JYOTIPRATIM RAY CHAUDHURI

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Curriculum Vitae

Education

Ph. D. (Science)	Jadavpur University, India (**IACS,** Kolkata-32)
M. Sc. (Physics) (Special Paper: Particle Physics)	Visva Bharati
B. Sc. (Hons. In Physics)	University of Calcutta, India

Other examination qualified

CSIR NET 1991
GATE – 94 (Percentile 97.18)

Ph. D. Thesis

Title: **Studies of Nonequilibrium Stochastic Processes in Some Model Systems.**

Advisor: **Professor Deb Shankar Ray**
Department of Physical Chemistry
Indian Association for the Cultivation of Science (IACS)
Jadavpur, Kolkata 700032, India

Post Doctoral Fellowship

1. **Postdoctoral work-with Professor Eli Pollak, Department of Chemical Physics, Weizmann Institute of Science, Israel, during September 2002 to March 2003, as Feinberg Graduate School Fellow**

2. **Awarded UGC post Doctoral Fellowship during 2009-2010.**

Affiliation

Associate Professor (in Physics)
Department of Physics, Katwa College
Katwa, Burdwan-713130

Teaching Experience

Sl No	Institute/Organisation	Start Date	End Date	Designation	Type of work
a	Katwa College, Katwa, Burdwan	10/03/2000	09/03/2004	Lecturer	Undergraduate Physics Teaching (Both Hons. and general)
b	-do-	10/03/2004	09/03/2009	Senior Lecturer	-do-
c	-do-	10/03/2009	31/10/2012	Reader	-do-
d	-do-	01/11/2012	Till date	Associate Professor	-do-

News-Highlights

1. Our paper entitled "***Taming the escape dynamics of nonadiabatic time-periodically driven quantum dissipative system within the frame of Wigner formalism***" [***Chemical Physics*** *431,* 26 (2014) http://dx.doi.org/10.1016/j.chemphys.2014.01.008] was among the **10 MOST DOWNLOADED** articles in March 2014.

2. Our paper "***Realization of a Brownian engine to study transport phenomena: A semiclassical approach***" [**Physical Review E 81**, 061112 (2010), doi:10.1103/PhysRevE.81.061112] has been cited as a "***RESEARCH HIGHLIGHT" in NATURE INDIA*** [doi:10.1038/nindia.2010.87; Published online 30 June 2010]

3. We have contributed One Chapter in "***Recent Advances in Spectroscopy: Astrophysical, Theoretical and Experimental Perspective***", published by Springer (Heidelberg, 2010).

Grants Support

1. **CSIR (New Delhi, 2008-2011)**: Title "**Development and applications of theoretical models to study anisotropic diffusion and transport phenomena in some complex systems**" [01/2257/08/EMR-II dated 01.11.2008] **(Completed)**

2. **(1).UGC-Minor Project (Kolkata, 2007-2009):** Title of the Project **"Quantum dynamics of dissipative systems." (Completed)**

3. **(3) UGC-Minor Project (Kolkata, 2005-2007):** Title of the Project **"Philosophical Consequences of Quantum Physics" (Completed)**

4. **UGC (New Delhi, 2007-2009)**: Title "**Study of Dissipative Dynamics to Investigate the Transport Problem : Effects of Velocity Dependent Coupling**" [UGC-32-304/2006(SR)] **(Completed).**

Ph. D. Students

1. **Dr. Satyabrata Bhattarcharya** (Degree Awarded 2011, BESUS, Presently IIEST Shibpur)
2. **Dr. Pradipta Ghosh** (Degree Awarded 2011, BESUS, Presently IIEST Shibpur)
3. **Dr. Anindita Shit** (Degree Awarded 2013, BESUS, Presently IIEST Shibpur)
4. **Ms. Poulomi Chatterjee** (Registered, IIEST Shibpur)

Other relevant information

1. National Scholarship: For securing Rank 112 in Madhyamik Examination and Second Position in Murshidabad District.
2. National Scholarship for Higher Secondary result.
3. Summer visting Teacher Fellow (2006) of the Indian Academic of Sciences, Bangalore.
4. Fellow of Satyendra Nath Bose National Centre for Basic Sciences, Kolkata.

