Department of Physics and Astronomy Faculty Research Areas

UNLV | COLLEGE OF SCIENCES

Theoretical and Computational

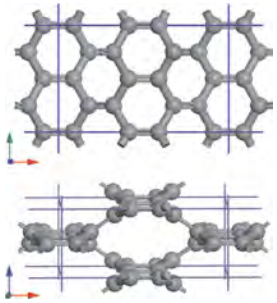
Condensed Matter and Materials Physics

Dr. Changfeng Chen
Department of Physics and Astronomy
Phone: 702-895-4230
Email: chen@physics.unlv.edu

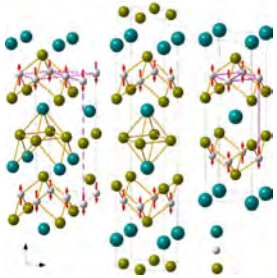
Expertise

- Novel states of matter: topological insulators and semimetals
- Superior bonding structures: superhard and supertough materials
- Intriguing quantum phenomena: superconductivity and magnetism
- Extreme mechanics: stress responses to complex large strains
- Ultimate thermodynamics: materials inside Earth and other planets

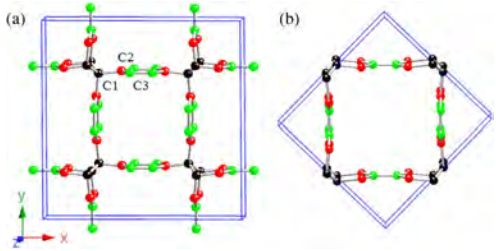
UNLV | COLLEGE OF SCIENCES



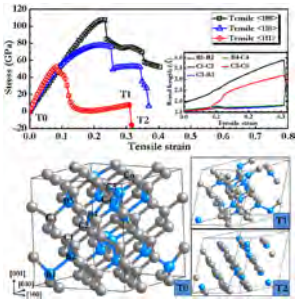
Nodal-ring Dirac semimetal states identified in bco-C_{16} crystal [Wang, Weng, Nie, Fang, Kawazoe, Chen, ***Phys. Rev. Lett.*** 116, 195501 (2016)].



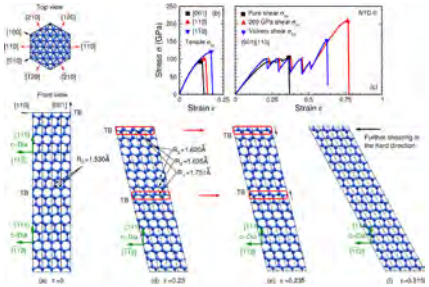
Magnetic Dirac materials $CaMnBi_2$ and $SrMnBi_2$ [Zhang, et al., ***Nature Commun.*** 7, 13833 (2016)].



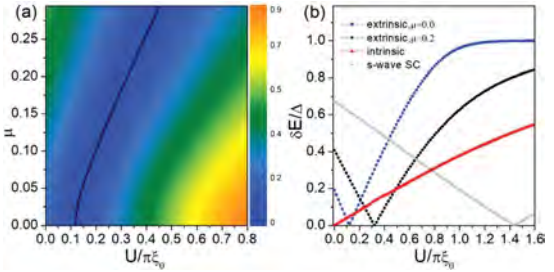
Nodal-net Dirac semimetal states in a graphene network structure [Wang, Nie, Weng, Kawazoe, Chen, ***Phys. Rev. Lett.*** 120, 026402 (2018)].



Superhard B_3C in diamond structure [Zhang, et al., ***Phys. Rev. Lett.*** 114, 015502 (2015)].

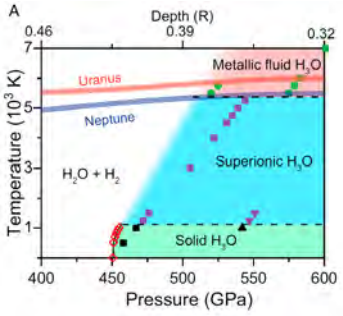


Extreme mechanics of nanotwinned diamond [Li, Sun, Chen, ***Phys. Rev. Lett.*** 117, 116103 (2016)].

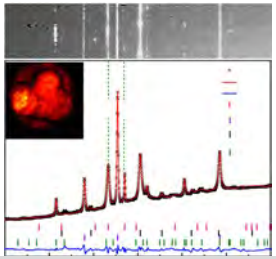


Kondo physics in 2D topological superconductors [Wang, et al., ***Phys. Rev. Lett.*** 122, 087001 (2019)].

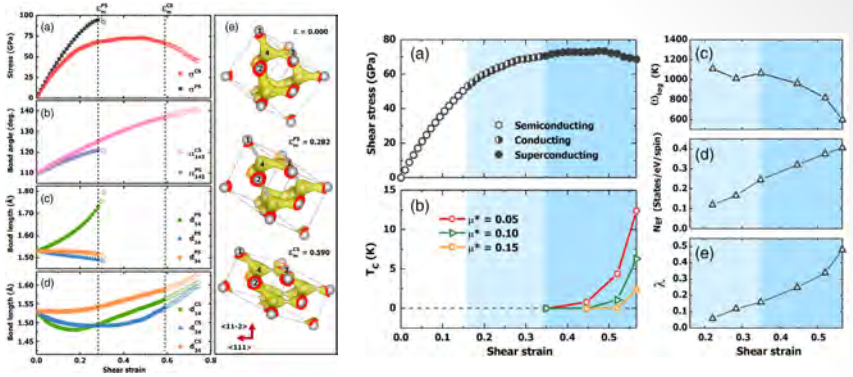
Helium-bearing compound FeO_2He predicted to stabilize at deep-Earth conditions [Zhang, et al., ***Phys. Rev. Lett.*** 121, 255703 (2018)].



Prediction of novel H_3O and implications for the magnetic fields of Uranus and Neptune [Huang, et al., ***Proc. Natl. Acad. Sci.*** 117, 5638 (2020)].



Pressure-stabilized divalent ozonide CaO_3 and its
impact on Earth's oxygen cycles [Wang, et al., ***Nature Commun.*** 11, 4702 (2020)].



Metallization and superconductivity in diamond [Liu, et al., ***Phys. Rev. Lett.*** 123, 195504 (2019); ***Phys. Rev. Lett.*** 124, 147001 (2020)].

Further Reading (selected papers by Chen Group, 2015-2020)

Anomalous Stress Response of Ultrahard WB_n Compounds, Li, Zhou, Zheng, Ma, Chen, ***Phys. Rev. Lett.*** 115, 185502 (2015).

Ultralow-Frequency Collective Compression Mode and Strong Interlayer Coupling in Multilayer Black Phosphorus, Dong, et al., ***Phys. Rev. Lett.*** 116, 087401 (2016).

Extraordinary Indentation Strain Stiffening Produces Superhard Tungsten Nitrides, Lu, Li, Ma, Chen, ***Phys. Rev. Lett.*** 119, 115503 (2017).

Xenon iron oxides predicted as potential Xe hosts in Earth's lower mantle, Peng, Song, Liu, Li, Miao, Chen, Ma, ***Nature Commun.*** 11, 5227 (2020).

Electronic and Magnetic Properties at High Pressure

Dr. Andrew Cornelius
Department of Physics & Astronomy
Phone (702) 895-1727

Expertise:

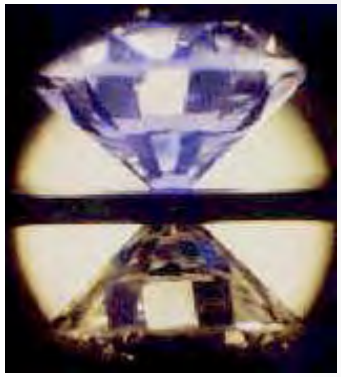
- Experimental high pressure measurements
- Magnetism
- Superconductivity

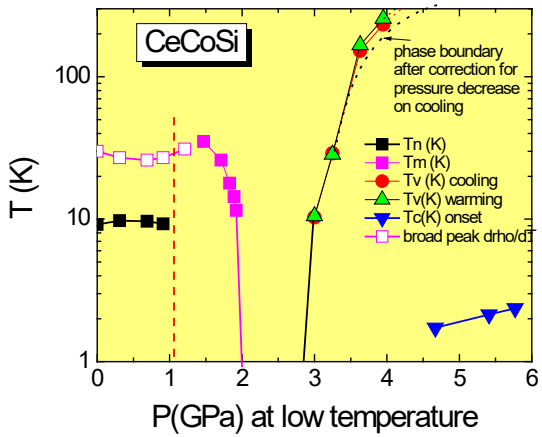
UNLV | COLLEGE OF SCIENCES

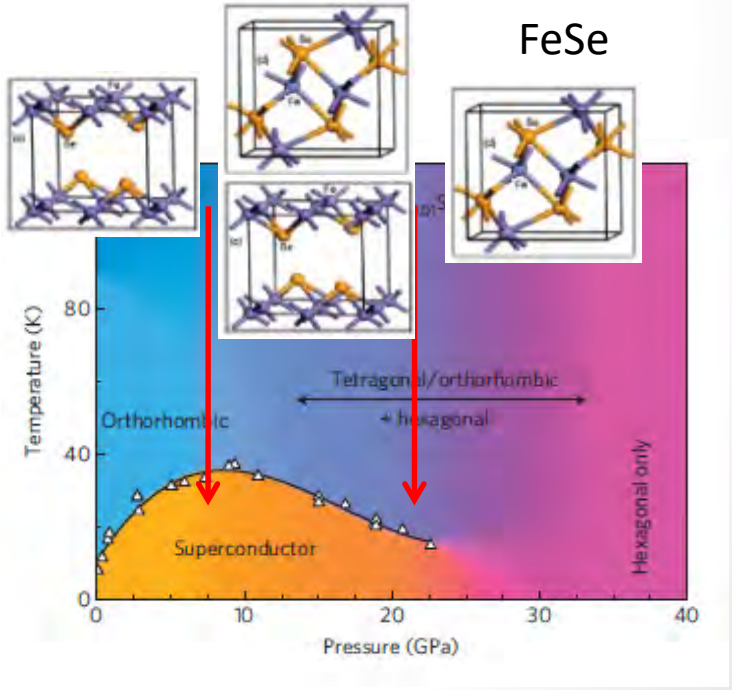
Superconductivity

Quantum Design PPMS at UNLV

- Measurements from 0.3 K to 400 K
  - Heat capacity, electric and thermal transport, and AC/DC magnetization
- Pressure cells to measure electrical properties (clamp to 3 GPa and diamond anvil cell to >100 GPa)

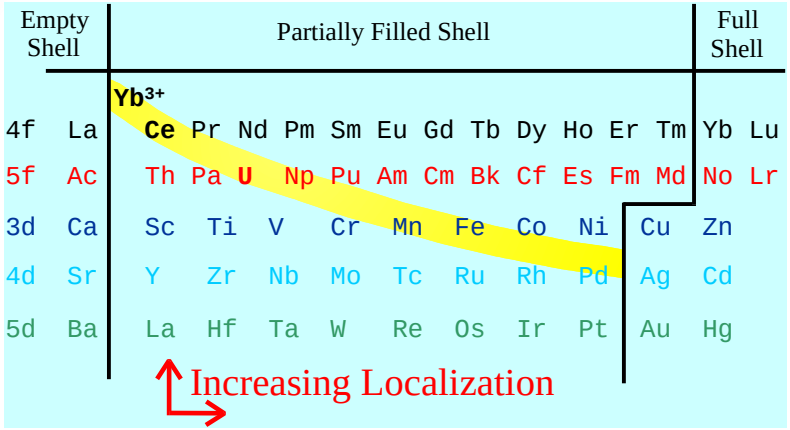






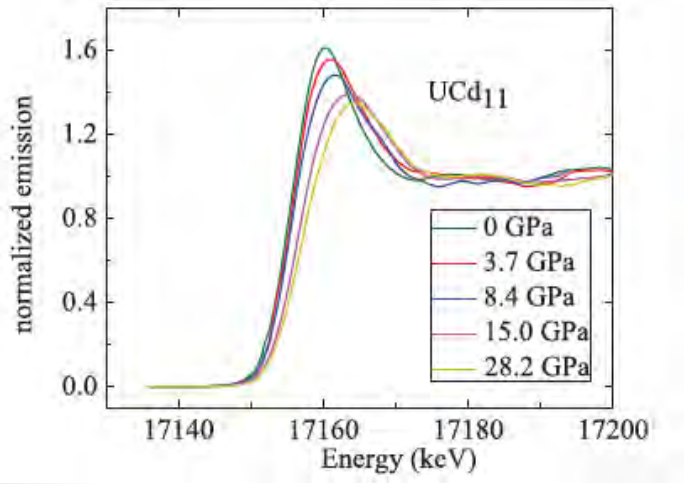
Addition of high pressure synchrotron experiments (diffraction and X-ray absorption) allows mapping of complex superconducting phase diagrams

