PARIS response to neutrons from LICORNE

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(on behalf of the PARIS collaboration)

PARIS workshop, 26.1.2018

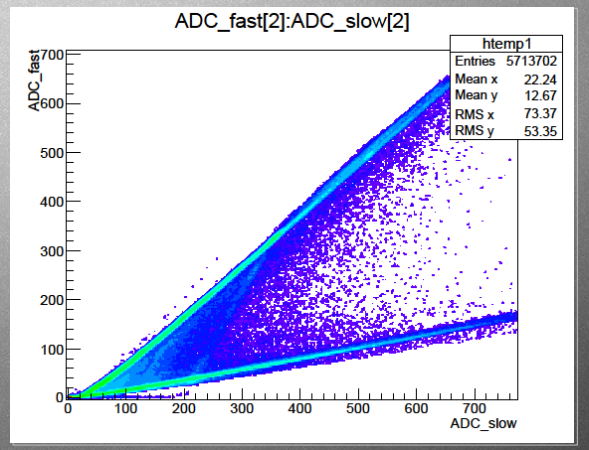
Testing PARIS with fast neutron from LICORNE

Test performer at IPN Orsay with LiCORNE neutron source (**I. Matea, J. Wilson et al.**).

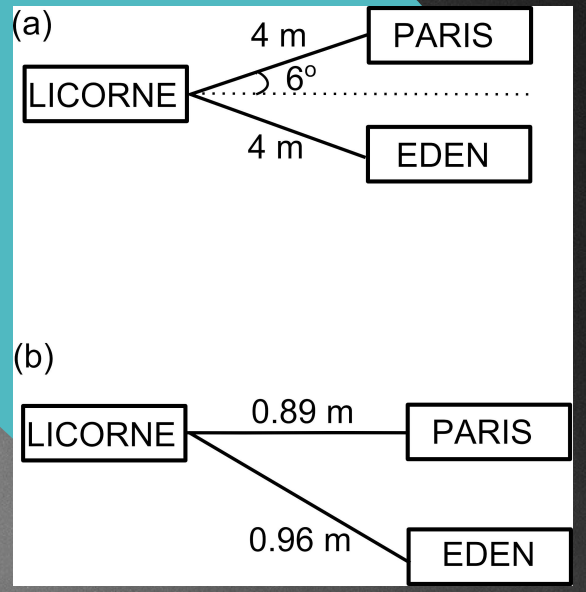
Neutrons produced in inverse kinematic reaction 1H(11B,11C)n

9 PARIS phoswiches used (1 cluster) and EDEN neutron detector for monitoring Moreover, 2 CLYC detectors and 3 more LaBr3 ones.

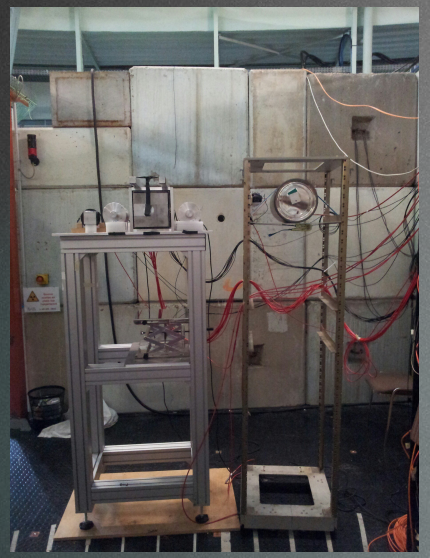
Used standard PARIS analog electronic: 2 ADC, 1 TDC with Milano designed LaBrPro(early stage of developement of PARISPro module).