Teaching plan in brief

My primary aim in teaching is to bring onto fore the basic essence of the subject via thorough classroom teaching, using the most orthodox form of classroom lectures – chalk-and-talk. I personally trust this to be the best mode of teaching, especially for the beginners, since it ensures a complete process of learning by providing the student

ample space and time to the listener while the teacher works out the details on the board. In addition, the student also gets a scope to master the art of thinking from the scratch and the way to reach out to the audience. This in turn ensures a better and direct student-teacher interaction, which to some extent gets jeopardized in virtual classrooms, and teaching modes heavily relying on ornamental presentations. Theoretical Physics, by its inherent nature, is a mathematical subject and I trust that it should be understood mathematically at the first place. Mathematical issues, under the hood of a well-structured curriculum, needs to be dealt in a patient manner, allowing the students to have a feel that they are not learning mathematics for the sake of it, instead they have a greater goal to achieve, namely, to unravel the mysteries of nature. In addition, to help the students to have a better understanding, I would like to address the issues pertaining to the chronological evolution of the subject as a whole. My aim will be to inculcate among the students a true interest in the subject and motivate them further to pursue it in a fruitful manner, both academically and socially. I would prefer to address the more classical domains of Physics, like: (1) Mathematical Physics, (2) Classical Mechanics and Dynamical Systems, (3) Statistical Mechanics, and (4) Electrodynamics.

Doctoral research

1. Although in the treatment of classical theory of activated rate processes where the noise is of internal origin, one has a unique Boltzman distribution to characterize the equilibrium state, it is not always easy to describe the corresponding situation due to external stochastic driving by a unique steady state distribution (if the steady state is attainable at all). To address this and related questions, both in classical and quantum domain, we developed a phenomenological and a microscopic model for spectroscopic models and to study the escape rate from a metastable state. We analyzed the classical and quantum dynamics in the various range of dissipation and performed numerical simulation to support our theoretical predictions.

2. While the classical theory of activated rate processes is based on the differential equation for evolution of probability distribution function of a particle executing Brownian motion in a force field, quantum approach is based on path integral formulation which rely on the evolution of quantum partition function of the system interacting with environment. We posed the question whether there is any natural extension of the classical method to the quantum dynamics and demonstrated that Wigner-Leggett-Caldeira equation for Wigner probability phase space function which describes the quantum Brownian motion of the particle in a force field in a high temperature Ohmic limit may be interpreted as

a semi-classical Kramers' equation. This equation has been used to obtain the semi-classical correction to Kramers' rate (a slightly modified form of our equation has later been used by Coffey *et.al.* [W. T. Coffey, Yu. P. Kalmykov, S. V. Titov, and B. P. Mulligan, ***J. Phys. A: Math. Theor***. 40, F91 (2007); ibid ***Phys. Chem. Chem. Phys.*** 9, 3361 (2007)] and Garcia-Palacios [Garcia-Palacios and D. Zueco, ***J. Phys. A*** 37, 10735 (2009)].

Main Focus of Post-Ph. D. Research Work

1. Developed and applied the quantum theory of Brownian motion in presence of non-linear system-bath coupling, applicable for arbitrary strength of coupling. Such non-linear coupling appears in a variety of contexts as in superconducting tunnelling junctions etc. Its treatment allows calculating escape rate from meta-stable state.

2. Analysis of the interplay of noise and nonlinear dynamics under non-equilibrium conditions. One aspect involves directed motion in presence of non-linear system-bath coupling for ratchet type potential. Another one non-equilibrium transport due to the presence of two or more reservoirs at different temperatures.

3. Tried to understand the underlying mechanisms of molecular motors and to realize and construct new nano-electronic devices.
4. Examination of stochastic dynamics both in classical and quantum regime when the system and/or the bath are externally driven by time dependent force.

5. Investigation of quantum Langevin and Smoluchowski equations in terms of an effective time-independent Hamiltonian in the presence of a rapidly oscillating field by invoking multiple time scale analysis. Applications of our methodology range from the Paul trap to controlling particle bunching and dilution in particle accelerators. This methodology may be relevant for the manipulation of cold atoms and for the suppression of photo-ionization by electromagnetic fields.

