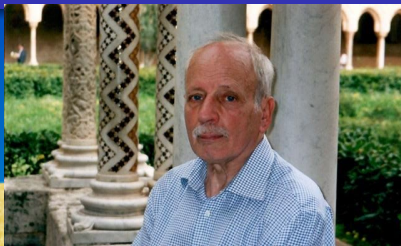


Sergio Rosati

(May 18, 1934 - February 27, 2022)



Laura E. Marcucci (Univ. Pisa - INFN Pisa)



TNPI2023 - XIX Conference on Theoretical Nuclear Physics in Italy

- Curriculum vitae
- Research activity:
 - The first years: from the “laurea” up to 1970s
 - From the 70s up to the second half of 1980s: the Fermi-Hypernetted-Chain equations and the many-body systems
 - The last period: the Hyperspherical-Harmonics method and the few-body systems
- Teaching activity
- ... and more

Curriculum vitae

- **May 18, 1934:** born in Lucca, 4th of 7 children
- **1952-1956:** student at the Univ. of Pisa and Scuola Normale Superiore (SNS) of Pisa
- **November 1956:** “laurea” in Physics with 110/110 *summa cum laude* and “diploma” of the SNS with 70/70 *summa cum laude* (Supervisor: Luigi Arialdo Radicati di Brozolo)
- **1960-1976:** assistant professor of Theoretical Physics at the Univ. of Pisa
- **1967:** “libera docenza” in Theoretical Physics
- **1976-2003:** full professor in Nuclear Physics
- **since 2003:** professor emeritus of the Univ. of Pisa
- **1957-2012:** INFN associate

Honors and awards

- 1957: **Italian Physics Society Award for young Italian physicist**
- 2000: “**Ordine del Cherubino**” (Univ. of Pisa), “for his scientific merits and in recognition of his successful activity as a teacher and trainer of several generations of physicists”

Research activity in the 1970s

- 1st article: L.A. Radicati and SR, *On the spin of the K_{μ} meson*, Nuovo Cimento **10**, 729 (1957)
- Research activity on **hypernuclei** in collaboration with **L. Lovitch**
 - B. Barsella and SR, *On the Possible Existence of Hyperfragments with Mass Number $A=6$* , Nuovo Cimento **13**, 458 (1959)
 - LL and SR, *The Hypernucleus ${}^6\text{He}_{\Lambda}$* , Nuovo Cimento A **51**, 647 (1968)
 - LL, SR, R.H. Dalitz, *The Stability of ${}^6\text{Li}_{\Lambda}$* , Nuovo Cimento A **53**, 301 (1968)
- Research activity on **few-body systems**
 - LL and SR, *Binding Energies and Wave Functions of Three Bosons Interacting through Local Potentials*, Nuovo Cimento B **63**, 335 (1969)
 - **S. Fantoni** and SR, *Alpha-Deuteron Model of ${}^6\text{Li}$* , Nucl. Phys. A **151**, 317 (1970)
 - SF and SR, *Expansion Procedure for Jastrow-Type Correlated Wave Functions*, Nuovo Cimento A **10**, 145 (1972)

→ fruitful collaboration with **S. Fantoni**

The years 1970s-1980s: many-body physics (I)

- Jastrow correlation and the **correlated basis function** (CBF) theory: from few- to **many-body** (up to infinite nuclear matter)
- Power series expansion for the Jastrow correlated w.f.
- **Fermi Hypernetted Chain (FHNC) equations** \Rightarrow microscopic approach to many-body systems: SF and SR
 - *Jastrow correlations and an irreducible cluster expansion for infinite Boson or Fermion systems*, Nuovo Cimento A **20**, 179 (1974)
 - *Hypernetted-chain approximation for a Fermion system*, Nuovo Cimento A **25**, 593 (1975)
 - *Fermi-hypernetted-chain method for state-dependent Jastrow-correlated functions*, Nuovo Cimento A **43**, 413 (1978)
 - *Extension of the FHNC method to finite systems*, Nucl. Phys. A **328**, 478 (1979) \rightarrow **finite nuclei**
- O. Benhar, C. Ciofi degli Atti, SF, SR, *Variational Calculation on Nuclear Matter*, Nucl. Phys. A **328**, 127 (1979)
- **A. Fabrocini**, SF, **A. Polls**, SR, *Variational Approach to the Fermi Hard-Sphere System*, Nuovo Cimento A **56**, 33 (1980)