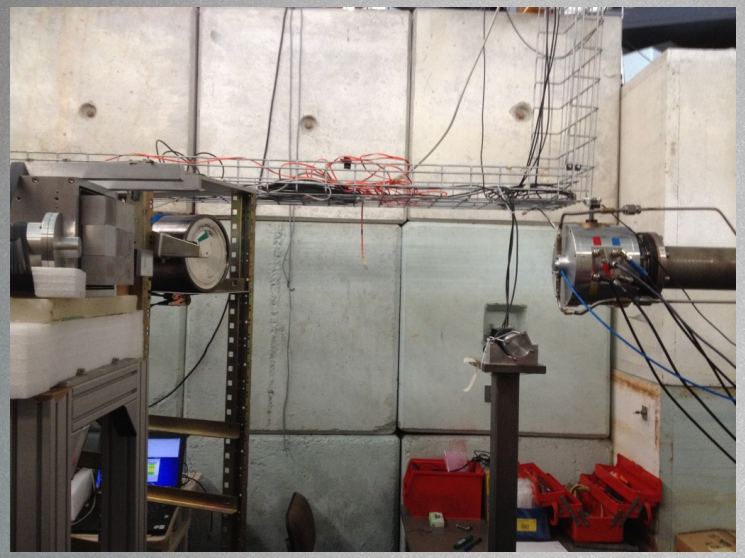


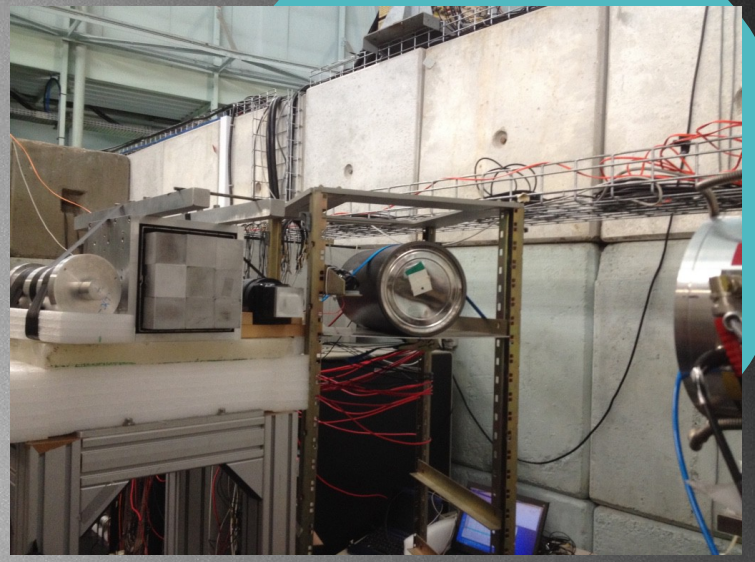
Schematic view



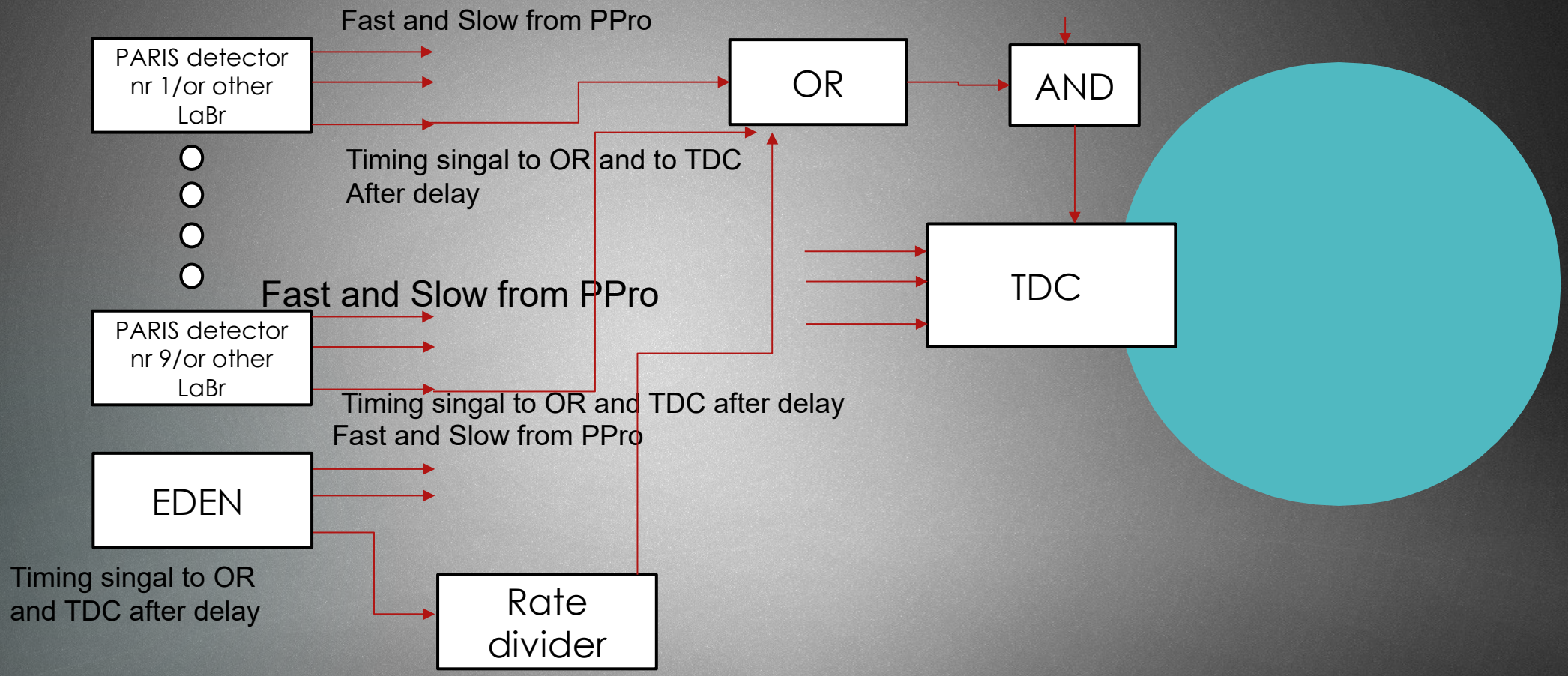
Testing PARIS with fast neutron from LICORNE - setup





