

Astronomy: The Stars and Beyond Research

Carl Haster

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Expertise

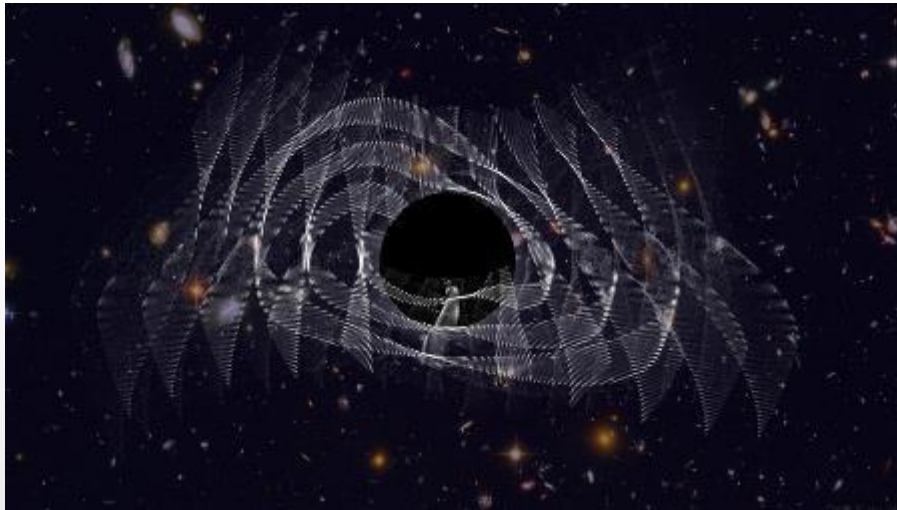
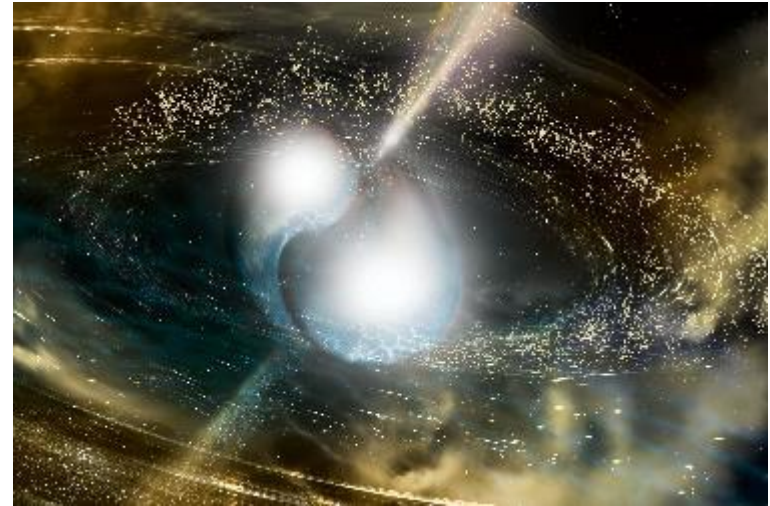
- Gravitational Wave Astrophysics
- Tests of General Relativity
- Compact Objects – Black Holes and Neutron Stars
- Multi-Messenger Astrophysics



Gravitational Wave Astrophysics

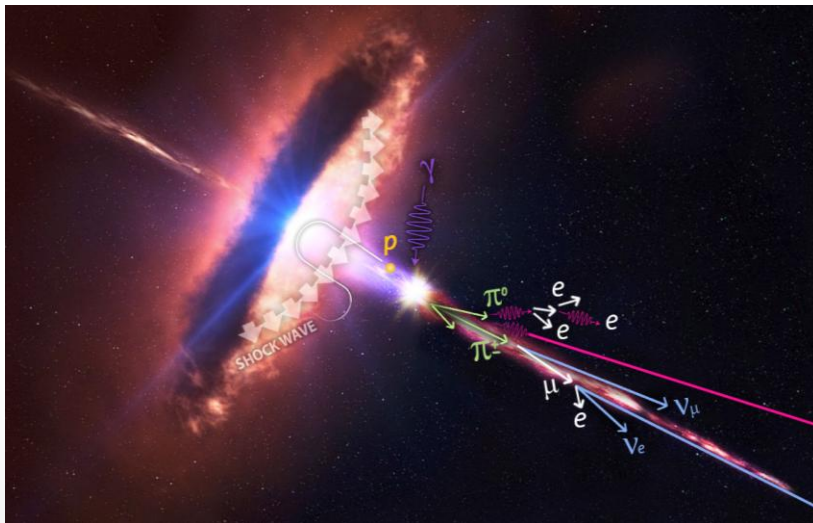
By observing ripples in spacetime, it is possible to study the absolute extremes of the Universe.