Research Interest and Future Plan

The focus of our research is the investigation of small systems. The properties of objects at the nanoscale are dominated by quantum effects and by thermal fluctuations. They are moreover strongly influenced by the coupling to external environments. The precise understanding of the dynamical effects induced by such a coupling is of central importance in most branches of physics, most prominently quantum optics, solid state physics and nonequilibrium statistical physics. The interaction with the environment

can either *perturb* the evolution of the nanosystem and should therefore be minimized as much as possible - or on the contrary can be used as a powerful tool to *control* its dynamics. Here is a list of major environment-induced effects (classical and/or quantum-mechanical) which belongs to our research area:

- **Diffusion and Fluctuation phenomena**
- **Relaxation and Dissipation processes**
- **Noise-induced transport (Barrier dynamics, Brownian motors, Ratchet effect)**
- **Nano-thermodynamics (Quantum heat engine)**

The study of these various phenomena becomes particularly rich and challenging when system and/or environment are nonlinear or in some sense complex. We would like to develop and implement theoretical tools to treat these different problems, including classical and quantum stochastic theories as well as path integral approach to name a few.

Future Plan

1. Over the last decades or so, the development within the framework of renormalization group (RG) has been found to be relevant for treating the problems that are of single particle variety but are non-linear. This makes the Duffing oscillators, the Mathieu equation, the van der Poll oscillator and related problems amenable to the RG techniques. I would like to extend this technique to the situation where there is an external force, which may be regular or stochastic. We would also like to examine whether this has any bearing to the corresponding quantum dynamics and the dynamics of certain hydrodynamic flows. In this context, multiple scale perturbation theory needs a generalization to encompass classical and quantum stochastic dynamics. One application of such a study will readily be found in the context of the quantum statistics of Paul trap. This proposal is also relevant for the modelling of manipulation of cold atoms by electromagnetic fields. Resonant coupling between a field and an atom results in a potential, proportional to the intensity, on the centre of mass of the atom. This potential may oscillate with a frequency that is much larger than the frequencies related to the dynamics of the centre of mass (but much lower than the frequency of the light of the laser). This is the way the atoms are trapped in an effective light billiard. This study may also be relevant for the analysis of the electronic motion of atoms and molecules in the presence of strong laser fields.

2. The energy and charge transport problem in low dimensional systems has been an effective field of interest. Such an interest has been obviated by the new

advances in nano technology. Almost all of the studies regarding energy transport in low dimensional system, in presence of heat bath are restricted to classical domain, as the quantum treatment involves the solution of either Master equation or quantum Langevin equation, which are basically the operator equation but the amazing advances in nano-technology require quantum or semi-quantum treatment to understand energy transport. During last decades, three groups (Ankerhold in Germany [S. A. Maier and J. Ankerhold, ***Phys. Rev. E*** 81, 021107 (2010)], Coffey in UK [W. T. Coffey, Y. P. Kalmykov, S. V. Titov and L. Cleary, ***J. Chem. Phys.*** 131, 084101 (2009)] and Ray Chaudhuri in India [S. Bhattacharya, S. Chattopadhyay, P. Chaudhuri, and J. Ray Chaudhuri ***J. Math. Phys.*** 42, 073302 (2011)]) have developed parallel methodology to treat quantum Langevin and Master Equation where the system-reservoir coupling is not necessarily weak. We would like to examine energy transfer problem in nano-scale by using our methodology and would like to compare the results with the others.

It is enlightening to point out at this juncture that we have already demonstrated our method to be equivalent to those of Ankerhold et al. and Coffey et al., for the harmonic oscillator case when terms up to h^2 are being preserved [Phys. Rev. E. 83, 031125, (2011)].

3. If nano-technological devices are to be as efficient and reliable as biological molecules, a good understanding of open systems will be indispensable to their design in the coming days. Physical systems interacting with dissipative environment in the presence of external perturbation (to yield open system) are no longer contemplated as mere theoretical constructs; rather they have achieved a firm foothold for being integrated as a part of the practicable "design" itself. Such type of modulated systems (resulting in many novel, interesting experimental observations) are characterized by an extremely high degree of control that enables one to explore various problems of physical and chemical interest. Response to a time dependent oscillating field is such an issue, and is also the subject of our future interest. ***At present, applying system-reservoir model in the rotating frame we want to investigate the impact of modification of fluctuation-dissipation relation on dynamics and spectroscopy.***

List of School, Seminar, Workshop etc. attended:

1. 46-th Orientation Programme Conducted by UGC Academic Staff College, The University of Burdwan, from 2nd January, 2004 to 29th January, 2004.
   Obtained Grade A.

