Search for New Physics in B-Meson Decays

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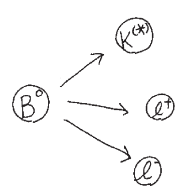
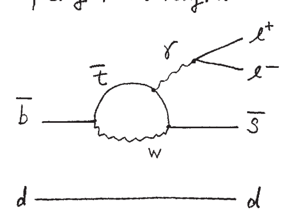
There are some theoretical arguments that new physics will emerge at the TeV energy scale. Two approaches are important for the new physics search in this region. One is an energy frontier experiment that directly generates new particles, and the other is a high luminosity experiment to explore rare decays. The Belle II experiment is representative of the latter experiment, and what is important here is the decay process caused by the penguin diagram. In the penguin diagram, when the bottom quark of the B meson changes to another quark, it passes through an intermediate state. For this intermediate state, an ultrahigh energy state that may have existed in the early universe is allowed to appear due to the uncertainty principle in quantum mechanics. Therefore, we can investigate the influence of the new physics. An example is shown below. The decay process caused by the penguin diagram is a rare process that occurs once in tens of thousands of B-meson decays. In the Belle II experiment, we will investigate new physics by taking 50 times the data of the Belle experiment.

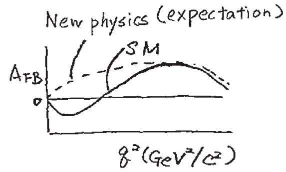
$B^0 \rightarrow K^{(*)} \ell^+ \ell^-$



penguin diagram



The lepton forward-backward asymmetry (A_{FB}) changes when there is new physics



$$A_{FB} = \frac{N(\cos\theta_\ell > 0) - N(\cos\theta_\ell < 0)}{N(\cos\theta_\ell > 0) + N(\cos\theta_\ell < 0)}$$

θ_ℓ : The angle of ℓ^+ with respect to the opposite direction to the B direction.