Precise Measurement of the Mass of the $\tau$ Lepton  
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An optimized energy scan near the $\tau$ pair production threshold has been performed using the BESIII detector. About 24 pb$^{-1}$ of data, distributed over four scan points, was collected. The $\tau$ mass is determined directly from the threshold behavior of the $\tau$ pair production cross section in the $e^+e^-$ collisions. The key question in the measurement is how to determine the beam energy precisely. Here the beam energy measurement system (BEMS) for BEPC-II is used to determine the beam energy. The relative systematic uncertainty of the electron and positron beam energy determination in our experiment is estimated as $2 \times 10^{-5}$; the relative uncertainty of the beam’s energy spread is about 6%. This analysis is based on the combined data from the $ee$, $e\mu$, $eh$, $\mu\mu$, $\mu h$, $hh$, $ep$, $\mu p$ and $\pi p$ final states, where $h$ denotes a charged $\pi$ or $K$. The mass of the $\tau$ lepton is measured as

$$m_{\tau} = 1776.91 \pm 0.12 ^{+0.09}_{-0.12} \text{ MeV}/c^2 \quad (1)$$

which is consistent with results from any other groups included by the Particle Data Group, but has the smallest uncertainty.