

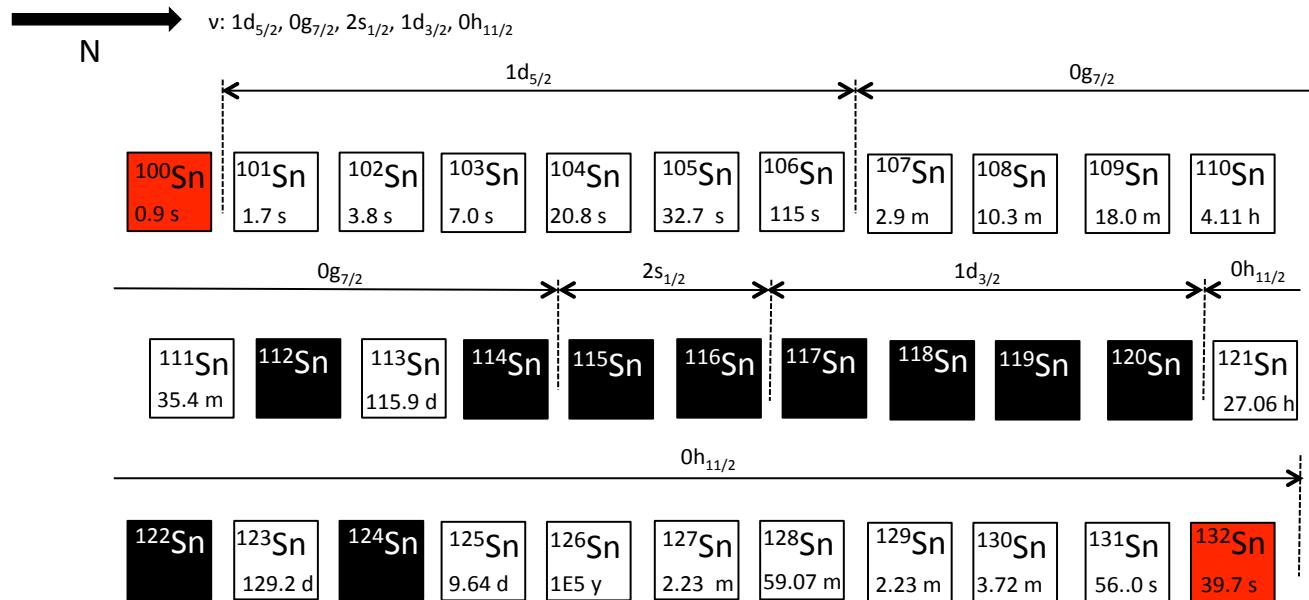


Summary of light Sn Coulex at HIE-ISOLDE

J. Cederkall, Lund university



The Sn chain



$0h_{11/2}$	2.6
$1d_{3/2}$	2.2
$2s_{1/2}$	1.6
$0g_{7/2}$	0.17
$1d_{5/2}$	0
n orbit	E (MeV)

Stable isotope

Double shell closure

${}^A_X T_{1/2}$
Unstable isotope

The Sn chain

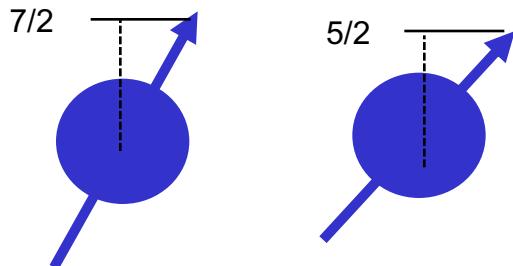
neutron orbit	E (MeV)
0h _{11/2}	2.6
1d _{3/2}	2.2
2s _{1/2}	1.6
0g _{7/2}	0.17
1d _{5/2}	0
N=50	