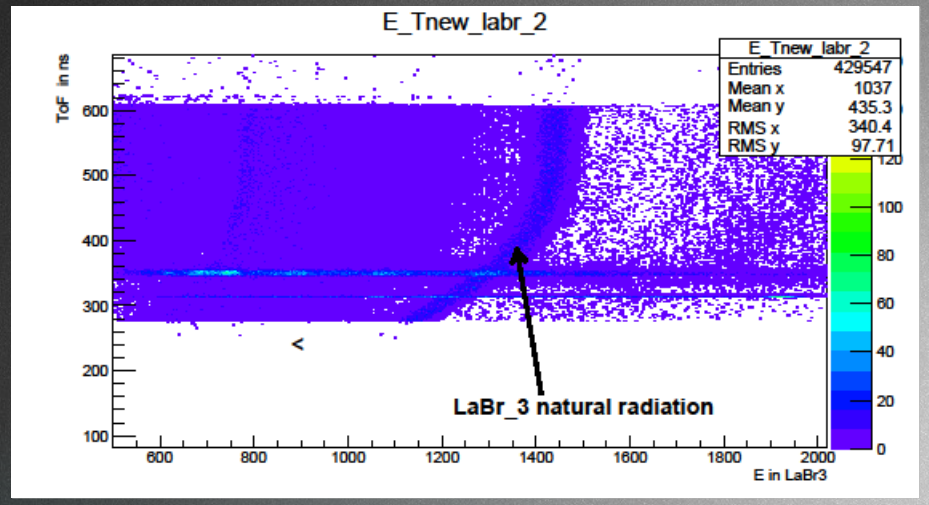


Testing PARIS with fast neutron from LICORN – conditions of TDC

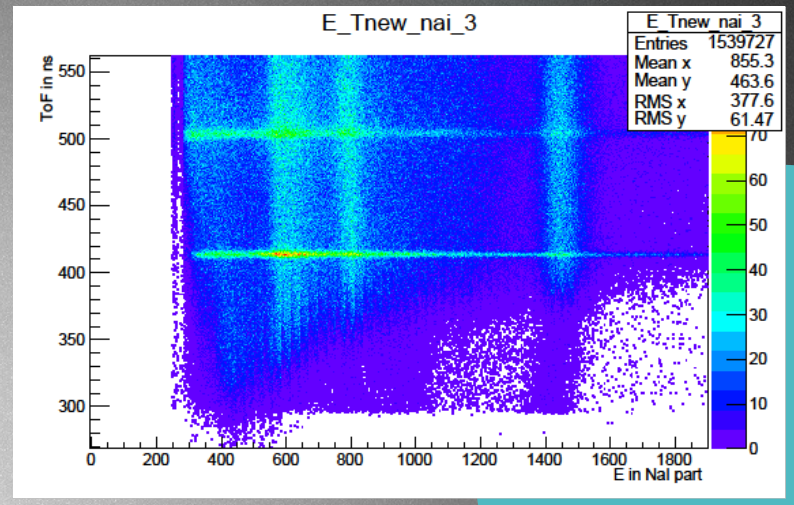


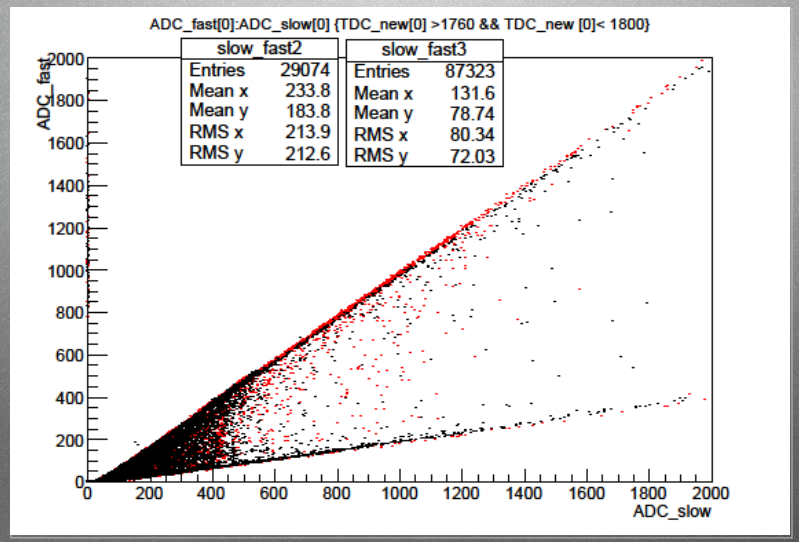
Common stop TDC, stop signal for TDC is generated by OR from all of detectors (EDEN scalled down) validated by beam pulsing.

Testing PARIS with fast neutron from LICORN



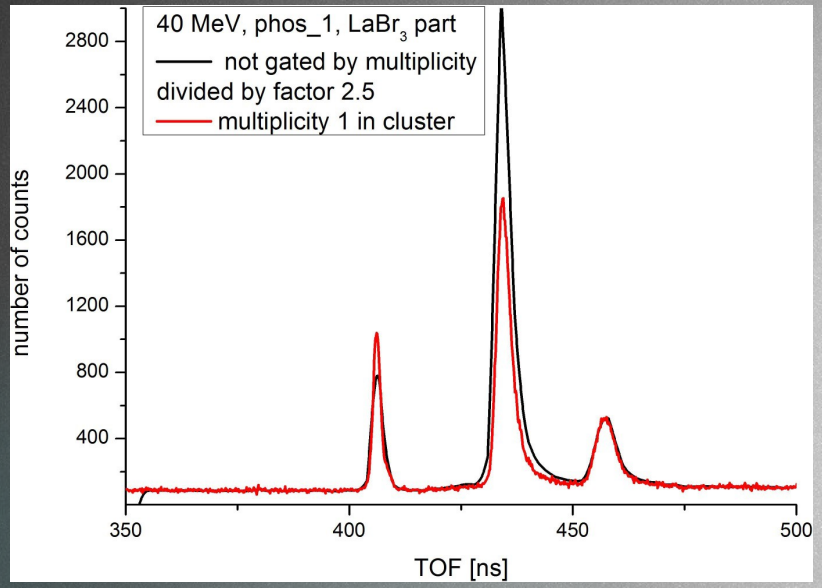
Nonlinearity in E in LaBr for different ToF due to ADC setteings

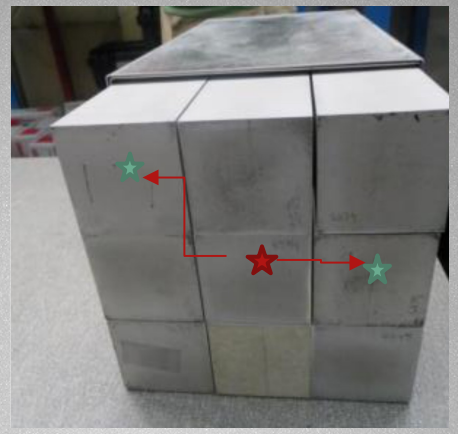


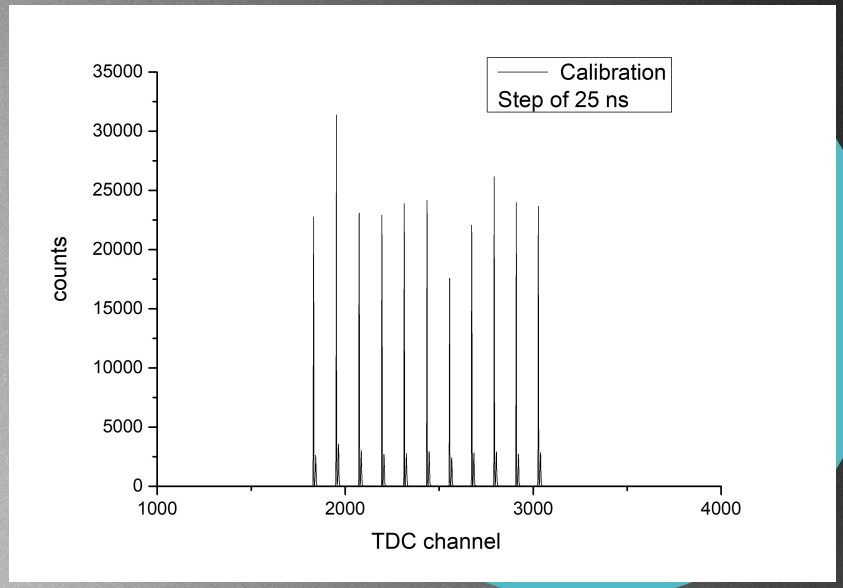


PARIS fast/slow with gamma (red) and neutron (black). No visible difference (no background substraced)

Testing PARIS with fast neutron from LICORN – ToF







For one neutron possible multiple interactions in the PARIS cluster – due neutron scaterring and gamma-rays from de-excitation of excited by Br and La with neutrons.