Correlated-Electron Systems

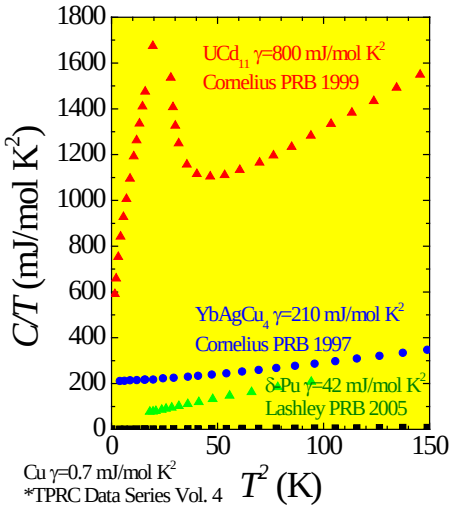


Modified periodic table

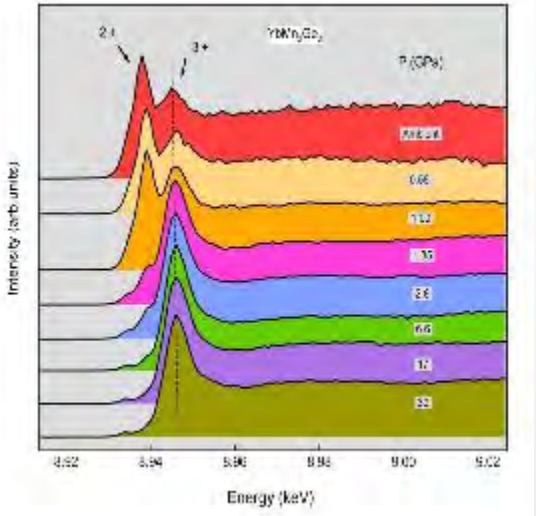
- Going from localized to delocalized electrons one often finds strong electron-electron correlations
- Correlated electron systems can yield interesting behavior: fluctuating valence, superconductivity, non-Fermi liquid, heavy fermion and many more



f-electron delocalization
X-ray absorption



Heavy fermions
Heat Capacity



Fluctuating valence
X-ray fluorescence

Carl Haster

- Assistant Professor - Astrophysics
- Department of Physics and Astronomy
- Email: carl.haster@unlv.edu
- Website: cjhaster.com
- Office: BPB 212

Expertise

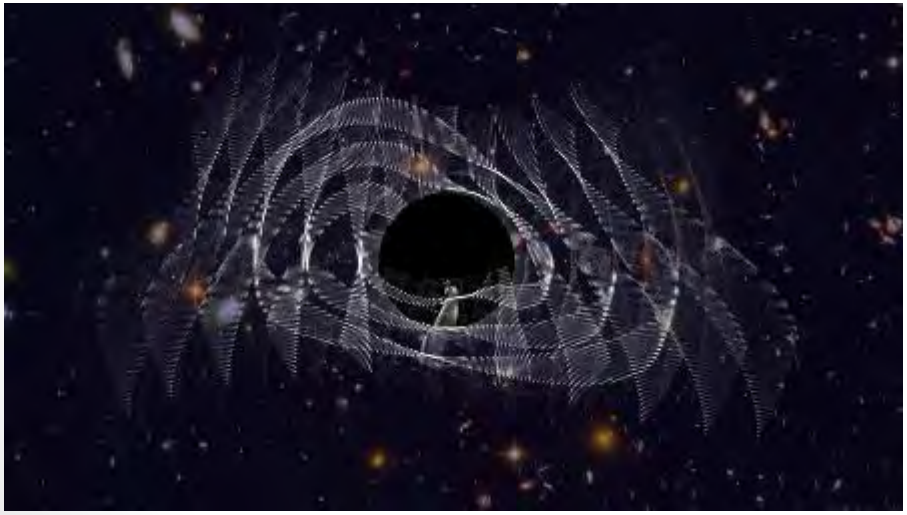
- Gravitational Wave Astrophysics
- Tests of General Relativity
- Compact Objects – Black Holes and Neutron Stars
- Multi-Messenger Astrophysics

UNLV College of SCIENCES

Gravitational Wave Astrophysics

By observing ripples in spacetime, it is possible to study the absolute extremes of the Universe.

This can teach us about the life and death of stars, the evolution of the Universe and the nature of gravitation itself.



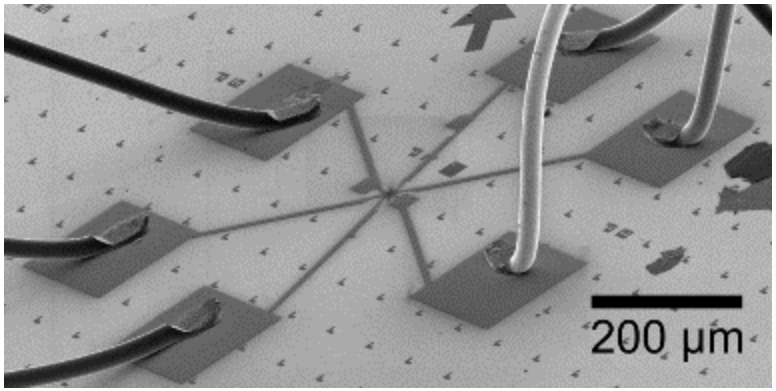
UNLV College of SCIENCES

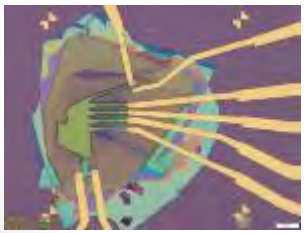
Island – Quantum computing, quantum sensing

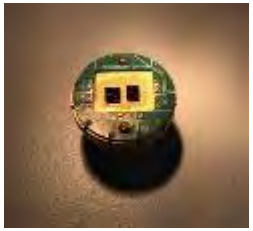
The Nanoscale Physics Group @ UNLV

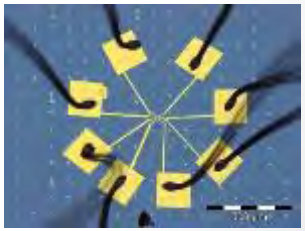
Areas of Research

- Nanotechnology, device physics
- Photodetection and quantum sensing
- Quantum computing, topological qubits
- Non-equilibrium, driven systems
- Superconductivity, proximity effects
- Low dimensional materials







UNLV | COLLEGE OF SCIENCES

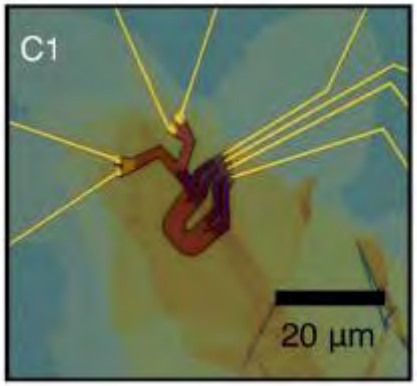
Island's Lab website

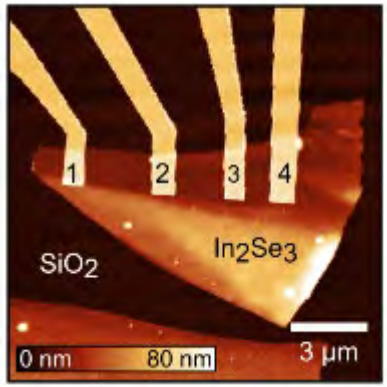
Island – Quantum computing, quantum sensing

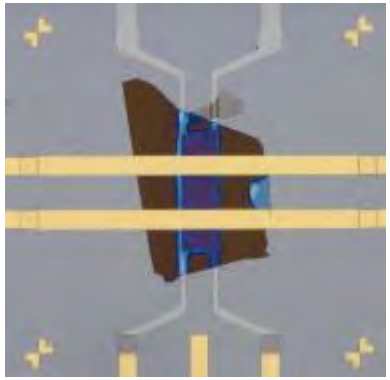
Quantum computing: Topological phases for fault-tolerant, universal quantum computing.

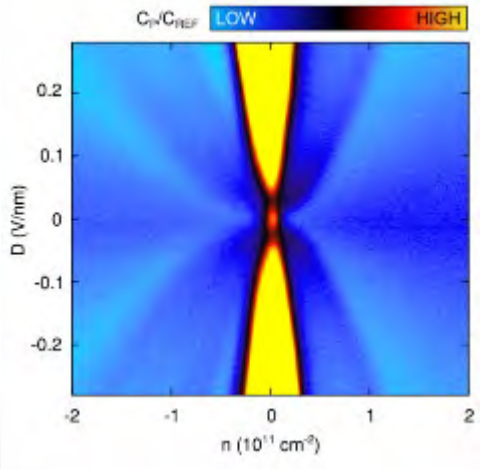
Industry-disruptive photodetectors: Ultra-sensitive phototransistors designed with 2D materials and heterostructures.

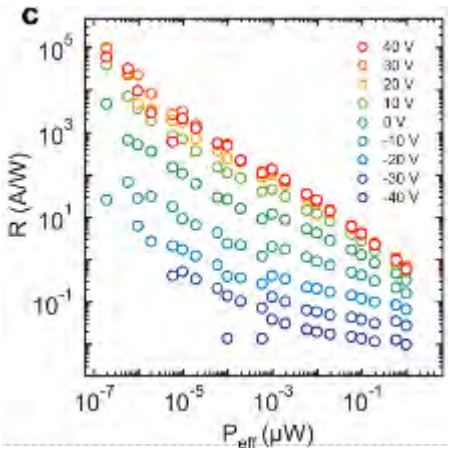
Transient phases of driven systems: Non-equilibrium response of pumped nanomaterials below the diffraction limit.

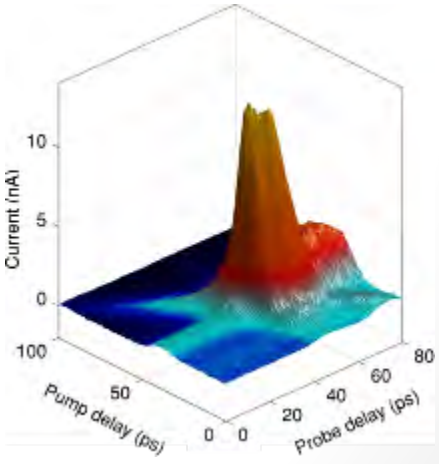












Island, J. O., et al. *Nature* **571** (2019): 85–89.

Island, J. O., et al. *Nano Letters* **15** (2015): 7853-7858.

Island's Lab website

Island – Quantum computing, quantum sensing

Journal publications:

Spin-orbit-driven band inversion in bilayer graphene by van der Waals proximity effect
J.O. Island, X. Cui, C. Lewandowski, J.Y. Khoo, E.M. Spanton, H. Zhou, D. Rhodes, J.C. Hone, T. Taniguchi, K. Watanabe, L.S. Levitov, M.P. Zaletel, A.F. Young, Nature, **571**, 85-89 (2019). (arXiv)

Enhanced superconductivity in atomically thin TaS2
E. Navano-Moiatalla*, J.O. Island*, S. Manas-Valero, E. Pinilla-Cienfuegos, A. Castellanos-Gomez, J. Queieda, G. Rubio- Bollinger, L. Chirolli, J.A. Silva-Guilin, N. Agrat, G.A. Steele, F. Guinea, H.S.J. van der Zant, E. Coronado, Nature Communications, **15**, 7853 (2016). (arXiv)

Proximity-induced Shiba states in a molecular junction
J. O. Island, R. Gaudenzi, J. de Bruijckere, E. Burzuri, C. Franco, M. Mas-Torrent, C. Rovira, J. Veciana, T. M. Klapwijk, R. Aguado, H.S.J. van der Zant, Physical Review Letters, **118**, 117001 (2017). (arXiv)

T1S3 transistors with tailored morphology and electrical properties
J.O. Island, M. Barawi, R. Biele, A. Almazan, J.M. Clamagirand, J.R. Ares, C. Sanchez, H.S.J. van der Zant, J.V. Alvarez, R. D'Agosta, I.J. Ferrer, A. Castellanos-Gomez, Advanced Materials, **27**, 2595 (2015). (arXiv)

Environmental instability of few-layer black phosphorus
J.O. Island, G.A. Steele. H.S.J. van der Zant, and A. Castellanos-Gomez, 2D Materials, **2**, 011002 (2015). (arXiv)

Ultrahigh photoresponse of few-layer TiS3 nanoribbon transistors
J.O. Island, M. Buscema, M. Barawi, J.M. Clamagirand. J.R. Ares, C. Sanchez, I.J. Ferrer, G.A. Steele, H.S. J van der Zant, and A. Castellanos-Gomez, Advanced Optical Materials, **2**, 641 (2014). (arXiv)

