Harsha *Suresh* Bhat

Chargé de Recherche de Classe Normale, CNRS
École Normale Supérieure, Paris

PERSONAL INFORMATION

▶ Address: Laboratoire de Géologie, 24 Rue Lhomond, 75005, Paris, France

▶ Nationality: Indian

▶ Website: `https://harshasbhat.github.io`

EDUCATION

2007/06	Ph. D.	*Mechanical Sciences*	Harvard University, USA
2002/06	M. S.	*Engineering Sciences*	Harvard University, USA
2001/06	B. E.	*Civil Engineering*	NITK, India

CURRENT POSITION

▶ *École Normale Supérieure, France*	2016/05 ▶ Present	*CNRS Research Scientist*
▶ *California Institute of Technology, USA*	2018/12 ▶ Present	*Visiting Professor in Aeronautics*

PAST POSITIONS

▶ *Institut de Physique du Globe de Paris, France*	2012/01 ▶ 2016/05	*CNRS Research Scientist*
▶ *University of Southern California, USA*	2010/03 ▶ 2011/12	*Asst. Professor (Research)*
▶ *University of Southern California, USA*	2007/11 ▶ 2010/03	*Post Doctoral Fellow*
▶ *California Institute of Technology, USA*	2007/11 ▶ 2010/03	*Visitor in Aeronautics*
▶ *Harvard University, USA*	2007/05 ▶ 2007/10	*Post Doctoral Fellow*
▶ *Harvard University, USA*	2001/11 ▶ 2007/05	*Grad. Research Associate*

GRANTS

▶ 2 Million Euros, ERC Consolidator Grant, PERSISMO (865411), Jan 1, 2021-Dec 31, 2025

HONORS AND AWARDS

▶ 2018 CNRS Award for Doctoral Supervision and Research
▶ 2018 Grand Prix Michel Gouilloud Schlumberger, French Academy of Sciences
▶ 2003, 2004 & 2006 Harvard University Certificate of Distinction in Teaching

TEACHING ACTIVITIES†

1) Mecanique des Milieux Continus *2)* Active Faults : Geometry *3)* Seismic Ruptures and Scaling Laws *4)* Introduction to Rock Physics *5)* Mathematical Methods in the Sciences *6)* Environmental Risks and Disasters *7)* Ordinary and Partial Differential Equations *8)* Complex and Fourier Analysis *9)* Computational Solid and Structural Mechanics *10)* Solid Mechanics *11)* Introduction to the Mechanics of Solids *12)* Mechanics of Fracture *13)* Advanced Geomechanics

† *Classes taught with various colleagues at Harvard, Caltech, IPGP and ENS*

ORGANISATION OF SCIENTIFIC MEETINGS

► June 2019: Coupled Processes In Fracture Propagation In Geo-Materials: From Hydraulic Fractures To Earthquakes: CISM Advanced School, Udine, Italy
► April 2015: Seismological Society of America, Multiscale Modeling and Characterization of Fragmentation and Damage Patterns in Fault Zones
► December 2014: American Geophysical Union, Fault Zone Properties And Processes During Dynamic Ruptures

INSTITUTIONAL RESPONSIBILITIES

► 2018 Onwards: Team Leader of Faults & Earthquakes Group, ENS (*11 Researchers, 8 postdocs and 8 PhD students)*
► 2018-2019: Co-organizer of the Internal Seminar, ENS

BOOKS

► Thomas, M. Y., T. M. Mitchell, and H. S. Bhat, eds. (2017). "*Fault Zone Dynamic Processes : Evolution of Fault Properties During Seismic Rupture, Geophysical Monograph 227*". American Geophysical Union (AGU). DOI: 10.1002/9781119156895.

► Bizzarri, A. and H. S. Bhat, eds. (2012). "*The mechanics of faulting: From laboratory to earthquakes*". Research Signpost. ISBN: 978-81-308-0502-3.

