Supplemental Material to the article

"Stability of the coexistence phase of chiral superconductivity and noncollinear spin ordering with nontrivial topology with regard to strong electron correlations"

A. Spin and electron Green functions in the Hubbard-I approximation. Let introduce the spin Green functions in the Matsubara representation:

$$D^{++}(x-x') = -\left\langle T_\tau X_f^{\uparrow\downarrow}(\tau)\, X_{f'}^{\downarrow\uparrow}(\tau')\, S(\beta)\right\rangle_{0,c}, \tag{1}$$

$$D^{+-}(x-x') = -\left\langle T_\tau X_f^{\uparrow\downarrow}(\tau)\, X_{f'}^{\uparrow\downarrow}(\tau')\, S(\beta)\right\rangle_{0,c}, \tag{2}$$

$$D^{-+}(x-x') = -\left\langle T_\tau X_f^{\downarrow\uparrow}(\tau)\, X_{f'}^{\downarrow\uparrow}(\tau')\, S(\beta)\right\rangle_{0,c}, \tag{3}$$

$$D^{--}(x-x') = -\left\langle T_\tau X_f^{\downarrow\uparrow}(\tau)\, X_{f'}^{\uparrow\downarrow}(\tau')\, S(\beta)\right\rangle_{0,c}, \tag{4}$$

where $S(\beta = 1/T)$ is the temperature scattering matrix.

In the simplest loopless approximation the matrix function composed of the spin Green functions for the transformed Hamiltonian (10*) (see the main text) can be presented in the form:

$$\begin{pmatrix} D^{++} & D^{+-} \\ D^{-+} & D^{--} \end{pmatrix} = \begin{pmatrix} G_0^{++} & G_0^{+-} \\ G_0^{-+} & G_0^{--} \end{pmatrix} \begin{pmatrix} 2M & 0 \\ 0 & -2M \end{pmatrix}, \tag{5}$$

where M is the amplitude of the magnetic order parameter. Then, the Dyson equation for the function $\widehat{G}_0$ in the loopless approximation is

$$\widehat{G}_0 \equiv \begin{pmatrix} G_0^{++} & G_0^{+-} \\ G_0^{-+} & G_0^{--} \end{pmatrix} = \begin{pmatrix} G^{(0)} & 0 \\ 0 & -\left(G^{(0)}\right)^* \end{pmatrix} + \begin{pmatrix} G^{(0)} & 0 \\ 0 & -\left(G^{(0)}\right)^* \end{pmatrix} \begin{pmatrix} 2M & 0 \\ 0 & -2M \end{pmatrix} \frac{1}{2} \begin{pmatrix} A_q^+ & A_q^- \\ A_q^- & A_q^+ \end{pmatrix} \widehat{G}_0, \tag{6}$$

where $G^{(0)} = (i\omega_m - 2h_Q)^{-1}$. Solving this equation we obtain

$$\widehat{G}_0^{-1} = \begin{pmatrix} i\omega_m - 2h_Q - MA_q^+ & -MA_q^- \\ MA_q^- & i\omega_m + 2h_Q + MA_q^+ \end{pmatrix}, \tag{7}$$

where $h_Q = -MJ_Q$, $A_q^{\pm} = J_q \pm (J_{q-Q} + J_{q+Q})/2$ as in the main text.

The spin-wave spectrum is defined from the equation $det\left(\widehat{G}_0^{-1}\right) = 0$ substituting $i\omega_m \to \omega + i\delta$ and has a form:

$$\omega_{0q} = 2M\gamma_q = 2M\sqrt{(J_q - J_Q)\left[\frac{J_{q-Q} + J_{q+Q}}{2} - J_Q\right]}. \tag{8}$$

The electron Green functions are defined by the expressions:

$$D_{\sigma 2,\sigma 2}(x-x') = -\left\langle T_\tau X_f^{\sigma 2}(\tau)\, X_{f'}^{2\sigma}(\tau')\, S(\beta)\right\rangle_{0,c}, \tag{9}$$

$$D_{\sigma 2,\bar\sigma 2}(x-x') = -\left\langle T_\tau X_f^{\sigma 2}(\tau)\, X_{f'}^{2\bar\sigma}(\tau')\, S(\beta)\right\rangle_{0,c}. \tag{10}$$

