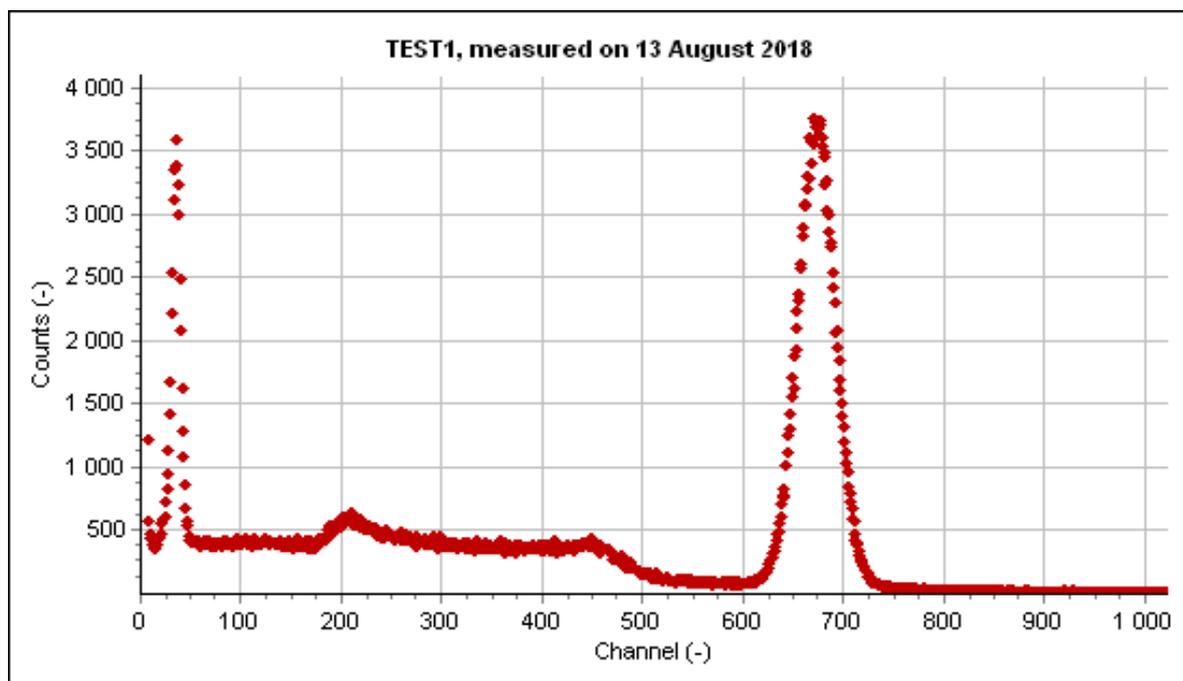
The aluminium foil must be connected with the mu-shield and also connected to cathode(ground) for good electrical shielding of the detector, than every thing is taped together with electrical tape to make a more solid construction.

For the tests I radiated the crystal from the front and used a main amplifier with a 3µsec. shaping time, because CsI(Tl) crystals has a relative “slow pulse”.

