NEWS letter

MIRROR

Issue 22 August 2022

Highlights

- Anti-matter research is changing gears
- ASACUSA sees surprising behaviour of hybrid matter
- BASE collaboration compares proton and anti-protons with an unprecedented precision
- Concept for new magnet type published in IEEE Transactions

Dear friends of low energy antimatter and ion physics,

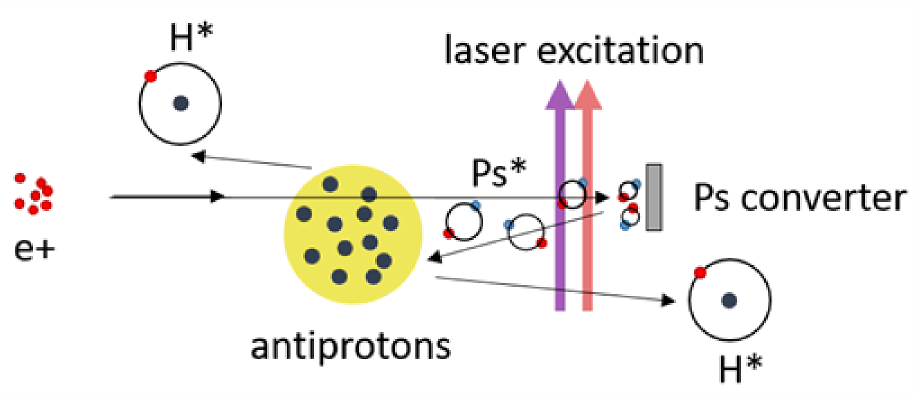
Last month, the global research community celebrated the 10th anniversary of the "Higgs Nobel Prize". The discovery of this illusive particle back in 2012 was a huge milestone for fundamental research, enabled by the construction of the world's highest energy particle accelerator, the Large Hadron Collider. It is a fantastic example of just how much international and in fact global collaboration can achieve. By bringing the brightest minds, most talented engineers and specialists together, the LHC has already helped us understand nature significantly better. When the accelerator started again, it reached an unprecedented collision energy of 13.6 TeV. Live coverage from the CERN LHC and experiment control rooms allowed those interested around the world to follow this exciting relaunch. Congratulations to everyone who helped make this possible!

I am excited to announce that I was successful in attracting funding for a new Horizon Europe MSCA network: The EuPRAXIA Doctoral Network will be the sixth Marie Curie network that I have initiated and start on 1 January 2023. It will train a cohort of Marie Curie Fellows on the research challenges of a next-generation plasma accelerator. Funded by the EU and UKRI, the network will build upon the success of AVA and involve a number of AVA partners, including Carbon Digital, Fistral, CIVIDEC, INFN and of course Liverpool. EuPRAXIA is the first European project that develops a dedicated particle accelerator research infrastructure based on novel plasma acceleration concepts and laser technology. The Fellows in the network will be trained between universities, research centers and industry and carry out interdisciplinary and cross-sector plasma accelerator R&D. They will benefit from the many experiences we have gained in AVA and of course all events will be open to AVA partners and former Fellows.

Prof Dr Carsten P Welsch,
Coordinator

Research News

Anti-matter research is changing gears



New collinear scheme of antihydrogen production at AEgIS

Antimatter research is changing gears. While the past decade was dominated by proof-of-concept experiments with antihydrogen at the Antiproton Decelerator (AD) at CERN, scientists are now using this extremely rare particle for precision measurements. The symmetries between matter and antimatter are being tested, and, if violated, could give us a hint at the answer to the great question of why our universe exists.

In 2018, the AEgIS (Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy) experiment at the AD facility succeeded in producing pulses of antihydrogen atoms with excellent time precision. Meanwhile the ALPHA (Antihydrogen Laser Physics Apparatus) experiment performed a series of spectroscopic measurements on the first excited levels of antihydrogen. More recently BASE (Baryon Antibaryon Symmetry Experiment) has measured the antiproton to proton charge-mass ratio to an accuracy of 16-parts-per-trillion. None of these have found any violations of symmetry.

During the recent long shutdown period at CERN, the new ELENA (Extra Low Energy Antiproton) storage ring was commissioned, and all AD experiments were connected to it, yielding a 100-fold increase of trappable antiprotons.

