

**Quantum Information (WiSe 2019/2020)**  
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Date	Type	Content
14.10.2019	L (MW)	Intro (what is “Information”?), overview, and a pico reminder of probability
15.10.2019	L (MW)	A little bit of information theory, covering the bit, the memoryless source, and the Shannon entropy
21.10.2019	L (MW)	Shannon source coding theorem, Huffman code
22.10.2019	X (TF)	Problem Set No 1
28.10.2019	L (MW)	Channel coding, covering the notion of a channel, the mutual information, channel rates and capacities
29.10.2019	L (MW)	Shannon channel coding theorem, error correcting codes
04.11.2019	L (MW)	Pico-review of cryptography
05.11.2019	X (TF)	Problem Set No 2
11.11.2019	L (MW)	Pico-review of the quantum mechanics of pure states, introducing the qubit
12.11.2019	L (MW)	Manipulation and Control of single qubit states
18.11.2019	L (MW)	Quantum-Cryptography (mostly BB84)
19.11.2019	X (TF)	Problem Set No 3
25.11.2019	L (MW)	Composite systems, entanglement (bi-partite, pure states)
26.11.2019	L (MW)	EPR, Bell inequalities and all that
02.12.2019	L (MW)	Nick Herberts superluminal telephone, No-Cloning-Theorem, Quantum-Dense-Coding, Quantum-Teleportation, and the Werner Magic Trinity
03.12.2019	X (TF)	Problem Set No 4
09.12.2019	L (MW)	Mixed states, von Neumann Entropy
10.12.2019	L (MW)	Quantum Channel
16.12.2019	L (MW)	Criteria/Measures of Entanglement
17.12.2019	X (TF)	Problem Set No 5
06.01.2020	L (MW)	Models of Computation
07.01.2020	L (MW)	Essence of Quantum Computation (Deutsch-Josza)
13.01.2020	L (MW)	Models of Quantum-Computation (Q-Gates and Networks)
14.01.2020	X (TF)	Problem Set No 6
20.01.2020	L (MW)	Shor Algorithm (fast factorization) – classical basics
21.01.2020	L (MW)	Shor Algorithm – quantum network model
27.01.2020	L (MW)	Grover Algorithm (fast data base search)
28.01.2020	SP	Student Presentation QuInfo mit Einzelphotonen (Schröder) BB84-update (Noell) Physics of Forgetting (Piotrowski) Pendry-Principle (Rick Simon)
03.02.2020	SP	Student Presentation Information Security (Alsbikhan) Elliptic Curve Cryptosystems (Kailmann) Shamir Secret Sharing (Michaelis) Qu-Data Compression (Krüger)
04.02.2020 12:00-14:00	SP	Student Presentation Zahlentheoretische Basis Shor (Mau) Grover in Genetik? (Hübner) Qu-Comp mit Ionenfallenprozessoren (Kutschera) Non-Standard Computing (Westermann)

### Topics for student presentation

- Landauer's principle No 1 and "The Physics of Forgetting".
- Landauer's principle No 2 and the limits on communication rates.
- The number-theoretic basis for the Shor factoring algorithm (Chinese remainder theorem etc)
- Quantum Cryptography – state of the art
- Current experimental lab-schemes for the implementation of elementary quantum gates.
- Google's "Bristlecone" – quantum supremacy or business inferiority?
- What's quantum about "D-Wave System's Quantum Computer"?
- "Bitcoin" – how does it work?
- Any other topic of your choice