All TDC channels were callbirated with sequent 25 ns delay.
Then use of prompt gamma peak for absolute call.
Background from ToF spectra substraced taken into account region after prompt gamma peak.

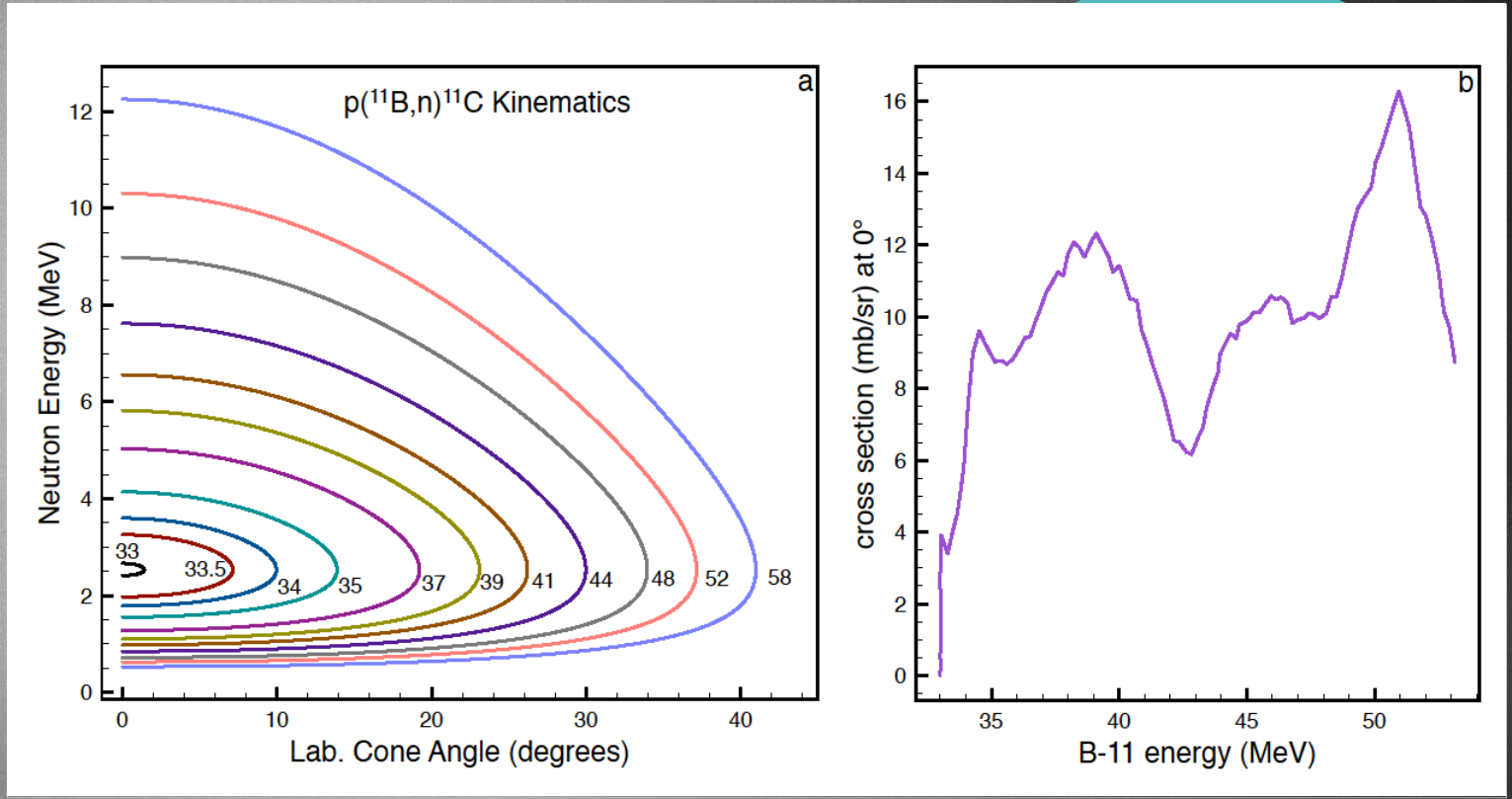
Testing PARIS with fast neutron from LICORN – data runs

Good data files (with statistic and proper TDC range) are for beam of 11B with:

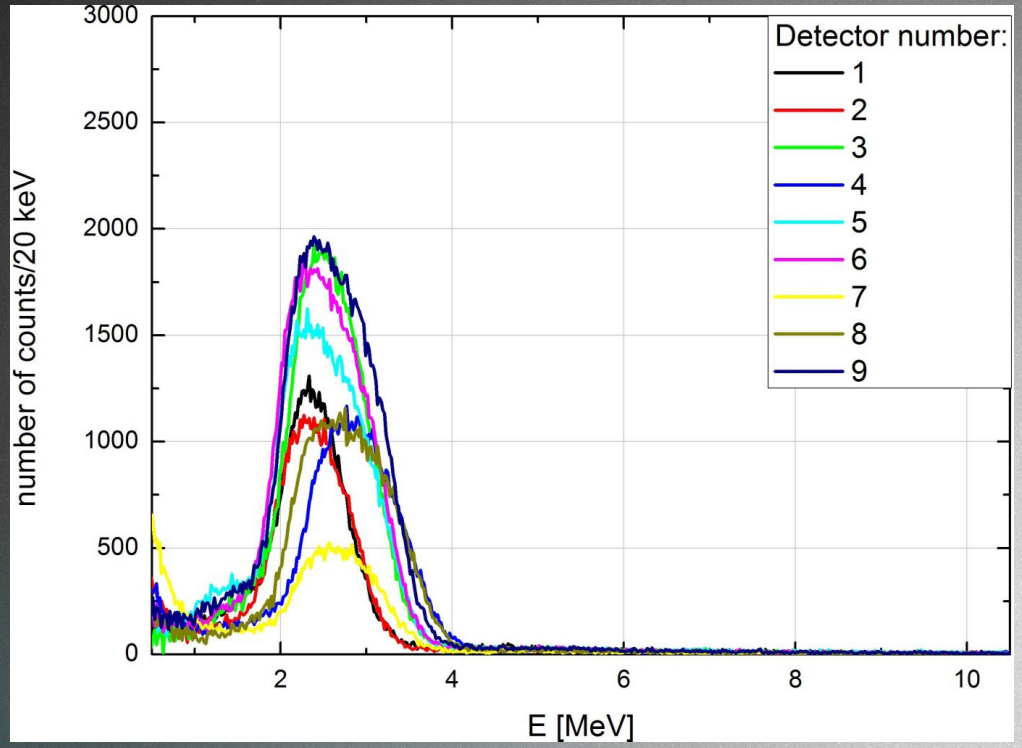
E = 37 MeV

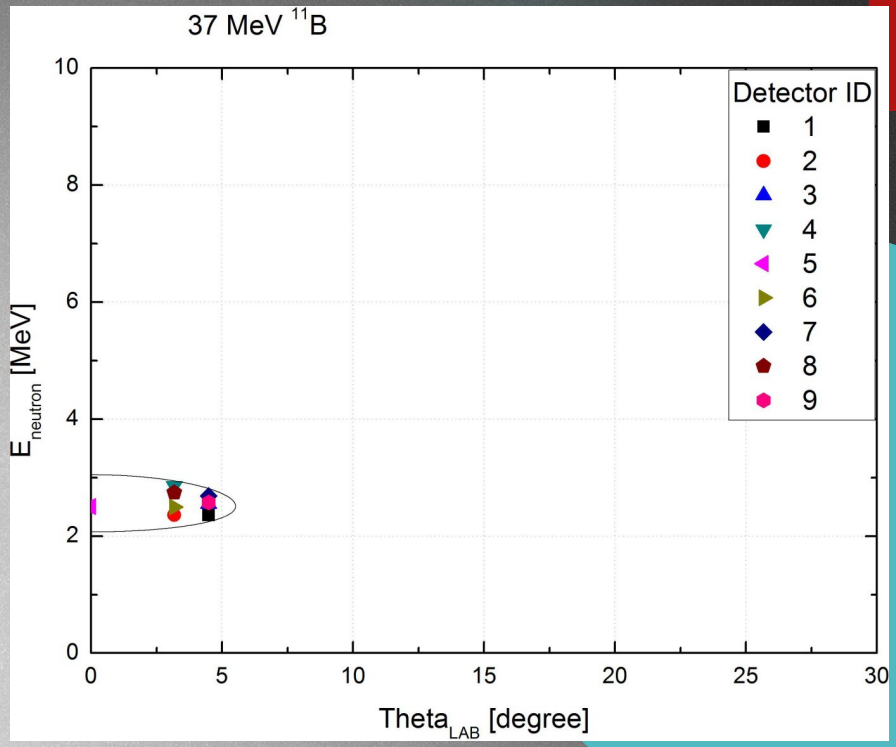
E = 40 MeV

E = 43 MeV



Results

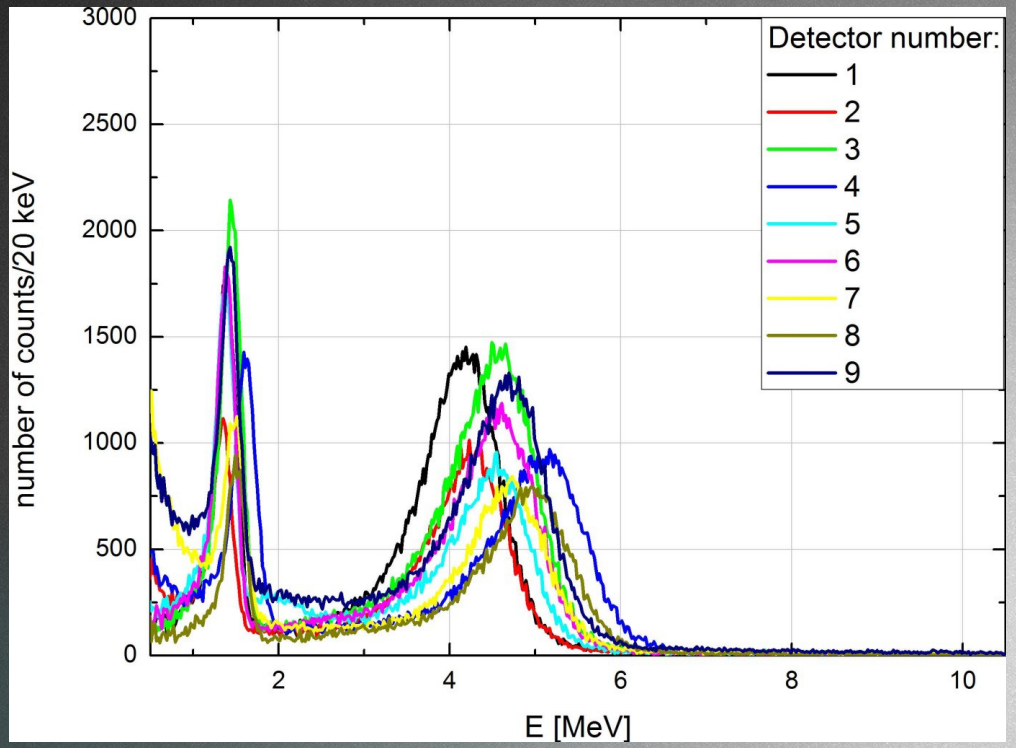


