Reto Trappitsch, PhD

Education

2010–2016 **Ph.D.**, *The University of Chicago*, Chicago, IL, USA, *The Department of the Geophysical Sciences*, Advisor: Andrew M. Davis.
Thesis: "Deciphering Galactic Chemical Evolution: Iron and Nickel Isotopes and Cosmic Ray Exposure Ages of Presolar Silicon Carbide Grains"

2008–2010 **M.S.**, *University of Bern*, Bern, Switzerland, *Physics*, Advisor: Ingo Leya.
Insigni cum laude, thesis: "Cosmogenic nuclides in micrometeorites – Solar cosmic-ray production rates and recoil loss effects"

2005–2008 **B.S.**, *University of Bern*, Bern, Switzerland, *Physics with Astronomy*.
Magna cum laude, thesis: "Studies of noble gas components and the weathering of two ureilites – Kenna and Ramlat as Sahmah 247"

Research experience

2020-present **Assistant Research Professor**, *Brandeis University, Waltham, MA, USA*, Department of Physics.
My lab focuses on combing isotopic measurements of stardust grains, astronomical observations, and models for stellar nucleosynthesis and galactic chemical evolution to further our understanding of element formation in the Milky Way. To this end we develop new techniques and measurements methods for resonance ionization mass spectrometry to analyze these micrometer-sized samples.

2017-2020 **Postdoctoral Researcher (2017-2019), Staff Scientist (2019-2020)**, *Lawrence Livermore National Laboratory, Livermore, CA, USA*, Nuclear and Chemical Sciences Division, Isotope signatures group, Supervisors: Michael R. Savina and Brett H. Isselhardt.
My research focused on applying resonance ionization mass spectrometry (RIMS) to determine the initial abundance of ^{60}Fe in the solar nebula and on developing techniques to measure ultra-trace levels of ^{244}Pu in atom-limited samples. Additionally, I improved and maintained the Laser Ionization of Neutrals (LION) RIMS instrument by developing hard- and software.

2010-2016 **Graduate Student (2010-2016)**, *The University of Chicago, Chicago, IL, USA*, Department of the Geophysical Sciences, Supervisor: Andrew M. Davis.
My research focused on analyzing the iron and nickel isotopic composition of SiC stardust grains to study galactic chemical evolution. In order to perform these measurements I co-developed and built the Chicago Instrument for Laser Ionization (CHILI).

2009-2010 **Master Student**, *University of Bern, Bern, Switzerland*, Physics Institute, Supervisor: Ingo Leya.
My research focused on modeling the cosmogenic nuclide production of short-lived radionuclides and noble gases induced by solar cosmic rays in micrometeorites and interplanetary dust particles. Using my physical model I determined the residence times of such particles in space.

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2008-2009 **Undergraduate Researcher**, *University of Bern, Bern, Switzerland*, Physics Institute, Supervisor: Ingo Leya.
My research focused on noble gas measurements in ureilites; stony, undifferentiated meteorites with a puzzling origin. Using noble gas analysis I studied the degree of weathering these samples experienced in the hot deserts they were found in.

Honors

2020 **Directorate Award**, *Physical and Life Sciences*, Lawrence Livermore National Laboratory.
"For showing that stardust grains could be as much as three times as old as previous studies have suggested – *Proceedings of the national Academy of Sciences (2020)*"

2019 **Directorate Award**, *Physical and Life Sciences*, Lawrence Livermore National Laboratory, Outstanding Postdoctoral Researcher Award.
"For contributing to LLNL's cosmochemistry program by establishing an international presence in cosmochemistry and broadening our understanding of solar system formation

2018 **Directorate Award**, *Physical and Life Sciences*, Lawrence Livermore National Laboratory.
"For determining how and when the Martian crustal dichotomy, a topographic and geophysical divide between the heavily cratered southern highlands and smoother plains of the norther lowlands, formed – *Science Advances (2018)"*

2016 **Nathan Sugarman Award for Excellence in Graduate Research**.
"For pioneering measurements of iron and nickel isotopes in presolar silicon carbide grains, which constrain models of stellar nucleosynthesis and galactic chemical evolution." – Andrew Davis. Enrico Fermi Institute, The University of Chicago, IL, USA.

