From Atom to Universe

Astronomy: The Stars and Beyond Research

UNLV | COLLEGE OF SCIENCES

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.

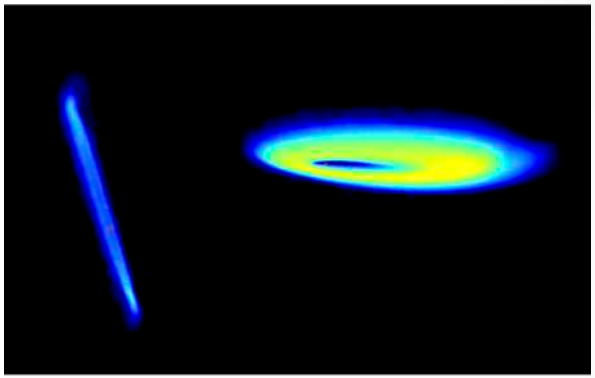
UNLV | COLLEGE OF SCIENCES

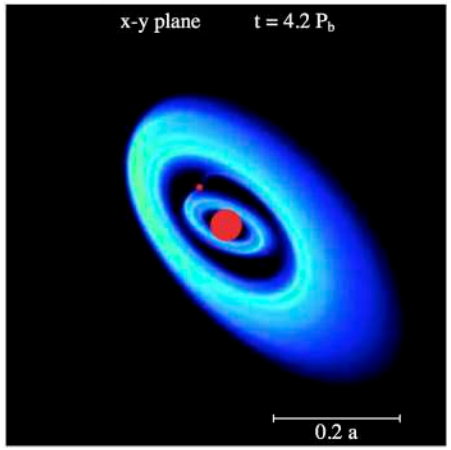
Rebecca Martin

- Assistant Professor of Astronomy, Department of Physics and Astronomy
- Ph.D., BPB 233, Rebecca.Martin@unlv.edu
- http:/www.physics.unlv.edu/~rgmartin/Rebecca_G._Martin.html

Areas of Expertise

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





Research Summary:

- My research deals with highly topical questions in astrophysics, such as how star and planetary systems form. I use analytic and numerical methods to study the theory of accretion disc dynamics, few body dynamics and planet-disc interactions.

