James Y-K. Cho

Brandeis University
415 South Street
Waltham, MA 02453
Tel: +1 (781) 736-2805
Email: jamescho@brandeis.edu

Education:

09/1996	Ph.D., Applied Mathematics, Columbia University (Advisor: Prof. Lorenzo Polvani)
05/1988	B.S., Physics, University of Maryland, College Park
05/1988	B.S., Astronomy, University of Maryland, College Park

Positions:

08/22—present	Professor, Department of Physics (joint Mathematics), Brandeis University (MA, USA)
09/18—08/22	Research Scientist, Center for Computational Astrophysics, Flatiron Institute (NY, USA)
01/18—08/22	Adjunct Professor, Department of Physics, Stevens Institute of Technology (NJ, USA)
08/10—01/19	Reader, School of Physics & Astronomy, Queen Mary University of London (London, UK)
09/05—07/10	Lecturer, School of Mathematical Sciences, Queen Mary University of London (London, UK)
09/02—08/05	Research Scientist, Department of Terrestrial Magnetism, Carnegie Institution of Washington (Washington DC, USA)
11/98—12/02	Senior Scientist, Space Physics Group, Spectral Sciences, Inc. (MA, USA)
10/96—10/98	Postdoctoral Scholar, Division of Geological & Planetary Sciences California Institute of Technology (CA, USA)
09/88—08/91	Assistant Staff Scientist, Group 91 – Space Surveillance , MIT Lincoln Laboratory (MA, USA)

Research Interests:

- Astrophysical-geophysical fluid dynamics
  - extrasolar planets, compact objects, and accretion disks
  - Earth, planetary, and stellar general circulation & climate
  - turbulence, vortex dynamics, and nonlinear waves
- mathematical physics
- numerical methods

Selected Research Support:

- *Astronomy Research at Queen Mary 2015 – 2018* (STFC consolidated grant ST/M001202/1, £1.24M, 2014 [Co-I])
- *Wave-Flow Interaction in Geophysics, Climate, Astrophysics, and Plasmas* (Kavli Institute for Theoretical Physics, Simons fund, £20K, 2014)
- *Atmospheric Decision Assistance Toolkit for Directed Energy* (DoD SBIR, MDA13-018: (Phase I), $125K, 2013 [Scientific-PI])
- *Astronomy Research at Queen Mary 2013--2015* (STFC consolidated grant ST/J001546/1, £1.63M, 2012 [Co-I])
- *Stochastic Resonance in Planetary Flows and Climates* (EPSRC pump-priming grant, EP/J501360/1, £8K, 2011 [PI])
- *Stochastic Modelling of Solar System and Extrasolar System Planet Climates* (Westfield Trust Grant, £7.3K, 2010 [PI])
- *Dynamics and Temperature Structure of Hot Jupiter Atmospheres* (STFC, PP/E001858/1, £367K, 2007 [PI])
- Spitzer Telescope Grant: Observing Grant (GO-20101, $17.5K, 2005 [Co-I])
- *Atmospheric Modeling of Hot Jupiters* (NASA, NNG06GF55G, $145K, 2005 [Co-I])
- *The Global Surface Temperature and Cloud Cover of Extrasolar Terrestrial Planets: Implications for Habitability and Detectability* (NASA, NNG04GN82G, $180K, 2004 [PI])
- *Global Atmospheric and Interior Modeling of Extrasolar Giant Planets* (NASA, NAG5-13478, $132K, 2003 [Scientific-PI])
- *High-Resolution, Stratospheric Variability and Dispersion Modeling for Assessing Collateral Effects of Hazardous Releases* (DoD, DTRA01-00-P-0102: (Phase II), $750K, 2001 [PI])
- *High-Resolution, Stratospheric Variability and Dispersion Modeling for Assessing Collateral Effects of Hazardous Releases* (DoD, DTRA01-00-P-0101: (Phase I), $100K, 2000 [PI])
- *Chemical and Flow Modeling for Enhanced Analysis of Contamination* (NASA, NASA99-25-01-4770: (Phase I), $70K, 1999 [Co-I])