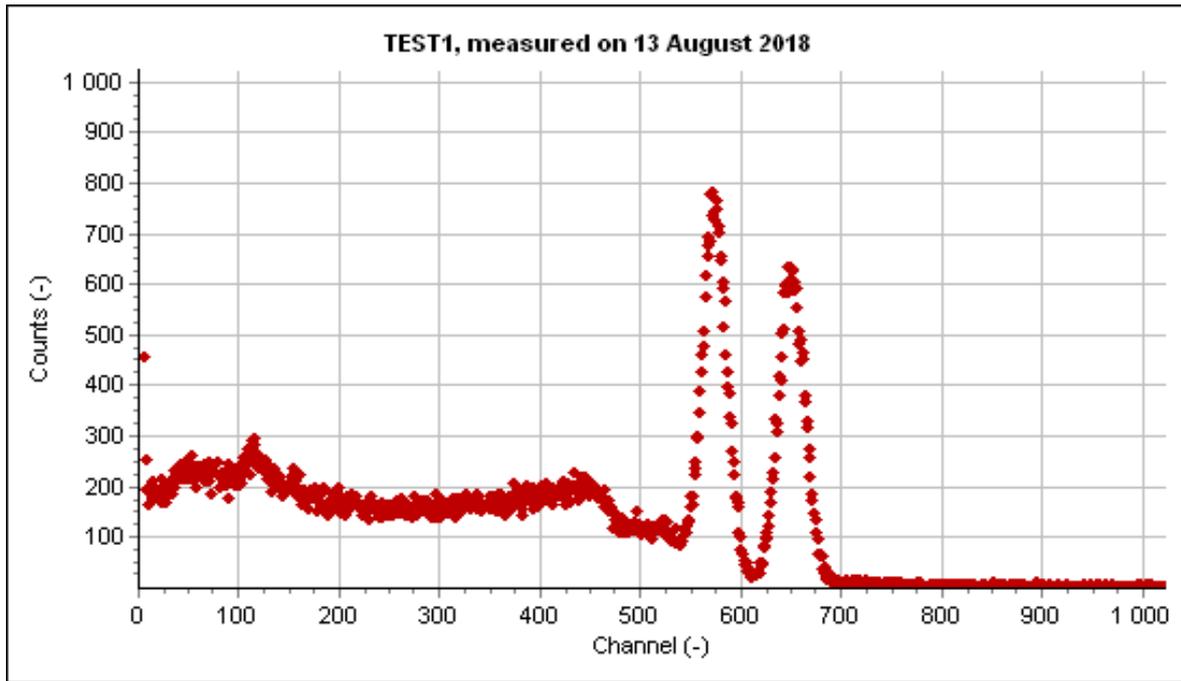
The for the test used my standard voltage divider this one is total 5.6MΩ that is for many of you maybe to low in resistance but you can easy make it any value you want or is needed I your situation.

So the results is a simple detector, it may not look very nice or professional but it works great and build in less than a 30 minutes what more do you want!

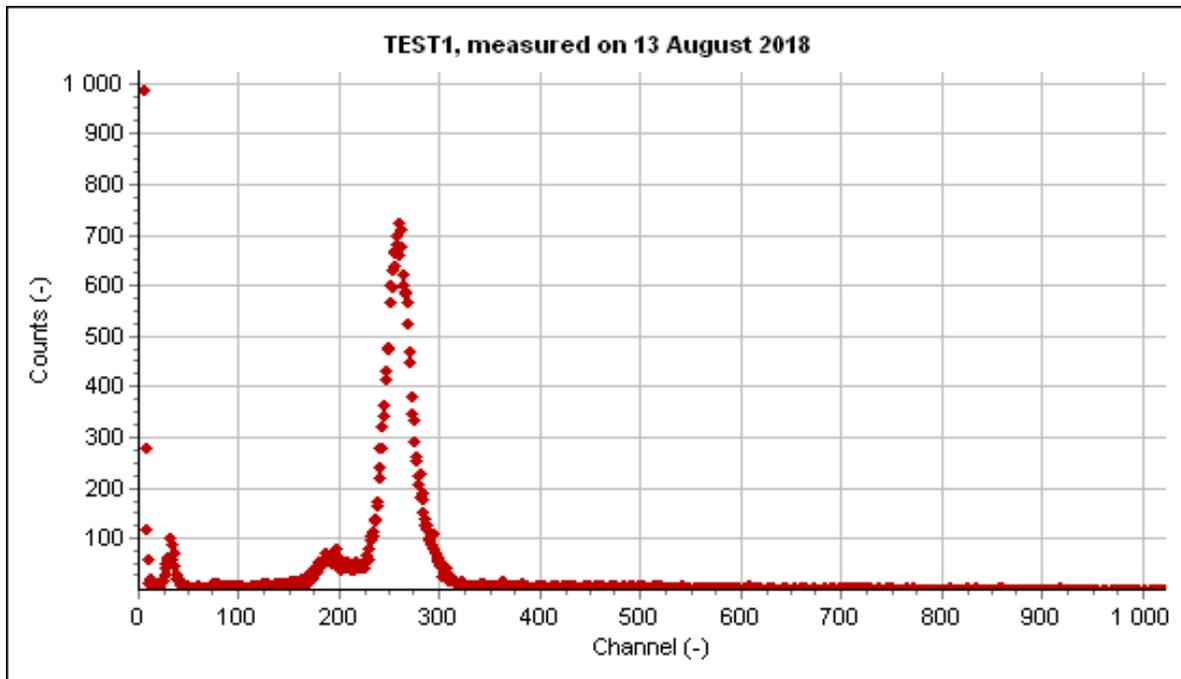
I did some test with Cs-137, Co-57, Co-60 and Am-241 sources and all the results are as expected.



