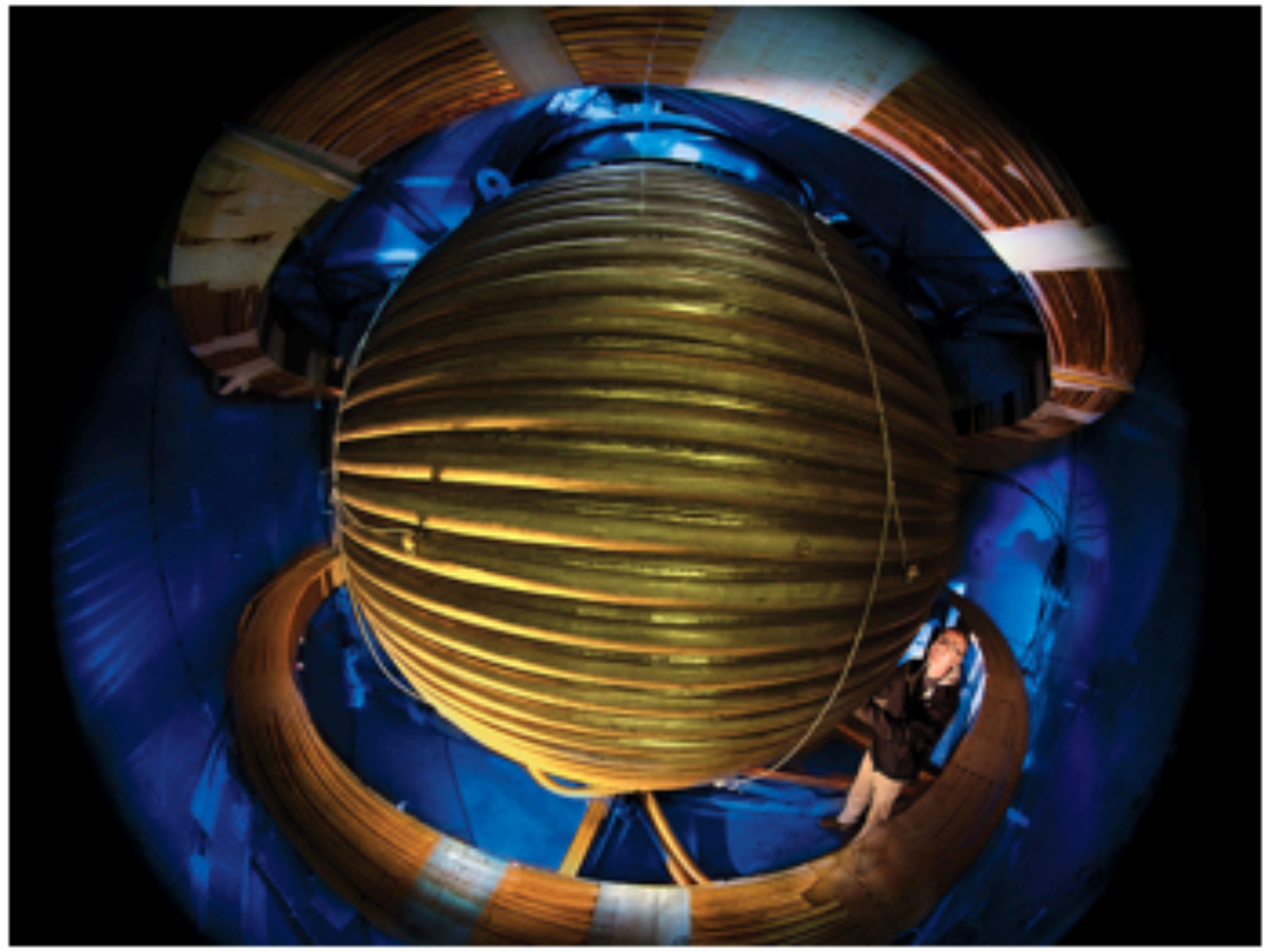
Chemical Physics Open House



PHYSICS & CHEMISTRY CORE

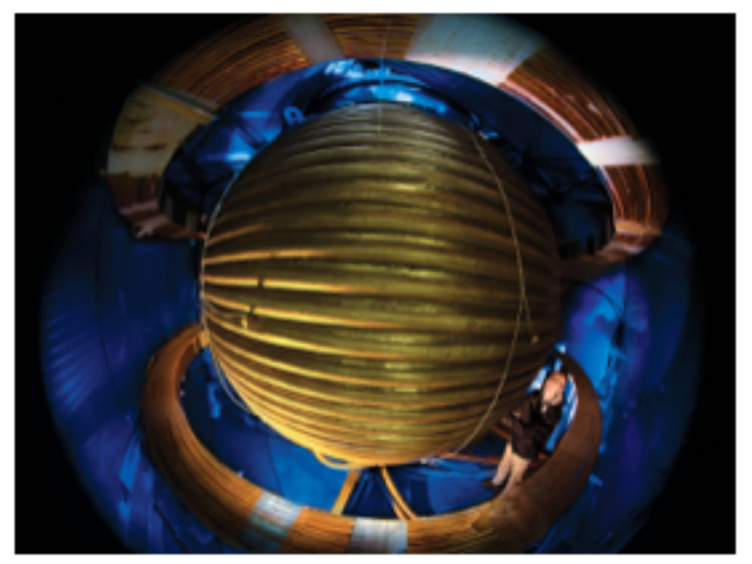
Grounded in both physics and chemistry, this program is for graduate students interested in multidisciplinary, rigorous education that crosses traditional academic boundaries.

DIVERSE STUDENT EXPERIENCES

Coursework and research placements are tailored to each student's background and interests.

LEARN MORE

INSTITUTE FOR PHYSICAL SCIENCE & TECHNOLOGY
CHEMICAL PHYSICS PROGRAM



Who are we

- A highly selective, interdisciplinary program that provides graduate students with a rigorous academic foundation in physics and chemistry while offering first-class research opportunities in disciplines ranging from physics to chemistry to material science to meteorology.
- Students carry out thesis research with Chemical-Physics faculty in numerous departments on campus, primarily within CMNS (College of Computer, Mathematical and Natural Sciences - 10 departments and 12 research institutes and centers) and the Clark School of Engineering, as well as nearby government research institutes.

- **Campus home:**
  Institute for Physical Science & Technology
  an interdisciplinary institution in CMNS.

- **Program administration:**
  Wendell T. Hill, III, Director
  IPST, Physics & JQI
  wth@umd.edu;
  Min Ouyang, Associate Director
  Physics, Quantum Materials Center & NanoCenter;
  mouyang@umd.edu
  Souad Nejjar, Program Coordinator
  IPST
  snejjar@umd.edu.

https://ipst.umd.edu/graduate-programs/chemical-physics

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Application Process

- **General Requirements:**
    - Transcripts.
    - CV/Resume.
    - Letters of Recommendation (3).
    - GRE (waived for applicants 2021 admission).
    - TOEFL (international students).
    - Statement of purpose.
    - Description of Research/Work Experience.
    - Description of courses including textbooks used.

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Basic Requirements

- **Pre-qualifier (first year)**
  - Laboratory rotations course, seminar course & several recommended courses to prepare for qual;
  - Written qualifier (end of summer after first year).
- **Post qualifier**
  - Advanced laboratory course, advanced course outside of main field of study at the 600 level or higher;
  - Admission to candidacy — scholarly paper and presentation;
  - Join a research group; *form a thesis defense team of advisors;*
- **Post-candidacy**
  - 12 credits of CHPH899 — thesis research — *annual progress reports;*
  - Written thesis and oral defense.

