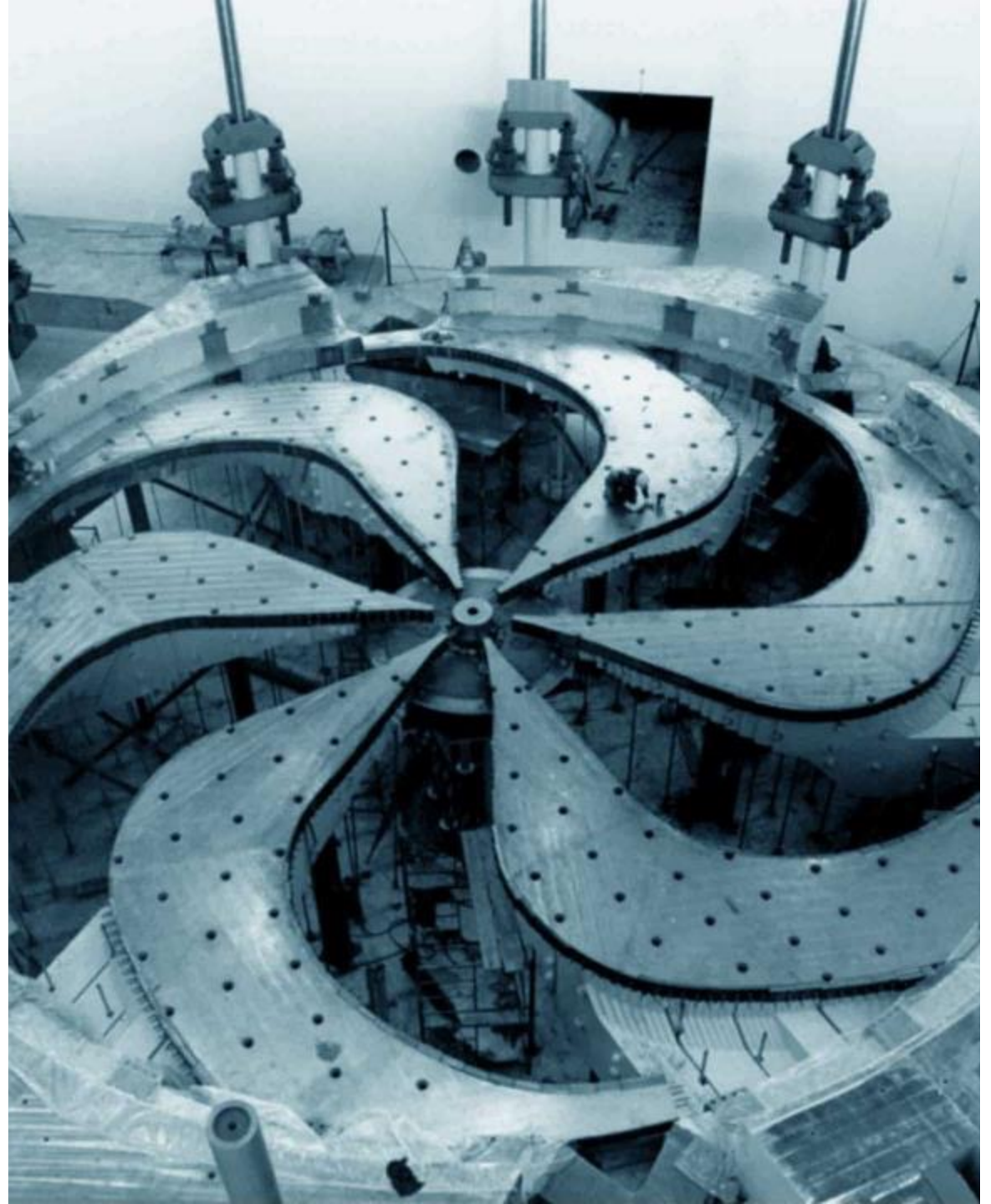


Theory Department Activities: 2023-current

David McKeen

PSD BAE Retreat

May 24, 2024



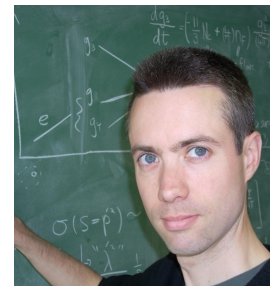
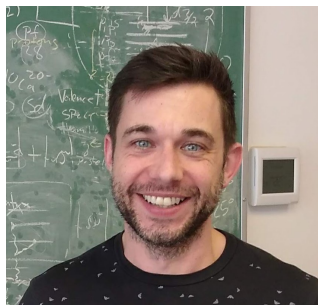
Theory Group

- 3 Nuclear Theory BAEs (Petr Navratil, Jason Holt, Nicole Vassh)
- 2 Particle Theory BAEs (David Morrissey, David McKeen)
- 2 Emeriti (John Ng, Richard Woloshyn)

- Nuclear Theory postdocs – Lotta Jokiniemi, Mehdi Drissi, Georgios Palkanoglou, Tsung-Han Yeh
- Particle Theory postdocs – Michael Shamma, Douglas Tuckler, Carlos de Lima, Navin McGinnis (former)

