

R-J. Standard model and new physics

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Physics analyses and theoretical work. — The CMS group members analyzed the discovery potential of supersymmetric processes; particularly such processes, in which top-stop pairs produced by gluino decays undergo 4-body or chargino decays. Members of the ATLAS collaboration validated the improvements of the simulation and reconstruction software packages that include the treatment of radiation-induced changes in the properties of the measurement devices and new reconstruction methods, and monitored the changes in the characteristics of the so-called topoclusters in QCD events containing top-antitop pairs and two jets with various transverse momenta. The ASACUSA group members have reached the point in the determination of the antiproton's mass with laser-spectroscopy of antiprotonic helium, where the precision is limited by the thermal movements of the helium atoms in low-pressure helium gas. The precision reached earlier with two-photon laser-spectroscopy has now been achieved with a single-photon method on a gas-target at 1.5 K temperature. The Schrödinger-Newton equation of non-relativistic quantum gravity, proposed earlier by a member of the group, continued to attract activity in 2015. His newly proposed experiment will contribute to a conclusive test of the related theory of spontaneous decoherence.

Work on instrumentation. — The CMS group has designed and produced prototypes for the control and read-out electronics of the Phase I Pixel Detector which is to be installed in CMS in 2017. The serial production has also been started. The group has organized the annual conference for the CMS detector collaboration in Visegrád hosting 70 participants from 7 countries. It has taken a leading role in starting and optimizing data-taking with the CMS tracking devices, studied the effects of radiation damage on measurement efficiency and resolution, and adjusted the simulation that is used in all physics analyses to the data recorded in 2015. The Liquid Argon Calorimeter is a basic component of the ATLAS detector. Its capabilities of detecting electrons, photons, jets and missing energy are crucial ingredients of discovering theoretically predicted new physics phenomena, like supersymmetry, and of analyzing features of the Standard Model, including detailed experimental study of the Higgs boson. The ATLAS members of our group participated in the simulation analyses targeting the upgrade of the LAr (Liquid Argon) calorimeter. The group has participated in the construction of the ELENA storage ring by performing the simulation and design of the beam line elements. The grid computing infrastructure used for analyses in the CMS and ALICE experiments was upgraded in order to fulfill the fraction of the whole CMS computing needs that is proportional to the size of the CMS group at Wigner RCP.

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Outreach. — The group has helped organizing several events in order to promote particle physics for the public. It appeared with the “All Colors of Physics Roadshow” at several venues. It participated in the annual Particle Physics Masterclass of CERN taking place at Wigner RCP. The groups presented its activities in the CERN-Wigner Open Days at Wigner RCP. It has contributed to a week-long curricular training for high school teachers at CERN. Our group helped the media in the explanation of fascinating scientific frontiers such as quantum teleportation; as well as, the research activities performed by the group (such as on quantum-gravitation) were displayed in popular media outlets.

Grants

OTKA K 109703: Consortial main: Hungary in the CMS experiment of the Large Hadron Collider (V. Veszprémi, Cs. Hajdu, P. Hidas, D. Horváth, Gy. Vesztergombi, T. Vámi); S&T Cooperation (J. Tóth); 2013-2016

OTKA K 103917: Antimatter investigations at the CERN Antiproton-Decelerator (D. Horváth, D. Barna, L. Diósi, 2012-2016)

EU COST Action MP1006 Fundamental Problems in Quantum Physics (L. Diósi, 2011-2015);

IUPAP support for FFK-2015 conference

International cooperation

CERN: CMS Collaboration (179 institutes), ATLAS Collaboration (174 institutes)

University of Kwa-Zulu Natal, South-Africa;

University of Calgary, Canada;

Stellenbosch University, South-Africa;

University of Tokyo, Japan;

RIKEN, Wako, Japan;

Stefan-Meyer-Institut, Vienna, Austria;

MPQ, München-Garching

Publications

Articles

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2. Aghai-Khozani H, Barna D, Corradini M, Hayano R, Hori M, Kobayashi T, Leali Marco, Lodi-Rizzini E, Mascagna V, Prest M, Soter A, Todoroki K, Vallazza E, Venturelli L, Zurlo N: Beam Diagnostics for Measurements of In-Flight Annihilation Cross Sections of Antiprotons at 130 keV. ***JPS CONFERENCE PROCEEDINGS*** 6: Paper 030111. 4 p. (2015) Proceedings of the Conference on Advances in Radioactive Isotope Science (ARIS2014).

