R-J. Standard model and new physics

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Physics analyses and theoretical work. — Our group has measured cross-section limits on supersymmetric processes leading to strongly boosted top quark decays in the data recorded by the CMS detector at the LHC prior to the 2017 installation of the new pixel detector. We have also doubled the recorded collision data using the new pixel detector during 2017. We provided a member for the Publication Committee of the CMS Experiment at CERN and played an important role in publishing CMS results of low-x QCD studies.

The group participated in the ASACUSA experiment at the Antimatter Factory of CERN, which provides a test of the CPT invariance, the theorem stating the equivalence of matter and antimatter, via measuring the transition energies of antiprotons trapped helium atoms using laser spectroscopy. The method leading to the precise determination of the agreement between the proton and antiproton masses earlier was extended to superfluid helium; the data are still in analysis. The first steps were made to use two-photon laser spectroscopy on antiprotonic helium atoms cooled down below 1.7 K in cryogenic low-pressure helium gas.

We wrote and published the first Hungarian textbook of quantum information theory. We proposed the Principle of Least Decoherence and, based on it, improved the widely used theory of semi-classical gravity, which will henceforth not violate the linearity of quantum mechanics.

Work on instrumentation. — The group has successfully commissioned the new pixel detector installed at the CMS experiment in 2017, the control and read-out electronics of which device was developed and manufactured by our group. We have prepared the 3D detector model and the software for the reconstruction of the new data, organized the spatial and temporal alignment of the new detector, and completed the calibration of the reconstruction algorithms. We also verified that the detector performance meets its design requirements.

The stable operation of the T2_HU_Budapest grid site continued in 2017. Our site is used extensively by the entire CMS collaboration including our group for reconstructing collision data in physics analyses. The disk capacity committed to CMS has increased to 900 TB.

We have successfully tested two superconducting shield prototypes for the *Superconducting Shield Septum* project: a high-temperature superconductor and MgB_2. The performance of the MgB_2 prototype was satisfactory for its application. We have designed and constructed a device called “SPS Diffuser”, which will be installed in the CERN SPS accelerator to decrease the radiation load on the electrostatic septum.

Outreach. – Two education programs were organized by Wigner RCP at CERN with the leadership of our group: the High-School Student Internship Programme (22 May - 2 June

2017) with the participation of 22 students and the Hungarian Teachers Programme (15-21 August 2016) for 21 physics teachers. For the teachers we organized a meeting on November 25 at Wigner RCP in the presence of representatives of the Hungarian Physical Society, the Hungarian CERN Committee and the main sponsor, the Pallas Sthene Domus Innovationis Foundation. We also participated in the organization of the annual Hands-on Particle Physics Master-classes on two occasions with 22 high-school students attending each session. In addition to conference talks and university teaching, many popular lectures were given by our group.

Grants

OTKA K-109703: Consortional main: Hungary in the CMS experiment of the Large Hadron Collider (V. Veszprémi, Cs. Hajdu, D. Horváth, T. Vámi, 2013-2017)

NKFI K-124850 Consortional assoc.: The Standard Model and beyond: Searching for New Physics with the CERN LHC CMS experiment (V. Veszprémi, Cs. Hajdu, D. Horváth, T. Vámi, 2017-2021)

NKFI K-124945 Research and development of novel technologies for particle accelerators (D. Barna, 2017-2021);

OTKA K-103917 Antimatter studies at the Antiproton Decelerator of CERN (D. Barna, L. Diósi, D. Horváth, 2012-2017)

International cooperation

CMS Collaboration (200 institutes)

University of Tokyo, Japan

RIKEN, Wako, Japan

Max-Planck-Institut für Quantenoptik, Germany

Università di Brescia & Istituto Nazionale di Fisica Nucleare, Italy

Publications

Articles

1. Adhikari R et al. incl. Glück F [136 authors]: A white paper on keV sterile neutrino dark matter. ***J COSMOL ASTROPART P*** **2017**:(1) 025/1-248 (2017)
2. Barna D: High field septum magnet using a superconducting shield for the Future Circular Collider. ***PHYS REV ACCEL BEAMS*** **20**:(4) 041002/1-9 (2017)
3. Bartmann W, Atanasov M, Barnes MJ, Borburgh J, Burkart F, Goddard B, Kramer T, Lechner A, Ull AS, Schmidt R, Stoel LS, Ostojic R, Rodziewicz J, van Trappen P, Barna D: Dump system concepts for the Future Circular Collider. ***PHYS REV ACCEL BEAMS*** **20**:(3) 031001/1-8 (2017)
4. Bassa H, Konrad T, Diósi L, Uys H: Equation of motion for estimation fidelity of monitored oscillating qubits. ***PHYS LETT A*** **381**:(29) 2293-2297 (2017)
5. Diósi L: New results on non-CP dynamics unearthed from urtexts of quantum state diffusion. ***J PHYS A-MATH THEOR*** **50**:(16) 16LT01/1-6 (2017)
6. Diósi L: Centre of mass decoherence due to time dilation: paradoxical frame-dependence. ***J PHYS-CONF SER*** **880**: 012020/1-8 (2017) (DICE - 8th International

Workshop on Decoherence, Information, Complexity andEntropy - Spacetime - Matter - Quantum Mechanics, Castiglioncello, Italy, 12-16 September 2016)

7. Diósi L, Tilloy A: On GKLS dynamics for local operations and classical communication. ***OPEN SYST INF DYN*** **24**:(4) 1740020/1-9 (2017)
8. Furse D et al. incl. Glück F [26 authors]: Kassiopeia: a modern, extensible C plus plus particle tracking package. ***NEW J PHYS*** **19**: 053012/1-24 (2017)
9. Homa G, Diósi L: On the earliest jump unravelling of the spatial decoherence master equation. ***PHYS LETT A*** **381**:(40) 3456-3459 (2017)
10. Tilloy A, Diósi L: Principle of least decoherence for Newtonian semiclassical gravity. ***PHYS REV D*** **96**:(10) 104045/1-6 (2017)
11. Horváth D: Antianyag-vizsgálatok a CERN-ben (Antimatter studies at CERN, in Hungarian). FIZIKAI SZEMLE 67:(4) pp. 115-121. (2017)
12. Horváth D: A részecskefizika sérült szimmetriái vajon megoldják-e a problémáit? (May the broken symmetries of particle physics solve its problems? In Hungarian) ***TERMÉSZET VILÁGA*** **148**:(11) pp. 495-499. (2017)

Book chapter

13. Horváth D: Ultra-fast neutrinos: What can we learn from a false discovery?. In: *Gribov-85 Memorial Volume: Exploring Quantum Field Theory: Proceedings of the Memorial Workshop Devoted to the 85th Birthday of VN Gribov (Budapest, Hungary, 17-20 June 2015).Eds::* Dokshitzer Y, Lévai P, Nyíri J, Singapore: World Scientific Publishing, 2017 pp. 364-376

See also:, R-H.1, R-H.2, R-I.1,

ATLAS collaboration

Due to the vast number of publications of the large collaborations in which the research group participated in 2016, here we list only a short selection of appearances in journals with the highest impact factor.

1.

See also: R-H NA49 Collaboration