- Nuclear Theory graduate students – Michael Gennari (Navratil, UVic), Peter Gysbers (former, Navratil, UBC), Antoine Belley (Holt, UBC), Maude Lariviere (Vassh, UBC), Yilin Wang (Vassh, UBC)
- Particle Theory graduate students – John Coffey (Morrissey, UVic), Riku Mizuta (Morrissey/McKeen, UVBC), Afif Omar (McKeen, UVic), Marina Stefanyk (Morrissey, UVic),

- Nuclear Theory co-op students – Kayle Majic (Vassh), Diego Araujo (Navratil), Ben Scully (Holt), Didar Sedghi (Holt), Gustavo Frehse (Holt), Sofia Vergara (Holt), Alex Todd (Holt)



Nuclear Theory: staff talks

- All three nuclear theory BAEs (N. Vassh, J. Holt, P. Navratil) had talks at the invitation only topical program: “Theoretical Justifications and Motivations for Early High-Profile FRIB Experiments” (FRIB, MSU, May 16-26)
 - It highlights that TRIUMF nuclear theory group is internationally recognized to have strong connections to rare isotope beam science
- Jason Holt, Petr Navratil were invited to participate and present talks in the Institute for Nuclear Theory 23-1b program, “New physics searches at the precision frontier” (INT, May 2023)
- P. Navratil at PROCON 2023 – June 26-30
- Jason Holt - Advances in Radioactive Isotope Science (ARIS2023) June 4-9, International Symposium on Physics of Unstable Nuclei (ISPUN23) – May 4-8, Nuclear Tapas: The shell model as a cornerstone of nuclear structure – April 27-28
- Nicole Vassh - CAP congress: “Rapid neutron capture in the multi-messenger era” (June 20)

Nuclear Theory: staff talks

- Nicole Vassh - TRIUMF Science Week: “Making the heaviest elements in astrophysics” (July 31)
- Nicole Vassh – Lectures at N3AS (Network for Neutrinos, Nuclear Astrophysics, and Symmetries) Summer School: “Nucleosynthesis: Connecting Nuclear Properties and Observations - I & II” (July 19 & 20)
- P. Navratil - “No-Core Shell Model and Shell Model,” The Past, Present, and Future of Nuclear Structure Theory in the FRIB Era, MSU, Sept 25th, 2023
- Jason Holt - invited talk at Workshop on Xenon Detector 0νbb Searches in Stanford, Oct 25-27, 2023
- P. Navratil – invited talk at ECT* workshop on Critical stability of few-body quantum systems, Trento, Oct 23 - 27, 2023
- Nicole Vassh: "Fission and r-process nucleosynthesis", APS/JPS DNP Conference Workshop: Science of Intense High Energy Rare Isotope Beams I
- Jason Holt presented UW Physics department colloquium on April 10th

Nuclear Theory: staff papers

IM-SRG theoretical interpretation for ISOLTRAP/ISOLDE, FRIB, and RIKEN experiments

PHYSICAL REVIEW LETTERS 131, 022502 (2023)

Isomeric Excitation Energy for $^{99}\text{In}^m$ from Mass Spectrometry Reveals Constant Trend Next to Doubly Magic ^{100}Sn

L. Nies^{1,2,*} D. Atanasov^{1,†} M. Athanasakis-Kaklamanakis^{1,3} M. Au^{1,4} K. Blaum⁵ J. Dobaczewski^{6,7}
B. S. Hu⁸ J. D. Holt^{8,9} J. Karthein¹⁰ I. Kulikov¹¹ Yu. A. Litvinov^{11,12} D. Lunney¹³ V. Manea¹³
T. Miyagi^{14,12,5} M. Mougeot^{1,5,‡} L. Schweikhard² A. Schwenk^{14,12,5} K. Sieja¹⁵ and F. Wienholtz¹⁴

PHYSICAL REVIEW LETTERS 130, 242501 (2023)

Featured in Physics

Microsecond Isomer at the $N=20$ Island of Shape Inversion Observed at FRIB

T. J. Gray¹ J. M. Allmond¹ Z. Xu² T. T. King¹ R. S. Lubna³ H. L. Crawford⁴ V. Tripathi⁵ B. P. Crider⁶
R. Grzywacz^{2,1} S. N. Liddick^{3,7} A. O. Macchiavelli¹ T. Miyagi^{8,9} A. Poves¹⁰ A. Andalib^{3,11} E. Argo^{3,11} C. Benetti⁵
S. Bhattacharya⁵ C. M. Campbell⁴ M. P. Carpenter¹² J. Chan² A. Chester³ J. Christie² B. R. Clark⁶ I. Cox²
A. A. Doetsch^{3,11} J. Dopfer^{3,11} J. G. Duarte¹³ P. Fallon⁴ A. Frotscher⁶ T. Gaballah⁶ J. T. Harke¹³ J. Heideman²
H. Huegen² J. D. Holt^{14,15} R. Jain^{3,11} N. Kitamura² K. Kolos¹³ F. G. Kondev¹² A. Laminack¹ B. Longfellow¹³
S. Luitel⁶ M. Madurga² R. Mahajan³ M. J. Mogannam^{3,7} C. Morse¹⁶ S. Neupane² A. Nowicki² T. H. Ogunbeku^{6,3}
W.-J. Ong¹³ C. Porzio⁴ C. J. Prokop¹⁷ B. C. Rasco¹ E. K. Ronning^{3,7} E. Rubino³ T. J. Ruland¹⁸
K. P. Rykaczewski¹ L. Schaedig^{3,11} D. Seweryniak¹² K. Siegl² M. Singh² A. E. Stuchbery¹⁹ S. L. Tabor⁵
T. L. Tang⁵ T. Wheeler^{3,11} J. A. Winger⁶ and J. L. Wood²⁰