\rightarrow fruitful collaboration with **A. Fabrocini et al.** on the quantum fluids

The years 1970s-1980s: many-body physics (II)

- AF and SR, *The Method of Interpolating Integral Equations for Quantum Fluids - n*
 - I Nuovo Cimento D **1**, 567 (1982)
 - II Nuovo Cimento D **1**, 615 (1982)
 - III Nuovo Cimento D **8**, 561 (1986) [the authors are **M. Viviani**, E. Buendia, AF, SR]
- AF, SF, A. Polls, SR, *Microscopic Calculation of the Excitation Spectrum of One He Impurity in Liquid He*, Phys. Rev. B **33**, 6057 (1986)

→ fruitful collaboration with **M. Viviani**

A. Kievsky joins the “Pisa group” → **few-body physics**

S. Fantoni, A. Fabrocini, O. Benhar, G. Co', ... → many-body physics

From the end of 1980s: few-body physics

(Long) series of articles of AK, SR, MV (and various permutations in the author order):

- *Euler and Correlated Harmonic Oscillator Wave Functions for Three-Nucleon Systems*, Nucl. Phys. A **501**, 503 (1989)
- *Correlated Hyperspherical-Harmonic Expansion for Three-Nucleon Systems*, Few-Body Syst. **9**, 1 (1990)

⇒ **Correlated Hyperspherical Harmonics (CHH) method**

- *Correlated Hyperspherical Harmonic Calculations for Three- and Four-Body Systems*, Nuovo Cimento A **105**, 1473 (1992)
- *The Three-Nucleon Bound-State with Realistic Soft and Hard Core Potentials*, Nucl. Phys. A **551**, 241 (1993)
- *Study of Bound and Scattering States in Three-Nucleon Systems*, Nucl. Phys. A **577**, 511 (1994)
- *Calculation of the Alpha-Particle Ground-State*, Few-Body Syst. **18**, 25 (1995)

CHH (or Pair correlated HH - PHH) method $\rightarrow A = 3, 4$ **bound and**
 $A = 3$ **scattering states** with realistic **local** interactions

- AK, **L.E. Marcucci**, SR, MV, *High Precision Calculation of the Triton Ground State within the Hyperspherical Harmonics Expansion Basis*, Few-Body Syst. **22**, 1 (1997)

\Rightarrow **from CHH/PHH to HH (no correlation)** still with local interactions

- MV, SR, AK, *Neutron- 3H and Proton- 3He Zero Energy Scattering*, Phys. Rev. Lett. **81**, 1580 (1998)

\Rightarrow CHH/PHH method for $A = 3, 4$ bound and scattering states: **ONLY**
method for low-energy scattering with Coulomb

The CHH/PHH method used to study

- **Elastic $A = 3, 4$ scattering**
 - AK, MV, SR, D. Hüber, W. Glöckle, H. Kamada, H. Witala, J. Golak, *Benchmark calculations for polarization observables in three-nucleon scattering*, Phys. Rev. C **58**, 3085 (1998)
 - T.C. Black, H.J. Karwosky, E.J. Ludwig, AK, SR, MV, *Determination of Proton-Deuteron Scattering Lengths*, Phys. Lett. B **471**, 103 (1999)
 - MV, AK, SR, E.A. George, L.D. Knutson, *The A_y Problem for p - ^3He Elastic Scattering*, Phys. Rev. Lett. **86**, 3739 (2001)
- **Electron scattering off $A = 3, 4$ nuclei & photodisintegration**
 - MV, AK, LEM, SR, **R. Schiavilla**, *Photo- and Electro-Disintegration of ^3He at Threshold and pd Radiative Capture*, Phys. Rev. C **61**, 064001 (2000)
 - LEM, MV, RS, AK, SR, *Electromagnetic structure of $A=2$ and 3 nuclei and the nuclear current operator*, Phys. Rev. C **72**, 014001 (2005)
- **Nuclear reactions of astrophysical interest**
 - LEM, RS, MV, AK, SR, J.F. Beacom, *Weak Proton Capture on ^3He* , Phys. Rev. C **63**, 015801 (2000)
 - LEM, M. Piarulli, MV, **L. Girlanda**, AK, SR, RS, *Muon capture on deuteron and ^3He* , Phys. Rev. C **83**, 014002 (2011)

