

$$H = - \sum_{i,j} t_{ij} c_{i\alpha}^\dagger c_{j\alpha} + U \sum_i \left( n_{i\uparrow} - \frac{1}{2} \right) \left( n_{i\downarrow} - \frac{1}{2} \right) - \mu \sum_i c_{i\alpha}^\dagger c_{i\alpha}$$

In the limit of large  $U$ , and at a density of one particle per site, this maps onto the Heisenberg antiferromagnet

$$H_{AF} = \sum_{i < j} J_{ij} S_i^a S_j^a$$

where  $a = x, y, z$ ,

$$S_i^a = \frac{1}{2} c_{i\alpha}^{a\dagger} \sigma_{\alpha\beta}^a c_{i\beta},$$

with  $\sigma^a$  the Pauli matrices and

$$J_{ij} = \frac{4t_{ij}^2}{U}$$