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



Particle Astrophysics with Neutrinos

- **Dr. Ali Kheirandish**
- Assistant Professor
- Department of Physics and Astronomy
- BPB 208, ali.kheirandish@unlv.edu
- Website: <https://www.physics.unlv.edu/~kheirand>

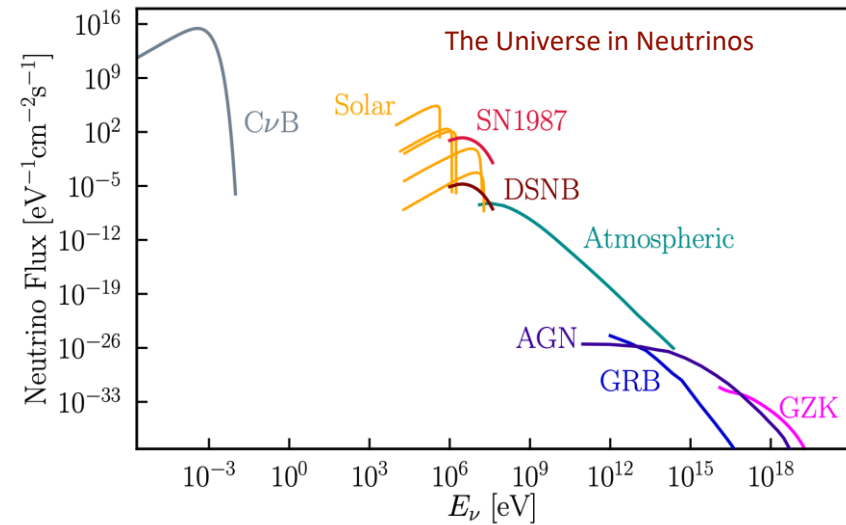


Expertise

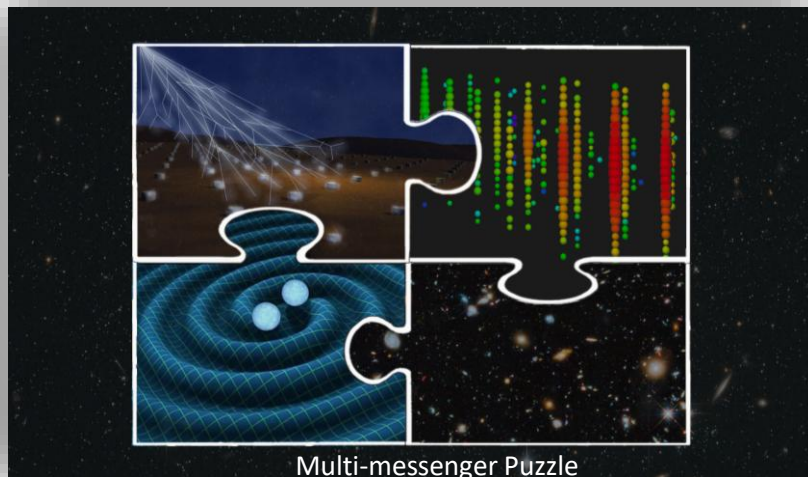
- Neutrino Astrophysics
- Multi-messenger Astrophysics
- High-Energy Astrophysical Phenomena
- Physics beyond the Standard Model
- Dark Matter

Research Summary

Dr. Kheirandish's research is centered on particle astrophysics with high-energy neutrinos from IceCube Neutrino Observatory. It covers theory as well as analysis of high-energy neutrino data to the search for the sources of cosmic neutrinos and physics beyond the Standard Model.



Neutrinos are the tiniest and the most enigmatic particles in the Standard Model. Current pressing puzzles in cosmology and astrophysics, such as dark matter, dark energy, and the origin of the cosmic rays, are tied to the nature of neutrinos. Thus, neutrinos offer a unique opportunity to look for answers to the problems at the intersection of particle physics, astrophysics, and cosmology.



Stephen Lepp

- Professor of Astrophysics, Department of Physics and Astronomy
- Ph.D., Physics, University of Colorado, Boulder
- BPB 234, Stephen.Lepp@unlv.edu
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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.

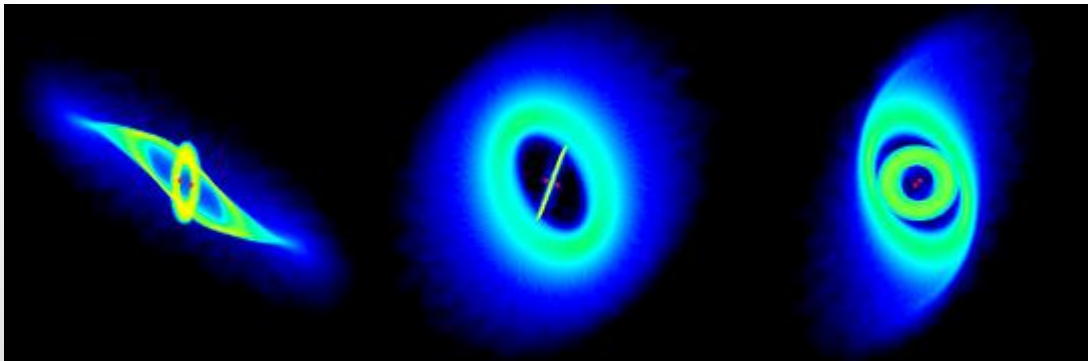
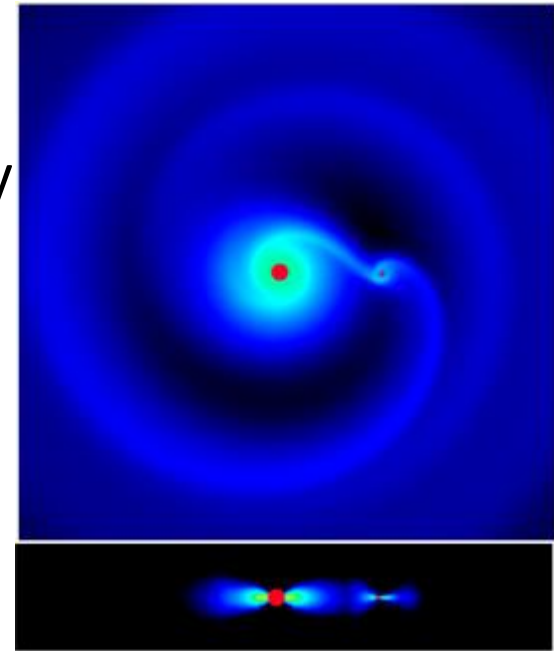


