DE LA RECHERCHE À L'INDUSTRIE

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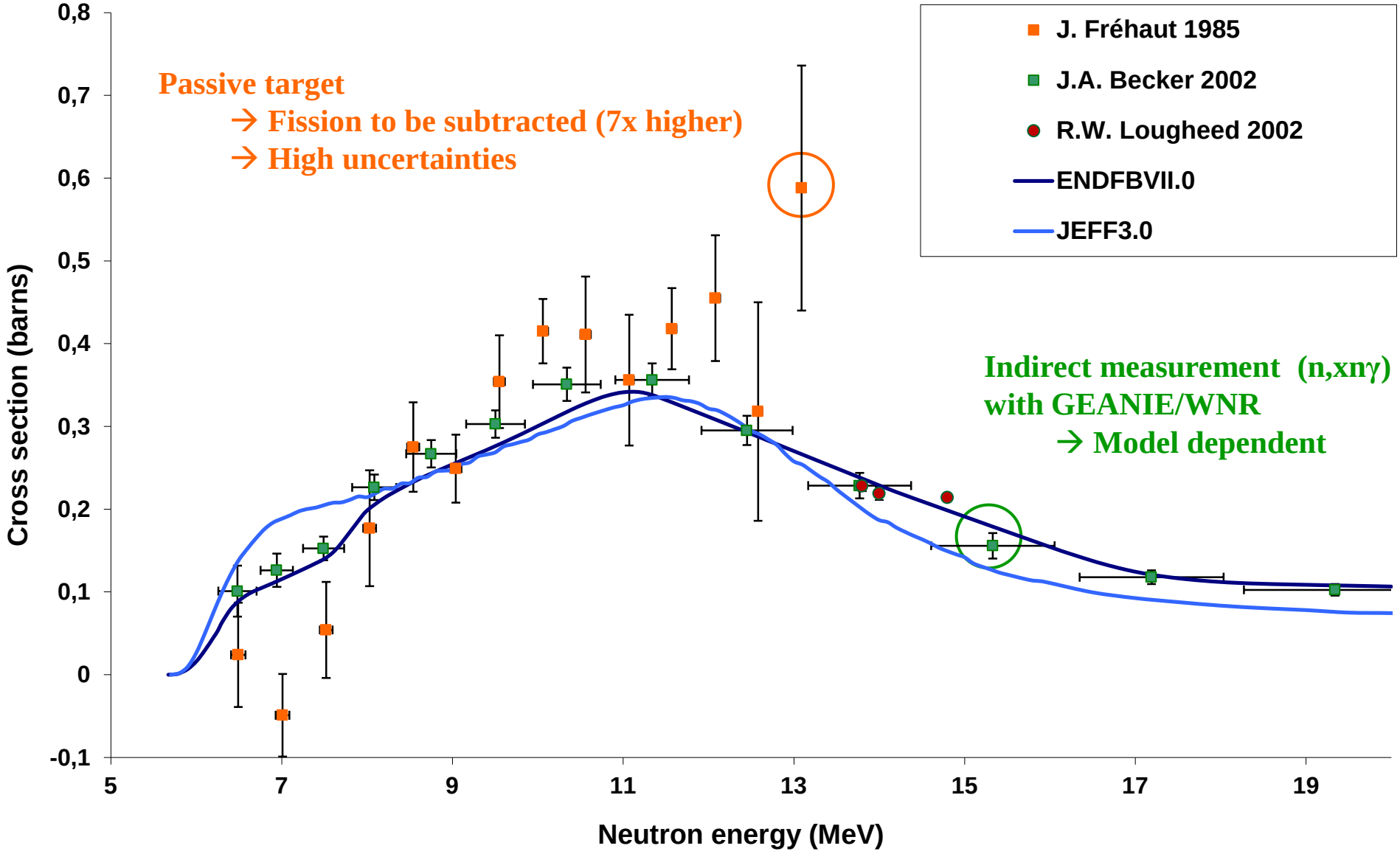
DIRECT MEASUREMENT OF (n,xn) REACTION CROSS SECTIONS ON ACTINIDES

