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Search for the radiative penguin decays $B^0 \to K^0_S K^0_S \gamma$ in the Belle experiment

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We report results from the first search for the rare penguin-dominated decay mode $B^0 \to K^0_S K^0_S \gamma$, which can result from the production of tensor mesons $f(1270)$ and $f'(1525)$ in association with a photon. The search uses the full data sample of 772×10^6 $B\bar{B}$ pairs collected with the Belle detector at the KEKB asymmetric-energy e^+e^- collider. No statistically significant signals are observed in the $K^0_S K^0_S$ invariant mass range 1 GeV/c^2 $< M_{K^0_S K^0_S} <$ 3 GeV/c^2, and the following upper limits at the 90% confidence level are obtained: $\mathcal{B}(B^0 \to K^0_S K^0_S \gamma) < 5.8 \times 10^{-7}$, $\mathcal{B}(B^0 \to f_2\gamma) \times \mathcal{B}(f_2(1270) \to K^0_S K^0_S) < 3.1 \times 10^{-7}$, and $\mathcal{B}(B^0 \to f'_2\gamma) \times \mathcal{B}(f'_2(1525) \to K^0_S K^0_S) < 2.1 \times 10^{-7}$. In addition, 90% confidence-level upper limits in the range of $[0.7\text{–}2.9] \times 10^{-7}$ are also obtained on the $B^0 \to K^0_S K^0_S \gamma$ branching fraction in bins of $M_{K^0_S K^0_S}$.

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Radiative $b \to s\gamma$ and $b \to d\gamma$ quark transitions are flavor-changing-neutral-current processes and are not allowed at tree level in the Standard Model (SM). Such decays proceed predominantly through radiative loop diagrams, referred to as radiative penguin diagrams [1], and are potentially sensitive to contributions from non-SM particles that can appear in the loop. For example, the two Higgs doublet model (2HDM) introduces an additional doublet of Higgs fields, and the associated charged Higgs boson can appear in the loop instead of the W. Wilson coefficients in the operator product expansion [2] are modified to include the effect of the 2HDM [3] and this new term depends on the mass of the charged Higgs [4]. Thus, assuming that effects from strong interaction corrections can be controlled, a disparity in the measured branching fraction with respect to SM expectations can be interpreted as arising from a new physics contribution.

In the SM, the $b \to d\gamma$ process is suppressed relative to $b \to s\gamma$ by the squared ratio of Cabibbo-Kobayashi-Maskawa matrix elements $|V_{td}/V_{ts}|^2$ [5]. The predicted branching fractions [6] and experimental world averages [7] for $b \to s\gamma$ and $b \to d\gamma$ are in agreement at the 1σ and $\sim 2.5\sigma$ level, respectively. Branching fractions of several exclusive $b \to s\gamma$ modes have been measured: $B \to K^*\gamma$ [8]; $B \to K_1(1270)\gamma$ [9]; $B \to \phi K\gamma$ [10]; $B \to K\eta'\gamma$ [11]; $B \to K\eta\gamma$ [12]. On the other hand, $B \to \rho\gamma$ and $B \to \omega\gamma$ are the only observed exclusive $b \to d\gamma$ modes [13] and measurements of additional exclusive X_d final states are needed.

The $B^0 \to K^0_S K^0_S \gamma$ decay, shown in Fig. 1, arises from a $b \to d\gamma$ transition and can proceed via a number of different intermediate states. Because the $K^0_S K^0_S$ system consists of two identical spinless particles, Bose-Einstein statistics requires that the angular momentum quantum number of this system, in its rest frame, must be even. If the system is produced in the decay of an intermediate-state parent meson, this meson must therefore have even spin. In

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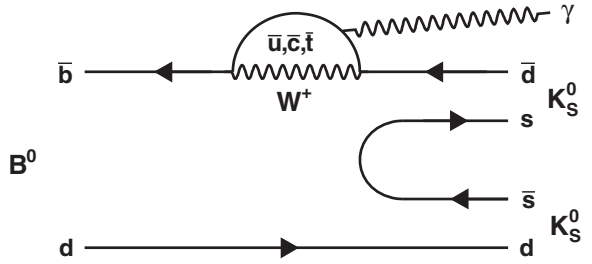

