

Prof. Giulio Cerullo (GC)

Research Experiences and Academic Career

- He was born on 16.02.1965 in Milano (Italy).
- He received the degree in Electronic Engineering at Politecnico di Milano (110/110 Cum Laude) in 1988.
- From 1991 to 1999 he was Staff Researcher with the Physics Department, Politecnico di Milano.
- In the years 1995-1996 he was Visiting Scientist with the Lawrence Berkeley National Laboratory (Berkeley, California, U.S.A.) with a Nato Advanced Research Fellowship, under the supervision of Prof. C.V. Shank.
- Since 1999 he is Associate Professor with the Physics Department, Politecnico di Milano.
- Since July 2011 he is Full professor with the Physics Department, Politecnico di Milano.

Research Activity

GC's research activity covers a broad area known as "Ultrafast Optical Science", and concerns on the one hand pushing our capabilities to generate and manipulate ultrashort light pulses, and on the other hand using such pulses to capture the dynamics of ultrafast events in molecular and solid-state systems. Additional research topics are the applications of ultrafast lasers to microscopy and micro/nanomachining.

GC has published **more than 300 scientific papers** on renowned international journals of high impact factor (including Science, Nature, Nature Materials, Nature Physics, Nature Photonics, Physical Review Letters). These papers have received **more than 11000 citations**. According to the ISI Web of Knowledge (V. 4.7) his **h-index is 56**.

His main research achievements can be summarized as follows:

Ultrafast optics:

- Kerr-lens mode-locking of the Ti:sapphire laser (*Opt. Lett.* **19**, 1040 (1994); *Opt. Lett.* **19**, 807 (1994)).
- Generation of tunable sub-10-fs pulses by the non-collinear optical parametric amplifier (*Appl. Phys. Lett.* **71**, 3616 (1997); *Opt. Lett.* **23**, 1283 (1998); *Opt. Lett.* **24**, 1529 (1999); *Opt. Lett.* **26**, 1155 (2001)).
- Generation of few-optical-cycle light pulses with stable carrier-envelope phase (*Opt. Lett.* **29**, 2668 (2004); *Opt. Lett.* **31**, 963 (2006) *Opt. Express* **14**, 10109 (2006)).
- Sub-10-fs pulse generation in the near- and mid-infrared (*Opt. Lett.* **33**, 741 (2008); *Opt. Lett.* **33**, 2901 (2008); *Opt. Express* **17**, 12510 (2009)).
- Coherent synthesis of optical parametric amplifiers (*Nature Photonics* **5**, 475(2011); *Opt. Lett.* **37**, 1880-1882 (2012)).
- Strong-field photoemission from metal nanotips (*Nature Photonics* **8**, 37 (2014)).
- Generation of phase-locked pulses for two-dimensional spectroscopy by a birefringent delay line (*Opt. Lett.* **37**, 3027 (2012); *Opt. Express* **22**, 9063 (2014))

Ultrafast spectroscopy:

- Measurement of the inter-system crossing rate of a prototypical transition metal complex (*Science* **275**, 54 (1997)).
- Study of charge generation dynamics in conjugated polymers (*Phys. Rev. Lett.* **81**, 3259 (1998); *Phys. Rev. Lett.* **89**, 117402 (2002); *Phys. Rev. Lett.* **90**, 247402 (2003); *Phys. Rev. Lett.* **94**, 117402 (2005); *J. Am. Chem. Soc.* **135**, 4282 (2013)).
- Time-domain vibrational spectroscopy of conjugated molecules (*Phys. Rev. Lett.* **83**, 231 (1999); *Phys. Rev. Lett.* **86**, 3439 (2001); *Phys. Rev. Lett.* **90**, 047402 (2003); *Nature Commun.* **4**, 1602 (2013)).
- Ultrafast charge-transfer processes in polymer-fullerene blends (*Chem. Phys. Lett.* **340**, 232 (2001); *Phys. Rev. B* **64**, 075206 (2001); *Chem. Phys. Lett.* **345**, 33 (2001); *Nature Materials* **12**, 29 (2013)).
- Study of ultrafast internal conversion dynamics in carotenoids and detection of novel excited states (*Phys. Rev. B* **63**, 241104 (2001); *Science* **298**, 2395 (2002); *Phys. Rev. Lett.* **93**, 163002 (2004)).
- Exciton relaxation dynamics in carbon nanotubes (*Phys. Rev. Lett.* **94**, 207401 (2005); *Nature Physics* **2**, 515 (2006)).