G.Bélier, T. Bonnet, J.M. Laborie, B. Laurent, X. Ledoux, C. Varignon
CEA, DAM, DIF, F-91297 Arpajon France

Worhshop (n,xn) Saclay 17-19 mars 2014

Need for a new (n,2n) reaction on ^{239}Pu + scarce data for x≥3



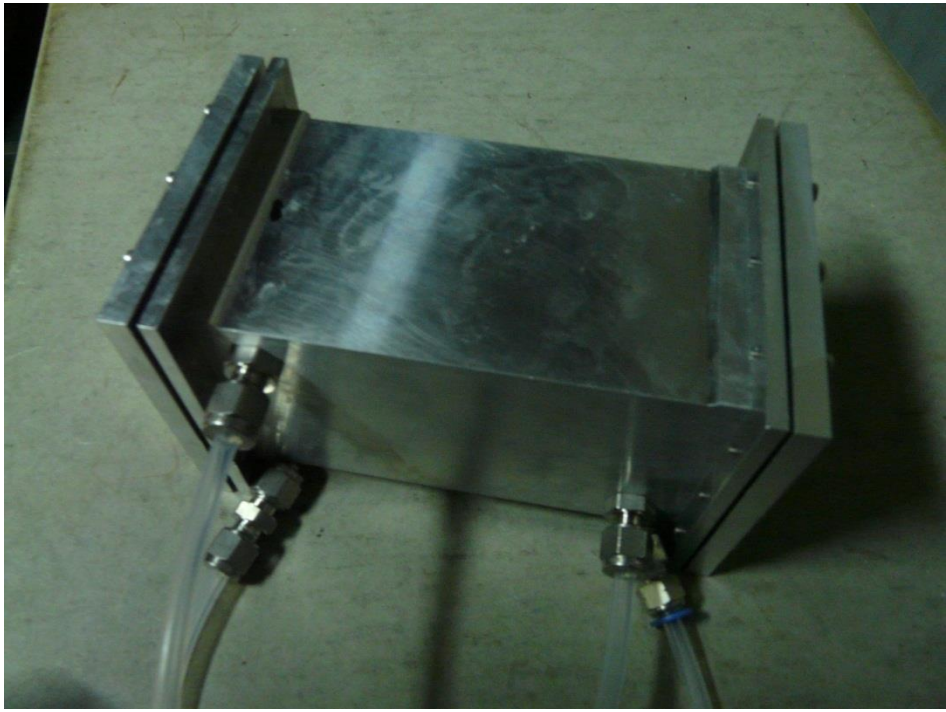
GOAL OF THE PRESENT PROPOSITION

First direct measurement of (n,xn) reactions

thanks to:

