

Dmitry S. Pestov

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CAREER OBJECTIVE

A postdoc position or equivalent (R&D) in experimental optics or related interdisciplinary fields. The present experience can be characterized by the following keywords: coherent anti-Stokes/Stokes Raman scattering (CARS/CSRS), femtosecond CARS, hybrid CARS, ultrashort laser pulses, pulse shaping, detection, time-resolved pump-probe measurements.

EDUCATION

Ph.D. in Physics, Texas A&M University, attending; GPA = 4.00/4
(expected graduation date – May 2008)

M.S. in Physics (with honors), Nizhniy Novgorod State University, Russia,
June 14, 2001; GPA = 4.00/4

B.S. in Physics (with honors), Nizhniy Novgorod State University, Russia,
June 25, 1999; Cumulative GPA = 3.85/4, Major GRA = 4.00/4

RESEARCH EXPERIENCE

Research Assistant

Advisor: Dr. Alexei V. Sokolov (e-mail: sokol@physics.tamu.edu)

Location: Institute for Quantum Studies and Physics Department, Texas A&M University, College Station, TX 77843-4242

Period: Fall 2004 – present

Accomplishments:

- Set up and carried out a series of femtosecond CARS experiments on liquids (such as methanol, ethanol, pyridine, benzene, NaDPA solution) and solids (NaDPA powder) to evaluate the potential of the time-resolved CARS for detection applications.
- For strongly scattering medium (NaDPA powder), demonstrated the selective excitation of molecular vibrations by shaping of the broadband pump-Stokes pulses.
- Co-developed and implemented a hybrid technique for coherent Raman spectroscopy (hybrid CARS/CSRS) that combines the advantages of time-resolved and frequency-resolved approaches for CARS; performed proof-of-principle experiments on liquids (pyridine) and solids (NaDPA powder).
- Carried out a comparative experimental analysis of spontaneous Raman and ultrafast coherent Raman spectroscopy on a neat solution of pyridine. Showed that the broadband pump-Stokes excitation of molecular coherence leads to 10^5 -fold enhancement in the efficiency of the inelastic scattering of the probe photons. Retrieved the magnitude of the molecular coherence excited via a pair of ultrashort pulses under the employed experimental conditions - 0.5×10^{-3} .

- Showed that hybrid CARS can be used for real-time spore detection (on *B. subtilis* spores). Optimized the initial hybrid-CARS setup and improved its detection capabilities by two-to-three orders of magnitude. Demonstrated a single-shot detection of $\sim 10,000$ spores.
- Assembled all-collinear hybrid CARS setup and observed CARS on ambient air (1555 cm^{-1} stretching mode of O_2) and natural gas samples.
- Demonstrated that standard femtosecond pump-probe measurements reveal the evolution of excited vibrational wave packets in Cs_2 through the probe transmission modulation; the frequency-resolved acquisition allows for selective monitoring of different subsets of the excited ro-vibrational levels.

Visiting Scientist

Advisor: Dr. Marlan O. Scully (e-mail: mscully@princeton.edu)

Location: Applied Physics and Materials Science Group, Engineering Quadrangle, Princeton University, Princeton, NJ 08544

Period: three visits over 2006 (6 weeks total)

Accomplishments:

- Assisted in on-going time-resolved and hybrid CARS experiments.

TEACHING EXPERIENCE

Location: Physics Department, Texas A&M University, College Station, TX 77843-4242

Teaching Assistant and Lab Instructor – Spring 2004

Course: PHYS 202 College Physics II (Fundamentals of classical electricity and light)

Teaching Assistant and Lab Instructor – Fall 2003

Course: PHYS 218 Mechanics.

Accomplishments:

- Taught three recitation and lab sections (~ 70 students total per course).
- Graded quizzes, lab reports, and exams.