Typical Curriculum

- **First Year Fall Semester**
  - CHPH718I (required): Chemical Physics Laboratory Rotation (1 credit);
  - PHYS622 (strongly recommended): Introduction to Quantum Mechanics (4 credits);
  - CHEM684 (strongly recommended): Chemical Thermodynamics (3 credits);
  - Seminar course (required*): choose form several possible — CHPH, PHYS, CHEM & JQI.
- **First Year Spring Semester**
  - CHPH718I (required*): Chemical Physics Laboratory Rotation (1 credit);
  - PHYS623 (strongly recommended): Introduction to Quantum Mechanics (3 credits);
  - CHEM687 (strongly recommended): Statistical Mechanics (3 credits);
  - Seminar course (required*).

* Caveats

Typical Curriculum

- **First Year Summer**
  - Join a research group; study for the qualifier;
  - Qualifier given (typically) the week before fall classes start.
- **Second Year**
  - Advanced laboratory course (required): choose form several possible;
  - Advanced course (required): must be outside your field of study at the 600 or higher level;
  - Prepare scholarly paper and presentation.
- **Third - Final Years**
  - Admission to Candidacy; 12 credits of research credits; thesis and oral defense.

Research Activities in the Chemical Physics Program

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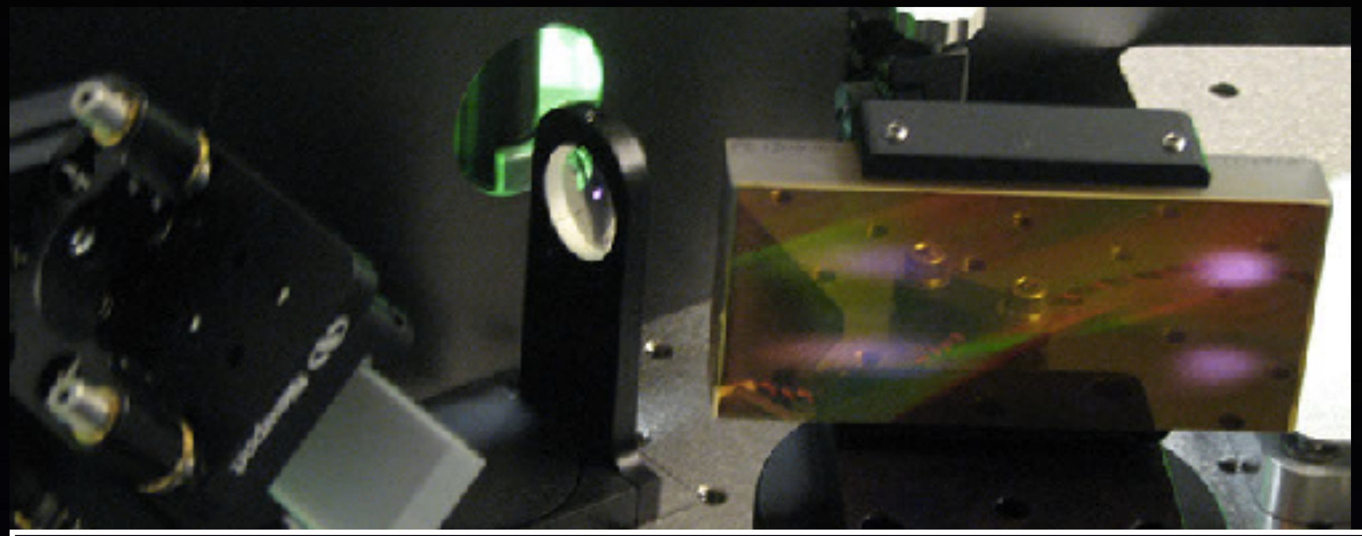
https://ipst.umd.edu/graduate-programs/chemical-physics



Wendell Hill's AMO Lab

Quantum dynamics under extreme conditions

Ultrafast: Photoinduced charge separation in molecules is the first step in many chemical processes and central to our understanding of electron correlation and the energy exchange between electronic and nuclear motion. Catalysis, photosynthesis, photovoltaics and radiation damage in biomolecules all depend on this dynamics. We study these processes with femtosecond and attosecond pulses. Figures 1 and 2 are examples near the Ar L-edge, i.e., the displacing of 2p electrons.