- An active target → fission veto,
- A neutron counter: **CARMEN.**

ACTIVE TARGET

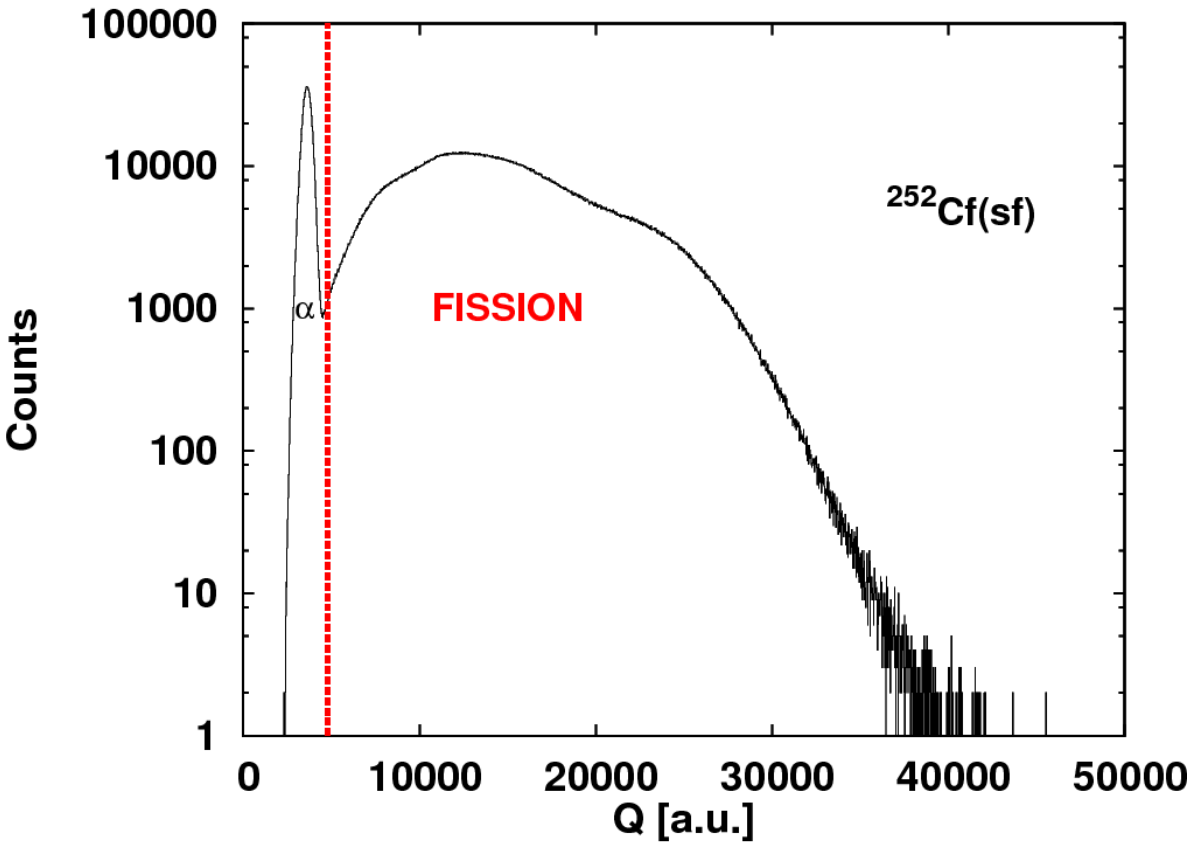


Multiplate fission chamber:

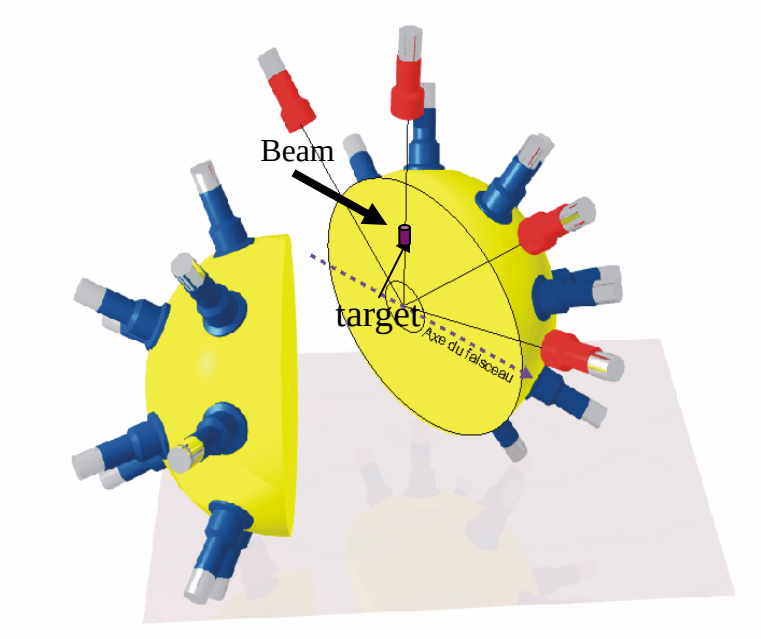
- Al case → low neutron distorsion
- Thin target backings
- Dedicated preamp + CF_4 flowing gas → up to 5 MBq/channel

