4- Detectors

4.1 A small Gas detector (BIDIM26, do it yourself)

4.2 Effect of the housing

Detectors: introduction

Simple ideal detectors are usually part of any simulation. Efficiency is 100%. I personally use Monitor_nD.

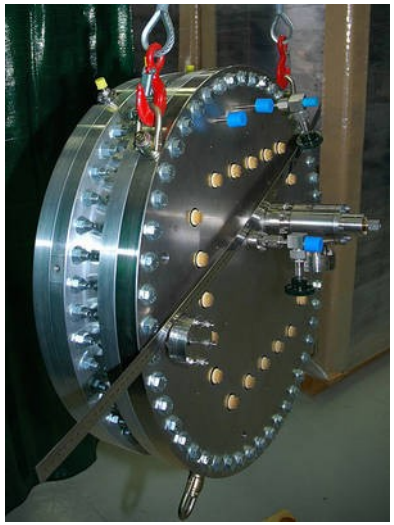
I will present how we simulate more realistically gas detectors.

When neutron enter a gas cell, it creates at some point a (p,t) pair. These charges drift, under electrical field, to a wire where the position is detected e.g. by charge division and coincidence criteria.

A cloud of charges is thus created around an incoming trajectory.

Let's see that...

Detectors: a multi-wire gas chamber



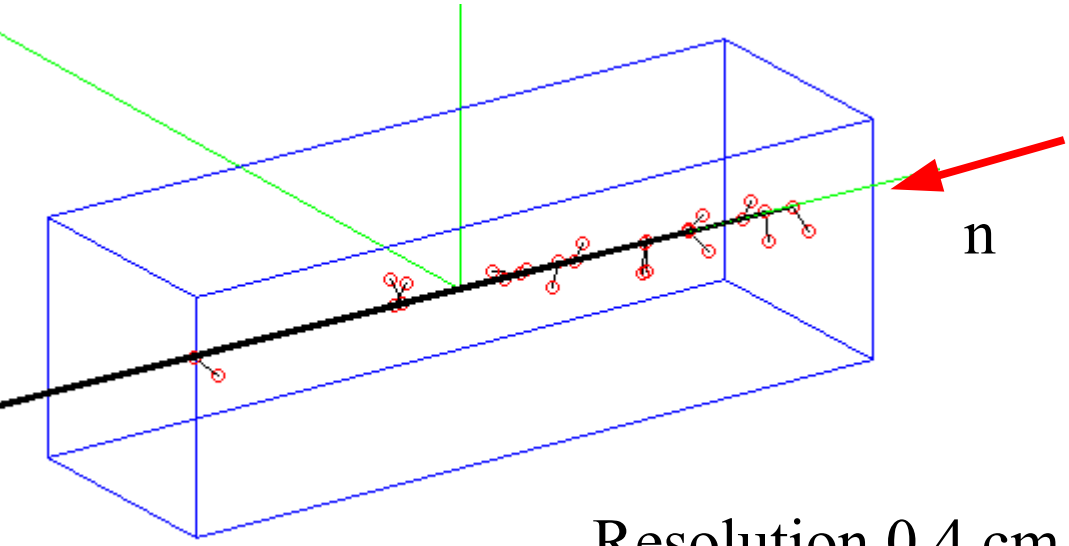
Detector model for MWPC:

Gas chamber with wires, (p,t) charge drift

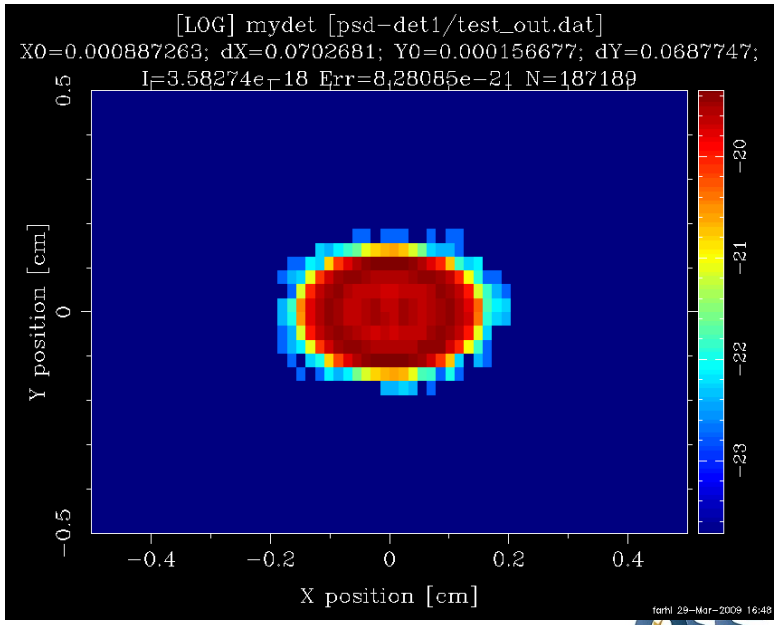
Can study:

- detector spatial resolution
- background generated from detector housing.
- estimate detector saturation (cur. not implemented)

Detection area 1x1 cm, He 5 bars, CF4 1 bar.