Applying the unitary transformation the expressions for the irreducible parts of the electron Green functions in the magnetic phase takes a form:

$$G_{\sigma 2,\sigma 2}(p, i\omega_n) = \frac{i\omega_n - \xi_p^+ + \eta_\sigma M\left(t_p^+ - J_Q\right)}{(i\omega_n - \varepsilon_{1p})(i\omega_n - \varepsilon_{2p})}, \quad G_{\sigma 2,\bar\sigma 2}(p, i\omega_n) = \frac{F_{\sigma 2} t_p^-}{(i\omega_n - \varepsilon_{1p})(i\omega_n - \varepsilon_{2p})}, \tag{11}$$

$$G_{2\sigma,2\sigma}(p, i\omega_n) = -G_{\sigma 2,\sigma 2}(-p, -i\omega_n), \quad G_{2\sigma,2\bar\sigma}(p, i\omega_n) = -G_{\sigma 2,\bar\sigma 2}(-p, -i\omega_n), \tag{12}$$

where $D_{\sigma2,\sigma2}(p,i\omega_n)=G_{\sigma2,\sigma2}(p,i\omega_n)F_{\sigma2}$, $D_{\sigma2,\bar\sigma2}(p,i\omega_n)=G_{\sigma2,\bar\sigma2}(p,i\omega_n)F_{\bar\sigma2}$ and so on. Here we have used the notation as in the main text: $t_p^{\pm}=\left(t_{p-Q/2}\pm t_{p+Q/2}\right)/2$ and introduced $\xi_p^{+}=\xi_0+nt_p^{+}/2$, $\xi_0=\varepsilon+U-\mu+J_0(1-n/2)+V_0n$, $F_{\sigma2}=\left\langle X_f^{\sigma\sigma}+X_f^{22}\right\rangle=n/2+\eta_\sigma M$. The Fermi spectrum in the magnetic phase is

$$\varepsilon_{1,2p}=\xi_p^{+}\mp\sqrt{\left(nt_p^{-}/2\right)^2+M^2(t_{p-Q/2}-J_Q)(t_{p+Q/2}-J_Q)}. \qquad (13)$$

The analytic expression obtained from the diagrammatic series for the average $N_\uparrow=\left\langle X_f^{\uparrow\uparrow}\right\rangle$ (Fig. 1 in the main text) has a form:

$$N_\uparrow=\left\langle X_f^{\uparrow\uparrow}\right\rangle_0+M\frac{T}{N}\sum_{qm}G^0(i\omega_m)\left[A_q^{+}G_{++}(q,i\omega_m)-A_q^{-}G_{+-}(q,i\omega_m)\right]+$$
$$-\frac{T}{N}\sum_{pn}G^0_{\uparrow2}(i\omega_n)\left[t_p^{+}G_{\uparrow2,\uparrow2}(p,i\omega_n)F_{\uparrow2}+t_p^{-}G_{\uparrow2,\downarrow2}(p,i\omega_n)F_{\downarrow2}\right], \qquad (14)$$

where $G^{(0)}_{\uparrow2}(i\omega_n)=\left(i\omega_n-\xi_\downarrow\right)^{-1}$ and $\xi_\sigma=\xi_0-\eta_\sigma h_Q$. Calculating the sum over Matsubara frequencies we obtain the Eq. (11*) (see the main text).

B. Calculation of the topological invariant $\tilde N_3$ and the excitation spectrum for the cylinder topology. The matrix Green function for fermions in the coexistence phase of superconductivity and noncollinear magnetism has a form:

$$\widehat{G}^{-1}(i\omega,p)=$$
$$=\begin{bmatrix} i\omega-\xi_p & -\Delta_p^* & -R_{p-Q} & 0\\ -\Delta_p & i\omega+\xi_p & 0 & R_{p-Q}\\ -R_p & 0 & i\omega-\xi_{p-Q} & \Delta^*_{-p+Q}\\ 0 & R_p & \Delta_{-p+Q} & i\omega+\xi_{p-Q}\end{bmatrix}.$$

Substituting the obtained expression into the definition of the topological invariant $\tilde N_3$ (13*) (see the main text) and calculating the trace of the product of the matrices we obtain integral in the following form:

$$\tilde N_3=\frac{i}{4\pi^2}\int_{-\infty}^{\infty}d\omega\iint_{-\pi}^{\pi}dp_1dp_2\frac{a(p)\omega^4-id(p)\omega^3-b(p)\omega^2+ig(p)\omega+c(p)}{\left(\omega^2+E_{1p}^2\right)^2\left(\omega^2+E_{2p}^2\right)^2}. \qquad (15)$$

