Harsha S. Bhat

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École Normale Supérieure, Paris

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PERSONAL INFORMATION

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EDUCATION

École Normale Supérieure, France	H. D. R.†	Supershear Earthquakes	2021/01
Harvard University, USA	Ph. D.*	Mechanical Sciences	2007/06
Harvard University, USA	M. S.	Engineering Sciences	2002/06
NITK, India	B. E.	Civil Engineering	2001/06

† *Habilitation à Diriger des Recherches* * *Supervised by Prof. J. R. Rice & Dr. R. Dmowska*

CURRENT POSITION

École Normale Supérieure, France	2016/05 ▶ Present	CNRS Research Scientist
Ecole Polytechnique, France	2022/09 ▶ Present	Teaching Professor (PCC)
NISER, India	2021/11 ▶ 2023/11	Visiting Professor

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

FUNDING & GRANTS†

- 2021-2025 ▶ 2M€ ERC Consolidator Grant, PERSISMO (Grant No. 865411)
- 2018-2018 ▶ 25k€ ENS Actions Incitatives
- 2017-2017 ▶ 6k€ TelluS INSU - action ALEAS

† *Full list at the end*

HONORS AND AWARDS

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

STUDENTS & POSTDOCS

A majority of the people below were/are being co-advised/co-supervised with colleagues from various institutes in EU, USA and France.

Ankit Gupta	2024-	Postdoc	
Navid Kheirdast	2022-	Postdoc	
Michelle Almakari	2021-2023	Postdoc	
Carlos Villafuerte	2021-2023	Postdoc	Asst. Prof. UNAM
Ekeabino Momoh	2019-2022	Postdoc	Postdoc at ISTEP Paris
Lucile Bruhat	2018-2021	Postdoc	Natural Catastrophe Risk Analyst at AXA
Lisa Gordeliy	2019	Postdoc	Post Doctoral fellow at Ecole Polytechnique
Marion Y. Thomas	2014-2016	Postdoc	CNRS Scientist at Sorbonne Université
Yishuo Zhou	2024-2027	PhD	
Thomas Melkior	2023-2026	PhD	
Caiyuan Fan	2023-2027	PhD	
Jinhui Cheng	2021-2024	PhD	
Augustin Thomas	2020-2023	PhD	
Joseph Flores Cuba	2020-2023	PhD	
Claudia Hulbert	2018-2021	PhD	Postdoc at ENS
Samson Marty	2017-2020	PhD	Postdoc at Penn. State Univ.
Marshall A. Martinez	2014-2019	PhD	Engineer at Joby Aviation
Kurama Okubo	2015-2018	PhD	Research Scientist at NIED, Japan
Pierre Romanet	2014-2017	PhD	Research Scientist at NIED, Japan
Vahe Gabuchian	2010-2015	PhD	Research Scientist at Caltech
François X. Passelègue	2011-2014	PhD	CNRS Scientist at GeoAzur, Nice
Jonathan Mihaly	2008-2013	PhD	Jet Propulsion Laboratory
Michael Mello	2007-2012	PhD	Teaching Professor at Caltech
Valentin Marnat	2022	Master	
Roxane Ferry	2021	Master	
Jinhui Cheng	2020	Master	
Phillipe Danre	2019	Master	
Nicolas Mercury	2018	Master	
Luc Illien	2018	Master	
Eleni Kolokytha	2015	Master	
Victor Barolle	2015	Master	
Kurama Okubo	2014	Master	
Thibaut Perol	2013	Master	
Lucile Bruhat	2012	Master	
Marion Olives	2004	Master	
Sonia Fliss	2003	Master	
Roxane Ferry	2019	Bachelor	
Hugo Lestrelin	2019	Bachelor	
Phillipe Danre	2017	Bachelor	

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
14) Mécanique de la Fracturation
15) Continuum Mechanics
16) Fracture Mechanics

