Quantum Few-Body Theory

Group Leader

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Group Members

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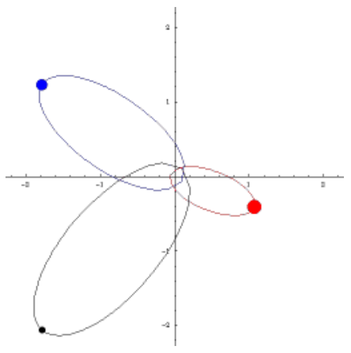
Research Activities

Research activities of this group can be outlined as follows :

- Developing of new methods (based on the Jost-matrix approach) for locating quantum resonances
- Studying of the spectral properties of non-Hermitian Hamiltonians
- Developing of new methods for extracting the resonance parameters from experimental scattering data
- Studying of nuclear fusion reactions that may take place among the nuclei confined inside molecules
- Theoretical search for possible bound and resonant states of few-body hypernuclear systems (involving Lambda-particles)
- Application of the Jost-matrix method for the description of quantum states of the charge-carriers in low-dimensional semiconductor nano-structures



Three-body bound state

All these activities involve both the mathematical derivations and state-of-the-art numerical calculations (programming in Fortran).

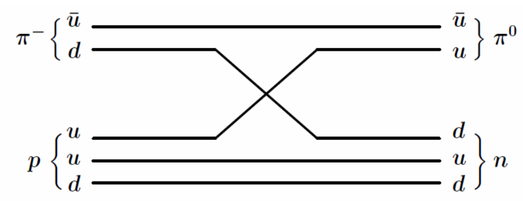
Collaboration

- International collaboration
  - Stockholm University (Sweden)
  - Joint Institute for Nuclear Research (Dubna, Russia)
  - St.-Petersburg University (Russia)
- Local collaboration
  - UNISA

Research Projects

Current research projects:

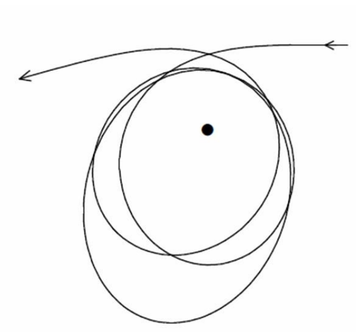
- Jost matrix expansions in theoretical analysis of collision experiments
- Power-series expansion of the 2D Jost matrix
- Resonances generated by non-Hermitian potentials



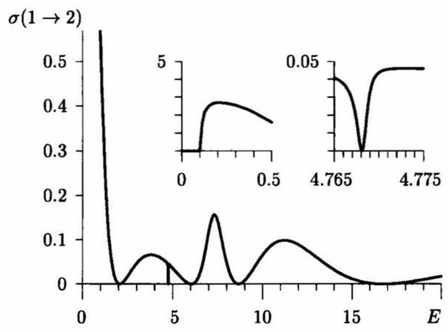
Quark rearrangements

Possible research projects for post graduate students:

- Dependence of the parameters of quantum resonances on the masses of the particles (BSc)
- Mutual transformation of the bound and resonant spectral points (Hon)
- Lambda-nucleus effective-range expansion (Hon)
- Power-series expansion in the complex plane of the angular momentum (MSc)
- Lambda-nucleus resonances (MSc)
- K-meson nucleus resonances (MSc)
- Low-energy scattering of the J/Ψ particle from light nuclei (MSc)
- Shift of the charge-carrier resonances in one-dimensional nano-structures due to the space-charge accumulation (PhD)
- Driven Schrödinger equation for two– and three-body problems (PhD)
- Jost function for two-dimensional problems (PhD)
- Stark-effect in one-dimensional semiconductor nano-structures (PhD)
- Nuclear fusion inside molecules (PhD)



Quantum Resonances



Computational Facilities

- Multi-processor Linux-cluster

Funding

- NRF
- UP research grant
- South Africa—Sweden agreement

Recent Publications

- S. A. Rakityansky, N. Elander, “Multi-channel analog of the effective-range expansion”, J. Phys. A: Math. Theor., **44**, 115303 (2011)
- S.A. Rakityansky, N. Elander, “Generalized effective-range expansion”, J. Phys. A: Math. Theor. 42 (2009) 225302
- V.B. Belyaev, S.A. Rakityansky, W. Sandhas, “Three-body resonances *Λnn* and *ΛΛn”,* Nuclear Physics A 803 (2008) 210–226
- S.A. Rakityansky, S.A. Sofianos, N. Elander, “Pade approximation of the *S*-matrix as a way of locating quantum resonances and bound states”, J. Phys. A: Math. Theor. 40 (2007) 14857–14869

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