2. Visitor Programme, Department of Physics, IIT-Kanpur, during October 10 to November 07, 2005.

3. Workshop- 'PHYSICS 2005', Conducted by Department of Physics, IIT- Kanpur, during 03-06 November, 2005 and delivered a lecture entitled, 'Wigner Distribution : A Semiclassical Approach to Kramers' Problem.

4. All India Refresher Course in 'APPLIED STOCHASTIC PROCESSES', Organized by Indian Academy of Sciences, Bangalore, at Indian Statistical Institute, New Delhi, during 5th December 2005 to 17th December 2005.

5. Four week Refresher Course in Physics, conducted by UGC Academic Staff College, Jawaharlal Nehru University, New Delhi, during January 30 to February 24, 2006. Obtained Grade A.

6. 13th State Science and Technology Congress (28th February-1st March, 2006) and delivered a lecture on 'Semiclassical Approach to Kramers' Problem'.

7. International Workshop on 'Common Trends In Traffic Systems: Physical and Computational Models in Transportation Engineering and Biological Science', held at IIT-Kanpur, during 8th February to 10th February, 2006.

8. Third SERC Scholl on 'Nonlinear Dynamics', Sponsored by Department of Science an Technology, Govt. of India, during 4th December to 23rd December 2006, at IACS, Kolkata.

9. National Seminar on 'Indian Scientific Heritage; Aryabhatta to Harish Chandra', Organized by Ramakrishna Mission Vivekananda University, Belur Math, Howrah, on 23 and 24 February, 2007.

10. 8th Refresher Course in Physics, from 10th March-2007 to 30th March 2007, Conducted by UGC Academic Staff College, The University of Burdwan. Obtained Grade A.

11. National Symposium on Quantum Chemistry, Soft Computing & Optimization (April 04-05, 2008), at IACS, Kolkata.

12. Participated and delivered a contributory talk at the International Conference on 'Recent Advances of Spectroscopy', held at Kodaikanal, during January 28th-31st, 2009, organized by Indian Institute of Astrophysics, Bangalore.

13. Participated and Presented a Poster in the CRSI (Kolkata Chapter) Symposium-viii on 'Advances in Chemical Research', held on August 06, 2010, organized by Department of Chemistry, BESUS.

14. Participated and presented a poster in National seminar on "recent advances in Selected Topics of Chemistry-II", held on March 24-25, 2011, organized by Department of Chemistry, BESUS.

Possible referees are:

(1) Professor Deb Shankar Ray
Department of Physical Chemistry,
Indian Association for the Cultivation of Sciences
Kolkata- 700 032, India.
E-mail: pcdsr@iacs.res.in

(2) Professor Jayanta Kumar Bhattacharjee
Director, Harish-Chandra Research Institute
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E-mail: **jayanta.bhattacharjee@gmail.com**
jkb@hri.res.in

(3) Professor Eli Pollak
Department of Chemical Physics
The Weizmann Institute of Science
Rehovot 76100 Israel
E-mail: eli.pollak@weizmann.ac.il

(4) Professor Abraham Nitzan
School of Chemistry, Tel Aviv University,
69978 Tel Aviv, **Israel**
E-mail: nitzan@post.tau.ac.il

(5) Professor Joachim Ankerhold
Professor, Institut fur Theoretische Physik ,
University of Ulm
E-mail: **joachim.ankerhold@uni-ulm.de**

(6) Professor Rigoberto Hernandez
School of Chemistry and Biochemistry
Georgia Institute of Technology
Atlanta, GA 30332-0400
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(7) Professor Yoshitaka Tanimura
Department of Chemistry, Graduate School of Science,
Kyoto University, Sakyoku, Kyoto 606-8502, Japan
E-mail: **tanimura@kuchem.kyoto-u.ac.jp**