Fig. 1

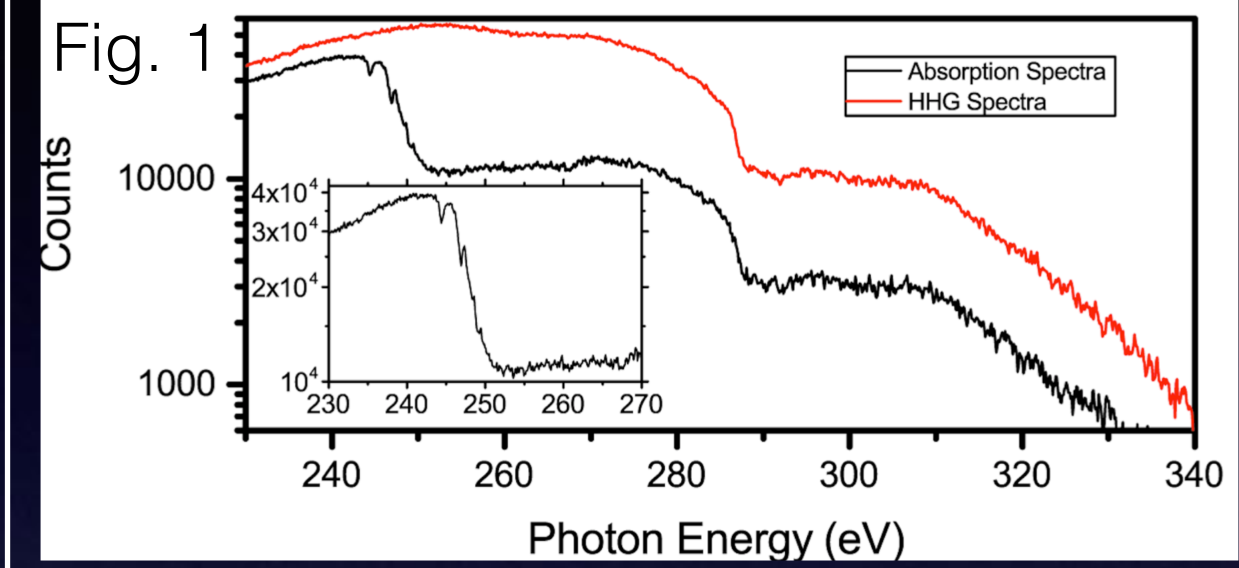
