

# Malaysian Small Angle Neutron Scattering (mySANS)

*Agensi Nuklear Malaysia*

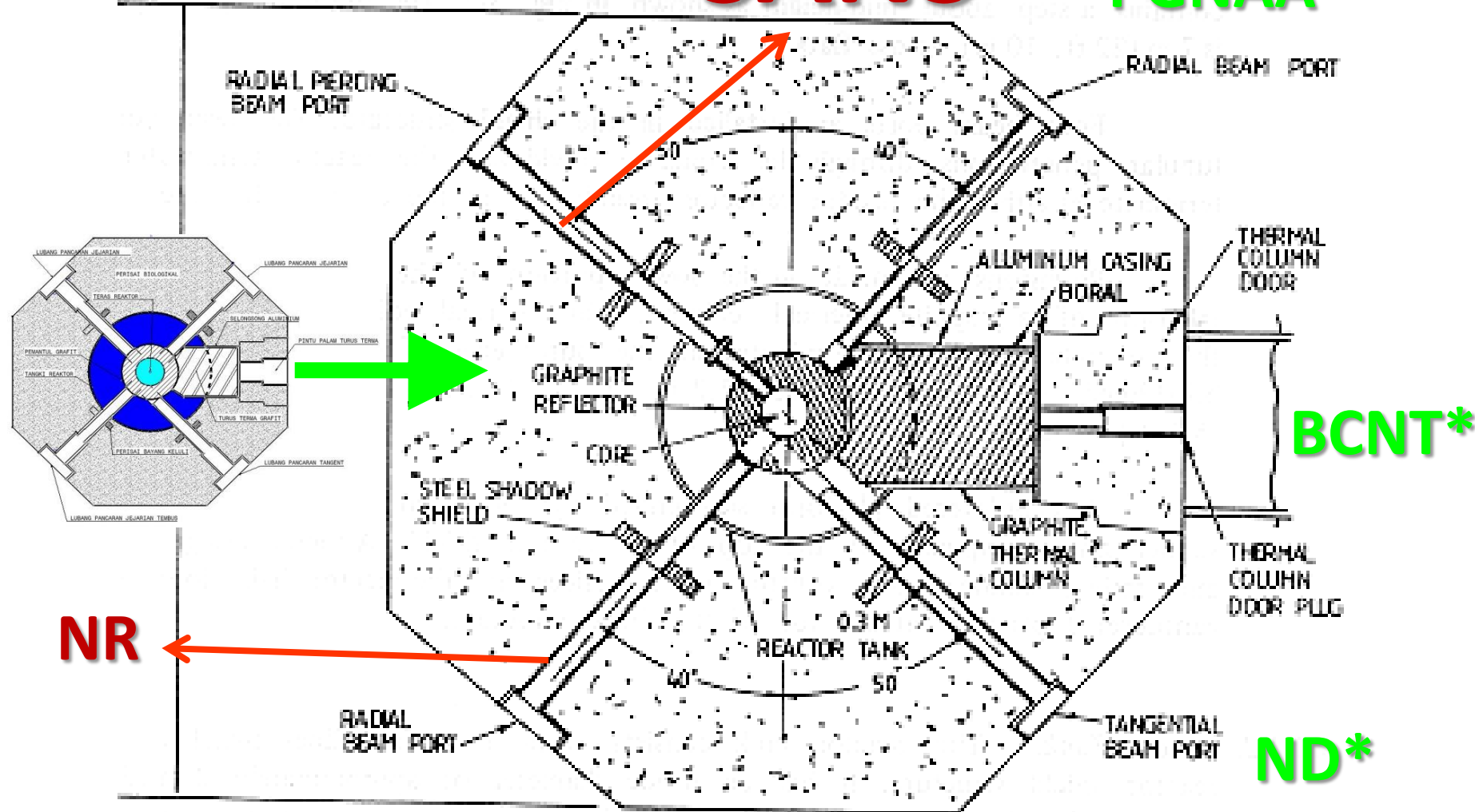
# Introduction - RTP



# RTP - Beamports

# SANS

**PGNAA\***



**\*not yet**

# Members of mySANS:

## Malaysian Nuclear Agency staffs (currently):

Abdul Aziz Mohamed, Muhammad Rawi Mohammed Zin,  
Faridah Mohd Idris, Megat Harun Al Rashid Megat Ahmad, Azraf Azman,  
Mohd Rizal Mamat, Hafizal Yazid, Rafhayudi Jamro

## Universities:

Universiti Malaya (UM) – 2 MSc students

Universiti Teknologi Malaysia (UTM) – 2 MSc students

Univeristi Kebangsaan Malaysia (UKM) – 1 PhD, 1 MSc student

## Industry:

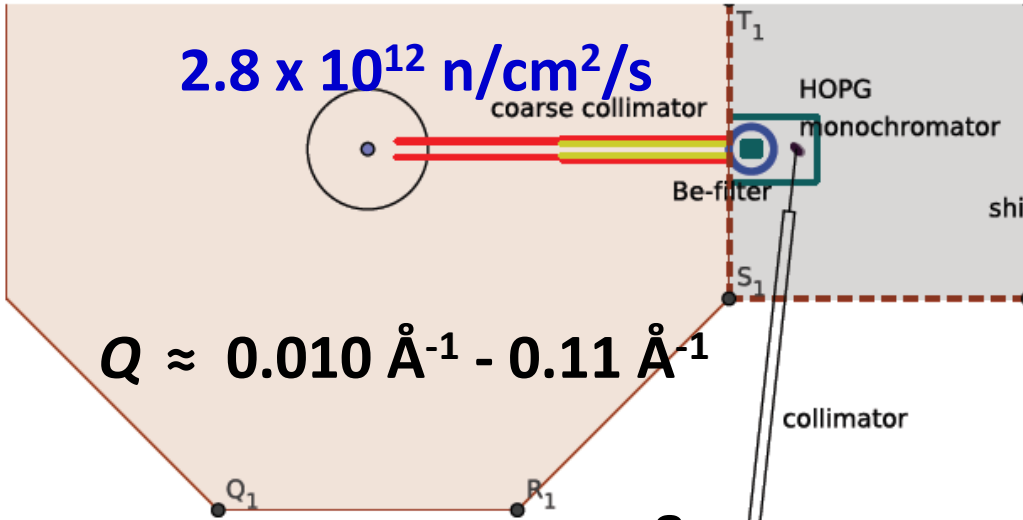
TMRND – 2 projects (1 CRP)

