◆ Goal:

Construction arbitrary dimension kp Hamiltonian, solve band structure, calculation of Berry curvature and first Chern number.

◆ Berry curvature calculation:

$$\overrightarrow{\Omega}_{uv}^{m}(\vec{R}) = i\sum_{n\neq m}\frac{<m|\nabla_{R_u}\mathrm{H}|\mathrm{n}><n|\nabla_{R_v}\mathrm{H}|m> - <m|\nabla_{R_v}\mathrm{H}|\mathrm{n}><n|\nabla_{R_u}\mathrm{H}|m>}{(\varepsilon_m-\varepsilon_n)^2}$$

$$C_{1,n} = \int_{B.Z.}\overrightarrow{\Omega}_n(\vec{R})\frac{d\vec{R}}{(2\pi)^{d-1}}$$

Ref: Rev. Mod. Phys. 82, 1959 (2010)

◆ Note:

1, Dimension of Hamiltonian is controlled by Kronecker tensor product of Pauli matrix representing different d.o.f.: sublattice, orbital, valley, spin…;
see the difference between two_band and four_band

2, In running the code, we need to change N, H, Hx, Hy and the band you concern;