Systematic Study of PDR, GDR and GQR for the Chain of Tin Isotopes

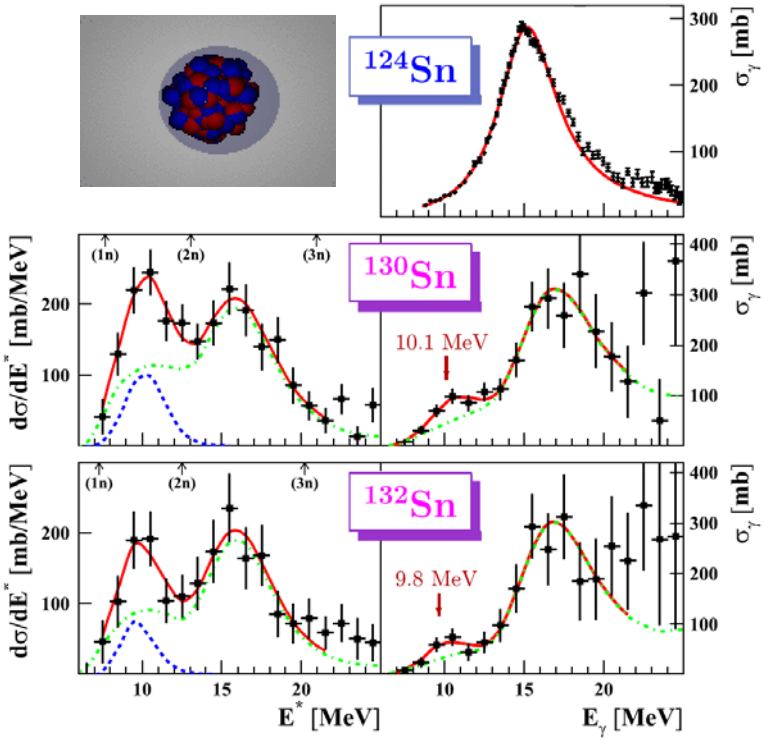
s412 experiment

for the R^{3}B collaboration

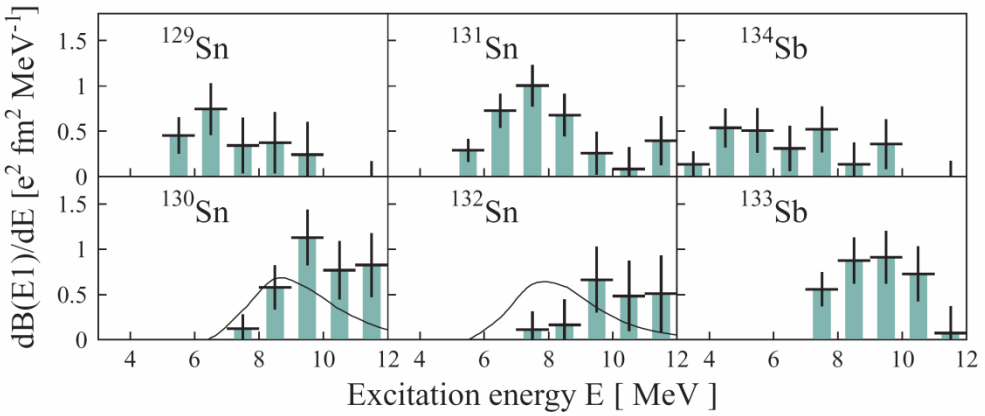
FRS User Meeting

09.11.2010

Measurement of Pygmy Dipole Resonances



P. Adrich *et al.*, PRL **95**, 132501 (2005)



A. Klimkiewicz *et al.*, Phys. Rev. C **76**, 051603(R) (2007)

- Pygmy Dipole Resonances (PDR) have been observed previously in Sn isotopes at LAND
- Overlap of PDR and GDR strength at low energies due to detector response
- Staggered PDR distributions in odd / even isotopes
- PDR strength distribution below or above neutron threshold, or varies with threshold?

