

Ab-initio description of monopole resonances in light- and medium-mass nuclei

Methods, uses and *preliminary* results

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Vittorio Som 

February 28th – March 3rd 2023

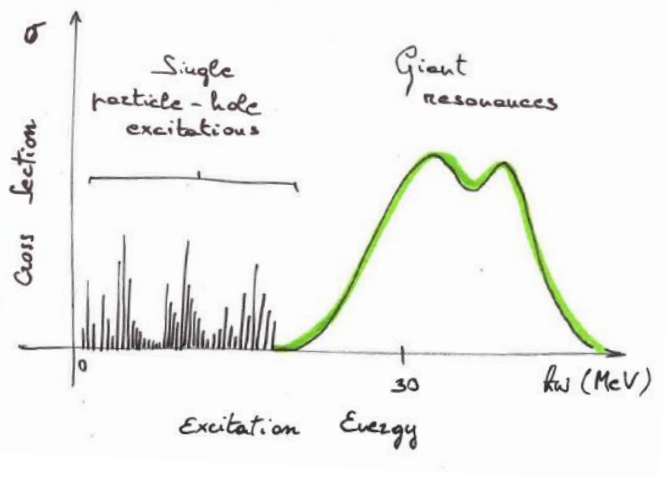
XI Workshop on Progress in *Ab-Initio* Nuclear Theory
TRIUMF, Vancouver



Giant Resonances

Dual nature of nucleus

- single-particle features
- collective behaviour



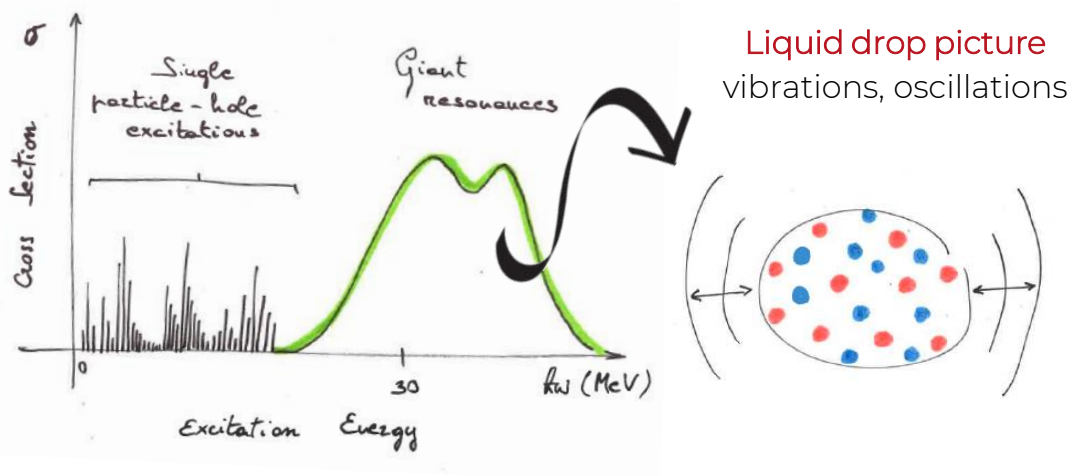
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Giant Resonances (GRs)

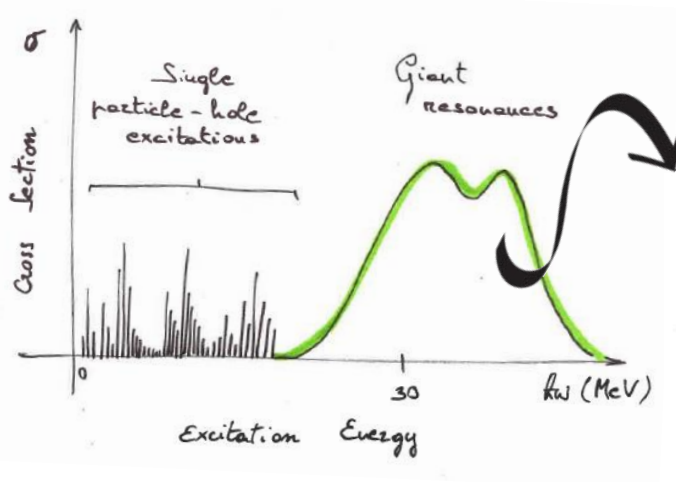
clearest manifestation of **collective motion**



Giant Resonances

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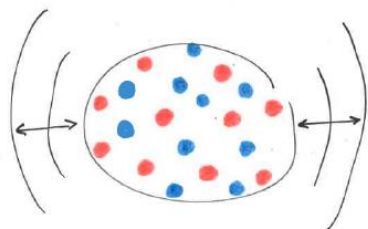
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Giant Resonances (GRs)

clearest manifestation of **collective motion**

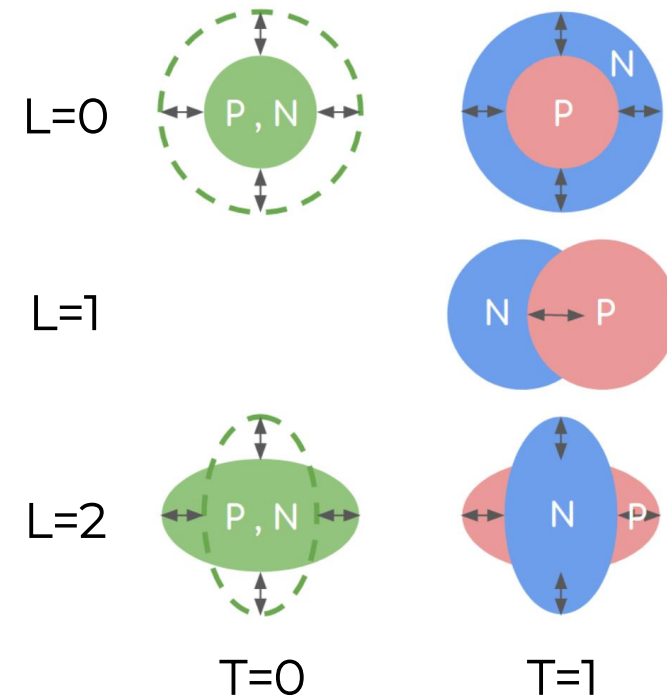
Liquid drop picture
vibrations, oscillations