REVIEWING ACTIVITIES

American Geophysical Union Seismological Society of America International Journal of Fracture Geological Society of America Science Nature Journal of the Mechanics and Physics of Solids European Journal of Mechanics - A/Solids Earth and Planetary Science Letters Geophysical Research Letters Journal of Structural Geology Proceedings of the National Academies of Science, USA Geology Geophysical Journal International Journal of Applied Mechanics National Science Foundation European Research Council

STUDENTS & POSTDOCS

Undergraduate Students : 6 weeks long research internship

- **Phillipe Danre (2017)** Étude de l'impact des marées sur le glissement sismique et asismique des failles actives *(Co-advised with Dr. R. Jolivet, ENS)*
- **Hugo Lestrelin (2019)** Theoretical investigation of radiation from a size distribution of fractures*(Co-advised with Dr. L. Bruhat, ENS)*
- **Roxane Ferry (2019)** Understanding the relationship between Slow Slip accélérations observed in natural and synthetic GPS *(Co-advised with Dr. J. Jara, ENS)*

Masters Students : 4-6 month long research internship

- **Sonia Fliss (2003)** Fault branching and rupture directivity *(Co-advised with Prof. J. R. Rice & Dr. R. Dmowska, Harvard)*
- **Marion Olives (2004)** Finite fault branches and rupture dynamics: Is it time to look more carefully at fault maps? *(Co-advised with Prof. J. R. Rice & Dr. R. Dmowska, Harvard)*
- **Aurelie Baudet (2004)** Finite element modeling of laboratory experiments on impact and shear rupture of pre-faulted specimens *(Co-advised with Prof. J. R. Rice & Dr. E. L. Templeton, Harvard)*
- **Lucile Bruhat (2012)** Near-field radiation from stopping ruptures *(Co-advised with Prof. J.-P. Vilotte, IPGP)*
- **Thibaut Perol (2013)** Micromechanics Based Permeability Evolution In Brittle Materials At High Strain Rates
- **Kurama Okubo (2014)** The effect of waste water injection on earthquake nucleation in damaged fault zones
- **Victor Barolle (2015)** Metastable phase transformation in the mantle: Evolution of a spinel inclusion into olivine
- **Eleni Kolokytha (2015)** Understanding the role of temperature evolution in the frictional behavior of fault zone and its effect on the seismic cycle *(Co-advised with Dr. M. Thomas)*
- **Luc Illien (2018)** Multiseismic phase characterization in laboratory rock deformation experiments, a Numerical and Experimental study *(Co-advised with Dr. N. Brantut)*
- **Nicolas Mercury (2018)** Modélisation physique de réseaux complexes de failles afin de déterminer l'origine de la loi de Gutenberg-Richter *(Co-advised with Dr. J-A Olive)*
- **Phillipe Danre (2019)** Nonlinear dynamics of faults subjected to periodic loads *(Co-advised with Dr. R. Jolivet, ENS)*
- **Jinhui Cheng (2020)** Analyze modes of slip and related synthetic GPS based on quasi-dynamic earthquake cycle modelling in complex fault networks

PhD students : Co-supervised

- **Michael Mello (2012)** Identifying the unique ground motion signatures of supershear earthquakes: Theory and experiments, *PhD, Caltech, Main Advisor : Prof. A. J. Rosakis*
- **Jonathan Mihaly (2013)** Investigation of hypervelocity impact phenomena using real-time concurrent diagnostics, *PhD, Caltech, Main Advisor : Prof. A. J. Rosakis*
- **François X. Passelègue (2014)** Étude Expérimentale de la Rupture Sismique, *PhD, École Normale Supérieure de Paris, Main Advisors : Prof. R. Madariaga & Dr. A. Schubnel*
- **Vahe Gabuchian (2015)** Experimental investigation of thrust fault rupture mechanics, *PhD, Caltech, Main Advisor : Prof. A. J. Rosakis*
- **Marshall Alan Rogers-Martinez (2019)** Source mechanics of near-field s-wave generation from explosive sources, *PhD, Univ. South. Calif., Main Advisor : Prof. C. G. Sammis*
- **Samson Marty (2020)** High frequency radiation and foreshocks during laboratory earthquakes, *PhD, ENS, Main Advisor : Dr. A. Schubnel*
- **Joseph Michael Flores Cuba (starting 2020)** *Main Advisor : Dr. M. Thomas*

