An introduction to quantum states and the tools used to measure them. Learn how to detect and measure single photons, how to count single and coincident events, how to operate a coincidence counter, and how to calculate accidental rates.

Using Qubitekk’s proprietary QES2 bi-photon source design, researchers explore the production of twin photons using Spontaneous Parametric Down Conversion in a PPKTP crystal. Investigate quantum randomness and learn what heralded photons are and why they are so important to quantum research.

When the universe can’t distinguish one photon from another, strange behaviors result. This experiment demonstrates the phenomenon of photon bunching which occurs when two indistinguishable photons are incident on a beamsplitter. Fundamental experimental measurements like the Hong-Ou-Mandel dip are visible, demonstrated and taught in this lab.
What are entangled photons and why did Einstein describe them as “spooky”? This lab produces entangled photons using two QES2 bi-photon sources and explores how they behave differently at a beamsplitter compared to non-entangled photons. Demonstrates anti-bunching and bunching of entangled photons in different bell states.

This lab experimentally demonstrates one of the most fundamental aspects of quantum mechanics, non-locality. By measuring entangled photons at two different locations, and in two different bases, our intuition about the reality of the universe is quickly challenged. The concept of non-locality is demonstrated and the impact on local realism is discussed. The application to quantum cryptography, and the creation of the BB84 and provably secure protocol are discussed.

Quantum computers are a powerful new technology based on the principle of quantum superposition and entanglement. But are these concepts just ideas or are they real? In this lab, data is collected to prove that one quantum particle (or qubit) can be two values at the same time. This lab details how this fundamental property of quantum physics is enabling a revolution in computing.

Classical photons will interfere, but what about entangled photons? This lab demonstrates how entangled photons interfere and why their unique behavior makes it possible to create sensors with sensitivities previously thought to be impossible.
The Quantum Mechanics Lab Kit includes the essential equipment needed for research and instruction in quantum mechanics.

THE KIT INCLUDES:

**BLUE, WAVELENGTH STABILIZED PUMP LASER**

This 405nm blue pump laser provides the narrow wavelength output, and long coherence length, required for pumping and producing entangled photons. Using volume holographic gratings to stabilize the wavelength output, this 5mW, research-grade laser has a linewidth of <160MHz.

**QES2 BI-PHOTON SOURCE**

Containing a 15mm long, periodically-poled KTP crystal, the QES2 source is capable of producing approximately 10,000 photon-pairs/sec/mW of pump light. An internal temperature controller ensures that the crystal’s temperature is maintained to within +/-0.1 degrees C. This allows degenerate, non-degenerate signal, and idler photon production depending on crystal temperature.

**SINGLE PHOTON COUNTING MODULES**

Two single photon counting modules (or SPCMs) from Excelitas are included with the kit. These modules are robust against accidental overload, have a response time of <200ps, a max count of 20 million cps, and a dark count of <1500 cps.

**COINCIDENCE COUNTER**

Coincidence counting has never been so easy or intuitive. This handheld device allows the singles and coincidence rates from two connected single photon counting modules to be recorded. Users can manually, or through a USB connection, set the coincidence window and dwell times for measurements. A back-lit LCD makes the counter easy to read in a darkened room. Simple serial commands over a USB connection permit logging of counter data.
Automating experiments can be a real time saver for both students and researchers. The kit’s variable optical delay line is a fiber coupled air gap that can be adjusted over a 10mm range with either a manual or a motorized actuator. With the motorized actuator attached, a USB-controlled motor driver allows automatic adjustment of the optical delay line. When combined with USB control of the coincidence counter, many of the experiments in this kit can be quickly automated.

One of the most challenging aspects of quantum optics experiments is the precision alignment that is required. This kit eliminates these challenge by realizing all optical components in polarization-maintaining singlemode optical fiber. Precision narrow-key, optical fiber connectors ensure that alignment between components is a snap for both students and researchers alike. Both polarizing and non-polarizing beamsplitters are included with the kit as well as custom couplers that allow the polarization of the light within the fiber to be carefully manipulated.

This kit is a turn key kit. We have included everything from safety goggles to Allen wrenches. The following miscellaneous items are included with every kit:
- Fiber optic tip cleaner
- Fiber optic port cleaner
- Fiber optic light meter
- Safety goggles for 405nm pump laser
- Allen wrenches for various equipment and mounts
- All manuals and support drivers/software
- Performance sheets on QES2 sources
Quantum mechanics seeks to understand the true nature of particles and energy.

How can particles be both waves and discrete particles at different times? How can a single particle be in two places simultaneously? These are a few of the questions that quantum theory addresses. Its development over the last century represents one of Science’s greatest achievements. But, in the absence of hands-on experiments that build intuition with quantum phenomena, translating this theoretical breakthrough into real-world applications has proven difficult. Qubitekk’s Quantum Mechanics Lab Kit eliminates this barrier by providing an education and research tool for both students and scientists alike. Finally, the power of quantum mechanics can be experienced and understood by all.

Contact us for a personalized quote or a demonstration at your facility.

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