

Scientific Methodology

Deductive versus Inductive Thought

Essential to the dark art of physics is determining whether the failing of a prediction of a theory is due to a minor anomaly or instead requires alteration reaching back to its foundations. By far, most research published each week in the physics journals is of the former type and progress in the knowledge base of physics, the *Nexus of Knowledge* (see Chapter 6), gradually grows as contributions continually expand and fine-tune our understanding, [Figure 5.22](#).



Figure 5.22: Nexus of Knowledge: knowledge base of physics grows outward from established results (trunk) by examining experimental results (branches) consistent with induction from current theoretical predictions within accepted error (black) and those not yet explained by existing theory (striped) which may require deduction.

Progress of this type can be achieved by using induction to extrapolate from existing theory (solid line branches). However, understanding of the quantum measurement problem is expected to be of the daring variety since it has resisted solution for so long and involves fundamental physics across a wide range of issues (striped branches). As discussed in Chapter 6, problems such as quantum measurement are expected to require a deductive approach rather than simply inductive extensions of existing theory. However, this clearly differs from a straightforward application of deductive logic since physics is further constrained both by the results of empirical observation and by the existing body of physical principles that have been historically established.

Due to the necessary consistency with these constraints, deduction within the foundations of physics is not an automatic process that can be easily mechanized, but rather an unruly enterprise requiring bold intuition and an ability to deal with paradox and uncertainty and contradiction. This is because, except for maintaining the established physical principles, all legitimate possibilities must remain on the table in the course of deduction and the investigator must be open to the circumstance found by Holmes that “when you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth.” [537]