Observation of large scissors resonance strength in actinides

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Scissors resonance in actinides

\[(\gamma,\gamma') \& (e,e')\]


Experiments on $^{232}\text{Th}$ at OCL

SiRi ΔE-E telescopes (x8)

Backwards angle (126°-140°) covers 14% of $4\pi$

12 MeV d & 24 MeV $^3\text{He}$

$^{232}\text{Th}$

CACTUS NaI(Tl) (x28)

eff$_{tot}$ $\sim$ 15.2%
ΔE-E bananas

\[(d,d')^{232}Th\]  \[(d,p)^{233}Th\]  \[(^3He,\alpha)^{231}Th\]  \[(^3He,t)^{232}Pa\]  \[(^3He,d)^{233}Pa\]
Significant hump was discovered in the RSF sitting on the low-energy tail of GDR.

$^{237}\text{Np}(d,p)^{238}\text{Np}$

($E_{\text{beam}} = 13.5$ MeV)

Backwards angle (126°-140°) covers 14% of 4π

SiRi ΔE-E telescopes (x8)

CACTUS NaI(Tl) (x28)

Fission fragment detector PPAC (x4)

$^{237}\text{Np}$ 150 $\mu$g/cm$^2$ on 20 $\mu$g/cm$^2$ C backing

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4th Workshop on Nuclear Level Density and Gamma Strength
Oslo 2013
Level density & RSF

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Expected scissors resonance is found in $^{238}$Np

average centroid $\approx 2.2$ MeV
Other possibilities in the existing $^{238}\text{Np}$ data

γ-fission branching ratio can be determined by the help of newly developed fission detector array

ENICE
(Electronic Nuclear device to Count fission Events)
4 x PPAC

T. G. Tornyi et al., to be published NIM (2013)
Fission probabilities via surrogate-reaction method

\[ ^{238}\text{U}(\text{d},\text{pf}) \]

\[ ^{238}\text{U}(^{3}\text{He},^{4}\text{He f}) \]

B. Jurado et al., EPJ Web of Conferences 42, 01003 (2013)
Development of a new fission detector (ENICE)

Requirements:

- High efficiency
- Large covered solid angle
- Insensitivity to light particle
- No aging effect

Low pressure gas filled detector seemed to be the best solution

T. G. Tornyi et al., to be published NIM (2013)
Advantages:

- fast working ($f \approx 0.1$ GHz)
  -> short deadtime
  -> high efficiency ($\approx 100\%$)
- insensitive to light charged particles
- large covered solid angle
  ($60\%$ of $2\pi$ -> $60\%$ of $4\pi$ virtually!)
- no aging effect
- low price

Disadvantage:

- very sensitive to the pressure difference between in- & outside
  ($\Delta p_{\text{max}} \approx 10$ mbar)
E-ΔE particle matrix

tritons (d,t)
deuterons (d,d)
protons (d,p)

E-ΔE matrix gated on fragments (d,pf)

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$E_x$-$E_y$ matrix

$E_x$-$E_y$ matrix gated on fragments (d,pf)
Thank you for your attention!

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