Curriculum vitae

AL MAGNIFICO RETTORE
DELL'UNIVERSITA' DEGLI STUDI DI MILANO **COD. ID: 6566**

Il sottoscritto chiede di essere ammesso a partecipare alla selezione pubblica, per titoli ed esami, per il conferimento di un assegno di ricerca presso il Dipartimento di _Fisica____

Responsabile scientifico: _Prof. Matteo Paris_________________________________

[Nome e cognome]

CURRICULUM VITAE

INFORMAZIONI PERSONALI

Cognome	Lakkaraju
Nome	Leela Ganesh Chandra

OCCUPAZIONE ATTUALE

Incarico	**Struttura**
Ph.D. scholar in Physics	Harish-Chandra Research Institute, Prayagraj, India

ISTRUZIONE E FORMAZIONE

Titolo	**Corso di studi**	**Università**	**anno conseguimento titolo**
Laurea Magistrale o equivalente	Physics	University of Hyderabad	2019
Specializzazione			
Altro	Bachelors in Technology in Electronics and communication engineering	Vardhaman college of Engineering, Hyderabad, India Affiliated to Jawaharlal Nehru Technological University, Hyderabad, India	2016

LINGUE STRANIERE CONOSCIUTE

lingue	**livello di conoscenza**
English	Fluent

PREMI, RICONOSCIMENTI E BORSE DI STUDIO

anno	Descrizione premio
2023	INFOSYS Scholarship for senior students - Harish Chandra Research Institute, India.
2019	Graduate Aptitude Test in Engineering in Physics – All India rank 16.
2019	Joint Entrance Screening Test in Physics – All India rank 55.
2019	National Eligibility Test (December NET) - Council of Scientific & Industrial Research, India – All India Rank-150.

ATTIVITÀ DI FORMAZIONE O DI RICERCA

descrizione dell'attività

PhD in Physics (ongoing)

I am doing a PhD in the Quantum Information and Computation Group at Harish-Chandra Research Institute, India started in 2019. I work under the guidance of Prof. Aditi Sen (De). My research focusses on both applicative and fundamental aspects of quantum manybody systems. I discuss the mainly the applicative side of the work in terms of quantum parameter estimation, quantum batteries and non-Hermitian systems from the perspective of open-quantum systems.

Quantum parameter estimation or quantum metrology:

Long-range quantum probe - (arXiv:2307.06901) - We have proposed a quantum sensor based on a many-body system to estimate the strength of the on-site magnetic field. The performance of the quantum probe gets enhanced by introducing long-range interactions. In particular, the probe is initialized as the ground state of the long-range Hamiltonian, an optimal measurement on the first qubit is performed followed by an evolution via the same Hamiltonian and by the interaction of the target field with the probe. We have found that the uncertainty in the measurement of the field decreases as the range of interaction increases. We have also found that in the presence of an environment, the advantage in terms of uncertainty for a long-range system persists.

Higher-dimensional probe - (arXiv:2401.14853) - Recently, we addressed a similar configuration as above, but the probe is made up of qudits rather than qubits. We showed that the upper bound on quantum fisher information increases as the dimension increases. We have proven dimensional advantage in two-folds – 1) The d-dimensional Ising model was utilized as the quantum probe, and as the dimension increases, the degree of uncertainty in the estimated magnetic field value decreases 2) the range of time for which the probe crosses the standard quantum limit increases with the dimension. In addition to it, there is contrasting behaviour in terms of half-integer and integer spins. Specifically, we have calculated how close the minimum uncertainty gets to the Heisenberg limit and found that the systems with half-integer spins perform much better as compared to their integer counterparts.

Quantum thermodynamics: Quantum batteries

Quantum batteries are some of the first devices that witnessed the wave of miniaturization. We have worked on two such designs.

Cold-atom quantum battery - (Phys. Rev. A 106, 022618 (2022)) - We investigated a battery composed of either bosons or fermions. By considering the initial state to be the ground state of the fermionic-(bosonic-) Hubbard model, we let it charge under the on-site interaction term. We have observed that fermions store more power when the initial state is the ground state while if the initial state is a thermal state, bosons store more energy than the fermions. We have also incorporated experimental noise as disorder present in the system and found that a certain kind of "order from disorder" emerges.

