LU EZDF ASI
Kvantu optikas laboratorijas atskaite par 2024. gadu

Jānis Alnis

2025.01.28.

LATVIJAS UNIVERSITĀTE

Novadītas lekcijas angliski
Maģistriem ar testu un eksāmenu

Latvian Quantum Initiative

Asoc. Prof. Jānis Alnis

LU EZTF ASI Laboratory of Quantum Optics

Coarse: «Quantum Optical Technologies»

0.5 credit points 12.2024

Precision measurements of fundamental constants
Atomic (optical) clocks SI second
Optical frequency combs
Spectroscopy with tunable lasers
Ultra-stable cavities
Optical microresonators

Kvantu Optikas laboratorijā sagatavots jauns lekciju kurss

atvērta pieteikšanās LUIS, var kā klausītājs

KURSS “KVANTU OPTISKĀS TEHNOLOĢIJAS”

- Pasniedzēji: I. Brice, A. Bundulis, K. Draguns, L. Mīlgrāve.
- Klasiskais un kvantu skaidrojums dažādiem optiskajiem elementiem.
- Nelineārā optika.
- COMSOL simulācijas - praktiskais darbs.
- Kvantu optisko tehnoloģiju piemēri, darbības princips.

Finansē Eiropas Savienība NextGenerationEU
2027
Latvijas Kvantu iniciatīva

2024 Publikācijas

Para-phenylenediamine Schiff base: highly fluorescent photostable solid-state organic dye
H Barhum, M Attrash, I Brice, VV Kim, C McDonnell, M Amer, M Matar, ...
Photonics Research 12 (11), 2639-2650

SU-8-meta-phenylenediamine-conjugated thin film for temperature sensing
H Barhum, M Attrash, I Brice, T Salgals, M Matar, M Amer, Z Abdeen, ...
Philosophical Transactions A 382 (2281), 20230322

Towards on polymer photonic platform
A Vembris, A Bundulis, S Grietena, E Laizane, J Alnis, S Spolitis
Integrated Photonics Platforms III

Nanojet Visualization and Dark-field Imaging of Optically Trapped Vaterite Capsules with Endoscopic Illumination
A Ushkov, A Machnev, D Kolchanov, T Salgals, J Alnis, V Bobrovs, ...
arXiv preprint arXiv:2404.11303

COMSOL Simulations of the Main Properties of the Whispering Gallery Mode Resonators for Bio-Sensing ApplicationsA Atvars, K Draguns, H Baumanis, I Brice, J Alnis
Preprints

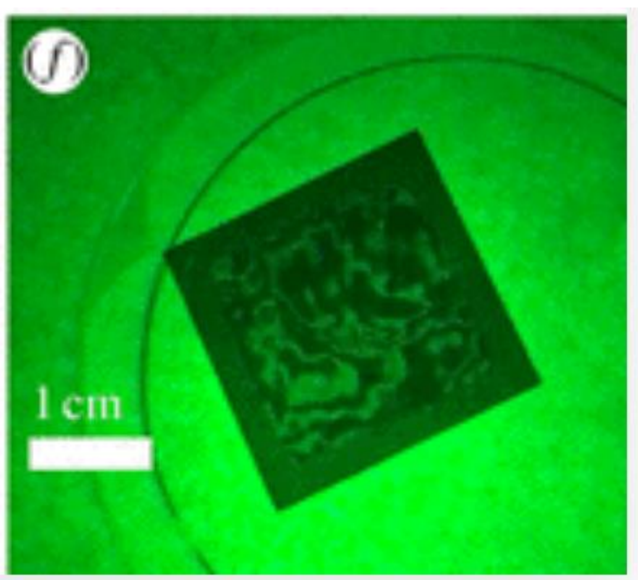
> Philos Trans A Math Phys Eng Sci. 2024 Oct 23;382(2281):20230322. doi: 10.1098/rsta.2023.0322. Epub 2024 Sep 9.

SU-8-meta-phenylenediamine-conjugated thin film for temperature sensing

Hani Barhum [1] [2], Mohammad Attrash [1] [2], Inga Brice [3], Toms Salgals [4], Madhat Matar [2], Mariam Amer [1] [2], Ziad Abdeen [5] [6], Jānis Alnis [3], Vjačeslavs Bobrovs [4], Abdul Muhsen Abdeen [5] [7], Pavel Ginzburg [1]

10 mkm plāna organikas kārtiņa starp puscaurspīdīgiem zelta spoguļiem. Luminiscences spektrā interferences vilnīši. Nobīdās no temperatūras.

Vīzija: no attāluma, ar teleskopu nolasāms temperatūras sensors .



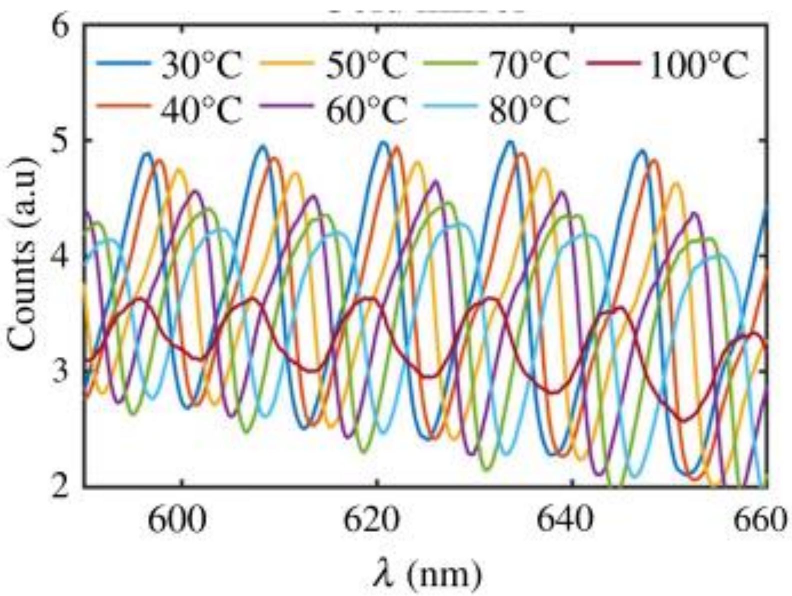


Foto un spektrs uzņemti LU ASI

Para-phenylenediamine Schiff base: highly fluorescent photostable solid-state organic dye

Hani Barhum,[1,2,*] Mohammad Attrash,[1,2] Inga Brice,[3] Vyacheslav V. Kim,[4,5] Cormac McDonnell,[2] Mariam Amer,[1,2] Madhat Matar,[1] Janis Alnis,[3] Toms Salgals,[6] Ibrahim Yehia,[1] Vjaceslavs Bobrovs,[6] Rashid A. Ganeev,[4,5,7,8] and Pavel Ginzburg[2]

Optiskās nelinearitātes dati uzņemti ar Z-scan Prof. Ganeeva iekārtotajā lab Jelgavas 3 715.

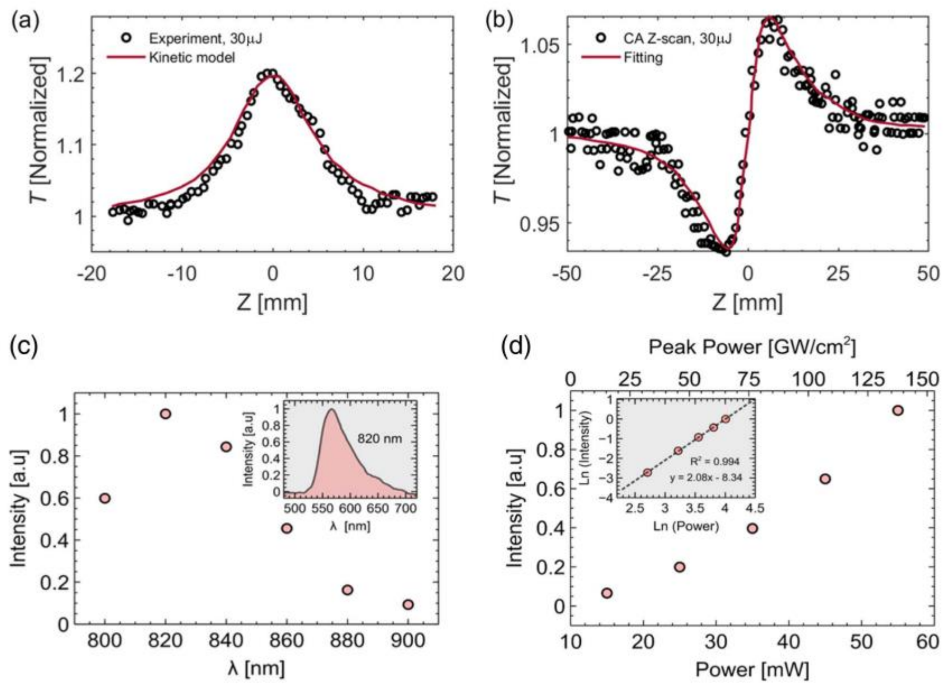
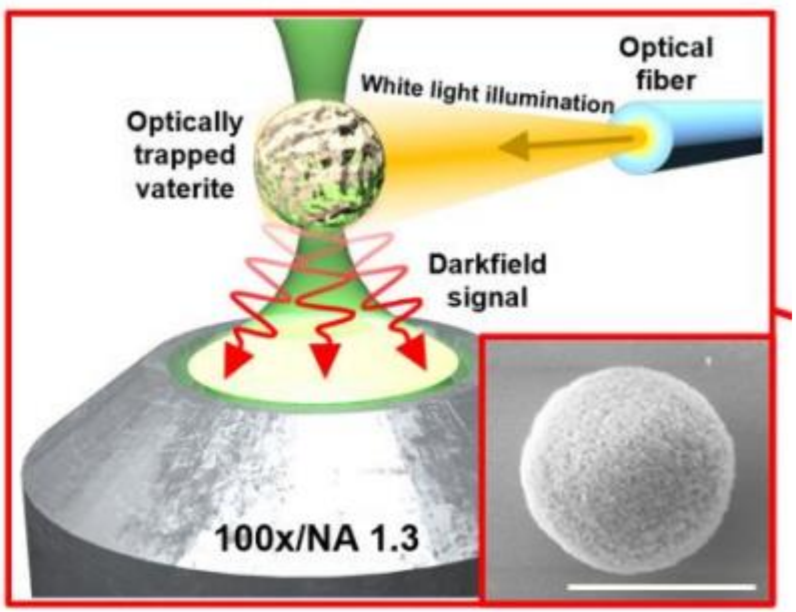


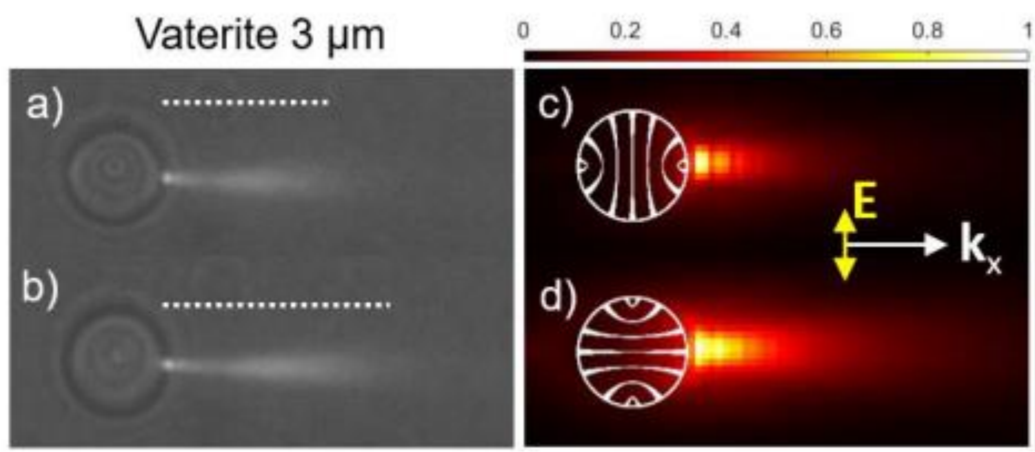
Fig. 10. (a) Open-aperture Z-scans of the material dissolved in DMSO measured at a laser pulse energy of 30 μJ. (b) Closed-aperture Z-scan of studied suspension using 30 μJ probe pulse. The fitting of the experimental curve using the measured radius of the focused beam at full width at the level of e^{-1} of maximum (47 μm) is shown as a red solid curve. (c) Two-photon fluorescence intensity versus wavelength. The peak fluorescence is observed for pump wavelengths around 820 nm for an excitation intensity of 50 $GW \cdot cm^{-2}$ used for all wavelengths. Two-photon fluorescence spectrum for a pumping wavelength of 820 nm (inset). (d) Change in the fluorescence intensity with increasing input power. The fitting of the data confirms a second-order two-photon process (inset).

Nanojet Visualization and Dark-field Imaging of Optically Trapped Vaterite Capsules with Endoscopic Illumination

Andrei Ushkov[1,2*], Andrey Machnev[1,2], Denis Kolchanov[1,2], Toms Salgals[3,4], Janis Alnis[5], Vjaceslavs Bobrovs[3], Pavel Ginzburg[1,2]

Vaterīts ir $CaCO_3$ piciņa. Noķer optiskā pincetē, spirtā.
Apaļa piciņa – gandrīz kā ČGM rezonators. Mie rezonanses. Optiskā mikrolēca.
Piedalījos mērījumos Telavivā 2023.





Inga Brice – LU Pēcdoktorantes projekts

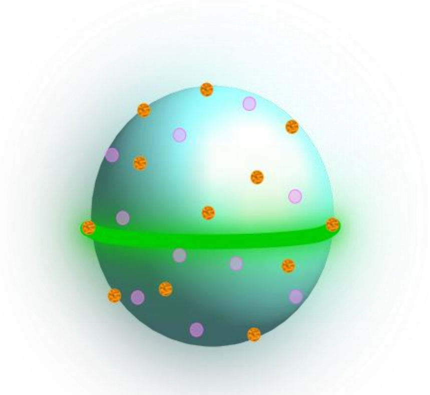
Optoplazmonisku dopētu čukstu galerijas modu rezonatoru izstrāde

Projekta numurs LU-BA-PG-2024/1-0009

- Projekta pētījuma mērķis ir iegūt un izplatīt jaunas zināšanas par virsmas funkcionalizētiem optoplazmoniski dopētiem čukstošās galerijas modu rezonatoriem hibrīda aktīvajām/pasīvajām pielietojuma sistēmām.
- Projekta īstenošanas periods
  - 01.09.2024. - 31.08.2025.
- Projekta vadītāja
  - Inga Brice

Finansē Eiropas Savienība NextGenerationEU

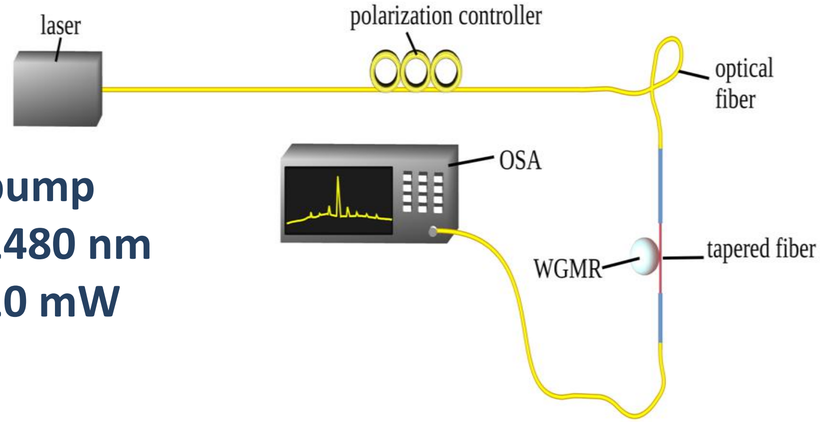
2027 Nacionālais attīstības plāns



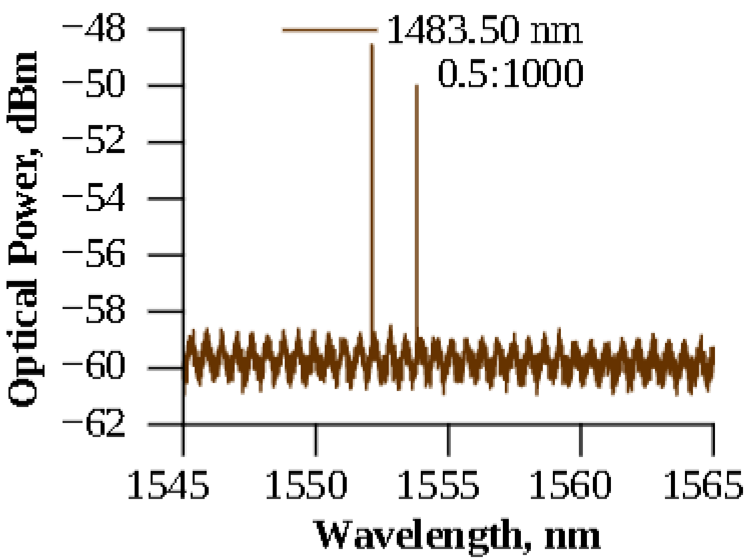
Pētījumu finansē Atveseļošanas un noturības mehānisma atbalstīts projekts “Latvijas Universitātes iekšējā un ārējā konsolidācija” (Nr. 5.2.1.1.i.0/2/24/I/CFLA/007).