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

ORGANIZATION OF SCIENTIFIC MEETINGS

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

INSTITUTIONAL RESPONSIBILITIES

- 2018-Curr: Team Leader of Faults & Earthquakes Group, ENS
- 2018-2019: Co-organizer of the Internal Seminar, ENS

LANGUAGES

English – *Native* | French – *Conversant* | Hindi – *Fluent* | Kannada – *Native* | Tulu – *Native* | Konkani – *Basic* | Havyaka Kannada – *Native*

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 Nature Communications Nature Geoscience Science Advances

BOOKS

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

Bizzarri, A., **Bhat, H. S.,** eds. (2012). "*The mechanics of faulting: From laboratory to earthquakes*". Research Signpost.

BOOK CHAPTERS

Thomas, M. Y., **Bhat, H. S.,** (2022b). "*Loi de friction et modélisation numérique du cycle sismique*". in **Le Cycle Sismique**. Ed. by F. Rolandone. ISTE-Wiley.

Thomas, M. Y., **Bhat, H. S.,** (2022a). "*Friction Laws and Numerical Modeling of the Seismic Cycle*". in **The Seismic Cycle: From Observation to Modeling**. Ed. by F. Rolandone. ISTE-Wiley.

MANUSCRIPTS

In Preparation

Thomas, M. Y., **Bhat, H. S.,** (2023). "*Combined effects of fault roughness and off-fault damage on earthquake dynamics*". **in prep**.

Flores-Cuba, J., Thomas, M. Y., **Bhat, H. S.,** (2023). "*Effect on off-fault damage on stepovers*". **in prep**.

Jeandet-Ribes, L., Ferry, R., Thomas, M. Y., **Bhat, H. S.,** (2023). "*Depth variation of co-seismic damage*". **in prep**.

Kheirdast, N., Almakari, M., Villafuerte, C. D., **Bhat, H. S.,** (2023). "*Energy budget of earthquake cycles*". **in prep**.

Villafuerte, C. D., **Bhat, H. S.**, Okubo, K., Almakari, M., Kheirdast, N., Rougier, E., Madariaga, R., (2023). "*Thrust fault dynamics*". **in prep**.

Cheng, J., Almakari, M., **Bhat, H. S.**, Lecampion, B., Peruzzo, C., (2023). "*3D quasi-dynamic earthquake cycles in complex fault systems*". **in prep**.

Almakari, M., Kheirdast, N., Villafuerte, C. D., Thomas, M. Y., **Bhat, H. S.,** (2023a). "*Full spectrum of slip dynamics of a fault zone: Source*". **in prep**.

Almakari, M., Kheirdast, N., Villafuerte, C. D., Thomas, M. Y., **Bhat, H. S.,** (2023b). "*Full spectrum of slip dynamics of a fault zone: Synthetics*". **in prep**.

Submitted

Momoh, E., **Bhat, H. S.**, Tait, S., (2022). "*Elasto-thermo-visco-plastic numerical modelling from a laboratory to geodynamic scale: implications for convergence-driven experiments*". **subm. Geophys. J. Int.**

Jeandet-Ribes, L., Thomas, M. Y., **Bhat, H. S.,** (2022). "*On the importance of 3D stress state in 2D earthquake rupture simulations with off-fault deformation*". **subm. Geophys. J. Int.**

Marty, S., Schubnel, A., **Bhat, H. S.**, Aubry, J., Fukuyama, E., Latour, S., Nielsen, S., Madariaga, R., (2022). "*Nucleation of laboratory earthquakes: quantitative analysis and scalings*". **subm. J. Geophys. Res.**

Published

Amlani, F., **Bhat, H. S.**, Simons, W. J. F., Schubnel, A., Vigny, C., Rosakis, A. J., Efendi, J., Elbanna, A., Dubernet, P., Abidin, H. Z., (2022). "*Supershear shock front contribution to the tsunami from the 2018 Mw 7.5 Palu, Indonesia earthquake*". **Geophys. J. Int.** 230, pp. 2089–2097. DOI: 10.1093/gji/ggac162.