Resolution 0.4 cm



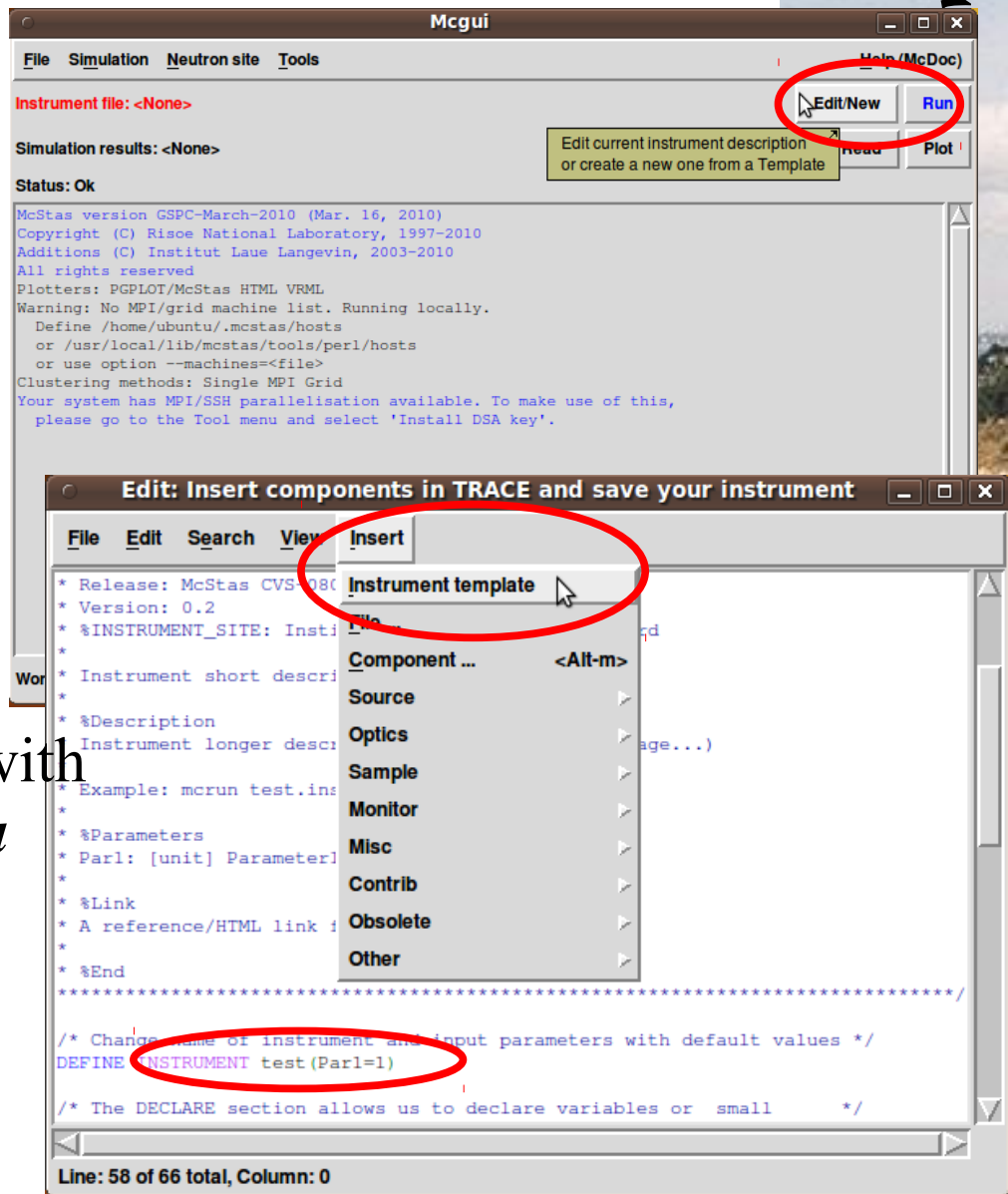
Detectors: simulating a simple gas cell

Select button **Edit/New.** *The Editor opens*
Select menu **Insert/Template** in
the Editor