RECENT PAPER SUBMISSIONS

- **D. Pestov**, Xi Wang, R. K. Murawski, G. O. Ariunbold, V. A. Sautenkov, and A. V. Sokolov, "Pulse shaping for mode-selective ultrafast coherent Raman spectroscopy of highly scattering solids", submitted to *J. Opt. Soc. Am. B* (2007).
- J. P. Ogilvie, M. Cui, **D. Pestov**, A. V. Sokolov, M. O. Scully, "Time-delayed Coherent Raman Spectroscopy", submitted to *Molecular Physics* (2007).
- A. Dogariu, A. Goltsov, **D. Pestov**, A. V. Sokolov, M. O. Scully, "Real-time detection of bacterial spores using Coherent anti-Stokes Raman Spectroscopy", submitted to *J. Applied Physics* (2007).
- **D. Pestov**, X. Wang, G. O. Ariunbold, R. K. Murawski, V. A. Sautenkov, A. Dogariu, A. V. Sokolov, and M. O. Scully, "Single-shot Detection of Bacterial Endospores via Coherent Raman Spectroscopy", accepted for publication in *Proc. Natl. Acad. Sci. U.S.A.* (2007).

PUBLICATIONS IN PEER-REVIEWED JOURNALS (2005-present)

1. **D. Pestov**, G. O. Ariunbold, X. Wang, R. K. Murawski, V. A. Sautenkov, A. V. Sokolov, and M. O. Scully, "Coherent versus incoherent Raman scattering: molecular coherence excitation and measurement", *Optics Letters* **32** (2007), pp. 1725-1727.
[selected for the August 2007 issue of *Virtual Journal of Ultrafast Science*]
2. M. Zhi, **D. Pestov**, X. Wang, R. K. Murawski, Y. V. Rostovtsev, Z.-E. Sariaynni, V. A. Sautenkov, N. G. Kalugin, and A. V. Sokolov, "Concentration dependence of femtosecond coherent anti-Stokes Raman scattering in the presence of strong absorption", *J. Opt. Soc. Am. B* **24** (2007), pp. 1181-1186.
[selected for the May 1, 2007 issue of *Virtual Journal of Biological Physics Research*]
3. **D. Pestov**, R. K. Murawski, G. O. Ariunbold, X. Wang, M. Zhi, A. V. Sokolov, V. A. Sautenkov, Y. V. Rostovtsev, A. Dogariu, Y. Huang, and M. O. Scully, "Optimizing the Laser-Pulse Configuration for Coherent Raman Spectroscopy", *SCIENCE* **316** (2007), pp. 265-268.
[highlighted in June 2007 issue of *Photonics Spectra*, p. 22]
4. Y. Huang, A. Dogariu, Y. Avitzour, R. K. Murawski, **D. Pestov**, M. Zhi, A.V. Sokolov, and M. O. Scully, "Discrimination of dipicolinic acid and its interferents by femtosecond coherent Raman spectroscopy", *J. Applied Physics* **100** (2006), 124912.
5. **D. Pestov**, M. Zhi, Z.-E. Sariyanni, N. G. Kalugin, A. Kolomenski, R. Murawski, Y. V. Rostovtsev, V. A. Sautenkov, A. V. Sokolov, and M. O. Scully, "Femtosecond CARS of methanol–water mixtures", *J. Raman Spectroscopy* **37** (2006), pp. 392-396.
6. **D. Pestov**, M. Zhi, Z.-E. Sariyanni, N. G. Kalugin, A. A. Kolomenskii, R. Murawski, G. G. Paulus, V. A. Sautenkov, H. Schuessler, A. V. Sokolov, G. R. Welch, Y. V. Rostovtsev, T. Siebert, D. A. Akimov, S. Graefe, W. Kiefer, and M. O. Scully, "Visible and UV coherent Raman spectroscopy of dipicolinic acid", *Proc. Natl. Acad. Sci. U.S.A.* **102**, n. 42 (2005), pp. 14976-14981.