$2 \times 7/2 + 1 = 8$

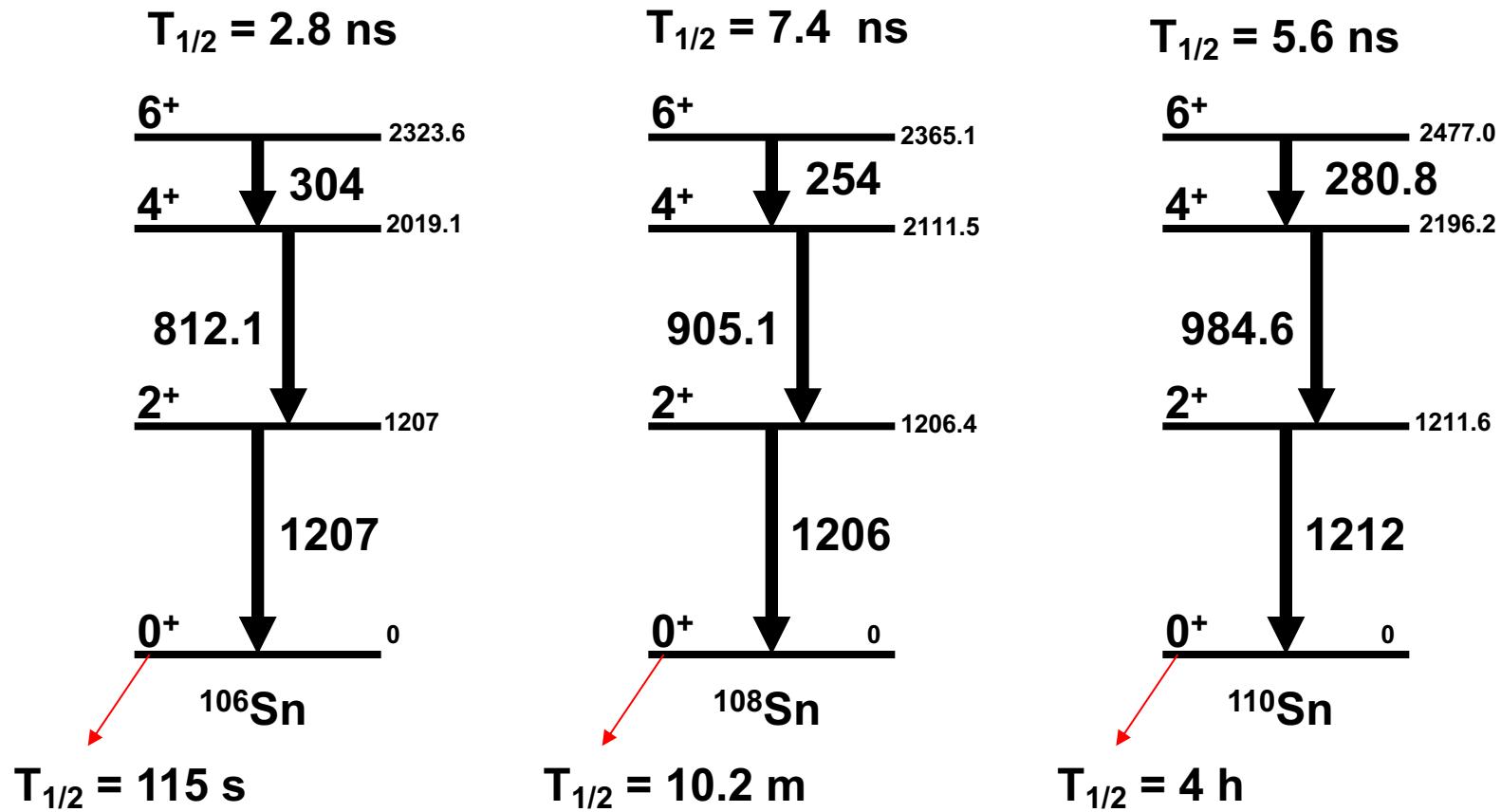
$2 \times 5/2 + 1 = 6$

14 neutrons

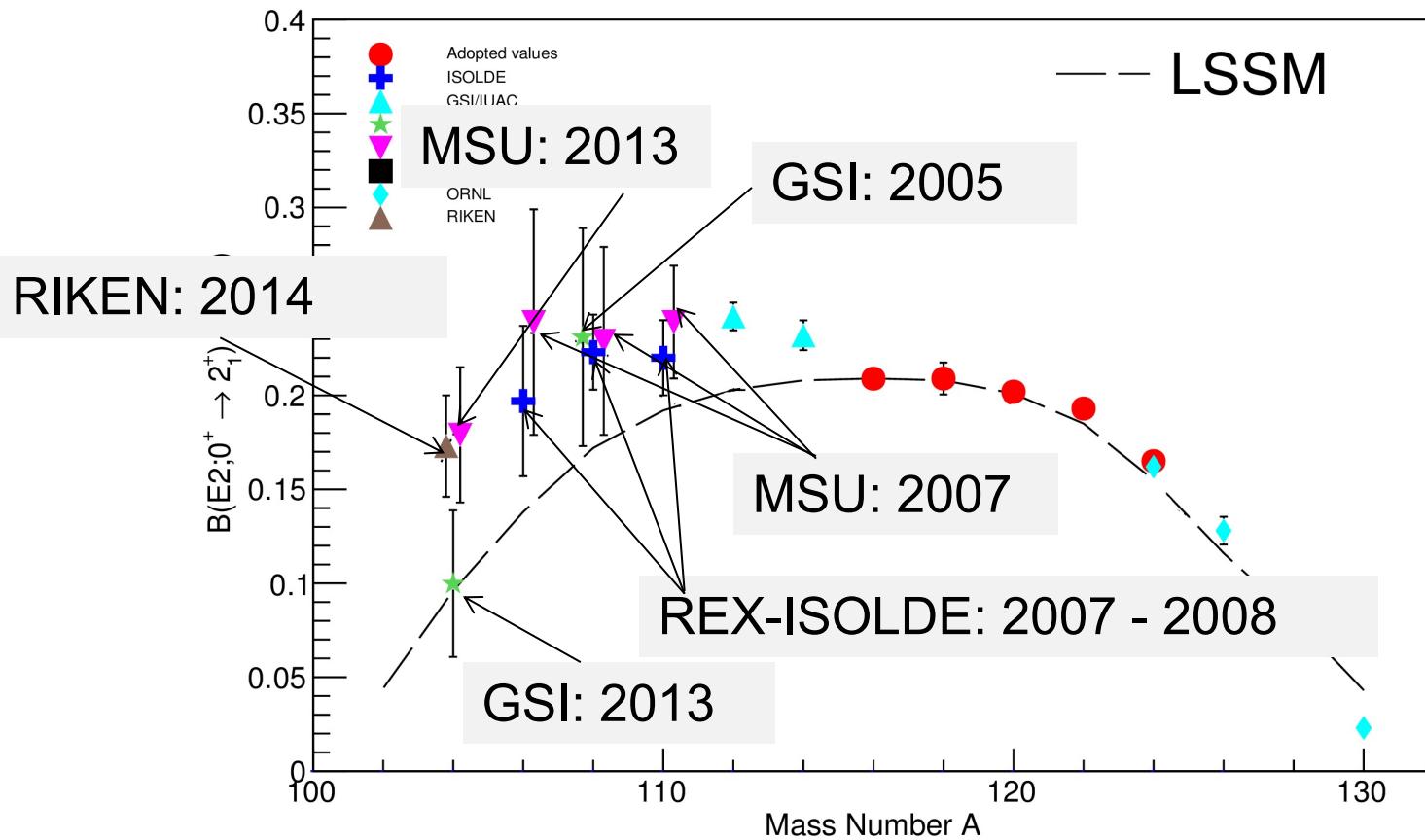
Two neutrons



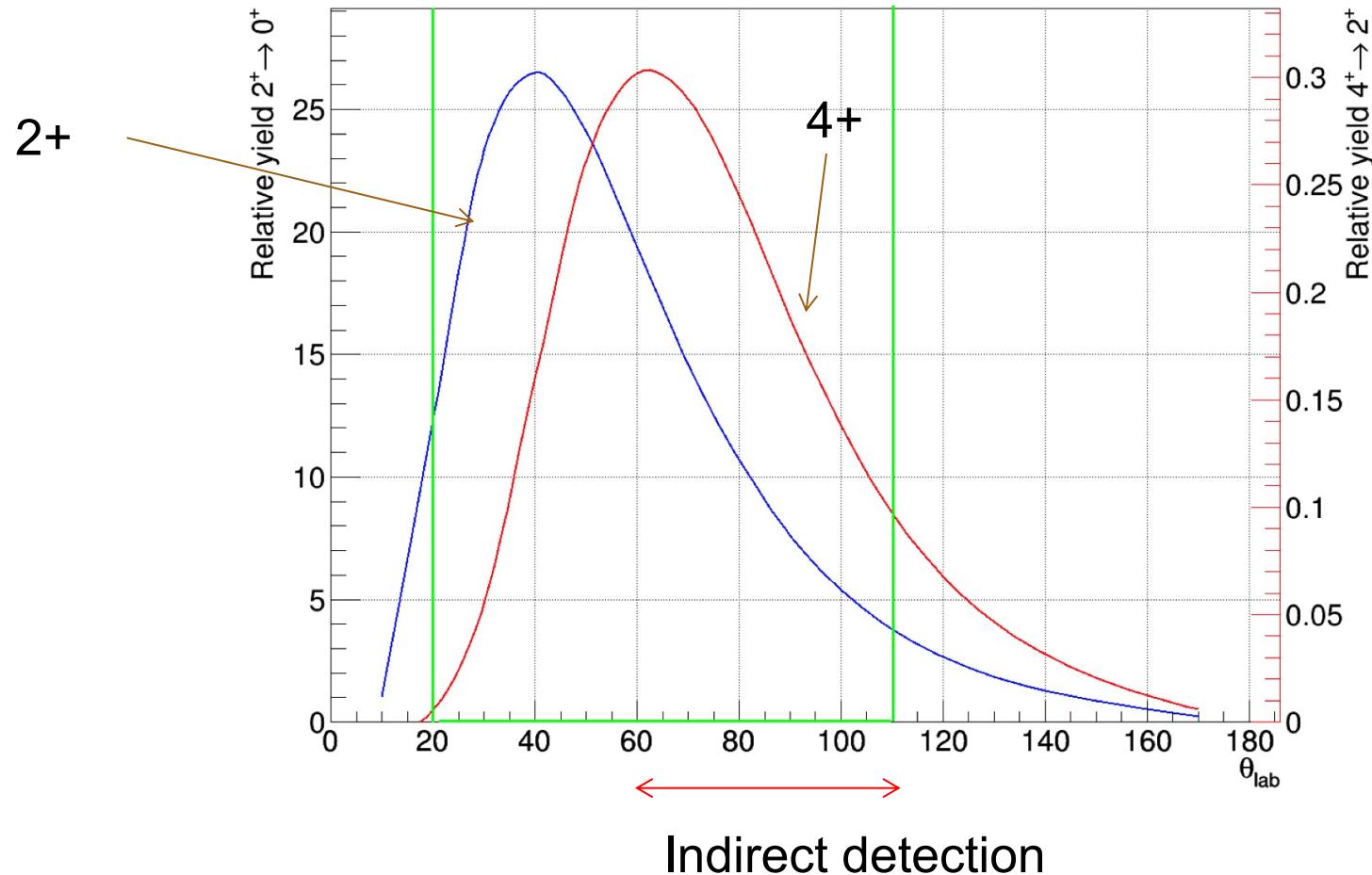
Life time of first 2+ state in even Sn isotopes