Rebecca Martin

- Professor of Astronomy
- BPB 233
- Department of Physics and Astronomy
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Expertise

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



Active Galactic Nuclei

Dr. Daniel Proga

Department of Physics and Astronomy

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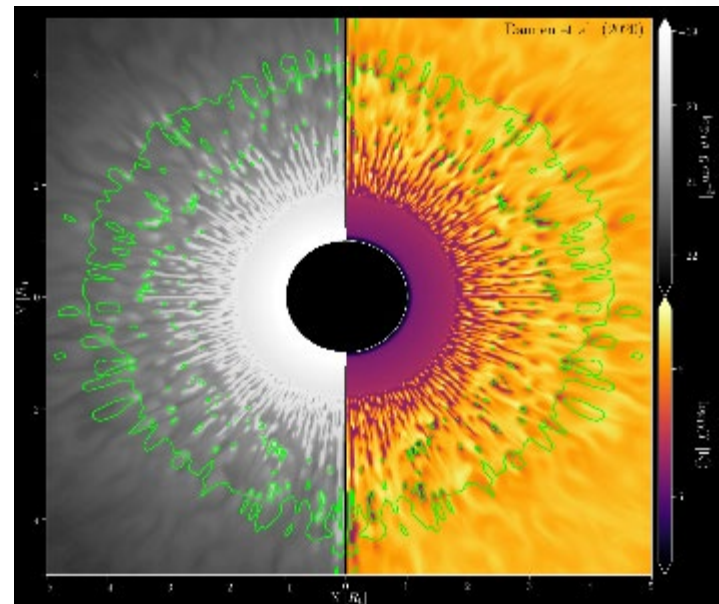
Email: dproga@physics.unlv.edu

Expertise:

