THEORY UPDATE

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A THEORY PAPER

- We are writing a theory paper to collect everything we understood in the past year and a half (Casale, A.E., Menichetti, Tozzini)

- Critical discussion of:

  - Solid state effects on the initial tritium-graphene interaction (loading level, spatial distributions, magnetization)

  - Limitations of phrasing the problem in terms of "potentials" and challenges of the DFT formalism in our context

  - Preliminary version of the decay rate including all helium excitations and rough recipe for theory systematics on m_ν

DIFFERENT RECIPES

- We discuss at length the problem of sudden approximation within DFT
- The problem has no rigorous solution in this context, as it is a fully dynamical situation

1. in $t \sim 10^{-18}$ s one nuclear charge is changed, $T^+ \rightarrow He^{++}$
2. at first the system wave function remains unchanged
3. then electrons move to compensate for the extra charge
4. as more time passes, the nuclei also move to follow the new electronic distribution

DIFFERENT RECIPES

- We adopt three "recipes" to determine the final He potential:

A. Sudden: for each position of the helium, electron density fixed as it was when the tritium was sitting at its equilibrium position

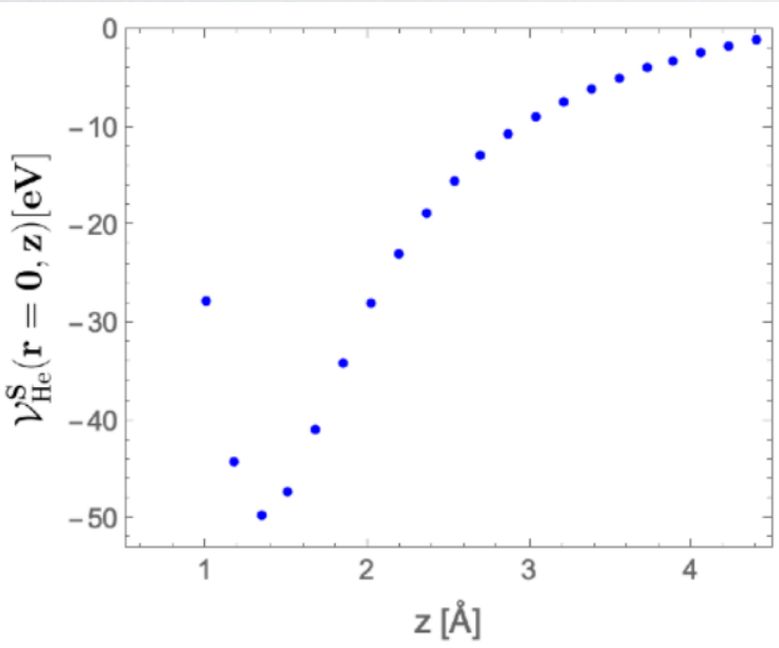
B. Semi-sudden: for each position of the helium, electron density fixed as it was when the tritium was at the same position as the helium

C. Adiabatic: allow to the whole system to relax to the new configuration

DIFFERENT RECIPES

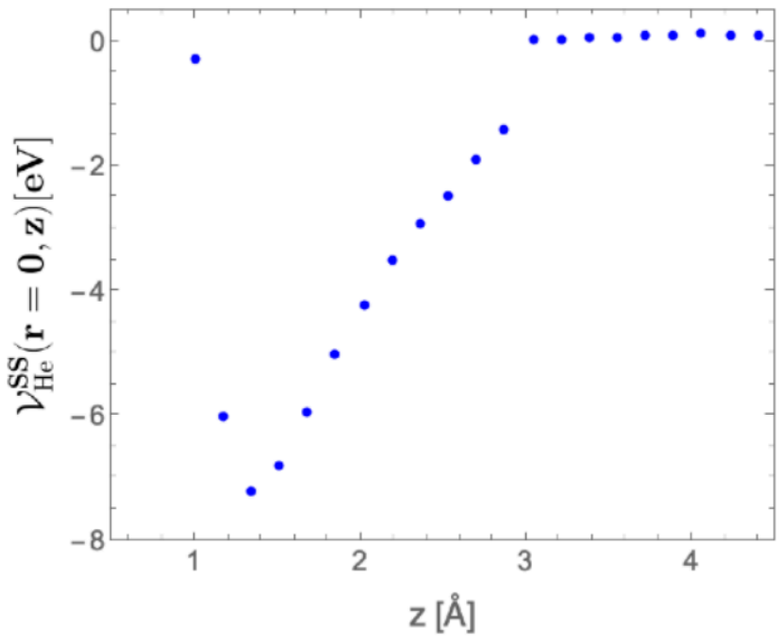
- Each recipe leads to different potentials for the final helium nucleus