# On-going Projects using SANS

- 1) Characterization of Low Temperature Co-Fired Ceramics (LTTC) material using SANS (BATAN's SANS) – *TMRND*
- 2) Microstructural investigation of materials for LTCC based fuel cell using small angle neutron scattering (CRP F1.20.22) – *TMRND*
- 3) Upgrading mySANS DAQ system using IgorPro – *UM*
- 4) ZnO based detector material - *UM*
- 5) Modeling and simulation of mySANS using ray-tracing method (McStas) – *UTM*
- 6) MCNP calculation for shielding - *UTM*
- 7) Modeling and simulation of future SANS (increase of flux) for low flux source at small research reactor - KB Mirrors, BPC, misaligned HOPG (our continuation works from CRP F1.20.21)
- 7) Cryogenic Modeling for Beryllium filter using CFD – *UKM*
- 8) Shielding material for instrumentation- *UKM*

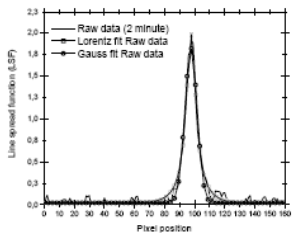


# MySANS RTP - Configuration

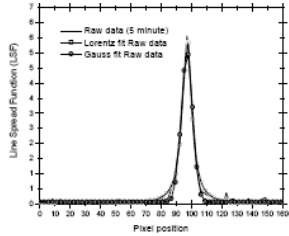


# mySANS RTP - Function

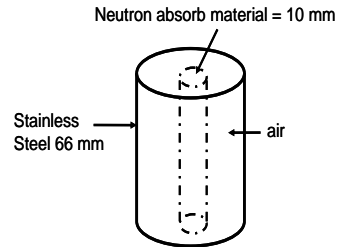
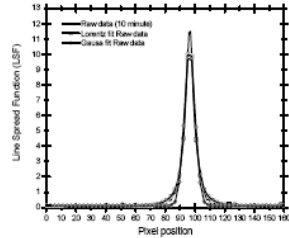
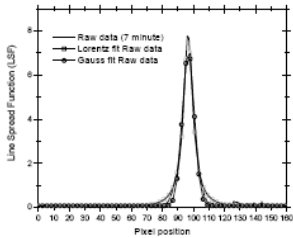
- Limited Q range - Students/Researchers to test their samples and familiarize themselves with SANS
- Most importantly we have facility to test our own ideas



(a) 2 minute



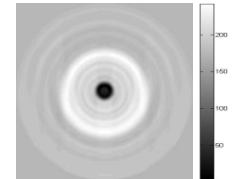
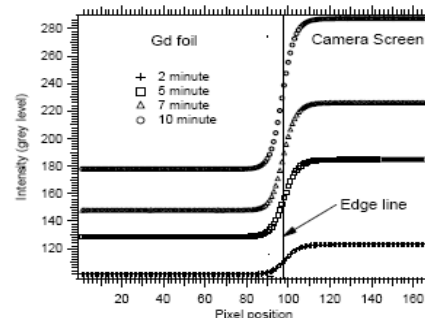
(b) 5 minute



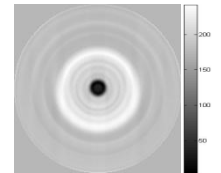
## 1-D PSD (SWPC)

*M.Z. Abdullah et al., Measurement, 41(7), 2009, 1017-1026*

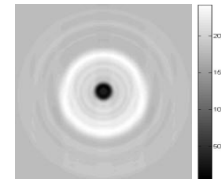
## Tomography



**Convolution**



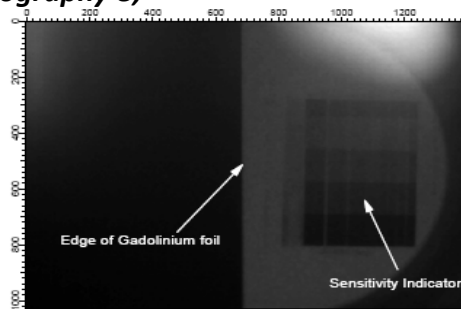
**Iterative**



**Filter back projection**

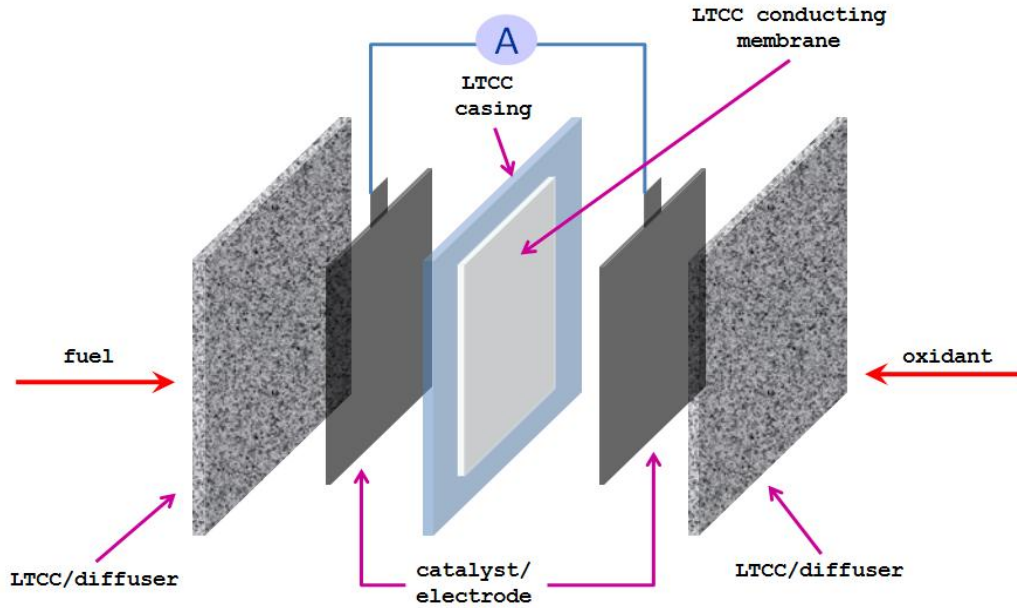
*M.R.M. Zin et al., Neutron Radiography 8, 2006, 97-105*

