Syllabus for Physics 709 Fall 2022.   Mark Saffman
revised 2022.09.27 (subject to change)
Lectures in Ch 2120, TR 11:00-12:15

week	lecture	day	date	topic	HW out	HW due	reading in QI notes	
1	1	R	8.sep	Introduction			ch.1	
2	2	T	13.sep	Q.M. refresher	1		App. A, ch.2	B.B. lecture
	3	R	15.sep	Finish Q.M. review, spin 1/2, qubits and Bloch sphere, quantum gates				
3	4	T	20.sep	global phases, phase kickback, subroutines, QFT, Universal gate set, Gottesman Knill theorem, Solovay Kitaev theorem		1		
	5	R	22.sep	no cloning, approximate cloning, measurements, quantum projection noise, measuring in Bell basis, parity measurement, POVM			ch.3	S.K. lecture
4	6	T	27.sep	DiVincenzo criteria, neutral atom qubits, Deutsch Jozsa algorithm	2		ch.4	
	7	R	29.sep	Grover's algorithm, Simon's problem				
5	8	T	4.oct	Shor algorithm 1				
	9	R	6.oct	Shor algorithm 2, VQE, QAOA	3	2		
6	10	T	11.oct	Complexity theory, classical vs. quantum			ch.5	
	11	R	13.oct	Density matrices, pure states, mixed states, entanglement measures			ch.6,7	
7	12	T	18.oct	EPR, Bell inequalities, quantum cakes paper, multiqubit entanglement, GHZ states for enhanced phase sensitivity		3	ch.8,9	
	13	R	20.oct	midterm review				
8	14	T	25.oct	MIDTERM in class				
		R	27.oct	midterm solutions. Pure vs. mixed states. Physical resources for quantum computation, high level survey of quantum computing platforms	4			
9	15	T	1.nov	quantum networks, quantum channel capacity, superdense coding, QKD			ch.10	
	16	R	3.nov	state and gate teleportation, entanglement swapping				
10	17	T	8.nov	quantum sensing, clocks	5	4		
	18	R	10.nov	quantum repeaters. Open quantum systems, time evolution			ch.11	
11	19	T	15.nov	Quantum processes, Lindblad equation				
	20	R	17.nov	Bloch equations, Rabi oscillations, Kraus operators				
12	21	T	22.nov	Quantum tomography of states and processes, Randomized Benchmarking		5	ch.12	
		R	24.nov	Thanksgiving				
13	22	T	29.nov	Error corrrection - Introduction	6		ch.13	
	23	R	1.dec	Classical Hamming codes, errors from environment, 3q bit flip code, Shor code				
14	24	T	6.dec	Stabilizer codes, Steane code, threshold theorem, fault tolerance				
	25	R	8.dec	Surface code, experiments		6		
15	26	T	13.dec	TBD				

Final exam - project presentations
Friday december 16, 10:05 - 12:05