α - FISSION SEPARATION

Prototype with ^{252}Cf – activity about 20 kBq



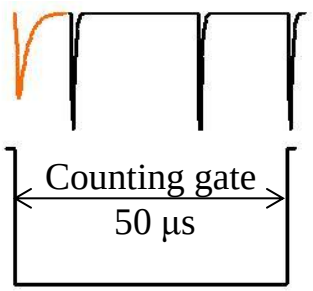
THE NEUTRON LONG COUNTER CARMEN



BC521 : Gd loaded (0.4%) scintillator ~1 m^3

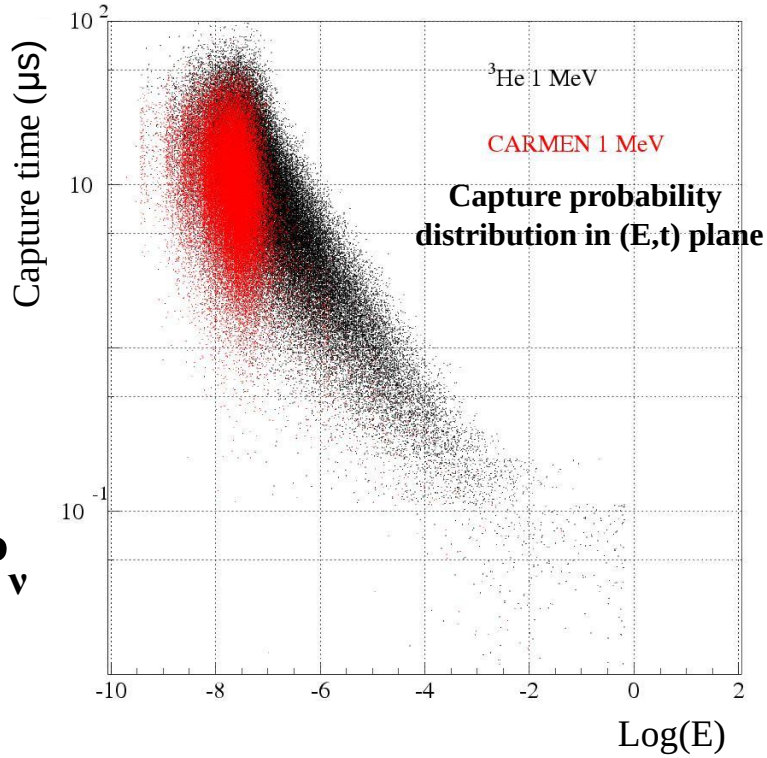
Detection efficiency : 85% for ^{252}Cf SF neutrons

