

Curriculum Vitae

Susan Kurien

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Employment

May 2004 – present: Scientist III, Applied Mathematics and Plasma Physics (T-5)
Theoretical Division, Los Alamos National Laboratory.

Jan 2002 – May 2004 : Postdoctoral Research Associate, Center for Nonlinear
Studies (CNLS) and the Mathematical Modeling and
Analysis group (T-7), Los Alamos National Laboratory.

Other Appointments

Since 2011: Affiliate Scientist, New Mexico Consortium, Los Alamos.

Nov 2008 – Sept 2009: Visiting Scholar, Courant Institute of Mathematical Sciences,
Climate, Atmosphere and Ocean Sciences program, New
York University.

Education

1995-2001: Yale University, New Haven, Connecticut
M. S., M. Phil., Physics, May 1998.
Ph.D., Physics, December 2001.

1991-1995: University of Pennsylvania, Philadelphia, Pennsylvania.
B.S. *cum laude*, Computer Science and Engineering, dual
major in Physics, minor in Mathematics. Benjamin Franklin
Scholar (Honors).

Research interests

I research fundamental and applied aspects of fluid dynamics, particularly in turbulent flows and mixing processes. I use a statistical approach to develop analytical, phenomenological and computational tools with applicability to experiments and turbulence models spanning a broad parameter space. Some current problems of interest are mixing, spectral models, arbitrary anisotropy and inhomogeneity, rotating and stratified flows, and statistical measures of structure formation.

Peer reviewed publications

- Leith diffusion model for homogeneous anisotropic turbulence, R. Rubinstein, T.T. Clark and S. Kurien, *Computers and Fluids*. DOI: 10.1016/j.compfluid.2016.07.009, (2016).
- Model of non-stationary inhomogeneous turbulence, A. D. Bragg, S. Kurien and T. T. Clark, *Theor. Comp. Fluid Dyn.* DOI 10.1007/s00162-016-0401-1 (2016).
- Scalar and tensor spherical harmonics expansion of the velocity correlation in homogeneous anisotropic turbulence. R. Rubinstein, S. Kurien and C. Cambon. *J. Turbulence* 16:11, 1058 – 1075 (2015).
- Effect of rotation and domain aspect-ratio on layer formation in strongly stratified Boussinesq flows. S. Kurien and L.M. Smith, *J. Turbulence* 15:4, 241 – 271 (2014).
- Asymptotics of unit Burger number rotating and stratified flows for small aspect-ratio. S. Kurien and L. M. Smith, *Physica D*, vol. 241, pp. 149 - 163, (2012).
- Joint downscale fluxes of energy and potential enstrophy in rotating and stratified Boussinesq flows. H. Aluie and S. Kurien, *Europhys. Lett.*, vol. 96, pp. 44006, (2011).
- Hyperviscosity, Galerkin truncation and bottlenecks in turbulence. U. Frisch, S. Kurien, W. Pauls, R. Pandit, S.S. Ray, A. Wirth and J.-Z. Zhou. *Phys. Rev. Lett.*, vol 101, pp. 144501 (2008).
- Anisotropic constraints on energy distribution in rotating stratified turbulence, S. Kurien, B. Wingate and M.A. Taylor. *Europhys. Lett.*, vol 84, pp. 24003, (2008).
- Helicity within the Kolmogorov phenomenology of turbulence, S. Kurien, “*Proceedings of the IUTAM Symposium on Computational Physics and New Perspectives in Turbulence, Nagoya 2006*”. Ed.: Y. Kaneda. *Springer*, (2008).
- Spectral scaling of the Leray- α model for two-dimensional turbulence, E. M. Lunasin, S. Kurien and E. S. Titi, *J. Physics A: Math. Theor.* vol 41, 344014, (2008).
- A study of the Navier-Stokes-alpha model for two-dimensional turbulence, E. Lunasin, S. Kurien, M.A. Taylor, E. S. Titi, *J. Turbulence* 8:30, 1-21 (2007).
- On the two-point correlation of potential vorticity in rotating and stratified flows, S. Kurien, L. Smith, B. Wingate, *J. Fluid Mech.*, vol 555, 131 (2006).
- Anomalous scaling of low-order structure functions of turbulent velocity, S. Chen, B. Dhruva, S. Kurien, K. R. Sreenivasan and M.A. Taylor. *Journal of Fluid Mechanics*, vol 533, 183-192 (2005).
- Isotropic third-order statistics in turbulence with helicity: the 2/15-law, S. Kurien, M.A. Taylor and T. Matsumoto, *Journal of Fluid Mechanics*, vol. 515, 87 (2004).
- Sign-symmetry of temperature structure functions, K.G. Aivalis, S. Kurien, J. Schumacher and K.R. Sreenivasan, *Physical Review E*, vol. 69, 066315 (2004).
- Cascade time-scales of energy and helicity in homogeneous, isotropic turbulence, S. Kurien, M.A. Taylor, T. Matsumoto, *Physical Review E*, vol. 69, 066313 (2004).
- Recovering isotropic statistics in turbulence simulations: The Kolmogorov 4/5th- Law, M.A. Taylor, S. Kurien and G. L. Eyink, *Physical Review E*, vol. 68, 026310 (2003).
- Reflection antisymmetric counterpart of the Karman-Howarth dynamical equation, S. Kurien, *Physica D: Nonlinear Phenomena*, vol. 175/3-4, 167 (2003).
- Anisotropy of small-scale scalar turbulence, S. Kurien, K.G. Aivalis and K.R. Sreenivasan, *Journal of Fluid Mechanics*, vol. 448, 279 (2001).
- Dynamical equations for high-order structure functions, and a comparison of a mean field theory with experiments in three-dimensional turbulence, S. Kurien and K.R.