Physics Letters B 843 (2023) 138025



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journal homepage: www.elsevier.com/locate/physletb



Level structures of $^{56,58}\text{Ca}$ cast doubt on a doubly magic ^{60}Ca



S. Chen^{a,b,c,*} F. Browne^b P. Doornenbal^b J. Lee^a A. Obertelli^{d,e,b} Y. Tsunoda^f
T. Otsuka^{b,g,h} Y. Chazonoⁱ G. Hagen^{n,j} J. D. Holt^{k,l} G. R. Jansen^{m,n} K. Ogata^{i,o}
N. Shimizu^f Y. Utsuno^{h,f} K. Yoshida^h N. L. Achouri^p H. Baba^b D. Calvet^e F. Château^e
N. Chiga^b A. Corsi^e M. L. Cortés^b A. Delbart^e J.-M. Geller^e A. Giganon^e A. Gillibert^e
C. Hilaire^e T. Isobe^b T. Kobayashi^q Y. Kubota^{b,f} V. Lapoux^e H. N. Liu^{e,d,r}
T. Motobayashi^b I. Murray^{s,b} H. Otsu^b V. Panin^b N. Paul^{e,t} W. Rodriguez^{b,u,v}
H. Sakurai^{b,g} M. Sasano^b D. Steppenbeck^b L. Stuhl^{f,w,x} Y. L. Sun^{e,d} Y. Togano^y
T. Uesaka^b K. Wimmer^{g,b} K. Yoneda^b O. Aktas^r T. Aumann^{d,z} L. X. Chung^{aa}
F. Flavigny^s S. Franchou^s I. Gasparic^{ab,d,b} R.-B. Gerst^{ac} J. Gibelin^p K. I. Hahn^{ad,x}
D. Kim^{ad,b,x} T. Koiwai^g Y. Kondo^{ae} P. Koseoglou^{d,z} C. Lehr^d B. D. Linh^{aa,af} T. Lokotko^a
M. MacCormick^s K. Moschner^{ac} T. Nakamura^{ae} S. Y. Park^{ad,x} D. Rossi^d E. Sahin^{ag}
P.-A. Söderström^d D. Sohler^w S. Takeuchi^{ae} H. Törnqvist^{d,z} V. Vaquero^{ah} V. Wagner^d
S. Wang^{ai} V. Werner^d X. Xu^a H. Yamada^{ae} D. Yan^{ai} Z. Yang^b M. Yasuda^{ae} L. Zanetti^d

Nuclear Theory: staff papers

Ab initio investigations of proton capture on ${}^7\text{Be}$ (${}^7\text{Li}$) published in PLB (submitted to PRC – work by recently graduated Peter Gysbers)



Ab initio informed evaluation of the radiative capture of protons on ${}^7\text{Be}$
 K. Kravvaris^{a,*}, P. Navrátil^b, S. Quaglioni^a, C. Hebborn^{c,a}, G. Hupin^d



Ab initio investigation of the ${}^7\text{Li}(p, e^+e^-){}^8\text{Be}$ process and the X17 boson

P. Gysbers^{1,2}, P. Navrátil¹, K. Kravvaris³, G. Hupin⁴, S. Quaglioni³

arXiv:2308.13751

Ab initio nuclear theory (VS IM-SRG) support for ISOLDE and NSCL experiments – PRL and PLB papers
Ab initio nuclear theory (NCSM) support for the QUARTET collaboration – charge radii measurements at PSI



Letter
 Electromagnetic moments of the antimony isotopes ${}^{112-133}\text{Sb}$
 S. Lechner^{a,b,*}, T. Miyagi^{c,d,e,f}, Z.Y. Xu^{a,h}, M.L. Bissell^{i,a}, K. Blaum^c, B. Cheal^j,
 C.S. Devlin^k, R.F. Garcia Ruiz^{a,1}, J.S.M. Ginges^k, H. He,
 P. Ingram^{c,d}, A. Kanellakopoulos^{g,2}, Á. Koszorús^{a,g}, S. Ma
 R. Neugart^{e,m}, G. Neyens^{a,g}, W. Nörtershäuser^c, P. Plattne
 G. Sanamyan^k, S.R. Stroberg^{h,3}, Y. Utsuno^{g,r}, X.F. Yang



PHYSICAL REVIEW LETTERS 131, 102501 (2023)

