

Letter of intent: **RADIANT - Radii Analysis and Data for Interactive Nuclear Table**

Project leaders: Ben Ohayon, Endre Takacs , Mikhail Gorshteyn

1. Research objectives

Nuclear charge radii play an important role in many aspects of fundamental physics. Having precise radii is prerequisite for precision tests of the Standard Model with nuclear, hadronic, and electroweak probes, precision atomic physics, nuclear astrophysics, and in direct and indirect searches for dark matter. Charge radii are used to benchmark *ab initio* nuclear theory calculations that describes and predicts nuclear structure and the properties of nuclear matter. Providing access to a continuously updated database of critically evaluated values of nuclear charge radii will thus benefit many fields of fundamental and applied physics.

In many cases, nuclear radii should be known at the level of 0.1-0.01%, which requires a close cooperation between theory and experiment. Moreover, different complementary experimental techniques must be combined to reach this accuracy. These include muonic X-rays spectroscopy, spectroscopy of ordinary and unstable atoms, elastic electron scattering, along with photoabsorption cross section measurements. **RADIANT will provide an appropriate framework for a fruitful interaction between experimentalists and theorists across these various fields with the scope of realizing and disseminating a modern interactive web-based table of nuclear radii.**

Leading up to this proposal was meeting in January 2025 at the International Atomic Energy Agency (IAEA) Headquarters organized by the Nuclear Data Section of the IAEA. There, the endorsers of this LOI discussed the *Compilation and Evaluation of Tables of Nuclear Charge Radii*. Specifically, we discussed the update and revision of the 2013 table of recommended nuclear charge radii by Angeli and Marinova <https://nds.iaea.org/radii/>. The meeting addressed new measurements and experimental techniques, evaluation methods and uncertainties, the role of atomic and nuclear theory, emerging needs and priorities, as well as revision and future maintenance of the tables. A White Paper reassuming the conclusions of the meeting is in preparation.

2. Connection to Transnational Access infrastructures (TAs) and / or Virtual Access projects (VAs)

RADIANT is a Virtual Access project. Moreover, it is connected to research related to nuclear radii which is ongoing at several key infrastructure facilities: GSI, PSI, CERN-ISOLDE, MAMI, MESA, and JLAB.

3. Estimated budget request

- 3 x Workshop = 45K Euro. First there will be a kick-off meeting to define the problem and identify the expertise needed to tackle it. The second would be to converge on a coherent plan for the table, and the third for summary, conclusions and future plans.
- Travel budget 25K Euro/year = 100K Euro. It will be used to bring experts from different countries and disciplines closer in order to address the needed issues to update and critically evaluate the charge radii.
- 1 x PHD/technician/post-doc position 4 years 300K Euro. They will act as the first contact point and lead this effort from start to finish.

4. Participating and partner institutions

Technion IIT, Haifa, Israel (Ohayon, Rathi)

JGU Mainz, Germany (Gorshteyn, Pohl, Bacca)

Clemson U., USA (Takacs , Dipti, Staiger)

TU Darmstadt, Germany (Nörtershäuser)

FRIB & MSU, East Lansing USA (Gueye, Minamisono, Seng)

Argonne NL Chicago USA (Kondev)

PRL Ahmedabad, India (Sahoo)

ELI-NP, Bucharest, Romania (Balabanski)

MPIK Heidelberg, Germany (Oreshkina)

IJCLAB Orsay France (Georgiev)

U. Manchester, UK (Flanagan)

Peking U. China (Xiaofei Yang)

CERN (Yordanov)