

The Nuclear Radius Extraction Collaboration (NREC)

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Center for Frontiers
in Nuclear Science



RBRC
RIKEN BNL Research Center



Stony Brook
University

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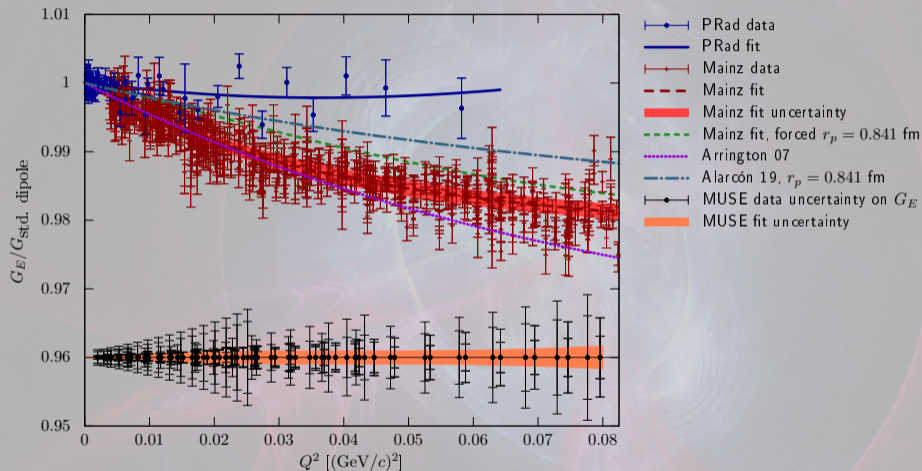
Nuclear Radius extraction collaboration

- » Loose collaboration of workers in the field
- » Inspired by PREN/HORIZON-2020

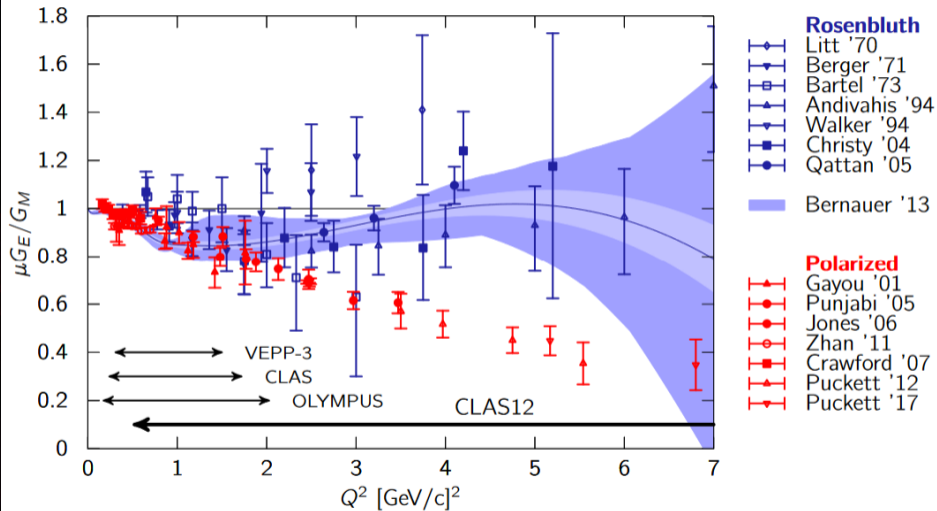
Extraction of radii, and associated topics, are relevant for many subfields.

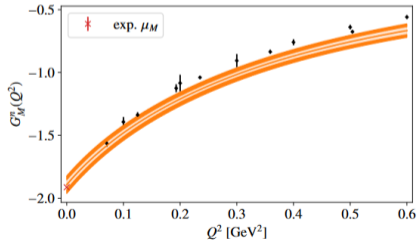
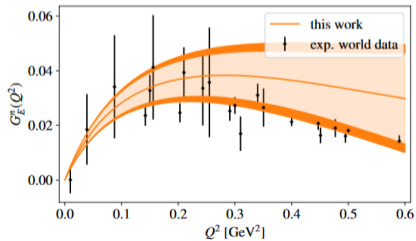
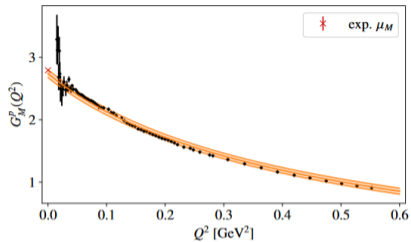
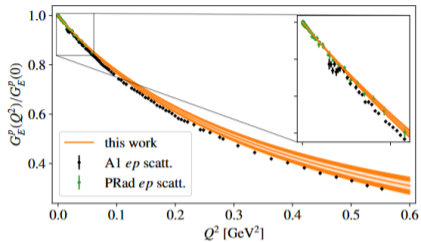
Can we optimize synergy?

