E528S
# Neutron correlation in ^{6}He studied through its <u>nuclear</u> break-up.

M.Assie, J.A.Scarpaci, D.Lacroix, M.Alahari, J.C.Angelique, T.Aumann, D.Bazin, Y.Blumenfeld, D.Beaumel, W.Catford, M.Chabot, A.Chatterjee, M.Fallot, D.Mengoni, J.Nyberg, C.Petrache, F.Skaza, H.Iwasaki, T.Tuna

Reaction : ^{6}He + Pb @ 20 MeV/A $\longrightarrow$ ^{4}He + n + n + Pb

SPIRAL beam

^{6}He is an archetype of a Borromean nucleus ; high intensities
most suitable nucleus to investigate new experimental approach and develop new theoretical tools

Cigar configuration Di-neutron configuration
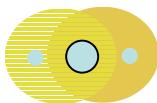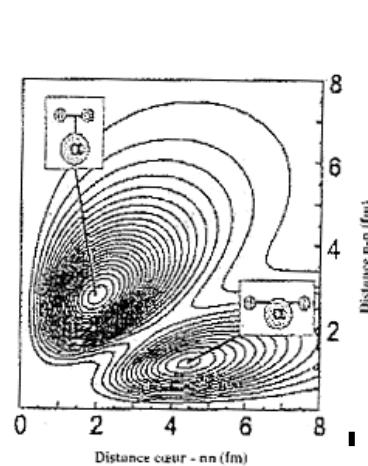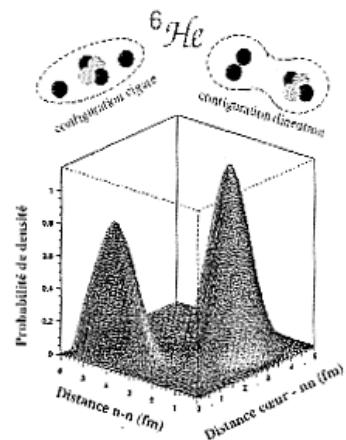
Zhukov et al., Phys. Rep. 231 (1993) 151

Neutron angular emission
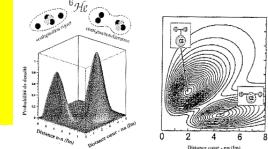
Large impact parameters
Coulomb break-up

cigar   di-neutron

$d\sigma/d\Omega_1 d\Omega_2$

Small differences
in <u>relative</u> angles

$0°$ $60°$ $\Delta\theta_n$
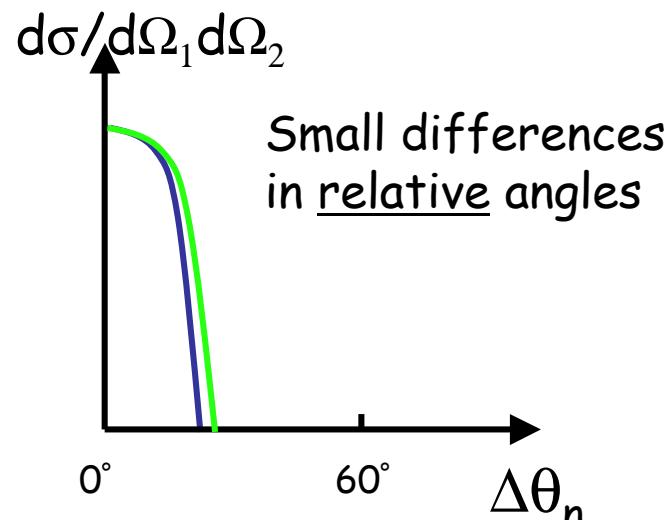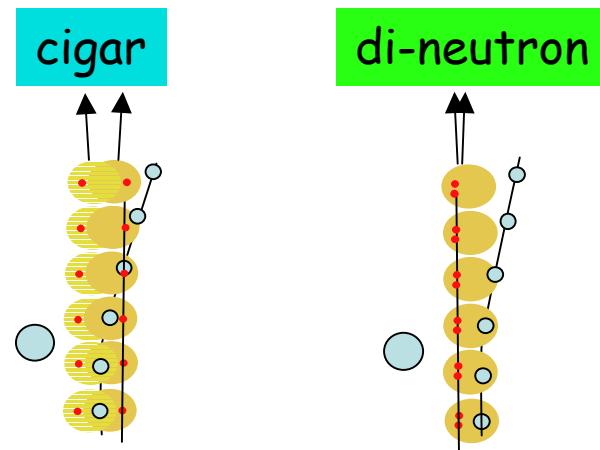
G.Normand, PhD thesis 2004
F.M.Marques, PR C64, 2001

Small impact parameters
Nuclear break-up

cigar   di-neutron

$d\sigma/d\Omega_1 d\Omega_2$

di-neutron

cigar

$0°$ $60°$ $\Delta\theta_n$
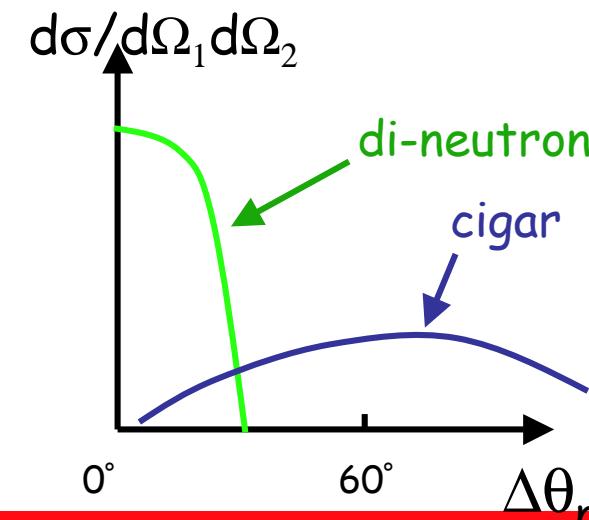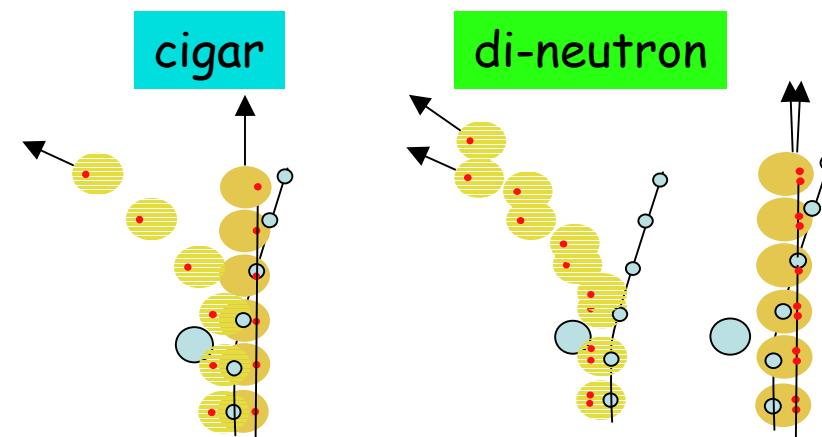
extension of TDHF (TDDM)
(M.Assie-D.Lacroix)

