

## CV format

### Personal Information

Name in Full : Satyajit Banerjee

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#### Address

##### Present

Department of Physics,  
Indian Institute of Technology Kanpur  
(IIT K),  
Kanpur – 208016, U. P.

#### Permanent

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#### Date of Birth

19/05/1972

#### Nationality

India

#### Sex

Male

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#### Present position(Designation, Organisation)

Professor, Dept. of Physics, IIT Kanpur

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## Area of Specialisation

Experimental Condensed Matter

## Current Areas of Research (no particular order)

1. Statics and Dynamics of the Vortex State. With current emphasis on exploring instabilities and non-equilibrium phases of the vortex matter and transitions between them. Study of Non equilibrium fluctuation relations for the driven vortex state and exploration of the dynamic Jamming phenomenon.

2. Properties of nano-patterned superconductors. Exploring and imaging the stability regimes, configurations and statics and dynamics

3. Effect of intense environments on magnetism and superconductivity and competition and interplay between magnetic and superconducting materials. Investigating effect of Giant magnetic fields produced due to laser plasma interaction on superconductors and magnetic materials especially in relation to magnonics.

4. Magnetism at nanoscales and 2D magnetic materials and interfaces with superconductors. General focus on excitations and emergent properties in Quantum Materials

5. Investigating the inhomogeneous magnetic state in oxides and Nematic superconducting state in pnictide compounds.

6. Topological Insulators and their heterostructures. Also doing direct imaging of topological edge currents and how they are affected by disorder. Topological superconductivity.

7. Developing applications based on superconductors especially for the power sector. Recently developed a new smart superconducting fault current limiter. Major goal is develop realtime imaging of superconducting fault current element during operation and study instabilities generated in the element. These will go into developing technologies for long term stability of these novel systems.

8. A continuous ongoing effort to developing high sensitivity magneto-optical imaging (MOI) technique to image magnetic field distribution with very high sensitivity inside superconductors as well as magnetic materials. This instrument is the first of its kind in India and with sensitivity comparable to best in the world. We have also developing MOI to do very sensitive imaging of transport currents distribution to study how locally currents distribute within, superconductors, magnetic systems, and topological insulators. Recently we have imaged currents inside superconductors as well as imaged surface currents in a 3D topological insulator.

We are working towards enhancing the field sensitivity of detecting few changes in local field of mG in few 100's of Gauss background field to even higher sensitivity. We want to also enhance the spatial resolution as well as enhance the capture speed capability to image dynamics.

9. Working towards developing Biosensors. We have recently worked on transport properties of protein fibers. This work has paved the way towards exploration of new devices.

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**Academic Record (starting with Bachelor's Degree)**

<b>Degree (subjects)</b>	<b>Institution</b>	<b>Year</b>	<b>Marks &amp; Division</b>	<b>Standing</b>	<b>Remarks</b>
B.Sc. (Phy)	University of Mumbai, India	1992	79%	-	St. Xaviers Mumbai
M.Sc (Phy)	University of Mumbai, India	1994	73.5%	2nd	
Ph.D (Phys).	Tata Institute of Fundamental Research/ University of Mumbai , India	2000			I was a Ph.D. student at TIFR, in the dept. of condensed matter Physics and materials sciences (1994 – 2000). I received my Ph.d Degree in 2000 from Univ. of Mumbai. During my time TIFR was not a  deemed University.

**Research Experience (in reverse chronological order)**

Current Research Activity and Interests (excluding research done for Ph.D. Degrees)

Duration	Organization	Area(s)
2004 –	Dept. of Physics, Currently a Professor in the Dept.	Experimental condensed matter physics
2000 – 2003	Dept. of condensed matter physics, Weizmann Institute of Science, Israel.  (Feinberg Postdoctoral Fellow).	Experimental condensed matter physics
Aug 2003 – April 2004	Visiting Scientist, Weizmann Institute of Science.	Experimental Condensed Matter Physics
Summers of 2005 to 2012.	Visiting Scientist, TIFR, Mumbai	Experimental Condensed Matter Physics

## Publications

List journal papers, refereed conference papers, book chapters, and other peer-reviewed articles

### Book Chapter:

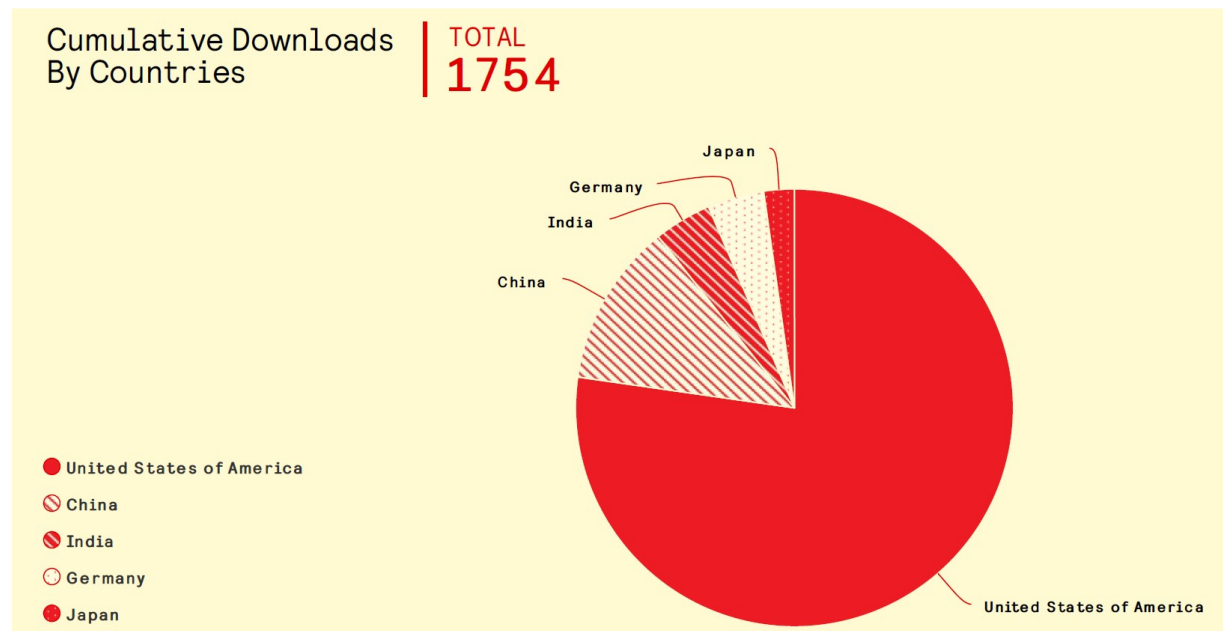
**Title :** Nonlinear response of the static and dynamic phases of the vortex matter

**Authors :** S. S. Banerjee\*, Shyam Mohan, Jaivardhan Sinha, Yuri Myasoedov, S. Ramakrishnan and A. K. Grover (\* : corresponding author)

**Book details:** Superconductivity - Theory and Applications, ISBN 978-953-307-151-0

**Publisher:** Intech – open access publishers (<http://www.intechweb.org/>). Published July, 2011.  
Book chapter downloadable at <http://www.intechopen.com/articles/show/title/nonlinear-response-of-the-static-and-dynamic-phases-of-the-vortex-matter>

Download stats of the book chapter (Jan 30<sup>th</sup> 2020)



### List of Publications:

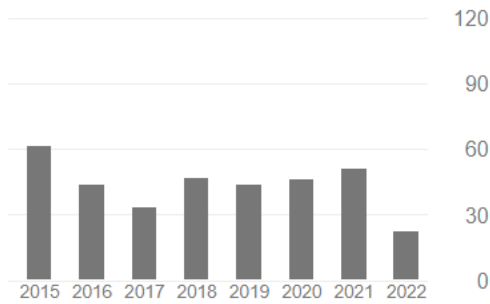
Publications summary (from Google scholar as on Nov. 2021, see [google scholar page](#))

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### **Papers in refereed International Journals**

Physical Review Letters (6 nos.), Physical Review B/Materials/Applied (21 nos.), Applied Physics Letters (2 nos.), New Journal of Physics (3 nos.), Scientific Reports (3 nos.), Journal of Physics: Condensed Matter (2 nos), Journal of applied Physics (2 nos), Journal of Magnetism and magnetic materials (1 nos), Materials Research Express (1 nos), Superconducting science and technology (3 nos), Physica C: superconductivity (18 nos.), Journal of Physics: conference serise (2 nos), AIP advances (2 nos), Nanotechnology (1 nos), Review of Scientific Instruments (1 nos), Applied Surface Science (1 nos), Journal of Nuclear Instruments and Methods (1 nos), Journal of Non crystalline solids (1 nos), Pramana Journal of Physics (4 nos.), Perspectives of Superconductivity Research : Nova Publishers (1 nos), Journal of Low Temperature Physics (1 nos), Journal of Physical Society of Japan (1 nos)

