Simulation Work and Plans at UT

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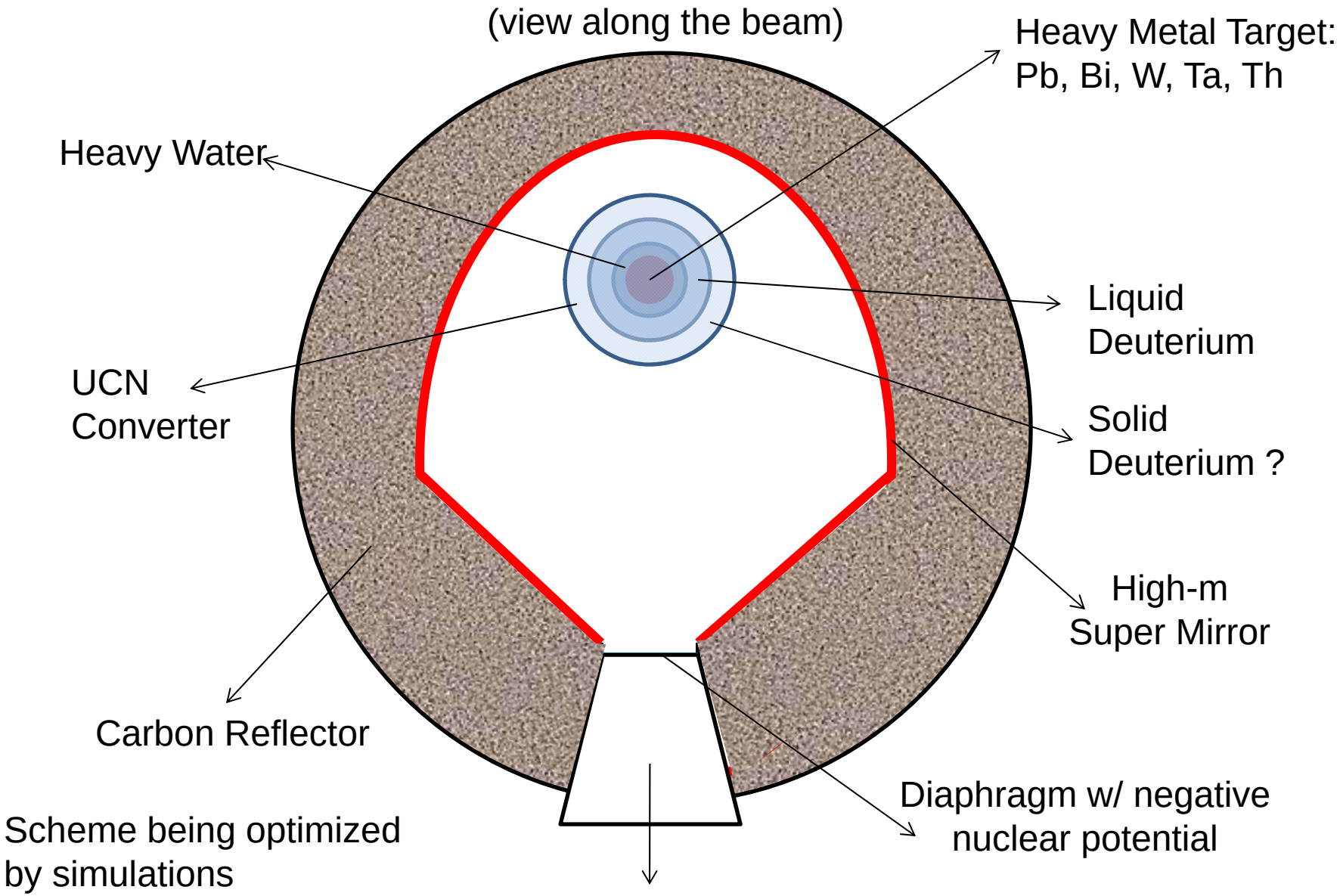
- Some initial simulation work have been performed at UT with 2 graduate students in Fall 2011; it was not finished; students are not available anymore.

- Simulation expertise at UT between collaborating groups: NE (L. Townsend), Physics (T. Handler), and SNS (F. Gallmeier) under leadership of Tony Gabriel

- Proposal submitted for internal UT seed-money support for two graduate student. Later in 2012 plan to submit R&D proposal to DOE for development of conceptual design of spallation target.

