New Journal of Physics
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PAPER • **OPEN ACCESS**

Synchronization of interacting quantum dipoles

To cite this article: B Zhu *et al* 2015 *New J. Phys.* **17** 083063

[illegible] (fi [illegible] 1) [illegible] (fi [illegible] 1). [illegible]

2. Dipole–dipole interaction and master equation

3. Mean-field treatment and connection to the KM

$$\frac{\mathrm{d}\varphi\,(\;)}{\mathrm{d}} = \delta \; + \sum_{=1,\;\neq}^{N} \text{—}\Big[\;(\mathbf{r}\;)\cos\big[\delta\varphi\;\big] + \;(\mathbf{r}\;)\sin\big[\delta\varphi\;\big]\Big], \tag{7}$$

$\delta\varphi\;(\;) = \varphi\;(\;) - \varphi\;(\;)$ [illegible] $(\mathbf{r}\;)$ [illegible] $(\;)$ [illegible]

[illegible] fi [illegible]

4. Quantum synchronization for the collective system

[illegible]

=

$, \delta \neq 0,$

$( ) \equiv \lim_{\to \infty} (\hat{\sigma}^-(+) + \hat{\sigma}^+(+))(\hat{\sigma}^-( ) + \hat{\sigma}^-( ))$,

( )

( ) $( ) = A \cos( ) \exp(-\gamma)$

a b, a b $= 0.$

$[-\Gamma/2, \Gamma/2]$ N 00 $= 1, 2, ..., 100$ a 101

fi ( )

D 1 , fi

$(\mathbf{r}\ ) = 0,$

Appendix A. Incoherent pumping

$3 = \varphi$

$e^{i\Phi} = \frac{1}{N} \sum e^{i\varphi}$ $_{\text{eff}} = \sum \sum_{\neq} (\mathbf{r})/(N-1)$

$_{\text{eff}} = \sum \sum_{\neq} (\mathbf{r})/(N-1).$

$$\overline{F}\left(\hat{\ }\right) \quad -\Big(F\left(\quad J\right) \quad F\left(\quad J\right) \quad F\left(\quad J\right)\Big)$$

01 Phys. Rev. Lett. 111 10
00 Nature 425 1
1 Phys. Rep. 93 01–
01 Opt. Express 22 1
01 Nature 484 – 1
010 Phys. Rev. 81 0
0 1 Phys. Rev. Lett. 71 –
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