CHI-KWAN CHAN

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Research Interests

HPC-Cloud Convergence, High-Energy Astrophysics, Very-Long-Baseline Interferometry, Event Horizon Telescope, Computational Physics, General Relativistic Ray Tracing, Computation- and Data-Intensive Science, Machine Learning, and Data Visualization in Virtual Reality

Employment

2018 –	Assistant Astronomer, Steward Observatory
2018 –	Data Science Fellow, University of Arizona
2017	Visiting Scientist, Harvard Black Hole Initiative
2013 – 17	Research Associate, Steward Observatory
2010 – 12	NORDITA Fellow, Nordic Institute for Theoretical Physics
2010	Teaching Fellow, Harvard University
2007 – 10	ITC Fellow, Harvard-Smithsonian Center for Astrophysics
2005 – 07	Summer Internship in Theory Division, Los Alamos National Laboratory
2003 – 07	Research Assistant in Astrophysics, University of Arizona
2002 – 03, 06	Teaching Assistant in Physics and Computational Physics, University of Arizona
2001	Teaching and Research Assistant in Mathematics, University of Arizona
2000	Software Developer in Computational Physics, Texas A&M University

Education

2007	Ph.D. in Physics, University of Arizona
2002	B.S. in Physics and Mathematics (Cum Laude), University of Arizona

Professional and Academic Service

2020 –	Science Council Secretary of the EHT
2018 –	Coordinator of the Software and Data Compatibility Working Group of the EHT
2009 –	Peer reviewer for ApJ, MNRAS, PASJ, AA, and SIGGRAPH
2019	Co-organizer of the "PIRE Cloud Computing Busyweek"
2015 – 2019	Co-founder of the AstroCardboard project
2018	Organizer of the "AstroContainers Workshop"
2012	Co-organizer of the "Astrophysics Code Comparison Workshop" at NORDITA
2010	Guest lecturer in numerical analysis class on topics of GPU computation
2009	Co-organizer of the "Plasma Astrophysics Meetings" at ITC
2008 – 09	Member of the CfA Postdoc Council
2008	Member of the local organizing committee of the "Saturation and Transport Properties of MRI-driven Turbulence" conference at IAS
2007 – 08	Organizer of the "Astrophysical Turbulence Meetings" at ITC

Selected Grants and Awards

2020	Einstein Medal 2020 (co-awardee as an EHT member)
2020	Breakthrough Prize in Fundamental Physics 2020 (co-awardee as an EHT member)
2019	NSF Diamond Achievement Award (co-awardee as an EHT member)
2018 –	"Data Science Pathways for a Vibrant TRIPODS Commons at Scale", Senior Personnel (PI: Nirav Merchant), NSF Partnerships between Science and Engineering Fields and the NSF TRIPODS Institutes
2018 –	"Black Hole Astrophysics in the Era of Distributed Resources and Expertise", Senior Partner (PI: Dimitrios Psaltis), NSF Partnerships for International Research and Education
2016 – 2017	"X-ray Variability of Sgr A* as a Probe of Plasma Physics in Accretion Flows", Co-I (PI: Feryal Özel), Chandra X-ray Observatory Cycle 17 (Theory)
2010 – 2012	NORDITA Fellowship
2007 – 2010	Harvard ITC Fellowship

Student Mentorship

2019	Undergraduate students Muaz Burhanudin on "Developing Augmented Reality App for Stellar Evolution"
2019	Undergraduate students Ryan Gatski on "Time Variability of Closure Phase"
2019	Undergraduate students Will Price and Devin Shawn Cameron on "Improving General Relativistic Ray Tracing"
2019	Undergraduate students Jose Perez, Elizabeth Champagne, and Yuan Jea Hew on "Developing Augmented Reality App for the Event Horizon Telescope"
2018	Undergraduate student Alexis Tinoco Cazarez on "Cloud Computing for Astronomy"
2015 –	Ph.D. student David Ball on plasma physics and general relativistic radiative transfer
2015 –	Ph.D. student Lia Medeiros on "Time Variability and Interferometric Images in GRMHD Models of Sgr A*"
2011 – 2012	Graduate student Phillip Jenks on "Growth of Massive Black Holes by Super-Eddington Accretion"
2005 – 2006	Undergraduate student Robert Marcus on senior thesis