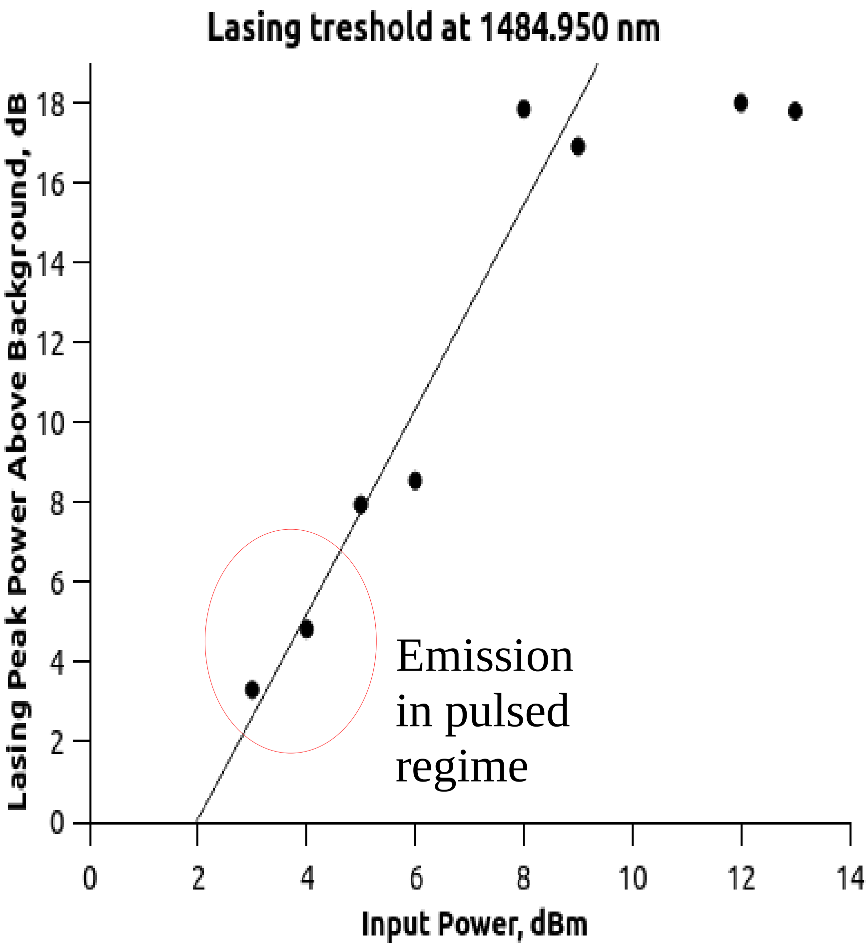
Ar erbiju dopētas mikrosfēras lāzeri

Izejas jauda ap 5 mikrovati ap 1550 nm.



pump
1480 nm
10 mW





Konferences

- 1st Internatial conference on QUANTUM PHOTONICS in Latvia 21.10.24. - 22.10.24.
- Cristmas 2024, France 10.12.24 – 13.12.24

- Publication in IOP Journal of Physics: Conference Series. Submitted January 14, 2025

- Extended abstract being prepared for inSTEMM Journal. Deadline February 15, 2025

- Forthem Seminar 21.11.24

Tailoring whispering gallery mode resonator for a wide range of potential applications: optoplazmonic erbium doped microspheres

Inga Brice[1], Arvids Sedulis[1,2], and Janis Alnis[1,2]

[1]Institute of Atomic Physics and Spectroscopy, Faculty of Science and Technology, University of Latvia, Riga, Latvia
[2]Institute of Photonics, Electronics and Telecommunications, Faculty of Computer Science, Information Technology and Energy, Riga Technical University, Riga, Latvia

E-mail: inga.brice@lu.lv

Abstract. Different WGM resonator geometries and materials can be used to tailor WGM resonators for specific applications. WGM resonators can reach ultra-high quality factors that lead to enhanced light-matter interaction. Additionally, the surface of a WGM resonator can be functionalized with a nanomaterial layer to enhance desirable optical properties, tailoring it further—from sensitivity to any perturbations of the surrounding environment to the generation of nonlinear effects at relatively low powers.

Silica doped with erbium is widely used for optical amplification while metal nanoparticles act like nano-antennas and increase sensitivity to surrounding media.

Doping silica microspheres with erbium ions, we have observed lasing at 1530 - 1560 nm at a threshold of 2 dBm (1.6 mW) when pumping with 1470 - 1500 nm. Lasing was also observed when additionally functionalizing the sphere surface with gold nanoparticles.

1 Introduction

Whispering gallery mode (WGM) resonators have attracted interest since they grant an extreme level of light and matter interaction leading to various potential passive (filters, resonators, sensors [1–3]) and active (lasers, optical frequency combs [4]) applications. The key is finding a suitable fabrication material and resonator geometry for each application. WGM resonators confine the light beam inside curved structures resulting in minimal losses. Different WGM resonator geometries (spheres, spheroids, microrings, etc.) and materials (silica, silicon nitride, tantalum pentoxide, polymers, etc.) [5, 6] can be used to tailor WGM resonators. By choosing a material with very low absorption, and fabricating a very smooth surface, it is possible to reach ultra-high quality factors, that allow the light circulating inside to have a lengthy ring down, leading to enhanced light-matter interaction and allowing high energy densities to circulate inside. Additionally, the surface of the WGM resonator can be functionalized with a nanomaterial layer to enhance desirable optical properties tailoring it further for specific applications from sensitivity to any perturbations of the surrounding environment to the generation of nonlinear effects at relatively low powers, ultimately aiming for real-world applications. Different coating methods are suitable depending on the geometry of the microresonator. For microsphere WGM resonators, the dip coating or drop-casting methods are feasible.

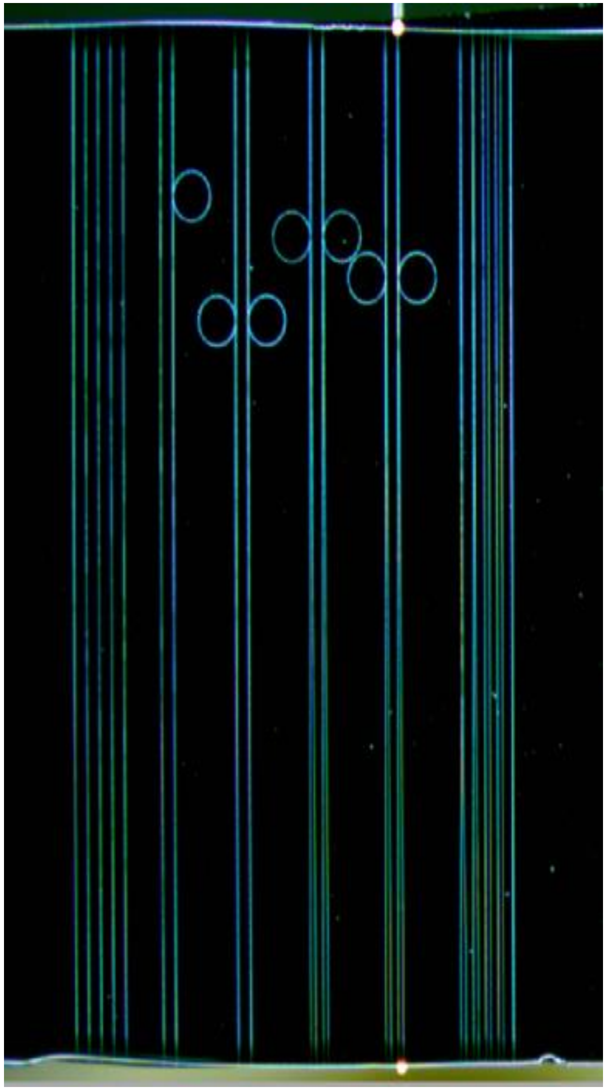
Silica doped with erbium is widely used for optical amplification [7, 8]. Er^{+3} ions incorporated into silica where the 4f energy states of Er ions are modified due to the Stark effect caused by the influence of

Lāse Mīlgrāve - doktorante

- Organized the student conference «Developments in Optics and Communications 2024»
- Summer school «European Frequency and Time Seminar» (Besancon, France)
- Course «Science ethics»
- Course «Project management in research and development»
- Testing the new photonic chips fabricated at the UL ISSP

Polymer integrated photonics on Si

- The goal is to create high-Q resonators for sensor and quantum applications.
- Improvement – using Si wafers instead of glass plates.
- Gap (waveguide-resonator) control is difficult when using photolithography – testing two different methods to have a precise gap:
  - Two-step photolithography;
  - Cutting the gap using SEM.



Valsts Pētījumu Programma VPP projekts: «Viedo materiālu, fotonikas, tehnoloģiju un inženierijas ekosistēma (MOTE)»

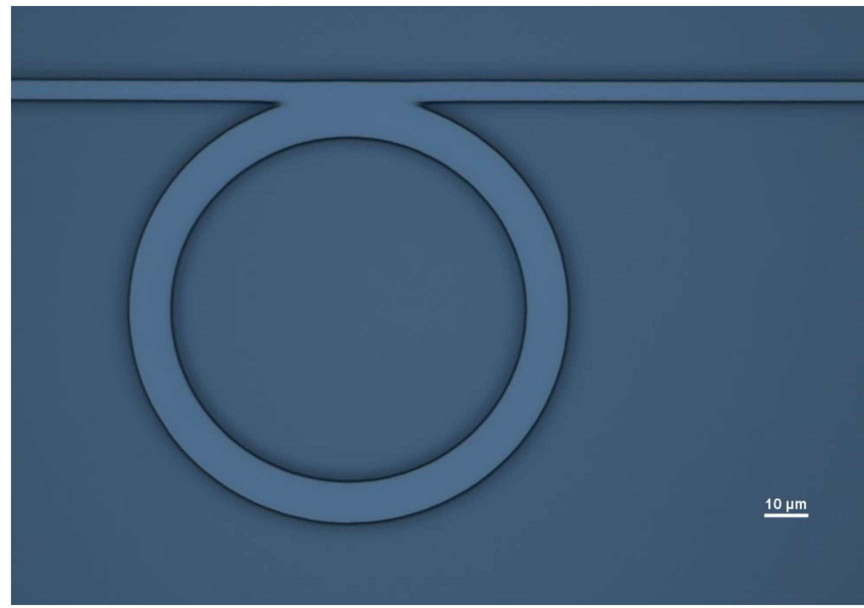
Polymer ring resonators for future quantum optics applications

Advantages:

- Low-cost and mass-produced
- Flexible, easy to integrate
- Physical, optical and electronic properties can be adjusted

Disadvantages:

- Higher optical losses → lower *Q* factor
- More sensitive to changes in the environment (temperature, humidity)

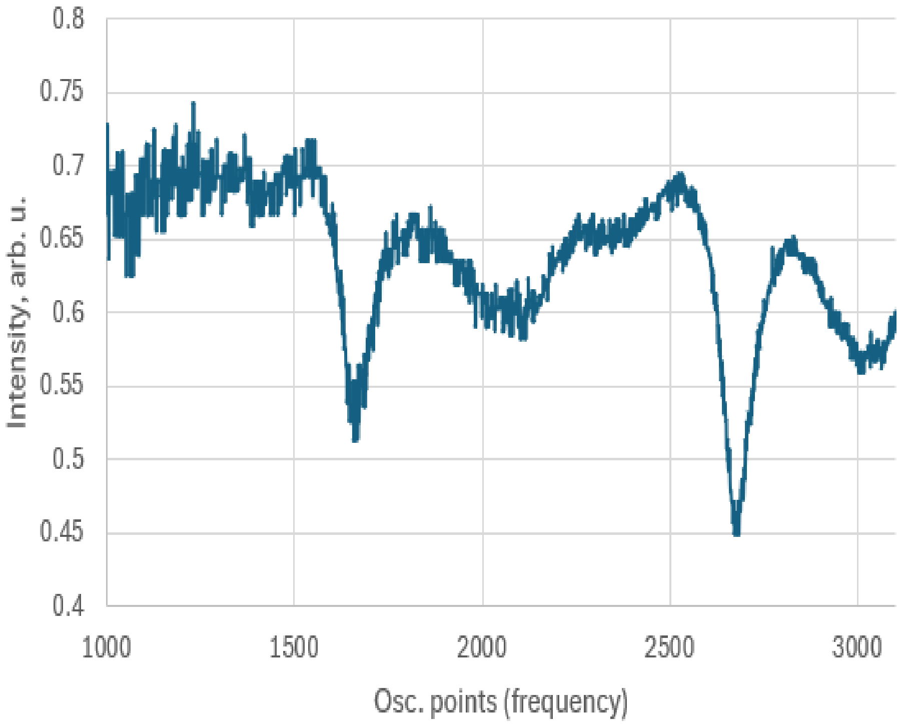


SU-8 – organic polymer

- Negative photoresist
- High quality vertical structures
- High refractive index (1.58 at 760 nm)
- Relatively low optical losses above 400 nm
- Used in integrated optics – telecommunications, sensors, bioapplications

