L'Iniziativa Specifica Few-Body Systems

Laura Elisa Marcucci

Presentazione Preventivi I.S.

4 luglio 2019

INFN-Pisa

I.S. FBS - Few-Body Systems (FBS)

Nuclear structure and reactions with Few-Body Systems

Units: Lecce, Padova, Pisa, Trento

Local Participants in the year 2019

Alejandro Kievsky (I Ric. INFN) 100%
Laura Elisa Marcucci (Ass. Prof. - Local Coor.) 100%
Michele Viviani (I Ric. INFN - National Coor.) 100%
A. Gnech (Dottorando presso il GSSI)

Local Participants in the year 2020

Alejandro Kievsky (I Ric. INFN) 100%
Laura Elisa Marcucci (Ass. Prof. - Local Coor.) 100%
Michele Viviani (I Ric. INFN - National Coor.) 100%
A. Bonaccorso (... enjoying retirement!) 100%
Jin Lei (Post-doc INFN starting in Nov. 2019) 100%

Other Participants in Italy - permanent

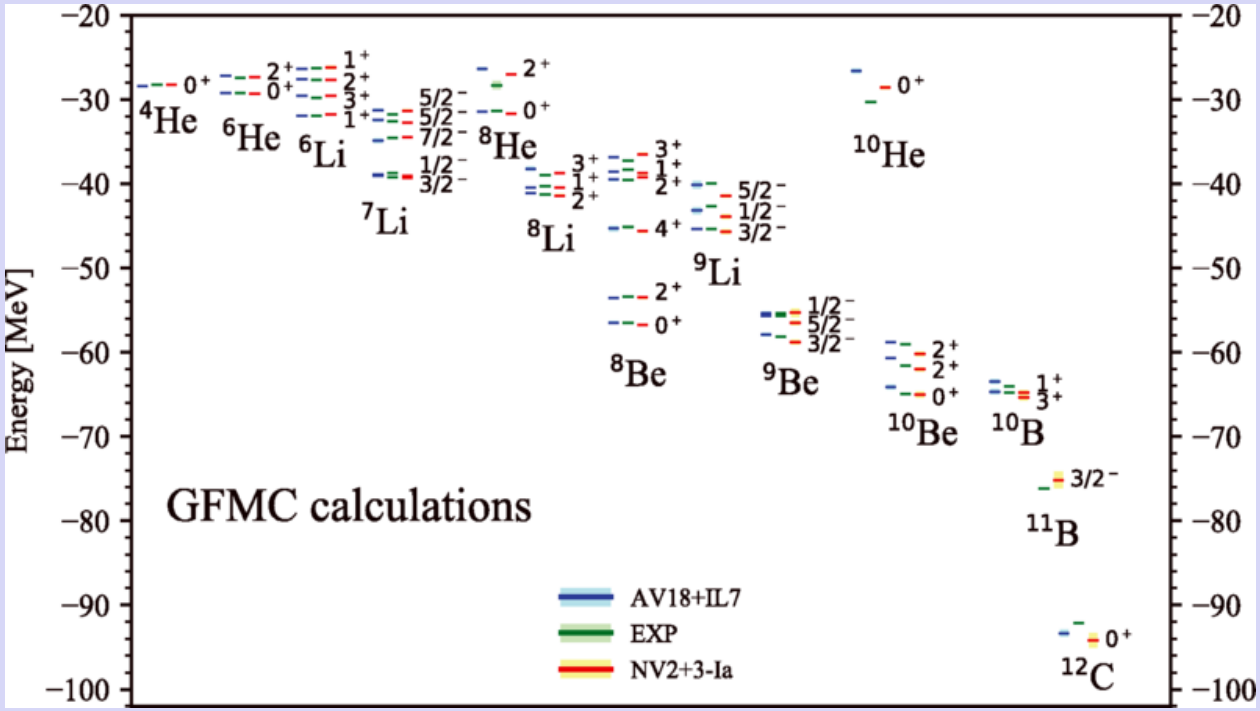
L. Girlanda (Lecce)
L. Canton (Padova)
W. Leidemann & G. Orlandini (Trento)

