

## Dissociation of Feshbach molecules via spin-orbit coupling in ultracold Fermi gases

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We study the dissociation of Feshbach molecules in ultracold Fermi gases with spin-orbit (SO) coupling. Since SO coupling can induce a quantum transition between Feshbach molecules and the fully polarized Fermi gas, the Feshbach molecules can be dissociated by the SO coupling. We experimentally realize this type of dissociation in ultracold gases of  $^{40}\text{K}$  atoms with SO coupling created by Raman beams and observe that the dissociation rate is highly nonmonotonic on both the positive and negative Raman-detuning sides. Our results show that the dissociation of Feshbach molecules can be controlled by different degrees of freedoms, i.e., the SO-coupling intensity or the momenta of the Raman beams, as well as the detuning of the Raman beams.

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### I. INTRODUCTION

Recently spin-orbit (SO) coupling has emerged as one of the most exciting research directions in ultracold-atom physics. It plays a key role in a variety of systems and has given rise to phenomena ranging from topological insulators [1–4] to Majorana fermions [5]. Ultracold atomic gases offer a unique platform for engineering synthetic SO coupling due to the wide tunability of experimental parameters. Many schemes of generating artificial Abelian and non-Abelian gauge fields have been developed via atom-light interaction [6–9]. An equal combination of Rashba and Dresselhaus SO coupling was realized experimentally in a neutral atomic Bose-Einstein condensate (BEC) by Lin *et al.* [10], in which two atomic spin states are dressed by a pair of counterpropagating laser beams with two-photon Raman transition. Successively, several groups were realized experimentally with the same scheme and studied the intriguing properties of SO-coupled BECs [11–15].

In parallel, SO-coupled Fermi gases [16] have also attracted a great deal of attention, since SO coupling induces coupling between spin-triplet and spin-singlet states and further gives rise to nontrivial topological order and Majorana fermions. Much progress has been made on the experimental exploration of the SO-coupled Fermi gases. The SO-coupled noninteracting fermionic  $^{40}\text{K}$  [17] and  $^6\text{Li}$  [18] atoms have been investigated. Subsequently, SO-coupled Fermi gases were studied experimentally near a Feshbach resonance. The SO-coupling-induced shift of the binding energy of a Feshbach molecule has been observed via both radio-frequency spectroscopy [19] and scattering resonance induced by Raman beams [20]. Furthermore, it has been observed that SO coupling can coherently produce *s*-wave Feshbach molecules from a fully

polarized Fermi gas and induce a coherent oscillation between these two [21].

In this Rapid Communication we report that SO coupling can dissociate *s*-wave Feshbach molecules formed by ultracold Fermi atoms in different pseudospin states. In our experiment we prepare Feshbach molecules of ultracold  $^{40}\text{K}$  atoms in states  $|F = 9/2, m_F = -7/2\rangle$  ( $|\uparrow\rangle$ ) and  $|F = 9/2, m_F = -9/2\rangle$  ( $|\downarrow\rangle$ ) and then create an SO coupling by ramping up two counterpropagating Raman beams, as in Refs. [10,17,18] [Fig. 1(a)]. After this ramping process, we measure the number of remaining Feshbach molecules as a function of the Raman detuning of the spin-orbit coupling. We observe that a significant loss of Feshbach molecules is induced by the SO coupling. The maximum loss occurs on both the positive and negative sides of the Raman resonance. These observations are consistent with our theoretical analysis. This analysis shows that the loss effect is due to the SO-coupling-induced transition from the Feshbach molecular state, in which the two atoms are in the singlet pseudospin state, to free-motion states of two atoms in the polarized pseudospin states  $|\uparrow\rangle_1|\uparrow\rangle_2$  or  $|\downarrow\rangle_1|\downarrow\rangle_2$ . It is quite different from radio-frequency (rf) beam-induced dissociation of a Feshbach molecule into two free atoms in the singlet state of different hyperfine states  $|\downarrow\rangle$  and  $|F = 9/2, m_F = -5/2\rangle$  [22–26]. Our work demonstrates that SO coupling, as a momentum-dependent Zeeman field, can entangle the two-atom internal state with the relative spatial motion and thus exhibits a significantly different effect on the Feshbach molecule compared to a momentum-independent Zeeman field.