Surprising Charge-Radius Kink in the Sc Isotopes at $N = 20$

Kristian König^{1,2,*}, Stephan Fritzsche^{3,4}, Gaute Hagen^{5,6}, Jason D. Holt^{7,8}, Andrew Klose⁹, Jeremy Lantis^{1,10},
 Yuan Liu¹, Kei Minamisono^{1,11,7}, Takayuki Miyagi^{2,12,13}, Witold Nazarewicz^{1,11}, Thomas Papenbrock^{6,14},
 Skyy V. Pineda^{1,10}, Robert Powel^{1,11} and Paul-Gerhard Reinhard¹⁵



Communication

Towards Precision Muonic X-ray Measurements of Charge Radii of Light Nuclei

Ben Ohayon^{1,*}, Andreas Abeln², Silvia Bara³, Thomas Elias Cocolios³, Ofir Eizenberg¹,
 Andreas Fleischmann², Loredana Gastaldo², César Godinho^{4,5}, Michael Heines³, Daniel Hengstler²,
 Guillaume Hupin⁵, Paul Indelicato⁶, Klaus Kirch^{7,8}, Andreas Knecht⁸, Daniel Kreuzberger²,
 Jorge Machado⁴, Petr Navrátil⁹, Nancy Paul^{6,*}, Randolph Pohl^{10,11}, Daniel Unger²,
 Stergiani Marina Vogiatzi⁸, Katharina von Schoeler^{7,8} and Frederik Wauters^{10,12}

Nuclear Theory: staff papers

- “Element abundance patterns in stars indicate fission of nuclei heavier than uranium” by I. Roederer, N. Vassh *et al.*, published in Science
 - Good publicity - press articles by Space.com, Live Science, CTV News, Live Science (including interview with N. Vassh)
- “Thallium-208: a beacon of in situ neutron capture nucleosynthesis” by N. Vassh, X. Wang, M. Lariviere, *et al.*, published in PRL

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RESEARCH

NUCLEOSYNTHESIS

Element abundance patterns in stars indicate fission of nuclei heavier than uranium

Ian U. Roederer^{1*}, Nicole Vassh², Erika M. Holmbeck³, Matthew R. Mumpower^{4,5}, Rebecca Surman⁶, John J. Cowan⁷, Timothy C. Beers⁶, Rana Ezzeddine⁸, Anna Frebel^{9,10}, Terese T. Hansen¹¹, Vinicius M. Placco¹², Charli M. Sakari¹³

The heaviest chemical elements are naturally produced by the rapid neutron-capture process (*r*-process) during neutron star mergers or supernovae. The *r*-process production of elements heavier than uranium (transuranic nuclei) is poorly understood and inaccessible to experiments so must be extrapolated by using nucleosynthesis models. We examined element abundances in a sample of stars that are enhanced in *r*-process elements. The abundances of elements ruthenium, rhodium, palladium, and silver (atomic numbers $Z = 44$ to 47 ; mass numbers $A = 99$ to 110) correlate with those of heavier elements ($63 \leq Z \leq 78$, $A > 150$). There is no correlation for neighboring elements ($34 \leq Z \leq 42$ and $48 \leq Z \leq 62$). We interpret this as evidence that fission fragments of transuranic nuclei contribute to the abundances. Our results indicate that neutron-rich nuclei with mass numbers >260 are produced in *r*-process events.

PHYSICAL REVIEW LETTERS 132, 052701 (2024)

Thallium-208: A Beacon of *In Situ* Neutron Capture Nucleosynthesis

Nicole Vassh^{1,*}, Xilu Wang^{2,†}, Maude Larivière^{1,3}, Trevor Sprouse^{4,5}, Matthew R. Mumpower^{4,5}, Rebecca Surman⁶, Zhenghai Liu⁷, Gail C. McLaughlin⁷, Pavel Denissenkov^{8,9,10} and Falk Herwig^{8,9,10}
¹TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia V6T 2A3, Canada
²Key Laboratory of Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, People's Republic of China
³Department of Physics and Astronomy, University of British Columbia, Vancouver, British Columbia V6T 1Z1, Canada
⁴Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA
⁵Center for Theoretical Astrophysics, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA
⁶Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556, USA
⁷Department of Physics, North Carolina State University, Raleigh, North Carolina 27695, USA
⁸Department of Physics and Astronomy, University of Victoria, Victoria, British Columbia V8W 2Y2, Canada
⁹CaNPAN (Canadian Nuclear Physics for Astrophysics Network) Collaboration
¹⁰NuGrid Collaboration

(Received 30 July 2023; revised 30 October 2023; accepted 15 November 2023; published 29 January 2024)

We demonstrate that the well-known 2.6 MeV gamma-ray emission line from thallium-208 could serve as a real-time indicator of astrophysical heavy element production, with both rapid (*r*) and intermediate (*i*) neutron capture processes capable of its synthesis. We consider the *r* process in a Galactic neutron star merger and show Tl-208 to be detectable from ~ 12 hours to ~ 10 days, and again ~ 1 – 20 years postevent. Detection of Tl-208 represents the only identified prospect for a direct signal of lead production (implying gold synthesis), arguing for the importance of future MeV telescope missions which aim to detect Galactic events but may also be able to reach some nearby galaxies in the Local Group.

