Title:	Study of γ γ → γ ψ (2 S) at Belle
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Keywords:	γ γ → γ ψ (2 S) at Belle
Issue Date:	2022
Publisher:	American Physical Society
Citation:	Physical Review D, 105(11), 112011(1-11).
Abstract:	Using 980 fb − 1 of data at and around the Y (n S) (n = 1 , 2, 3, 4, 5) resonances collected with the Belle detector at the KEKB asymmetric-energy e + e − collider, the two-photon process γ γ → γ ψ (2 S) is studied from the threshold to 4.2 GeV for the first time. Two structures are seen in the invariant mass distribution of γ ψ (2 S) : one at M R 1 = 3922.4 ± 6.5 ± 2.0 MeV / c 2 with a width of Γ R 1 = 22 ± 17 ± 4 MeV , and another at M R 2 = 4014.3 ± 4.0 ± 1.5 MeV / c 2 with a width of Γ R 2 = 4 ± 11 ± 6 MeV ; the signals are parametrized with the incoherent sum of two Breit-Wigner functions. The first structure is consistent with the X (3915) or the χ c 2 (3930) , and the local statistical significance is determined to be 3.1 σ with the systematic uncertainties included. The second matches none of the known charmonium or charmoniumlike states, and its global significance is determined to be 2.8 σ including the look-elsewhere effect. The production rates are Γ γ γ B (R 1 → γ ψ (2 S)) = 9.8 ± 3.6 ± 1.3 eV assuming (J P C , | λ |) = (0 + + , 0) or 2.0 ± 0.7 ± 0.2 eV with (2 + + , 2) for the first structure and Γ γ γ B (R 2 → γ ψ (2 S)) = 6.2 ± 2.2 ± 0.8 eV with (0 + + , 0) or 1.2 ± 0.4 ± 0.2 eV with (2 + + , 2) for the second. Here, the first errors are statistical and the second systematic, and λ is the helicity.
Description:	Only IISER Mohali authors are available in the record.
URI:	https://doi.org/10.1103/PhysRevD.105.112011 (https://doi.org/10.1103/PhysRevD.105.112011) http://hdl.handle.net/123456789/5093 (http://hdl.handle.net/123456789/5093)
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