

Collaborations in Particle Physics: Israel and DESY /Uni HH



Prof. Dr. Beate Heinemann

Deutsches Elektronen-Synchrotron (DESY Hamburg) und Universität Freiburg

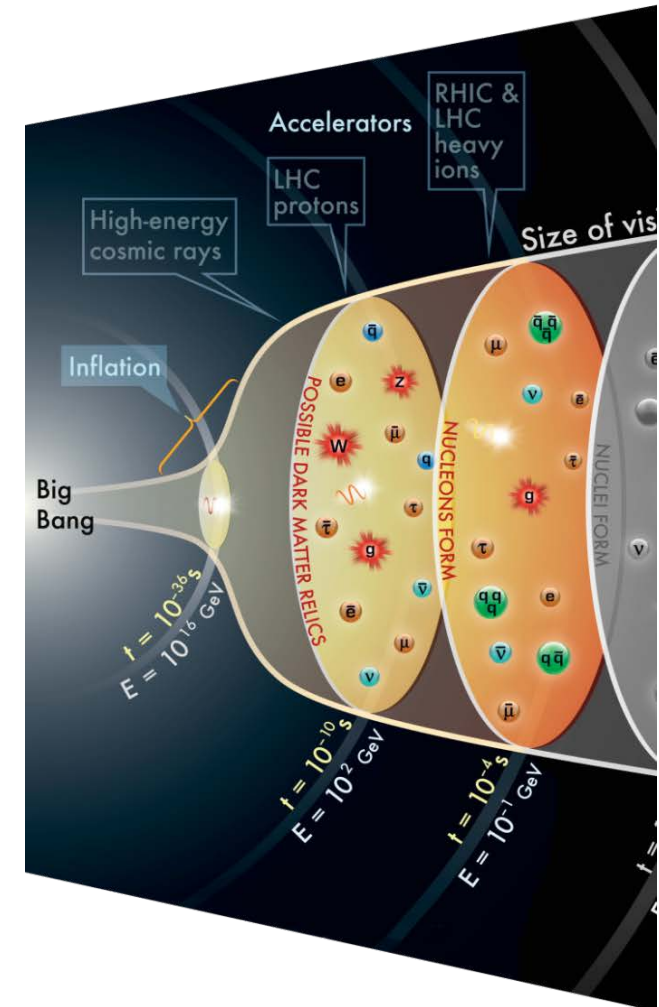
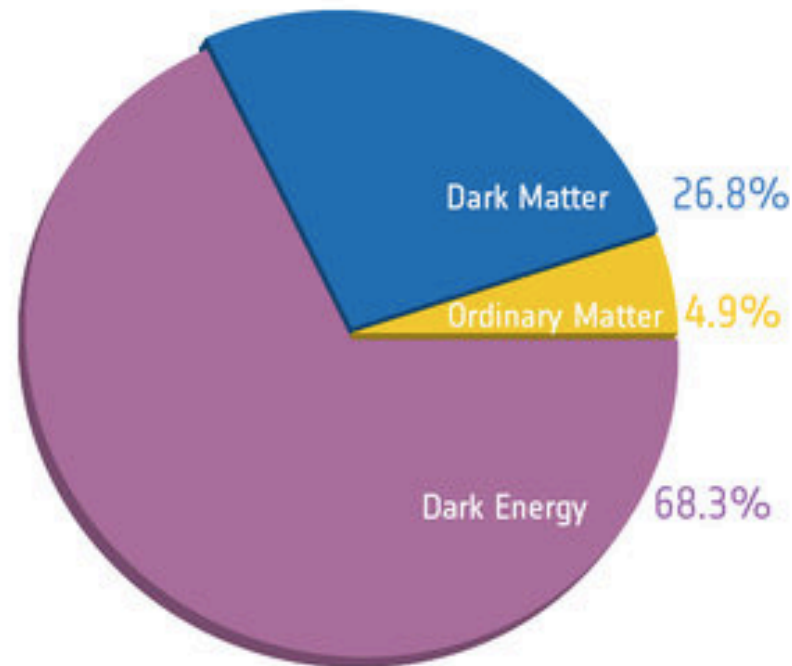
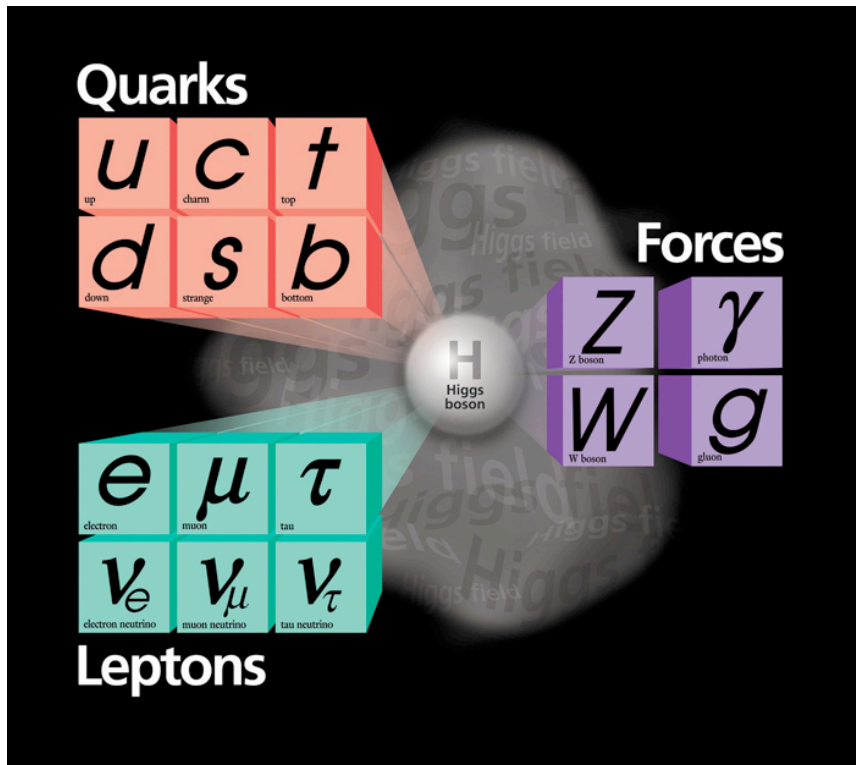


HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES



Major Goals of Particle Physics today

- What role(s) does the Higgs boson play?
- What is dark matter and dark energy?
- Where did all the anti-matter go?
- ...

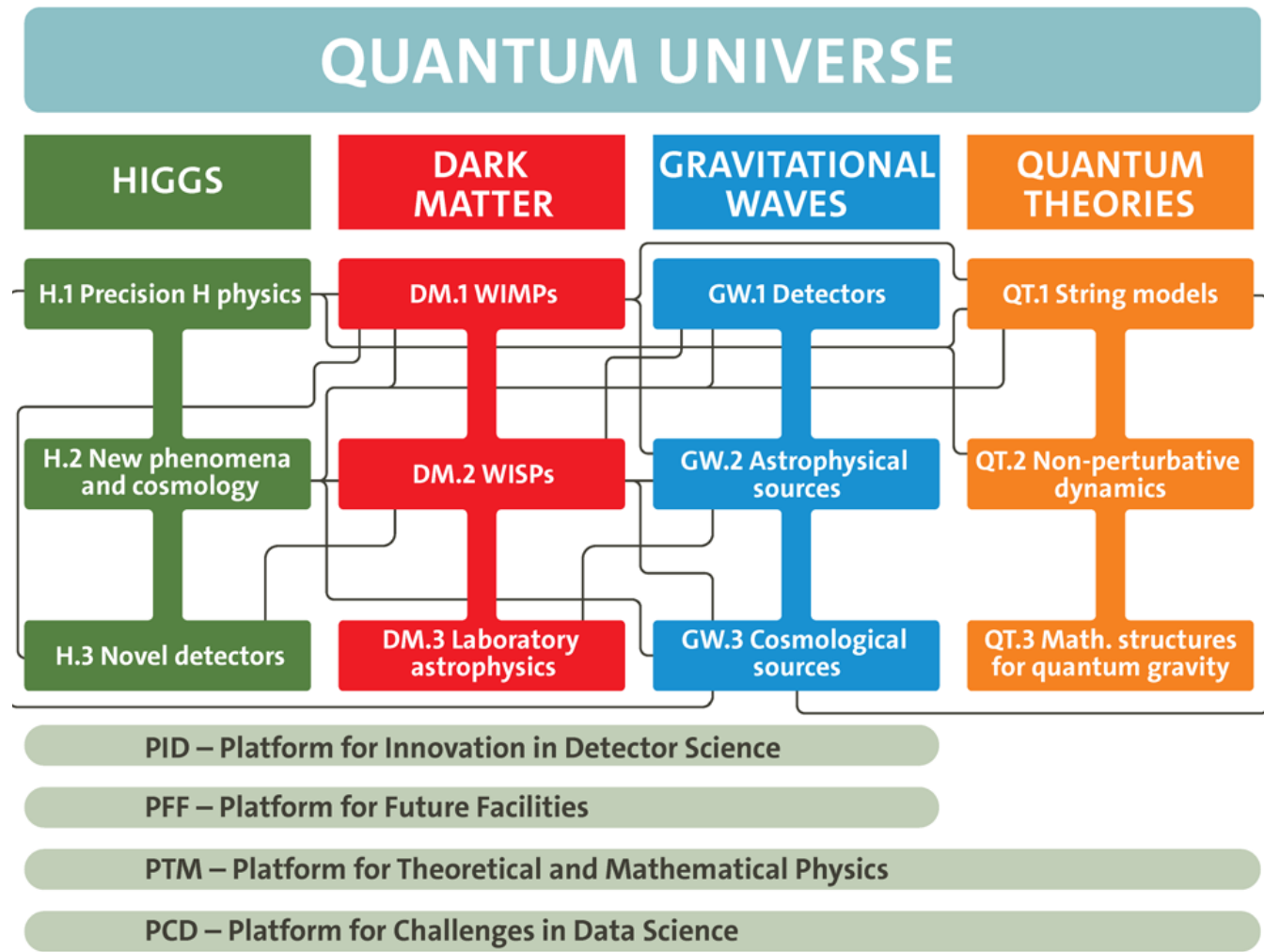


Started in Jan. 2019

- University of Hamburg & DESY
- More than 200 scientists involved



Principle Investigators of Quantum Universe

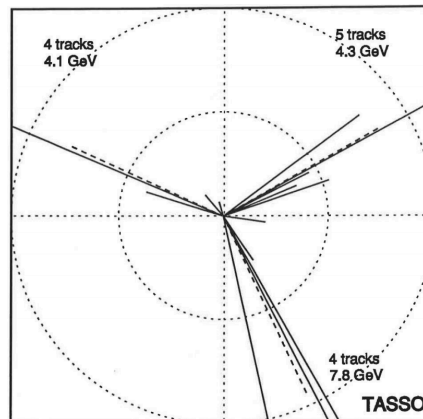
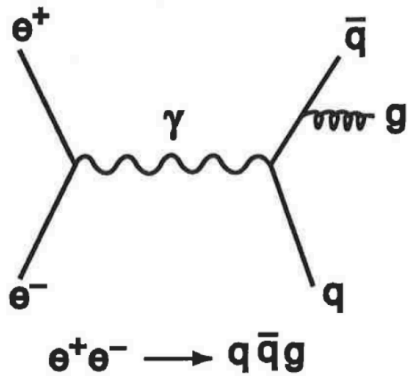