UNLV | COLLEGE OF SCIENCES

Active Galactic Nuclei

Dr. Daniel Proga

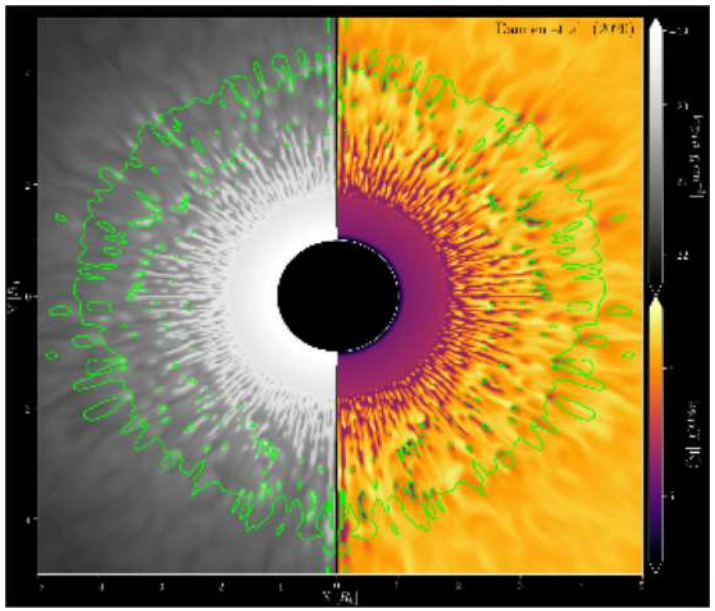
Department of Physics and Astronomy

Phone: (702) 895 3507

Email: dproga@physics.unlv.edu

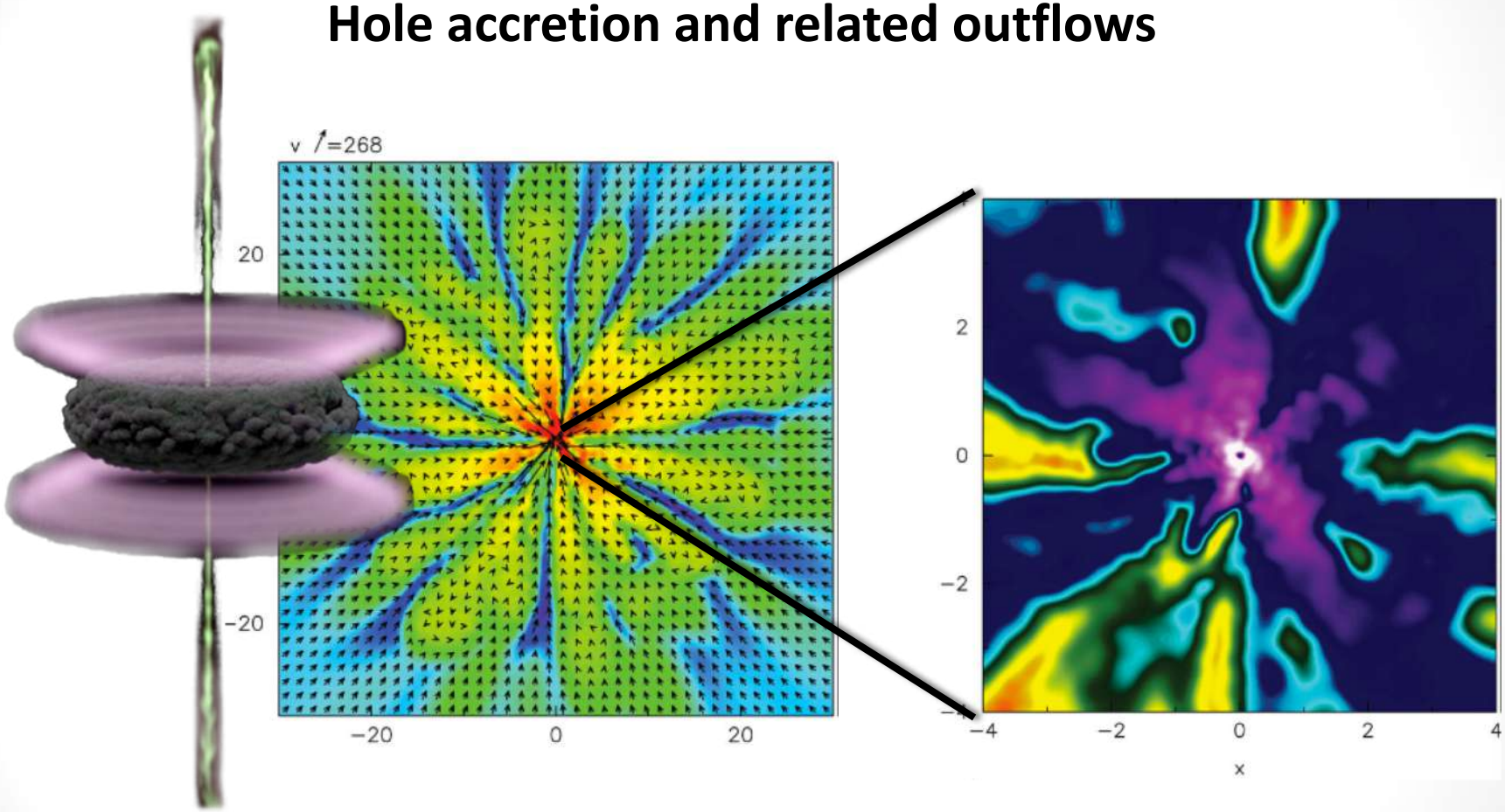
Expertise:

- Radiation-Magnetohydrodynamics
- Accretion Physics
- Radiation Transfer & Photoionization