DOI: 10.1103/PhysRevLett.132.052701

Nuclear Theory: staff papers

- Experiment/theory PRL paper on charge radii of Si isotopes
- Experiment/theory PRC paper on collectivity in Ar isotopes
- Investigation of muon capture on light nuclei submitted to PRC & an *ab initio* reaction study accepted in PRC
- *Ab initio* investigation of M1 transition in ^{48}Ca – submitted to PRL
- Paper submitted to the Astrophysical Journal: “Nuclear uncertainties associated with the ejecta of a neutron-star black-hole accretion disk” by Mumpower, ... **Vassh**, et al. (arXiv:2404.03699)
- “Impact of two-body currents on magnetic dipole moments of nuclei” by T. Miyagi, ..., J. D. Holt, et al. (arXiv:2311.14383) to appear in PRL
- J. D. Holt et al. theory/exp study of moments in n-deficient In isotopes to elucidate ^{100}Sn structure to appear in Nature Phys.

PHYSICAL REVIEW LETTERS **132**, 162502 (2024)

Nuclear Charge Radii of Silicon Isotopes

Kristian König^{1,2,*} Julian C. Berengut³ Anastasia Borschevsky⁴ Alex Brinson⁵ B. Alex Brown^{1,6}
Adam Dockery^{1,6} Serdar Elhatisari^{7,8} Ephraim Eliav⁹ Ronald F. Garcia Ruiz^{5,†} Jason D. Holt^{10,11}
Bai-Shan Hu^{12,13} Jonas Karthein⁵ Dean Lee^{1,6} Yuan-Zhuo Ma^{1,6} Ulf-G. Meißner⁸ Kei Minamisono^{1,6,‡}
Alexander V. Oleynichenko^{14,15} Skyy V. Pineda^{1,16,§} Sergey D. Prosnjak^{14,17} Marten L. Reitsma⁴
Leonid V. Skripnikov^{14,17} Adam Vernon⁵ and Andréi Zaitsevskii^{14,18}

PHYSICAL REVIEW C **109**, 014327 (2024)

Suppressed electric quadrupole collectivity in ^{32}Si

J. Heery^{1,*} J. Henderson^{1,†} C. R. Hoffman^{2,‡} A. M. Hill^{3,4} T. Beck⁴ C. Cousins¹ P. Farris^{3,4} A. Gade^{3,4}
S. A. Gillespie⁴ J. D. Holt^{5,6} B. Hu⁵ H. Iwasaki^{3,4} S. Kisyov^{7,8} A. N. Kuchera⁸ B. Longfellow⁷
C. Müller-Gatermann² A. Poves⁹ E. Rubino^{4,||} R. Russell¹ R. Salinas^{3,4} A. Sanchez^{3,4}
D. Weisshaar⁴ C. Y. Wu⁷ and J. Wu^{4,¶}

Muon Capture on ^6Li , ^{12}C , and ^{16}O from *Ab Initio* Nuclear Theory

Lotta Jokiniemi^{1,*} Petr Navrátil^{1,2,†} Jenni Kotila^{3,4,5,‡} and Kostas Kravvaris^{6,§}

arXiv:2403.05776 – accepted in PRC

PHYSICAL REVIEW C **109**, 034312 (2024)

Onset of collectivity for argon isotopes close to $N = 32$

B. D. Linh^{1,2} A. Corsi³ A. Gillibert³ A. Obertelli^{3,4,5} P. Doornenbal⁴ C. Barbieri^{6,7} T. Duguet^{3,8} M. Gómez-Ramos⁹
J. D. Holt^{10,11} B. S. Hu¹⁰ T. Miyagi^{5,12,13} A. M. Moro^{9,14} P. Navrátil¹⁰ K. Ogata^{15,16} S. Péru^{17,18} N. T. T. Phuc^{19,20}
N. Shimizu^{21,22} V. Somà³ Y. Utsuno^{22,23} N. L. Achouri²⁴ H. Baba⁴ F. Browne⁴ D. Calvet³ F. Château³ S. Chen^{4,25,26}
N. Chiga⁴ M. L. Cortés⁴ A. Delbart³ J.-M. Gheller³ A. Giganon³ C. Hilaire³ T. Isobe⁴ T. Kobayashi²⁷ Y. Kubota^{4,22}
V. Lapoux³ H. N. Liu^{3,5,8} T. Motobayashi⁴ I. Murray^{4,29} H. Otsu⁴ V. Panin⁴ N. Paul^{3,30} W. Rodriguez^{4,31,32} H. Sakurai^{4,33}
M. Sasano⁴ D. Steppenbeck⁴ L. Stuhl^{22,34,35} Y. L. Sun^{3,5} Y. Togano³⁶ T. Uesaka⁴ K. Wimmer^{4,33} K. Yoneda⁴ O. Aktas²⁸
T. Aumann^{5,37} L. X. Chung² F. Flavigny^{24,29} S. Franchoo²⁹ I. Gašparić^{4,5,38} R. B. Gerst³⁹ J. Gibelin²⁴ K. I. Hahn^{40,35}
N. T. Khai¹ D. Kim^{40,4,35} T. Koiwai³³ Y. Kondo⁴¹ P. Koseoglou^{5,37,42} J. Lee²⁵ C. Lehr⁵ T. Lokotko²⁵ M. MacCormick²⁹
K. Moschner³⁹ T. Nakamura⁴¹ S. Y. Park^{40,35} D. Rossi⁵ E. Sahin⁴³ D. Sohler³⁴ P.-A. Söderström^{5,44} S. Takeuchi⁴¹
H. Törnqvist^{5,37} V. Vaquero⁴⁵ V. Wagner⁵ S. T. Wang⁴⁶ V. Werner^{5,42} X. Xu²⁵ Y. Yamada⁴¹
D. Yan⁴⁶ Z. Yang⁴ M. Yasuda⁴¹ and L. Zanetti⁵

