

# ***Rena Jumshud Kasumova***



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## ***QISA BİOĞRAFİK MƏLUMAT***

Kasumova R.J. was born in Baku, Azerbaijan, Dec. 11, 1952. Her family was Azerbaijanian.

At the 1960 she entered to the school, after finishing the school in 1970 she joined to the Physical Department of Baku State University. In 1972 after passing course Kasumova was transferred to the Special Physics Department at the Moscow Physical Engineering Institute. In 1976 after graduating Moscow Physical Engineering Institute with honours automatically were taken in post-graduate course at the department of the Nobel Prize laureate, academician N. Q. Basov. In 1979 graduated it. After defending Ph.D. thesis she started to work at the Physical Department of Baku State University to present day at the professor position and head of the department of “Optics and Molecular Physics”.

Scientific interests - the development of quantum electronics and laser physics, nonlinear optics. According to the results of scientific research in this direction at the Department "Optics and Molecular Physics", the most important results were included in the "Report of the Presidium of the NAS of Azerbaijan for 2015 and 2017" (Executive: Prof. Kasumova R.J.)

At present, in the course of this career, Kasumova wrote six books, was awarded two patents and published over 165 scientific works. She is an expert on both nonlinear optics - nonlinear interaction of the optical waves in the nonlinear medium and quantum electronics - laser physics.

## ***TƏHSİLİ VƏ ELMİ DƏRƏCƏ VƏ ELMİ ADLARI***

Graduated from the Moscow Physical Engineering Institute --- 1976.  
Defended Ph. D. in Moscow Physical Engineering Institute - 1982.  
The thesis of Ph.D.: Investigation of the He-Ne laser at 0,63 microns with internal phase anisotropy.  
Defended Doctor of Sciences in Baku State University - 2003.  
The thesis of D. of Sc.: Nonlinear interaction of optical waves with account phase changes in medium.

## ***ƏMƏK FƏALİYYƏTİ***

Since 2018                      member of the Specialized Council for Azerbaijan defending dissertations under the Higher Attestation Commission at the Military Academy

2015-at present	head of the department of “Optics and Molecular Physics”,	
2014-2015	head of the “SABAH” center at the BSU,	
2012-2015	deputy Dean of the Faculty of Physics for Science and Magistracy,	
2009-2010 and 2013-2016	member of the Expert Council under the Higher Attestation Commission,	
2005-at present	Scientist Secretary of Physics Department Academic Council.	
Baku State University	2004	professor
Baku State University	3 May 2003	defended Doctor of Sciences
Baku State University	1994	associate Professor
Moscow Physical Engineering Institute	1982	Physical Doctor
Moscow Physical Engineering Institute	1976-1979	post-graduate student
Moscow Physical Engineering Institute	1972-1976	student
Baku State University	1970-1972	student

At the Baku State University, the bachelor's degree is taught by “General Physics” courses at the Physics Department and other faculties of the natural sciences of the University, as well as the following special courses: "Laser Physics", "Fundamentals of Quantum Electronics". In the magistracy in the specialty "Quantum Electronics" she gives lectures, conducts seminars and laboratory works. Manages the graduate work of bachelors and master's theses. Under her leadership, more than 15 master's dissertations were defended.

She graduated 3 candidates of science, 2 doctoral students are preparing to defend the thesis. According to the state program for the preparation of doctors of philosophy, 1 doctoral student and 1 dissertant and one candidate for the state program for the preparation of a doctor of sciences perform a scientific work.

### *Aparulan tədqiqatlardan alınmış nəticələrin praktiki əhəmiyyəti*

LASER FREQUENCY CONVERTERS FOR INVESTIGATION OF ENVIRONMENT AND NEW MATERIALS (see attach).:

- determination of nonlinear susceptibilities of new materials;
- development of high – sensitivity dispersion laser interferometer;
- efficient nonlinear frequency conversion using layered structures.
- a new efficient optical converter based on a crystal, which has a Kerr nonlinearity, is proposed. In a similar layered structure, due to modulation in the refractive index space, it is possible to control the propagation of a probe coherent field.

Achievements include invention of \instrument Measuring Frequency Characteristic. She was awarded two medals (silver and bronze) of SSSR Exhibition (VDNX).

**SCIENTIFIC COLLABORATION:** Arizona University, Texas A&M University, Institute of Physics of Azerbaijan National Academy of Sciences, of Russian Academy of Sciences, of Ukraine Academy of Sciences, Siberia and Samara Dept. of Russian Academy of Sciences, Moscow State University, MPTI, MEPI, Irkutsk State University.