## CCD camera test



# SANS (with BATAN)

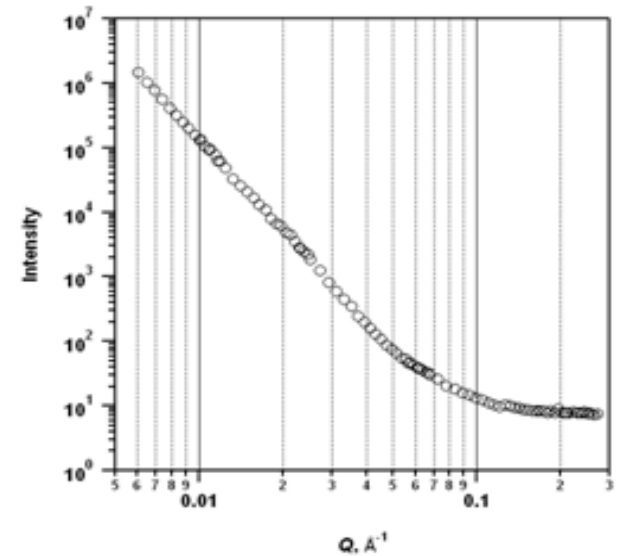
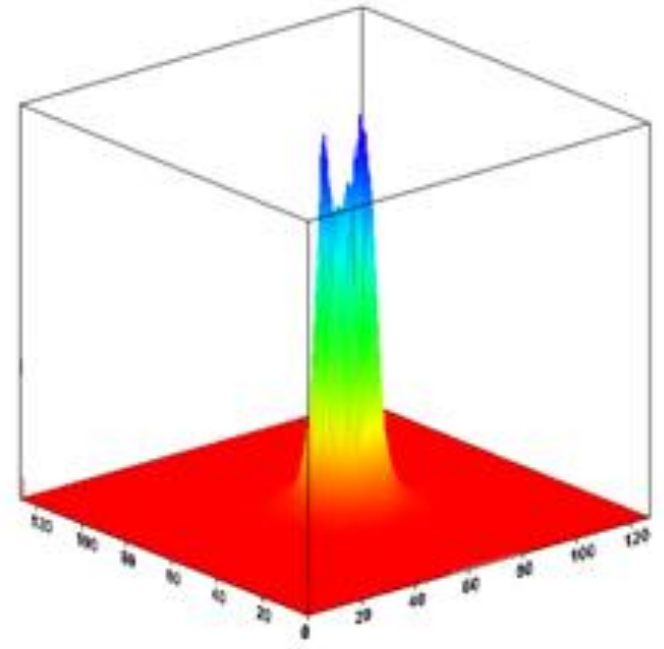
LTCC material;  
LTCC based fuel cell - CRP F1.20.22



*A.A. Mohamed et al., CRP Meeting Report,  
June 27 – July 1, 2011, Oslo, Norway*

## SANS:

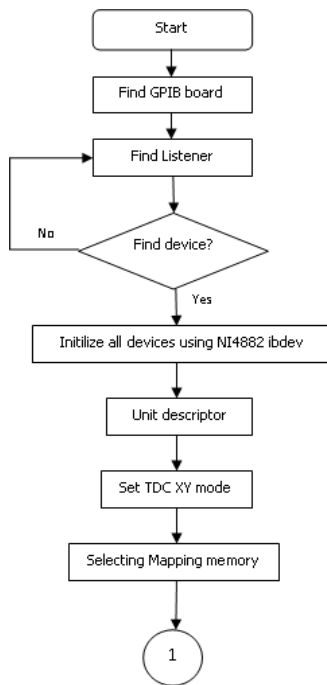
- Porosity changes of electrode (paste)
- Changes in phase (membrane – ND)





# SANS DAQ system

Upgrading of SANS DAQ system using IgorPro



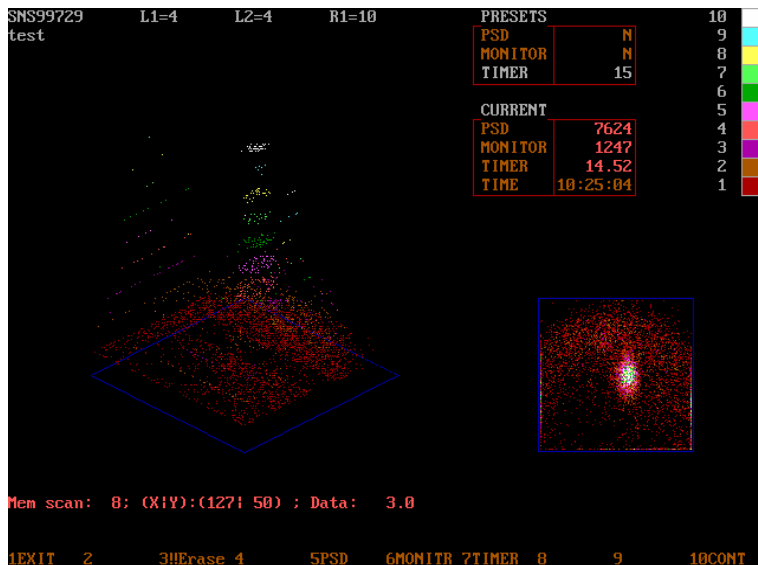
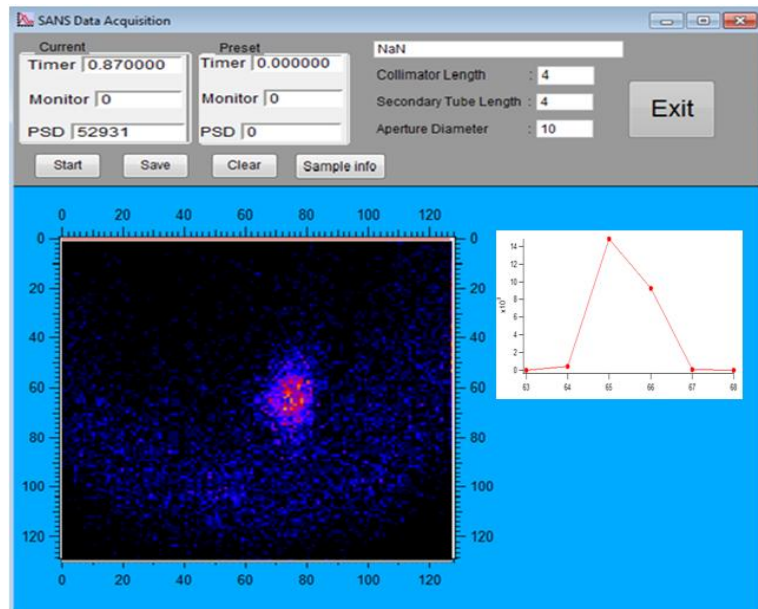
```

NI4882 ibrd= {UdPSD,4} //start sini
PSDbuffer = S_value
sscans! PSDbuffer[0], "%c", Buffdata
lsb2=Buffdata
il (lsb2<0) //then
  print "-ve lsb2", lsb2, 256+lsb2
  lsb2=256+lsb2
endif

//print "PSDBuffer0: lsb2 ", PSDbuffer, Buffdata //, str2num(Buffdata)
sscans! PSDbuffer[1], "%c", Buffdata
lsb1=Buffdata
il (lsb1<0) //then
  print "-ve lsb1", lsb1, 256+lsb1
  lsb1=256+lsb1
endif
  
