What's SO exciting about Quantum???

Today, it is Quantum theory that best explains the physical nature of the universe. Consider the sub-atomic world : energy is quantized, it only comes in multiples of the same quanta; Albert Einstein won a Nobel Prize for proving this. The quanta here is the Planck constant. By proposing that energy is quantized, he was able to align theory with experiments on hot bodies like the sun.

The wave-particle duality of electrons as well as light, proposed by de Broglie, is a cornerstone of quantum physics. Simply put, it means that quantum entities exhibit both particle and wave properties, according to the experiment carried out. Wave-particle duality is an example of superposition, that is, a quantum object existing in multiple states at once. An electron, for example, is both 'here' and 'there' simultaneously. It's only once we do an experiment to find out where it is that it settles down into one state or the other. Thus ShrÖdinger's cat is simultaneously alive and dead until we look. This makes quantum physics all about probabilities.

Quantum entanglement is another phenomenon which is real , but not fully understood. Let's say that we bring two particles together in such a way that their quantum states are inexorably bound, or entangled. The Pauli exclusion principle says that they can't both be in the same state. If we change one, the other instantly changes to compensate. This happens even if we separate the two particles from each other on opposite sides of the universe. It's as if information about the change we've made has traveled between them faster than the speed of light, something Einstein said was impossible.

Quantum physics explains the large-scale structure of the universe, by modifying the Big Bang theory. As it was initially smaller than an atom, the infant universe would have been dominated by quantum fluctuations linked to the Heisenberg uncertainty principle. Inflation caused the universe to grow rapidly before these fluctuations had a chance to fade away. This concentrated energy into some areas rather than others — something astronomers believe acted as seeds around which material could gather to form the clusters of galaxies we observe now. Quantum theory helps us characterize stars, why the sun shines and why dead stars do not collapse (Pauli'exclusion principle). Considering that nature is quantum at the sub-atomic and atomic levels, it is only right that 'the quantum of things' is gaining more and more prominence.

https://www.space.com/quantum-physics-things-you-should-know

***Some famous quantum quotes of Richard P. Feynmann* :**

Nature isn't classical and if you want to make a simulation of nature, you'd better make it quantum mechanical.

If you think you understand quantum mechanics, you don't understand quantum mechanics.