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Curriculum vitae

Rok Pestotnik

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e-mail:Rok.Pestotnik@ijs.si
born Jan 3 1972 Ljubljana, Slovenia.
Married, father of four (Dora 12 years, Svit 10 years, Luna 7 years, Ana 0 years)
Citizenship: Slovene.

Education:

- Ph.D. University of Ljubljana, Oct. 2001, Faculty of Math. and Physics, Department of Physics
- B.Sc. University of Ljubljana, Sept.1996, Faculty of Math. and Physics, Department of Physics
- European School of High energy physics, 1998, St.Andrews, UK.
- Extended stays at Deutsches Elektronen Synchrotron, Hamburg, Germany, including 16 months in the period 1999 – 2000
- Extended stays at KEK, Tsukuba, Japan, 2001-2013
- European Organization for Nuclear Research - CERN Fellow 2005/2006

Employment:

- 1996-2001 Young Researcher, University of Ljubljana, Faculty of Mathematics and Physics, Department of Physics
- 2001- 2008 research assistant, Jožef Stefan Institute, Experimetal Particle Physics Department, Ljubljana, Slovenia.
- 2005-2006 research fellow, CERN, the European Organization for Nuclear Research
- 2009- present senior researcher, Jožef Stefan Institute, Experimetal Particle Physics

Habilitations:

- 1999 - 2013 assistant for physics, University of Ljubljana, Faculty of Mathematics and Physics
- 2001 - 2008 research assistant, Jožef Stefan Institute , Ljubljana
- 2009 - senior research associate, Jožef Stefan Institute , Ljubljana

Languages:

- Slovene, native language
- English, luently
- German, functional
- Serbian Croatioan, fluently
- French, functional

Awards:

- 1986 First prize Slovene Championship in Mathematics, Ljubljana
- 1986 First prize Yugoslavian Championship in Physics, Dečani, Srbija.
- 1986-1996 Zois fellow
- 1996 Prešern award for students for diploma thesis, University of Ljubljana, Faculty of Mathematics and Physics

Fields of Research:

- HERA-B experiment: planning, design, construction, commissioning of HERA-B RICH , data taking (1996-2001)
- BELLE experiment: (2001-)
- Belle II experiment: design of the proximity focusing RICH with aerogel as a radiator (2001-)
- ALICE experiment: calibration of the Time Projection Chamber, 2005-2006
- Detector development: photon detectors and electronics for ring imaging Cherenkov counters (2005-)
- Environmetal physics: development of Cherenkov detector for low concentration Sr-90 measurements (2001-2009)
- Medical physics : detector development for position emission tomography (2005-)

Technical skills:

- Text editors: MS Office, Open Office, Latex.
- Simulation and experimental data analysis: PAW, Hbook, Cernlib, Rootsys, Geant3, Geant4, GATE
- Physics analysis frameworks of HERA-B, BELLE and Belle II
- Data Acquisition: National Instruments LabWindows CVI & LabView .
- Databases: Berkeley DB, MySql, Postgresql
- CAD: Autodesk AutoCad
- IC and electronic board design and programming tools : Altium Designer, Xilinx ISE, Altera Quartus
- Computer languages: C++, C, Fortran77, python, perl, tcltk, awk, make, php and html.
- Computer platforms: PC; parallel computers: Cray T3E, real time: Cetia, Solaris Sparc, HP-RT.
- Computer Operation Systems: UNIX, Linux, Microsoft OS, real time: Lynx, HP-RT
- Modular systems in nuclear electronics: VME, CAMAC, NIM.

Scientific work

My scientific work covers the field of experimental particle physics. It is manly focused in the development and application of Cherenkov photon detectors in elementary particle physics, environmental physics and medical physics. The detectors exploit the phenomenon of Cherenkov radiation caused by high-speed charged particles in the transparent media. As the intensity and direction of the emitted photons depend on the particle velocity, the identity of the charged particles can be determined if the momenta of particles is measured.

My research was conducted mainly in the context of international research groups HERA-B, Belle and Belle II, but also in the context of research projects of the research group at IJS. During postdoctoral training at CERN I joined the research group ALICE.