### II. EXPERIMENT

Our experimental setup [27–30] for the preparation of the Feshbach molecules and SO coupling in the ultracold Fermi gas  $^{40}\text{K}$  has been described in detail in Refs. [19,21]. We prepare an equal mixture of  $2 \times 10^6$  ultracold  $^{40}\text{K}$  atoms in the pseudospin states  $|\uparrow\rangle$  and  $|\downarrow\rangle$  and then adiabatically sweep the magnetic field across the Feshbach resonance

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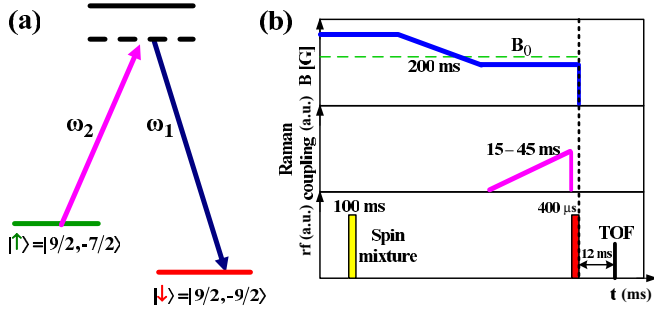


FIG. 1. (Color online) (a) Schematic diagram of SO coupling for  $^{40}\text{K}$ . (b) Time sequence of the homogeneous bias magnetic field, the Raman coupling, and the rf field. Here  $B_0 = 202.2$  G is the Feshbach resonance point of atoms in  $|F = 9/2, m_F = -9/2\rangle$  and  $|F = 9/2, m_F = -7/2\rangle$ . The time of flight is denoted by TOF.

point  $B_0 = 202.20$  G [Fig. 1(b)]. As a result of this adiabatic sweeping, many pairs of atoms in state  $|\uparrow\rangle_1|\downarrow\rangle_2$  are converted into the  $s$ -wave Feshbach molecules. The binding energy of the molecules is determined by the final magnetic-field strength in the sweeping process. Subsequently, we apply the SO coupling by switching on a pair of counterpropagating Raman laser beams [10,17,18], which effectively couple the states  $|\uparrow\rangle$  and  $|\downarrow\rangle$  [Fig. 1(a)]. The momentum transfer in the Raman process is  $2k_r \equiv 4\pi\hbar/\lambda$ , where  $\lambda = 772.4$  nm is the wavelength of the Raman beams. In our system the two-photon detuning is defined as  $\eta = \hbar(\omega_1 - \omega_2 - \omega_Z)$ , where  $\omega_{1,2}$  are the frequencies of the two Raman beams [Fig. 1(a)] and  $\hbar\omega_Z$  is the Zeeman splitting between states  $|\uparrow\rangle$  and  $|\downarrow\rangle$ .

In each experiment, we fix the value of  $\eta$  and ramp the intensity of the Raman coupling from zero to a maximum value and then switch off the Raman beams [Fig. 1(b)]. When the Raman beams are switched off, we measure the number of remaining Feshbach molecules in the trap with the approach in Refs. [19,21]. We apply an rf pulse with duration about  $400\ \mu\text{s}$  to dissociate these molecules into free atoms in states  $|\downarrow\rangle$  and  $|F = 9/2, m_F = -5/2\rangle$  and then measure the number  $N_j$  ( $j = -7/2, -5/2$ ) of atoms in  $|F = 9/2, m_F = j\rangle$  via a time-of-flight technique. The number of remaining molecules is known as  $N_{\text{rem}} = N_{-5/2}$ , while  $N_{\text{tot}} = N_{-5/2} + N_{-7/2}$  is half the number of all the  $^{40}\text{K}$  atoms in our system.