$B(E2)$ – evolution of data 2005 to 2017

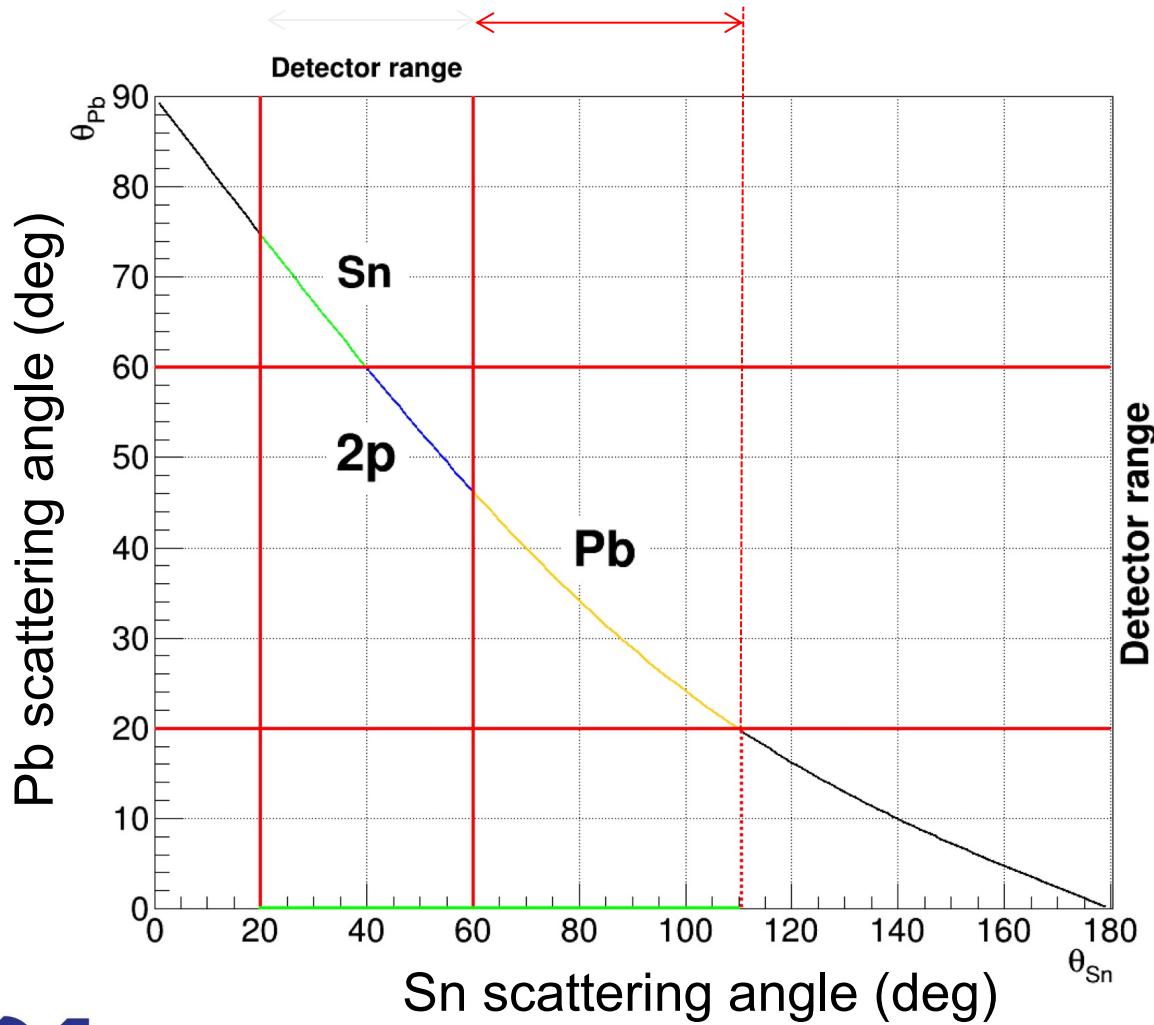


Cross sections for 2^+ and 4^+ excitation

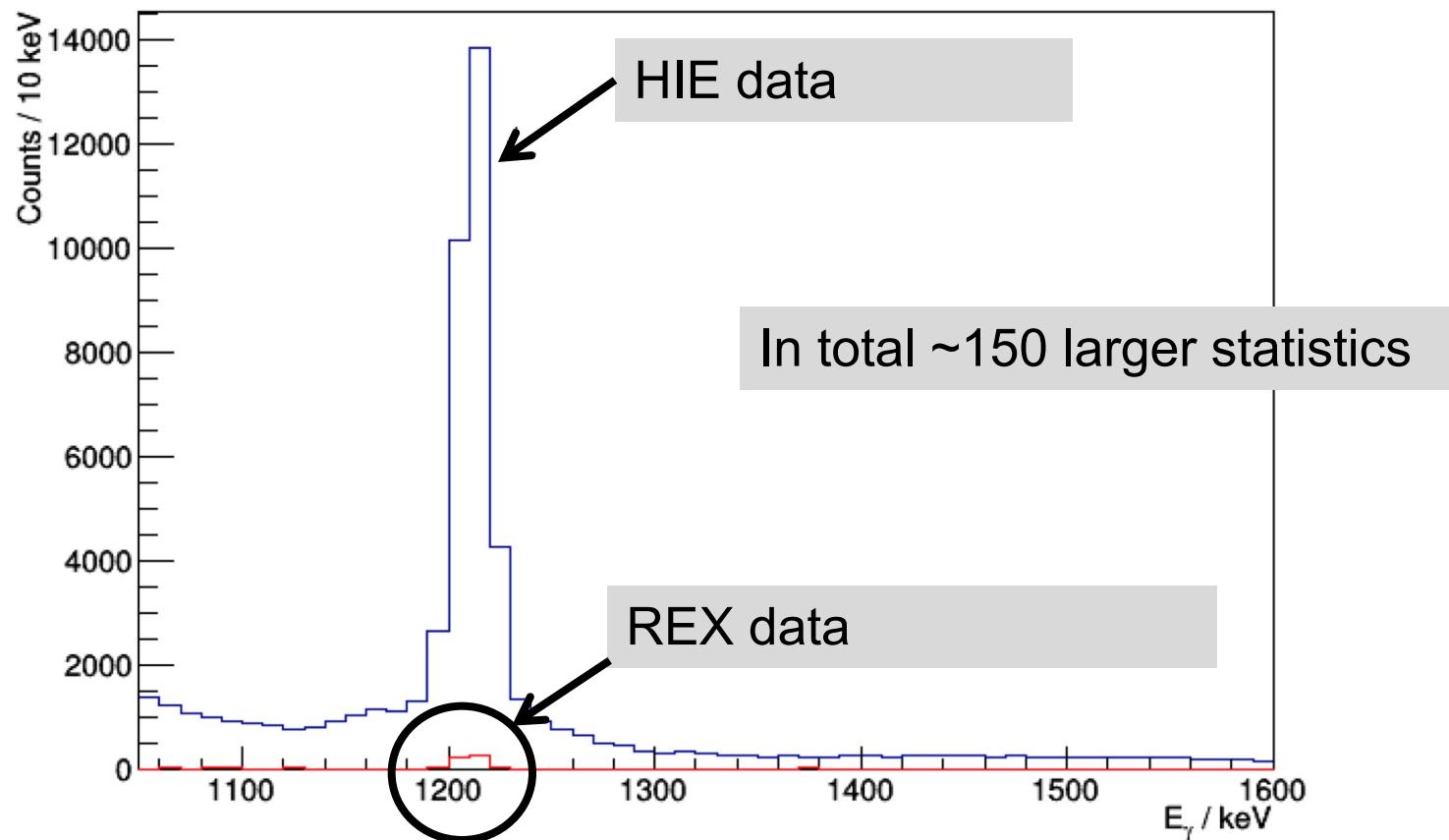


Kinematics

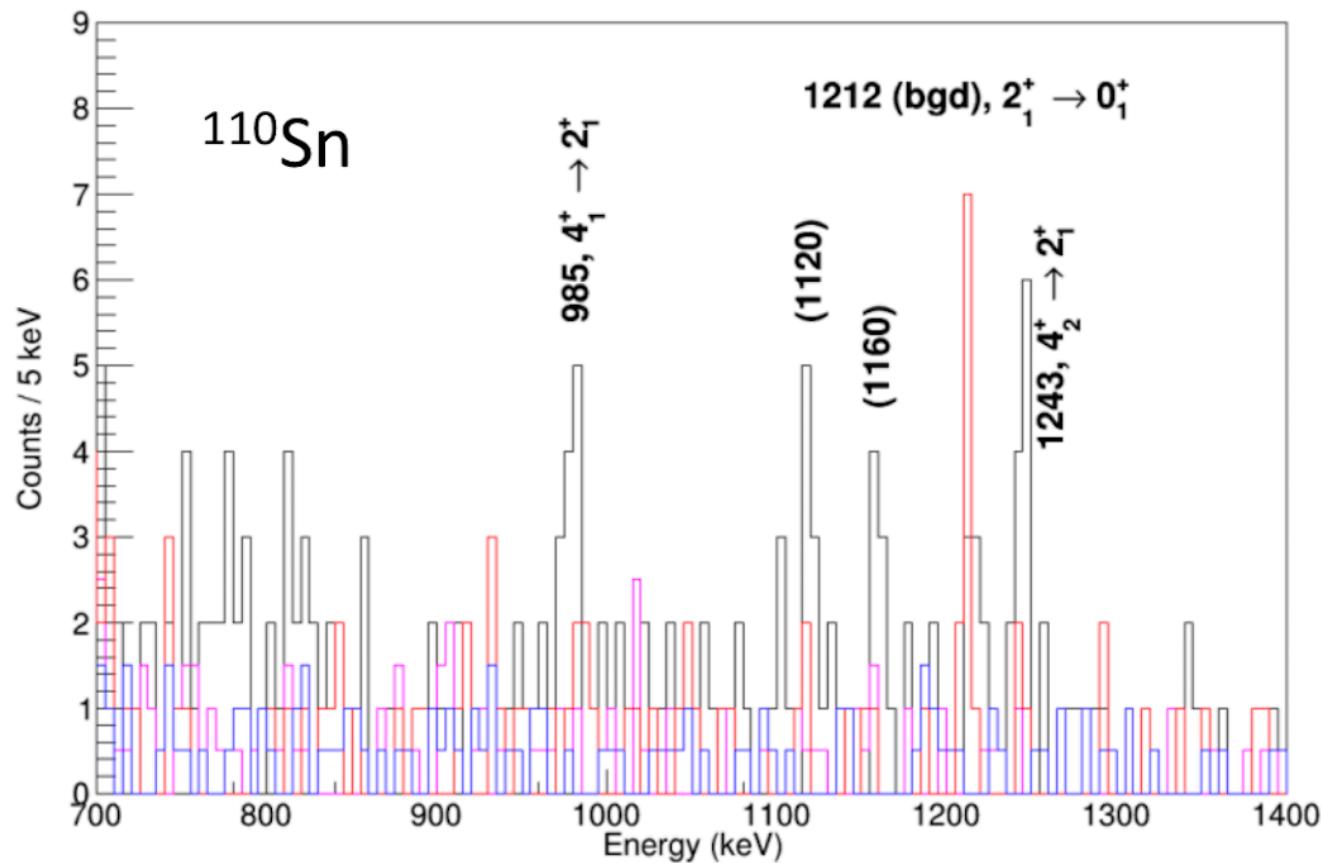
Direct Indirect
detection detection



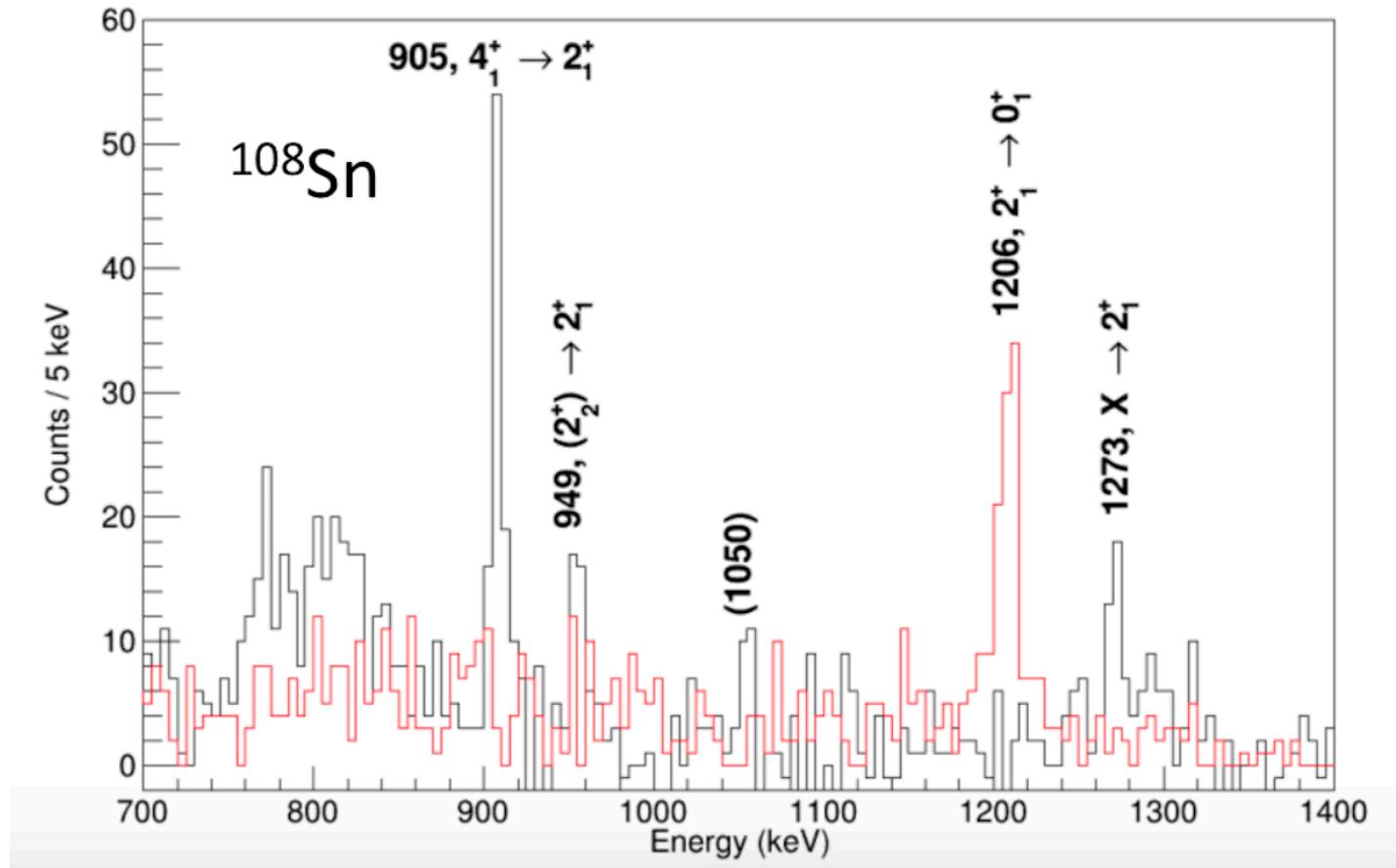
Sn-110: 2^+ to 0^+ HIE-ISOLDE and REX-ISOLDE?