Deformation



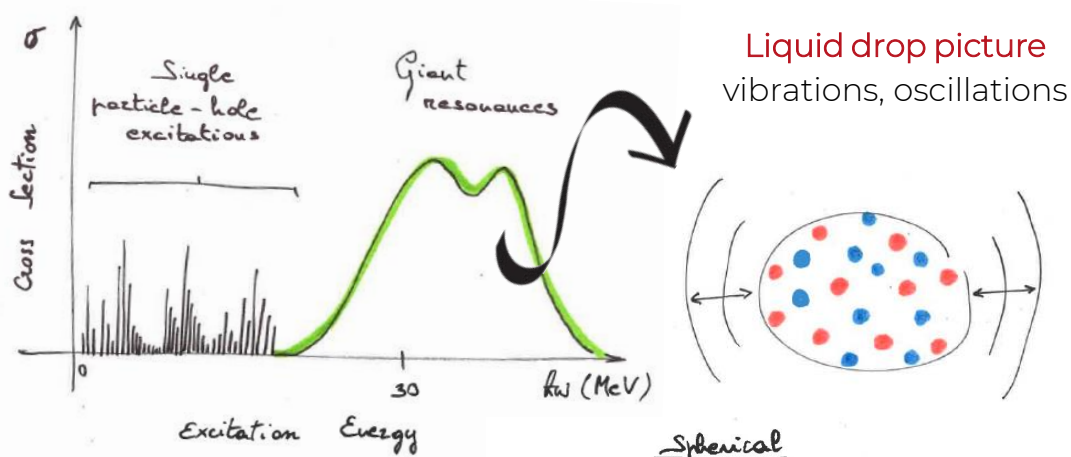
Coupling between different L



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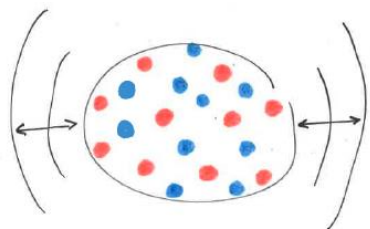
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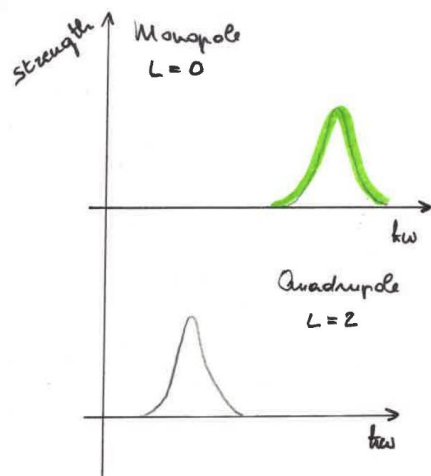
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Spherical

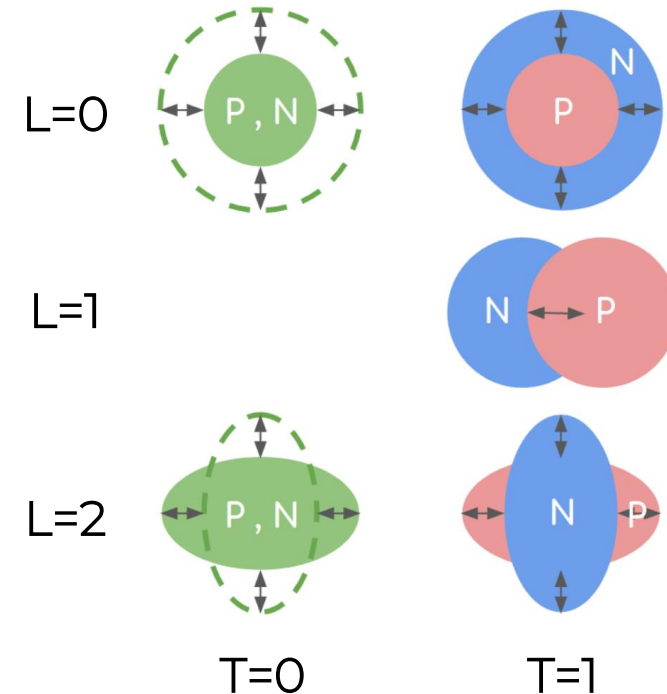
Spherical
(no deformation)



Deformation



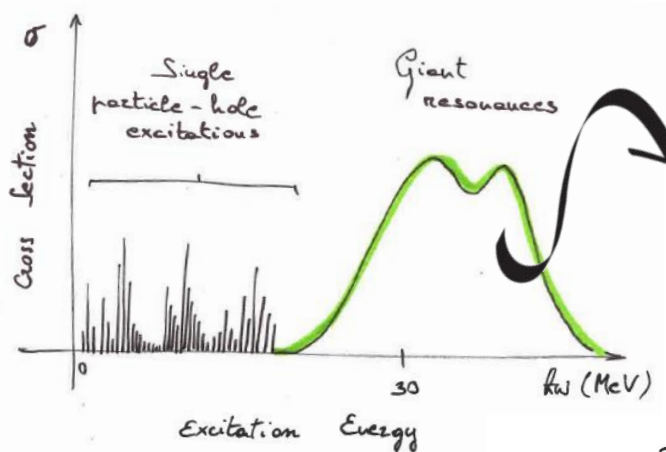
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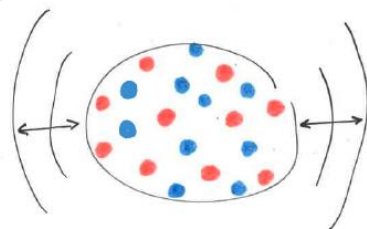
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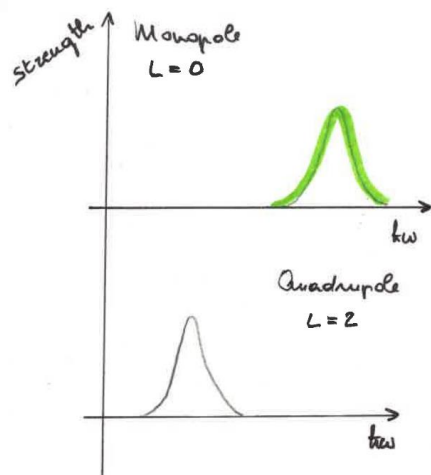
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Spherical

Spherical
(no deformation)



Spheroidal
(deformed)



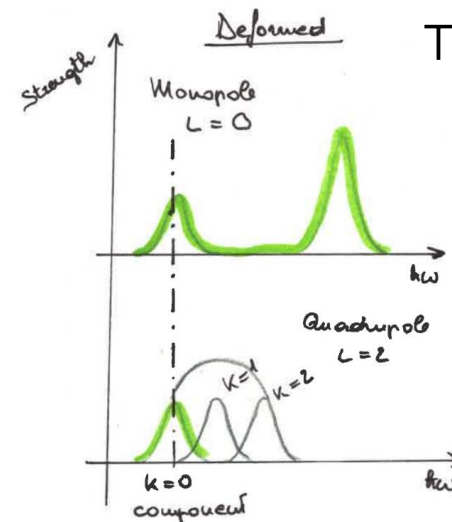
Prolate
(cigar type)