```

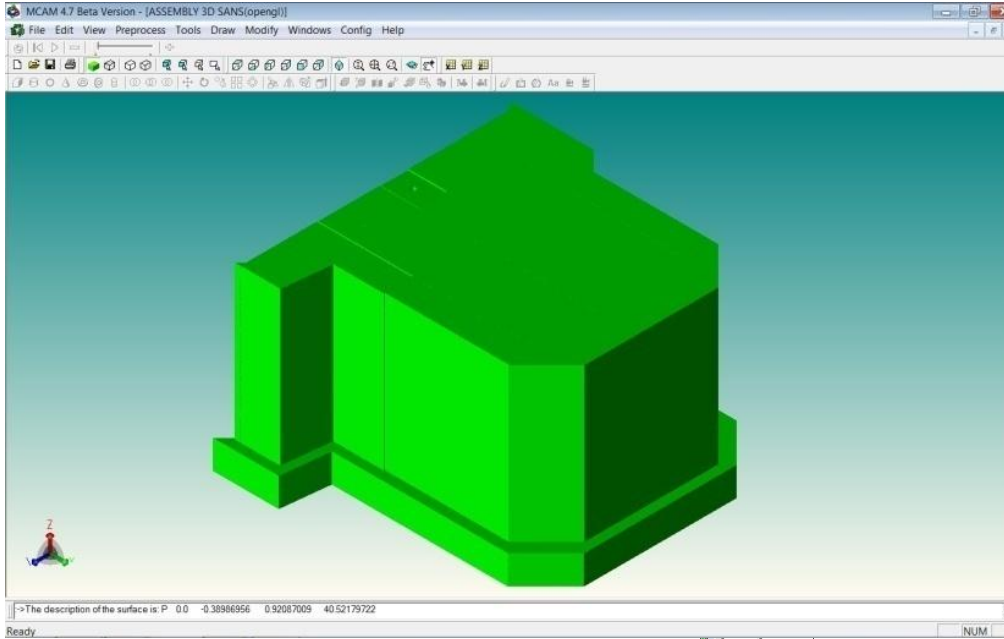
```

Experiment_SANSDAQ_GPIB_4_Timr&Cntr1_USB_ok_withTDC-
MNA 0 0 0 0 0
MNA 0 0 0 0 0
MNA 0 0 0 0 0
MNA 0 0 0 0 0
-ve lsb2 -94 162
MNA $ 1 162 0 0 418
MNA =: 58 0 0 0 14848
MNA 8$ 36 56 0 0 9272
MNA S 0 83 0 0 83
MNA 0 0 0 0 0
MNA 0 0 0 0 0
MNA 0 0 0 0 0
MNA 0 0 0 0 0
MNA 0 0 0 0 0
  