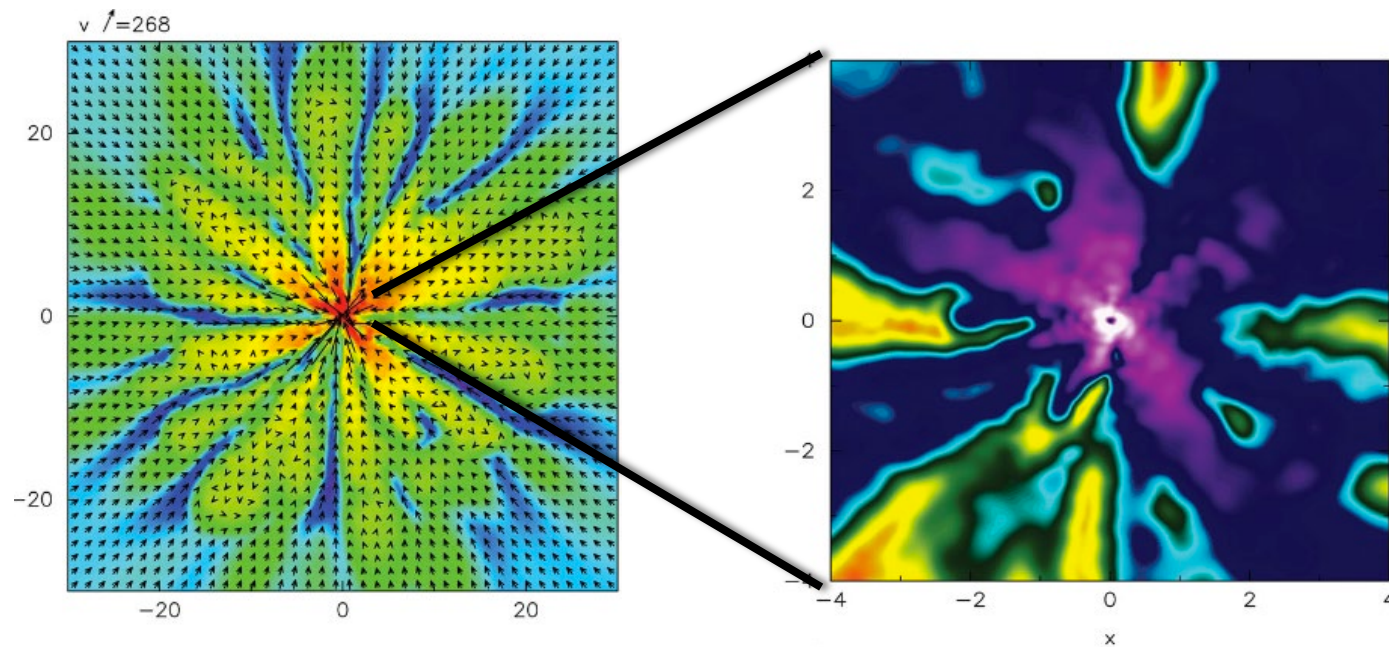
Radiation-Magnetohydrodynamics

Accretion Physics

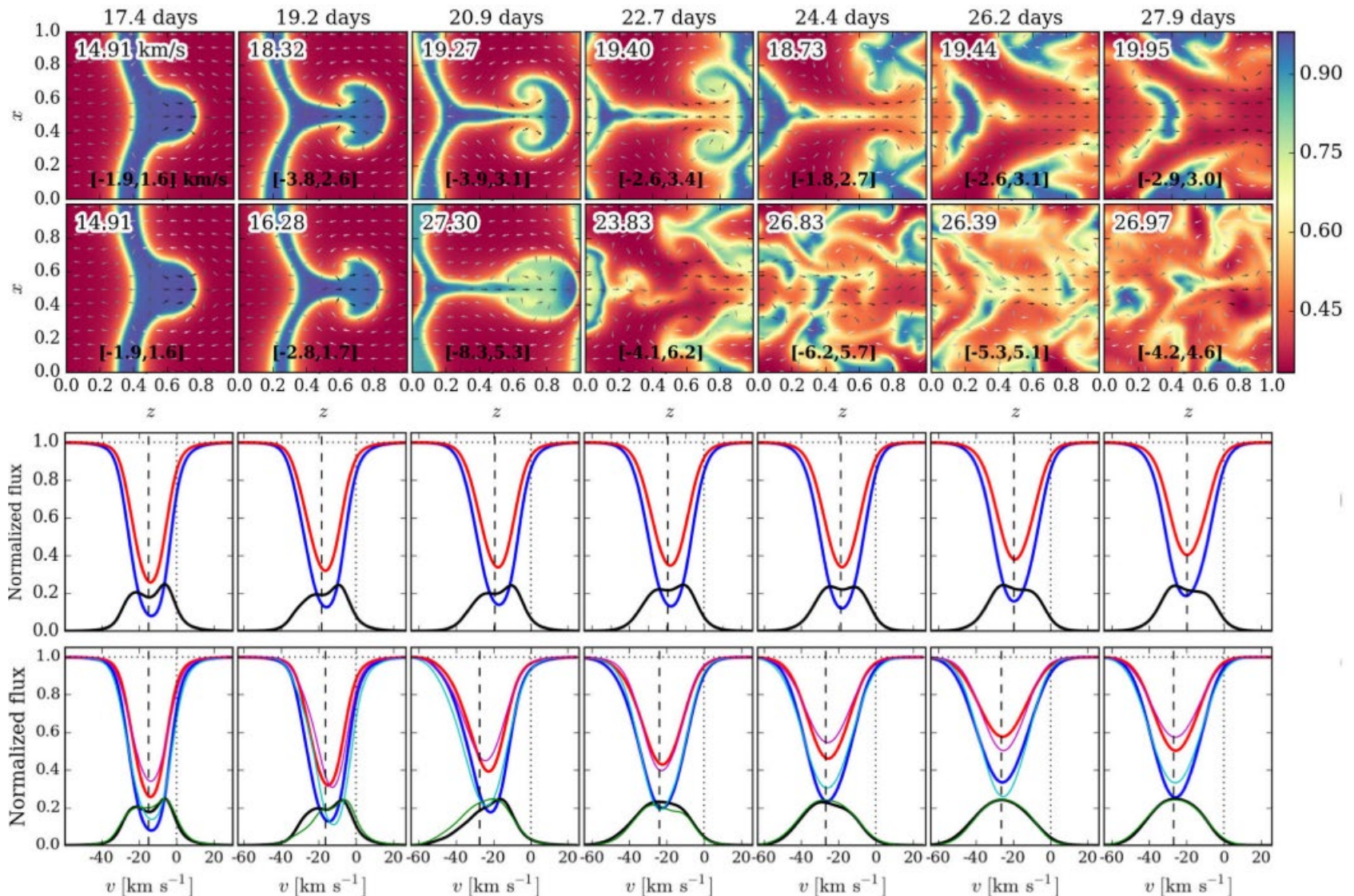
Radiation Transfer & Photoionization



Radiation-hydrodynamic simulations of black hole accretion and related outflows



Generated absorption spectra from simulations



Climate Change; Renewable Energy; Astronomy

Dr George Rhee

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“Expertise:”