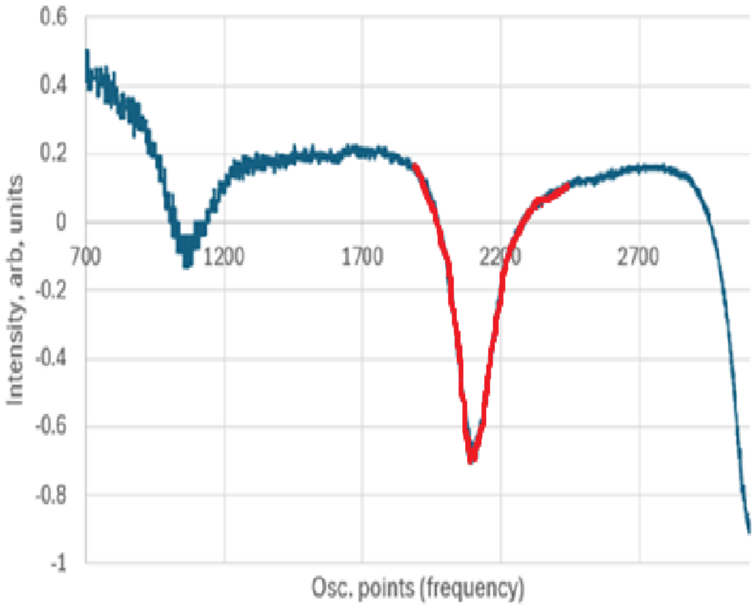
SU-8 rings

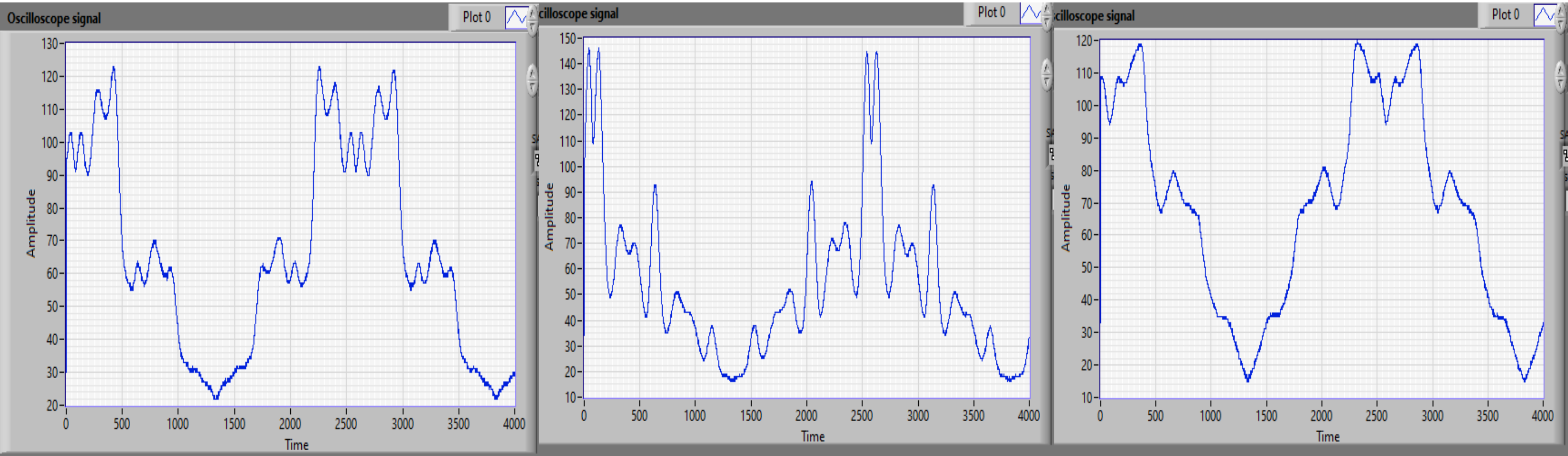
- Max Q = 37 000
- FSR designed to be ~100 GHz
- Multimode at 760 nm laser wavelength



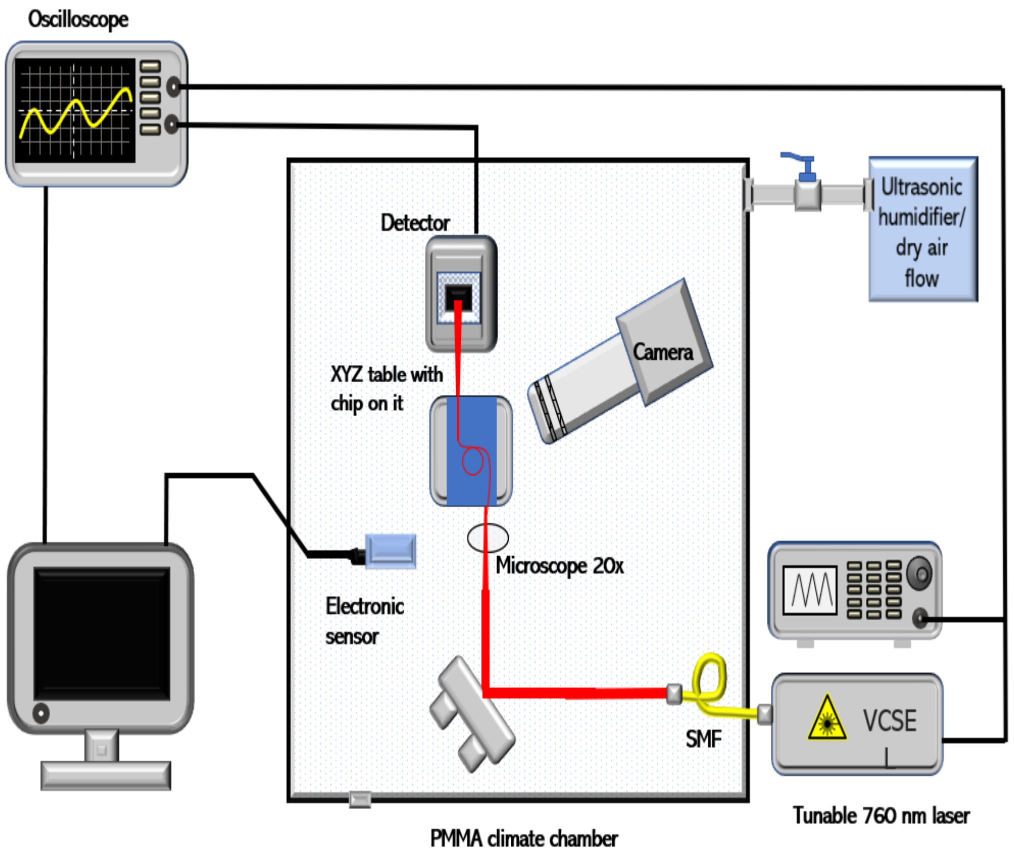
SU-8 microring with PMMA coating

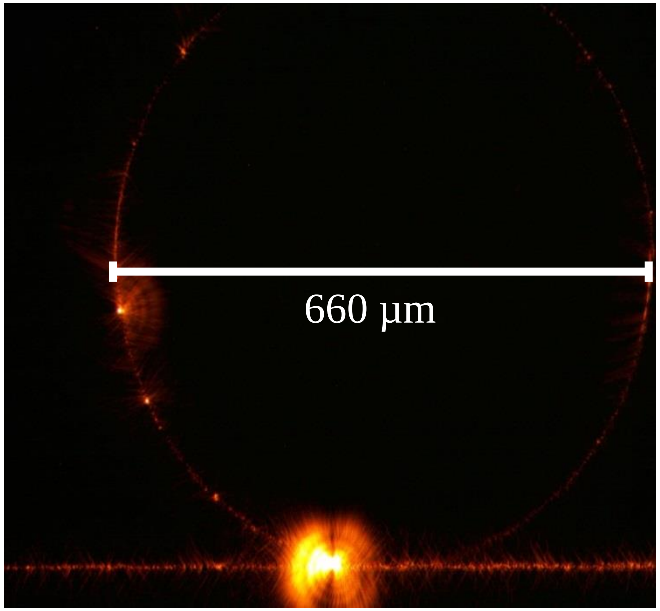
- Resonance shapes vary
- Q (red resonance) = 25 000
- Doesn't improve the Q, but could be useful for improving gas selectivity





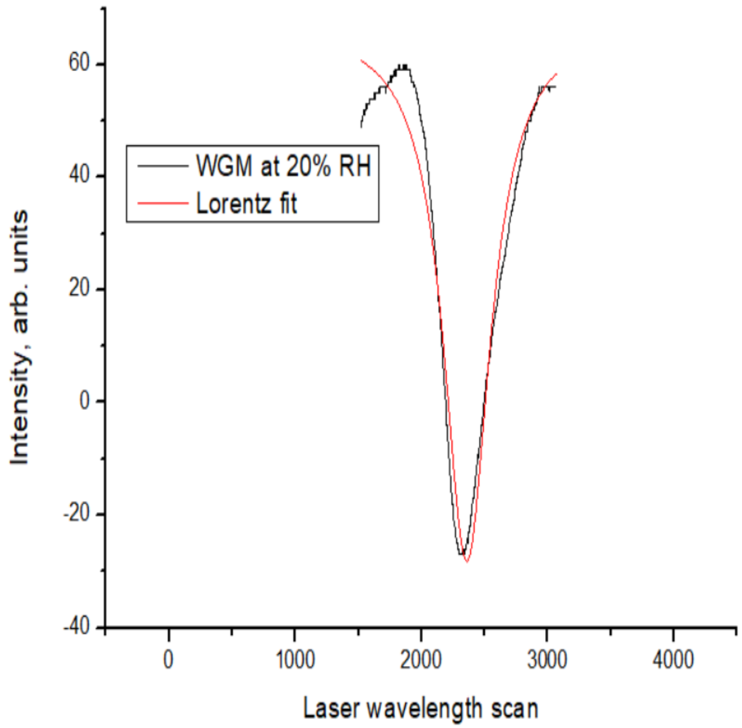
Relative humidity (RH) sensing



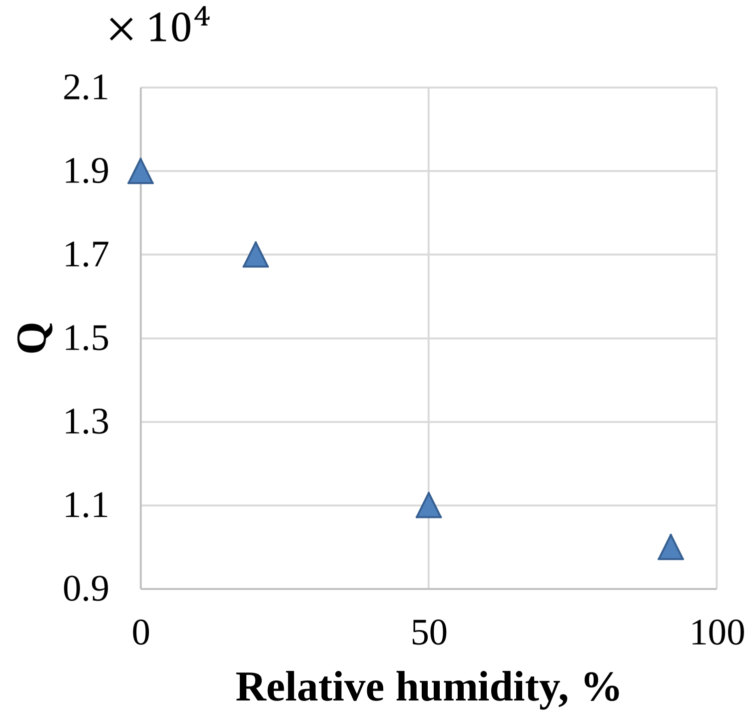


Experimental setup and the ring resonator with circulating light. Some power is visibly lost at the coupling point.

Quality *Q* factor



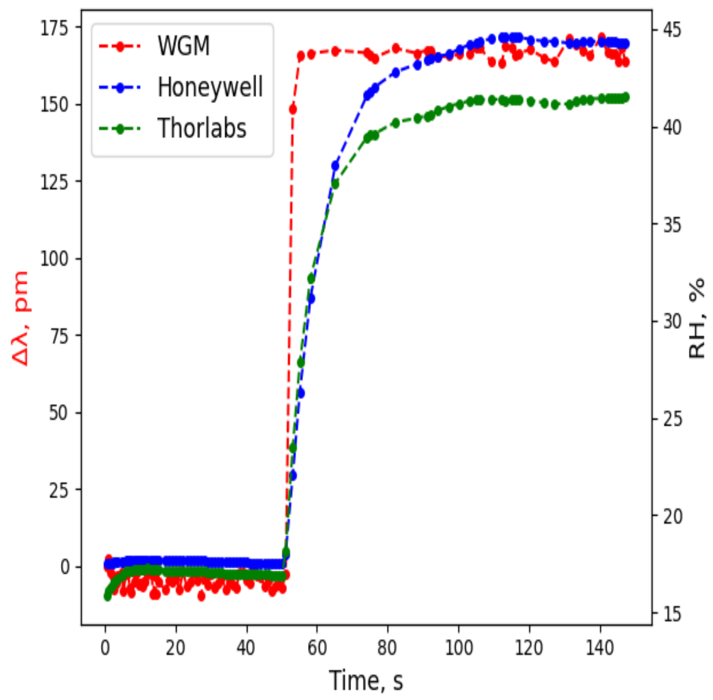
Approximation using Lorentz fit to calculate the *Q* factor



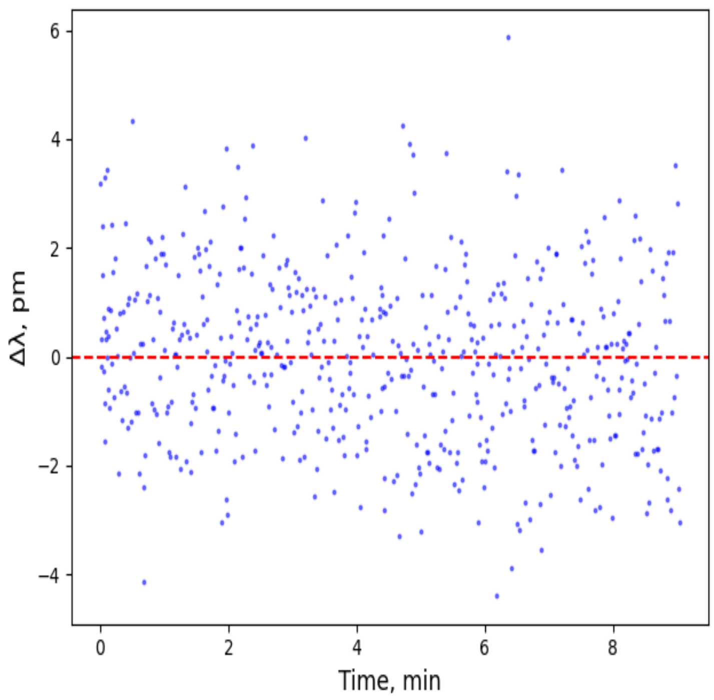
Q factor degradation with increasing relative air humidity

Q factor could be improved by increasing coupling efficiency and optimizing the coupling gap.