### *BEYNƏLXALQ SEMİNAR, SİMPOZİUM VƏ KONFRANSLARDA İŞTİRAKI*

1. S.A. Gonçukov, R.C.Qasımova, E.D.Protsenko. **III Ümumiittifaq konf. “Fotometriya i ee metroloğičeskoe obespeçenie”**. **Materiallar toplusu**, M., 1979, səh. 290.
2. V.A. Vaskov, S.A. Gonçukov, R.C.Qasımova. **Ümumittifaq konf. “Primenenie lazerov v nauke i texnike”**, **Materiallar toplusu**, L., 1980., səh. 73-74.

3. F.N. Hacıyev, R.C.Qasımova, F.A.Rustamov. **Koherent və qeyri-xətti optika üzrə XIV Ümumittifaq konf. (K i NO' 91), Materiallar toplusu**, 1991, səh. 165.
4. R.C. Qasımova. **Asiya-Pasifik Beynəlxalq konf. "Opto- və Mikroelektronikanın Fundamental Problemləri"**, **Materiallar toplusu**, Vladivostok, Rusiya, 2001, səh. 65-68.
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8. R.C. Qasımova. **Beynəlxalq konfr. "Kavkaz reg. və Xəzər dəniz. bass. ətrafındakı ölkələrin ekologiyasına ionizasiya şüal. təsiri"**, **Materiallar toplusu**, Bakı, Azərbaycan, okt. 23-25, 2002, səh. 196-198.
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10. R.C. Qasımova, G.Ə. Səfərova, V.J. Dəmirova. **Beynəlxalq SPIE konf. Materiallar toplusu (Proceedings of SPIE)**, 2004, c. **5851**, səh. 66-73.
11. R.C. Qasımova, G.Ə.Səfərova. **"Fizika - 2005" AMEA-nın Fiz. İnst. 60 illiyinə həsr olunmuş Beynəlxalq konfransın material toplusu**, Bakı, Azərbaycan, iyun, 2005, səh.663-666.
12. Z.H. Tağıyev, R.C.Qasımova, G.Ə. Səfərova. Periodik strukturlu qeyri-xətti mühitlərdə üçüncü harmonikanın generasiyası. **"Fizikanın müasir problemləri" V Beynəlxalq Elmi-Texniki Konfransının məqalələr toplusu**, Bakı, 25-27 iyun 2007, səh.45-48.
13. R.J. Kasumova, L.S. Gadjieva, G.A. Safarova. **Proceed. of III International Research and Practical Conf « Youth and science: the Reality and the future »**, Kiev-Columbia, 2010, t. 5, c. 88-90.
14. R.J. Kasumova, A. Karimi. **Proceed. of III International Research and Practical Conf « Youth and science: the Reality and the future »**, Kiev-Columbia, 2010, t. 5, c. 90-91.
15. R.J. Kasumova, G.A. Safarova. **Proceed. of Asia-Pacific Conference on Fundamental Problems of Opto- and Microelectronics (Russia, Moscow-Samara, 4-8 July)**. - LPI, 2011. - 1 DVD-ROM, SAMP 1. ISBN 978-5-902622-20-8.
16. R.J. Kasumova, G.A. Safarova. **The International Academy of Science and Higher Education (Great Britain). VIII International Scientific and Practical Conference "Space and time - coordinate system of human development"**. August 25 – 1 Sept. 2011, p. 85-86.
17. R.J. Kasumova, L.S. Gadjieva. **Proceed. of IV International Research and Practical Conf "Youth and science: the Reality and the future"**, Kiev-Columbia, 2011, v. 4, c. 216-217.
18. R.J. Kasumova, G.A. Safarova, L.S. Gadjieva. **Proceed. of the IV International Research and Practical Conf "Youth and science: the Reality and the future"**, Kiev-Columbia, 2011, v. 4, p. 218-220.
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20. R.J. Kasumova. **Proceed. of VIII International Research and Practical Conf. "Science and technologies: a step to the future-2012,"** Febr. 17 – Febr.25, 2012, Bulgaria, Sofia, p. 77-79.
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23. R.J. Kasumova, N.V. Kerimova. **Materials digest of the XXXIX International Research and Practical Conf. and III stage of the Championship in technical, physical and mathematical sciences. "Physico-Matematical and Technical Sciences as Postindustrial Foundation of the Informational Society Evolution,"** London, December 19 – December 24, 2012, 124.
24. R.J. Kasumova. **Proceed. of the IX International Research and Practical Conf. "European Science in XXI century,"** Poland, 7-15 May, 2013, 41-44.
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27. R.J. Kasumova, H.M.Mamedov, V.C.Mamedova, Sh.A.Shamilova, R.V.Veliyev. **Proceedings of NATO Conference "Nuclear radiation nanosensors and nanosensory systems"** (Georgia, Tbilisi,6-8 March 2014, 94-96.