Strong collaboration with scientists from Israel in many of these areas

History: Gluon Discovery at PETRA

PETRA (Positron-Electron-Tandem-Ring-Anlage)

- 1978-1986: world's highest energy e^+e^- collider, length: 2.3 km
- Now: PETRA-III used to create synchrotron radiation for photon science

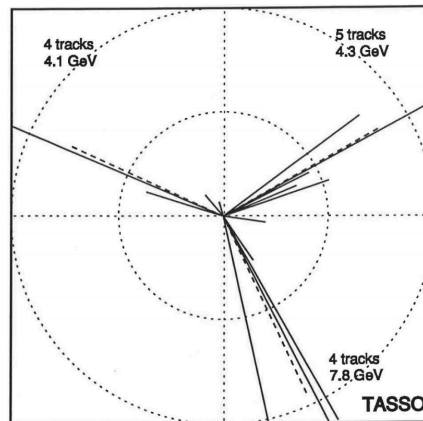
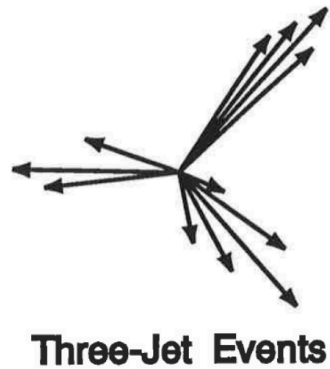
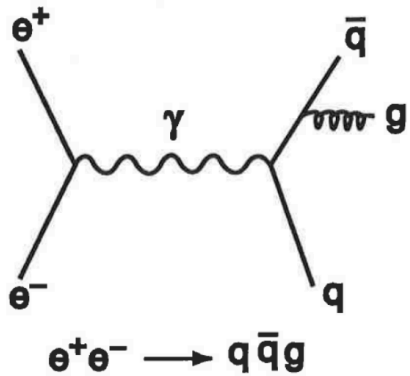


Event shown by B. Wiik of TASSO at conference in Bergen 1979

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Yehuda Eisenberg

Volume 86B, number 2

PHYSICS LETTERS

24 September 1979

EVIDENCE FOR PLANAR EVENTS IN e^+e^- ANNIHILATION AT HIGH ENERGIES

TASSO Collaboration

R. BRANDELIK, W. BRAUNSCHWEIG, K. GATHER, V. KADANSKY, K. LÜBELSMEYER, P. MÄTTIG, H.-U. MARTYN, G. PEISE, J. RIMKUS, H.G. SANDER, D. SCHMITZ, A. SCHULTZ von DRATZIG, D. TRINES and W. WALLRAFF
*I. Physikalisches Institut der RWTH Aachen, Germany*⁵

H. BOERNER, H.M. FISCHER, H. HARTMANN, E. HILGER, W. HILLEN, G. KNOP, W. KORBACH, P. LEU, B. LÖHR, F. ROTH¹, W. RÜHMER, R. WEDEMEYER, N. WERMES and M. WOLLSTADT
*Physikalisches Institut der Universität Bonn, Germany*⁵

R. BÜHRING, R. FOHRMANN, D. HEYLAND, H. HULTSCHIG, P. JOOS, W. KOCH, U. KÖTZ, H. KOWALSKI, A. LADAGE, D. LÜKE, H.L. LYNCH, G. MIKENBERG², D. NOTZ, J. PYRLIK, R. RIETHMÜLLER, M. SCHLIWA, P. SÖDING, B.H. WIJK and G. WOLF
Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

M. HOLDER, G. POELZ, J. RINGEL, O. RÖMER, R. RÜSCH and P. SCHMÜSER
*II. Institut für Experimentalphysik der Universität Hamburg, Germany*⁵

D.M. BINNIE, P.J. DORNAN, N.A. DOWNIE, D.A. GAR BUTT, W.G. JONES, S.L. LLOYD, D. PANDOULAS, A. PEVSNER³, J. SEDGEBEER, S. YARKER and C. YOUNGMAN
*Department of Physics, Imperial College, London, England*⁶

R.J. BARLOW, R.J. CASHMORE, J. ILLINGWORTH, M. OGG and G.L. SALMON
*Department of Nuclear Physics, Oxford University, England*⁶

K.W. BELL, W. CHINOWSKY⁴, B. FOSTER, J.C. HART, J. PROUDFOOT, D.R. QUARRIE, D.H. SAXON and P.L. WOODWORTH
*Rutherford Laboratory, Chilton, England*⁶