FIG. 1. $b \to d\gamma$ penguin diagram for $B^0 \to K_S^0 K_S^0 \gamma$ decay.

addition, the photon, as a massless $J = 1$ particle, can only have helicities $\lambda = \pm 1$ along the B-meson decay axis. The sum of the spin projections of the particles along this axis must be zero, since $J(B) = 0$ and there cannot be any projection of the orbital angular momentum along this axis. As a consequence, the $K_S^0 K_S^0$ system cannot be a spin-0 system, and its lowest allowed value is $J = 2$. This constraint motivates the search for the $J = 2$ mesons $f_2(1270)$ and $f_2'(1525)$, which can decay into the $K_S^0 K_S^0$ final state. This paper presents results from a search for the $B^0 \to K_S^0 K_S^0 \gamma$ decay, where the $K_S^0 K_S^0$ system is also studied for evidence of an intermediate-state tensor meson.

The $\Upsilon(4S)$ meson is produced at the KEKB asymmetric-energy e^+e^- collider [14] with electrons and positrons having energies of 8 GeV and 3.5 GeV, respectively, and subsequently decays to $B\bar{B}$ pairs which are nearly at rest in the center-of-mass system (CMS). The z axis is defined as opposite to the e^+ beam direction. We search for the decay $B^0 \to K_S^0 K_S^0 \gamma$ using the full data sample of $(772 \pm 11) \times 10^6 B\bar{B}$ pairs collected at the $\Upsilon(4S)$ resonance with the Belle detector at the KEKB asymmetric-energy e^+e^- collider. This is the first search for a B^0 decay to two pseudoscalars K_S^0 with a prompt photon in the final state.

The Belle detector, a hermetic magnetic spectrometer designed to detect the decay products of B mesons, consists of a silicon vertex detector, a 50-layer central drift chamber (CDC), an array of aerogel threshold Cherenkov counters, a barrellike arrangement of time-of-flight scintillation counters, and an electromagnetic calorimeter comprised of CsI(Tl) scintillation crystals (ECL). These detector components, providing high vertex resolution, good tracking, sophisticated particle identification capability, and excellent calorimetry, are located inside a superconducting solenoid coil providing a 1.5 T magnetic field. An iron flux-return is located outside of the magnetic coil which is instrumented to detect K_L^0 mesons and identify muons. The detector is described in detail elsewhere [15].

The event selections are optimized using simulated Monte Carlo (MC) samples. The MC samples for the signal and background processes are generated with E VTG EN [16] and the detector response is then simulated using G EANT3 [17]. Any environmental changes in the Belle detector and KEKB accelerator machine during the operations are reflected in the detector simulation. To generate the signal MC sample of B^0 decaying to a tensor meson (as an intermediate state) and a prompt photon, a two-body decay model is used with equal helicity amplitudes for the allowed tensor-meson helicities of ± 1. The decay of the intermediate state system to $K_S^0 K_S^0$ is then simulated. To allow for study of the $K_S^0 K_S^0 \gamma$ system across the full kinematically accessible range in $m(K_S^0 K_S^0)$, simulated signal events are distributed uniformly in the range $1\ \mathrm{GeV}/c^2 < m(K_S^0 K_S^0) < 3\ \mathrm{GeV}/c^2$.

Photons must have no associated tracks in the CDC, be in the ECL barrel region ($33° < \theta_\gamma < 128°$), and have a 95% or higher fraction of energy deposition in the central 3×3 of 5×5 ECL crystals centered on the highest energy deposit crystal. The center-of-mass energy of the prompt photon candidate, E_γ, must satisfy the requirement $1.6\ \mathrm{GeV} < E_\gamma < 2.8\ \mathrm{GeV}$. Most background photons originate from $\pi^0 \to \gamma\gamma$ and $\eta \to \gamma\gamma$ decays. We combine the photon candidate with all other photons with momenta larger than $50\ \mathrm{MeV}/c$ in the event and calculate the probabilities of the reconstructed photon candidate to be π^0-like or η-like [18]. Backgrounds are suppressed by removing π^0-like and η-like candidates using a likelihood-based selector. About 86% of the photons from the signal B are retained and about 62% from the accompanying B are rejected. If more than one candidate satisfies the selection criteria for the prompt photon, the most energetic photon is chosen as the prompt photon candidate. The selection efficiency of the prompt photon is approximately 50%, and 99.5% are found to be correctly matched in signal MC sample.