Oblate
(pancake type)

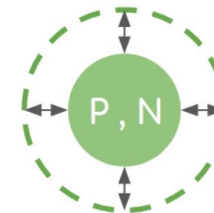
Deformation



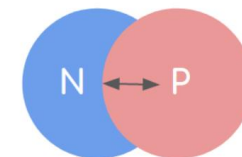
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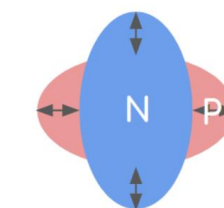
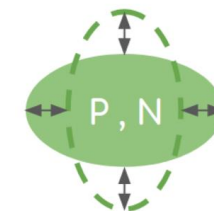
L=0



L=1



L=2



T=0

T=1

Giant Monopole Resonance

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What is it ?

- Collective excitation (breathing mode)
- Involving most if not all the nucleons
- Coherent particle-hole excitations

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- Renewed experimental interest
- Investigate new physics

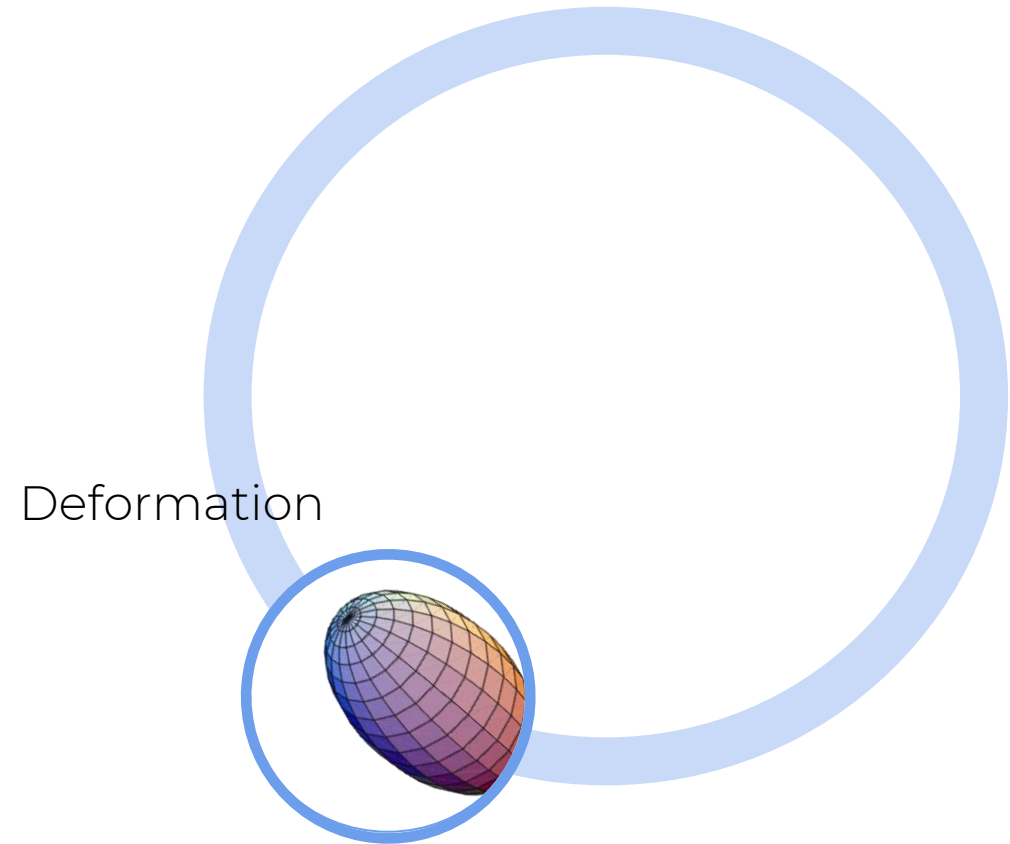