In Figs. 2(c), 2(e), and 2(g) we illustrate the ratio  $N_{\text{rem}}/N_{\text{tot}}$  between the number of remaining molecules and half the number of all the atoms, as a function of two-photon detuning  $\eta$ . It is clearly shown that in some parameter regions this ratio approaches zero. Therefore, in these regions most of the molecules are dissociated. For comparison, we also do measurements [Fig. 2(a)] in the system where the two Raman beams propagate along the same direction [the other parameters are the same as in Fig. 2(c)]. In this case, SO coupling cannot be created by the Raman beams and we find that the ratio  $N_{\text{rem}}/N_{\text{tot}}$  is large and does not change with  $\eta$ . Note that the narrow peak in the blue Raman detuning of about  $58E_r$  is due to the bound-to-bound (the Feshbach molecular state to deeply bound molecular states) transitions with the Raman lasers [31]. Therefore, in our system the dissociation of the Feshbach molecules is induced by the SO coupling. Below we will give a theoretical explanation

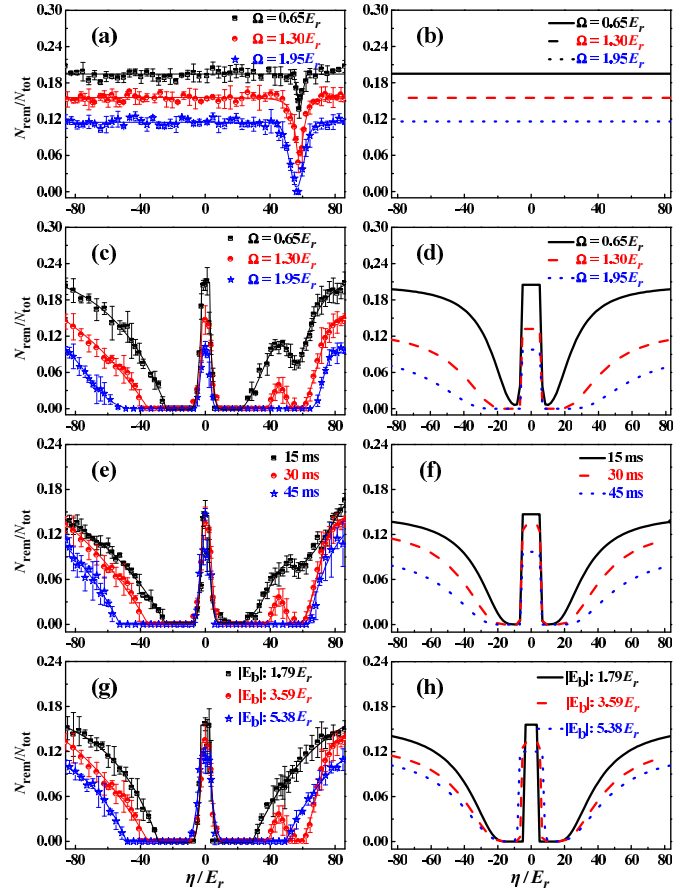


FIG. 2. (Color online) Ratio  $N_{\text{rem}}/N_{\text{tot}}$  between the number  $N_{\text{rem}}$  of remaining Feshbach molecules and half the number  $N_{\text{tot}}$  of all atoms. Here we illustrate (a), (c), (e), and (g) experimental and (b), (d), (f), and (h) theoretical results as functions of Raman detuning  $\eta$ : (a) and (b) without SO coupling (the two Raman beams propagating along the same direction); (c) and (d) with binding energy of the Feshbach molecule  $|E_b| = 3.59E_r$ , ramping time  $T = 30$  ms, and different values of the final intensity  $\Omega$  of Raman coupling; (e) and (f) with  $|E_b| = 3.59E_r$ ,  $\Omega = 1.30E_r$ , and different  $T$ ; and (g) and (h) with  $\Omega = 1.30E_r$ ,  $T = 30$  ms, and different  $|E_b|$ .

for this SO-coupling-induced dissociation. We show that in the presence of SO coupling, the Raman beams can induce a transition from the Feshbach molecular state to the free-motion states of two atoms in  $|\uparrow\rangle_1|\uparrow\rangle_2$  or  $|\downarrow\rangle_1|\downarrow\rangle_2$ . As a result, the molecules can be dissociated. Nevertheless, when there is no SO coupling, this transition is forbidden by the symmetry of the system.