In the initial period during and after the diploma thesis I worked in the international group HERA-B, which studied the B and D mesons production in collisions of high-energy protons with the fixed target [5]. For the measurements of the reaction products, it was necessary to construct an instrumented magnetic spectrometer. My research has been primarily dedicated to the design, construction, calibration and operation of one of the subsystems, Cherenkov ring imaging detector (RICH). The detector consisted of a gas Perfluorobutane radiator, the focusing system of mirrors, a lens system to increase the efficiency of the detected light and more than 2300 multianode photomultipliers. In the context of my doctoral thesis I worked in the design, construction and calibration of a variety of components and systems for controlling operation of the RICH [1,4]. Detailed knowledge of the operation was a great help during the study of the identification of charged particles with Ring Imaging Ceherenkov detector [4]. With 33 detected photons in the saturated ring and a single photon resolution in the measurement of Čerenkov angle of 0.7 mrad the RICH of the HERA-B spectrometer fully met the expectations. It was the first Ring Imaging Cherenkov detector operating at high charged particle rates of up to 1 MHz per channel.

In the period after the doctoral degree I joined the BELLE research collaboration , which also studies the physics of B and D mesons, by analyzing the reaction products of collisions of electrons and positrons in an asymmetric collider measured by the spectrometer BELLE. Very soon after the start, the group published the results of measurements of small differences in properties of the matter (B mesons) and antimatter (anti-B mesons). The difference can be attributed to the violation of one of the fundamental symmetries of nature, called CP symmetry [7]. Violation of this symmetry is closely related to the apparent predominance of matter over antimatter in the universe today's universe. The result of the measurement represented one of the most important physics results in 2001. In 2007, the group published the existence of mixing in the system of neutral D mesons [9]. In addition to these measurements, the collaboration discovered the existence of a series of new states, and measured a number of precision measurements of rare B and D meson decays. Numerous measurements of CP violation in the B meson system, which were carried out by Belle and BaBar (Stanford, USA) have experimentally confirmed prediction of M. Kobayashi and T. Maskawa, for which both theoretical physicists got a Nobel prize for physics in 2008.

For precision measurements in the experimental physics of B and D mesons, it is essential to increase the sample size. The upgrade of the KEKB accelerator SuperKEKB will significantly increase the frequency of interaction, leading also to increase of the particle beam related background. For this reason it will be necessary to upgrade the majority of components of the spectrometer. The researchers have for the upgrade and subsequent data acquisition and analysis gathered in an international research group Belle II. To increase the accuracy of measurements it is essential to improve the identification of particles in the final state. In collaboration with colleagues

from universities of Nagoya and Tokyo we are testing a new type of position-sensitive single photon detector, which should improve the identification of particles in the forward direction. Due to the limited space available, we decided to develop the proximity focusing Cherenkov Ring Imaging detector with a silica aerogel radiator [2,6]. We expect that the detector will enable reliable identification of kaons and pions in the momentum range of about 4 GeV /c, which was uncovered in the previous identification system. Particularly interesting novelty is the use of a multi-layered irradiators, where the Cherenkov rings from layers of different refractive index overlap on the photon detector at a selected momentum [8]. Because the space provided for the detector is located within the magnet, it is important to choose a suitable photon detector, which will operate reliably in a high magnetic field of 1.5 T [10].

In the development and implementation of identification algorithms [11] I utilize the experience I have gained in the HERA-B experiment. Due to the small number of detected photons the development of the identification algorithm represents a special challenge. Improved identification of particles in the final state enables the background reduction, which further increases the sensitivity of the apparatus for the extremely rare processes.