Experiment Overview

- Aims of proposed experiment:
  1. Systematic investigation of E1 strength in Sn isotopic chain from A = 124 to 134
  2. PDR measurement below and above the neutron threshold
  3. Measurement of E2 strength in ^{124}Sn to ^{128}Sn
  4. Excitation with isoscalar probe (CD_2 target)

- Improvements compared to previous experiments
  - Better mass resolution
  - Improved detector response
  - Better statistics

Aim of Proposed Experiment

1. **Measurement of isovector GDR in complete Sn isotopic chain from A = 124 to 134 with high statistics**
   - Reduce statistical error for the systematical extraction of GDR parameters
   - Observation of direct photon-decay of GDR
   - Measurement of stable isotope for comparison with other experimental data

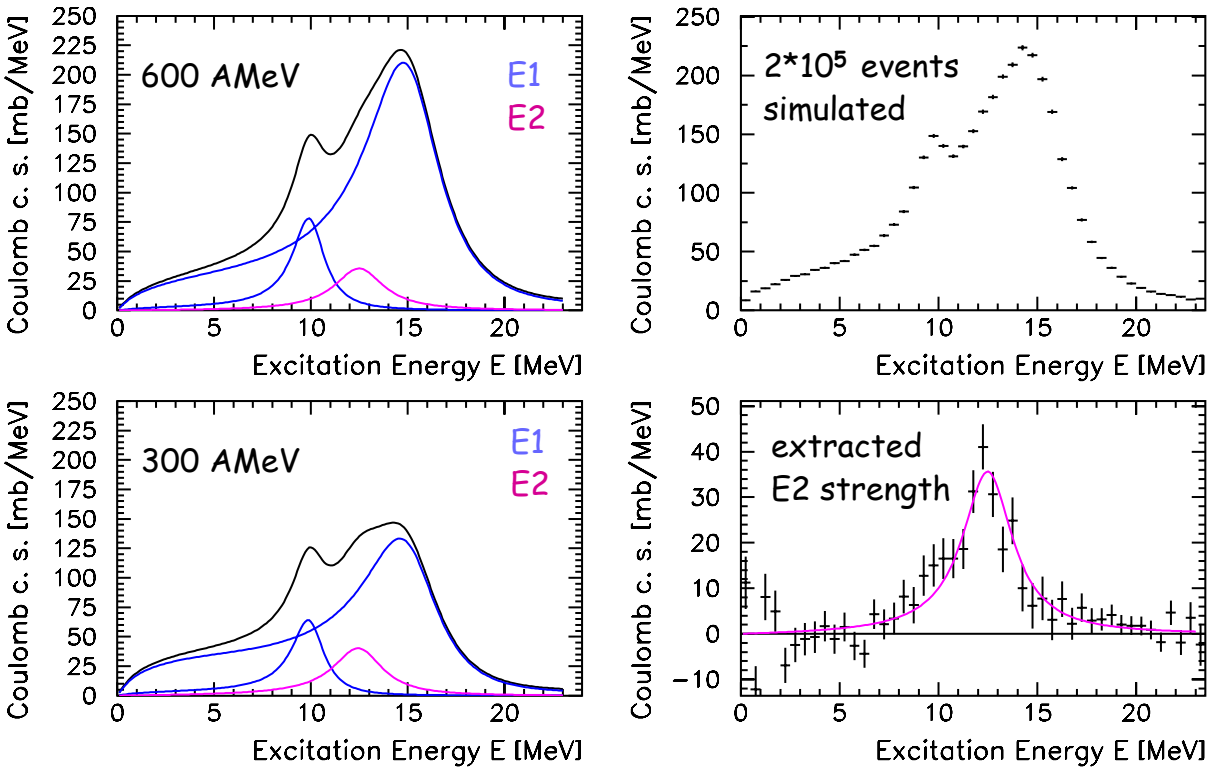
2. **Measurement of PDR in complete Sn isotopic chain below and above the neutron threshold**
   - Measurement of (γ,xn) and (γ,γ') channels

   $\Rightarrow$ PDR strength distribution independent of neutron threshold

Aim of Proposed Experiment (cont'd)