```

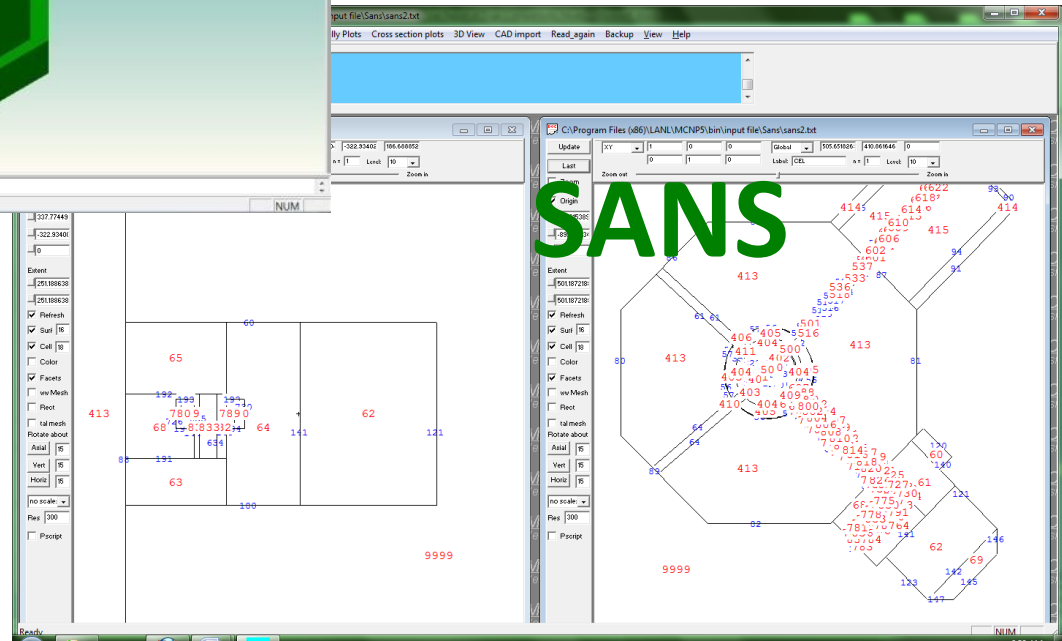


Akmal et al., ICNX 2011, June 27 – July 1, 2011, Hsinchu, Taiwan

# MCNP – Shielding



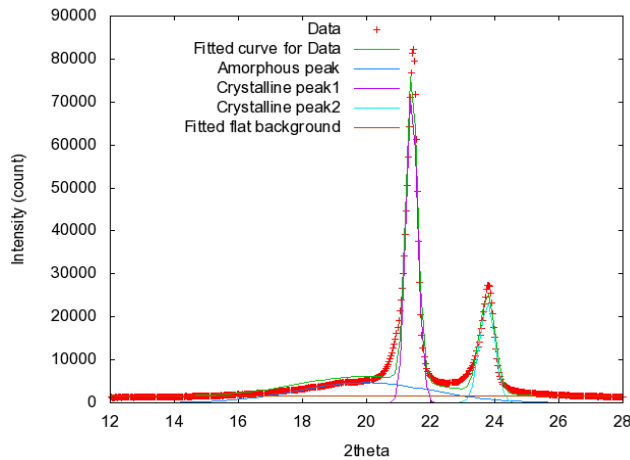
*Mazni, MSc thesis, UTM, in progress*



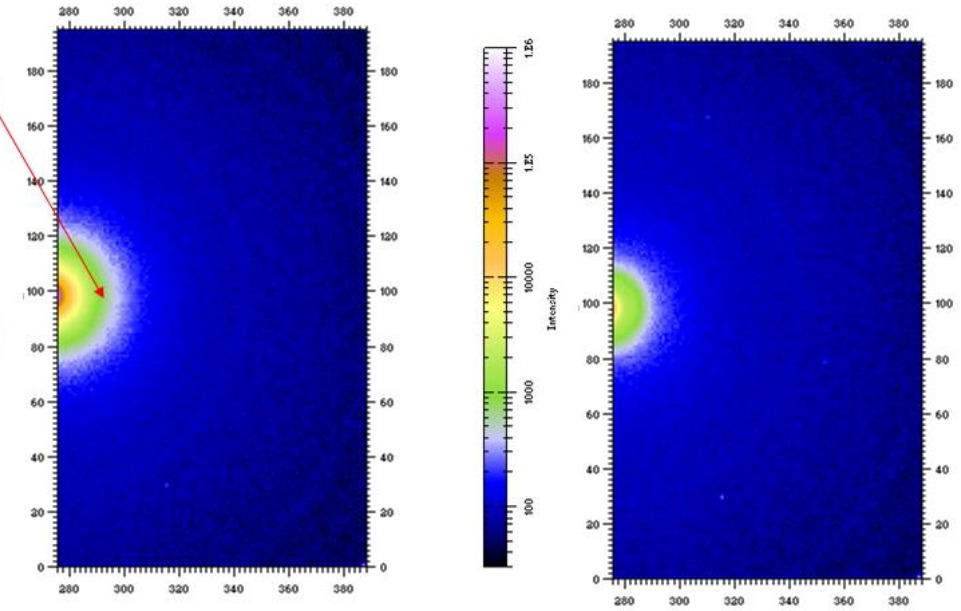
# Shielding material for instrumentation

## Boronated NR-HDPE composite

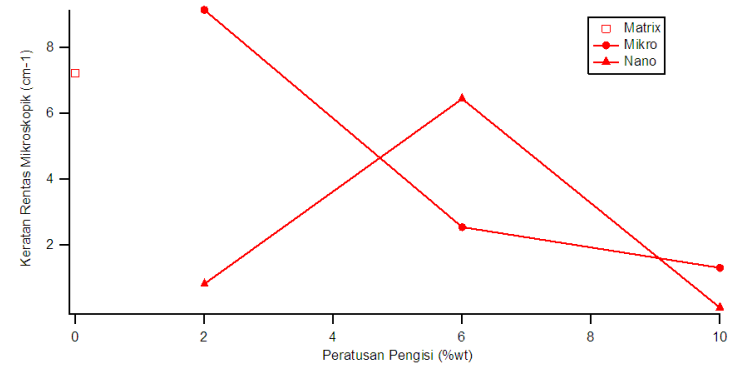
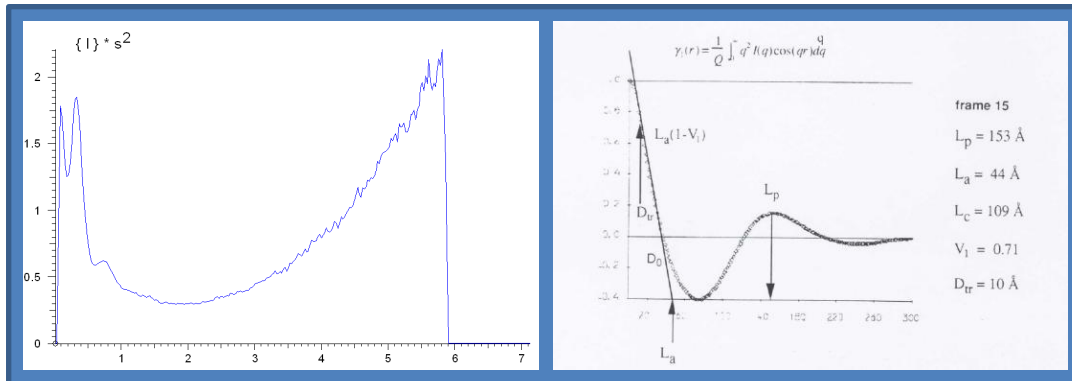
Hafizal Yazid, PhD thesis, UKM, in progress



*B<sub>4</sub>C particles are clearly visible by the excess SAXS signal. There is no preferred orientation of the nanostructure within the plane of the samples. This does not exclude the possibility that a preferred nematic type orientation exists perpendicular to the surface. Rings at larger angles due to Be window.*



