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Synchronization of interacting quantum dipoles

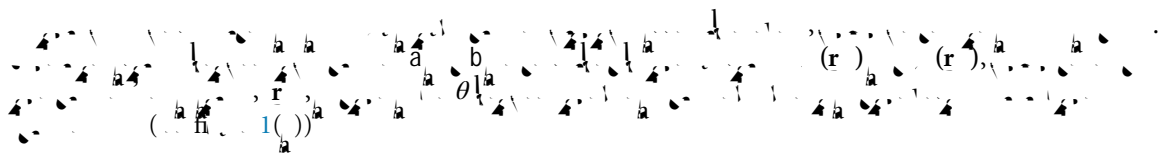
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2. Dipole-dipole interaction and master equation



$$-\frac{1}{4\pi\epsilon_0} \frac{3(\mu_a \cdot \hat{r})(\mu_b \cdot \hat{r}) - \mu_a \cdot \mu_b}{r^3}$$

$$-\frac{1}{4\pi\epsilon_0} \frac{3(\mu_a \cdot \hat{r})(\mu_b \cdot \hat{r}) - \mu_a \cdot \mu_b}{r^3}$$

3. Mean-field treatment and connection to the KM

$$\hat{\rho} = \frac{1}{2^N} \sum_{\sigma, \sigma'} \rho^{\sigma, \sigma'} \sigma \sigma' \quad (2 \times 2)$$
$$\rho = \frac{1}{2} \{ \sigma, \sigma' \}$$

$$\frac{d\varphi(\mathbf{r})}{d} = \delta + \sum_{n=1}^N \left[\frac{r_n}{d} \cos[\delta\varphi_n] + \frac{r_n}{d} \sin[\delta\varphi_n] \right], \quad (7)$$

$$\delta\varphi_n(\mathbf{r}) = \varphi(\mathbf{r}) - \varphi(\mathbf{r}_n) \approx \frac{(\mathbf{r} - \mathbf{r}_n) \cdot \nabla \varphi(\mathbf{r}_n)}{d}$$

4. Quantum synchronization for the collective system

$$N_{\text{eff}}(\mathbf{r}) = \frac{\hbar}{\delta} \left[\frac{\partial}{\partial \mathbf{r}} \cdot \left(\frac{\partial \psi(\mathbf{r})}{\partial \mathbf{r}} \right) + \psi(\mathbf{r}) \right] = 0 \quad (1)$$

find (\cdot). D $Z_{0,1}$
 W 1
 D
 $1, 6$

$$\nabla \cdot \mathbf{v}(\mathbf{r}) = 0,$$

A musical score for a string quartet, consisting of four staves. The notation includes various musical symbols such as notes, rests, and dynamics. The first staff begins with a forte dynamic (f) and a fermata. The second staff features a fortissimo dynamic (ff) and a fermata. The third staff includes a dynamic marking of f and a fermata. The fourth staff contains a dynamic marking of f and a fermata. The score is marked with φ (ritardando) and includes performance instructions such as $rit.$ and $rit. 6$. The notation is dense and complex, typical of a classical string quartet score.

Appendix A. Incoherent pumping

$$\begin{aligned} \dot{\rho}_{fi} &= -\Gamma_{fi} \rho_{fi} + \Gamma_{if} \rho_{if} + \Gamma_{fj} \rho_{fj} - \Gamma_{jf} \rho_{jf} \\ &= -\Gamma_{fi} \rho_{fi} + \Gamma_{if} \rho_{if} + \Gamma_{fj} \rho_{fj} - \Gamma_{jf} \rho_{jf} \\ &= -\Gamma_{fi} \rho_{fi} + \Gamma_{if} \rho_{if} + \Gamma_{fj} \rho_{fj} - \Gamma_{jf} \rho_{jf} \end{aligned}$$

3 = φ

Handwritten musical notation on a staff. The notation includes a treble clef, a key signature of one flat (B-flat), and a time signature of 3/4. The melody consists of several measures of music with notes and rests. A dynamic marking 'f' (forte) is present at the beginning. The notation is somewhat faint and appears to be a sketch or a handwritten score.

$$e^i = \frac{1}{N} \sum_{\mathbf{r}} e^{i\varphi_{\mathbf{r}}} \quad \text{eff} = \frac{(\mathbf{r})}{(N-1)}$$

$$\bar{F}(\hat{\cdot}) = (F(J) \ F(J) \ F(J))$$

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