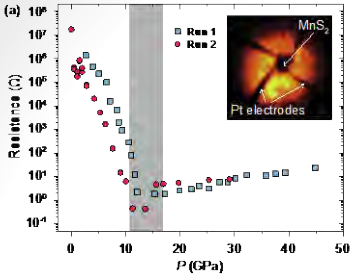
Gate controlled photocurrent generation mechanisms in high-gain ln2Se3 phototransistors
J.O. Island*, S.I. Blanter*, M. Buscema, H.S.J. van der Zant, and A. Castellanos-Gomez, Nano Letters, **15**, 7853(2015). (arXiv)

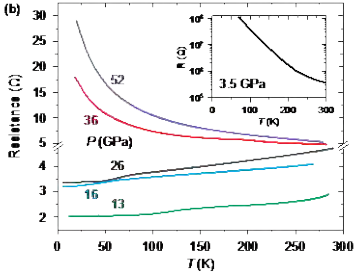
Precise and reversible band gap tuning In single-layer MoSe2 by uniaxial strain
J.O. Island, A. Kuc, E.U. Diependaal, H.S.J. van der Zant, T. Heine, and A. Castellanos- Gomez, Nanoscale, **8,** 2589 (2016). (arXiv)

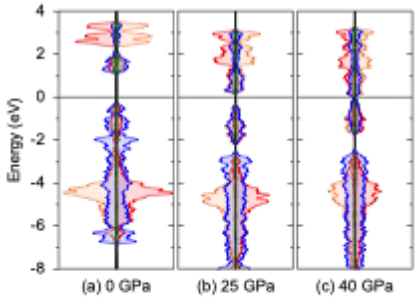
Island's Lab website

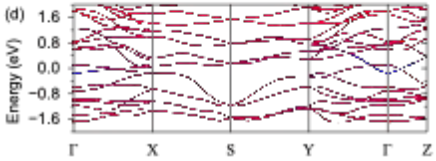
Keith Lawler

Materials Properties at Extreme Conditions

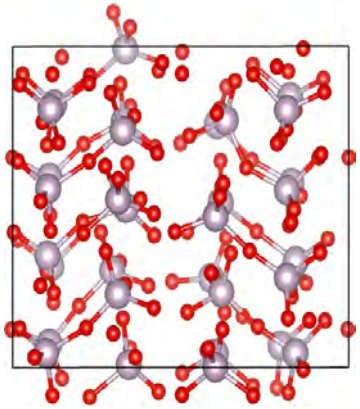


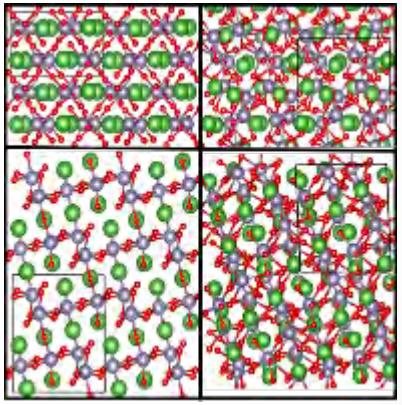




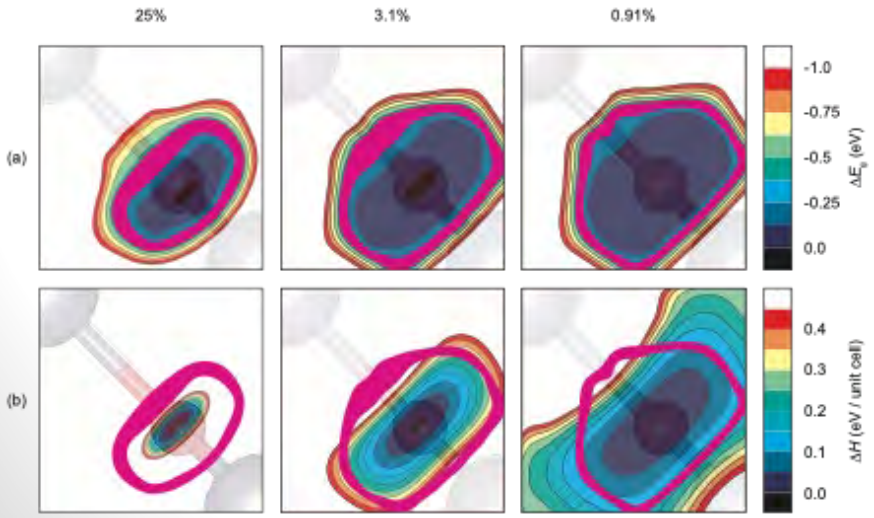


We primarily perform electronic structure simulations to understand pressure driven phenomenon particularly related to correlated electron systems and changes in bonding.





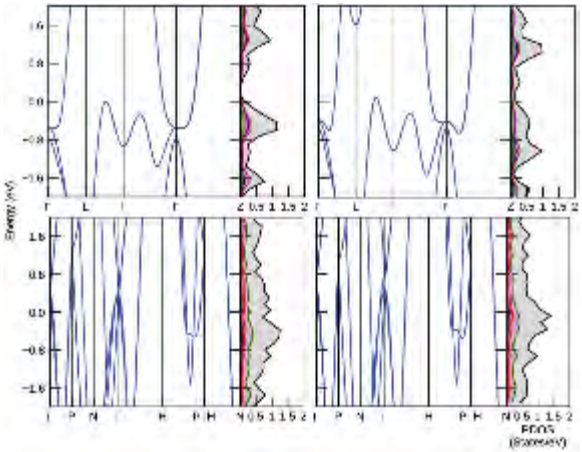
This includes molecular dynamics to understand the thermal behavior of materials and melts,

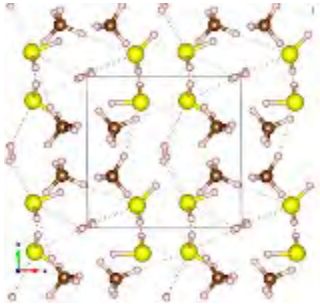


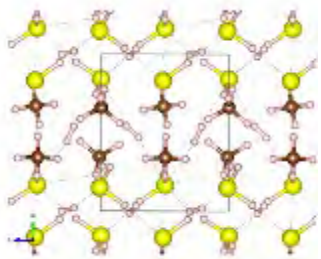
as well as crystal structure prediction and the electronic response to pressure driven perturbations in crystalline lattices.

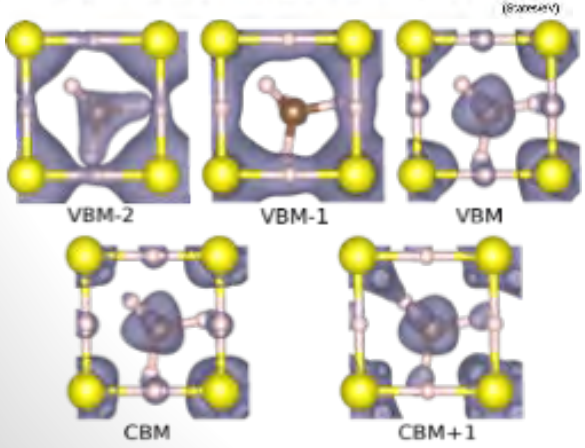
UNLV | COLLEGE OF SCIENCES

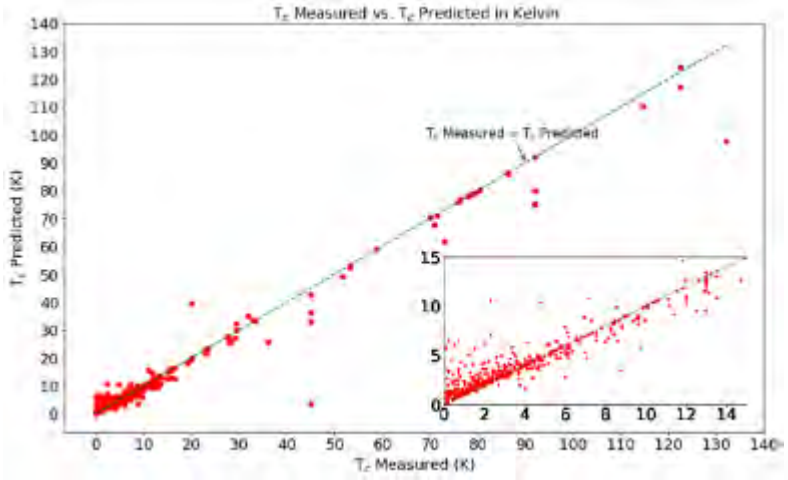
Our group is also focused on understanding and predicting high temperature superconductivity in pressurized systems. As part of the team that reported room temperature superconductivity in a carbonaceous sulfur hydride system, we have been focused on understanding the molecular pathway to that system, the fundamental interactions driving its superconductivity, and building machine learning tools to predict such properties in new materials.





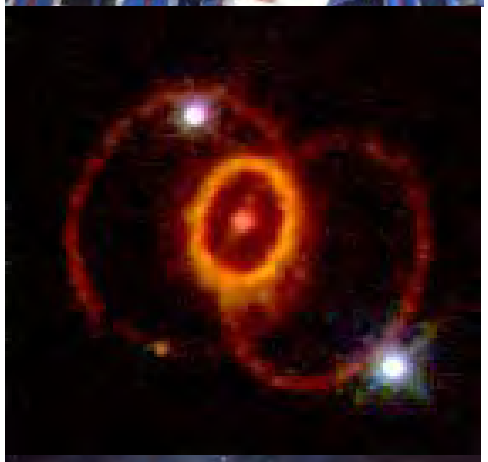






Stephen Lepp

- Professor of Astrophysics, Department of Physics and Astronomy
- Ph.D., Physics, University of Colorado, Boulder
- BPB 234, Stephen.Lepp@unlv.edu
- http://www.physics.unlv.edu/~lepp/



Areas of Expertise

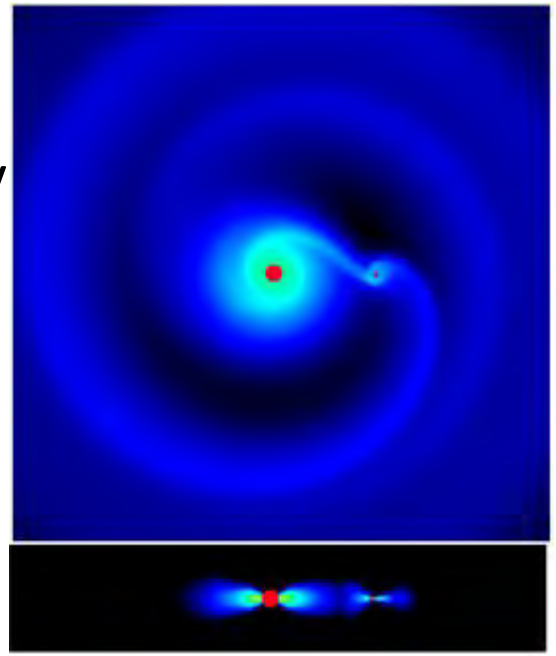
- Astrochemistry
- Interstellar Medium
- SN1987A
- Formation of first objects in the Early Universe
- Thermal Phases in Astrophysics
- X-ray chemistry

Research Summary:

I work primarily at the intersection of Atomic and Molecular Physics with Astrophysics. Making models of astronomical environments to further our understanding of them. I have modeled: interstellar clouds, star forming regions, active galactic nuclei, SN1987A, and the Early Universe.

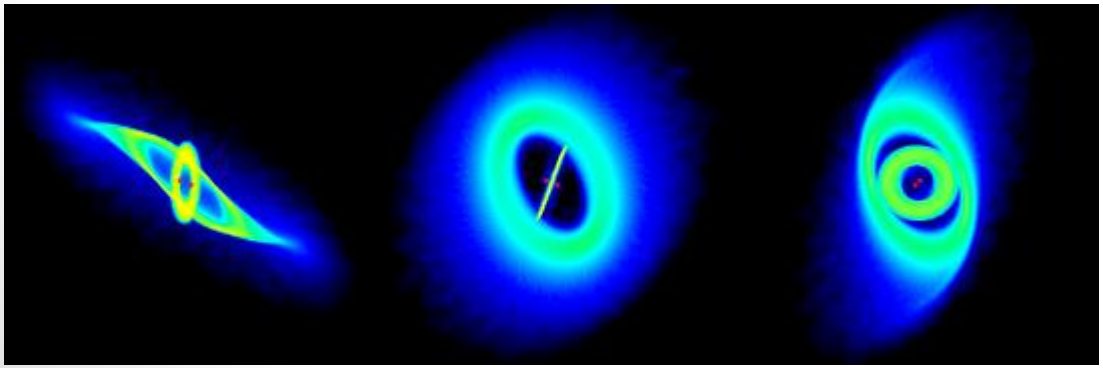
Rebecca Martin

- Professor of Astronomy
- BPB 233
- Department of Physics and Astronomy
- Email: Rebecca.martin@unlv.edu



Expertise

- Star and planet formation
- Astrophysical Fluids
- Binary Star Systems
- Planetary System Dynamics



UNLV College of SCIENCES

Condensed Matter Theory

- **Dr. Tao Pang**
- Professor of Physics
- Department of Physics and Astronomy
- Email: tao.pang@unlv.edu
- Website: physics.unlv.edu/~pang/

Expertise

- Theoretical and computational studies of novel materials, such as cold atoms and molecules, superconductors and superfluids, and other highly correlated systems.
- Path-integral and diffusion quantum Monte Carlo simulations and other first-principles calculations.
- Functional variation, correlated-basis, mean-field, and other analytical approaches.