AEgIS now has arrived at its second phase with the goal to create an intense pulsed beam of antihydrogen atoms for gravitational measurements. The increase in the number of antiprotons is one of the three major developments which will help to reach this goal. Another is a novel positron-to-positronium (Ps) converter target based on nano channelled silicon with the ability to emit up to five times more positronium than the old converter did, which also increases the antihydrogen production rate. Finally, in the new experimental alignment positronium and antiprotons only propagate along the beam axis, avoiding Ps losses due to self-ionization by moving perpendicular to strong magnetic fields which was found previously.

Several new groups have recently joined AEgIS. These are Warsaw University of Technology, Raman Research Institute, Nikolaus-Copernicus-Universität Toruń, the Polish Academy of Sciences and the University of Liverpool. The addition of these groups significantly increases the scientific expertise within the collaboration; The formation of positronium beams for QED precision measurements and creating novel antiproton systems for fundamental studies on hadronic (anti)matter are some of the key topics to be addressed soon. Stay tuned!

ASACUSA sees surprising behaviour of hybrid matter – antimatter atoms in superfluid helium

Masaki Hori, ASACUSA co-spokesperson (Image: CERN)

The ASACUSA collaboration has reported the unexpected behaviour of a hybrid matter–antimatter helium atom immersed in superfluid helium. The results are described in a paper recently published in the journal Nature.

The ASACUSA (Atomic Spectroscopy And Collisions Using Slow Antiprotons) collaboration uses the Radio Frequency Decelerator downstream of Antiproton Decelerator at CERN to make hybrid matter–antimatter helium atoms containing an antiproton instead of one of the electrons. Then they use precision laser spectroscopy to determine the antiproton's mass and compare it with that of the proton.

These hybrid atoms are made by mixing the antiprotons with a low-density helium gas at low temperature. Low gas densities and temperatures have played a key role in the spectroscopic measurements of the hybrid atoms, as high gas densities and temperatures result in spectral lines that are too broad to allow the mass of the antiproton to be determined.

This is why it came as surprise to the ASACUSA researchers that, when liquid helium was used instead of gaseous helium, they saw a decrease in the width of the antiproton spectral lines. Moreover, when they decreased the temperature of the liquid helium so that it became superfluid, they found an abrupt further narrowing of the spectral lines.

The researchers think that the surprising behaviour observed is linked to the radius of the electronic orbital, which, in the case of the hybrid atoms, changes very little when laser light is shone on them. Therefore, it would not affect the spectral lines even when the atom is immersed in superfluid helium. However, further studies are needed to confirm this hypothesis.

The result has several implications. Firstly, researchers may create other hybrid helium atoms, such as **pionic helium atoms**, in superfluid helium to measure the particle masses by laser spectroscopy. Secondly, the substantial narrowing of the lines in superfluid helium suggests that hybrid helium atoms could be used to study this form of matter and potentially other condensed-matter phases.

Finally, the narrow spectral lines could be used to search for cosmic low-energy antiprotons or antideuterons that hit the liquid helium used to cool experiments in space or in high-altitude balloons.

The full article can be found in:

Sótér, A., Aghai-Khozani, H., Barna, D. et al., **High-resolution laser resonances of antiprotonic helium in superfluid ^{4}He,** Nature **603,** 411–415 (2022). https://doi.org/10.1038/s41586-022-04440-7

Concept for new magnet type published in IEEE Transactions

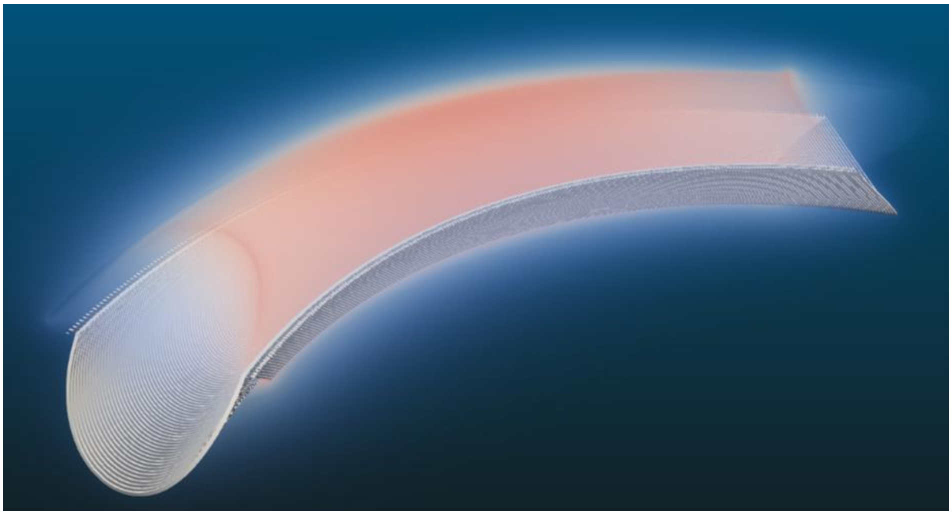
In a paper recently published in IEEE Transactions on Applied Superconductivity, Glyn Kirby together with AVA Fellow Volodymyr Rodin and colleagues, have presented a new concept for a 2.2 T Curved Cosine Theta (CCT) magnet for the future HIE-ISOLDE Superconducting Fragment Separator (ISRS).