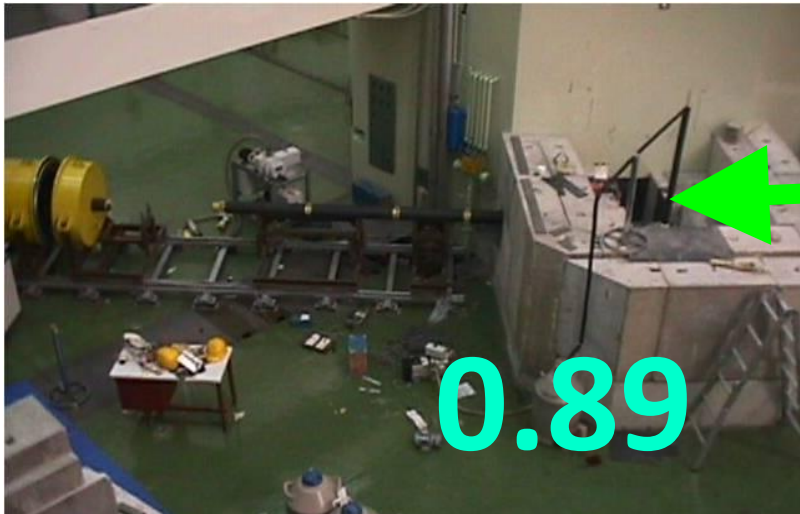
Keratan Rentas Makroskopik Min Komposisi Pengisi



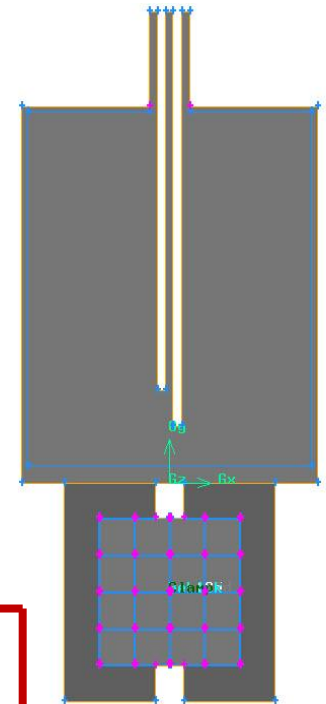
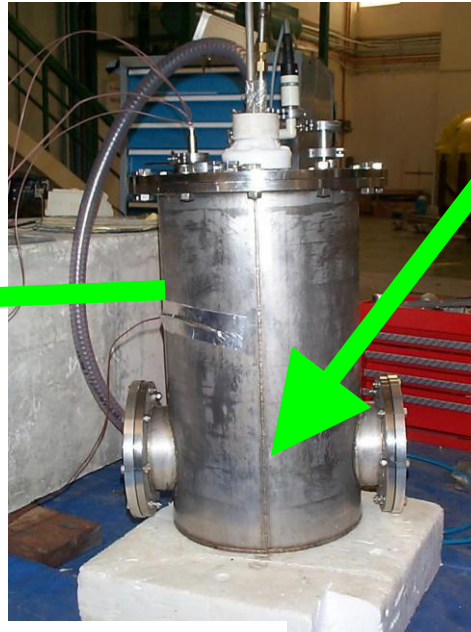
# Cryogenics – the Be-filter

Filter efficiency - Analytically

- neutron absorption
- phonon scattering
- cooling increase the flux two-fold



0.89



$$\Sigma_{\text{total}}(\lambda, T) = \Sigma_{\text{abs}}(\lambda) + \Sigma_{\text{sph}}(\lambda, T) + \Sigma_{\text{mph}}(\lambda, T)$$

$$\Sigma_{\text{mph}}(\lambda, T) = A_{\text{mph}} \lambda = \sum_{fa} \left\{ 1 - e^{\left[ \frac{-(B_0 + B_T)(\sin^2(\frac{\theta}{2}))}{\lambda^2} \right]} \right\}$$

$$\Sigma_{\text{abs}}(\lambda) = A_{\text{abs}} \lambda = N(\sigma_{\text{abs}} / \lambda_0) \lambda$$

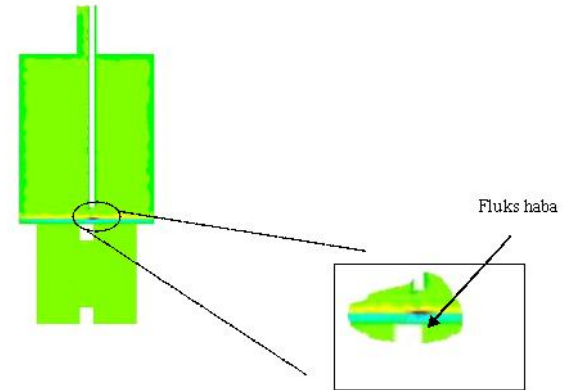
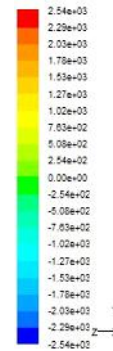
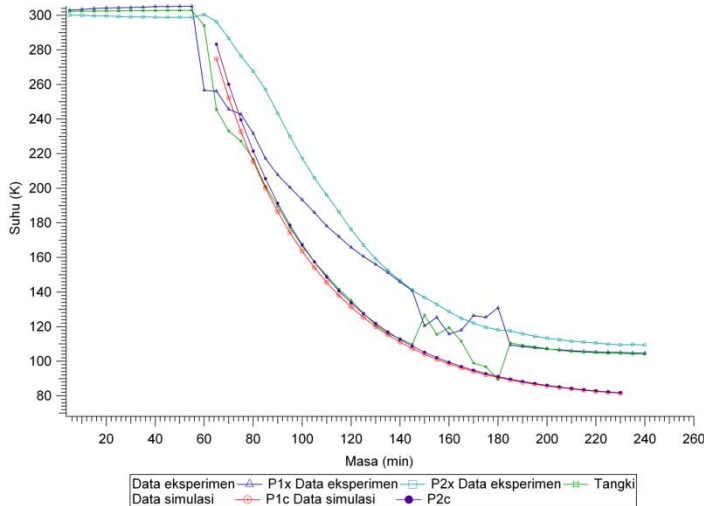
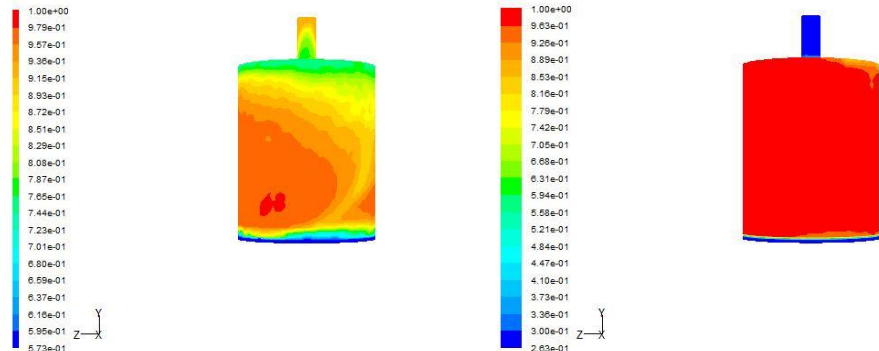
$$\Sigma_{\text{sph}}(\lambda, T) = A_{\text{sph}} \lambda = \left( \frac{3N\sigma_b}{M} \right) \left( \frac{2m_n k_B \theta_D}{h^2} \right)^{\frac{1}{2}} \lambda \times \sum_{n=0} \frac{B_n x^{n-1}}{[n! (n + 2.5)]}$$