PhD students : Main Supervisor

- **Pierre Romanet (2017)** Fast algorithms to model quasi-dynamic earthquake cycles in complex fault networks, *PhD, Institut de Physique du Globe de Paris & École Normale Supérieure, Co-Advisor : Prof. R. Madariaga*, *Currently Postdoc at Univ. Tokyo with Prof. S. Ide*
- **Kurama Okubo (2018)** Earthquakes in fault networks and dynamic off-fault fracture networks developed during earthquakes, *PhD, Institut de Physique du Globe de Paris & École Normale Supérieure, Co-Advisor : Dr. Y. Klinger*, *Currently Postdoc at Harvard Univ. with Prof. M. Denolle*
- **Claudia Hulbert (starting 2018)** Machine learning techniques for event identification and simulation of earthquake cycles, *Co-Advisors : Dr. R. Jolivet & Dr. A. Schubnel*
- **Jinhui Cheng (starting 2021)** Earthquake cycles in 3D fault networks

Post Doctoral Associates

- **Marion Y. Thomas (2014-2016)** Dynamic damage and earthquake ruptures, *Co-Advisor : Dr. Y. Klinger*
- **Marion Y. Thomas (May 2018 - Dec. 2018)** Earthquake cycles accounting for off-fault damage, Prestige Marie-Curie Fellow; *Currently CNRS Research Scientist at Univ. Paris VI*
- **Lisa Gordeliy (Jan. 2019 - Oct. 2019)** Hydraulic Fracturing *Co-Advisor : Prof. B. Lecampion*
- **Lucile Bruhat (July 2018 onwards)** Dynamics of subduction zone earthquakes, Prestige Marie-Curie Fellow

- **Ekeabino Momoh (starting 2019)** Long term dynamics of subduction zones, *Co-Advisor : Dr. S. Tait*
- **Michelle Almakari (starting 2021)**
- **Carlos Villafuerte (starting 2021)**

MANUSCRIPTS

Over 40 publications in peer reviewed international journals including Nature, Nature Communications and Science. h-index of 20 with an average of 70 citations per year since 2012. Google Scholar ID: ZHskR34AAAAJ

- Jara, J., L. Bruhat, S. Antoine, K. Okubo, M. Y. Thomas, Y. Klinger, R. Jolivet, and H. S. Bhat (2020). "*Signature of supershear transition seen in damage and aftershock pattern*". *to be submitted*.
- Thomas, M. Y. and H. S. Bhat (2020). "*Loi de friction et modélisation numérique du cycle sismique*". *Le Cycle Sismique*. Ed. by F. Rolandone. ISTE Editions.
- Jeandet-Ribes, L., N. Cubas, H. S. Bhat, and P. Steer (2020). "*Response of a single fault to transient normal stress change, and implications of large erosional events on the seismic cycle*". *accepted with minor rev. Geophys. Res. Lett.*
- Amlani, F., H. S. Bhat, W. J. F. Simons, A. Schubnel, C. Vigny, A. J. Rosakis, J. Efendi, A. Elbanna, and H. Z. Abidin (2020). "*Supershear Tsunamis and insights from the M_w 7.5 Palu Earthquake*". *under review in Nat. Geosci.*
- Jolivet, R, M Simons, Z Duputel, J.-A. Olive, H. S. Bhat, and Q. Bletery (2020). "*Interseismic Loading of Subduction Megathrust Drives Long-Term Uplift in Northern Chile*". *Geophys. Res. Lett.* DOI: 10.1029/2019GL085377.
- Okubo, K., E Rougier, Z. Lei, and H. S. Bhat (2020). "*Modeling earthquakes with off-fault damage using the combined finite discrete element method*". *J. Comp. Part. Mech.* DOI: 10.1007/s40571-020-00335-4.
- Okubo, K., H. S. Bhat, E. Rougier, S. Marty, A. Schubnel, Z. Lei, E. E. Knight, and Y. Klinger (2019). "*Dynamics, radiation and overall energy budget of earthquake rupture with coseismic off-fault damage*". *J. Geophys. Res.* DOI: 10.1029/2019JB017304.
- Marty, S., F. X. Passelègue, J. Aubry, A. Schubnel, H. S. Bhat, and R. Madariaga (2019). "*Origin of high-frequency radiation during laboratory earthquakes*". *Geophys. Res. Lett.* DOI: 10.1029/2018GL080519.
- Aubry, J., F. X. Passelègue, D. Deldicque, F. Girault, S. Marty, A. Lahfid, H. S. Bhat, J. Escartin, and A. Schubnel (2018). "*Frictional heating processes and energy budget during laboratory earthquakes*". *Geophys. Res. Lett.* DOI: 10.1029/2018GL079263.
- Klinger, Y., K. Okubo, A. Vallage, J. Champenois, A. Delorme, E. Rougier, Z. Lei, E. E. Knight, A. Munjiza, C. Satriano, S. Baize, R. Langridge, and H. S. Bhat (2018). "*Earthquake damage patterns resolve complex rupture processes*". *Geophys. Res. Lett.* DOI: 10.1029/2018GL078842.
- Cruz-Atienza, V. M., C. D. Villafuerte, and H. S. Bhat (2018). "*Rapid tremor migration and pore-pressure waves in subduction zones*". *Nat. Commun.* DOI: 10.1038/s41467-018-05150-3.
- Thomas, M. Y. and H. S. Bhat (2018). "*Dynamic evolution of off-fault medium during an earthquake: a micromechanics based model*". *Geophys. J. Int.* DOI: 10.1093/gji/ggy129.

