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Observation of the $\chi(b1)(3P)$ and $\chi(b2)(3P)$ and Measurement of their Masses

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Abstract

The $\chi(b1)(3P)$ and $\chi(b2)(3P)$ states are observed through their $\gamma(3S)(\gamma)$ decays, using an event sample of proton-proton collisions collected by the CMS experiment at the CERN LHC. The data were collected at a center-of-mass energy of 13 TeV and correspond to an integrated luminosity of 80.0 fb⁻¹. The $\gamma(3S)$ mesons are identified through their dimuon decay channel, while the low-energy photons are detected after converting to e^+e^- pairs in the silicon tracker, leading to a $\chi(b)(3P)$ mass resolution of 2.2 MeV. This is the first time that the $J = 1$ and 2 states are well resolved and their masses individually measured: 10513.42 \pm 0.41(stat) \pm 0.18(syst) MeV and 10524.02 \pm 0.57(stat) \pm 0.18(syst) MeV; they are determined with respect to the world-average value of $\gamma(3S)$ mass, which has an uncertainty of 0.5 MeV. The mass splitting is measured to be 10.60 \pm 0.64(stat) \pm 0.17(syst) MeV.

Keywords

KeyWords Plus: HEAVY QUARKONIUM; BOTTOMONIUM SPECTRUM; QCD

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