- Ultrafast phase transitions in strongly correlated materials (*Nature Materials* **6**, 643 (2007); *Phys. Rev. Lett.* **99**, 027401 (2007); *Phys. Rev. Lett.* **105**, 257001 (2010); *Nature Physics* **7**, 114-118 (2011); *Nature Physics* **11**, 421 (2015)).
- Ultrafast isomerization of rhodopsin (*Nature* **467**, 440 (2010); *Angew. Chem. Intl. Ed.* **53**, 2504 (2014)).
- Ultrafast electron relaxation in graphene (*Nature Commun.* **4**, 1987 (2013)).
- Coherent acoustic phonons in solids and metal nanoparticles (*ACS Nano* **5**, 57852011; *Nano Lett.* **13**, 504 (2013); *Nano Lett.* **13**, 4914 (2013); *Nature Commun.* **4**, 1793 (2013)).
- Strong coupling in metal-molecular hybrid nanostructures (*ACS Nano* **4**, 7559-7565 (2010), *Nature Photonics* **7**, 128 (2013)).

International scientific collaborative network. The research group led by GC has a wide network of international collaborations with scientific groups that are leaders in the fields of ultrashort pulse generation and their application to ultrafast optical spectroscopy. Here we only mention the most important ones: Prof. Franz Kärtner, M.I.T., U.S.A. (*Generation of few-optical-cycle pulses with stable carrier-envelope phase*); Prof. Alfred Leitenstorfer, University of Konstanz, Germany (*Generation of single-cycle mid-infrared pulses*); Prof. Andrea Cavalleri, Max-Planck Research Group for Structural Dynamics, Hamburg, Germany (*Dynamics of phase transitions in strongly correlated systems*); Prof. Richard Mathies, Berkeley University, U.S.A. (*Ultrafast isomerization of rhodopsin*); Prof. Richard Cogdell, Glasgow University, U.K. (*Ultrafast energy transfer processes in light-harvesting systems*); Prof. Christoph Lienau, Oldenburg University, Germany (*Ultrafast dynamics in plasmonic nanostructures*); Prof. Harald Giessen, Stuttgart University, Germany (*Laser sources for coherent Raman microscopy*).

Organisation of International conferences

In the last years GC has been heavily involved in the organizing committees of the main international conferences in the field of laser physics and ultrafast optical spectroscopy.

- *CLEO Europe 2005, 2007* member of the Subcommittee “Ultrafast Optics, Electrooptics and Applications”.
- *Ultrafast Phenomena 2006, 2008, 2010* member of the Program Committee.
- *Photonics Europe 2006, 2008* member of the Subcommittee “Solid-State Lasers and Amplifiers”.
- *Ultrafast Optics 2007, 2009* member of the Steering Committee.
- *CLEO U.S.A. 2008, 2009, 2010* member of the Subcommittee “Ultrafast Optics, Electrooptics and Applications”.
- *1st EOS Topical Meeting on Lasers, 2009*, member of the Program Committee.
- *CLEO Europe-EQEC 2011-2013*, Sub-committee chair, “Ultrafast Phenomena and Frequency Combs”.
- *Ultrafast Optics 2013*, Program Chair.
- *CLEO Europe-EQEC 2015*, Program Chair.
- *Ultrafast Phenomena 2016*, Program Chair.
- *CLEO Europe-EQEC 2017*, General Chair.
- *ICORS 2016*, Member of the Steering Committee.

Memberships to Editorials Boards of International Journals.

From 2006 to 2012 he has been **Topical Editor** of **Optics Letters** in the area of “**Ultrafast Phenomena**”. *Optics Letters*, published by the Optical Society of America, is one of the leading scientific journals in the field of laser science and photonic applications. He is on the editorial boards of the journals “*Chemical Physics*” (Elsevier), “*Journal of Raman spectroscopy*” (Wiley) and “*Laser and Photonics Reviews*” (Wiley). Since April 2016 he is Associated Editor of *Optica* (Optical Society of America).

Memberships to International committees.