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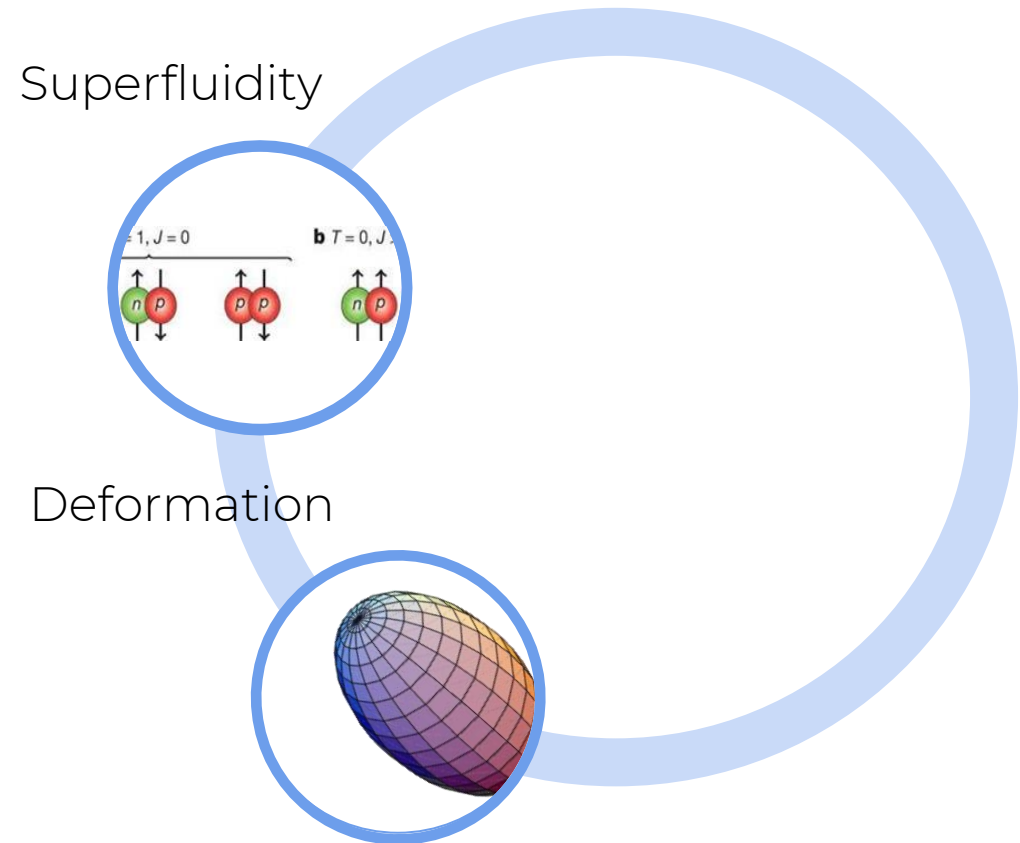
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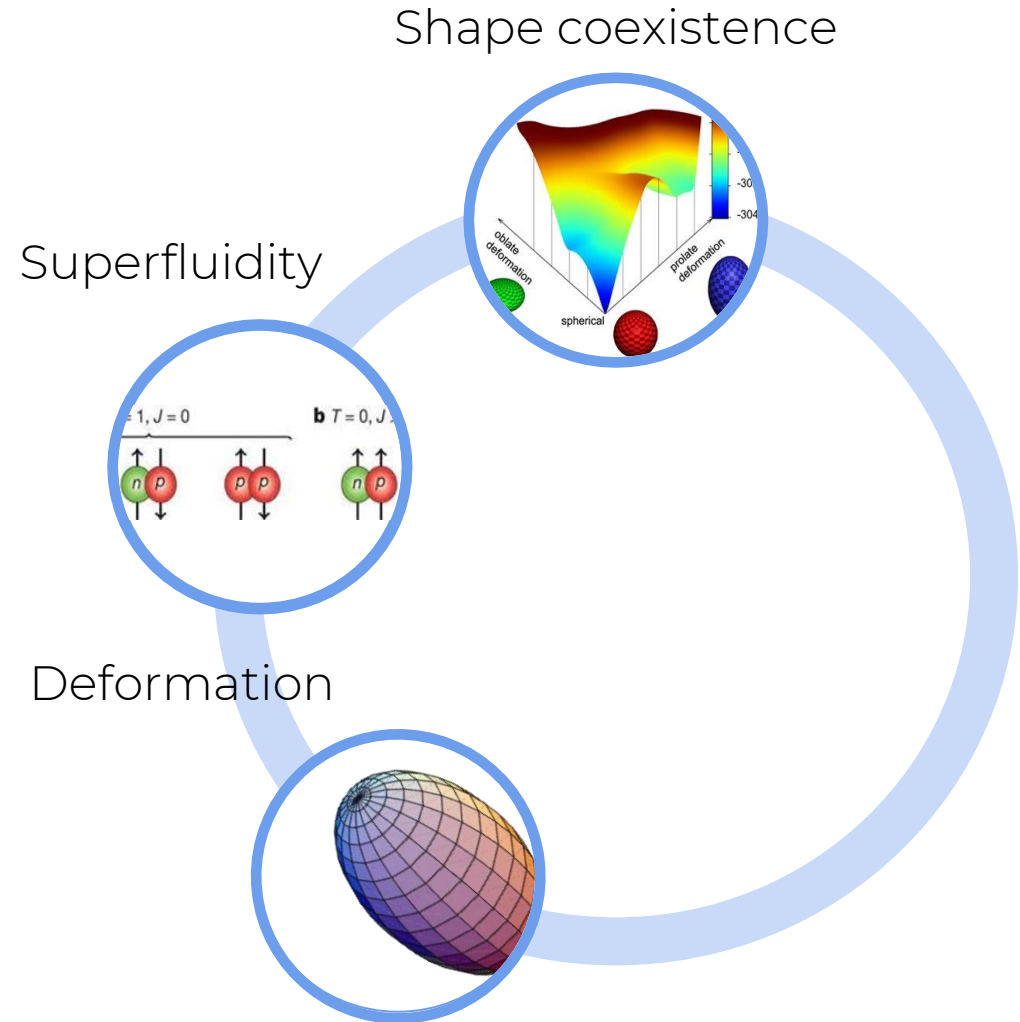
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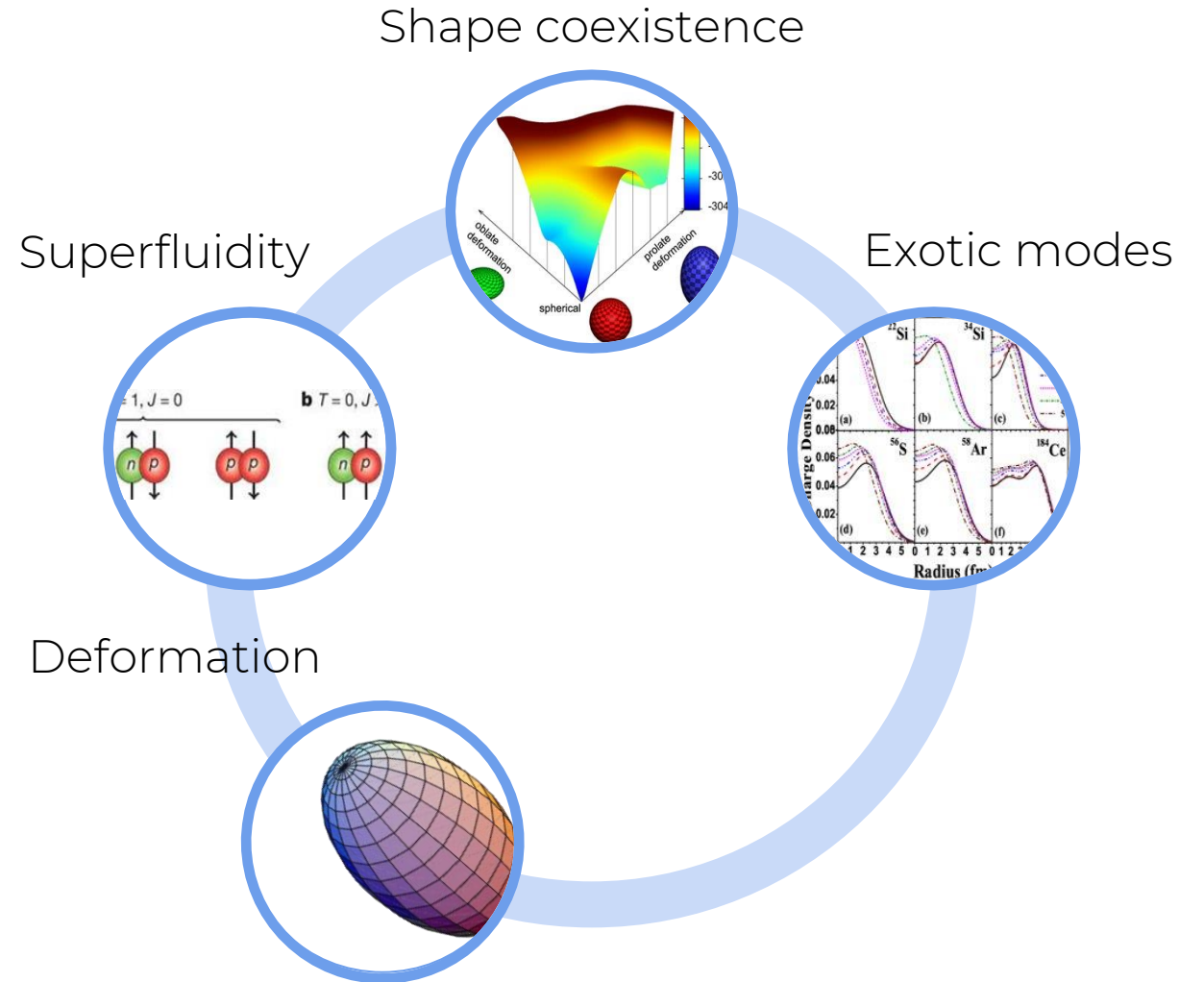