Y. EISENBERG, U. KARSHON, E. KOGAN, D. REVEL, E. RONAT and A. SHAPIRA
*Weizmann Institute, Rehovot, Israel*⁷

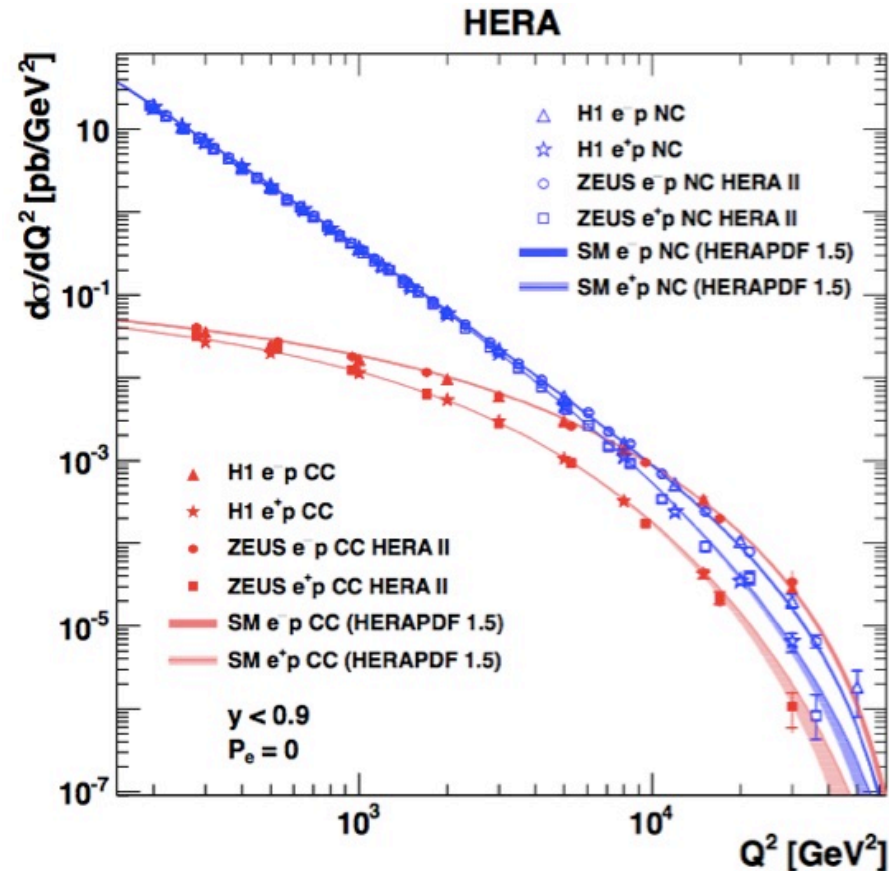
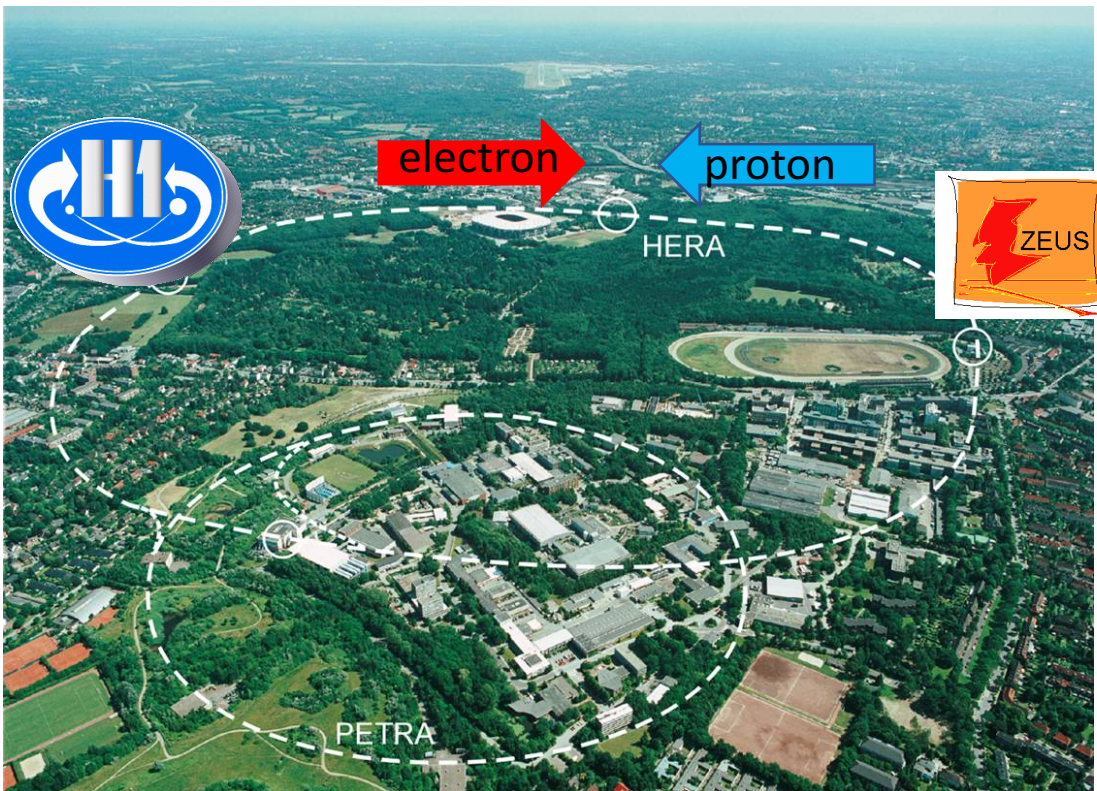
J. FREEMAN, P. LECOMTE, T. MEYER, SAU LAN WU and G. ZOBERNIG
*Department of Physics, University of Wisconsin, Madison, WI, USA*⁸

Received 29 August 1979

History: Understanding the Proton at HERA

HERA: (Hadron-Electron-Ring-Anlage)

- 1992-2007: world's first *electron-proton* collider
- Experiments: H1, ZEUS, HERMES → proton structure, unification of forces, ...



supported by GIF grant: Abramowicz, Levy,...