Change the instrument **name** as
PSD_test and parameter ***lambda=2***

Position the **cursor** after the
TRACE keyword and ***Progress_bar***

Insert a **Source/Source_simple**
and call this instance '*Source*'
Make it a disk of ***radius=0.1*** [mm],
focusing to a 0.1 x 0.1 [mm^2] at 2 m with
neutron wavelength ***lambda0=lambda***
dlambda=0.1



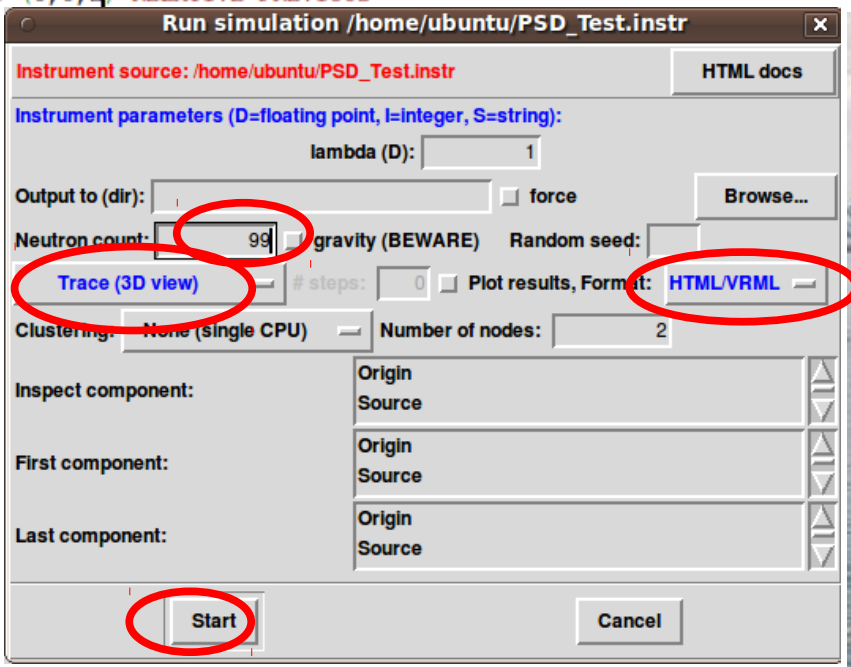
Detectors: simulating a simple gas cell

Insert a **Contrib/PSD_Detector**
at 2 [m] from the *PREVIOUS* component. Make it a BIDIM26 Detector, but with 2.6x2.6 cm2
FN_Conv="He3inHe.table",
FN_Stop="He3inCF4.table"

```
COMPONENT Source = Source_simple(
    radius = 0.1e-3, focus_xw = .1e-3, focus_yh = .1e-3,
    lambda0 = lambda)
  AT (0, 0, 0) RELATIVE PREVIOUS

COMPONENT MILAND19 = PSD_Detector(xwidth=0.192, yheight=0.192, nx=64, ny=64,
                    zdepth=0.03, threshold=100, borderx=-1, bordery=-1,
                    PressureConv=5, PressureStop=1,
                    FN_Conv="Gas_tables/He3inHe.table", FN_Stop="Gas_tables/He
                    xChDivRelSigma=0, yChDivRelSigma=0,
                    filename="BIDIM19.psd")
| AT (0,0,2) RELATIVE PREVIOUS
```

Save instrument as '*PSD_test.instr*', and click the **Run** button.

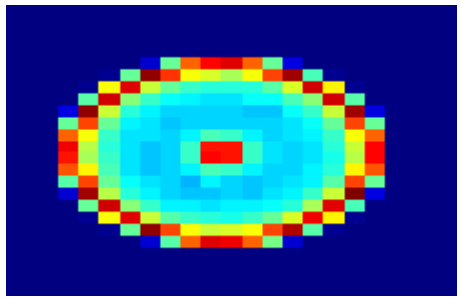


Select **Trace (3D)** instead of *Simulate*.

Click on the **Start** button.
Look at neutrons inside the detector
zoom with Z key, pass neutrons with SPACE key
Change to Format=PGPLOT and zoom.