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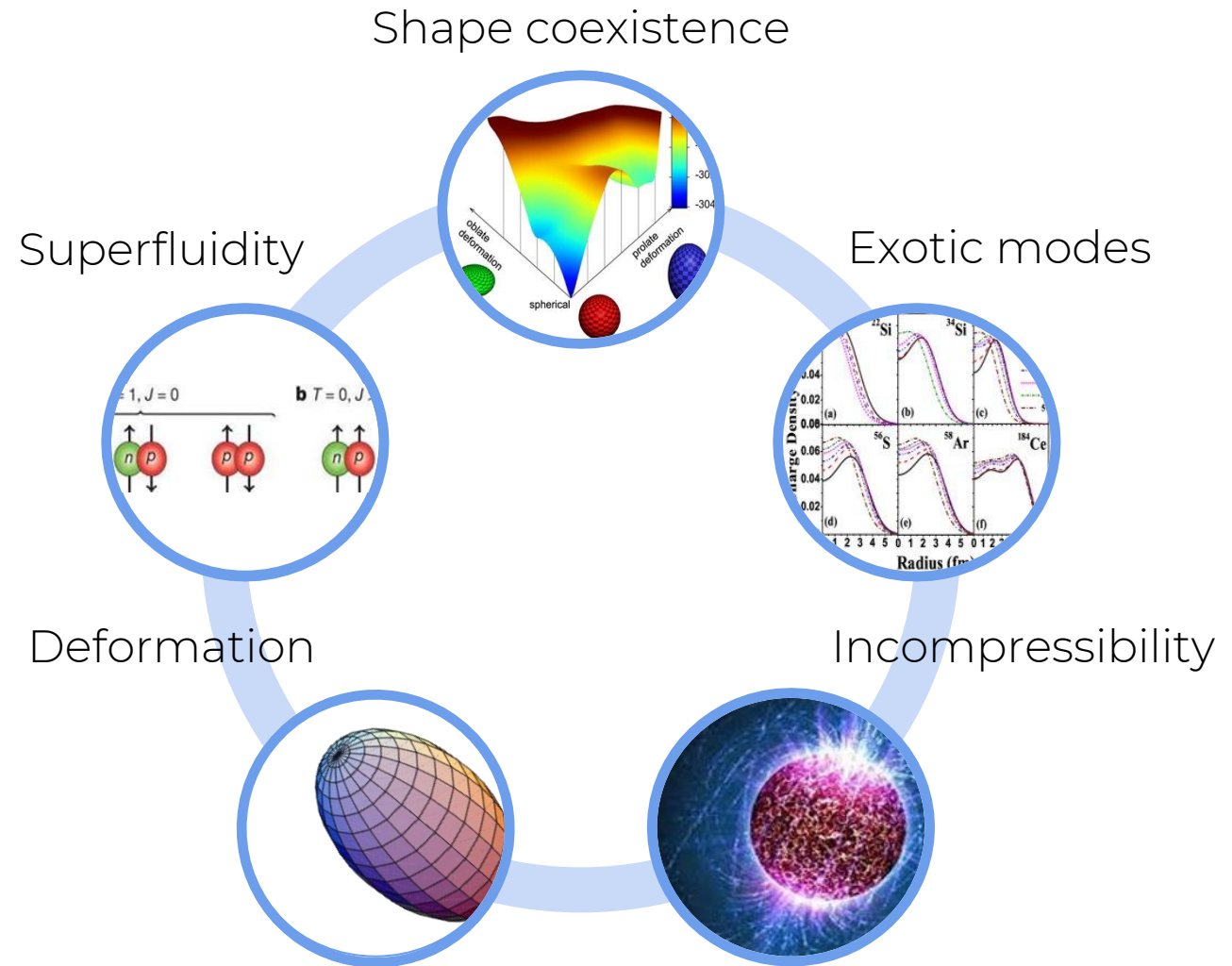
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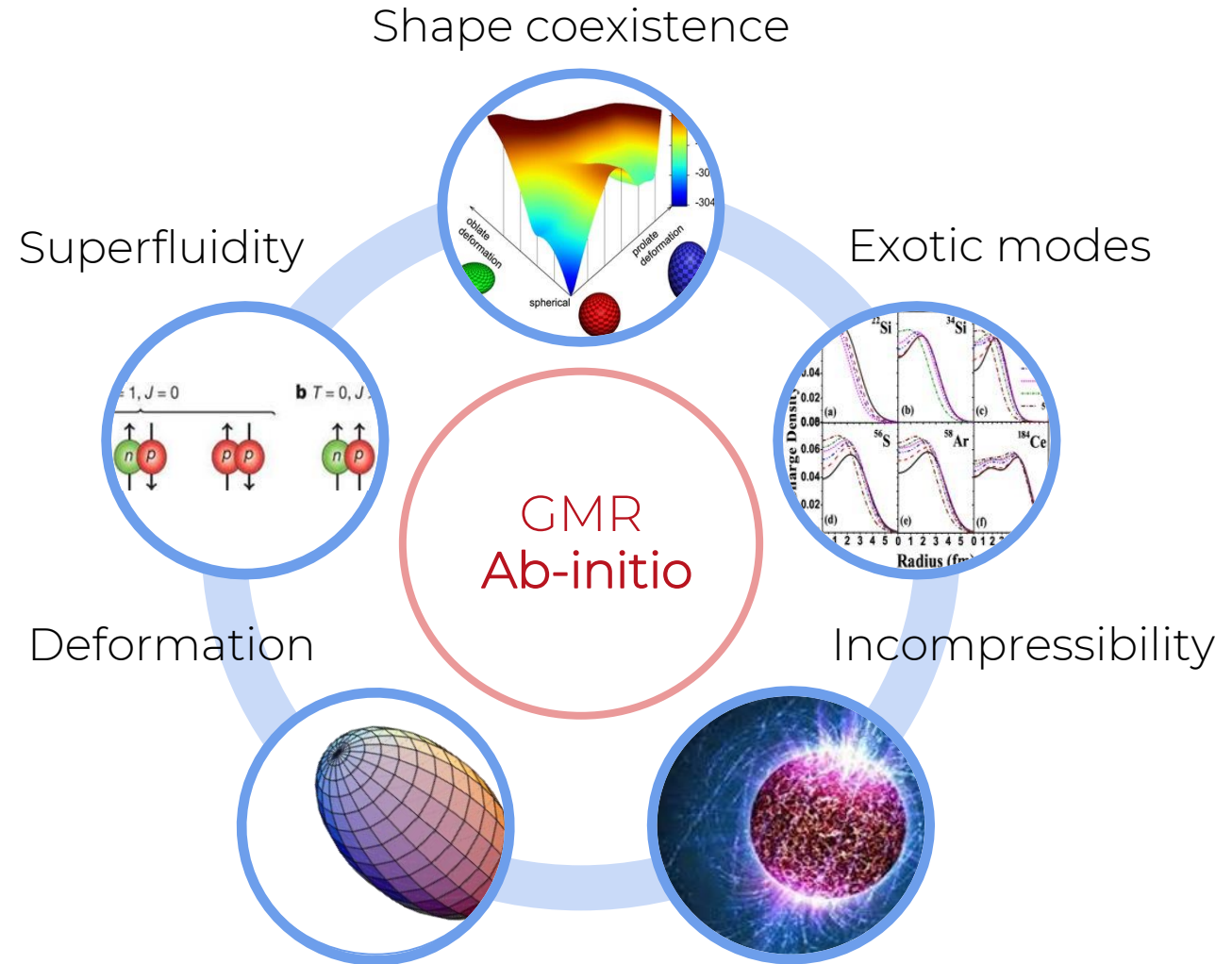
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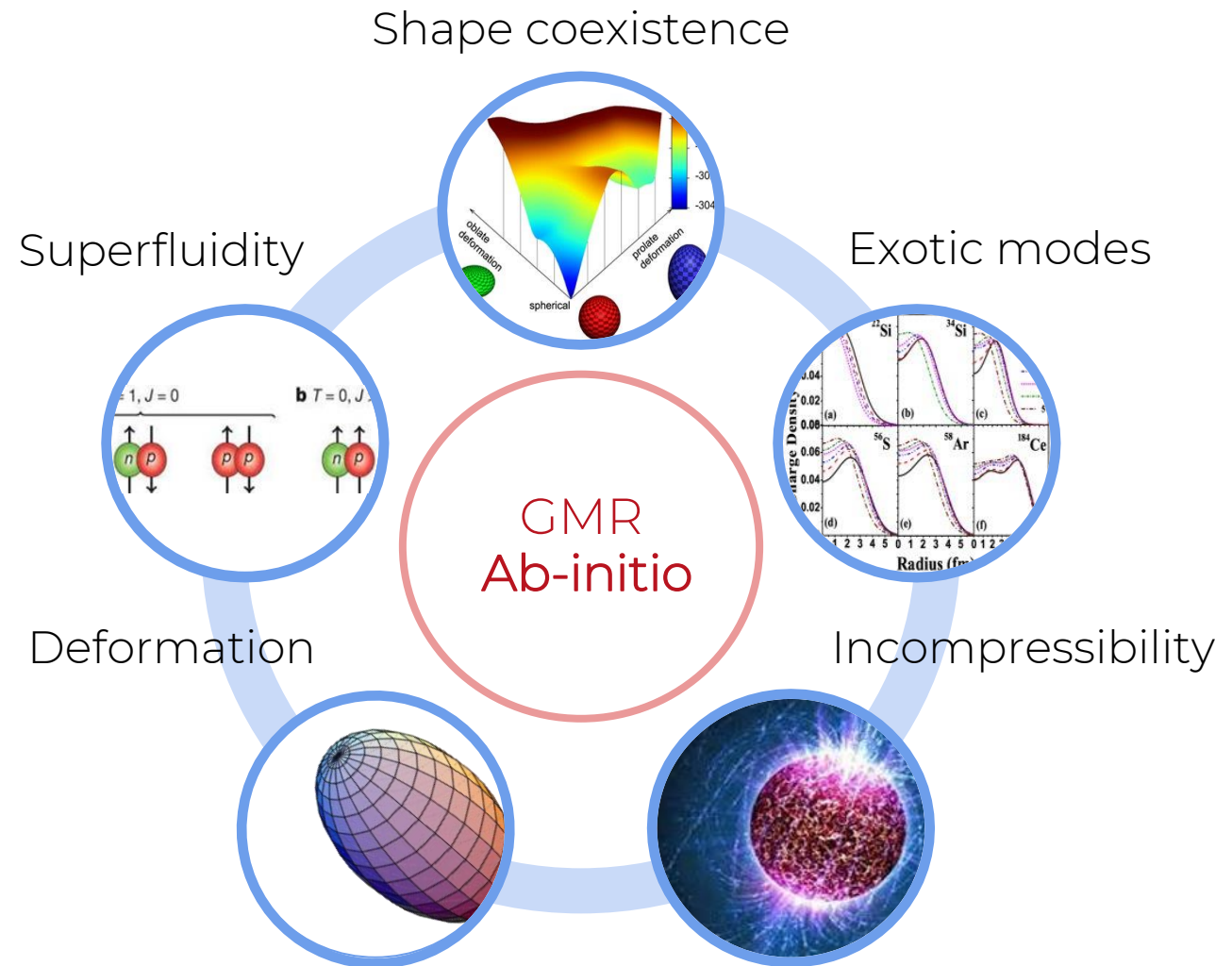
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Much is still to be understood !