γ - γ coincidences for higher excited states



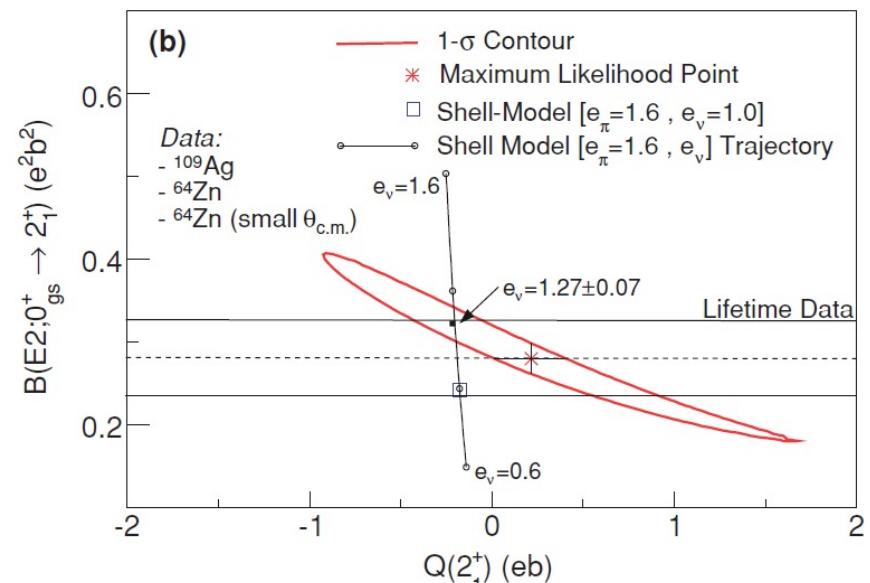
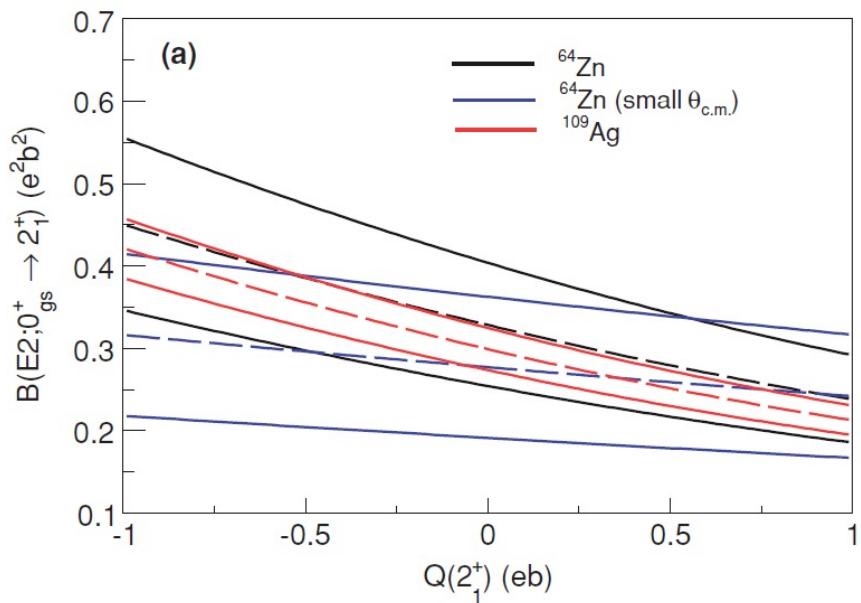
Gated on 1206(black)/905(red)-keV gammas



Lifetime measurements, $B(E2)$ and Q_2

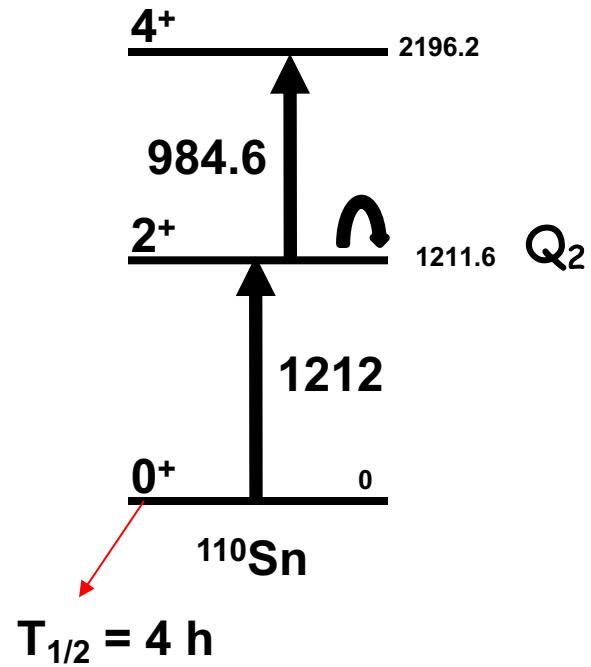
The old case of ^{104}Cd

Coulomb excitation cross section depends on Z_{targ} , E_{beam} , $B(E2)$ and spectroscopic quadrupole moment $Q(2^+)$



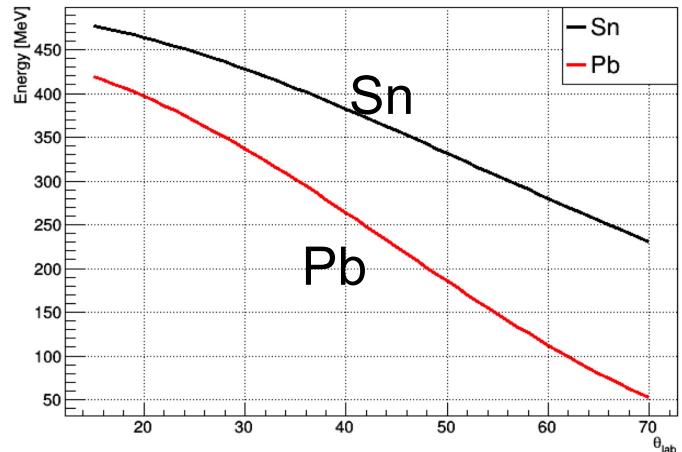
$B(E2)$, $Q(2^+)$ from Coulex can be constrained by lifetime data, or alternative target/energies

Life time of first 2+ state in even Sn isotopes

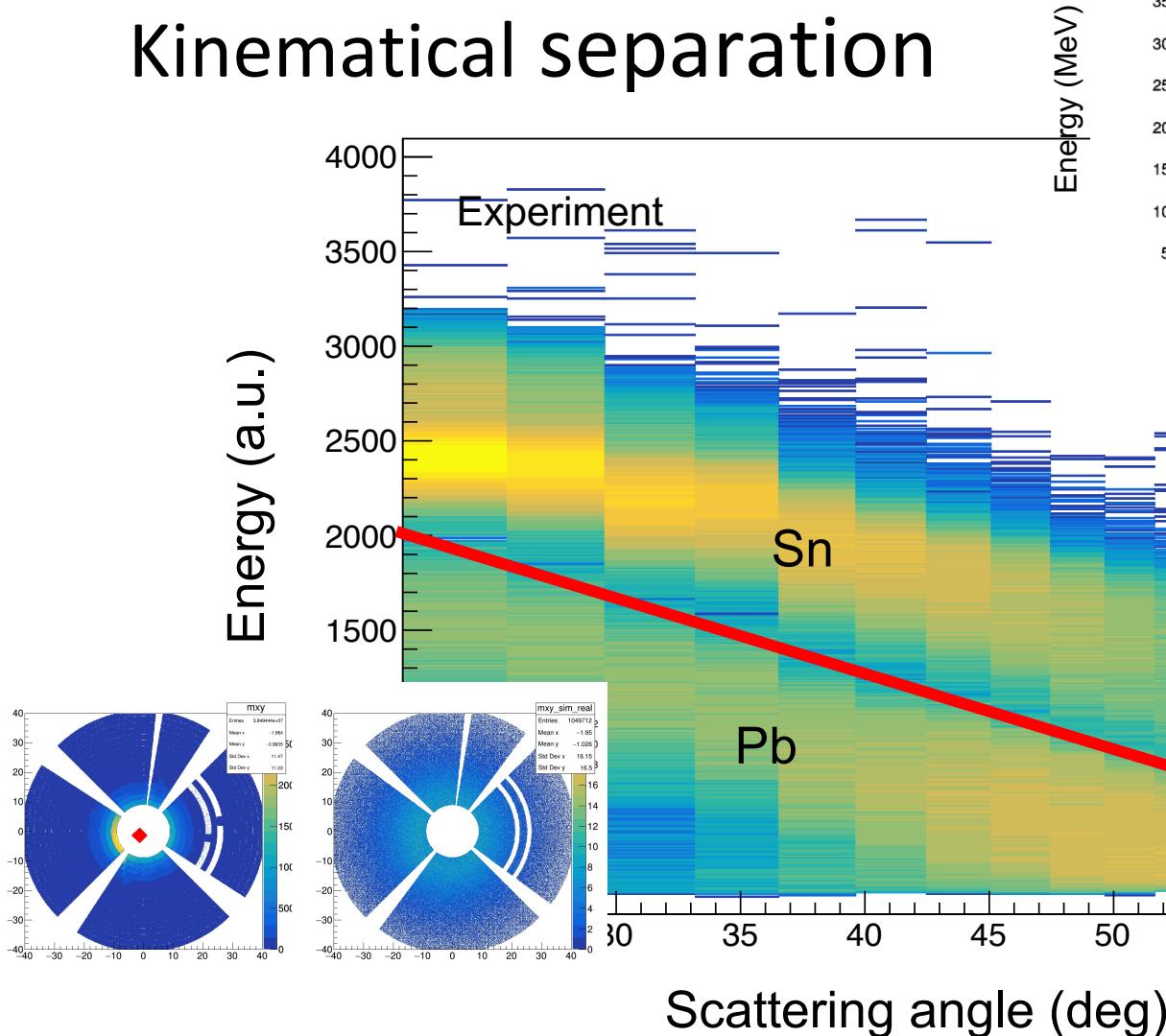


$$\sigma_{E2} = \sigma_R [\kappa_1(\theta_{\text{c.m.}}, \xi) B(E2)(1 + \kappa_2(\theta_{\text{c.m.}}, \xi) Q(2_1^+))]$$