Attività svolta nel 2019

Ab-initio method + χEFT framework

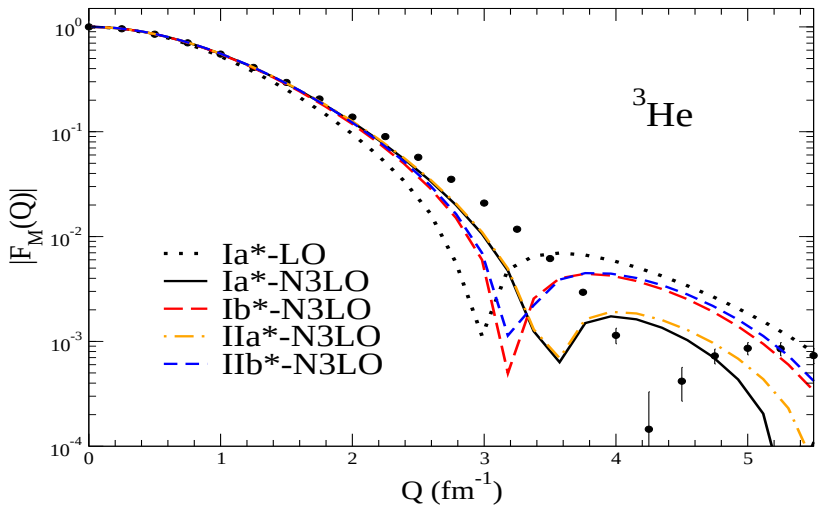
- Hyperspherical Harmonics method: $A = 3, 4$ bound and scattering systems solved essentially "exactly"
- χEFT framework to derive consistently potentials (to describe the spectrum of nuclei) and electro-weak currents (to describe EM structure and reactions) $\longrightarrow$ working in r-space

