Basic ideas of the quantum field theory[1]

Spontaneous emission

The spontaneous emission is described as

$$A(\beta \to \alpha) = \left(\frac{8\pi h\nu^3}{c^3}\right) B(\beta \to \alpha)$$

Free scalar Lagrangian

For a free complex scalar field, $\phi(x)$, the Lagrangian is

$$\mathcal{L} = \int d^3x \left[\dot{\phi}^\dagger \dot{\phi} - c^2(\nabla\phi)^\dagger \cdot (\nabla\phi) - \left(\frac{mc^2}{\hbar}\right)^2 \phi^\dagger\phi\right]$$

which is from

$$\delta\mathcal{L} = \int d^3x \left[\dot{\phi}^\dagger \delta\dot{\phi} + \dot{\phi}\delta\dot{\phi}^\dagger - c^2(\nabla\phi)^\dagger \cdot (\nabla\delta\phi) - c^2\nabla\phi\cdot\nabla\delta\phi^\dagger - \left(\frac{mc^2}{\hbar}\right)^2 \phi^\dagger\delta\phi - \left(\frac{mc^2}{\hbar}\right)^2 \phi\delta\phi^\dagger\right]$$

The quantum fields are constructed by many of the harmonic oscillators. Then, they are describe with the creation and annihilation of the particles.

The successful calculation by Fermi of the electron energy distribution in the beta decay deserves to be counted as one of the early triumphs of quantum field theory. [2]

References

[1] S. Weinberg, *The Quantum Theory of Fields*. Addison-Wesley, Reading MA, 1986

[2] E. Fermi, Z. f. Phys. 88, 161, (1934)