Calculation

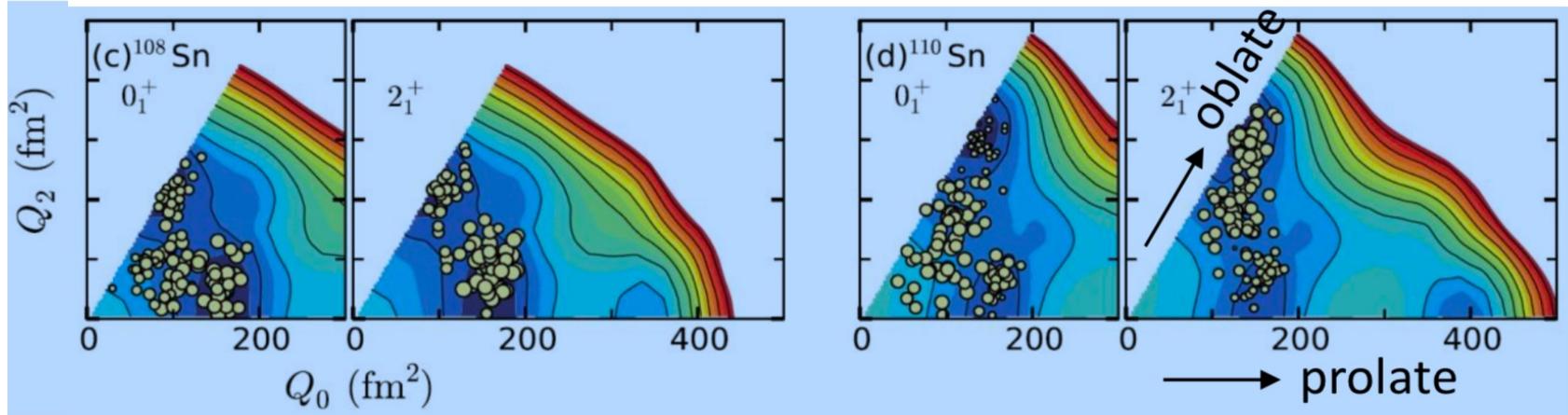


Kinematical separation

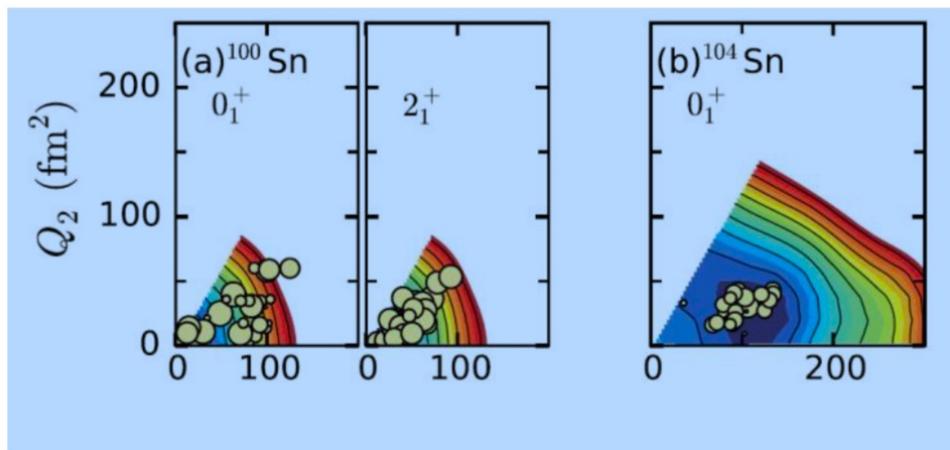


$^{110,108,106}\text{Sn}$ on ^{206}Pb at 4.5 MeV/u

Q_2 of the 2^+_1 state

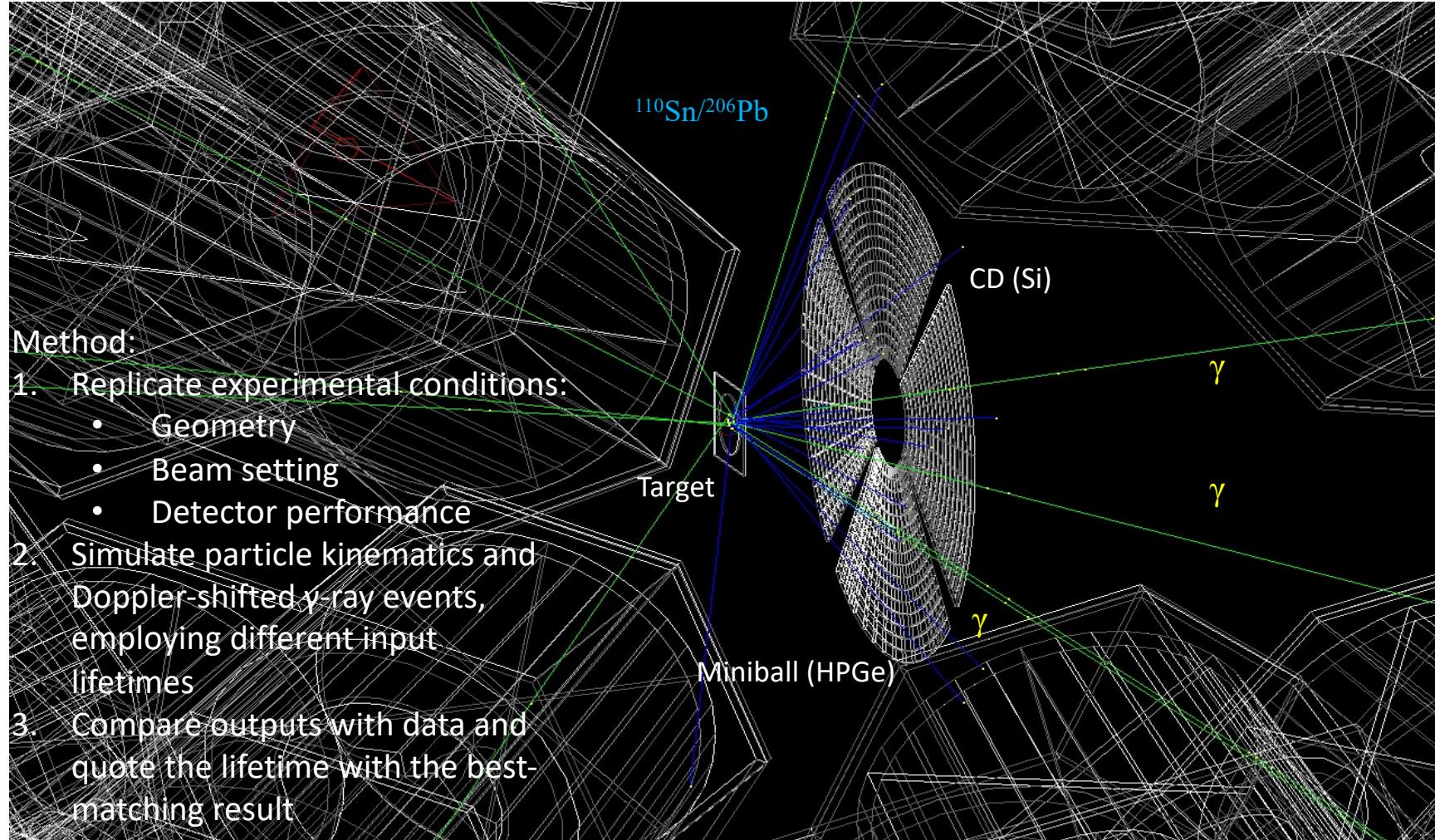


T. Togashi *et al.*, PRL **121**, 062501 (2018)

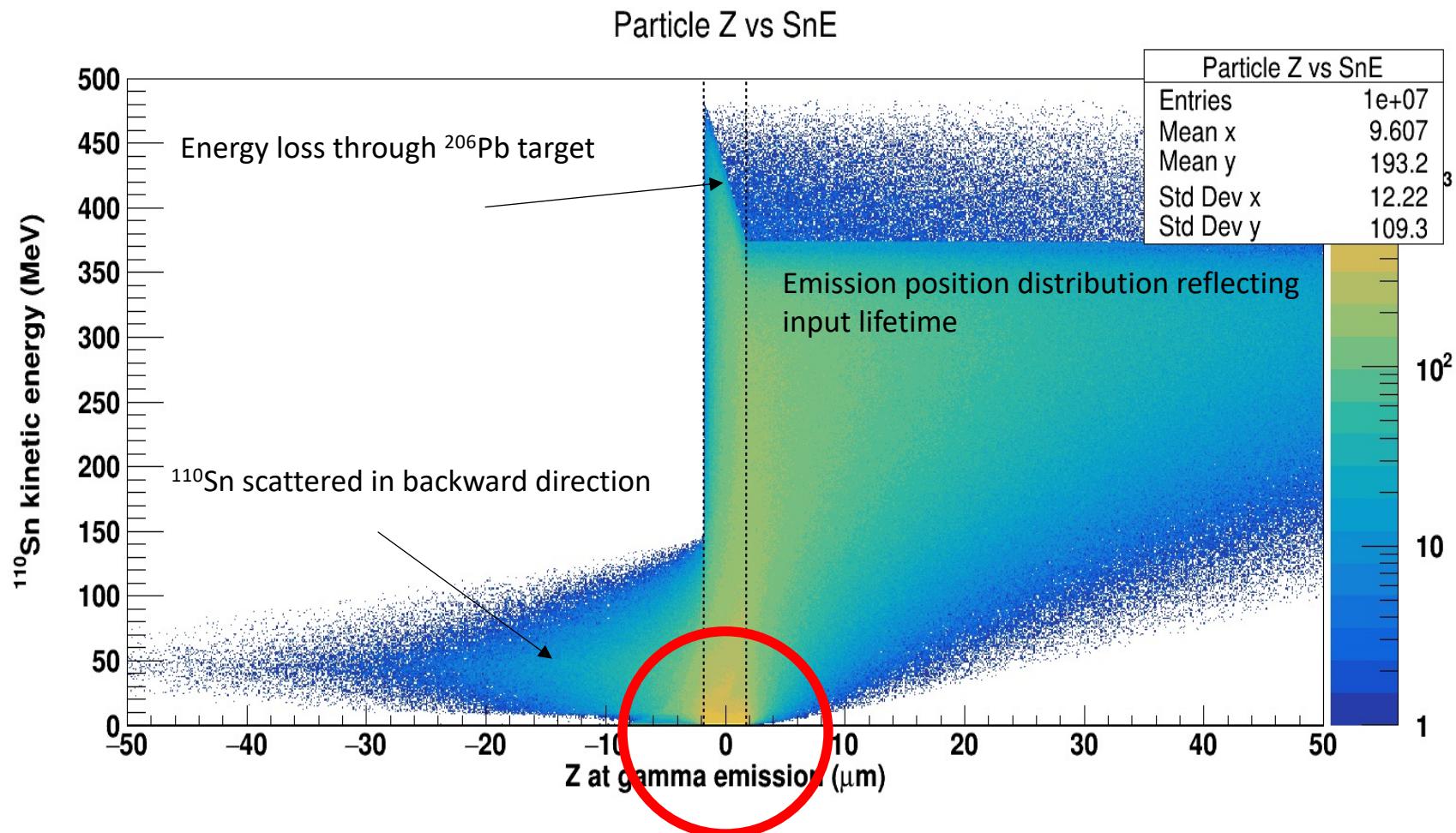


Measuring the 2_1^+ state lifetime in ^{110}Sn with simulation

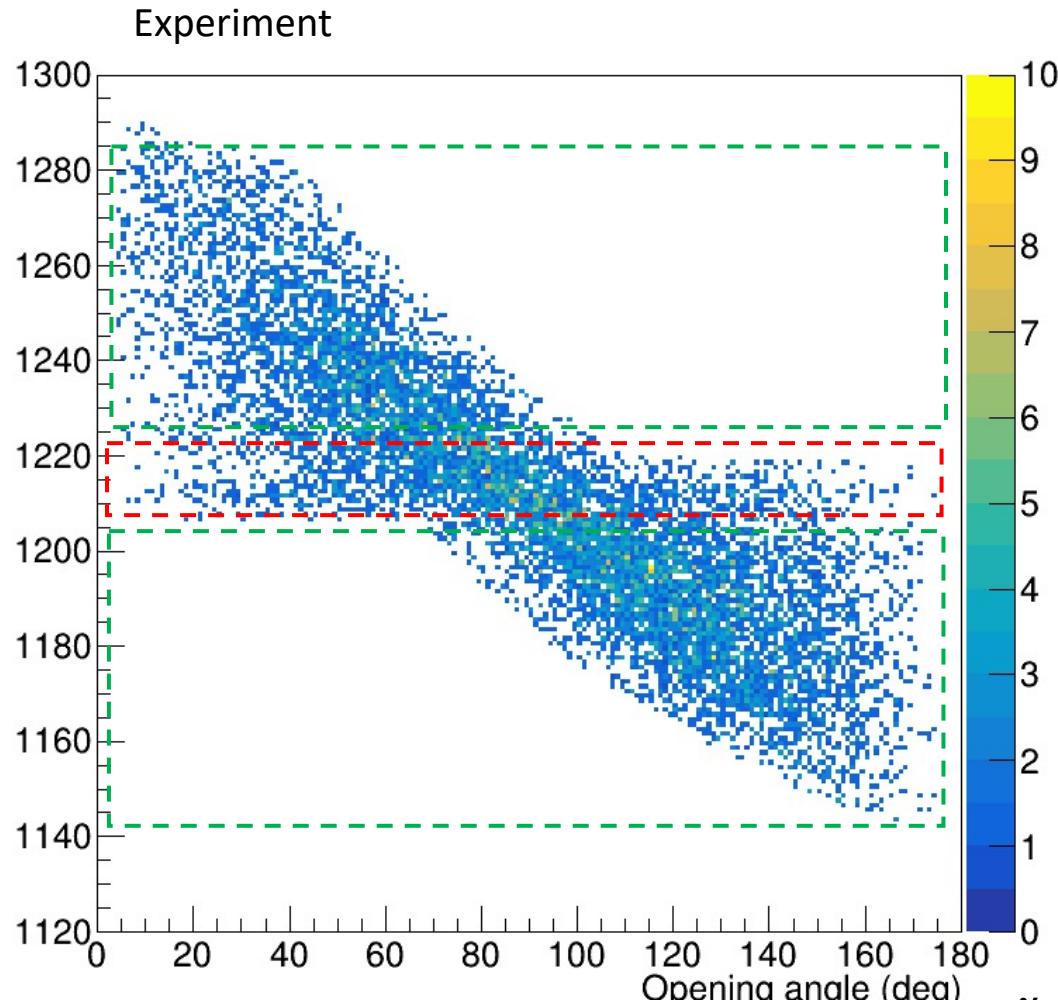
