Ab initio description of nuclear-breakup and decay reactions in light nuclei

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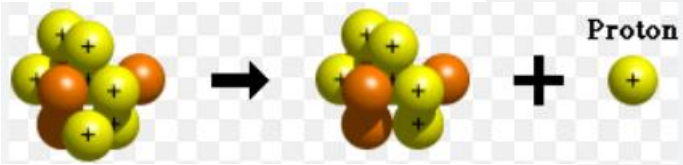
MY Journey

- I am from Syria.
- Academic Track:
  - Bachelor's degree: Applied physics.
  - Master's degree: Erasmus Mundus Nuclear Physics program (NUPHYS).
- Past research:
  - Internship: modeling of atmospheric muon flux for the KM3NET experiment.
  - Thesis: radiative capture reaction rates of interest for the rp-process nucleo-synthesis, in a three body module.

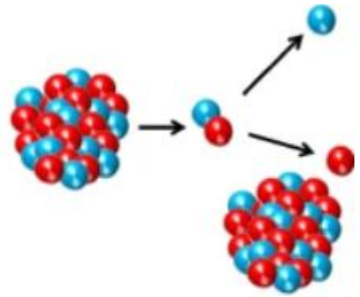
Motivations

We want to develop a unique tool applicable to both nuclear structure and reactions, to enhance our understanding of the strong force at low energy.

Enabling calculation of complex charged nuclear decay.



Enabling us to study nuclear breakup reactions.



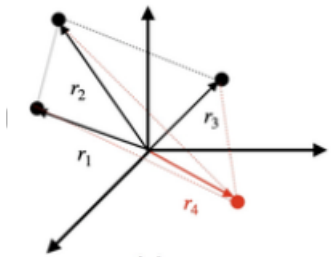
Method

- Configuration Interaction (CI):
  - Eigen-value problem → Matrix diagonalizaiton
- No Core Shell Model (NCSM):
  - HO wavefunctions.
  - Single particle basis.
  - Jacobi basis.
- NCSM with continuum (NCSMC):
  - For reaction calculation.

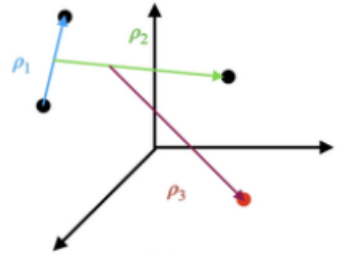
$$\Psi^{(A)}_{NCSM} = |A\lambda J^\pi T\rangle = \sum_\alpha c_\alpha \; |A\alpha j_z{}^\pi t_z\rangle$$

Mixing coefficients(unknown)

A-body harmonic oscillator states



(a)



(b)

$$\left|\Psi^{J^\pi T}_A\right\rangle = \sum_\lambda c^{J^\pi T}_\lambda |A\lambda J^\pi T\rangle + \sum_\nu \int dr r^2 \frac{\gamma^{J^\pi T}_\nu(r)}{r} \hat{\mathcal{A}}_\nu \left|\Phi^{J^\pi T}_{\nu r}\right\rangle$$

Complex Scaling

- Resonances are associated with complex poles of the S matrix.
- The wave solution associated with resonances diverges.
- Complex scaling makes these solutions square integrable.

$$\phi(r \to \infty) = A(k)\mathrm{e}^{-\mathrm{i}kr} + B(k)\mathrm{e}^{+\mathrm{i}kr} \simeq \mathrm{e}^{-\mathrm{i}kr} + S(k)\mathrm{e}^{+\mathrm{i}kr}$$

$$\phi_n^{\mathrm{res}}(r \to \infty) = B(k_n)\mathrm{e}^{+\mathrm{i}|k_n|\mathrm{e}^{-\mathrm{i}e\alpha}r} = B(k_n)\mathrm{e}^{\mathrm{i}a_n r}\mathrm{e}^{+b_n r} \to \infty$$

$$\left(\hat{S}\hat{H}\hat{S}^{-1}\right)\left(\hat{S}\phi_n^{\mathrm{res}}\right) = (\varepsilon_n - (\mathrm{i}/2)\Gamma_n)\left(\hat{S}\phi_n^{\mathrm{res}}\right)$$

$$\hat{S}\phi_n^{\mathrm{res}} \to 0 \text{ as } \mathrm{r} \to \infty$$

$$\hat{S}f(r) = f\left(r\mathrm{e}^{\mathrm{i}\theta}\right)$$

More about myself

My Hobbies:

- Table tennis.
- Swimming and jogging.
- Playing PC games.
- Chess.

My Hometown:

Food

Merci pour votre attention