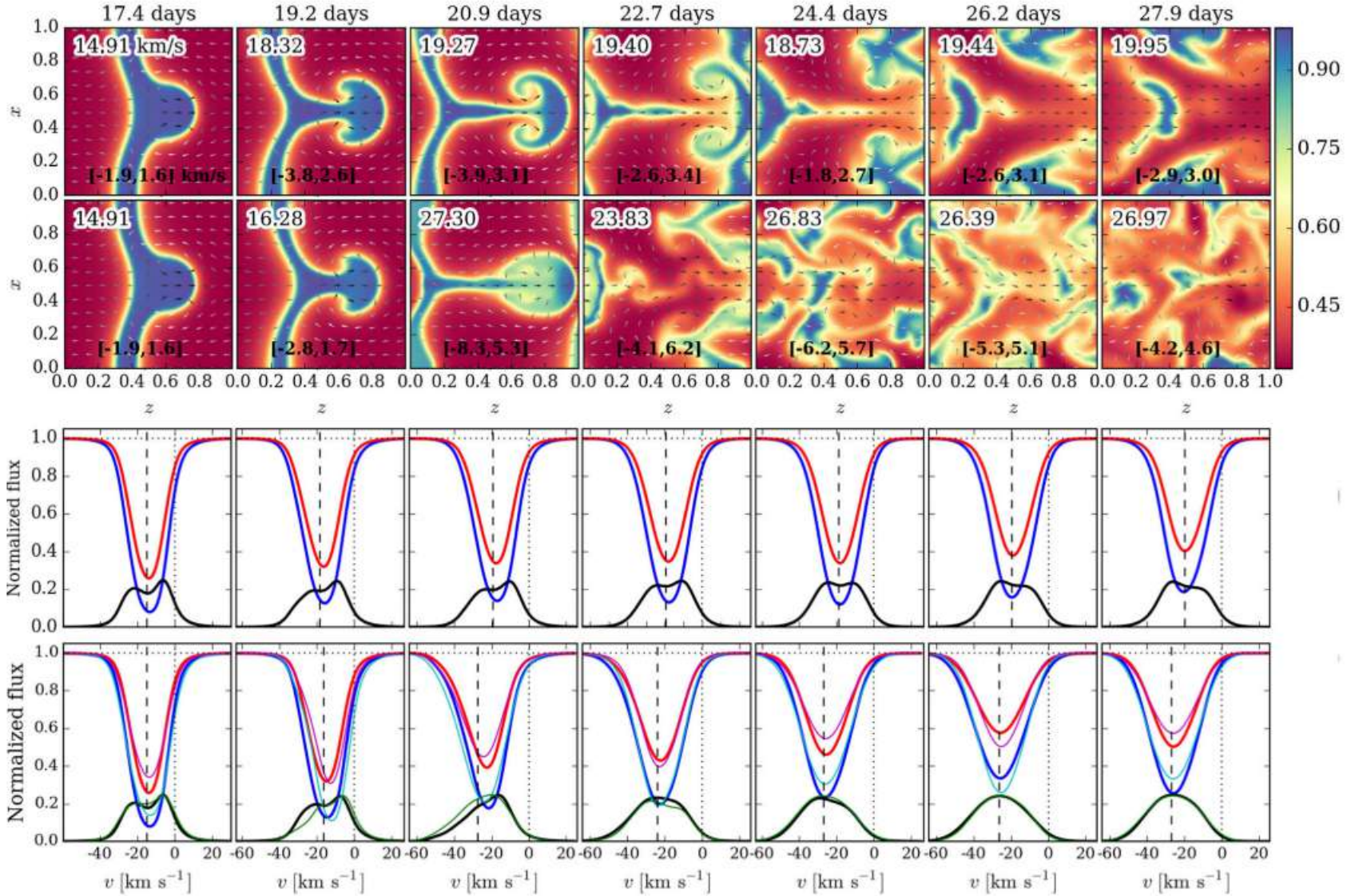
UNLV | COLLEGE OF SCIENCES

Magnetohydrodynamic simulations of Black Hole accretion and related outflows



UNLV | COLLEGE OF SCIENCES

Generated absorption spectra from simulations



Climate Change; Renewable Energy; Astronomy

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

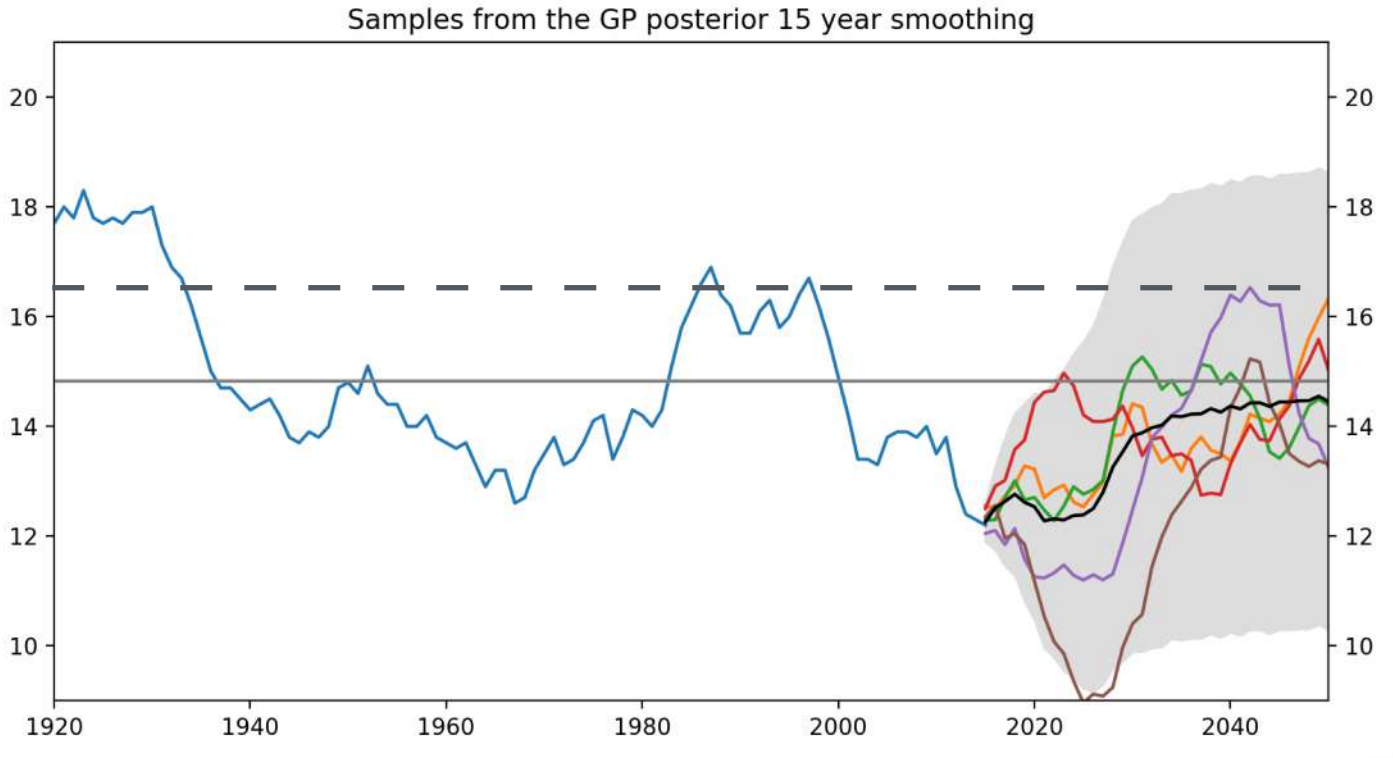
Expertise

- 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.