**(In the list below, \* represents corresponding author)**

S.No	Author(s)	Title	Complete Reference of Journal
86	Md Arif Ali, <b><u>S.S Banerjee*</u></b>	Coexistence of different pinning mechanisms in Bi-2223 superconductor and its implications for using the material for high current applications	Journal of Applied Physics 131 (24), 243901 (2022)

85	Md Arif Ali, <b><u>S. S. Banerjee*</u></b>	Demonstration of a three-dimensional current mapping technique around a superconductor in a prototype of a conventional superconducting fault current limiter	IEEE Transactions on Applied Superconductivity, vol. 32, no. 5, pp. 1-11, Aug. (2022), Art no. 5601311, doi: 10.1109/TASC.2022.3169924.
84	A Jash, S Ghosh, A Bharathi, <b><u>S. S. Banerjee *</u></b>	Exploration of the role of disorder and the behaviour of the surface state in the three-dimensional topological insulator—Bi <sub>2</sub> Se <sub>3</sub>	Bulletin of Materials Science 45 (1), 1-16 (2022) <i>(Invited Review Article)</i>
83.	N Roy, S Ghosh, S Saha, GL Prajapati, R Dagar, DS Rana, <b><u>S. S. Banerjee*</u></b>	Imaging of current crowding effect across the metal to insulator transition in a thin film with thickness gradient	Physical Review B 105 (8), 085143 (2022)
82	B Bag, SM Karan, G Shaw, AK Sood, AK Grover, <b><u>S. S. Banerjee*</u></b>	Negative differential resistance state in the free-flux-flow regime of driven vortices in a single crystal of 2H-NbS <sub>2</sub>	Phys. Rev. B 104 (18), 184510 (2022)
81.	Kamalika Nath, PC Mahato, AMIT DATTATRAYA LAD, Moniruzzaman Shaikh, Kamalesh Jana, Deep Sarkar, Rajdeep Sensarma, G.	Macroscopic, layered onion shell like magnetic domain structure generated in YIG films using ultrashort, megagauss magnetic pulses	New Journal of Physics <b>23</b> , 083027 (2021).



	Ravindra Kumar, <b><u>S S Banerjee*</u></b> ,		
80.	N Roy, MA Ali, A Sen, DT Adroja, P Sen, <b><u>S. S. Banerjee*</u></b>	Exploring a low temperature glassy state, exchange bias effect, and high magnetic anisotropy in Co <sub>2</sub> C nanoparticles	Journal of Physics: Condensed Matter 33 (37), 375804 (2021)
79.	Amit Jash, Ankit Kumar, Sayanta Ghosh, A Bharathi, <b><u>S. S. Banerjee*</u></b>	Imaging current distribution in a topological insulator Bi <sub>2</sub> Se <sub>3</sub> in the presence of competing surface and bulk contributions to conductivity	Scientific Reports volume 11, Article number: 7445 (2021).
78	Dibya J. Sivananda, Nirmal Roy, P. C. Mahato, and <b><u>S. S. Banerjee*</u></b>	Exploring the non-equilibrium fluctuation relation for quantum mechanical tunneling of electrons across a modulating barrier	Phys. Rev. Research <b>2</b> , 043237 (2020).
77	Ankit Kumar, Amit Jash, Tsuyoshi Tamegai, <b><u>S. S. Banerjee*</u></b>	Imaging the effect of drive on the low-field vortex melting phenomenon in Ba <sub>0.6</sub> K <sub>0.4</sub> Fe <sub>2</sub> As <sub>2</sub> single crystal	Phys. Rev. B 101, 184516 (2020)
76	Nirmal Roy, Arpita Sen, Prasenjit Sen, <b><u>S. S. Banerjee*</u></b>	Localized spin waves at low temperatures in a Cobalt Carbide nanocomposite	Journal of Applied Physics 127, 124301 (2020)

75	Amit Jash, Sayantan Ghosh, A. Bharathi, and <b><u>S. S. Banerjee*</u></b>	Coupling-decoupling of conducting topological surface states in thick Bi <sub>2</sub> Se <sub>3</sub> single crystals	Phys. Rev. B 101, 165119 (2020).
74	Ankit Kumar , Sayantan Ghosh, Tsuyoshi Tamegai, and <b><u>S. S. Banerjee*</u></b>	Low-field vortex melting in a single crystal of Ba <sub>0.6</sub> K <sub>0.4</sub> Fe <sub>2</sub> As <sub>2</sub>	Phys. Rev. B 101, 014502 (2020)
73	Amit Jash, Kamalika Nath, T. R. Devidas, A. Bharathi, <b><u>S. S. Banerjee*</u></b>	A non-contact mutual inductance based measurement of an inhomogeneous topological insulating state in Bi <sub>2</sub> Se <sub>3</sub> single crystals with defects	Phys. Rev. Applied 12, 014056 (2019)  <a href="https://arxiv.org/abs/1812.06909">https://arxiv.org/abs/1812.06909</a>
72.	Kamalika Nath, Jaivardhan Sinha, <b><u>S.S Banerjee*</u></b>	Flipping anisotropy and changing magnetization reversal modes in nano-confined Cobalt structures	Journal of Magnetism and Magnetic Materials 476, 412-416 (2019)
71.	DJ Sivananda, A Kumar, MA Ali, <b><u>S.S Banerjee*</u></b> , P Das, J Müller, Z Fisk	Magneto-optical imaging of stepwise magnetic domain disintegration at characteristic temperatures in EuB <sub>6</sub>	Physical Review Materials 2 (11), 113404 (2018)
70.	Biplab Bag, Dibya J. Sivananda, Pabitra Mandal, and <b><u>S. S. Banerjee*</u></b> , A K Sood, A. K. Grover	Vortex depinning as a nonequilibrium phase transition phenomenon: Scaling of current-voltage curves near the low and the high critical-current states in 2H-NbS <sub>2</sub> single crystals	Phys. Rev. B 97, 134510 (2018)
69.	Ankit Kumar, Amit Jash, Amarish Dubey, Alok Bajpai, Deepu Philip,	Water mediated dielectric polarizability and electron charge transport properties of high	Scientific Reports(Nature) <b>volume 8</b> , Article number: 2726 (2018)

	Kalpna Bhargava, Sushil K. Singh, Mainak Das <b><u>S. S. Banerjee*</u></b>	resistance natural fibers	doi:10.1038/s41598-018-20313-4
68	Kamalika Nath, Jaivardhan Sinha, Md Arif Ali, <b><u>S. S. Banerjee*</u></b>	Evidence of magneto-structural coupling affecting magnetic anisotropy in a cobalt nano-composite	Journal of Physics: Condensed Matter <b>29</b> 425804 (2017).
67	Dibya.J.Sivananda, Amit Banerjee, <b><u>S. S. Banerjee*</u></b>	Detecting sub-nanometer anharmonic vibrations in MHz range perpendicular to a piezo crystal surface excited in the thickness shear mode using a tunneling current technique.	Journal of Applied Physics <b>122</b> , 114302 (2017).
66	Biplab Bag, Gorky Shaw, <b><u>S. S. Banerjee*</u></b> , Sayantan Majumdar, A. K. Sood and A. K. Grover	Negative velocity fluctuations and non-equilibrium fluctuation relation for a driven high critical current vortex state	Scientific Reports (Nature) 7, 5531 (2017)
65.	Amit Banerjee, <b><u>S.S. Banerjee*</u></b>	Growing gold fractal nano-structures and studying changes in their morphology as a function of film growth rate	Materials Research Express 3 (10), 105016 (2017)
64.	Biplab Bag, K Vinod, A Bharathi, <b><u>S.S. Banerjee*</u></b>	Observation of anomalous admixture of superconducting and magnetic fractions in	New Journal of Physics 18 (6), 063025 (2016)

		BaFe <sub>2-x</sub> Co <sub>x</sub> As <sub>2</sub> single crystals	
63.	Gorky Shaw, <b><u>S.S. Banerjee*</u></b> , T Tamegai, H Suderow	Metastable inhomogeneous vortex configuration with non-uniform filling fraction inside a blind hole array patterned in a BSCCO single crystal and concentrating magnetic flux inside it	Superconductor Science and Technology 29 (6), 065021 (2016)
62.	Gorky Shaw, <b><u>S S Banerjee*</u></b> , T Tamegai, Hermann Suderow	Commensurate - incommensurate vortex phase in a nanopatterned superconductor.	Journal of Physics: Conf. serise 638, 012009 (2015)
61	I. Guillamon, H. Suderow, P. Kulkarni, S. Vieira R. Cordoba, J. Sese, J.M. De Teresa, M.R. Ibarra G. Shaw, <b><u>S.S Banerjee</u></b>	Nanostructuring superconducting vortex matter with focused ion beams	Physica C 503, 70 (2014)
60	Amit Banerjee <b><u>S. S. Banerjee*</u></b>	Spatially resolved energy dispersive x-ray spectroscopic method for in-situ evaluation of mechanical properties during the growth of a C - Pt composite nanowire	AIP ADVANCES 4, 057119 (2014)
59	V. Crespo, A. Maldonado, J.A. Galvis, P. Kulkarni, I.	Scanning microscopies of superconductors at very low temperatures,	Physica C, 479, 19 (2013).