OTHER PUBLICATIONS

7. **D. S. Pestov**, A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, and M. O. Scully, "Mid/far-infrared few-cycle-pulse emission via resonant mixing in semiconductor heterostructures", *J. Modern Optics* **51**, n. 16-18 (2004), pp. 2523-2531.
[see also A. A. Belyanin *et al.*, *Acta Physica Polonica A* **107** (2005), pp. 151-157]
8. A. A. Belyanin, D. Deppe, V. V. Kocharovskii, V. V. Kocharovskii, **D. S. Pestov**, M. O. Scully, "New semiconductor laser designs and the exploratory investigation of the terahertz frequency range", *Physics-Uspokhi* **46**, n. 9 (2003), pp. 986-992 [translated from Russian].
9. A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, and **D. S. Pestov**, "Laser transistors for multi-frequency generation in the infrared range", *Izv. Ross. Akad. Nauk, Ser. Fiz.* **67** (2003), p. 263 [Russian].
[translated - *Bull. Russ. Acad. Sci. Phys.* **67** (2003), p. 262]
10. A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, and **D. S. Pestov**, "Novel Schemes and Prospects of Superradiant Lasing in Heterostructures", *Laser Physics* **13**, n. 2 (2003), pp. 161-167.
11. A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, and **D. S. Pestov**, "Optical superradiance and pulsed IR generation in quantum-well heterolasers under cw pumping", *Izv. Ross. Akad. Nauk, Ser. Fiz.* **66** (2002), pp. 365-368 [Russian].
[translated - *Bull. Russ. Acad. Sci. Phys.* **66** (2002), p. 394]
12. A. A. Belyanin, F. Capasso, V. V. Kocharovskiy, V. V. Kocharovskiy, **D. S. Pestov**, M. O. Scully, "Resonance parametric generation of IR radiation on intersubband transitions in

quantum-well heterostructures", *Izv. Ross. Akad. Nauk, Ser. Fiz.* **66** (2002), pp. 247-249 [Russian].

[translated - *Bull. Russ. Acad. Sci. Phys.* **66** (2002), p. 262]

13. A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, **D. S. Pestov**, "One- and two-colour superradiant lasing in magnetized quantum-well heterostructures", *Nanotechnology* **12**, n. 4 (2001), pp. 581-584.
14. A. A. Belyanin, F. Capasso, V. V. Kocharovskiy, V. V. Kocharovskiy, **D. S. Pestov**, M. O. Scully, "Resonant parametric generation of infrared radiation on intersubband transitions in low-dimensional semiconductor heterostructures", *Nanotechnology* **12**, n. 4 (2001), pp. 450-452.
15. A. A. Belyanin, V. V. Kocharovskiy, V. V. Kocharovskiy, **D. S. Pestov**, "Features of Superradiance in a Cyclotron Quantum-Dot Heterolaser Under Continuous Pumping", *Radiophysics and Quantum Electronics* **44**, nn. 1-2 (2001), pp. 184-195.

INVITED TALKS

1. Seminar at Texas A&M University (College Station, TX; November 12, 2007), "*Molecular coherence enables spore detection*"
2. Seminar at UC-Berkeley (Berkeley, CA; November 9, 2007), "*Ultrafast Coherent Raman Spectroscopy: Towards real-time spectroscopy of real-life samples*"
3. Seminar at Los Alamos National Lab (Los Alamos, NM; November 6, 2007), "*Hybrid Technique for Ultrafast Coherent Raman Spectroscopy*"
4. Middleton Meeting on Classical, Semiclassical, and Quantum Noise (Princeton, NJ; November 2-3, 2007), "*Using CARS for endospore detection*"
5. Frontiers in Optics 2007/Laser Science XXIII (San Jose, CA; September 16–20, 2007), "*Hybrid Technique for Coherent Raman Spectroscopy*"
6. Summer School on Quantum Optics and Molecular Physics (Casper, WY; July 15-21, 2007), "*Towards "on-the-fly" detection of Bacterial Endospores*"
7. Princeton-TAMU Symposium on Quantum Coherence and Laser Spectroscopy (Princeton, NJ; March 16-17, 2007), "*Hybrid CARS for Anthrax Detection*"
8. TAMU Molecular Physics and Quantum Optics Symposium (College Station, TX; January 9-10, 2007), "*Hybrid CARS for Bacterial Spore Detection*"
9. 37-th Winter Colloquium on The Physics of Quantum Electronics (Snowbird, Utah; January 2-6, 2007), "*Detection of Bacterial Spores by means of Multiplex CARS spectroscopy*"
10. Anthrax Workshop (College Station, TX; January 23, 2006), "*UV-probe Coherent Raman Spectroscopy of NaDPA*"
11. 36-th Winter Colloquium on The Physics of Quantum Electronics (Snowbird, Utah; January 2-6, 2006), "*UV-probe Coherent Raman Spectroscopy of DPA and its salts*"
12. 35-th Winter Colloquium on The Physics of Quantum Electronics (Snowbird, Utah; January 2-6, 2005), "*Femtosecond CARS on Organic Molecules*"