K_S^0 candidates are reconstructed from two oppositely charged tracks. A displaced vertex consistent with $K_S^0 \to \pi^+\pi^-$ decay is required using a neural network (NN) discriminator with 20 inputs [19]; this selection also suppresses $\Lambda \to p\pi^-$ decays. The invariant mass of the pion pairs is then required to satisfy $|M_{\pi\pi} - m_{K_S^0}| < 4.7\ \mathrm{MeV}/c^2$, corresponding to a $\pm 2.6\sigma$ interval in mass resolution, where $m_{K_S^0}$ is the nominal K_S^0 mass [7]. B^0 candidates are formed by combining two K_S^0 candidates and one prompt photon candidate. The energy difference $\Delta E \equiv E_B^{\mathrm{cms}} - E_{\mathrm{beam}}^{\mathrm{cms}}$ and the beam-energy-constrained mass $M_{\mathrm{bc}} \equiv \sqrt{(E_{\mathrm{beam}}^{\mathrm{cms}})^2 - |\vec{p}_B^{\,\mathrm{cms}}|^2 c^2}/c^2$, where $E_{\mathrm{beam}}^{\mathrm{cms}}$ is the beam energy, and E_B^{cms} and $\vec{p}_B^{\,\mathrm{cms}}$ are the energy and momentum of the reconstructed B^0, respectively, are used to identify B^0 candidates. The candidates satisfying the requirements $5.20\ \mathrm{GeV}/c^2 < M_{\mathrm{bc}} < 5.29\ \mathrm{GeV}/c^2$ and $|\Delta E| < 0.5\ \mathrm{GeV}$ are retained for further analysis. We find that 6% of the events have more than one B^0 candidate. In case of multiple candidates, we choose the one with the smallest χ^2, as defined by $\chi^2 = \sum_{i=1}^{2} [(m_{K_S^0} - M_i(\pi^+\pi^-))/\sigma_{\pi\pi}]^2$, where $\sigma_{\pi\pi}$ is the mass resolution for the reconstructed K_S^0.

The dominant background arises from $e^+e^- \to q\bar{q}(q = u, d, s, c)$ continuum events. We use another NN with four

input variables calculated in the CMS to suppress this background [20]: the cosine of the polar angle ($\cos\theta_B$) of the B^0 candidate flight direction; the cosine of the angle ($\cos\theta_T$) between the thrust axis of the B^0 candidate and that of the rest of the event; a flavor-tagging quality parameter of the accompanying B meson [21]; and a likelihood ratio obtained from the modified Fox-Wolfram moments [22]. The NN outputs for the signal and continuum MC events peak at $+1$ and -1, respectively. A figure-of-merit (FOM) is calculated as [23]:

$$\mathrm{FOM} = \frac{\epsilon_S(t)}{a/2 + \sqrt{N_{\mathrm{bkg}}(t)}}, \tag{1}$$

where t is the NN output; $\epsilon_S(t)$ is the signal efficiency as a function of t determined by using the signal MC sample; N_{bkg} is the number of background events for a high t selection and a is taken to be 3 for a 3σ significance due to the low signal-to-background ratio, as suggested in Ref. [23]. The FOM is maximized for the $t > 0.93$ region which rejects 99% of the continuum MC events and retains 37% of the signal MC events. Since we expect only a few signal events and relatively large backgrounds, we further suppress the continuum background by using the helicity angle, θ_H, which is the angle between the direction opposite to the B^0 candidate and that of the K^0_S momentum in the rest frame of the $K^0_S K^0_S$ system. To maximize the FOM, we require $0.24 < |\cos\theta_H| < 0.86$ which removes 60% of the background while retaining 86% of the signal.

