REN-JIE SHEN

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EDUCATION

University of Science and Technology of China *China*
MPhil in Astrophysics *Sep. 2020 - Jun. 2023*
Relevant Coursework: General Relativity, Astrophysical Radiation Mechanisms, Observational Astrophysics, Radio Astronomy, Stellar Formation and Evolution, Cosmology.

Hebei Normal University *China*
BSc in Space Science and Technology *Sep. 2015 - Jun. 2019*
Relevant Coursework: Quantum Mechanics, Optics, Probability Theory and Mathematical Statistics, Linear Algebra, Mathematical Methods in Physics, Linux Systems and IDL for Data Visualization.

RESEARCH INTERESTS

Black hole physics and observable phenomena, Computational astrophysics including ray tracing simulations in strong gravitational fields, Theoretical underpinnings of general relativity such as differential geometry and topology, Hierarchical structure of giant molecular clouds, Development and optimization of algorithms for astrophysical data processing.

PUBLICATIONS

Ren-Jie Shen, et al. Hierarchical Structure and Self-gravity in the Maddalena Giant Molecular Cloud, The Astrophysical Journal, 2024, 971:14-28.

Shuang Jin, Jin Wang, Ming-Zhi Kong, **Ren-Jie Shen**, et al. Does Feedback from Supermassive Black Holes Coevolve with the Host in Type 2 Quasars? The Astrophysical Journal, 2023, 950:16-27.

RESEARCH EXPERIENCE

Hierarchical Structure and Self-gravity in the Maddalena Giant Molecular Cloud
Advisor: Prof. Hong-Chi Wang *Dec 2021 - July 2024*

- Optimized the Dendrogram algorithm to decompose the 13CO emission datacube of the Maddalena giant molecular cloud into hierarchical substructures, allowing for the study of gravity and turbulence effects on different levels of molecular cloud structures
- Expanded the research scope to investigate the influence of self-gravity and turbulence on a broader range of spatial scales (0.3pc to 10pc)
- Conducted data analysis using Python and utilized Glue to visualize hierarchical data structures

Does Feedback from Supermassive Black Holes Coevolve with the Host in Type 2 Quasars
Prof. Ming-Zhi Kong *Dec 2017 - July 2019*

- Conducted a systematic study on 221 Type 2 quasars using spectral data from the Sloan Digital Sky Survey (SDSS)
- Investigated various parameters such as the [O III] emission line profiles, black hole accretion rates, and stellar population ages to explore the coevolution relationship between black hole feedback and stellar population in Type 2 quasars
- Utilized IDL for data processing and analysis, revealing a consistent coevolution pattern between black hole feedback and stellar population ages in Type 2 quasars

EMPLOYMENT

iMotion Inc. *China*
Graphic Algorithm Engineer *July 2023 - Present*

- Utilized the powerful OSG engine to render highly realistic parking lot views, seamlessly integrating 3D car models and 2D UI elements
- Implemented precise coordinate transformations to accurately display environmental and vehicle positions, ensuring a visually immersive experience for users
- Created captivating interactive animations for car models, enhancing user engagement and bringing the parking lot scenes to life
- Maintained and optimized camera view switching functionality, resulting in a smoother and more seamless user experience

PROJECT EXPERIENCE

Simulating Relativistic Effects: Photon Trajectories near Schwarzschild Black Holes
Researcher *Oct 2023 - Present*

- Engineered a real-time C++/GLSL simulation to model photon trajectories and gravitational lensing phenomena in Schwarzschild spacetime, employing fourth-order Runge-Kutta integration.
- Systematically addressed and resolved numerical instabilities in the ray tracing algorithm that led to visual artifacts under specific geometric conditions, ensuring physically consistent depictions of light deflection.
- Implemented robust numerical techniques for handling radial turning points and integrating conserved quantities (e.g., signed angular momentum) to accurately simulate a range of photon orbits and their ultimate fates (escape or capture).
- Deepened expertise in applying general relativity to computational astrophysics, with a keen interest in extending these methods to explore more complex scenarios such as rotating black holes or the dynamics of matter and radiation in extreme gravitational environments.

Ray Tracing Model Extension
Lead Developer *April 2022 - July 2022*

- Incorporated additional ray tracing features to enhanced the Ray Tracing in One Weekend project, resulting in more realistic and visually complex rendered scenes
- Integrated BRDF models to accurately simulate light-material interactions, improving the overall visual fidelity of the rendered images
- Developed a Bounding Volume Hierarchy (BVH) data structure using C++, optimizing the ray-object intersection calculations and reducing the time required to render a single frame from 164 seconds to 60 seconds

SKILLS

Programming Languages: C++, Python (NumPy, matplotlib, SciPy, pandas), IDL
Graphics and Visualization: OSG, OpenGL, Plotly, Glue, Mayavi
Operating Systems and Tools: Linux, Git, MESA