Selected Software Projects

lux	A versatile, scalable, extendable framework to simulate astrophysical systems, fully open sourced once completed
mockservation	A python package for managing and manipulating mock observations for the Event Horizon Telescope (http://github.com/chanchikwan/mockservation)
RosettaTour	A virtual reality mobile app compatible with Google Cardboard for touring the Rosetta mission (http://github.com/AstroCardboard/RosettaTour)
insight	An OpenGL-based interactive virtual reality data visualizer for Oculus Rift (http://github.com/chanchikwan/insight)
gray	A massive parallel ODE integrator for performing general relativistic radiative transfer using ray tracing (http://github.com/chanchikwan/gray)
orbits	A collection of symplectic integrators that are ideal for solving celestial mechanic problems (http://github.com/chanchikwan/orbits)

fg2   A 2D grid-based partial differential equation solver written in CUDA C and runs on nVidia GPUs (http://github.com/chanchikwan/fg2)

sg2   A 2D spectral Galerkin code written in CUDA C and runs on nVidia GPUs (http://github.com/chanchikwan/sg2)

Selected Talks

19. "Imaging the Supermassive Black Hole at the Center of the M87 Galaxy: A Data Analysis Perspective"
    UA-TRIPODS Seminar, Oct 2019

18. "Capturing Black Holes in the Era of Distributed Resources and Expertise"
    Zoomtopia, Oct 2019

17. "Imaging the Supermassive Black Hole at the Center of the M87 Galaxy: A Computation Perspective"
    31st IUPAP Conference on Computational Physics, Jul 2019

16. "Bringing Black Holes into Focus: The Event Horizon Telescope's First Image"
    University of Arizona, Apr 2019

15. "Imaging Event Horizons—A Journey Walked Together by Observers and Theorists"
    Shanghai Astronomical Observatory, Sep 2018

14. "GPU Computing: from PC & HPC to the Cloud & the Edge"
    PIRE Launch Event, Feb 2018

13. "Recent Progress in General Relativistic Ray Tracing"
    Black Hole Initiative Colloquium, Sep 2017

12. "GRay2: Improving General Relativistic Ray Tracing and Beyond"
    TCAN Collaboration Meeting, Oct 2016

11. "Fast Variabilites in GRMHD Models of Sgr A* and Their Implications for EHT Observations"
    International Astronomical Union Symposium 322, Jul 2016

10. "On MHD Turbulence and Angular Momentum Transport in Accretion Disk Boundary Layers"
    International Astronomical Union Symposium 294, Aug 2012

9. "Condensates in Two Dimensional Turbulence"
   FrischFest: the Solar Course, the Chemic Force, and the Speeding Change of Water, Oct 2011

8. "The Pseudospectral Method: Recent Advances and Prospects, Part II"
   The Nature of Turbulence Workshop at KITP, Mar 2011

7. "Local Anisotropy in MHD Turbulence"
   RädlerFest: α Effect and Beyond, Feb 2011

6. "High Order Numerical Methods on GPUs"
   Computational Physics with GPUs Conference at Lund Observatory, Nov 2010

5. "Lessons from Radiative and MHD Simulations for Supermassive Black Hole Growth"
   Aspen Winter Conference on Formation and Evolution of Black Holes, Feb 2010

4. "What do Spectra Mean in MHD Turbulence?"
   Institute for Advanced Study Thursday Seminar, May 2009

3. "Generalized Shearing Boxes for Multi-Scale Studies of MHD Turbulence"
   Saturation and Transport Properties of MRI-driven Turbulence Conference at IAS, Jun 2008

2. "Turbulence Generation in Magnetized Accretion Disks"
   Harvard-Smithsonian Center for Astrophysics PEOPLE Lecture, Dec 2007

1. "Toward Realistic Accretion Disk Simulations"
   Los Alamos National Laboratory Theory Seminar, Jul 2007