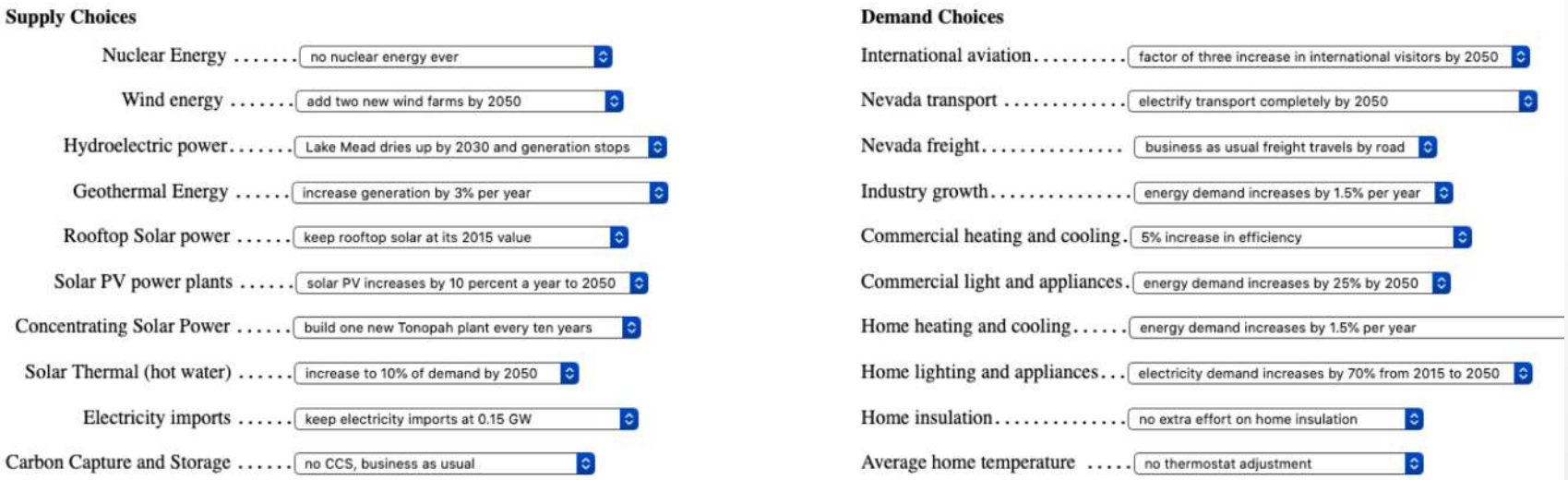


UNLV | COLLEGE OF SCIENCES

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

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

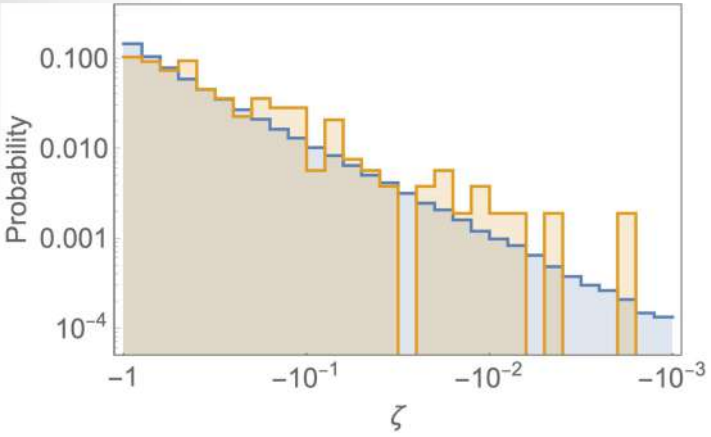
Extrasolar Planets

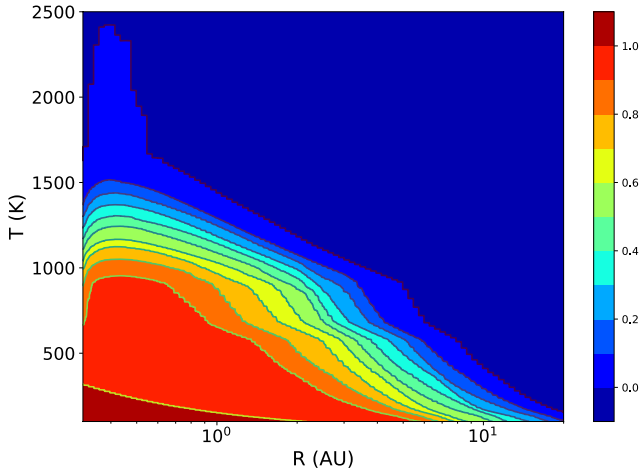
Dr. Jason Steffen
Assistant Professor of Physics
Department of Physics and Astronomy
Phone: 702-895-3485
Email: jason.steffen@unlv.edu

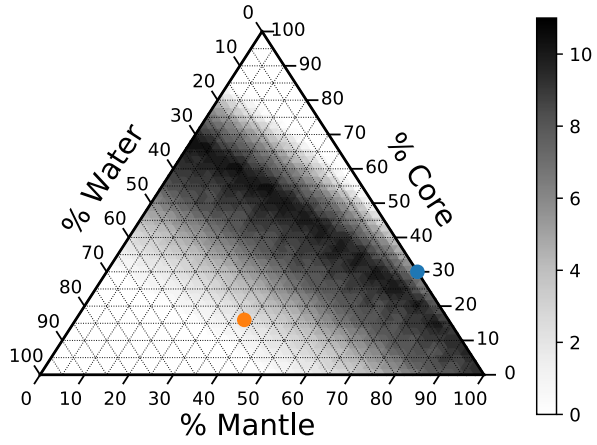
Expertise:

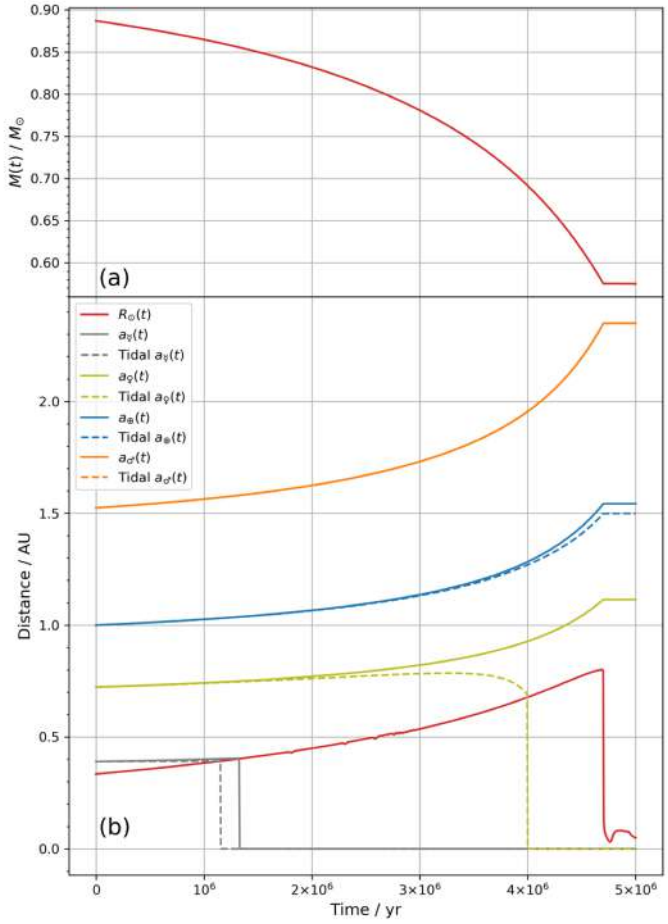
- Data Analysis
- Computer Modeling

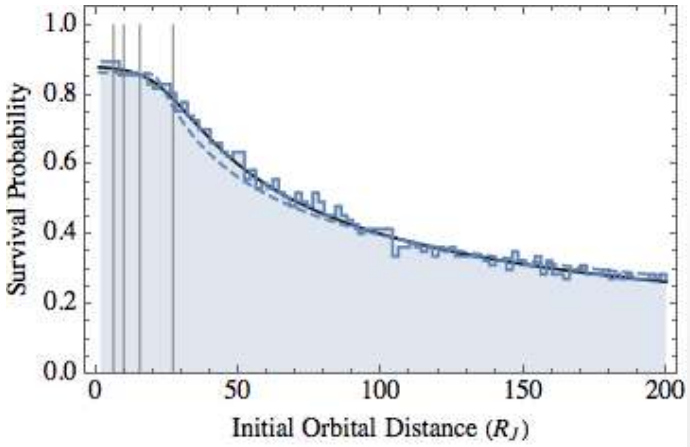
UNLV | COLLEGE OF SCIENCES


Probability
0.100
0.010
0.001
10^{-4}
−1
-10^{-1}
-10^{-2}
-10^{-3}
ζ


T (K)
2500
2000
1500
1000
500
10^{0}
10^{1}
R (AU)
1.0
0.8
0.6
0.4
0.2
0.0


% Water
% Core
% Mantle
0
10
20
30
40
50
60
70
80
90
100
10
8
6
4
2
0


$M(t)$ / $M_\odot$
0.90
0.85
0.80
0.75
0.70
0.65
0.60
(a)