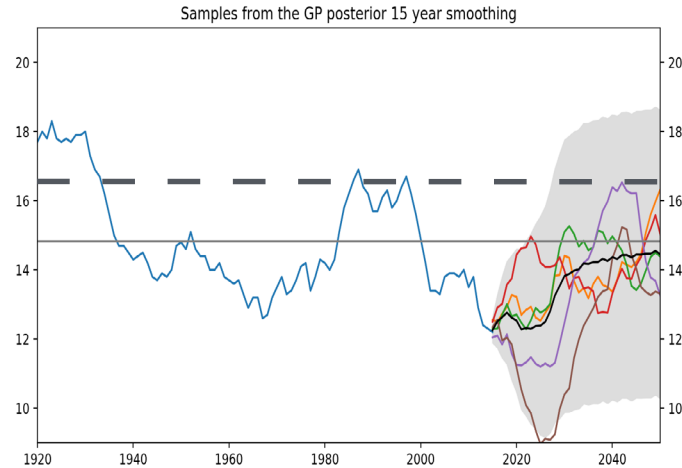
Observational Astronomy/Cosmology

Renewable Energy

Colorado River flow projections

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 brightness measurements

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>

Supply Choices

Nuclear Energy	<input type="text" value="no nuclear energy ever"/>	⬇
Wind energy	<input type="text" value="add two new wind farms by 2050"/>	⬇
Hydroelectric power	<input type="text" value="Lake Mead dries up by 2030 and generation stops"/>	⬇
Geothermal Energy	<input type="text" value="increase generation by 3% per year"/>	⬇
Rooftop Solar power	<input type="text" value="keep rooftop solar at its 2015 value"/>	⬇
Solar PV power plants	<input type="text" value="solar PV increases by 10 percent a year to 2050"/>	⬇
Concentrating Solar Power	<input type="text" value="build one new Tonopah plant every ten years"/>	⬇
Solar Thermal (hot water)	<input type="text" value="increase to 10% of demand by 2050"/>	⬇
Electricity imports	<input type="text" value="keep electricity imports at 0.15 GW"/>	⬇
Carbon Capture and Storage	<input type="text" value="no CCS, business as usual"/>	⬇

Demand Choices

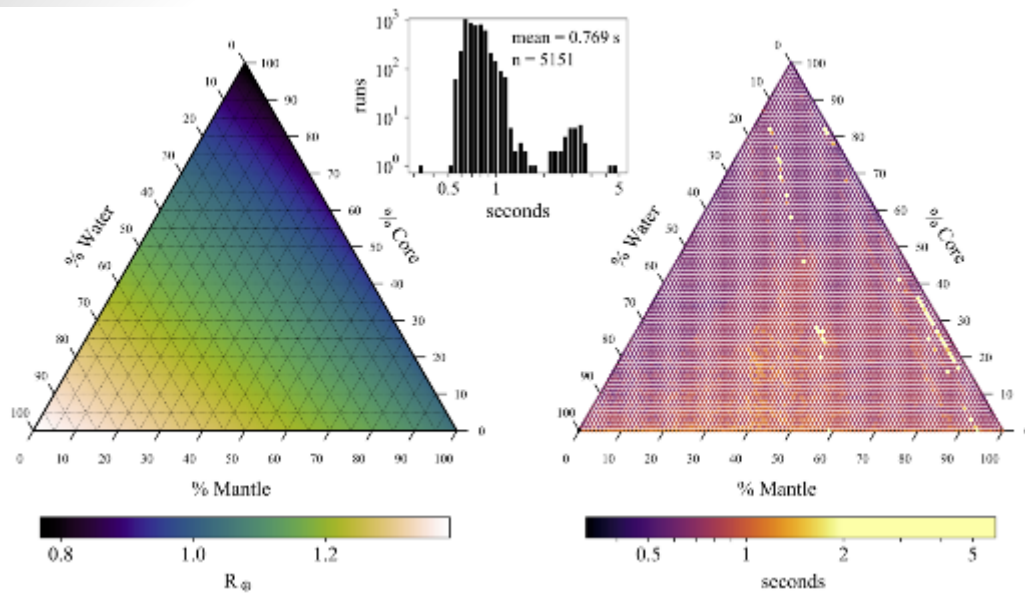
International aviation	<input type="text" value="factor of three increase in international visitors by 2050"/>	⬇
Nevada transport	<input type="text" value="electrify transport completely by 2050"/>	⬇
Nevada freight	<input type="text" value="business as usual freight travels by road"/>	⬇
Industry growth	<input type="text" value="energy demand increases by 1.5% per year"/>	⬇
Commercial heating and cooling	<input type="text" value="5% increase in efficiency"/>	⬇
Commercial light and appliances	<input type="text" value="energy demand increases by 25% by 2050"/>	⬇
Home heating and cooling	<input type="text" value="energy demand increases by 1.5% per year"/>	⬇
Home lighting and appliances	<input type="text" value="electricity demand increases by 70% from 2015 to 2050"/>	⬇
Home insulation	<input type="text" value="no extra effort on home insulation"/>	⬇
Average home temperature	<input type="text" value="no thermostat adjustment"/>	⬇