EDEN

Gazeous profiler

Si Li

Neutron Wall

Pb 10 mg/cm²

EDEN

^{6}He
20 MeV/u

I = $10^6 \sim 10^7$ pps

Measurement

Strips

E-Δ E

ΔE (MeV) vs E (MeV)

^{6}He

^{4}He

SiLi

T_{vol} (canaux) vs ZCO (canaux)

neutrons

NWall

Ecin (MeV)
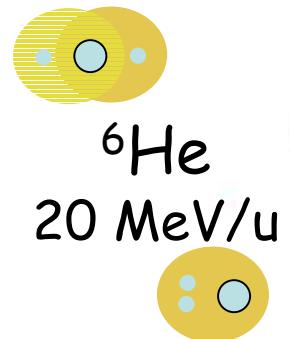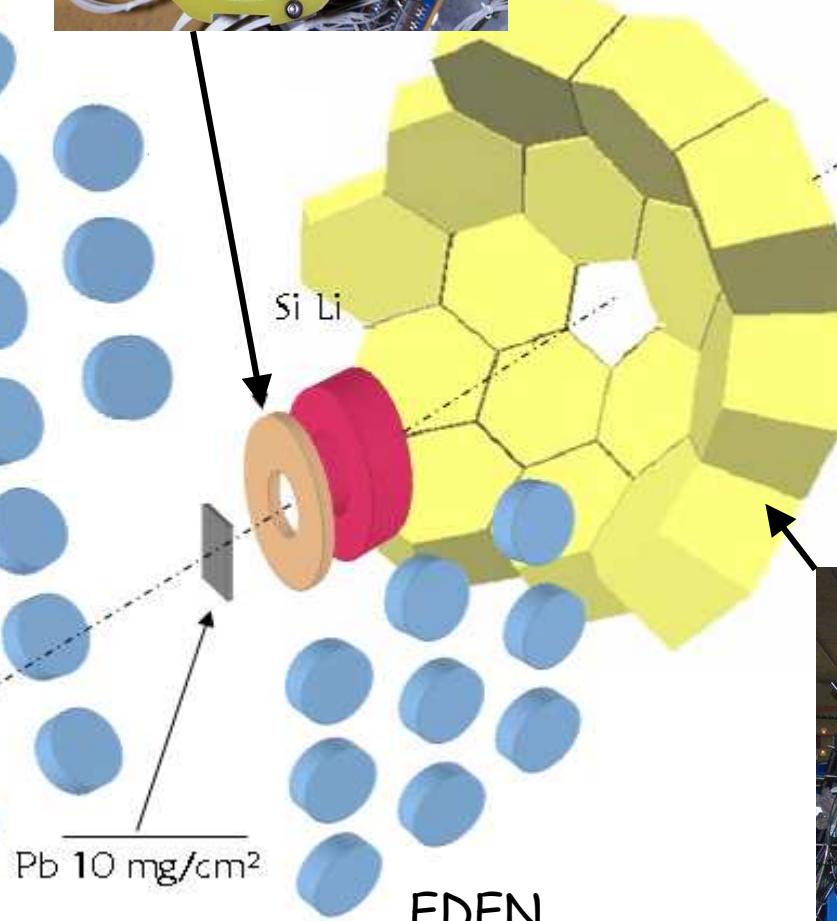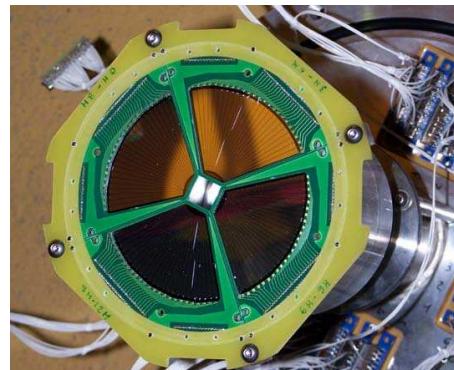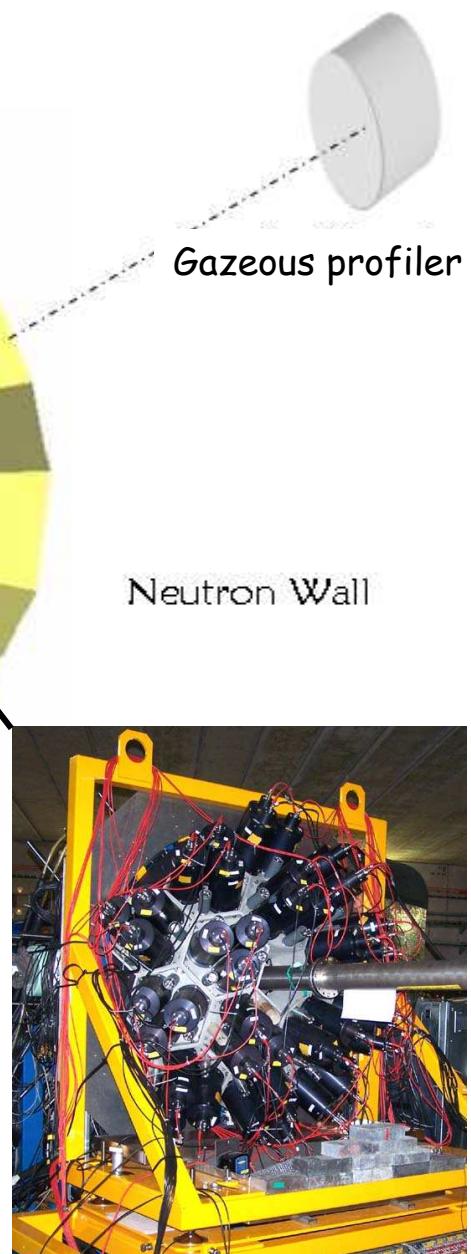