3. Amsbaugh JF et al, incl. Glück F (50 authors): Focal-plane detector system for the KATRIN experiment. **NUCL INSTRUM METH A** 778: pp. 40-60. (2015)
4. Bassa H, Goyal SK, Choudhary SK, Uys H, Diósi L, Konrad T: Process tomography via sequential measurements on a single quantum system. **PHYS REV A** 92:(3) Paper 032102. 6 p. (2015)
5. Diósi L: Testing spontaneous wave-function collapse models on classical mechanical oscillators **PHYS REV LETT** 114:(5) Paper 050403. 5 p. (2015)
6. Diósi L: Is spontaneous wave function collapse testable at all? 7th International Workshop on Decoherence, Information, Complexity and Entropy (DICE) - Spacetime - Matter - Quantum Mechanics. Castiglioncello, Italy, 15.09.2014 – 19.09.2014. **J PHYS CONF SER** 626: Paper 012008. 5 p. (2015).
7. Goyal SK, Konrad T, Diósi L: Unitary equivalence of quantum walks. **PHYS LETT A** 379:(3) pp. 100-104. (2015)
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11. László A, Dénes E, Fodor Z, Kiss T, Kleinfelder S, Soós Cs, Tefelski D, Tölyhi T, Vesztegombi Gy, Wyszyński O: Design and Performance of the Data Acquisition System for the NA61/SHINE Experiment at CERN. **NUCL INSTRUM METH A** 798: pp. 1-11. (2015)
12. Mertens S, Dolde K, Korzeczek M, Glück F, Groh S, Martin RD, Poon AWP, Steidl M Wavelet approach to search for sterile neutrinos in tritium β -decay spectra **PHYS REV D** 91:(4) Paper 042005. (2015)
13. Mertens S, Lasserre T, Groh S, Drexlin G, Glück F, Huber A, Poon AWP, Steidl M, Steinbrink N, Weinheimer C: Sensitivity of next-generation tritium beta-decay experiments for keV-scale sterile neutrinos. **J COSMOL ASTROPART P** 2015:(2) Paper 020. (2015)
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Articles in Hungarian

15. Horváth D: Higgs-bozon és a világ vége vagy kezdete (Higgs boson and the start or end of the world, in Hungarian). *FIZIKAI SZEMLE* 95:(4) pp. 115-117. (2015)
16. Horváth D, Oláh É, Sükösd Cs, Varga D, Patkós A: Beszélgetés az elektron méretéről (Chat about the size of the electron, in Hungarian). *FIZIKAI SZEMLE* 65:(5) pp. 151-156. (2015)

ATLAS collaboration

Due to the vast number of publications of the large collaborations in which the research group participated in 2014, here we list only a short selection of appearances in journals with the highest impact factor.

1. Aad G et al., incl. Pásztor G, Tóth J (2890 authors): Centrality and rapidity dependence of inclusive jet production in $\sqrt{s_{NN}}=5.02$ TeV proton-lead collisions with the ATLAS detector. *PHYS LETT B* 748: pp. 392-413. (2015)
2. Aad G et al., incl. Pásztor G, Tóth J (2851 authors): Measurement of colour flow with the jet pull angle in $t\bar{t}$ events using the ATLAS detector at $\sqrt{s}=8$ TeV. *PHYS LETT B* 750: pp. 475-493. (2015)
3. Aad G, et al., incl. Pásztor G, Tóth J (2850 authors): Measurement of exclusive $\gamma\gamma \rightarrow \ell^+ \ell^-$ production in proton-proton collisions at $\sqrt{s}=7$ TeV with the ATLAS detector. *PHYS LETT B* 749: pp. 242-261. (2015)
4. Aad G et al., incl. Pásztor G, Tóth J (2856 authors): Measurement of the branching ratio $\Gamma(\Lambda_0 b \rightarrow \psi(2S)\Lambda_0)/\Gamma(\Lambda_0 b \rightarrow J/\psi\Lambda_0)$ with the ATLAS detector. *PHYS LETT B* 751: pp. 63-80. (2015)
5. Aad G et al., incl. Pásztor G, Tóth J (2882 authors): Measurement of the production of neighbouring jets in lead-lead collisions at $\sqrt{s_{NN}}=2.76$ TeV with the ATLAS detector. *PHYS LETT B* 751: pp. 376-395. (2015)
6. Aad G et al., incl. Pásztor G, Tóth J (2857 authors): Measurement of transverse energy-energy correlations in multi-jet events in pp collisions at $\sqrt{s}=7$ TeV using the ATLAS detector and determination of the strong coupling constant $\alpha_s(m_Z)$. *PHYS LETT B* 750: pp. 427-447. (2015)
7. Aad G et al., incl. Pásztor G, Tóth J (2898 authors): Search for pair-produced long-lived neutral particles decaying to jets in the ATLAS hadronic calorimeter in pp collisions at $\sqrt{s}=8$ TeV. *PHYS LETT B* 743: pp. 15-34. (2015)
8. Aad G et al., incl. Pásztor G, Tóth J (2889 authors): Search for s-channel single top-quark production in proton-proton collisions at $\sqrt{s}=8$ TeV with the ATLAS detector. *PHYS LETT B* 740: pp. 118-136. (2015)
9. Aad G et al., incl. Pásztor G, Tóth J (2828 authors): Search for the associated production of the Higgs boson with a top quark pair in multilepton final states with the ATLAS detector. *PHYS LETT B* 749: pp. 519-541. (2015)
10. Aad G et al., incl. Pásztor G, Tóth J (2886 authors): Search for $W^+ \rightarrow t\bar{b}$ in the lepton plus jets final state in proton-proton collisions at a centre-of-mass energy of $\sqrt{s}=8$ TeV with the ATLAS detector. *PHYS LETT B* 743: pp. 235-255. (2015)