Selected Publications:

- Skinner, J. W., Nättilä, J., & **Cho, J. Y-K.**, "Repeated Cyclogenesis on Hot-ExoplanetAtmospheres with Deep Heating," *Phys. Rev. Lett.* (submitted)
- Edwards B. *et al.*, "Exploring the Ability of HST WFC3 G141 to Uncover Trends in Populations of Exoplanet Atmospheres Through a Homogeneous Transmission Survey of 70 Gaseous Planets", *Astrophys. J. Supp.*, (in press)
- Changeat, Q., Edwards, B., Al-Refaie, A. F, Tsiaras, A., Skinner, J. W., **Cho, J. Y-K.** *et al.*, "Five key exoplanet questions answered via the analysis of 22 hot-Jupiter atmospheres in eclipse", *Astrophys. J. Supp.*, **260**, 3 (2022)
- Skinner, J. W. & **Cho, J. Y-K.,** "Modons on tidally-synchronized planets," *Mon. Not. Roy. Astron. Soc.*, **511**, 3584 (2022)
- **Cho, J. Y-K.**, Skinner, J. W., & Thrastarson, H. Th., "Storms, variability, and multiple equilibria on hot-Jupiters," *Astrophys. J. Lett.*, **913**, L32 (2021)
- Skinner, J. W. & **Cho, J. Y-K.,** "Numerical convergence of hot-Jupiter atmospheric flow solutions," *Mon. Not. Roy. Astron. Soc.*, **504**, 5172 (2021)

- Moon, W. & **Cho, J. Y-K.**, "A balanced state consistent with planetary-scale motion for quasi-geostrophic dynamics," *Tellus*, **72**, 1 (2020)
- **Cho, J. Y-K.**, Thrastarson, H. Th., Koskinen, T., Read, P., Tobias, S., Moon, W., & Skinner, J. W. "Exoplanets and the Sun," (in *Jets*: eds. Galperin, B. & Read, P. L., 2019)
- Tinetti, G. *et al.*, "A chemical survey of exoplanets with ARIEL," *Exp. Astron.*, **46**, 135 (2018)
- Polichtchouk, I. & **Cho, J. Y-K.**, "Equatorial superrotation under reduced equator-to-pole surface temperature gradients," *Quart. J. Roy. Met. Soc.*, **142**, 1528 (2016)
- Tinetti, G., Drossart, P., Eccleston, P., Hartogh, P., Isaak, K., Linder, M., Lovis, C., Micela, G., Ollivier, M., Puig, L., Ribas, I., Snellen, I., Swinyard, B. Allard, F., Barstow, J., **Cho, J. Y-K.**, & the EChO Team, "The EChO science case," *Exp. Astron.*, **40**, 329 (2015)
- **Cho, J. Y-K.**, Politchouk, I. & Thrastarson, H. Th., "Sensitivity and variability redux in hot-Jupiter simulations," *Mon. Not. R. Astron. Soc.*, **454**, 3423 (2015)
- Koskinen, T. T., Yelle, R. V., Lavvas, P., & **Cho, J. Y-K.**, "Electrodynamics on extrasolar giant planets," *Astrophys. J.*, **796**, 16 (2014)
- Politchouk, I., **Cho, J. Y-K.**, Watkins, C., Thrastarson, H. Th., Umurhan, O. M., & de la Torre Júarez, M., "Intercomparison of general circulation models for hot extrasolar planets," *Icarus,* **229**, 355 (2014)
- Watkins, C. & **Cho, J. Y-K.**, "The vertical structure of Jupiter's equatorial zonal wind, above the cloud deck, derived using mesoscale gravity waves," *Geophys. Res. Lett.,* **40**, 472 (2013)
- Tinetti, G., Beaulieu, J. P., Henning, T., Meyer, M., Micela, G., Ribas, I., Stam, D., Swain, M., Krause, O., Ollivier, M., Pace, E., Swinyard, B., Aylward, A., van Boekel, R., Coradini, A., Encrenaz, T., Snellen, I., Zapatero-Osorio, M. R., Bouwman, J., **Cho, J. Y-K.**, & the EChO Team, "EChO. exoplanet characterisation observatory," *Exp. Astro.*, **34**, 311 (2012)
- Polichtchouk, I. & **Cho, J. Y-K.**, "Baroclinic instability on hot extrasolar planets," *Mon. Not. R. Astron. Soc.*, **424**, 1307 (2012)
- Beaulieu, J.-P., Tinetti, G., Kipping, D. M., Ribas, I., Barber, R. J., **Cho, J. Y-K.** *et al.*, "Methane in the atmosphere of the transiting hot Neptune GJ436B?," *Astrophys. J.*, **731**, 1 (2011)
- Thrastarson, H. Th. & **Cho, J. Y-K.**, "Relaxation time and dissipation interaction in hot extrasolar planet atmosphere flows," *Astrophys. J.*, **729**, 117 (2011)
- Crossfield, I. J. M., Hansen, B. M. S., Harrington, J., **Cho, J. Y-K.**, Deming, D., Menou, K. & Seager, S., "A new 24 μm phase curve for υ Andromedae b," *Astrophys. J.*, **723**, 1436 (2011)
- Showman, A., **Cho, J. Y-K.**, & Menou, K., "Atmospheric circulation of exoplanets," in *Exoplanets* (Seager, S. ed., Space Science Series, Tucson, AZ, 2011)
- Tinetti, G., **Cho, J. Y-K.**, & the EChO Science Team. "The science of EChO," in *Proc. of the IAU*, **276**, 359 (2010)