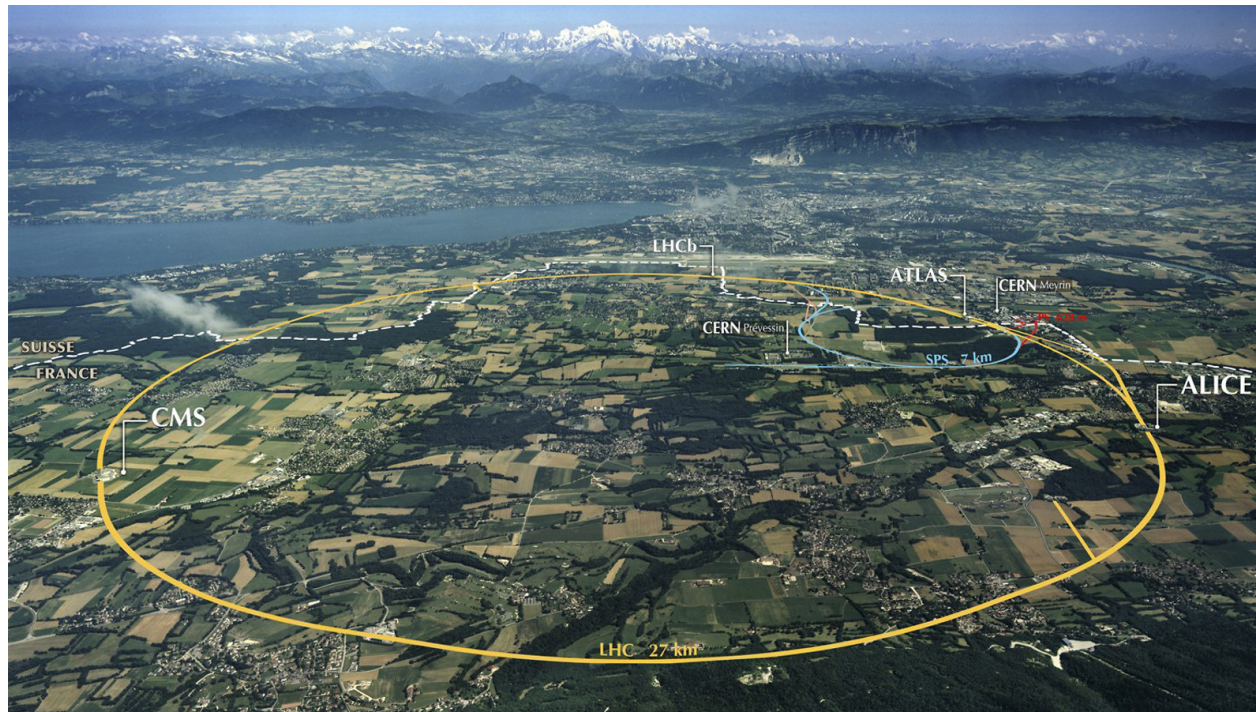


Working together at CERN

LHC (Large Hadron Collider)

- 2008-2037: world's highest energy pp collider at CERN near Geneva
- Experiments: ATLAS, CMS, LHCb, ALICE => Higgs boson discovery, ...
- Germany and Israel member states of CERN

Ceremony for admission of Israel, 2013



ATLAS Collaboration: A Global Experiment

38 Countries
103 nationalities
~2000 Scientists
~1800 Students
~5000 Members

Scientists and students

- DESY: ~100
- Technion U.
- Tel Aviv U.
- Weizmann Inst.

} ~60



ATLAS Collaboration
member nationalities

Over 5500 members of 103 nationalities

Collaboration among particle physics theorists

Vibrant exchange program: focus on young scientists

- Student and postdoc exchanges
- Joint postdoc: Wolfgang-Pauli-Center HH & WIS
- Many joint grant: GIF, Minerva, Helmholtz Research School, ...



Joint grants currently

International Helmholtz-Weizmann Research School “Multimessenger Astronomy”

Among PIs: Kfir Blum & Yossi Nir & Gilad Perez (Weizmann), Christophe Grojean (DESY)

Minerva grant “Probing the Higgs force and new physics with isotope shift spectroscopy”

Weizmann PIs: Roei Ozeri & Gilad Perez

German PIs: Dmitry Budker (Mainz) & Christophe Grojean (DESY)

COST Action “Connecting insights in fundamental physics”

Sofja Kovalevskaja “New tools in the quest for new physics” (declined)

PI: Yotam Soreq

DESY host: Christophe Grojean

GIF project “Electroweak Symmetry Breaking Beyond the Higgs” (under review)

Technion PIs: Yael Shadmi & Yotam Soreq

DESY PIs: Christophe Grojean & Géraldine Servant



GIF Young Scientists' Meetings



DESY-GIF Young Scientists' Meeting

“Origins: from elementary particles to complex chemical and biological systems”