UNLV College of SCIENCES

Research Methods and Systems Studied

- Analytical Approach

  Quantum Hall effect; quantum transport phenomena, superconductor-insulator transitions; vibrational modes in glasses; and slow light in cold atoms.

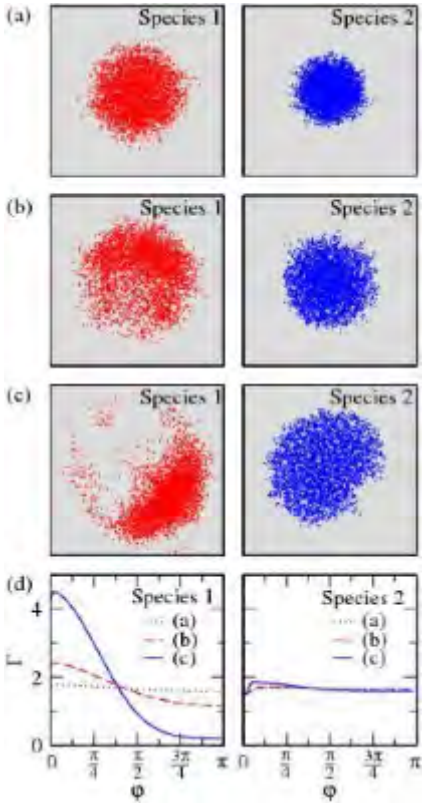
- Diffusion Quantum Monte Carlo Simulation

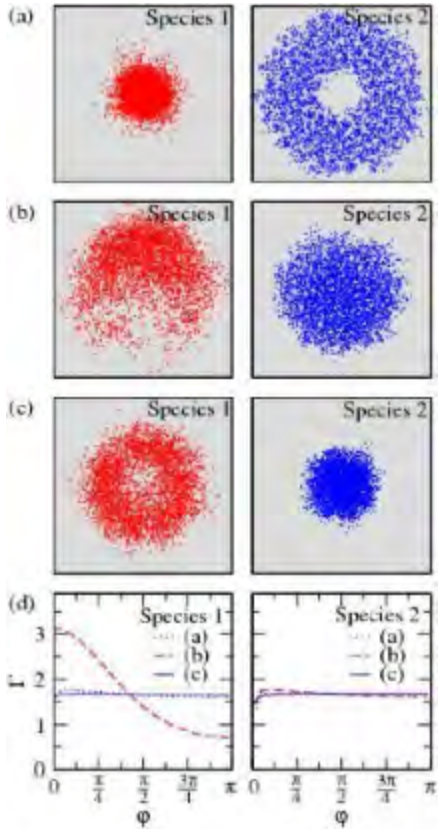
  Negative donor centers in semiconductors; hydrogen molecules in confinement; ionic hydrogen clusters; and helium clusters with modified interactions.

- Path Integral Quantum Monte Carlo Simulation

  Bosons trapped in potential wells in one dimension or two dimensions; Bose-Einstein condensation of cold atoms; and asymmetric distributions of Bose-Einstein condensates of boson mixtures.

An Example: Asymmetry of the Mixed Bose Condensates:





Asymmetric distributions of two Bose-Einstein condensates in the same trap with different cluster parameters.

H. Ma and T. Pang, Phys. Rev. A **70**, 063606 (2004).

Timothy Porter

- Professor of Physics, Department of Physics and Astronomy
- Ph.D., Physics, Arizona State University
- BPB 226, Tim.Porter@unlv.edu
- http://www.physics.unlv.edu/~tporter/

Areas of Expertise

- Study of greenhouse gas sources and sinks in soils of forests and other ecosystems.
- Fabrication of chemical and biological microsensors using piezoresistive microcantilever technology.
- Studies of inorganic/organic hybrid materials.
- Polymer and semiconductor surface physics.

Research Summary:

Microbial activity in the soils of forests and other ecosystems may contribute up to thirty percent of all greenhouse gas respiration worldwide.

We are currently using a unique battery powered quadrupole mass spectrometer to make real-time, in-situ measurements of greenhouse gases

in the soils of the Coconino National Forest with part per billion sensitivity in order to assess the effects of forest thinning and wildfires on

long-term greenhouse gas emissions.

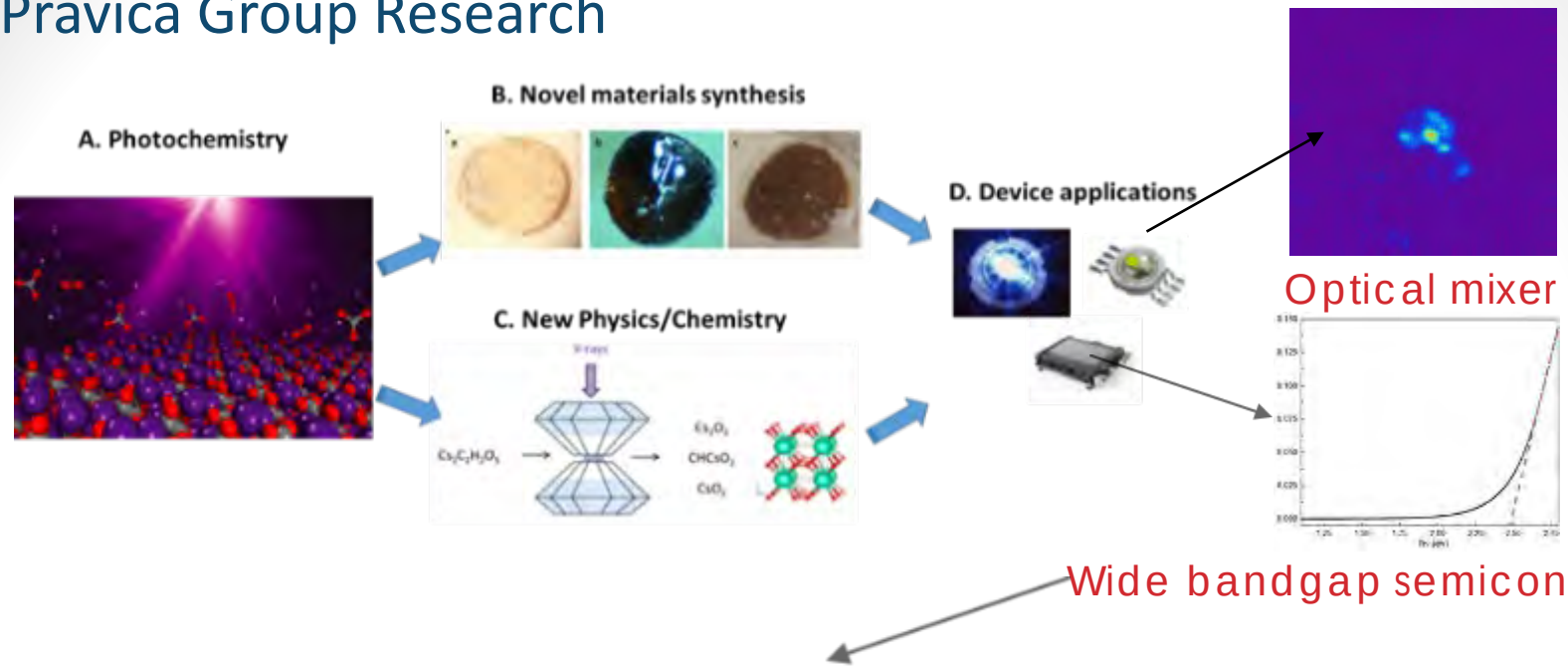
Novel chemistry and biology using highly ionizing radiation

Michael Pravica, Ph.D.
Professor of Physics
Department of Physics and Astronomy
Phone: (702)895-1723
Email: michael.Pravica@unlv.edu

Expertise:
Useful Hard X-ray photochemistry
High pressure
Spectroscopy
Ion Beam Nuclear Transmutation Doping
High quality synthesis of vaccines using tuned hard x-rays

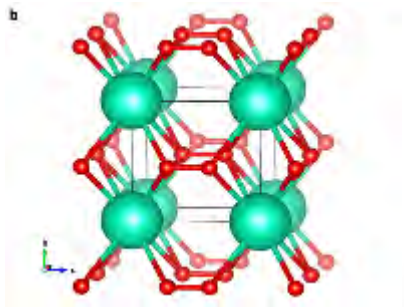
UNLV | COLLEGE OF SCIENCES

Pravica Group Research



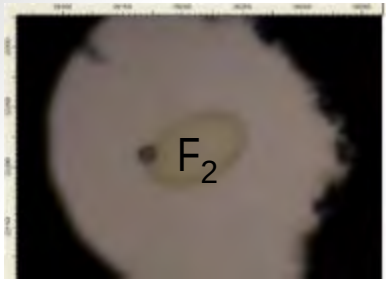
Radiation-hardened sensors/direct energy conversion devices for EXTREME CONDITIONS or tuned solar materials

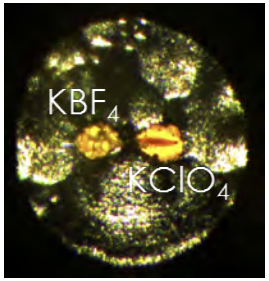
Useful hard x-ray photochemistry



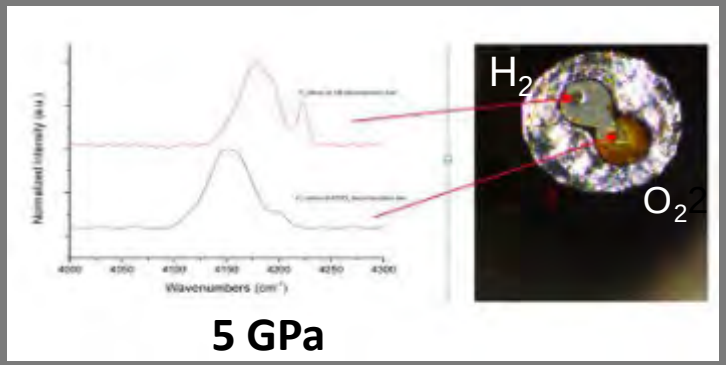
Novel structures of known materials produced With hard x-rays and high pressure (e.g. CsO_2)

High Pressure Fluorine Chemistry





$$2F_2 + O_2 \xrightarrow{h\nu} 2OF_2 \ @\ 3\ GPa$$



5 GPa

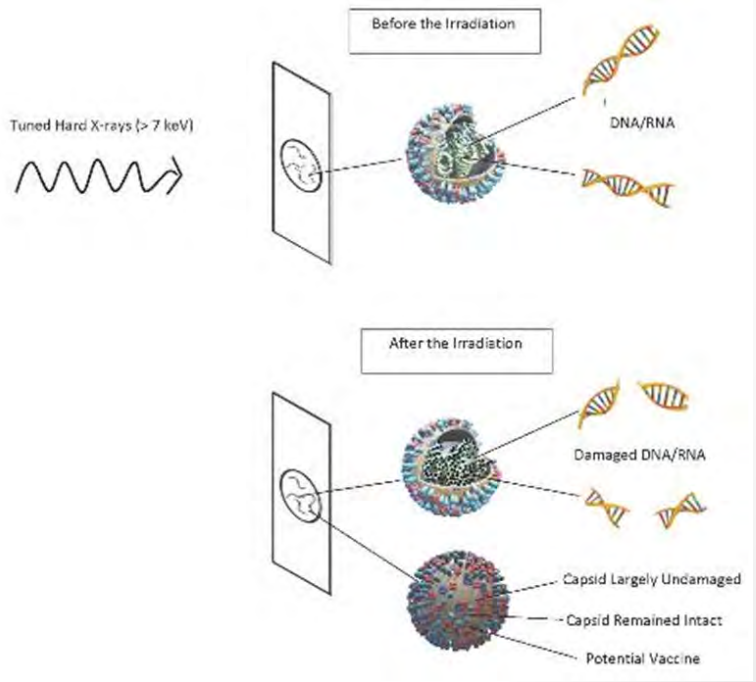
Molecular mixtures at high pressure

X-ray induced combustion

Inner shell chemistry at high pressure

$$XeF_2 \xrightarrow{h\nu} Xe + F_2 \text{ (}\textit{in situ}\text{ x-ray fluorination)}$$

$$HgF_2 + F_2 \xrightarrow{h\nu} HgF_4$$



Using tuned hard x-rays to damage viruses to create high quality vaccines by targeting specific molecular groups/bonds that resonantly absorb x-ray energy leading to decomposition chemistry.