In this form the integral over energy can be calculated analytically:

$$\tilde N_3=-\frac{i}{8\pi}\iint_{-\pi}^{\pi}dp_1dp_2\sum_{j=1,\,2}\left\{\frac{3a(p)E_{jp}^4+b(p)E_{jp}^2-c(p)}{4E_{jp}^3\nu_p^4}-(-1)^j\cdot\frac{a(p)E_{jp}^4+b(p)E_{jp}^2+c(p)}{2E_{jp}\nu_p^6}\right\}. \qquad (16)$$

It should be noted that the terms proportional to the odd power of the energy in (15) are omitted as they do not contribute to the result. The coefficients $d(p)$ and $g(p)$ appear when the corrections to the exchange field due to the kinematic interaction are taken into account and they are proportional to ∂_jR_p, ∂_jR_{p-Q}, $j=1,\,2$.

The coefficient $a(p)$ do not depend on the effective exchange field:

$$\begin{aligned} a(p) &= \left[\xi_p\cdot\partial_1\Delta_p^*\cdot\partial_2\Delta_p+\xi_{p-Q}\cdot\partial_1\Delta^*_{-p+Q}\cdot\partial_2\Delta_{-p+Q}+\Delta_p\cdot\left(\partial_1\xi_p\cdot\partial_2\Delta_p^*-\partial_2\xi_p\cdot\partial_1\Delta_p^*\right)+\right.\\ &+ \left.\Delta_{-p+Q}\cdot\left(\partial_1\xi_{p-Q}\cdot\partial_2\Delta^*_{-p+Q}-\partial_2\xi_{p-Q}\cdot\partial_1\Delta^*_{-p+Q}\right)\right]-[\text{h.c.}], \end{aligned} \qquad (17)$$

where h.c. is hermitian conjugate.

The remaining coefficients can be represented in the following form:

$$b(p) = A(p)\cdot R_pR_{p-Q}+B(p)+C(p)\cdot R_p+D(p)\cdot R_{p-Q}, \qquad (18)$$
$$c(p) = \alpha(p)\cdot R_p^2R_{p-Q}^2+\beta(p)\cdot R_pR_{p-Q}+\gamma(p)-C(p)\cdot R_p^2R_{p-Q}-D(p)\cdot R_pR_{p-Q}^2+\eta(p)\cdot R_p+\zeta(p)R_{p-Q}, \qquad (19)$$

where

$$
\begin{aligned}
A(p) &= a(p) + \left[(\xi_p + \xi_{p-Q})\left(\partial_1\Delta_p^* \cdot \partial_2\Delta_{-p+Q} - \partial_2\Delta_p^* \cdot \partial_1\Delta_{-p+Q}\right) + 3\xi_p \cdot \partial_1\Delta_{-p+Q}^* \cdot \partial_2\Delta_{-p+Q} + \right. \\
&+ 3\xi_{p-Q} \cdot \partial_1\Delta_p^* \cdot \partial_2\Delta_p + 3\Delta_{-p+Q}\left(\partial_1\xi_p \cdot \partial_2\Delta_p^* - \partial_2\xi_p \cdot \partial_1\Delta_p^*\right) + \\
&+ 3\Delta_p\left(\partial_1\xi_{p-Q} \cdot \partial_2\Delta_{-p+Q}^* - \partial_2\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^*\right) + \\
&+ \left.(\Delta_p + \Delta_{-p+Q})\left(\partial_1\xi_p \cdot \partial_2\Delta_{-p+Q}^* + \partial_1\xi_{p-Q} \cdot \partial_2\Delta_p^* - \partial_2\xi_p \cdot \partial_1\Delta_{-p+Q}^* - \partial_2\xi_{p-Q} \cdot \partial_1\Delta_p^*\right)\right] - [\text{h.c.}]\,, \qquad (20)
\end{aligned}
$$