Response time and detection limit



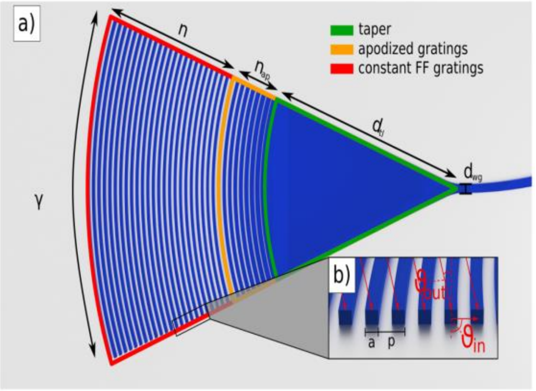
Response time of the ring resonator (around 3 s) compared to two electronic RH sensors

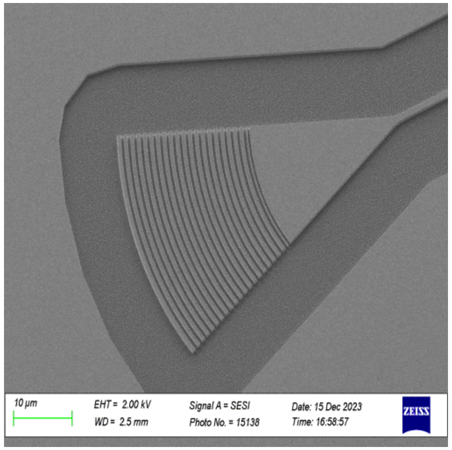


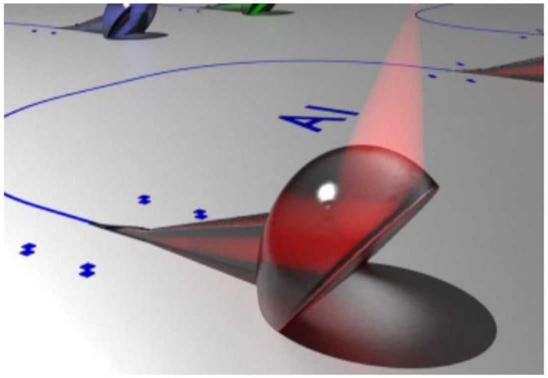
Signal-to-noise ratio ± 1.6 pm (constant temperature and RH)

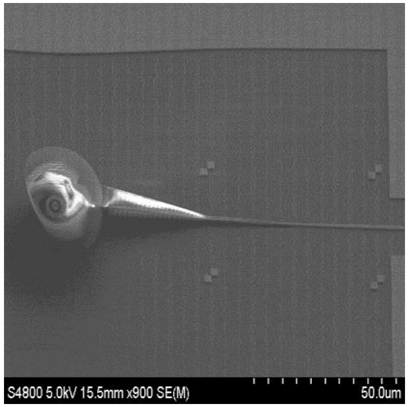
Kristians Draguns - doktorants

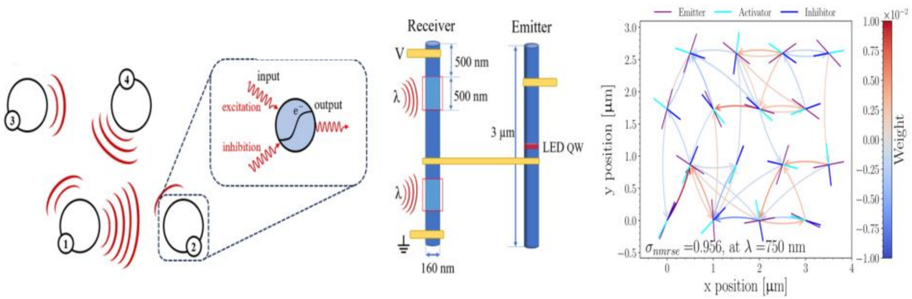
- Jauni Ta_2O_5 čipi:
  - Ar difrakcijas režģa savienotājiem
    - Ievades zudumi -23 dB
    - Q faktors 1.5M
  - Ar polimēru lēcām
    - Ievades zudumi -7 dB
    - Q faktors 1.17M
  - Ar malas ievadi
    - Ievades zudumi -32 dB
    - Ar pašaurinājumu ievadē -?dB (vēl jāizgatavo patievināta šķiedra ievadei)
- Pabeigta publikācija par optisko nanovadu neironu tīkliem (iesniegta žurnālā Nanophotonics)





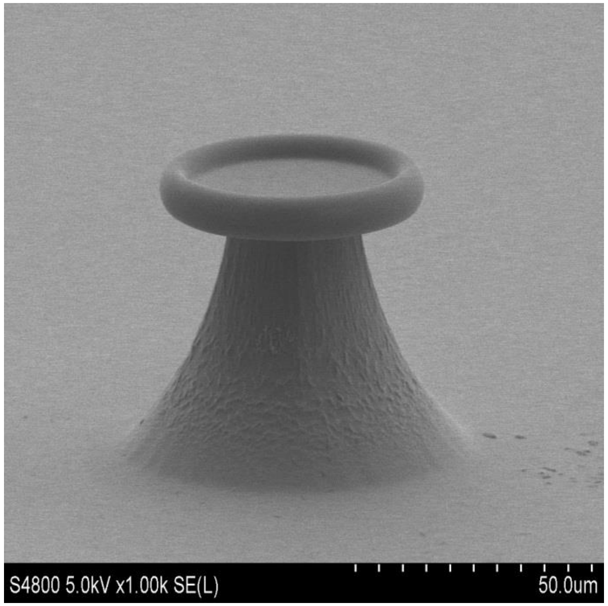






Profesionālā pilnveide, sadarbības

- **Strādā projektā Latvijas Kvantu iniciatīva.**
- Dalība «European Frequency and Time Seminar», Besanconā, Francijā 30.06.2024. - 06.07.2024.
- Eksmatrikulēts kā doktora studiju programmu izpildījis 23.10.2024
- Komandējums uz «Max Planck Institute for the Science of Light», Erlangenā, Vācijā 17.11.2024. - 30.11.2024.

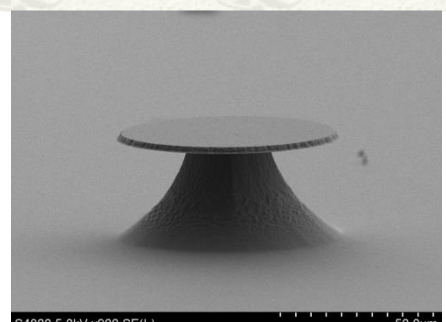


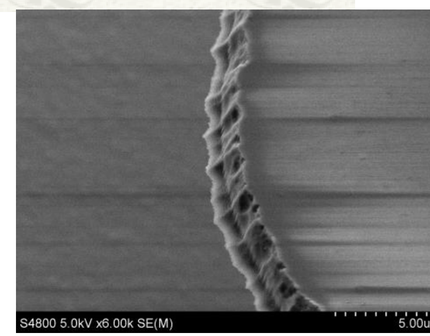
Optiskie mikrorezonatori uz čipa izgatavoti rūpnīcā ALFA, testi RTU un LU ASI

1.ALFA RPAR AS īsteno pētniecības projektu Latvijas Atveseļošanas un noturības mehānisma plāna 5.1.r. reformu un investīciju virziena "Produktivitātes paaugstināšana caur investīciju apjoma palielināšanu P&A" 5.1.1.r. reformas "Inovāciju pārvaldība un privāto P&A investīciju motivācija" 5.1.1.2.i. investīcijas "Atbalsta instruments inovāciju klasteru attīstībai" īstenošanas noteikumu kompetences centru ietvaros.

Projekts Nr. 5.1.1.2.i.0/1/22/A/CFLA/002
Pētījums Nr. 1.16 "Uz čipa veidots optiskās frekvenču ķemmes gaismas avots (CHIP-comb)"
Projekta partneris: Rīgas Tehniskā Universitāte
Pētījuma īstenošanas periods : No 2024. gada 1. marta līdz 2024. gada 31. decembrim
Šī projekta "Uz čipa veidots optiskās frekvenču ķemmes gaismas avots (CHIP-comb)" galvenais mērķis ir izstrādāt energoefektīvu uz optiskā čipa veidotu toroidālo čukstošās galerijas modu (angl. whispering gallery mode (WGM)) augsta Q faktora mikrorezonatoru kā jaunu gaismas avotu plašam lietojumu klāstam. Tas paredz izveidot mikrolāzera optisko čipu, kura pamatā ir WGM mikrorezonatori, t.i. pārskaņojamai OFC ģenerēšanai. Primāri, tiek plānota uz čipa veidota toroidāla mikrorezonatora projektēšana un izstrāde. Rezultātā tiks izstrādāts izmaksu efektīvs WGM mikrolāzers stabilu un pārskaņojamu (optisko harmoniku) nepārtrauktu viļņu (angl. continuous wavelenght (CW)) ģenerēšanai optiskajā C-joslā (1530–1565 nm) un plašākā optiskajā diapazonā.

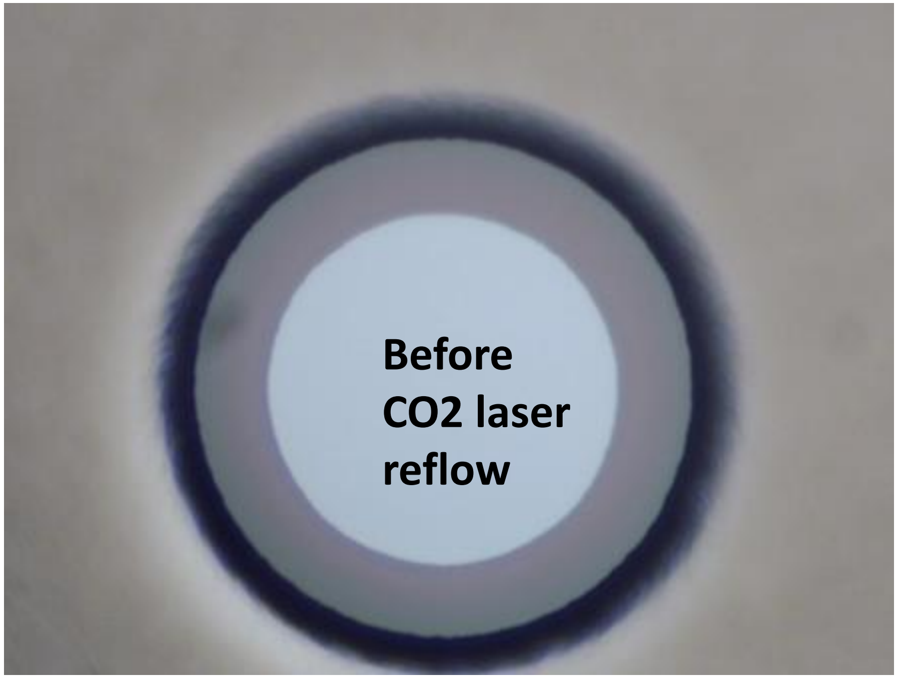
SiO_2 microtoroid resonatos on chip made by ALFA optical lithography Need CO_2 laser edge smoothening at LU ASI

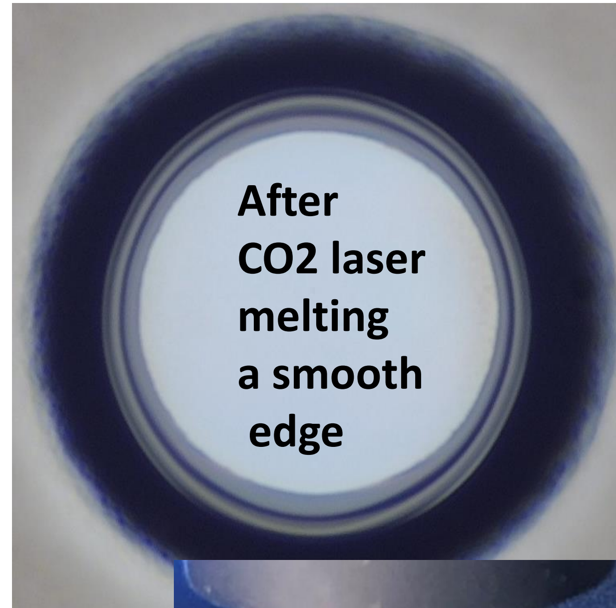


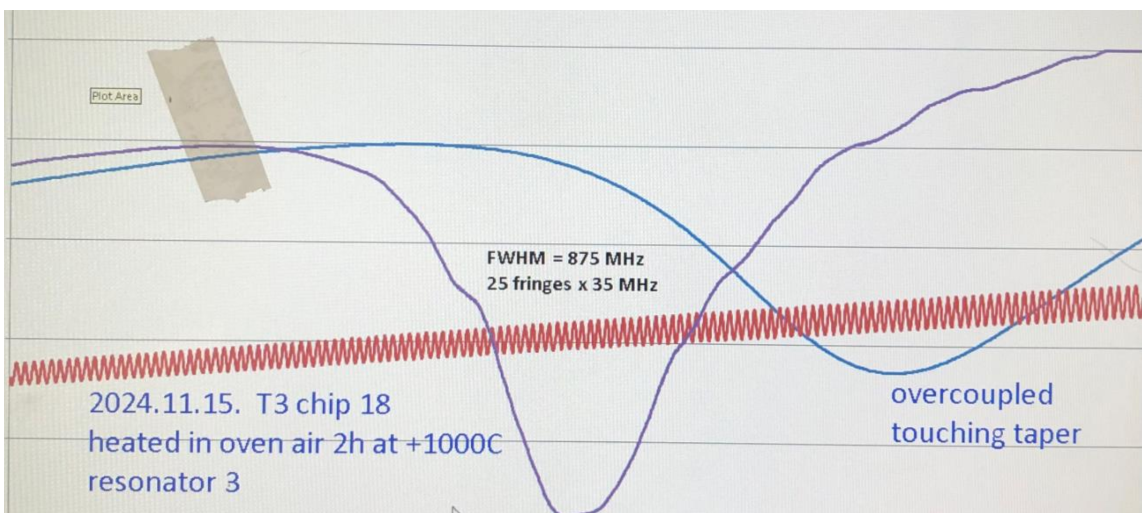


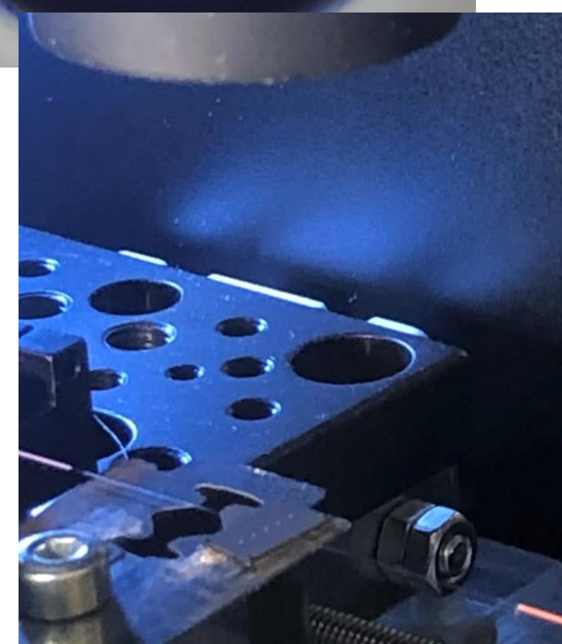
ALFA resonator. SiO_2 microtoroids on a Si pilar.

Box T3 ,
Chip 18 , Nr. 3.
2024.11.









Arvīds Sedulis
tiks izvirzīts par viespētnieku

- Aizstāvēja RTU maģistra darbu par optiskajiem mikrorezonatoriem.

- Iestājās doktorantūrā RTU no 2024.g. oktobra.
  Fotonikas, elektronikas un elektronisko sakaru institūtā (FEESI).

