PROBLEM SET 4.1

100 pts

+15 pts extra credit

SHOW YOUR WORK!

1. (10 pts) State a comparison that analogously illustrates the concept of infinite & continuous vs. finite & discrete.

   Ex. all real numbers $\mathbb{R}$ (infinite & continuous)
   vs.
   a subset of integers $\mathbb{Z}$ (finite & discrete)

2. The state of an emot-1 person, YOU, is given by

$$|\heartsuit\rangle_Y = \frac{\sqrt{2}}{2}|\heartsuit\rangle_Y + \frac{3i}{4}|\text{😐}\rangle_Y + \frac{\sqrt{3}}{2}|\text{☹}\rangle_Y$$

a) (10 pts) Which of the following LQs in the operator space ME → YOU are already normalized?

i. $\hat{L}_{M\to Y} \longrightarrow \begin{pmatrix} \frac{4}{\sqrt{29}} & 0 & 0 \\ 0 & \frac{4}{\sqrt{29}} & 0 \\ 0 & 0 & \frac{4}{\sqrt{29}} \end{pmatrix}$

ii. $\hat{Q}'_{M\to Y} \longrightarrow \begin{pmatrix} 2i & 3 & 0 \\ 0 & 4i & 3 \\ 3 & 0 & 3i \end{pmatrix}$

iii. $\hat{K}_{M\to Y} \longrightarrow \begin{pmatrix} \frac{\sqrt{2}}{3\sqrt{3}} & -\frac{2}{3\sqrt{3}}i & 0 \\ \frac{2}{3\sqrt{3}}i & -\frac{4}{3\sqrt{3}} & \frac{2}{3}i \\ 0 & -\frac{2}{3}i & \frac{2}{3\sqrt{3}} \end{pmatrix}$

b) (10 pts) Explain when normalization would be required & how it should be implemented.

3. Consider two observers, ALICE & BOB, whose strong-L LQs in the → YOU operator space are given by

$$\hat{L}_{A\to Y} \longrightarrow \begin{pmatrix} \frac{2\sqrt{2}}{\sqrt{27}} & \frac{4}{\sqrt{27}}i & 0 \\ -\frac{4}{\sqrt{27}}i & \frac{2\sqrt{2}}{\sqrt{27}} & \frac{6\sqrt{2}}{\sqrt{27}} \\ 0 & \frac{6\sqrt{2}}{\sqrt{27}} & \frac{2\sqrt{2}}{\sqrt{27}} \end{pmatrix}$$

$$\hat{L}_{B\to Y} \longrightarrow \begin{pmatrix} \frac{4\sqrt{2}}{\sqrt{37}} & 0 & \frac{8i}{3\sqrt{37}} \\ \frac{2\sqrt{2}}{3\sqrt{37}}i & 0 & \frac{4\sqrt{3}}{3\sqrt{37}} \\ \frac{4\sqrt{2}}{3\sqrt{37}} & \frac{4}{3\sqrt{37}} & \frac{2\sqrt{3}}{3\sqrt{37}} \end{pmatrix}$$

Use the same YOU state given in problem 2.

a) (5 pts) What is the probability of ALICE measuring YOU in the state LOVES ME through strong-L, *before* BOB measures YOU?

b) (5 pts) What is the probability of BOB measuring YOU in the state LOVES ME through strong-L, before ALICE measures YOU?

c) (5 pts) What is the probability of ALICE measuring YOU in the state LOVES ME through strong-L, after BOB measures YOU through strong-L?

d) (5 pts) What is the probability of BOB measuring YOU in the state LOVES ME through strong-L, after ALICE measures YOU through strong-L?

e) (5 pts) If ALICE wants to find YOU in the state LOVES ME, should she measure YOU through strong-L before or after BOB does?

f) (5 pts) If BOB wants to find YOU in the state LOVES ME, should he measure YOU through strong-L before or after ALICE does?

g) (5 pts) Why is strong-L defined differently for ALICE & BOB?

4. Strong-L & strong-Q in the ME → YOU operator space are given by

$$\hat{L}_{M\to Y} \longrightarrow \begin{pmatrix} \frac{\sqrt{3}}{9} & \frac{4}{9} & \frac{2\sqrt{3}}{9}i \\ \frac{2\sqrt{6}}{9} & \frac{2}{3} & \frac{1}{9} \\ 0 & \frac{2}{9} & \frac{\sqrt{3}}{9} \end{pmatrix}$$

$$\hat{Q}_{M\to Y} \longrightarrow \begin{pmatrix} \frac{4}{39} & \frac{20}{39\sqrt{2}}i & -\frac{20}{39\sqrt{2}}i \\ \frac{20}{39} & 0 & \frac{20\sqrt{3}}{39\sqrt{2}} \\ \frac{20}{39} & \frac{20}{39\sqrt{2}}i & \frac{4\sqrt{3}}{39\sqrt{2}} \end{pmatrix}$$

Using the same YOU state given in problem 2, what is the probability of finding YOU in the state LOVES ME through

a) (5 pts) strong-L ?

b) (5 pts) strong-Q?

c) (5 pts) strong-L followed by strong-Q?

d) (5 pts) strong-Q followed by strong-L?

e) (5 pts) If I want to find YOU in the state LOVES ME, which LQ(s) should I use and in what order?

5. (5 pts) Write 2-3 sentences from your perspective defending either position on ontological causality (discretization by origin or discretization by poiesis), as applied to QM, QR, or both.

EXTRA CREDIT (10 pts)

Consider the norm-factored LQ in the operator space ME → YOU given by

$$\hat{LQ}_{M\to Y} \longrightarrow \begin{pmatrix} \sqrt{2} & 0 & \sqrt{3} \\ 1 & i & \sqrt{3}/2 \\ 0 & i & 0 \end{pmatrix}$$

Using the YOU state from problem 2, what would be the normalization factor? What is the matrix representation of the normalized LQ?

EXTRA EXTRA CREDIT (1 - 5 pts)
Name up to five other common LQs not listed in lecture. (1 pt per valid LQ)

SUPPLEMENTARY NOTES