GC is a member of the Laser Advisory Committee (LAC) of European XFEL and DESY (Hamburg, Germany). He is a member of the Advisory Scientific Board of LENS (Florence, Italy).

Awards

In 2015 GC was elected Fellow of the Optical Society of America.

Funding ID

GC has a considerable experience in managing and running research projects, both at a national and international level, and managed to attract substantial funding over the last 10 years. Here is a list of the projects in which he has been involved:

Completed projects:

- EU-FP5 CRAFT project *DACO (Development and application of a Compact femtosecond Oscillator)*, years 2003-2005. “Laser application in waveguide writing” (€ 308,000, Research Line Leader).
- EU-FP6 STREP project *HIBISCUS (Hybrid Integrated Biophotonic Sensors Created by Ultrafast laser Systems)*, years 2006-2009 (€ 464,000, Project Coordinator).
- National Research Project “*PRIN- Spectral and temporal control of femtosecond pulses with second order nonlinear processes*”, years 2006-2008 (€ 104,286, Project Coordinator).
- EU-FP7 STREP project *microFLUID (micro-Fabrication of polymeric Lab-on-a-chip by Ultrafast lasers with Integrated optical Detection)*, years 2008-2011 (€ 433,000, Workpackage Leader).
- US Air Force Research Laboratories project: “*Single-cycle pulse synthesis by coherent superposition of ultra-broadband optical parametric amplifiers*”, years 2009-2010 (\$ 100,000, Project Leader).
- National Research Project “*PRIN-Tracking ultrafast photoinduced intra- and inter-molecular processes in natural and artificial photosensors*”, years 2008-2009 (€ 62,000, Project Coordinator).
- EU-FP7 STREP project *CROSS TRAP (Coherently-enhanced Raman one-beam standoff spectroscopic tracing of airborne pollutants)*, years 2010-2012 (€ 327,480, Workpackage Leader).
- Regional Research Project: “*Passive optical memories by liquid crystals in three-dimensional microstructures*”, years 2009-2010 (€ 80,000, Leader of the Research Unit).
- Regional Research Project: “*Development of a coherent Raman microscopy system for biomedical imaging*”, years 2010-2012 (€ 180,000, Project coordinator).

Running projects:

- European Research Council (ERC) Advanced Grant “*STRATUS: structure and dynamics of biomolecules by two-dimensional UV spectroscopy*” years 2012-2017 (€ 2,493,000, Principal Investigator).
- European Research Council (ERC) Proof of Concept Grant “*MISSION: Mid Infrared Spectroscopy by Innovative Optical Interferometers*” years 2015-2016 (€ 149,600, Principal Investigator).
- FET Flagship project GRAPHENE (“*Graphene-Driven Revolutions in ICT and Beyond*”) years 2013-2016 (€ 477,067, participant to WP5 (Optoelectronics)).

SHORT CURRICULUM VITAE

MILTCHO BOYANOV DANAILOV

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Education:

1983 *M.Sc.* equivalent degree in Physics, Dept. of Optics and Spectroscopy, Faculty of Physics, Sofia University, Sofia, Bulgaria.

1990 *Ph.D.* degree, Department of Quantum Electronics, Faculty of Physics, Sofia University, Sofia, Bulgaria.

Present position (since 2006) : Laser Systems Project leader at the FERMI Free Electron Laser facility, Trieste, Italy. This includes the coordination of the FERMI laser group activities on R&D , design, installation, maintenance and operation of the laser systems deployed at the FEL facility, namely Photoinjector Laser, Laser Heater and Seed Laser. Since 2012 also in charge of the setups for Time-resolved FEL-optical laser User experiments at the FERMI beamlines.

Scientific Interests and Experience: Laser Physics, Coherent and Nonlinear Optics, generation and applications of Ultrashort laser pulses, solid-state laser research and development oriented towards applications to large facilities. About 33 years of R&D experience on the above listed research lines

Publications:

- *Peer reviewed journals:* more than 100 published papers (a list of the main publication for the period 2012-2015 is attached)
- *Scientific Conferences:* co-author of 14 invited papers and more than 40 other conference presentations published in proceedings