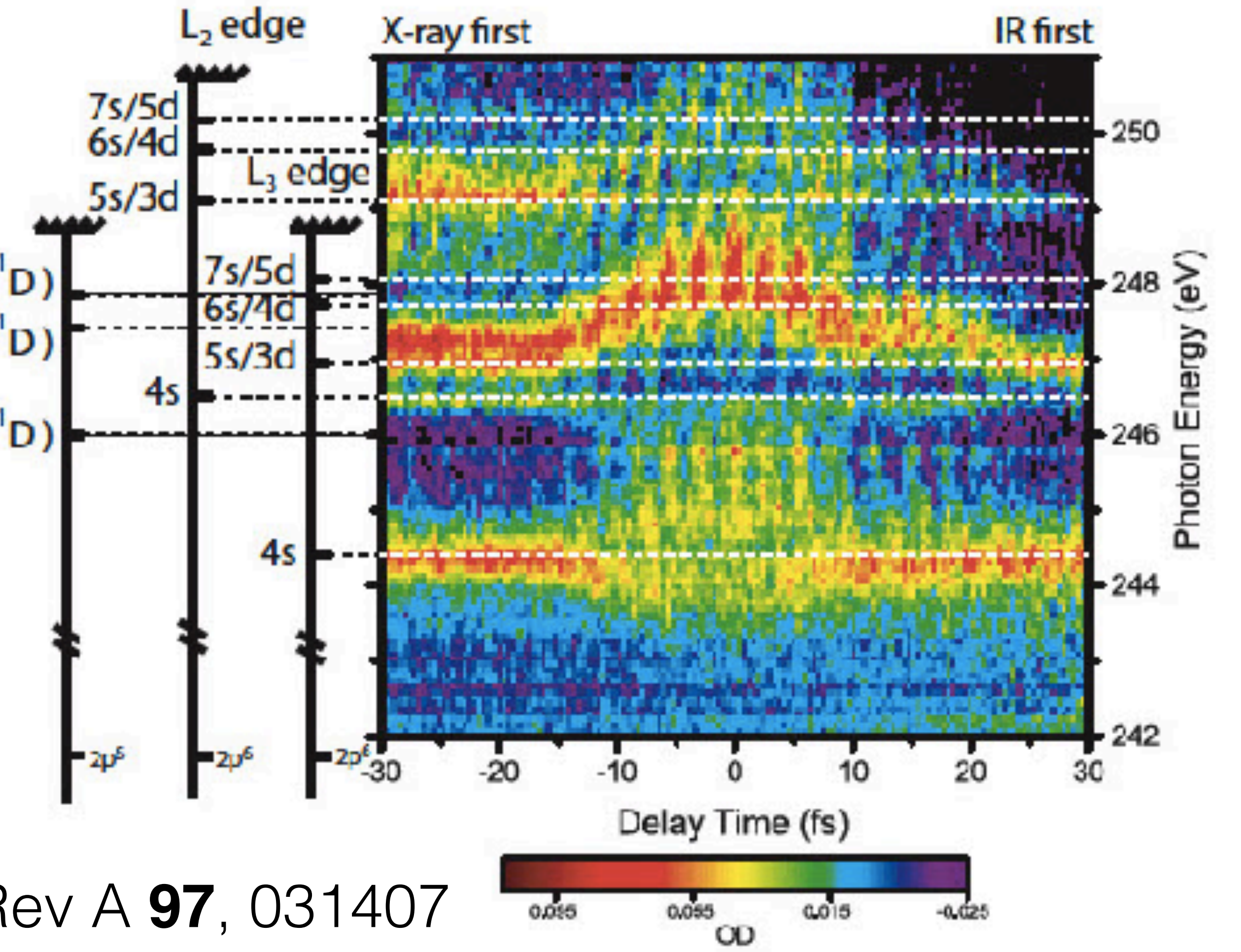
