# Viacheslav Duk

## Curriculum Vitae


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### Research interests

**Flavour physics**: radiative kaon decays, tests of Standard Model and New Physics in rare processes.
**Particle detectors**: proportional wire chambers, scintillator counters, hodoscopes, ring imaging cherenkov counters.

### Academic positions

**2001 - 2007** Institute for Nuclear Research of the Russian Academy of Sciences (INR RAS), Moscow, Russia - Research Assistant.
**2007 - 2012** INR RAS - Junior Researcher.
**2012 - 2014** INFN Perugia - PostDoc Researcher.
**2014 - present** INFN Perugia - PostDoc Researcher.

### Education

**2002** Moscow Institute of Physics and Technology (MIPT), Moscow, Russia: Bachelor of Science (B.Sc.), graduated with honour.
**2004** MIPT: Master of Science (M.Sc.), graduated with honour.
**2011** INR RAS: PhD in experimental particle physics. Thesis: Measurement of kaon form factors from $K^- \to \mu^- \bar{\nu}_\mu \gamma$ decay at ISTRA+ setup.

### Collaboration membership

**2001 - present** ISTRA+ (IHEP Protvino, Russia).
**2003 - 2004** CKM (FNAL, USA).
**2006 - present** OKA (IHEP Protvino, Russia).
**2007 - present** KLOD (IHEP Protvino, Russia).
**2007 - present** NA62 (CERN, Switzerland).

### Responsibilities

**2008** - 15th International Seminar Quarks-2008: Scientific Secretary, proceedings editor.

**Brief research summary**

**ISTRA+**

- Calibration of the guard system;
- leader of the $K^- \to \mu^- \bar{\nu}_\mu \gamma$ analysis (observation of destructive interference term INT$^-$, extraction of kaon form factors);
- leader of the analysis on heavy neutrino search in $K^- \to \mu^- \nu_h (\nu_h \to \nu\gamma)$ decay (limits on $|U_{\mu h}|^2$ for various masses and lifetimes);
- co-author of six papers and three preprints on kaon decays.

**CKM**

- Simulations of Beam Interaction Veto System (BIVS);
- co-author of two CKM notes.

**OKA**

- Beam proportional chambers (design, maintenance, simulation studies);
- co-author of two INR and one IHEP preprints.

**KLOD**

- Co-author of one paper (experiment proposal).

**NA62**

- Contribution to the future data analysis of the $K^+ \to \pi^+ \nu\bar{\nu}$ decay: simulation of the $K^+ \to \mu^+ \nu_\mu \gamma$ background;
- old CHOD detector (refurbishment of the NA48 CHOD detector): maintenance, data analysis, software development;
- new charged hodoscope: design and prototype tests;
- RICH detector: simulations of the detector performance, detector control system, mirror alignment;
- co-author of six papers: three published in PLB, two published in NIM and one published in Nuovo Cimento.

**Publications and talks**

Author of 40 publications (list attached) of which 14 are peer-reviewed journal publications. Numerous talks at international conferences and seminars (list attached).

### Student supervision

**2004-2008** - undergraduate student supervision at INR RAS.
**2008-2012** - postgraduate student supervision at INR RAS.
**2015** - summer student supervision at CERN.

### Awards

**1998** - Outstanding high school graduation, Gold medal.
**2002** - B.Sc. Diploma with honour.
**2004** - M.Sc. Diploma with honour.
**2006** - Russian Science Support foundation, grant winner.
**2010** - INR RAS prize for young scientists, winner.