Geant4 simulation of Miniball + CD detector



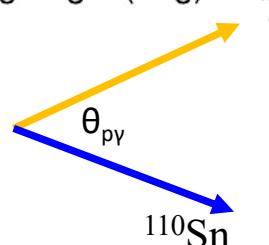
Measuring the 2_1^+ state lifetime in ^{110}Sn with simulation



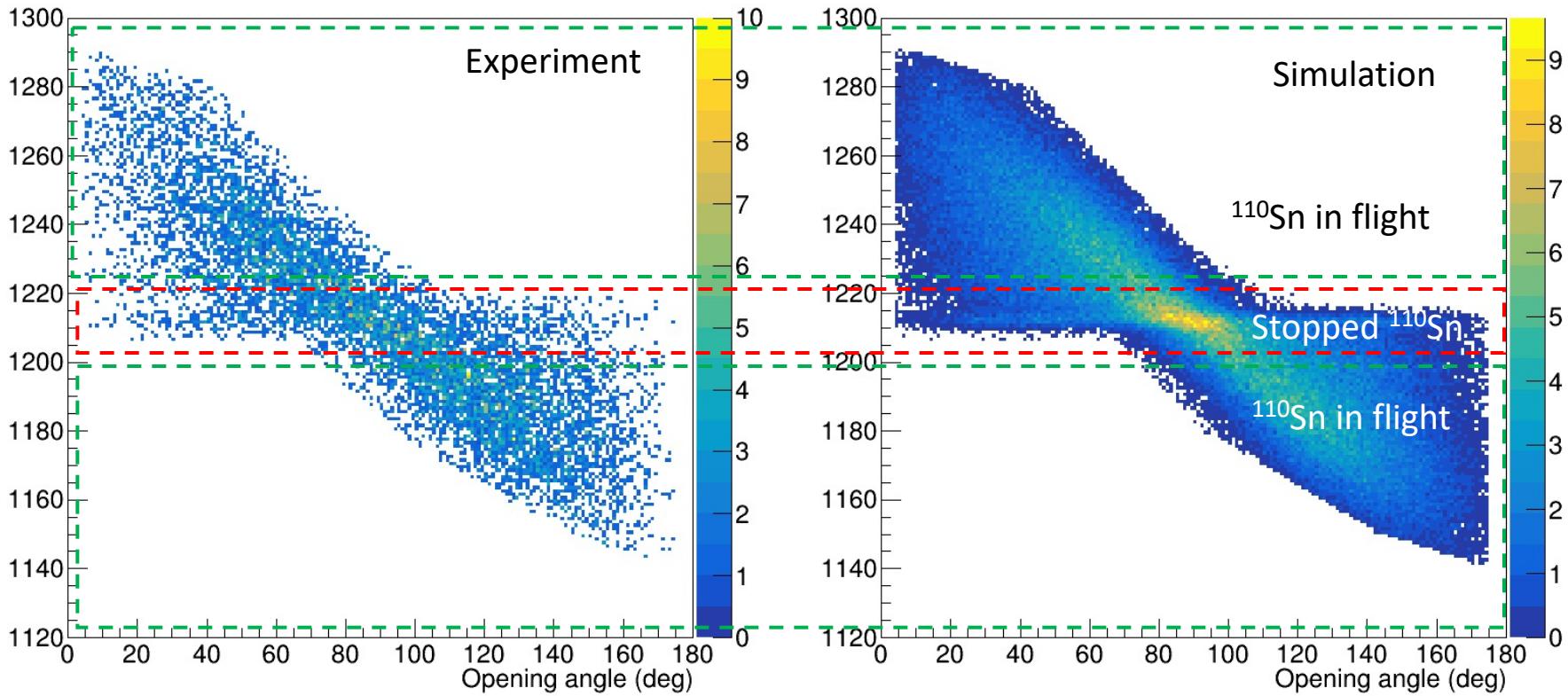
Lifetime analysis of the 2_1^+ state in ^{110}Sn



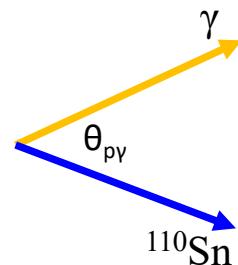
$$E_\gamma = E_0 \frac{\sqrt{1 - \beta^2}}{1 - \beta \cos\theta}$$



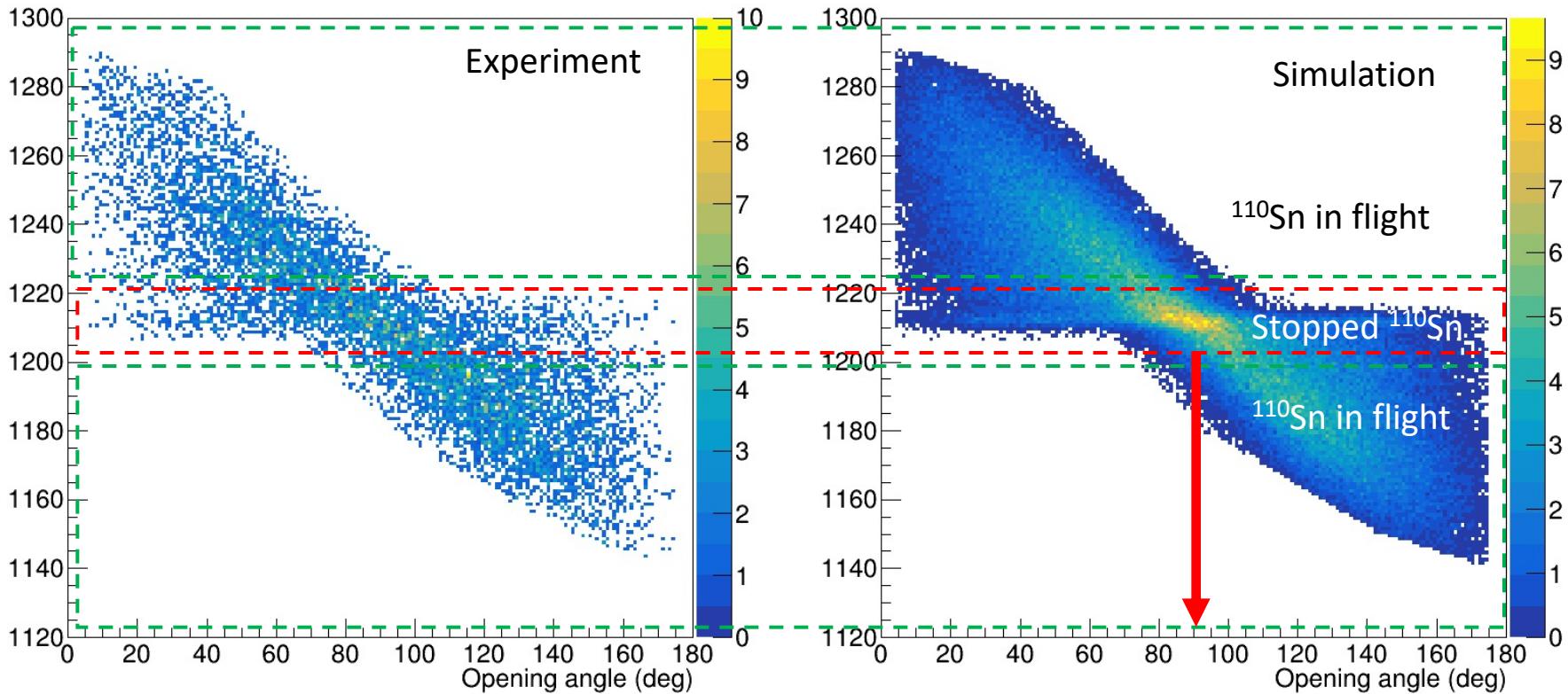
Lifetime analysis of the 2_1^+ state in ^{110}Sn



