Introduction to Quantum Information

(3 hours per week)

1. Classical probability theory ([4, 9, 6, 8, 17])
   - Definition of probability space
   - Basic concepts and usage
   - Large deviation theory
2. Classical information ([11, 15, 6])
   - Is information physical?
   - Shanon theory of information
   - Correlation and information
3. Quantum mechanics ([12, 16])
   - Postulates of quantum mechanics
   - Interpretations of quantum mechanics (very briefly)
   - Density matrices, completely positive trace preserving maps, positive operator valued measure
   - Non-classicality of quantum mechanics (various approaches: Statistical theory with restriction)
4. Quantum information ([18, 12, 3])
   - Von Neumann Entropy
   - Conditional entropy
   - Quantum mutual information
5. Resource theory ([7, 14, 10, 13])
   - Resource inequalities, monotones
   - Entanglement
   - Quantum discord
   - Generalized entropies and quantum thermodynamics
6. Bell inequalities ([1, 2, 5])
   - A Game
   - CHSH inequality

Approximately each week the students will have to do homework which will be evaluated and will represent 50% of the score for the course. At the end of the course there will be a final exam, which will represent the other 50% of the score.

References

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[6] T. M. Cover and J. A. Thomas. *Elements of information theory.* John Wiley, 1991.

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