25.11. Bell's Speakable and Unspeakable in Quantum Mechanics (1974): Chapter 4, Introduction to the hidden-variable question.

Presenter (10 min):
Sketch the key result. (Hint: Do not spend too much time on section 3)
Bibliometrics: what do you know about the author? Which papers and results does it build on? What are the implications of this result?

Everybody:

1. What are the 'hidden variables' and the hypothesis of incompleteness of the wave-function description as argued by Einstein, Podolsky and Rosen? Where lies the paradox?
2. What are conjugate variables in Heisenberg's uncertainty principle? Can you give some examples?
3. What are 'dispersion-free' states, why quantum-mechanical states cannot have this property and what is the connection with the hidden-variable problem.
4. Why does the requirement for additive expectation values exclude the possibility of dispersion-free sates?
5. What is the connection drawn from the example of the three operators in p.32 with respect to additivity and von Neumann's argument.
6. What is the exact setup of the example of the two spin-1/2 particles in section 4?
7. What does locality mean for the probability distribution of the measurement outcomes?
8. What is P here? Nowadays we use a different letter to denote it.
9. Bell is making a new assumption, which in the Clauser,Horne 1974 paper gets a proper name, can you figure out what that is?
10. Why do we now have (8) instead of (7)? What is the extra underlying consideration?
11. Which inequality is applied to derive equation (9)? Can you follow all the steps?
12. Can we actually take Equation (9) even one step further, and what is this inequality now known as?
13. What is the connection between the original Bell inequality and Eq. (9)?
14. Does the singlet state satisfy the inequalities presented above?
15. Do you already know what is the maximum value with which an entangled state violates the inequality?
16. Are you aware of the translation of this inequality to a two-party game? What is the formulation of it?