- Levine, R. Y. & **Cho, J. Y-K.**, "The $W^{\pm}$-mediated weak decay as an information channel," *Gauge. Inst. J. Math Phys.,* **6**, 27 (2010)
- Levine, R. Y. & **Cho, J. Y-K.**, "Extension of the Lorentz group and left-right handed fermionic representations," *Gauge Inst. J. Math Phys.*, **6**, 2 (2010)
- Koskinen, T. T., **Cho, J. Y-K.**, Achilleos, N., & Alyward, A. D., "Ionization of extrasolar giant planet atmospheres," *Astrophys. J.*, **722**, 178 (2010)
- Thrastarson, H. Th. & **Cho, J. Y-K.**, "Effects of initial flow on close-in planet atmospheric circulation," *Astrophys. J.*, **716**, 144 (2010)
- Watkins, C. & **Cho, J. Y-K.**, "Gravity Waves on hot extrasolar planets: I. propagation and Interaction with the background," *Astrophys. J.*, **714**, 904 (2010)
- Schneider, J., Boccaletti A., Baudoz P., Beuzit J.-L., Mawet D., Aylward A., **Cho, J. Y-K.**, Rauer H., Stam D., Tinetti G., Udry S., & the SEE-COAST Team, "Super Earth Explorer Coronagraphic Off-Axis Space Telescope," *Exp. Astro.*, **23**, 357 (2009)
- **Cho, J. Y-K.**, "Atmospheric dynamics of tidally synchronised extrasolar planets," *Phil. Trans. Roy. Soc. A*, **366**, 4477 (2008)
- Rauscher, E., Menou, K., **Cho, J. Y-K.**, Seager, S., & Hansen, B. M. S., "On signatures of atmospheric features in thermal phase curves of hot Jupiters," *Astrophys. J.*, **681**, 1646 (2008)
- **Cho, J. Y-K.**, Menou, K., Hansen, B. M. S., & Seager, S., "Atmospheric circulation of close-in extrasolar giant planets: I. global, barotropic, adiabatic simulations," *Astrophys. J.*, **675**, 817 (2008)
- Rauscher, E., Menou, K., Seager, S., Deming, D., **Cho, J. Y-K.**, & Hansen, B. M. S., "Toward eclipse mapping of hot Jupiters," *Astrophys. J.*, **664**, 1119 (2007)
- Rauscher, E., Menou, K., **Cho, J. Y-K.**, Seager, S., Hansen, B. M. S., "Hot Jupiter variability in eclipse depth," *Astrophys. J.*, **662,** L115 (2007)
- Harrington, J., Hansen, B. M. S., Luszcz, S. H., Seager, S., Deming, D., Menou, K., **Cho, J. Y-K.,** & Richardson, L.J., "The phase-dependent infrared brightness of the extrasolar planet υ Andromedae b," *Science*, **314**, 623 (2006)
- **Cho J. Y-K.** & Stewart, S. T., "Dispersion and mixing of impact-generated aerosols in the Martian middle atmosphere," *Role of Volatiles and Atmospheres on Martian Impact Craters* (Laurel, MD) (2005)
- Seager, S., Richardson, L. J., Hansen, B. M. S., Menou, K., **Cho, J. Y-K.**, & Deming, D., "On the dayside thermal emission of hot Jupiters," *Astrophys. J.*, **632**, 1211 (2005)
- Menou, K., **Cho, J. Y-K.**, Seager, S., & Hansen, B. M. S., "'Weather' variability of close-in extrasolar giant planets," *Astrophys. J. Lett.*, **587**, L113 (2003)
- **Cho, J. Y-K.**, Menou, K., Hansen B. M. S., & Seager, S., "Changing face of the extrasolar giant planet, HD 209458 b" *Astrophys. J. Lett.*, **587**, L117 (2003)
- **Cho, J. Y-K.** & Levine R. Y., "High-resolution stratospheric variability and dispersion modeling for assessing collateral effects of hazardous releases," *SSI Technical Reports*/TR-4670 (prepared for Defense Threat Reduction Agency), (2002)