2012–2015 **NASA Earth and Space Science Fellowship**.

2011–2013 **Chicago Center for Cosmochemistry Fellowship**.

2012 **Wiley Blackwell Award**.
Received for "an outstanding oral presentation" at the Annual Meeting of the Meteoritical Society in Cairns, Australia.

Funding – $2.18M total

2020–2023 **Laboratory Directed Research and Development Program, Lawrence Livermore National Laboratory**, *$1.5M*, Starry Messengers: Deciphering fingerprints of stellar nucleosynthesis through nuclear reaction rate measurements and isotopic analyses of stardust, Co-I (lead science PI).

2019–2020 **Laboratory Directed Research and Development Program, Lawrence Livermore National Laboratory**, *$531k*, Proliferation of interstellar Pu into the Solar System, Lead PI.

2019 **Laboratory Directed Research and Development Program, Lawrence Livermore National Laboratory**, *$149k*, Establishing Hands-On Astrophysics at LLNL, Lead PI.

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Teaching Experience

2019–2020 **Mentoring**, *Lawrence Livermore National Laboratory*, Nuclear and Chemical Sciences Division.
Co-mentoring of one graduate student (Christopher J. Dory, Post College Apointee. Develop and pursue starudst measurement strategies: SEM/EDX mapping of sample mounts, NanoSIMS, and subsequent RIMS analyses of he same samples.

2017 **Mentoring**, *Lawrence Livermore National Laboratory*, Nuclear and Chemical Sciences Division.
Co-mentoring of one graduate student (Dorothy Miller, NNSA Graduate Student Fellow, University of Tennessee) to measure U, Pu, and Th by RIMS.

2016 **Mentoring**, *The University of Chicago*, Department of the Geophysical Sciences.
Co-mentoring of one undergraduate student (Olivia Pardo, now graduate student at Caltech) to apply RIMS to cosmochemistry measurements.

2010–2016 **Teaching assistant**, *The University of Chicago*, Department of the Geophysical Sciences.
Science courses, among others: Physics of the Earth, Natural Sciences 101, Global Warming, Chemistry and the Atmosphere.

2008–2010 **Teaching assistant**, *University of Bern*, Physics Institute.
Laboratory courses for non-science undergraduate students.

2007–2008 **Teaching assistant**, *University of Bern*, Institute for Theoretical Physics.
General mechanics course.

Invited Talks

2021 **16th International Symposium on Nuclei in the Cosmos**, Chengdu, China.

2020 **Michigan State University, MI, USA**, JINA-CEE Seminar, Department of Physics and Astronomy.
"Understanding stellar nucleosynthesis, its sites, and galactic chemical evolution by analyzing stardust grains"

2019 **University of Notre Dame, IN, USA**, Department of Physics.
"Understanding the origin of our solar system and beyond by analyzing meteorites and stardust"

2019 **16th Russbach School on Nuclear Astrophysics, Russbach, Austria**.
"Analyzing the witnesses of short-lived radionuclides in the Solar System"

2019 **University of California Davis, CA, USA**, Earth and Planetary Sciences.
"Tracing the origin of the Solar System one isotope at a time"

2016 **Lawrence Livermore National Laboratory, CA, USA**, Nuclear and Chemical Sciences Division.
"Iron and nickel isotopic abundances measured simultaneously in presolar silicon carbide grains with CHILI"

2016 **Washington University in St. Louis, MO, USA**, Laboratory for Space Sciences.
"CHILI – A status update"

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2013 **ETH Zürich, Zürich, Switzerland**, Department of Earth Sciences, Isochat.
"Using Resonance Ionization Mass Spectrometry for Presolar Grain Analyses"

2012 **University of Victoria, BC, Canada**, Physics & Astronomy Department, StarTalk.
"Stardust – Probing stellar nucleosynthesis and galactic chemical evolution"

Professional Service

2019–present **Russbach School for Nuclear Astrophysics**, Scientific Advisory Committee.