Jara, J., Bruhat, L., Thomas, M. Y., Antoine, S., Okubo, K., Klinger, Y., Jolivet, R., **Bhat, H. S.,** (2021). "*Signature of transition to supershear rupture speed in coseismic off-fault damage zone*". **Proc. R. Soc. A.** 477, p. 20210364. DOI: 10.1098/rspa.2021.0364.

Elbanna, A., Abdelmeguid, M., Ma, X., Amlani, F., **Bhat, H. S.**, Synolakis, C., Rosakis, A. J., (2021). "*Anatomy of Strike Slip Fault Tsunami Genesis*". **Proc. Natl. Acad. Sci. USA**. DOI: 10.1073/pnas.2025632118.

Bhat, H. S. (2021). "*Supershear Earthquakes*". PhD thesis. Habilitation à Diriger des Recherches, Ecole Normale Supérieure.

Jeandet-Ribes, L., Cubas, N., **Bhat, H. S.**, Steer, P., (2020). "*Response of a single fault to transient normal stress change, and implications of large erosional events on the seismic cycle*". **Geophys. Res. Lett.** 47.e2020GL087631. DOI: 10.1029/2020GL087631.

Jolivet, R, Simons, M, Duputel, Z, Olive, J.-A., **Bhat, H. S.**, Bletery, Q., (2020). "*Interseismic Loading of Subduction Megathrust Drives Long-Term Uplift in Northern Chile*". **Geophys. Res. Lett.** 47.8, e2019GL085377. DOI: 10.1029/2019GL085377.

Okubo, K., Rougier, E, Lei, Z., **Bhat, H. S.,** (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., **Bhat, H. S.**, Rougier, E., Marty, S., Schubnel, A., Lei, Z., Knight, E. E., Klinger, Y., (2019). "*Dynamics, radiation and overall energy budget of earthquake rupture with coseismic off-fault damage*". **J. Geophys. Res.** 124. DOI: 10.1029/2019JB017304.

Marty, S., Passelègue, F. X., Aubry, J., Schubnel, A., **Bhat, H. S.**, Madariaga, R., (2019). "*Origin of high-frequency radiation during laboratory earthquakes*". **Geophys. Res. Lett.** 46. DOI: 10.1029/2018GL080519.

Aubry, J., Passelègue, F. X., Deldicque, D., Girault, F., Marty, S., Lahfid, A., **Bhat, H. S.**, Escartin, J., Schubnel, A., (2018). "*Frictional heating processes and energy budget during laboratory earthquakes*". **Geophys. Res. Lett.** 45. DOI: 10.1029/2018GL079263.

Klinger, Y. (2018). "*Earthquake damage patterns resolve complex rupture processes*". **Geophys. Res. Lett.** DOI: 10.1029/2018GL078842.

Cruz-Atienza, V. M., Villafuerte, C. D., **Bhat, H. S.,** (2018). "*Rapid tremor migration and pore-pressure waves in subduction zones*". **Nat. Commun.** 9.1, p. 2900. DOI: 10.1038/s41467-018-05150-3.

Thomas, M. Y., **Bhat, H. S.,** (2018). "*Dynamic evolution of off-fault medium during an earthquake: a micromechanics based model*". **Geophys. J. Int.** 214.2, pp. 1267–1280. DOI: 10.1093/gji/ggy129.

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

Gabuchian, V., Rosakis, A. J, **Bhat, H. S.**, Madariaga, R., Kanamori, H., (2017). "*Experimental evidence that thrust earthquake ruptures might open faults*". **Nature** 545.336–339. DOI: 10.1038/nature22045.

Thomas, M. Y., **Bhat, H. S.**, Klinger, Y., (2017a). "*Effect of Brittle off-fault Damage on Earthquake Rupture Dynamics*". in **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), pp. 255–280. DOI: 10.1002/9781119156895.ch14.