### List of publications

### Peer-reviewed papers

1. Experimental study of direct photon emission in $K^- \to \pi^-\pi^0\gamma$ decay using ISTRA+ detector.
V.A. Uvarov et al.
Published in Phys.Atom.Nucl.69:26-34, 2006.
IHEP preprint 2004-39.
arXiv: hep-ex/0410049.
2. Observation of the radiative kaon decay $K^- \to \mu^-\bar{\nu}_\mu\pi^0\gamma$.
O.G. Tchikilev et al.
Published in Phys.Atom.Nucl.70:29-34,2007.
IHEP preprint 2005-20.
arXiv: hep-ex/0506023.
3. Study of $K^- \to \pi^0 e^-\bar{\nu}_e\gamma$ decay with ISTRA+ setup.
V.N. Bolotov et al.
Published in Phys.Atom.Nucl.70:702-708,2007.
INR preprint 1150/2005.
arXiv: hep-ex/0510064.
4. Pion program for the future rare-decay experiments.
V.N. Bolotov, V.A. Duk.
Published in Phys.Atom.Nucl.72:63-76,2009.
5. Search for the $K_L \to \pi^0\nu\bar{\nu}$ decay at the IHEP U-70 accelerator: The KLOD project.
A.S. Kurilin et al.
Published in Phys.Part.Nucl.Lett.7:21-26,2010.
IHEP preprint 2007-8.
6. Extraction of kaon formfactors from $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay at ISTRA+ Setup.
V.A. Duk et al.
Published in Phys. Lett. B 695 (2011) 59-66.
INR preprint 1254/2010.
arXiv: hep-ex/1005.3517.

7. Test of lepton flavour universality in $K^+ \to l^+\nu$ decays.
C. Lazzeroni et al.
Published in Phys. Lett. B 698 (2011) 105-114.
CERN-PH-EP-2011-004.
arXiv: hep-ex/1101.4805.
8. Search for heavy neutrino $K^- \to \mu^-\bar{\nu}_h(\bar{\nu}_h \to \bar{\nu}\gamma)$ decay at ISTRA+ Setup.
V.A. Duk et al.
Published in Phys. Lett. B 710 (2012) 307-317.
arXiv: hep-ex/1110.1610.
9. Precision Measurement of the Ratio of the Charged Kaon Leptonic Decay Rates.
C. Lazzeroni et al.
Published in Phys. Lett. B 719 (2013) 326-336.
CERN-PH-EP-2012-367.
arXiv: hep-ex/1212.4012.
10. The ring imaging Cherenkov detector of the NA62 experiment at CERN.
P. Cenci et al.
Published in Nucl.Instrum.Meth. A732 (2013) 342-345.
11. Study of the $K^\pm \to \pi^\pm\gamma\gamma$ decay by the NA62 experiment.
C. Lazzeroni et al.
Published in Phys.Lett. B732 (2014) 65-74.
12. Measurement of charged kaon semileptonic decay branching fraction $K^- \to e^-\nu_e\pi^0$ using ISTRA+ detector
V.A. Uvarov et al.
Published in Phys.Atom.Nucl. 77 (2014) 725-732.
IHEP preprint 2013-7.
13. The RICH detector of the NA62 experiment at CERN.
D. Aisa et al.
Published in Nucl.Instrum.Meth. A766 (2014) 1-4.
14. Prospects for $K^+ \to \pi^+\nu\bar{\nu}$ observation at CERN in NA62.
V. Duk, for the NA62 collaboration.
Published in Nuovo Cim. C38 (2016) no.4, 133.

**Conference proceedings**

1. The search for tensor interaction in pion and kaon decays.
V.N. Bolotov, V.A. Duk.
Published in "Dubna 2003, Proceedings of the XII Conference on Selected Problems of Modern Physics".
2. Study of $K^- \to \pi^0 e^-\bar{\nu}_e\gamma$ and $K^- \to \pi^0\mu^-\bar{\nu}_\mu\gamma$ with ISTRA+ setup.
V.N. Bolotov et al.
Published in "Jalta 2005, New Trends in High Energy Physics" p.16-28.
3. Study of $K^- \to \pi^0 e^-\bar{\nu}_e\gamma$ with ISTRA+ setup.
V.N. Bolotov et al.
Published in "Moscow 2005, Particle physics at the year of 250th Anniversary of Moscow University", p.206-214.
4. Recent results on charged kaon decays from ISTRA+ experiment.
V.A. Duk.
Published in "Moscow 2007, ICHEP-2006 proceedings", p.777-781.
5. Study of $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay at ISTRA+ Setup.
V.A. Duk.
Published in "Moscow 2008, Quarks-2006 proceedings", p.383-385.

