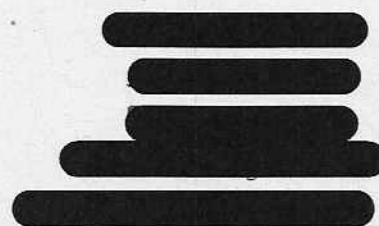


Eugenio Damiano

Curriculum Vitae



Titoli conseguiti

- 2016-2019 **Dottorato di Ricerca in Fisica Sperimentale**, *Università degli Studi di Siena (IT)*, Conseguito in data: 04/12/2019, Valutazione: Eccellente.
- 2013-2015 **Laurea Magistrale in Fisica (LM-17)**, *Università di Pisa (IT)*, Conseguito in data: 23/07/2015, Valutazione: 110/110.
- 2009 -2013 **Laurea Triennale in Fisica**, *Università di Pisa (IT)*, Conseguito in data: 27/02/2013, Valutazione: 98/110.
- 2004-2009 **Diploma di Liceo Scientifico (P.N.I.)**, *Liceo 'A. Aprozio', Ventimiglia (IT)*, Valutazione: 97/100.

Dettaglio dei titoli

Corso di Dottorato

Titolo della tesi *Tunable Solid-State Lasers Based on Rare-Earth-Doped Fluoride Single Crystals*

Relatore Prof. Alberto Di Lieto (tutor) e Prof. Mauro Tonelli (supervisor)

Abstract Allegato CV n.1
(EN)

Corso di Laurea Magistrale

Curriculum: Fisica della Materia

Titolo della tesi *Sorgenti laser in regime CW e Passive Q-switched basate su Tm^{3+} e Nd^{3+}*

Relatore Dott. Stefano Veronesi

PISA 06/01/2020



Abstract A spectroscopic analysis of six sample of $\text{Tm}^{3+}:(\text{Lu}_x\text{Gd}_{1-x})_3\text{Ga}_5\text{O}_{12}$ (Tm: LGGG) with different Tm and Lu concentration has been performed. In particular, the Stark sublevels energy of $^3\text{H}_6$ and $^3\text{F}_4$ manifolds have been determined via low-temperature spectroscopy. This is the first spectroscopic characterization for this material. Diode-pumped laser emission has been achieved for the first time with this host, with a maximum slope efficiency of 20% and maximum output power of 170 mW centered at 2013 nm, with evidence of multiline structure. Moreover a characterization of laser emission at 1 micron, both CW, and Q-switched, for a Nd:LGGG sample has been accomplished.

Corso di Laurea Triennale

Titolo della tesi *UV Laser Sources with Cerium-doped Fluorides*

Relatore Dott. Stefano Veronesi

Precedenti esperienze

- 2018–2019 **Borsa di studio**, NEST, Istituto Nanoscienze - CNR, Pisa (Italy).
Study and development of solid-state lasers in the red region for metrological applications
- 2017–2018 **Borsa di ricerca**, Dipartimento di Fisica - Università di Pisa, Pisa (Italy).
Studio e sviluppo di laser a stato solido nel visibile
- 2015–2017 **Borsa di studio e approfondimento**, Dipartimento di Fisica - Università di Pisa, Pisa (Italy).
Studio per la crescita di fibre monocristalline quali mezzi attivi per laser a stato solido

Competenze professionali

- Comprovata esperienza nella crescita di monocristalli con la tecnica Czochralski, in particolare fluoruri drogati con ioni trivalenti di terre rare.
- Competente nella crescita di fibre monocristalline con la tecnica denominata micro-pulling-down, in particolare fibre di fluoruri.
- Competente nella spettroscopia di solidi nelle regioni UV-VIS-NIR, nel dominio del tempo e della frequenza.
- Comprovata esperienza nello sviluppo e realizzazione di cavità laser a stato solido per applicazioni laser.
- Padronanza nell'utilizzo di cavità e dispositivi laser.
- Familiarità con apparati sperimentali ottici ed elettronici, e con l'analisi dei dati.