Non-Hermitian quantum battery - (Phys. Rev. A 109, 042207 (2024)) - The initial state of the battery belonging to the Hermitian Hamiltonian is charged by a non-Hermitian Hamiltonian. Such a non-Hermitian charger can be realized when the Hermitian Hamiltonian is in contact with an environment. More specifically if the quantum jumps are ignored in an open quantum system evolution governed by a Lindbladian, the effective Hamiltonian is non-Hermitian. We have examined a local PT-symmetric charger with an interacting battery Hamiltonian and an RT-symmetric charger for a local battery Hamiltonian. Especially the RT-symmetric charger can be realized if the system is in contact with an engineered reservoir. We have found that the amount of stored power via a non-Hermitian charger is higher than the Hermitian charging scenario.

Non-Hermitian spin-systems:

Factorization and exceptional points - (Phys. Rev. A 104, 052222 (2021)) - Non-Hermitian systems are ubiquitous. Such systems are distinct from their Hermitian counterparts due to the presence of exceptional points, line energy gaps, and skin effects. We consider an XY spin-½ model that contains an imaginary anisotropy parameter, say iXY. We have shown an intricate connection between iXY and the Hermitian XY model. The factorization point of the XY model, where the entanglement of the ground state vanishes is related to the exceptional point of the iXY model, where the Hamiltonian becomes defective and the parameter space splits into broken (complex spectrum) and unbroken(real spectrum) phases.

Non-hermitian DQPT - (arXiv:2212.12403) - In the following paper, we have explored the role of quench dynamics in identifying the exceptional point. We took the initial state as the ground state of the Hamiltonian when the spectrum is real and quenched with the Hamiltonian corresponding to both sides of the exceptional point. The dynamics have been shown to distinguish whether the evolving Hamiltonian belongs to the unbroken or broken phase and thus detects the exceptional point with the help of Loschmidt echo and bipartite entanglement.

Non-Hermitian spins with KSEA interaction - (arXiv:2305.08374) - We have recently found that if we add Hermitian KSEA interaction to the iXY model, an interesting phase diagram emerges in terms of critical points. We have established the existence of quantum critical points, where the gap closing occurs as the strength of KSEA interaction is greater than gamma. In this setting, the model resembles the properties of the XY model even though it is non-Hermitian. In the reverse scenario, when KSEA > gamma, we have found the analytical forms of exceptional and factorization points. Finally, bipartite entanglement has been shown to indicate, both in and out of equilibrium, all of the mentioned interesting transition points

CONGRESSI, CONVEGNI E SEMINARI

Data	Titolo	Sede
May 8 – June 15, 2023	(Talk) Entanglement and phase transition in the long-range extended Ising model	4th International Conference on Quantum Information and Quantum Technology at Indian Institute of Scientific Education and Research, Kolkata, India
February 15-18, 2023.	(Poster) Detecting Exceptional Point through Dynamics in Non-Hermitian Systems and Quantum Battery with Non-Hermitian Charging	Young Quantum, 2023 at Harish-Chandra Research Institute, Prayagraj, India
September 18-22, 2022	(Poster) Detection of unbroken phase of non-Hermitian system via Hermitian factorization surface	Meeting on Quantum condensed matter at Indian Institute of Technology, Kanpur, India
March 7-11, 2022	(Poster) Detection of unbroken phase of non-Hermitian system via Hermitian	Quantum Information Processing at California Institute of Technology, California, USA (online)

	factorization surface	
September 1 - 4, 2021	(Poster) Randomness Amplification under Simulated PT -symmetric Evolution	Asian Quantum Information Science Conference, Tokyo, Japan
October 12-15, 2022	(Poster) Distribution of entanglement with variable range interactions	Young Quantum,2022 Harish Chandra Research Institute, India

PUBBLICAZIONI

Articoli su riviste
"Quantum Battery with Ultracold Atoms: Bosons vs. Fermions", *T. K. Konar*, ***L. G. C. Lakkaraju***, *S.Ghosh and Aditi Sen (De)*, **Phys. Rev. A. 106, 022618 (2022).**
"Quantum Battery with Non-Hermitian Charging", *T. K. Konar*, ***L. G. C. Lakkaraju***, *and Aditi Sen (De)*. **Phys. Rev. A 109, 042207 (2024).**
"Detection of unbroken phase of non-Hermitian system via Hermitian factorization surface", ***L. G. C. Lakkaraju*** *and Aditi Sen (De)*. **Phys. Rev. A. 104, 052222 (2021).**
"Mimicking quantum correlation of a long-range Hamiltonian by finite-range interaction", ***L. G. C. Lakkaraju***, *S. Ghosh, D. Sadhukhan and Aditi Sen (De)* - **Phys. Rev. A. 106, 052425 (2022).**
"Distribution of entanglement with variable range interactions", ***L. G. C. Lakkaraju***, *S. Ghosh, Saptarshi Roy and Aditi Sen (De)*, **Phys. Lett. A. 418, 127703 (2021).**
"Predicting Topological Quantum Phase Transition via Multipartite Entanglement from Dynamics", ***L. G. C. Lakkaraju***, *S. K. Haldar and Aditi Sen (De)*, **Phys. Rev. A. 109, 022436 (2024).**
"Emergence of maximal acceleration from non-commutativity of space-time", *E. Harikumar*, ***L. G. C. Lakkaraju***, *V. Rajagopal*, **Mod. Phys. Lett. A. 36, 10, 2150069 (2021).**