The recent development of radioactive beam facilities, such as the HIE-ISOLDE facility at CERN, delivers the largest range of low-energy radioactive beams, exploited by several detector systems to investigate nuclear properties from the stable isotopes to the very exotic systems close to the neutron or proton drip lines.

Compact, low-cost, curved multi-function superconducting magnets with a large aperture are needed to contain the large emittance circulating beam of reaction fragments. This will allow to store several light/heavy radioisotopes simultaneously and to separate them from the main beam.

The designed magnet plays a key role in the proposed concept of the spectrometer. The demanding features that led to the selection of the CCT coil are extreme field profile flexibility, compact coil, and the short distance from the coil to the end of the magnet support. For low field magnets up to about 5 T, the CCT concept offers significant cost savings over more traditional collared coil designs.

This magnet is expected to provide great flexibility in the operation of the HIE-ISOLDE spectrometer across various modes of operation. Additionally, it will provide vital experience in the operation of CCT magnets for the HL-LHC team, which plans to utilize a similar technology as part of future upgrades.



3D field inside the CCT magnet (Image credit: V. Rodin and G. Kirby)

Full article:

G. Kirby et al., **Superconducting Curved Canted–Cosine–Theta (CCT) for the HIE-ISOLDE Recoil Separator Ring at CERN**, in IEEE Transactions on Applied Superconductivity, vol. **32**, no. 6, pp. 1-5, Sept. 2022, Art no. 4004105, 10.1109/TASC.2022.3158332.

Network News

AVA welcomes new Project Manager

AVA Project Manager, Naomi Smith.

The AVA consortium would like to extend a very warm welcome to Naomi Smith, who joined AVA as part-time Project Manager in April 2022.

Naomi obtained a first degree in Physics from the University of Manchester after which she started working as an accelerator physicist in the ASTeC accelerator physics group. She worked on the design study for the Diamond Light Source and was involved in the operation of the Synchrotron Radiation Source as well as communication activities such as editing the ASTeC annual report and maintaining the ASTeC website. She also became a STEM Ambassador and became experienced in science outreach activities.

She went on to study for an M.Sc. in Science Communication and worked in Science Centres in Wrexham and Widnes before joining CERN as a Communications Officer in the EU Projects Office.

Next she went on to work at Jodrell Bank Discovery Centre as an Education and Events Manager. During her time there she developed and delivered workshops for school children and organised events for families and adult audiences such as Stargazing nights and the Lovell lecture series. She was also involved in the development and delivery of several externally funded projects such as Explore your Universe, Destination Space and Operation Earth.

Naomi will primarily work on Liverpool's Centres for Doctoral Training in Data Science, LIV.DAT and the brand-new LIV.INNO, but she will also be your contact point for all matters AVA and look after our MIRROR.

Welcome!

International Conference on EXotic Atoms and Related Topics proceedings published

The International Conference on Exotic Atoms and Related Topics (EXA2021) took place online in September 2021. The proceedings of this conference have just been published here and are available for everyone to view.

EXA2021 was organized by the Stefan-Meyer-Institute for Subatomic Physics of the Austrian Academy of Sciences. The conference was sponsored by AVA and was attended by over 120 participants from around the world including some students funded by AVA.

The conference series focusses on muonic, pionic, kaonic, and antiprotonic atoms and related topics. AVA Coordinator Prof Carsten P Welsch (University of Liverpool) has been a member of its International Advisory Committee. This edition of the conference covered a wide range of topics including Antihydrogen: CPT and gravity and Hadron physics with antiprotons as well as future facilities and instrumentation.

There were a number of plenary talks each morning which are included in the published proceedings and an all-day virtual “poster session” on the Thursday where researchers could discuss their work in small break out rooms.

The EXA conference series normally takes place every three years.

Fellows Activity

AVA Fellow wins Early Career Award

The winners of the 2021 Cockcroft Institute Early Career Excellence Awards have been announced. Volodymyr Rodin, who is a PhD student and Marie Curie Fellow in the University of Liverpool QUASAR group, has been awarded the prize for Best Sustained Contribution.