I have used the experience gained in working with the development of Cherenkov photon detectors also in the development of the apparatus for the detection of radiotoxic Strontium Sr-90 in the environment. The apparatus consists of Čerenkov counter with silica aerogel radiator [3,12]. Strontium is beacuse of the chemical similarities to calcium easily binded in bones. Due to the extremely long half-life of 28.5 years and a longer biological half-life of 49.3 years, the isotope Sr-90 is highly radiotoxic. Sr isotope 90 is one of the degradation products from nuclear power plants, and might during the accidents be released into the environment. Isotope Sr-90 and Y-90 daughter are pure beta emitters and cannot be identified by the standard gamma spectrometry methods. Nuclide identification by using beta spectrometry is complicated by the fact that the spectrum is continuous, with a lot of overlaps of the contributions from various nuclides in the sample. The standard method is based on a multistage chemical analysis and is time consuming and complicated. Detector which we have developed exploits the property that only electrons with high enough energy emitts Cherenkov photons, while those with energy below the threshold for the radiation does not [3]. On the potential of the method shows also the attention, which is dedicated to our results in the book on radioactivity measurements (MF L'Annunziata, Handbook of Radioactivity Analysis 3rd edition, Elsevier 2012, ISBN 9780123848734).

During postdoctoral training at CERN I joined the ALICE research collaboration , which is now with the analysis of collisions of high-energy heavy nuclei at the Large Hadron Collider (LHC) at CERN in Geneva studying quark gluon plasma. Measurement sof the properties of the plasma will significantly contribute to the understanding of "confinement" of quarks and chiral symmetry in quantum chromodynamics. To reconstruct track and identify particles in the spectrometer the time projection chamber is employed. Due to the high density of up to 20,000 particles in the sensitive volume of the chamber, it was necessary to develop and manufacture the individual parts of the chamber with a special care. I participated in the planning and implementation of the high voltage control system, in the design of tools for visualization of data from the chamber, testing of the readout electronics and in the calibration of the chamber after construction. For the calibration the cosmic rays and laser beams were used. Based on the results, parts of the chamber were replaced with a spare. We have found that the central electrode was slightly curved due to the construction tension, which impacts on the distortion of the very homogeneous electrical field and consequently on the track reconstruction.

Experience gained in the test photon detectors are also used in my work in the field of medical

physics, where we explore the potential of a new type of photon detector, silicon photomultipliers, as a detector in positron tomography, one of the most important non-invasive methods for imaging of living tissue. A tomograph with silicon photomultipliers would be more compact, it would operate in high magnetic fields (i.e. in combination with NMR tomograph), would have better resolution and would allow easier handling. In our laboratory for the development of radiation detectors we are studying two options for increasing the spatial and temporal resolution of the positron emission tomograph [16,18,19,20]. The first is related to the determination of the depth of interaction by means of crystals, which are segmented differently in different planes. The second is a study of the possibility of the reduction of the contribution of the random coincidences by measurement of the time of interaction of annihilation gammas, which further increases the usefulness of tomography. The limiting factor that affects the accuracy of the reconstruction in positron emission tomography is the time resolution of the scintillator and the photon sensor. By using photomultiplier tubes with microchannel plate, which have a time resolution of 22 ps for single photons, a significant contribution is due to scintillator. By replacing the scintillator radiator with the Cherenkov radiator, where the photons are emitted promptly, we measured the time resolution of 75ps, which is the current world record.

The most important scientific interests / achievements

1. in HERA-B:
- measurement of the properties of multianode photomultipliers for detection of individual photons (diploma thesis) [1]
- design, development, calibration and operation control of the RICH in the HERA-B spectrometer (PhD topic) [4]
- testing and implementation of identification algorithms for HERA-B RICH (PhD topic) [4]
- measurements of reactions of energetic protons with fixed target [5]

2.in BELLE:
- development of the proximity focusing RICH whut aerogel as a radiator. The focus includes planning, development, calibration, acquisition and analysis of data, which were acquired during: testing of a prototype detector with cosmic particles at JSI 2001, 2007 and 2008 [2], testing of the prototype detector in the pion test beam at the Institute KEK, Tsukuba, Japan in 2001, 2003, 2004 and 2005 [6,8] and at CERN (2008, 2001).
-algorithms for charged particle identification by RICH with aerogel as a radiator[11],
-measurements of rare processes in B and D decays [7,9].