(8) Professor Satyajit Banerjee
Department of Physics, IIT Kanpur
Kanpur, UP 208016
Email: **satyajit@iitk.ac.in**

List of Publications

(A) Before Ph. D. Degree

1. Quantum theory of dissipation of a harmonic oscillator coupled to a nonequilibrium bath; Wigner-Weisskopf decay and physical spectra, **J. Ray Chaudhuri**, B.Deb,G.Gangopadhyay and D. S. Ray, ***J. Phys. B*** **31**, 3859 **(1998) .**
   URL: http://iopscience.iop.org/0953-4075/31/17/011

2. Theory of nonstationary activated rate processes: Nonexponential kinetics, **J. Ray Chaudhuri**, G. Gangopadhyay and D. S. Ray, ***J. Chem. Phys.*** **109**, 5565 **(1998).**
   URL: http://jcp.aip.org/resource/1/jcpsa6/v109/i13/p5565_s1?isAuthorized=no

3. Theory of adiabatic fluctuations: third-order noise, S. K. Banik, **J. Ray Chaudhuri** and D. S. Ray, ***J. Phys. A*** **31**, 7301 **(1998).**
   URL: http://iopscience.iop.org/0305-4470/31/36/005

4. Modified Bloch equations in the presence of a nonstationary bath, **J. Ray Chaudhuri**, S. K. Banik, B. Deb and D. S. Ray, ***Euro. Phys. J. D*** **6**, 415 **(1999).**
   URL: http://www.springerlink.com/content/ybuequxd60f71j1j/

5. A simple semiclassical approach to the Kramers' problem, **J. Ray Chaudhuri**, B. C. Bag and D. S. Ray, ***J. Chem Phys***. **111**, 10852 **(1999)**.
   URL: http://jcp.aip.org/resource/1/jcpsa6/v111/i24/p10852_s1?isAuthorized=no

6. A semiclassical theory of quantum noise in open chaotic systems, B. C. Bag, S. Chaudhuri, **J. Ray Chaudhuri** and D. S. Ray, ***Physica D***, **125**, 47 **(1999).**
   URL: http://www.sciencedirect.com/science/article/pii/S016727899800236X

7. Adiabatic noise induced escape rate for nonequilibrium open systems, S. K. Banik**, J. Ray Chaudhuri** and D. S. Ray, ***Indian J. Chem.*** **39A**, 300 **(2000). [Invited]**

8. The generalized Kramers' theory for nonequilibrium open one-dimensional systems, S. K. Banik, **J. Ray Chaudhuri** and D. S. Ray, ***J. Chem. Phys***. **112,** 8330 **(2000)**.
   URL: http://jcp.aip.org/resource/1/jcpsa6/v112/i19/p8330_s1?isAuthorized=no

9. Chaos and information entropy production, B. C. Bag**, J. Ray Chaudhuri** and D. S. Ray, ***J. Phys. A*** **33**, 8331 **(2000)**.
   URL: http://iopscience.iop.org/0305-4470/33/47/301
10. Analytical and numerical investigation of escape rate for an external noise driven bath, **J. Ray Chaudhuri**, S. K. Banik, B. C. Bag and D. S. Ray, ***Phys. Rev. E*** **63**, 61111 **(2001)**.
    URL: http://pre.aps.org/abstract/PRE/v63/i6/e061111

(B) After Ph. D. Degree

11. Escape rate from a metastable state weakly interacting with a heat bath driven by external noise, **J. Ray Chaudhuri**, D. Barik and S. K. Banik, ***Phys Rev. E* 73**, 051101 **(2006).**
URL: http://pre.aps.org/abstract/PRE/v73/i5/e051101

12. Dynamics of a metastable state nonlinearly coupled to a heat bath driven by external noise, **J. Ray Chaudhuri**, D. Barik and S. K. Banik, ***Phys Rev E.* 74**, 061119 **(2006)**.
URL: http://pre.aps.org/abstract/PRE/v74/i6/e061119

13. Generalization of the escape rate from a metastable state driven by external cross-correlated noise processes **J. Ray Chaudhuri**, S. Chattopadhyay and S. K. Banik, ***Phys. Rev. E*. 76,** 021125 **(2007).**