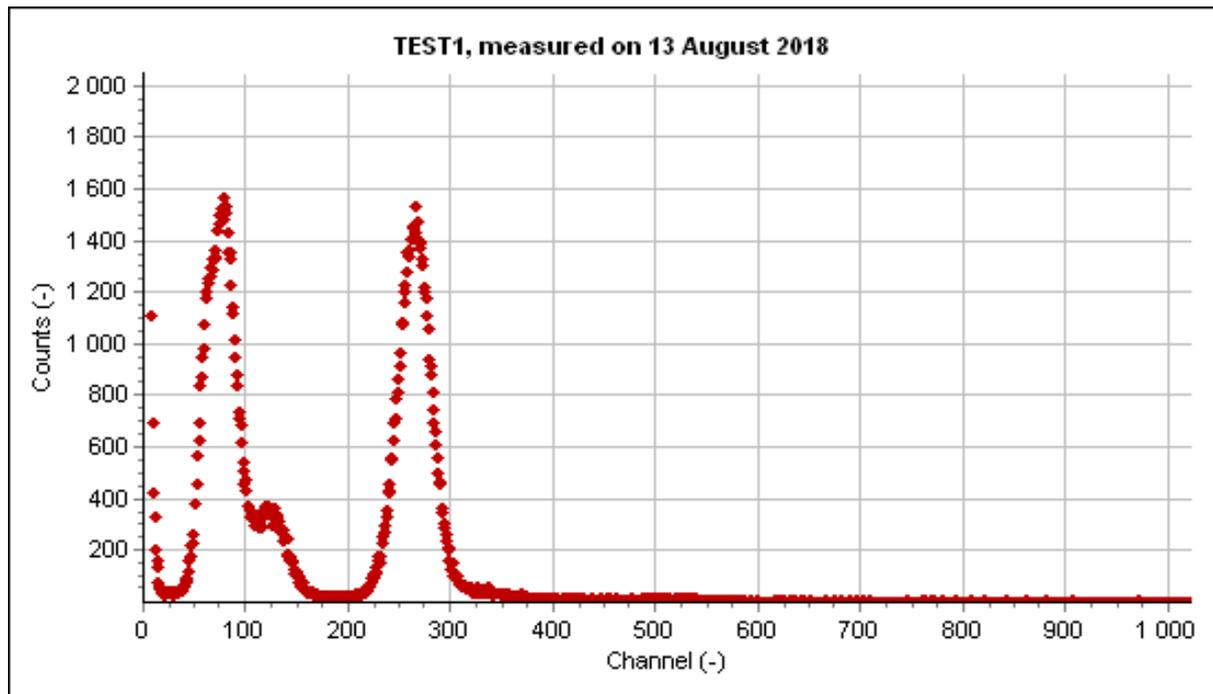
First test is done with Cs-137 and the result is great: 6.4%



Second test with Co-60, the peaks are nicely separated the resolution is: 4.7% @ 1332KeV, the peak to valley is: 22:1.



Third test with Co-57 resolution: 10.7%.



The final test with Am-241 here you can see that the can(foil) is very thin because the low 13 and 17 KeV peaks (in this spectrum showed as almost one peak) are even a little higher then the 59.5KeV peak, with a standard aluminium can these lower peaks will only be $\leq 50\%$ of the main peak.

The resolution: 13.6%.

My conclusion is: that it is very simple to make a good working detector with a CsI(Tl) crystal you don't have to worry that the crystal is getting wet, resolution is almost the same as with a NaI(Tl) crystal stopping power is relative high, and the crystal is durable, what more do you want!

It is certainly not the best looking detector I ever build but it works as expected.

Any questions about this detector and/or crystal please let me know,

Luuk

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