- No systematic studies (EDF as well)
 - Very generic numerical codes needed
- **Ab-initio description still seminal**



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Closed- and open-shell systems up to $A \sim 100$

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Exploiting **symmetry breaking** and **restoration** to capture **collective correlations**

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Closed- and open-shell systems up to $A \sim 100$
- Use of **existing** and **novel** many-body techniques
Exploiting **symmetry breaking** and **restoration** to capture **collective correlations**
- Test bench for **nuclear interactions**
Incompressibility and saturation properties

Projection in GCM and RPA

DIFFERENT FLAVOURS OF SYMMETRY BREAKING AND RESTORATION

(Q)RPA

Symmetry breaking

GCM



Symmetry conserving

Projection in GCM and RPA

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Harmonic fluctuations around
deformed HF(B)

Symmetry breaking



GCM

Large amplitudes superposition
of def. HF(B) states



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PROJECTION AFTER DIAGONALIZATION
AD-AMP RPA



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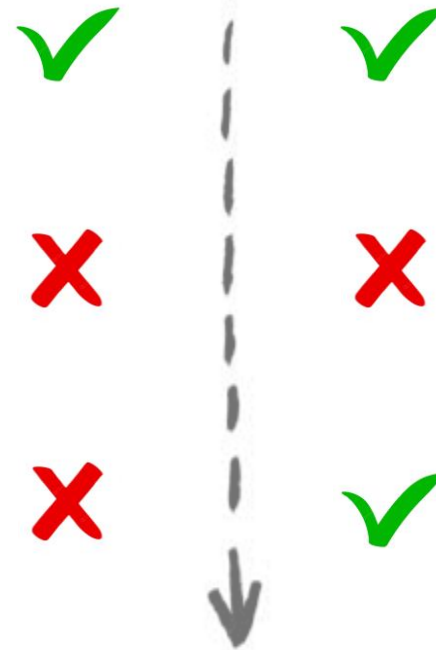
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PROJECTION BEFORE DIAGONALIZATION
P(Q)RPA ⁽¹⁾

PROJECTION BEFORE DIAGONALIZATION
PGCM

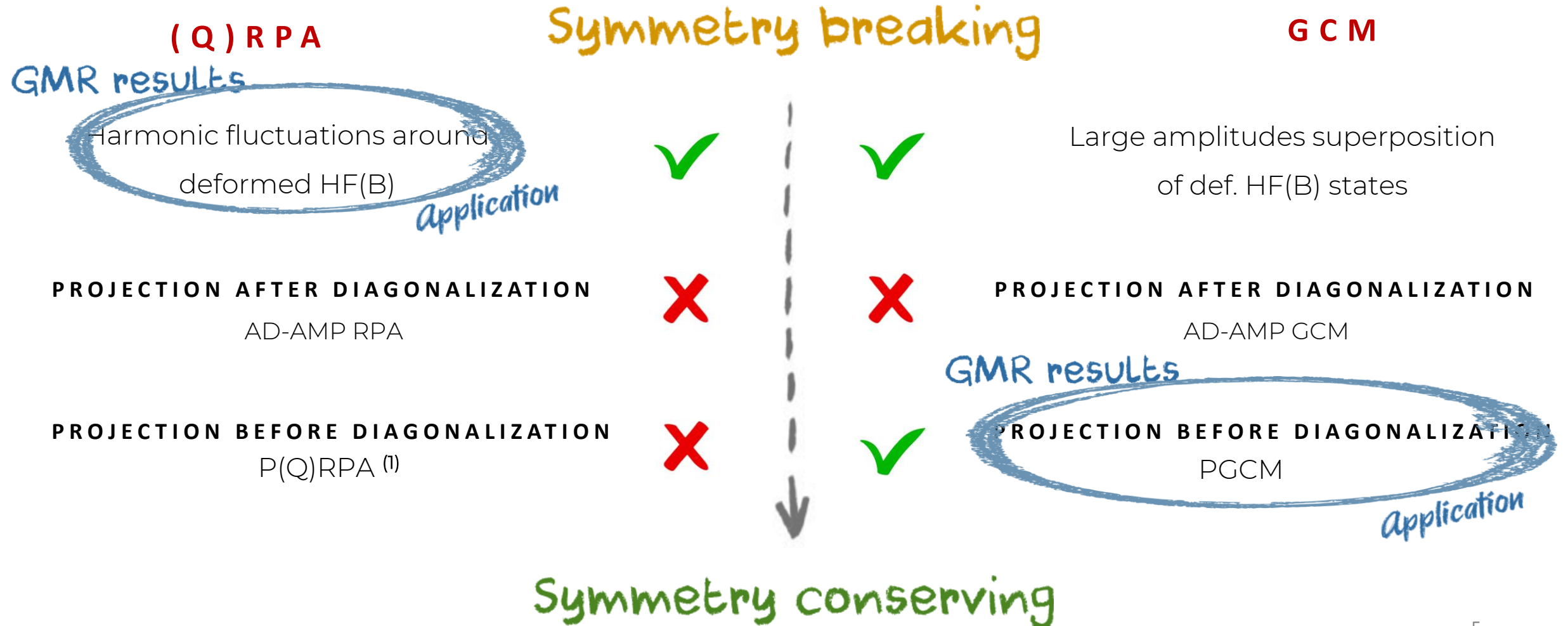


Symmetry conserving

(1) [Federsmidt and Ring, NucPhysA, 1985]