The magnetic dipole transition in ^{48}Ca

B. Acharya¹ B. S. Hu^{2,1} S. Bacca^{3,4} G. Hagen^{1,5} P. Navrátil⁶ and T. Papenbrock^{5,1}
arXiv:2311.11438 – accepted in PRL

PHYSICAL REVIEW C **109**, 054603 (2024)

Tunable-fidelity wave functions for the *ab initio* description of scattering and reactions

Konstantinos Kravvaris^{1,*} Sofia Quaglioni¹ and Petr Navrátil²

Nuclear Theory: additional staff activities

- Sabbatical visitor Arnau Rios (U Barcelona) - July, August
 - Colloquium on Thursday July 27th on “Neutron stars: Extreme laboratories for nuclear physics”
- Workshop on Progress in *Ab Initio* Nuclear Theory 2024 (PAINT 24)
 - Next week at TRIUMF, February 27 - March 1, 2024
 - 55 registered participants including ~15 students, 43 international
 - TRIUMF colloquium by Chien-Yeah Seng (FRIB) on Feb 29th at 2 p
- Jason Holt selected as a 2024 CAP Lecture Tour Speaker
- INT PROGRAM INT-24-1 “Fundamental Physics with Radioactive Molecules”, March 4 - April 12, 2024
 - Co-organized by Jason Holt
 - Six TRIUMF scientists participated
- Nicole Vassh appointed Canadian Institute for Nuclear Physics (CINP) Scientific Working Group Nuclear Astrophysics chair & appointed to APS DNP program committee
- Nicole Vassh served on UBC PHAS Graduate Admission Committee
- Nicole Vassh co-organized two local conferences at TRIUMF: Neutrinos in Astrophysics and Cosmology (with D. Morrisey and D. McKeen) March 6-8, 2024 & CaNPAN collaboration meeting (with Chris Ruiz and Iris Dillmann) May 1-3, 2024

Nuclear Theory: student and postdoc talks, papers, and activities

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- Lotta Jokiniemi and Michael Gennari were invited to participate and present talks in the Institute for Nuclear Theory 23-1b program, “New physics searches at the precision frontier” (INT, May 2023)
- Peter Gysbers had his UBC PhD graduation ceremony last year and has begun postdoc in FRIB/MSU theory group
- PhD students Antoine Belley and Michael Gennari were admitted to participate in the ECT* Doctoral Training Program “*Ab Initio* Methods and Emerging Technologies for Nuclear Structure” (July 10-28, 2023)
- Georgios Palkanoglou (graduated from U Guelph) started as a new nuclear theory postdoc on Oct 13th
- Talk by Mehdi Drissi - Many-body quantum physics with machine learning, ECT* Trento (Italy), 4-8 September 2023.
- Mehdi Drissi received support by the CINP Junior Scientist Travel Support Program
- Machine learning one-dimensional spinless trapped fermionic systems with neural-network quantum states, Mehdi Drissi *et al.*, accepted in Physical Review A
- PhD student Maude Lariviere gave a talk “Thallium-208 as a Real-Time Signal for Probing Heavy Element Synthesis” at the Winter Nuclear and Particle Physics Conference (WNPPC) on Feb 15
- PhD student Maude Lariviere won UBC’s Bill Stothard Memorial Award in Astronomy
- PhD student Antoine Belley led paper on neutrinoless double beta decay NMEs in Phys. Rev. Lett. 132, 182502
- A. Belley received NSERC fellowship for postdoc at MIT

Particle Theory: staff talks

- David McKeen: invited theory overview talk at the [2nd International Summit on Neutrinoless Double Beta Decays](#) at SNOLAB
- David Morrissey: invited talk at [Beyond the SM from Colliders to the Early Universe](#)
- David McKeen, “Muon catalyzed fusion,” at Muons in Minneapolis workshop at U Minnesota
- D. McKeen, “Looking for Dark Matter in Strange Places,” physics colloquium at U. Alberta

Particle Theory: staff papers

- D. McKeen, D. Morrissey, M. Pospelov, H. Ramani, A. Ray, “[Dark Matter Annihilation Inside Large-Volume Neutrino Detectors](#)”, Phys. Rev. Lett. 131 (2023) 1, 011005 [[arxiv: 2303.03416](#)].
- D. McKeen and M. Pospelov, “[How long does the hydrogen atom live,](#)” Universe 9 (2023) 11, 473
- D. McKeen, J. Ng, D. Tuckler, “Higgs Portal Interpretation of the Belle II $B^+ \rightarrow K^+ \nu \bar{\nu}$ Measurement”, Phys. Rev. D 109 (2024) 7, 075006, [[arXiv:2312.00982](#)].
- A. Gaspert, P. Giampa, N. McGinnis, D. Morrissey, “Dark Matter Direct Detection on the Moon”, Phys. Rev. D108, 115015, [[arXiv:2305.04943](#)].

