Rahul Kannan

Curriculum Vitæ

Rahul Kannan Massachusetts Institute of Technology ☎ +1 (617) 258 7805 ⊠ kannanr@mit.edu

Personal Information

Name: Rahul Kannan

- Address: Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139
 - Email: kannanr@mit.edu

Education

July,2010– **Ph.D. in Astronomy** & **Astrophysics**, *Max Planck Institute for Astronomy*, June,2014 Heidelberg, Germany.

- Supervisors Prof. Andrea Macciò, Dr. Greg Stinson
- Thesis Title Hydrodynamical simulations of galaxy formation in a cosmological context
 - July,2005– Master of Science & Bachelor of Science (Honors) in Physics, Indian Insti-June,2010 tute of Technology, Kharagpur, India.

Supervisor Prof. Krishna Kumar

Thesis Title Modelling dynamics of convective patters

Honors

- 1. Grade 1.0 (highest grade possible) and Magna Cum Laude for the Ph.D. thesis
- 2. Ranked among the top 1.5% students in India in the Joint Entrance Examination (JEE) conducted by the Indian Institute of Technology.
- 3. Ranked among the top 1% students in India in the Birla Institute of Technology and Science Aptitude Test.

Research Interests

I am in interested in a variety of astrophysical problems, mainly using numerical techniques to model and understand the outstanding problems in the field of cosmological structure formation. The following are my major points of interest:

- Impact of processes like conduction and magnetic fields in cluster environments
- AGM-ICM interaction
- Clusters as a cosmological probe
- Simulations of galaxy mergers and physics of merger events
- Effect of radiation fields on galaxy properties

Research Experience

2014–Present Postdoctoral Fellow, Massachusetts Institute of Technology, Cambridge,	МA	٩.
---	----	----

Supervisor Prof. Mark Vogelsberger

Mainly worked on accurately simulating cluster ICM physics.

- Implemented the first ever stable and efficient anisotropic diffusion solver on unstructured meshes.
- The efficient algorithm allowed me to simulate the highest resolution cosmological simulations to date of galaxy clusters with anisotropic thermal conduction.
- Gained new insights into the coupling between AGN jets and the ICM.
- Revealed the importance of forced turbulent mixing in quenching star formation in clusters.

2010–2014 Graduate Student, Max Planck Institute for Astronomy, Heidelberg, Germany.

Supervisors Prof. Andrea Macciò, Dr. Greg Stinson

Worked on a variety of problems in galaxy formation.

- Worked on a method to account for the effect of local photo-ionizing sources on gas cooling in galaxies in the numerical code GASOLINE.
 - Allows for the correct calculation of gas cooling in presence of local radiation fields in the galaxy.
 - This mechanism acts as a 'preventive' feedback mechanism, which produces realistic disk galaxies without resorting to very strong feedback mechanisms.
- Performed a large volume simulation to test the effectiveness of the early stellar feedback model in a wide range of galaxy masses and environments.
- Quantified the different mass transfer channels during galaxy mergers.
- 2009–2010 Master Student, Indian Institute of Technology, Kharagpur, India.
- Supervisor Prof. Krishna Kumar
 - Worked on the modeling of convective patterns in a rotating Rayleigh-Benard unstable system.
- Summer 2008 Research Intern, University of Zürich, Zürich, Switzerland.
 - Supervisors Dr. Prasenjit Saha, Prof. Kim-Vy Tran
 - Looked into the effect of frame-dragging on the orbits of galactic center stars
 Infrared color selection of active galactic nuclei

Talks

- November "Quenching, blackhole feedback and anisotropic thermal conduction", AstroPlasma 2016 Seminar, Princeton University, Princeton, NJ
- October 2016 "Quenching, AGN feedback and anisotropic thermal conduction", ITC Luncheon, CfA, Cambridge, MA