PISA 06/01/2020

Pubblicazioni

Articoli di ricerca

- [1] S. Veronesi, Z. Jia, D. Parisi, **E. Damiano**, W. Mu, Y. Yin, M. Tonelli, and X. Tao. "Spectroscopy and diode pumped laser emission in $(\text{Lu}_x \text{Gd}_{1-x})_3 \text{Ga}_5\text{O}_{12}:\text{Tm}^{3+}$ single crystal". In: *Journal of Physics D: Applied Physics* 48, 385302 (Sept. 2015), p. 385302. DOI: 10.1088/0022-3727/48/38/385302.
- [2] A. Sottile, **E. Damiano**, and M. Tonelli. "Diode-pumped laser operation of $\text{Pr}^{3+}:\text{Ba}(\text{Y}_{0.8}\text{Lu}_{0.2})_2\text{F}_8$ in the visible region". In: *Opt. Lett.* 41.23 (2016), pp. 5555–5558. DOI: 10.1364/OL.41.005555.
- [3] **E. Damiano**, J. Shu, A. Sottile, and M. Tonelli. "Spectroscopy and visible laser operations of a μ -PD grown $\text{Pr}^{3+}:\text{LiYF}_4$ single-crystal fiber". In: *Journal of Physics D: Applied Physics* 50.13 (Mar. 2017), p. 135107. URL: <http://stacks.iop.org/0022-3727/50/i=13/a=135107>.
- [4] Shu, J. and **Damiano, E.** and Sottile, A. and Zhang, Z. and Tonelli, M. "Growth by the μ -PD Method and Visible Laser Operation of a Single-Crystal Fiber of $\text{Pr}^{3+}:\text{KY}_3\text{F}_{10}$ ". In: *Crystals* 7 (2017). ISSN: 2073-4352. URL: <http://www.mdpi.com/2073-4352/7/7/200>.
- [5] A. Sottile, **E. Damiano**, M. Rabe, R. Bertram, D. Klimm, and M. Tonelli. "Widely tunable, efficient 2 μm laser in monocrystalline $\text{Tm}^{3+}:\text{SrF}_2$ ". In: *Opt. Express* 26.5 (2018), pp. 5368–5380. DOI: 10.1364/OE.26.005368. URL: <http://www.opticsexpress.org/abstract.cfm?URI=oe-26-5-5368>.
- [6] **E. Damiano**, E. Cavalli, A.Yu. Tarasova, L.I. Isaenko, and M. Tonelli. "Polarized optical spectra of Ho^{3+} -doped KPb_2Cl_5 single-crystal". In: *J. Lumin.* 199 (C 2018), pp. 71–77. DOI: 10.1016/j.jlumin.2018.02.068.
- [7] Jun Shu, Zhitai Jia, **Eugenio Damiano**, Haoyuan Wang, Yanru Yin, Na Lin, Xian Zhao, Xinguang Xu, Mauro Tonelli, and Xutang Tao. "Charge compensations of Eu^{2+} and O_i^{2-} co-exist in $\text{Eu}^{3+}:\text{CaMoO}_4$ single-crystal fibers grown by micro-pulling-down method". In: *CrystEngComm* (2018). DOI: 10.1039/c8ce01160e. URL: <https://doi.org/10.1039/c8ce01160e>.
- [8] Alberto Sottile, **Eugenio Damiano**, Alberto Di Lieto, and Mauro Tonelli. "Diode-pumped solid-state laser platform for compact and long-lasting strontium-based optical clocks". In: *Opt. Lett.* 44.3 (2019), pp. 594–597. DOI: 10.1364/OL.44.000594.

Contributi a conferenze

- [9] A. Sottile, S. Veronesi, **E. Damiano**, D. Parisi, and M. Tonelli. "Spectroscopy and laser operation of $\text{Pr}^{3+}:\text{Ba}(\text{Y}_{0.8}\text{Lu}_{0.2})_2\text{F}_8$ single crystal". In: *7th EPS-QEOD Europhoton Conference*, no. PO-3.8, Vienna, Austria, 21-26 August 2016.
- [10] J. Shu A. Sottile **E. Damiano** and M. Tonelli. "Visible Laser Operation of a μ -PD Grown $\text{Pr}^{3+}:\text{LiYF}_4$ Single Crystal Fiber". In: *DGKK - Arbeitskreis "Kristalle für Laser und Nichtlineare Optik" Leibniz Institute for Crystal Growth Berlin, Germany September 15 - 16, 2016*.