- Sreenivasan, *Physical Review E*, vol. 64, 6302, (2001).
- Measures of anisotropy and the universal properties of turbulence, S. Kurien and K.R. Sreenivasan, In "*Les Houches 2000: New Trends in Turbulence*, Eds.: M. Lesieur, A. Yaglom and F. David, *Springer EDP-Sciences*, (2001).
 - Anisotropic scaling contributions to high-order structure functions in high-Reynolds-number turbulence, S. Kurien and K.R. Sreenivasan, *Physical Review E*, vol. 62, 2206 (2000).
 - Scaling structure of the velocity statistics in atmospheric boundary layers, S. Kurien, V.S. L'vov, I. Procaccia and K.R. Sreenivasan, *Physical Review E*, vol. 61, 407 (2000).
 - Extraction of anisotropic contributions in turbulent flows, I. Arad, B. Dhruva, S. Kurien, V.S. L'vov, I. Procaccia and K.R. Sreenivasan, *Physical Review Letters*, vol. 81, 5330 (1998).

Other publications and internal LANL reports

- Increasing shot and data collection rates of the shock/shear experiment at the national ignition facility, Doss, F. W., Flippo, K. A., Capelli, D., Cardenas, T. , DeVolder, B., Kline, J., Kot, L., Kurien, S., Loomis, E., Merritt, E. C., Perry, T., Schmidt, D. and Di Stefano, C. *Journal of Physics: Conference Series* ; Vol.717, iss.1, p.012059, 2016. 9th International Conference on Inertial Fusion Sciences and Applications (IFSA 2015) ; Seattle, WA, USA ; 20-25 Sept. 2015. DOI: [10.1088/1742-6596/717/1/012059](https://doi.org/10.1088/1742-6596/717/1/012059), lanl-repo/lapr/LAPR-2016-025027.
- The LANS-alpha model for computing turbulence: Origins, Results and Open Problems, D. D. Holm, D. Livescu, C. Jeffery, S. Kurien, M. A. Taylor and B. A. Wingate, *Los Alamos Science*, No. 29, 152 – 171 (2005).
- Direct Numerical Simulation of Turbulence: Data Generation and Statistical Analysis, S. Kurien and M. A. Taylor, *Los Alamos Science*, No. 29, 142 – 151 (2005).

Total number of citations: ~ 833 as of Dec 2016

h-index: 15

10-index: 19

(Source: Google Scholar citation index)

Papers submitted, available on ArXiv, or in preparation

- Generation of anisotropy in turbulent flows subjected to arbitrary distortion, T.T. Clark, S. Kurien, R. Rubinstein and C. Zemach, in preparation for *Phys. Rev.* 2016.
- Characteristic length-scales of strongly rotating Boussinesq flow in variable aspect-ratio domains, X.M. Zhai, S. Kurien and P.K. Yeung, in preparation for *J. Fluid Mech.* 2016
- Scaling of high-wavenumber energy spectra in the unit aspect-ratio rotating Boussinesq system, S. Kurien <http://arxiv.org/abs/1005.5366>.

Talks/Presentations

- Frequent contributed talks to American Physical Society Division of Fluid Dynamics

meeting (2001 – present).