$R_\odot(t)$
$a_\varphi(t)$
Tidal $a_\varphi(t)$
$a_\varphi(t)$
Tidal $a_\varphi(t)$
$a_\oplus(t)$
Tidal $a_\oplus(t)$
$a_\sigma(t)$
Tidal $a_\sigma(t)$
Distance / AU
2.0
1.5
1.0
0.5
0.0
(b)
0
10^6
2×10^6
3×10^6
4×10^6
5×10^6
Time / yr


Survival Probability
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
Initial Orbital Distance (R_J)

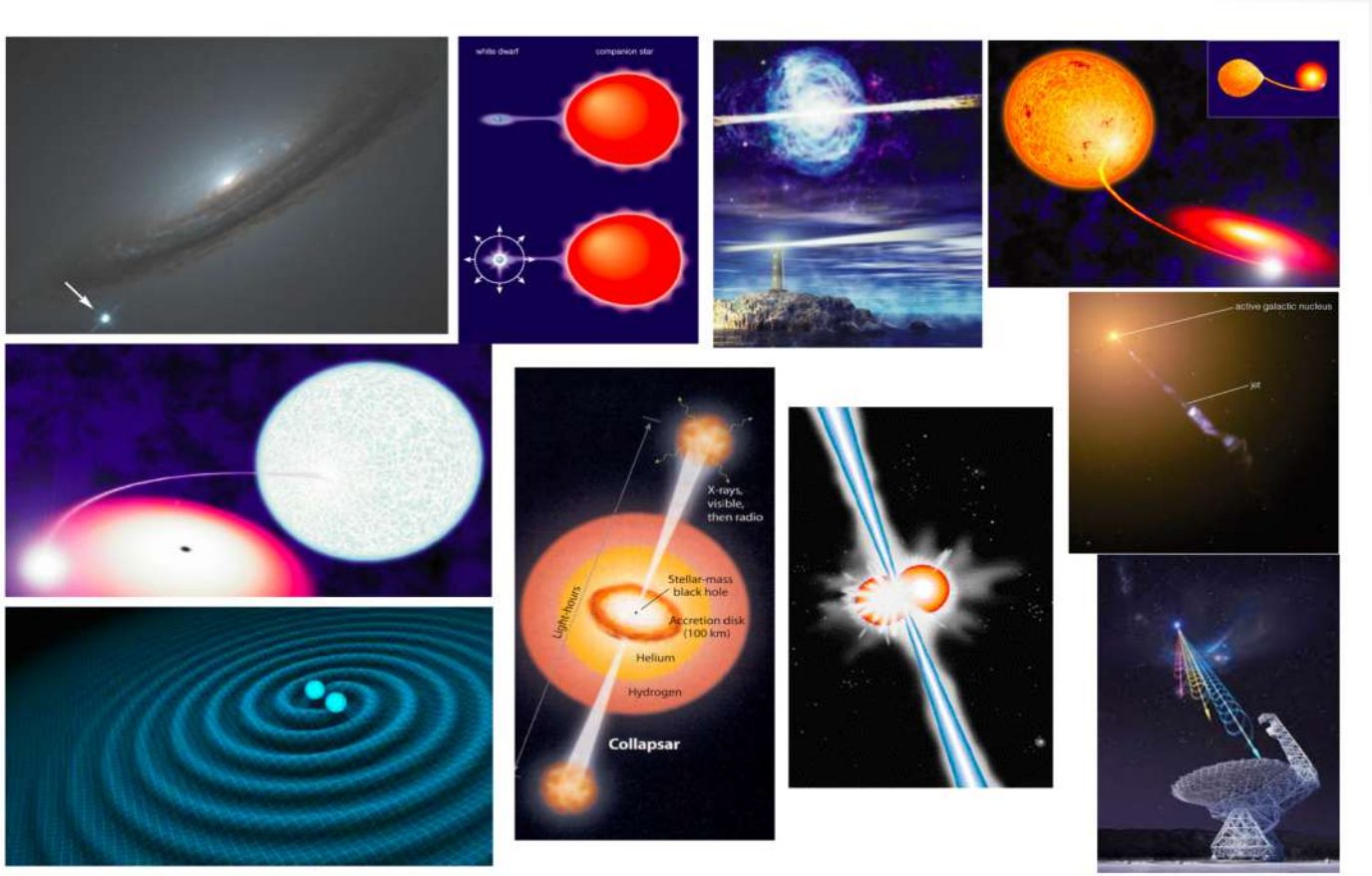
Multi-Messenger High Energy Astrophysics