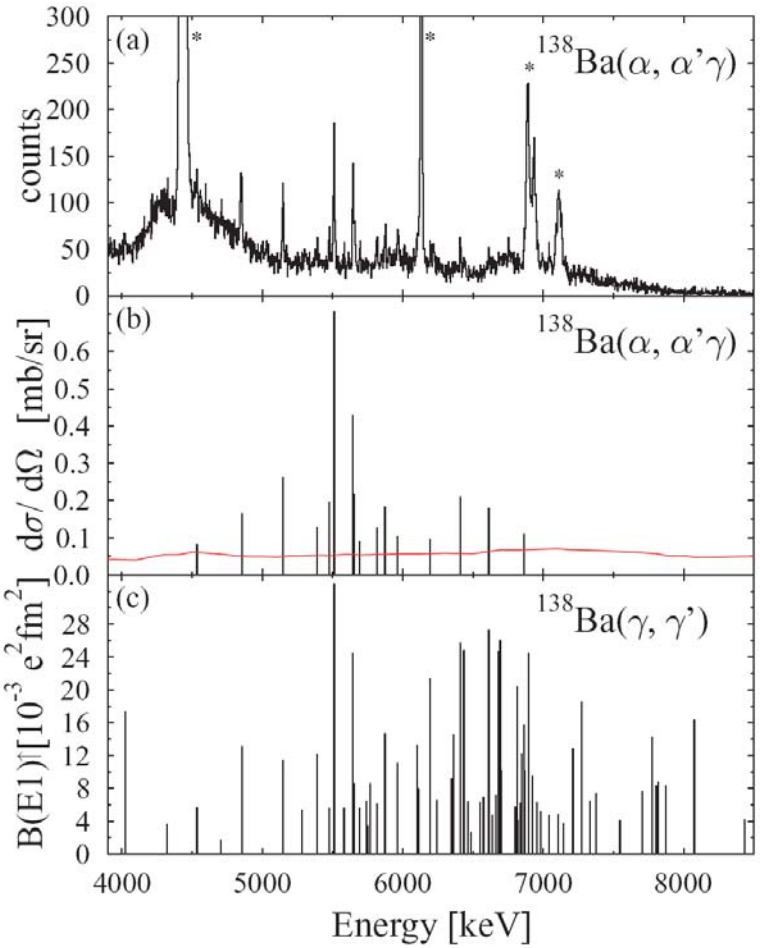
3. Measurement of GQR in ^{124}Sn to ^{128}Sn

- Two beam energies required to disentangle E1 and E2 components
- Requires total E1+E2 strength distribution with good statistics



- Example:
  - ^{132}Sn at 600 and 300 AMeV
  - 100% TRK sum rule strength for E1
  - 100% EWSR strength for E2

Aim of Proposed Experiment (cont'd)

