THE THEORY OF PTOLEMY

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MANY FIELDS

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The PTOLEMY project touches many different fields. An extremely fascinating problem!

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What does this tell us about new physics?

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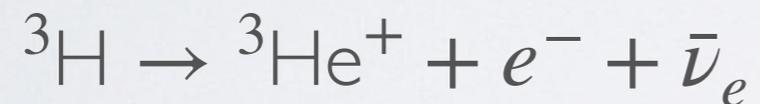
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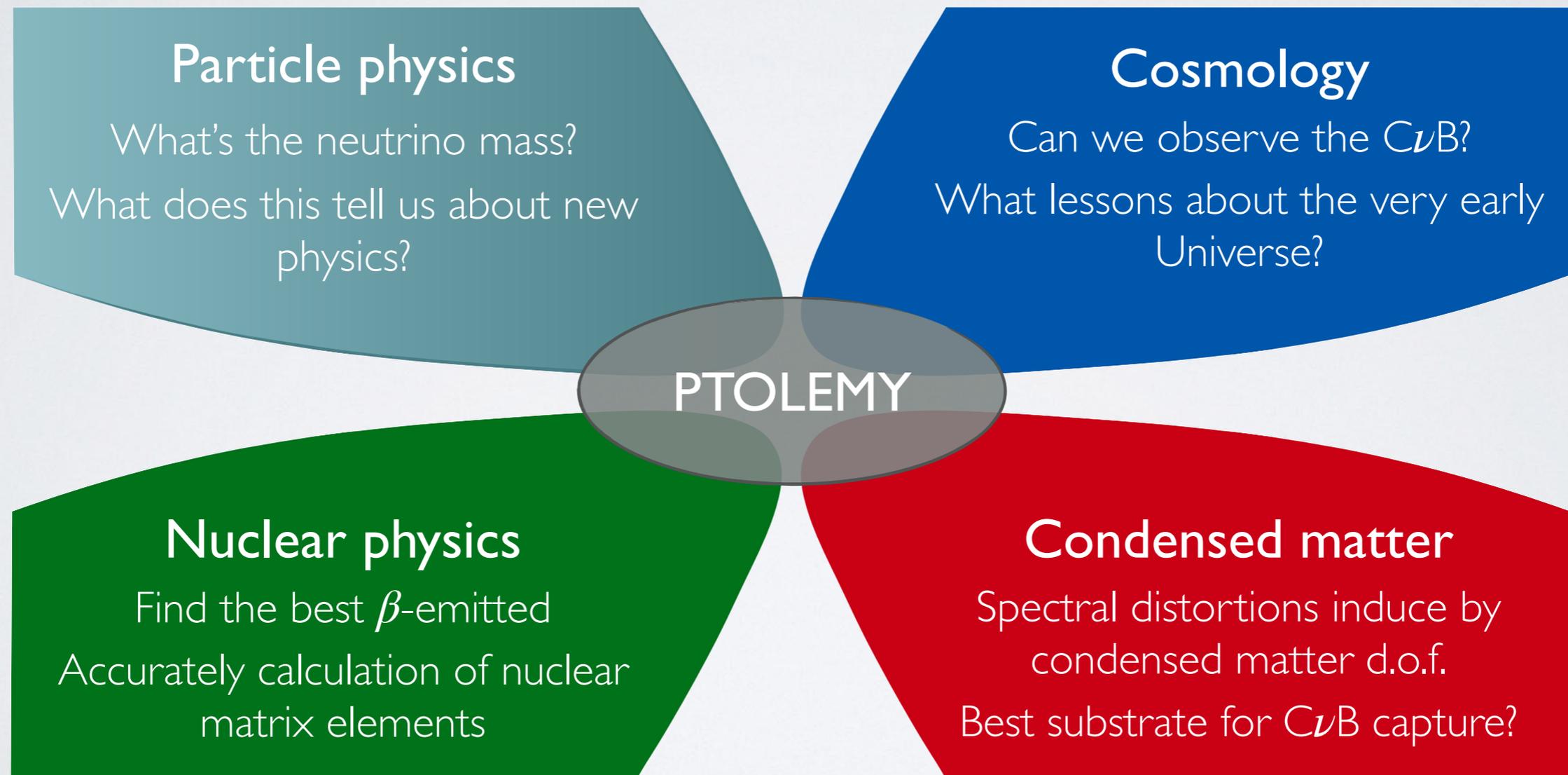
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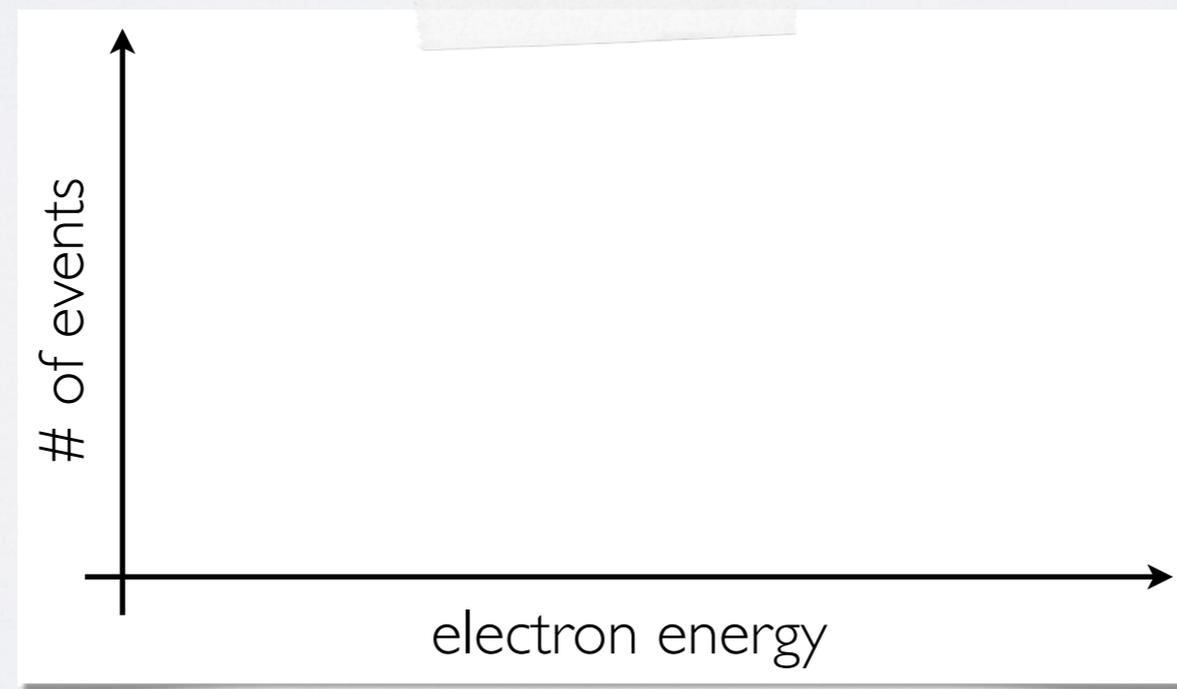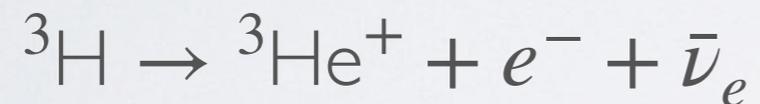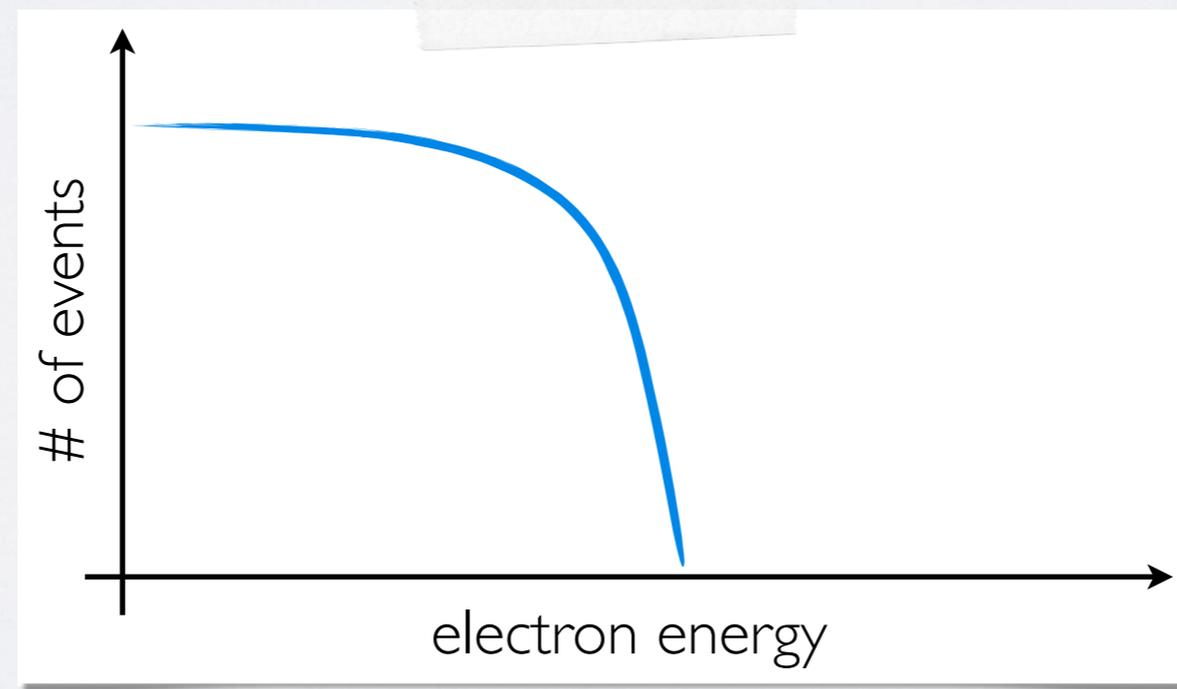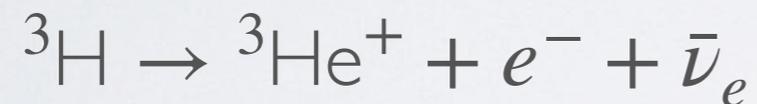
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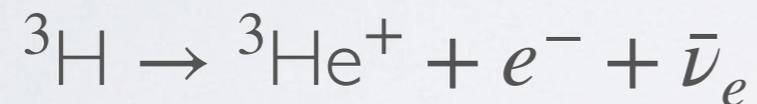$$^3\text{H} \to {}^3\text{He}^+ + e^- + \bar{\nu}_e$$