6. OKA experiment for studying rare kaon decays.
V.A. Duk.
Published in "Moscow 2010, Quarks-2008 proceedings", p.415-418.
7. Study of radiative decay $K^- \to \mu^- \bar{\nu}_\mu \gamma$ at ISTRA+ setup.
V.A. Duk.
Published in PoS KAON09:036,2009.
8. Extraction of kaon formfactors from $K^- \to \mu^- \bar{\nu}_\mu \gamma$ decay at ISTRA+ Setup.
V.A. Duk.
Published in "Moscow INR(2010), Quarks-2010 proceedings".
9. Search for Heavy Neutrino in $K^- \to \mu^- \bar{\nu}_h (\bar{\nu}_h \to \bar{\nu}\gamma)$ decay at ISTRA+ Setup.
V.A. Duk.
Published in PoS QFTHEP2011 (2013) 013.
10. Search for heavy neutrino in kaon decays.
V.A. Duk.
Published in "Moscow 2014, Quarks-2012 proceedings", p.296.
11. The NA62 RICH detector.
G. Anzivino et al.
Published in DOI: 10.1109/ANIMMA.2013.6727910.
12. Recent results from NA62.
V. Duk, for the NA62 collaboration.
Published in doi: 10.1142/9789814663618_0058.
13. LFV and exotics at the NA62 experiment.
V. Duk, for the NA62 collaboration.
Published in J.Phys.Conf.Ser. 556 (2014) 012067.
14. Study of the rare decay $K^\pm \to \pi^\pm \gamma\gamma$ decay at the NA62 experiment.
V. Duk, for the NA62 collaboration.
Published in "Moscow 2016, Quarks-2014 proceedings", p.165.

**Preprints**

1. V.N. Bolotov, V.A. Duk, A.R. Pastsyak.
The study of $\pi \to e\nu\gamma$ decay at CKM setup.
INR preprint 1101/2003.
2. V.N. Bolotov, V.A. Duk.
The possibilities of tensor interaction study in $\pi \to e\nu\gamma$ and K$\to e\nu\pi^0$ decays.
INR preprint 1102/2003.
3. V.A. Duk, A.A. Khudyakov, V.K. Semenov.
Tests of tracking detectors.
INR preprint 1176/2006.
4. V.I. Romanovsky et al.
Measurement of the $K^- \to \pi^0 e^- \bar{\nu}_e$ branching ratio.
IHEP preprint 2007-5.
5. O.G. Tchikilev et al.
Measurement of the INT$^-$ term in radiative decay $K^- \to \mu^- \bar{\nu}_\mu \gamma$.
IHEP preprint 2008-27.
6. S.A. Akimenko et al.
Study of OKA beam spectrometer.
IHEP preprint 2008-28.
7. S.A. Akimenko et al.
Study of U-70 separated beam.
INR preprint 1242/2009.

**Notes**

1. V.N. Bolotov, V.A. Duk, A.R. Pastsyak.
The study of $\pi \to e\nu\gamma$ decay at CKM setup.
CKM note 84, May 2003.
2. V.N. Bolotov et al.
The investigation of the BIVS loads.
CKM note 94, January 2004.
3. V.A. Duk et al.
CHOD in the Technical Run 2012.
NA62 note NA62-13-06.
4. V. Duk et al.
Hodoscope prototype tests for the NA62 experiment.
NA62 note NA62-14-11.
5. M. Barbanera et al.
TELDES assessment procedures for the LKr Calorimeter of the NA62 experiment.
NA62 note NA62-15-01.

**List of most significant talks**

1. International School Baksan-2005.
Recent results from ISTRA+ experiment.
2. International conference BEACH-2006.
Highlights on rare charged kaon decays.
3. International Seminar Quarks-2006.
Study of $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay at ISTRA+ Setup.
4. International conference ICHEP-2006.
Recent results on charged kaon decays from ISTRA+ experiment.
5. International School Baksan-2007.
CKM unitarity and kaon decays.
6. International conference KAON-2007.
Measurement of $Ke3$ BR and study of $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay at ISTRA+ Setup.
7. International Seminar Quarks-2008.
OKA experiment for studying rare kaon decays.
8. International conference KAON-2009.
Study of radiative decay $K^- \to \mu^-\bar{\nu}_\mu\gamma$ at ISTRA+ setup.
9. International Seminar Quarks-2010.
Extraction of kaon formfactors from $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay at ISTRA+ Setup.
10. International School Baksan-2011.
Search for heavy neutrino in $K \to \mu\nu\gamma$ decay at ISTRA+ setup.
11. International Seminar Quarks-2012.
Search for heavy neutrino in $K \to \mu\nu\gamma$ decay at ISTRA+ setup.
12. KAON-20113.
The RICH detector of the NA62 experiment at CERN (poster talk).
13. International conference ANIMMA-2013.
The NA62 RICH Detector.
14. 16th Lomonosov Conference on Elementary Particle Physics.
Recent results from NA62.
15. International Seminar Quarks-2014.
Study of the rare decay $K^+ \to \pi^+\gamma\gamma$ at the NA62 experiment.

