QC Lecture 2

Indhold

Agenda for Lecture 2

Recap and Kahoot

QCE 2.1, 2.2, 2.3, and 2.4

The mandatory report of your own choice

4 videos Qubit, Geometrical interpretation and Heisenbergs Uncertainty principle

Matlab – The complex number “I”, Pauli Operators – outer products

QCE 2.1, 2.2, 2.3, and 2.4

QCE 3.1, You try it p-42, QCE 3.2, You try it p-45, QCE 3.3

Exercises:

Coderanch – Continuing on the Helloworld example

L2.1

Stop training on Umesh Vaziranis Video

1:14 What Energy states should be used for |0> and |1> respectively ?

1:14 What do we call this Notation Bra or Ket : |0> and |1> ?

1:14 How would You describe the Kets like |0> and |1> on matrix form ?

2:48 What do we mean by a superposition here ?

3:37 Could You describe how an complex amplitude could be look like – it's atricky and dirty question – admitted :o)

4:32 Which conditions should be satisfied for a normalized condition ?

4:32 If alpha and beta has the values 1/sqrt(2) what would be the possibility to find the qubit in |0> or |1> ?

5:10 Is this state normalized (½ +½i)|0> - ½|1> ?

6:44 Do we measure a superposition between |0> and |1> ?

6:49 what happens when You measure the system in a superpositioned state ?

7:05 With which probability will the value turn out to be a |0> or |1> ?Q

Extra question what is "i to the power of 2" ?

Extra question what is "SQRT(-1)" ?

L2.2

Stop training on Umesh Vaziranis Video about *Geometrical interpretation of Quantum bits*

0:38 Alpha l0> + Beta l1> : What do we call this

0:49 How do we describe a normalized expression

0:49 How do we describe an expression that are not normalized yet ?

1:21 How could You describe the superposition in a 2 dimensional vector space

1:29 Show an example of Alpha and Beta as complex numbers

1:43 What is this "lAlphal to the power of 2"

2:17 Please describe Alpha l0> + Beta l1> as vectors and place them in a 2 dimensional vectorspace

3:17 Please describe a superposition of an angle of 45 , 60 and 135 degrees with Alpha l0> + Beta l1>

4:32 Recap write examples of Dirac's Bra and Ket notation respectively

7:11 If You have a Wavefunctions vector with the angle Theta, how could You describe it's vector based upon this angle ?

7:46 Which probabilities for for measuring l0> or l1> would You get for the wavefunction with an angle Theta ?

8:53 How could You describe the possibility for the exited state in two different ways

10:33 What do You mean by measuring "in an arbitrary basis"

L2.3

Stop training on Umesh Vaziranis Video – Polarization

2:18 How do You measure light In a ground or exited state ?

2:28 How does Dirac's notation look like when light is involved

3:32 What if the light is in a super positioned state – what comes through ?

4:06 What do we mean by that - *the light is blocked with probability(wp)*, dependent on its orientation

4:57 When You have to polarized-lenses placed together but vertical oriented with respect to their polarization effect, what happens then if You try to send light through the lenses ?

6:27 What happens if You interpose a third lens in an angle of 45 degrees in the middle, between the front and the back lens ?

7:05 Have much light I now transmitted (hint light from front->middle and from middle to back)

L2.4

Stop training on Umesh Vaziranis Video – Qubits & Uncertainty Principle

0:42 What Happens if You try to measure the electrons in a double slit experiment ?

1:43 What exactly where we destroying when tried to measure the electrons in the double slit experiment ?

1:43 What are the two major physical topics in Werner Heisenbergs *Uncertainty principle*

2:15 Which two basis are we dealing with on the circle ?

3:28 The inner product is zero for orthonormal vectors – prove this for the +/- basis try

4:57 What do we measure if we use the zero/one basis ?

5:19 What do we measure if we use the plus/minus basis ?

5:39 So the two zero/one and plus/minus basis refers what principle ?

6:40 ***The Bit value is known as even l0> or l1>*** - Try to find an example of explaining this by your own words

6:40 ***The Sign value another angle l+> or l->*** - Try to find an example of explaining why the sign is not so easy to identify by your own imagination.

9:13 Why is the SPREAD(l0>) = 1+ 0 - what are ***1 +0*** presenting respectively ????

9:13 Why is the SPREAD(l1>) = 0 + 1 - what are ***0 + 1*** presenting respectively ????

9:45 Why is the SPREAD(l+>) = 1/sqrt(2) + 1/sqrt(2) - what are ***1/sqrt(2) + 1/sqrt(2)*** presenting respectively ????

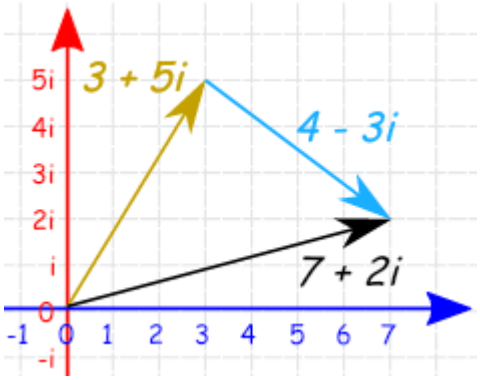
10:00 Why is 1/sqrt(2) + 1/sqrt(2) = sqrt(2) ?????

HINT: try to multiply by sqrt(2) over and under the fraction line

10:42 Why can't both SPREADS for the zero/one and +/- basis be one simultaneously ???

MatLab

The figure shows that the place vectors of the numbers (place vector: arrow from (0, 0) to the point) are added in succession. We can thus come from Origo to our result by consistently moving the total real part along the first axis and the total imaginary part up / down the second axis. Some will probably recognize the process from vector calculation.



Exercise: Have the sideman to create 3 complex numbers and decide how to add / subtract them. Now find the answer by graphically drawing these vectors one after the other (as illustrated above).

$$i^0 = 1$$

$$i^1 = i$$

$$i^2 = -1$$

$$i^3 = -i$$

$$i^4 = 1$$