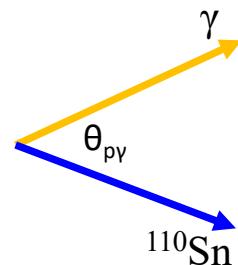
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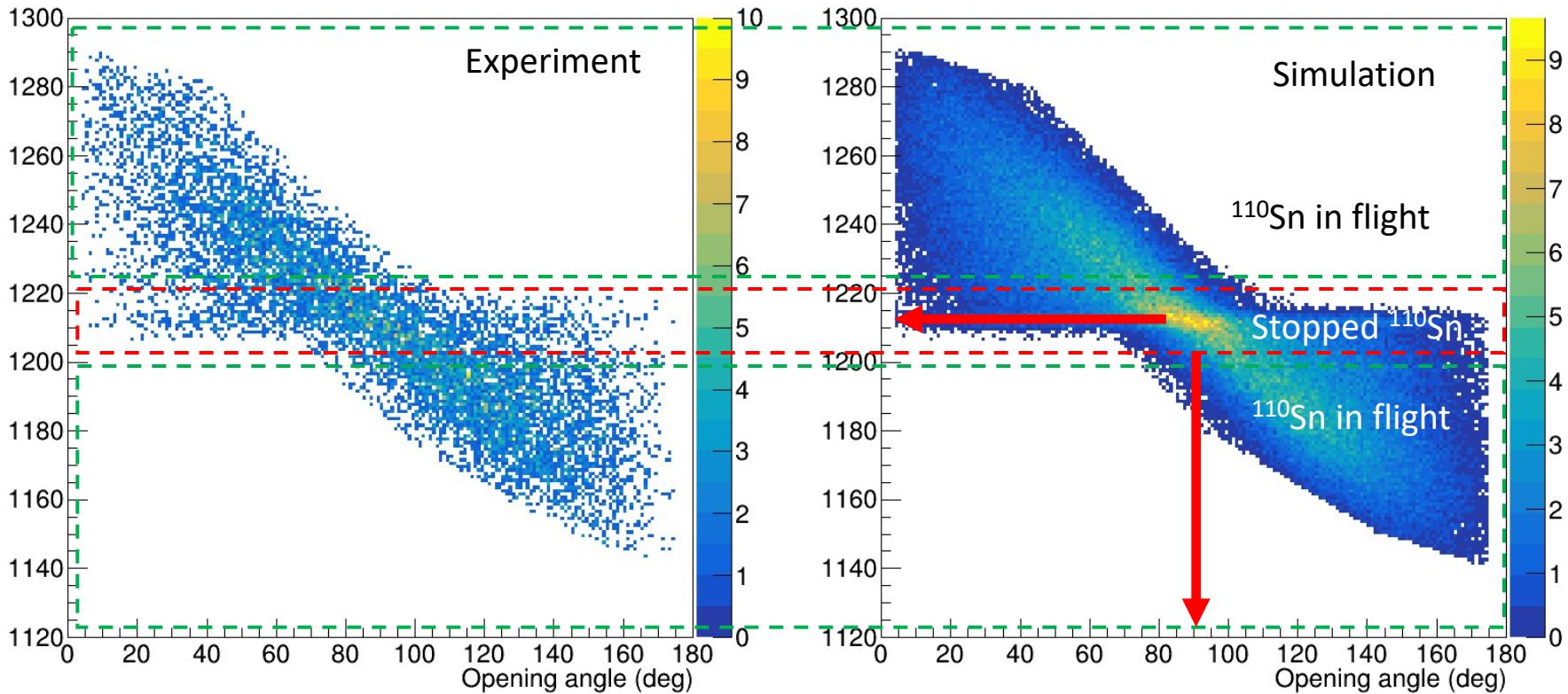
Lifetime analysis of the 2_1^+ state in ^{110}Sn



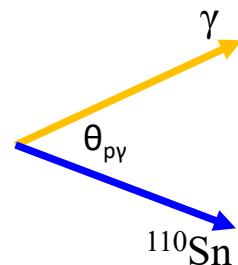
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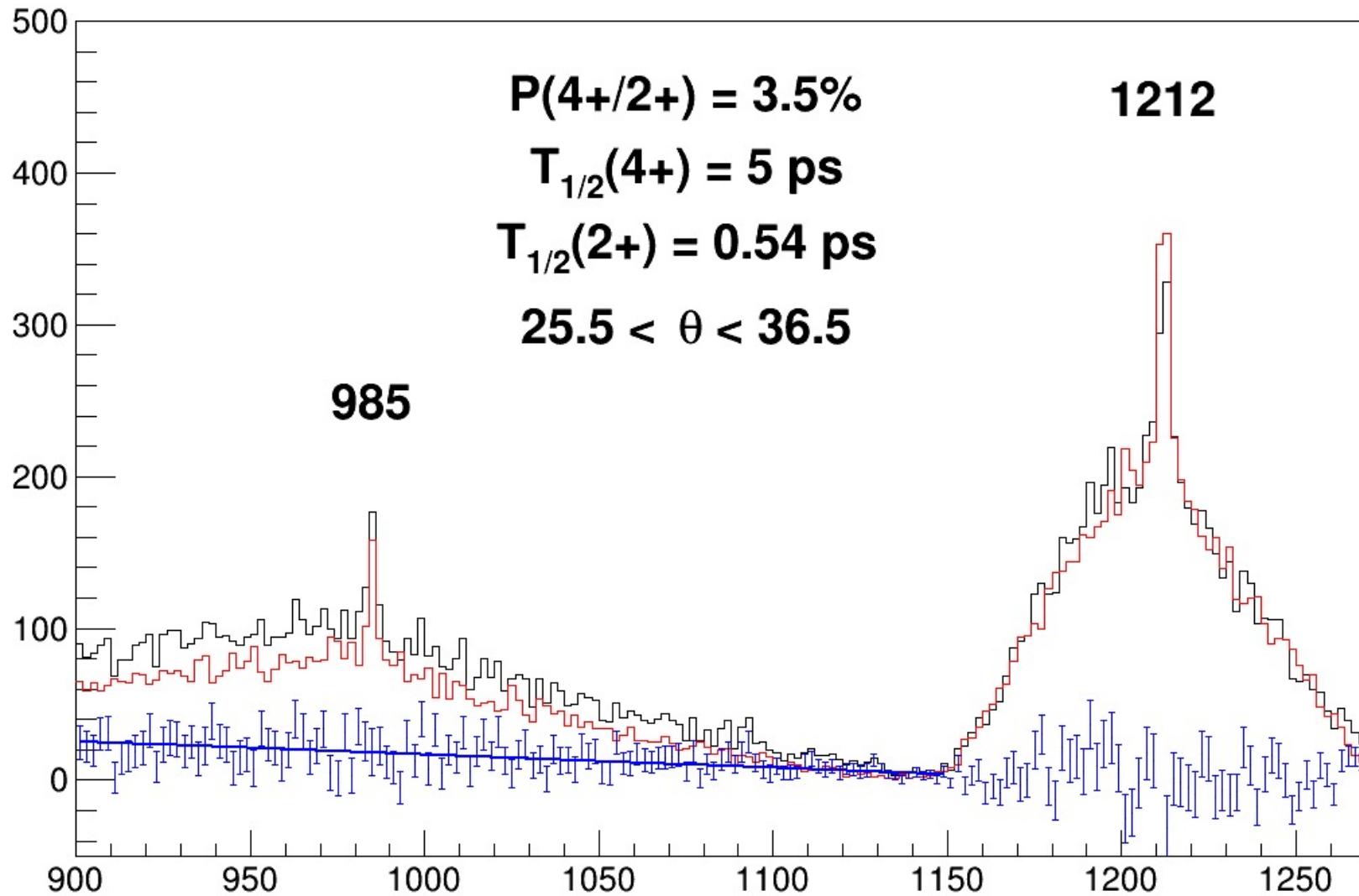


Lifetime analysis of the 2_1^+ state in ^{110}Sn



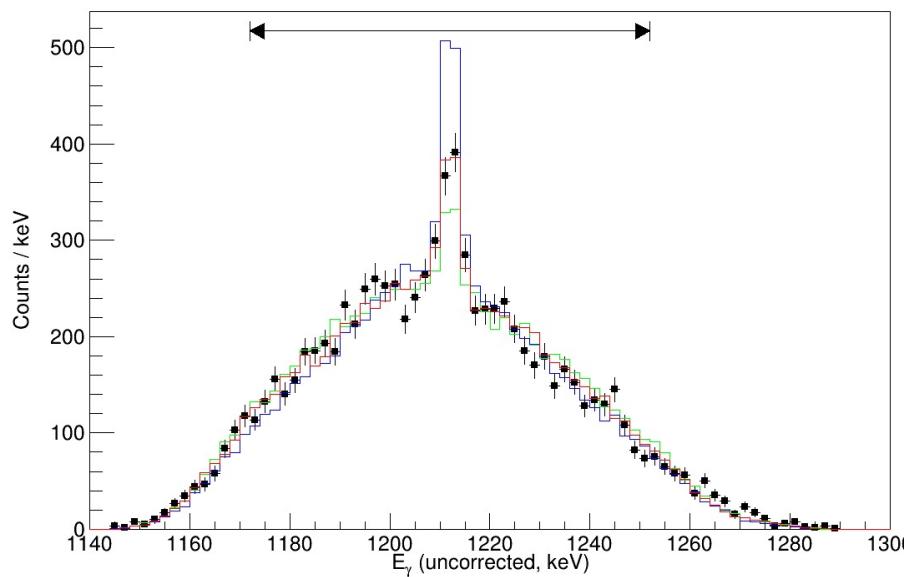
$$E_\gamma = E_0 \frac{\sqrt{1 - \beta^2}}{1 - \beta \cos\theta}$$