We use a Crystal Ball line shape [24] and a first-order polynomial for the signal and contributions from misreconstructed events, respectively. The signal region is defined as $-0.16\,\mathrm{GeV} < \Delta E < 0.09\,\mathrm{GeV}$ and $5.272\ \mathrm{GeV}/c^2 < M_{\mathrm{bc}} < 5.290\ \mathrm{GeV}/c^2$, corresponding to $\pm 3\sigma$ windows. In signal MC samples, about 99% of the reconstructed B^0 candidates in the signal region correctly match a true B^0.

From MC, we estimate that 2.2 ± 0.6 background events from continuum processes contribute to the signal region. In addition to the continuum, various $B\bar{B}$ background sources are also studied. Both neutral and charged $B\bar{B}$ MC samples corresponding to an integrated luminosity six times larger than that of the full data sample are used. We expect 0.3 ± 0.2 events from generic $B\bar{B}$ decays in the signal region. The decay $B^0 \to D^0(\to K^0_S\pi^0)K^0$, with a branching fraction of 5.2×10^{-5} [7], is treated separately from the generic $B\bar{B}$ because its ΔE and M_{bc} distributions are different from those of generic $B\bar{B}$ events. We estimate a contribution of about 0.1 background events from this decay.

A dedicated MC sample consisting of rare B decays was produced. Various decays with branching fractions smaller than $\mathcal{O}(10^{-4})$ are included and their total branching fraction is $\mathcal{O}(10^{-3})$. Rare B decays having one or two K^0_S with γ in the final state can peak in the M_{bc} distribution. The backgrounds from the charged B meson pairs do not show any peaking behavior in the $\Delta E - M_{\mathrm{bc}}$ signal region. On the other hand, the background from the neutral B meson pairs peaks in the signal region and the largest contribution (34%) to the peak comes from $B^0 \to X_{d\bar{d}}\gamma$. Here, $X_{d\bar{d}}$ is a meson whose flavor wave function includes a $d\bar{d}$ pair, and all $b \to d\gamma$ processes except $B^0 \to \rho^0\gamma$ and $B \to \omega\gamma$ are included. We regard this as signal because the quark level transition and the final state are the same as for the signal. When we treat this decay mode as signal by using MC information, the peaking background is removed. Neutral and charged rare B backgrounds are estimated to be 1.0 ± 0.1 and 0.9 ± 0.1 events in the signal region, respectively.

Four additional rare decay modes which are not included in the rare B MC samples, with the following branching fractions, are considered: $\mathcal{B}(B^0 \to K^0_S K^0_S \pi^0) < 9 \times 10^{-7}$ [25]; $\mathcal{B}(B^0 \to K^0_S K^0_S \eta) < 1.0 \times 10^{-6}$; $\mathcal{B}(B^0 \to K^0_S \pi^+\pi^-\gamma) = 1.99 \times 10^{-5}$ [26]; $\mathcal{B}(B^0 \to \pi^+\pi^-\pi^+\pi^-\pi^0) < 9.1 \times 10^{-3}$ [7]. The first two decay modes occur via a $b \to s$ quark transition and become background when π^0 or η are replaced by a photon. $B^0 \to K^0_S\pi^+\pi^-\gamma$ decays occur through a $b \to s\gamma$ quark transition and can be misidentified as the signal. $B^0 \to \pi^+\pi^-\pi^+\pi^-\pi^0$ decays occur at the tree level via a $b \to u$ transition and can be misidentified as the signal when the π^0 is replaced by a photon. We estimate that the background contribution from these four decay modes is negligible.

We estimate the total number of background events in the signal region to be 4.5 ± 0.7 via the counting method. To estimate the background events in the signal region using an extended unbinned maximum-likelihood fitting method, we fit the M_{bc} distribution satisfying $-0.16\ \mathrm{GeV} < \Delta E < 0.09\ \mathrm{GeV}$ with an ARGUS function [27] and a Crystal Ball line shape for the continuum and peaking backgrounds, respectively. The fitting parameters of the Crystal Ball line shape are fixed to those for the signal MC. We obtain 5.6 ± 0.8 background events in the signal region. This result is consistent with that of the counting method.