Research Group of Dr. Steffen

- **Dr. Jason H. Steffen**
- Associate Professor
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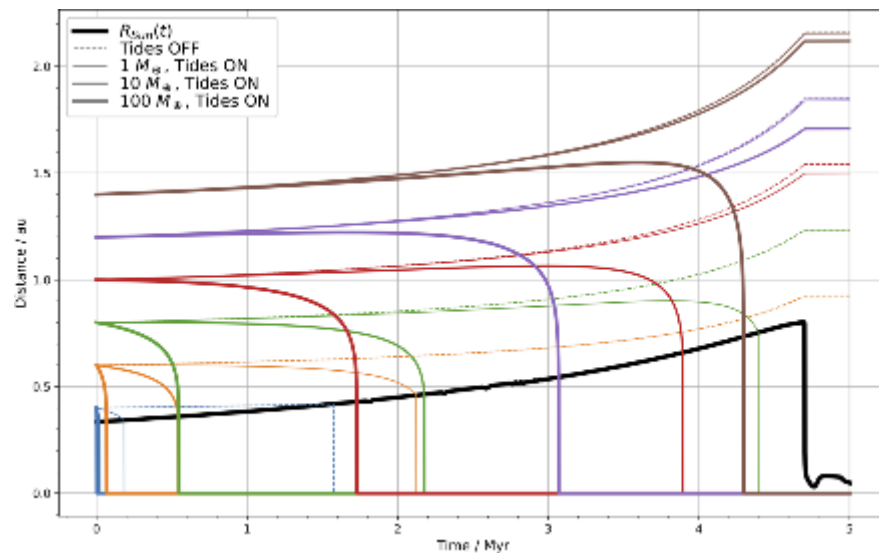
Expertise

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



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.



Multi-Messenger High Energy Astrophysics

Dr. Bing Zhang

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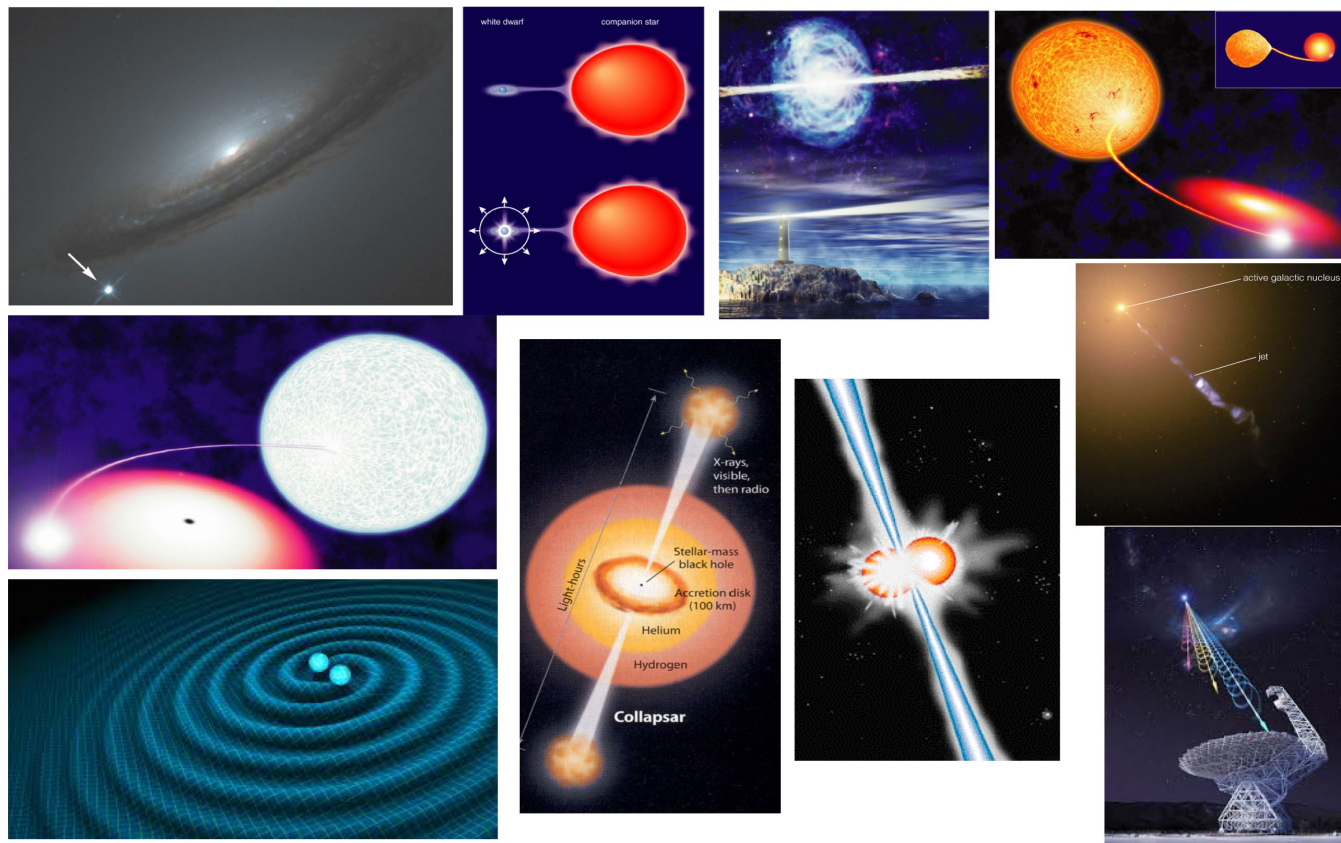
Email: zhang@physics.unlv.edu, bing.zhang@unlv.edu