Passelègue, F. X., Latour, S., Schubnel, A., Nielsen, S., **Bhat, H. S.**, Madariaga, R., (2017). "*Precursory Processes during Laboratory Earthquakes*". in **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, pp. 229–242. DOI: 10.1002/9781119156895.ch12.

Perol, T., **Bhat, H. S.,** (2016). "*Micromechanics based permeability evolution in brittle materials at high strain rates*". **Pure Appl. Geophys.** Pp. 1–12. DOI: 10.1007/s00024-016-1354-4.

Passelègue, F. X., Schubnel, A., Nielsen, S., **Bhat, H. S.**, Deldicque, D., Madariaga, R., (2016). "*Dynamic rupture processes inferred from laboratory microearthquakes*". **J. Geophys. Res.** 121. DOI: 10.1002/2015JB012694.

Mello, M., **Bhat, H. S.**, Rosakis, A. J., (2016). "*Spatiotemporal properties of sub-Rayleigh and supershear rupture velocity fields : Theory and Experiments*". **J. Mech. Phys. Solids** 93, pp. 153–181. DOI: 10.1016/j.jmps.2016.02.031.

Vallage, A, Klinger, Y, Grandin, R, **Bhat, H. S.**, Pierrot-Deseilligny, M, (2015). "*Inelastic surface deformation during the 2013 Mw 7.7 Balochistan, Pakistan, earthquake*". **Geology** 43.12, pp. 1079–1082. DOI: 10.1130/G37290.1.

Frank, W. B., Shapiro, N. M., Husker, A. L., Kostoglodov, V, **Bhat, H. S.**, Campillo, M, (2015). "*Along-fault pore-pressure evolution during a slow-slip event in Guerrero, Mexico*". **Earth Planet. Sc. Lett.** 413, pp. 135–143. DOI: 10.1016/j.epsl.2014.12.051.

Siriki, H., **Bhat, H. S.**, Lu, X., Krishnan, S., (2015). "*A Laboratory Earthquake-Based Stochastic Seismic Source Generation Algorithm for Strike-Slip Faults*". **Bull. Seism. Soc. Am.** 105.4, pp. 2250–2273. DOI: 10.1785/0120140110.

Mello, M., **Bhat, H. S.**, Rosakis, A. J., Kanamori, H., (2014). "*Reproducing The Supershear Portion Of The 2002 Denali Earthquake Rupture In Laboratory*". **Earth Planet. Sc. Lett.** 387, pp. 89–96. DOI: 10.1016/j.epsl.2013.11.030.

Passelègue, F. X., Schubnel, A., Nielsen, S., **Bhat, H. S.**, Madariaga, R., (2013). "*From Sub-Rayleigh to Supershear Ruptures During Stick-Slip Experiments on Crustal Rocks*". **Science** 340.6137, pp. 1208–1211. DOI: 10.1126/science.1235637.

Bhat, H. S., Rosakis, A. J., Sammis, C. G., (2012). "*A Micromechanics Based Constitutive Model For Brittle Failure at High Strain Rates*". **J. Appl. Mech.** 79.3. DOI: 10.1115/1.4005897.

Bhat, H. S., Sammis, C. G., Rosakis, A. J., (2011). "*The Micromechanics of Westerley Granite at Large Compressive Loads*". **Pure Appl. Geophys.** 168.12, pp. 1–18. DOI: 10.1007/s00024-011-0271-9.

Bhat, H. S., Biegel, R. L., Rosakis, A. J., Sammis, C. G, (2010). "*The Effect of Asymmetric Damage on Dynamic Shear Rupture Propagation II: With Mismatch in Bulk Elasticity*". **Tectonophysics** 493.3, pp. 263–271. DOI: 10.1016/j.tecto.2010.03.016.