- July 2016 "Accurately simulating the physics of the ICM", Galaxy Coffee, MPIA, Heidelberg, Germany
- April 2016 "Effect of thermal conduction in clusters", MIT PostDoc Symposium, Cambridge, MA
- November "X-ray radiation quenching: A so far overlooked environmental quenching mecha-2015 nism", High Energy Astrophysics Seminar, CfA, Cambridge, MA
- June 2015 "X-ray radiation quenching: A so far overlooked environmental quenching mechanism", Let's group. The life cycle of galaxies in their favorite environment , Garching, Germany
- July 2014 " The effect of local radiation fields on galaxy properties", Quenching & Quiescence Conference, Heidelberg, Germany
- May 2014 "Galaxy formation with local photoionization feedback", From Dark matter to Galaxies Conference, Xi'an, China
- October 2013 "Galaxy formation with local photoionization feedback", Leiden Observatory, Lunch Seminar, Leiden, The Netherlands
- August 2013 "Galaxy formation with local photoionization feedback", University of Washington, Lunch Talk, Seattle, WA, USA
- August 2013 "Galaxy formation with local photoionization feedback", Galaxy Formation Workshop, UC Santa Cruz, Santa Cruz, CA, USA
 - June 2013 "Galaxy formation with local photoionization feedback", Enigma Group Workshop, MPIA, Heidelberg, Germany
- October 2012 "From discs to bulges: Effect of mergers on the morphology of galaxies", Galaxies and Cosmology Conference, Nanjing, China
 - November The MaGICC volume : Matching statistical properties of galaxies at high redshift", 2012 Galaxies & Cosmology Retreat, Lobbach, Germany

Computer skills

- Languages : C, C++, MPI, Basic CUDA, Basic OpenMP, Python, IDL
- ${\rm \circ}$ Astro Codes: AREPO, Gadget, Gasoline & ChaNGa
- Visualization: Tipsy, Pynbody and SPLASH

Teaching Experience

- 2012-2013 Instructor, CCD Photometry in Modern Astronomy
 - University of Heidelberg
- 2015-2016 Instructor, Ekapob Kulchoakrungsun Bachelor Thesis, MIT
 - 2016- Instructor, Reginald Caginalp Graduate Student, MIT

Synergistic Activities

Referee for The Astrophysical Journal

Academic References

 PROF. MARK VOGELSBERGER
 Massachusetts Institute of Technology, 77 Massachusetts Avenue, 02139 Cambridge, MA, USA
 +1 617 253 3718

mvogelsb@mit.edu

- 2. PROF. VOLKER SPRINGEL
 Heidelberg Institute for Theoretical Studies, Schloss-Wolfsbrunnenweg 35, D-69118
 Heidelberg, Germany
 +49 (0) 6221 533 241
 volker.springel@h-its.org
- PROF. ANDREA V. MACCIÒ
 New York University, Abu Dhabi, PO Box 129188, Abu Dhabi, UAE +971 262 84386 maccio@nyu.edu
- PROF. PRASEJIT SAHA
 Physics Institute, University of Zürich, Winterthurerstr. 190, CH-8057 Zürich, Switzerland
 +41 44 635 6194 *psaha*@physik.uzh.ch

Key Collaborators

Mark Vogelsberger (MIT), Volker Springel (HITS), Lars Hernquist (Harvard), Christoph Pfrommer (HITS), Rüdiger Pakmor (HITS), Massimo Gaspari (Princeton), Andrea V. Macciò (NYU Abu Dhabi), Federico Marinacci (MIT), Joe Hennawi (MPIA), Greg Stinson (MPIA), Paul Torrey (MIT), Fabio Fontanot (INAF), Ben Moster (MPA), Rachel Somerville (Rutgers), James Wadsley (McMaster), Tom Quinn (Univeristy of Washington), Joshua Suresh (Harvard)

Rahul Kannan

Massachusetts Institute of Technology ☎ +1 (617) 258 7805 ⊠ kannanr@mit.edu

Publications

1. "Quenching, blackhole feedback and anisotropic thermal conduction"

Rahul Kannan, Mark Vogelsberger, Christoph Pfrommer, Rainer Weinberger, Volker Springel, Lars Hernquist, Ewald Puchwein, Rüdiger Pakmor Submitted to ApJ Letters