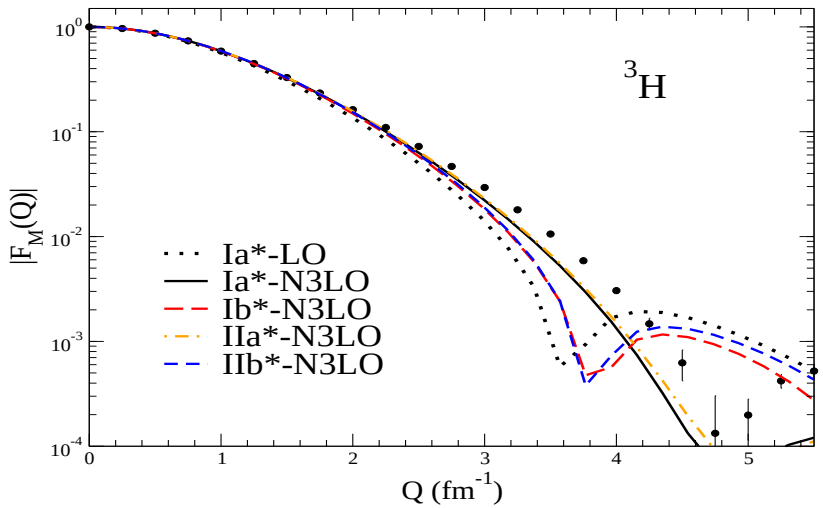
Spectrum of light nuclei

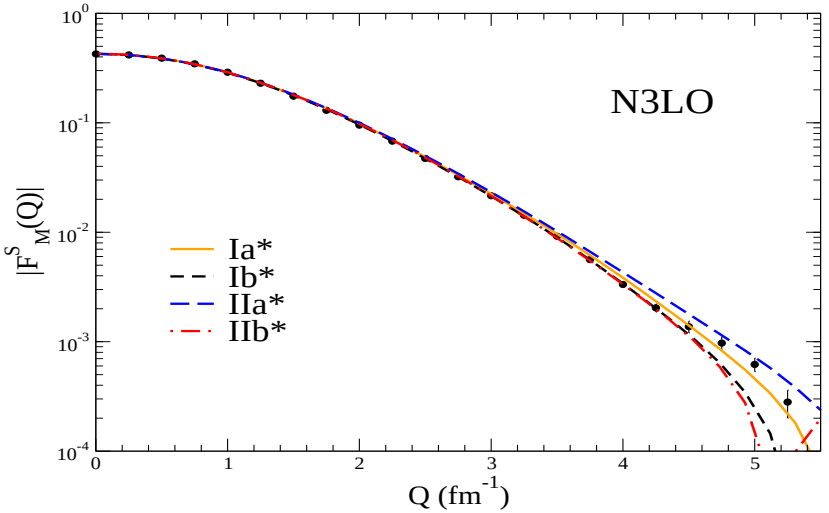


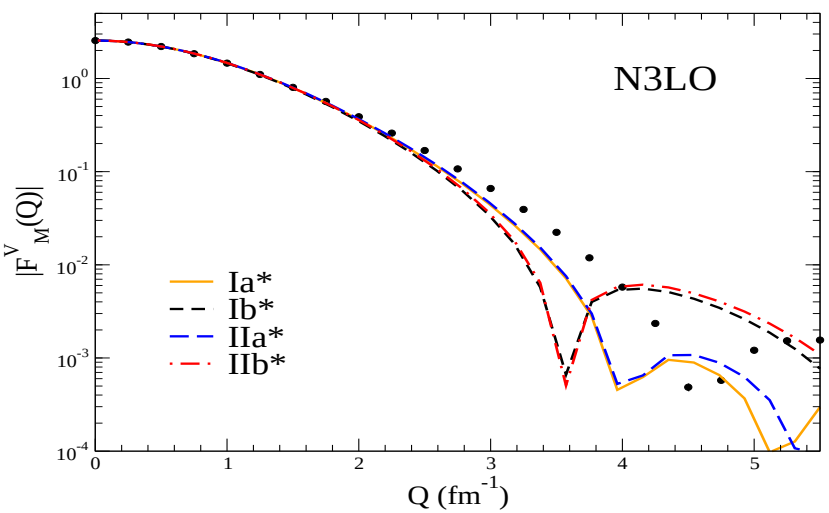
M. Piarulli *et al.*, Phys. Rev. Lett. **120**, 052503 (2018)