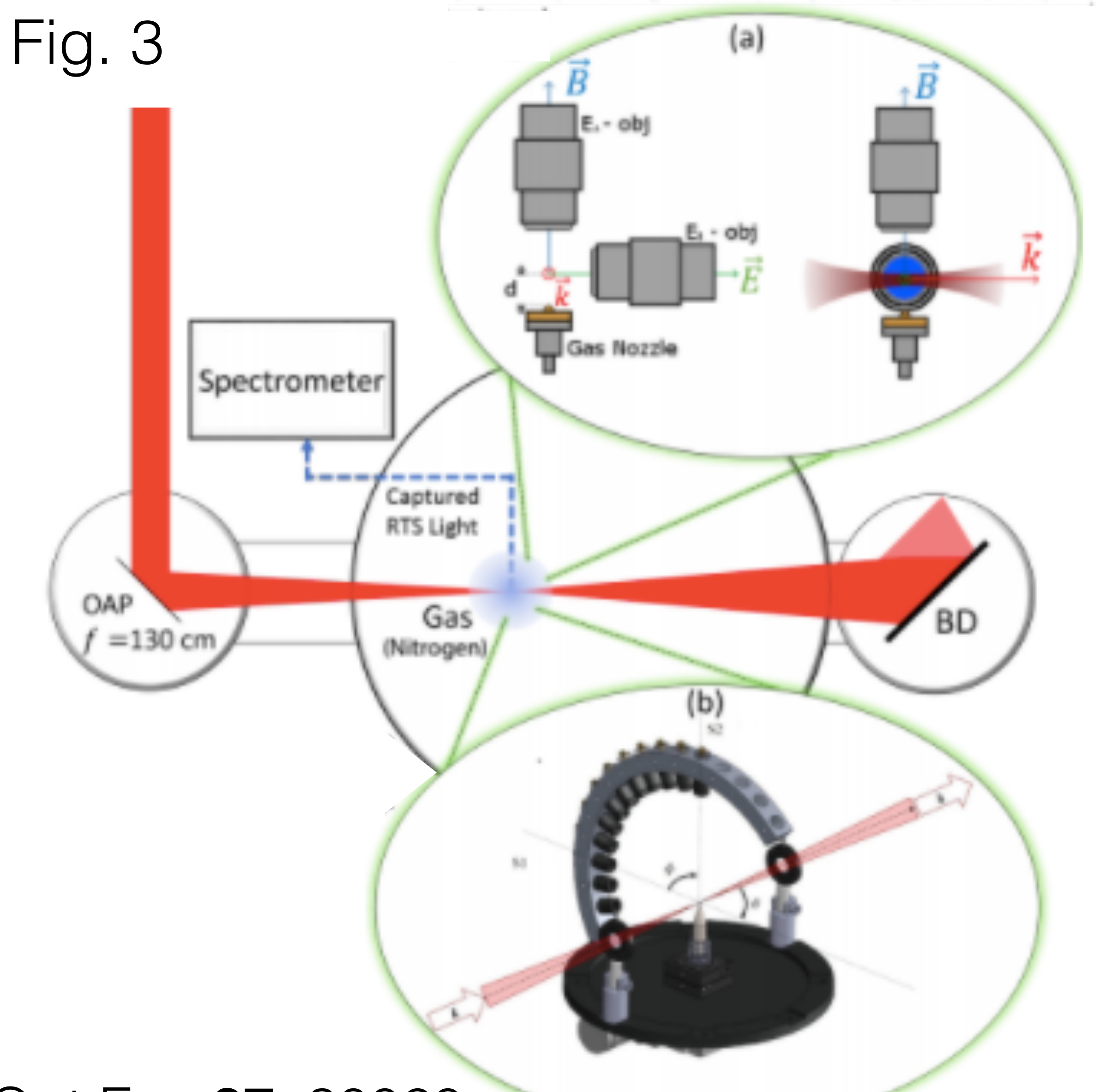