E/M form factors: small Q^2

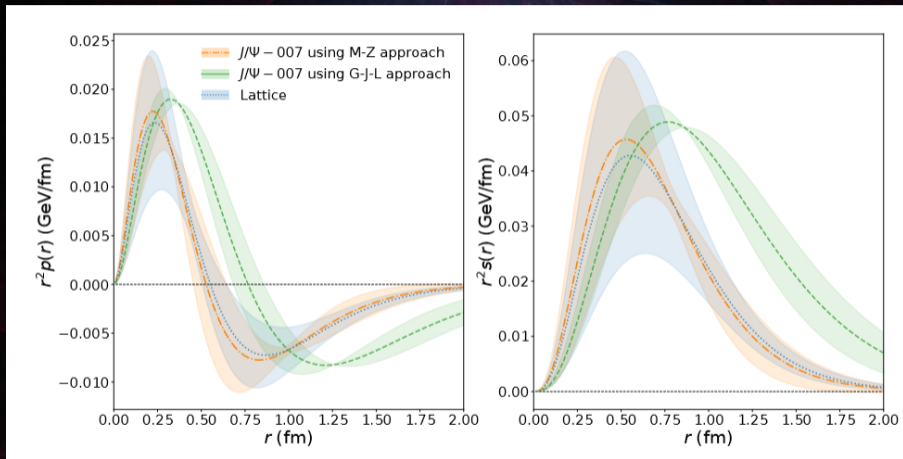


E/M form factors: large Q^2



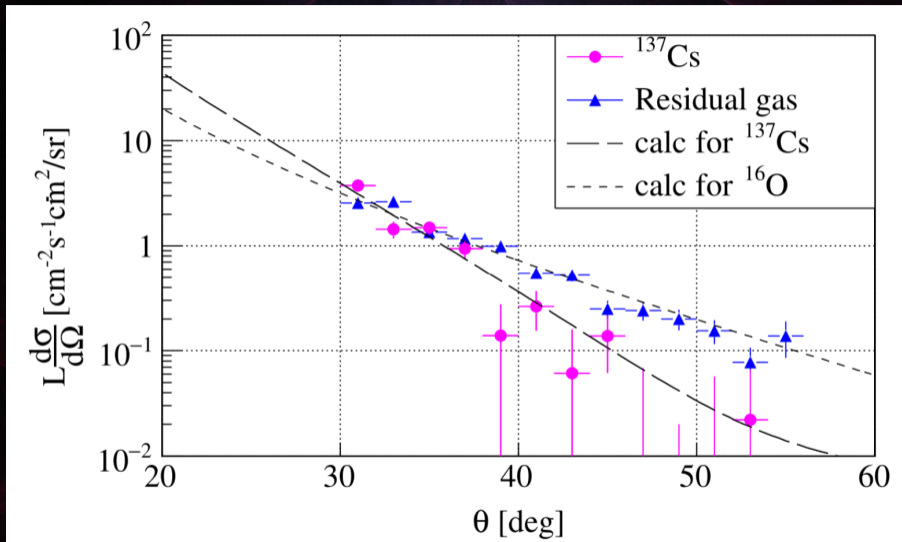


Gravitational / mechanical form factors



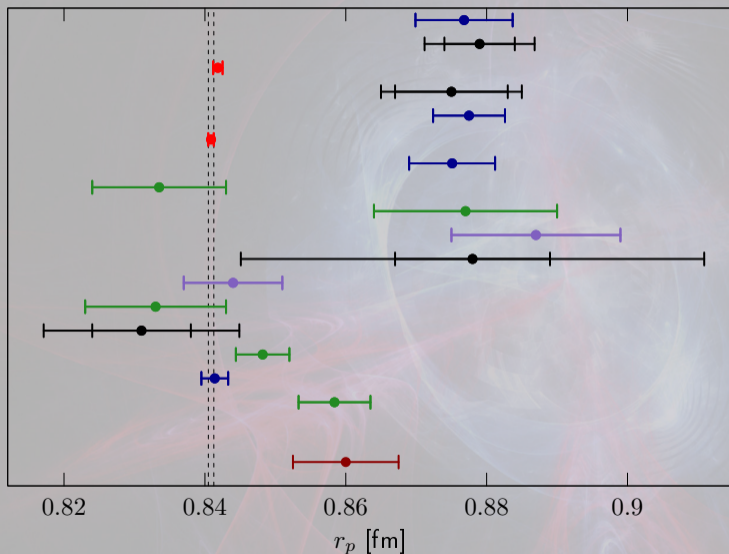
Meziani, arXiv:2403.08423

Short lived-nuclei



Tsukada et al. PRL 131, 092502 (2023)