Figures 2(c), 2(e), and 2(g) also show that, when the two-photon detuning  $\eta$  is zero, the ratio  $N_{\text{rem}}/N_{\text{tot}}$  remains unchanged compared with the case in which the SO coupling is not applied. Therefore, in that case there is no dissociation effect. Nevertheless, when  $|\eta|$  is increased to a sufficient detuning,  $N_{\text{rem}}/N_{\text{tot}}$  rapidly decreases, which corresponds to the steep threshold behavior of the dissociation process. In some regions with finite  $|\eta|$ ,  $N_{\text{rem}}/N_{\text{tot}}$  is negligible. This implies that in these regions the dissociation effect is very strong and saturated. This phenomenon is due to the energy conservation in the Raman-beam-induced transition. As shown

in the theoretical analysis below, when  $\eta = 0$ , the Feshbach molecular state lies in the lowest-energy state of the system and all the polarized states are energetically off-resonance with the Feshbach molecular state. Thus there is no dissociation effect. When the detuning  $\eta$  takes a sufficient positive value, the Feshbach molecular state becomes resonant with the lower free-motion states in  $|\uparrow\rangle_1|\uparrow\rangle_2$ . As a result, the transitions from the Feshbach molecular state to these states can take place and are strong if  $\eta$  is not too large. We thus can observe a significant dissociation effect and a steep threshold behavior. Similarly, when  $\eta$  reaches a sufficiently negative value, the Feshbach molecular state becomes resonant with polarized states in  $|\downarrow\rangle_1|\downarrow\rangle_2$  and thus dissociation can take place.

Furthermore, as shown in Figs. 2(c), 2(e), and 2(g), in the regions where  $|\eta|$  is extremely large, the ratio  $N_{\text{rem}}/N_{\text{tot}}$  gradually increases with  $|\eta|$ . Therefore, in these regions the dissociation effect becomes weak again. According to our theoretical analysis, this is because the Feshbach molecular state is resonant with free-motion states with high momentum when  $|\eta|$  is very large. As a result, the matrix element of the Hamiltonian between these two states (Franck-Condon factor) becomes small and thus the transition rate from the molecular state to the polarized states is decreased.

We also investigate the dependence of the dissociation effect on other physical parameters. In Fig. 2(c) we illustrate  $N_{\text{rem}}/N_{\text{tot}}$  measured with the binding energy of the Feshbach molecule  $|E_b| = 3.59E_r$ , ramping time  $T = 30$  ms, and final intensity of Raman coupling in the ramping process  $\Omega = 0.65E_r, 1.30E_r$ , and  $1.95E_r$ , where  $E_r = k_r^2/2m = \hbar \times 52.52$  kHz is the recoil energy of the Raman beams. Here  $m$  is the single-atom mass. In Fig. 2(e) we show the values of  $N_{\text{rem}}/N_{\text{tot}}$  for  $|E_b| = 3.59E_r$ ,  $\Omega = 1.30E_r$ , and  $T = 15, 30$ , and  $45$  ms. Our measurements show that the dissociation effect is strong under the condition of a long ramping time and high final intensity of Raman coupling. In Fig. 2(g) we illustrate  $N_{\text{rem}}/N_{\text{tot}}$  for  $T = 30$  ms,  $\Omega = 1.30E_r$ , and  $|E_b| = 1.79E_r, 3.59E_r$ , and  $5.38E_r$ . We find that the dissociation effect increases with the binding energy  $|E_b|$  of the Feshbach molecule [note that the narrow peak for the bound-to-bound transitions with the Raman lasers is shifted when the magnetic field (binding energy) is changed [31]]. This phenomenon can possibly be explained with the following analysis. When  $|E_b|$  becomes larger, the Feshbach molecular state has a broader momentum distribution. As a result, there are more free-motion states that have a large overlap (Franck-Condon factor) with the molecular state.

In the following we present a detailed theoretical analysis for our experiment. We calculate theoretically the ratio  $N_{\text{rem}}/N_{\text{tot}}$  with the same parameters as in our experiments, which agree well with the experimental measurements.