Foreign Languages: English, Italian and Russian- fluent

PUBLICATIONS WITH PARTICIPATION OF M.B.DANAILOV
For the period 2012-2015

1. AA Kananovich, SV Voitikov, AA Demidovich, MB Danailov, VA Orlovich, *Output Power and Intracavity Intensity Profiles of a Quasi-Continuous End-Pumped Nd:YVO₄ self-Raman mini laser*, **Applied physics. B** 106 (2012), 9-17.
2. E Allaria, R Appio, L Badano, WA Barletta, S Bassanese, SG Biedron, A Borga, E Busetto, D Castronovo, P Cinquegrana, S Cleva, D Cocco, M Cornacchia, P Craievich, I Cudin, G D'Auria, M Dal Forno, MB Danailov et al, *Highly coherent and stable pulses from the FERMI seeded free-electron laser in the extreme ultraviolet* , **Nature Photonics** 6 (2012). pp. 699-704.
3. G Penco, E Allaria, L Badano, P Cinquegrana, P Craievich, M Danailov, A Demidovich, R Ivanov, A Lutman, L Rumiz, P Sigalotti, C Spezzani, M Trovò and M Veronese, **Journal of Instrumentation** 8 (2013).
4. E. Allaria, F. Bencivenga, R. Borghes, F. Capotondi, D. Castronovo, P. Charalambous, P. Cinquegrana, M. B. Danailov, G. De Ninno, A. Demidovich et al, *Two-colour pump-probe experiments with a twin-pulse-seed extreme ultraviolet free-electron laser*, **Nature Communications** 4 (2013) 2476 .
5. E. Allaria, D. Castronovo, P. Cinquegrana, P. Craievich, M. Dal Forno, M. B. Danailov, G. D'Auria, A. Demidovich, G. De Ninno, S. Di Mitri et al, *Two-stage seeded soft-X-ray free-electron laser* , **Nature Photonics** 7, (2013) 913–918.
6. B.Mahieu, E.Allaria, D.Castronovo, M.B.Danailov, A.Demidovich, G.De Ninno, S.Di Mitri, W. M. Fawley, E. Ferrari, L.Fröhlich et al, *Two-colour generation in a chirped seeded free-electron laser: a close look* , **Optics Express** 21 (2013) , 22728-22741.
7. F.Bencivenga, S.Baroni, C.Carbone, M.Chergui, M.B.Danailov, G.De Ninno, M.Kiskinova, L.Raimondi, C.Svetina and C.Masciovecchio, *Nanoscale dynamics by short-wavelength four wave mixing experiments* , **New J. Phys.** 15 (2013) 123023.

8. G. Penco, M. B. Danailov, A. Demidovich, E. Allaria, G. De Ninno, S. Di Mitri, W. M. Fawley, E. Ferrari, L. Giannessi, and M. Trovò, Experimental demonstration of electron longitudinal phase space linearization by shaping the photoinjector laser pulse , **Phys.Rev.Lett.** **112** (2014) 044801
9. P.Cinquegrana, S.Cleva, A.Demidovich, G.Gaio, R.Ivanov, G.Kurdi, I.Nikolov, P.Sigalotti and M.B.Danailov, *Optical beam transport to remote location for low jitter pump-probe experiments with Free Electron Laser* , **Phys. Rev. ST Accel. Beams** **17** (2014), 040702 .
10. S Spampinati, E Allaria, L Badano, S Bassanese, S Biedron, D Castronovo, P Craievich, MB Danailov, A Demidovich, et al, *Laser heater commissioning at an externally seeded free electron laser* , **Phys. Rev. ST Accel. Beams** **17** (2014), 120705.
11. B.Mahieu, E.Allaria, D.Castronovo, M.B.Danailov, A.Demidovich, G.De Ninno, S.Di Mitri, W. M. Fawley, E. Ferrari, L.Fröhlich et al, *Two-colour generation in a chirped seeded free-electron laser: a close look* , **Optics Express** **21** (2013) , 22728-22741.
12. F.Bencivenga, S.Baroni, C.Carbone, M.Chergui, M.B.Danailov, G.De Ninno, M.Kiskinova, L.Raimondi, C.Svetina and C.Masciovecchio, *Nanoscale dynamics by short-wavelength four wave mixing experiments* , **New J. Phys.** **15** (2013) 123023.
13. G. Penco, M. B. Danailov, A. Demidovich, E. Allaria, G. De Ninno, S. Di Mitri, W. M. Fawley, E. Ferrari, L. Giannessi, and M. Trovò, Experimental demonstration of electron longitudinal phase space linearization by shaping the photoinjector laser pulse , **Phys.Rev.Lett.** 112 (2014).
14. P.Cinquegrana, S.Cleva, A.Demidovich, G.Gaio, R.Ivanov, G.Kurdi, I.Nikolov, P.Sigalotti and M.B.Danailov, *Optical beam transport to remote location for low jitter pump-probe experiments with Free Electron Laser* , **Phys. Rev. ST Accel. Beams** **17** (2014), 040702 (2014).
15. M.B. Danailov, F.Bencivenga, F.Capotondi, F.Casolari, P.Cinquegrana, A.Demidovich, E. Giangrisostomi, M. P. Kiskinova, G.Kurdi, M.Manfredda, C.Masciovecchio,R.Mincigrucci, I. P. Nikolov, E.Pedersoli, E Principi and P. Sigalotti, *Towards jitter-free pump-probe measurements at seeded free electron laser facilities* , **Optics Express** **22** (2014), 12869-12879.