March 18-20, 2019

DESY Hamburg, Germany

Scientific Organizing Committee:

Prof. Christophe Grojean, DESY

Prof. Simone Techert, DESY

Prof. Gonen Ashkenasy, Ben Gurion University

Prof. Erez Etzion, Tel-Aviv University



*Elina Fuchs,
Uni HH PhD 2015,
Minerva postdoc
fellow at WIS*

Examples of Joint Publications



PUBLISHED FOR SISSA BY SPRINGER

RECEIVED: October 31, 2018
ACCEPTED: January 8, 2019
PUBLISHED: January 14, 2019

New axion searches at flavor factories

Xabier Cid Vidal,^a Alberto Mariotti,^b Diego Redigolo,^{c,d,e} Filippo Sala^f and Kohsaku Tobioka^{g,h}

^aInstituto Galego de Física de Altas Enerxías (IGFAE), Santiago de Compostela, Spain

^bTheoretische Natuurkunde and IHE/ELEM,

Vrije Universiteit Brussel, and International Solvay Institutes, Pleinlaan 2, B-1050 Brussels, Belgium

^cRaymond and Beverly Sackler School of Physics and Astronomy, Tel-Aviv University, Tel-Aviv 69978, Israel

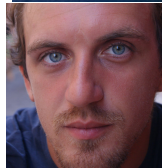
^dSchool of Natural Sciences, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540, U.S.A.

^eDepartment of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 7610001, Israel

^fDESY, Notkestraße 85, D-22607 Hamburg, Germany

^gDepartment of Physics, Florida State University, Tallahassee, FL 32306, U.S.A.

^hTheory Center, High Energy Accelerator Research Organization (KEK), Tsukuba 305-0801, Japan



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PUBLISHED: October 31, 2018

PHYSICAL REVIEW LETTERS **120**, 091801 (2018)

Probing New Long-Range Interactions by Isotope Shift Spectroscopy

Julian C. Berengut,^{1,*} Dmitry Budker,^{2,3,4,†} Cédric Delaunay,^{5,‡} Victor V. Flambaum,^{1,§} Claudia Frugiuele,^{6,||} Elina Fuchs,^{6,‡} Christophe Grojean,^{7,8,*} Roni Harnik,^{9,††} Roee Ozeri,^{10,‡‡} Gilad Perez,^{6,§§} and Yotam Soreq^{11,|||}

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⁴Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA

⁵Laboratoire d'Annecy-le-Vieux de Physique Théorique LAPTh, CNRS—Université Savoie Mont Blanc, BP 110, F-74941 Annecy-le-Vieux, France

⁶Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 7610001, Israel

⁷DESY, D-22607 Hamburg, Germany

⁸Institut für Physik, Humboldt-Universität zu Berlin, D-12489 Berlin, Germany

⁹Theoretical Physics Department, Fermi National Accelerator Laboratory, Batavia, Illinois 60510, USA

¹⁰Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot 7610001, Israel

¹¹Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA



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Fusing vectors into scalars at high energy lepton colliders

Dario Buttazzo,^a Diego Redigolo,^{b,c,d} Filippo Sala^e and Andrea Tesi^f

^aINFN Sezione di Pisa, Largo B. Pontecorvo 3, I-56127 Pisa, Italy

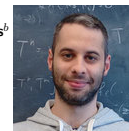
^bSchool of Natural Sciences, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540, U.S.A.

^cRaymond and Beverly Sackler School of Physics and Astronomy, Tel-Aviv University, Chaim Lewinson St 55, Tel-Aviv 69978, Israel

^dDepartment of Particle Physics and Astrophysics, Weizmann Institute of Science, 234 Herzl Street, Rehovot 7610001, Israel

^eDESY, Notkestraße 85, D-22607 Hamburg, Germany

^fINFN Sezione di Firenze, Via G. Sansone 1, I-50019 Sesto Fiorentino, Italy



Calogero-Sutherland approach to defect blocks

Mikhail Isachenkov,^a Pedro Liendo,^b Yannick Linke^b and Volker Schomerus^b

^aDepartment of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 76100, Israel

^bDESY Hamburg, Theory Group,

Notkestraße 85, D-22607 Hamburg, Germany

PHYSICAL REVIEW D **99**, 123503 (2019)

Classical nonrelativistic effective field theory and the role of gravitational interactions

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¹Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 761001, Israel

²DESY, Notkestraße 85, D-22607 Hamburg, Germany

³Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221, USA

⁴Institute of Cosmology, Department of Physics and Astronomy, Tufts University, Medford, Massachusetts 02155, USA

PHYSICAL REVIEW D **99**, 103020 (2019)

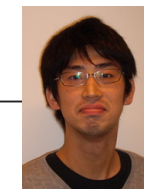
Ultralight dark matter in disk galaxies

Nitsan Bar,^{1,*} Kfir Blum,^{1,2,†} Joshua Eby,^{1,‡} and Ryosuke Sato^{3,§}

¹Weizmann Institute of Science, Rehovot 7610001, Israel

²Theory department, CERN, CH-1211 Geneva 23, Switzerland

³Deutsches Elektronen-Synchrotron (DESY), Notkestraße 85, D-22607 Hamburg, Germany



The Higgs program and open questions in particle physics and cosmology

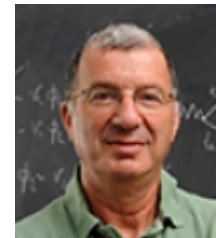
Beate Heinemann^{1,2a}, and Yosef Nir^{3b1}

¹Deutsches Elektronen-Synchrotron, 22607 Hamburg, Germany

²Albert-Ludwigs-Universität Freiburg, Physikalisches Institut, 79104 Freiburg, Germany

³Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot, Israel 7610001*

The Higgs program is relevant to many of the open fundamental questions in particle physics and in cosmology. Thus, when discussing future collider experiments, one way of comparing them is by assessing their potential contributions to progress on these questions. We discuss in detail the capabilities of the various proposed experiments in searching for singlet scalars, which are relevant to several of the open questions, and in measuring Higgs decays to fermion pairs, which are relevant to the flavor puzzles. On other interesting questions, we list the most relevant observables within the Higgs program.