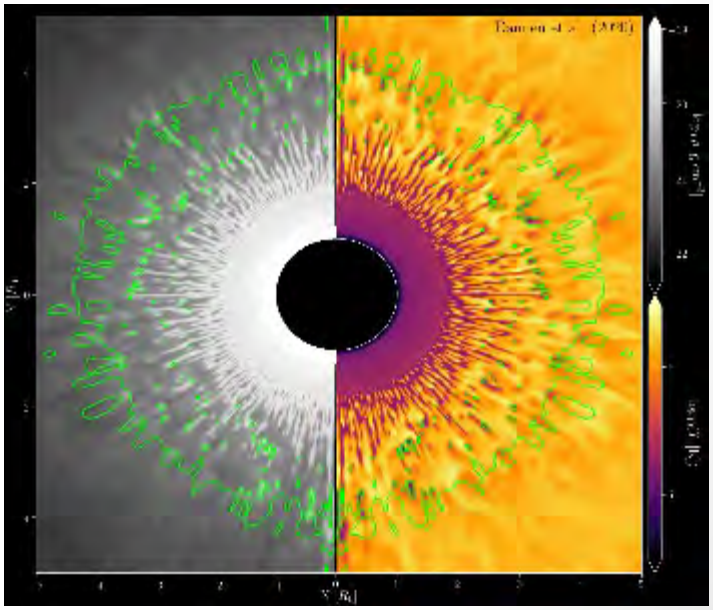
Active Galactic Nuclei

Dr. Daniel Proga

Department of Physics and Astronomy

Phone: (702) 895 3507

Email: dproga@physics.unlv.edu



Expertise:

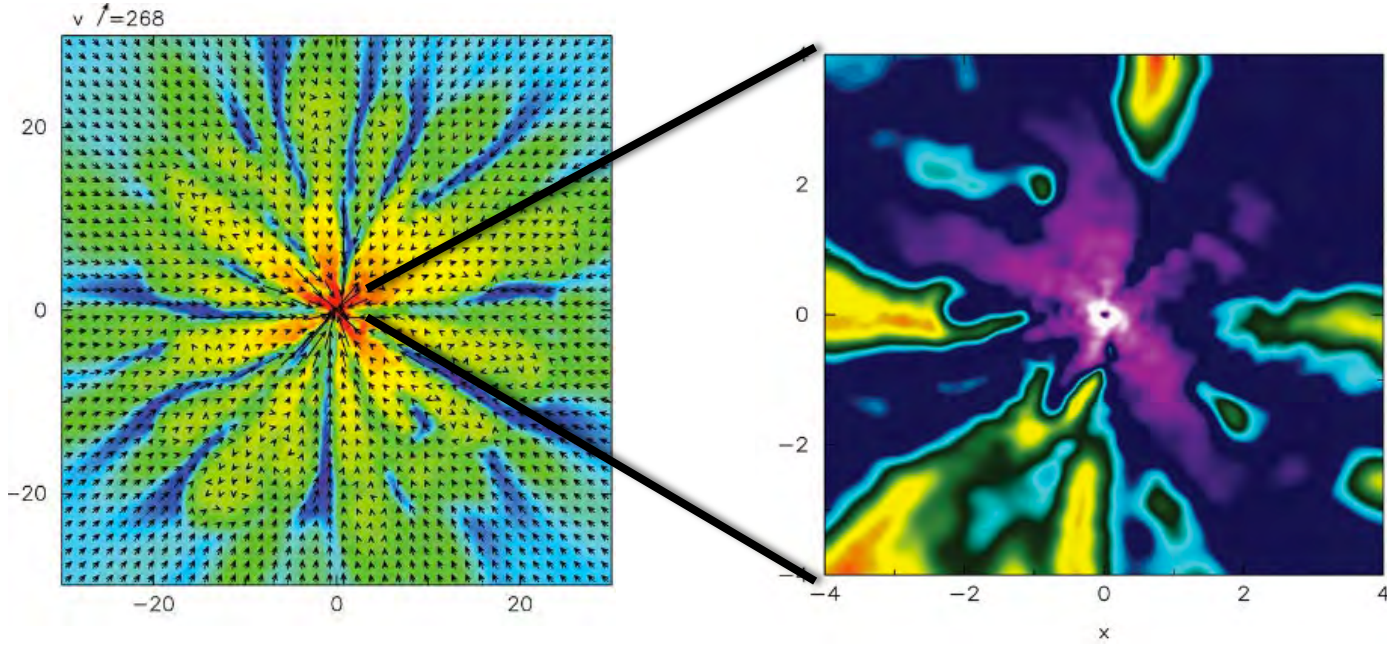
Radiation-Magnetohydrodynamics

Accretion Physics

Radiation Transfer & Photoionization

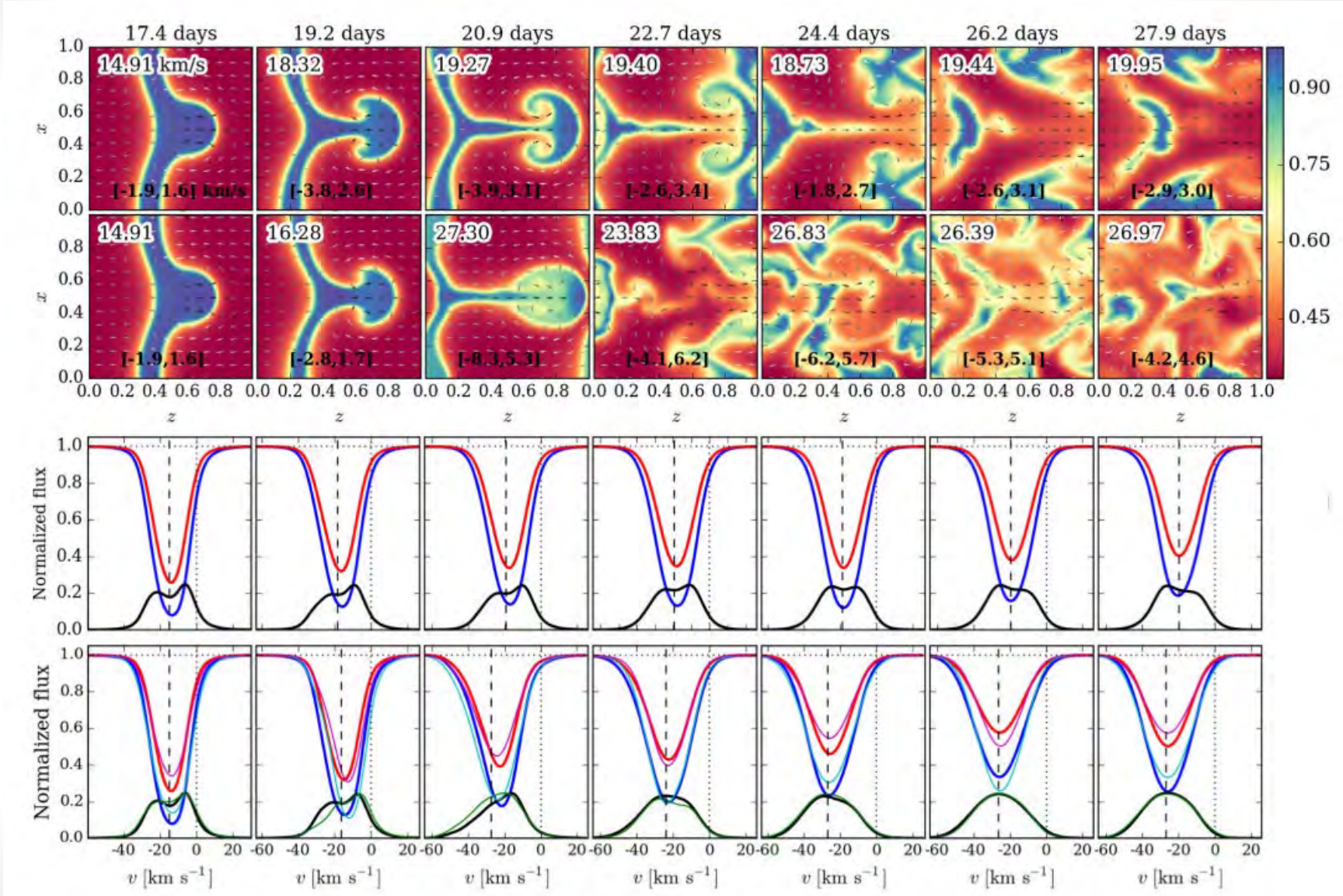
UNLV | COLLEGE OF SCIENCES

Radiation-hydrodynamic simulations of black hole accretion and related outflows



UNLV | COLLEGE OF SCIENCES

Generated absorption spectra from simulations



UNLV | COLLEGE OF SCIENCES

Climate Change; Renewable Energy; Astronomy

Dr George Rhee
Department of Physics and Astronomy
Phone: (702) 895-4453
email: grhee@physics.unlv.edu

“Expertise:”

Observational Astronomy/Cosmology

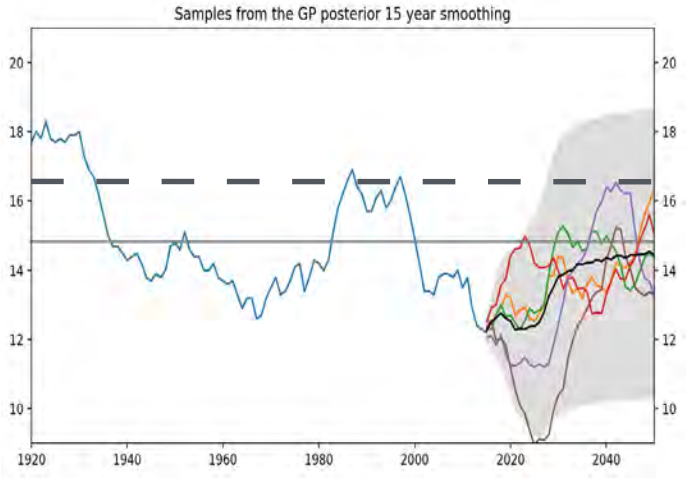
Renewable Energy

Colorado River flow projections

UNLV | COLLEGE OF SCIENCES

Climate Change

River flow projections using statistics from tree ring data from the upper Colorado River Basin. Gaussian processes with known covariance can be used to predict properties of river flows. Figure shows predictions for Colorado river flow 2015-2050.



Astrophysics

Interested in:

Dark matter distribution in galaxies inferred from the rotation of neutral hydrogen gas in disks

Properties of galaxies in extreme low density environments (voids)

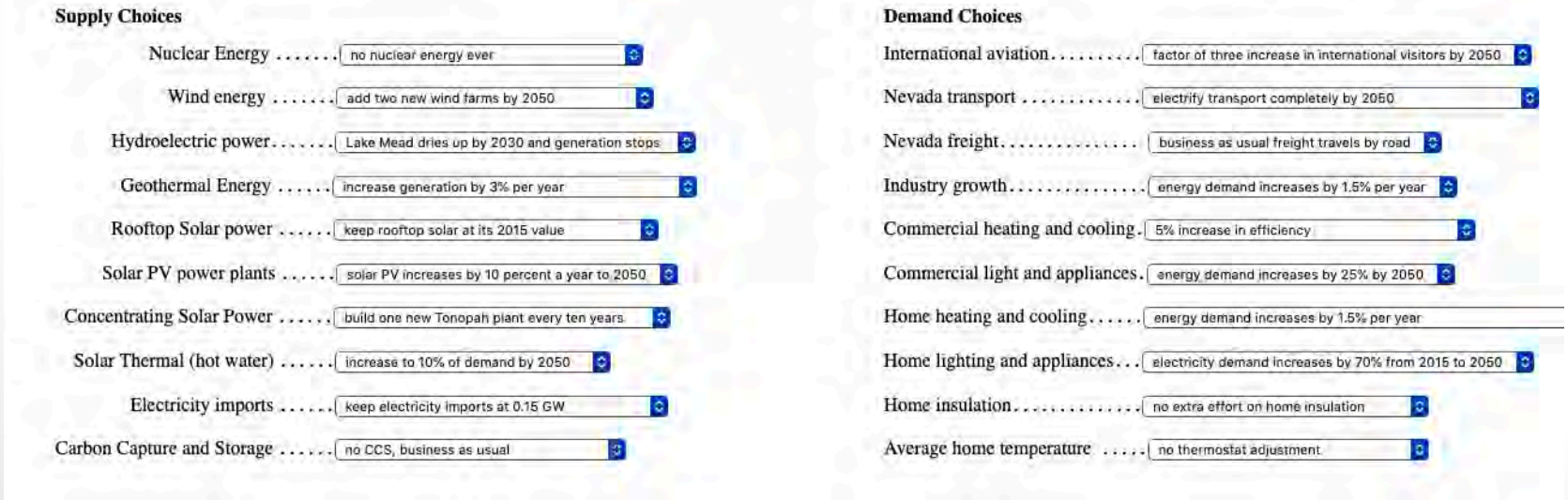
Measuring the masses of black holes using the variability of the central region in Seyfert galaxies and quasars. spectral and brigtness measurements