	Guillamon, J.G. Rodrigo, H. Suderow, S. Vieira, S. <b>Banerjee, P.</b> Rodiere,		
58	Amit Banerjee, <u>S.</u> <b><u>S. Banerjee*</u></b>	Fabrication of single and coupled metallic  nanocantilevers and their  nanomechanical response at resonance	Nanotechnology 24 (2013) 105306
57	Amit Banerjee, Nitul S. Rajput, and <u>S. S.</u> <b><u>Banerjee*</u></b>	Unusual dimensional dependence of resonance frequencies of Au  nanocantilevers fabricated with self- organized microstructure	AIP Advances 2, 032105 (2012).
56	Pabitra Mandal, Gorky Shaw, <u>S. S.</u> <b><u>Banerjee*</u></b> , Neeraj  Kumar, S. K. Dhar and A. Thamizhavel	Anomalous local magnetic field distribution  and strong pinning in CaFe <sub>1.94</sub> Co <sub>0.06</sub> As <sub>2</sub> single  crystals	Euro Phys. Lett. 100, 47002 (2012)
55	Gorky Shaw, Pabitra Mandal, <u>S.</u> <b><u>S. Banerjee*</u></b> , A. Niazi, A. K. Rastogi, A. K. Sood,  S. Ramakrishnan, and A. K. Grover	Critical behavior at depinning of driven disordered vortex matter in 2H-NbS <sub>2</sub>	Phys. Rev. B <b>85</b> , 174517 (2012)

54	Pabitra Mandal, Debanjan Chowdhury, <b>S. S. Banerjee*</b> and T. Tamegai.	High sensitivity differential magneto-optical imaging with a compact Faraday-modulator	Review of Scientific Instruments <b>83</b> , 123906 (2012).
53	Gorky Shaw, Pabitra Mandal, <b>S S Banerjee*</b> and T Tamegai	Visualizing a dilute vortex liquid to solid phase transition in a Bi <sub>2</sub> Sr <sub>2</sub> CaCu <sub>2</sub> O <sub>8</sub> single crystal.	New Journal of Physics 14, 083042 (2012).
52	Gorky Shaw, Biplab Bag, <b>S S Banerjee*</b> , Hermann Suderow and T Tamegai.	Generating strong magnetic flux shielding regions in a single crystal of Bi <sub>2</sub> Sr <sub>2</sub> CaCu <sub>2</sub> O <sub>8</sub> using a blind hole array.	Supercond. Sci. Technol. 25, 095016 (2012)
51	Gorky Shaw, Pabitra Mandal, Biplab Bag, <b>S.S. Banerjee*</b> , T. Tamegai, Hermann Suderow	Properties of nanopatterned pins generated in a superconductor with FIB	Appl. Surf. Science 258, 4199 (2012)
50	P. D. Kulkarni, <b>S. S Banerjee</b> , C. V. Tomy, G. Balakrishnan, D. McK. Paul, S. Ramakrishnan and A. K. Grover	Crossover from paramagnetic compressed flux regime to diamagnetic pinned vortex lattice in a single crystal of cubic Ca <sub>3</sub> Rh <sub>4</sub> Sn <sub>13</sub>	Phys. Rev. B 84, 014501 (2011)
49	Gorky Shaw, Jaivardhan Sinha, Shyam Mohan and <b>S. S. Banerjee*</b>	Driven weak to strong pinning crossover in partially nanopatterned 2H-NbSe <sub>2</sub> single crystal	Superconducting Science and Technology 23, 075002 (2010)

			Work highlighted on the front cover page of the Journal
48.	<b>S. S. Banerjee*</b> , Jaivardhan Sinha, Shyam Mohan, A.K. Sood, S. Ramakrishnan and A. K. Grover	Evolution in the time series of vortex velocity fluctuations across different regimes of vortex flow	Physica C 470, S830 (2010)
47.	<b>S. S. Banerjee*</b> , Gorky Shaw, Jaivardhan Sinha, Shyam Mohan, Pabitra Mandal	Metastable magnetization response of the vortex state due to patterned blind hole pins	Physica C 470, S817 (2010)
46.	Shyam Mohan, Jaivardhan Sinha, and <b>S. S. Banerjee*</b> ,  A.K. Sood*, S. Ramakrishnan and A. K. Grover*	Large Low-Frequency Fluctuations in the Velocity of a Driven Vortex Lattice in a Single Crystal of 2 H–NbSe <sub>2</sub> Superconductor	Phys. Rev. Lett. 103, 167001 (2009)  Also, October 15, 2009 issue of Virtual Journal of Applications of Superconductivity, ( <a href="http://www.vjsuper.org">http://www.vjsuper.org</a> )
45.	Work reported in  Phys. Rev. B 78, 214504 (2008)  Was a focus new item in  Nature India of Nature Magazine	Cool Crystal	<a href="http://www.nature.com/nindia/2008/081228/full/nindia.2008.342.html">http://www.nature.com/nindia/2008/081228/full/nindia.2008.342.html</a>  doi:10.1038/nindia.2008.342;  Published online 28th Dec. 2008

44.	Pradip Das, C. V. Tomy, <b>S. S. Banerjee*</b> , H. Takeya, S. Ramakrishnan, A. K. Grover	Surface Superconductivity, positive field cooled magnetization and peak effect phenomenon observed in a spherical single crystal of niobium	Phys. Rev. B 78, 214504 (2008)
43.	G. Ravindra Kumar, Subhendu.Kahaly, Jaivardhan Sinha, Shyam Mohan, and <b>S. S. Banerjee*</b>	High resolution magneto optical microscopy of megagauss axial magnetic fields generated in laser plasma interaction	Journal of Physics: Conference Series 112, 022083 (2008)
42.	Jaivardhan Sinha, Shyam Mohan, <b>S. S. Banerjee*</b> , Subhendu Kahaly and G. Ravindra Kumar	Mapping giant magnetic fields around dense solid plasmas by high resolution magneto-optical microscopy	Phys. Rev. E 77, 046118 (2008)
41.	S.R. Sarath Kumar, P. Malar, Thomas Osipowicz, <b>S.S.Banerjee</b> , S. Kasiviswanathan	Ion beam studies on reactive DC sputtered manganese doped indium tin oxide thin films	J. Nucl. Inst. and Meth B. 266, 142 (2008).
40.	E. Rozenberg, A. I. Shames, M. Auslender, G. Jung, I. Felner, Jaivardhan Sinha, <b>S. S. Banerjee</b> , D. Mogilyansky, E. Sominski, A. Gedanken, Ya. M. Mukovskii, G. Gorodetsky.	Disorder-induced phase coexistence in bulk doped manganites and its suppression in nanometer-sized crystals: The case of $\text{La}_{0.9}\text{Ca}_{0.1}\text{MnO}_3$ .	Phys. Rev. B 76, 214429 (2007).



39.	Shyam; Mohan, Jaivardhan Sinha, <b>S. S. Banerjee*</b> , Yuri Myasoedov	Instabilities in the vortex matter and peak effect phenomenon	Phys. Rev. Lett. 98, 027003 (2007).
38.	Shyam Mohan, Jaivardhan Sinha, <b>S. S. Banerjee *</b> , Yuri Myasoedov.	Instabilities in the vortex matter and peak effect phenomenon	Virtual Journal of Applications of Superconductivity, Jan. 15, 2007 issue
37.	E. Rozenberg, <b>S.S. Banerjee</b> , I. Felner, E. Sominski, A. Gedanken	Nano-particles of La <sub>0.9</sub> Ca <sub>0.1</sub> MnO <sub>3</sub> manganite: Size- induced change of magnetic ground state and interplay between surface and core contributions to its magnetism	Journal of Non-Crystalline Solids 353, 817 (2007).
36.	<b>S. S. Banerjee*</b> , Shyam Mohan, Jaivardhan Sinha, Yuri Myasoedov	Pinning regimes in the vortex solid and crossover between them in single crystals of 2H-NbSe <sub>2</sub>	Physica C 460-462, 710 (2007).
35.	<b>S. S. Banerjee*</b> , S. Goldberg, Y. Myasoedov, M. Rappaport, E. Zeldov, A. Soibel, F. de la Cruz, C. J. van der Beek, M. Konczykowski, T. Tamegai, V. Vinokur	Melting of heterogeneous vortex matter: the vortex “nanoliquid	Pramana Journal of Physics, 60, 43 (2006).
34.	A. D. Thakur, <b>S. S. Banerjee*</b> , M. J. Higgins, S. Ramakrishnan, A. K. Grover.	Effect of pinning and driving force on the metastability effects in weakly pinned superconductors and	Pramana Journal of Physics, 66, 159 (2006).