Prompt peak γ,n → trigger

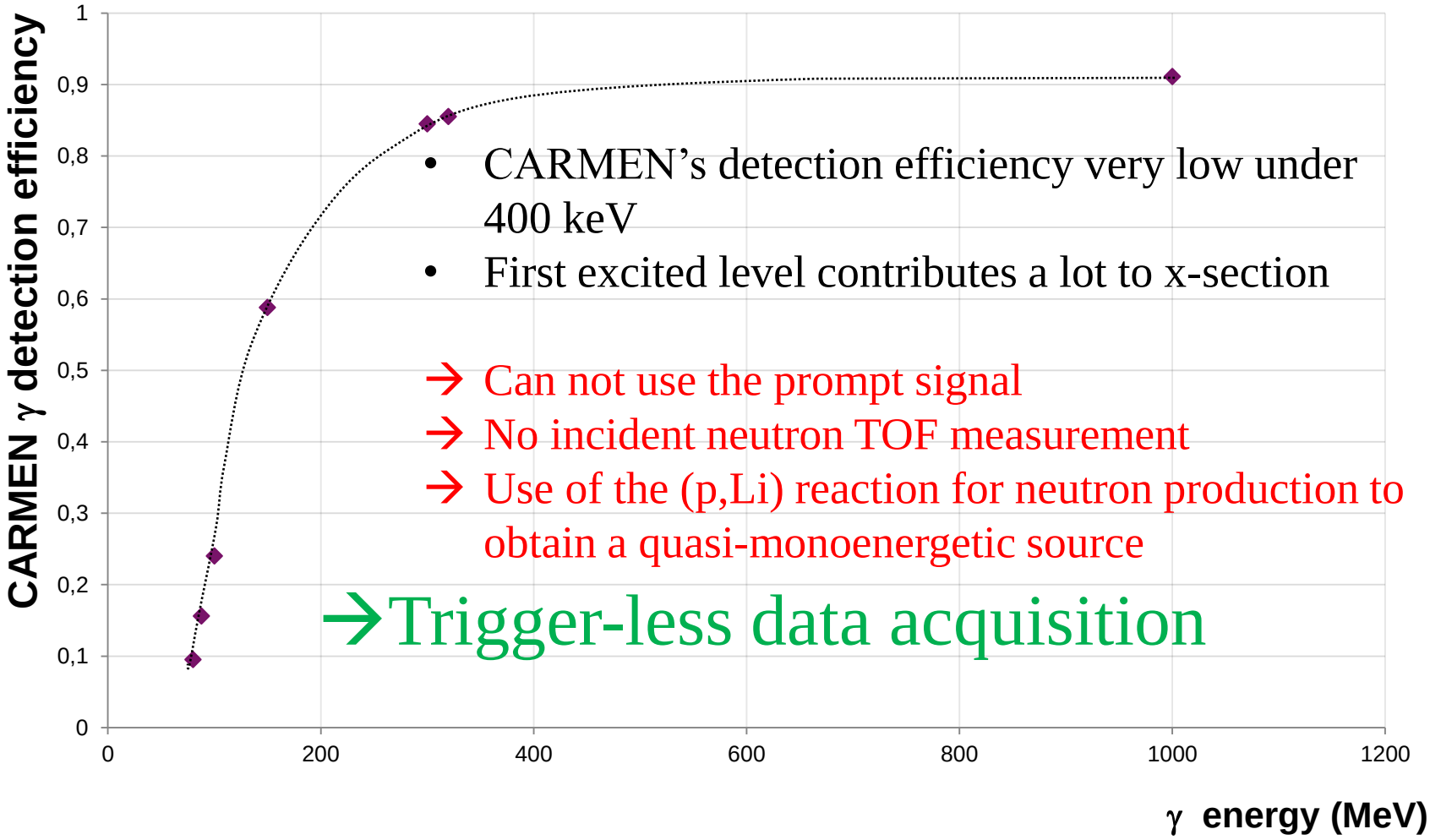


→ ΣE_γ

→ Stockastic captures → P_ν



EXPERIMENT TRIGGERING