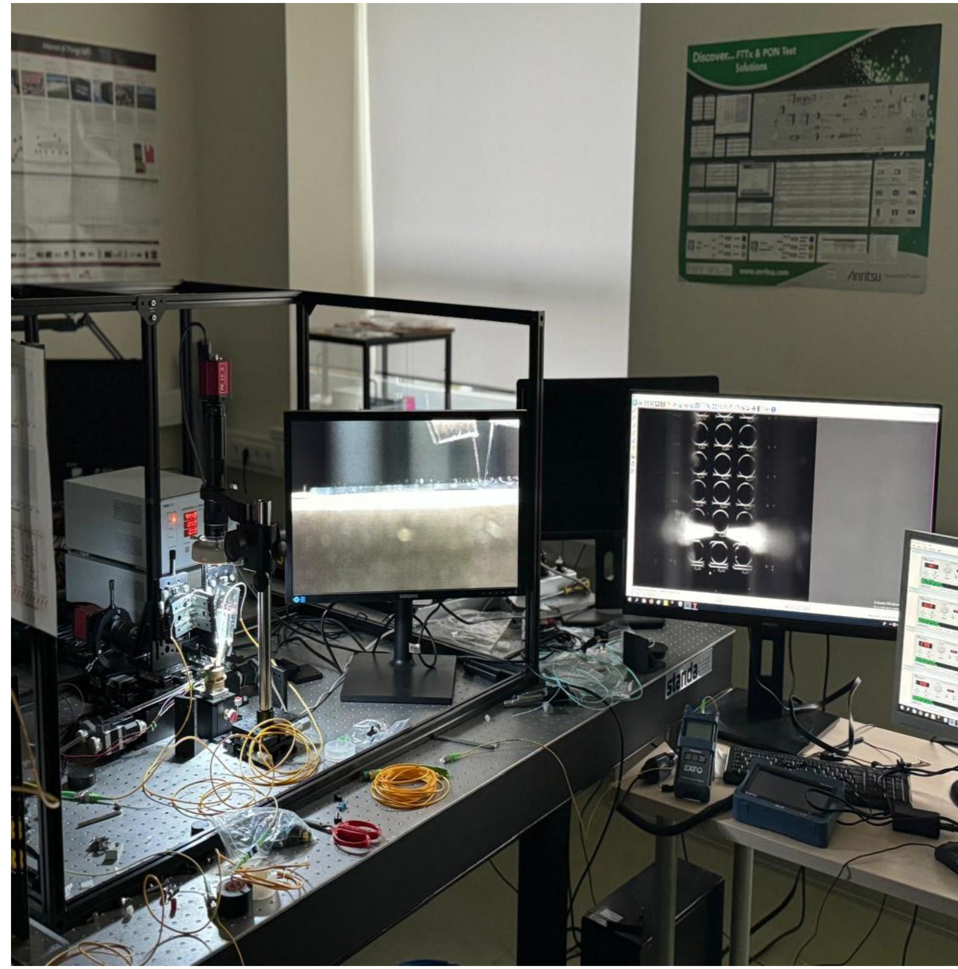
- Ievēlēts RTU pētnieka amatā.

- Šobrīd doktorantūrā klausās kursus:

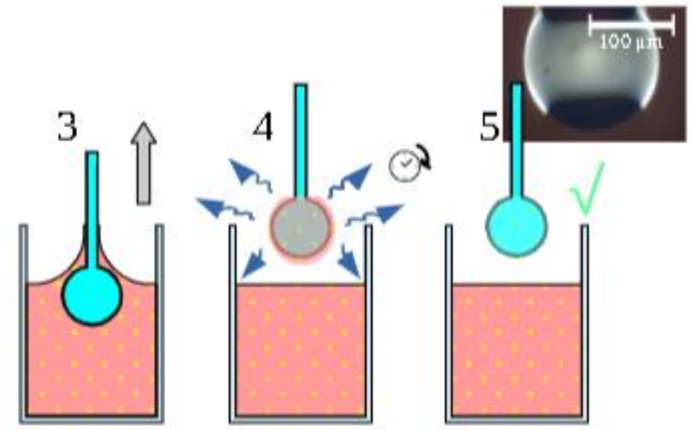
  Kvantu sakaru sistēmas,
  Mikroviļņu fotonikas ierīces un sistēmas.

Ta_2O_5 optiskie čipi ar mikroriņķu rezonatoriem testēšana RTU ar 1550 nm skenējama viļņa garuma lāzeri

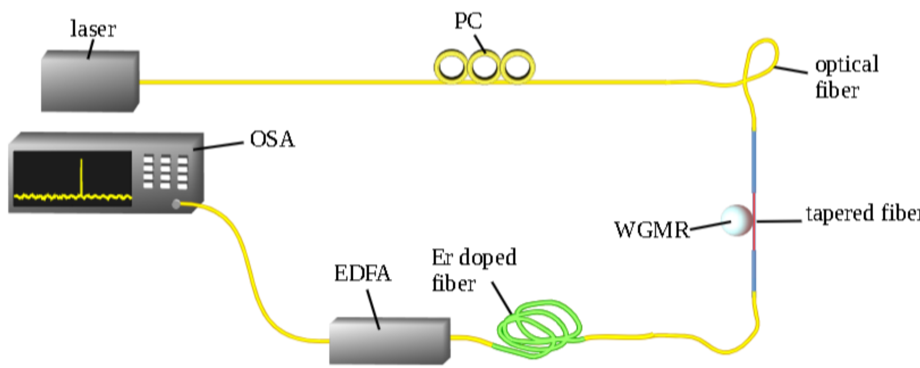
- A. Sedulis kopā ar K. Dragunu RTU telpās mērīja 3 dažādu iterāciju tantāla pentoksīda viļņvadu optiskos čipus.
- Izstrāde tika veikta Minsteres universitātes ietvaros ar K. Draguna dotajiem parametriem.
- Daļa no mērījumu rezultātiem tika izmantoti priekš A. Seduļa maģistra darba, labākie tiks savukārt pielietoti K. Draguna doktora darbam.
- Pēdējais variants strādāja ar minimāliem zudumiem, tomēr dizainu nepieciešams optimizēt, lai iegūtu frekvenču ķemmes.



Optoplazmoniskās erbija dopētas mikrosfēras lāzeri



- LU telpās, ar RTU iekārtu palīdzību tika mērīta ar aktīvo elementu erbiju dopētas mikrosfēras.

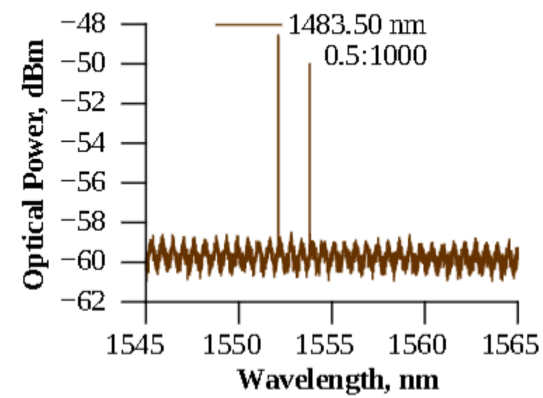


- Mikrosfēras gaisma tika ievadīta ar izstieptu optisko šķiedru. Signāla avots bija šaurjoslas pusvadītāja lāzers, kas strādāja pie aptuveni ~1480nm viļņa garuma. Signālu pastiprināja EDFA, un uztvēra OSA.

- Pētījuma ietvaros tika pētītas erbija sekundārā signāla emisijas līnijas 1545-1565nm viļņa garuma diapazona apkaimē.

- Rezultāti prezentēti konferencē Parīzē, un ir iesniegts konferences raksts.

Er doped microsphere lasing



Zinātnieku naktī demonstrēju Wilsona miglas kameru, kura vizualizē dabisko radiāciju

un Latvijas SIA SAF-Tehnika izstrādāto jauno radona atomu sensoru, kuru laipni uzdāvināja testēšanai

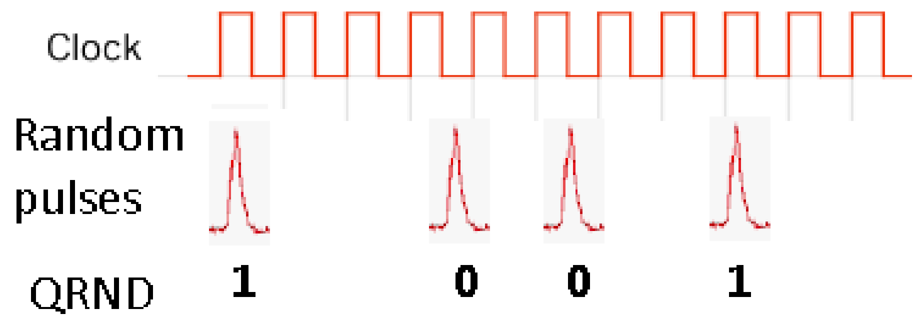
Amazon.com

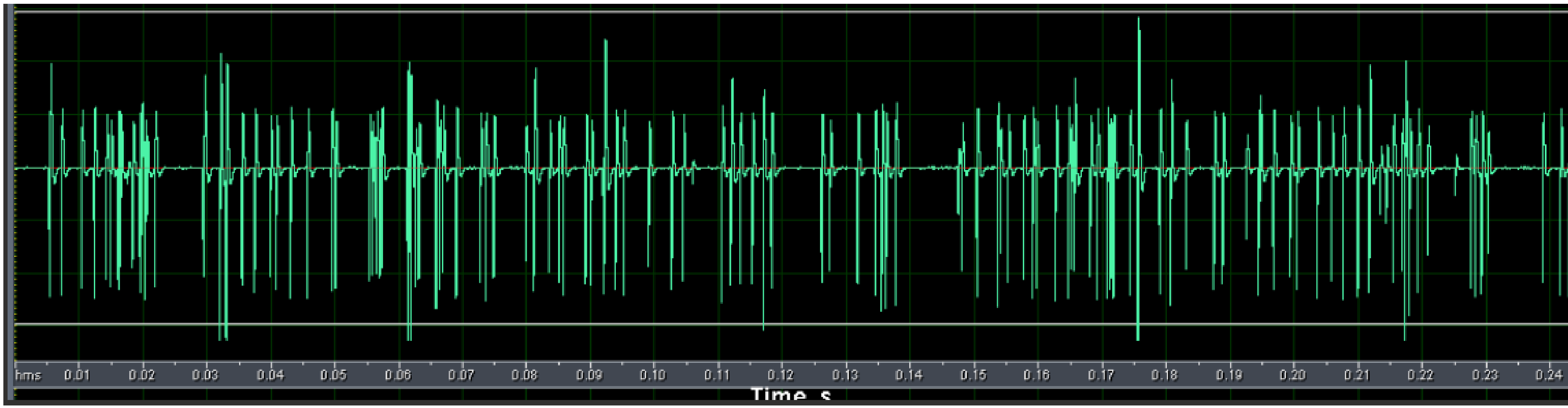
SAF Aranet Radon Detector

Quantum random number generation (QRND) using radioactive decay process Teaching demonstration

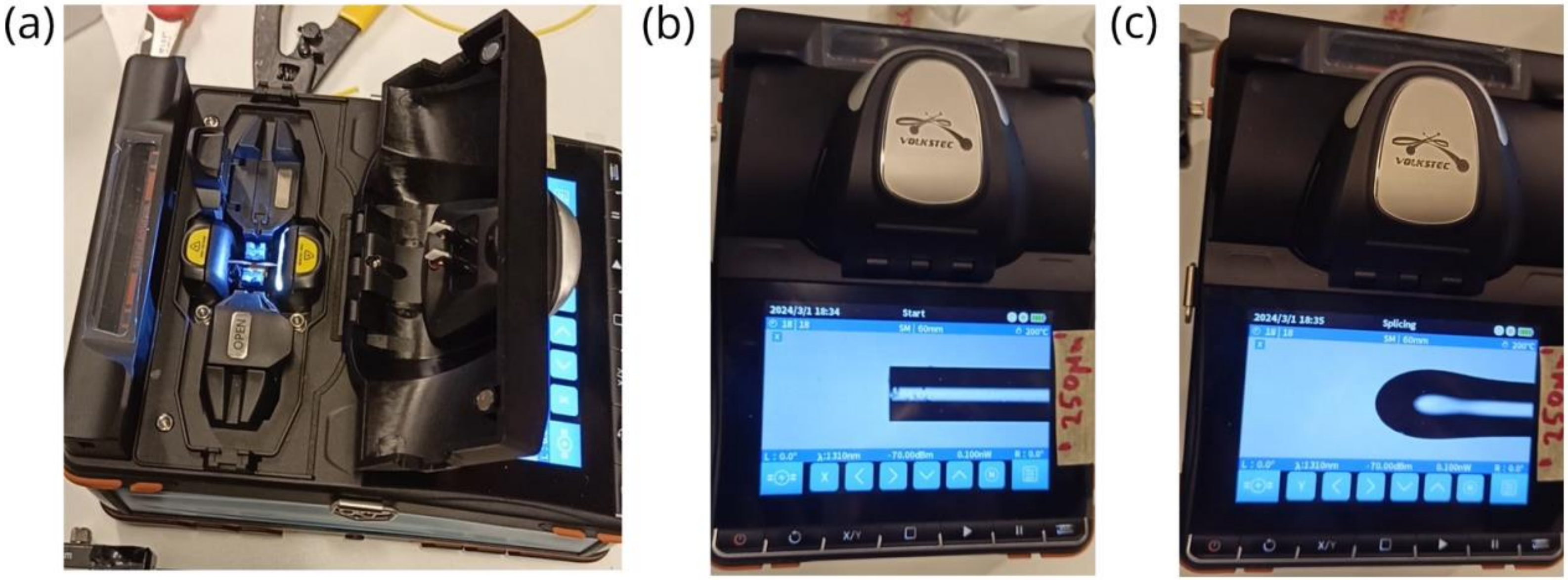
Latvian Quantum Initiative

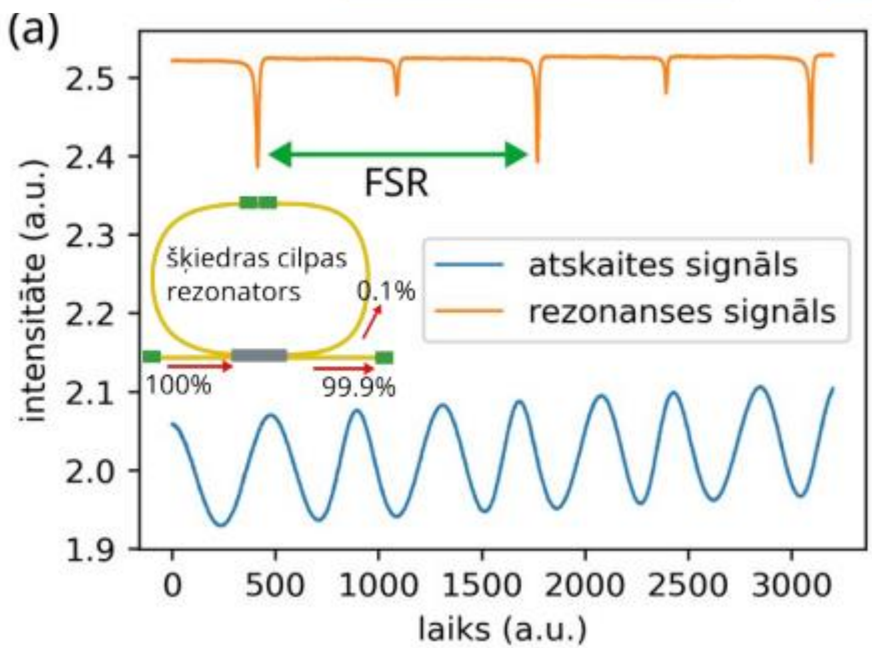
Latvijas Kvantu Iniciatīvas seminārs, Jelgavas iela 3 2024.04.04.