Magnetic form factors of $A = 3$ nuclei









R. Schiavilla *et al.*, Phys. Rev. C **99**, 034005 (2019)

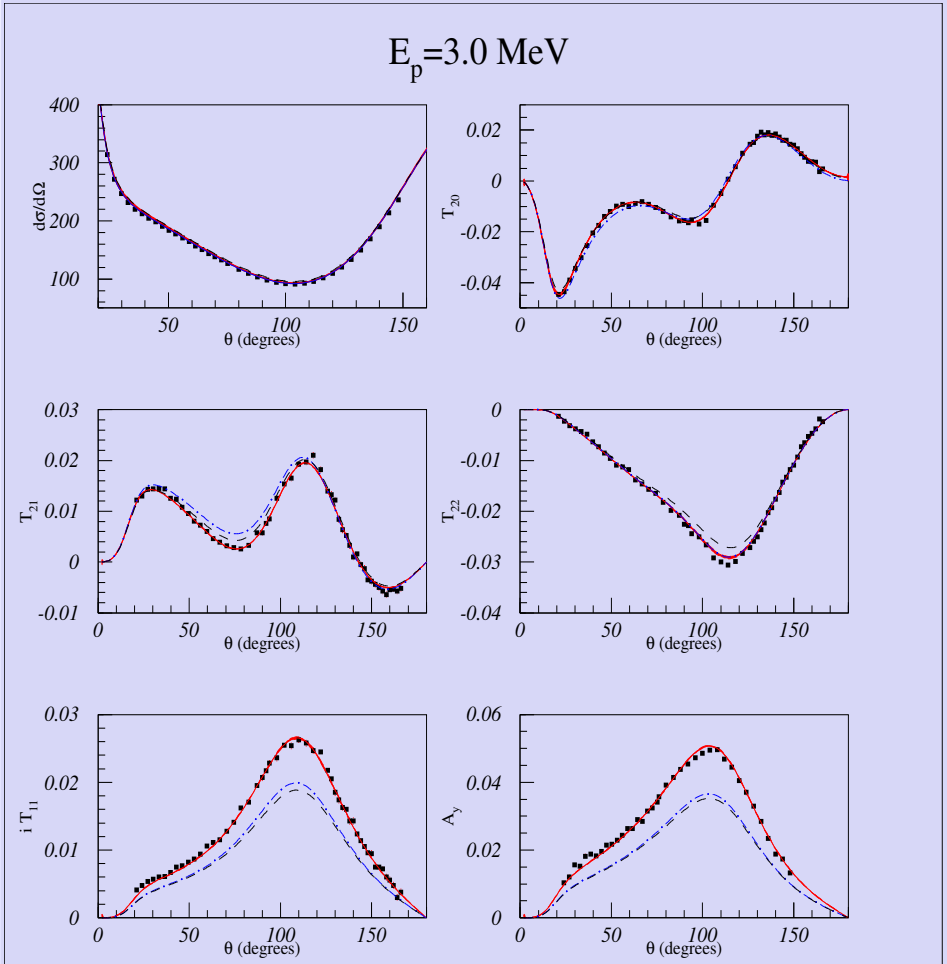
Attività prevista per il 2020: premessa

The three-nucleon interaction

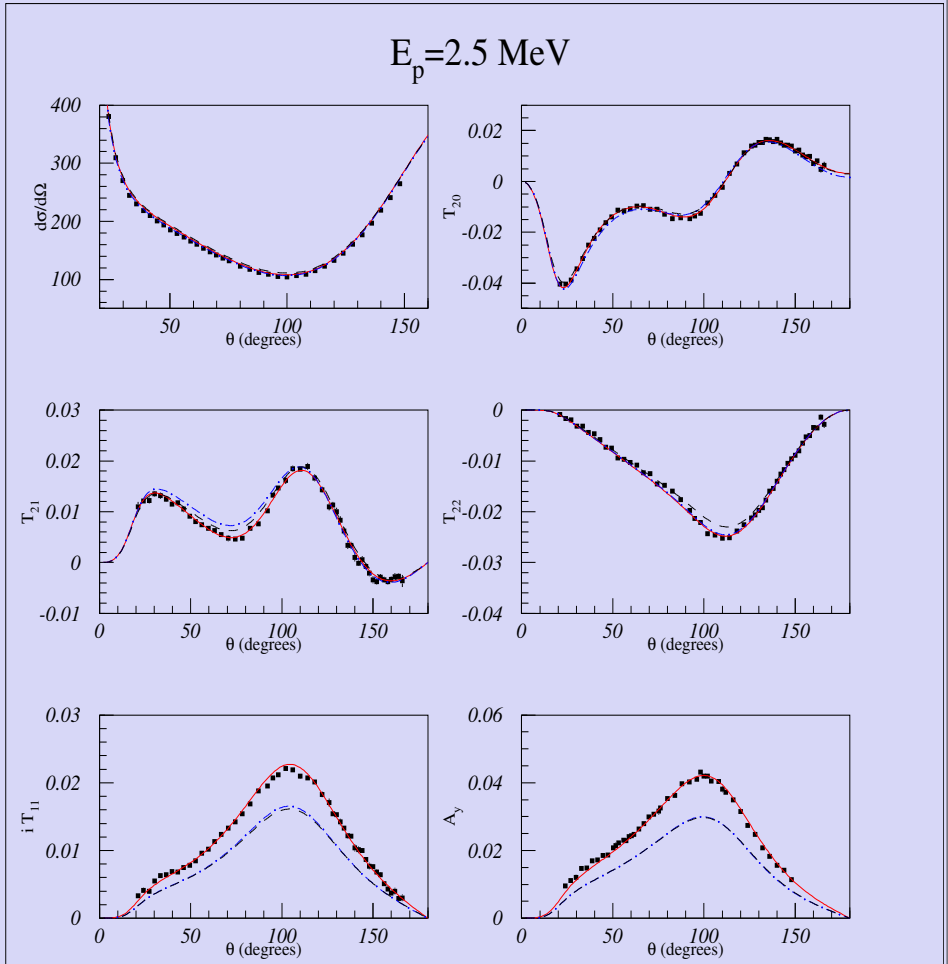
A "new"χEFT-inspired TNI which solves the long-standing A_y-puzzle

L. Girlanda *et al.*, Phys. Rev. C **99**, 054003 (2019)

FIT



PREDICTIONS



Attività prevista per il 2020

- A "fully consistent" χEFT interaction which solves the few-body systems with the same accuracy at which the two-body systems are solved by the *NN* interaction
- "Push the few to less few": application of the HH method to study the $A = 5, 6$ nuclear systems (A. Gnech's PhD thesis) and associated processes
- "Keep pushing": application of the HH method to study the full breakup process $n + d \to n + n + p$ (only one other method existing in the world)
- Nuclear reactions of astrophysical interest: *ab-initio* study within "our" χEFT framework of
  - $p + d \to {}^3\mathrm{He} + \gamma$ (LUNA at LNGS) and $p + d \to {}^3\mathrm{He} + e^+ + e^-$ (REDTOP at FermiLab)
  - $p + p \to d + e^+ + \nu_e$ and $p + {}^3\mathrm{He} \to {}^4\mathrm{He} + e^+ + \nu_e$
  - muon captures on light nuclei (MuSun at PSI)
  - tritium β-decay and inverse neutrino-capture process (PTOLEMY at LNGS)
  - $\ldots$
- Further investigation on Efimov physics and the unitary limit
- One- and two-body momentum distributions in light nuclei (Hall A and B at JLab)

Supporto per il 2019 (grazie)

- **Elba 2019: Lepton Interactions with Nucleons and Nuclei (Elba XV)**,
  Marciana Marina (Isola d'Elba), 23-29 giugno 2019
  (Claudia e Lucia: scientific and organizing secretariat)
  `https://agenda.infn.it/event/17166/`
- **Summer School "Rewriting Nuclear Physics Textbooks: one more step forward"**,
  Pisa, 22-26 luglio 2019
  (spazi, Claudia e Lucia: scientific and organizing secretariat)
  `https://agenda.infn.it/event/17273/`
- **Cortona 2019: XVII Conference on Theoretical Nuclear Physics in Italy**,
  Cortona, 9-11 ottobre 2019
  (Claudia e Lucia: scientific and organizing secretariat)
  `https://agenda.infn.it/event/19425/`