

# Exercises for nonlocality, entanglement und geometry of quantum systems

## Sheet 8

Prof. Reinhold A. Bertlmann & Philipp Köhler

15.01.2014

### Exercise 26

The set of separable states is defined by

$$S = \left\{ \rho = \sum_i p_i \rho_i^A \otimes \rho_i^B \mid 0 \leq p_i \leq 1, \sum_i p_i = 1 \right\}$$

Proof that  $S$  is a convex set, i.e.

if  $\rho_1, \rho_2 \in S$  then  $\tau\rho_1 + (1 - \tau)\rho_2 = \rho \in S$ .

### Exercise 27

Formulate the CHSH inequality (see exercise 25) in terms of density matrices, what is the explicit form of the Bell-CHSH operator?

### Exercise 28

What is the explicit form in Bloch decomposition of the separable state  $\rho_0$  with minimal distance to the Bell state  $\rho^- = |\psi^-\rangle\langle\psi^-|$  (exercise 21)?

### Exercise 29

Calculate the Hilbert-Schmidt measure - as a measure for entanglement - of the Werner state  $\rho_W(p)$  (exercise 23), i.e. the minimal distance of  $\rho_W(p)$  to the set of separable states

$$D(\rho) = \|\rho_0 - \rho_W(p)\|$$