Fig. 2



Phys Rev A **97**, 031407

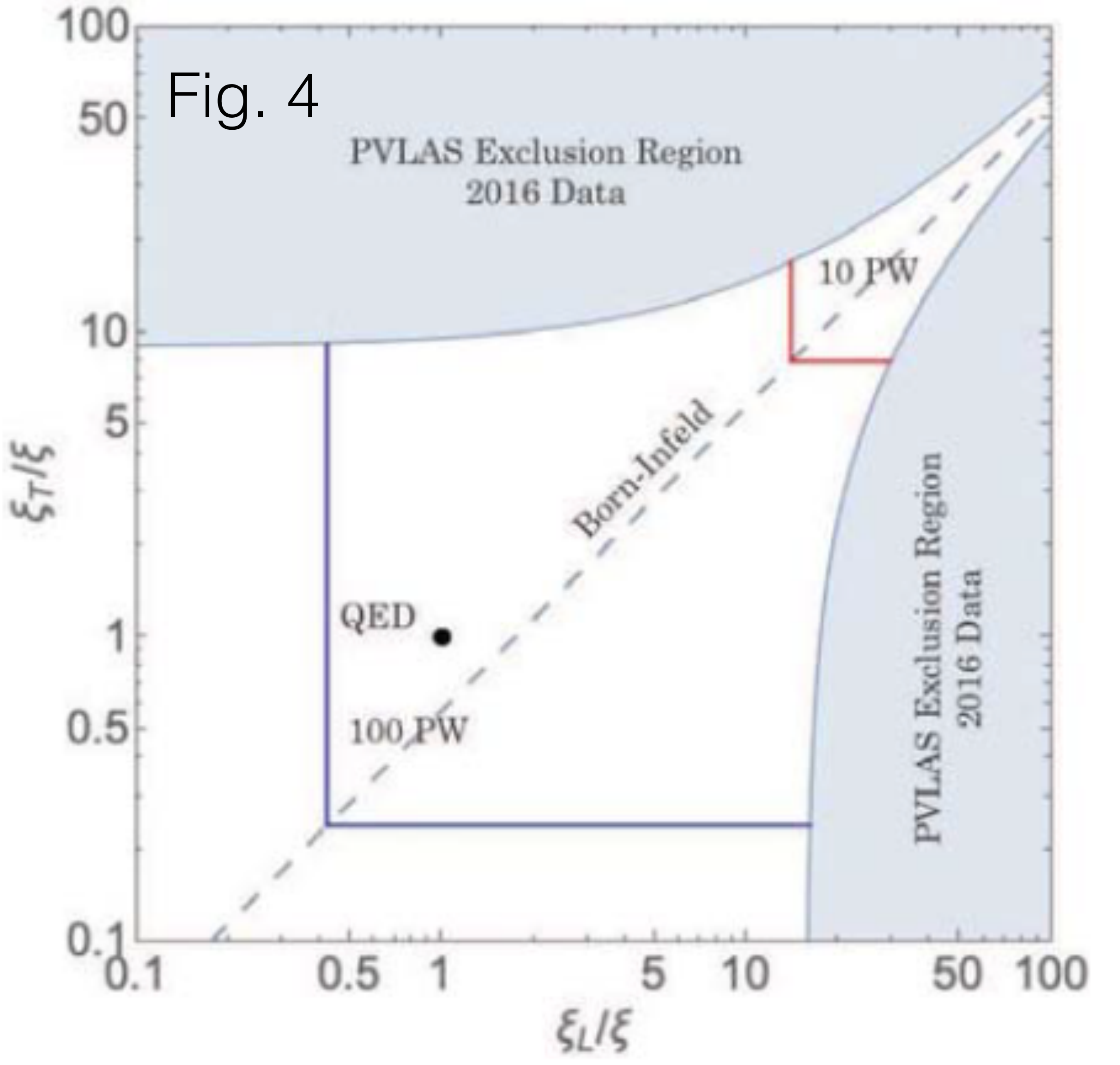
Fig. 3



Opt Exp **27**, 30020

Ultraintense: Petawatt-class lasers have placed us at the threshold of a new era where novel experiments of nonlinear aspects of electrodynamics -- quantum electrodynamics (QED) -- will be possible. We are developing technology to study virtual electron-positron pairs, the birefringence of the quantum vacuum and testing QED from the photon side. Figure 3 shows a potential technology for measuring extreme intensities while Fig. 4 indicates the predicted strength of the birefringence of the quantum vacuum.

Fig. 4



J Phys: Conf. Series **869**, 012015

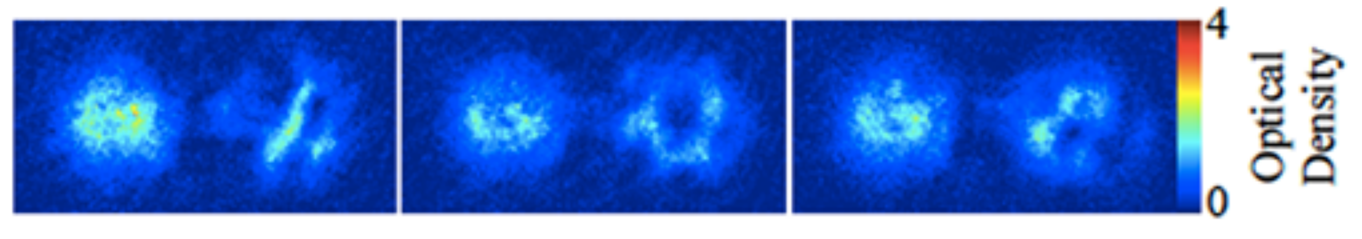


Fig. 5. Phys Rev A **93**, 063619

Ultracold: Ultracold atoms have revolutionized how some key questions in physics and chemistry are being addressed by providing a platform to study longstanding problems that are difficult, if not impossible to study otherwise. We are interested in exploiting these degenerate ensembles of gases (see for example, Fig. 5) to study fundamental questions related to the time-scale for tunneling.