

TWIST: Measuring the space-time structure of muon decay

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This past year, TWIST published improved measurements of the Michel parameters ρ and δ in normal muon decay [1] based on the final analysis of the data that were recorded during 2004. We found $\rho = 0.75014 \pm 0.00017(\text{stat.}) \pm 0.00044(\text{syst.}) \pm 0.00011(\eta)$ and $\delta = 0.75067 \pm 0.00030(\text{stat.}) \pm 0.00067(\text{syst.})$. These results were included in a new global analysis of muon decay measurements. The correlation between the uncertainties in ρ and δ was also included in the global analysis for the first time. We find the total contribution from right-handed muon couplings to be $Q_R^\mu < 0.0024$ with 90% confidence. This is a 20% reduction in the limit for Q_R^μ compared to the previous global analysis [2].

The focus of TWIST has now turned to the analysis of the final data sets, which were taken in 2006 and 2007. The leading systematics for ρ and δ in the 2004 analysis involved wire chamber response, energy scale calibration, and positron interactions. New procedures were developed very late in the 2004 data analysis to extract precise drift chamber distance vs. time relationships from the measured data. The new distance vs. time relationships came too late to be used in the primary 2004 data analysis. They were only used to estimate the chamber response systematic. They have now been adopted for the standard analysis of the '06 and '07 data, which reduces the corresponding systematic uncertainty dramatically. Work is underway to minimize the effects of the other two leading systematics. Overall, we expect that the final precisions for ρ and δ will be approximately ± 0.0003 . The final precision for $P_\mu \xi$ should be ± 0.001 or better. Our group is playing a much smaller role in this final analysis round than we did for the 2002 and 2004 data analyses.

[1] R. P. MacDonald *et al.* (TWIST Collaboration), Phys. Rev. D **78**, 032010 (2008).

[2] C. A. Gagliardi, R. E. Tribble, and N. J. Williams, Phys. Rev. D **72**, 073002 (2005).