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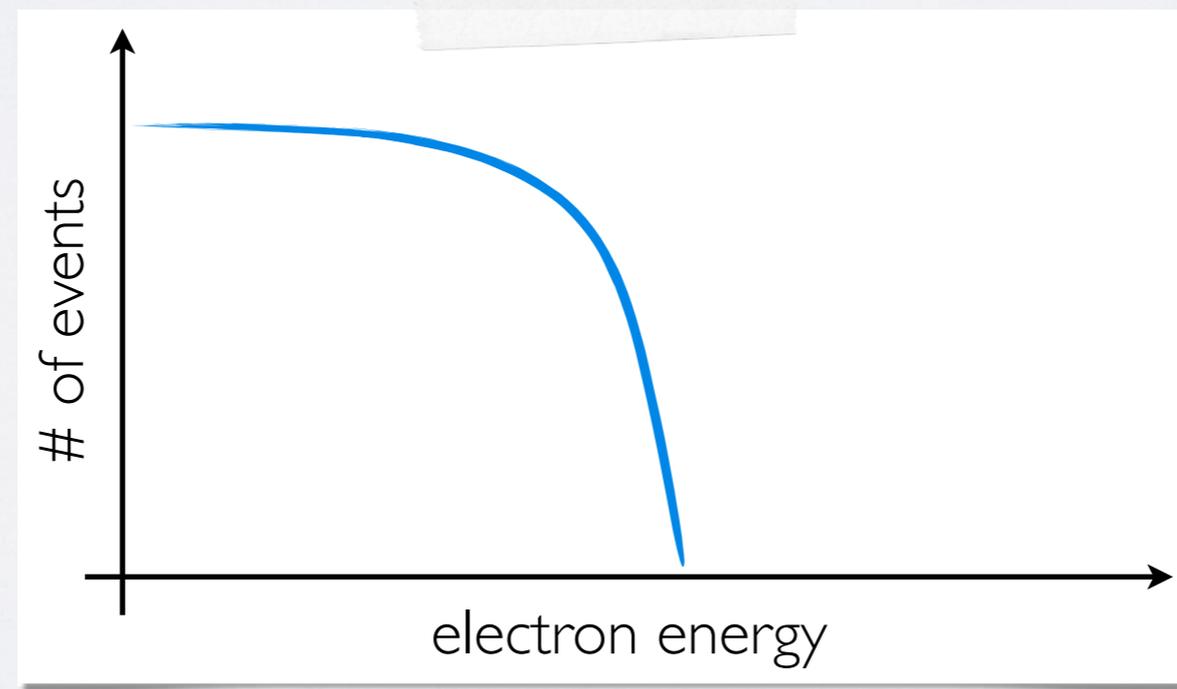
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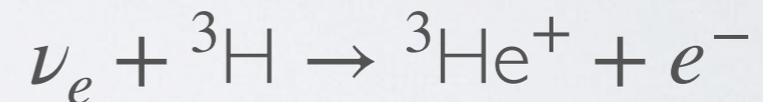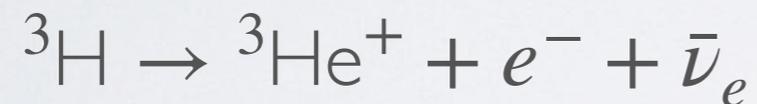
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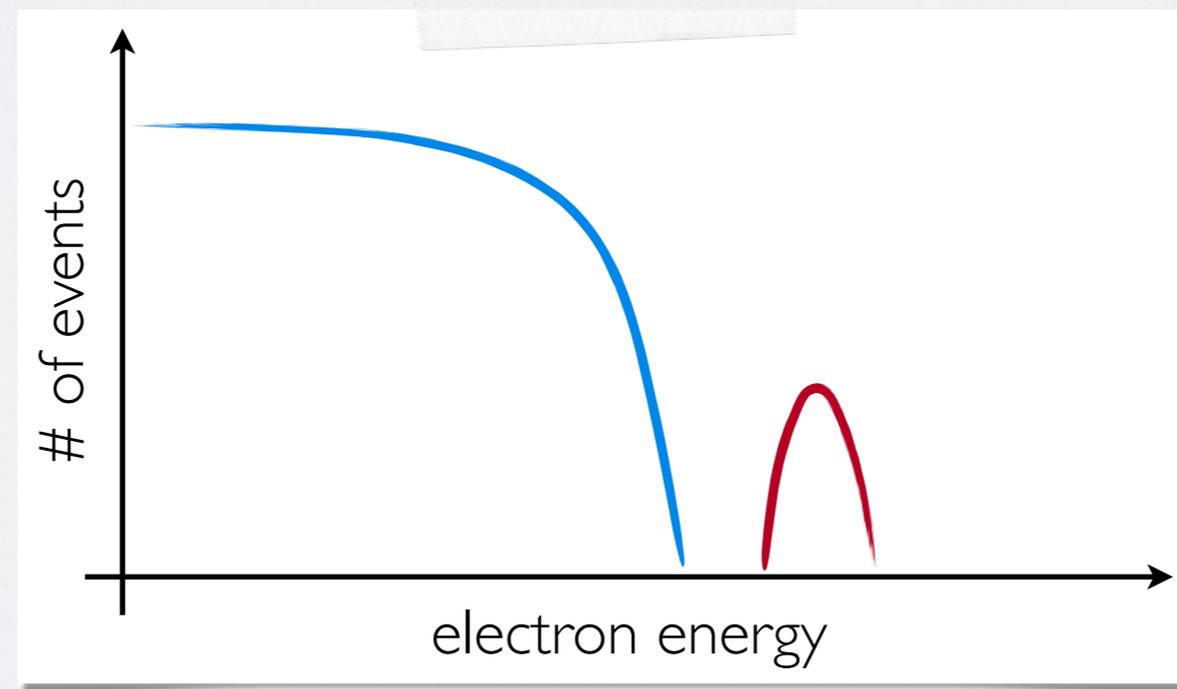*Measure the neutrino mass*

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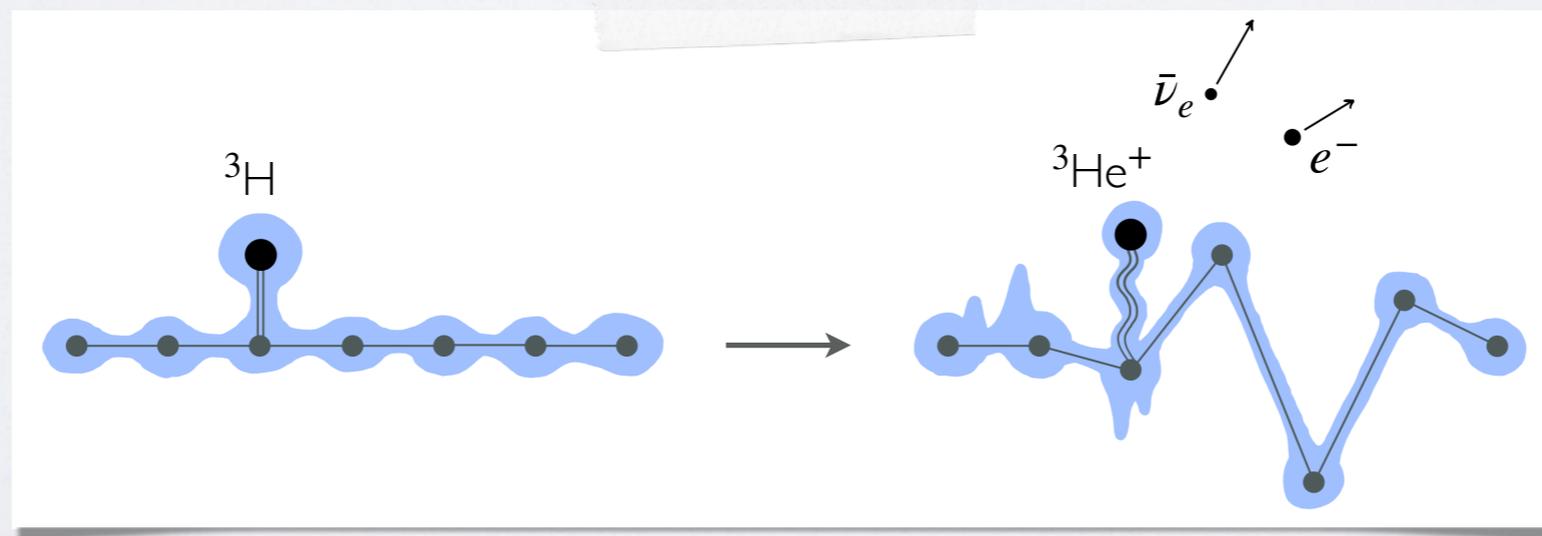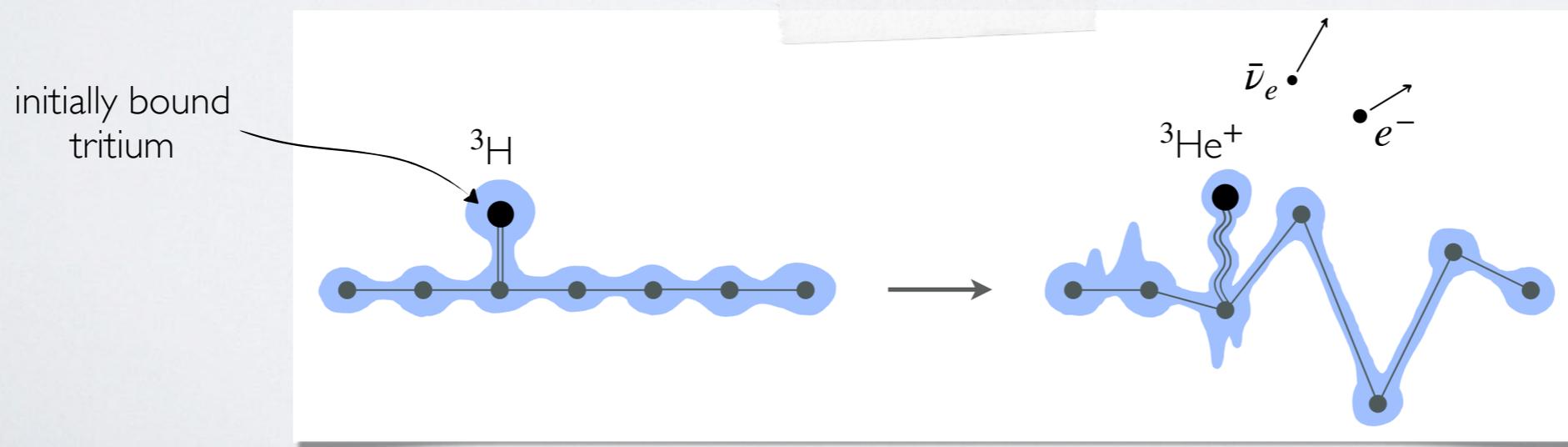The condensed matter d.o.f. actively participate to the reactions!

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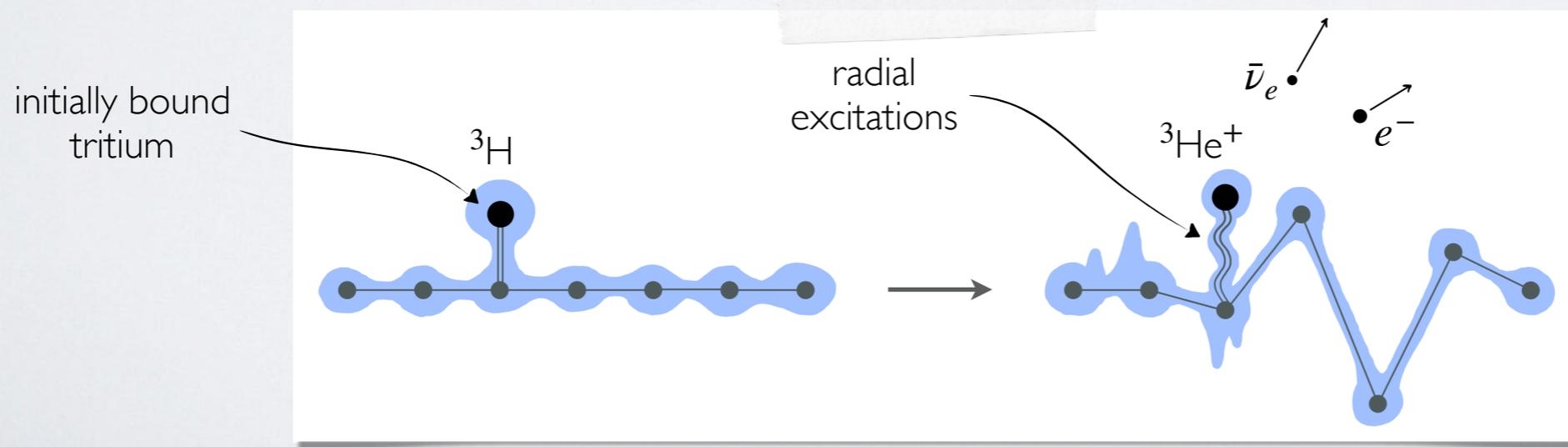The condensed matter d.o.f. actively participate to the reactions!