UNLV | COLLEGE OF SCIENCES

Renewable Energy

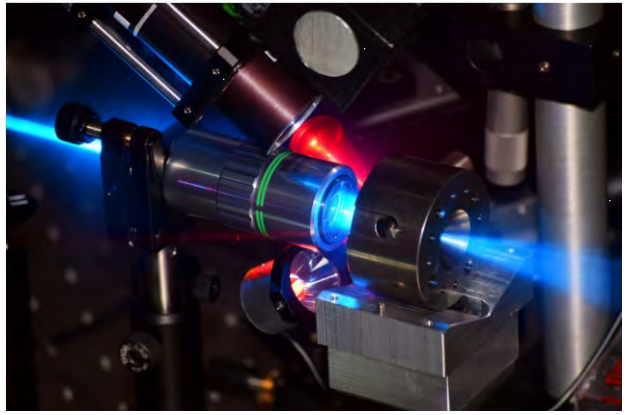
Created an online calculator allowing the user to choose supply and demand options to make plans to zero out emissions in Nevada by 2050.
http://nv2050.physics.unlv.edu/. I

Interview on KPNR and writeup describing the idea:
https://knpr.org/desert-companion/2018-12/do-math

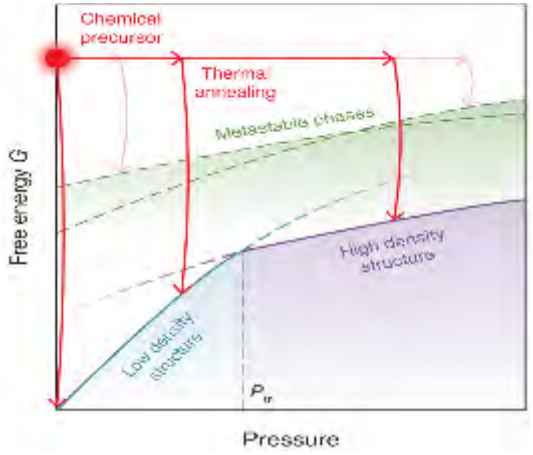


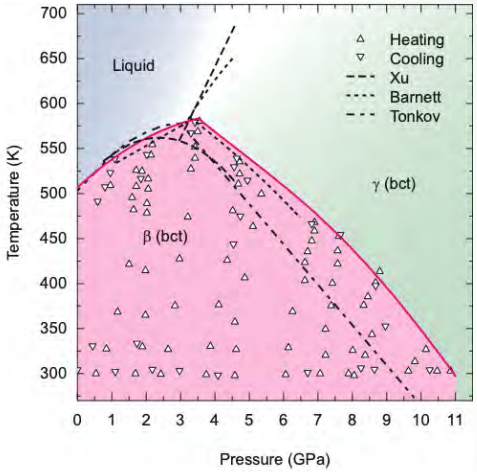
UNLV | COLLEGE OF SCIENCES

Salamat Group – Collaboration with MSTS

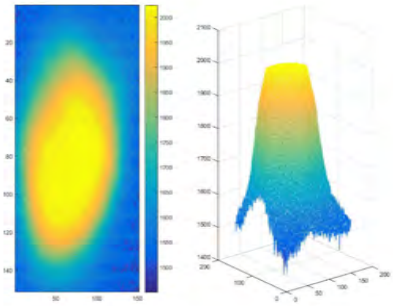


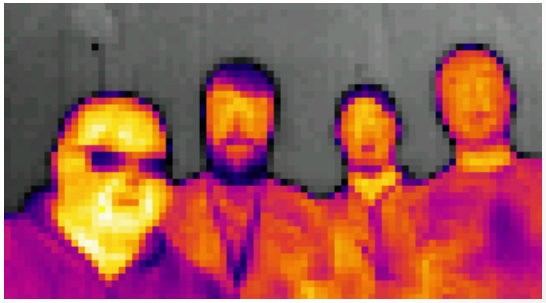
Metrology – accurate mapping of P, V, T





High temperature modelling – understanding emissivity under extreme conditions



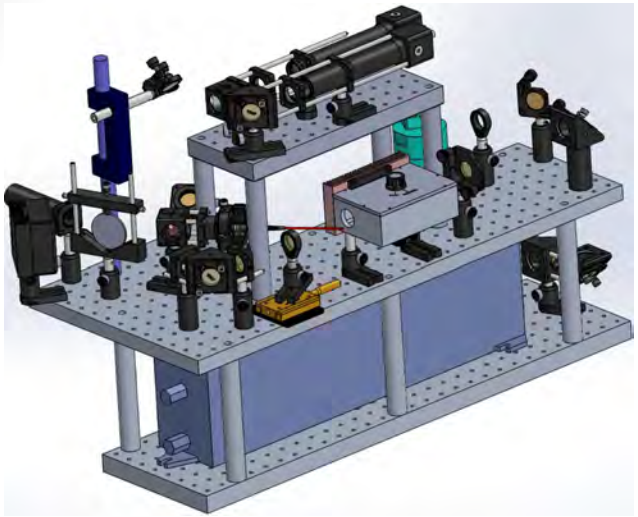


Los Alamos NATIONAL LABORATORY

MSTS MISSION SUPPORT AND TEST SERVICES LLC

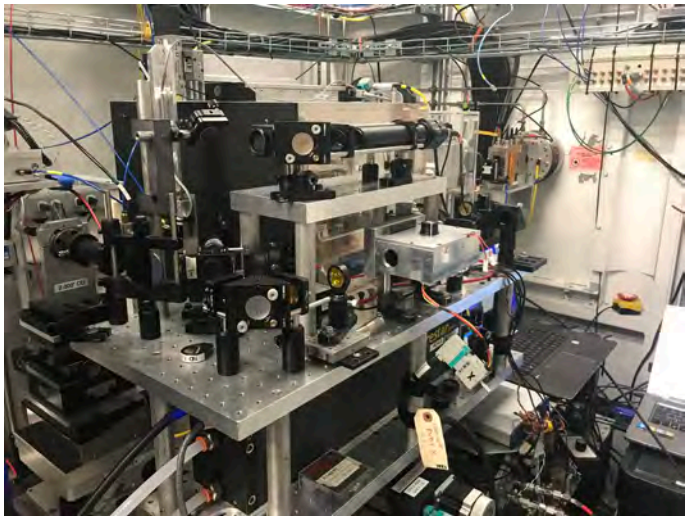
UNLV COLLEGE OF SCIENCES

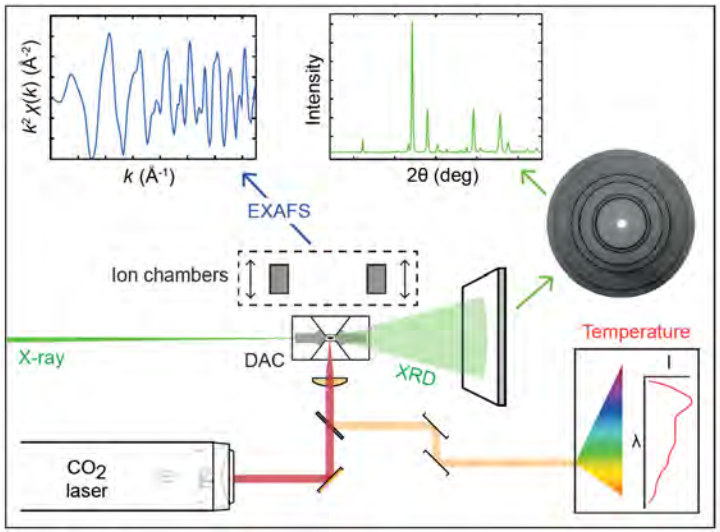
Warm dense matter – probed using EXAFS



- Development of a CO_2 laser heating
- Direct heating of non-metallic systems in a DAC
- First HTHP EXAFS measurements of insulators

- In situ and post heating measurements
- Determining absolute temperature from X-ray spectroscopy





Publications

(1) D. Smith, D. Sneed, N. Dasenbrock-Gammon, E. Snider, G. A. Smith, C. Childs, J. S. Pigott, N. Velisavljevic, C. Park, K. V. Lawler, R. P Dias, A. Salamat*, Anomalous Conductivity in the Rutile Structure Driven by Local Disorder The Journal of Physical Chemistry Letters 10 18 5351-5356 (2019)

(2) J. Kearney M. Grauzinyte D. Smith A. Gulans D. Sneed C. Childs, J. Hinton C. Park J. S. Smith, E. Kim, S. D. S. Fitch, A. L. Hector, C. J. Pickard J. A. Flores-Livas, A. Salamat*, Pressure tuneable visible range band gap in the ionic spinel tin nitride Angewandte Chemie International Edition, 57, 11623-11628 (2018)

(3) C. Childs, K. V. Lawler, A. L. Hector, S. Petitgirard, O. Noked, J. S. Smith, D. Daisenberger, L. Bezacier, M. Jura, C. J Pickard, A. Salamat*, Covalency is Frustrating: $La_2Sn_2O_7$ and the Nature of Bonding in Pyrochlores under High Pressure Temperature Conditions Inorganic chemistry, 57, 15051-15061, (2018)

(4) D. Smith, K. V. Lawler, M. Martinez-Canales, A. W. Daykin, Z. Fussell, G. A. Smith, C. Childs, J. S. Smith, C. J. Pickard, and A. Salamat*, Postaragonite phases of $CaCO_3$ at lower mantle pressures Physical Review M 2, 013605 (2018)

(5) D. Smith, J. S. Smith, C. Childs, E. Rod, R. Hrubiak, G. Shen, A. Salamat*, A CO_2 laser heating system for in situ high pressure-temperature experiments at HPCAT Review of Scientific Instruments 89, 083901 (2018)

(6) R. Briggs, D. Daisenberger, O. T. Lord, A. Salamat, E. Bailey, M. J. Walter, P. F. McMillan*, High-pressure melting behavior of tin up to 105 GPa Physical Review B 95, 054102 (2017)

(7) M. Zaghoo, A. Salamat, I. F. Silvera*, A first order phase transition to metallic hydrogen. Physical Review B 93, 155128 (2016)

(8) A. Salamat*, R. Fischer, R. Briggs, M. I. McMahon, S. Petitgirard, In situ synchrotron X-ray diffraction in the laser heated diamond anvil cell: melting phenomena and synthesis of new materials. Coordination Chemistry Reviews 277-278, 15 (2014)

UNLV | COLLEGE OF SCIENCES

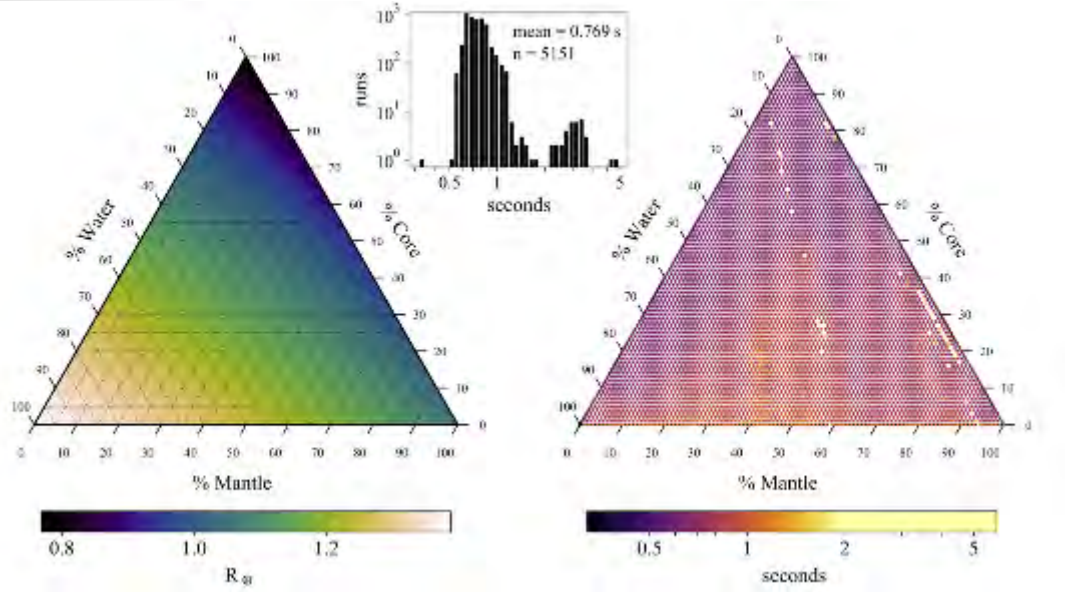
Research Group of Dr. Steffen

- **Dr. Jason H. Steffen**
- Associate Professor
- Department of Physics and Astronomy
- Email: jason.steffen@unlv.edu
- Website: jasonhsteffen.com

Expertise

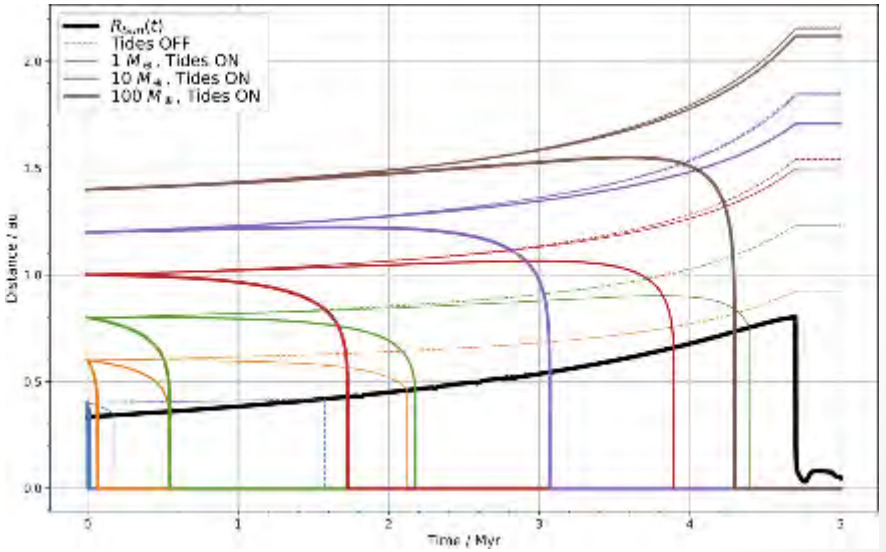
- Understanding the properties of extrasolar planets and planetary systems
- Planetary dynamics
- Planet interior modeling
- Composition of planet-forming materials

UNLV | College of SCIENCES



Timing results for planet models using the MAGRATHEA code, developed by our group at UNLV.