- [11] Z. Zhang J. Shu S. Veronesi D. Parisi A. Di Lieto A. Sottile **E. Damiano** and M. Tonelli. "Visible laser operation in Pr-doped fluoride crystals grown by the micro-pulling-down method". In: *Italian Physical Society (SIF) 102nd National Congress, Padova, Italy, 26 - 30 September 2016*.
- [12] A. Sottile, **E. Damiano**, Z. Zhang, and M. Tonelli. "Visible laser operation of a $\text{Pr}^{3+}:\text{KY}_3\text{F}_{10}$ single-crystal fibre". In: *Fotonica 2017 AEIT, Padova, Italy 3-5 May 2017*.
- [13] A. Sottile, **E. Damiano**, and M. Tonelli. "Wavelength tuning in a diode-pumped $\text{Pr}^{3+}:\text{Ba}(\text{Y}_{0.8}\text{Lu}_{0.2})_2\text{F}_8$ laser". In: *CLEO/EUROPE Conference - EQEC 2017, Munich, Germany, 25-29 June 2017*.
- [14] A. Sottile, **E. Damiano**, M. Rabe, R. Bertram, D. Klimm, and M. Tonelli. "Efficient and Broadly Tunable Eye-Safe Laser Operation in a Single Crystal of Tm-Doped Strontium Fluoride ($\text{Tm}:\text{SrF}_2$)". In: *Conference on Lasers and Electro-Optics*. Optical Society of America, 2018, SM4N.2. DOI: 10.1364/CLEO_SI.2018.SM4N.2.
- [15] **E. Damiano**, A. Sottile, A. Di Lieto, and M. Tonelli. "Fluoride single crystals for solid-state laser applications". In: *3rd German Polish Conference on Crystal Growth, Poznan, Poland, 17-21 March 2019*.
- [16] Alberto Di Lieto, **Eugenio Damiano**, Alberto Sottile, and Mauro Tonelli. "A Fascinating Material for Metrology: the $\text{Pr}:\text{LiGdF}_4$ Solid-state Laser". In: *2019 Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference (CLEO/EUROPE - EQEC), Munich, Germany, 23-27 June 2019*.
- [17] **E. Damiano**, G. Cittadino, A. Di Lieto, and M. Tonelli. "Tunable visible and infrared solid-state lasers based on fluoride single crystals". In: *SPIE Security+Defence, Strasbourg, France, 9-12 September 2019*.

— In preparazione

- [18] G. Cittadino, **E. Damiano**, A. Sottile, A. Di Lieto, and M. Tonelli. "First Demonstration of the Optical Refrigeration Efficiency Greater Than 4% at Ambient Temperature". Manuscript in preparation.
- [19] **E. Damiano**, A. Matteo, A. Sottile, L. McKnight, G. Bonner, and M. Tonelli. "Single-longitudinal-mode diode-pumped deep-red laser operation of $\text{Pr}^{3+}:\text{LiLuF}_4$ ". Università di Pisa and Fraunhofer Centre for Applied Photonics, 99 George Street, Glasgow G1 1RD, manuscript in preparation.

— Competenze digitali

Conoscenze Ottima conoscenza dei sistemi operativi Windows e Linux. Ottima conoscenza della
 generali suite Office e del linguaggio $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$.

Linguaggi di PYTHON, C, C++, HTML, XML, LabView, PHP (basics)
 program-
 mazione

Analisi dati Mathematica, Origin, Gnuplot, Python scientific libraries, Matlab



Varie Autodesk Inventor (Disegno tecnico - meccanica), Inkscape, GIMP (Grafica), Arduino (Piattaforma di prototipazione elettronica)

Competenze comunicative, organizzative e personali

- o Esperienza nella presentazione orale a conferenze internazionali.
- o Ottime capacità interpersonali, amichevole, aperto alle critiche e al confronto costruttivo.
- o Paziente, capace di ispirare fiducia, buon ascoltatore.
- o Organizzazione metodica del lavoro e dello studio acquisita durante gli anni di studio e durante il lavoro di tesi.
- o Grande attenzione per i dettagli, approccio pratico alla risoluzione dei problemi.