### III. THEORETICAL ANALYSIS

Our experimental results can be qualitatively explained with a simple two-body analysis. For convenience, here we discuss our problem in the comoving frame, which is related to the original frame via a spin-dependent unitary transformation  $\mathcal{U} = e^{-ik_0(x_1\sigma_z^{(1)} + x_2\sigma_z^{(2)})}$ , with  $\sigma_z^{(i)} = |\uparrow\rangle_i\langle\uparrow| - |\downarrow\rangle_i\langle\downarrow|$  and  $k_0 = k_r \sin \frac{\theta}{2}$ , where  $\theta$  is the angle between two Raman beams. In

this comoving frame, the Hamiltonian of the two atoms is  $H = H_1 + H_2$ , with ( $\hbar = m = 1$ )

$$H_1 = \sum_{i=1,2} \left[ \frac{1}{2} (\mathbf{p}^{(i)} + k_0 \sigma_z^{(i)} \mathbf{e}_x)^2 - \frac{\eta}{2} \sigma_z^{(i)} \right] + V, \quad (1)$$

$$H_2 = \frac{\Omega}{2} (\sigma_x^{(1)} + \sigma_x^{(2)}). \quad (2)$$

Here  $\mathbf{p}^{(i)}$  ( $i = 1, 2$ ) is the momentum of atom  $i$ ,  $\mathbf{e}_x$  is the unit vector along the  $x$  direction,  $\sigma_x^{(i)} = |\uparrow\rangle_i\langle\downarrow| + |\downarrow\rangle_i\langle\uparrow|$ , and  $\Omega$  is the Raman-coupling strength. In Eq. (1),  $V$  is the atomic interaction operator in the comoving frame. In the low-energy case, we only consider the interaction between fermionic atoms in different pseudospin states. Based on this model, we can explain our experimental results.

#### A. Finite $k_0$ is necessary for the dissociation of the Feshbach molecule

According to Eqs. (1) and (2), when the Raman beams are turned on, the pseudospin-dependent part of the total Hamiltonian  $H$  of the two atoms can be written as  $\mathbf{h}(\mathbf{p}^{(1)})\sigma_1 + \mathbf{h}(\mathbf{p}^{(2)})\sigma_2$ , where  $\mathbf{h}(\mathbf{p}^{(i)}) = \frac{\Omega}{2} \mathbf{e}_x + p_x^{(i)} k_0 \mathbf{e}_z$  is the effective Zeeman field experienced by atom  $i$ . In the system where the two Raman beams propagate along the same direction, we have  $k_0 = 0$  and there is no synthetic SO coupling. As a result, the effective field is momentum independent. Thus, when the Raman beams are applied, the pseudospins of the two atoms rotate along the same axis. Furthermore, the two atoms in the Feshbach molecule are in the singlet state  $|S\rangle$ , which cannot be changed by such rotation. Therefore, the Raman beams cannot dissociate the Feshbach molecule. On the other hand, when the two Raman beams propagate along different directions, we have  $k_0 \neq 0$  and the synthetic SO coupling is induced by the Raman beams. In this case the two atoms with different momenta  $\mathbf{k}_1$  and  $\mathbf{k}_2$  can experience different effective fields  $\mathbf{h}(\mathbf{k}_1)$  and  $\mathbf{h}(\mathbf{k}_2)$ . Thus, the Raman beams can rotate the pseudospins of the two atoms along different axes. Therefore, although the two atoms in the Feshbach molecule are polarized along opposite directions, when the Raman beams are turned on, they have some probability of evolving to the parallel-polarized state where the pseudospins are along the same direction. As a result, the Feshbach molecule can be dissociated by the Raman beams.

This result can also be understood with the following detailed analysis. According to Eqs. (1) and (2), before the Raman beams are applied, we have  $\Omega = 0$  and thus  $H_2 = 0$ . Therefore, the two-atom Hamiltonian in the comoving frame is  $H_1$ . The atoms are prepared in the Feshbach molecular state. In the original frame, this state is  $|\Phi_b\rangle = \int d\mathbf{r}_1 d\mathbf{r}_2 \phi_b(\mathbf{r}) |\mathbf{r}_1\rangle_1 |\mathbf{r}_2\rangle_2 |S\rangle$ , where  $|S\rangle = (|\uparrow\rangle_1 |\downarrow\rangle_2 - |\downarrow\rangle_1 |\uparrow\rangle_2) / \sqrt{2}$  is singlet state,  $|\mathbf{r}_i\rangle_i$  is the eigenstate of the position of the  $i$ th atom,  $\mathbf{r} = \mathbf{r}_1 - \mathbf{r}_2$ , and  $\phi_b(\mathbf{r}) = e^{-r/a} / \sqrt{2a\pi}$ , with  $a$  the scattering length between atoms in states  $|\uparrow\rangle$  and  $|\downarrow\rangle$ . Therefore, in the comoving frame the Feshbach molecular state is  $|\Phi_b^{(C)}\rangle \equiv \mathcal{U} |\Phi_b\rangle$ . It is an eigenstate of  $H_1$ , with eigenenergy  $E_b = -a^{-2}$ .