16. International conference BEACH-2014 (Birmingham, 07.2014).
LFV and exotics at the NA62 experiment.
17. International conference Les Rencontres de Physique de la Vallée d'Aoste (La Thuile, 03.2015).
Prospects for measuring $K^+ \to \pi^+\nu\bar{\nu}$ decay at the NA62 experiment.
18. Crete-2015 conference (Crete, 07.2015).
The RICH detector of the NA62 experiment.

## Research statement
## Viacheslav Duk

**2001 - present** ISTRA+ (IHEP Protvino, Russia).

I contributed to the calibration of the guard system and measured its efficiency. The results are reported in my B.Sc. diploma. I made contributions to 3 publications in Phys.Atom.Nucl. The results are reported at numerous international conferences.

I performed the analysis of $K^- \to \mu^-\bar{\nu}_\mu\gamma$ decay, the results are published in a PLB paper. For the first time a negative interference term $\mathrm{INT}^-$ was observed in this decay that allowed to measure form factor difference $\mathrm{F}_V$-$\mathrm{F}_A$.

I performed the analysis on a search for heavy neutrino in $K^- \to \mu^-\nu_h(\nu_h \to \nu\gamma)$ decay. The results are published in a PLB paper. For the first time the limits on the $|U_{\mu h}|^2$ for the radiatively decaying $\nu_h$ were put in the 30–80 MeV/c$^2$ mass region.

**2003 - 2004** CKM (FNAL, USA).

I contributed to the design of the BIVS detector and calculated BIVS loads. Simulations on the possibility of studying $\pi \to e\nu\gamma$ decay at CKM setup were done. Results are published in two CKM notes and reported in my M.Sc. diploma.

**2006 - present** OKA (IHEP Protvino, Russia).

I took an active part in designing, testing and commissioning of beam proportional chambers (BPC). I also participated in the data analysis on BPC working performances during several runs. Results are published in 3 preprints. I participated in the OKA runs at IHEP in 2006-2012.

**2007 - present** KLOD (IHEP Protvino, Russia).

I contributed to one paper (experiment proposal) published in Phys.Part.Nucl.Lett.

**2007 - present** NA62 (CERN, Switzerland).

Participation in shits and meetings: 2007–2015.

MC simulations:

Monte-Carlo calculations of the $K^+ \to \mu^+\nu_\mu\gamma$ background to the $K^+ \to \pi^+\nu\bar{\nu}$ decay. The results are reported at the collaboration meetings.

NA48 CHOD detector:

In 2012 I participated in the Technical Run (TR) aimed at beam testing a subset of the NA62 detector with new trigger and data acquisition system. I took the responsibility of the functioning of the old CHOD (refurbishment of the NA48 CHOD detector). I performed the analysis of the TR data. Results are published in an NA62 note. In 2014 I participated in the Commissioning Run (CR) being the responsible for the CHOD performance and for the RICH DCS. The results are reported at the collaboration meetings. In 2015 I was responsible for the CHOD performance during the run. The results are reported at the collaboration meetings. I am responsible for the software development of the CHOD reconstruction.

NA62 CHOD detector (R&D):

In 2013 I participate in the R&D of the new CHOD detector. I contributed to the prototype

tests during the TR (the results are published in an NA62 note). In 2013 I participated in the tests of new CHOD counters at CERN, the results are reported at the collaboration meetings. In 2014 I contributed to the bea tests of the NA62 CHOD prototype. The results are reported at the collaboration meetings. The journal paper is in preparation.

RICH detector:

I contributed the simulation of the RICH detector performance. In particular, I estimated the fraction of PM's that receive light from the same mirror for different decay modes. Since 2013 I am responsible for the detector control system. I developed the control system for the front-end part. In 2015 I performed the offline mirror alignment using the information from the spectrometer. The results are reported at the collaboration meetings. The improved mirror alignment allowed to significantly increase the muon-pion separation in the RICH.