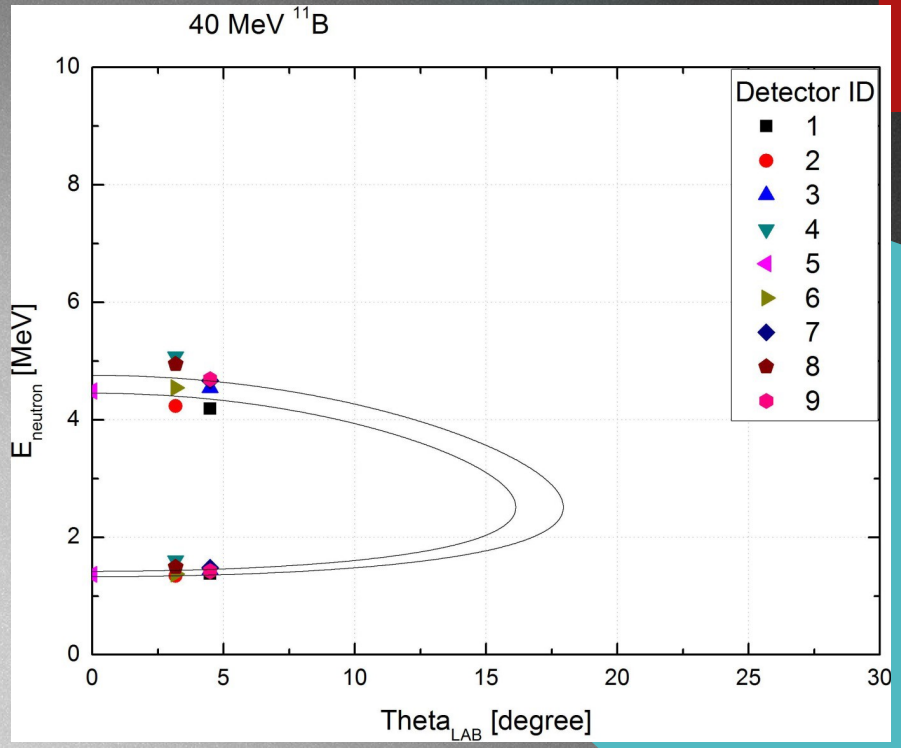


Left: Energy spectra for PARIS phoswiches (from ToF); Right mean energies of neutrons (points) compared to calculated values for reaction kinematics (solid lines).