$$
\begin{aligned}
B(p) &= \left\{2\left(\xi_p^2 + \left|\Delta_p^2\right|\right)\left[\Delta_{-p+Q}\left(\partial_2\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^* - \partial_1\xi_{p-Q} \cdot \partial_2\Delta_{-p+Q}^*\right) + \xi_{p-Q} \cdot \partial_1\Delta_{-p+Q} \cdot \partial_2\Delta_{-p+Q}^*\right] + \right. \\
&+ \left. 2\left(\xi_{p-Q}^2 + \left|\Delta_{-p+Q}^2\right|\right)\left[\Delta_p\left(\partial_2\xi_p \cdot \partial_1\Delta_p^* - \partial_1\xi_p \cdot \partial_2\Delta_p^*\right) + \xi_p \cdot \partial_1\Delta_p \cdot \partial_2\Delta_p^*\right]\right\} - \{h.c.\}\,, \qquad (21)
\end{aligned}
$$

$$
\begin{aligned}
C(p) &= \left\{(\Delta_p\xi_{p-Q} - \Delta_{-p+Q}\xi_p)\left[\partial_1 R_{p-Q}\left(\partial_2\Delta_p^* - \partial_2\Delta_{-p+Q}^*\right) - \partial_2 R_{p-Q}\left(\partial_1\Delta_p^* - \partial_1\Delta_{-p+Q}^*\right)\right] - \right. \\
&- \left. \Delta_p\Delta_{-p+Q}^*\left[\partial_1 R_{p-Q}\left(\partial_2\xi_p - \partial_2\xi_{p-Q}\right) - \partial_2 R_{p-Q}\left(\partial_1\xi_p - \partial_1\xi_{p-Q}\right)\right]\right\} - \{h.c.\}\,, \qquad (22)
\end{aligned}
$$

$$
D(p) = C(p)|_{\partial_j R_{p-Q} \longrightarrow \partial_j R_p}\,, \qquad (23)
$$

$$
\begin{aligned}
\alpha(p) &= \left\{(\xi_p + \xi_{p-Q})\left(\partial_1\Delta_p^* \cdot \partial_2\Delta_{-p+Q} - \partial_2\Delta_p^* \cdot \partial_1\Delta_{-p+Q}\right) - \xi_p \cdot \partial_1\Delta_{-p+Q}^* \cdot \partial_2\Delta_{-p+Q} - \xi_{p-Q} \cdot \partial_1\Delta_p^* \cdot \partial_2\Delta_p + \right. \\
&+ (\Delta_p + \Delta_{-p+Q})\left[\partial_1\xi_p \cdot \partial_2\Delta_{-p+Q}^* + \partial_1\xi_{p-Q} \cdot \partial_2\Delta_p^* - \partial_2\xi_p \cdot \partial_1\Delta_{-p+Q}^* - \partial_2\xi_{p-Q} \cdot \partial_1\Delta_p^*\right] \\
&+ \left. \Delta_p\left(\partial_2\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^* - \partial_1\xi_{p-Q} \cdot \partial_2\Delta_{-p+Q}^*\right) + \Delta_{-p+Q}\left(\partial_2\xi_p \cdot \partial_1\Delta_p^* - \partial_1\xi_p \cdot \partial_2\Delta_p^*\right)\right\} - \{\text{h.c.}\}\,, \qquad (24)
\end{aligned}
$$