Manuscript reviewing, *The Astrophysical Journal*, *Geochimica et Cosmochimica Acta*, *Meteoritics & Planetary Sciences*, *Monthly Notices of the Royal Astronomical Society*, *Nature Astronomy*, *Revista Mexicana de Física*, *Treatise on Geochemistry Volume 1*, *Spectrochimica Acta Part B: Atomic Spectroscopy*.

Grant proposal reviewing, *NASA (various programs)*.

Publications

A full publication list including conference abstracts can be found on Google Scholar.

`https://scholar.google.com/citations?user=nuqrAOUAAAAJ&hl=en`

Selected publications

Trappitsch R., Savina M.R., and Isselhardt B.H. (2018) Resonance ionization of titanium: high useful yield and new autoionizing states. *Journal of Analytical Atomic Spectrometry*, 33:1962–1962.

Trappitsch R., Boehnke P., Stephan T., Telus M., Savina M.R., Pardo O., Davis A.M., Dauphas N., Pellin M.J., and Huss G.R. (2018) New constraints for the abundance of ^{60}Fe in the early solar system. *The Astrophysical Journal Letters*, 857:L15 (6pp).

Trappitsch R., Stephan T., Savina M.R., Davis A.M., Pellin M.J., Rost D., Gyngard F., Gallino R., Bisterzo S., Cristallo S., and Dauphas N. (2018) Simultaneous iron and nickel isotopic analyses of presolar silicon carbide grains. *Geochimica et Cosmochimica Acta*, 221:87–108.

Trappitsch R. and Leya I. (2016) Production and recoil loss of cosmogenic nuclides in presolar grains. *The Astrophysical Journal*, 823:12 (11pp).

Book chapters

Savina M.R. and **Trappitsch R.** (2021) *Photoionization and Photo-Induced Processes in Mass Spectrometry*, chapter Resonance Ionization Mass Spectrometry (RIMS): Fundamentals and Applications Including Secondary Neutral Mass Spectrometry, pages 203–232. Wiley-VCH.

Peer-reviewed articles

Heck P.R., Greer J., Boesenberg J.S., Bouvier A., Caffee M.W., Cassata W.S., Corrigan C., Davis A.M., Davis D.W., Fries M., Hankey M., Jenniskens P., Schmitt-Kopplin P., Sheu S., **Trappitsch R.**, Velbel M., Weller B., Welten K., Yin Q.Z., Sanborn M.E.,

Ziegler K., Rowland D., Verosub K.L., Zhou Q., Liu Y., Tang G., Li Q., Li X., and Zajacz Z. (in press) The fall, recovery, classification, and initial characterization of the Hamburg, Michigan H4 chondrite. *Meteoritics & Planetary Science*.

Füri E., Zimmermann L., Deloule E., and **Trappitsch R.** (2020) Cosmic ray effects on the isotope composition of hydrogen and noble gases in lunar samples: Insights from Apollo 12018. *Earth and Planetary Science Letters*, 550:116550.

Lugaro M., Cseh B., Világos B., Karakas A.I., Ventura P., Dell'Agli F., **Trappitsch R.**, Hampel M., D'Orazi V., Pereira C.B., Tagliente G., Szabó G.M., Pignatari M., Battino U., Tattersall A., Ek M., Schönbächler M., Hron J., and Nittler L.R. (2020) Origin of large meteoritic SiC stardust grains in metal-rich AGB stars. *The Astrophysical Journal*, 898(2):96.