Expertise:

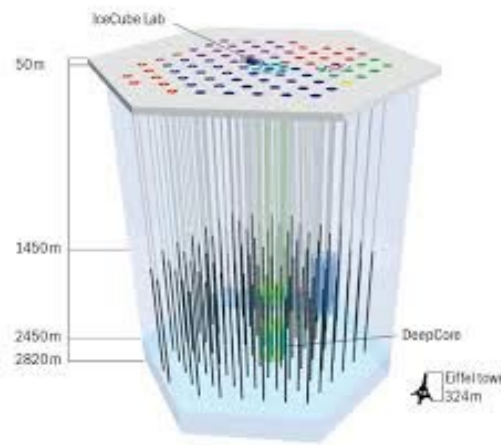
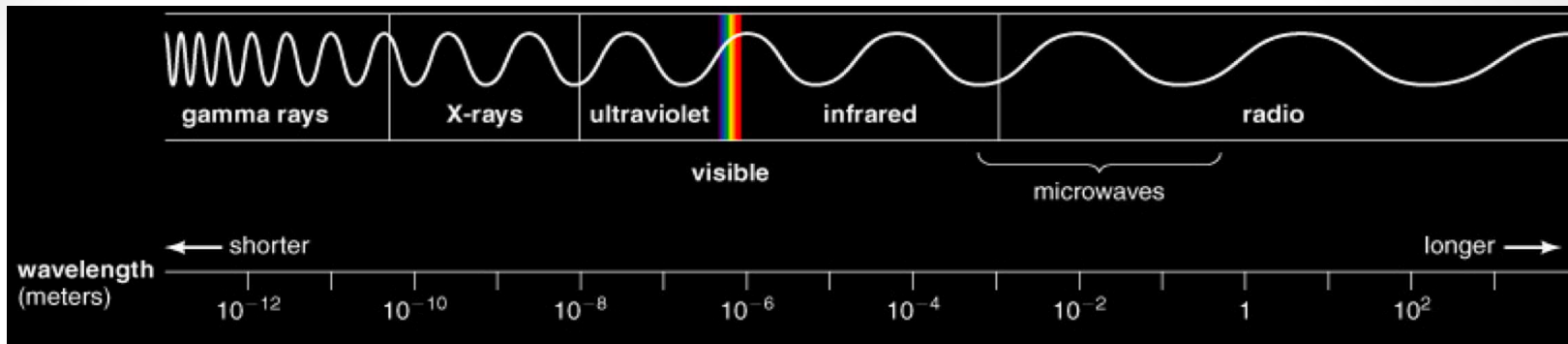
Theoretical astrophysics

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

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



- 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.

