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Measuring Luminosity at OLYMPUS

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The OLYMPUS experiment seeks to provide a high-precision measurement (<1% error) of the positron-proton versus electron-proton elastic scattering cross section ratio. This requires fine control of all systematic uncertainties, including the calculation of the luminosity. For this purpose, multiple independent subsystems were operated alongside the main spectrometer during data taking to allow for empirical determination of the luminosity as a function of time. An approximate value is computed based on parameters of the lepton beam and gaseous target, while small-angle elastic scatters of known cross section are counted by two sets of ionization-based detector systems. The most precise value comes from counting coincidences of high-rate (pure QED) lepton-lepton scatters using a pair of calorimetric lead fluoride Cherenkov detectors.

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