16. T Mazza, M Ilchen, AJ Rafipoor, C Callegari, P Finetti, O Plekan, KC Prince, R Richter, MB Danailov, A Demidovich et al, *Determining the Polarization State of an Extreme Ultraviolet Free Electron Laser Beam Using Atomic Circular Dichroism* **Nature Communications** 5 (2014), 3648.

17. M.B. Danailov, F.Bencivenga, F.Capotondi, F.Casolari, P.Cinquegrana, A.Demidovich, E. Giangrisostomi, M. P. Kiskinova, G.Kurdi, M.Manfreda, C.Masciovecchio, R.Mincigrucci, I. P. Nikolov, E.Pedersoli, E Principi and P. Sigalotti, *Towards jitter-free pump-probe measurements at seeded free electron laser facilities* , **Optics Express** 22 (2014), 12869-12879

18. F.Bencivenga, F.Capotondi, F.Casolari, F. Dallari, M.B Danailov, G.De Ninno, D. Fausti, M. Kiskinova, M. Manfreda, C.Masciovecchio, E.Pedersoli, *Multi-colour pulses from seeded free electron lasers: towards the development of non-linear core-level coherent spectroscopies* , **Faraday Discussions** 171 (2014), 487-503.

19. SV Voitikov, AA Demidovich, MB Danailov, VA Orlovich, SV Voitikov, AA Demidovich, MB Danailov, VA Orlovich, *Semiclassical theory of transient intracavity stimulated Raman scattering in compact lasers*, **J. Phys. B: At. Mol. Opt. Phys.** 47 (2014) ,105402.

20. C Spezzani, E Ferrari, E Allaria, F Vidal, A Ciavardini, R Delaunay, F Capotondi, E Pedersoli, C Svetina, L Raimondi, M Zangrando, R Ivanov, I Nikolov, A Demidovich, MB Danailov, H Popescu, M Eddrief, G De Ninno, M Kiskinova, M Sacchi, *Magnetization and Microstructure Dynamics in Fe/MnAs/GaAs (001): Fe Magnetization Reversal by a Femtosecond Laser Pulse*, **Phys.Rev.Lett.** 113 (2014), 247202.

21. M.B.Danailov, M.B.Alsous, P.Cinquegrana, A.Demidovich, G.Kurdi, I.Nikolov and P.Sigalotti, *Study of a Collinear Single-shot Cross-correlator for Laser Timing Applications*, **Applied Physics B: Lasers And Optics** 120 (2015), 97-104.

22. F.Bencivenga, R.Cucini, F.Capotondi, A.Battistoni, R.Mincigrucci, E.Giangrisostomi, A.Gessini, M. Manfreda, I.P.Nikolov, E.Pedersoli, E. Principi, C.Svetina, P. Parisse, F. Casolari, M.B. Danailov, M. Kiskinova, C.Masciovecchio, *Four-wave mixing experiments with extreme ultraviolet transient gratings*, **Nature** 520 (2015), 205-208.