- **Cho, J. Y-K.**, de la Torre Júarez, M., Ingersoll, A. P., & Dritschel, D. G., "A high-resolution, 3-D Model of Jupiter's Great Red Spot," *J. Geophys. Res.*, **106**, E3 (2001)
- **Cho, J. Y-K.** & Polvani, L. M., "The robustness of self-organized zonal jets in unforced, turbulent vorticity fields," in *Vortex Flows and Related Numerical Methods II* (Gagnon, Y., Cottet, G.-H., Dritschel, D. G., Ghoniem, A. F. & Meiburg, E., eds., ESAIM, 1996)
- **Cho, J. Y-K.** & Polvani, L. M., "The morphogenesis of bands and zonal winds in the atmospheres of the giant outer planets," *Science*, **273**, 335 (1996)
- **Cho, J. Y-K.** & Polvani, L. M., "The emergence of jets and vortices in freely-evolving,shallow-water turbulence on a sphere," *Phys. Fluids*, **8**, 1531 (1996)
- Tapia, S., Beavers, W. I., & **Cho, J. Y-K.**, "Photopolarimetric observations of satellites," *SPIE*, **1317**, 252 (1990)

Research Supervision and Mentoring:

- Research Scientist and Postdoc Supervision:
  Quentin Changeat (current – STScI, MD)
  Joonas Nättilä (current – Flatiron Institute, NY)
  Orkan M. Umurhan (QMUL, U.K.; 20010-2013)

- Students Advised:
  Jack Skinner (Ph.D.), Inna Polichtchouk (Ph.D.), Chris L. Watkins (Ph.D.),
  Heidar Th. Thrastarson (Ph.D.);
  Michael Purves (M.Sc.), Annelize van Niekerk (M.Sc.), Ahmed Al-Refaie (M.Sc.);
  Amy Renne (B.Sc.), Robert Scully (B.Sc.), Erica Staehling (B.Sc.), Sonali Schukla (B.Sc.)

