NOTE ON REPRODUCING THE RESULTS OF W. RZĄDKOWSKI

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Introduction

This short note shows the results obtained by using the quantum channel and the input states from W. Rządkowski master's thesis *Radiation pressure effects in optical quantum interferometry* and his note dated December 22, 2017:

ΛEl(element_,ind_) :=
element $\exp(-i(1-f)t\omega 0(\mathsf{ind}[[2]]-\mathsf{ind}[[1]]))$
$\exp\left(i(t\omega\mathsf{m}-\sin(t\omega\mathsf{m}))^2\left(\frac{((1-2f)g)(\mathsf{ind}[[2]]-1)}{\omega\mathsf{m}}\right)^2\right)$
$\exp\left(-i(t\omega\mathsf{m}-\sin(t\omega\mathsf{m}))^2\left(\frac{((1-2f)g)(\mathsf{ind}[[1]]-1)}{\omega\mathsf{m}}\right)^2\right)$
$\exp\left(4\left(\frac{(1-2f)g}{\omega\mathsf{m}}\right)^2\left(-0.5(\mathsf{ind}[[1]]-1)^2+(\mathsf{ind}[[2]]-1)(\mathsf{ind}[[1]]-1)-0.5(\mathsf{ind}[[2]]-1)^2\right)\sin^2\left(\frac{t\omega\mathsf{m}}{2}\right)\right);$

$\psi_1=\left\{\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right\};$

$\psi_2=\left\{0.2,0.1i,0.3i,0.1,\sqrt{1-0.2^2-0.3^2-2*0.1^2}\right\};$

Obtained results seem to confirm the correctness of calculations of cited references. The fact that the new script was created independently, except the quantum channel and input states used to compare the charts, gives us confidence that derived equations and code contain no errors.

Since a derivation of the problem has been presented in references and the purpose of this note is to compare Wojtek's results with an independent implementation, it does not include neither a theoretical introduction nor an comprehensive explanation of presented figures.

QFI calculated with the fast iterative algorithm by K. Macieszczak

Apart from minor differences, probably caused by numerical reasons, the results are analogical to the ones from referred master's thesis.

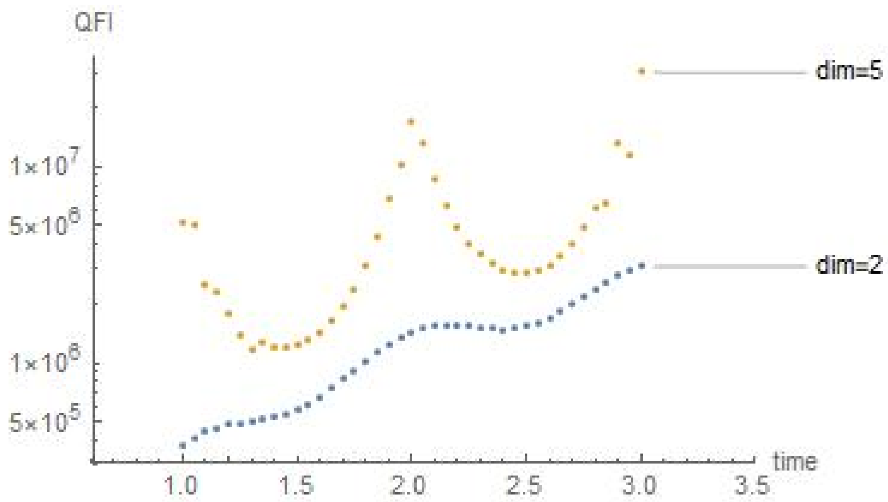

Figure 1: QFI vs time for 2-dimensional and 5-dimensional states of Hilbert space.

Spin-squeezed states

QFI vs θ

The figures below present the dependence of quantum Fisher information from squeezing angle for different values of coupling constant g (coupling between light and mirror from the respective part of the Hamiltonian).

