

1/21/2021

Subject: Pure energy

Dear First Three Minutes Class,

I am not sure I answered one question last night: what does Weinberg mean by “pure energy” in Chapter 1, (page 6, last full paragraph). In this case, he is referring to the time of 0.01 s after the start of the universe. In 1977, when the book was written, it was unclear what particles there could be aside from the electrons, positrons, neutrinos, and photons Weinberg knew about. I believe he used the term “pure energy” to refer to an unknown kind of particle present at this time that decayed to the known particles.

We now know and have studied at CERN, that the Universe was filled with quarks and gluons. These particle combine together to

make up protons and neutrons. Experiment revealed their existence in the period 1969-1976 and the theory was just emerging in 1977. At 0.01 s, the universe was so hot, that the quarks and gluons could not combine to make protons and neutrons. The state was referred to as a Quark-Gluon Plasma and it existed from until about 10 millions of a second after the start of the Big Bang.

Sorry if I missed answering this.

Peter