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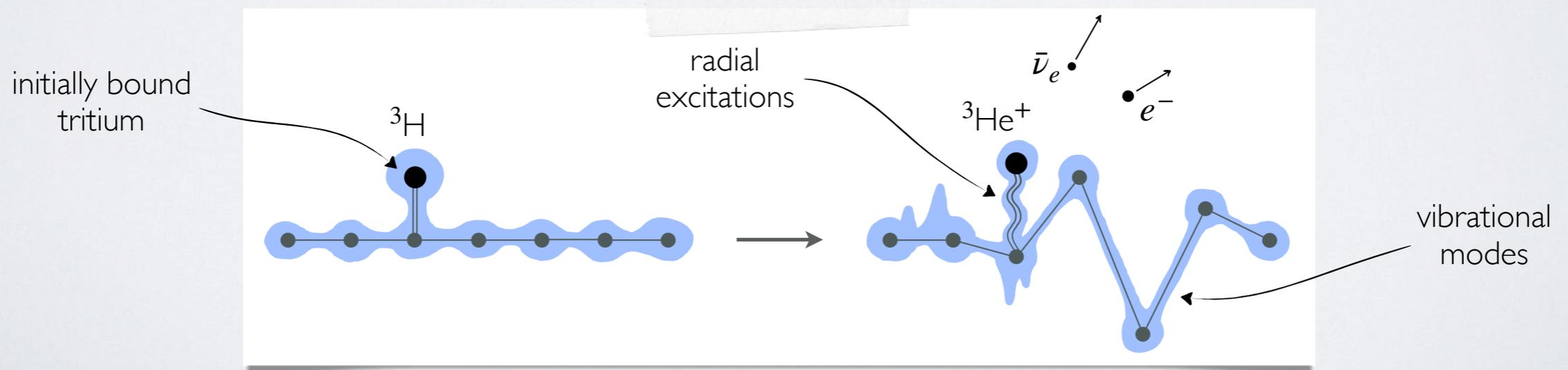The condensed matter d.o.f. actively participate to the reactions!

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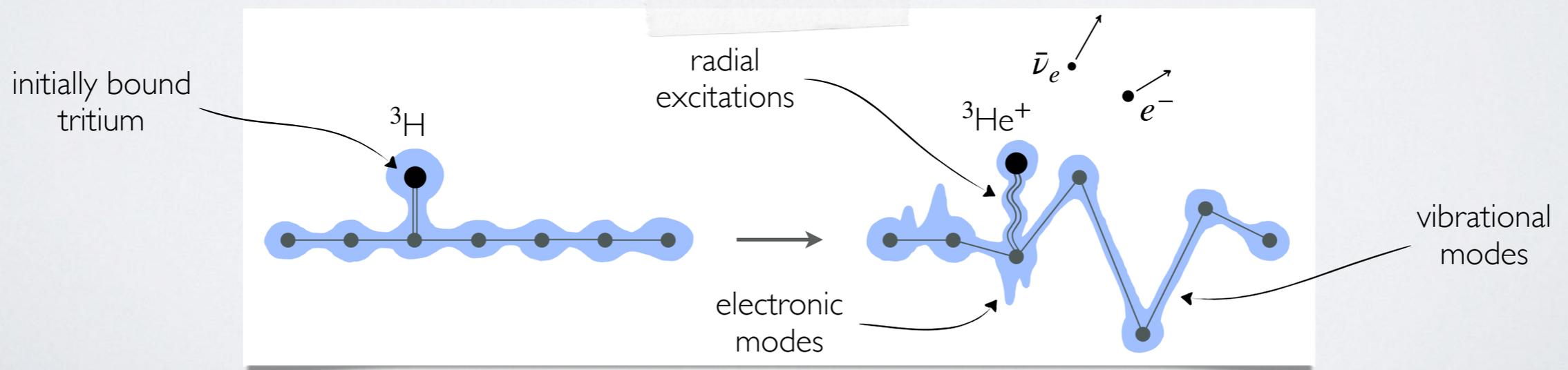The condensed matter d.o.f. actively participate to the reactions!

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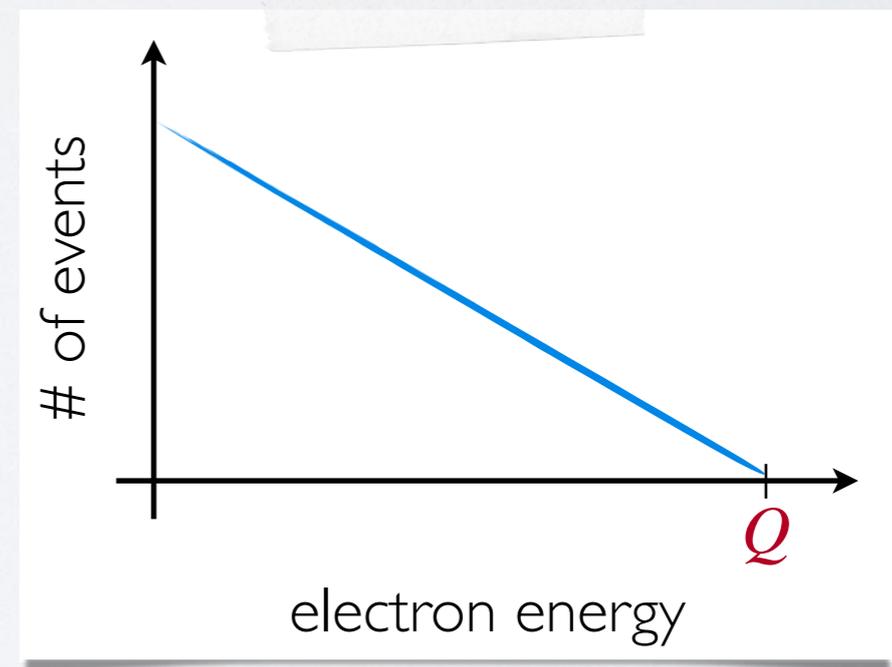
NEUTRINO MASS

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The β-decay part of the spectrum depends parametrically on the effective neutrino mass:

$$\frac{dN_\beta}{dK_e} \equiv f(E_e, m_\nu)\,, \qquad\qquad m_\nu^2 = \sum_{i=1}^{3} |U_{ei}|^2 m_i^2$$
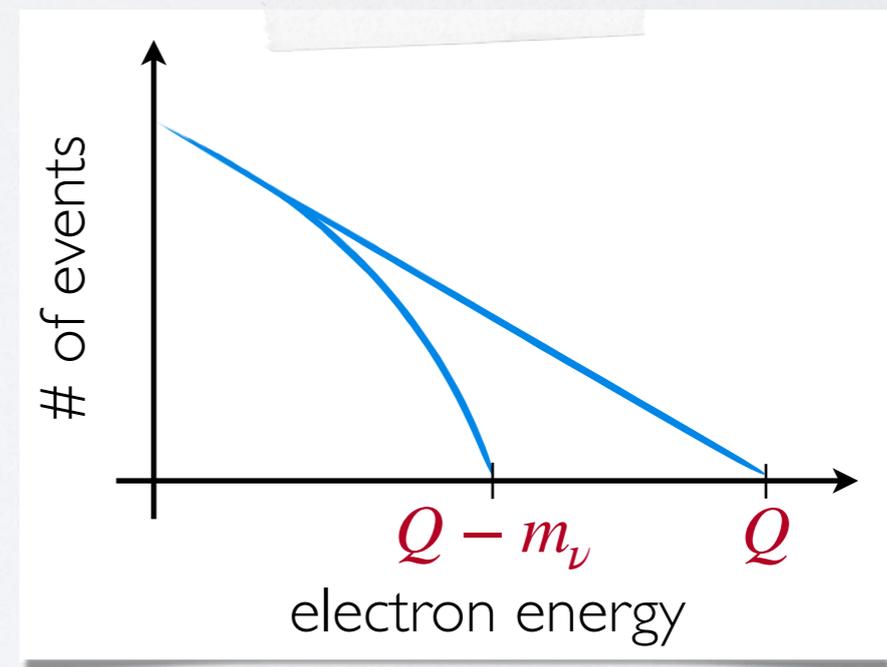
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Measure the end-point region

⬇

Extract m_ν
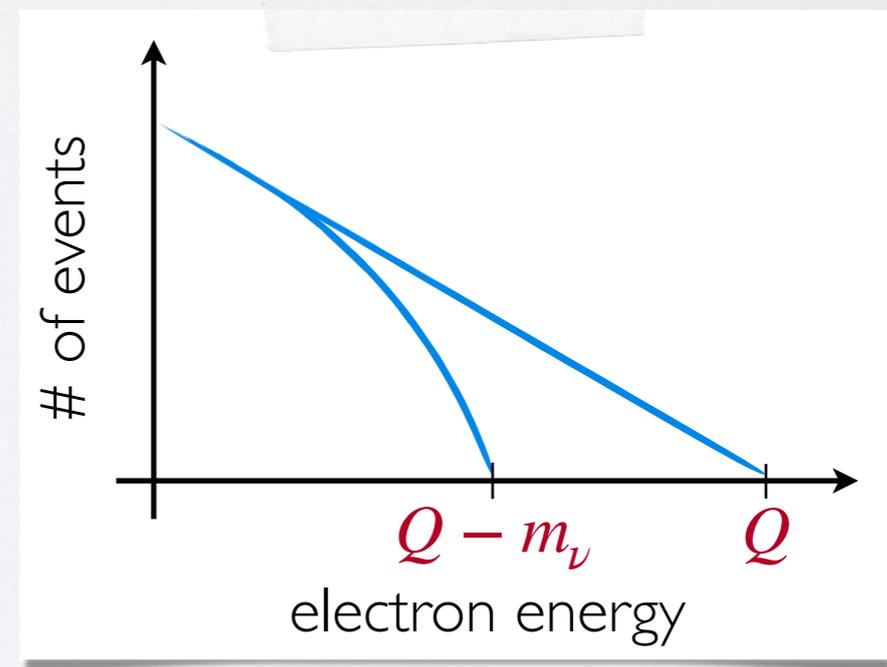
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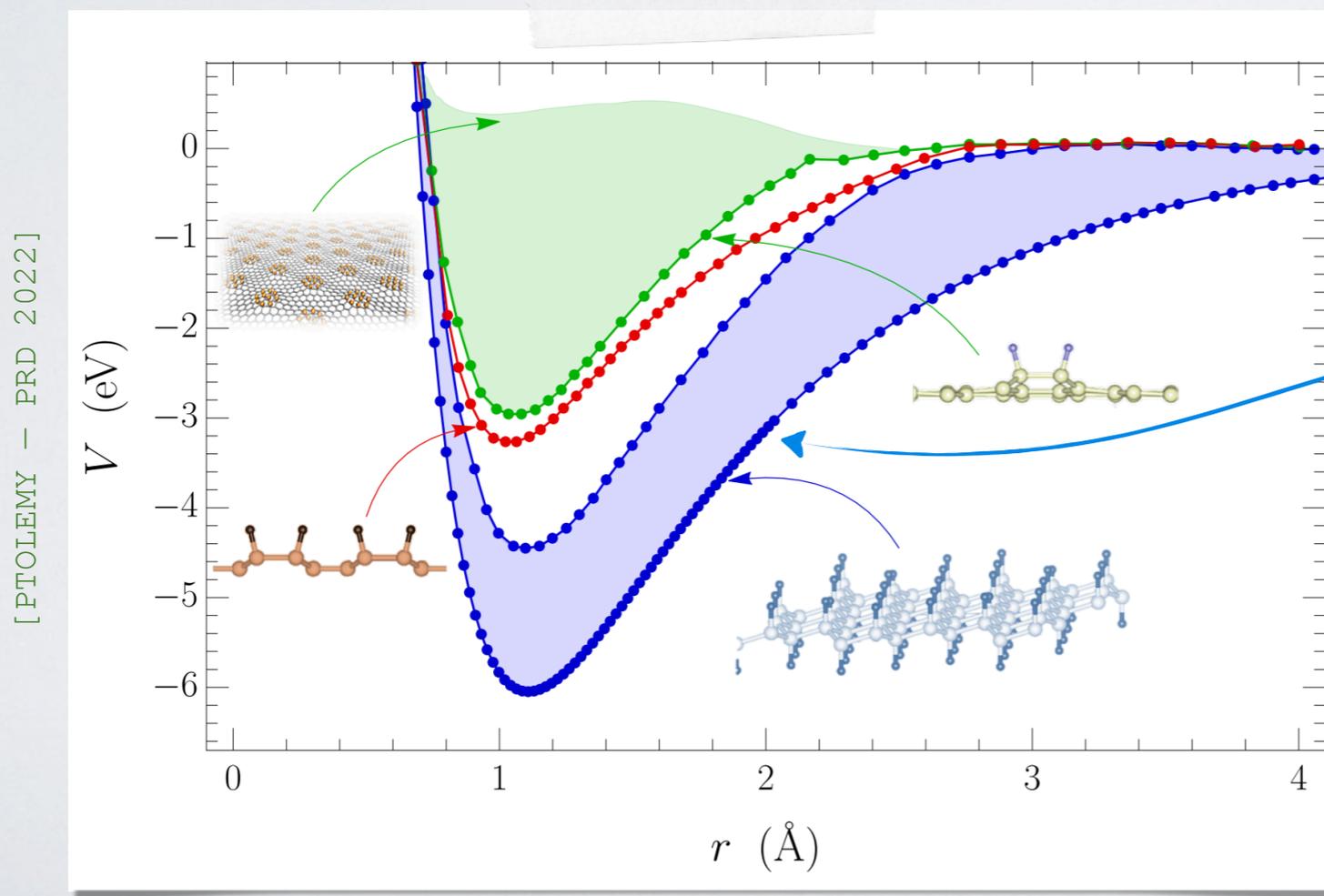
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Tritium-graphene binding potential obtained from *Density Functional Theory (DFT)*