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

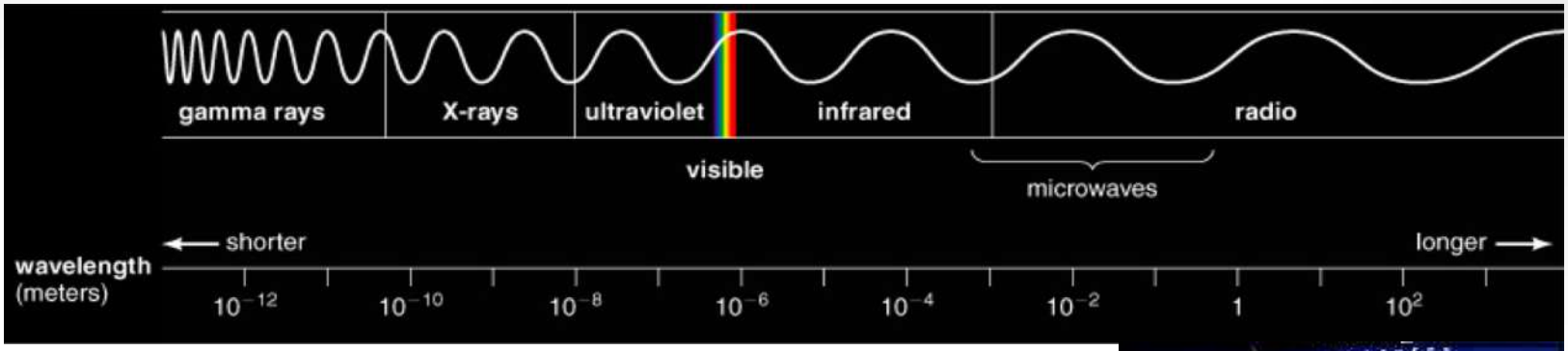
Expertise:

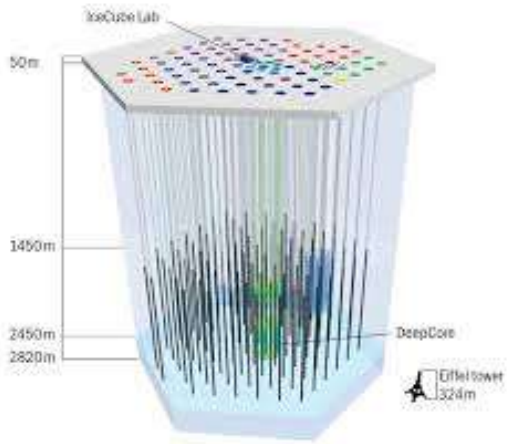
- Theoretical astrophysics
- Transients (gamma-ray bursts, fast radio bursts, etc.) astrophysics
- Multi-messenger (EM, gravitational waves, neutrinos, etc.) astrophysics

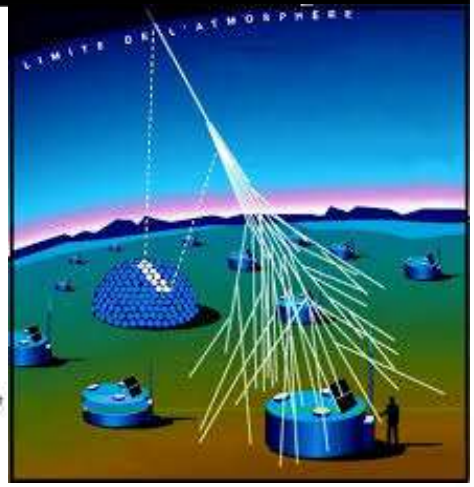
UNLV | COLLEGE OF SCIENCES



- 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.

Astrophysical Fluid Dynamics

Dr. Zhaohuan Zhu

Department of Physics and Astronomy

Phone: (702) 895- 3563

Email: zhaohuan.zhu@unlv.edu

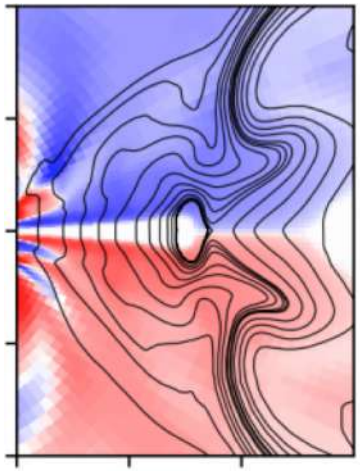
Expertise:

- Fluid dynamics for astronomical project
- Star and planet formation

UNLV | COLLEGE OF SCIENCES

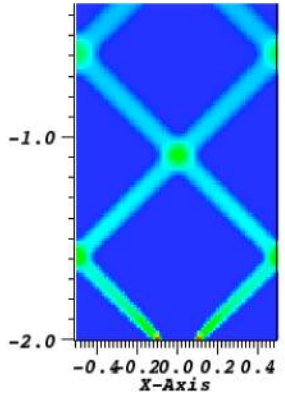
Fluid dynamics:

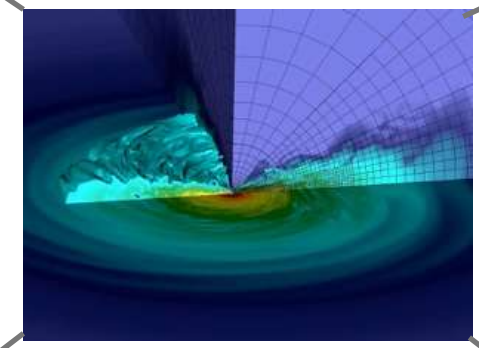
- Developing and using the state of the art numerical code to solve astrophysical fluid problem.

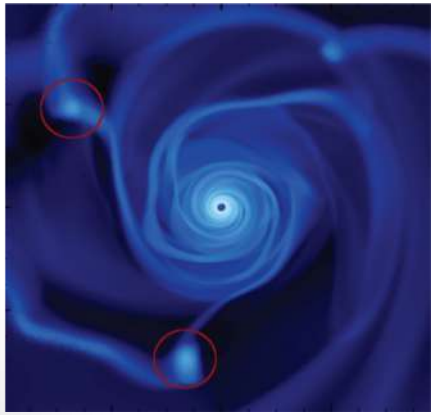


Magnetic field

Radiation

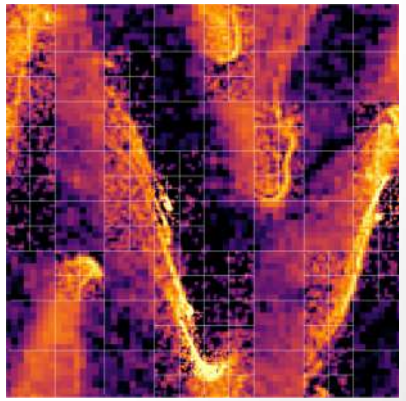






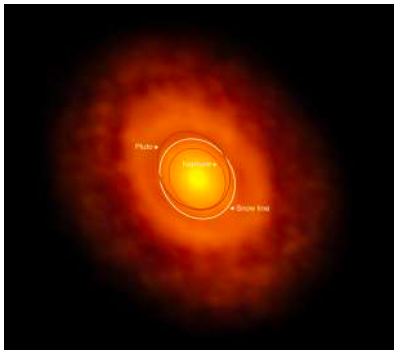
gravity

particles



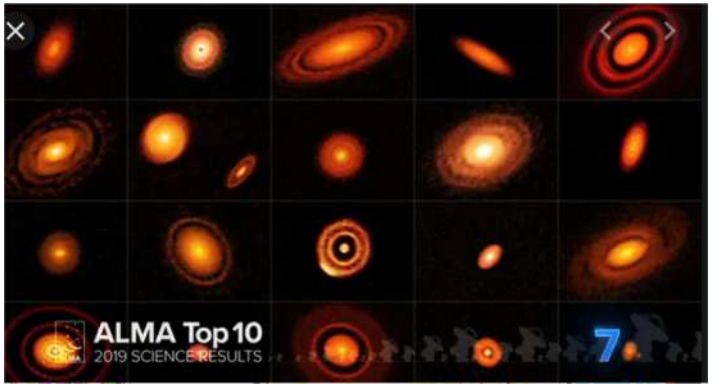
Star and planet formation:

- Protoplanetary disk dynamics:



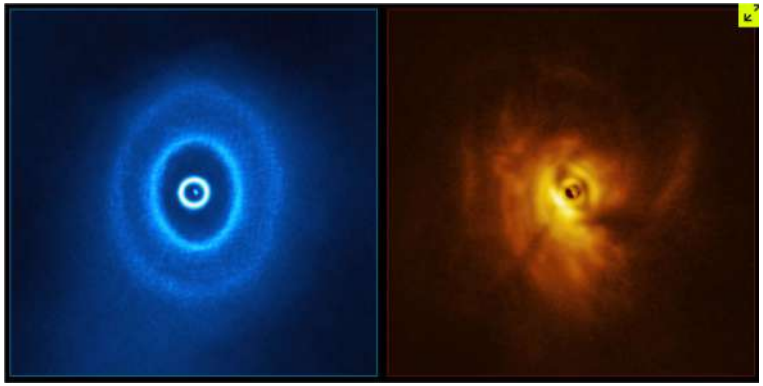
V883 Ori, *Nature*

- Planet formation



DSHARP

- Planet-disk interaction



GW Ori, *Science*