Preprints
"Better sensing with variable-range interactions", *M. Mothsara*, ***L. G. C. Lakkaraju***, *S. Ghosh and Aditi Sen (De)*, **arXiv:2307.06901.**
"Dimensional gain in sensing through higher-dimensional quantum spin chain", *S. Singh*, ***L. G. C. Lakkaraju***, *S. Ghosh and Aditi Sen (De)*. **arXiv:2401.14853.**
"Discovering Factorization Surface of Quantum Spin Chains with Machine Learning", *Nakul Aggarwal, Keshav Das Agarwal, Tanoy Kanti Konar*, ***L. G. C. Lakkaraju*** *and Aditi Sen (De)*, **arXiv:2404.10910.**
"Framework of dynamical transitions from long-range to short-range quantum systems", ***L. G. C. Lakkaraju***, *S. Ghosh, D. Sadhukhan* and Aditi Sen (De), **arXiv:2305.02945**.
"Decoherence-free mechanism to protect long-range entanglement against decoherence", ***L. G. C. Lakkaraju***, *S. Ghosh, and Aditi Sen (De)*, **arXiv:2012.12882**.
"Recognizing critical lines via entanglement in non-Hermitian systems", *K. D. Agarwal, T. K. Konar*, ***L. G. C. Lakkaraju*** *and Aditi Sen (De)*, **arXiv:2305.08374.**
"Detecting Exceptional Point through Dynamics in Non-Hermitian Systems", *K. D. Agarwal, T. K. Konar*, ***L. G. C. Lakkaraju*** *and Aditi Sen (De)*, **arXiv:2212.12403.**
"Necessary condition for information transfer under simulated PT-symmetric evolution", ***L. G. C. Lakkaraju***, *S. Mal and Aditi Sen (De)*, **arXiv:2102.13630.**
"Trade-off between Noise and Banding in a Quantum Adder with Qudits", *G. Agrawal, T. K. Konar*, ***L. G. C. Lakkaraju*** *and Aditi Sen (De)*, **arXiv:2310.11514.**

"Quantum Resources in Harrow-Hassidim-Lloyd Algorithm", *P. Kumar, T. K. Konar, **L. G. C. Lakkaraju** and Aditi Sen (De)*, **arXiv:2308.04021.**
"Predicting Critical Phases from Entanglement Dynamics in XXZ Alternating Chain", *K. D Agarwal, **L. G. C. Lakkaraju** and Aditi Sen (De)*. **arXiv:2112.12099.**

ALTRE INFORMAZIONI

Tutoring Activities January - May 2022: Teaching assistant for course on Quantum information and computation 2 - Instructor: Prof. Aditi Sen De and Ujjwal Sen, Harish Chandra Research Institute, India January - May 2021: Teaching assistant for course on Electronics- Instructor: Prof. Sitangshu Bhattacharya, Harish Chandra Research Institute, India
Organizing activities December 04 - 10, 2023: Member of the organizing committee - QIPA 2023 - Harish Chandra Research Institute, India February 15 - 18, 2023: Member of the organizing committee - YouQu 2023 - Harish Chandra Research Institute, India October 12 - 15, 2022: Member of the organizing committee - YouQu 2022 - Harish Chandra Research Institute, India
Referee for Scientific Journals Journal of Physics A: Mathematical and Theoretical and Journal of Physics: Condensed Matter.

Le dichiarazioni rese nel presente curriculum sono da ritenersi rilasciate ai sensi degli artt. 46 e 47 del DPR n. 445/2000.

Il presente curriculum, non contiene dati sensibili e dati giudiziari di cui all'art. 4, comma 1, lettere d) ed e) del D.Lgs. 30.6.2003 n. 196.

RICORDIAMO che **i curricula SARANNO RESI PUBBLICI sul sito di Ateneo** e pertanto si prega di non inserire dati sensibili e personali. Il presente modello è già precostruito per soddisfare la necessità di pubblicazione senza dati sensibili.

Si prega pertanto di **NON FIRMARE** il presente modello.

Luogo e data: Harish Chandra Research Institute, India - 20/04/2024