



Highlights

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Dear friends of low energy antimatter and ion physics,

Curiosity-driven research requires innovation in terms of research techniques and technology. In antimatter research, these innovations have been linked to beam handling and storage techniques, novel sensor and beam diagnostics techniques, as well as numerical tools that allowed scientists to better model their experiments for a very long time.

Looking back at what other applications these innovations have enabled, there is a very clear history of developments that originally targeted fundamental research and later had massive impact on society as a whole. This includes the world wide web, originally developed for particle physics experiments; ion beam therapy using the same accelerator technologies that find application in large scale research facilities like CERN and FAIR; machine learning techniques originally developed for the analysis of experiment data and then used for medical applications, modelling traffic flow in cities or helping internet sites optimize their search algorithms. Looking at all these examples, I am convinced that fundamental research is ideal (and required) for the continuous production of frontier technologies in ever more rapidly evolving markets.

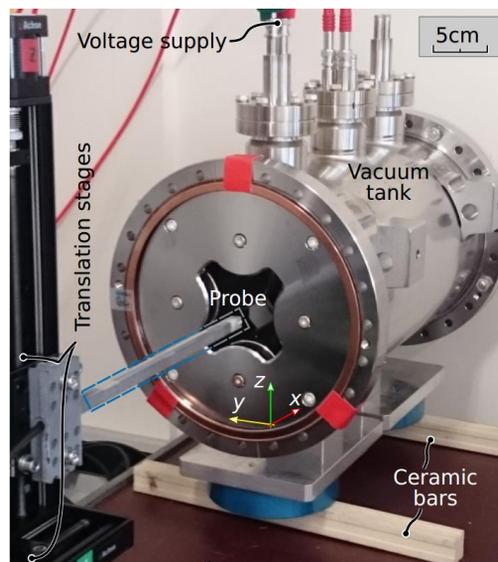
This week we will shine a light on how R&D into particle accelerators has benefited – and will benefit – science and society. A large scale **Symposium** in Liverpool showcases several flagship applications of accelerators, including antimatter research, that have helped advanced knowledge and enabled numerous innovations. It is very easy to participate in the event by [registering](#) for free and joining the live-streamed talks. Please join us and send your comments and questions via Twitter [@livuniphysics](#) [#AccSciSoc](#).

A handwritten signature in black ink, appearing to read 'Carsten Welsch'.

Prof. Carsten P. Welsch,
Coordinator

Research News

PRL paper describes realistic 3D modelling of electrostatic elements in low energy machines



Photograph of the experimental setup.

The transport and manipulation of very low energy antiproton and ion beams relies on the use of electrostatic elements, as magnets are no longer efficient at keV beam energies. It is important to precisely know the field distribution in these elements to optimize beam transport and maximize experimental outputs. Thus far, accelerator designers had to rely on 3D field simulations to take effects like manufacturing tolerances or the effects from misalignment into account as no sensor was available to precisely measure the 3D electrostatic field distribution.

In an article just published in *Physical Review Letters*, AVA Fellow [Volodymyr Rodin](#) and co-workers describe a new method to precisely map the electrostatic field in an arbitrary 3D volume with a microsensor. In a collaboration between

researchers from Vienna, CERN and the University of Liverpool/Cockcroft Institute the sensor was extensively tested to characterize an electrostatic quadrupole from one of the ELENA beam transfer lines.

Experimental results have shown that remarkable spatial resolution can be achieved for fields with sufficiently low curvature. Measurements have also confirmed that electrostatic elements behave largely like numerical simulations predict.

A precise field measurement technique as now presented offers an interesting opportunity to relax manufacturing requirements. It offers a powerful method to mitigate any effects from tolerances by e.g. sorting electrostatic elements or even active compensation of unwanted effects.

Network News

Particle Colliders – Accelerating Innovation



The Symposium took place at the Arena and Convention Centre Liverpool.

AVA Fellows based at University of Liverpool participated in the organization of an international Symposium on Particle Colliders - Accelerating Innovation which was held on 22 March 2019 at the Liverpool Arena and Convention Centre. The event showcased the science and technology opportunities related to the Future Circular Collider (FCC) study, a potential successor to the Large Hadron Collider and attracted nearly 1,000 delegates.

The Symposium featured several keynote talks, an industry exhibition, a careers fair for University of Liverpool students, an industry-academia co-innovation workshop, as well as hands-on activities for high school children from England's North-West to explain accelerator science.