From CHH/PHH to uncorrelated HH

SR, *The Hyperspherical Harmonic Method: A Review and Some Recent Developments*, in **Introduction to Modern Methods of Quantum Many-Body Theory and their Applications**, eds. A. Fabrocini *et al.* (World Scientific, Singapore, 2002), p. 339 → **nice review of HH method**

Removing the correlations

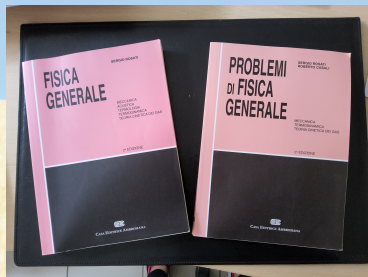
- ① makes it “easy” to use non-local potential models
 - ② gives more accurate results for $A \geq 4$
- MV, LEM, SR, AK, LG, *Variational Calculation on $A=3$ and 4 Nuclei with Non-Local Potentials*, *Few-Body Syst.* **39**, 159 (2006)
 - AK, SR, MV, LEM, LG, *A High-Precision Variational Approach to Three- and Four-Nucleon Bound and Zero-Energy Scattering States*, *J. Phys. G: Nucl. Part. Phys.* **35**, 063101 (2008) → **review paper**
 - LEM, AK, LG, SR, MV, *N -d elastic scattering using the hyperspherical harmonics approach with realistic local and nonlocal interactions*, *Phys. Rev. C* **80**, 034003 (2009)
 - MV, A. Deltuva, R. Lazauskas, J. Carbonell, A.C. Fonseca, AK, LEM, SR, *Benchmark calculation of n - ^3H and p - ^3He scattering*, *Phys. Rev. C* **84**, 054010 (2011)

The HH method in use for $A = 3, 4, 6$ bound states, for $A = 3, 4$ scattering states in a wide energy range

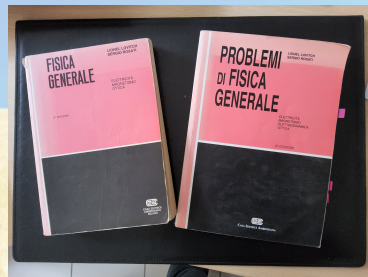
Teaching activity

Sergio taught essentially ... **everything** [classical mechanics and electromagnetism, statistical mechanics, quantum mechanics, atomic physics and nuclear physics] to generations of students

→ **unforgettable textbooks**



Physics 1



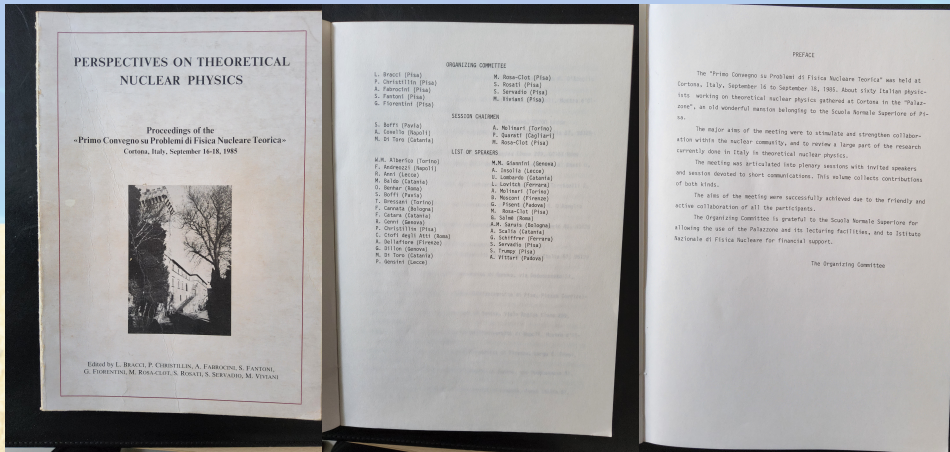
Physics 2

Sergio supervised many young people (MS, PhD, and postdocs)