Publications

37. "Discretization and Filtering Effects on Black Hole Images Obtained with the Event Horizon Telescope"
Psaltis, D; ...; **Chan, C.K.**; et. al. 2020 arXiv:2004.06210

36. "Prospects for Wideband VLBI Correlation in the Cloud"
Gill, A.; Blackburn, L.; Roshanineshat, A.; Chan, C.K.; et. al. 2019 PASP, 131, 124501

35. "EHT-HOPS pipeline for millimeter VLBI data reduction" Blackburn, L.; **Chan, C.K.**; et. al. 2019 ApJ, 882, 23

34. "The Event Horizon General Relativistic Magnetohydrodynamic Code Comparison Project"
Porth, O.; Chatterjee, K.; Narayan, R.; Gammie, C.F.; Mizuno, Y.; Anninos, P.; Baker, J.G.; Bugli, M.; **Chan, C.K.**; et. al. 2019 ApJS, 243, 26

33. "First M87 Event Horizon Telescope Results. VI. The Shadow and Mass of the Central Black Hole"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019f ApJL, 875, L6

32. "First M87 Event Horizon Telescope Results. V. Physical Origin of the Asymmetric Ring"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019e ApJL, 875, L5

31. "First M87 Event Horizon Telescope Results. IV. Imaging the Central Supermassive Black Hole"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019d ApJL, 875, L4

30. "First M87 Event Horizon Telescope Results. III. Data Processing and Calibration"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019c ApJL, 875, L3

29. "First M87 Event Horizon Telescope Results. II. Array and Instrumentation"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019b ApJL, 875, L2

28. "First M87 Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole"
Event Horizon Telescope Collaboration; ...; **Chan, C.K.**; et. al. 2019a ApJL, 875, L1

27. "GRay2: A General Purpose Geodesic Integrator for Kerr Spacetimes"
Chan, C.K.; Medeiros, L.; Özel, F.; & Psaltis, D. 2017 ApJ, 867, 59

26. "GRMHD Simulations of Visibility Amplitude Variability for Event Horizon Telescope Images of Sgr A*"
Medeiros, L.; **Chan, C.K.**; Özel, F.; Psaltis, D.; Kim, J.; Marrone, D.P.; & Sądowski, A. 2018 ApJ, 856, 163

25. "The Properties of Reconnection Current Sheets in GRMHD Simulations of Radiatively Inefficient Accretion Flows"
Ball, D.; Özel, F.; Psaltis, D.; **Chan, C.K.**; Sironi, L. 2018 ApJ, 853, 184

24. "Variability in GRMHD Simulations of Sgr A*: Implications for EHT Closure Phase Observations"
Medeiros, L.; **Chan, C.K.**; Özel, F.; Psaltis, D.; Kim, J.; Marrone, D.P.; & Sądowski, A. 2017 ApJ, 844, 35

23. "Bayesian Techniques for Comparing Time-Dependent GRMHD Simulations to Variable Event Horizon Telescope Observations"
Kim, J.; Marrone, D.P.; **Chan, C.K.**; Medeiros, L; Özel, F.; Psaltis, D. 2016 ApJ, 832, 156

22. "Particle Acceleration and the Origin of X-ray Flares in GRMHD Simulations of Sgr A*"
Ball, D.; Özel, F.; Psaltis, D.; & **Chan, C.K.** 2016 ApJ, 826, 77

21. "Persistent Asymmetric Structure of Sagittarius A* on Event Horizon Scales"
Fish, V.L.; Johnson, M.D.; Doeleman, S.S.; ...; **Chan, C.K.**; et al. 2016 ApJ, 820, 90

20. "GRMHD Simulations of Visibility Amplitude Variability for EHT Images of Sgr A*"
Medeiros, L.; **Chan, C.K.**; Özel, F.; Psaltis, D.; Kim, J.; Marrone, D.P.; & Sądowski, A. 2016 submitted to ApJ (arXiv:1601.06799)

19. "A General Relativistic Null Hypothesis Test with Event Horizon Telescope Observations of the Black Hole Shadow in Sgr A*"
Psaltis, D.; Özel, F.; **Chan, C.K.**; & Marrone, D.P. 2015 ApJ, 814, 115