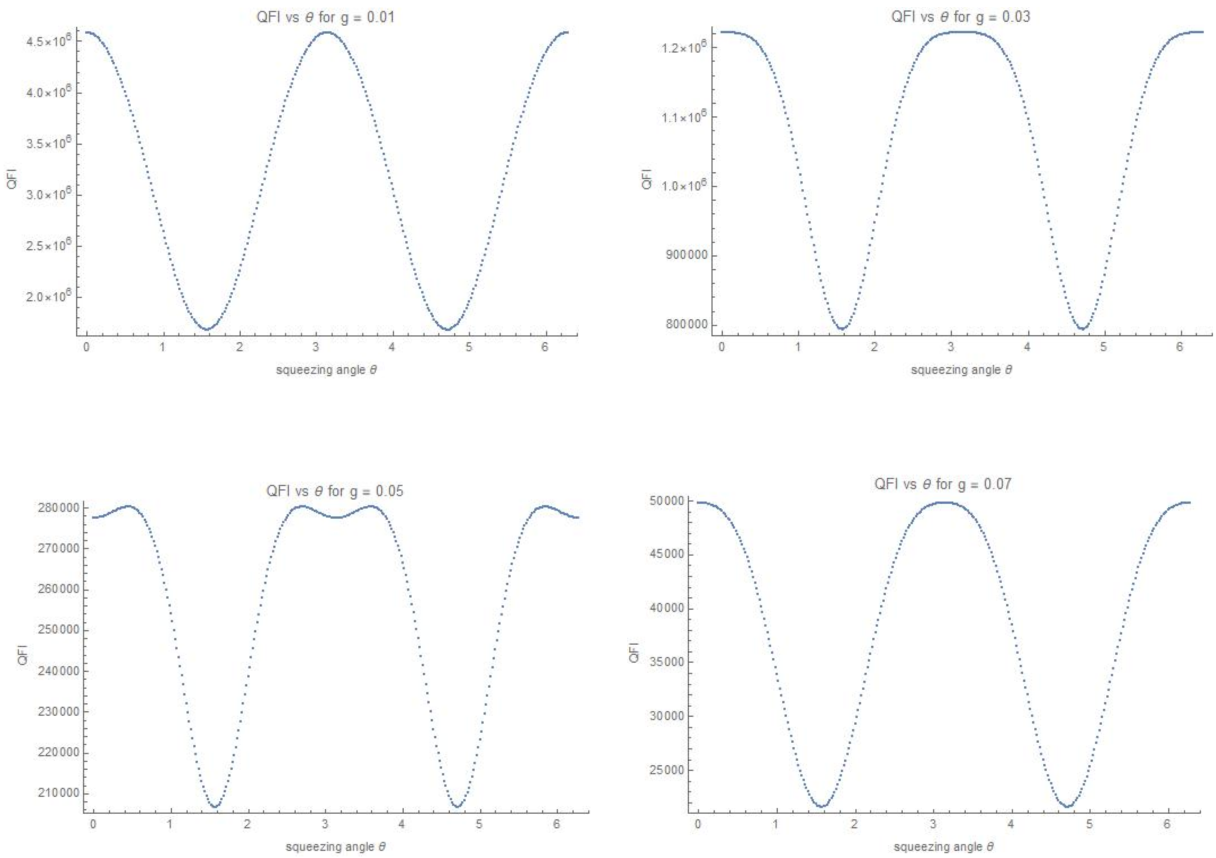

Figure 2: Quantum Fisher information vs θ for different values of light-mirror coupling constant.

Finding the optimal squeezing angle

The plots presented in this note are identical to the ones from references. The only difference is the scale of vertical axis: values on the plots below are not divided by Π, i.e. these plots show real value of angle þin radians.

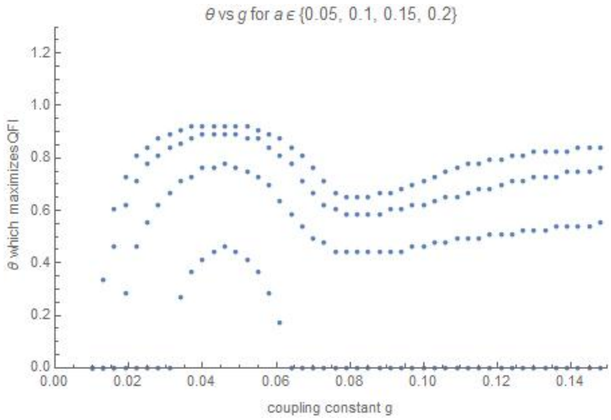

Figure 3: Squeezing angle vs light-mirror coupling for various values of squeezing parameter a. From below a = 0.05, 0.1, 0.15, 0.2, respectively.