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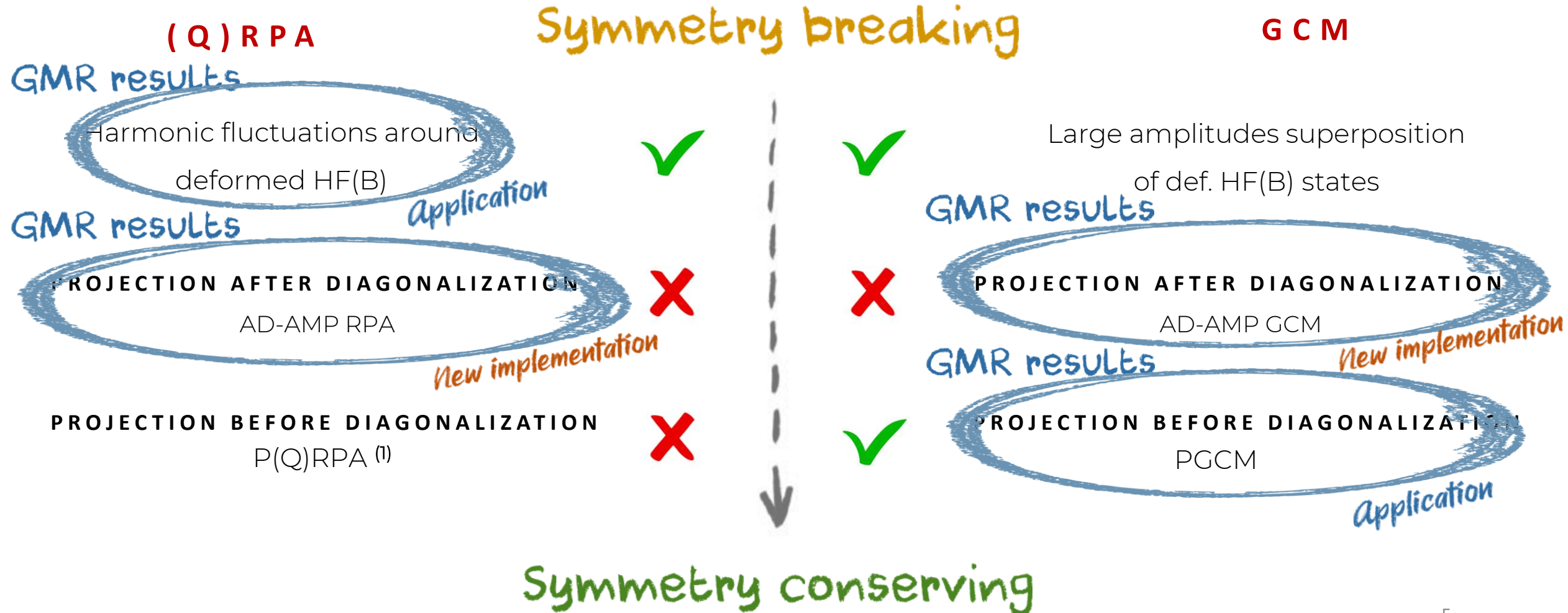
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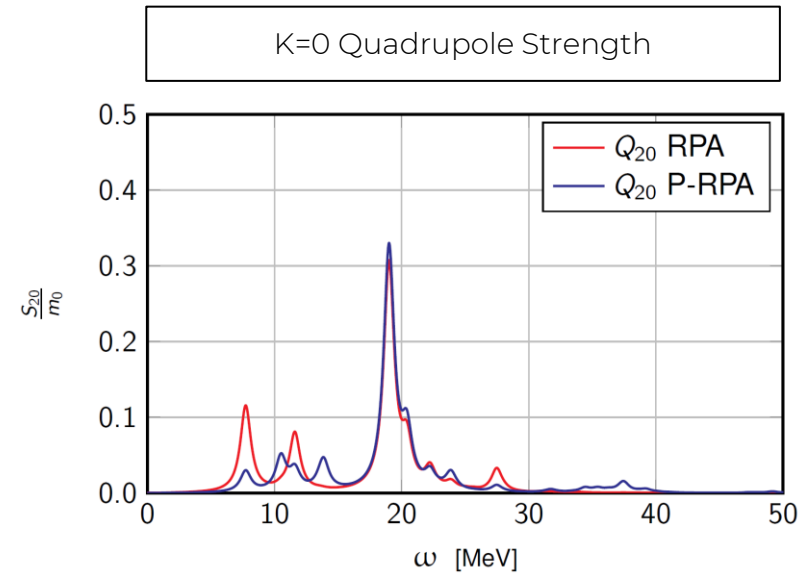
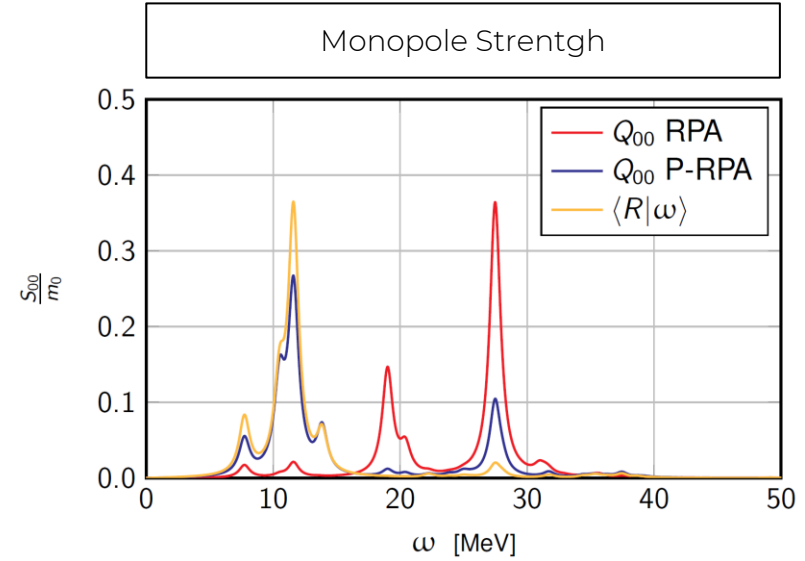
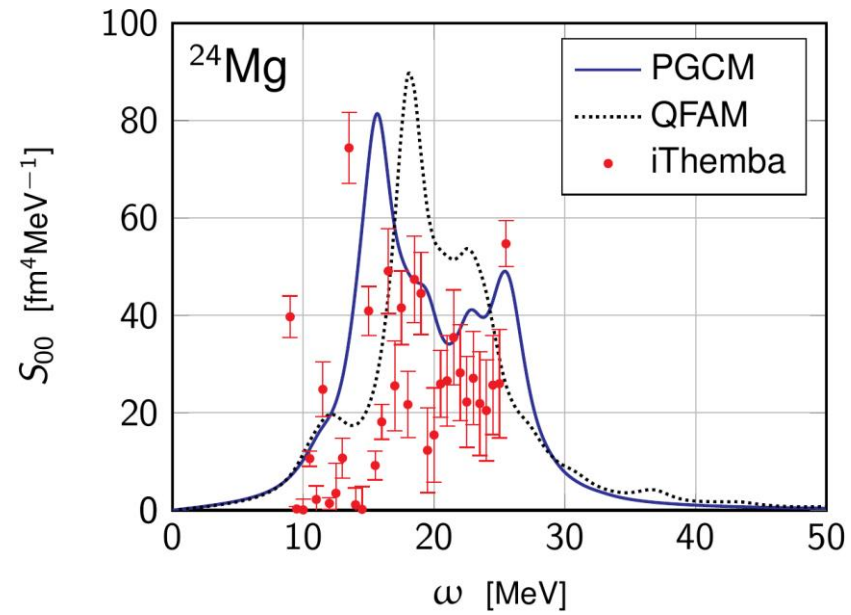
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Some results



Thanks for the attention



CEA DRF

Thomas Duguet
Vittorio Somà
Benjamin Bally
Alberto Scalesi



CEA DES

Mikael Frosini



CEA DAM

Jean-Paul Ebran
Yann Beaujeault-Taupier
Antoine Roux



Gianluca Colò
Danilo Gambacurta



Technische Universität Darmstadt

Alexander Tichai



KU Leuven

Pepijn Demol