In his PhD project, Volodymyr investigates 6D beam dynamics in low energy ion and antiproton storage rings and beamlines. His goal is the realistic description of an experimental setup under consideration of all of the real-world effects ranging from fringe fields, stray fields, space charge, etc. to give an accurate representation of the beam transport and handling in simulation. This requires advanced simulations of stored beams, targets, as well as of all magnetic and electrostatic extraction, guiding and imaging fields that are part of each setup. Such a comprehensive simulation suite did not exist before the start of his studies, but is now available and will serve as a template for low energy beam transport studies for years to come.

Volodymyr has been invited to present his research results at a number of international seminars, conferences and workshops. Furthermore, he has authored and co-authored several peer-reviewed articles and many conference proceedings.

Volodymyr said "*I am very appreciative to win this award, it tells me that my research work, communication with people, and experimental collaboration moving in the right direction. I will continue to advance various aspects of the accelerator physics and help to overcome the existing obstacles*."

Volodymyr will give a Cockcroft Institute Seminar on his research later this year to celebrate this award.

Congratulations!

Volodymyr Rodin (Image credit: I. Prasad)

AVA Fellow Interviews – Spotlight on Amit Nanda

Amit Nanda

For this interview we have spoken with Amit Nanda who joined the AVA network at Stefan Meyer Institute of the Austrian Academy of Sciences.

His project focused on the development of a Ramsey type spectrometer to measure the ground state hyperfine structure of antihydrogen.

What did attract you to the AVA network? Has it fulfilled your expectations?

"The main attractive feature of AVA for me was the opportunity to work across and together with fundamental research facilities and industries. I am very happy that during my AVA fellowship I got the chance to do so.“

Why did you choose to go to Stefan Meyer Institute of the Austrian Academy of Sciences?

“The project at Stefan Meyer Institute of the Austrian Academy of Sciences comprised of the complete evolution of an experiment: design, simulations, construction, performing the experiment and analyzing the data. It was this possibility to get trained continuously during the different phases of the project that made me choose Stefan Meyer Institute. Adding to this fact, it was also the location of my host institution: Vienna, which I liked very much.”

Can you explain in a few words what your project was about and what have you achieved?

“My project was to develop a Ramsey type spectrometer to measure the ground state hyperfine structure of antihydrogen. Comparison of this measurement against that of hydrogen would be a very precise way of testing the fundamental CPT theorem. The spectrometer along with the coils and shielding were studied in detailed finite element simulations and the design phase was concluded. I gained a lot of experience in radio frequency and electromagnetic simulations. Besides that, due to my involvement with the ASACUSA collaboration at CERN, I can now also make control systems for experiments, work with plasma sources, ultra-high vacuum, and cryogenic systems.”

What has AVA provided you professionally?

“The schools and workshops of AVA gave me a very comprehensive understanding of the different aspects of accelerator technologies, beam monitors, novel particle detectors, precision spectroscopy methods, and interfacing machines to an experiment. I had a fantastic time learning from the professionals from industries such as Bergoz Instrumentation, Stahl Electronics and COSYLAB. The outreach activities and participation in each AVA workshop boosted my skills in communicating research to people from scientific and non-scientific background. All the different experiences and skills set I have acquired during my AVA fellowship would enhance my employability in the future.”

Can you say something about your next career move?

"I have my personal interests in moving forward towards the field of machine learning and artificial intelligence. This is something that is currently inevitable in any field of research. I would be extremely glad if I have an opportunity to contribute to applied research involving artificial intelligence. I am also very open to working on accelerator facilities."

What will be your most cherished memory from AVA?

*"It was during mid-January in 2018 that we spent a week at Manchester and worked with Carbon Digital to make a **short film** about our project network. It was one of the most fun events and one of the very first events where I got to meet and know the other AVA fellows. Working on a script, acting in front of green screen, filming and post processing on the short film was something I would have never thought I would do. I must say it was very fun and interesting to learn something completely different."*

The AVA Fellows at the media school with Carbon Digital.

Bianca Veglia successfully passed her viva

AVA Fellow Dr Bianca Veglia, based at the Cockcroft Institute (UK) has successfully passed her PhD viva on 21 March 2022. Bianca carried out research into 'Beam Stability and Life Time in Low Energy Storage Rings', where she did comprehensive investigations into low energy electron cooling and associated effects on stored low energy beams.