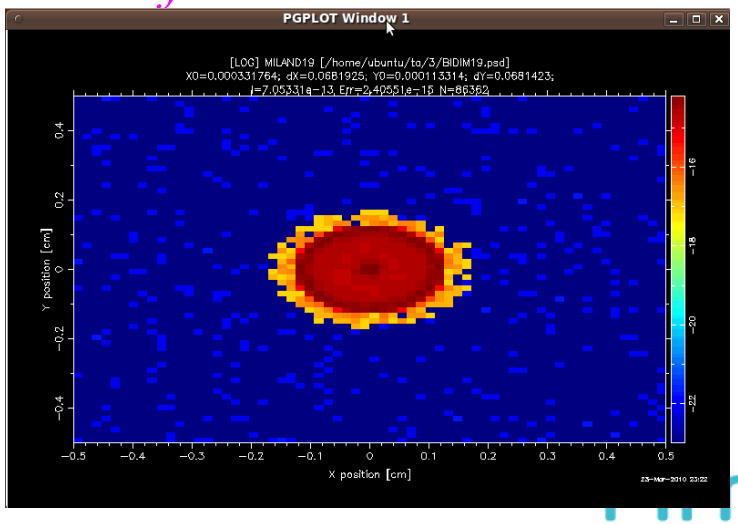
Detectors: adding housing

Close the Trace view and click again on the **Run** button.
Now select **Simulate** mode with ***Neutron count=1e6.***
Start simulation and **Plot** results.
What is the detector resolution ?



Add a 1 [mm] **Al** layer with *reflections="Al.laz"* in front of the detector, using the *PowderN* component. This is to model the detector entry window.

Launch a single simulation with *lambda=1* and Plot results. Show Log scale with 'L' key.
Estimate the background from the window.



Detectors: wavelength behaviour

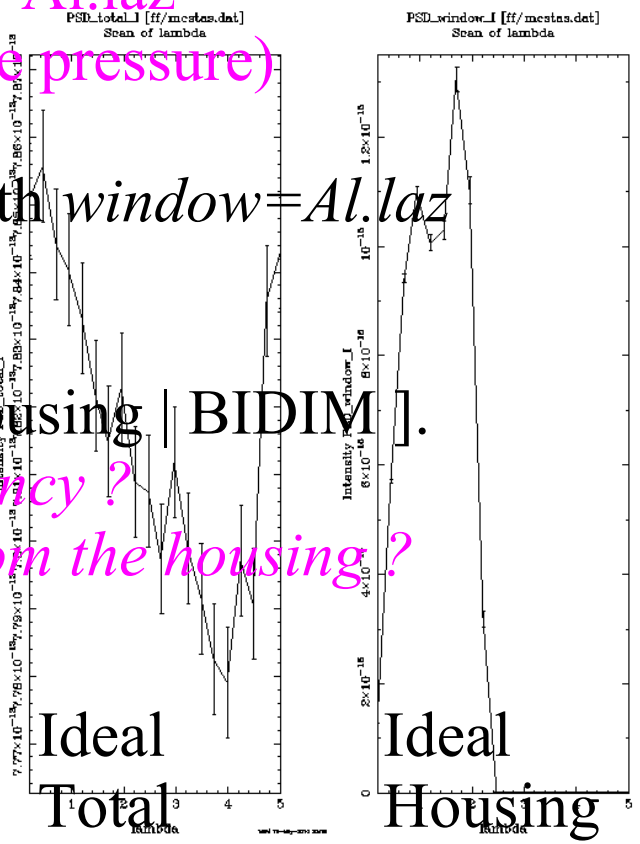
Get the **Ex_4.instr** file from essworkshop.org/storage.

Improvements:
- '*window*' parameter to specify the housing material
- Ideal detectors for total signal and scattered from housing

Launch simulation with default *window=Al.laz*
Repeat with *window=Fe.laz* (to stand the pressure)

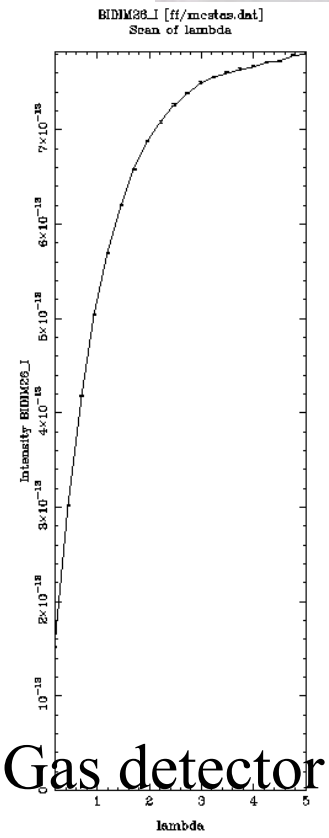
Launch a set of simulations scanning with *window=Al.laz*
lambda=.2,5 [Angs] in 20 steps.

Plot results [Ideal total | scattered on housing | BIDIM].
Comments about the gas detector efficiency ?
Comments about the scattered signal from the housing ?



Ideal Total

Ideal Housing



Gas detector