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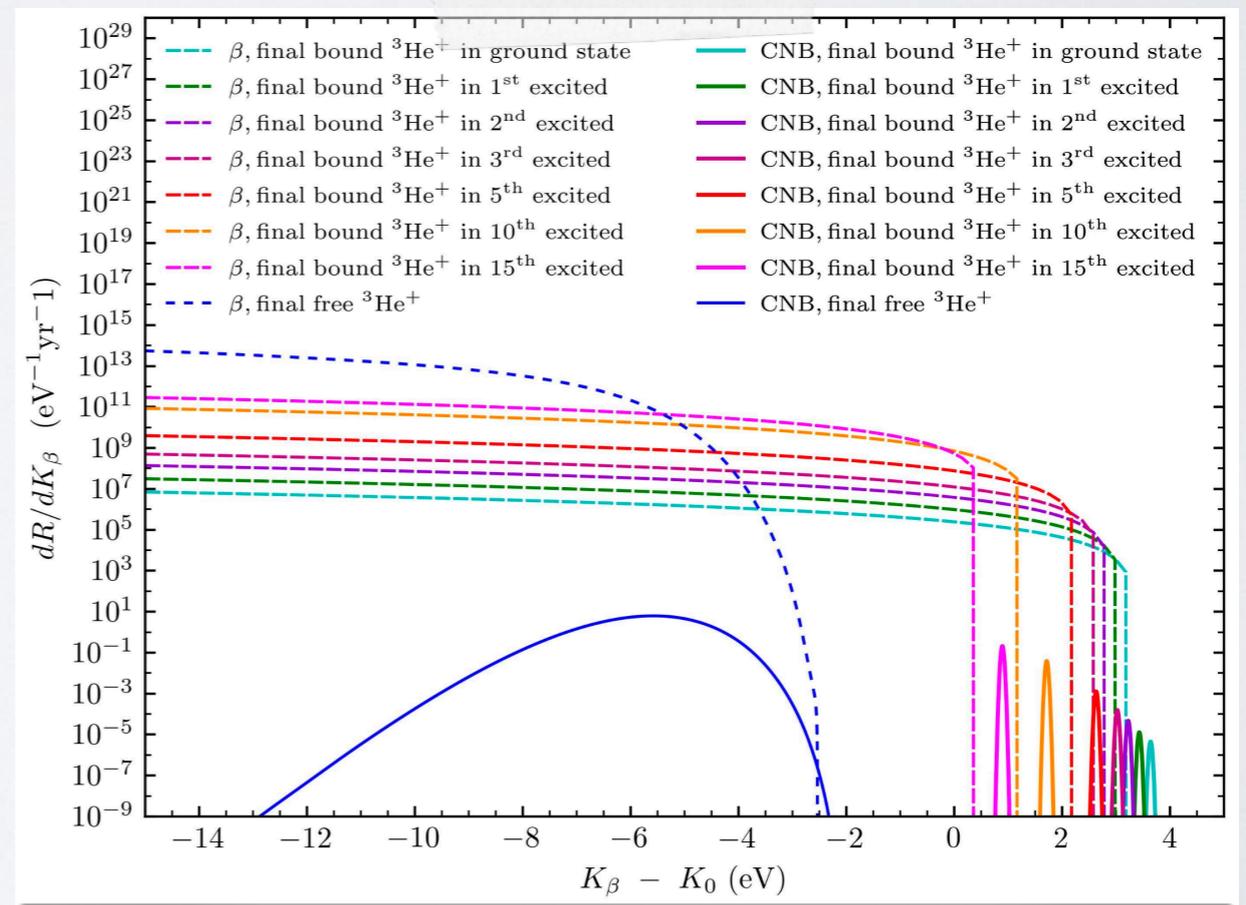
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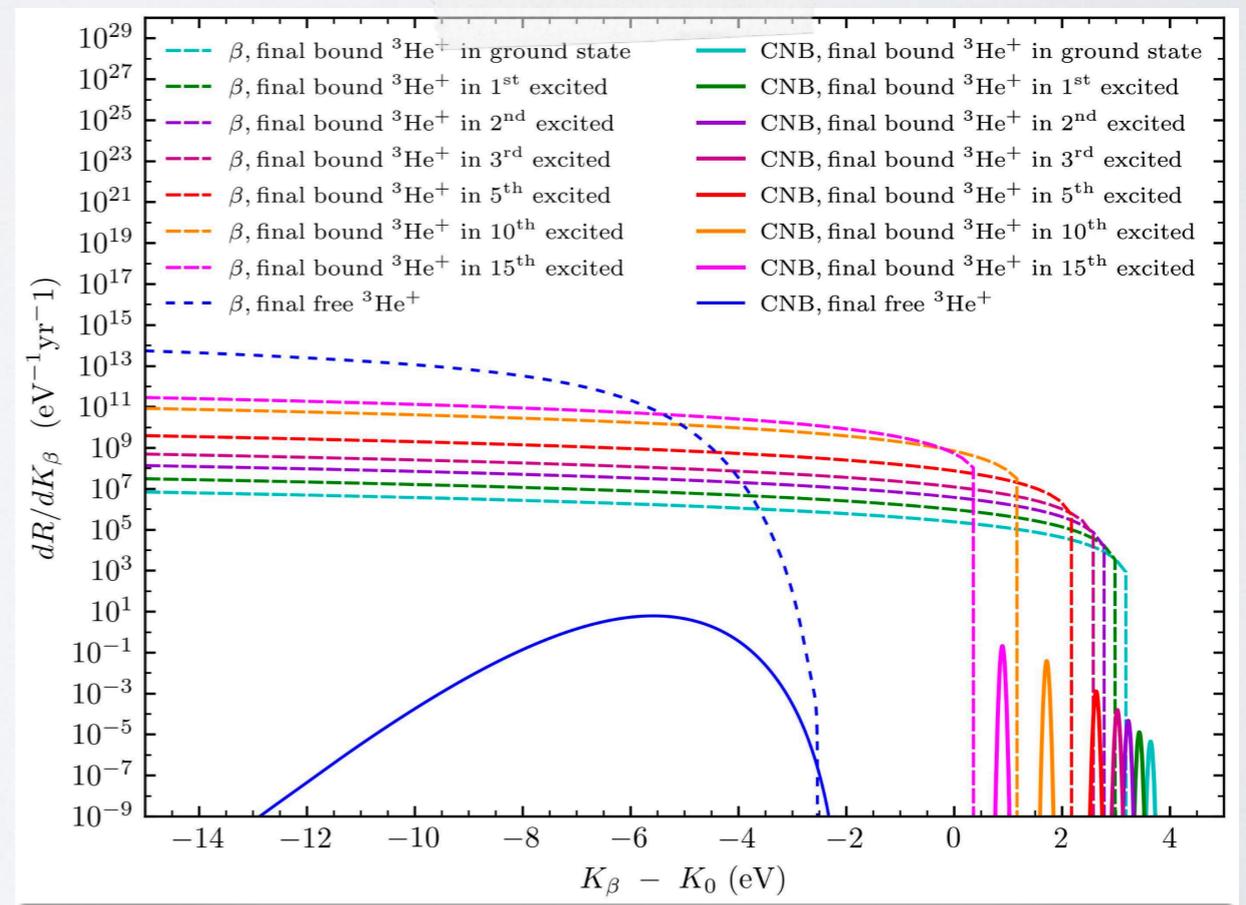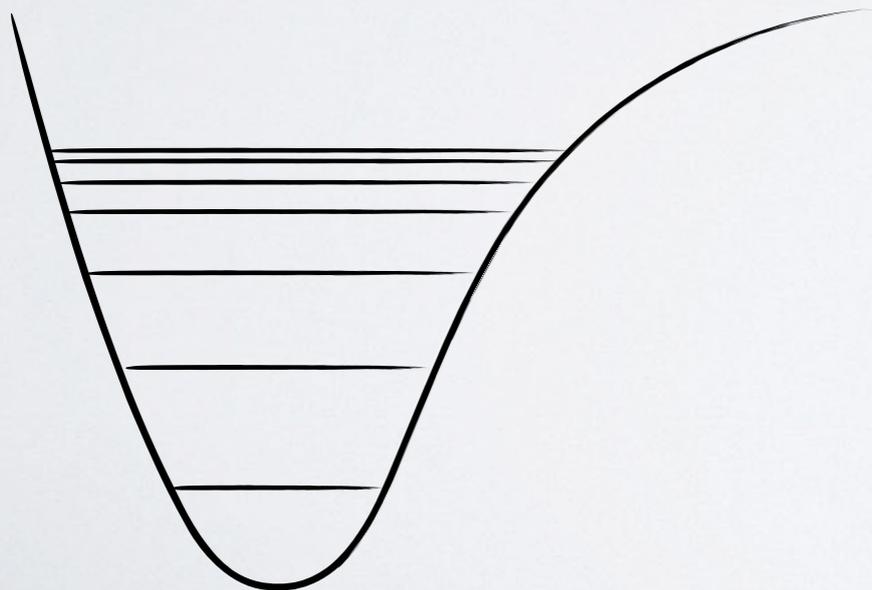
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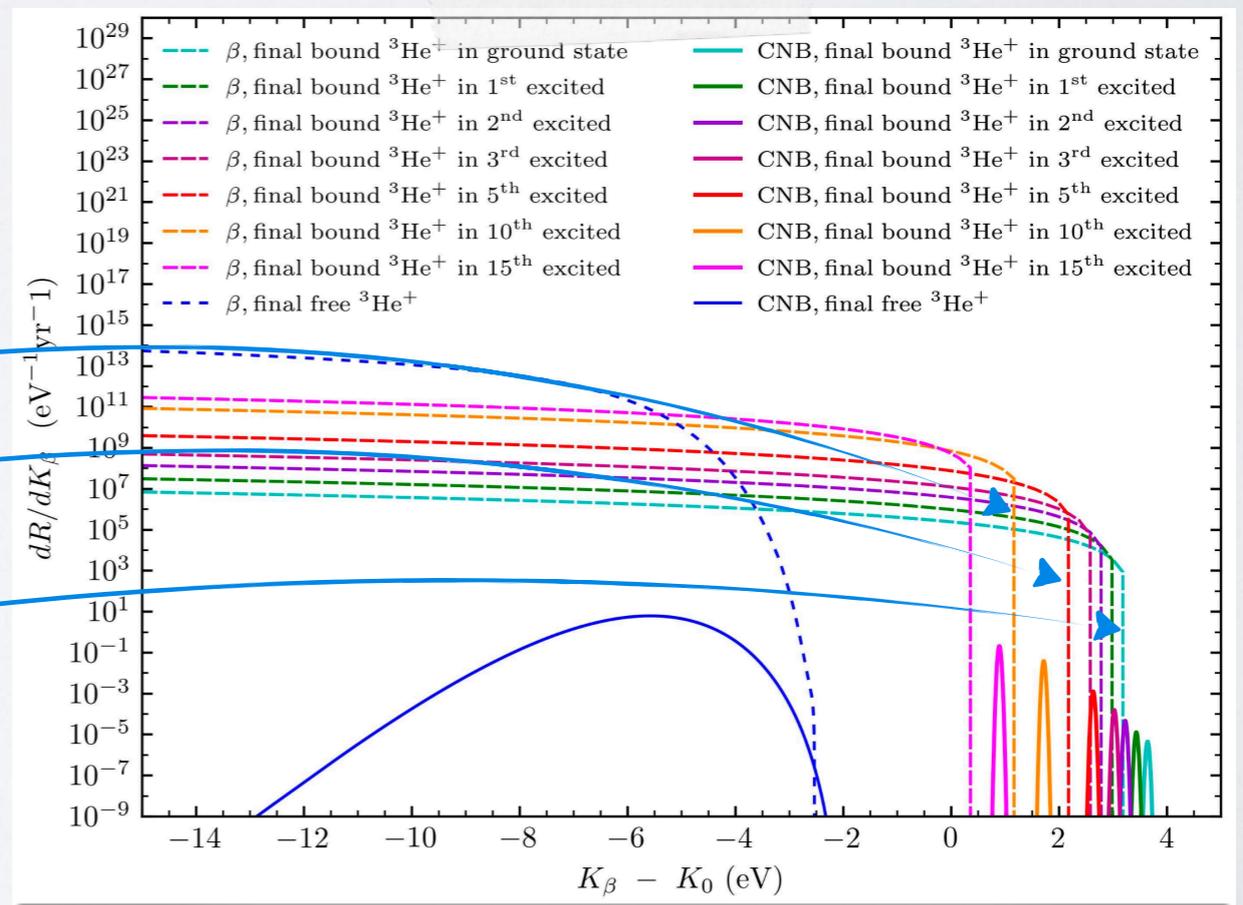
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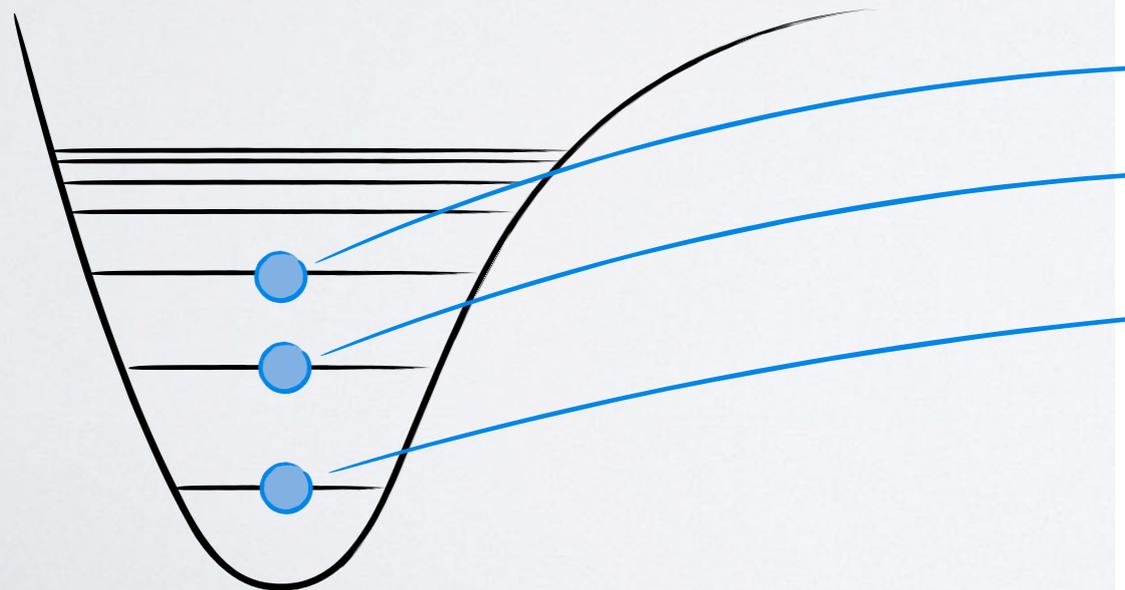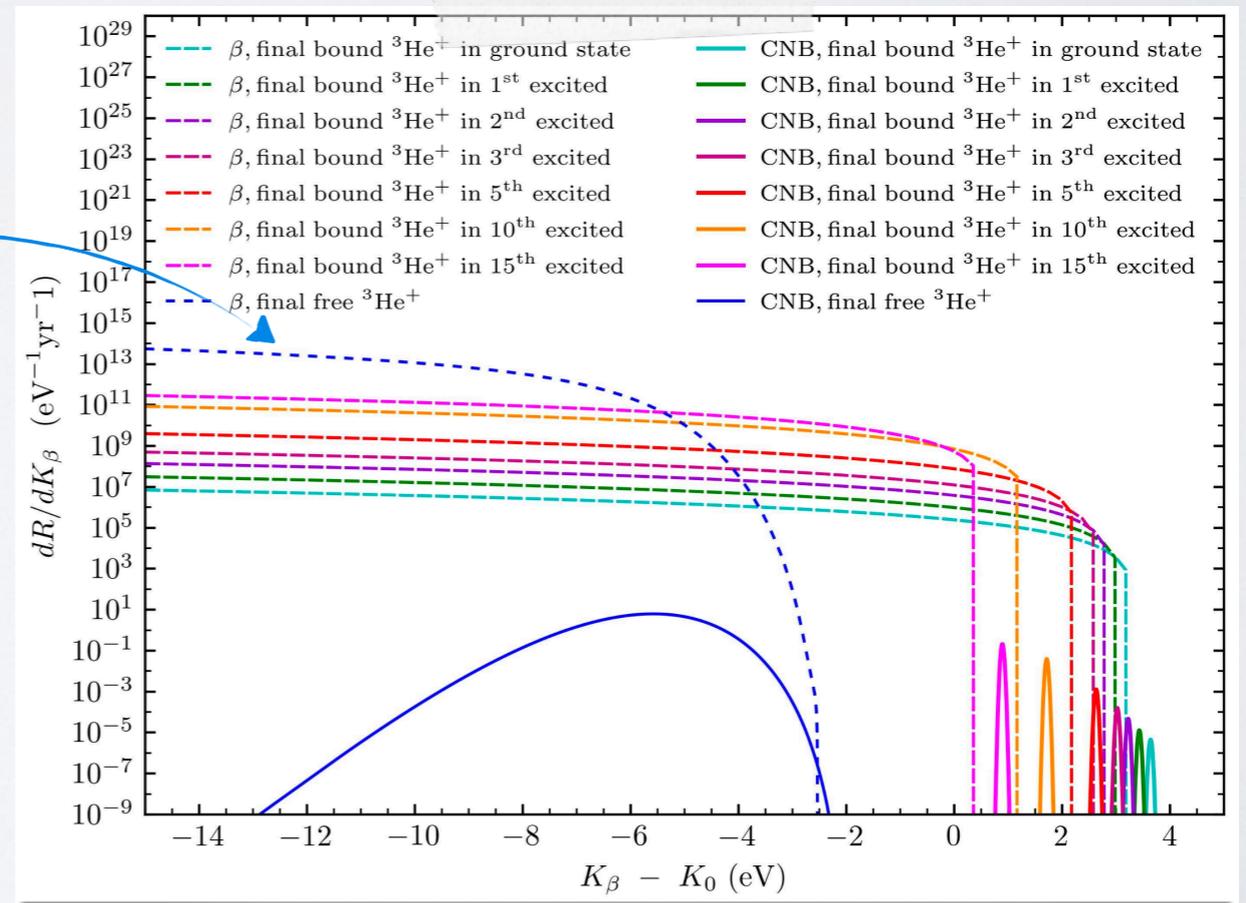