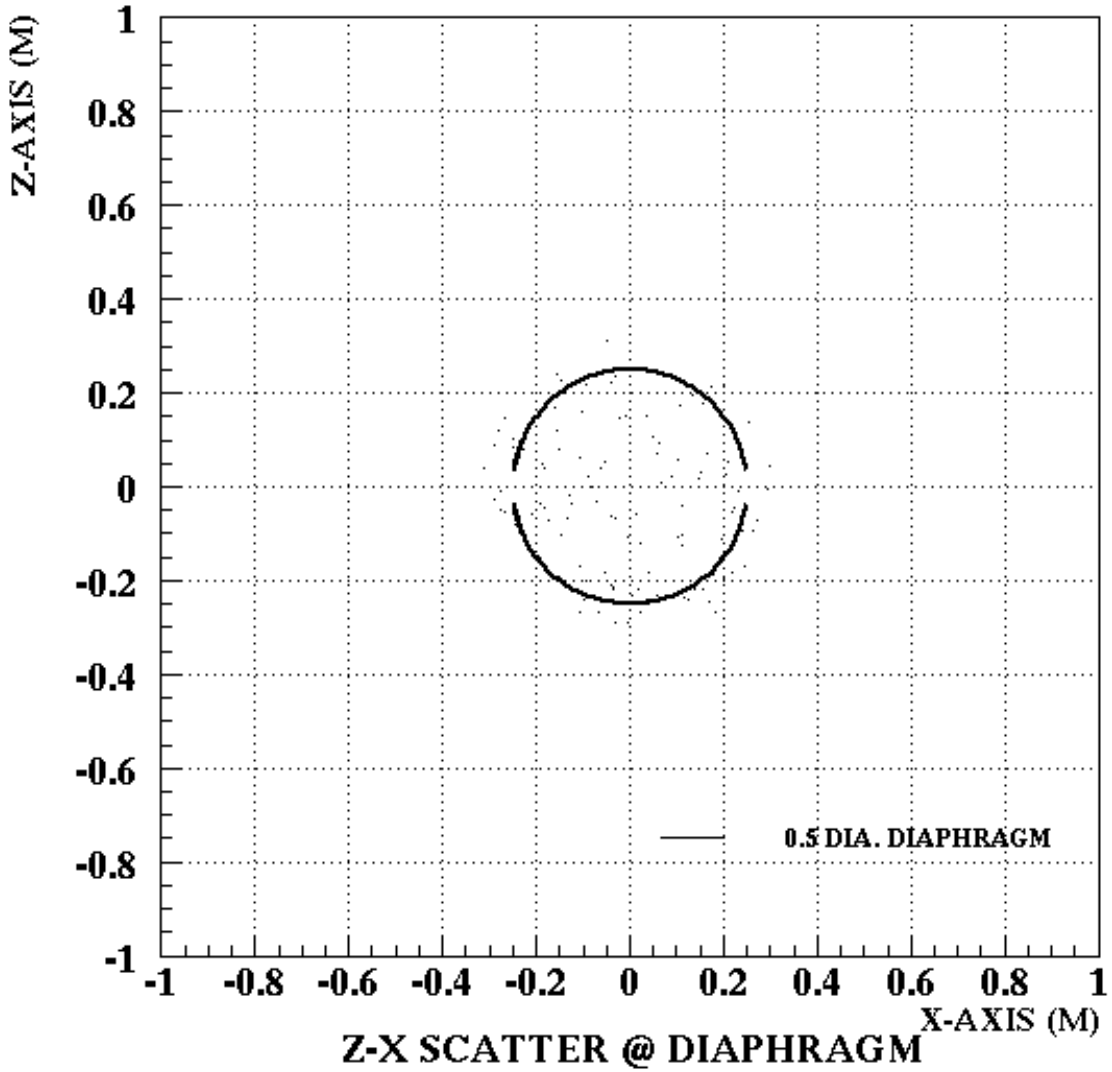
- Some preliminary results of Chris Tate and Usama al-Binni (UT) are shown below.