Bianca Veglia

New simulation tools have been developed with the aim to guarantee the best possible beam quality from ELENA and for other next generation ultra-low energy antiproton and ion facilities. To accurately describe the behaviour of the antiproton beam before it reaches the experiment, implementations of the different effects acting on the low energy antiprotons were based on both, theoretical derivations and empirical observations. These includes an updated electron cooling force formula for negatively charged ions, which has been proved to be a valid instrument for electron cooling modelling.

Bianca was supervised by by Dr Javier Resta Lopez, Dr Aaron Farricker and Prof Carsten P Welsch (University of Liverpool) and has already started a postdoc position at DESY in Hamburg, Germany.

Congratulations!

Partner News

Liverpool announced as first UK university to join AEgIS experiment at CERN

The University of Liverpool has become the first UK university to join the AEgIS antimatter experiment at CERN.

The AEgIS experiment (Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy) aims to measure the gravitational fall of an antihydrogen pulsed beam. It is understood that matter and antimatter were created equally in the Big Bang, and when they meet, they annihilate each other. However, we live in a universe dominated by matter. Physicists in CERN's Antimatter Factory are creating small quantities of antimatter and conducting a range of experiments to learn more about its properties and answer the question 'what happened to the antimatter?'.

AEgIS is one of the very few experiments that use antiprotons to directly investigate the properties of antimatter by exploiting the charge exchange reaction between cold antiprotons and excited Rydberg-positronium, the bound state of an electron and a positron, in order to generate Rydberg-antihydrogen.

The AEgIS experiment involves physicists from a number of countries in Europe as well as from India. The University of Liverpool is the first UK university to join.
Amongst the research challenges that AEgIS will address over the next few years are the development of next-generation positron/positronium converter targets, the formation and transport of pulsed antihydrogen beams with unprecedented intensity and Stern-Gerlach type experiments on a cold positronium beam.

AEgIS spokesperson Dr Michael Doser said: *"I am delighted to welcome Liverpool as a new member in the AEgIS collaboration! We look forward to pushing the limits of low energy antimatter physics with the UK group."*

The University of Liverpool has closely collaborated with CERN on low energy antimatter physics for more than a decade. The University's Department of Physics has made key contributions to the ALPHA experiment and through the QUASAR Group, Liverpool experts have pioneered a number of instrumentation solutions. This includes a cryogenic current comparator for the non-invasive intensity measurement of nA beams, gas jet-based beam profile monitors, as well as novel sensors for the 3D mapping of electrostatic fields in ion traps and beam transport lines.

Moreover, Liverpool has initiated and coordinated the Horizon 2020 "Accelerators Validating Antimatter physics" (AVA) network between 2016 and 2021. This was the largest-ever research and training network on low energy antimatter physics and included a Fellow based in AEgIS.

AVA Coordinator and Liverpool's Head of the Physics Department, Professor Carsten P Welsch said: *"We are excited to be a member of the AEgIS collaboration and the first UK University to join this experiment. We have been working with the collaboration for many years - initially on studies into new beam monitors and later within the framework of the AVA project. The experiment offers excellent prospects for ground-breaking research and we look forward to continuing our successful collaboration."*

For further information on AEgIS, please visit: https://aegis.web.cern.ch/

Facility for Antiproton and Ion Research (FAIR) top management visits Cosylab

Image credit: Cosylab

AVA partner Cosylab recently hosted the senior managers from the Facility for Antiproton and Ion Research (FAIR) at GSI Darmstadt who visited the company to present the current functioning of FAIR, learn more about the technology and services provided by Cosylab and discuss future cooperation with this mega science facility. FAIR is under construction at GSI Darmstadt who are also a partner in the AVA project.

Facility for Antiproton and Ion Research in Europe GmbH (FAIR), Darmstadt, Germany, is an international accelerator facility for research with antiprotons and ions. At FAIR matter that usually only exists in the depth of space will be produced in a lab for research.

Cosylab is one of the leading partners in Tehnodrom, a consortium of 12 Slovenian high-tech companies developing and supplying high-tech research equipment according to the specifications of the FAIR Center, namely the control system for the accelerator and components of the beam diagnostics system.

"*The participation of Cosylab and other Slovenian high-tech companies in large scientific projects, such as FAIR, is important for strengthening the development competencies based on joint work with top experts from around the world and for the exchange of scientific knowledge and practical experience, while it also brings the multiplicative effects of the investment to Slovenia and other participating countries. We are proud of the Cosylab's and other experts working together with scientists and engineers from around the globe to enable the FAIR Center's fascinating discoveries in basic research, gain new insights into the structure of matter and the evolution of the universe*," said Dr. Mark Pleško, Co-founder and CEO of Cosylab.