► Romanet, P., H. S. Bhat, R. Jolivet, and R. Madariaga (2018). "*Fast and slow earthquakes emerge due to fault geometrical complexity*". *Geophys. Res. Lett.* DOI: 10.1029/2018GL077579.

► Gabuchian, V., A. J Rosakis, H. S. Bhat, R. Madariaga, and H. Kanamori (2017). "*Experimental evidence that thrust earthquake ruptures might open faults*". *Nature*. DOI: 10.1038/nature22045.

► Thomas, M. Y., H. S. Bhat, and Y. Klinger (2017). "*Effect of Brittle off-fault Damage on Earthquake Rupture Dynamics*". *Fault Zone Dynamic Processes : Evolution of Fault Properties During Seismic Rupture, Geophysical Monograph 227*. Ed. by M. Y. Thomas, H. S. Bhat, and T. M. Mitchell. American Geophysical Union (AGU). DOI: 10.1002/9781119156895.ch14.

► Passelègue, F. X., S. Latour, A. Schubnel, S. Nielsen, H. S. Bhat, and R. Madariaga (2017). "*Precursory Processes during Laboratory Earthquakes*". *Fault Zone Dynamic Processes : Evolution of Fault Properties During Seismic Rupture, Geophysical Monograph 227*. Ed. by M. Y. Thomas, H. S. Bhat, and T. M. Mitchell. American Geophysical Union (AGU). Chap. 12. DOI: 10.1002/9781119156895.ch12.

► Perol, T. and H. S. Bhat (2016). "*Micromechanics based permeability evolution in brittle materials at high strain rates*". *Pure Appl. Geophys.* DOI: 10.1007/s00024-016-1354-4.

► Passelègue, F. X., A. Schubnel, S. Nielsen, H. S. Bhat, D. Deldicque, and R. Madariaga (2016). "*Dynamic rupture processes inferred from laboratory microearthquakes*". *J. Geophys. Res.* DOI: 10.1002/2015JB012694.

► Mello, M., H. S. Bhat, and A. J. Rosakis (2016). "*Spatiotemporal properties of sub-Rayleigh and supershear rupture velocity fields : Theory and Experiments*". *J. Mech. Phys. Solids*. DOI: 10.1016/j.jmps.2016.02.031.

► Vallage, A, Y Klinger, R Grandin, H. S. Bhat, and M Pierrot-Deseilligny (2015). "*Inelastic surface deformation during the 2013 Mw 7.7 Balochistan, Pakistan, earthquake*". *Geology*. DOI: 10.1130/G37290.1.

► Frank, W. B., N. M. Shapiro, A. L. Husker, V Kostoglodov, H. S. Bhat, and M Campillo (2015). "*Along-fault pore-pressure evolution during a slow-slip event in Guerrero, Mexico*". *Earth Planet. Sc. Lett.* DOI: 10.1016/j.epsl.2014.12.051.

► Siriki, H., H. S. Bhat, X. Lu, and S. Krishnan (2015). "*A Laboratory Earthquake-Based Stochastic Seismic Source Generation Algorithm for Strike-Slip Faults*". *Bull. Seism. Soc. Am.* DOI: 10.1785/0120140110.

► Mello, M., H. S. Bhat, A. J. Rosakis, and H. Kanamori (2014). "*Reproducing The Supershear Portion Of The 2002 Denali Earthquake Rupture In Laboratory*". *Earth Planet. Sc. Lett.* DOI: 10.1016/j.epsl.2013.11.030.

