**Search for lepton universality violation in J-PARC E36 Experiment**

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**Abstract**

The J-PARC E36 experiment aims to search for a lepton universality violation in the ratio of decay widths, $R_K = \frac{\Gamma(K^+ \rightarrow e^+\nu)}{\Gamma(K^+ \rightarrow \mu^+\nu)}$, by adopting a stopped $K^+$ beam method. A structure dependent (SD) radiative $K^+ \rightarrow e^+\nu\gamma(K_{e2\gamma})$ decay is one of serious backgrounds to deduce the $R_K$ value. The SD $K_{e2\gamma}$ branching ratio and its decay form factor are successfully determined in the analysis.

**J-PARC E36 experiment** [3]

- **Cryostat**
- **GV**
- **C4**
- **PGC**
- **Iron Polo**
- **Lead Shield**
- **Cherenkov**
- **Degrader**
- **TOF2**
- **TTC**
- **SFT, TOF1**
- **Active Target**

**R_K and SD K_{e2\gamma} study**

**Critical background**

$$R_{K}^{SD} = \frac{\Gamma(K_{2\gamma})}{\Gamma(K_{2\gamma}(IB))}$$

Background: $K_{2\gamma}$ (SD) $K_{2\gamma}: K^+ \rightarrow e^+\nu\gamma$

Structure Dependent (SD)

- $K_{e2\gamma}$ (SD) (0\\gamma) contaminate to $R_K$ calculation.
- $R_K$ determine should be corrected $K_{e2\gamma}$ (SD).
- $K_{e2\gamma}$ (SD) status ($\beta$, $\lambda$) is studied precisely.
- In $K_{e2\gamma}$ (SD)
  - $E_{\gamma}$ tends to 100–200 MeV.
  - $\theta_{e\gamma}$ tends to 150–180 deg.

**Summary**

E36 exp. aims to $e^+ - \mu^+$ LUV test by $R_K$ measurement. Critical BG is $K_{e2\gamma}$ SD event. Our detector has observed familiar kaon decay channel which is consistent with MC. So, we ready to determine a branching ratio and form factor for $K_{e2\gamma}$ in used these spectra. Then, Applying the BG correction, $R_K$ would be determine carefully.

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**Lepton Universality**

$$K^+ \rightarrow l^+\nu_l\Gamma(K_{l2\gamma})$$

$$R_{K}\Gamma = G(\frac{\Gamma(K^+ \rightarrow e^+\nu)}{\Gamma(K^+ \rightarrow \mu^+\nu)})$$

$$g_2 = g_\mu^2$$

$$r_{K2e}^2 = \frac{\Gamma(K^+ \rightarrow e^+\nu\gamma)}{\Gamma(K^+ \rightarrow \mu^+\nu\gamma)} = \frac{m_e^2}{m_e^2 - m_\gamma^2} \cdot \frac{1}{(1 + \delta_{e\gamma})^2}$$

**Specification**

- Stopping positive kaon system at J-PARC, Japan
- E36 detector based 12 sector toroidal magnet system
- Phys data taking until Dec. 2015
- $e+/\mu^+$ PID with TOF + AC + PGC
- $\gamma$ detected by CsI(Tl) + GV
- Lepton tracking using Target + SFT + C2-4 chambers

**Momentum Reconstruction**

- $K_{2\mu}, K_{2\tau}$ are familiar decay channel.
- These channel are used for calibration.
- Waveform model was developed [4].
- Pileup correction was success.
- $\sigma_{e\gamma} \approx 2.6\% @ 153 $MeV, $\sigma_{\gamma\gamma} \approx 10$ns

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**CsI(Tl) photon detector Waveform analysis**

**Where is E36 mark?**