

# QRPA: Year 3

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- Application of Deformed QRPA
  - Beyond QRPA
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## Applications:

- Extend systematic studies of  $2^+$  states and giant resonances to deformed nuclei
- With charge-changing version of code, calculate:
  - $\beta$ -decay rates out to the  $r$ -process path to advance understanding of nucleosynthesis
  - $\beta\beta$  matrix elements in all candidates
  - neutrino cross sections for detector candidates

## Beyond QRPA: Width of states

∃ myriad extensions to incorporate resonance widths by including two-phonon states, e.g., 2nd QRPA . In Bethe-Salpeter equation for response function result is energy dependence in interaction.

### Problems:

- Energy dependence of interaction in these extensions not consistent with KS TDFT (which puts constraints on dependence).
- Extensions never fully implemented because of number of two-phonon configurations (probably  $\gtrsim 10^6$  for good calculation).

### Solutions:

- Decide if we really want to be confined to KS DFT. If so, determine good way to modify energy dependence accordingly.
- Code the extension. Rely on computer scientists and/or shell-model experience to solve large-matrix problem. For many applications need only first 10 or so moments of distribution

Possible collaboration with T. Nakatsukasa to implement non-matrix version?