- "ON THE OVI ABUNDANCE IN THE CIRCUMGALACTIC MEDIUM OF LOW-REDSHIFT GALAXIES"
 Joshua Suresh, Kate H. R. Rubin, Rahul Kannan, Jessica K. Werk, Lars Hernquist, Mark Vogelsberger
 2016, Accepted for publication in MNRAS, arXiv:1511.00687
- "A SEMI-IMPLICIT LOCAL TIMESTEPPING SOLVER FOR ANISOTROPIC COSMIC RAY DIFFUSION ON AN UNSTRUCTURED MOVING MESH"
 Rüdiger Pakmor, Christoph Pfrommer, Christine M. Simpson, Rahul Kannan, Volker Springel
 2016, MNRAS 462, 2603
- 4. "Galaxy formation with local photoionization feedback II. Effect of X-ray emission from binaries and hot gas"

Rahul Kannan, Mark Vogelsberger, Greg S. Stinson, Joseph F. Hennawi, Federico Marinacci, Volker Springel, Andrea V. Macciò 2016, MNRAS 458, 2516

5. "Accurately simulating anisotropic thermal conduction on a moving mesh"

Rahul Kannan, Volker Springel, Rüdiger Pakmor, Federico Marinacci, Mark Vogelsberger

2016, MNRAS 458, 410

6. "Toward the Dynamical Classification of Galaxies: Principal Component Analysis of SAURON and CALIFA circular velocity curves"

Kalinova, Colombo, Rosolowsky, van de Ven, Lyubenova, Falcon-Barroso, **Kannan**, Lasker, Galbany, Garcla-Benito, Gonzalez Delgado, Sanchez, Ruiz-Lara and the CALIFA collaboration

Submitted to MNRAS, arXiv:1509.03352

7. "From Discs to Bulges: effect of mergers on morphology of galaxies"

Rahul Kannan, Andrea V. Macciò, Fabio Fontanot, Benjamin P. Moster, Wouter Karman, Rachel S. Somerville

2015, MNRAS 452, 4346

8. "Star formation in mergers with cosmologically motivated initial conditions"

Wouter Karman, Andrea V. Macciò, **Rahul Kannan**, Benjamin P. Moster, Rachel S. Somerville

2015, MNRAS 452, 1984

- 9. "ON THE DEPENDENCE OF GALAXY MORPHOLOGIES ON GALAXY MERGERS"
 Fabio Fontanot, Andrea V. Macciò, Michaela Hirschmann, Gabriella De Lucia, Rahul Kannan, Rachel S. Somerville, Dave Wllan
 2015, MNRAS 451, 2968
- 10. "Galaxy formation with local photoionization feedback I. Methods"

R. Kannan, G.S. Stinson, A.V. Macciò, J.F.Hennawi, R. Woods, J.Wadsley, S. Shen, T. Robitaille, S. Cantalupo, T. Quinn, C. Christensen 2014, MNRAS 437, 2882

11. "The MAGICC volume: reproducing statistical properties of high redshift galaxies"

Rahul Kannan, Greg S. Stinson, Andrea V. Macciò, Chris Brook, Simone M. Weinmann , James Wadsley , Hugh M. P. Couchman 2014, MNRAS 437, 3529

12. "Interaction between dark matter sub-halos and galactic gaseous disk"

Rahul Kannan, Andrea V. Macciò, Benjamin P. Moster, Anna Pasquali, Fabian Walter

2012, ApJ, 746, 10

 "TURBULENCE IN ROTATING RAYLEIGH-BENARD CONVECTION IN LOW PRANDTL NUMBER FLUIDS"
 Hirdesh K. Pharasi, Rahul Kannan, Krishna Kumar, Jayanta K. Bhattacharjee

2011, Phys. Rev. E 84, 047301

14. "FRAME DRAGGING & THE KINEMATICS OF GALACTIC CENTER STARS"
 Rahul Kannan & Prasenjit Saha
 2009, ApJ, 690, 1553

Papers in preparation

1. "The AESTUS project I: Non-radiative simulations of galaxy clusters with magnetic fields and anisotropic thermal conduction"

Rahul Kannan, Mark Vogelsberger, Christoph Pfrommer, Rüdiger Pakmor, Federico Marinacci, Massimo Gaspari

In Prep.

2. "Sunyaev-Zel'dovich scaling relations in the IllustrisTNG simulation"

Rahul Kannan, Mark Vogelsberger, Paul Torrey & the Illustris collaboration In Prep.

Publication Record

- 7 First author papers in press, 1 First author paper submitted, 2 First author papers in preperation
- 6 Co-author papers