[Andrea Casale's Master's thesis]

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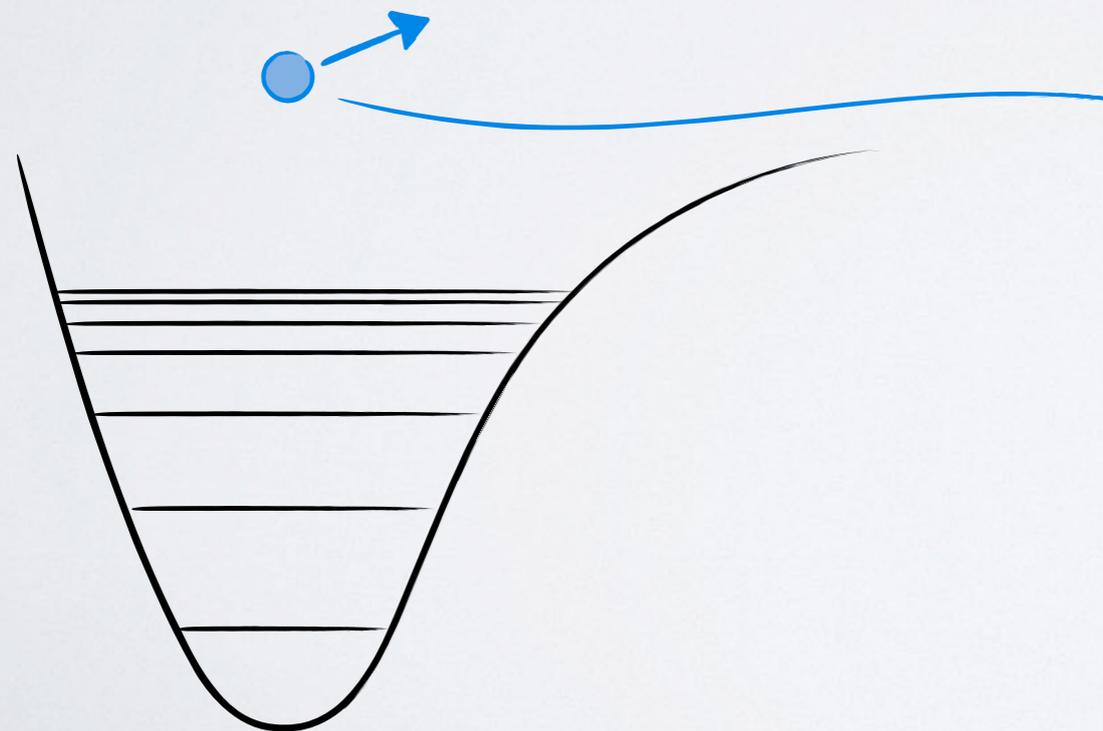