Future of planets in a system during the late stages of stellar evolution, including the effects of tides and stellar mass loss.



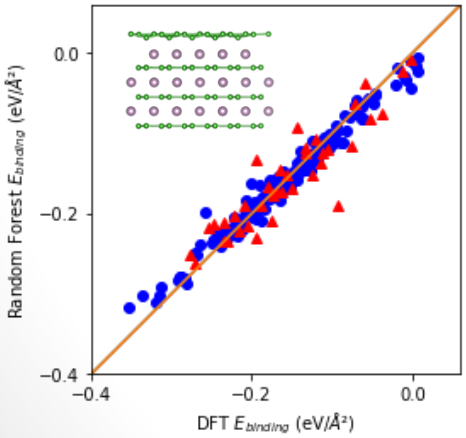
UNLV College of SCIENCES

Computational Materials Science

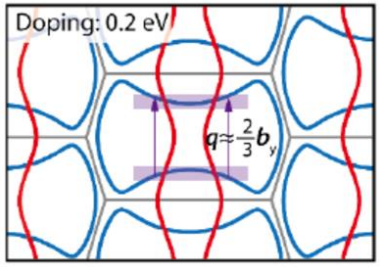
- **Dr. Luqing Wang**
- Assistant Professor - Physics
- Department of Physics and Astronomy
- Email: luqing.wang@unlv.edu
- Office: BPB 232

Expertise

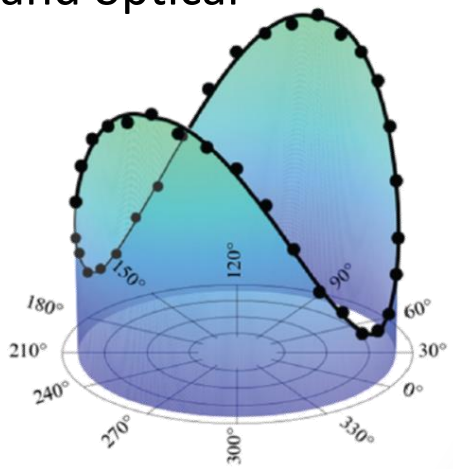
- Density functional theory calculations and machine learning.
- Two-dimensional (2D) materials functionalization and quantum effect.
- Electronic, mechanical, thermodynamic, chemical and optical properties of materials.
- Energy conversion & sustainability.



2D Materials Synthesis



2D Electronic and Quantum



2D Electro-Mechanics

UNLV College of SCIENCES

Multi-Messenger High Energy Astrophysics

Dr. Bing Zhang
Department of Physics and Astronomy
Phone: (702)895-4050
Email: zhang@physics.unlv.edu, bing.zhang@unlv.edu

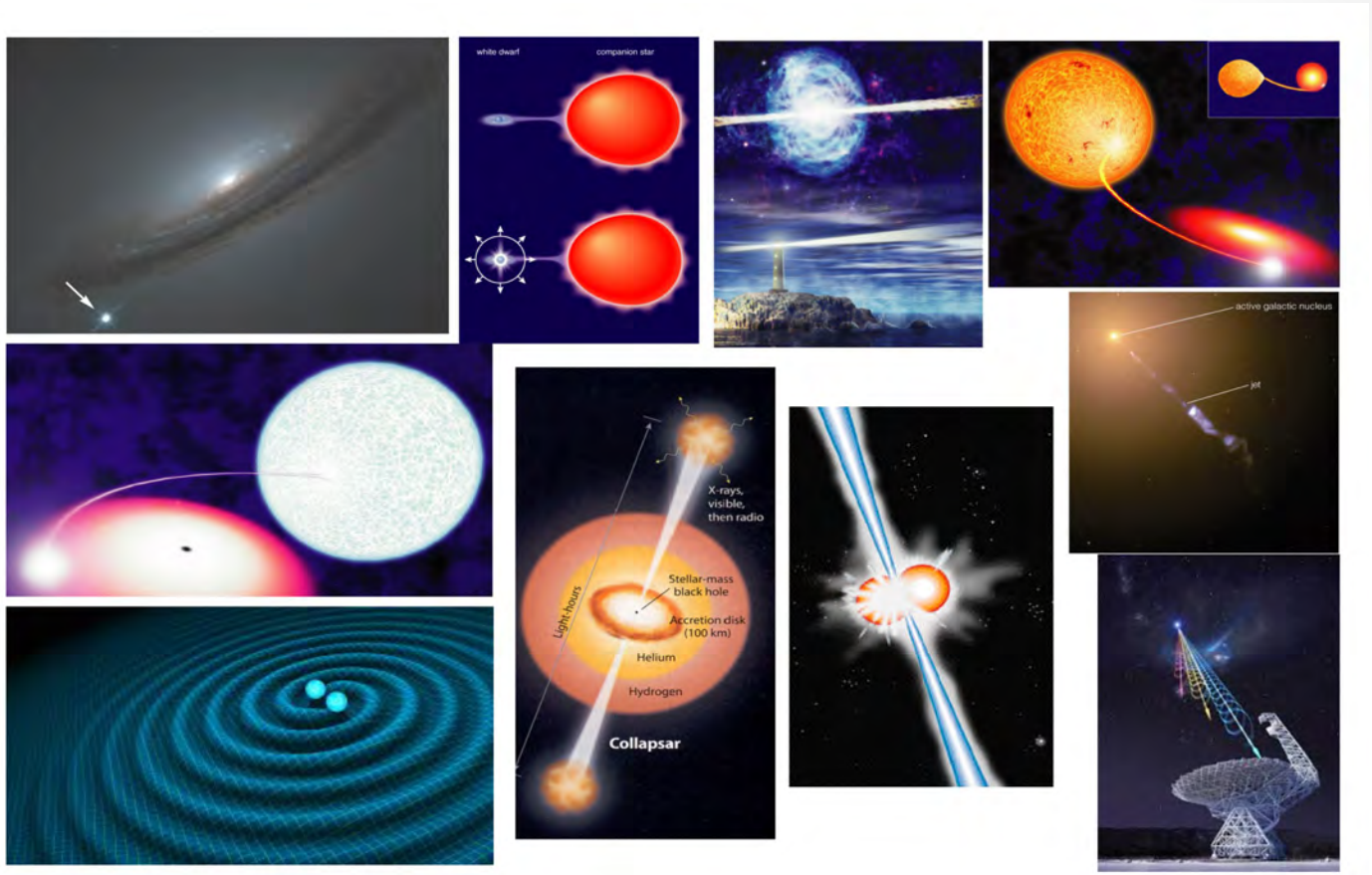
Expertise:

Theoretical astrophysics

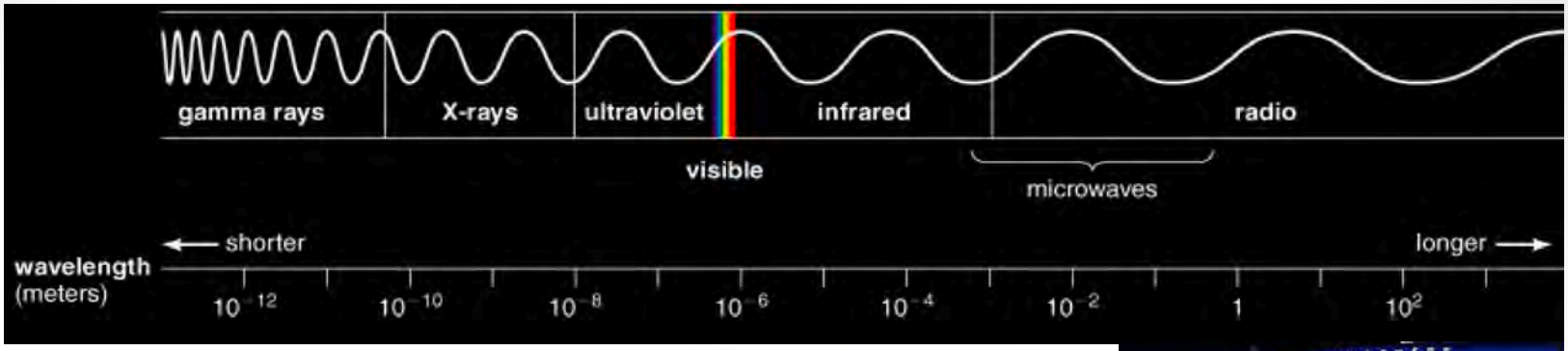
Transients (gamma-ray bursts, fast radio bursts, etc) astrophysics

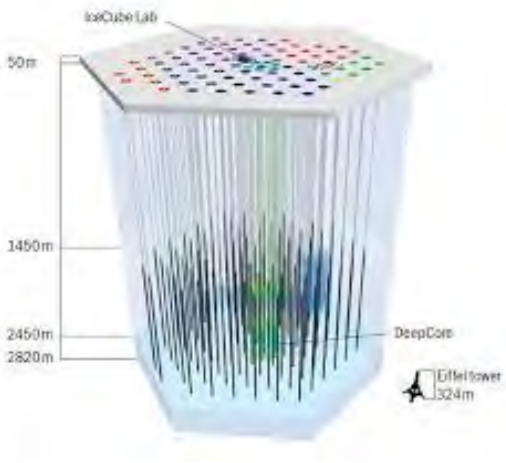
Multi-messenger (EM, gravitational waves, neutrinos, etc) astrophysics

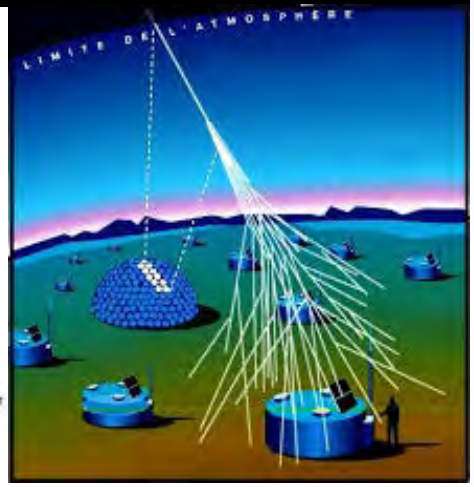
UNLV | COLLEGE OF SCIENCES



- Dr. Zhang's research covers a broad spectrum in high-energy astrophysics. He studies black holes of different scales, neutron stars of different species, and intense jets they launch. He is most actively working on the following three directions:
  - Gamma-ray bursts (the most luminous explosions in the universe)
  - Electromagnetic counterparts of gravitational waves
  - Fast radio bursts (a mysterious type of radio bursting signal)







- In terms of observational data, Dr. Zhang's theoretical work make use of multi-wavelength and multi-messenger data:
  - Multi-wavelength: across the entire electromagnetic spectrum (from MHz radio waves to TeV gamma-rays)
  - Multi-messenger: Besides the traditional electromagnetic radiation, also include gravitational waves, neutrinos, and cosmic rays.

