Isomer studies @ CARIBU
using CPT near $^{132}\text{Sn}$

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Where?
Why?
How?
Where?

N = 82
Z = 50

83\text{As}

166\text{Tb}

N = 82

\pi \nu^{-1} \quad \pi \nu

\nu^{-1} \quad \text{Core} \quad \nu

\pi^{-1} \nu^{-1} \quad \pi^{-1} \quad \pi^{-1} \nu
Why?

• Not much is known on neutron – rich side of the beta – stability valley e.g. first excited state, half-lives etc.

• Direct information on single – particle energies

• To fix level energies of known isomers

• To understand isomeric yield

• Provide crucial input to shell models
Why with CARIBU and CPT?

- $^{252}\text{Cf}$ fission will provide neutron–rich isotopes near $^{132}\text{Sn}$ with sufficient intensity ($10^6$ ions/sec).
- The isomer half–lives are long enough (seconds to minutes) so that they can be extracted from the ion–source.
- Expected energy separation between the ground state and the isomeric state is large enough to separate them using the CPT.
- Ground state masses of all the isotopes of interest are known very precisely.
- Neutron hole in $N = 82$
- Yield: $8 \times 10^5$ ions/sec
- Weisskopf estimates suggest $E_{11/2^-} = 700 - 900$ keV; in agreement with $N = 81$ syst.
- Experimental studies expect this value to be around 65 keV --- in accordance with Odd-A Sn isotopes.
Yield: $1.9 \times 10^6$ ions/sec

- Ordering of both the isomers is not well established.
- $8^-$ is expected less than 200 keV above $4^+$. 
• Yield: \(1.5 \times 10^6\) ions/sec
• Ordering of \(0^-\) and \(7^-\) is not known experimentally
• Shell model predicts \(7^-\) to lie between 250-550 keV above \(0^-\) state.

\(^{134}\text{Sb}\)
How?

- No gamma rays originate from the isomeric states.
- All the isomers decay with 100% beta decay branch to their daughter nuclei.
- Two approaches to determine the excitation of such isomers

(1.) Beta – Gamma coincidence:
   Limitations: Beta and gamma efficiencies, large errors (few tens of keV), background.

(2.) Mass measurements:
   Limitations: Half lives and mass resolution
Well known isomers in \(^{130}\text{In},^{133}\text{Te},^{134}\text{I},^{135}\text{Xe},^{136}\text{I}\) etc. could be used for calibration and/or to check feasibility of the technique.
Alternatively,

The beta – gamma coincidence studies at decay station can also be performed to estimate the excitation energies of the isomers.

The two measurements will complement each other.
Summary

- Possible candidates for isomeric studies using CPT near neutron-rich doubly magic $^{132}$Sn are discussed.
- Isotopic yields are of the order of $10^6$ ions/sec.
- Half lives are long enough to extract ions from the ion source.
- Expected energy difference between the ground states and the isomeric states is well above mass resolution of the CPT.
- These measurements will provide a test of shell model calculations on neutron-rich side of nuclear chart.
- These measurements require expertise from the CPT group.
Thank you