Take-Home Exam No. 01 (Spring 2014)

PHYS 530A: Quantum Mechanics II

Due date: Monday, 2014 Mar 3

1. (**25 points.**) Read the discussion in Ref. [1].

2. (**25 points.**) Briefly summarize Sec. 1 of Ref. [1] using the mathematical fact that, two operators (or matrices) can be diagonalized simultaneously only when their product commute.

3. (**25 points.**) Briefly summarize Sec. 2 of Ref. [1].

4. (**25 points.**) Consider a system described by the Hamiltonian

$$H(x_1, x_2, p_1, p_2), \tag{1}$$

where

$$[x_1, p_1] = i\hbar, \quad [x_2, p_2] = i\hbar, \tag{2}$$

and

$$[x_1, x_2] = 0, \quad [x_1, p_2] = 0, \quad [x_2, p_1] = 0, \quad [p_1, p_2] = 0. \tag{3}$$

Since an experiment measures

$$P = p_1 + p_2, \quad p = p_1 - p_2, \tag{4}$$

you redefine the Hamiltonian

$$H'(X, x, P, p) = H(x_1, x_2, p_1, p_2), \tag{5}$$

where

$$X = x_1 + x_2, \quad x = x_1 - x_2. \tag{6}$$

Can the quantities X and x be measured simultaneously with P and p?

References

[1] A. Einstein, B. Podolsky, and N. Rosen. Can quantum-mechanical description of physical reality be considered complete? *Phys. Rev.*, 47:777–780, May 1935.