The signal efficiency depends on the reconstructed K^0_S-pair mass ($M_{K^0_S K^0_S}$) as shown in Table I and is obtained from signal MC by performing an extended unbinned maximum-likelihood fit to the M_{bc} distribution satisfying $-0.16\ \mathrm{GeV} < \Delta E < 0.09\ \mathrm{GeV}$ and $5.2\ \mathrm{GeV}/c^2 < M_{\mathrm{bc}} < 5.9\ \mathrm{GeV}/c^2$ in ten equal-size bins in $M_{K^0_S K^0_S}$ between $1\ \mathrm{GeV}/c^2$ and $3\ \mathrm{GeV}/c^2$.

The systematic uncertainties on the number of produced $B\bar{B}$ pairs and the $\Upsilon(4S) \to B^0\bar{B}^0$ branching fraction are 1.4% and 1.2% [7], respectively. The systematic uncertainty in the photon detection efficiency is studied using radiative Bhabha events and estimated to be 2.0% [28]. Using a systematic uncertainty of 0.2% for K^0_S reconstruction efficiency and per track uncertainty in efficiency of 0.4% [29] leads to the estimate of 1.4% for the uncertainty in the reconstruction efficiency for the two $K^0_S \to \pi^+\pi^-$ decays. The systematic uncertainty due to the

TABLE I. Summary of the number of observed events ($N_{\rm obs}$), number of estimated background events ($N_{\rm bkg}$), efficiencies (ϵ_S), upper limits on the signal yield (S_{90}), and branching fraction upper limits (U.L.) at the 90% C.L. in each $M_{K^0_SK^0_S}$ bin for the $B^0 \to K^0_SK^0_S\gamma$ decay.

Mass bin (GeV/c^2)	ϵ_S (%)	$N_{\rm bkg}$	$\sigma_{\rm sys}$ (%)	$N_{\rm obs}$	S_{90}	U.L. (10^{-7})
1.0–1.2	3.3	0.8 ± 0.3	3.2	0	1.8	0.7
1.2–1.4	3.0	0.9 ± 0.3	3.2	3	6.5	2.8
1.4–1.6	2.7	0.8 ± 0.3	3.2	1	3.6	1.7
1.6–1.8	2.5	0.3 ± 0.1	3.2	0	2.1	1.1
1.8–2.0	2.3	0.8 ± 0.3	3.2	2	5.1	2.9
2.0–2.2	2.2	0.2 ± 0.1	3.2	1	4.2	2.5
2.2–2.4	2.2	0.4 ± 0.2	3.2	1	3.9	2.4
2.4–2.6	2.2	0.2 ± 0.2	3.2	0	2.2	1.3
2.6–2.8	2.3	0.0 ± 0.0	3.2	1	4.2	2.3
2.8–3.0	2.4	0.1 ± 0.0	3.2	0	2.3	1.2

background suppression using the NN selection and π^0/η veto is 0.6% [28]. The signal efficiency depends on $M_{K^0_SK^0_S}$ and the MC statistical uncertainty in the efficiency varies between 0.5% and 0.7% depending on $M_{K^0_SK^0_S}$. The total systematic uncertainty is 3.2% and is summarized in Table II.

There are 9 events in the ΔE-$M_{\rm bc}$ signal region. The fit to the $M_{\rm bc}$ distribution is carried out with an extended unbinned maximum-likelihood with a Crystal Ball line shape including contributions from the peaking background for the signal and an ARGUS function for the background, respectively, as shown in Fig. 2. We obtain 3.8 ± 3.0 signal and 5.6 ± 0.8 background events in the signal region. The fitting parameters for the signal are fixed to those for the signal MC. The number of the background events in the signal region agrees well with that of the estimated background events in the signal region from MC samples.

The $|\cos\theta_H|$ distributions for events in the $\Delta E - M_{\rm bc}$ signal region are shown in Fig. 3 for data and MC samples. The $|\cos\theta_H|$ distribution results from data are consistent with MC simulation.