		the determination of spinodal line pertaining to order-disorder transition	
33	M. Menghini, Yanina Fasano, F. de la Cruz, <b>S. S. Banerjee</b> , Y. Myasoedov, E. Zeldov, C. J. van der Beek, M. Konczykowski and T. Tamegai	Role of the Vortex Solid Topology in a First-Order Liquid-Solid Phase Transition	Perspectives on Superconductivity Research", edited by P.S. Lewis , Nova Publishers (2005). ISBN: 1-59454-523-5  Pg.81-102 (2005)
32.	A. Jukna, I. Barboy, G. Jung, <b>S. S. Banerjee</b> , Y. Myasoedov, V. Plausinaitiene, A. Abrutis, X. Li, D. Wang, Roman Sobolewski	Laser processed channels of easy vortex motion in YBa <sub>2</sub> Cu <sub>3</sub> O <sub>7-δ</sub> films	Applied Physics Letters, 87, 192504 (2005).
31.	A. D. Thakur, <b>S. S. Banerjee</b> , M. J. Higgins, S. Ramakrishnan, A. K. Grover.	Exploring metastability across the Peak effect via the third harmonic measurements in single crystals of 2H -NbSe <sub>2</sub>	Phys. Rev. B, 72, 1345241 (2005).
30	M. Menghini, Y. Fasano, F de la Cruz, <b>S. S. Banerjee</b> , Y. Myasoedov, E. Zeldov, C. J. van der Beek, M. Konczykowski, T. Tamegai	Amorphous vortex phase in Bi <sub>2</sub> Sr <sub>2</sub> CaCu <sub>2</sub> O <sub>8</sub> after the first order liquid-solid phase transition	JOURNAL OF LOW TEMPERATURE PHYSICS, 135, 139 (2004)
29	<b>S. S. Banerjee</b> , E. Zeldov, A. Soibel, Y. Myasoedov, M. Rappaport, M.	Porous vortex matter	Physica C 408, 495 (2004)

	Menghini, Y. Fasano, F. de la Cruz, C J van der Beek, M. Konczykowski, T. Tamegai,		
28.	<b><u>S. S. Banerjee</u></b> , S. Goldberg, A. Soibel, Y. Myasoedov, M. Rappaport, E. Zeldov, F. de la Cruz, C. J van der beek, M. Konczykowski, T. Tamegai, V. Vinokur,	Vortex nanoliquid in high temperature superconductors	Phys. Rev. Lett. 93, 097002 (2004).
27.	<b><u>S. S. Banerjee</u></b> , E. Zeldov, A. Soibel, Y. Myasoedov, M. Rappaport, M. Menghini, Y. Fasano, F. de la Cruz, C. J. van der Beek, M. Konczykowski and T. Tamagai	'Porous' vortex matter'	PhysicaC: Superconductivity 408-410, 495 (2004).
26.	<b><u>S. S. Banerjee</u></b> , A. Soibel, Y. Myasoedov, M. Rappaport, E. Zeldov, M. Menghini, Y. Fasano, F. de la Cruz, C. J. van der Beek, M. Konczykowski and T. Tamagai	Melting of 'Porous' vortex matter	Phys. Rev. Lett. 90, 087004 (2003).

25.	M. Menghini, Y. Fasano, F. de la Cruz, <b>S. S. Banerjee</b> , Y. Myasoedov, E. Zeldov, C. J. van der Beek, M. Konczykowski and T. Tamagai	First order phase transition from the vortex liquid to an amorphous solid	Phys. Rev. Lett. 90, 147001 (2003).
24.	C. V.Tomy, D. Pal, <b>S. S. Banerjee</b> , S. Ramakrishnan, a. K. Grover, S. Bhattacharya, M. J. Higgins, G. Balakrishnan, D. MckPaul,	Study of the peak effect phenomenon in single	Pramana J. of Phys 58, 925 (2002).
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## Development

*List development / demonstration of technologies, products, patents, technology transfer*

**Patents:** Total of 4 patents filed in different countries (3 national, 4 International)

- Hall sensor based local vibration detector (hslvd) for monitoring vibrations in a structure  
Pranesh Chandra Mahato and Satyajit S. Banerjee  
Filed on: May 2022, ref. nos.: 18089122IN-CS (**National**)
- System and method for a hall sensor - superconductor based limiter of fault current  
Inventors: Arif Ali and Satyajit S. Banerjee  
Filed on : 19 March 2020. Ref. nos: 1808939IN-CS (**National**)



### 3. Systems And Methods For Imaging Characteristics Of A Sample And For Identifying Regions Of Damage In The Sample:

INVENTORS: Prof. Satyajit Banerjee, Dr. Shyam Mohan and Dr. Jaivardhan Sinha

- (a) Issued **US Patent: 9,778,202, US 20140176698 A1** (Granted: 12 March 2014, filed 29 Nov 2010)
- (b) **Japanese Patent** IN-800835-04-JP-NAT,
- (c) **Korean Patent** : IN-800835-05-KR-NAT
- (d) **National patent** nos: INDEL20102433A

4. Switch useful at superconducting temperatures and comprising superconducting material (**completely** based on my publication S. S. Banerjee et al. Appl. Phys. Lett. 74, 126 (1999), I am the first author from the Indian side.). **6,184,765** , **US Patent Nos. : US6184765 B1**, (Granted February 6, 2001, Filed: *January 7, 1999*)  
List of names in patent application (ordered as in the patent): Sabyasachi Bhattacharya, Mark J. Higgins, Satyajit S. Banerjee, Nitin G. Patil, Srinivasan Ramakrishnan, Arun K. Grover, Chandrasekhar V. R. Turumella, Vinod C. Sahni, Gurazada Ravikumar, Prashant K. Mishra,.

## Technology developed and Press coverage of work

### Press coverage of work

- i) ***Development of a Smart superconducting fault current limiter prototype*** : (Md. Arif Ali, S. S. Banerjee, *IEEE Transactions on Applied Superconductivity (2022 In press)*; **Patent**: *System and method for a hall sensor - superconductor based limiter of fault current. Inventors: Md. Arif Ali and Satyajit S. Banerjee; Filed on : 19 March 2020. Ref. nos: 1808939IN-CS*)

The work was highlighted through a press release by Press Information Bureau Government of India Ministry of Science & Technology, 29<sup>th</sup> Nov. 2021 (<https://pib.gov.in/Pressreleaseshare.aspx?PRID=1776078>).

- ii) The work was also covered in an article in Hindu (<https://www.thehindu.com/sci-tech/science/an-innovation-that-can-better-protect-power-grids/article37842349.ece?homepage=true>), 5<sup>th</sup> Dec. 2021

## An innovation that can better protect power grids

High current surges, if unchecked, cause heating of the wires and perhaps melting and consequent short-circuits and fire accidents

SHUBASHREE DESIKAN event of a surge. These suf situation even while it is de innovations by the acade

And Blitz India (9<sup>th</sup> May 2022) (<https://blitzindiamedia.com/iit-kanpurs-unique-smart-shield/>)

# IIT Kanpur's unique smart shield



**Prof Satyajit Banerjee**  
IIT Kanpur

## A game changing technology to protect power grid outage

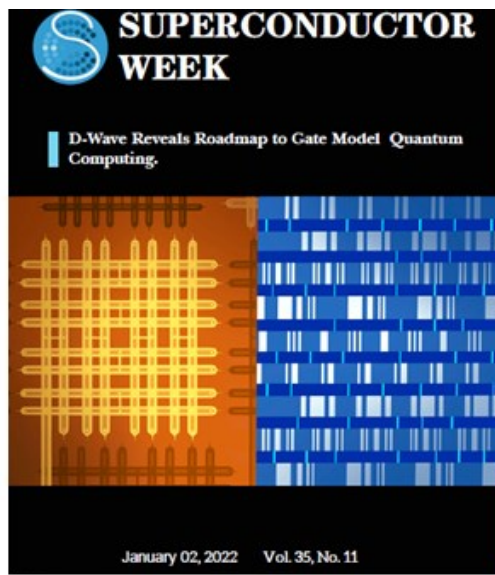
**A**n Indian researcher has developed a unique innovation of a prototype of a smart

switch. The array of hall sensors allows continuous monitoring of current flowing through different regions of the superconductor used in the SC-

switch. The array of hall sensors allows continuous monitoring of current flowing through different regions of the superconductor used in the SC-

any instability sets in the superconductor while the SCFLsm is operating at high currents, the mapping technology will detect its development. Subsequently, corrective action can be initiated to divert the current from the superconductor and protect the SCFL. Thus the common problem of failures of the superconductors experienced in

- iii) An article carried an international magazine on superconductivity, named Superconductor week (02 January 2022, Vol 35 Issue nos. 11, page 05, paid magazine and free browsing not available).