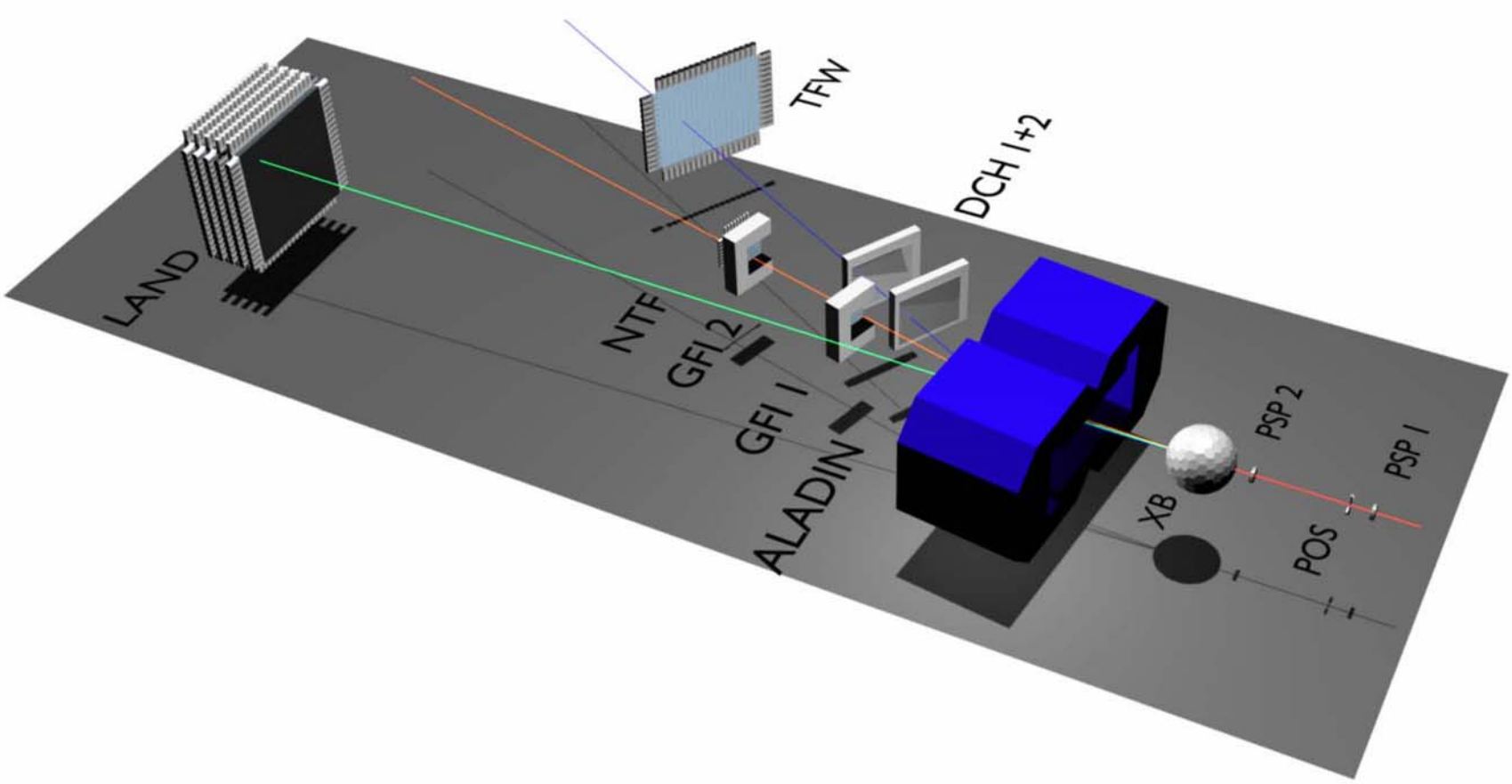


J. Endres *et al*., Phys. Rev. C **80**, 034302 (2009)

4. Investigation of the isospin character of the low-lying dipole strength

- Nuclear inelastic scattering with an isoscalar probe, using (d,d'γ)
- Analysis of photon decay branch allows the selection of dipole excitations
- Foreseen for high-statistics beams, such as ^{124}Sn and ^{128}Sn

Experiment setup



Technical Improvements

- New readout electronics for LAND and Crystal Ball
  Incoming tracking with diamond or Si microstrip detector
- Use of thinner Pb target (100 mg/cm^2) for (γ,γ') measurements
  → reduction of amount of Bremsstrahlung
- Vacuum pipe for fragments up to the last position measurement
- New plastic fiber detector for first position measurement after magnet; 250 μm pitch and 250 μm thickness

Summary of Beam-time Request

	setting 1	setting 2	setting 3	setting 4	setting 5	setting 6	setting 7
		2 energies	**2 energies**	**2 energies**	**2 energies**		
Primary beam int. (1/sec)	^{136}Xe 2×10^{10}	^{136}Xe 2×10^{10}	^{136}Xe 2×10^{10}	^{136}Xe 2×10^{10}	^{136}Xe 2×10^{10}	^{238}U 2×10^{9}	^{238}U 2×10^{9}
Sec. beam int. (1/sec)	**^{136}Xe 10^4**	**^{124}Sn 10^4**	**^{126}Sn 10^4**	**^{128}Sn 10^4**	**^{130}Sn 5000**	**^{132}Sn 300**	**^{134}Sn 10**
Measurements	calibration GDR Pygmy γ,γ'	GDR Pygmy γ,γ' d,d' GQR	GDR Pygmy γ,γ‘ GQR	GDR Pygmy γ,γ' d,d’ GQR	GDR Pygmy γ,γ‘ GQR	GDR Pygmy	GDR Pygmy
Target							
Pb	2	2+2	2+2	2+2	2+2	6	6
Be	0.5	0.5+0.5	0.5+0.5	0.5+0.5	0.5+0.5	1	1
CD2		4		4			
C		1.5		1.5			
empty	0.5	0.5+0.5	0.5+0.5	0.5+0.5	0.5+0.5	1	1
setting FRS	0.5	1	0.5	0.5	0.5	2	1
Sum setting	3.5	12.5	6.5	12	6.5	10	9
Total requested:		**60 (20 d)**	**Total allocated:**		**54 (18 d)**		