Biegel, R. L., **Bhat, H. S.**, Sammis, C. G., Rosakis, A. J., (2010). "*The Effect of Asymmetric Damage on Dynamic Shear Rupture Propagation I: No Mismatch in Bulk Elasticity*". **Tectonophysics** 493.3, pp. 254–262. DOI: 10.1016/j.tecto.2010.03.020.

Mello, M., **Bhat, H. S.**, Rosakis, A. J., Kanamori, H., (2010). "*Identifying the unique ground motion signatures of supershear earthquakes: Theory and experiments*". **Tectonophysics** 493, pp. 297–326. DOI: 10.1016/j.tecto.2010.07.003.

Templeton, E. L., **Bhat, H. S.**, Dmowska, R., Rice, J. R., (2010). "*Dynamic rupture through a branched fault configuration at Yucca Mountain and resulting ground motions*". **Bull. Seism. Soc. Am.** 100.4, pp. 1485–1497. DOI: 10.1785/012009012110.1785/0120090121.

Harris, R. A. (2009). "*The SCEC/USGS dynamic earthquake rupture code verification exercise*". **Seismol. Res. Lett.** 80.1. DOI: 10.1785/gssrl.80.1.119.

Sammis, C. G., Rosakis, A. J., **Bhat, H. S.,** (2009). "*Effects of Off-fault Damage on Earthquake Rupture Propagation: Experimental Studies*". **Pure Appl. Geophys.** 166. DOI: 10.1007/s00024-009-0512-3.

Templeton, E. L., Baudet, A., **Bhat, H. S.**, Dmowska, R., Rice, J. R., Rosakis, A. J., Rousseau, C. E., (2009). "*Finite Element Simulations of Dynamic Shear Rupture Experiments and Dynamic Path Selection Along Kinked and Branched Faults*". **J. Geophys. Res.** B08304. DOI: 10.1029/2008JB006174.

Dunham, E. M., **Bhat, H. S.,** (2008). "*Attenuation of radiated ground motion and stresses from three-dimensional supershear ruptures*". **J. Geophys. Res.** 113.B08319. DOI: 10.1029/2007JB005182.

Bhat, H. S., Dmowska, R., King, G. C. P., Klinger, Y., Rice, J. R., (2007a). "*Off-fault damage patterns due to supershear ruptures with application to the 2001 M_w 8.1 Kokoxili (Kunlun) Tibet earthquake*". **J. Geophys. Res.** B06301. DOI: 10.1029/2006JB004425.

Bhat, H. S., Olives, M., Dmowska, R., Rice, J. R., (2007b). "*Role of fault branches in earthquake rupture dynamics*". **J. Geophys. Res.** B11309. 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., **Bhat, H. S.**, Dmowska, R., Rice, J. R., (2005). "*Fault branching and rupture directivity*". **J. Geophys. Res.** B06312. DOI: 10.1029/2004JB003368.

Bhat, H. S., Dmowska, R., Rice, J. R., Kame, N., (2004). "*Dynamic slip transfer from the Denali to Totschunda faults, Alaska: Testing theory for fault branching*". **Bull. Seism. Soc. Am.** 94, S202–S213. DOI: 10.1785/0120040601.

DETAILED PROPOSAL/FUNDING HISTORY

Year	Funding Agency	Status
2012	ANR	Reject
2013	ANR	Reject
2013	Paris - EMERGENCE	Reject
2013	ERC Starting Grant	Reject
2014	ANR	Reject
2014	Paris - EMERGENCE	Reject
2014	Université Sorbonne Paris Cité	Reject
2014	NERC UK	Reject
2015	ANR	Reject
2015	Paris - EMERGENCE	Reject
2016	ANR	Reject
2016	INSU	Accept
2017	Simone and Cino Del Duca Foundation	Reject
2017	INSU Mi-Lourds	Reject
2017	ENS-Action Incitatives	Accept
2017	Thomas Jefferson Fund	Reject
2018	Thomas Jefferson Fund	Reject
2019	ERC Consolidator Grant	Accept
2019	INSU	Reject