- “*Characterization of emergent lengthscales in rotating and stratified flows*”, Texas A&M Turbulence Symposium, College Station, NM, April 2015.
- “*Statistical Measures of Structure Formation in Massive Flow Simulations*”, Plenary Speaker, Conference on Data Analysis (CoDA), Santa Fe, NM, March 2014.
- “Aspect-ratio effects on $Bu = 1$ Boussinesq flows”, DOE Applied Mathematics Program Meeting, Reston, VA, Oct 2011.
- “Aspect ratio effects on $Bu = 1$ rotating and stratified flows”, Current Challenges in Computing 2010: Climate Modeling , invited poster presentation, Napa, CA, Sept 2010.
- “A Parameter study of spectral energy constraints in the Boussinesq system”, invited. Courant Institute of Mathematical Sciences Colloquium, New York, February 2009.
- “Anisotropic constraints on energy in rotating and stratified flows”, NCAR-IMAGE Workshop on Turbulent Theory and Modeling, Boulder, February 2008.
- “A study of the Navier-Stokes α -model for two-dimensional turbulence”, SIAM Conference on Mathematical and Computational Issues in the Geosciences, March 2007.
- “Turbulence: from theoretical prediction to numerical verification”, TSC Capability Workshop, Los Alamos National Laboratory, February 2007.
- “Helicity within the Kolmogorov phenomenology of turbulence”, IUTAM symposium, Nagoya University, Japan, September 2006.
- “Potential enstrophy cascades in rotating and stratified flows”, invited, Research Institute of Mathematical Sciences, Kyoto University, Japan, September 2006.
- “Potential enstrophy cascades in rotating and stratified flows”, invited, CNLS workshop on New directions in two-dimensional turbulence, Center for Nonlinear Studies, Los Alamos National Laboratory, August 2006.
- “On the existence of potential enstrophy inertial ranges”, (co-author, presented by B. Wingate), American Geophysical Union, 13th Ocean Sciences Meeting, Honolulu, February 2006.
- “Helicity and the Kolmogorov Phenomenology of Turbulence”, invited. Mathematics department seminar, University of California, Irvine, November 2005.
- “Timescales and Intermittency in Statistical Turbulence”, invited. P-24 seminar, Physics Division, LANL, June 2005.
- “Cascade timescales for energy and helicity in isotropic homogeneous turbulence”, University of New Mexico, American Mathematical Society Sectional Meeting, October 2004.
- “Anomalous scaling of low-order turbulence velocity statistics”, Center for Nonlinear Studies Seminar, Los Alamos National Laboratory, July 2004.
- “Helicity and the Kolmogorov Phenomenology of Turbulence”, Center for Nonlinear Studies Colloquium, April 2004.
- “Helicity and the Kolmogorov Phenomenology of Turbulence”, University of Illinois at Urbana-Champaign, Mechanical Engineering Colloquium, Invited speaker, April 2004.
- “Symmetry breaking in turbulent velocity statistics – Rotation and Reflection”, University of Central Florida, Mathematics Special Colloquium, Invited speaker, February 2004 .
- “Symmetry breaking in turbulent velocity statistics – Rotation and Reflection”, Purdue

- University, Mathematics Seminar, Invited speaker, February 2004.
- “Helicity and the Kolmogorov Phenomenology of Turbulence”, Purdue University, Earth and Atmospheric Sciences Seminar, Invited speaker, February 2004.
 - “The Scaling Structure of Velocity Statistics in Turbulence”. Workshop for “Subgrid scale turbulence modeling in geophysical flows” at the Institute for Pure and Applied Mathematics, UCLA, August 2003.
 - “The Scaling Structure of Velocity Statistics at High Reynolds Numbers”. Mini-symposium at the Society for Industrial and Applied Mathematics (SIAM) Conference on Applications of Dynamical Systems, Snowbird, Utah, May 2003.
 - “The Scaling Structure of Velocity Statistics at High-Reynolds Numbers”. University of New Mexico, Department of Mathematics Navier-Stokes Seminar Series, Invited speaker, December 2002.
 - “Karman-Howarth Dynamical Equation for Reflection-Symmetry Breaking in Turbulent Flows”. The “Geometrical Mechanics and Turbulence Modeling Workshop”, Santa Fe, New Mexico, November 2002.
 - “Recovering isotropic statistics in turbulence simulations”. Center for Nonlinear Studies Postdoc Forum, Los Alamos, New Mexico, August 2002.
 - “Equations for higher-order structure functions in turbulence: Experimental evaluation of a model for the pressure contributions”. Center for Nonlinear Studies “Arizona Days”, Los Alamos, New Mexico, February 2002.
 - “Scaling properties of statistical hydrodynamics”. Meeting for “Adaptive and High-Order Methods with Applications in Turbulence”, National Center for Atmospheric Research, February 2002.
 - “Anisotropy and the Universal Properties of Turbulence”. Cornell University, Mechanical and Aerospace Engineering Colloquium, Invited speaker, October 2001.