In the system with  $k_0 = 0$ , we have  $\mathcal{U} = 1$  and thus  $|\Phi_b^{(C)}\rangle = |\Phi_b\rangle \propto |S\rangle$ . When the Raman beams are turned on, the atom-laser interaction is described by the Hamiltonian  $H_2$

in Eq. (2). Nevertheless, since  $H_2|S\rangle = 0$ , the Raman beams cannot induce quantum transition from  $|\Phi_b^{(C)}\rangle$  to other states. Therefore, the Raman beams cannot dissociate the Feshbach molecule.

When  $k_0 \neq 0$ , we have  $\mathcal{U} \neq 1$ . In this case the Feshbach molecular state in the comoving frame is  $|\Phi_b^{(C)}\rangle = \mathcal{U}|\Phi_b\rangle = |\phi_+\rangle|S\rangle + |\phi_-\rangle|T\rangle$ , where  $|T\rangle = (|\uparrow\rangle_1|\downarrow\rangle_2 + |\downarrow\rangle_1|\uparrow\rangle_2)/\sqrt{2}$  is a triplet state and

$$|\phi_{\pm}\rangle = \frac{1}{2} \int d\mathbf{r}_1 d\mathbf{r}_2 [\phi_b(\mathbf{r})e^{-ik_0\mathbf{e}_x \cdot \mathbf{r}} \pm \phi_b(\mathbf{r})e^{ik_0\mathbf{e}_x \cdot \mathbf{r}}] |\mathbf{r}_1\rangle_1 |\mathbf{r}_2\rangle_2.$$

It is clear that  $H_2|\Phi_b^{(C)}\rangle \propto H_2|T\rangle \propto (|\uparrow\rangle_1|\uparrow\rangle_2 + |\downarrow\rangle_1|\downarrow\rangle_2)$ . Therefore, when the Raman beams are turned on, the atom-laser interaction  $H_2$  can induce a quantum transition from the Feshbach molecular state  $|\Phi_b^{(C)}\rangle$  to other eigenstates of  $H_1$  and thus dissociate the Feshbach molecules.

### B. Nonmonotonic dependence of dissociation on detuning $\eta$

Now we consider the dependence of the dissociation effect on the two-photon detuning  $\eta$ . As shown above, the dissociation is due to Raman-beam-induced transition from the Feshbach molecular state  $|\Phi_b^{(C)}\rangle$ . With direct calculation, we find that in the first-order processes the final states of these transitions are  $|\Psi_+(\mathbf{k})\rangle = |\uparrow\rangle_1|\uparrow\rangle_2(|\mathbf{k}\rangle_1 - |\mathbf{k}\rangle_2 - |-\mathbf{k}\rangle_1|\mathbf{k}\rangle_2)/\sqrt{2}$  and  $|\Psi_-(\mathbf{k})\rangle = |\downarrow\rangle_1|\downarrow\rangle_2(|\mathbf{k}\rangle_1 - |\mathbf{k}\rangle_2 - |-\mathbf{k}\rangle_1|\mathbf{k}\rangle_2)/\sqrt{2}$ , where  $|\mathbf{k}\rangle_i$  is the eigenstate of the momentum of atom  $i$  and  $|\Psi_{\pm}(\mathbf{k})\rangle$  are eigenstates of  $H_1$ , with corresponding eigenenergies  $E_{\pm}(\mathbf{k}) = |\mathbf{p}|^2 + k_0^2 \mp \eta$ .