Akadēmiskā prakse novadīta M.Čakšam





LZP projekts negatīvo jonu lāzeru spektroskopija

Vadītājs U. Bērziņš

Pārņēma Prof. R. Ganeeva laboratoriju, LU AI Jelgavas 3, 715

pikosekunžu lāzers, ablācija, plazmas spektroskopija

Šķūņu iela 4, A. Ūbelis

Gadolīnija spektroskopija dobā katoda lampā

Sadarbība ar Prof. Dag Hanstorp Gēteborgā un eksperimenti jonu slazdā Stokholmā

D. Hanstorp LU goda doktors 2024.

Acetylene molecule spectroscopy for laser wavelength calibration

University of Latvia (LU) Team:

- Uldis Berzins - project leader
- Janis Alnis - Asoc. Prof., lead researcher
- Arturs Cinins - researcher
- Arturs Bilzens - BSc student
- Matiss Cakšs - BSc student
- Aleksandrs Kapralovs - glassblover

Riga Technical University (RTU) team:

Toms Salgals - Asoc. Prof., lead researcher

Arvids Sedulis - PhD student

Vjačeslavs Bobrovs – Professor, head of RTU lab.

Acetilēna molekulu spektrs lāzera viļņa garuma kalibrēšanai, DOC konference, A. Bilzēns.

Molecular Gas References for Laser Wavelength Calibration

Alberts Bilzens, Janis Alnis, Arvīds Sedulis, Uldis Berzins

University of Latvia, Institute of Atomic Physics and Spectroscopy

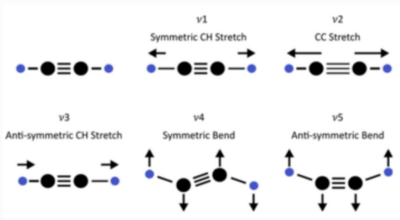
ABSTRACT

Our presentation investigates the utilization of acetylene (C2H2) and hydrogen cyanide (HCN) gases as molecular references for precise laser wavelength calibration within the 1530-1560 nm range. Leveraging distinct absorption features of these gases, we establish robust calibration standards. In addition to discussing experimental setups and calibration procedures, we explore simpler measurement techniques and ways for obtaining samples for acquiring these molecular references, including alternative approaches to measuring absorption spectra. The potential applications in telecommunications, spectroscopy, and metrology show their significance in advancing optical technology.

The saturated absorption spectroscopy method is also used, as it allows for studying the given molecular gas system with much higher resolution and accuracy than regular spectroscopy methods which use just single laser signal. [1,2]

These molecular references will be used in an upcoming project of measuring Sn negative ion energies and lifetimes of different states. The calibrated laser of 1535 nm wavelength will be used for exciting the negative ions so that their energies could be determined to a higher precision, and afterwards the lifetimes of the excited states could be measured. This experiment will provide results with a higher precision for gaining more information about the Sn- ion. [3,4]

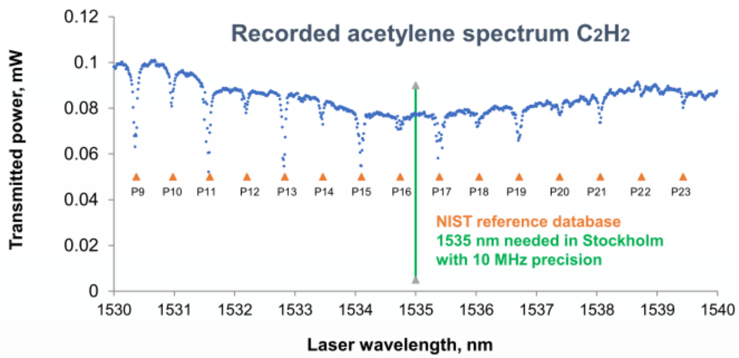
THEORY



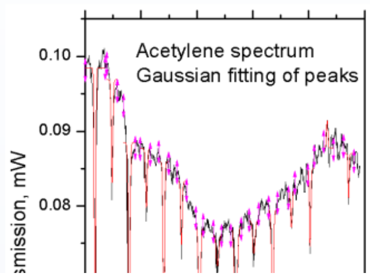
R-branch	Q	P
$J_e = J_g + 1$	$\Delta J = 0$	$\Delta J = -1$

$$v_1 + v_3 \text{ for } 1533nm$$

MEASUREMENTS



RESULTS



transition	NIST, [nm]	fitted, [nm]	Δ, [nm]	Δ, [GHz]
P9	1530.3711	1530.35	-0.0211	-2.701
P10	1530.97627	1530.963	-0.01327	-1.697
P11	1531.5879	1531.57	-0.0179	-2.288
P12	1532.206	1532.191	-0.015	-1.915
P13	1532.83045	1532.8159	-0.01455	-1.857
P14	1533.46136	1533.448	-0.01336	-1.703
P15	1534.0987	1534.094	-0.0047	-0.599
P16	1534.7425	1534.737	-0.0055	-0.700

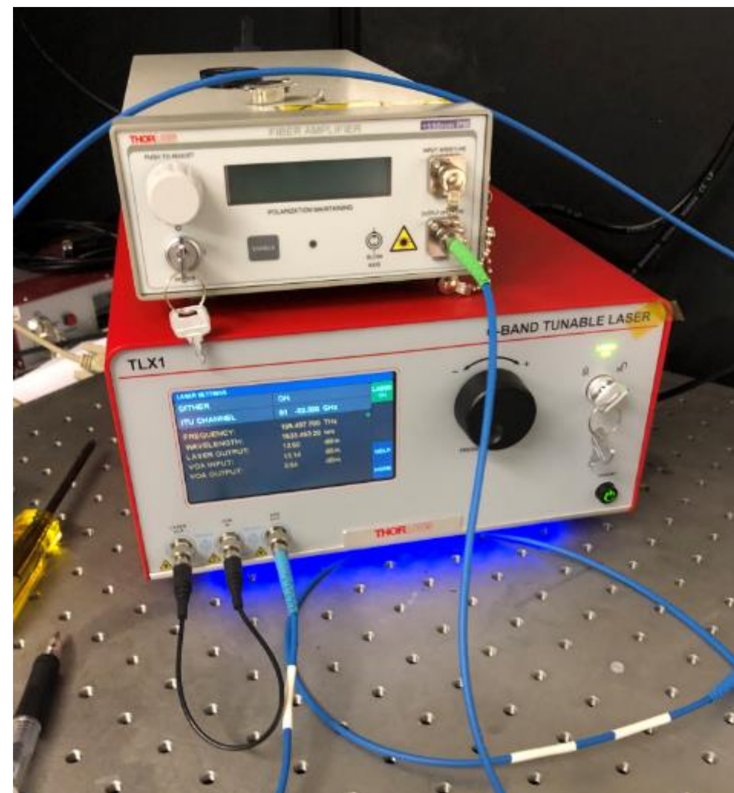
Gothenburg Sept 2-6 2004.

Thorlabs 5 cm long C_2H_2 cell
50 torr (66 mbar).

J. Alnis, A. Bilzens

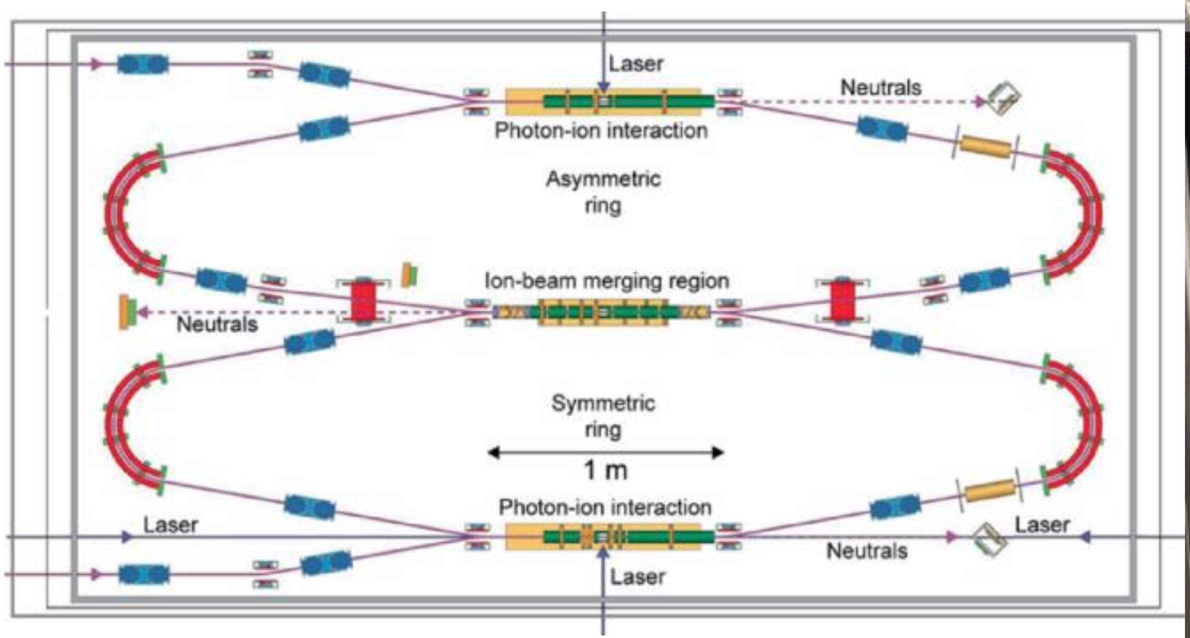
GCA50 - Acetylene Gas Reference Cell with Angled Ø1" UVFS Wedged Windows, 50.0 mm Long

Package Weight:	0.56 kg / EACH
Available:	Today
RoHS:	N/A
Price:	€ 438,09
Add To Cart:	Qty : 1
	Add To Cart
Release Date:	25-jul-2022



DESIREE: The Double ElectroStatic Ion Ring ExpEriment
Stockholm University Physics 2024.10.

U. Berzins, J. Alnis, A. Cinins, J. Sniķeris



2024.10. Tin negative ion affinity mesurement at DESIREE

- The goal of this experiment is:
    - Measure the isotope shift using the $Sn^-(^4S_{3/2}) \rightarrow Sn^-(^2D_{5/2})$ transition across the entire stable region (112-124)
    - Determine the $Sn^-(^4S_{3/2}) \rightarrow Sn^-(^2D_{5/2})$ transition to higher precision (currently is 6512.37(10) 1/cm Scheer *et al.* 1998)
- The experimental scheme can be seen in Fig. 1
    - First, both ^2D states will be depleted with the 1kHz OPO at 1200 nm in crossbeam geometry
    - Next, the 1535 nm diode will be used in a two-photon scheme to selectively re-excite to the $^2D_{5/2}$ state and to detach into a neutral state that will be detected
    - Sn-120 will be used as the reference isotope due to abundance

- Beam requirements:
    - 30 keV ion beam from SnO_2
- Technical requirements:
    - Connection of wavemeter
- Laser requirements:
    - 1 kHz OPO in crossbeam
    - 1535 nm diode in colinear

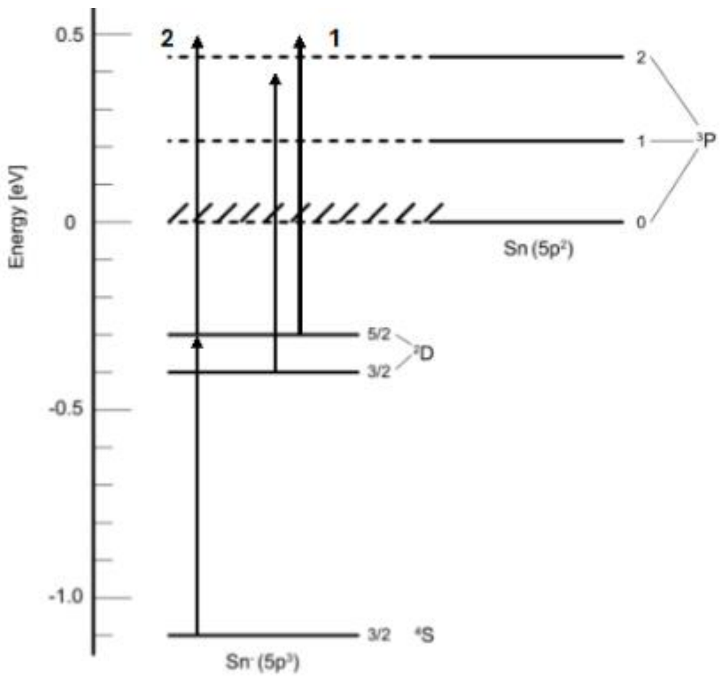
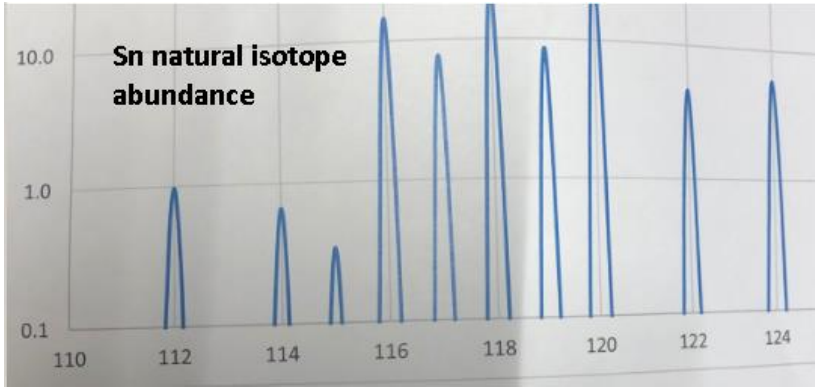
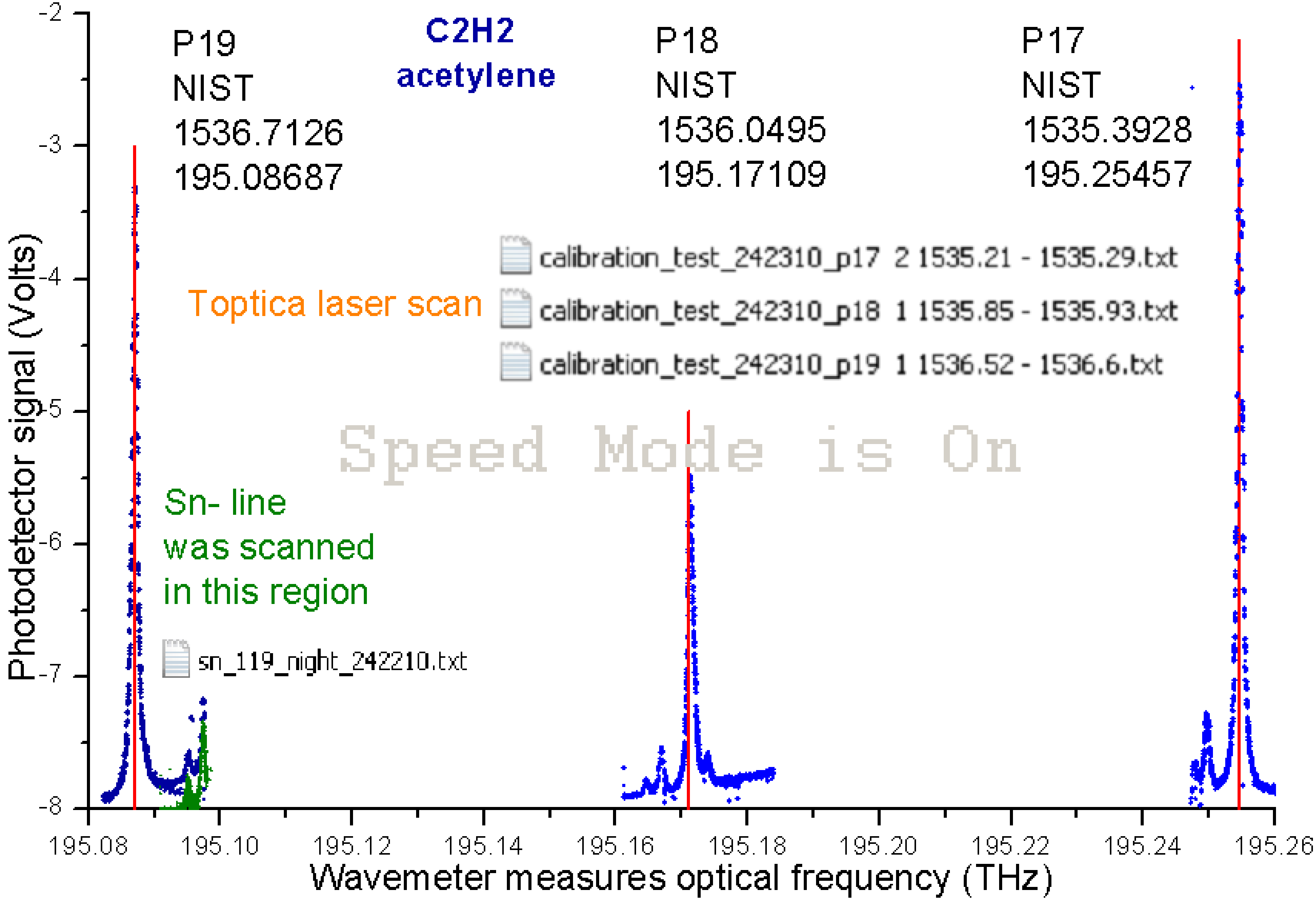


Fig. 1- Experimental scheme where 1 is the 1 kHz OPO set to a wavelength that will detach both states ie 1200 nm and 2 is the 1535 nm diode used for the two-photon detachment.



