

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Physics

MIT 8.422

Atomic Physics II

February 4, 2009

**General Information & Syllabus**

**General Information:**

Prereq.: 8.05

Units: 3-0-9

Course catalog description: The second of a two-term subject sequence that provides the foundations for contemporary research in selected areas of atomic and optical physics. Non-classical states of light- squeezed states; multi-photon processes, Raman scattering; coherence- level crossings, quantum beats, double resonance, superradiance; trapping and cooling- light forces, laser cooling, atom optics, spectroscopy of trapped atoms and ions; atomic interactions- classical collisions, quantum scattering theory, ultracold collisions; and experimental methods.

Lectures: Mon. & Wed. (and some Fri.) 11am-12:30pm, Room 4-159

Instructors: Prof. Wolfgang Ketterle, 26-243 <ketterle@mit.edu>

Prof. Isaac Chuang, 26-251 <ichuang@mit.edu>

office hours: email

TAs: Caleb Christensen, Yufei Ge, Andrew Grier, Aviv Keshet, Cheng-Hsun Wu

Textbook: none (see website)

Grading: Homework (10 problem sets) 50%, Term paper 50%

Schedule: Final term paper due on May 13, 2009

Web site: <http://cua.mit.edu/8.422>

**Syllabus:**

[W 04-Feb ] Lecture 1: Introduction to Atomic Physics

[M 09-Feb ] Lecture 2: Quantum properties of light – photons & statistics

[HW#1 out]

[W 11-Feb ] Lecture 3: Light II – non-classical states

[M 16-Feb ] No class (MIT holiday)

[T 17-Feb ] No class (MIT Monday schedule)

[W 18-Feb ] Lecture 4: Light III – single photons

[HW#2 out, HW#1 due]

[F 20-Feb ] Lecture 5: Light IV – entangled photons

[M 23-Feb ] Lecture 6: Light V – interferometry and metrology

[W 25-Feb ]	Lecture 7: Light VI – cavity QED	[HW#3 out, HW#2 due]
[M 02-Mar ]	Lecture 8: Optical Bloch Equations – derivation	
[W 04-Mar ]	Lecture 9: OBE II – solutions, transient and steady-state	[HW#4 out, HW#3 due]
[M 09-Mar ]	Lecture 10: OBE III – absorbed energy	
[W 11-Mar ]	Lecture 11: OBE IV – open quantum system dynamics	[HW#5 out, HW#4 due]
[M 16-Mar ]	Lecture 12: Photon-Atom Interactions – Casimir force	
[W 18-Mar ]	No class	[HW#6 out, HW#5 due]
[F 20-Mar ]	Lecture 13: PAI II – diagrams	
[M 23-Mar ]	Spring Break	
[W 25-Mar ]	Spring Break	
[M 30-Mar ]	Lecture 14: PAI III – Van der Waals	
[W 01-Apr ]	Lecture 15: Light Forces – mean radiation forces	[HW#7 out, HW#6 due]
[M 06-Apr ]	Lecture 16: Forces II – dressed atoms	
[W 08-Apr ]	Lecture 17: Forces III – dipole forces	[HW#8 out, HW#7 due]
[M 13-Apr ]	Lecture 18: Forces IV – spontaneous light force traps	
[W 15-Apr ]	Lecture 19: Bose-Einstein Condensates – cooling to ultralow T	[HW#9 out, HW#8 due]
[M 20-Apr ]	MIT Holiday: Patriot’s day	
[W 22-Apr ]	Lecture 20: BEC II – properties	[HW#10 out, HW#9 due]
[M 27-Apr ]	Lecture 21: BEC III – Mott insulator transition	
[W 29-Apr ]	Lecture 22: BEC IV – ultracold Fermi gases	[HW#10 due]
[M 04-May ]	Lecture 23: Trapped ions and quantum information I	
[W 06-May ]	Lecture 24: Trapped ions and quantum information II	
[M 11-May ]	Lecture 25: Molecules	
[W 13-May ]	Lecture 26: Precision Measurement	[Term papers due]