The event in Liverpool was live-streamed to institutions across Europe and the talks from

leading researchers are now available to watch via the [event website](#).

In parallel to the industry exhibition, hands-on demonstrations engaged hundreds of high school students in the technologies behind FCC.



Exhibition Hall at ACC Liverpool.

More than a dozen different activities, each one offered several times in parallel, were available to the high school students. This included the Plasmatron, an interactive game explaining the physics behind plasma accelerators, [salad bowl accelerators](#) showing how high voltages can be generated, the augmented reality accelerator [acceleratAR](#) that turns paper cubes into components of a particle accelerator, and cryo-experiments that turned flowers into glass-like objects...which were then smashed into pieces by the children, as can be seen below.



LHC interactive tunnel.



Cryo-experiments turned flowers into glass-like objects.

The entire hall was full of physics! AVA Fellows - [Bianca](#), [Milena](#), [Volodymyr](#) and [Bruno](#) - had the lead on one demonstration each.

Milena introduced particle detectors using a homemade cloud chamber, whilst **Bruno** guided the students through CERN's interactive LHC tunnel which came for the very first time to the UK. A true centre-piece of the hands-on physics fair, the LHC tunnel allowed children to play 'proton football' and smash particles at high energies. If energy and direction were well chosen, they could even create a Higgs particle!

Volodymyr demonstrated a simple way for accelerating macroscopic size projectiles utilizing Gauss rifle principle – converting attractive force

(accelerating gradient) of the permanent magnets into particle kinetic energy.

Multiple-stage construction along with Newton cradles demonstrated natural laws of momentum conservation and beam acceleration. Another experiment was demonstrating slowing down of free falling of a magnetic ball inside copper pipe caused by Eddy currents.

“More than hundred of children were curious about how that works and tenths of them initialised a chain of improvised accelerators themselves. We demonstrated interesting physics effects, using magnetic flux detectors. This idea caused many “Wow!”-s and raised curiosity among school teachers and children”, Volodymyr described.

“Many pupils were curious about how pasta made its way into a Physics Symposium. It intrigued them and they were happy to listen to how I related pasta to the Standard model of particle physics”, described Bianca who introduced the concept of different particles via something close to her Italian roots – PASTA in different shapes and colours.

For more information see the [event website](#)

AVA presented at IPAC'19



The world's largest conference on particle accelerators (**IPAC'19**) took place this year in the Australian city of Melbourne, from 19 to 24 of May. Over 1,000 delegates from five continents gathered in the Melbourne Exhibition Centre to hear about the latest advances in accelerator science through an intense programme of talks and poster sessions together with an industry exhibition.

Project Coordinator Prof Carsten Welsch presented research results within AVA on the performance of ultra-thin diamond membranes, electron cooling

and beam life time studies of low energy ion and antiproton beams, as well as efficient integration and performance optimization of cryogenic detectors in ELENA and associated trap experiments.

A dedicated industry stand showcased the AVA project along with the many projects coordinated or participated by the University of Liverpool: [OMA](#), [LIV.DAT](#), [EuPRAXIA](#) and [EuroCirCol](#), as well as the spin-out company [D-Beam](#), specialized in advanced beam diagnostics.



New Fellow joins AVA

The AVA network welcomes new Fellow **Yeqiang Wei** who will work at **CIVIDEC** in Austria.



Yeqiang Wei

Yeqiang Wei received his bachelor degree in June, 2014 from Suzhou University majoring in electronic information engineering. In June 2017 he received his master degree from Anhui University with the major of electromagnetic field and microwave technology. After graduation, he has been working as an electronic engineer and his work mainly focused on the design of RF devices including RF cavities and high power combiners.

Yeqiang joined AVA as a Marie Curie research fellow in June 2019. He will be investigating the application of a diamond membrane detector for antimatter research at CIVIDEC Instrumentation GmbH in cooperation with Vienna University of Technology. He will be studying the interaction mechanisms of antimatter with matter and designing an ultra-thin, vacuum compatible diamond membrane detector and the related front-end electronics for antimatter research.

Upcoming AVA Events

Symposium on Accelerators for Science and Society, 28 June 2019

Particle accelerators have numerous applications across many fields including fundamental research, medicine, electronics, environment and energy.

The AVA network, together with partners from the [OMA](#) and [LIV.DAT](#) projects, are delighted to host an International Symposium on *Accelerators for Science and Society* on 28th June 2019, at the Liverpool Arena and Convention Centre near the famous Albert Docks.