11B beam E = 37 MeV

Results

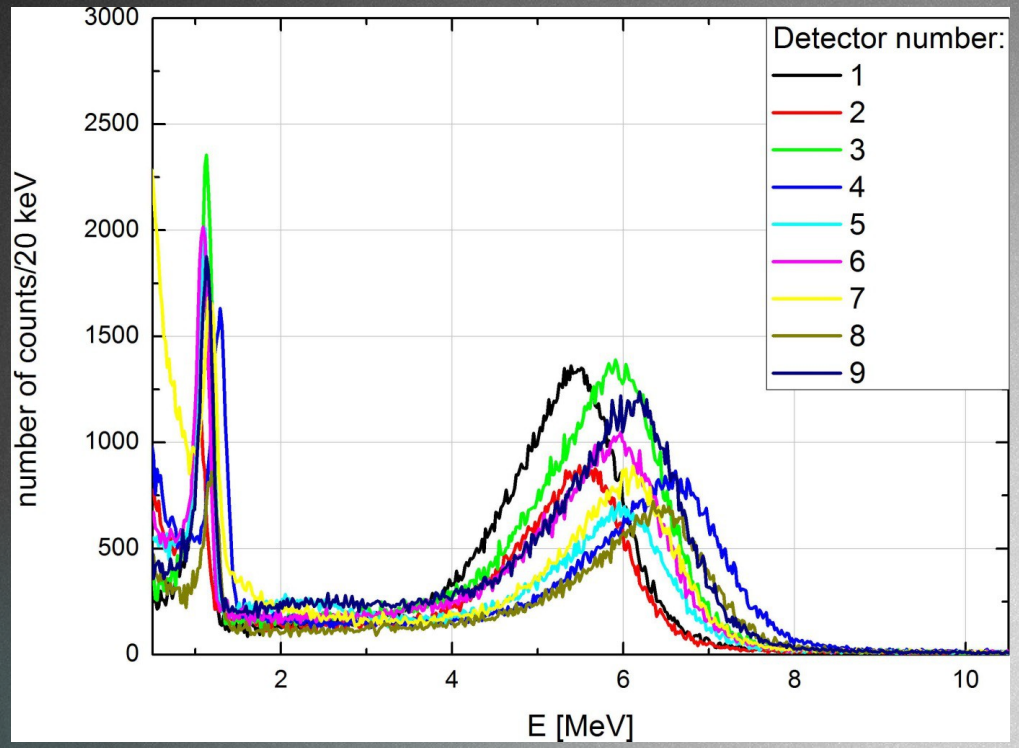


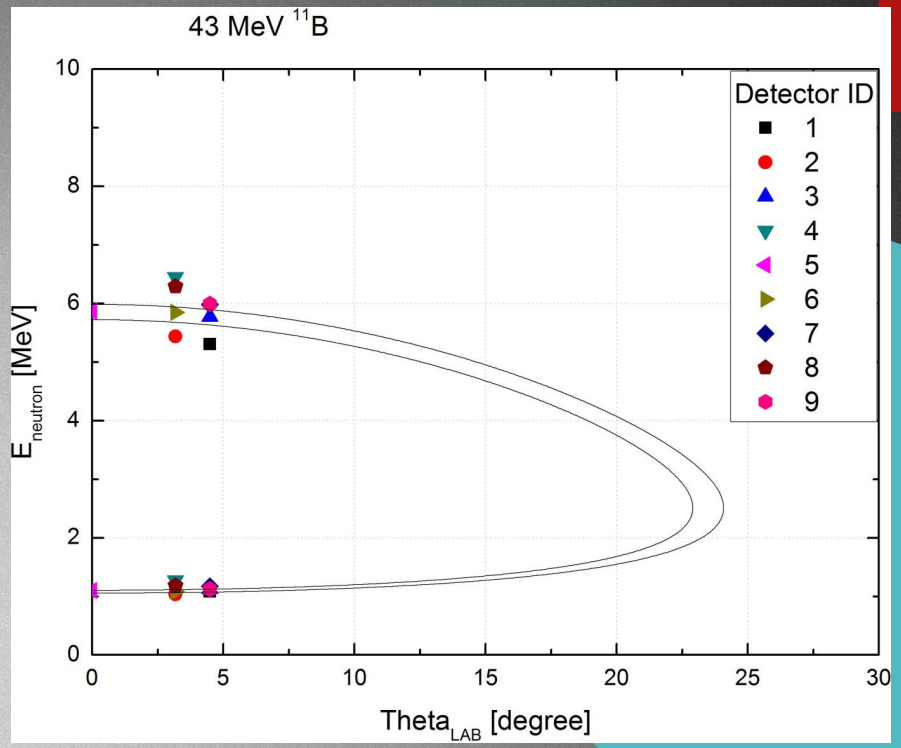


Left: Energy spectra for PARIS phoswiches (from ToF); Right mean energies of neutrons (points) compared to calculated values for reaction kinematics (solid lines).

11B beam E = 40 MeV

Results





Left: Energy spectra for PARIS phoswiches (from ToF); Right mean energies of neutrons (points) compared to calculated values for reaction kinematics (solid lines).

11B beam E = 43 MeV

Testing PARIS with fast neutron from LICORN – trigger conditions

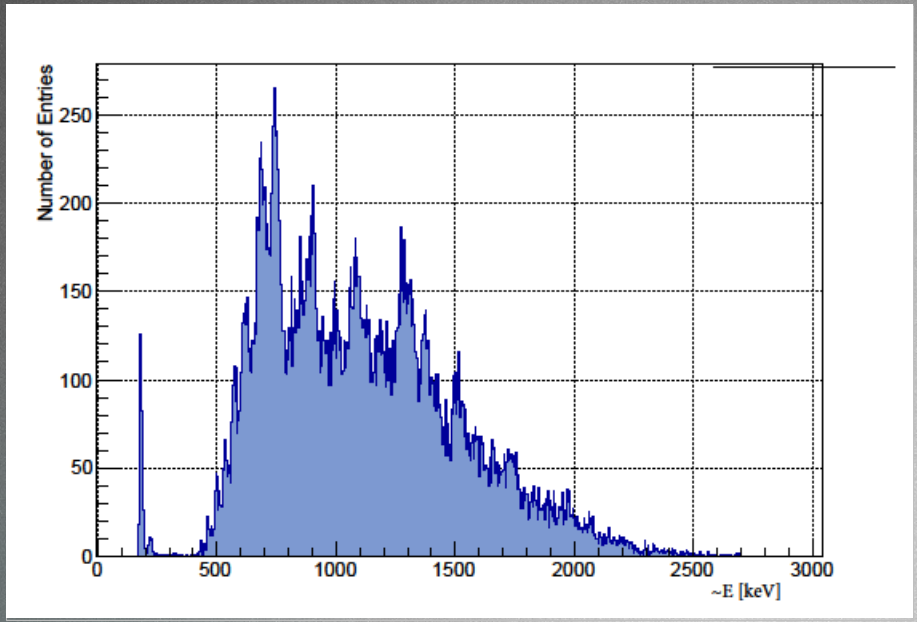
Energy resolution with effect of summing over different neutron energies.