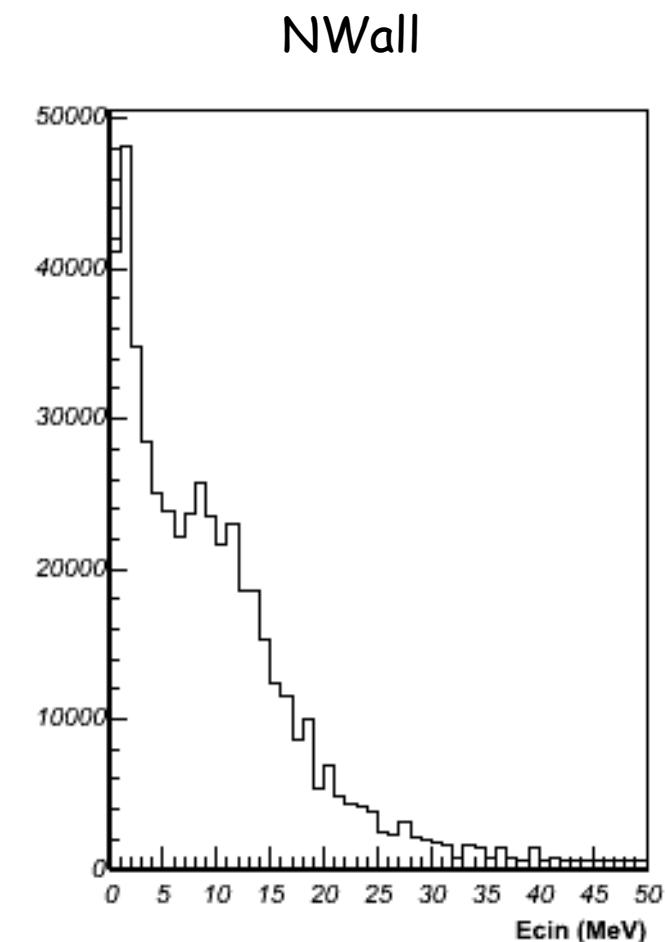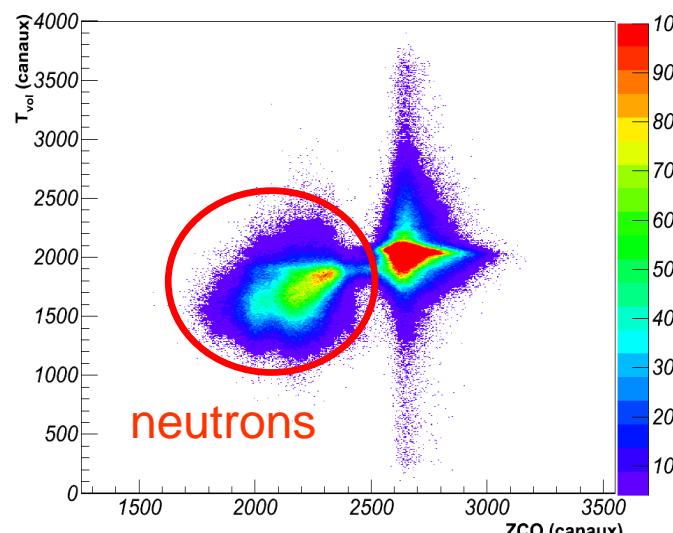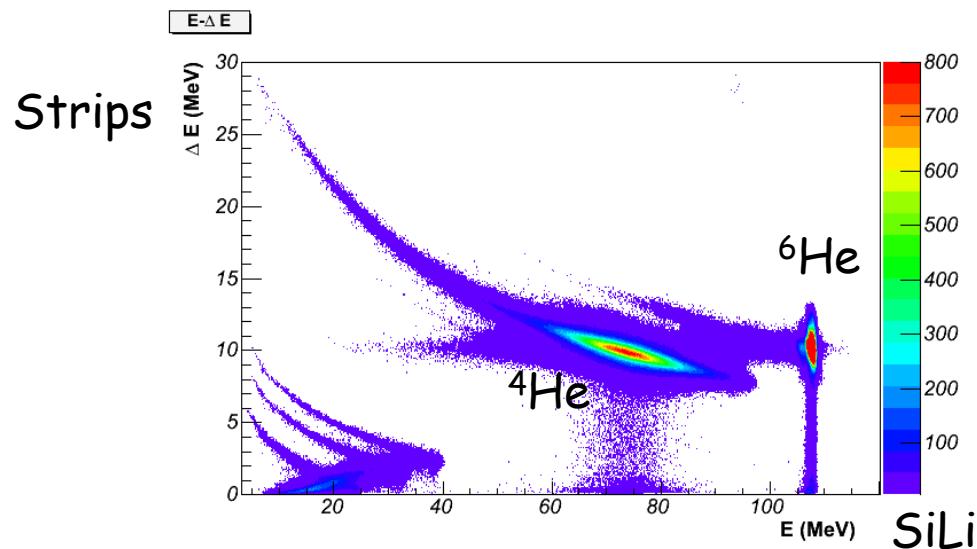
Experimental _relative_ angular distribution
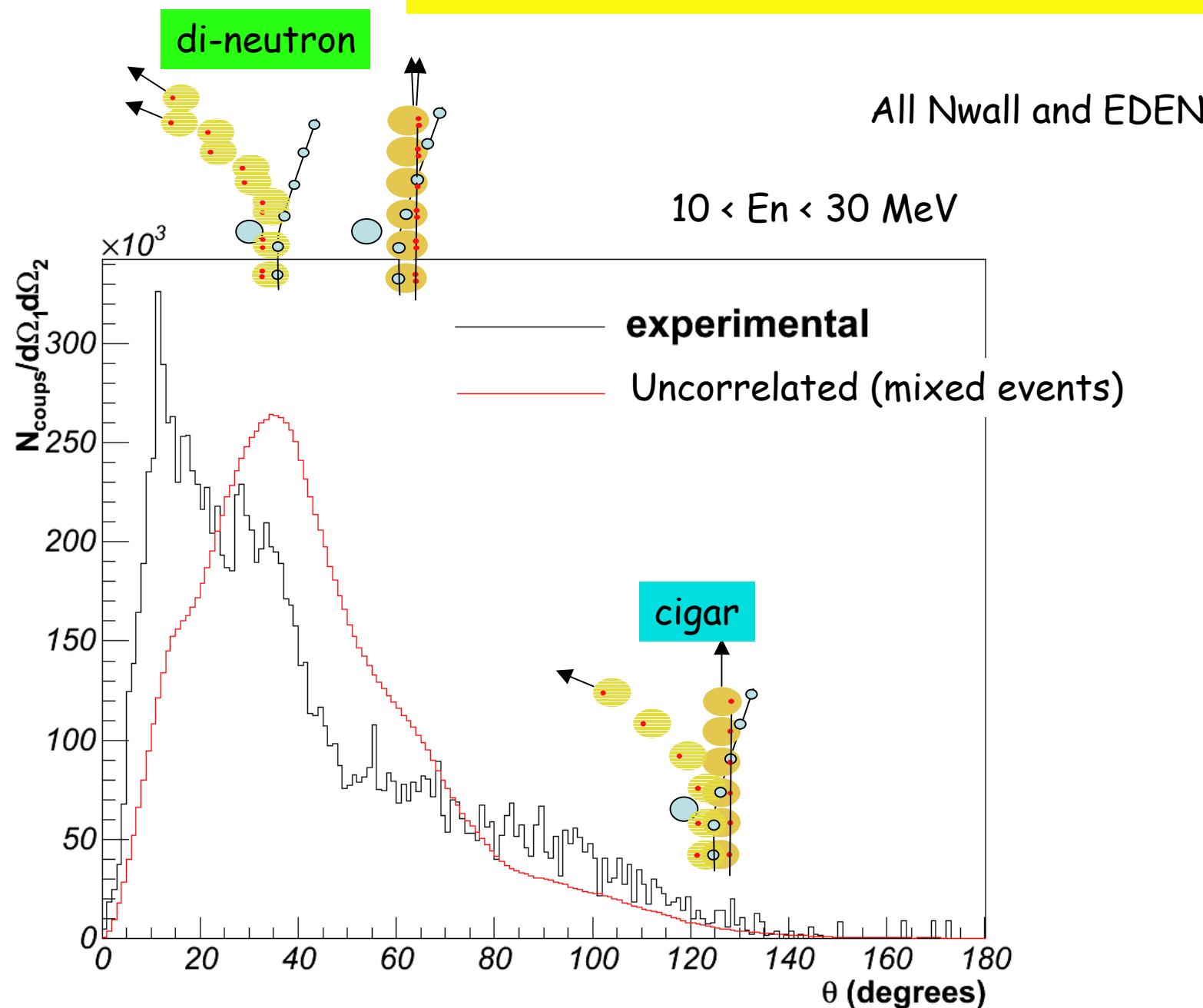
Measurement of crosstalk
with $^{12}C + ^{208}Pb \longrightarrow ^{10}B$
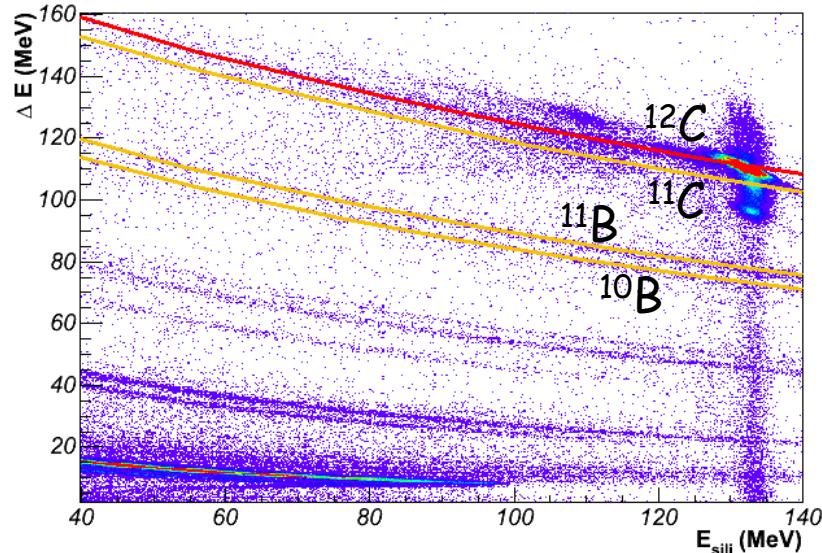
1n+1p
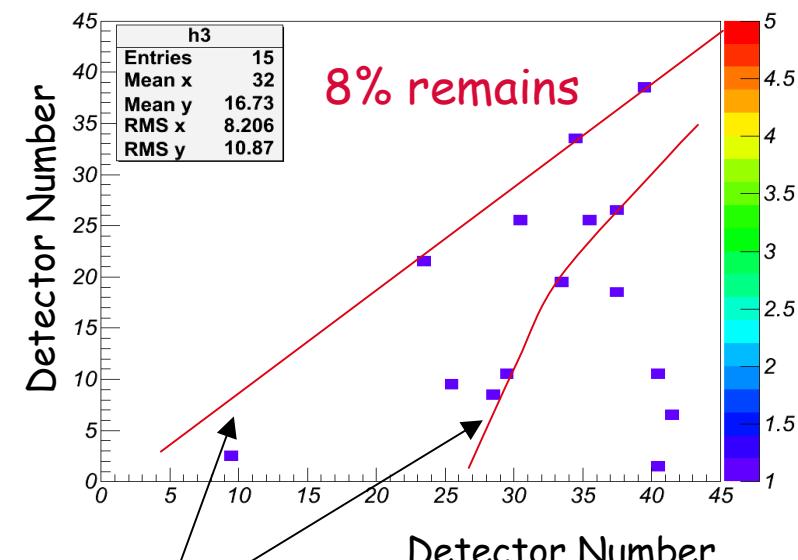
8% remains