Radii: e/m



- CODATA'06 (2008)
- Bernauer (2010)
- Pohl (2010)
- Zhan (2011)
- CODATA'10 (2012)
- Antognini (2013)
- CODATA'14 (2015)
- Beyer (2017)
- Fleurbaey (2018)
- Sick (2018)
- Mihovilović (2019/2021)
- Alarcón (2019)
- Bezginov (2019)
- Xiong (2019)
- Grinin (2020)
- CODATA'18 (2021)
- Brandt (2022)

MUSE (proj.)

More radii

The background of the slide is a dark, abstract composition of swirling, ethereal patterns. Red and blue lines and shapes flow and overlap, creating a sense of depth and movement. The patterns are reminiscent of particle tracks or complex mathematical structures, with some areas appearing more dense and others more sparse.

- » Mass/mechanical radii
- » Radii of heavier nuclei
- » Neutron
- » Mesons
- » Exotic and short-lived hadrons

Radiative Corrections: From Medium to High Energy Experiments

Andrei Afanasev^{1*}, Jan C. Bernauer^{2,3*}, Peter Blunden⁴, Johannes Blümlein^{5*},
Ethan W. Cline^{2*}, Jan M. Friedrich^{6,7}, Franziska Hagelstein^{8,9,10*}, Tomáš Husek^{11,12*},
Michael Kohl¹³, Fred Myhrer¹⁴, Gil Paz¹⁵, Susan Schadmand^{16*}, Axel Schmidt¹⁷,
Vladyslava Sharkovska^{10,18}, Adrian Signer^{10,18*}, Oleksandr Tomalak¹⁹,
Egle Tomasi-Gustafsson²⁰, Yannick Ulrich^{21*}, Marc Vanderhaeghen^{8,9}

Topics

Main topics, not a limitation!

- » Form factors.
 - » Not limited to e/m
 - » Not limited to nuclei
 - » Not limited to experiments
 - » If it's not point-like, it's on topic.
- » Associated radii
- » Radiative corrections
- » Geometry of heavy nuclei, neutron skin

Goals

- » Learn from each other. Sounding board!
- » Highlight the significance of the field
 - » Helps with funding for research
 - » And for workshops!
- » Work on published data – we do not want to replace the role of experiments
- » NREC papers: 75% of authors
- » Collaborate with other collaborations, e.g.
 - » PREN
 - » μ ASTI
 - » McMule
 - » JAM
 - » USQCD

Status

- » Over **100** signees!
- » Logo/website is work in progress
- » We'll have our first meeting soon (see later)

How does the PWG fit in?

Biggest impact: Test of radiative corrections

How NREC benefits:

- » New measurements of TPE
- » Better guidance for fits

How experiment benefit

- » Exchange of generators
- » Experience with extraction methods
- » Access to more theorists

How both can benefit:

- » Better choice of measurement: High impact kinematics

How do I sign up?

» Please sign the charter on the overleaf page here:

<https://www.overleaf.com/6259126791cfhhkjbdjspd#5e7c24>

First meeting

Workshop on NREC 2024 (Nuclear Radius Extraction Collaboration) in cooperation with PREN 2024 (Proton Radius European Network) and μ ASTI (Muonic Atom Spectroscopy Theory Initiative)

- » May 6–10
- » At CFNS/SBU
- » Indico here: <https://indico.cfns-sbu.physics.sunysb.edu/event/253/>

Meeting program

Overview talks:

- » Phiala Shanahan (MIT): Lattice QCD
- » Ronald Fernando Garcia Ruiz (MIT): Nuclear radii from laser spectroscopy
- » Krzysztof Pachucki (FUW): Atomic Spectroscopy of light elements
- » Dima Kharzeev (SBU): F.F., Radii (not only e/m!), RadCor

Sessions on:

- » e/m F.F. and radii
- » Gravitational F.F, mechanical radii etc.
- » Weak f.f. / axial radii
- » RadCorr
- » Heavier nuclei, neutron skin, radii of other baryons/mesons, exotics