3 in BELLE II:
- development of the proximity focusing RICH whut aerogel as a radiator.
- studies of the photo sensors: Hybrid avalanche photodiode, silicon photomultiplier, microchannel plate photomultiplier [2,6,10,13,14,18]
- design and development of readout electronics for hybrid avalanche photodiode [17]
- design and development of readout electronics for an array of silicon photomultipliers
- study of hybrid avalanche photodiode readout electronics operation during irradiation. [Sent for publication]
- study of the influence of magnetic field on the operation of the readout electronics. [15]
- algorithms for charged particle identification by RICH with aerogel as a radiator[11],

4 Environmental Physics:
- Development of a detector for the measurement of low activity radioactive isotope Sr-90 [3,12]
  * review and development of various components of the detector

* computer simulation of the detector response
* prototype detector
* testing of the detector efficiency for the various sources of radiation and determination of the lower limits of detection.

5 Medical physics: positron tomography
- study of positron tomography using silicon photomultipliers [18]
- study of positron tomography that would exploit the time of flight of scintillation photons [16,20]
- study of positron tomography t that would exploit the time of flight of Cherenkov photons [19]
- measurement of the depth of interaction with the vertically segmented scintillation crystals.
- design an setup of a demonstration apparatus for an exercise in the course Experimental Medical Physics

Scientific guidelines

I will continue with my scientific work in the field of experimental particle physics within Belle II collaboration. I am particularly interested in studying new Cherenkov photon detectors, the development of charged particle identification methods and studying the possible application of experimental methods in the field of medical applications.

Invited lectures at conferences and institutions

Invited lecture at the European Organisation for Nuclear Resarch (CERN), Geneva, 10.12.2004: Aerogel RICH for the upgrade of the BELLE spectrometer

Principal works:

[1] KRIZAN, Peter, KORPAR, Samo, PESTOTNIK, Rok, STANIC, Samo, STANOVNIK, Ales, STARIC,Marko, MICHEL, E., OEHSER, C., SCHMIDT-PARZEFALL, W., SCHWARZ, A., HAMACHER, T., BROEMMELSIEK, D., PYRLIK, J. Tests of a multianode PMT for the HERA-B RICH. Nucl. instrum, methods phys res., Sect. A, Accel.. [Print ed.], 1997, vol. 394, str. 27-34. [COBISS.SI-ID 12670503]

[2] ADACHI, I., BIZJAK, Ilija, KORPAR, Samo, KRIZAN, Peter, PESTOTNIK, Rok, STARIC, Marko, STANOVNIK, Ales. Tests of a proximity focusing RICH with aerogel as radiator. IEEE trans. nucl. sci., 2003, vol. 50, str. 1142-1146. [COBISS.SI-ID 17855015]

[3] PESTOTNIK, Rok, DOLENC, Irena, KORPAR, Samo, KRIZAN, Peter, STANOVNIK, Ales. Cherenkov detector based on aerogel radiator and at panel PMT for detection of 90Sr. V: METZLER, Scott (ur.). 2003 IEEE : Nuclear science symposium [and] Medical Imaging Conference : conference record : 19-25 October 2003, Portland, Oregon, USA. [S.l.]: IEEE: Nuclear & Plasma Sciences Society, 2004, [COBISS.SI-ID 18242343]

[4] ARINO, I., GORISEK, Andrej, KORPAR, Samo, KRIZAN, Peter, PESTOTNIK, Rok, STARIC, Marko, STANOVNIK, Ales, SKRK, Damijan, ZIVKO, Tomi. The HERA-B ring imaging Cherenkov counter. Nucl. instrum, methods phys res., Sect. A, Accel.. [Print ed.], 2004, vol. 516, str. 445-461. [COBISS.SI-ID 17999911]

[5] HERA-B Collaboration, ABT, I., GORISEK, Andrej, KORPAR, Samo, KRIZAN, Peter, PESTOTNIK, Rok, STANOVNIK, Ales, STARIC, Marko, ZIVKO, Tomi. Limits for the central production of Theta+ and Xi-- pentaquarks in 920-GeV pA collissions. Phys. rev. lett., 2004, vol. 21, str. 212003-213003-6. [COBISS.SI-ID 18767911]

[6] MATSUMOTO, Takahiro, KORPAR, Samo, FRATINA, Sasa, KRIZAN, Peter, PESTOTNIK, Rok. Studies of proximity focusing RICH with an aerogel radiator using a flat-panel multi-anode PMTs (Hamamatsu H8500). Nucl. instrum, methods phys res., Sect. A, Accel.. [Print ed.], 2004, vol. 521, str. 367-377. [COBISS.SI-ID 18249511]

