



FACING UNCERTAINTY AND TRAVELING IN TIME

Seminar Leader: **Li Tian**

House Leader: **Shoya Takahata**

Course Description

The world that you live in is predictable and boring. When you throw a ball, you can guess where it will land. When you sit on a train and see another train going in the opposite direction, it looks like it's going twice as fast. But when we go to the extremes, we see that the world is not quite the same. When you throw a really small ball, you can't predict where it will go. And when you ride a really fast train...well, things just get weird. Parallel universes, time travel, this is the wonderfully weird world of physics. By the end of the seminar, students will gain a new perspective of the relationship between science and life. This seminar is designed for people with all backgrounds, regardless of your level or interest in physics!

Schedule

Day 1: *Introduction to Quantum Mechanics and Schrödinger's Cat*

We face uncertainties everyday and seek explanations for them. Similarly, in physics, the ideas of uncertainty and probability dominate quantum mechanics, the world of the very small. First we will learn the basic ideas of quantum mechanics through the double-slit experiment. With this knowledge, we will then explore a famous but weird thought experiment called "Schrödinger's Cat." Can a cat be both dead and alive in the quantum world? How did people make sense of this weird experiment? By studying several competing interpretations, we will peek into the mystery of the quantum world.

Day 2: *Wigner's Friend*

On the second day, we will take a step further. What if we introduce another observer in the Schrödinger's Cat scenario? Can the observer both know and not know whether the cat is dead or alive? By introducing this new scenario, called Wigner's Friend, we are ready to think about what consciousness really is and how it impacts the quantum world. We will finish our discussion of quantum mechanics by exploring how all these ideas relate to our daily lives.

Day 3: *Twin Paradox*

What happens when things are moving near the speed of light? We will try to answer the question by delving into the physics and mathematical world of special relativity, the model of motion. Can twins born on the same day end up having different ages? By studying the Twin Paradox, another famous but perplexing thought experiment, we will discuss the idea of time and time travel. Can we go back in time or can we move faster into the future?



Day 4: *Recap and Final presentation*

Let's relax and appreciate the beauty of physics and the new ways it gives us to view the world we live in. What ideas unsettle you most? What have we learned from these thought experiments? We will reflect and share our newfound understanding.

Final Presentation

Students will each give a five minute presentation on the biggest thing that they have learned from this seminar. Suggested topics are listed below:

- Which interpretation of quantum mechanics do you relate to most?
- Did any of those interpretations challenge your way of thinking?
- What do you think is the definition of time?
- Are relativity and superposition new ideas for you? Have you heard about similar concepts before?

Presentations will be given orally, and should last 3-5 minutes. There is no need to submit a written copy of your report, but the presentation should be logical and easy to follow. Try to support your opinion using the knowledge we have learned in the seminar. Be prepared to ask and answer questions!

Pre-Seminar Assignments and Readings

- Double Slit Experiment (日本語) <https://www.youtube.com/watch?v=-EYmgL8kD2g>
- Schrodinger's Cat <https://www.youtube.com/watch?v=IOYyCHGWJq4>
- Twin Paradox <https://www.youtube.com/watch?v=n2s1-RHuljo>
- Multiple implications https://en.wikipedia.org/wiki/Schr%C3%B6dinger%27s_cat

Message from the House Leader

Ola, I'm Shoya. I'm from Japan and have lived in England, Brazil and Portugal for almost half of my life. I'm majoring in international liberal studies at Waseda University, and am interested in marketing and finance. I like communicating with people of different cultures and backgrounds. So I am greatly excited to meet you all to learn something new! I also am a very relaxed and laid back person, so-called chill, so don't hesitate to talk!



Tian and Takahata

Message from the Seminar Leader

Hello, I am Li. I am from Shanghai and am now studying at Swarthmore College in the United States. I am interested in astrophysics, aspiring to be a non-awkward female physicist in academia. I am also fascinated by art history throughout Asia. So talk about anything scientific or artsy with me! Additionally I love experiencing different cultures through constant travelling and exploration. Great food, interesting conversations and cute puppies are always welcome.