Conference, Workshop, Panel Participation

- Peer-reviewer for NSF-Fluid Dynamics
- Co-organizer, Turbulence Workshop 2012, Kavli Institute of Theoretical Physics, UC Santa Barbara, February – June 2012.
- National Science Foundation Cyber-Fluid Dynamics Workshop, NSF Headquarters, Virginia, July 2007.
- “Euler Equations: 250 Years On”, Co-Organized by the Centre National de Recherche Scientifique, Aussois, France, June 2007.
- DOE Applied Mathematics Research, Principal Investigator Meeting, Lawrence Livermore National Laboratory, May 2007.

Teaching and mentoring

PhD Students :

Xiaomeng Zhai (2015 -), currently PhD candidate at Georgia Tech.

Evelyn Lunasin (2004-2006, UC Irvine). Assistant Professor, Department of Mathematics, US Naval Academy, Annapolis, MD.

Postdoctoral fellows:

Andrew Bragg (2015 – 2016), Assistant Professor, Civil and Environmental Engineering, Duke University.

Lee Tschaepe (2013 - 2014), Engineer III, Wolf Creek Nuclear Operating Corporation
Hussein Aluie, (2009 – 2012), Assistant Professor, Mechanical Engineering, University of Rochester.

Dr. Jian-Zhou Zhu (2006 – 2008), WCI Center for Fusion Theory, National Fusion Research Institute, South Korea

Summer /Fall 2003-present: Mentor to PhD candidates who participate in the Summer Graduate Research Assistantship program at LANL. Advisory and collaborative role on various projects.

1995-2001: Teaching Assistant and tutor at Yale University. Undergraduate Physics Laboratory courses and recitation sections for Physics, Astronomy and Mathematics.

Grants and Awards

FY 2015-2017: PI, NSF-Fluid Dynamics proposal “Coherent structures and mixing in rotation and stratified flows” award amount \$293,292 through the New Mexico Consortium.

FY2013-2015: PI, DOE Office of Science, Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program allocation of 112M processor hours on IBM Blue Gene/P for proposal “Parameter study of rotating and stratified Boussinesq flows”.

FY2011-2013: co-PI with L. Smith (U. Wisconsin, Madison) and A. Pouquet (NCAR), NSF Collaborations in Mathematics and Geosciences, “Analysis and Modeling of Rotating and Stratified flows” awarded \$750K (\$177K to Kurien through the New Mexico Consortium).

FY2009-2011: PI, DOE Office of Science, Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program allocation of 25M processor hours on IBM Blue Gene/P for proposal “Numerical Study of Multiscale Coupling in Low-Aspect Ratio Rotating and Stratified Turbulence”.

FY2006-2008: co-PI (unfunded), NSF Collaborations in Mathematics and Geosciences, (PI: L. Smith, U. Wisconsin, Madison), “Multiscale Coupling in Geophysical Flows”.

FY2006-2008: PI, DOE Office of Science, Advanced Scientific Computing Research, Multiscale Mathematics Research and Education grant for proposal "Multiscale coupling in geophysical and climate models". (Joint with Leslie Smith, U. Wisconsin, Madison). See highlight in ASCR Discovery New Faces <http://ascr-discovery.science.doe.gov/newfaces/kurien1.html>

2003: Los Alamos Achievement Award for "Fundamental Breakthrough in Turbulence Theory and Data Analysis".

Other activities

Referee: Physical Review Letters, Physical Review E, Journal of Fluid Mechanics,

Proceedings of the Royal Society A, Journal of Turbulence, Physics Letters A.

Peer Review: NSF-Fluid dynamics, DOE Office of Science

Review Team Member, DOE ASC Alliance Center for Integration Turbulence Simulations at Stanford University (2004-2005).

Co-organizer, 13th Annual Arizona Days Conference (January 30-31, 2004, Center for Nonlinear Studies, LANL).

Member: American Physical Society, American Geophysical Union.