OTHER PRESENTATIONS (2005-present)

13. Joint Fall Meeting of the Texas Sections of the APS, AAPT and Zone 13 SPS (College Station, TX; October 18-20, 2007), "*Towards Single-Shot Detection of Bacterial Spores*" [oral]
14. CLEO/QELS/PhAST Conference (Baltimore, Maryland; May 6-11, 2007)

- *"Hybrid of Frequency and Time Resolved CARS"* [CLEO, oral]
 - *"Detection of B. subtilis spores via Hybrid CARS"* [PhAST, oral]
 - *"Monitoring Vibrational Wave Packet Dynamics via Direct Femtosecond Pump-Probe Measurements"* [QELS, poster]
15. 10-th Annual Student Research Week (College Station, TX; March 26-30, 2007), *"Hybrid Technique for Coherent Raman Spectroscopy"* [oral, 1-st prize]
 16. Princeton-TAMU Molecular Physics Symposium (Princeton, NJ; May 18-19, 2006), *"UV-probe coherent Raman scattering on DPA in H₂O/NaOH solution: Resonant enhancement and absorption"* [poster]
 17. 9-th Annual Student Research Week (College Station, TX; March 27-31, 2006), *"Molecular detection by means of Coherent Raman Scattering of ultrashort optical pulses"* [oral, 1-st prize]
 18. Seminar at the Institute of Applied Physics RAS (Nizhniy Novgorod, Russia; June 3, 2005), *"Femtosecond CARS/CSRS on Organic Molecules: Towards Anthrax Detection"* [oral]
 19. 8-th Annual Student Research Week (College Station, TX; March 28-April 1, 2005), *"Vibrational Coherence in Organic Compounds: Excitation and Probing via fs-CARS technique"*, [oral, 2-nd prize]
 20. Joint Spring Meeting of the Texas Sections of the APS, AAPT and Zone 13 SPS (Nacogdoches, TX; March 3-5 2005), *"Femtosecond CARS on Organic Molecules"* [oral]

COMPETITIVE HONORS AND AWARDS

- Student Presentation Award (Fall 2007 TSAPS meeting)
- 2007 Robert Hyer Award of the Texas Section of the American Physical Society
- FiO Student Presentation Award (OSA's Annual Meeting – Frontiers in Optics, 2007)
- Incubic/Milton Chang Travel Award (OSA's Annual Meeting – Frontiers in Optics, 2007)
- TAMU Student Research Award, 1-st prize, Texas A&M University, 2007
- TAMU Student Research Award, 1-st prize, Texas A&M University, 2006
- TAMU Student Research Award, 2-nd prize, Texas A&M University, 2005
- Honorary Diploma of Russian Ministry of Education, Student Research Competition, 2001
- The Scholarship of the President of Russian Federation, Nizhniy Novgorod State University, 1999-2000 and 2000-2001
- Honorary Diploma of Russian Ministry of Education, Student Research Competition, 1999
- Sakharov Scholarship, Nizhniy Novgorod State University, 1998-1999

PROFESSIONAL AFFILIATIONS

- Optical Society of America
- American Physical Society
- Sigma Xi, The Scientific Research Society