Courses Taught:

- *Dynamics of Physical Systems* (undergraduate course in introductory mechanics for mathematics students)
- *B.Sc.* and *M.Sc. Mathematics Projects* (Thesis research in pure and applied mathematics)
- *Essential Foundation in Mathematics* (secondary school level course in mathematics for non-traditional students entering the Mathematics B.Sc. Program)
- *Nonlinear Dynamics* (undergraduate course in dynamical systems and chaos theory)
- *Solar System* (graduate course in planetary physics for astrophysics students)
- *Fluid Dynamics* (undergraduate and graduate courses in theoretical fluid dynamics for mathematics and physics students)
- *Geophysical Fluid Dynamics* (graduate course in geophysical fluid dynamics)
- *Solar System Dynamics* (graduate course in orbital dynamics for astrophysics students)
- *Extrasolar Planets & Astrophysical Discs* (graduate course in planet formation and protoplanetary disks for astrophysics students)
- *Theoretical Astronomy Project* (MSc Thesis research)
- *Numerical Methods for PDEs* (upper-level undergraduate/graduate course in numerical analysis and methods for partial differential equations for mathematics students)
- *Geometric Algebra* (upper-level undergraduate course in introductory Clifford algebra for physics students)

- *Introduction to Cosmology* (upper-level undergraduate course in introductory general relativity and its applications in cosmology for physics students)
- *Introduction to General Relativity* (upper-level undergraduate introductory course in tensor analysis and general relativity for physics and engineering students)
- *Kinetic Theory and Transport Phenomenon* (upper-level undergraduate course in kinetic theory and transport in neutral and ionized gases for chem. engineering students)
- *Physics of Compact Objects* (upper-level undergraduate course in white dwarfs, neutron stars, and black holes for physics students)
- *Astrophysical Flows* (upper-level undergraduate course in the fluid and plasma dynamics of stars and disks for physics students)

Administrative Activities:

- Steering Committee member, *Learning Management System*, Brandeis (2022—present)
- Head of *Academic Development, Education and the Promotion of Teaching*, QMUL (2015—2019): ensured certification and compliance of the new U.K. higher education goals
- Program Organizer (Course Director) for Astronomy in the School of Physics and Astronomy, QMUL (2011—2013)
- Director of Postgraduate Astronomy Admissions, QMUL (2008—2010)
- Undergraduate Mathematics Admissions committee member, QMUL (2006—2007)

Recent Synergistic Activities:

- Co-organizer, *Geometric and Field Theoretic Methods for Astro-, Geo-, and Bio-physical Flows*, Aspen Center for Physics (Aspen, 2023)
- Lead organizer, *Exoplanet GCM/Data-Analysis/Observation Synergy,* CCA (NY, 2022)
- Lead organizer, *Coherent Structures in Turbulence:* Topical Meeting, CCA (NY, 2022)
- Co-organizer, *5th Chianti Focus Workshop on Earth, Solar System planet, and exoplanet atmospheres*, Osservatorio Polifunzionale del Chianti (San Donato in Poggio, 2022)
- Co-organizer, *Weather and Climate on Neutron Stars: Flow and Observation Connections*, Princeton Center for Theoretical Science (Princeton, 2022)
- Co-organizer, *Transport and Mixing of Tracers in Geophysics and Astrophysics*: summer program, Aspen Center for Physics (Aspen, 2021)
- Lead organizer, *Vorticity in the Universe: From Superfluids to Weather and Climate, to the Universe*, Aspen Center for Physics (Aspen, 2017)
- Committee member of the APS Topical Group on the Physics of Climate (2016—2019)
- European Geosciences Union Division Secretary (Planetary Science, 2008—2018)
- Convener, *Extrasolar Planets and Planet Formation* session, European Geosciences Union Assembly (2004—2017)
- Convener, *Observations and Modelling of Exoplanetary Atmospheres, Interiors and Orbits*, European Planetary Science Congress (2010—2018)
- Co-organizer, *Theoretical advances in planetary flow dynamics and climate*, Les Houches (Chamonix, 2015)
- Lead organizer, *Wave-Mean Flow Interaction in Geophysics, Climate, Astrophysics, and Plasmas*, Kavli Institute for Theoretical Physics (Santa Barbara, 2014)
- Lead organizer, *Stochastic Flow and Climate Modeling*, Aspen Center for Physics (Aspen, 2013)

Selected Invited Presentations and Long-Term Visits:

- University of Colorado, Boulder, joint *Applied Mathematics and Planetary Science Colloquia* (Dec 2021)
- University College London, *Department of Physics & Astronomy Colloquia* (Nov 2021)
- Brandeis University, Dept. of Physics (Waltham, MA): *Physics Colloquia* (Sep 2021)
- Aspen Center for Physics *Colloquium* (Jun 2021)
- École Normale Supérieure (Paris, France): visiting scientist (2020—2021, postponed due
- to pandemic)
- Jet Propulsion Lab (Pasadena, CA): *Earth & Planetary Science Colloquia* (Jun 2018)
- University of Central Florida, Dept. of Mathematics (Orlando, FL): *Mathematics Colloquia* (Mar 2018)
- Princeton University, Dept. of Astrophysical Sciences (Princeton, NJ): *Visiting Scientist, Sabbatical year* (Oct 2017 –Aug 2018)
- Institute for Advanced Study (Princeton, NJ): seminar and visits (Oct 2017, Jun 2008)
- Brown University, Department of Physics (Providence, RI): *Physics* and *Fluid Dynamics Colloquia* (Oct 2017, Feb 2014)
- Les Houches Winter School (Les Houches, France): invited speaker, "*Diversity of planetary circulation regimes, in our solar system and beyond*" (Mar 2017)
- National Center for Atmospheric Research Workshop (Boulder, CO): invited speaker, *Turbulence and Waves in Flows Dominated by Rotation* (Aug 2016)
- Leverhulme International Network Meeting (Oxford, UK): invited speaker, *Waves and Turbulence* (Sep 2015)
- University of P. and M. Curie (Paris, France): *Frontiers in Geophysical Fluid Dynamics* (Nov 2014)
- Institute for Pure and Applied Mathematics (Los Angeles, CA): Workshop on *Geophysical and Astrophysical Turbulence* (Oct 2014)
- Kavli Institute for Theoretical Physics (Santa Barbara, CA): *Planetary Boundary Layers in Atmospheres, Oceans, and Ice on Earth and Moons* (2018); *Wave-Mean Flow Interaction in Geophysics, Climate, Astrophysics, and Plasmas* (2014); *Extrasolar Planets* (2010); *Planet Formation* (2004)
- Isaac Newton Institute (Cambridge, UK): *Mathematics in Geophysics: Partial Differential Equations in GFD* (2013); *Planet Formation*; *Rotating-Stratified* (2009)
- American Physical Society/Division of Fluid Dynamics (Pittsburgh, PA): invited speaker, "*Global Climate Models: Dynamical Cores, Strengths and Weaknesses*" (2013)
- Harvard University, Institute for Theory & Computation, Theoretical Astrophysics Division (Cambridge, MA): *Visiting Scholar, sabbatical year* (Aug 2013 – Aug 2014)
- International Space Science Institute (Bern, Switzerland): *Jets* network meeting (2013, 2012)
- Royal Astronomical Society, (London, UK): *Extrasolar Planets*; *Vorticity*; *Planetary Atmospheres* (2013, 2011, 2010)
- University of Oxford, Dept. of Physics (Oxford, UK): *Seminar* (2015, 2013, 2010)
- University of Cambridge, DAMTP (Cambridge, UK): *Seminar* (2013, 2012, 2010)
- Aspen Center for Physics (Aspen, CO): *Stochastic Flows and Climate Modeling* (2012)
- Wave-Flow Interactions network meeting II, III, IV (invited) (2012, 2010, 2009)
- *GCM Workshop*: Univ. of Exeter (Exeter, UK) (2011)
- International Centre for Theoretical Physics (Trieste, Italy): *Turbulence and Mixing* (2011)'

- Seoul National University (Seoul, S. Korea), *Astronomy* and *Earth Science* colloquia (2010, 2005)
- University of Oxford, Dept. of Physics, Atmospheric, Oceanic and Planetary Physics (Oxford, UK): *Visiting Scientist*, *sabbatical term* (Fall 2010)
- Tokyo Institute of Technology and University of Tokyo (Tokyo, Japan) (invited) (2007)
- Sackler Lecture, Harvard University (Cambridge, MA): *Invited Lecture,* School of Engineering and Applied Science visit (2004)