Designing Optimal Quantum Information Strategies that achieve Fundamental Performance Limits

Context of the Project : In the recent past, it has been established beyond doubt that by leveraging the unique quantum properties of sub-atomic particles, one can design information processing strategies that yield unparalleled advantages in diverse disciplines of information processing including computing, communication, cryptography and control. In fact, protocols such as quantum key distribution accomplish tasks hitherto believed impossible. Notably, these protocols have been demonstrated in practice and research is underway to scale them up. We are shaping up towards emergence of a new age in information processing. Recognizing this vast potential, developed countries across the world including United States, France, Germany, Netherlands, China, Singapore and others are investing vast amounts of money and resources in quantum information. New labs are being formed, several startups are emerging. Just like the last two decades offered great jobs in technology, research and academia in classical digital information, the coming decades is expected to generate such opportunities in quantum information. The younger generation who now gets trained in this new emerging area will be able to command great opportunities as they grow in their career.

Mastering quantum information is a challenging task today. It is at the intersection of physics, mathematics and engineering - computer science and electrical engineering. More so, the field is currently dominated more by physicists and mathematicians. The doctoral program advertised below provides a unique opportunity to gain expertise and become a leader in quantum information. Hosted at EURECOM - a top research institution of France that is strongly connected to leading universities of Europe including TU Munich, IMT, Telecom Paris - it provides an ideal environment to pursue research. With leading research labs such as INRIA right beside EURECOM, the doctoral student will get a unique opportunity to interact with leading researchers in France and beyond. Moreover, this project on which the PhD student will be recruited is an international project jointly funded by agence nationale de la Recherche, France and National Science Foundation, USA. This project will involve collaborations with leading researchers in France and USA and will involve workshops and project meetings that will provide a great opportunity for the student to interact with the top researchers working in quantum information.

Broad outline of the Project: The PhD project will be in the broad areas of quantum information theory, quantum learning, quantum statistics, quantum source compression, intersecting one or multiple of these areas. The focus will be on designing technology-independent strategies for different quantum information processing tasks such as source compression, qubit communication, quantum statistical learning that are optimal in the sense of achieving fundamental performance bounds. The listed references [1]–[7] indicate a related set of problems to the one the PhD student will be working on.

Specific advantages of this job offering : A close hands-on regular interactions with faculty advisors and hands-on research mentoring and training. This is a crucial aspect to educate oneself and become an expert in this deep field of research. An opportunity to work on foundational problems and thereby obtain a thorough understanding of the intricacies of the field. For a student, GENUINELY interested to ACQUIRE KNOWLEDGE, and become an expert, the former is very valuable in shaping up one's career. This specific advantage offered in this position is perhaps less available in large research groups. The faculty advisor will provide an interested candidate with earlier and/or senior students so the candidate gets a good understanding of the research culture and the both the advantages and disadvantages of joining the group. Any candidate genuinely interested to elevate one's knowledge, learn research skills and enhance oneself is strongly encouraged to have a transparent interaction with the group they wish to join including past and present students who have experienced the research culture. This will be facilitated by transparently providing contacts of students who have worked with the faculty advisor.

Faculty Supervisor : Dr. Arun PADAKANDLA

Duration of the Project : June 2026 - May 2029

Location of the PhD Studies : EURECOM, Sophia-Antipolis, Alpes Maritime, France.

REFERENCES

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