Electron affinity is the change in energy of a neutral atom when an electron is added to the atom to form a negative ion.

Sn^- signals are near the P19 line of acetylene



Radioaktīvo izotopu lāzerspektroskopija CERN ar Prof. D. Hanstorpu, iespēja braukt piedalīties

CERN

Users
Cooperation Associates
Visiting Scientists

HOME INSTITUTION DECLARATION (HID)

FAP-DHO-GT - Version: 24.10.2022 - 5

To be completed by an authorised representative of the candidate's home institution[1] for the purpose of issuing the candidate with a contract of association with CERN.

Full name of the candidate: JANIS ALNIS (Asoc. Prof., Dr.)

Name and address of the home institution: INSTITUTE OF ATOMIC PHYSICS AND SPECTROSCOPY, UNIVERSITY OF LATVIA, JELGAVAS IELA 3, LV-1004, RIGA, LATVIA

Expected overall period of association with CERN *(Day/ Month/ Year)*: from 18-Mar-2024 to 17-Mar-2027

I certify that, for the entire duration of the contract of association with CERN, the candidate will be:

☑ employed by INSTITUTE OF ATOMIC PHYSICS AND SPECTROSCOPY, UNIVERSITY OF LATVIA

Pasaules retākā elementa spektroskopija CERN saražo astatu At no urāna šķembām

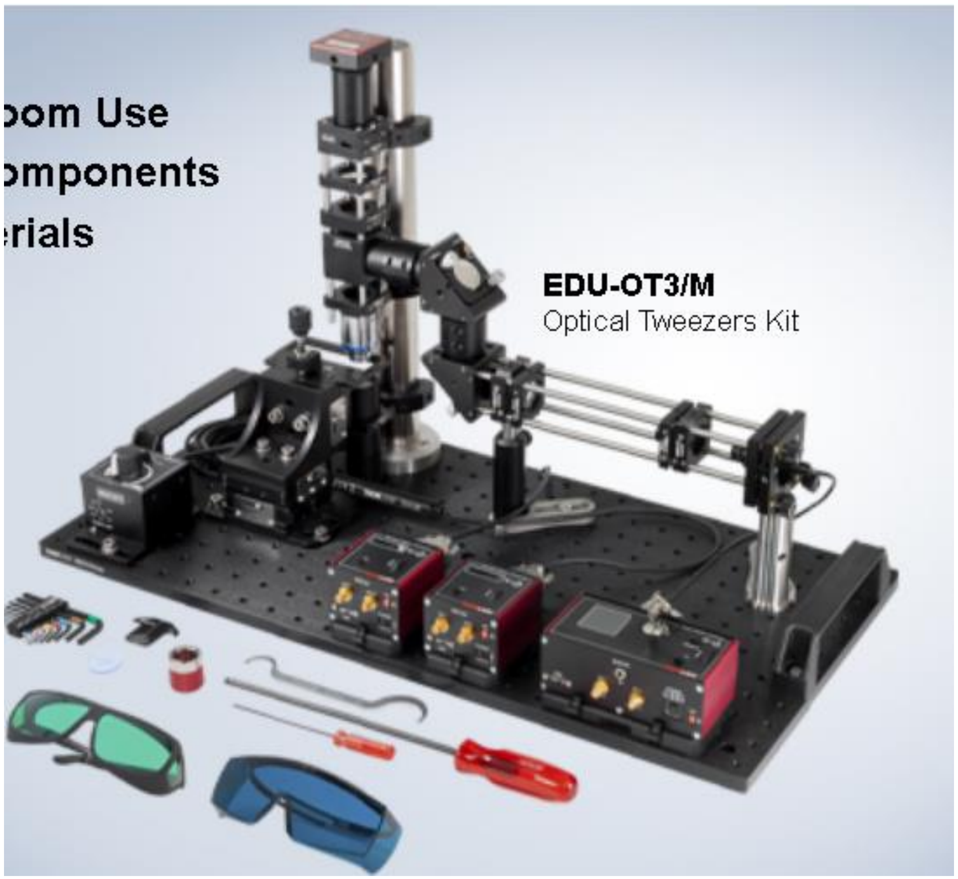
> Nat Commun. 2020 Jul 30;11(1):3824. doi: 10.1038/s41467-020-17599-2.

The electron affinity of astatine

Noklausījos radiācijas drošības kursu pie Guntas Ķizānes, Jelgavas ielā 1

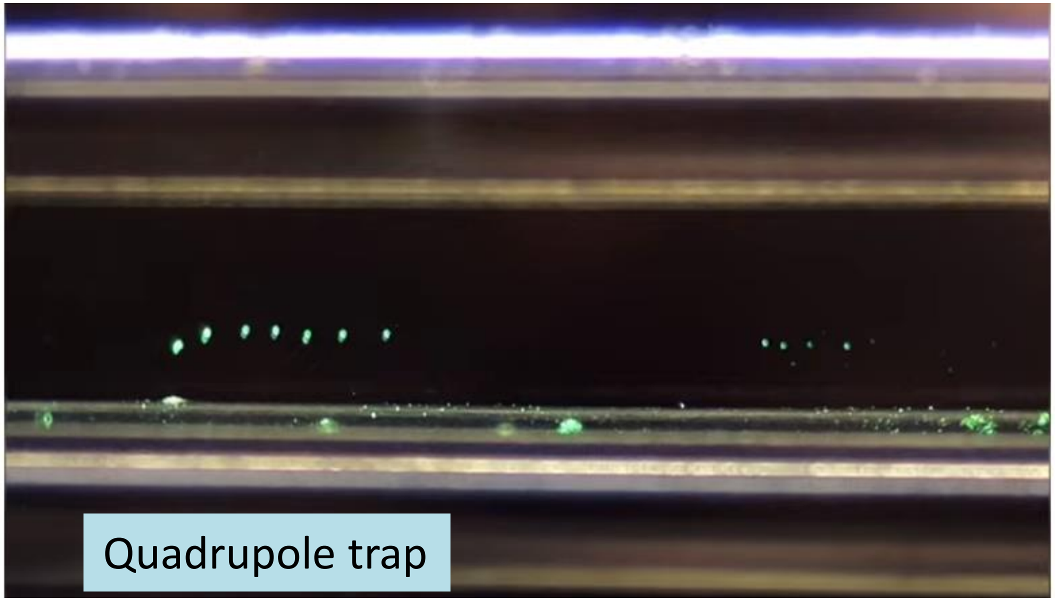
Palaidām *Thorlabs* optiskās pincetes mācību komplektu.

Izveidoju vienkāršotu optisko pinceti, kas ļauj saķert lāzera fokusā dimanta mikroputekļus un glicerīna pilienus gaisā, un mikrosfēras ūdenī.



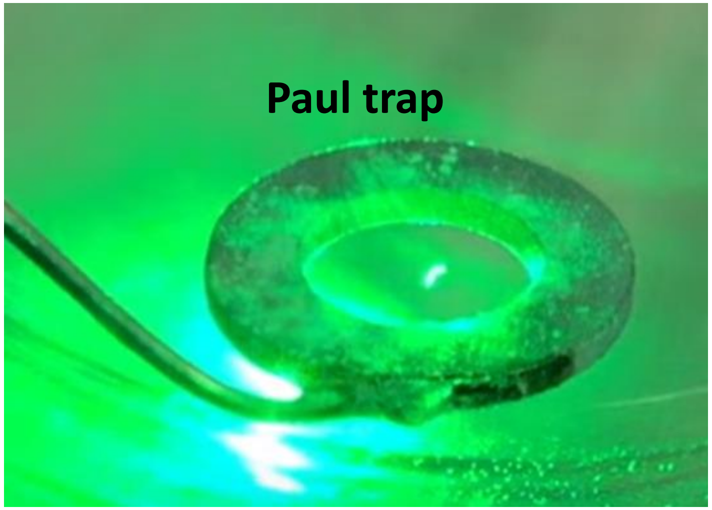
DIY optical tweezers for glycerol or oil droplets in air with red and blue lasers.

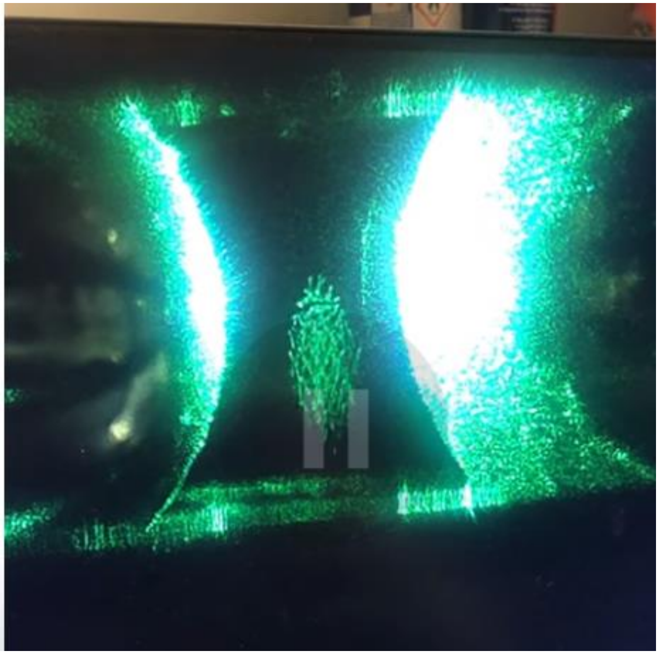
Izgatavoju lādētu mikrodaļiņu (jonu) slazdus



Veidojas jonu kristāli
Demo jonu slazdam - kvantu datoram
15 mkm plastmasas PMMA lodītes

ČGM mikropilieni
Mikropilienu krāsvielu vai Erbija lāzers
Dimanta putekļi NV centri





Mathieu vienādojumi jonu slazdiem

ir tie paši, kas lādētu putekļu slazdam

atoma joniem slazdošanas frekvence ap 10 MHz

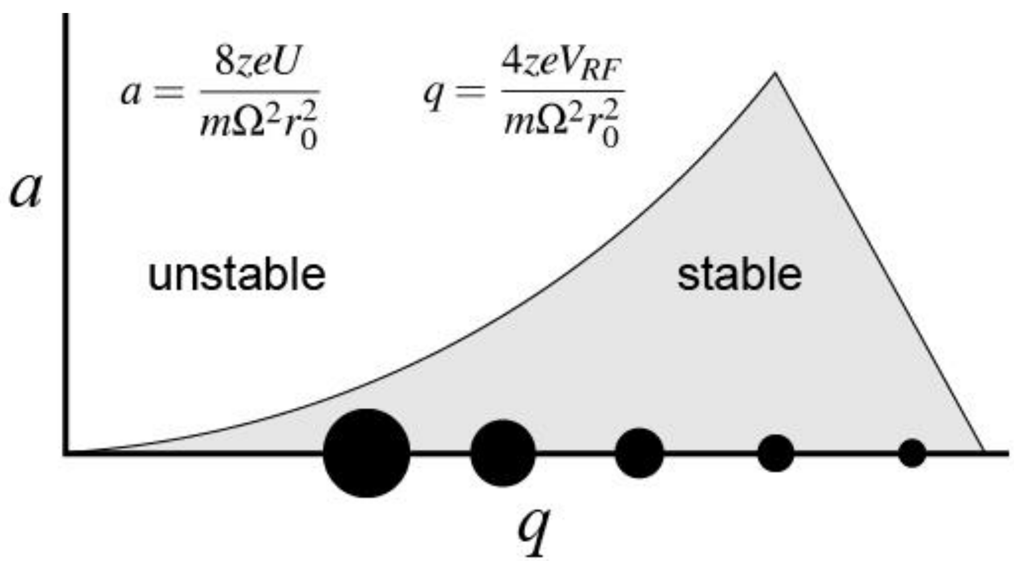
lādētām mikrodaļiņām slazdošanas frekvence ap 100 Hz