Lingue (autocertificato)

	Comprensione		Parlato		Scrittura
	Ascolto	Lettura	Interazione	Produzione orale	
Italiano	Madrelingua				
Inglese	C1	C1	C1	C1	C1
Francese	A2	A2	A2	A2	A2

Altre attività

2016–oggi **OSA Student Chapter**, *Università di Pisa*, Co-fondatore e tesoriere.

2016–oggi **Greenpeace volunteer**, *Gruppo Locale di Pisa*.

2019 **Progettazione laboratorio didattico "Fisica con lo Smartphone e Arduino"**, *LUS - Ludoteca Scientifica, Pisa (IT)*.

Pisa 06/01/2020

Allegato CV n.1

Tunable Solid-State Lasers Based on Rare-Earth-Doped Fluoride Single Crystals

Ph.D Thesis abstract

Eugenio Damiano

Rare-earth-doped fluorides single crystals have been proven to be reliable and interesting active media for solid-state lasers (SSLs). In particular, they possess long spectral lifetimes, narrow emission linewidths and the high-quality output beams. These features allow them to compete both with semiconductor laser and solid-state lasers based on other insulating materials and also to achieve laser emission in previously uncovered wavelength regions. In this work I report on the development of SSLs in the visible, and in the near infrared region around 2 μm .

Fluoride crystals doped with thulium or co-doped with thulium and holmium can be pumped with laser diode near 800 nm to achieve efficient laser emission in the range 1.8-2.1 μm . Thanks to the peculiar absorption properties of water and atmospheric gases in this region, these sources can be used for laser scalpels, surveillance, long-range LIDARs, and gas detection in the atmosphere. We investigated the spectroscopic, laser properties and tunability of two cubic materials, SrF_2 doped with thulium ($\text{Tm}:\text{SrF}_2$) and KY_3F_{10} , doped with thulium ($\text{Tm}:\text{KYF}$) or co-doped ($\text{Tm-Ho}:\text{KYF}$). For the single doped we obtained maximum slope efficiencies of 67% and 56% respectively, and tunability of 180 nm and 194 nm. In the co-doped sample, we obtained a slope efficiency of 24% and a tunability of 61 nm around 2.1 μm .

In the visible part of the spectrum, compact and reliable laser sources in the deep red region are nowadays required to pump strontium atomic lattice clocks, to reduce the size and complexity of the system for space-oriented applications. We studied the laser capabilities of two different hosts: $\text{Pr}^{3+}:\text{Ba}(\text{Y}_{1-x}\text{Lu}_x)_2\text{F}_8$ ($\text{Pr}:\text{BYLF}$) and $\text{Pr}^{3+}:\text{LiGdF}_4$ ($\text{Pr}:\text{GLF}$). In both we observed tunability around 698 nm "clock transition". In $\text{Pr}:\text{GLF}$ we achieved continuous-wave laser emission at 674, 688, 689, 698, and 707 nm, thus covering all the deep-red wavelengths required for Sr^0 clocks and the "clock transition" of Sr^+ . These results provide the basis for the development of a compact and long-lasting laser platform for strontium metrology, based on diode-pumped solid-state lasers.

Moreover we demonstrated the potential of praseodymium-doped single-crystal fibers (SCFs) as compact and cost-efficient active media for visible lasers, by obtaining for the first time laser emission in $\text{Pr}:\text{LiYF}_4$ ($\text{Pr}:\text{YLF}$) and $\text{Pr}:\text{KYF}$ SCFs. These fibers were grown using the relatively new technique of micro-pulling-down, which was proven to be a valid alternative to the 'more traditional' Czochralski method for the growth of monocrystalline laser materials.

Pisa 06/01/2020