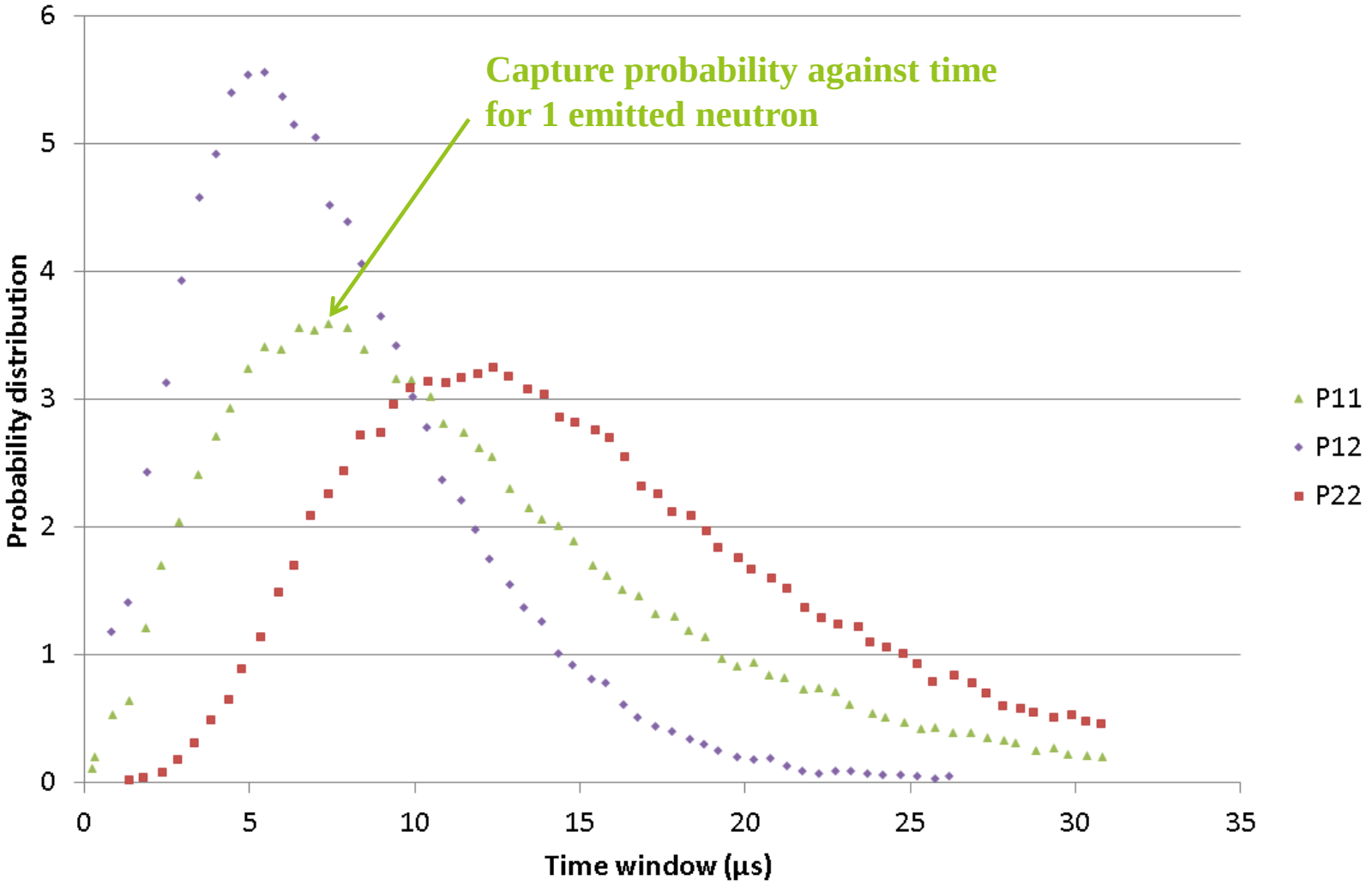


- CARMEN's detection efficiency very low under 400 keV
- First excited level contributes a lot to x-section