Schematic of spallation target with VCN-UCN converter for Top-Down configuration



M=0

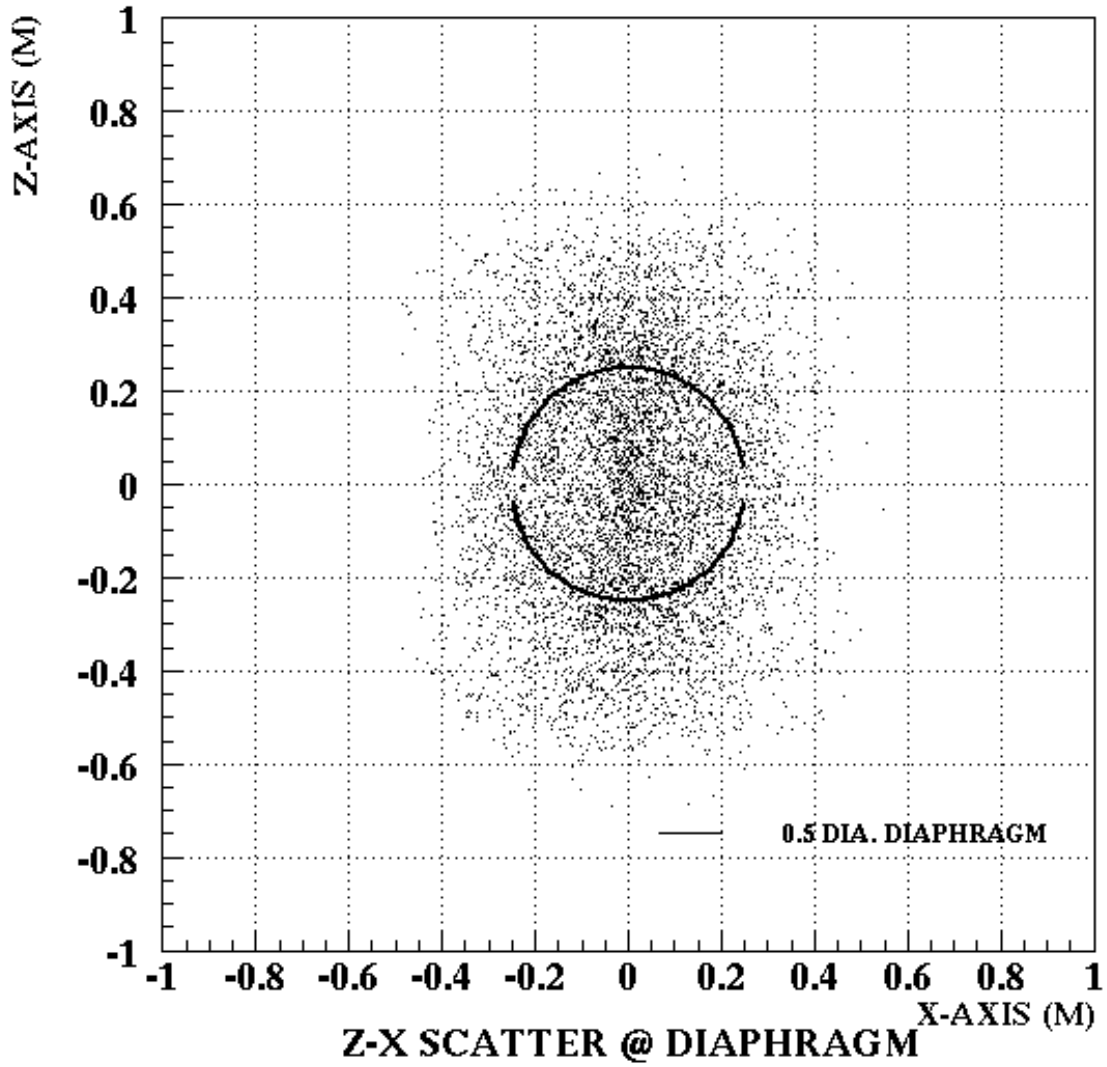
I.e. no reflector. Shown are neutrons that went straight to diaphragm. Also shown is 0.5m diameter diaphragm.