Emean [MeV]	FWHM [MeV]
5.89	1.46
4.61	0.98
1.44	0.26
1.13	0.18

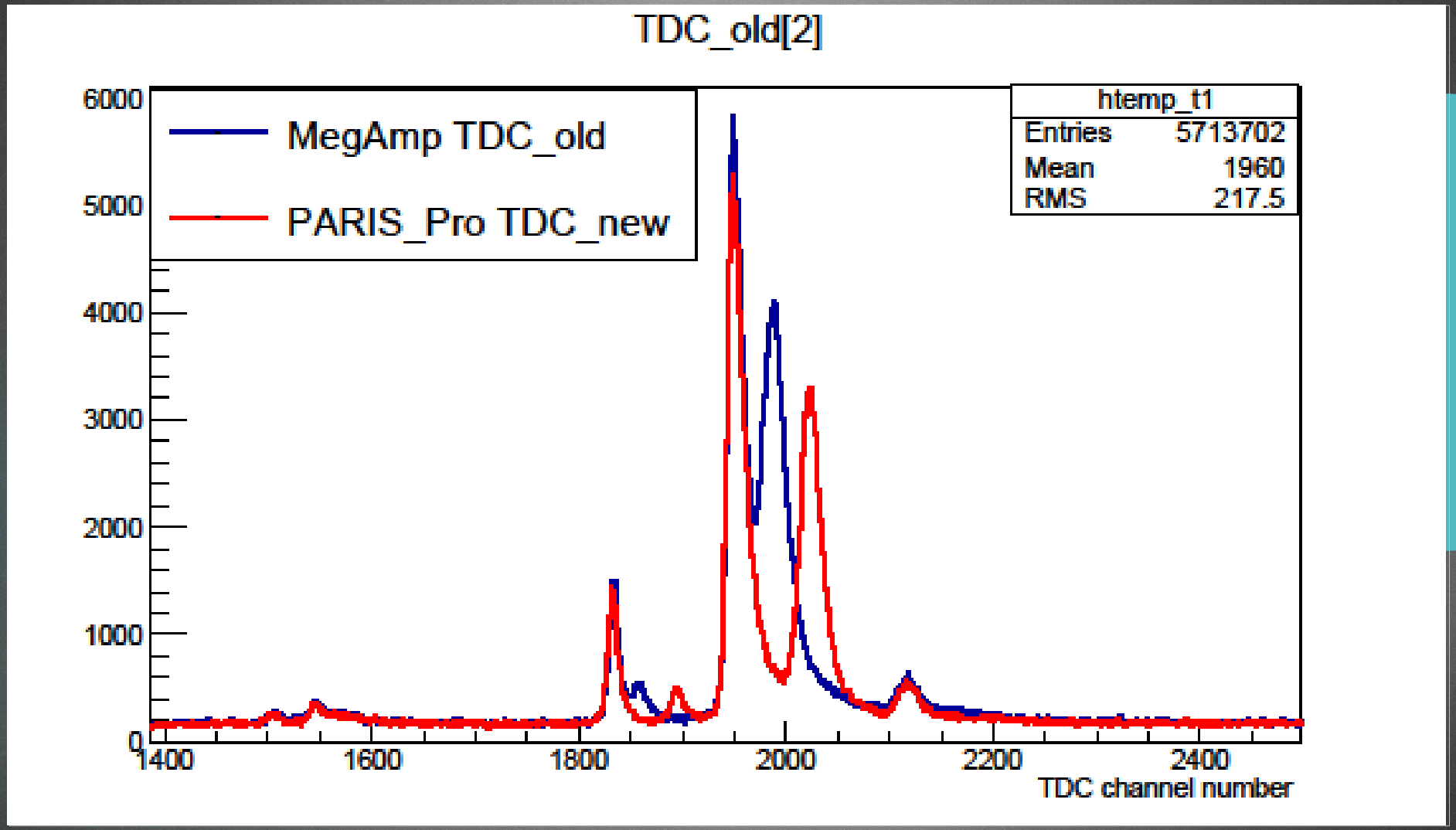
Conclusions

- PARIS can be used for neutron ToF energy measurements.
- Gamma-rays coming from neutron excited states can make it hard to deconvolute from FOLD real neutron multiplicity.
- To be done: neutron Energy vs. Neutron Energy deposit.

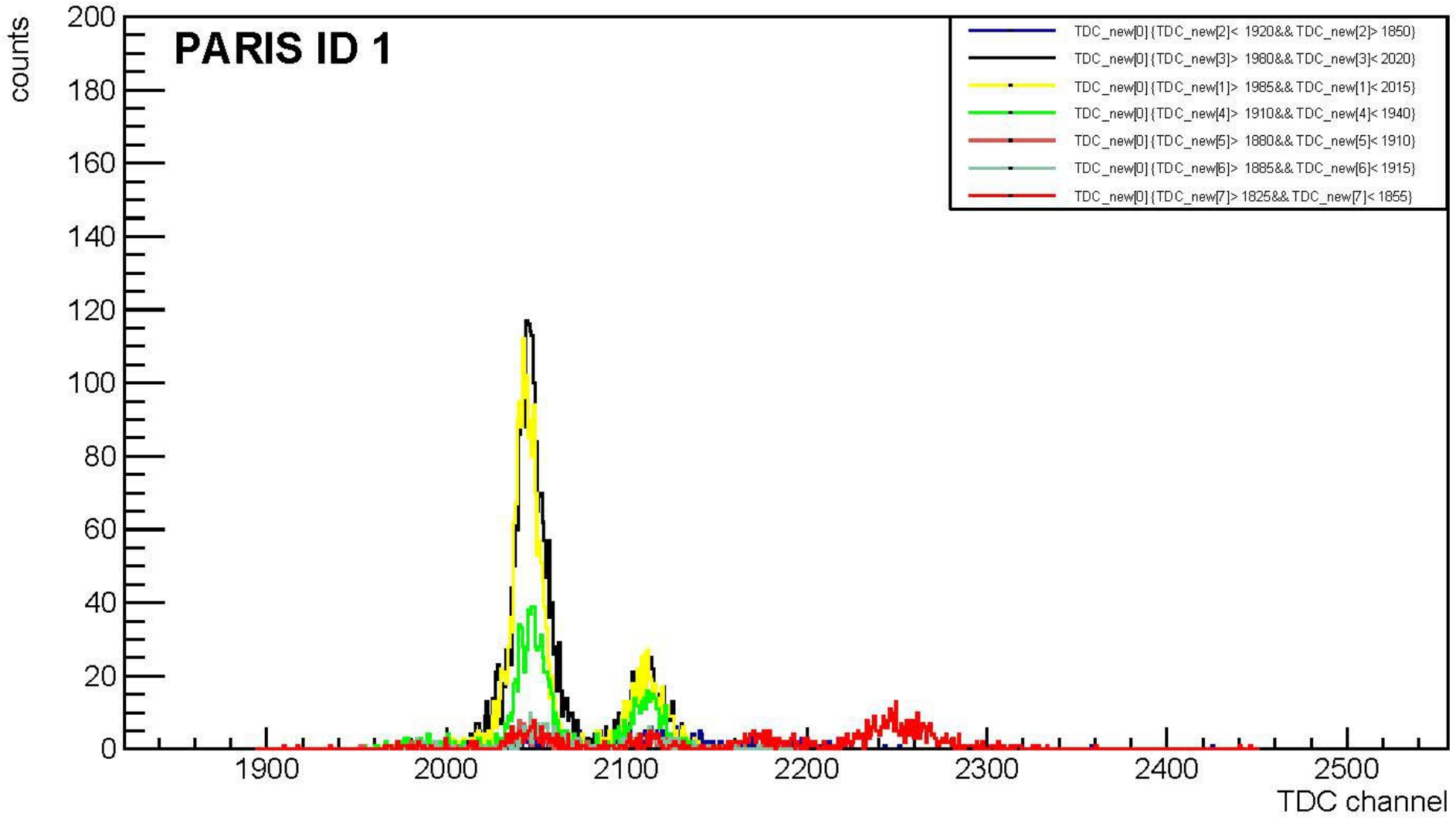
Many thanks to Krakow, Milano, Warsaw, IPN Orsay, Strasbourg and Lyon collaborateurs.



Gamma-rays from
Br excitations


TDC_old[2]
MegAmp TDC_old
PARIS_Pro TDC_new
htemp_t1
Entries 5713702
Mean 1960
RMS 217.5
6000
5000
4000
3000
2000
1000
0
1400
1600
1800
2000
2200
2400
TDC channel number

Case of 43 MeV, gated by prompt gamma peak in different PARIS det.



Testing PARIS with fast neutron from LICORN – improvements

- To improve the Energy from ToF Re(calibration) of the detectors, basing on a shift between „neutron" FOLD = 2 events between them.

- Try to recover the scaling factor of rate divider of EDEN + use of simulations to estimate the relative efficiency of PARIS.