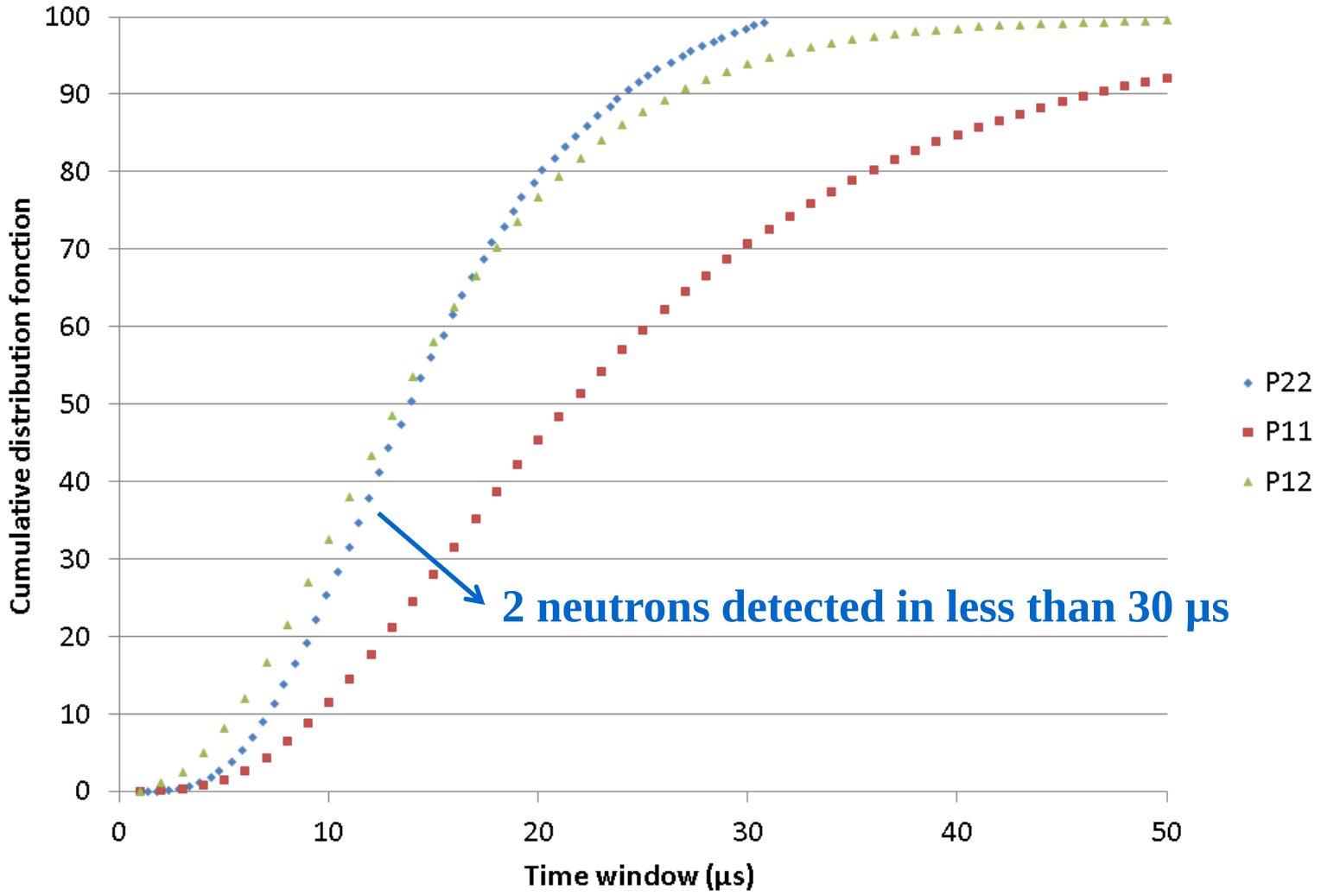
→ Can not use the prompt signal
→ No incident neutron TOF measurement
→ Use of the (p,Li) reaction for neutron production to obtain a quasi-monoenergetic source