This article is based on an original article published on the Cosylab website which can be found here: Facility for Antiproton and Ion Research (FAIR) top management visits Cosylab

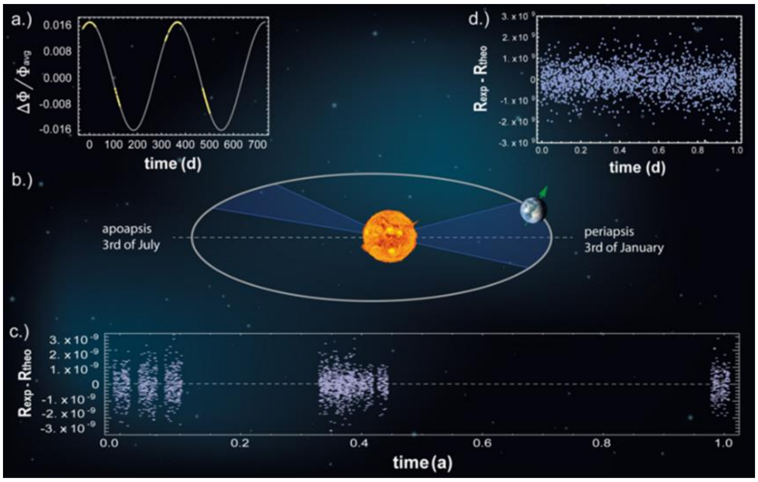
New results from BASE collaboration on matter/antimatter symmetry and antimatter clock

The BASE collaboration at CERN has reported in the journal Nature on the world's most accurate comparison between protons and antiprotons: The charge-to-mass ratios of antiprotons and protons are identical to eleven significant digits. This new measurement improves the accuracy of the previous best value by more than a factor of four. The data set, collected over a period of one and a half years, also enables a rigorous test of the weak equivalence principle, which says that matter and antimatter behave the same under gravity.

Symmetry and beauty are closely related, not only in music, art and architecture, but also in the fundamental laws of physics that describe our universe. It is in some sense ironic that we seem to owe our existence to a broken symmetry in the best fundamental theory that exists, the Standard Model (SM) of particle physics. One of the cornerstones of the SM is the charge, parity, time (CPT) reversal invariance. Applied to the equations of the SM, the CPT transformation translates matter into antimatter. As a consequence of CPT symmetry, pairs of matter and antimatter have the same masses, charges and magnetic moments, the latter two with opposite signs. Another consequence of CPT: if a particle meets its antiparticle, they annihilate to pure energy, as confirmed in numerous laboratory experiments. In this sense, the existence of our universe is by no means self-evident. We have reason to assume that in the Big Bang matter and antimatter were created in equal quantities. Why only the matter remained, that makes up our solar system and the celestial bodies in the universe, is as yet unclear.

Another hot topic in modern physics is the question of whether matter and antimatter behave the same under gravity. In their new paper, the BASE scientists compare the charge-to-mass ratios of antiprotons and protons and – as the Earth orbits the Sun – the similarity of antimatter and matter clocks. So, they investigated both questions at the same time with one measurement.

For their high-precision investigations, the team led by Stefan Ulmer, chief-scientist at RIKEN in Japan

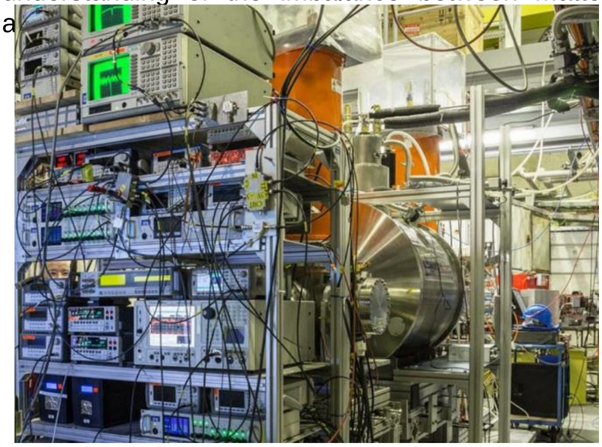


Trajectory of the earth on its orbit around the sun. Graphics: BASE collaboration and spokesperson of the BASE collaboration, used a Penning trap, i.e., an electromagnetic container that can store and detect a single charged particle.