Particle Theory: additional staff activities

- Co-organization of [Beyond the SM from Colliders to the Early Universe](#), in honour of Marcela Carena and Carlos Wagner, May 28-30
- Michael Trott (Perimeter Inst., Niels Bohr Inst.) visited July 25 - August 1
- Gopolang Mohlabeng (Assist. Prof. SFU) became TRIUMF Affiliate
- David Morrissey will join the Board of Trustees of the Institute for Particle Physics for a three-year term.
- Theory Related Colloquia and Seminars:
 - Julio Parra Martinez (UBC), Nov. 23, “From particle to black hole colliders”
 - Gopolang Mohlabeng (SFU), Nov. 30, “New Directions for Discovering Dark Matter”
 - Anna Suliga (UC Berkeley/N3AS), March 7, “Core-collapse supernovae as probes of (not only) non-standard neutrino physics” (part of TD workshop)
 - Seminars by T. Tait (UCI), D. Cyncynates (UW), M. Ratz (UCI), B. Lillard (UO), G. Alonso-Alvarex (U of T), R. Plestid (Caltech), R. McGehee (UMN), D. Saadeh (Portsmouth)
- Vancouver-Area Cosmology Meetup with SFU, UBC, and UVic, November 14, 2-5pm
- David McKeen was interviewed by Physics Today about “tabletop tests of fundamental physics”
- Particle Theorist Sophie Renner received UBC Faculty offer. Potential for collaboration, etc.



Gopolang Mohlabeng

Particle Theory: additional staff activities

- Successful theory workshop “[Neutrinos in Astrophysics and Cosmology](#)” (co-org. with N. Vassh) held at TRIUMF March 6-8, 2024, about 30 in-person and 15 remote attendees, excellent discussions!
- Communication with SNOLAB about TRISEP 2024 summer school (to be held at SNOLAB)
- Planning underway for GUINEAPIG 3.0 workshop on light dark matter, at U Toronto in August
- Planning underway with Gopi Mohlabeng for Dark Interactions 2024 to be held at SFU in October
- D. McKeen (co-co-)chair Science Week 2024 organizing committee
- D. Morrissey serving on NSERC Subatomic Physics evaluation section (Feb.18-23), invited to join UBC internal CFI review panel.

Particle Physics Workshops

- **GUINEAPIG (GeV and Under Invisibles with New Experimental Assays for Particles in the Ground) 2.0**
 - Workshops on theories and tests of lighter dark matter (mass < 1 GeV)
 - Held at Université de Montréal, July 11-13
 - Organized by Pietro Giampa (TRIUMF), David McKeen (TRIUMF), David Morrissey (TRIUMF) together with Erica Brunelle (SNOLAB), Miriam Diamond (U Toronto), Jeter Hall (SNOLAB), Alan Robinson (U Montreal), and Katelin Schutz (McGill)
 - Over 60 participants from all over the world with a mix of experimentalists and theorists
 - Version 3.0 to be held in Toronto in August
- **Dark Interactions 2024**
 - To be held at SFU Harbour Centre, Oct. 16-18
 - Dark matter and dark sectors in cosmology, astrophysics, terrestrial experiments
- **Neutrinos in Astrophysics and Cosmology (with N. Vassh)**
 - Held at TRIUMF March 16-18
 - Mix of theory and experiment, lots of nuclear astro. and particle cosmology
- **Upcoming Physics Possibilities at Future Colliders (PPFC)**
 - Currently being organized with ATLAS group
 - ~25 theorists and experimentalists
 - Focus on opportunities with planned and proposed collider experiments



Dark Interactions 2024
Vancouver, Oct. 16-18



**New Perspectives from
Theory and Experiment**

Organizing Committee
Kétévi Assamagan (BNL)
Matthias Danninger (SFU)
David McKeen (TRIUMF)
Gopojang Mohlabeng (SFU)
David Morrissey (TRIUMF)
Heather Russell (UVic)

Topics
Dark Sectors
Experiment!!
Theory!!
...