28. R.J. Kasumova, Sh.A.Shamilova. **Materials digest of the X International Scientific and Prac. Conf. "Trends of modern science 2014"**, Sheffield, May 30-June 7, 2014, v.23, Chemistry and chemical technology, Physics (Optics), p. 58 – 60.
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31. R.J. Kasumova, H.M. Mamedov, Sh.A. Shamilova, V.C. Mamedova. **Materials of 8th International Scientific Conference «Science and Society» (SCIEURO-ISPC), UK, London, 24-29 November, 2015**, Physics, p. 43-46.
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33. R.J. Kasumova, G.A. Safarova, N.V. Kerimova. **"Fizikanın aktual problemləri" VIII Resp. Konf-ransının materialları**, Bakı, 17 dekabr, 2015, səh. 174-178.
34. R.J. Kasumova, G.A. Safarova, Sh.A. Shamilova. **Science and Education Ltd (England) -30.11-07.12.2015, Physics/7. Optics**, p. 90-91.
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38. R.J. Kasumova, Sh.Sh. Amirov, G.A. Safarova, N.N. Heydarov. **Материалы XII Международной научно-практической конференции «Фундаментальная и прикладная наука– 2016»**, 30.10-07.11.2016, **Science and Education Ltd (England), Physics/5. Optics**, p. 74-78.
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40. R.J. Kasumova, S.R. Figarova, G.A. Safarova. **Eastern-European Scientific Journal (Gesellschaftswissenschaften): Dusseldorf (Germany): Auris Verlag, Auris Verlag, Oct. 28, Ausgabe 5-2016**, p. 115-117.
41. R.J. Kasumova, H.M. Mamedov, Sh.A. Shamilova. **Eastern-European Scientific Journal (Gesellschaftswissenschaften): Dusseldorf (Germany): Auris Verlag, Oct. 28, Ausgabe 5-2016**, p. 112-115.
42. R.J. Kasumova, S.R. Figarova, G.A. Safarova. **Proceedings of IX International Conference "Global Science and Innovation"**, November 9-10, 2016. USA, Chicago.
43. R.J. Kasumova, Sh.A. Shamilova. **"Fizikanın aktual problemləri" IX Resp.Konfransı-nın materialları**, Bakı, dekabr, 2016, p.174-178.
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45. R.J. Kasumova, G.A. Safarova, N.V. Kerimova. **XI Международная научно-практическая конференция "Advances in Science and Technology"**, 2017, p. 127-128.
46. R.J. Kasumova, G.A. Safarova, A.R. Ahmadova. Sh. Sh. Amirov. **X Международная научно-практическая конференция "Научный форум: технические и физико-математические науки"**, 2017, №9(10), 167-172.
47. R.J. Kasumova, Sh. Sh. Amirov, G.A. Safarova. **XIII Международной научно-практической конференции EUROPEAN RESEARCH**, 2017, 16-18.
48. R.J. Kasumova, G.A. Safarova. **XIII Международной научно-практической конференции EUROPEAN RESEARCH**, 2017, 19-22.
49. R.J. Kasumova, A.R. Ahmadova. **STAR-NET Magistrantların və gənc tədqiqatçı-ların "Fizika və astronomiya problemləri"** Beynəlxalq Elmi konfransının Materialları, 24-25 may 2018, Bakı, BDU, səh.66-69.
50. R.J. Kasumova, G.A. Qulieva, G.A. Safarova. **STAR-NET Magistrantların və gənc tədqiqatçı-ların "Fizika və astronomiya problemləri"** Beynəl-xalq Elmi konfransının Materialları, 24-25 may 2018, Bakı, BDU, səh.134-137.
51. R.J. Kasumova, L.V. Priyeva **STAR-NET Magistrantların və gənc tədqiqatçı-ların "Fizika və astronomiya problemləri"** Beynəlxalq Elmi konfransının Materialları, 24-25 may 2018, Bakı, BDU, səh.127-130.