23. F.Capotondi, E.Pedersoli, F.Bencivenga, M.Manfreda, N.Mahne, L.Raimondi, C.Svetina, M.Zangrando, A.Demidovich, I.Nikolov, M.Danailov, C.Masciovecchio, M.Kiskinova , *Multipurpose end-station for coherent diffraction imaging and scattering at the FERMI FEL facility*, **Journ.Synchrotron Radiation** 22 (2015),544-552.
24. D.Gauthier, P.R. Ribič, G.De Ninno, E.Allaria, P.Cinquegrana, M.B.Danailov, A.Demidovich, E.Ferrari, L. Giannessi, B.Mahieu, G.Penco, *Spectrotemporal Shaping of Seeded Free-Electron Laser Pulses*, **Phys.Rev.Lett.** 115 (2015), 114801
25. S.J Goh, Y.Tao, P.J.M van der Slot, H.J.M.Bastiaens, J.Herek, S.G.Biedron, M.B.Danailov, S.V.Milton, K-J Boller, *Single-shot fluctuations in waveguidede high-harmonic generation* , **Opt.Express** 23 (2015), 24888-24902.
26. E.Roussel, E.Ferrari, E.Allaria, G.Penco, S. Di Mitri, M.Veronese, M.Danailov, D.Gauthier, L.Giannessi, *Multicolor High-Gain FEL driven by Seeded Microbunching Instability*, **Phys.Rev.Lett.** 115 (2015), 214801.

CURRICULUM VITAE

Lyubomir Ivanov Stoychev

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Education:

1998 – **M.Sc.** in Physics, Faculty of Physics, Plovdiv University, Plovdiv, Bulgaria.

2008 - **Ph.D.** degree in Laser Physics, Department “Metal Vapour Lasers”, Institute of Solid State Physics, Bulgarian Academy of Sciences, Sofia, Bulgaria.

Present position (since 2009):

Postdoctoral fellow at the ICTP-INFN-SPIE Quantum Cascade Laser Laboratory, Trieste, Italy.

Associated with INFN, sezione Trieste, to work on the FAMU project.

Scientific Interests and Experience:

Laser Physics, Nonlinear Optics, Optical resonators. More than 13 years of R&D experience in these research fields.

Foreign Languages: English, Italian and Russian

List of selected publications:

D.N.Astadjov, L.I.Stoychev, S.K.Dixit, S.V.Nakhe and N.V.Sabotinov, "High-brightness CuBr MOPA laser with diffraction-limited throughout-pulse emission", IEEE J. Quantum Electronics, vol.41, no.8, p. 1097-1101, 2005.

D.N.Astadjov, L.I.Stoychev and N.V.Sabotinov, "Improvement of CuBr Laser Coherence Properties", Proc. SPIE Vol. 6252, 625229 (Jun. 9, 2006)

D.N.Astadjov, L.I.Stoychev and N.V.Sabotinov, "M2 of MOPA CuBr Laser Radiation", Optical and Quantum Electronics, vol. 39, no. 7, p. 603-610, 2007.

Andrzej Adamczak, Dimitar Bakalov, Lyubomir Stoychev, Andrea Vacchi, "Hyperfine spectroscopy of muonic hydrogen and the PSI Lamb shift experiment", Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, Volume 281, 15 June 2012, Pages 72-76, ISSN 0168-583X, 10.1016/j.nimb.2012.04.001.

Lyubomir I. Stoychev, Miltcho B. Danailov, Alexander A. Demidovich, Ivaylo P. Nikolov, Paolo Cinquegrana, Paolo Sigalotti, Dimitar Bakalov, Andrea Vacchi, "DFG-based mid-IR laser system for muonic-hydrogen spectroscopy", Proc. SPIE. 9135, Laser Sources and Applications II, 91350J. (May 01, 2014), doi: 10.1117/12.2052110

L.I. Stoychev, M.B. Danailov, I.P. Nikolov, A.A. Demidovich, D. Bakalov, A. Vacchi, "Increasing the Output Energy of MID-IR Laser System for Muonic-Hydrogen Spectroscopy", 2015 Fotonica AEIT, Italian Conference on Photonics Technologies, Turin, Italy, May 6-8, 2015, ISBN: 978-1-78561-068-4

L. I. Stoychev, M. B. Danailov, A. Demidovich, I. Nikolov, D. Bakalov, and A. Vacchi, "Mid-IR Laser System for Muonic-Hydrogen Spectroscopy," in Advanced Solid State Lasers, OSA Technical Digest (online) (Optical Society of America, 2015), paper ATh2A.4.