[7] Belle Colaboration, ABE, K., BITENC, Urban, BIZJAK, Ilija, BRACKO, Marko, FRATINA, Sasa,

GOLOB, Bostjan, KORPAR, Samo, KRIZAN, Peter, PESTOTNIK, Rok, STANIC, Samo, STARIC, Marko, ZONTAR, Dejan. Improved measurement of CP-violation parameters sin2phi1 and lambda, B meson lifetimes, and B0 -anti B0 mixing parameter md. Phys. rev., D Part. fields gravit. cosmol., 2005, vol. 71, str. 072003-1-072003-12. [COBISS.SI-ID 19226151]

[8] IIJIMA, T., KORPAR, Samo, FRATINA, Sasa, GORISEK, Andrej, KRIZAN, Peter, PESTOTNIK, Rok. A novel type of proximity focusing RICH counter with multiple refractive index aerogel radiator. Nucl. instrum, methods phys res., Sect. A, Accel.. [Print ed.], 2005, vol. 548, str. 383-390. [COBISS.SI-ID 19287847]

[9] Belle Collaboration, STARIC, Marko, GOLOB, Bostjan, BITENC, Urban, BRACKO, Marko, FRATINA, Sasa, GORISEK, Andrej, KORPAR, Samo, KRIZAN, Peter, PESTOTNIK, Rok, STANIC, Samo, ZUPANC, Anze. Evidence for D0-D 0 mixing. Phys. rev. lett., 2007, vol. 98, no. 21, str. 211803-1-211803-6. [COBISS.SI-ID 20795943]

[10] KORPAR, Samo, DOLENEC, Rok, HARA, K., IIJIMA, Toru, KRIŽAN, Peter, MAZUKA, Y., PESTOTNIK, Rok, STANOVNIK, Aleš, YAMAOKA, M. Measurement of Cherenkov photons with silicon photomultipliers. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2008, vol. 594, no. 1, str. 13-17. [COBISS.SI-ID 22075431],

[11] PESTOTNIK, Rok, KRIŽAN, Peter, KORPAR, Samo, IIJIMA, Toru. Design optimization of the proximity focusing RICH with dual aerogel radiator using a maximum-likelihood analysis of Cherenkov rings. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2008, vol. 595, no. 1, str. 256-259. [COBISS.SI-ID 22074919],

[12] PESTOTNIK, Rok, KORPAR, Samo, KRIŽAN, Peter, DOLENEC, Rok. Cherenkov detector of [sup](90)Sr based on aerogel as radiator. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2008, vol. 595, no. 1, str. 278-280, doi: 10.1016/j.nima.2008.07.069. [COBISS.SI-ID 22075175],

[13] PESTOTNIK, Rok. The SuperBelle project. *Nucl. phys., Sect. A*. [Print ed.], 2009, vol. 827, no. 1/4, str. 608c-613c. [COBISS.SI-ID 22775079],

[14] ADACHI, Ichiro, DOLENEC, Rok, KORPAR, Samo, KRIŽAN, Peter, PESTOTNIK, Rok. Study of 144-channel multi-anode hybrid avalanche photo-detector for the Belle RICH counter. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2010, vol. 623, no. 1, str. 285-287. [COBISS.SI-ID 24016423]

[15] KORPAR, Samo, ADACHI, Ichiro, DOLENEC, Rok, KRIŽAN, Peter, PESTOTNIK, Rok, STANOVNIK, Aleš. Photonis MCP PMT as a light sensor for the Belle II RICH. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2011, vol. 639, no. 1, str. 162-184, doi: 10.1016/j.nima.2010.10.148. [COBISS.SI-ID 24867623]

[16] PESTOTNIK, Rok, KORPAR, Samo, CHAGANI, Hassan, DOLENEC, Rok, KRIŽAN, Peter, STANOVNIK, Aleš. Silicon photo-multipliers as photon detectors for PET. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2010, vol. 623, no. 1, str. 594-596. [COBISS.SI-ID 24017703]