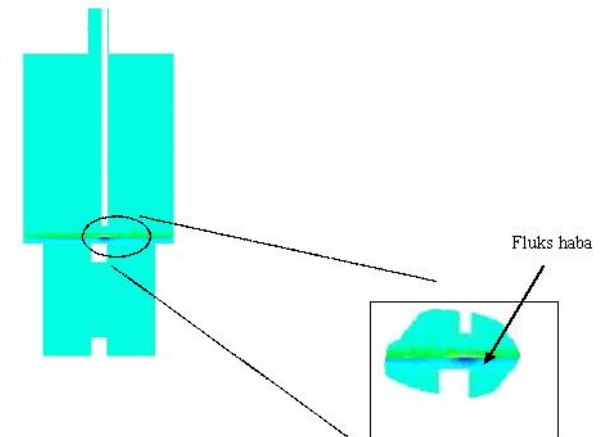
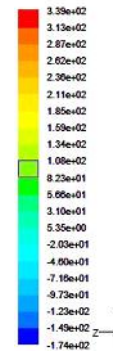
# Cryogenics – the Be-filter

## Computational Fluid Dynamics: Modeling and Simulation

- To understand current system
- To build new efficient cryogenics



(a)



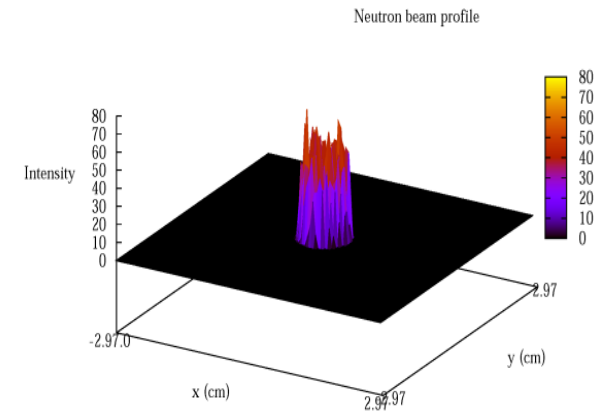
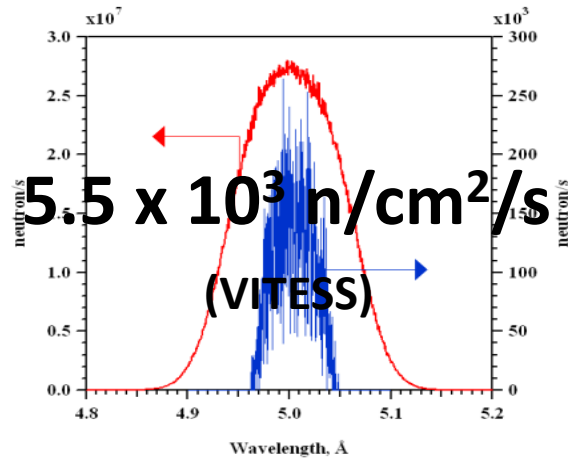
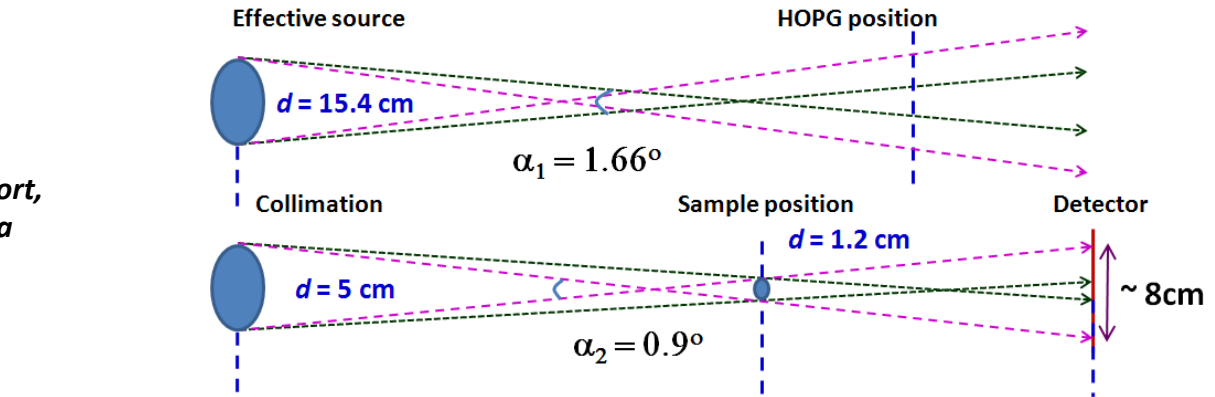
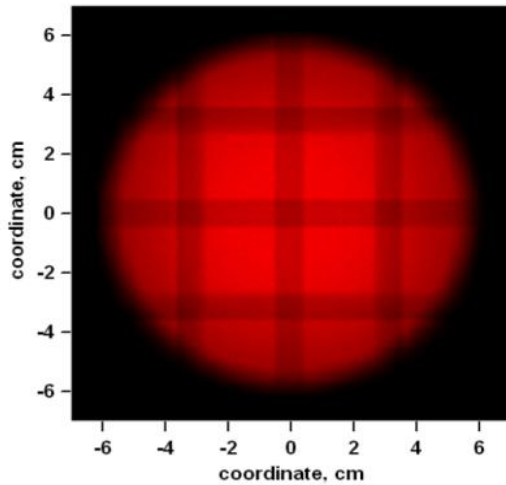
*Azraf Azman, MSc thesis, UKM, in progress*