Chris Tate,
UT, 2011

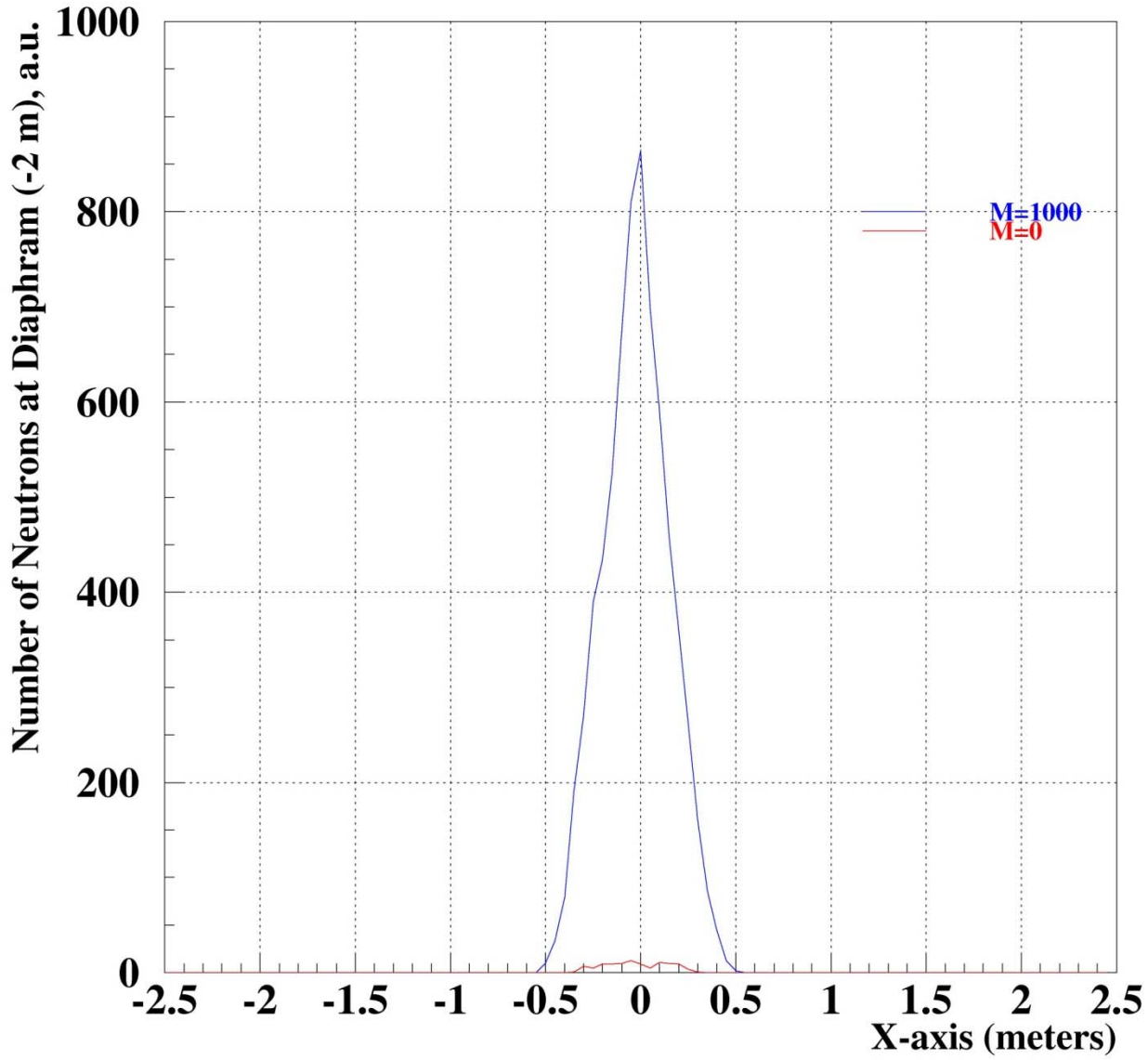
M=1000

All reflected neutrons + neutrons that passed straight to diaphragm. Shown is 0.5m diameter diaphragm.