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-5- January 02, 2022

### IIT Kanpur Develops Smart Superconducting Fault Current Limiter

A schematic of the SFCLam and its location on the power grid either on the source side (top half) or the distribution side (lower half)

Researchers at the Indian Institute of Technology (IIT) Kanpur have devised a prototype smart superconducting fault current limiter (SFCLam) system to protect power grids from large current surges. While the technology is still in an early development stage, this new SFCL may offer a solution for utilities to improve energy transmission, prevent outages, and reduce costs in the operation of municipal grids.

"We are working on ways of developing intelligent SFCL technology systems and pathways which will allow the SFCL to automatically and quickly take

- (ii) Generating unusual giant concentric domain patterns using ultra intense laser light source Kamalika Nath, et al New Journal of Physics 23, 083027 (2021). : Some press coverage

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[https://www.spacedaily.com/reports/Giant\\_magnetic\\_pulse\\_rounds\\_up\\_spins\\_far\\_and\\_wide\\_99\\_9.html](https://www.spacedaily.com/reports/Giant_magnetic_pulse_rounds_up_spins_far_and_wide_99_9.html)

## Funding

List R&D projects with details of funding, duration, whether PI or co-PI

S. N	Period	Sponsoring Organization	Title of Project	Amount of Grant	Co-Investigators (if any)
1.	2006 - 2009	Council of Scientific and Industrial Research (CSIR)	A high sensitivity magneto-optical setup for imaging the magnetic response in superconducting – magnetic heterostructures and for use in engineering sciences	Rs.9,50,000/-	None
2.	2007 - 2010	Department of Science and Technology (DST)	Developing a high sensitivity magneto-optical imaging technique	Rs.66,71,629/-	None
3.	2007-2008	Asian Office of Airforce Research and Development (AOARD), USA	Imaging Phase separation in CMR materials	US\$ 25,000/- (Rs. 11,07,150/- )	None.

4.	2009-2010	International Center for Theoretical Sciences, belonging to TIFR, Mumbai, India	For organizing the international conference titled NESP (NON-EQUILIBRIUM STATISTICAL PHYSICS)), 2010.	Rs. 34,00,000/-	Co. PI's Prof. Debashish Chowdhury and Prof. Amit Dutta; from the Dept. of Physics. IIT Kanpur
5.	2010-2014	Department of Science and Technology (DST)	Engineering superconducting nanostructures in dichalcogenides and investigating their properties	Rs. 35,58,500/-	Prof. Hermann Suderow, Spain
6.	2010-2014	Ministry of human resource and Development (MHRD)	A proposal for virtual laboratory (waves and phenomenon)	Rs.40,00,000/-	None
7.	2012-2014	Department of Science and Technology (DST)	Creation of heterogeneous pinning in iron pnictides and cuprate superconductors by introducing nanopatterned pins	Rs.2,57,000	Prof. Tsuyoshi Tamegai, Univ. of Tokyo, Japan.
8.	2014-2014	Department of Science and Technology (DST)	PI for holding the 7th PAC - SERB meeting for DST on "condensed matter Physics and materials science" at IIT Kanpur between 17 -19th Sept. 2014	Rs.16,50,000/-	Satyajit Banerjee
9.	2016-2019	DST – Technology development Program (DST – TSDP)	Developing a prototype of a smart Superconducting Fault	Rs.1,30,26,000/-	Satyajit Banerjee

			Current Limiter (SCFCL <sub>sm</sub> ) with three dimensional field and current mapping technology for early fault and hot spot detection		
10	2018-2021	DST-SERB Imprint II	Developing a compact Graphene based Hall sensor for monitoring steel structures under stress	Rs. 59,52,719	Satyajit Banerjee
11	2022 -	DST – SERB-SUPRA	Building a unique Magneto-optical setup with capability for simultaneous imaging of electric current, magnetization and bulk transport measurements at low temperature with vector magnet for imaging strong correlation driven topological insulators and its heterostructures.	Rs. 1,76,06,240/-	Satyajit Banerjee, Phy, IITK (PI)  Ashish Garg (SEE dept and MSE, IITK) (Co-PI)

### PhD Supervision

S.No	Name	Year of completion	Title of Thesis	Co-guides(if any)
1.	Shyam Mohan. (Ph.D)	Degree awarded in Oct. (2009).	Instabilities in the vortex state of superconductors.	None

2.	Jaivardhan Sinha (Ph.D)	Degree awarded in Oct, 2010.	Properties of magnetic materials under extreme conditions.	None
3.	Gorky Shaw (Ph.D).	Degree awarded in April, 2013	Static and Driven phases of vortex matter in superconductors with intrinsic and nanopatterned pins	None
4.	Amit Banerjee (Ph.D)	Degree awarded in Oct 2013	Resonance Behavior of FIB grown nanomechanical systems and the role of microstructure	None
5.	Pabitra Mondal (submitted thesis for the award of Ph.D degree)	Degree Awarded in May, 2014	Anomalous magnetic response of $\text{CaFe}_{1.94}\text{Co}_{0.06}\text{As}_2$ superconductor and nonlinear response of the driven vortex state in $2\text{H-NbS}_2$ superconductors	None
6.	Biplab Bag	Degree awarded Nov. 2017	A study of interplay between magnetic and superconducting order in $\text{BaFe}_{2-x}\text{Co}_x\text{As}_2$ , and driven	None

			vortex state properties in 2H-NbS <sub>2</sub> superconductor	
7.	Dibyajyoti Sivananda	May 2020	Stepwise disintegration of magnetic domains in a EuB <sub>6</sub> single crystal observed by magneto-optical imaging	None
8.	Kamalika Nath	May 2020	Study of magnetic response in very high magnetic field and nano-confined structures	None
9.	Ankit Kumar	May 2020	Exploring low magnetic field instabilities in the static and driven vortex state of K-doped BaFe <sub>2</sub> As <sub>2</sub> superconductor	None
10.	Amit Jash	March.2021	Study on non-magnetic disorder effect on high conducting surface states of a three-dimensional Bi <sub>2</sub> Se <sub>3</sub> topological insulator	None
11.	Md. Arif Ali	June 2022 (submitted thesis)	Developing a smart superconducting fault current limiter, exploring	None

			and producing high Jc state in Bi-2223	
12.	Nirmal Roy	June 2022	Emergent magnetic properties in nano-structured materials: magnetism in Cobalt Carbide nanoparticles and metal-insulator transition in Nickelate thin films	None
13	Sayantana Ghosh	PhD (ongoing)	Exploration of Strongly Correlated Topological Insulators	None
14	Pranesh Chandra Mahato	PhD (ongoing)	Exploration of magnetism in a 2D material and building tools for exploring the magnetism in these systems	None
15.	Sourav Karan	PhD (ongoing)	Study of driven high Jc state in the vortex state of superconductors	
16.	Sugata Paul	PhD (ongoing)	Thesis topic not decided	
17.	Suprotim Saha	PhD (ongoing)	Thesis topic not decided	



## **Peer Recognition**

*Awards, Fellowships, other recognitions*

1. Poonam and Prabhu Goel Chair, IITK. 2017 – 2020.
2. Invited to serve on the Editorial board of Pramana - Journal of Physics from 2015 - 2018.
3. P. K. Kelkar Young Faculty Research Fellowship Award, June 1, 2012 - May 31st, 2015.
4. Received the NASI-Scopus Young Scientist award for Physics, 2012 (Feb. 2nd, 2012) .
5. On advisory board for the Journal, Superconductor Science and Technology from January 2009 - Dec. 2014 (impact factor Journal ~ 2.5).
6. Young Achiever's award, 2007 -08, awarded by the Department of Atomic energy (DAE) at the Solid State Physics Symposium, Mysore 27<sup>th</sup> – 31<sup>st</sup> Dec. 2007.
7. Awarded the INSA (Indian National Science Academy) medal for Young Scientists, India, 2002.
8. Best poster award at the NATO Advanced Research Workshop on Magneto-optical imaging held at Oystese, Norway between 28-30 August, 2003.
9. First prize and Cash Award at the Colloquium for Young Physicists, organized by Indian Physical Society, Calcutta on 20-21 August 1998, at Saha Institute of Nuclear Physics, Calcutta.

## **Contributions**

*Participation in national/international level committees*

1. Served and continue to serve on various National and International Committees.
2. Referee for research various International Journals.

## **Others: conferences / events organized, nos. of invited talks in conferences/colloquiums**

1. Organized the 7th PAC - SERB meeting for DST on "condensed matter Physics and materials science" at IIT Kanpur between 17 -19th Sept. 2014.