Close detectors

E_{calc}=time of flight
$E_{out}=E_{calc}-E_{loss}$
E_{ij}^{min}=minimum E to go from i to j
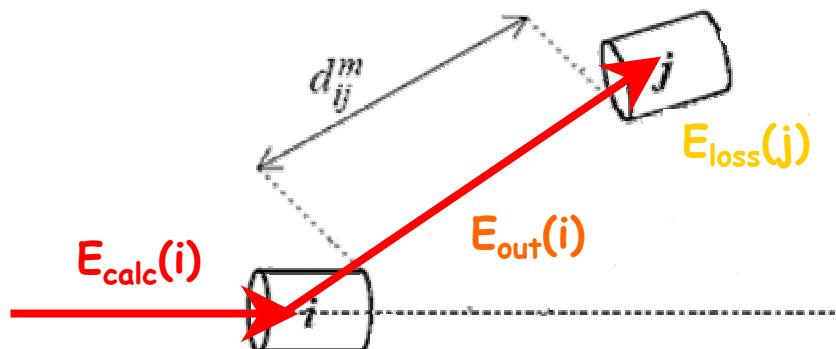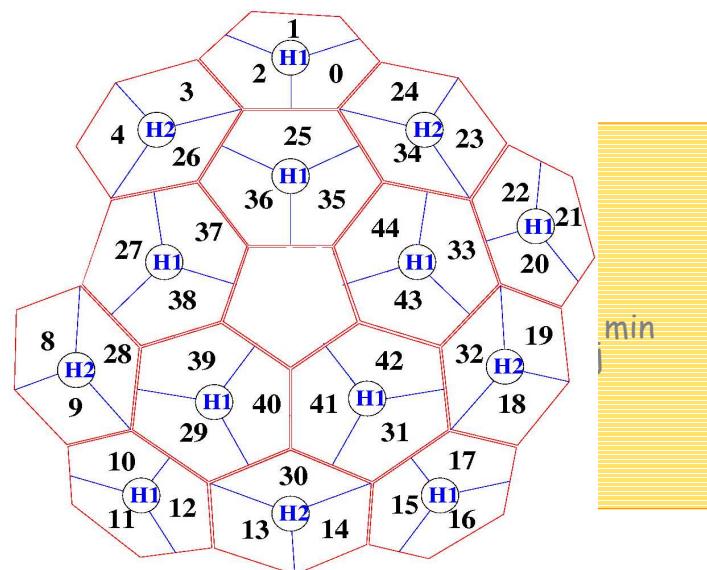
Test of the rejection algorithm with GEANT4