18. "Fast Variability and mm/IR flares in GRMHD Models of Sgr A* from Strong-Field Gravitational Lensing"
Chan, C.K.; Psaltis, D.; Özel, F.; Medeiros, L.; Marrone, D.P.; Sadowski, A.; & Narayan, R. 2015 ApJ, 812, 103

17. "The Power of Imaging: Constraining the Plasma Properties of GRMHD Simulations using EHT Observations of Sgr A*"
Chan, C.K.; Psaltis, D.; Özel, F.; Narayan, R.; & Sadowski, A. 2015 ApJ, 799, 1

16. "GRay: A Massively Parallel GPU-based Code for Ray Tracing in Relativistic Spacetimes"
Chan, C.K.; Psaltis, D.; & Özel, F. 2013 ApJ, 777, 13

15. "On Magnetohydrodynamic Turbulence and Angular Momentum Transport in Accretion Disk Boundary Layers"
Chan, C.K. & Pessah, M.E. 2013 IAU Symposium, 294, 349

14. "Angular Momentum Transport in Accretion Disk Boundary Layers Around Weakly Magnetized Stars"
Pessah, M.E. & **Chan, C.K.** 2013 EPJ Web of Conferences, 46, 04004

13. "On Hydromagnetic Stresses in Accretion Disk Boundary Layers"
Pessah, M.E. & **Chan, C.K.** 2012 ApJ, 751, 48

12. "Dynamics of Saturated Energy Condensation in Two-Dimensional Turbulence"
Chan, C.K.; Mitra, D.; & Brandenburg, A. 2012 PhRvE, 85, 036315

11. "A Class of Physically Motivated Closures for Radiation Hydrodynamics"
Chan, C.K. 2011 ApJ, 727, 67

10. "Oscillations of the Inner Regions of Viscous Accretion Disks"
Chan, C.K. 2009 ApJ, 704, 68

9. "MHD Simulations of Sgr A*: Quiescent Fluctuations, Outbursts, and Quasi-Periodicity"
Chan, C.K.; Lui, S.; Fryer, C.L.; Psaltis, D.; Özel, F.; Rockefeller, G.; & Melia, F. 2009 ApJ, 701, 521

8. "Spectral Methods for Time-Dependent Studies of Accretion Flows. III. Three-Dimensional, Self-Gravitating, Magnetohydrodynamic Disks"
Chan, C.K.; Psaltis, D.; & Özel, F. 2009 ApJ, 700, 741

7. "Viscous, Resistive Magnetorotational Modes"
Pessah, M.E. & **Chan, C.K.** 2008 ApJ, 684, 498

6. "The fundamental difference between shear α-viscosity and turbulent magnetorotational stresses"
Pessah, M.E.; **Chan, C.K.**; & Psaltis, D. 2008 MNRAS, 383, 683

5. "Angular Momentum Transport in Accretion Disks: Scaling Laws in MRI-driven Turbulence"
Pessah, M.E.; **Chan, C.K.**; & Psaltis, D. 2007 ApJ, 668, 51

4. "A Local Model for Angular Momentum Transport in Accretion Disks Driven by the Magnetorotational Instability"
Pessah, M.E.; **Chan, C.K.**; & Psaltis, D. 2006 PRL, 97, 1103

3. "The Signature of the Magnetorotational Instability in the Reynolds and Maxwell Stress Tensors in Accretion Discs"
Pessah, M.E.; **Chan, C.K.**; & Psaltis, D. 2006 MNRAS, 372, 183

2. "Spectral Methods for Time-Dependent Studies of Accretion Flows. II. Two-Dimensional Hydrodynamic Disks with Self-Gravity"
Chan, C.K.; Psaltis, D.; & Özel, F. 2006 ApJ, 645, 506

1. "Spectral Methods for Time-Dependent Studies of Accretion Flows. I. Two-dimensional, Viscous, Hydrodynamic Disks"
Chan, C.K.; Psaltis, D.; & Özel, F. 2005 ApJ, 628, 353