Characterization of NeuLAND Prototypes and of the LAND Detector Using Fast “Monoenergetic” Neutrons

s406 experiment

for the R3B collaboration

Aim of Proposed Experiment

- Proof-of-principle for NeuLAND full-size prototypes
  - time resolution
  - efficiency as a function of neutron energy

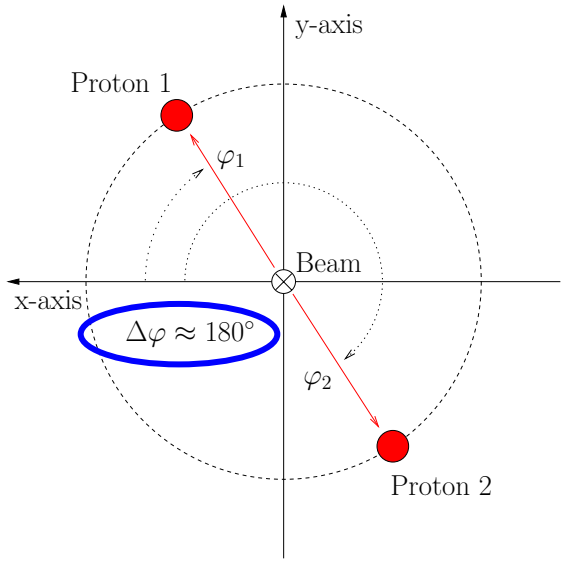
  → critical decision towards TDR !!!

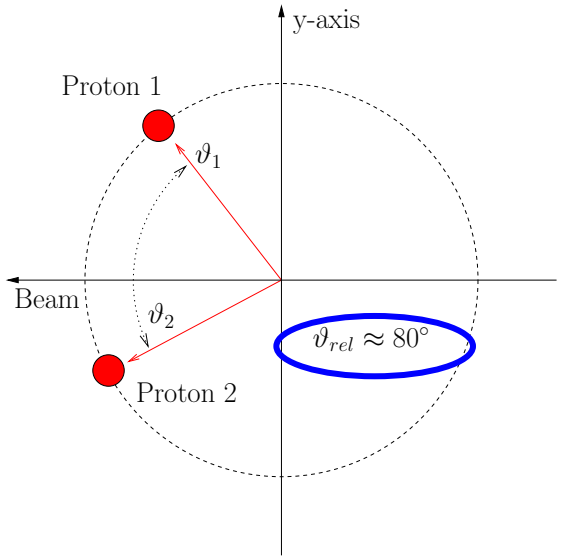
- Recalibration of LAND after 20 years of operation and after installation of new electronics
  - time resolution
  - efficiency as a function of neutron energy
  - one-neutron data sets as input to detector simulation
  - two-neutron data sets as cross-check for detector simulation
  - check of neutron simulations ↔ NeuLAND

Source of high-energy „monoenergetic“ neutrons?

quasi-free scattering reaction in inverse kinematics:

