

# Oxford University Summer School for Adults

**Title:** Smaller Than the Atom: A Primer on All Things Quantum

**Dates:** Week 3, 25 Jul-1 August 2026

**Tutor:** Timothy Charlton



## Course Overview

In “Smaller Than the Atom: A Primer on all Things Quantum” we will start by grounding ourselves with a short history of science focusing on macro-observations and the overall relationship between the various fields of science. We will then turn the dial on our metaphorical microscopes to describe the atom and its relation to one of the most important recurring problems in physics, natural harmonic motion. We will use our newfound understanding to explore “quantum oddities” where our macro intuition fails to predict occurrences in the micro-world. These include both thought experiments like Schrödinger’s cat, and experimental observations such as the self-interference of a particle projected at a double slit. We will uncover the rules that let quantum-scale things pass through barriers but stop macro-objects in their tracks. We will ask, is there a limit on how small we go? Do the concepts of space and time become irrelevant below the Planck-length? By the end of the course, you will understand the fundamentals underpinning quantum computers, quantum communication and remote sensing.

## Course Outline

<b>Seminar 1</b> Sun, 9.00 am –10.30am	Summary of physics before 1920
<b>Seminar 2</b> Sun, 11.00 am –12.30pm	Relationship of physics to the other sciences
<b>Seminar 3</b> Mon, 9.00 am –10.30am	Concepts that bridge between classical and quantum
<b>Seminar 4</b> Mon, 11.00 am –12.30pm	The road to small starts with the atom
<b>Seminar 5</b> Tue, 9.00 am –10.30am	Atomic details
<b>Seminar 6</b> Tue, 11.00 am –12.30pm	Bound electrons and the harmonic oscillator
<b>Seminar 7</b> Wed, 9.00 am –10.30am	Uncertainty: The probability of observation
<b>Seminar 8</b> Wed, 11.00 am –12.30pm	Schrödinger: What is a wave function & how to use it
<b>Seminar 9</b> Thu, 9.00 am –10.30am	Quantum interference
<b>Seminar 10</b> Thu, 11.00 am –12.30pm	The subatomic zoo — More than just quarks
<b>Seminar 11</b> Fri, 9.00 am –10.30am	Am I a particle or just a wave in a field
<b>Seminar 12</b> Fri, 11.00 am –12.30pm	Organizing small: Nanometers to the Planck length

## Tutor

Timothy Charlton has a doctorate in physics specializing in material science and magnetism. He has performed peer reviewed experiments at large science facilities world-wide including the ISIS Neutron and Muon Source located in Oxfordshire where he worked for 14 years before moving abroad.

## Course Aim

This course aims to provide a clear description of the quantum world including how it fits in with other sciences and everyday life. It will provide a starting point for understanding new technology such as quantum computing, communication and sensing.

## Course Objectives

This course will enable students to:

- shift their perspective from the macro to the nano scale and beyond.
- understand which concepts span both the classical and quantum worlds.
- identify the limits where normal intuition fails when describing small things.
- understand key concepts associated with emerging quantum technologies.

## Learning Outcomes

By the end of this course, students will be expected to understand:

- the differences between the classical world and the quantum world.
- quantum states, wave functions and their relationship with the observed world.
- the basic concepts underpinning quantum technologies.

## Recommended Reading

Author(s)	Year	Title	Publisher
Richard P. Feynman	2011	Six Easy Pieces	Basic Books

## Assessment

Students are required to submit pre-course and on-course assignments as follows:

### *Pre-course assignment (c. 1500 words):*

In this essay we want to start our exploration of small in the classical sense. Taking inspiration from the book powers of 10 where each picture zooms in 10X, choose a length scale (example the size of an ant or a spec of dust) describe the world from this point of view then zoom in 10X. How would your observations of the world change?

**Please note that the submission for the pre-course essay is Monday 8<sup>th</sup> June 2026 and should be submitted as Word format to [oussa@conted.ox.ac.uk](mailto:oussa@conted.ox.ac.uk).**

**Also complete the Declaration of Authorship or the Assignment Cover Sheet form and add it at the beginning of your essay.**

### *On-course assignment (c. 1000 words):*

To be agreed upon with your tutor on arrival.