What Is Fundamental in Fundamental Physics? By Pentcho Valev

The following quotation, combined with an additional assumption, makes the answer to the question in the title short, obvious, and requiring little further discussion. Here is the quotation:

Albert Einstein: *From a systematic theoretical point of view, we may imagine the process of evolution of an empirical science to be a continuous process of induction. Theories are evolved and are expressed in short compass as statements of a large number of individual observations in the form of empirical laws, from which the general laws can be ascertained by comparison. Regarded in this way, the development of a science bears some resemblance to the compilation of a classified catalogue. It is, as it were, a purely empirical enterprise. But this point of view by no means embraces the whole of the actual process; for it slurs over the important part played by intuition and deductive thought in the development of an exact science. As soon as a science has emerged from its initial stages, theoretical advances are no longer achieved merely by a process of arrangement. Guided by empirical data, the investigator rather develops a system of thought which, in general, is built up logically from a small number of fundamental assumptions, the so-called axioms.*

Here is the additional assumption: Einstein's text concerning "deductive thought" can be regarded as a definition of theory in fundamental physics:

Definition: A theory is a system of thought built up logically from a small number of fundamental assumptions, the so-called axioms.

If the additional assumption is correct, a theory in fundamental physics consists of a set of axioms and a set of arguments leading from the axioms to the conclusions. Critics look for false axioms and invalid (the conclusion does not follow from the premises) arguments. If they are unable to find any, all the conclusions of the theory are accepted as true.

The above definition does not imply that only deduction matters in fundamental physics. "Anything goes" at the initial stages of theorizing – don't hesitate to exploit even the wildest idea – but the final version of your theory should be explicit about the axioms and the arguments. If not – e.g. if the axioms are missing and the equations are just guessed, not deduced – your theory is not even wrong.

Now the question in the title: What is fundamental in fundamental physics? The answer is more than obvious: The axioms.