A particle in such a trap oscillates at a characteristic frequency defined by its mass. “Listening” to the oscillation frequencies of antiprotons and protons in the same trap makes it possible to compare their masses. “By loading a cylindrical stack of several such Penning traps with antiprotons and negative hydrogen ions, we were able to perform a mass comparison within just four minutes, 50 times faster than previous proton/antiproton comparisons performed by other groups,” explains Stefan Ulmer. “Since our earlier measurements, we have also made substantial technical improvements to the experimental setup. This increases the stability of the experiment and reduces systematic shifts in the measured values.” With this optimised instrument, the BASE team collected a data set of around 24,000 individual frequency comparisons over the course of one and a half years. By combining all the measurement results, the researchers found that the charge-to-mass ratio of antiprotons and protons is identical, with an accuracy of 16 parts in a trillion, a number with 11 significant digits. This improves the accuracy of the best measurement to date – also from BASE – by more than a factor of four: a significant advance in precision physics.

A particle oscillating in a Penning trap can be considered a “clock”, an antiparticle an “anti-clock”. In the case of strong gravity, the clocks go slower. During the long-term measurement of one and a half years, the Earth, on its elliptical orbit, was exposed to the varying gravitational pull from the Sun. If antimatter and matter reacted differently to gravity, the matter and antimatter clocks would experience different frequency shifts along the Earth's trajectory. However, within the uncertainty of the measurement, the BASE scientists were unable to detect any such frequency anomaly when analysing their data. Thus, for the first time, they were able to set direct and largely model-independent limits for anomalous behaviour of antimatter under gravity – or, in other words, confirmed the validity of the weak equivalence principle for clocks within the limits of measurement accuracy.

To be able to measure with even higher precision, the antiprotons must be moved from the accelerator environment of CERN’s antimatter factory to a calm laboratory. For this purpose, the BASE collaboration is currently constructing the transportable antiproton trap BASE-STEP. The current plan is to move the antiprotons to a different laboratory at CERN, and later also to other precision laboratories. The improved measurement conditions will enhance the fractional precision further and hopefully contribute to our understanding of the imbalance between matter a



The BASE experiment at the antiproton decelerator at CERN in Geneva. Photo: Stefan Sellner, RIKEN/BASE

Work carried out at the BASE experiment has contributed to the ‘Antimatter Experiments’ work package of the AVA project and co-author Markus Wiesinger was an AVA fellow.

This article is based on an original article published on the Max-Planck-Institut website which can be found here.

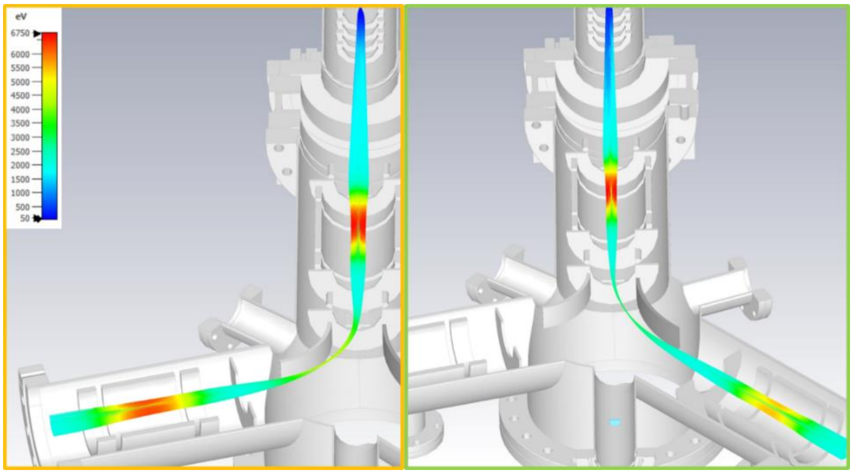
The University of Liverpool breaks ground on its new collaboration with the AEgIS Experiment

After being the first UK university to join the AEgIS (Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy) antimatter experiment at CERN the University of Liverpool (UoL) participated in its first official collaboration meeting. Several members of the QUASAR Group joined the meeting and after only a few weeks officially in the collaboration are already making valuable contributions.

In this meeting the status of the AEgIS experiment, its progress to being operational after the restart of the CERN accelerator complex and the future pathway of the experiment were discussed. For the collaboration and the AVA network the use of the newly commissioned ELENA ring for precision antimatter research is particularly exciting. The use of 100 keV antiprotons is completely new territory and opens new doors into understanding of the universe. The opportunities opened by this new era formed a cornerstone of the of the talks at the collaboration meeting.