One emitted neutron - 2 detectors hit
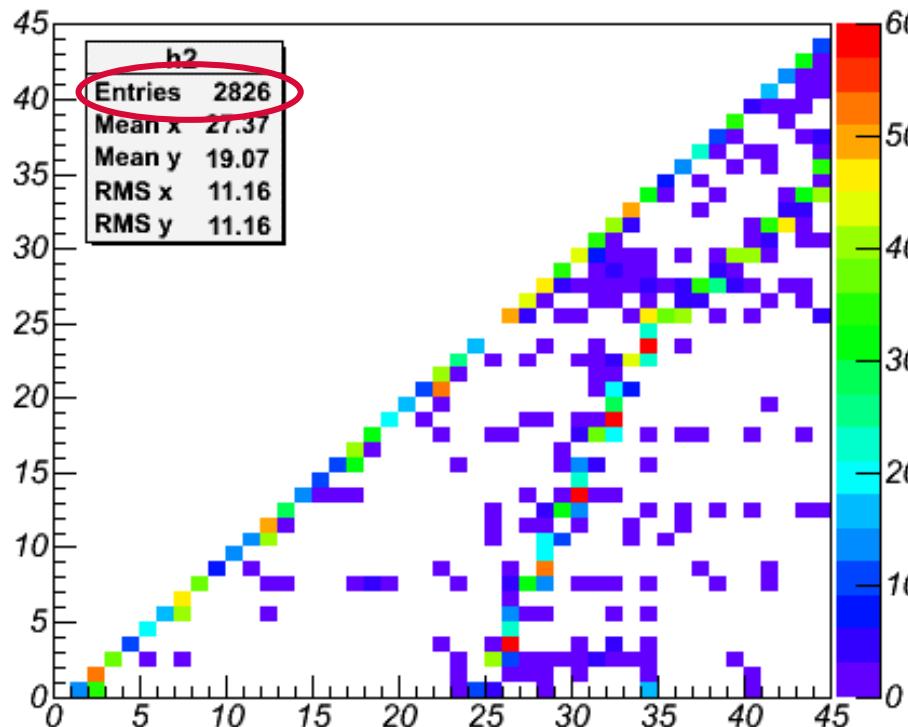
Only 15% of the crosstalk events remain
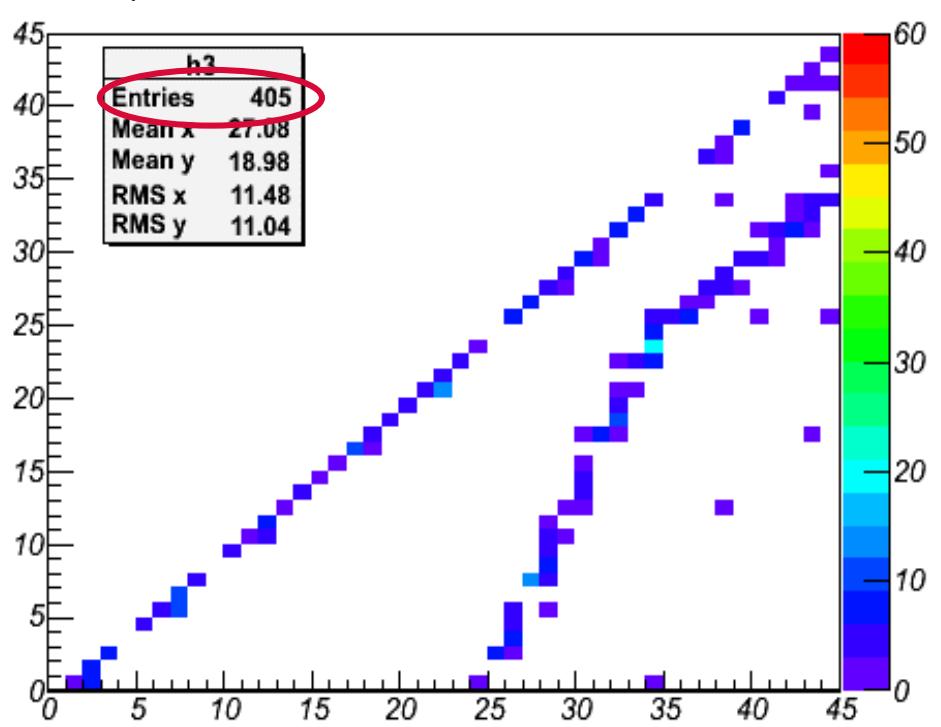
With and without crosstalk for θ>40° (nuclear break-up)