$$
\begin{aligned}
\beta(p) &= \left\{(\xi_p - \xi_{p-Q})\left[\left(\xi_p^2 + |\Delta_p|^2\right) \cdot \partial_1\Delta_{-p+Q} \cdot \partial_2\Delta_{-p+Q}^* - \left(\xi_{p-Q}^2 + |\Delta_{-p+Q}|^2\right) \cdot \partial_1\Delta_p \cdot \partial_2\Delta_p^*\right] + \right. \\
&+ \left(\xi_p\xi_{p-Q} + \Delta_p\Delta_{-p+Q}^*\right)(\xi_p + \xi_{p-Q})\left(\partial_2\Delta_p^*\partial_1\Delta_{-p+Q} - \partial_1\Delta_p^* \cdot \partial_2\Delta_{-p+Q}\right) + \\
&+ \left(\xi_p^2 + |\Delta_p|^2\right)(\Delta_p - \Delta_{-p+Q})\left(\partial_2\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^* - \partial_1\xi_{p-Q} \cdot \partial_2\Delta_{-p+Q}^*\right) + \\
&+ \left(\xi_{p-Q}^2 + |\Delta_{-p+Q}|^2\right)(\Delta_p - \Delta_{-p+Q})\left(\partial_1\xi_p\partial_2\Delta_p^* - \partial_2\xi_p\partial_1\Delta_p^*\right) + \\
&+ \left[\left(\xi_p^2 - |\Delta_p|^2 - \Delta_{-p+Q}\Delta_p^*\right)\Delta_{-p+Q} - \left(\xi_{p-Q}^2 + 2\xi_p\xi_{p-Q}\right)\Delta_p\right]\left(\partial_1\xi_p\partial_2\Delta_{-p+Q}^* - \partial_2\xi_p\partial_1\Delta_{-p+Q}^*\right) \\
&+ \left[\left(\xi_{p-Q}^2 - |\Delta_{-p+Q}|^2 - \Delta_p\Delta_{-p+Q}^*\right)\Delta_p - \left(\xi_p^2 + 2\xi_p\xi_{p-Q}\right)\Delta_{-p+Q}\right]\left(\partial_1\xi_{p-Q}\partial_2\Delta_p^* - \partial_2\xi_{p-Q}\partial_1\Delta_p^*\right) \\
&+ (\xi_p\Delta_{-p+Q} - \xi_{p-Q}\Delta_p)(\Delta_p + \Delta_{-p+Q})\left(\partial_1\Delta_p^* \cdot \partial_2\Delta_{-p+Q}^* - \partial_2\Delta_p^* \cdot \partial_1\Delta_{-p+Q}^*\right) \\
&+ \left. 2(\xi_p + \xi_{p-Q})\Delta_p\Delta_{-p+Q}^*\left(\partial_1\xi_p \cdot \partial_2\xi_{p-Q} - \partial_2\xi_p \cdot \partial_1\xi_{p-Q}\right)\right\} - \{\text{h.c.}\}\,, \qquad (25)
\end{aligned}
$$

$$
\begin{aligned}
\gamma(p) &= \left\{\left(\xi_p^2 + |\Delta_p|^2\right)^2 \cdot \left[\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^* \cdot \partial_2\Delta_{-p+Q} + \Delta_{-p+Q}\left(\partial_1\xi_{p-Q} \cdot \partial_2\Delta_{-p+Q}^* - \partial_2\xi_{p-Q} \cdot \partial_1\Delta_{-p+Q}^*\right)\right] + \right. \\
&+ \left. \left(\xi_{p-Q}^2 + |\Delta_{-p+Q}|^2\right)^2 \cdot \left[\xi_p \cdot \partial_1\Delta_p^* \cdot \partial_2\Delta_p + \Delta_p\left(\partial_1\xi_p \cdot \partial_2\Delta_p^* - \partial_2\xi_p \cdot \partial_1\Delta_p^*\right)\right]\right\} - \{\text{h.c.}\}\,, \qquad (26)
\end{aligned}
$$

$$
\begin{aligned}
\eta(p) &= \left\{\left(\xi_p^2 + |\Delta_p|^2\right)(\xi_p\Delta_{-p+Q} - \xi_{p-Q}\Delta_p)\left(\partial_2 R_{p-Q} \cdot \partial_1\Delta_{-p+Q}^* - \partial_1 R_{p-Q} \cdot \partial_2\Delta_{-p+Q}^*\right) + \right. \\
&+ \left(\xi_{p-Q}^2 + |\Delta_{-p+Q}|^2\right)(\xi_{p-Q}\Delta_p - \xi_p\Delta_{-p+Q})\left(\partial_2 R_{p-Q} \cdot \partial_1\Delta_p^* - \partial_1 R_{p-Q} \cdot \partial_2\Delta_p^*\right) + \\
&+ \left(\xi_p^2 + |\Delta_p|^2\right)\Delta_p\Delta_{-p+Q}^*\left(\partial_1\xi_{p-Q} \cdot \partial_2 R_{p-Q} - \partial_2\xi_{p-Q} \cdot \partial_1 R_{p-Q}\right) + \\
&+ \left. \left(\xi_{p-Q}^2 + |\Delta_{-p+Q}|^2\right)\Delta_p^*\Delta_{-p+Q}\left(\partial_1\xi_p \cdot \partial_2 R_{p-Q} - \partial_2\xi_p \cdot \partial_1 R_{p-Q}\right)\right\} - \{\text{h.c.}\}\,, \qquad (27)
\end{aligned}
$$

$$
\zeta(p) = \eta(p)|_{\partial_j R_{p-Q} \longrightarrow \partial_j R_p}\,. \qquad (28)
$$