52. R.J. Kasumova, Sh.A. Shamilova. STAR-NET Magistrantların və gənc tədqiqatçı-ların “**Fizika vəastronomiya problemləri**” Beynəlxalq Elmi konfransının Materialları, 24-25 may 2018, Bakı, BDU, səh144-146.
53. R.J. Kasumova, H.M. Mamedov, V.C. Mamedova. STAR-NET Magistrantların və gənc tədqiqatçı-ların “**Fizika vəastronomiya problemləri**” Beynəlxalq Elmi konfransının Materialları, 24-25 may 2018, Bakı, BDU, səh168-172.
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### *TƏDQIQAT SAHƏSİ*

Kasumova investigated the nonlinear wave interaction in dissipative medium in the constant intensity approximation taking into account the reciprocal influence of excited wave on phase of the pumping wave. The theory of the intracavity II, III and IV harmonic generations, parametric interaction of the Raman scattering components at various configurations of nonlinear media (intracavity, in the external resonator and out of cavity), degenerate four-wave mixing, nonlinear wave interaction under coherent population trapping conditions and in optical fiber has been developed in this approximation. The analysis of the theoretical expression of the change of higher harmonic intensity versus the parameters of the problem in the constant intensity approximation allows to define a high-order nonlinear susceptibility of substances more precisely than in traditionally used constant field approximation. This approximation uses the dependence of the period of spatial beats of the harmonic amplitude on the nonlinear susceptibility of a medium. Intensity minima of the second harmonic (as opposed to the constant field approximation) in the constant intensity approximation are shown to depend on dispersion of the refractive index of the medium under study, which makes it possible to determine dispersion of the refractive index of the substance under study directly and accurately. Intracavity location of the nonlinear medium leads to increase of the sensitivity of dispersion interferometer. She theoretically investigated the effective frequency conversion in regular domain structures and layered media.

Her present research problem is analysis of the generation of TG in the PZI showed that the nonlinear optical response in ZnO films with Ag and Cu impurities is weaker than in the case of a pure ZnO film. The result obtained depends to a large extent on the type of impurity and its concentration. By adding Ag ions to ZnO, the zinc oxide lattice loses the electron and this leads to an increase in the resistance. In the case of Cu ions, the electrons occupy both the lattice and the interstitial space, which is associated with an increase in the electron concentration. Thus, the efficiency of THG in ZnO films with Cu impurities will be higher than in ZnO films with Ag impurities.

The discovery of metamaterials contributed to the emergence of the possibility of regulating light radiation by changing the optical properties of such artificial structures. In the paper, taking into account phase effects, parametric interaction of waves is considered for low-frequency and high-frequency pumping in a quadratic medium, which is the "left" wave for the signal wave. It is received, that the efficiency of process of amplification of a signal wave that the above, the more in the first place a parity of levels of intensities of blank and a signal wave at an input in a metamaterial. In addition, it is possible to realize a smooth tuning of the frequency of the parametric converter at a significant level of the pump wave and idler waves.

Member of Optical Soc. Am. (№ 323126) and American Chemical Society (№ 0513SAC030).

### *LIST OF PUBLICATION IN ISI JOURNALS (SEE ATTACH)*

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*DÖVLƏT VƏ BEYNƏLXALQ PROGRAM VƏ GRANTLAR*

2004-2006 - **INTAS** Ref. N 04-78-6839 "Ultrafast Position-sensitive Detectors on the Basis of New Avalanche Micropixel Photodiodes with Single Photon Detection Efficiency and with High Amplitude Resolution for Visible and UV Light." The project was related with experimental elaboration of photodetectors sensitive in visible and UV range of spectrum.

2008-2010 - **CRDF –ANSF** Project AZP1-3123-BA-08 "Efficient nonlinear frequency conversion using layered structures and quantum coherent effects", where there were studied quasi phase matched generation of the second and third harmonics of laser radiation, as well generation of terahertz impulses of high efficiency was examined.

2010-2012 - Grant **N EIF-2010-1(1)-40/14-M-9** "Investigation of quasi phase matched nonlinear interaction of waves for elaboration of highly efficient sources of laser scanning radiation".

2013 - took part in the following grant **FP7-INCO-2010-6 project** "Nanotechnology platform for electronics and photonics".

2014-2016 - Grant **N EIF-2013-9(15)-46/04-1** (70 000 AZN) "Nonlinear optical features of nanostructures and phase effects in metamaterials".