10 < En < 30 MeV


Counts for θ_{rel} <20°:   1 492 860 (with crosstalk)
953 203 (without crosstalk)
63% remains
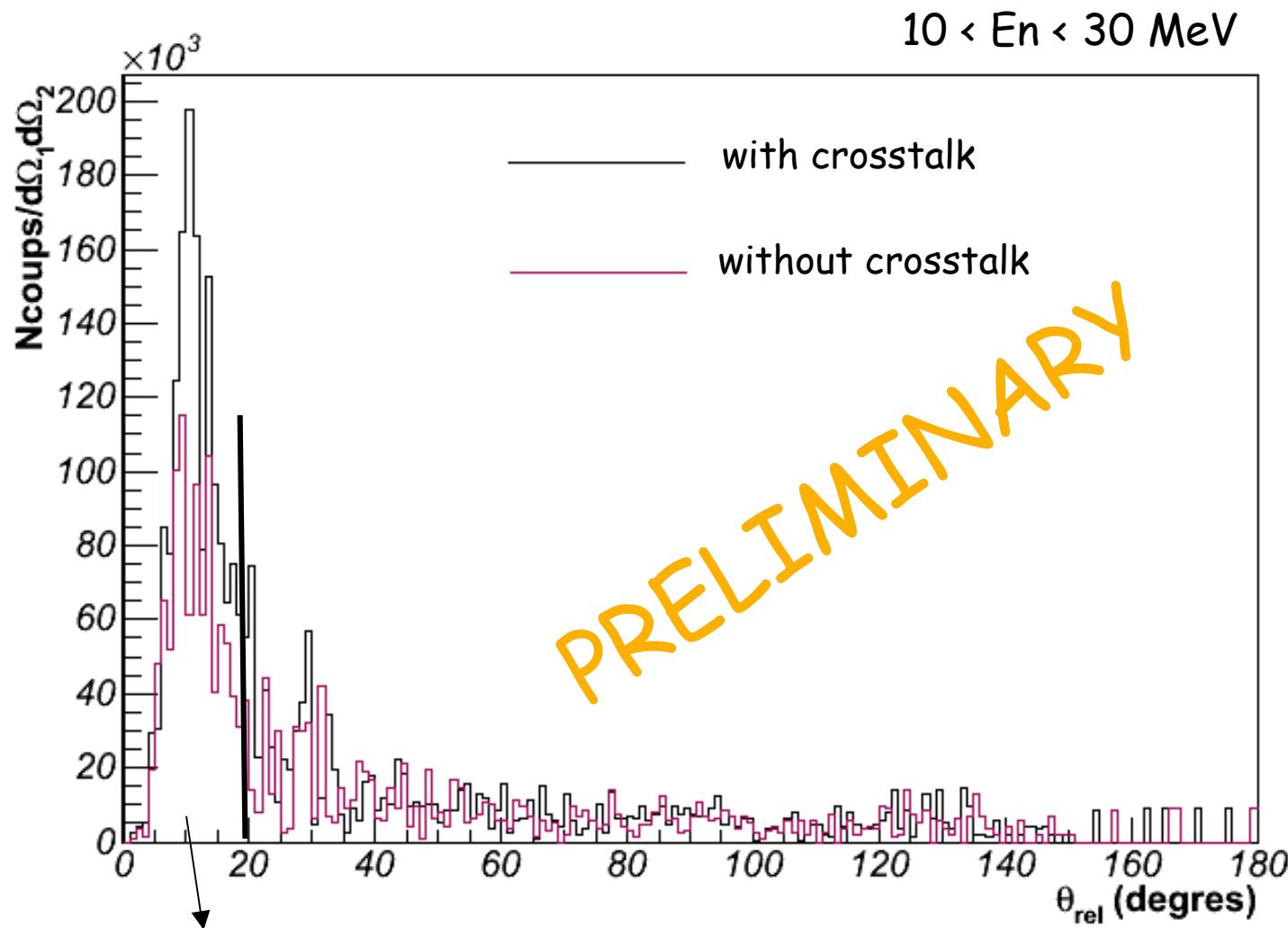
35% of the events remains in the Neutron Wall after