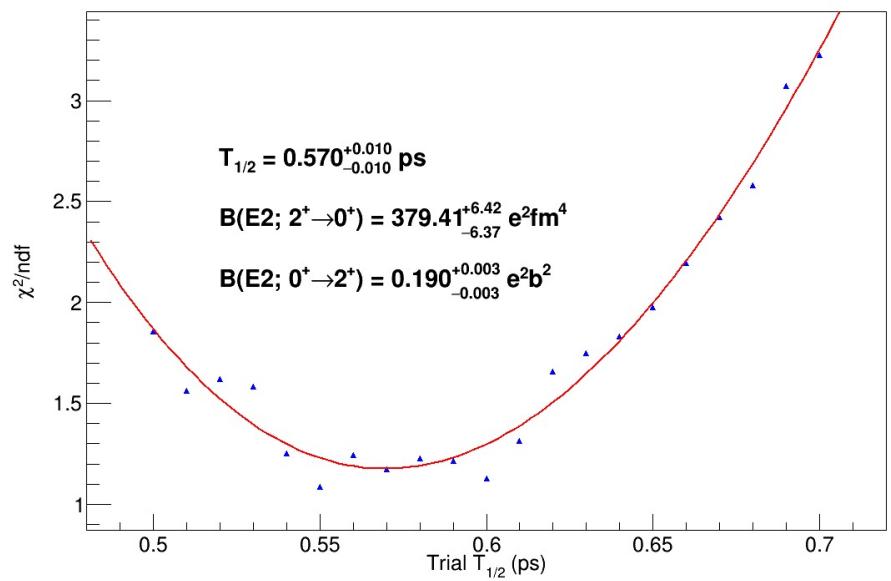


Lifetime analysis of the 2_1^+ state in ^{110}Sn

χ^2 minimization along a range of trial τ

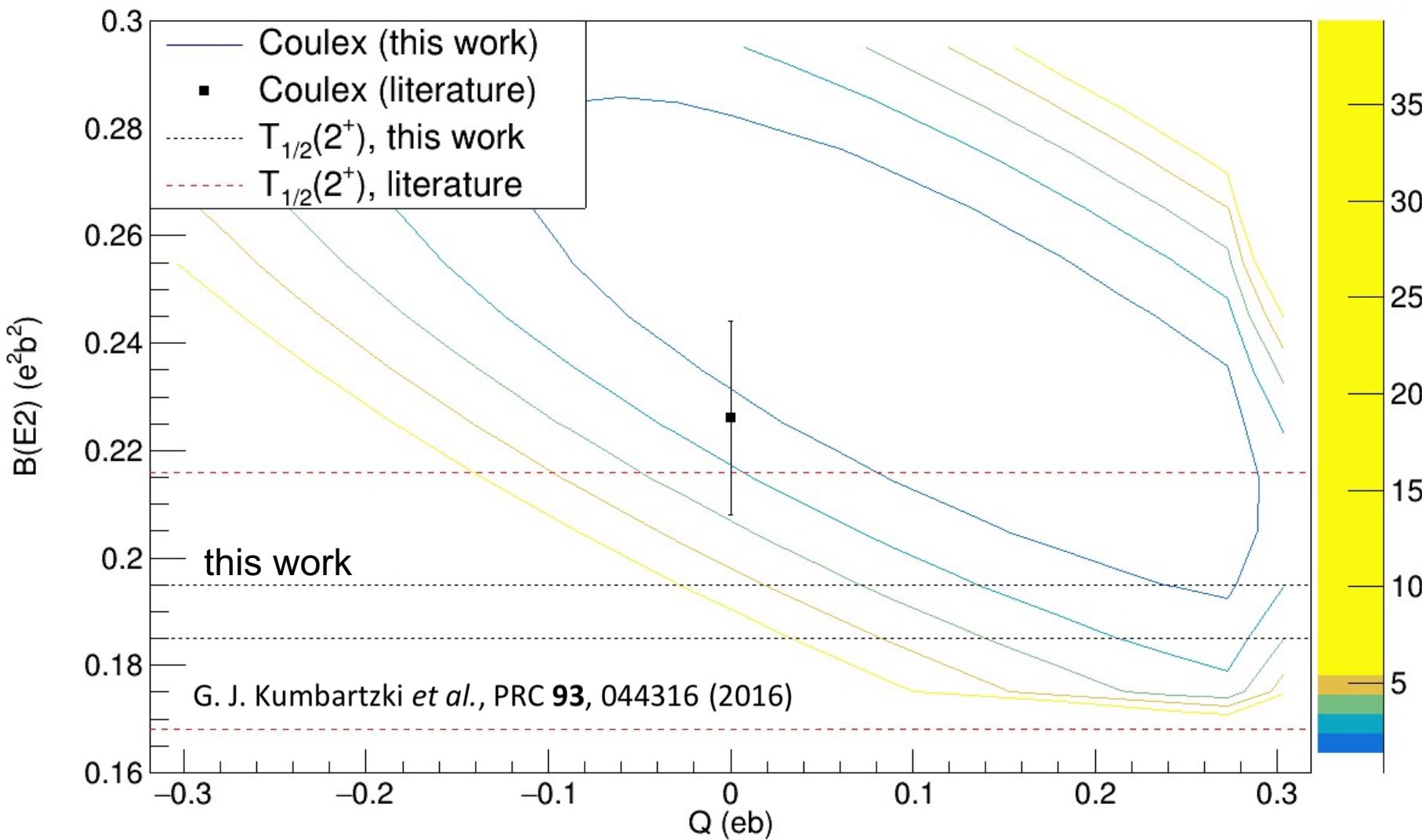


χ^2/ndf on opening angle distributions of 1212-keV



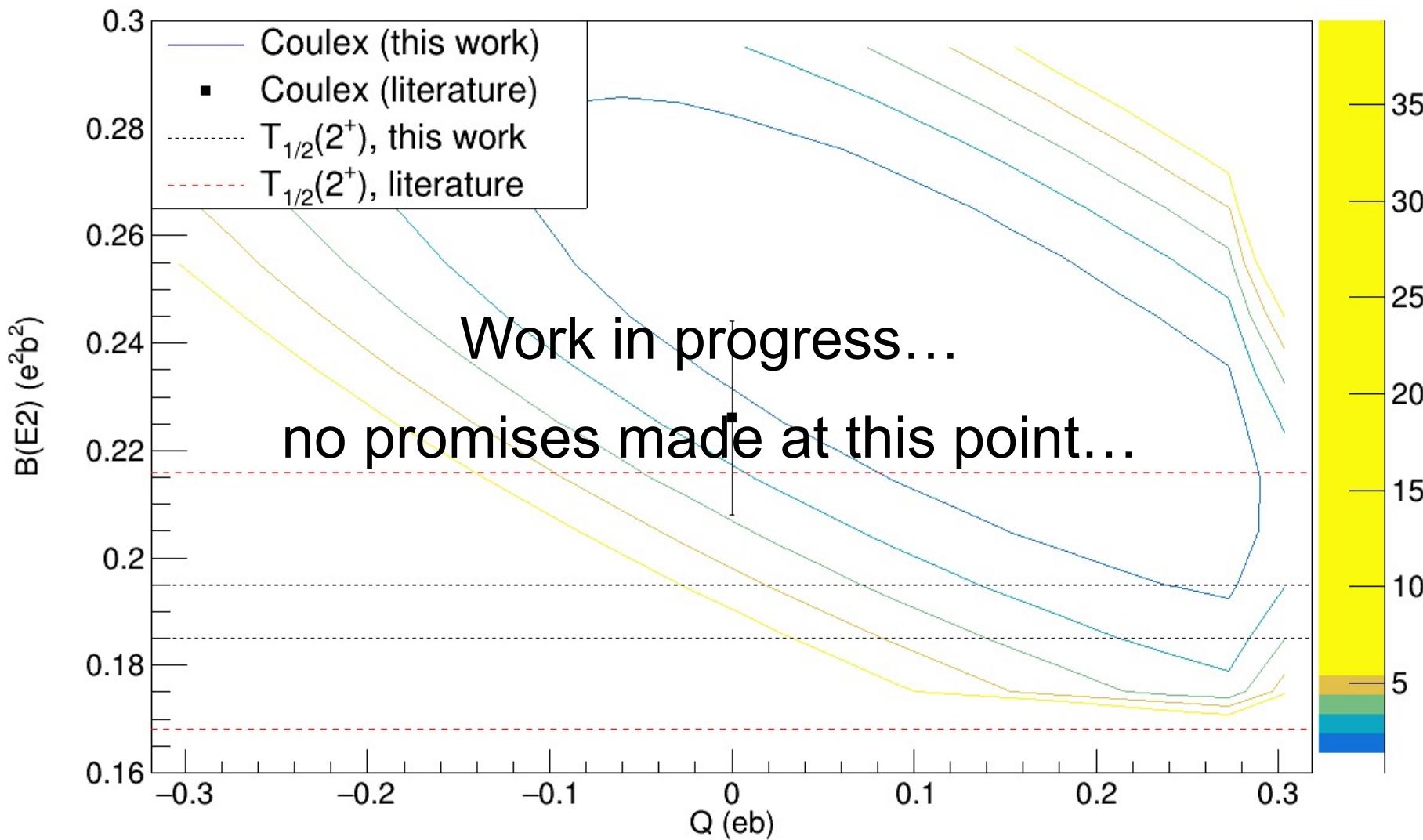
Error analysis ongoing...

BQ: ^{110}Sn



First attempt, now new results for sets with different angular cuts...

BQ: ^{110}Sn

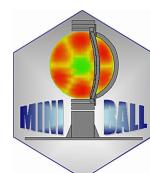
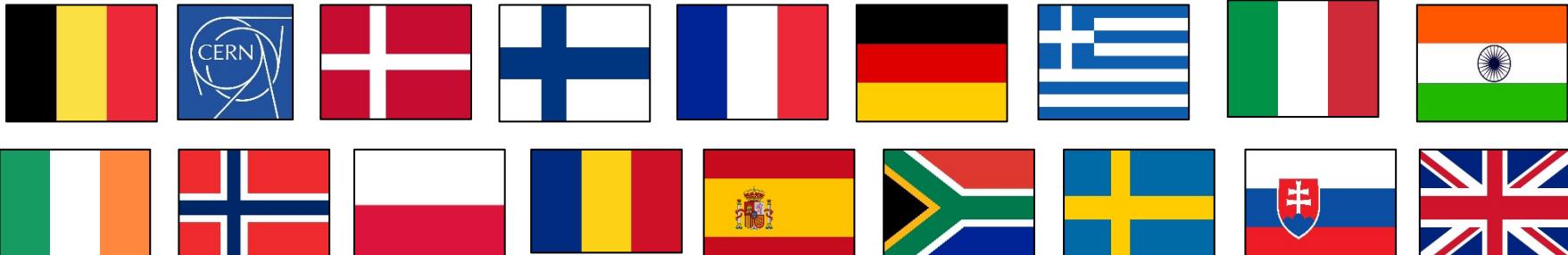


Collaboration

Christoph Berger, Christian Berner, Tom Berry, Maria J. Borge, Joakim Cederkall, Daniel Cox, Hilde de Witte, Liam Gaffney, Roman Gernhauser, Tobias Habermann, Anna-Lena Hartig, Corinna Henrich, Andres Illana Sisón, **Jedrek Iwanicki**, Thorsten Kröll, Paweł J. Napiorkowski, **Joochun Park**, Georgi Rainovski, Peter Reiter, Sudipta Saha, Marcel Schilling, Michael Seidlitz, Jacob Snäll, Christian Stahl, Piet van Duppen, Nigel Warr, Fredrik Wenander, **Kasia Wrzosek-Lipska** et al.

TU München, Germany - University of Surrey, United Kingdom - TU Darmstadt, Germany - CERN-ISOLDE, Switzerland - KU Leuven, Belgium - UW HIL Warsaw, Poland - University of Jyväskylä, Finland - SU Sofia, Bulgaria - University of Cologne, Germany - Lund University, Sweden - CSIC Madrid, Spain

Yacine Kadi, Valter Venturi with the HIE-ISOLDE team and the ISOLDE collaboration



χ^2/ndf on opening angle distributions of 803-keV