The observed number of events in each $M_{K^0_SK^0_S}$ bin is obtained by counting the events in the ΔE-$M_{\rm bc}$ signal region. Figure 4 shows the observed number of events

TABLE II. Systematic uncertainties in branching fractions.

Source	Uncertainty (%)
Number of $B\bar{B}$	1.4
Branching fraction of $\Upsilon(4S) \to B^0\bar{B}^0$	1.2
Photon detection efficiency	2.0
Two K^0_S reconstruction	1.4
NN selection and π^0/η veto	0.6
MC statistics in $M_{K^0_SK^0_S}$ bin efficiency	0.5–0.7
Total	3.2

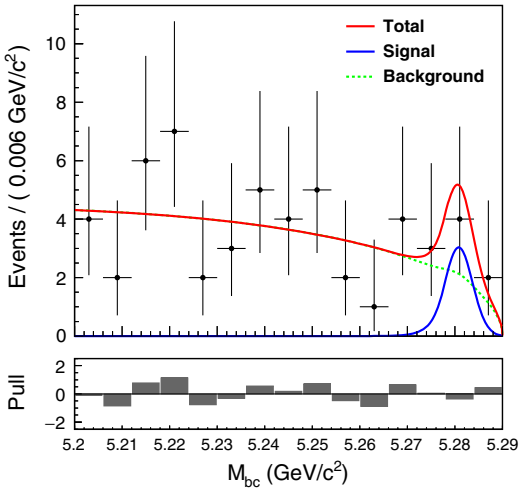

FIG. 2. Distribution of the data in the variable $M_{\rm bc}$, together with the fit to contributions from background and signal events, after requiring -0.16 GeV $< \Delta E < 0.09$ GeV and $0.24 < |\cos\theta_H| < 0.86$.

($N_{\rm obs}$) in the full data sample and the estimated background events in each $M_{K^0_SK^0_S}$ bin. No significant excess over the estimated background is observed in the data, and we derive an upper limit for the signal yield (S_{90}) at the 90% confidence level (C.L.) using the POLE program by taking into account the uncertainties associated with the signal selection efficiency, background expectation, and systematic uncertainty [30]. The branching fractions are obtained from

$$\mathcal{B}(B^0 \to K^0_SK^0_S\gamma) = \frac{S_{90}}{\epsilon_S \times N_{B\bar{B}}}, \tag{2}$$

where $N_{B\bar{B}}$ and ϵ_S are the number of $B\bar{B}$ pairs and signal efficiency, respectively. We obtain 90% C.L. upper limits on the partial branching fractions for the decay

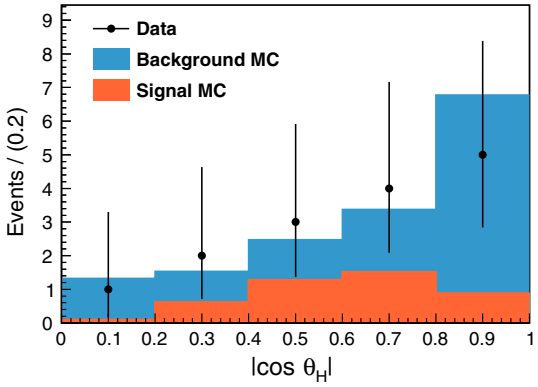

FIG. 3. The helicity angle distribution of the observed events in the signal region. The background and signal histograms are stacked.

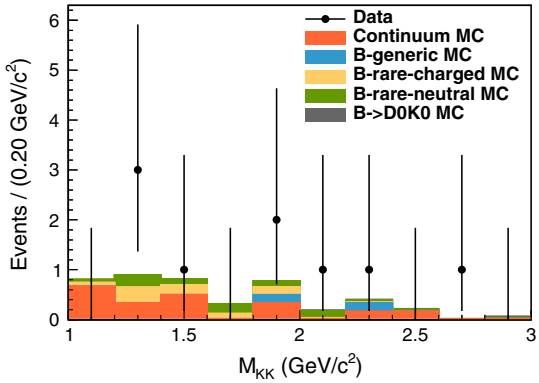

FIG. 4. The $M_{K^0_S K^0_S}$ distribution in the signal region. The dots represent data and the stacked histograms are the estimated number of backgrounds from the MC background samples.