Significant quantum transitions can occur between  $|\Phi_b^{(C)}\rangle$  and the resonant final states  $|\Psi_{\pm}(\mathbf{k})\rangle$ , which satisfies the resonance condition  $E_{\pm}(\mathbf{k}) = E_b = -a^{-2}$ . Since  $E_{\pm}(\mathbf{k}) \geq k_0^2 \mp \eta$ , when the two-photon detuning  $\eta = 0$ , this resonance condition cannot be satisfied by any value of  $\mathbf{k}$  [Fig. 3(a)]. As a result, the dissociation is very weak and the number of remaining molecules is large. When the two-photon detuning  $\eta$  is increased so that  $\eta \gtrsim k_0^2 + 1/a^2$ ,  $|\Phi_b^{(C)}\rangle$  becomes resonant with free-motion states  $|\Psi_+(\mathbf{k})\rangle$  [Fig. 3(b)]. These states have relatively small momentum  $\mathbf{k}$  and thus have large overlap with the Feshbach molecular state (i.e., large Franck-Condon factor). Thus, the transitions from  $|\Phi_b^{(C)}\rangle$  to these states are significant. Similarly, when  $\eta$  is tuned to be negative and  $-\eta \gtrsim k_0^2 + 1/a^2$ ,  $|\Phi_b^{(C)}\rangle$  becomes resonant with  $|\Psi_-(\mathbf{k})\rangle$  with small  $\mathbf{k}$  [Fig. 3(c)] and thus the transitions to these states are strong. Therefore, for the cases with either positive or negative  $\eta$ , when the condition  $|\eta| \gtrsim k_0^2 + 1/a^2$  is satisfied, the dissociation becomes significant and the ratio  $N_{\text{rem}}/N_{\text{tot}}$  between the number of remaining Feshbach molecules and half the number of all the atoms becomes very small. In addition, when  $|\eta|$  is further increased so that  $|\eta| \gg k_0^2 + 1/a^2$ ,  $|\Phi_b^{(C)}\rangle$  is resonant with states  $|\Psi_{\pm}(\mathbf{k})\rangle$  with very large  $\mathbf{k}$ .

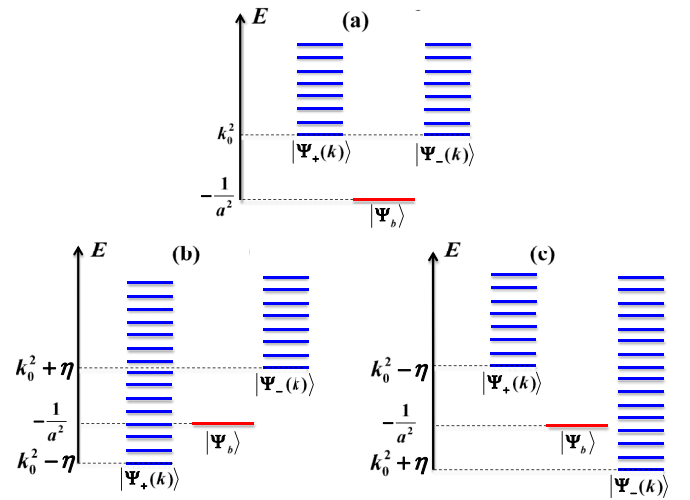


FIG. 3. (Color online) Energy spectra of eigenstates of  $H_F$  with two-photon detuning (a)  $\eta = 0$ , (b)  $\eta > 0$ , and (c)  $\eta < 0$ .

As a result, the overlap of the molecular state and  $|\Psi_{\pm}(\mathbf{k})\rangle$  becomes very small. Thus, the dissociation rate is decreased and  $N_{\text{rem}}/N_{\text{tot}}$  is increased in the region with large  $|\eta|$ . As shown in Figs. 2(a), 2(c), 2(e), and 2(g), all these effects are observed in our experiment.

Based on the analysis above, we phenomenologically calculate the ratio  $N_{\text{rem}}/N_{\text{tot}}$  with Fermi's golden rule [32]. We perform the calculations with the same parameters as in the experiments of Figs. 2(a), 2(c), 2(e), and 2(g) and illustrate our results in Figs. 2(b), 2(d), 2(f), and 2(h). It is clear that our theoretical result is qualitatively consistent with the experimental measurements.

## IV. CONCLUSION

In summary, we investigated experimentally and theoretically the dissociation effect of Feshbach molecules in the presence of SO coupling. This dissociation effect is due to the SO-coupling-induced transition from the Feshbach molecular state with atoms in the singlet pseudospin state to free-motion states of two atoms in polarized pseudospin states. This work demonstrates that SO coupling in a Fermi gas constitutes a dissociation tool for Feshbach molecules.

## ACKNOWLEDGMENTS

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