Heck P.R., Greer J., Kööp L., **Trappitsch R.**, Gyngard F., Busemann H., Maden C., Ávila J.N., Davis A.M., and Wieler R. (2020) Lifetimes of interstellar dust from cosmic-ray exposure ages of presolar silicon carbide. *Proceedings of the National Academy of Science*, 117(4):1884–1889.

Battino U., Tattersall A., Lederer-Woods C., Herwig F., Denissenkov P., Hirschi R., **Trappitsch R.**, den Hartogh J.W., and M. P. (2019) NuGrid stellar data set - III. updated low-mass AGB models and *s*-processnucleosynthesis with metallicities Z=0.01, Z=0.02 and Z=0.03. *Montly Notices of the Royal Astronomical Society*, 489:1082–1098.

Liu N., Stephan T., Cristallo S., Gallino R., Boehnke P., Nittler L.R., Alexander C.M.O'D.., Davis A.M., **Trappitsch R.**, Pellin M.J., and Dillmann I. (2019) Presolar silicon carbide grains of types Y and Z: Their molybdenum isotopic compositions and stellar origins. *The Astrophysical Journal*, 881:28 (14pp).

Trappitsch R. (2019) Mixed messages from a nova outburst. *Nature Astronomy*, 3:583–584.

Stephan T., **Trappitsch R.**, Hoppe P., Davis A.M., Pellin M.J., and Pardo O.S. (2019) Molybdenum isotopes in presolar silicon carbide grains: Details of *s*-process nucleosynthesis in parent stars and implications for *r*- and *p*-processes. *The Astrophysical Journal*, 877(2):101.

Jones S.W., Möller H., Fryer C.L., Fontes C.J., **Trappitsch R.**, Even W.P., Couture A., Mumpower M.R., and Safi-Harb S. (2019) ^{60}Fe in core-collapse supernovae and prospects for X-ray and gamma-ray detection in supernova remnants. *Montly Notices of the Royal Astronomical Society*, 485(3):4287–4310.

Zingale M., Fryer C., Hungerford A., Safi-Harb S., **Trappitsch R.**, Fisher R., Calder A., and Shen K. (2019) MMA SAG: Thermonuclear supernovae. In *Bulletin of the American Astronomical Society*, volume 51, page 259.

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Fryer C., Burns E., Roming P., Couch S., Szczepańczyk M., Slane P., Tamborra I., and **Trappitsch R.** (2019) Core-collapse supernovae and multi-messenger astronomy. In *Bulletin of the American Astronomical Society*, volume 51, page 122.

Trappitsch R., Savina M.R., and Isselhardt B.H. (2018) Resonance ionization of titanium: high useful yield and new autoionizing states. *Journal of Analytical Atomic Spectrometry*, 33:1962–1962.

Savina M.R., **Trappitsch R.**, and Isselhardt B.H. (2018) Electronic excitation of uranium atoms sputtered from uranium metal and oxides. *Spectrochimica Acta Part B: Atomic Spectroscopy*, 149:214–221.

Liu N., Gallino R., Cristallo S., Bisterzo S., Davis A.M., **Trappitsch R.**, and Nittler L.R. (2018) New constraints on the major neutron source in low-mass AGB stars. *The Astrophysical Journal*, 865(2):112.

Savina M.R., **Trappitsch R.**, Kucher A., and Isselhardt B.H. (2018) New resonance ionization mass spectrometry scheme for improved uranium analysis. *Analytical Chemistry*, 90(17):10551–10558.

Boehnke P., Bell E.A., Stephan T., **Trappitsch R.**, Brenhin Keller C., Pardo O.S., Davis A.M., Harrison T.M., and Pellin M.J. (2018) Potassic, high-silica Hadean crust. *Proceedings of the National Academy of Science*, 115:6353–6356.