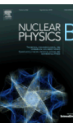


Collider
BSM
Cosmo
Mathematical Physics



Nuclear Physics B

Volume 480, Issues 1–2, 25 November 1996, Pages 185–212

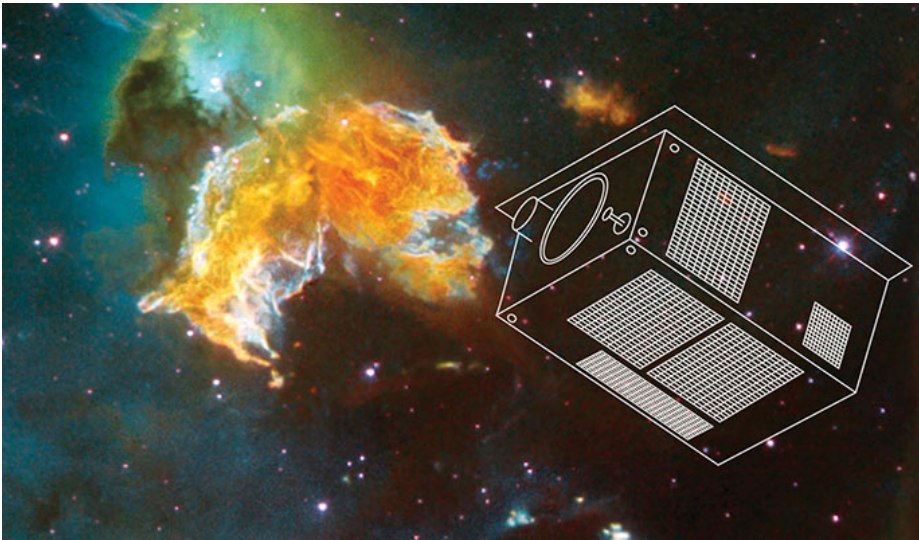


Non-perturbative properties of heterotic string vacua compactified on $K3 \times T^2$ ☆

J. Louis^a, J. Sonnenschein^b, S. Theisen^a, S. Yankielowicz^b



Astrophysics: New Satellite “ULTRASAT”



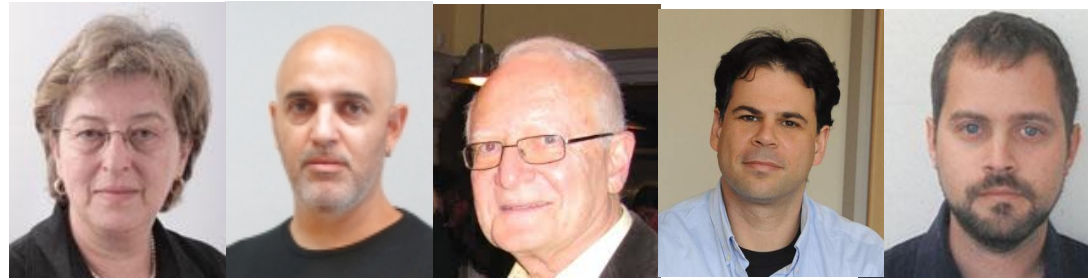
E. Waxman, WIS



R. Bühler, DESY

- **Satellite hosts telescope with very large view in ultraviolet regime**
 - Increases extra-Galactic volume sensitivity for UV by ~ 300
 - Cost \$70M, weight 160 kg, size 1 m³, geosynchronous orbit
- **Ultrafast search for electromagnetic sources to follow up or provide alert for astrophysical event within minutes**
 - e.g. gravitational waves or supernovae
- **DESY will contribute UV camera (Focal Plane Array)**
- **Launch into space planned for 2023**