URL: http://pre.aps.org/abstract/PRE/v76/i2/e021125

14. Simple model for transport phenomena: Microscopic construction of Maxwell Demon like engine **J. Ray Chaudhuri**, S. Chattopadhyay and S. K. Banik, ***J. Chem. Phys.* 127**, 224508 **(2007)**.
URL:
http://jcp.aip.org/resource/1/jcpsa6/v127/i22/p224508_s1?isAuthorized=no

15. Directed motion generated by heat bath nonlinearly driven by external noise, **J. Ray Chaudhuri**, D. Barik and S. K. Banik, ***J. Phys. A: Math. Theor.* 40,** 14715 **(2007)**.
URL: http://iopscience.iop.org/1751-8121/40/49/007

16. Nonequilibrium fluctuation induced escape from a metastable state, **J. Ray Chaudhuri**, D. Barik and S. K. Banik, **Eur.** ***Phys. J. B.* 55**, 333 **(2007).**
URL: http://www.springerlink.com/content/53n600xgr1774814/

17. The quantum rate of escape from a metastable state non-linearly coupled to a heat bath driven by external colored noise , P. Ghosh and **J. Ray Chaudhuri**, ***J. Stat. Mech.*: *Theory and Experiment* doi:10.1088/1742-5468/2008/02/P02014.**
URL: http://iopscience.iop.org/1742-5468/2008/02/P02014

18. State-dependent diffusion in a periodic potential for a nonequilibrium open system, **J. R. Chaudhuri** and D. Barik, ***Eur. Phys. J. B* 63**, 117 **(2008).**
URL: http://www.springerlink.com/content/x1013m20t6h35316/

19. Multiplicative cross-correlated noise induced escape rate from a metastable state, **J. Ray Chaudhuri,** S. Chattopadhyay and S. K. Banik, ***J. Chem. Phys.* 128,** 154513 **(2008)**.
URL: http://jcp.aip.org/resource/1/jcpsa6/v128/i15/p154513_s1?isAuthorized=no

20. Time dependent current in a nonstationary environment: A microscopic approach, S. Bhattacharya, S. K. Banik, S. Chattopadhyay and **J. Ray Chaudhuri,** ***J. Math. Phys.*** **49,** 063302 **(2008)**.
URL: http://jmp.aip.org/resource/1/jmapaq/v49/i6/p063302_s1?isAuthorized=no

21. Directed motion in a periodic potential of a quantum system coupled to a heat bath driven by a colored noise, S. Bhattacharya, P. Chaudhuri, S. Chattopadhyay and **J. Ray Chaudhuri,** ***Phys. Rev. E*** **78,** 021123 **(2008).**
URL: http://pre.aps.org/abstract/PRE/v78/i2/e021123

22. Self consistent microscopic theory of frictional ratchet in a nonequilibrium environment, **J. Ray Chaudhuri** and D. Barik, ***Indian J. Phys.*** **82,** 1577 **(2008).**

23. Phase induced current in presence of non-equilibrium bath: A quantum approach, S. Bhattacharya, P. Chaudhuri, S. Chattopadhyay and **J. Ray Chaudhuri,** ***J. Chem. Phys.*** **129,** 124708 **(2008).**
URL: http://jcp.aip.org/resource/1/jcpsa6/v129/i12/p124708_s1?isAuthorized=no

24. Effect of correlated noises on directed motion, P. Chaudhuri, B. Mukherjee, S. Chattopadhyay and **J. Ray Chaudhuri,** ***Phys. Chem. Chem. Phys.*** **10**, 6097 **(2008)**.
URL: http://pubs.rsc.org/en/content/articlepdf/2008/CP/B808703B

25. Transport and bistable kinetics of a Brownian particle in a nonequilibrium environment, **J. Ray Chaudhuri,** S. K. Banik, S. Chattopadhyay and P. Chaudhuri, ***J. Math. Phys.*** **49**, 113303 **(2008)**.
URL: http://jmp.aip.org/resource/1/jmapaq/v49/i11/p113303_s1?isAuthorized=no

