1 Lec 18, 19 and ch. 3

1.1 Lec 18

- a few lines above equation 18.9, it says "the qauntity e^S is the minimal number of .... ". How can we see that it is really the *minimal* number of new states needed. I think this might just follow from 18.11.
- [2] Why do we expect for the spin chain that A should be in general maximally entangled with B?
- [2] Intuitively I see why the ground state should have less entanglement than a generic state but why is it specifically area instead of volume? And why is it only for gapped theories?
  - What is the justification for equation 18.15?
- equation 18.16: What is meant by the 'area' of a system with one spatial dimension?
- He says that a diagonal density matrix is a classical distribution and I see why but we can always diagonalize the matrix so what exactly does that mean?
  - Classically, the operators commute and, therefore, if you diagonalize one of them, you can diagonalize all of them. We can't do that in QM. So, either ρ or σ would be diagonalizable in the end I would say.
- I don't understand the interpretation of the relative entropy that he talks about in the classical case.
- We know how to interpret entanglement entropy for reduced density matrices but what is the interpretation for the full state?
- What does a maximally entangled state of 3 qubits look like?
- I think I should be able to do it but I don't know how to get (18.21) and (18.23) from relative entanglement entropy.
- If we can define and talk about entropy, could we also define and talk about other thermodynamic quantities? Is that useful?

1.2 Lec 19

- Recent results on entanglement of spacetime couldn't indicate it should have some underlying discretization?
- What does he mean by: "In the UV, any finite energy state is the same as the vacuum state."?
- The claim that "groundstates occupy a tiny, special corner of the Hilbert space" which has low entanglement doesn't seem to carry through to QFT where the ground state is maximally entangled. Is this related to the fact that QFT is not bipartite and if so, which of the "things to worry about" discussed after eq 19.2 is responsible for this?
- In 19.3: is there also a divergent piece which is an integral over the bulk of A (i.e. the usual UV divergences of QFT)? Shouldn't the functional F also depend on the fields of the QFT?
- shortly after 19.3: "UV modes ..., and the number of these modes is proportional to the area". Isn't there an infinite number of UV modes?

1.3 Ch. 3

- How fair is the comparison of the 2-spin system with the infinite continuum degrees of freedom of spacetime?
- When considering a 2-spin system, if in the 'right' basis, we can reproduce all the results as if they were classical, having the nature of entanglement showing up only when considering different basis. Is this that is happening when we change from energy eigenstates to boos generator ones?
- What in the heck means the vaccum is an entangled state?