11. Abbott B et al., incl. [Pásztor G](#), [Tóth J](#) (2826 authors): Search for a CP-odd Higgs boson decaying to Zh in pp collisions at $\sqrt{s}=8$ TeV with the ATLAS detector. *PHYS LETT B* 744: pp. 163-183. (2015)
12. Abbott B et al., incl. [Pásztor G](#), [Tóth J](#) (2889 authors): Search for $H \rightarrow \gamma\gamma$ produced in association with top quarks and constraints on the Yukawa coupling between the top quark and the Higgs boson using data taken at 7 TeV and 8 TeV with the ATLAS detector. *PHYS LETT B* 740: pp. 222-242. (2015)
13. Abbott B et al., incl. [Pásztor G](#), [Tóth J](#): (2890 authors): Search for the X_b and other hidden-beauty states in the $\pi^+\pi^-\Upsilon(1S)$ channel at ATLAS. *PHYS LETT B* 740: pp. 199-217. (2015)
14. Aad G et al., incl. [Pásztor G](#), [Tóth J](#), [Bencze G](#), [Hajdu C](#), [Hidas P](#), [Horváth D](#), [Siklér F](#), [Veszpremi V](#), [Vesztergombi G](#), [Zsigmond AJ](#) (5154 authors): Combined Measurement of the Higgs Boson Mass in pp Collisions at $\sqrt{s} = 7$ and 8 TeV with the ATLAS and CMS Experiments. *PHYS REV LETT* 114:(19) Paper 191803. 45 p. (2015)
15. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2854 authors): Determination of the Ratio of b - Quark Fragmentation Fractions f_s / f_d in pp Collisions at $\sqrt{s} = 7$ TeV with the ATLAS Detector. *PHYS REV LETT* 115:(26) Paper 262001. 18 p. (2015)
16. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2828 authors): Evidence of $W_{\gamma\gamma}$ Production in pp Collisions at $\sqrt{s}=8$ TeV and Limits on Anomalous Quartic Gauge Couplings with the ATLAS Detector. *PHYS REV LETT* 115:(3) Paper 031802. 18 p. (2015)
17. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2877 authors): Measurement of Spin Correlation in Top-Antitop Quark Events and Search for Top Squark Pair Production in pp Collisions at $\sqrt{s}=8$ TeV Using the ATLAS Detector. *PHYS REV LETT* 114:(14) Paper 142001. 19 p. (2015)
18. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2890 authors): Measurements of the Nuclear Modification Factor for Jets in Pb + Pb Collisions at $\sqrt{s_{NN}}=2.76$ TeV with the ATLAS Detector. *PHYS REV LETT* 114:(7) Paper 072302. 18 p. (2015)
19. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2820 authors): Measurements of the Total and Differential Higgs Boson Production Cross Sections Combining the $H \rightarrow \gamma\gamma$ and $H \rightarrow ZZ^* \rightarrow 4 \ell$ Decay Channels at $\sqrt{s} = 8$ TeV with the ATLAS Detector. *PHYS REV LETT* 115:(9) Paper 091801. 19 p. (2015)
20. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2825 authors): Search for a Charged Higgs Boson Produced in the Vector-Boson Fusion Mode with Decay using pp Collisions at $\sqrt{s}=8$ TeV with the ATLAS Experiment. *PHYS REV LETT* 114:(23) Paper 231801. 18 p. (2015)
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22. Aad G et al., incl. [Pásztor G](#), [Tóth J](#) (2827 authors): Search for Dark Matter in Events with Missing Transverse Momentum and a Higgs Boson Decaying to Two Photons in pp Collisions at $\sqrt{s}=8$ TeV with the ATLAS Detector. *PHYS REV LETT* 115:(13) Paper 131801. 19 p. (2015)
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See also: R-H CMS Collaboration, R-H. NA49 Collaboration