d-beam on CH_2 target

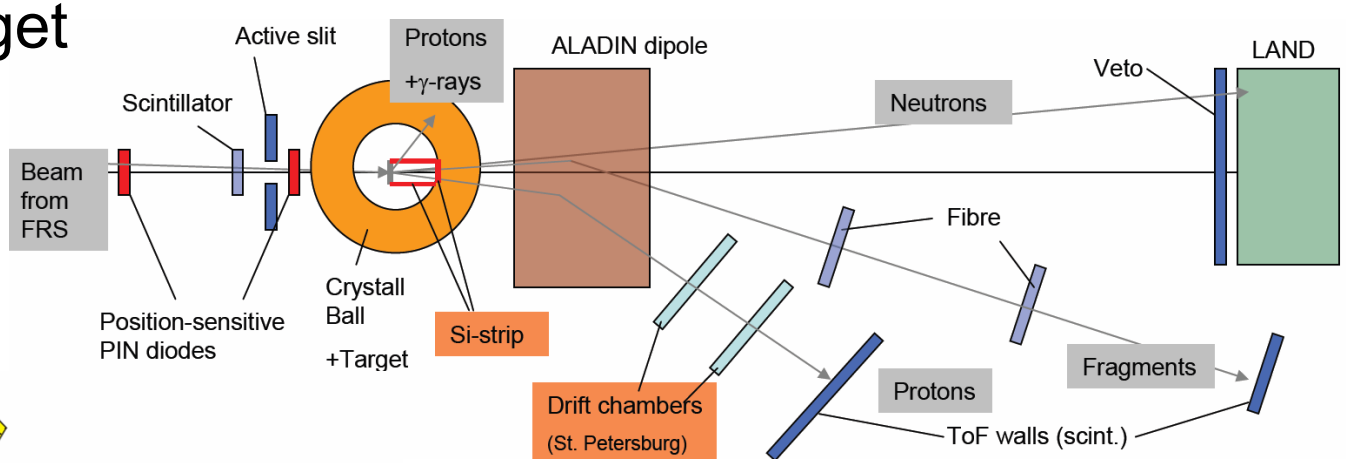


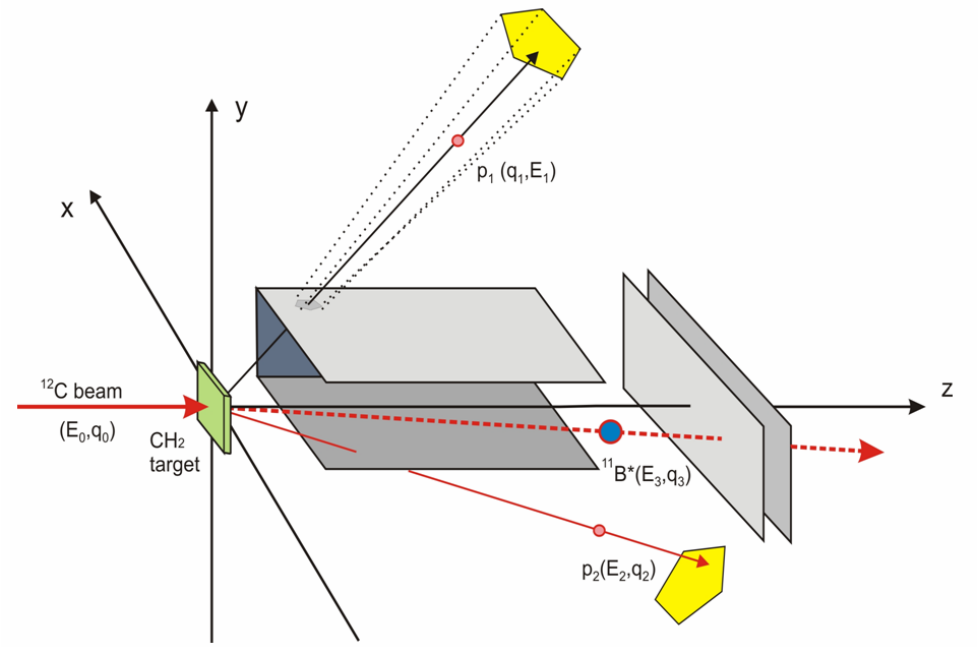


Neutrons from quasi-free scattering with
defined energy and angle on an event-by-event basis

Experiment setup

quasi-free scattering reaction in inverse kinematics:
d-beam on CH_2 target





Program and beam request for the beam time

a) general setup of all detectors plus trigger → 1 sh

b) time resolution of LAND and NeuLAND prototypes

1500 AMeV

LAND: 2 distances and with 2 Targets (CH_2, C): → 2 sh

4 NeuLAND prototypes, full acceptance at 5 m, ~1% eff. → 2 sh

c) energy-dependent efficiency of NeuLAND prototypes

4 NeuLAND prototypes: 200, 300, 500, 800 MeV. → 5 sh

d) full characterization of LAND for one neutron events

efficiencies and data patterns, measurements at 200, 400, 600, 800, 1050 MeV

at typical experiment distance (12m), high statistics required for data patterns → 4 sh

e) characteristics of LAND for real two-neutron events

break up from tritium, 400 and 800 AMeV

Beam preparation (FRS or stripper + direct beamline) & data taking → 4 sh

Total requested: 18 sh = 6 days

Total allocated: 15 sh = 5 days