projectSiegen | Summary

May 15, 2015

1 May 7-13

1.1 Impressions

- I started with reading about Modular Variables from 'Dynamical quantum non-locality', a perspective paper from Nature Physics. The paper basically talks about how modular variables capture the essence of a quantum state in a way that no other variable we've considered so far does. It relates this to non-locality in quantum mechanics. This non-locality however is not the one usually considered in the context of say the singlet state. The point they make is that this non-locality arises from the equations of motion (Heisenberg picture), which are non-local themselves (since operators are involved). I found the paper is simple, subtle and interesting.

- Next I started reading a paper titled 'Quantum interference experiments, modular variables and weak measurements' from IOP Science. This I was told is an elaboration of the perspective paper. However, I didn't complete this for I hadn't frozen the topic yet.

- I talked to a person named 'Roope' at the group and his work came across as rather fascinating. I was impressed by his work; it is related to 'measurement equivalent of mixed state'. You make a certain kind of measurment with a certain classical probability. With this type of measruement operators, he was able to show that for compatiblity, commutation is not the best criterion. Of course compatability means that the two measurement can be done simultaneously without affecting each other. He gave a good example from his paper 'Joint Measureablity of Generalized Measruements Implies Classicality', PRL to illustrate the points. His main result was unification of the concept of steering with that of his test of joint measurement, viz. compatibility.

- Modular variables are discussed quite neatly in the book by Aharonov et. al., titled 'Quantm Paradoxes: Quantum Theory for the Perplexed'. I read the first few pages, which are a delight to read (about how paradoxes help, classification of paradoxes etc.). I read the main chapter related to modular variables. I still have some small doubts which I'll clarify soon. Other than that, I have a good basic idea of the concept.

- I talked to 'Costentino' who basically told me that his work revolves around looking at Bells inequalities in more complicated systems. I didn't find that particularly attractive. I also talked to 'Nicolai' and he told me he works on finding interesting states. The kind of states he/they look for are such that the sub systems (partially traced) are separable but the entire state is 'genuinely entangled' (this is the region of state space excluding separable and after tracing entangled states). He talked about witnesses and an algorithm to find an optimal witness and an optimal state correspondingly, recursively, starting from a random initial state matrix. This was ok, but again, not very appealing to me. And last person for the (that) day, I talked to 'Marius' and he told me about how he studies bell's inequalities in decaying particles, and his system of choice was Kions. Again, it maybe non trivial and hard, but didn't come accross as worth pursuing.

- Discussed various topics with Roope including
  - How contextuality is expected from usual understanding of QM, but it is essential to characterize the quantum feature of the system (later Dr. Guehne explained how in Bell's case, local hidden variable is the assumption, whereas here, the assumption is non-contextuality [since we're talking about only one system])
  - Discussed how one can exponentiate an unbounded operator. He seemed to have some big mathematical machinary, but I am still not convinced that it is necessary.
  - I wasn't able to understand how to prove (especially after the new definition of exponentiation) $[e^A, e^B] = 0 \implies [A, B] = 0$. We tried some things, but they didn't help much.
  - Implementing causality etc.

- Maria: She works on hypergraph states. The idea is to represent quantum states as graphs. One can show the limits of usual graphs of this form. The limit is that one can represent say the GHZ state, but not a related less entagled state (forgot the name). She had made a lot of new progress in barely 3 months. She found states which maximally violate the bell inequality in 3 qubits, which weren't known earlier. She was able to even derive conditions on probablities of certain outcomes which consequently rule out various local hidden variable models. In the course of doing this, she'd made various conjectures and proven them, by looking at patterns in certain calculations. I found her work rather interesting and impressive, given that she did it all in barely 3 months (and that she is/was a computer science student), but not something I'd pursue.

- Frank: He started with explaining various usual quantum optics subtopics, such as action of a beam splitter in terms of creation anhilation operators, how its action is similar to that of CNOT, how it can easily convert superposition to entanglement, how a coherent state would pass through it etc. Then he mentioned what's called a P distribution, (stands for P something and Sudarshan distribution) which is given for a state ρ as $P_\rho(\alpha)$, with $\alpha \in C$, and s.t. $\rho = \int P_\rho(\alpha) |\alpha\rangle \langle\alpha|$. This he said is more useful in characterizing quantum properties. Then he discussed how like in the one qubit case, we have a bloch sphere, we can construct similar objects with more qubits also. Then he talked about relating $|\alpha\rangle = D(\alpha)|0\rangle$ with creating states from the extremum state, like $|j,j\rangle$ by applying similarly constructed D equivalents, except in this case with $J_\pm$ instead of a, $a^\dagger$. He claimed that the states in the orbit of this group (group of transformations), don't span the full space. He said that mixed states so produced can then be mapped to entangled state like was done with the beam splitter. The details he said are involving. This also looked interesting, but again, not the direction in which I'd like to work at the moment.