[17] SELJAK, Andrej, ADACHI, Ichiro, IKEDA, H., HARA, K., IIJIMA, Toru, IWATA, S., KORPAR, Samo, KRIŽAN, Peter, KURODA, E., PESTOTNIK, Rok, NISHIDA, Shohei, SUMIYOSHI, T., TAKAGAKI, H. Readout electronics for a Hybrid Avalanche Photon Detector. *Journal of instrumentation*, 2011, vol. 6, no. 12, str. C12051-1-C12051-9, doi: 10.1088/1748-0221/6/12/C12051. [COBISS.SI-ID 25652519]

[18] PESTOTNIK, Rok, DOLENEC, Rok, KORPAR, Samo, KRIŽAN, Peter, STANOVNIK, Aleš. Module of silicon photomultipliers as a detector of individual Cherenkov photons. *Nucl. instrum, methods phys res., Sect. A, Accel.*. [Print ed.], 2011, vol. 639, no. 1, str. 99-102, doi: 10.1016/j.nima.2010.09.122. [COBISS.SI-ID 24686631]

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Recenzentstvo

I am the reviewer for the following journals:

- Nuclear Inst. and Methods in Physics Research, A ,
- Current Applied Physics

Project manager

Z1-3301: Fast method for measuring the Sr-90 activity with Cherenkov radiation in silica aerogel r Duration: 1.7.2001 - 30.6.2004

Teaching

1 supervision of thesis:
- Working supervisor of thesis Irena Dolenc "Determination of Sr-90 activity by detecting the Cherenkov photons in silica aerogel", Ljubljana, 2003
- Working supervisor of thesis Andrej Petelin "Identification of hadrons with RICH detector in the spectrometer Belle", Ljubljana, 2007
- research supervisor for doctoral work, Andrej Seljak, to be completed in 2013
- supervisor for doctoral work, Eva Ribežl , to be completed in 2014
- supervisor for doctoral work Elvedin Tahirović, to be completed in 2015

2 varoius courses

Since 1999, I am an assistant at the Faculty of Mathematics and Physics, University of Ljubljana. I am participatin in the conduct of exercises and laboratory exercises of the following courses:
1 1998/1999 Physics, Faculty of Chemical Technology, University of Ljubljana,
2 2001/2002 Laboratory Course in Physics II, Faculty of Mathematics and Physics, University of Ljubljana,
3 2003-2013, Laboratory Course in Physics III (now Laboratory Course in Physics V and VI), Faculty of Mathematics and Physics, University of Ljubljana,
4 2003-2013, Laboratory Course in Physics IV (now Physics experiments), Faculty of Mathematics and Physics, University of Ljubljana,
5 2004/2005, Measurements in Physics II, Faculty of Mathematics and Physics, University of Ljubljana,
6 2005 Physics, Faculty of Chemistry and Chemical Engineering, University of Maribor
7 2010-2013, Experimental Medical Physics: Exercise positron emission tomography.
8 XI ICFA School on Instrumentation and Elementary Particle Physics, Bariloche, Argentina, 2010

I am taking care for the experiments that fall within the scope of nuclear physics and elementary particle and medical physics in Laboratory Course in Physics V and VI, the Physical Experiments and Experimental Medical Physics.

Training period abroad

In the context of active participation in HERA-B, Belle and Belle II collaborations I am taking part in the development and deployment of detector assemblies, participation in the measurement and analysis of the acquired data. In development phase the initial measurement of the detectors are held at JSI in the laboratory for the development of photon detectors, then in particle test beams abroad and during the operation mainly on collaborative spectrometrometers. In addition to permanent trainings of duration of a few weeks, I was abroad several times for a longer time:

- institute Deutsches Elektron Synchrotron, Hamburg, Germany, May 1996 (1 month) - before graduation
- institute Deutsches Elektron Synchrotron, Hamburg, Germany, June 1999 - September 2000 (16 months) - PhD
- European Organisation for Nuclear reasearch (CERN) - Felowship program, September 2005 - August 2006 (12 months) - post-doctoral training.

Ljubljana, April 10 , 2013

Rok Pestotnik