2. Non-equilibrium Statistical Physics (NESP), sponsored by the International Center for Theoretical Sciences, unit at TIFR (more details at the conference link: <http://www.icts.res.in/program/nesp>) . Venue : IIT Kanpur, Dates : 30st Jan. 2010 to 4th Feb. 2010. Followed by a satellite meeting (IITK:GJ).
3. Under the auspices of the Golden Jubilee celebrations of IIT K, organized an International Conference on the specialized topics Interaction, Instability, Transport and Kinetics: Glassiness and Jamming (IITK:GJ) during the five days, February 4-8, 2010. (more details at the conference: <http://www.cse.iitk.ac.in/users/gj/new/conference/pages.php?confID=25>)
4. Being a member of the scientific advisory committee for the international vortex workshop, I Organized the 18<sup>th</sup> International Vortex conference 2021 as a fully online conference. Due to Covid, I organized the 18th International Online conference on Vortex Matter in Superconductors as an online conference between May 27<sup>th</sup> to June 4<sup>th</sup>, 2021 (<https://www.iitk.ac.in/vortex2021/>). The 18<sup>th</sup>- Vortex-2021 conference commemorates the Diamond Jubilee (60 years) of IIT Kanpur. The conference had 50 International speakers from renowned Universities and Institutes abroad and 10 National speakers along with about 50 international poster presenters and about 12 national poster presenters. Overall there was a participation of 120 scientists, postdocs and PhD students from all over the world. This was a prestigious international event, by invitation only. The 18<sup>th</sup>- Vortex-2021 continues the tradition of focused biannual meetings on Vortex Matter in Superconductors and related topics, which began in 1994 in Palaiseau, France.

**Total national and international Invited Talks/colloquiums/session chair: 79**

1. *Invited Talk at the QMat conference, titled “Studying the peculiarities of the Metal Insulator Transition in NdNiO<sub>3</sub> films using the self field imaging technique”, Sept. 17, 2022*
2. *Colloquium in Dept. of Physics at IIT Madras, 3<sup>rd</sup> August, 2022 “A new way to image and map surface conductivity in condensed matter systems”*
3. *Invited talk at IIT Hyderabad, Conference on Recent advances in magnetis, 20<sup>th</sup> Dec, 2021 “Imaging the current distribution across the Metal Insulator Transition in NdNiO<sub>3</sub> thin film”.*
4. *Invited talk at Online QMat Conference, S. N. Bose Center 10<sup>th</sup> Sept 2020. “Using current mapping to image a phase transformation in Bi<sub>2</sub>Se<sub>3</sub> topological insulator”*
5. *Invited talk at Vortex Workshop 2019, “Disorder induced lowering of vortex dimension in Pnictide superconductor and precipitation of thermal melting of a dilute vortex solid phase” May 20-25<sup>th</sup>, 2019, Antwerp, Belgium*
6. *Invited talk “Low field vortex melting phenomenon in Pnictide superconductors” Current Trends in Material Science and Engineering, 18-20<sup>th</sup> July 2019, S. N. Bose Center Kolkata.*
7. *Invited talk “Exploring the interplay between surface and bulk conductivity in Bi<sub>2</sub>Se<sub>3</sub> and the role of disorder, using a sensitive non contact technique” 5-6<sup>th</sup> September 2019, Flatlands, S . N. Bose Center, Kolkata*
8. *Delivered IISER Bhopal, Colloquium, “ From Magnetic polarons to Magnetic domains” 14<sup>th</sup> March 2019.*

9. *Indo – Singapore Physics Symposium, Puri, Bhubaneswar, 2-4<sup>th</sup> March 2019. Delivered Invited Talk” Exploring the magnetic polaronic state near the ferromagnetic transition in EuB<sub>6</sub> through domain imaging using Magneto-optical imaging” .*
10. *MRSI AGM, IISc Bangalore, 14-17<sup>th</sup> Feb. 2019 Delivered Invited talk,.” Exploring the magnetic polaronic state near the ferromagnetic transition in EuB<sub>6</sub> through domain imaging using Magneto-optical imaging”.*
11. *Delivered Seminar in Dept of Physics, IISc Bangalore, 12<sup>th</sup> Nov. 2018 “Low Dimensional Melting in Pnictide Superconductor”*
12. *QMat Conference, IISER Mohali, 24<sup>th</sup> July – 27<sup>th</sup> July 2018. Invited talk on “Exploring nature of magnetic ordering and probing magnetic polaronic state near the ferromagnetic transition in EuB<sub>6</sub> single crystal using Magneto-optical imaging”*
13. *Colloquium TIFR Hyderabad 14<sup>th</sup> March 2018 “Seeing magnetic fields and electric currents using light”.*
14. *Invited talk at Recent Trends in Condensed Matter Physics, IACS Kolkata, 16<sup>th</sup> – 17 January 2018, Kolkata. Talk title ”Evidence of superconducting and magnetic fluctuations both above and below T<sub>c</sub> in BaFe<sub>2-x</sub>CoxAs<sub>2</sub> single crystals”*
15. *Invited as session organizer Chairman and member for the 6th International Symposium on Integrated Functionalities ([www.isif2017.com](http://www.isif2017.com)), which will take place in New Delhi, India from Dec 10-13, 2017.*
16. *Invited speaker at Vortex 2017, held in International Institute of Physics, UFRN, Natal Brazil May 28<sup>th</sup> - June 3, 2017 (<http://vortex2017.org/>). Talk title “Evidence of superconducting and magnetic fluctuations both above and below T<sub>c</sub> in BaFe<sub>2-x</sub>CoxAs<sub>2</sub> single crystals”*
17. *Invited talk at 4th Indian Statistical Physics Community Meeting to be held during 17–19 February 2017 at ICTS, Bangalore. Title ” Validity of Fluctuation Relations in driven condensed matter systems”*
18. *Invited talk “Jamming phenomenon and fluctuation relations in the driven vortex state of superconductors” Contemporary issues in condensed matter systems, IISc Bangalore, 14<sup>th</sup> June 2016.*
19. *Invited talk “Evidence of Interplay between magnetic and superconducting fluctuations above T<sub>c</sub> in doped iron arsenide compound” IIT Kanpur, Dept. day talk, 6<sup>th</sup> Feb. 2016.*
20. *Invited talk “Evidence of magnetic and superconducting fluctuations present below and above T<sub>c</sub> in doped Iron Arsenide superconductor”, Conference on Quantum Disordered Systems, IMSc, Chennai, 2<sup>nd</sup> March 2016.*
21. *Colloquium, IISER Bhopal “Multiple current carrying states in a nanopatterned superconductor”, 30<sup>th</sup> Sept. 2015.*

22. *Invited talk "Large Negative velocity events and validity of non equilibrium fluctuation relations at the unjamming threshold in the driven vortex state of 2H-NbS<sub>2</sub>" Vortex Workshop, SL Escorial ,Spain, 10<sup>st</sup> -15<sup>th</sup> May, 2015 Talk : 15<sup>th</sup> May, 2015.*
23. *Invited talk on "Multiple current carrying states in nanopatterned superconductors" Indo Japan workshop on Nanomagnetism, NISER-IOP Bhubaneshwar, Jan 9 - 12th, 2015.*
24. *Invited talk on "Jamming phenomenon and Fluctuation relations for the driven vortex state in superconductors" the 6th Indo Israel Meeting on frontiers in condensed matter physics, Israel academy of Science and Humanities, Jerusalem, Israel from 6th - 11th Dec. 2014.*
25. *Invited talk "Commensurate - incommensurate domains and driven domain walls in the vortex state of nanopatterned superconductors", StatPhys-Kolkata VIII, 2014, S. N. Bose center, Dec.1 to 5th, 2014.*
26. *Invited talk "Unusual Critical state in nanopatterned SC" International Workshop on Advances in nanostructured superconductors: materials, properties and theory "La Cristalera", Miraflores de la Sierra, Madrid, 4 - 7 May (2014).*
27. *Invited talk at the Indian Statistical Physics Community meeting (ISPCM) in IISc Bangalore, 1st - 3rd Feb. 2014 (Saturday). The title is "Dynamic phases of the driven vortex state in superconductors: Jamming phenomena"*
28. *Invited talk " Competition between magnetic and superconducting order in an Iron Pnictide superconductor", IUMRS conference, IISc. Bangalore, 16th to 20th Dec.2013.*
29. *Invited Talk "Competition between magnetism and superconductivity in an underdoped Iron Pnictide superconductor", 14th International Workshop on Vortex matter in superconductors, Nanjing China, May 21 - 28th, 2013.*
30. *Invited Talk "Detecting ultra small changes in magnetization associated with phase transition in superconductors and the development of sensitive metallic nanocantilevers" 6th India - Singapore Joint Physics Symposium (ISJPS - 2013) at IIT Kharagpur, between February 25 -27, 2013.*
31. *Invited Talk "Advances in magneto-optical imaging" at Punjab University 7<sup>th</sup> Chandigarh Science congress (CHASCON), from March 1-3, 2013.*
32. *Invited Talk "Magneto-Optical imaging of competing order parameters in pnictide superconductor", at the 5<sup>th</sup> Indo – Singapore Joint Symposium at IIT Delhi 20<sup>th</sup> – 22<sup>nd</sup> Feb. 2012.*