26. Harmonic Oscillator in Presence of Non-equilibrium Environment **J. Ray Chaudhuri,** P. Chaudhuri and S. Chattopadhyay ***J. Chem. Phys.*** **130**, 234109 **(2009)**.
URL: http://jcp.aip.org/resource/1/jcpsa6/v130/i23/p234109_s1?isAuthorized=no

27. Investigation of noise- induced escape rate: A quantum mechanical approach, S. Bhattacharya, S. Chattopadhyay and **J. Ray Chaudhuri,** ***J. Stat. Phys.*** **136**, 733 **(2009)**.
URL: http://www.springerlink.com/content/h051800688328762/

28. Microscopic realization of Kubo Oscillator, **J. Ray Chaudhuri** and S. Chattopadhyay ***Chem. Phys. Lett.,*** **480,** 140 **(2009).**
URL: http://www.sciencedirect.com/science/article/pii/S0009261409010495

29. Quantum transport in a periodic symmetric potential of a driven quantum system, S. Bhattacharya, P. Chaudhuri, S. Chattopadhyay and **J. Ray Chaudhuri,** ***Phys. Rev. E*** **80**, 041127 **(2009)**.
URL: http://pre.aps.org/abstract/PRE/v80/i4/e041127

30. Kubo Oscillator and its Application to Stochastic Resonance: a Microscopic Realization" in "***Recent Advances in Spectroscopy: Astrophysical, Theoretical and Experimental Perspective***", **J. Ray Chaudhuri** and S. Chattopadhyay (**Springer, 2010***)*.
URL: http://www.springerlink.com/content/r5000605m23620pr/

31. Stochastic resonance in a microscopically realized quantum linear system, P. Ghosh., S. Chattopadhyay and **J. Ray Chaudhuri, *J. Phys. Chem.* B.** *114*, 1368 **(2010)**.
URL: http://pubs.acs.org/doi/abs/10.1021/jp909858c

32. Generalized Einstein relation in tilted periodic potential: A Quantum mechanical approach, A. Shit, S. Chattopadhyay, S. K. Banik, **J. Ray Chaudhuri, *J. Phys. Chem. B.* 114**, 7854 **(2010).**
URL: http://pubs.acs.org/doi/abs/10.1021/jp912069k

33. Escape of a driven particle from a metastable state: A semiclassical approach, P. Ghosh. A. Shit, S. Chattopadhyay and **J. Ray Chaudhuri, *J. Chem. Phys.* 132**, 244506 **(2010)**.
URL: http://jcp.aip.org/resource/1/jcpsa6/v132/i24/p244506_s1?isAuthorized=no

34. Realization of a Brownian engine to study transport phenomena: A semiclassical approach, P. Ghosh., A. Shit, S. Chattopadhyay and **J. Ray Chaudhuri, *Phys. Rev. E* 81**, 061112 **(2010)**.
URL: http://pre.aps.org/abstract/PRE/v81/i6/e061112

35. Microscopic realization of cross-correlated noise processes, A. Shit, S. Chattopadhyay and **J. Ray Chaudhuri, *Chaos* 20**, 023130 **(2010)**.
URL: http://chaos.aip.org/resource/1/chaoeh/v20/i2/p023130_s1?isAuthorized=no

36. External noise driven bath and the generalized semiclassical Kramers theory, P. Ghosh., A. Shit, S. Chattopadhyay and **J. Ray Chaudhuri, *Phys. Rev. E* 82**, 041113 **(2010)**.
URL: http://pre.aps.org/abstract/PRE/v82/i4/e041113

37. A microscopic model for noise induced transport: Heat bath nonlinearly driven by external white noise, P. Ghosh., A. Shit, S. Chattopadhyay and **J. Ray Chaudhuri, *Chaos* 21**, 013117 **(2011).**
URL: http://chaos.aip.org/resource/1/chaoeh/v21/i1/p013117_s1?isAuthorized=no

38. Development of a quantum mechanical approach to compute mobility and diffusion coefficient of Brownian particle in a nonequilibrium environment, A. Shit, P. Ghosh., S. Chattopadhyay and **J. Ray Chaudhuri, *Phys. Rev. E.* 83**, 031125**, (2011)**.
URL: http://pre.aps.org/abstract/PRE/v83/i3/e031125

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