

Note on how to differentiate X

$$I = (i, \sigma), J = (j, \sigma')$$

$$F_{IJ} = f_{ij} \times \alpha(\sigma, \sigma')$$

$$X = F_{IJ} - F_{JI} = f_{ij} \times \alpha(\sigma, \sigma') - f_{ji} \times \alpha(\sigma', \sigma)$$

$$Y_{IJ} = \left(\frac{\partial X}{\partial f_{ab}} \right) = \delta_{ia} \delta_{jb} \times \alpha(\sigma, \sigma') - \delta_{ja} \delta_{ib} \times \alpha(\sigma', \sigma)$$

$$\sum_{M,L} (X^{-1})_{ML} Y_{ML} = \sum_{m,l,\sigma,\sigma'} (X^{-1})_{m\sigma,l\sigma'} Y_{l\sigma',m\sigma}$$

$$= \sum_{\sigma,\sigma'} (X^{-1})_{m\sigma,l\sigma'} [\delta_{la} \delta_{mb} \times \alpha(\sigma, \sigma') - \delta_{ma} \delta_{lb} \times \alpha(\sigma', \sigma)]$$

$$= -2 \sum_{\sigma,\sigma'} \alpha(\sigma, \sigma') (X^{-1})_{a\sigma,b\sigma'}$$

f_{ab} が虚部なら前にiがつくだけ

Note on how to differentiate X

$$\alpha(\uparrow, \uparrow) = -cs \qquad c = \cos(\beta/2), s = \sin(\beta/2)$$

$$\alpha(\uparrow, \downarrow) = cc$$

$$\alpha(\downarrow, \uparrow) = -ss$$

$$\alpha(\downarrow, \downarrow) = cs$$

$$(X^{-1})_{IJ} = -(X^{-1})_{JI} \text{ (skew symmetry)}$$