Particle Theory: student and postdoc talks, papers, and activities

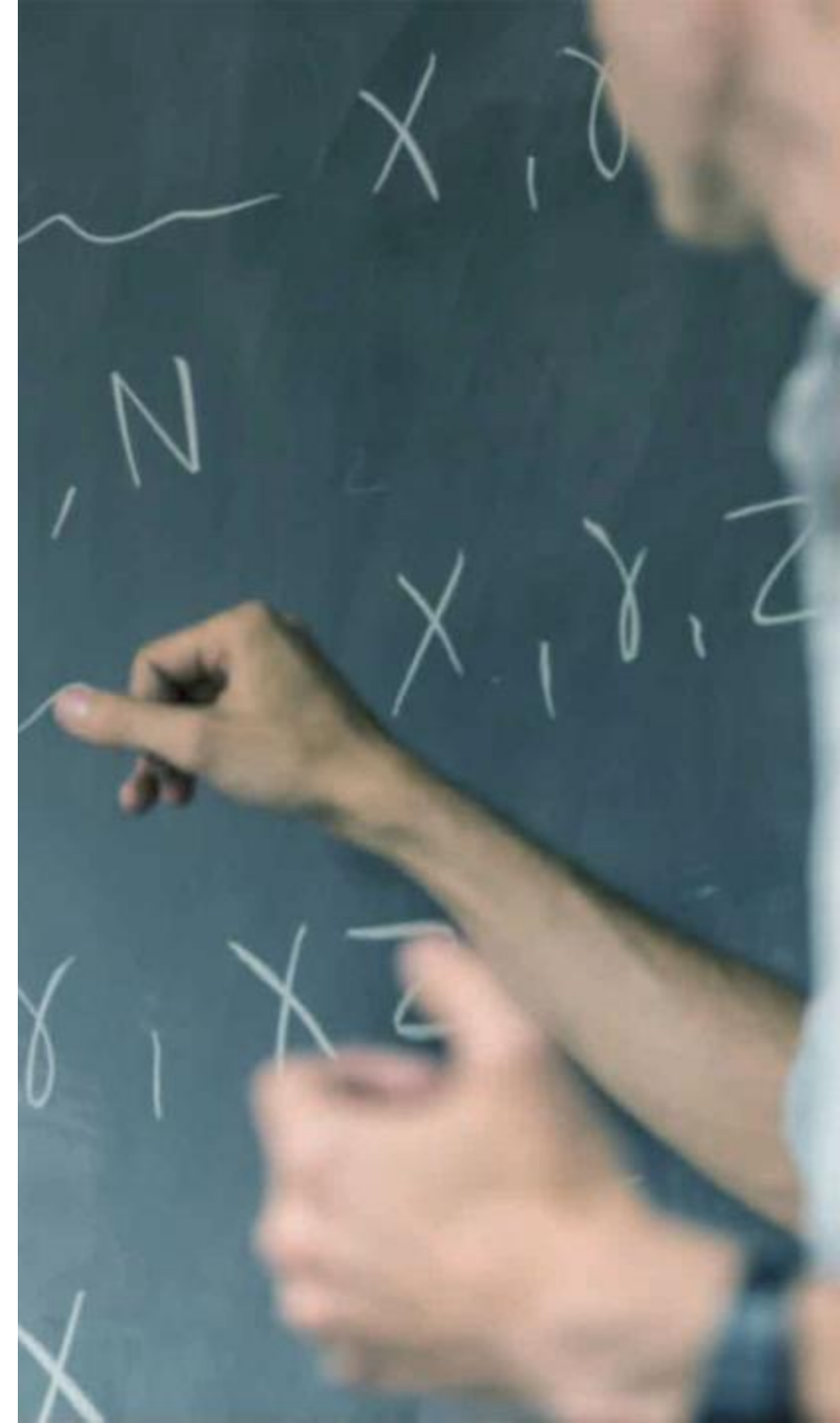
- Former PhD student N. Blinov started faculty position at York University fall '23
- Former PDF N. McGinnis moved to new postdoc at U. Arizona after completing appointment here
- D. Tuckler (joint with SFU) and C. de Lima started as postdocs fall '23
- N. McGinnis papers: "[Predictions for Muon Electric and Magnetic Dipole Moments from Higgs Decays to Muons in Two-Higgs Doublet Models with New Leptons](#)", Phys.Rev.D 108 (2023) 5, 055019 [[arxiv:hep-ph/2306.13212](#)], "[Effective Field Theory of Chirally-Enhanced Muon Mass and Dipole Operators](#)", Phys.Rev.D 107 (2023) 9, 095043 [[arxiv:hep-ph/2302.14144](#)], "Dark Matter Direct Detection on the Moon", Phys. Rev. D108, 115015, [[arXiv:2305.04943](#)]
- C. de Lima papers: "Influence of new states in searches for negative gauge-Higgs couplings", [[arxiv:2404.10815](#)], "Can CP be conserved in the 2HDM?", [[arxiv:2403.17052](#)], "Electrobaryonic axion: hair of neutron stars", [[arxiv:2311.18794](#)]

Particle Theory: student and postdoc talks, papers, and activities

- D. Tuckler paper: “Higgs Portal Interpretation of the Belle II $B^+ \rightarrow K^+ \nu \bar{\nu}$ Measurement”, Phys. Rev. D 109 (2024) 7, 075006, [[arXiv:2312.00982](https://arxiv.org/abs/2312.00982)]
- N. McGinnis talk at Pheno 2023
- M. Shamma talks at Brookhaven Forum, MIT, Pheno 2024
- C. de Lima talks at Carleton, Pheno 2024
- D. Tuckler talks at TAU2023, UMN, FNAL
- PhD student Riku Mizuta presented a poster at Science Week and has facilitated many EDI-related events including the SW EDI Workshop, GAPS EDI workshops, and public tours for Indigenous youth

Theory: Looking to the Future

- Theory Department helps to push the science that TRIUMF is interested in
 - Direct collaboration with TRIUMF experimentalists
 - Organizing workshops, seminars, colloquia that are of broad interest
 - Training HQP: PDFs, PhD, MS, co-op
 - Fostering a vibrant intellectual community
- Will continue to do so in all scenarios



Thank you
Merci

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