subtraction of the crosstalk pour θ_{rel}<20°
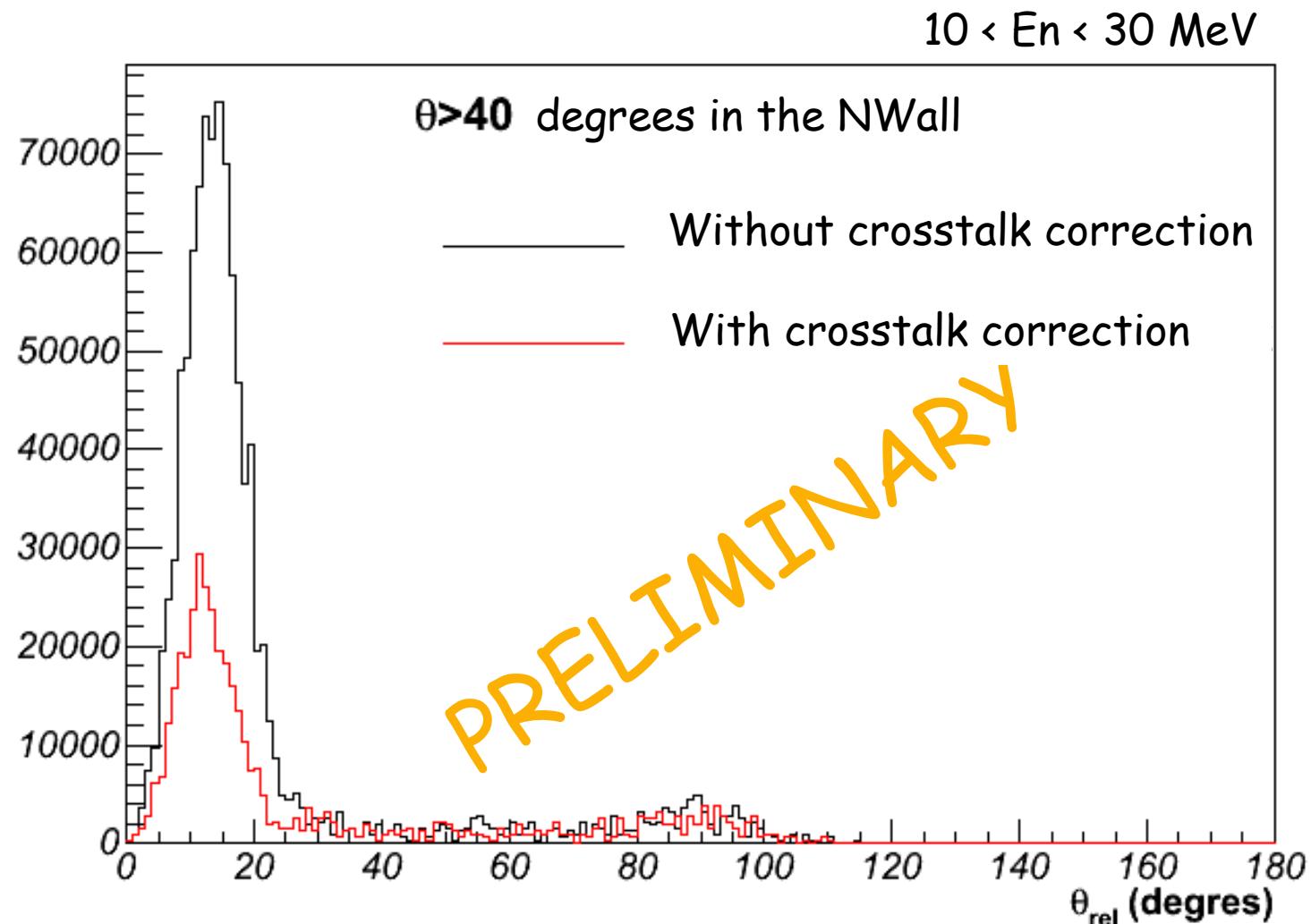
Correlations subtracted from the cross-talk
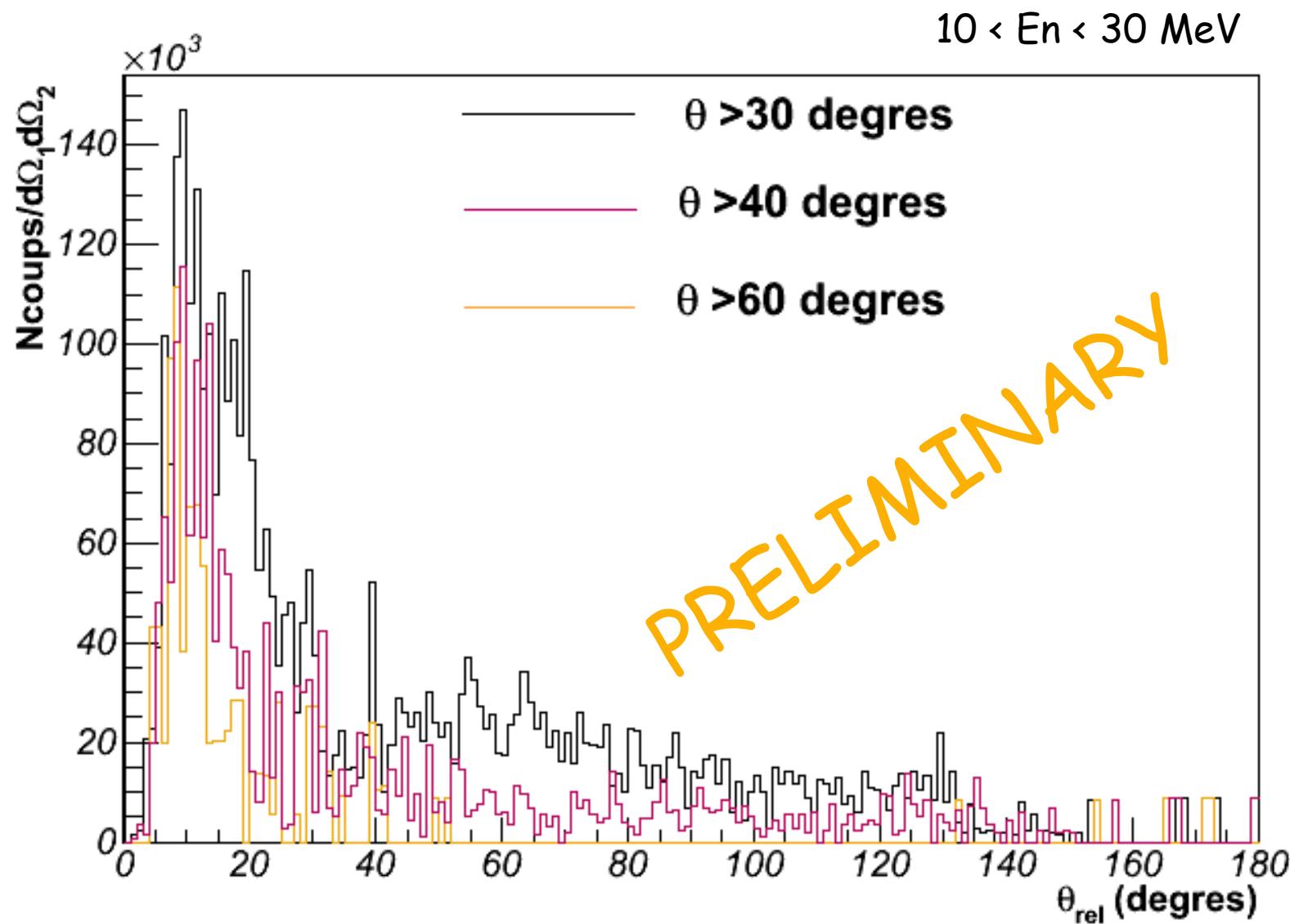
New neutron detector characteristics