Cassata W.S., Cohen B.E., Mark D.F., **Trappitsch R.**, Crow C.A., Wimpenny J., Lee M.R., and Smith C.L. (2018) Chronology of martian breccia NWA 7034 and implications for formation of the martian crustal dichotomy. *Science Advances*, 4:eaap8306 (11pp).

Trappitsch R., Boehnke P., Stephan T., Telus M., Savina M.R., Pardo O., Davis A.M., Dauphas N., Pellin M.J., and Huss G.R. (2018) New constraints for the abundance of ^{60}Fe in the early solar system. *The Astrophysical Journal Letters*, 857:L15 (6pp).

Liu N., Stephan T., Boehnke P., Nittler L.R., Meyer B.S., Alexander C.M.O'D.., Davis A.M., **Trappitsch R.**, and Pellin M.J. (2018) Common occurrence of explosive hydrogen burning in type ii supernovae. *The Astrophysical Journal*, 885:144 (9pp).

Weisz D.G., Crowhurst J.C., Finko M.S., Rose T.P., Koroglu B., **Trappitsch R.**, Radousky H.B., Siekhaus W.J., Armstrong M.R., Isselhardt B.H., Azer M., and Curreli D. (2018) Effects of plume hydrodynamics and oxidation on the composition of a condensing laser-induced plasma. *The Journal of Physical Chemistry A*, 122(6):1584–1591.

Kodolányi J., Stephan T., **Trappitsch R.**, Hoppe P., Pignatari M., Davis A.M., and Pellin M.J. (2018) Iron and nickel isotope compositions of presolar silicon carbide grains from supernovae. *Geochimica et Cosmochimica Acta*, 221:127–143.

Pignatari M., Hoppe P., **Trappitsch R.**, Fryer C., Timmes F.X., Herwig F., and Hirschi R. (2018) The neutron capture process in the he shell in core-collapse supernovae:

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Presolar silicon carbide grains as a diagnostic tool for nuclear astrophysics. *Geochimica et Cosmochimica Acta*, 221:37–46.

Stephan T., **Trappitsch R.**, Davis A.M., Pellin M.J., Rost D., Savina M.R., Jadhav M., Kelly C.H., Gyngard F., Hoppe P., and Dauphas N. (2018) Strontium and barium isotopes in presolar silicon carbide grains measured with CHILI–two types of X grains. *Geochimica et Cosmochimica Acta*, 221:109–126.

Trappitsch R., Stephan T., Savina M.R., Davis A.M., Pellin M.J., Rost D., Gyngard F., Gallino R., Bisterzo S., Cristallo S., and Dauphas N. (2018) Simultaneous iron and nickel isotopic analyses of presolar silicon carbide grains. *Geochimica et Cosmochimica Acta*, 221:87–108.

Füri E., Deloule E., and **Trappitsch R.** (2017) The production rate of cosmogenic deuterium at the Moon's surface. *Earth and Planetary Science Letters*, 474:76–82.

Liu N., Stephan T., Boehnke P., Nittler L.R., Alexander C.M.r., Wang J., Davis A.M., **Trappitsch R.**, and Pellin M. (2017) J-type Carbon Stars: A Dominant Source of ^{14}N-rich Presolar SiC Grains of Type AB. *The Astrophysical Journal Letters*, 844:L12.

Savina M.R., Isselhardt B.H., Kucher A., **Trappitsch R.**, King B.V., Ruddle D., Gopal R., and Hutcheon I. (2017) High useful yield and isotopic analysis of uranium by resonance ionization mass spectrometry. *Analytical Chemistry*, 89(11):6224–6231.

Roth A.S.G., **Trappitsch R.**, Metzler K., Hofmann B.A., and Leya I. (2017) Neon produced by solar cosmic rays in ordinary chondrites. *Meteoritics & Planetary Science*, 52:1155–1172.

Cherniak D., Watson E., **Trappitsch R.**, Thomas J., and Chaussende D. (2016) Diffusion of helium in SiC and implications for retention of cosmogenic He. *Geochimica et Cosmochimica Acta*, 192:248 – 257.