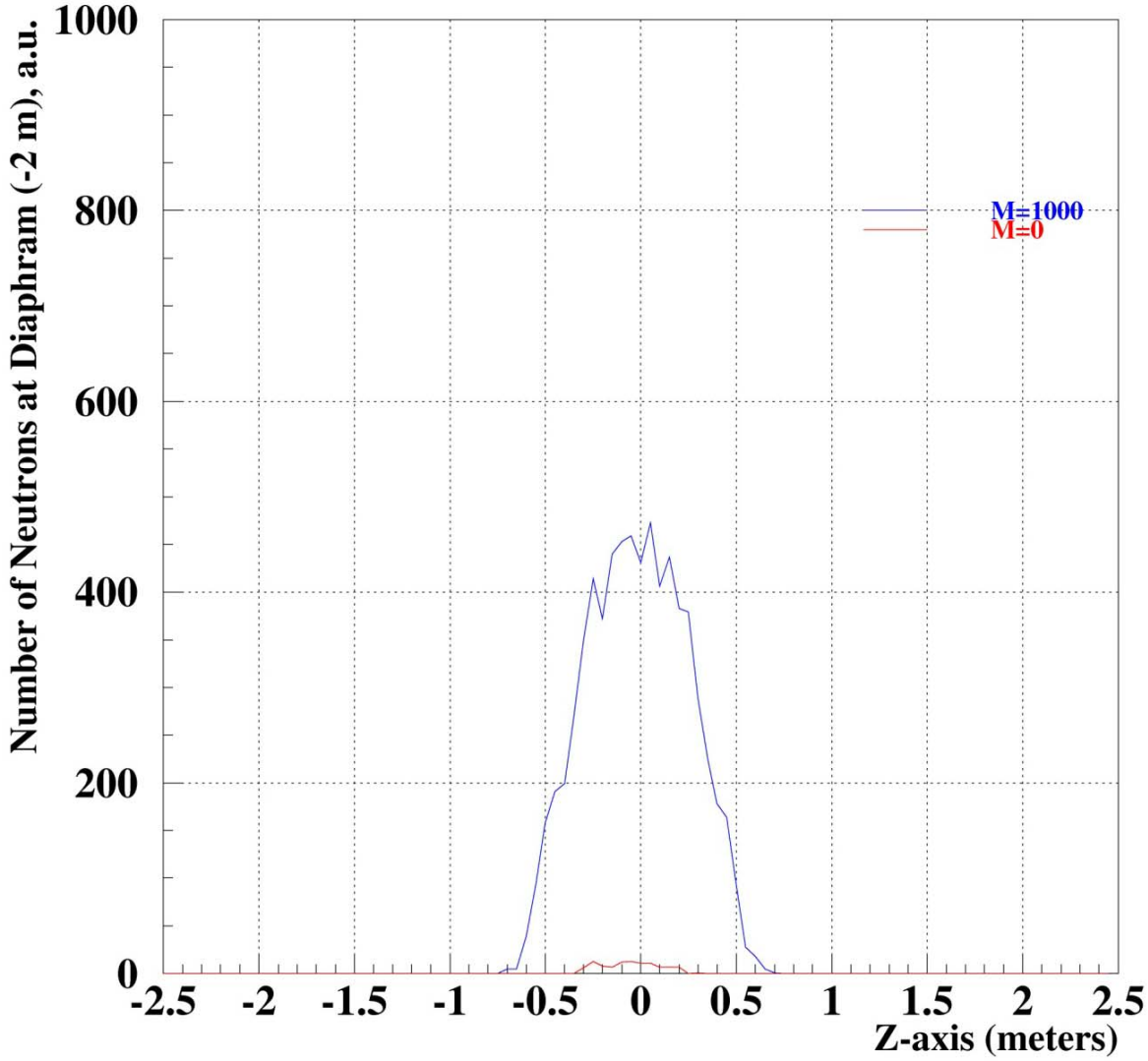
Chris Tate,
UT, 2011

Number of neutrons for m=1000 & m=0 shown vs x-axis at diaphragm



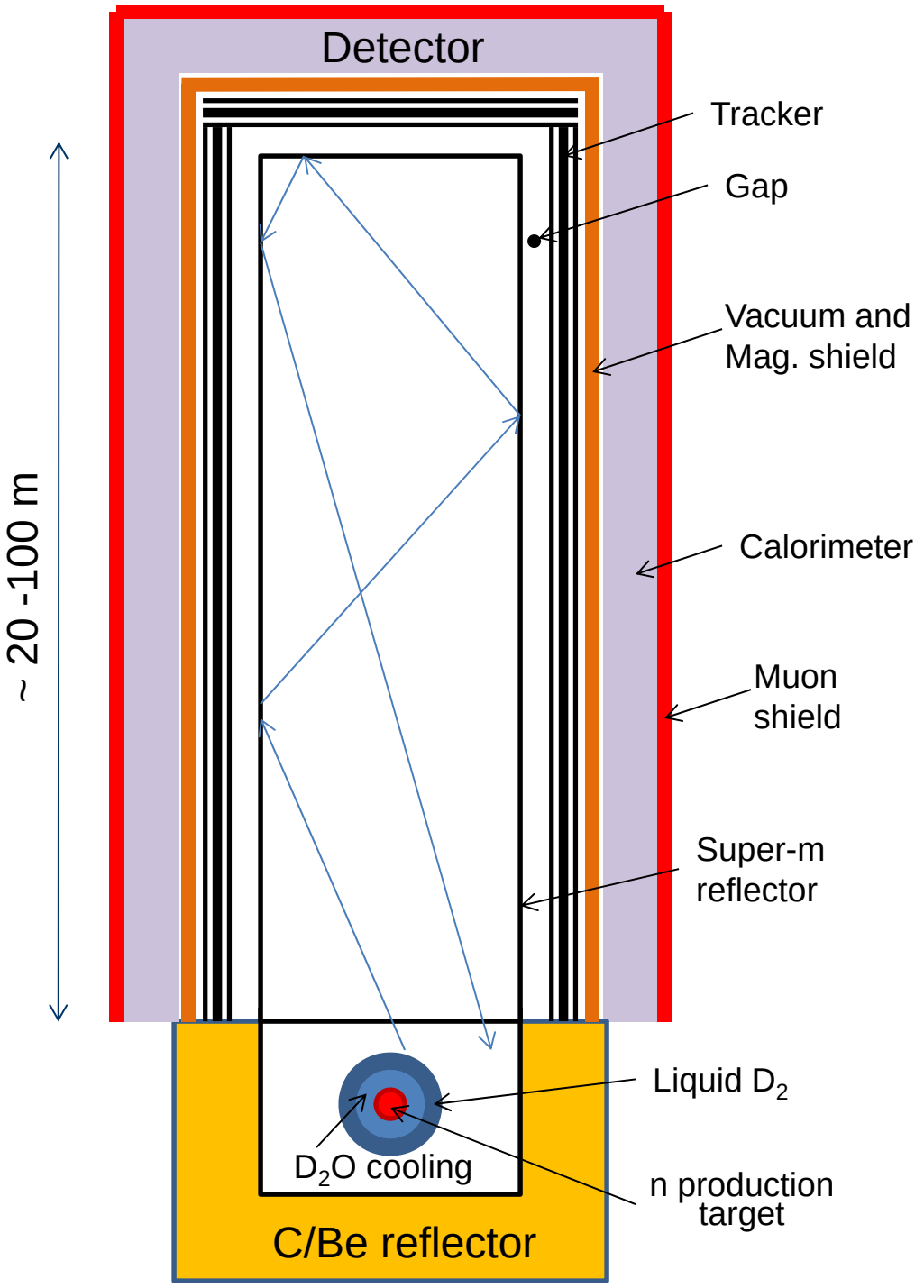
Chris Tate,
UT, 2011

Number of Neutrons for m=1000 & m=0 shown vs z-axis at diaphragm



Chris Tate,
UT, 2011

Bottom – Up scheme using VCN source

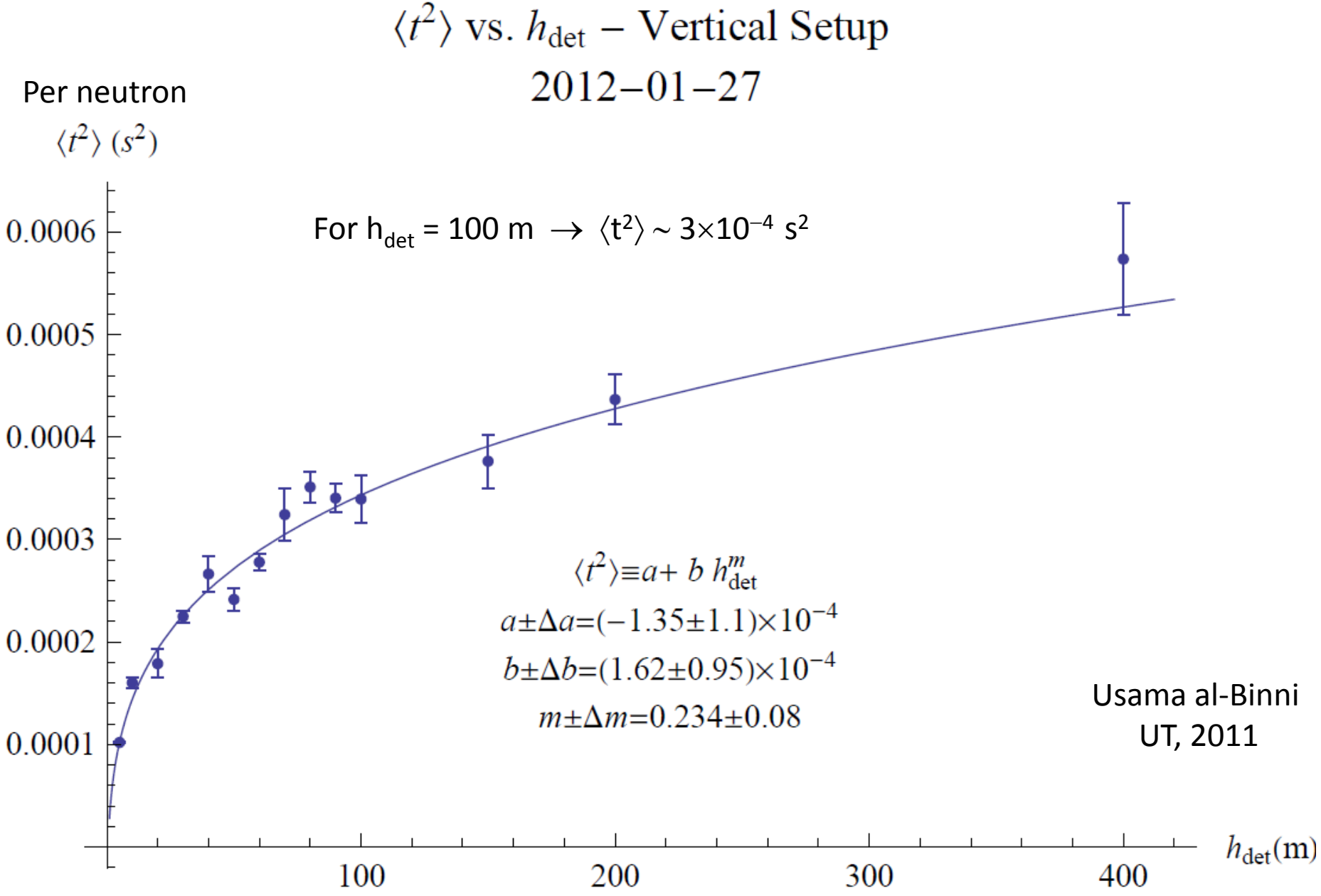


Bottom-Up base configuration:

Detector length: 100 m
Detector Radius: 1.5 m
mSuper mirror: 10
Number of Emissions per run: 10000
Roughness: 5 Å
Source Length: 0.8 m
Source Radius: 0.3
Source height above detector base 2.5 m
N-temperature: 30 K
Time transport limit: 100 s
V_T (Ni-cr): 6.9 m/s
V_{min}: 0 m/s
V_{max}: 3000 m/s

Usama al-Binni
UT, 2011

Simulation


⟨t²⟩ vs. h_det – Vertical Setup
2012–01–27
Per neutron
⟨t²⟩ (s²)
For h_det = 100 m → ⟨t²⟩ ~ 3×10⁻⁴ s²
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
100
200
300
400
h_det(m)
⟨t²⟩≡a+ b h_det^m
a±Δa=(−1.35±1.1)×10⁻⁴
b±Δb=(1.62±0.95)×10⁻⁴
m±Δm=0.234±0.08
Usama al-Binni
UT, 2011

Determining sensitivity (preliminary)

For h_{det} = 100 m $\rightarrow$ $\langle t^2 \rangle \sim 3\times10^{-4}$ s^2

For 200 kW beam $\rightarrow 3\times10^{16}$ n/s;

Assuming 80% (?) of spectrum thermalized $\rightarrow 2.5\times10^{16}$ n/s;

Assuming detection efficiency 50%;