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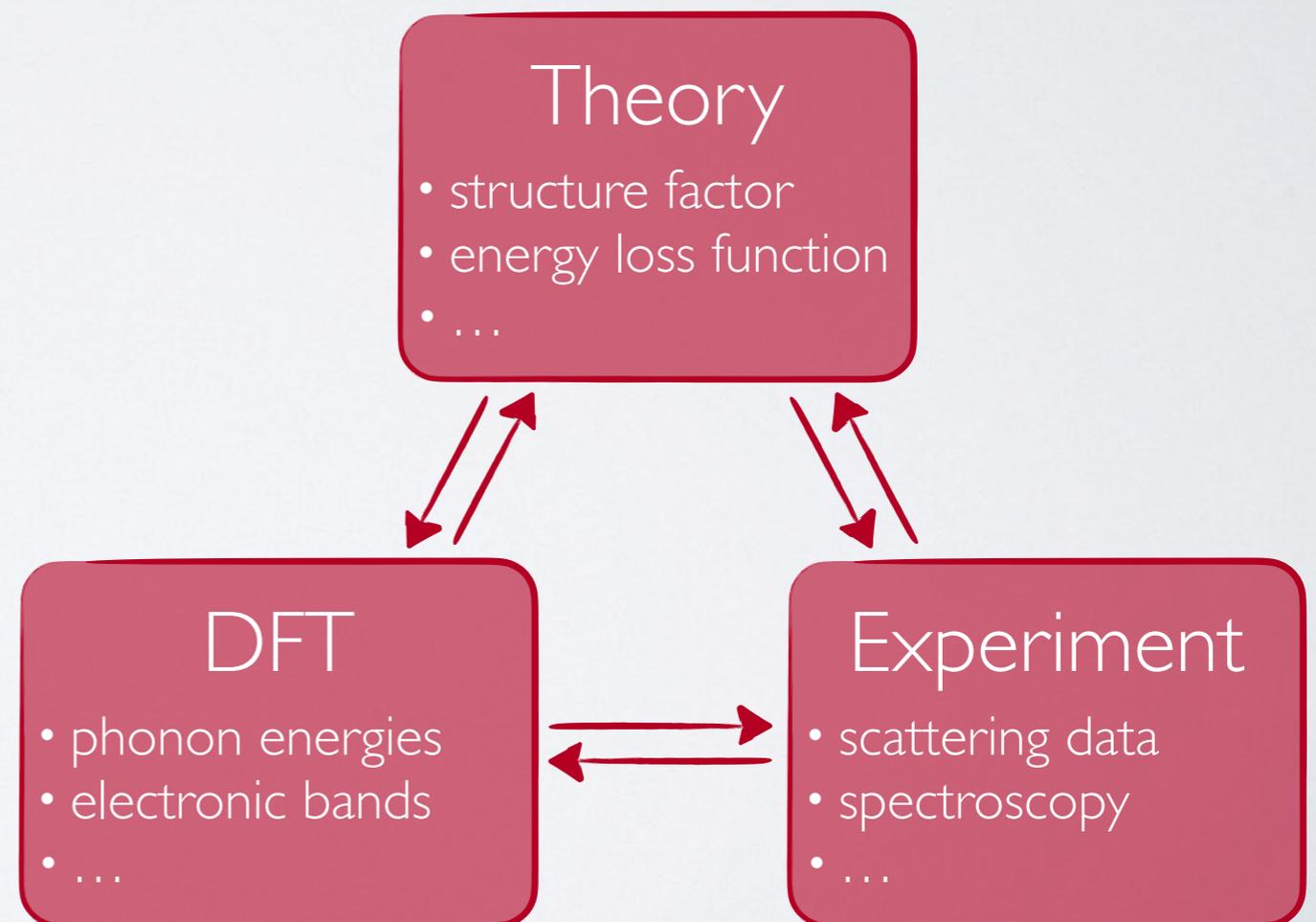
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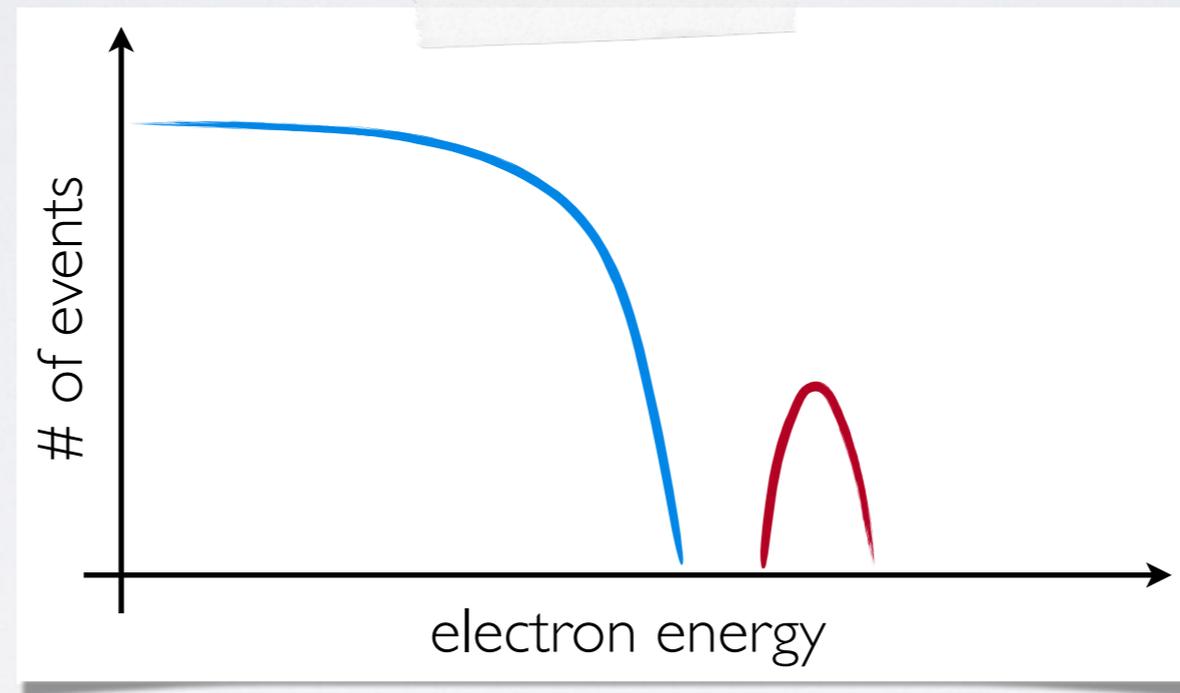To pin them down with sufficient accuracy will require a lot of feedback from different corners of the field

Theory
- structure factor
- energy loss function
- …

DFT
- phonon energies
- electronic bands
- …

Experiment
- scattering data
- spectroscopy
- …

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CνB

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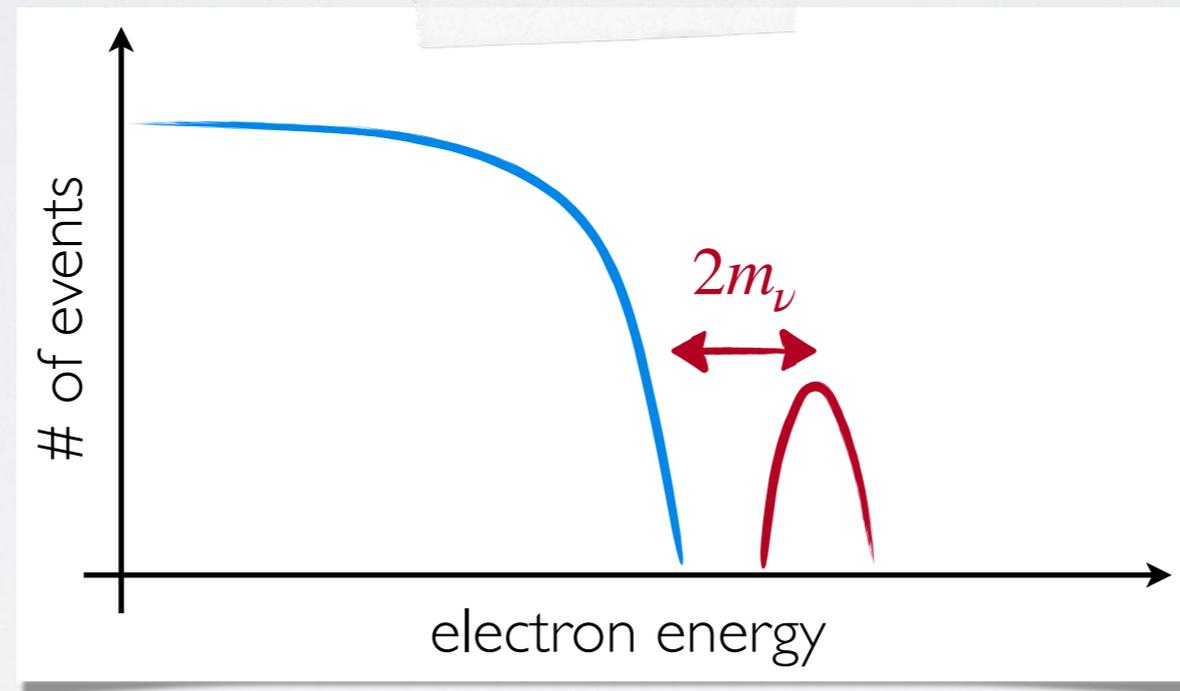To hunt for the CνB one must try to observe the tiny peak coming from the absorption process

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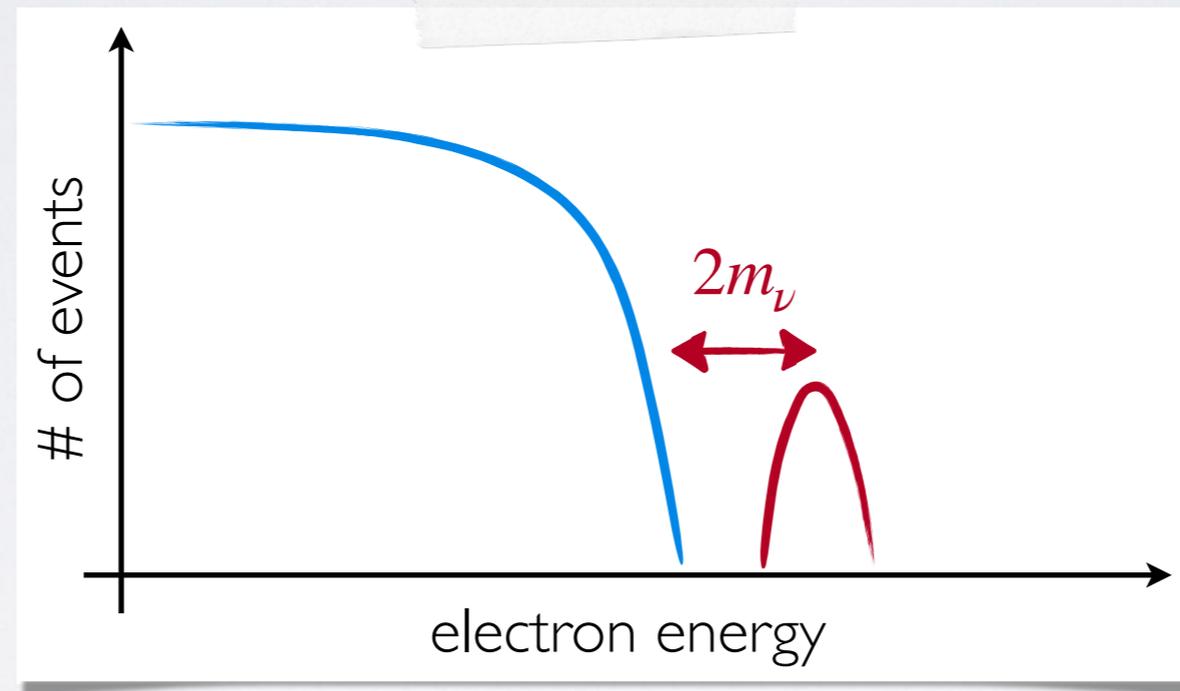
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It crucial to be able to distinguish the peak from the "background" coming from the β-decay part of the spectrum