→Trigger-less data acquisition

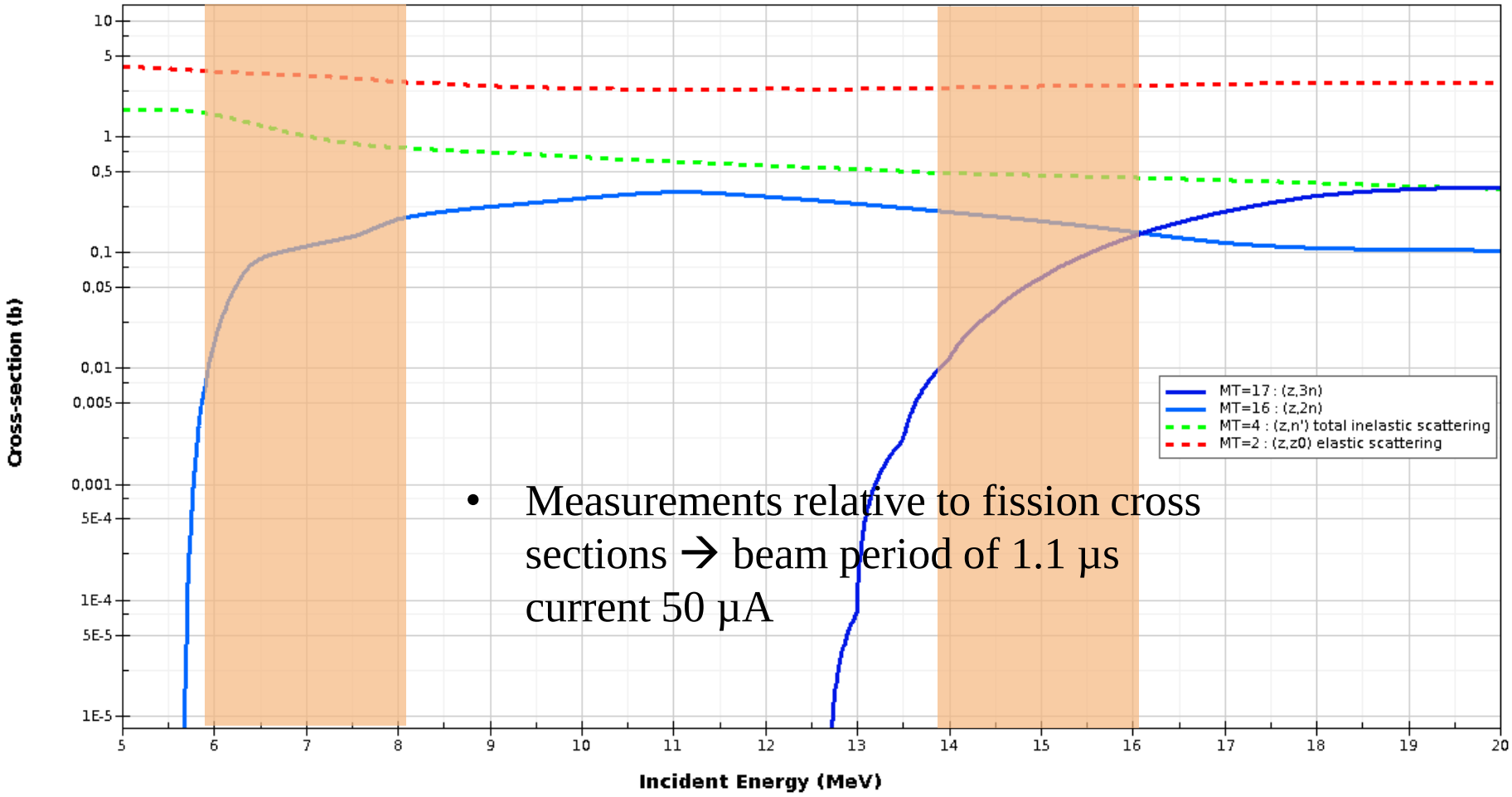
NEUTRON COUNTING IN LARGE Gd LOADED SCINTILLATORS



PROBABILITY TO DETECT I NEUTRON AMONG J



STRATEGY



- Measurements relative to fission cross sections → beam period of 1.1 µs current 50 µA

Quasi mono kinetic (p,Li) at reaction opening, white spectrum (d,Be) otherwise

COUNT RATES

Total mass: 40 mg

	reactions rates (s^{-1})				
Energy	(n,fission)	(n,n)	(n,n')	(n,2n)	(n,3n)
7.3	21.6	33.9	9.5	**1.3**	-
13.3	11.3	12.7	2.5	**1.2**	**0.0**
15.3	15.2	17.6	2.9	**1.1**	**0.5**
17.3	18.3	22.8	3.3	**0.9**	**1.9**
19.3	21.8	27.6	3.5	**1.0**	**3.4**

Background simulation → 0.1 neutrons / 50 µs (2000 n/s)

CONCLUSION

- Start with the (p,Li) reaction
- Measurement on ^{238}U → easier to handle
- Measurement on ^{239}Pu
- Complete the measurement by (d,Be) reaction