- No cross-talk! (think of the best protocol to remove it)
- Variable thickness (two sets of detectors)
- Large angular coverage (nuclear break-up, SPIRAL2)
- Compact electronics
- New materials!

Efficiencies measured with Californium and calculated ?

Seuil =100 keVee

Exp E337

$^{11}\text{Be} \rightarrow {}^{10}\text{Be} + n + \gamma$
@ 41 MeV/A

Neutron energy spectra

no-γ

n-detectors

^{48}Ti

^{11}Be

Château de cristal

γ

3 m

^{10}Be

SPEG

$d\sigma/dE$ (b/MeV)

$S_{2s} = 0,47 \pm 0,04$

TDSE calc. 2s

En (MeV)

γ in coincidence

$d\sigma/dE$ (b/MeV)

$S_{1d} = 0,50 \pm 0,20$

$S_{1p} = 3.9$

4*1p

0.5*1d

E (MeV)

TDSE Calculation non-perturbative

^{48}Ti

^{10}Be
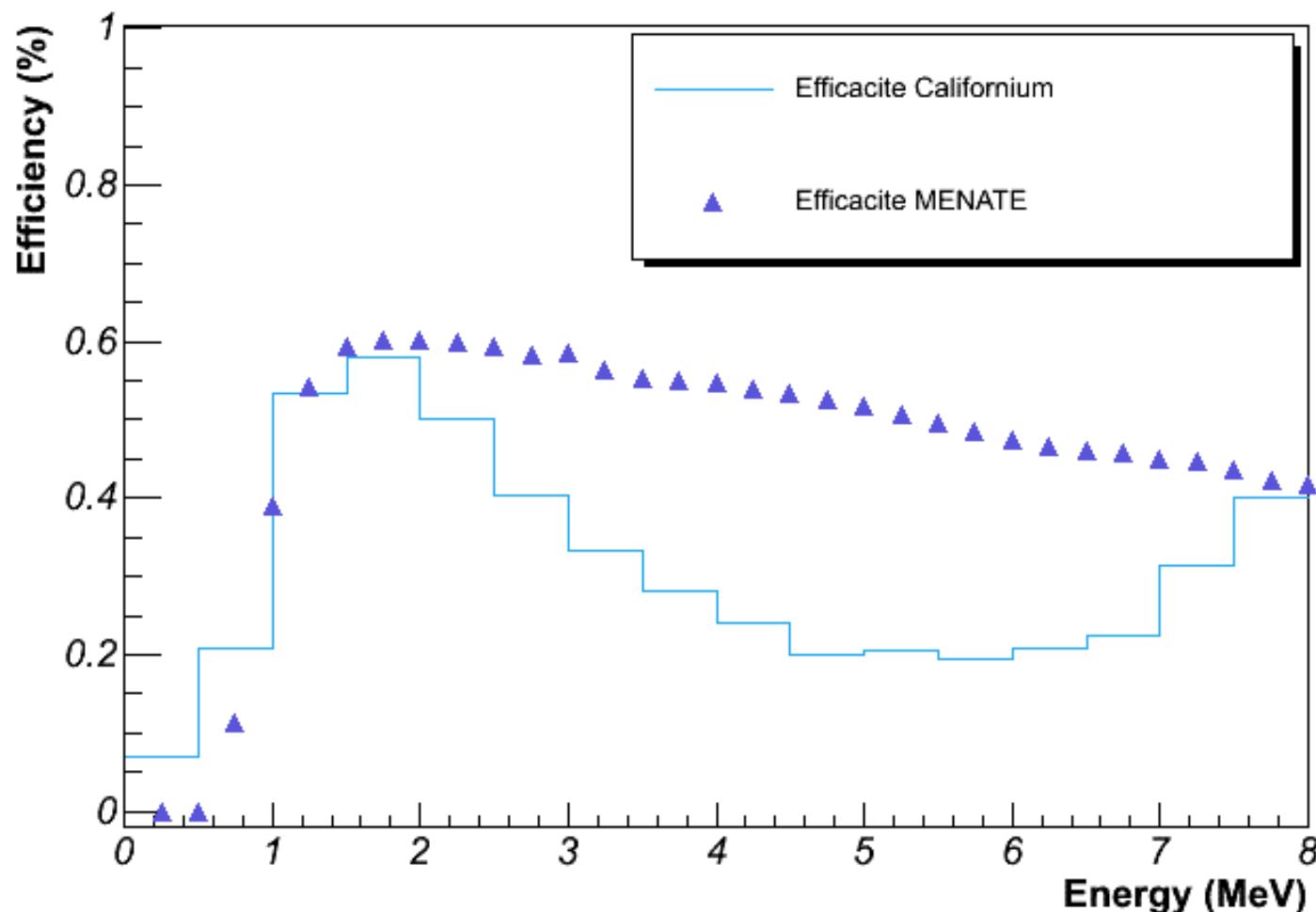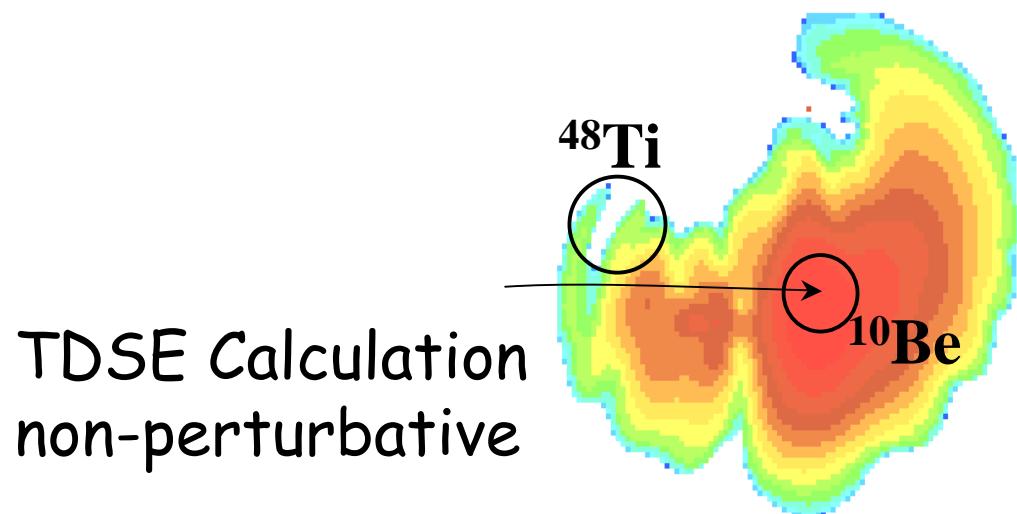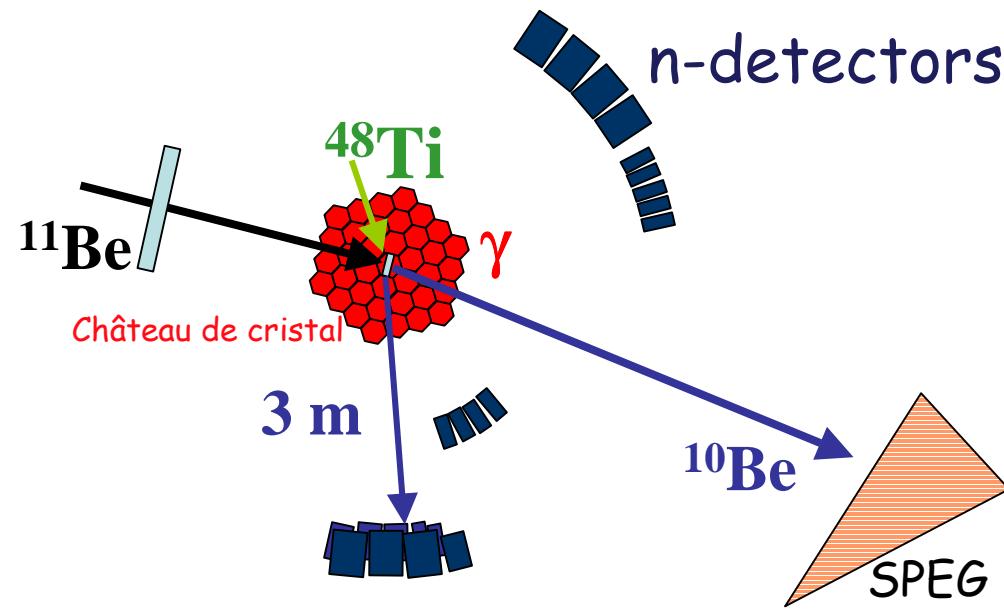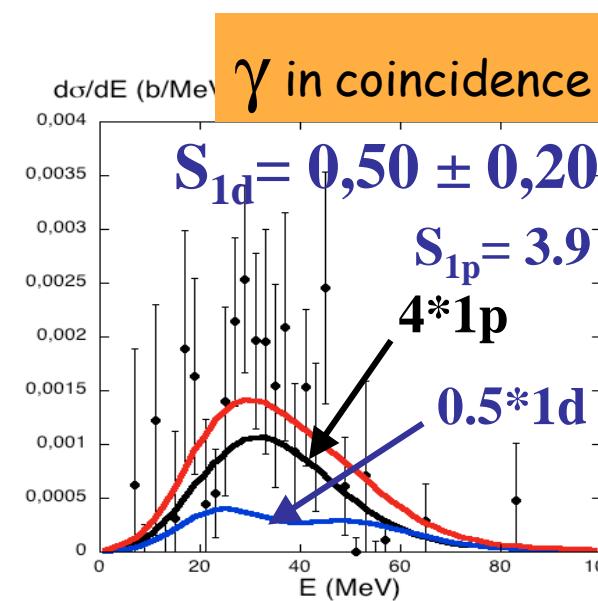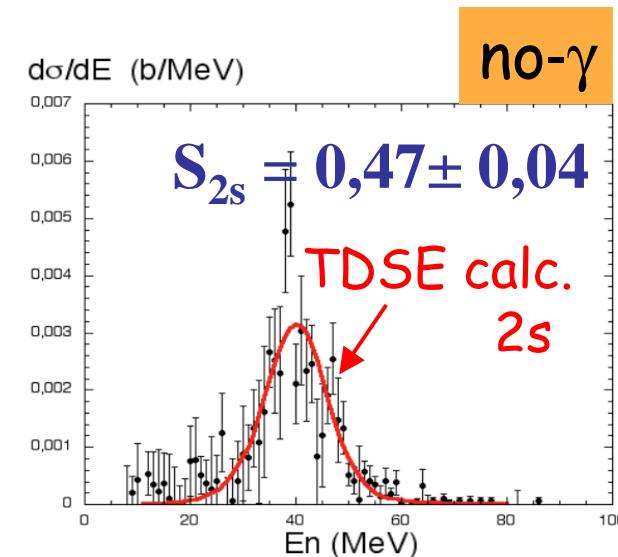
V.Lima et al., Bormio 2004
V.Lima, Ph.D. Paris XI, oct 2004
V.Lima et al., in preparation