► Passelègue, F. X., A. Schubnel, S. Nielsen, H. S. Bhat, and R. Madariaga (2013). "*From Sub-Rayleigh to Supershear Ruptures During Stick-Slip Experiments on Crustal Rocks*". *Science*. DOI: 10.1126/science.1235637.

► Bhat, H. S., A. J. Rosakis, and C. G. Sammis (2012). "*A Micromechanics Based Constitutive Model For Brittle Failure at High Strain Rates*". *J. Appl. Mech.* DOI: 10.1115/1.4005897.

► Bhat, H. S., C. G. Sammis, and A. J. Rosakis (2011). "*The Micromechanics of Westerley Granite at Large Compressive Loads*". *Pure Appl. Geophys.* DOI: 10.1007/s00024-011-0271-9.

► Bhat, H. S., R. L. Biegel, A. J. Rosakis, and C. G Sammis (2010). "*The Effect of Asymmetric Damage on Dynamic Shear Rupture Propagation II: With Mismatch in Bulk Elasticity*". *Tectonophysics*. DOI: 10.1016/j.tecto.2010.03.016.

► Biegel, R. L., H. S. Bhat, C. G. Sammis, and A. J. Rosakis (2010). "*The Effect of Asymmetric Damage on Dynamic Shear Rupture Propagation I: No Mismatch in Bulk Elasticity*". *Tectonophysics*. DOI: 10.1016/j.tecto.2010.03.020.

► Mello, M., H. S. Bhat, A. J. Rosakis, and H. Kanamori (2010). "*Identifying the unique ground motion signatures of supershear earthquakes: Theory and experiments*". *Tectonophysics*. DOI: 10.1016/j.tecto.2010.07.003.

► Templeton, E. L., H. S. Bhat, R. Dmowska, and J. R. Rice (2010). "*Dynamic rupture through a branched fault configuration at Yucca Mountain and resulting ground motions*". *Bull. Seism. Soc. Am.* DOI: 10.1785/012009012110.1785/0120090121.

► Harris, R. A. et al. (2009). "*The SCEC/USGS dynamic earthquake rupture code verification exercise*". *Seismol. Res. Lett.* DOI: 10.1785/gssrl.80.1.119.

► Sammis, C. G., A. J. Rosakis, and H. S. Bhat (2009). "*Effects of Off-fault Damage on Earthquake Rupture Propagation: Experimental Studies*". *Pure Appl. Geophys.* DOI: 10.1007/s00024-009-0512-3.

► Templeton, E. L., A. Baudet, H. S. Bhat, R. Dmowska, J. R. Rice, A. J. Rosakis, and C. E. Rousseau (2009). "*Finite Element Simulations of Dynamic Shear Rupture Experiments and Dynamic Path Selection Along Kinked and Branched Faults*". *J. Geophys. Res.* DOI: 10.1029/2008JB006174.

► Dunham, E. M. and H. S. Bhat (2008). "*Attenuation of radiated ground motion and stresses from three-dimensional supershear ruptures*". *J. Geophys. Res.* DOI: 10.1029/2007JB005182.

► Bhat, H. S., R. Dmowska, G. C. P. King, Y. Klinger, and J. R. Rice (2007). "*Off-fault damage patterns due to supershear ruptures with application to the 2001 M_w 8.1 Kokoxili (Kunlun) Tibet earthquake*". *J. Geophys. Res.* DOI: 10.1029/2006JB004425.

► Bhat, H. S., M. Olives, R. Dmowska, and J. R. Rice (2007). "*Role of fault branches in earthquake rupture dynamics*". *J. Geophys. Res.* DOI: 10.1029/2007JB005027.

► Bhat, H. S. (2007). "*Role of Geometric Complexities and Off-Fault Damage in Dynamic Rupture Propagation*". PhD thesis. Harvard University.

► Fliss, S., H. S. Bhat, R. Dmowska, and J. R. Rice (2005). "*Fault branching and rupture directivity*". *J. Geophys. Res.* DOI: 10.1029/2004JB003368.

► Bhat, H. S., R. Dmowska, J. R. Rice, and N. Kame (2004). "*Dynamic slip transfer from the Denali to Totschunda faults, Alaska: Testing theory for fault branching*". *Bull. Seism. Soc. Am.* DOI: 10.1785/0120040601.