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Links between fundamental and applied research in the field of nuclear data

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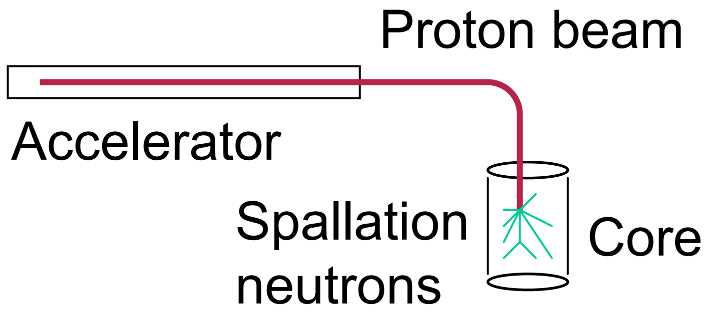
New nuclear applications

Large scale:	Transmutation of nuclear waste
	Electronics failures by cosmic neutrons
Smaller:	Fast-neutron cancer therapy
	Dosimetry for airfare
Always there:	Fundamental nuclear physics

Transmutation

Nuclear waste can be destroyed in the lab

Possible also at industry scale?



Up to now: Cross sections for design and assessment

Trends:

- Cross sections above 100 MeV
- Integral tests above 70 MeV
- Technical development (ADS diagnostics)

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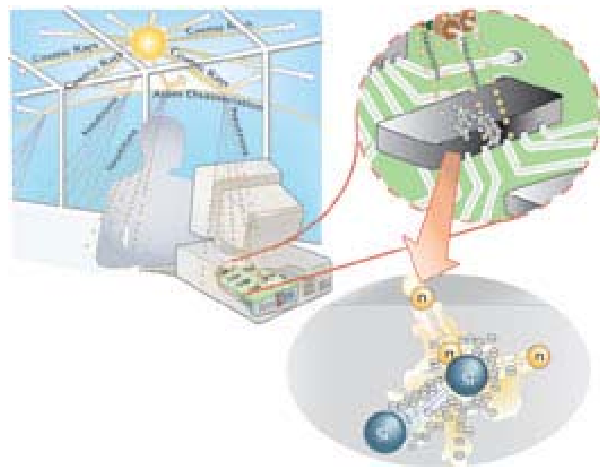
Electronics failures

Cosmic-ray neutrons induce bit flips

Terminate silicon technology?

Commercial activity



Trends:

Rapidly increasing problem — Aviation since 10 years

Now also ground level:

1 server crash / week…

New worries: Complex errors (e.g. multi-bit)

Needs: Higher energy (>100 MeV)

Larger intensity

Aims: Component tests

Code validation

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Nuclear data situation

Application	Tendency	Role of fast n	Funding
ADS	Slow growth	Small but imp	Good
N-therapy	Steady	Does the job	Bad
SEE	Rapid growth	Disturbance	Direct: bad Indirect: possible

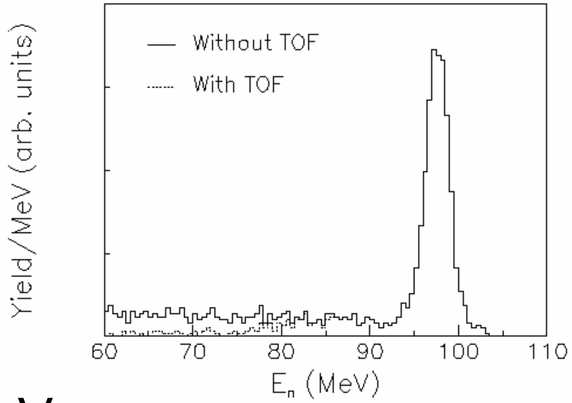
Application	En(MeV)	Targets	Reactions
ADS	0-1000	Many	Many
N-therapy	20-100	C,N,O,Ca	(n,LI), (n,n)
SEE	10-500	Si	(n,HI), (n,LI)

Present status

Reaction	Status	Error
(n,n)	Done up to 100 MeV	5 %
	Can be done up to 200 MeV	
(n,xn')	Underway at 100 MeV	10 %
	Can be done up to 200 MeV	
(n,LI)	Done up to 100 MeV	5 %
	Up to 200 MeV underway	
(n,f)	Cross sections up to 200 MeV	15 %
	Possible up to 5 GeV	
	Absolute scale problem	
	$d\sigma/d\Omega$, yields, etc. remaining	

Overall limiting factor: normalization 5 %

Comparison mono-E vs. white



Mono-E:

Large intensity at a given energy

10^6 n/cm^2 s ($\Delta E \approx 1$ MeV)

TOF for tail rejection

White: Lower intensity / MeV

10^6 n/cm^2 s (1/En, 1-800 MeV)

many MeV simultaneously

Necessary: Useful rate in reasonable interval

$\rightarrow$ Fairly large cross sections

TOF for energy identification

$\rightarrow$ Event-by-event mandatory

White beam possibilities:

Advantage: Energy evolution mapping

Requirements: Event-by-event + large cross sections

Best case: Fission cross sections

Next best: Reaction cross sections (σ_R)

Few experiments from ~ 1950

Third: n-d scattering for 3N forces

Data at 65, 95 and 250 MeV

Map out 50-250 MeV

Why not: n-p scattering

Done, but data base discrepancies

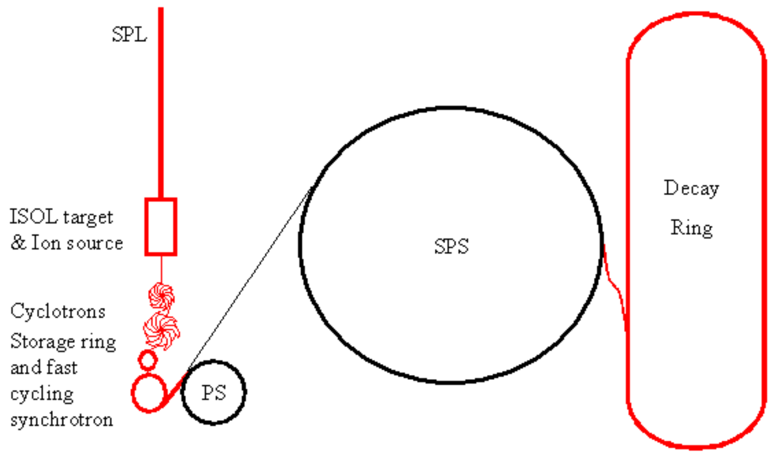
New approaches welcome

CERN beta-beam facility

ν_e-production by β decay

Spin-off: Intense n-beams (10^{11} s^{-1}!)

(10^6 today…)



Technique:

Produce β-delayed n emitting nuclei

Accelerate and store in racetrack decay ring

Beams along straight sections due to Lorentz boost

First beams: ~2015

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Research options

Limit: Imagination !

Starting point: 10^{11} n/s, ΔE = 1-2 MeV

Almost proton beam intensity, but worse resolution

Large fraction of ”proton nuclear physics” revisited with neutrons

Nuclear data for applications: Energy resolution rarely critical

Accuracy more important

Solution: tagging np scattering, detect p recoil

$\rightarrow$ ΔE = 100 keV possible

1 % error in cross section possible

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- Ringhals Power AB
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