Sudden



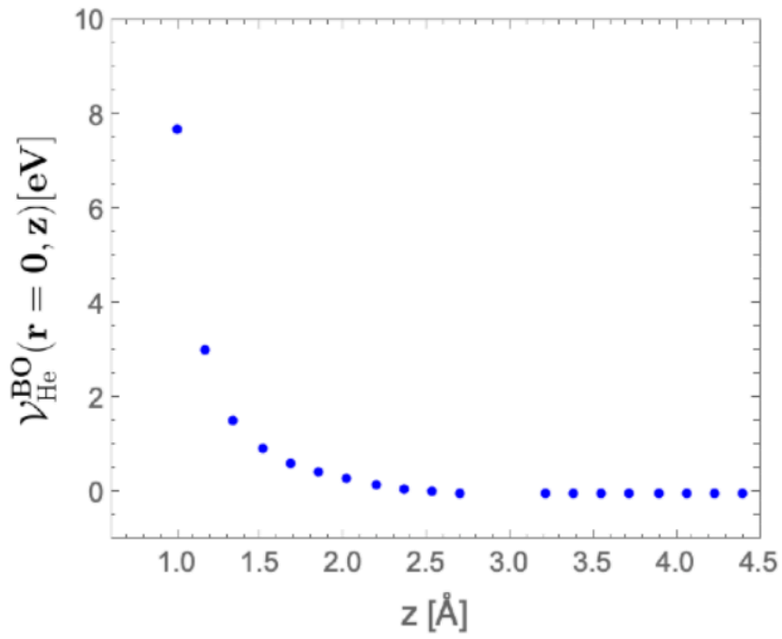
Bound states present. Very deep.

Semi-sudden



Bound states present. Shallower.

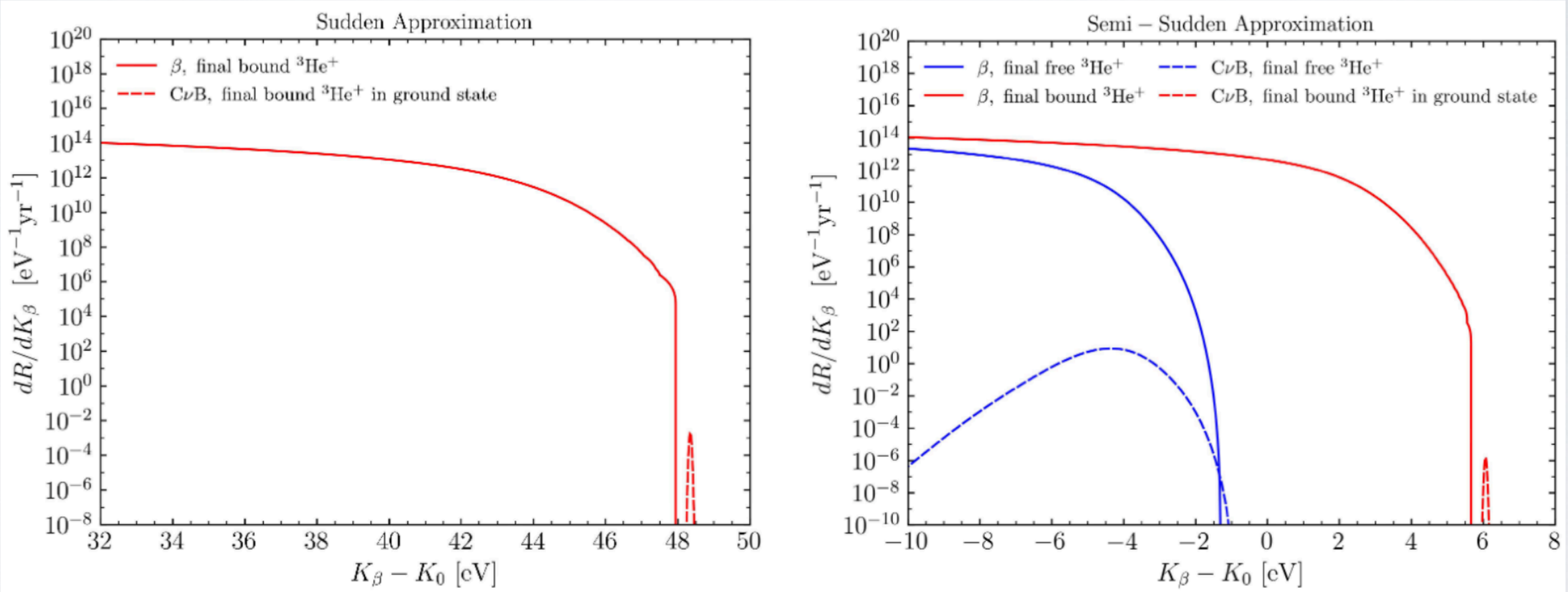
Adiabatic



No bound states.

DIFFERENT RATES

- Each recipe leads to different decay rates:



- Extracting m_ν from these recipes and comparing gives a first idea of theory systematics (which can very much be improved)