# mySANS – modeling and simulation

For VITESS:  
 $10^9$  particles are generated

A.A. Mohamed et al., CRP Meeting Report,  
December 6 – 9, 2010, Vienna, Austria



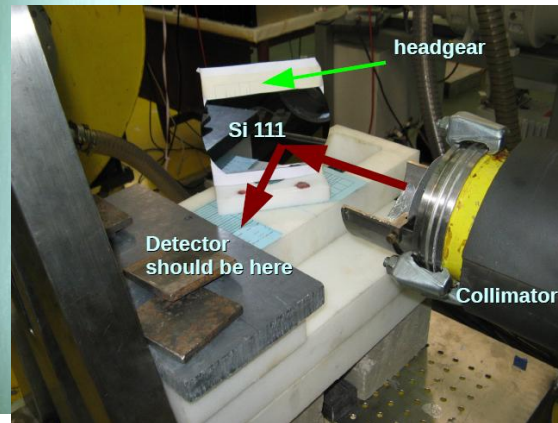
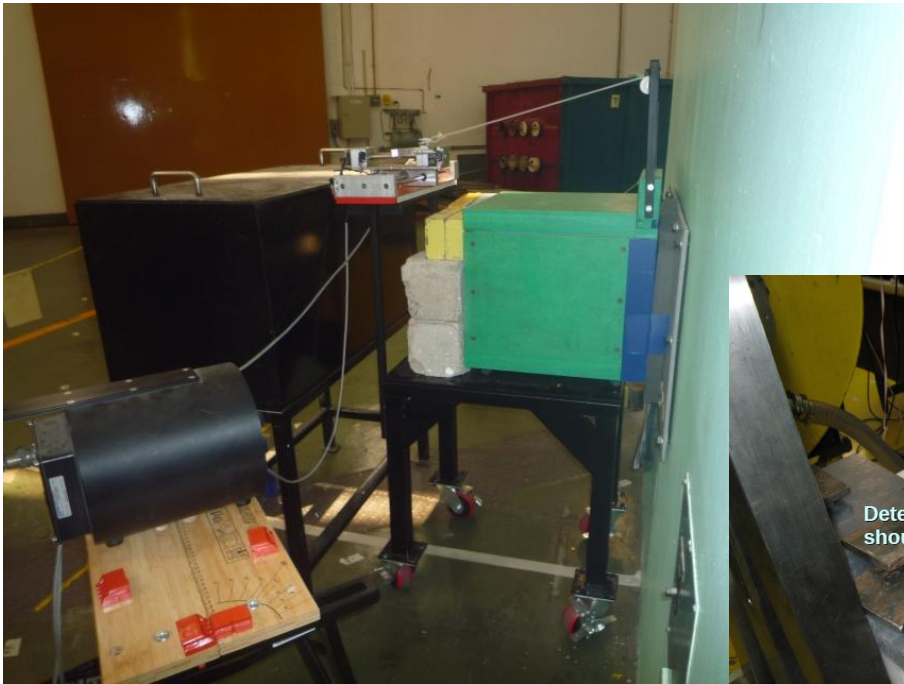
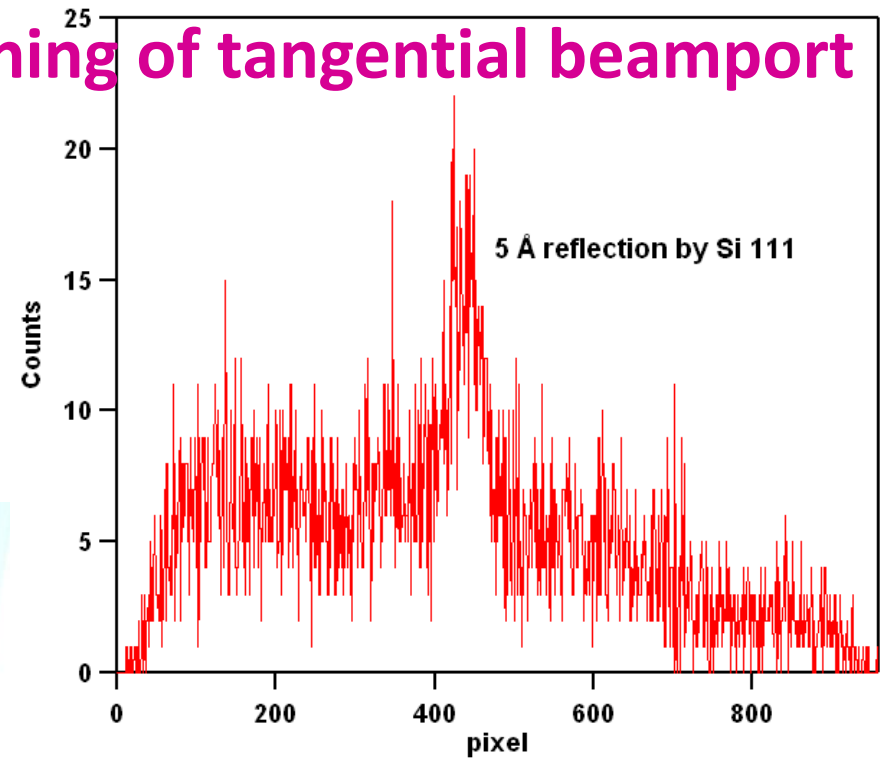
Incoming beam density  
from Be-filter at HOPG  
position

Wavelength profile after HOPG (red)  
and at sample position (blue)

$6.5 \times 10^3 \text{ n/cm}^2/\text{s}$   
(experimentally)

# Focusing SANS – opening of tangential beamport

- Utilization of tangential beamport
- testing of focusing optics
- Also for future testing Neutron Diffraction and tomography



# Conclusion

- Significant increase in interest and participation of on neutron beams use and instrument design especially in the past 2 years
- Testing on tangential beamport for focusing optics for SANS
- Major issues: funding – both funding proposal for neutron scattering and further cryogenics system recently rejected; dedicated and skilled manpowers (almost all involved staffs are *part-timers*) for neutron instrumentation works; reactor irregular operation.



# Agensi Nuklear Malaysia's neutron group - Truly happy to share with everyone



**THANK YOU FOR YOUR KIND ATTENTION**