CνB

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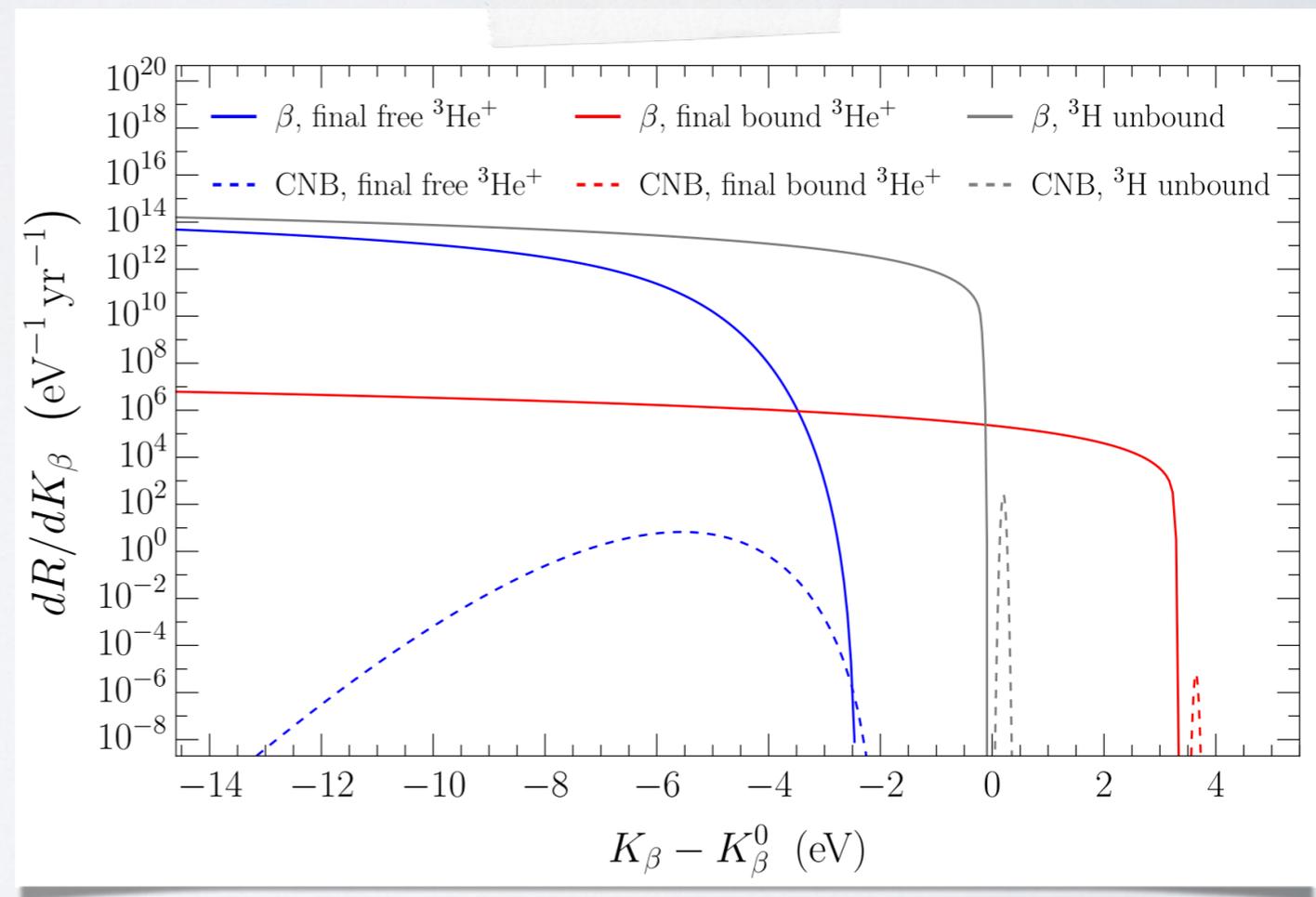
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[PTOLEMY — PRD 2022]

CνB

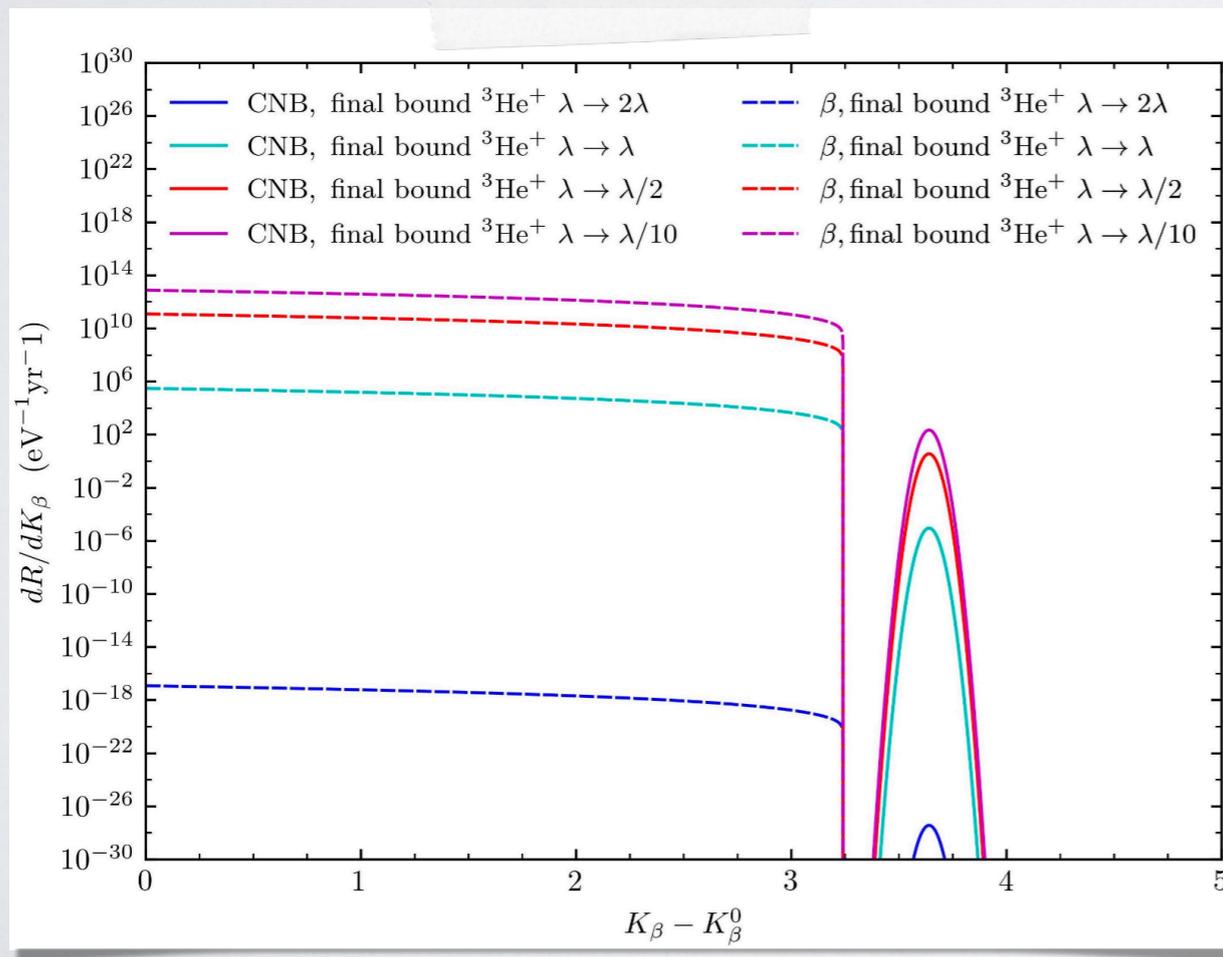# CνB

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Localize tritium more
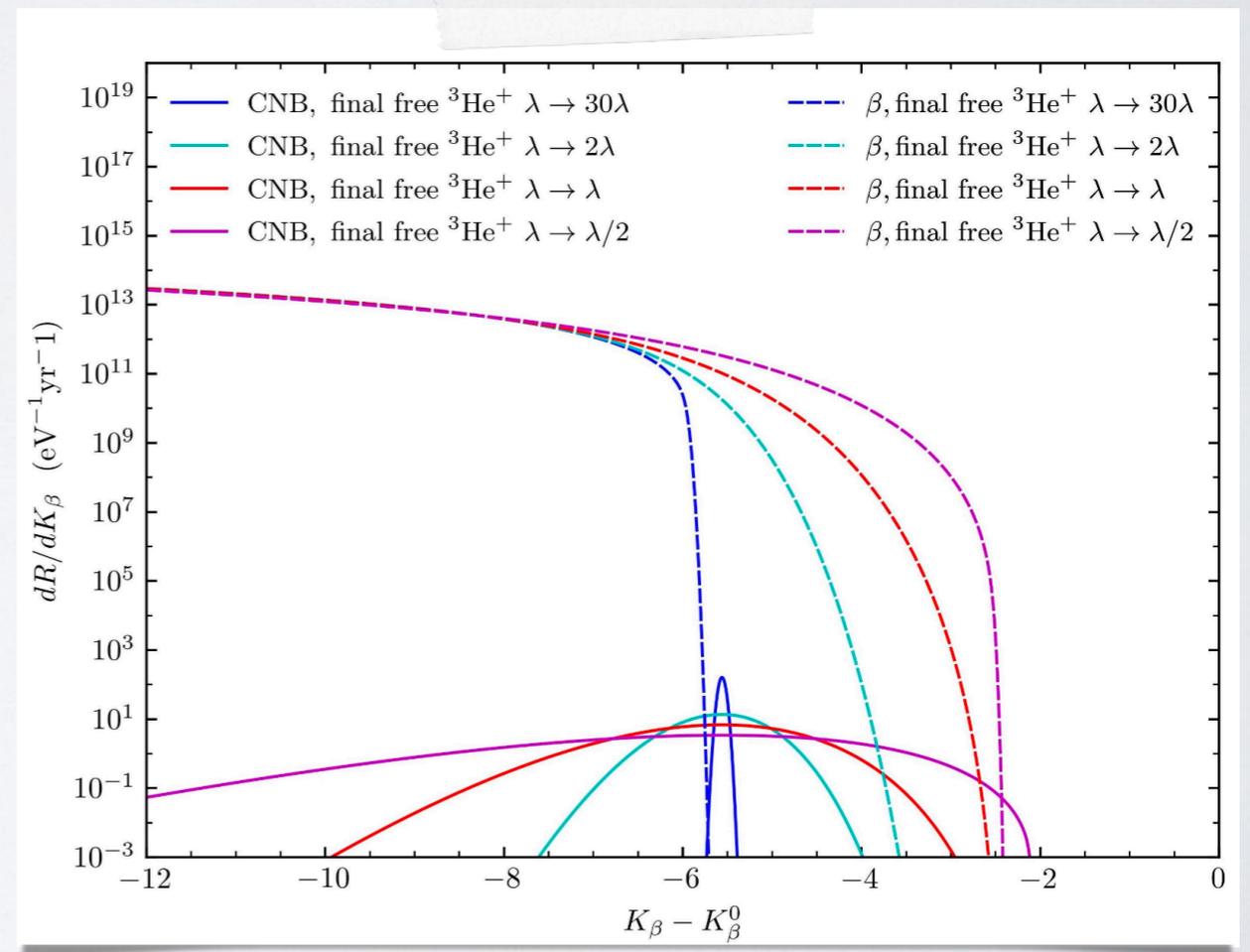right-most peak gets enhanced

[Andrea Casale's Master's thesis]

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left-most peak emerges from β-decay