Service to the community

Prospective on Theoretical Nuclear Physics → Theoretical Nuclear Physics in Italy

September 16-18, 1985: "Primo Convegno su Problemi di Fisica Nucleare Teorica"



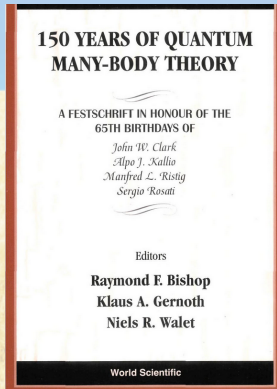
Continued every two years ... until today!

20th European Conference on Few-Body Problems in Physics (Pisa, September 2007)



Events in honor of Sergio

- 1994 **Cortona**: Scientific Meeting to honor Sergio on his **60th** birthday
- 2000 **Manchester**: 150 Years of Quantum Many-Body Theory: A Festschrift in honour of the **65th** birthdays of J.W. Clark, Alpo J. Kallio, Manfred L. Ristig, Sergio Rosati
- 2014 **Marciana Marina**: Mini-symposium to honor Sergio on his **80th** birthday



Friday, June 27: Mini-symposium to honor Professor Sergio Rosati on his 80th Birthday

Morning Session: 9:00-12:45	
Chairperson: E. Marucci	
9:00-9:15	Opening
9:15-9:45	Co' (Univ. of Salento) The Fermi-hypernetted-chain method for finite systems
9:45-10:15	Poils (Barcelona) Momentum distributions in strongly interacting many-body systems
Coffee Break: 10:15-10:45	
10:45-11:15	Viviani (INFN-Pisa) Study of bound and scattering states of few-body systems with the HH method
11:15-11:45	Witala (Krakow) Achievements and challenges in understanding of three-nucleon reactions
11:45-12:15	Tornow (TUNL) Experimental results for few-nucleon systems
12:15-12:45	Kievsky (INFN-Pisa) Universality in few-body systems: from few atoms to few nucleons
Coffee Break: 16:30-17:00	
Afternoon Session: 17:00-19:00	
Chairperson: E. Marucci	
17:00-17:30	Wiringa (ANL) Nuclear Quantum Monte Carlo
17:30-18:00	Schiavilla (ODU/Lab) Electroweak structure of few-body nuclei
18:00-18:40	Fantoni (ANVUR-Rome) Sergio Rosati: personal recollections
18:40-19:00	Closing



Marciana Marina 2014, conference picture

Main collaborators



Lionel Lovitch



Stefano Fantoni



Adelchi Fabrocini



Artur Polls



Michele Viviani



Alejandro Kievsky



Rocco Schiavilla



Luca Girlanda

Laura E. Marucci



Laura E. Marucci

Sergio Rosati (1934-2022)

... and many more

Sergio was much more: an outstanding fisherman ...



A proud farmer (olives, and much more)



In conclusion, Sergio will be remembered as an inspirational mentor and a wonderful friend. He will be missed for his deep knowledge of physics in general, and nuclear physics in particular, for his foresight and intuition, for his irony and great sense of humor, with the many jokes and funny stories he was used to tell with incredible ability. Most of all, Sergio will be missed for his great humanity, and his safe and strong presence in the most difficult moments.

SF, AK, LEM, MV, Few-Body Syst. **63**, 73 (2022)

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SF, AK, LEM, MV, Few-Body Syst. **63**, 73 (2022)



Bogota Airport, 1986

Extra pictures