$$F = ma = mx'' = qE, \text{ (Newton's 2nd \& Lorentz force laws)}$$

$$E = -\nabla\phi,$$

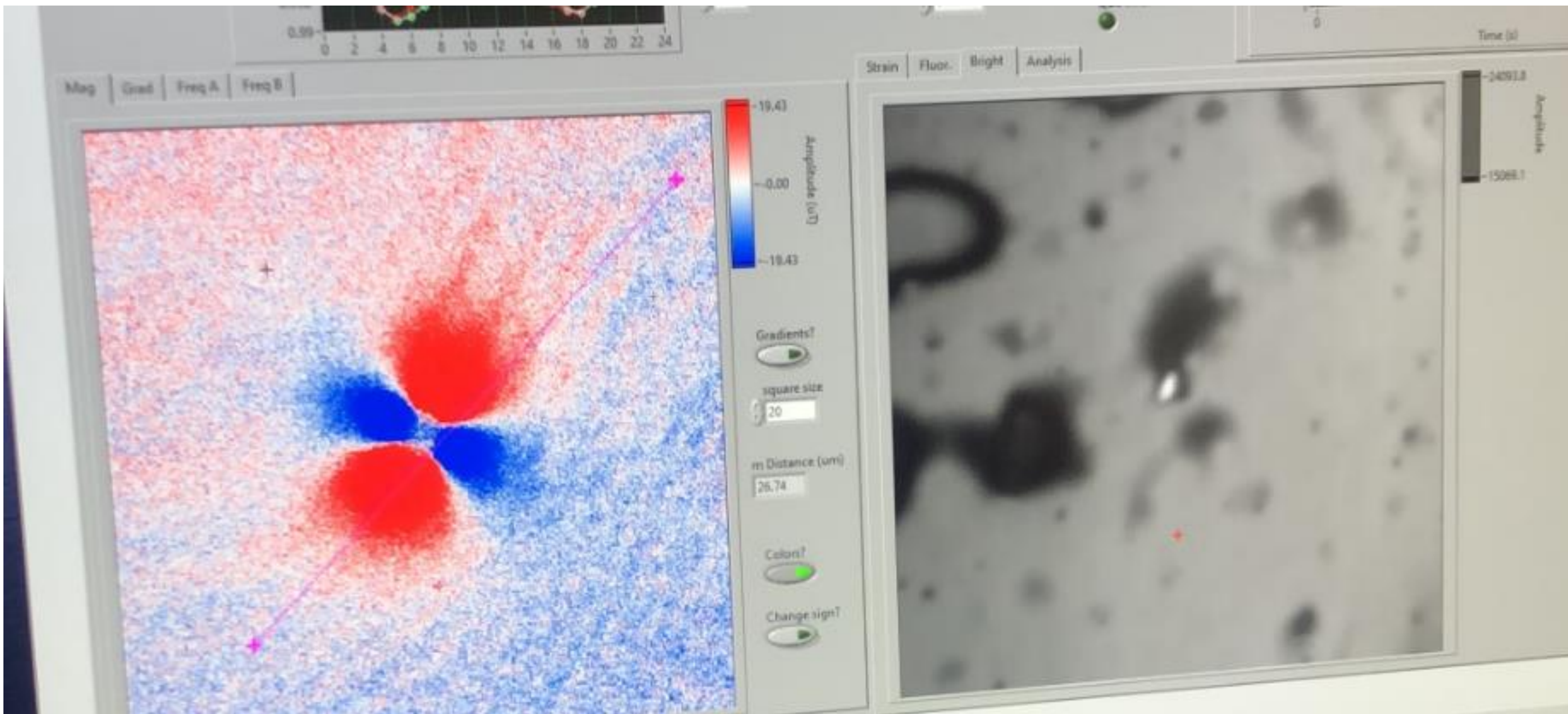
$$\phi = \frac{\phi_0}{r_0^2}(r^2 - 2z^2), \text{ (ideal quadrupole field)}$$

$$\phi_0 = U + V cos(\Omega t) \text{ (RF electrode voltages)}$$



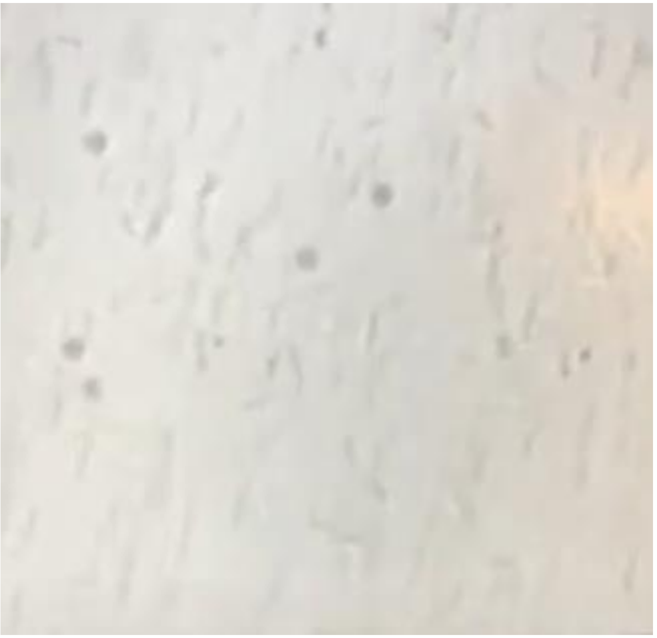
Sadarbība ar LU Lāzercentra Prof. M. Auziņa dimantu magnetometru laboratoriju Dr. I. Fescenko (kvantu iniciatīva) un Prof. P. Ginzburg Telavivā

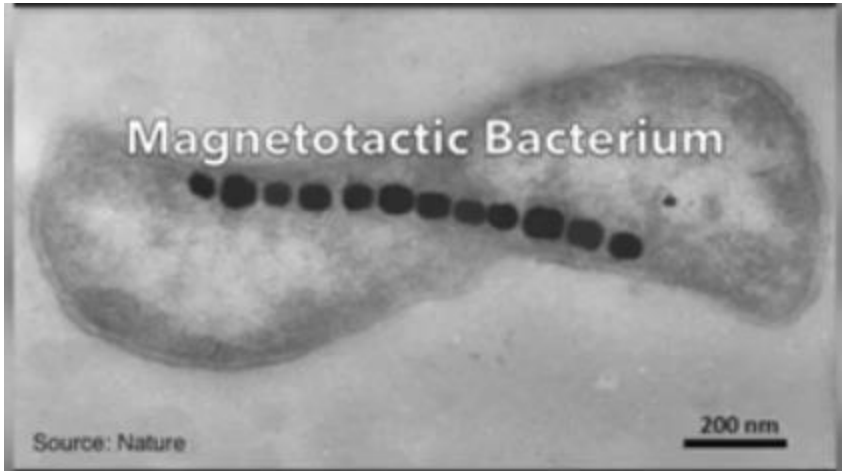
- **Ar NV centru magnetometru vizualizēts 10 nm mazuvmagnētisku nanodaļiņu magētiskais lauks kuras atrodas apmēram 1 mikrometru diametra vaterīta $CaCO_3$ piciņu porās.**
  Vaterīts ar nanodaļiņām no Prof. P. Ginzburga grupas Telavivā.



Magnētiskās baktērijas no G. Kittenberga

- Satur magnētiskas daļiņas
- Orientējas ārējā lauka virzienā kā kompasa adata
- Peld uz priekšu un atpakaļ gar lauka līnijām, vicinot astīti
- Apskatīt baktēriju magnētisko lauku ar NV centru mikroskopu. I. Fescenko, M., Jani, Latvijas Kvantu iniciatīvas projekts.





Sadarbība ar LU mediķiem – ģenētiķiem izgatavoju jutīgus svarus tremora (ekstremitāšu drebēšanas) ierakstīšanai no pelītēm datorā Konferences raksts, publikācija top.

MYBPC1-associated myopathy with myogenic tremor, a study of an animal model

Stavusis Janis[1], Zdanovica Anna[1], Lunge Megija[1], Zayakin Pawel[1], Upite Jolanta[2], Dzirkale Zane[2], Alnis Janis[3], Lace Baiba[2,4], Jansone Baiba[2], **Inashkina Inna**[1]

[1]*Latvian Biomedical Research and Study Centre, Riga, Latvia*
[2]*Department of Pharmacology, Faculty of Medicine, University of Latvia, Riga, Latvia*
[3]*Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia*
[4]*Riga East Clinical University Hospital, Riga, Latvia*

Background. Congenital myopathy with tremor, currently classified as congenital myopathy-16, represents a highly rare disease phenotype associated with domain-specific variants in the *MYBPC1* gene. This gene encodes myosin binding protein-C slow (sMyBP-C), a cytoskeletal protein expressed in skeletal muscle tissues with at least 10 different isoforms. This protein plays a crucial role in stabilizing the thick filament and regulating actin-myosin binding during cross-bridge formation. Previous research has indicated that observed sarcomeric deficits may underlie the molecular mechanisms causing the disease.

Aim. In our study, we generated a mouse model harbouring a patient-specific variant (c.739T>C, p.(Y247H)). Here, we present a comprehensive description of the observed phenotype using a plethora of quantitative and qualitative methods.

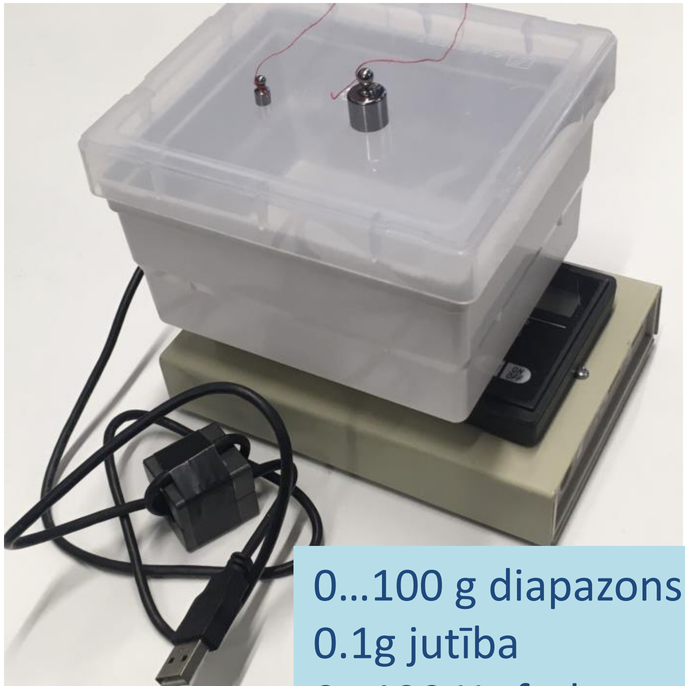
Methods. Included behavioural tests, immunofluorescent microscopy, protein quantification, biochemical assays including spectrophotometric measurements of OXPHOS enzyme activities, transcriptome analysis by RNA-seq, and proteomics.

Results. Our findings reveal strength deficits, myogenic tremor, and homozygous lethality in the model, as well as the localization of the mutant protein, similar to a previous model, carrying another patient-specific variant in the *MYBPC1* gene. While we observed expected sarcomere disorder and misalignment, they were not as pronounced. Transcriptome data and biochemical assays unveil not only morphological abnormalities in mitochondria but also functional deficits in the oxidative phosphorylation system.

Conclusions. This research reinforces the myogenic tremor phenotype observed in patients and the initial animal model, highlighting the correlation between phenotypic severity and changes in the binding potential of the mutant protein, as suggested in our previous work. Additionally, we demonstrate that this disease involves an aspect of mitochondrial dysregulation.

Acknowledgements. ERAF Nr. 1.1.1.1/18/A/097.

Peļu tremora mērījumi ar izgatavotajiem vibrācijas svariem



0…100 g diapazons
0.1g jutība
0…120 Hz frekvence

2023.04. Mouse vibration tremor sensing with home-built tensometric transducer force sensor scale.

Mērījumi Jelgavas ielā 1
20 peles, ar un bez ģenētiskā defekta,
5 nedēļas zāļu kurss

Intervija Latvijas radio

Zināmais nezināmajā

Atompulksteņi - zinātnieki radījuši pasaulē precīzākos laikrāžus

Paula Gulbinska, Sandra Kropa, Zane Lāce-Baltalksne | 25. septembris 2024, 10:05

Mēs dzīvojam laikmetā, kad precīzam laikam un katrai sekunei mēdz būt ļoti liela nozīme, sākot no navigācijas automašīnā, līdz pat kosmosa kuģu startiem. Un precīza laika atskaite nav iedomājama bez precīziem pulksteņiem. Atompulksteņi - pasaulē precīzākie laikrāži. Kādam mērķim tie radīti? Kā tie darbojas un kāpēc dažkārt viena sekunde nemaz nav viena sekunde? Kāda atomam saistība ar laiku un kur jau šodien izmantojam atompulksteņus? Raidījumā *Zināmais nezināmajā* skaidro Latvijas Universitātes Eksakto zinātņu un tehnoloģiju fakultātes Atomfizikas un spektroskopijas institūta asociētais profesors **Jānis Alnis** un LU Astronomijas institūta direktors **Kalvis Salmiņš.**

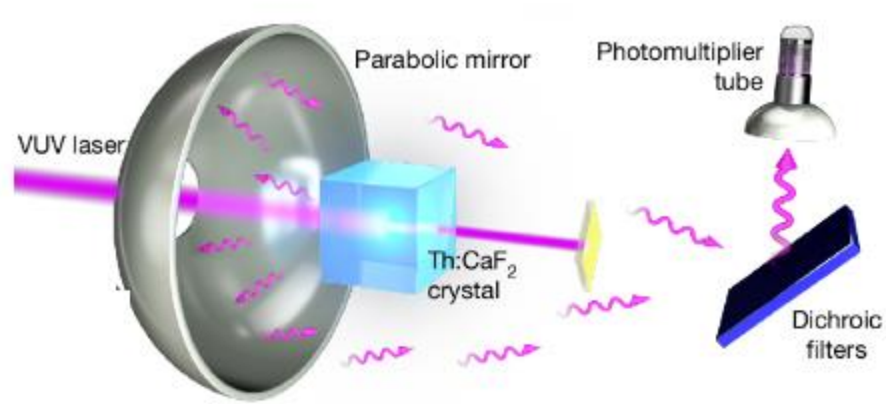
Optiskais kodolpulkstenis jaunums

- Mesbauera efekts – ļoti šauras līnijas, bet enerģijas Rentgenstaru diapazonā.

- Torijā 229 atrada sen paredzētu optisko pāreju. Vāja, metastabila, aizliegta- dzīvo ap 1000 s, ļoti šaura pec frekvences.

- Vajag 140 nm VUV lāzeri.
- Th-229 atomi CaF_2 kristālos. Nav Dopler aun photon recoil shift.

- Var testēt vai kodolspēki dreifē laikā.



At 11:30 one night in May 2024, a graduate student, Chuankun Zhang, saw a signal that physicists have sought for 50 years. As a peak rose from the static on his monitor at the research institute JILA in Boulder, Colorado, Zhang dropped a screenshot in a group chat with his three lab mates. One by one they hopped out of bed and trickled in. After several sanity checks to make sure that what they were looking at was real — a signal from a thorium-229 nucleus switching between two states, known as the "nuclear clock" transition — the young researchers took a selfie to commemorate the moment. Time stamp: 3:42 a.m.

Zinātnes Vēstnesis

Latvijas Zinātņu akadēmijas, Latvijas Zinātnes padomes un Latvijas Zinātnieku savienības laikraksts

4 (642) ISSN 1407-6748 2024. gada 29. aprīlis

Krītam vai nekrītam melnajā caurumā?

Ierodoties LU Zinātņu mājā, sastopu Jāni Alni, vienu no jaunajiem LU Atomfizikas un spektroskopijas institūta laboratorijas vadītājiem. Ārā spelgs sals, salejam krūzītē siltu tēju, un prasu – vai gadījumā neesi jaunākais LZA biedrs?

Galīgi nē! Par mani jaunāks ir gan Kaščejevs, gan vesela rinda citu jauno fiziķu. Tas bija liels un patīkams pārsteigums, kad mani negaidīti aicināja kļūt par LZA biedru. Jūtos pagodināts, kad man lūdz parakstīt ieteikuma vēstuli kāda raksta publicēšanai "Zinātnes Vēstnesī". Tādējādi laiku pa laikam varu "celt asti" zinātnieku kopai, jo kas gan to cits cels, ja ne paši.

Ja te būtu kāds jaunāks cilvēks vēl no skolas sola, kādu padomu tam dotu? Diez vai piedzimi ar domu – izaugšu un kļūšu par zinātnieku. Kā liktenis tevi izvēlējās? Kas jādara tādam jaunam cilvēkam, ja tam šķistu vilinoša zinātnieka karjera?

Man viss notika pats no sevis. Skolā patika fizika, skolotājs bija stingrs, taču ļoti labs. Viņš skolotāja darbam atdeva sevi visu, bez atlikuma. Tad pienāca bezgala melna diena, kad viņš atdeva visdārgāko – sirds neizturēja stundas laikā.

Turpinājums – 4. lpp.

Foto: privātais arhīvs.

Ekonomikas ministrs V. Valainis apmeklēja Latvijas Universitāti 2025. g. 24. janvārī.

Kvantu optikas laboratorijā rādījām optiskos čipus.