$B^0 \to K^0_S K^0_S \gamma$ in ten bins of $M_{K^0_S K^0_S}$ for 1.0 GeV/c^2 < $M_{K^0_S K^0_S}$ < 3.0 GeV/c^2, which are listed in Table I.

For the full range 1.0 GeV/c^2 < $M_{K^0_S K^0_S}$ < 3.0 GeV/c^2, we use the average efficiency of all bins, $(2.5 \pm 0.4)\%$. The standard deviation of efficiencies among $M_{K^0_S K^0_S}$ bins is assigned as a systematic uncertainty (16.0%). Adding to other systematic uncertainties listed in Table II in quadrature, the total systematic uncertainty is 16.2%. Using the POLE program with 9 observed events and expected background of 4.5 ± 0.7, we obtain the upper limit on the branching fraction for the 1.0 GeV/c^2 < $M_{K^0_S K^0_S}$ < 3.0 GeV/c^2 mass range to be 5.8×10^{-7} at the 90% C.L.

We also obtain upper limits on the product branching fractions for the intermediate tensor f_2 states, $\mathcal{B}(B^0 \to f_2\gamma) \times \mathcal{B}(f_2 \to K^0_S K^0_S)$. The signal mass regions are taken to be 1.00 GeV/c^2 < $M_{K^0_S K^0_S}$ < 1.44 GeV/c^2 and 1.44 GeV/c^2 < $M_{K^0_S K^0_S}$ < 1.63 GeV/c^2 for $f_2(1270)$ and $f'_2(1525)$, respectively. These mass regions contain 80% of signal events. The results are summarized in Table III.

In summary, we have reported the results from the first search for radiative B-meson decays to the $K^0_S K^0_S \gamma$ final state using a data sample of $772 \times 10^6 B\bar{B}$ pairs. No significant signal is observed for the full data sample. The signal efficiency depends on $M_{K^0_S K^0_S}$ and we obtain upper limits at the 90% C.L. on the partial branching fractions for the decay $B^0 \to K^0_S K^0_S \gamma$ in ten bins of $M_{K^0_S K^0_S}$ for 1.0 GeV/c^2 < $M_{K^0_S K^0_S}$ < 3.0 GeV/c^2 to be $[0.7\text{–}2.9] \times 10^{-7}$. We also obtain an upper limit on its branching fraction as 5.8×10^{-7} at the 90% C.L. for the 1.0 GeV/c^2 < $M_{K^0_S K^0_S}$ < 3.0 GeV/c^2 mass range. The upper limits at the 90% C.L. on the products of the branching fractions $\mathcal{B}(B^0 \to f_2\gamma) \times \mathcal{B}(f_2(1270) \to K^0_S K^0_S)$ and $\mathcal{B}(B^0 \to f'_2\gamma) \times \mathcal{B}(f'_2(1525) \to K^0_S K^0_S)$ are obtained to be 3.1×10^{-7} and 2.1×10^{-7}, respectively.

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TABLE III. Summary of the number of observed events ($N_{\rm obs}$), number of estimated background events ($N_{\rm bkg}$), efficiencies (ϵ_S), upper limits on the signal yield (S_{90}), and product branching fraction upper limits (U.L.) at the 90% C.L. for the $B^0 \to f_2\gamma$ and $f_2 \to K^0_S K^0_S$ decays.

Branching fraction product	$\epsilon_S(\%)$	$N_{\rm bkg}$	$\sigma_{\rm sys}(\%)$	$N_{\rm obs}$	S_{90}	U.L.(10^{-7})
$B^0 \to f_2(1270)(\to K^0_S K^0_S)\gamma$	2.3	1.8 ± 0.4	3.1	3	5.7	3.1
$B^0 \to f'_2(1525)(\to K^0_S K^0_S)\gamma$	2.2	0.8 ± 0.3	3.1	1	3.6	2.1

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