Astrophysical Fluid Dynamics

Dr. Zhaohuan Zhu

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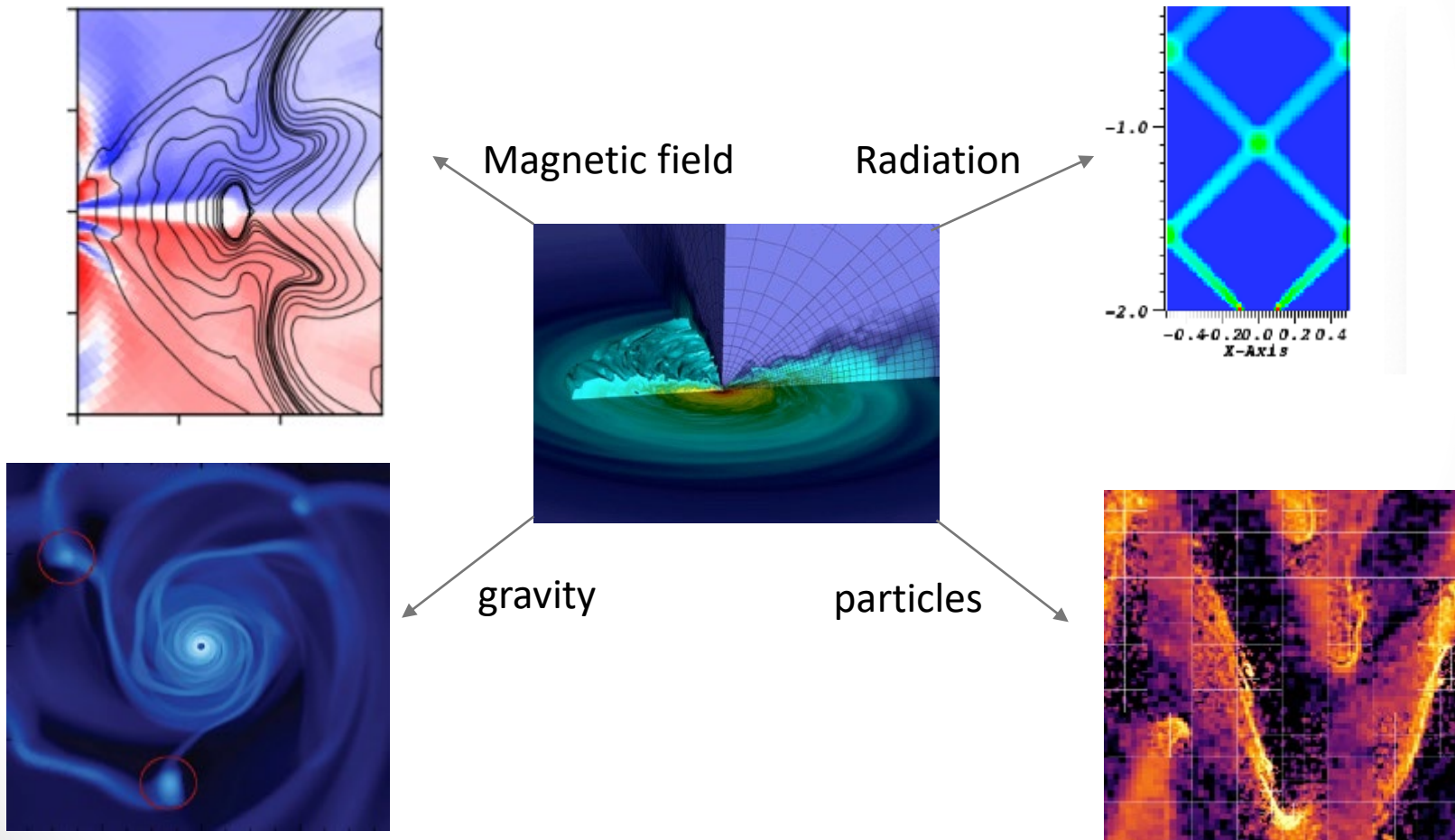
Expertise:

Fluid dynamics for astronomical project

Star and planet formation

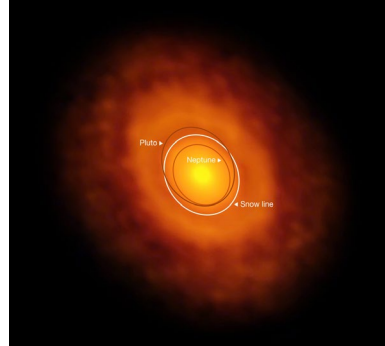
Fluid dynamics:

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



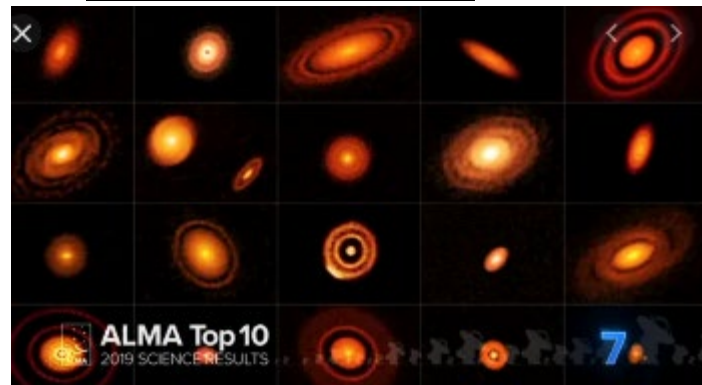
Star and planet formation:

- Protoplanetary disk dynamics:



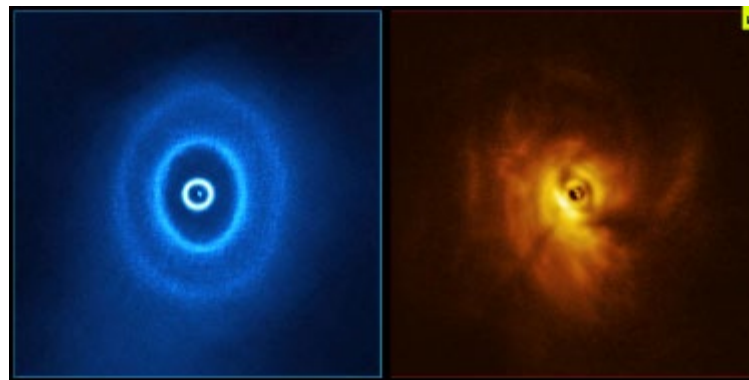
V883 Ori, *Nature*

- Planet formation



DSHARP

- Planet-disk interaction



GW Ori, *Science*