Zhou Lab – Experimental AMO physics

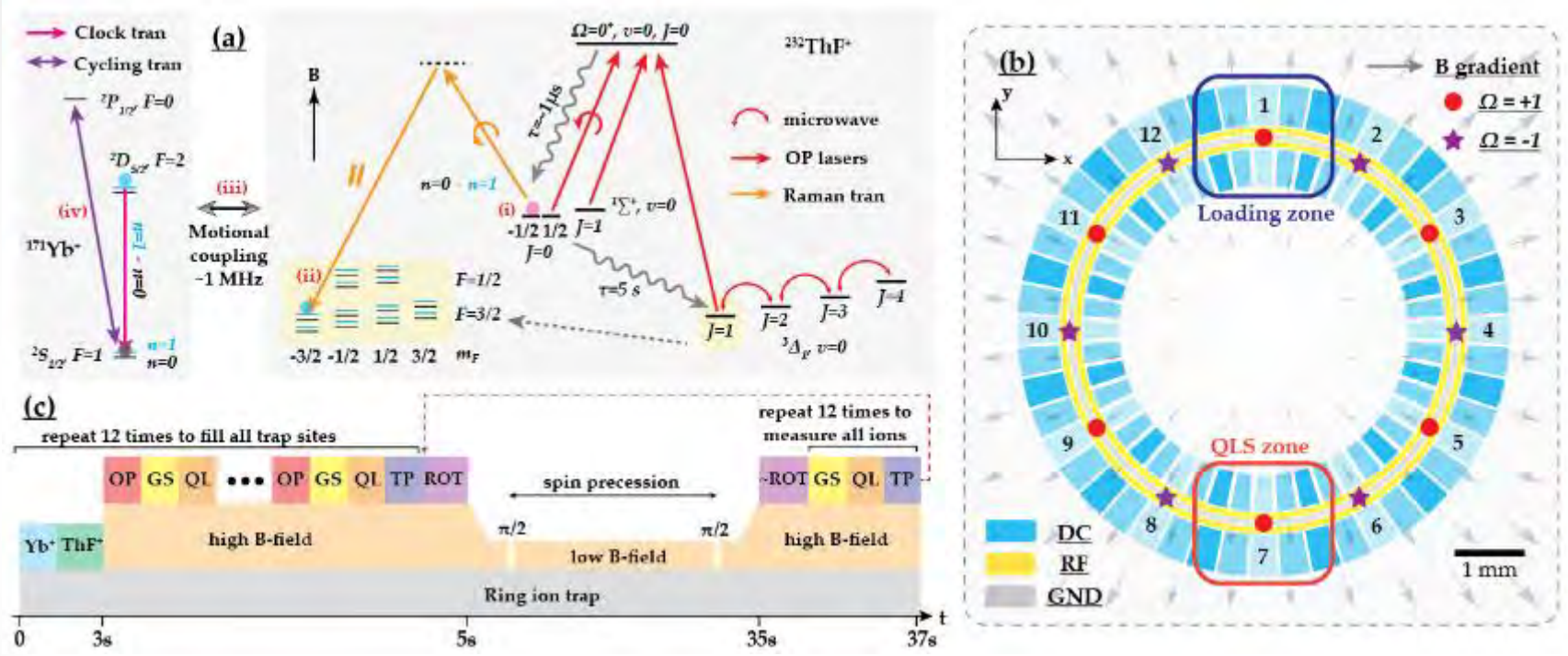
- **Dr. Yan Zhou**
- Assistant Professor
- Department of Physics and Astronomy
- Email: yan.zhou@unlv.edu
- Website: https://www.physics.unlv.edu/~yanzhou/index.html

Research projects

- Explore new physics beyond the Standard Model by precision measurements using quantum logically controlled molecular ions
- Precision metrology and spectroscopy using optical frequency combs
- Quantum transducer – link ion trap and superconducting quantum computers
- Experimental astrochemistry – cold ion-radical collisions

UNLV | College of SCIENCES

Search for *T,P*-odd symmetry violation



- On-chip Quantum sensors
- Entanglement between atomic ions and molecular ions
- Scalability and multiplexing measurements
- New table-top platform to investigate nuclear physics

UNLV College of SCIENCES

Astrophysical Fluid Dynamics

Dr. Zhaohuan Zhu

Department of Physics and Astronomy

Phone: (702) 895- 3563

Email: zhaohuan.zhu@unlv.edu

Expertise:

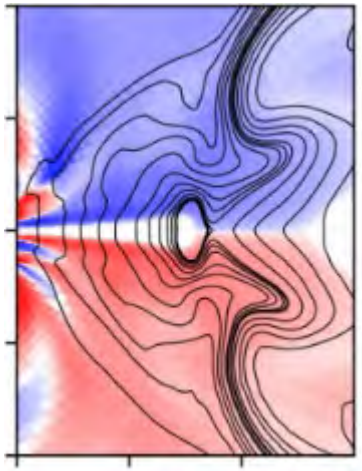
Fluid dynamics for astronomical project

Star and planet formation

UNLV | COLLEGE OF SCIENCES

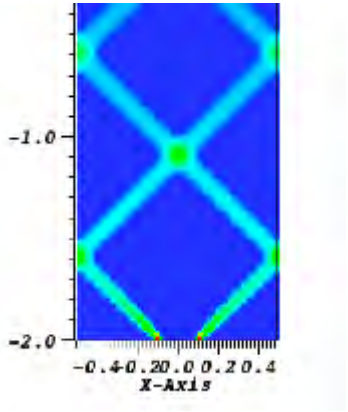
Fluid dynamics:

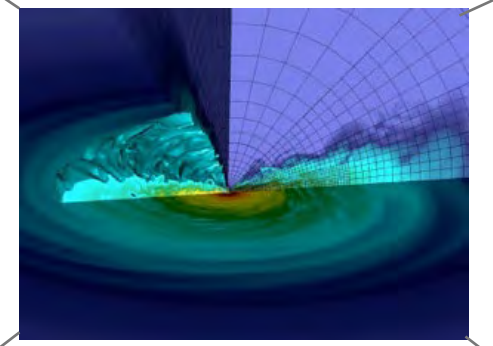
- Developing and using the state of the art numerical code to solve astrophysical fluid problem.

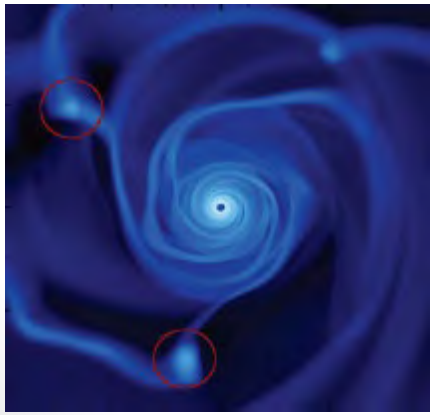


Magnetic field

Radiation

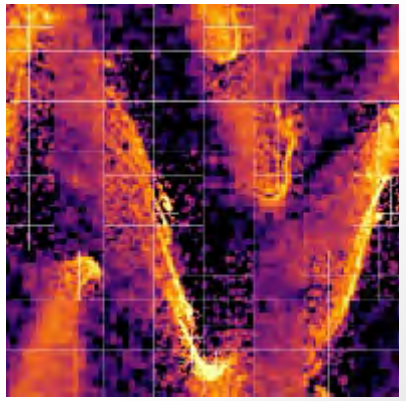






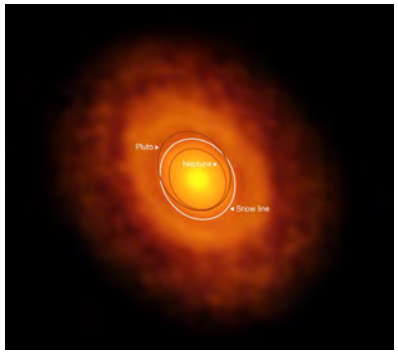
gravity

particles



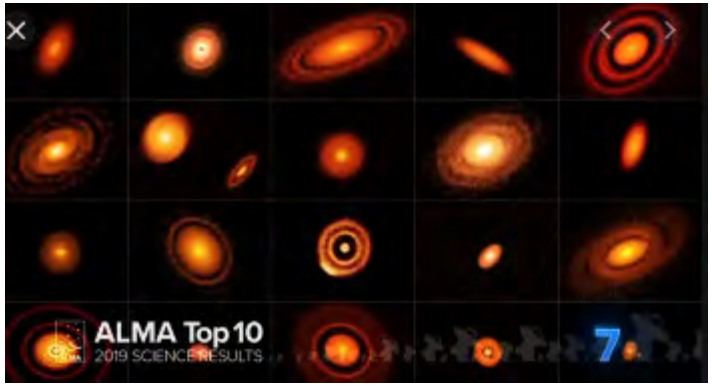
Star and planet formation:

- Protoplanetary disk dynamics:



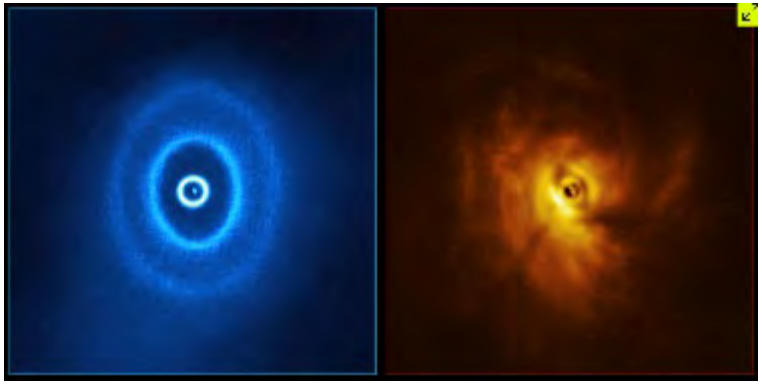
V883 Ori, *Nature*

- Planet formation



DSHARP

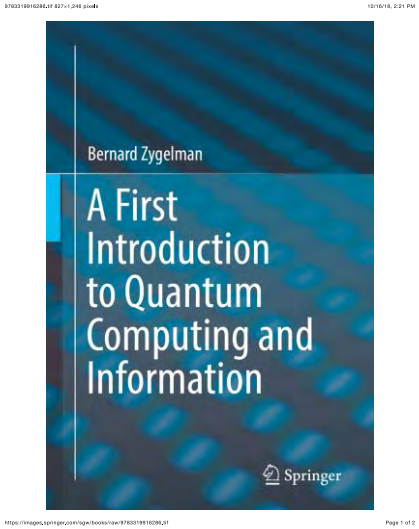
- Planet-disk interaction

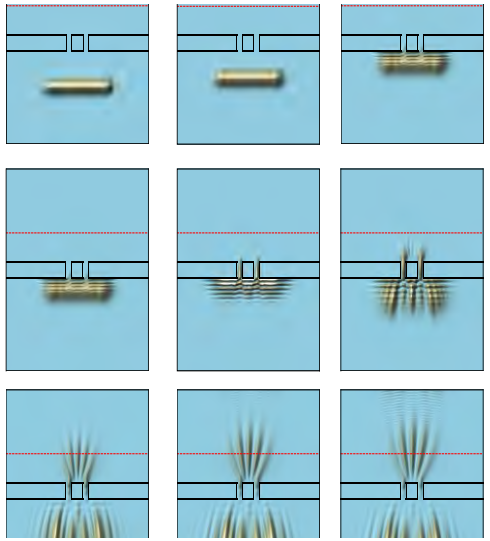


GW Ori, *Science*

Bernard Zygelman

- Quantum Computing and Information
- Computational Physics
- Atomic and Molecular Processes in Plasmas
- Quantum Workforce Development





Research Expertise and Activities

- Over 70 publications, h-index 27-Google Scholar
- Work funded by AFOSR, DOE, IAEA, NSF, NASA, W. M. Keck Foundation
- Topics include remote sensing of the thermosphere, matter-anti-matter interactions, QED, radiative and non-radiative charge transfer in hot plasmas, atomic processes in the early universe, ultra-cold physics, geometric phase and magnetism, quantum computing and information

Relevant Publications

1. B. Zygelman, *Appearance of gauge potentials in atomic collision physics*, Physics Letters A, 125, 476, 1987; (Re-printed in Geometric Phases in Physics ed. A. Shapere and F. Wilczek (Nobel laurate in Physics)).

2. Sharma, R, Zygelman, von Esse, F., Dalgarno, A., Geophys. *On the relationship between the population of the fine structure levels of the ground electronic state of atomic oxygen and the translational temperature*, Geophysics Res. Lett., 21, 1731, 1994

3. Stancil, P. C. and Zygelman, B., *Kinematic Isotope Effects in Low Energy Electron Capture*, Phys. Rev. Lett. 75, 1495,1995

4. Zygelman, B. Saenz, A. Froelich, P. and Jonsell, S., *Cold collisions of atomic hydrogen with anti-hydrogen atoms: An optical potential approach*, Phys Rev A. 69, 042715, 2005

5. Zygelman, B. *Hyperfine Level–changing Collisions of Hydrogen Atoms and Tomography of the Dark Age Universe*, Ap. J, 622, 1356, 2005

6. Zygelman B. Lucic Z., and Hudson E., *Cold ion-atom chemistry driven by spontaneous radiative relaxation: a case study for the formation of the YbCa+molecular ion*, J. Phys. B 47, 015301, 2013

7. B. Zygelman, *Geometric-phase atom optics and interferometry*, Phys. Rev. A., 92, 043620, 2015

8. B. Zygelman, *A First Introduction to Quantum Computing and Information*, Springer-Nature, 2018.