Stephan T., **Trappitsch R.**, Davis A.M., Pellin M.J., Rost D., Savina M.R., Yokochi R., and Liu N. (2016) CHILI – the Chicago Instrument for Laser Ionization – a new tool for isotope measurements in cosmochemistry. *International Journal of Mass Spectrometry*, 407:1–15.

Battino U., Pignatari M., Ritter C., Herwig F., Denisenkov P., Den Hartogh J.W., **Trappitsch R.**, Hirschi R., Freytag B., Thielemann F., and Paxton B. (2016) Application of a theory and simulation-based convective boundary mixing model for AGB star evolution and nucleosynthesis. *The Astrophysical Journal*, 827:30.

Pignatari M., Herwig F., Hirschi R., Bennett M., Rockefeller G., Fryer C., Timmes F., Heger A., Jones S., Battino U., Ritter C., Dotter A., Trappitsch R., Diehl S., Frischknecht U., Hungerford A., Magkotsios G., Travaglio C., and Young P. (2016) NuGrid stellar data set. I. stellar yields from H to Bi for stars with metallicities Z= 0.02 and Z= 0.01. *The Astrophysical Journal Supplement*, 225:24 (54pp).

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Trappitsch R. and Leya I. (2016) Production and recoil loss of cosmogenic nuclides in presolar grains. *The Astrophysical Journal*, 823:12 (11pp).

Wieler R., Huber L., Busemann H., Seiler S., Leya I., Maden C., Masarik J., Meier M.M.M., Nagao K., **Trappitsch R.**, and Irving A.J. (2016) Noble gases in 18 martian meteorites and angrite Northwest Africa 7812 – exposure ages, trapped gases, and a re-evaluation of the evidence for solar cosmic ray-produced neon in shergottites and other achondrites. *Meteoritics & Planetary Science*, 51:407–428.

Pignatari M., Zinner E., Hoppe P., Jordan C.J., Gibson B.K., **Trappitsch R.**, Herwig F., Fryer C., Hirschi R., and Timmes F.X. (2015) Carbon-rich presolar grains from massive stars: Subsolar $^{12}C/^{13}C$ and $^{14}N/^{15}N$ ratios and the mystery of ^{15}N. *The Astrophysical Journal Letters*, 808:L43.

Trappitsch R. and Ciesla F.J. (2015) Solar cosmic-ray interaction with protoplanetary disks: Production of short-lived radionuclides and amorphization of crystalline material. *The Astrophysical Journal*, 805:5 (11pp).

Meier M.M.M., Schmitz B., Alwmark C., **Trappitsch R.**, Maden C., and Wieler R. (2014) He and Ne in individual chromite grains from the regolith breccia Ghubara (L5): Exploring the history of the L chondrite parent body regolith. *Meteoritics & Planetary Science*, 49:576–594.

Denissenkov P.A., Truran J.W., Pignatari M., **Trappitsch R.**, Ritter C., Herwig F., Battino U., Setoodehnia K., and Paxton B. (2014) MESA and NuGrid simulations of classical novae: CO and ONe nova nucleosynthesis. *Monthly Notices of the Royal Astronomical Society*, 442(3):2058–2074.

Pignatari M., Zinner E., Bertolli M.G., **Trappitsch R.**, Hoppe P., Rauscher T., Fryer C., Herwig F., Hirschi R., Timmes F.X., and Thielmann F.K. (2013) Silicon carbide grains of type C provide evidence for the production of the unstable isotope ^{32}Si in supernovae. *The Astrophysical Journal Letters*, 771:L7 (5pp).

Trappitsch R. and Leya I. (2013) Cosmogenic production rates and recoil loss effects in micrometeorites and interplanetary dust particles. *Meteoritics & Planetary Science*, 48:195–210.

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