For the case of periodic boundary conditions along the direction $\mathbf{a}_2$ of the triangular lattice we obtain the system of equations for the Green functions:

$$\begin{pmatrix} i\omega_n - \hat{\xi}_{k_2} & \hat{h}_{k_2-Q_2}(Q_1) & \hat{0} & \hat{D}_{k_2} \\ \hat{h}_{k_2}(-Q_1) & i\omega_n - \hat{\xi}_{k_2-Q_2} & -\hat{D}_{k_2-Q_2} & \hat{0} \\ \hat{0} & -\hat{D}^{\dagger}_{k_2-Q_2} & i\omega_n + \hat{\xi}_{k_2-Q_2} & -\hat{h}_{k_2}(-Q_1) \\ \hat{D}^{\dagger}_{k_2} & \hat{0} & -\hat{h}_{k_2-Q_2}(Q_1) & i\omega_n + \hat{\xi}_{k_2} \end{pmatrix} \cdot \begin{bmatrix} G_{\downarrow 2,\downarrow 2}(k_2,k_2;l';i\omega_n) \\ G_{\uparrow 2,\downarrow 2}(k_2-Q_2,k_2;l';i\omega_n) \\ G_{2\downarrow,\downarrow 2}(k_2-Q_2,k_2;l';i\omega_n) \\ G_{2\uparrow,\downarrow 2}(k_2,k_2;l';i\omega_n) \end{bmatrix} = \begin{bmatrix} \hat{\delta} \\ \hat{0} \\ \hat{0} \\ \hat{0} \end{bmatrix}, \quad (29)$$

where N_1 by N_1 (N_1 is the number of sites along $\mathbf{a}_1$ direction) matrices $\hat{\xi}_{k_2}$, $\hat{D}_{k_2}$ and $\hat{h}_{k_2}(Q_1)$ have the form

$$\hat{\xi}_{k_2} = \begin{pmatrix} \xi_0 + F_2 t_{k_2} & F_2 T_{k_2} & 0 & 0 \\ F_2 T_{-k_2} & \ddots & \ddots & 0 \\ 0 & \ddots & \ddots & T_{k_2} \\ 0 & 0 & F_2 T_{-k_2} & \xi_0 + F_2 t_{k_2} \end{pmatrix}, \quad \hat{D}_{k_2} = -\begin{pmatrix} \Delta^*_{k_2} & \psi^*_{-k_2} & \Delta^*_{22}e^{ik_2} & 0 & 0 \\ \psi^*_{k_2} & \ddots & \ddots & \ddots & 0 \\ \Delta^*_{22}e^{-ik_2} & \ddots & \ddots & \ddots & \Delta^*_{22}e^{ik_2} \\ 0 & \ddots & \ddots & \ddots & \psi^*_{-k_2} \\ 0 & 0 & \Delta^*_{22}e^{-ik_2} & \psi^*_{k_2} & \Delta^*_{k_2} \end{pmatrix}.$$

$$\hat{h}_{k_2}(Q_1) = -M \begin{pmatrix} (t_{k_2} - J_Q)e^{iQ_1} & T_{k_2}e^{iQ_1} & 0 & 0 \\ T_{-k_2}e^{i2Q_1} & \ddots & \ddots & 0 \\ 0 & \ddots & \ddots & T_{k_2}e^{i(N_1-1)Q_1} \\ 0 & 0 & T_{-k_2}e^{iN_1Q_1} & (t_{k_2} - J_Q)e^{iN_1Q_1} \end{pmatrix}.$$

Here $F_2 = n/2$ is the Hubbard renormalization, $t_{k_2} = 2t_1\cos(k_2)$, $\Delta_{k_2} = 2\Delta_{21}\cos(k_2)$, $T_{k_2} = t_1\left(1 + \exp(ik_2)\right)$, and

$$\psi_{k_2} = \Delta_{21}\exp(i2\pi/3)\left(1 + \exp(i2\pi/3 + ik_2)\right) + \Delta_{22}\exp(i2\pi/3)\left(\exp(i2k_2) + \exp(i2\pi/3 - ik_2)\right).$$

Solving the Eq. (29) we obtain the excitation spectrum containing the Majorana mode and the structure of such mode as described in the main text.