33. *Invited Talk "Competition between magnetism and superconductivity in an under-doped iron arsenide superconductor" at International Conference on Functional Oxides and New carbon materials, S. N. Bose Center for Basic Sciences, Kolkata, May 8th, 2012.*
34. *Colloquium, "Exploring the coexistence of order parameter and a search for broken symmetry in the vortex state of superconductors", Department of Physics, IIT Kanpur, Jan. 20, 2012.*
35. *Invited talk on Vortex Physics, to celebrate 100 years of superconductivity, arranged by Physics Society, Dept. of Physics IIT Kanpur, Nov. 12, 2011.*
36. *Invited talk "Magneto-optical imaging of competing order parameters in Iron Arsenide superconductor" 5<sup>th</sup> Indo – Israeli Conference, 15<sup>th</sup> – 18<sup>th</sup> Oct, Ramada Inn Resort, Cochin, Kerala, India.*
37. *Invited talk "Instabilities and random organization in driven vortex matter in 2H-NbS<sub>2</sub>" Current Trends in Condensed Matter (CTCM, 2011), organized by ISER Kolkata, 7 – 9<sup>th</sup> Oct, 2011.*
38. *Invited talk on "Varieties of organization in the flowing driven state of vortex matter", at international conference of Vortex Matter in Superconductors, Chicago, Organizers, Argonne National Laboratory, USA. July 31<sup>st</sup> – 5<sup>th</sup> Aug, 2011.*
39. *Physics Colloquium at TIFR, Mumbai, on "Driving through traffic jams in superconductors", on March, 2011.*
40. *Invited talk, titled "Strange magnetic properties of ferromagnetic nanowires" at Mahabaleshwar, in the ICTS (International center for theoretical studies of TataInstitute of Fundamental Research, Mumbai) organized condensed matter program, 2009 (ICMP09), between 5<sup>th</sup> – 23<sup>rd</sup> Dec. 2009. Talk was on 20<sup>th</sup> Dec. 2009.*
41. *Invited talk at the Dept. of Atomic Energy (DAE) – SSPS (solid state physics symposium), titled "Novel large amplitude low frequency velocity fluctuations in the elastic phase of the driven vortex matter", Baroda on 17<sup>th</sup> Dec. 2009, at the Maharaja Sayajirao University of Baroda, Vadodara, India.*
42. *Physics Colloquium titled "Low frequency, large amplitude vortex velocity fluctuations and novel dynamics of the driven vortex state" at Indian Institute of Science (IISc) Bangalore, dated 4<sup>th</sup> Dec. 2009.*
43. *Invited talk on Large amplitude low frequency velocity fluctuations and its evolution with different phases of the driven vortex state at the 12th International workshop on vortex matter in superconductors, Sept.12-16, 2009 at the Lake Yamanaka, Yamanashi, Japan.*

44. *Invited talk on “Magneto-optical imaging technique: from superconductors to plasma’s” at the Condensed Matter Physics Workshop held at IIT Kanpur, India from Feb. 20 – 22<sup>nd</sup>, 2009.*
45. *Invited talk on “Controlling magnetic and superconducting properties at extreme scales” in the International symposium on clusters, cluster assemblies and nanomaterials (ISCANM 2009), held at HRI, Allahabad, India from Feb. 9 - 11, 2009.*
46. *Invited talk on “Controlling magnetic and superconducting properties at extreme scales” in the Workshop on Magnetic Nanomaterials and their Application (MNTA), at S.N. Bose Center, Kolkata, from Jan. 27-28, 2009.*
47. *Invited talk on “Instabilities and nonlinearities in bulk and nanopatterned superconductors” at the Indian Condensed Matter Physics Workshop, Mahabaleshwar, 9<sup>th</sup> – 22<sup>nd</sup> Dec. 2008.*
48. *Invited talk on “Instabilities and nonlinearities in bulk and nanopatterned superconductors” at 4<sup>th</sup> Indo-Israeli conference in Condensed Matter Physics, Nov. 3-5 2008, Zfat, Israel.*
49. *Talk in the Condensed Matter Seminar at Weizmann institute of Science, Israel, 6<sup>th</sup> Nov. 2008, on “Instabilities and nonlinearities in bulk and nanopatterned superconductors”.*
50. *Lecture Series on Superconductivity, Invited talks (4 nos.) at a School Organized on Condensed Matter Physics, at Harish Chandra Research Institute Allahabad, 5<sup>th</sup> June 2007.*
51. *Advances in magneto-optical imaging and imaging instabilities in vortex matter; (Invited Talk); East Asia symposium on Superconducting Electronics, IIT Delhi 14<sup>th</sup> December, 2007.*
52. *Instabilities in superconductors and giant magnetic fields associated with plasma’s; (Invited Talk); Department of Atomic Energy, Solid State Physics Symposium, Mysore, 27<sup>th</sup> to 31<sup>st</sup> Dec. Mangalore, 2007.*
53. *Lecture Series on Superconductivity, Invited talks (4 nos.) at a School Organized on Condensed Matter Physics, at Harish Chandra Research Institute Allahabad, 5<sup>th</sup> June 2007.*
54. *Institute Colloquium titled: Advances in magneto-optical imaging, 18<sup>th</sup> July, Tata Institute of Fundamental Research, Mumbai.*
55. *Instabilities in superconductors and mapping megagauss magnetic fields associated with laser plasma interactions. S. N. Bose National Center for Basic Sciences, Kolkata, 30<sup>th</sup> March, 2007.*

56. *Oral and Poster Presentation: Crossover in pinning regimes of the vortex solid and the peak effect at the 11<sup>th</sup> International workshop on Vortex Matter at Wroclaw, Poland, July 3<sup>rd</sup> – 8<sup>th</sup>, 2006.*
57. *Chaired a session: At the 11<sup>th</sup> International workshop on Vortex Matter at Wroclaw, Poland, July 3<sup>rd</sup> – 8<sup>th</sup>, 2006.*
58. *Poster presentation: Pinning regimes in the vortex solid and the crossover between them in single crystals of 2H-NbSe<sub>2</sub> at the 8<sup>th</sup> International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors, Dresden, July 9<sup>th</sup> – 14<sup>th</sup>, 2006.*
59. *Invited talk: Instabilities in Superconductors, National conference on Emerging trends in engineering materials, Thapar Institute of Engineering and Technology, Patiala, Punjab, Feb1-3, 2007.*
60. *Chaired a session: At the National conference on Emerging trends in engineering materials, Thapar Institute of Engineering and Technology, Patiala, Punjab, Feb1-3, 2007.*
61. *Presented an invited talk at the condensed matter physics seminar organized in the dept. of Physics, IIT Kanpur, from 4<sup>th</sup> – 6<sup>th</sup> Feb, 2005. Title of my talk was on "Effect of dilute density of correlated disorder on the vortex state in superconductors: The porous vortex matter".*
62. *Presented an invited talk titled "Melting of heterogenous vortex matter: the vortex nanoliquid" at the x<sup>th</sup> international vortex state studies workshop (IVW-X) at the Tata Institute of Fundamental Research, Mumbai, 9<sup>th</sup> – 14<sup>th</sup> Jan, 2005.*
63. *Presented a tutorial titled "Magneto-optical imaging of superconductors" at a satellite tutorial session arranged prior to the the x<sup>th</sup> international vortex state studies workshop (IVW-X) at the Tata Institute of Fundamental Research, Mumbai, 7<sup>th</sup> – 9<sup>th</sup> Jan, 2005*
64. *Presented the Condensed Matter Physics Seminar in the Dept. of Condensed matter Physics, at the Hebrew University, Jerusalem, on 6<sup>th</sup> May. 2004. Title of my presentation was "Porous Vortex Matter".*
65. *Presented the Condensed Matter Physics Seminar in the Dept. of Condensed matter Physics, at the Weizmann Institute of Science, on 28<sup>th</sup> Jan. 2004. The title of my presentation was "Porous Vortex Matter".*