The first day of the meeting focussed on preparation for the 2022 antiproton run and the readiness of the experiment. This included updates on the installation of new hardware and commissioning of older hardware. The improvements in the trap, control and laser systems will lead to improved measurements in the next run.

Particularly interesting for the UoL was the discussion on the ion sources as the QUASAR Group has already made significant contributions to the design of the ion injection chamber and its beam dynamics design. The optics design from the UoL side was led by AVA Fellow Volodymyr Rodin and resulted in the so-called `starship' chamber to allow injection from two ion sources, as well as antiprotons from ELENA, into the AEgIS experiment. This new component is already in production and will be installed in the transfer line in the coming weeks.



Beam dynamics simulation for the ion injection chamber carried out by Volodymyr Rodin. (Image: G. Khatri)

AVA Fellow Volodymyr Rodin commented on the design work he carried out: "*It doesn't happen very often that we can consider all important aspects of the design before the construction phase, but with our simulation framework we already have a thorough understanding of the fine adjustment which will be needed in the future experiment.*"
The addition of the ion sources is an exciting development that opens new areas of research for the collaboration and is one which the UoL hope to continue to contribute. These areas detailed studies of exotic atoms and areas of nuclear physics.

The UoL wants to build on its early contributions to the experiment, providing its expertise through the coming run and contributing to the ground-breaking future studies that will be carried out by AEgIS.

QUASAR Group member Aaron Farricker said: "*It was great to see the progress made within the AEgIS experiment looking towards the next run and to see what an exciting physics program the QUASAR Group will be involved in through the coming years.*"

Ion injection chamber nearing the end of production before being shipped to CERN.

Upcoming Event

LINAC2022 will take place in Liverpool

In 2022, the linear accelerator conference (LINAC) will come to England, the birthplace of accelerator science, and take place at the Arena and Convention Centre in beautiful Liverpool, UK on 28 August - 2 September 2020.

LINAC is the main bi-yearly gathering for the worldwide community of linear accelerator experts. The conference will provide a unique opportunity to hear about the latest advances in R&D on hadron and lepton linacs and their applications.
Following a long and successful tradition, LINAC2022 will feature invited and contributed talks, as well as poster sessions and an industry exhibition. The scientific programme will be complemented by social events that promote informal knowledge exchange. There are a number of sponsorship opportunities for all those who would like to support the event and gain visibility.

Travel to the UK is now possible without any specific vaccination requirements. **In-person registration is now closed, but the conference now offers remote registration at a significantly reduced fee which will give access to all talks.**

https://linac2022.org/

Position Vacancies

Open Position at Cosylab, Slovenia

PLC Engineer (m/f)
We're looking for PLC Engineers, who will have an opportunity to help develop control systems for industrial and research accelerators, such as ITER and FAIR, or participate in the development of complex medical devices for radiation therapy.

More information: https://www.cosylab.com/careers/plc-engineer/
Further job vacancies at Cosylab: https://www.cosylab.com/careers/

Permanent position at the University of Liverpool, UK

Research Coordinator in Accelerator Science (permanent)
The QUASAR Group is looking for an outstanding senior accelerator scientist to make important contributions to the Group's wide-ranging research and training program. Your research will involve leadership in our beam dynamics and particle tracking R&D, the development and application of Monte Carlo and Machine Learning techniques, research into novel acceleration techniques, as well as developing accelerator applications. There are opportunities to contribute to teaching and supervision, as well as to major European projects such as HLLHC, EuPRAXIA and AWAKE.
This permanent role is based at the Cockcroft Institute on the campus of Daresbury Laboratory. The research will be carried out at partner institutions around the world and some national and international travel will be required. Candidates should have a PhD in a relevant discipline, several years of postdoc experience, and an excellent track record in accelerator design and optimization, demonstrated through publications in high impact journals. Experience in the training and supervision of students will be an asset.

To apply, please visit: https://bit.ly/3zNVooU
For informal information, please contact Professor Carsten P Welsch.

Events

7th – 12th Aug 2022	North American Particle Accelerator Conference (NAPAC2022), Albuquerque, New Mexico
22nd Aug – 26th Aug 2022	40th International Free Electron Laser Conference (FEL2022), Trieste, Italy
28th Aug – 2nd Sept 2022	International Linear Accelerator Conference 2022 (LINAC 2022), Liverpool, UK
11th – 15th Sept 2022	IBIC'22, Krakow, Poland

Notice Board

DEADLINE FOR THE NEXT NEWSLETTER CONTRIBUTIONS: 15th October 2022

www.ava-project.eu

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 721559.