Let us consider the cases with default interaction which gives no sign problem for ^6He. The default combination are

$$\begin{aligned} &SU(4), \quad C_0, \quad C_S i\sigma_S, \quad C_I i\tau_x, \\ &C_{SI} i\sigma_S\tau_y,\ C_{SI} i\sigma_S\tau_z, \quad g_A\sigma_S\tau_x. \end{aligned} \tag{203}$$

All these interactions can be simultaneously transformed to it's complex conjugate by $\sigma_2\tau_z$. Thus, these interactions does not give rise to any sign problem. Remaining interactions are

$$C_I i\tau_y,\ C_I i\tau_z,\ C_{SI} i\sigma_S\tau_x,\ g_A\sigma_S\tau_y,\ g_A\sigma_S\tau_z \tag{204}$$

Following table shows the effects of each terms to the complex phase of fermion determinant and binding energy for ^6He.

Table 4: Variation in coupling strength for ^6He

index	$C_I i\tau_y$	$C_I i\tau_z$	$C_{SI} i\sigma_S\tau_x$	$g_A\sigma_S\tau_y$	$g_A\sigma_S\tau_z$	Re$\langle e^{i\theta}\rangle$	B.E.
default						1.0	-21.2(3)
26	1					0.972	-22.2(4)
27		1				0.905	-22.0(3)
29			1			0.927	-24.3(3)
30				1		0.969	-16.2(3)
31					1	0.966	-14.9(3)
28	1	1				0.875	-24.1(3)
33	1		1			0.897	-28.3(3)
34	1			1		0.939	-17.7(3)
35	1				1	0.933	-17.0(2)
36		1	1			0.831	-27.2(4)
37		1		1		0.871	-16.7(4)
38		1			1	0.868	-16.3(3)
39			1	1		0.891	-20.0(4)
40			1		1	0.882	-18.9(3)
32				1	1	0.929	-9.8(2)
41	1	1	1			0.802	-31.6(4)
42	1	1		1		0.840	-19.3(3)
43	1	1			1	0.834	-18.8(3)
44	1		1	1		0.862	-24.5(3)
45	1		1		1	0.849	-22.6(4)
46	1			1	1	0.893	-11.5(4)
47		1	1	1		0.793	-22.9(4)
48		1	1		1	0.787	-21.9(4)
		1		1	1		
49			1	1	1	0.841	-14.7(4)
50	1	1	1	1		0.768	-27.9(5)
51	1	1	1		1	0.755	-26.5(5)
52	1	1		1	1	0.794	-13.7(4)
53	1		1	1	1	0.808	-19.5(4)
54		1	1	1	1	0.743	-17.4(5)
full	1	1	1	1	1	0.714	-23.0(4)