# Online monitor of neutron spectrum

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L202
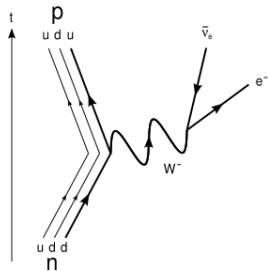
16th November 2012

# Motivation

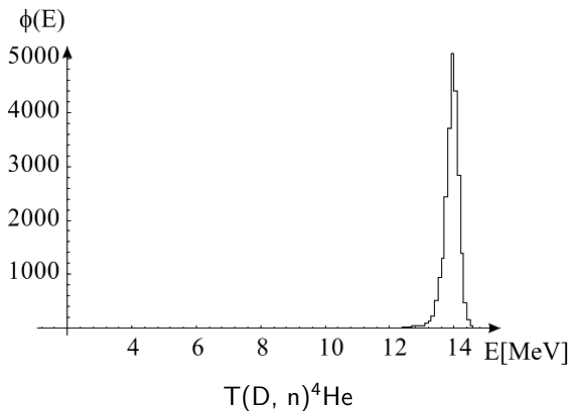Neutron radiation ($+$ gamma radiation $=$ mixed field)

Occurrence:

- Fission reactors
- (Fusion reactors)
- Cyclotrons, Colliders
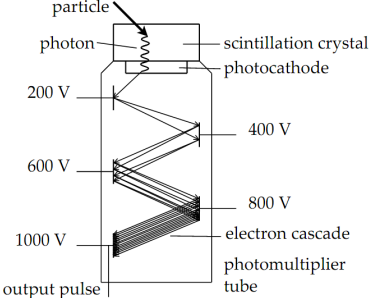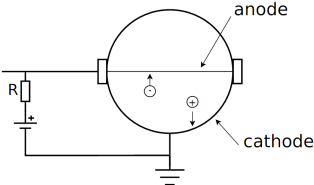- Radiotherapy
- Imaging
- Radiation protection
- Nature

# Motivation II

Measurement and analysis not trivial
Physical quantity of our interest: **neutron spectrum**
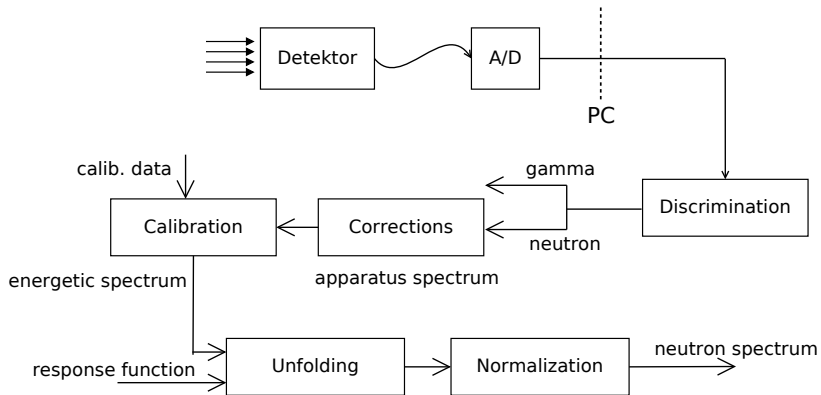


T(D, n)$^4$He

# Detectors



anode

cathode

R

particle

photon

scintillation crystal

photocathode

200 V

400 V

600 V

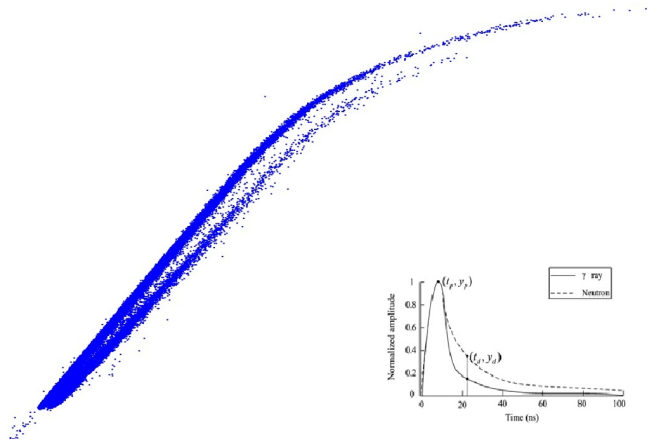800 V

1000 V

electron cascade

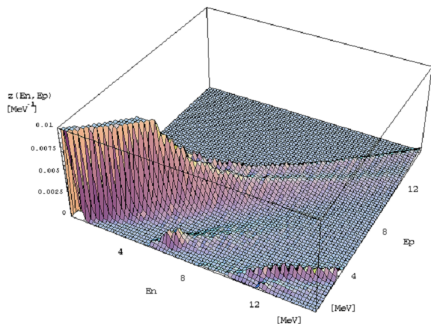photomultiplier tube

output pulse

# Context

# Discrimination

# Response function

= Formal characteristics of a device,
obtained by Monte Carlo simulations

Phenomena:

- H(n, n)H
- C(n, n)C
- C(n, $3\alpha$, n)
- B(n, $\alpha$)Li
- . . .

## Unfolding - linear inverse problem

Fredholm integral equation of the first kind

$$g(x) = \int\limits_{(I)} A(x, y)f(y)\,\mathrm{d}y$$

How to solve?:
Regularization, (Non-) Linear Model, Maximum Entropy,
**Maximum Likelihood Estimation**, genetic algorithms, . . .

# Achieved so far

- Simulation SW for response function of proportional detector
- Expectation maximization method for unfolding
- Online separation using some of the methods

# Yet to do

- Connect all the parts into one online system
- ($\Rightarrow$ Develop missing parts)
- Similar online processing for $\gamma$ radiation
- Improve or develop new simulations for RF (proportional, stilben, NE213, boron, . . . )
- Statistical evaluation of results (uncertainties, comparison)