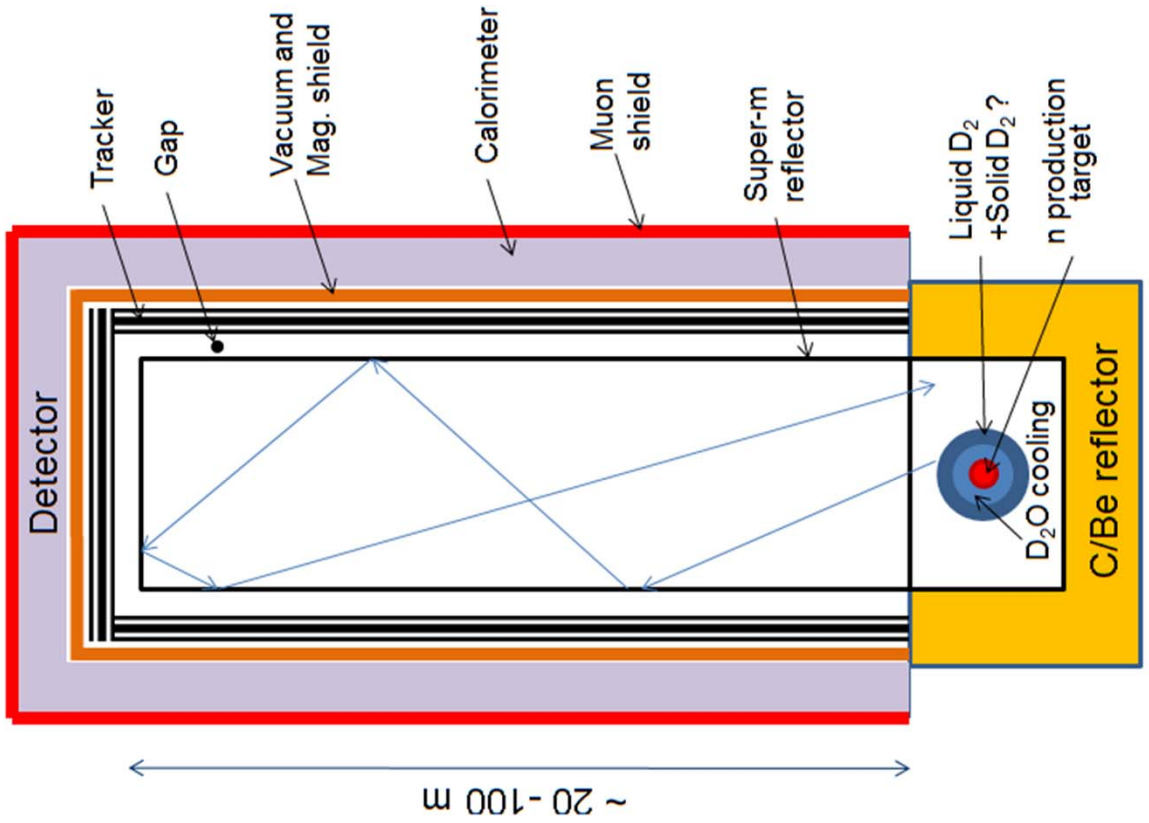
Assuming 3 years of running:

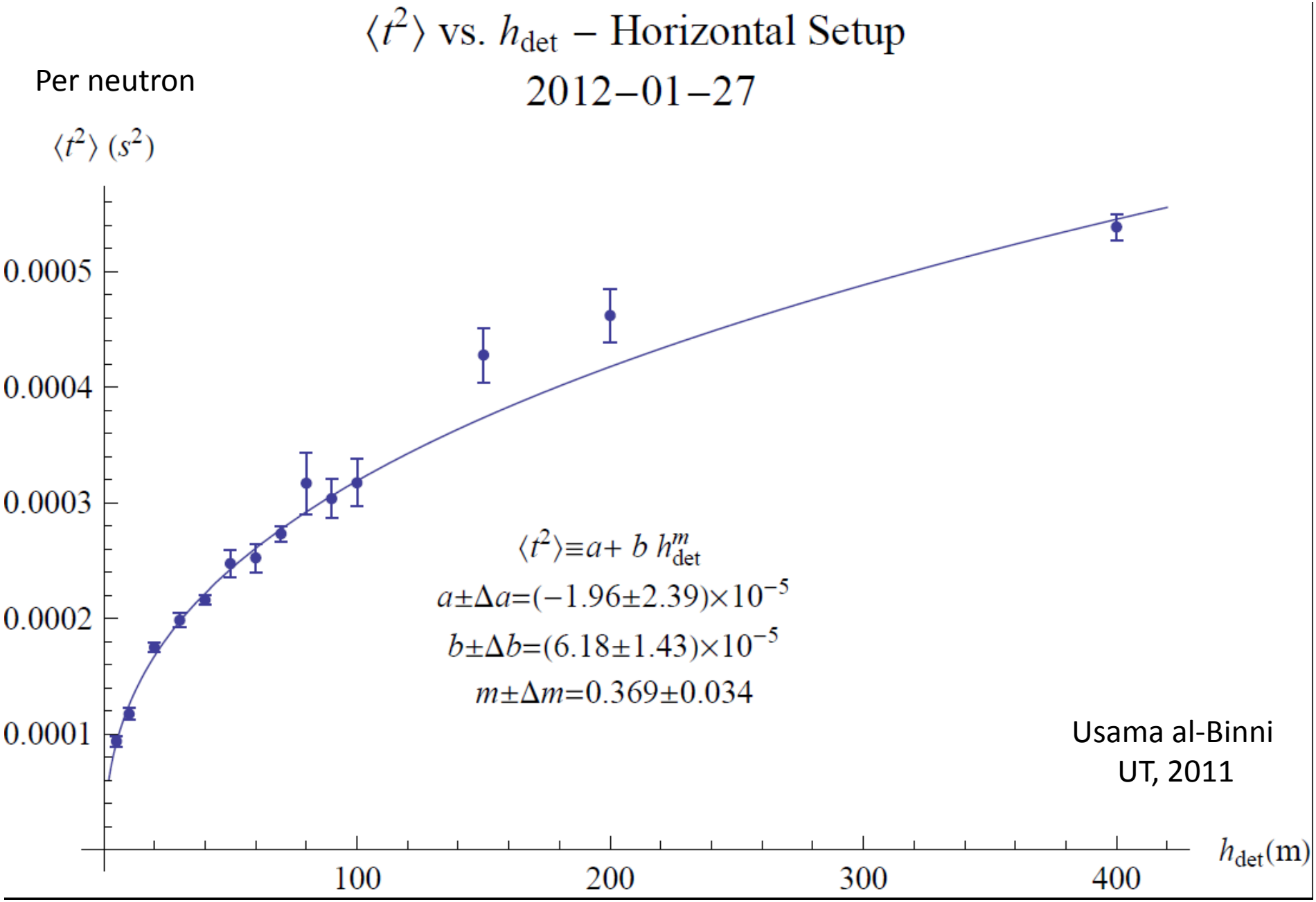
$$N\overline{t}^2 \cong 1.12E+13 \text{ s} \cong 7,500 \text{ u ILL}$$

No timing cuts yet for pulsed operation.

