

VACUUM FOR QUANTUM LABS

A Self Paced Course for Quantum & Cold-Atom Laboratories

“ Design vacuum systems once and let the experiment succeed on its own ”



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The Problem: Why Do Quantum Experiments Fail?

It's not the lasers. It's the vacuum.



The Wrong Focus

Most failures aren't due to lasers or control software, but underlying vacuum infrastructure.



Poor Design & Integration

Many UHV systems are designed without deep understanding, leading to integration and operation failures.



The UHV Challenge

Persistent struggle to reach Ultra-High Vacuum (UHV) and maintain it stable throughout the experiment.



Trial & Error vs. Engineering

Debugging often relies on guesswork rather than a structured engineering methodology.



CRITICAL SYSTEM

UHV Architecture

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Who Is It For?

 MSc & PhD Students

 Cold Atom & AMO Labs

 Quantum Startups

 System Engineers

The Solution: A Practical System-Level Course

This is not a generic vacuum course. It is written by an experimentalist for working quantum laboratories, bridging the gap between textbook physics and real-world systems.

Course Highlights: From Theory to Reality



System Thinking

Moving beyond isolated components (pumps, flanges) to understand the system as a whole working in synergy with optics and magnetics.



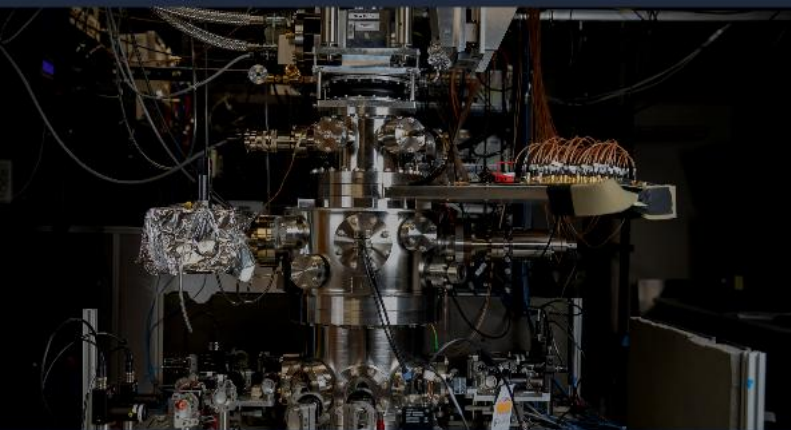
Applied Physics


Focus on real experimental systems: 2D/3D MOTs, Zeeman Slowers, and using physical models to predict performance.



Engineering Design

Developing an engineering approach to Failure Analysis and making design decisions based on calculations, not guesswork.



 Advanced quantum lab equipment

Course Structure: 6 Advanced Modules

Comprehensive curriculum from fundamental physics to full system integration



01

Vacuum Fundamentals

Pressure regimes, flow types, mean free path, and why UHV is fundamentally different from rough vacuum.



02

Gas Kinetics & Collisions

Collision rates, Maxwell-Boltzmann statistics, and predicting atom trap lifetimes from pressure data.



03

Pumps & Architectures

Effective pumping speed calculations, conductance limits, and differential pumping strategies.



04

Materials, Surface Physics & Cleaning

Adsorption, hydrogen diffusion, material selection, cleaning workflows, and bakeout procedures.



05

Vacuum Hardware & Diagnostics

Flanges, feedthroughs, gauges, advanced leak detection, and real-world failure analysis.



06

System Integration

Integrating vacuum with lasers, magnetic coils, thermal management, automation, and interlocks.

WHAT YOU WILL LEARN & MASTER

Acquire a practical toolkit for designing, building, and maintaining advanced vacuum systems



01

Trap Lifetime Prediction

Predict collision-limited trap lifetimes directly from pressure readings and system data.



02

Pumping Architecture

Design optimal pumping architectures for atomic beamlines and beam sources.



03

UHV Materials & Cleaning

Select correct materials, define strict cleaning workflows, and plan efficient bakeout strategies.



04

Hardware Failure Analysis

Identify hardware-level failure modes and critical component issues early and accurately.



05

System Integration

Integrate vacuum systems seamlessly with lasers, magnetic coils, and control software.



06

Systematic Debugging

Move from trial-and-error to a systematic, data-driven engineering approach to debugging.

JOIN NOW

This course is offered as a professional, self-paced resource for academic and industrial quantum laboratories.

Request access or discuss collaboration:



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