New Experiment at European XFEL: **LUXE**



*Halina Abramowicz, A. Levy, I. Pomerantz (TAU)
Noam Tal Hod, G. Perez (WIS)*

New Experiment to probe quantum physics

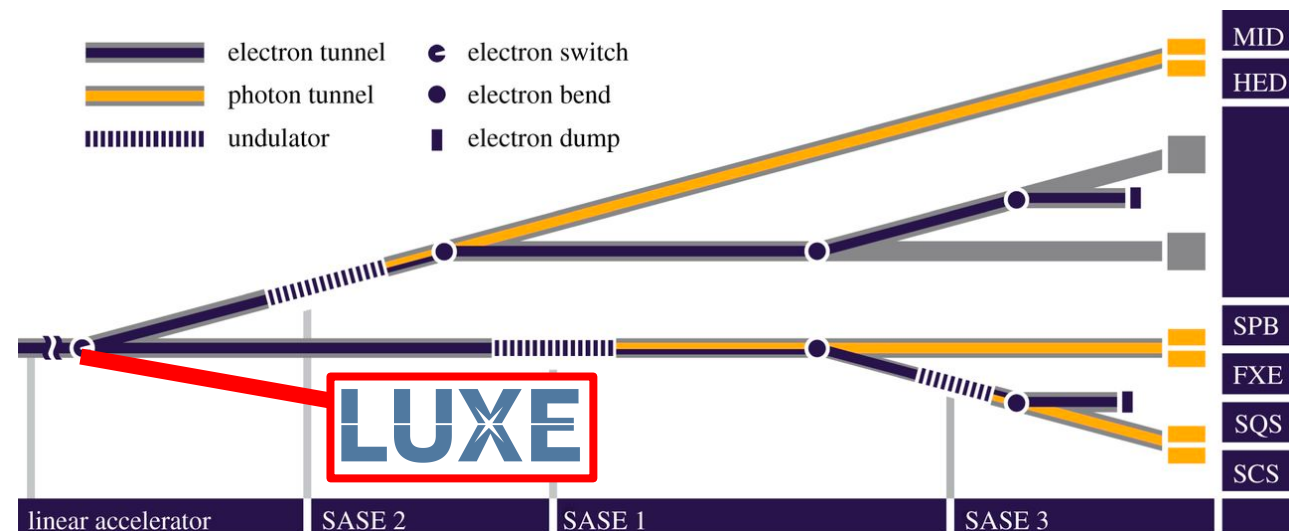
- Laser Und XFEL Experiment
- Quantum Electrodynamics in strong field
- Hope to start data taking ~2022/2023

GIF and MINERVA applications pending

Letter of Intent for the LUXE Experiment

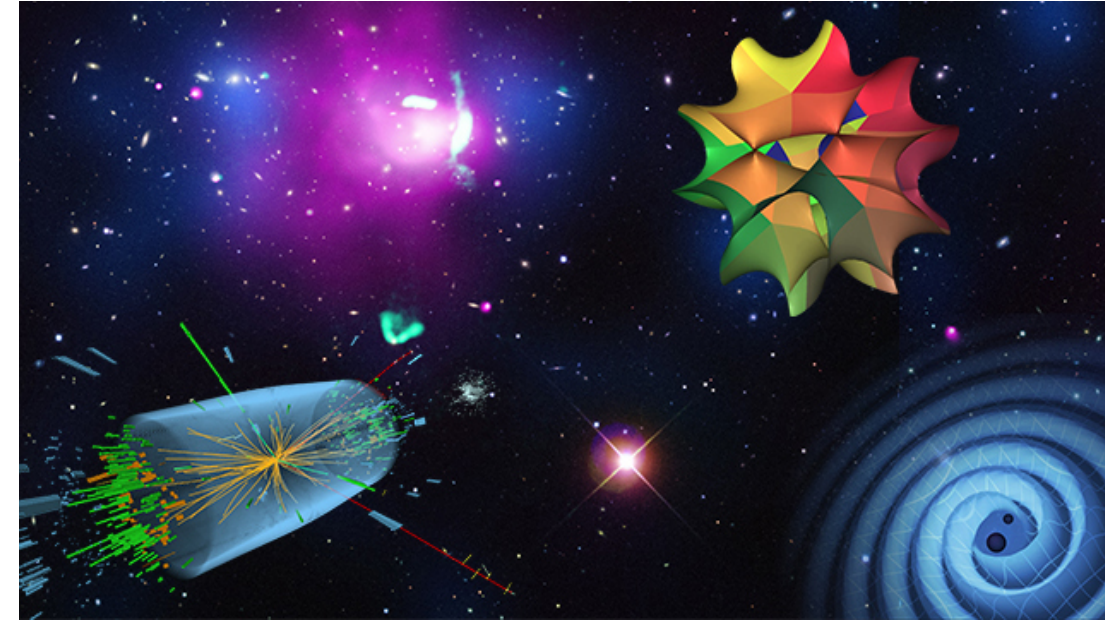
H. Abramowicz¹, M. Altarelli², R. Aßmann³, T. Behnke³, Y. Benhammou¹, O. Borysov³, M. Borysova⁴, R. Brinkmann³, F. Burkart³, K. Büber³, O. Davidi⁵, W. Decking³, N. Elkina⁶, H. Harsh⁶, A. Hartin⁷, I. Hartl³, B. Heinemann^{3,8}, T. Heinzl⁹, N. Tal Hod⁵, M. Hoffmann³, A. Ilderton⁹, B. King⁹, A. Levy¹, J. List³, A. R. Maier¹⁰, E. Negodin³, G. Perez⁵, I. Pomerantz¹, A. Ringwald³, C. Rödel⁶, M. Saimpert³, F. Salgado⁶, G. Sarri¹¹, I. Savoray⁵, T. Teter⁶, M. Wing⁷, and M. Zepf^{6,11,12}

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⁷University College London, London, WC1E 6BT, UK
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¹¹Queens University Belfast, Belfast BT7 1NN, UK
¹²Friedrich Schiller Universität Jena, Jena, 07743, Germany



Conclusions

- **Particle physics is a truly global endeavor**
 - Understand fundamental laws of physics in our Universe (“Quantum Universe”)
- **Past and present collaboration Israel/DESY**
 - Strong history of collaboration since 1970s
 - New projects starting (ULTRASAT, LUXE, Helmholtz Research School, joint postdoc, ...)
 - GIF, ISF and Minerva grants very important



Looking forward to further deepen interactions in particle physics and other science areas!