66. Presented a poster on “Magneto-optical investigations into the melting of porous vortex matter in the presence of columnar defects” at the NATO Advanced Research Workshop on Magneto-optical imaging held at Oystese, Norway between 28-30 August, 2003.
67. Oral presentation (23<sup>rd</sup> June, 2003) titled “Heterogeneous melting of ‘porous’ vortex matter” at the 9<sup>th</sup> international workshop on vortex dynamics and vortex matter (ESF), Oleron Island, France 22-27 June, 2003.
68. Oral presentation (27<sup>th</sup> May, 2003) titled “Porous vortex matter” at the M2S-HTSC-VII, materials and mechanism of superconductivity and high temperature superconductors, held in Rio de Janeiro, Brazil 25-30 May, 2003.
69. Chaired the Superconductivity and Ferromagnetism session on 30<sup>th</sup> May, 2003 at the recently concluded M2S – HTSC – VII conference on materials and mechanisms of superconductivity and high temperature superconductors held at Rio de Janeiro, Brazil, between May 25 -30, 2003.
70. Phases of vortex matter in the presence of columnar defects: a magneto-optical study of BSCCO superconductors. Presented in the Condensed Matter Physics seminar at the Ben-Gurion University, Beer Sheeva, Israel, 25<sup>th</sup> Nov, 2002.
71. Phases of vortex matter in the presence of columnar defects: a magneto-optical study. Presented in the condensed matter physics seminar at ETH Zurich (laboratorium fur Festkorperphysik), Switzerland, Oct. 11, 2002.
72. Phases of vortex matter in the presence of columnar defects: a magneto-optical study. Presented at Ecole Polytechnique (Laboratoire des Solides Irradies), Palaiseau, France, Oct.7, 2002.
73. Presented a seminar in the Dept. of Condensed matter Physics and material sciences, TIFR, pertaining to Investigations into the phases of vortex matter using the differential magneto-optical technique, October, 2001.
74. Presented a colloquium at the Tata Institute of Fundamental Research on Pristine issues in condensed matter Physics via Vortex State Studies, July, 2000.
75. Oral presentation on “Peak Effect and its relation to Phases of Vortex Matter” during a panel discussion session Chaired by Gianni Blatter at the “Experimental Workshop on High Temperature Superconductors and related materials (Advanced Activities)” held between Nov.19 - Dec.6, 1998, in San Carlo de Bariloche, Argentina.



76. Oral presentation on “Phases of Vortex Matter and Transformation Amongst them” at the Colloquium for Young Physicists organized by Indian Physical Society and held at Saha Institute of Nuclear Physics, Calcutta on August 20-21, 1998.
77. Oral presentation on “Metastable states of Vortex Matter” in a Discussion Meeting on Vortices, held in T. I. F. R. on July 8, 1998.
78. Invited presentation on “Peak Effect in Superconductors: A Key to Elucidate Different Phases of Vortex Matter” at the International Conference on Superconductivity held between Dec. 15-17, 1997 in University of Hyderabad.
79. Oral presentation on “Thermodynamic Evidence for Reentrant Peak Effect in a Clean Single Crystal of  $2H-NbSe_2$  and the Effect of Disorder and Thermomagnetic History on it” at the  $V^{th}$  International Conference on Materials and Mechanisms of Superconductivity, High Temperature Superconductors,  $M^2S-HTSC-V$ , held in Beijing, China from Feb.28 to March 4, 1997 .

-----Miscellaneous-----

### Outreach (teaching related)

1. Developed an MHRD funded, Virtual experimentation platform on Oscillations and waves: <http://www.iitk.ac.in/oscillations/>
  2. In 2019, Developed a Massive Online Open Course (MOOC) / NPTEL course titled “Introduction to Solid State Physics” together with Prof. Manoj Harbola from the Dept. of Physics, IIT Kanpur. (win th 1500 students enrolled for the course from India and abroad) [https://onlinecourses.nptel.ac.in/noc19\\_ph02/preview](https://onlinecourses.nptel.ac.in/noc19_ph02/preview)  
<https://nptel.ac.in/courses/115104109/82>  
*Total of 88 lectures (46 Lectures by Satyajit Banerjee and 42 by Prof. Manoj K. Harbola.*  
*Lectures also available on :*  
<https://www.youtube.com/watch?v=xTNkipm2bZc&list=PLFW6IRTa1q83HGEihqwcY7KeTLUuBu3WF>
- Course has run twice (2019 and 2021)
3. Developed a series of online lectures on the fundamentals of superconductivity and application (in the process of being updated)  
 Title: A course in superconductivity  
 Link: <https://www.youtube.com/channel/UC5rgQ0PVG4NW4hw4ZOV1PEQ/about>

### Courses taught

Course No. & Title	Level (UG/PG)	Number of Times	Developed by you?
Phy102N (Mechanics & relativity)	UG	7 (Three times, received Letter of appreciation from Director, IIT Kanpur)	No. However developed a virtual web based lab. for demonstrating various physics concepts  <a href="http://www.iitk.ac.in/oscillations/">http://www.iitk.ac.in/oscillations/</a>  Also developing demonstration laboratory experiments.
Phy 102 Tutorial (mechanics & relativity)	UG	7	
Phy 102 S(mechanics & relativity)	UG	8 (three letter of appreciation received from Director, IIT Kanpur)	
Phy103R (electrodynamics)	UG	1	
Phy 101 Labs (Undergraduate Physics Lab)	UG	6	I have introduced a new experiment in Phy101 lab, and also wrote the write up in the Phy101 lab manual. The name of the experiment was

			Measuring the velocity of light.
Phy 690T (Superconductivity and Applications, an advanced elective course)	PG	4 (Two letter of appreciation received from Director, IIT Kanpur)	Yes. Phy690T, was graduate level elective on introduction to the phenomenon of superconductivity and its application. (Covers BCS theory, Ginzburg Landau theory, Mixed State of SC and vortices, Josephson effect, SQUIDS, Experiments related to Superconductors). <a href="https://www.youtube.com/channel/UC5rgQ0PVG4NW4hw4ZOV1PEQ/about">https://www.youtube.com/channel/UC5rgQ0PVG4NW4hw4ZOV1PEQ/about</a>
Phy543 (Introduction to Condensed Matter Physics)	UG/Masters/PhD students)	3 (Three times received letter of appreciation from Director, IIT Kanpur)	
Computational Physics	UG (MSc final year students)	1 (Received letter of Appreciation from the Director )	
MSc Final year, one year experimental projects.	UG- MSc final year, 2 semester projects	17	Two students have received best project award.

## Contributions to the Institute

*Academic and non-academic administration, mentoring, setting up laboratories*

### **Research Facilities developed (and also being currently developed) in my laboratory at IIT Kanpur**

- *We have developed a state of the art Magneto-optical imaging technique to map with high local field sensitivity the distribution of local magnetic field across magnetic, superconducting and semiconducting samples at different temperatures and magnetic fields.*
- *We are developing the magnet-optical imaging technique to develop a new setup which will enable imaging of transport current distributing through materials as they flow.*
- *We have developed techniques to make nanopores in anodized aluminium (AAO) templates. Using them we make nanowires.*
- *We have a sputtering unit for making thin films (insulating and metallic).*
- *We use bulk transport and magnetization measurements. We have developed a technique for sensitive time series transport measurements.*
- *We are developing a tunneling current based setup for high sensitive measurement of low magnetization samples.*
- *We are developing a very high sensitivity mutual inductance measurement technique for measuring very sensitively diamagnetic response of materials.*
- *We are attempting to develop sensitive temperature imaging system.*
- *We are also developing a transport current imaging setup where we can image the flow of transport currents inside any material and map the local conductivity of materials.*
- *We are involved in developing a scanning hall probe setup.*
- *Developing superconducting fault current limiters for power distribution applications*

Period	Organisation	Nature of Responsibility	Designation
2005 – 07 (sept)	IIT Kanpur	Member of DUGC*, Making Dept. Exam timetable, Student related matter associated with DUCG.	Member of DUGC.
2007 – 2009	IIT Kanpur	Departmental Budget Convener	Convener

2009 – 2011 2014-2016	IIT Kanpur	Member of DPGC** , Dept. IRDC committee	Member, DPGC
2011 - 2013	IIT Kanpur	Convener DPGC** (Departmental Postgraduate committee).	Convener
2012-2013	IIT Kanpur	Vice Chairman, GATE exam (a major all india exam through which students are selected into the M. Tech program in Engineering and PhD programs in Engineering and Sciences in Indian Institute of Technology across India)	Vice Chairman
2013 - ongoing	IIT Kanpur	Central Cryogenics Facility, Convener. Inchange of Liquid Helium and Liquid Nitrogen facility of the facility	Convener  *Notable work done:  1. Installed a new Liquid Nitrogen Plant from Linde.  2. Helped enhance liquid He budget for Institute.  3. Set up a new helium recovery manifold of cylinders for the plant.  4. Setup a new website for the helium and liquid nitrogen plant.

2013 -	IIT Kanpur	Co - Convener, Magnetic measurements facility, ACMS	Co - Convener. Installed a new low temperature (1.5 K) – high temperature (700 K) SQUID magnetometer from Cryogenics, UK. Although a co-convener I have been doing the job of the convener.
2015 – 2017	IIT Kanpur	Member of the Institutes ethics cell	
2016 – 2017	IIT Kanpur	Convener, Institute Ranking committee.	
2017 (for six months)	IIT Kanpur	Convener, IRDC	
2017-2019	IIT Kanpur	Associate Dean of Faculty Affairs	
2017-2019	IIT Kanpur	Secretary Faculty Club	

**Other miscellaneous activities**

1. *Warden Hall 1 & Warden Incharge (for last 4 months) 2007 - 2011*
2. *Serving various National exams in different capacities.*
3. *Served on various Staff selection committee.*