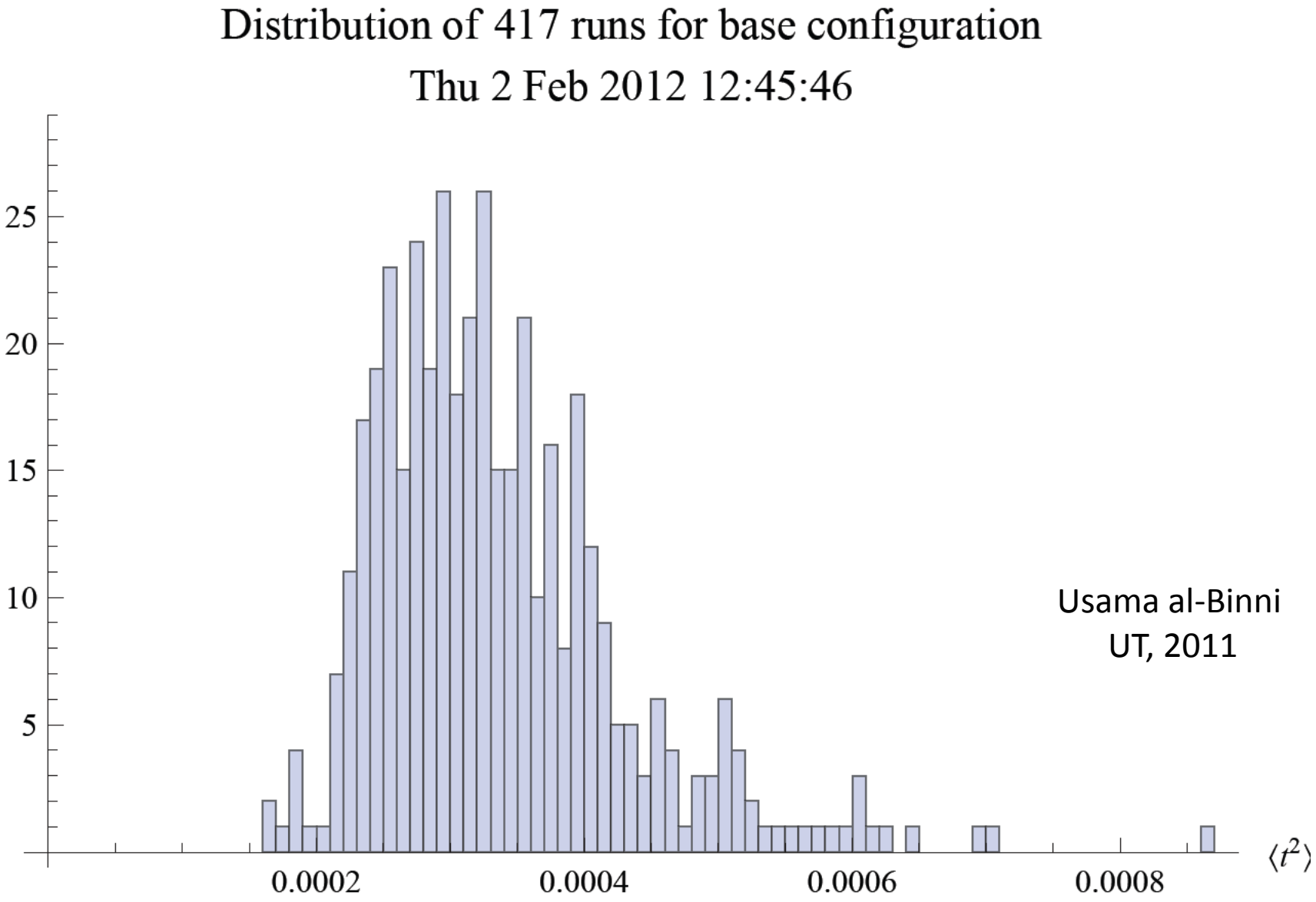
Usama al-Binni
UT, 2011

Horizontal option




$\langle t^2 \rangle$ vs. h_{det} – Horizontal Setup
2012–01–27
Per neutron
$\langle t^2 \rangle$ (s^2)
0.0005
0.0004
0.0003
0.0002
0.0001
100
200
300
400
h_{det}(m)
$\langle t^2 \rangle \equiv a + b\, h_{\text{det}}^m$
$a \pm \Delta a = (-1.96 \pm 2.39) \times 10^{-5}$
$b \pm \Delta b = (6.18 \pm 1.43) \times 10^{-5}$
$m \pm \Delta m = 0.369 \pm 0.034$
Usama al-Binni
UT, 2011

Determining MC error in simulations



Usama al-Binni
UT, 2011