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CνB

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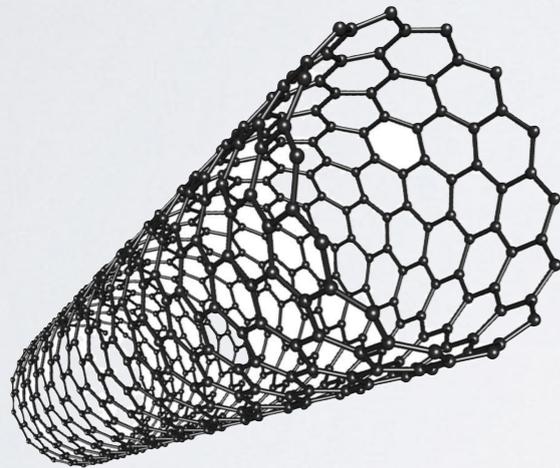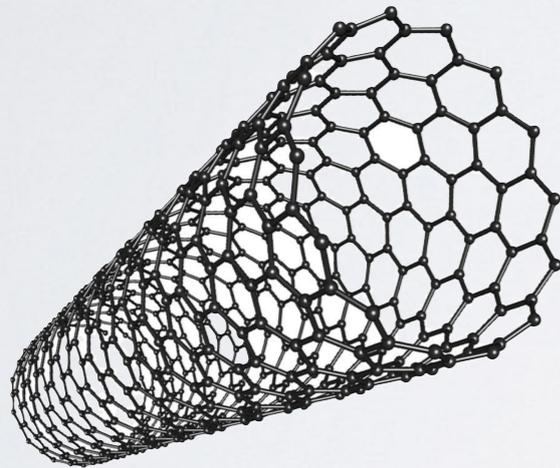$$\Delta K_e \sim 100 \text{ meV} \quad \implies \quad \Delta x_T \sim 1 \text{ Å}$$

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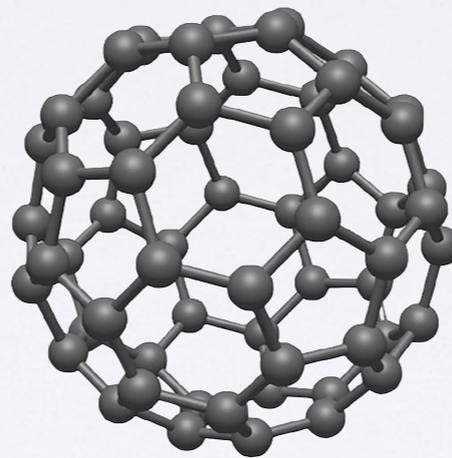Can we find a substrate that does this job?

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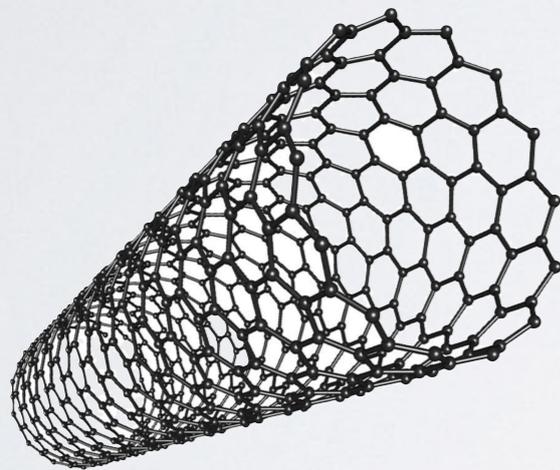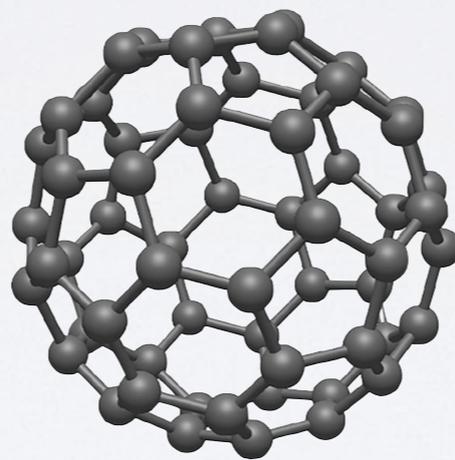
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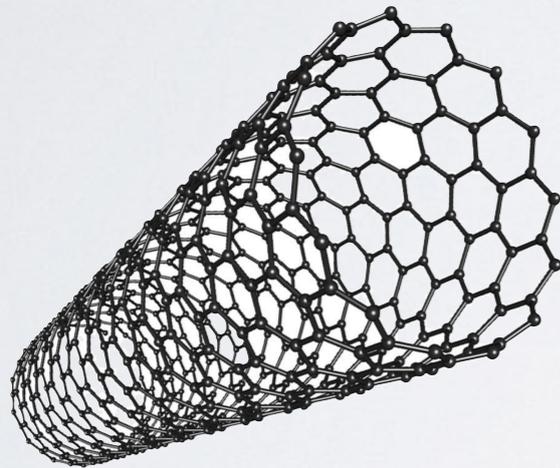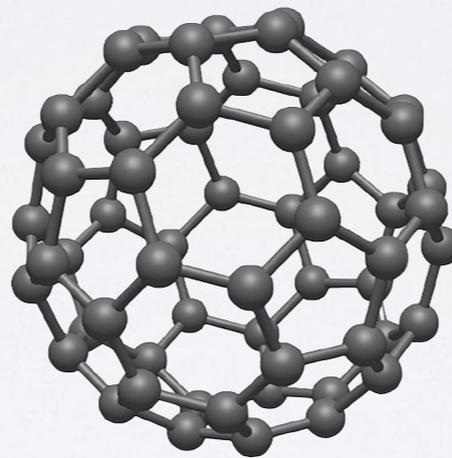Can we find a substrate that does this job?

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fullerenes?

…what else?

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We need to be creative and get to work!

OUTLOOK

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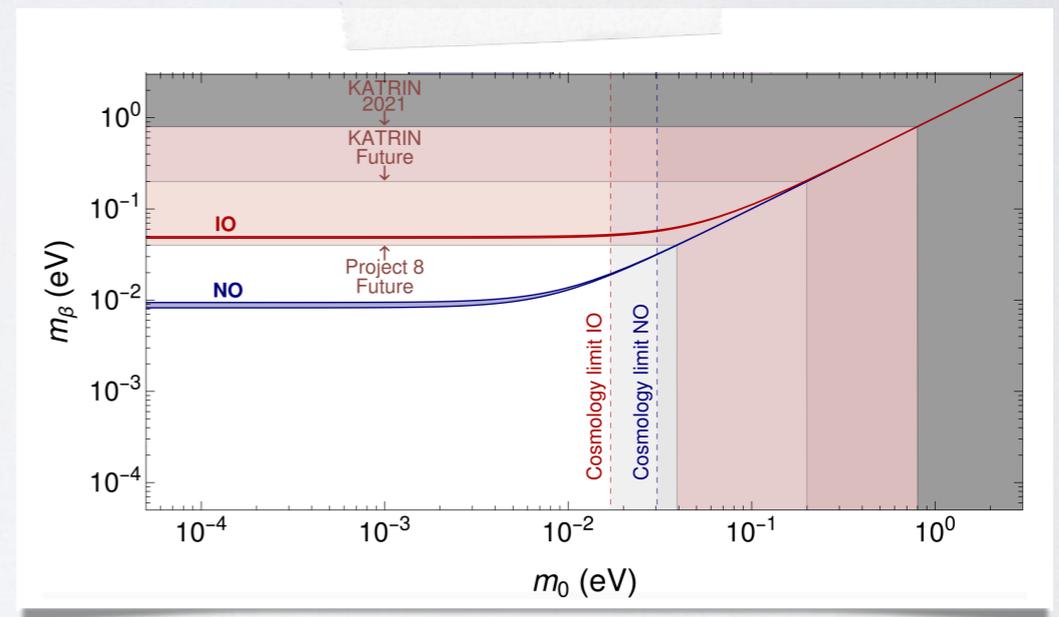There's a lot theory involved in the PTOLEMY project. It's challenging, interesting… and worth doing it!

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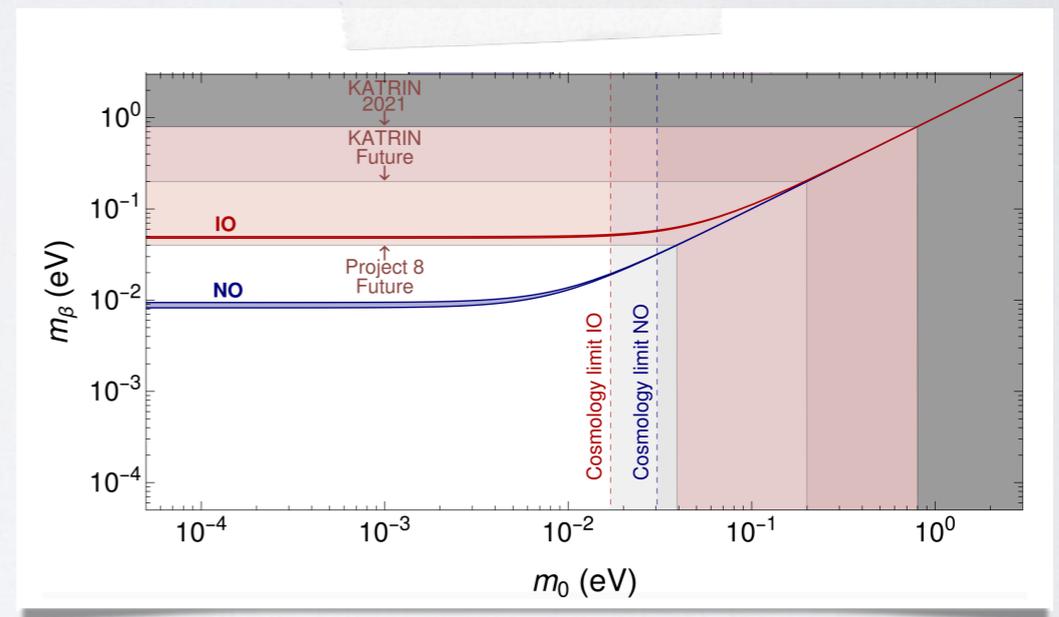# OUTLOOK

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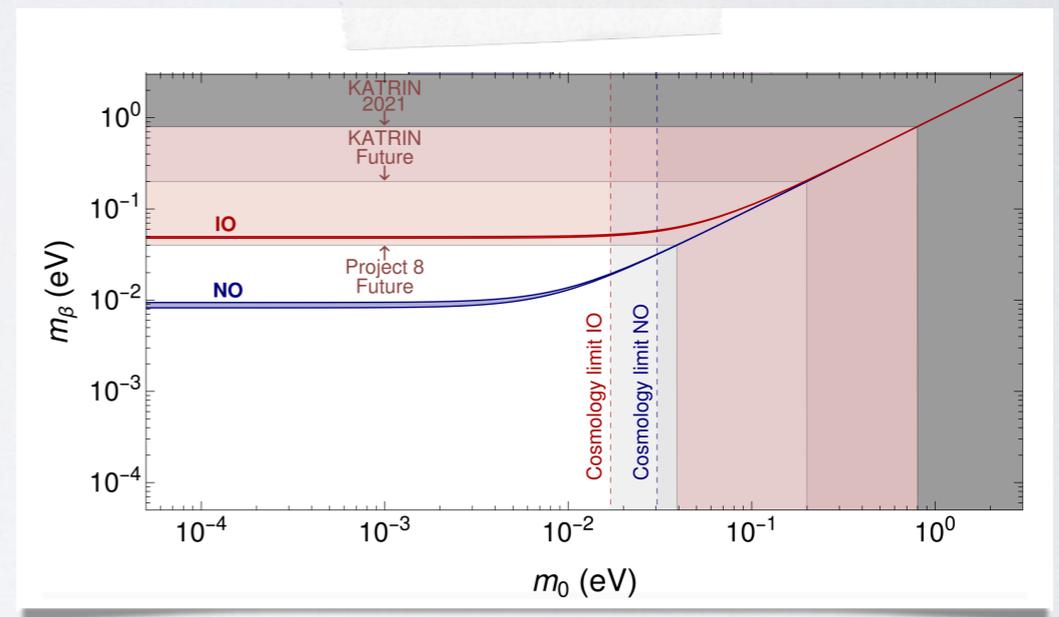To hunt for the CνB we need to study possible substrates to win against Heisenberg. Lots of studies to be done!

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Thanks for your attention!