In this special event, scientists and educators from all across Europe present highlights and advances in accelerator research and the enormous impact these tools have had on science and society.

They will give a unique insight into current research programmes and also outline the exciting plans for the future. They will be joined by Fellows from the European networks OMA and AVA, as well as researchers from the LIV.DAT centre for Big Data

Science who will all present results of their research and share their fascination for science through hands-on demonstrations.

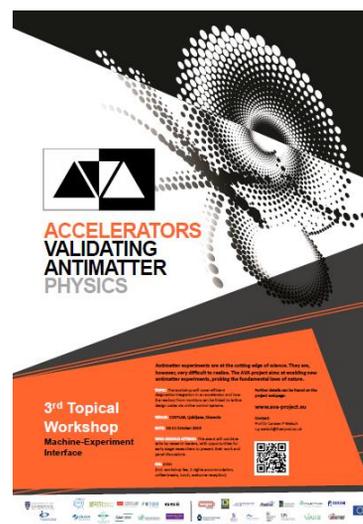


All presentations can be followed for free by web [live-stream](#). Tune in! Register your interest today!

3rd AVA Topical Workshop: Machine-Experiment Interface, October 2019

We are delighted to announce a two-day workshop on 'Machine-Experiment Interface' with a focus on efficient diagnostics integration in an accelerator and how the readout from monitors can be linked to lattice design codes via online control systems. The event will be hosted by COSYLAB, Ljubljana, Slovenia on 10-11 October 2019.

The [workshop](#) will combine talks by research leaders, with opportunities for early stage researchers to present their work and panel discussions.



Partner News

Professor Klaus Blaum (MPI) was awarded his 2nd ERC Advanced Grant



Prof Dr Klaus Blaum from the MPI For Nuclear Physics, supervisor of AVA Fellow Markus Wiesinger, secured his second funding (2.5M EUR/5 years) from the European Research Council (ERC) for his project entitled "Funl."

The four fundamental interactions and their symmetries, the fundamental constants as well as the properties of elementary particles such as their masses determine the basic structure of the Universe and form the basis for the Standard Model of particle physics.

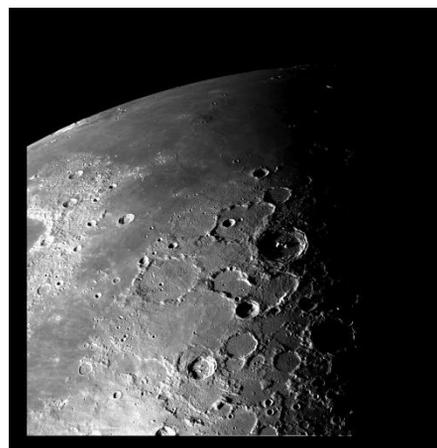
After receiving an ERC Advanced Grant in 2011 for the determination of fundamental constants such as the mass of the electron and the proton, Klaus Blaum is now devoting himself to fundamental interactions in his new ERC Advanced Grant called "Funl." Among other things, experiments with stored highly charged ions are planned for mandatory tests of quantum electrodynamics and special relativity, the latter via an improved verification of the equivalence of mass and energy, $E=mc^2$. In order to significantly improve the current boundaries, Funl also targets technical innovation, such as sympathetic cooling of individual ions.

The ERC awards Advanced Grants to established scientists who have already made significant contributions to their field of expertise for groundbreaking, new and risky projects. The funds are very competitive; the latest round of tenders had 222 applicants and a success rate of 10.8%. This is a significant achievement for Klaus Blaum and his research group.

Congratulations!

Exciting Opportunity for Stahl Electronics

Stahl-Electronics is being considered by the European Space Agency (ESA) for supplying essential electronic components for space probe missions to the south pole of Earth's moon. This region is appealing for harvesting recently discovered water resources for a future moon base or for other manned space missions. Temperatures in moon craters can go down to -240°C which requires specialised electronics to operate in such cold environments. Stahl-Electronics develops devices for harsh and hostile ambient conditions that are similar to the cold electronics related to the AVA project.





Position Vacancies

PhD position in antimatter physics at CERN with the ALPHA antihydrogen collaboration.

The foreseen start date is 1st October 2019.

Application deadline: 30th June 2019

Details here : <https://www.swansea.ac.uk/postgraduate/scholarships/research/physics-epsrc-phd-antimatter-physics-2019.php>

Postdoctoral research associate in physics The Department of Physics at the University of Liverpool is seeking a postdoctoral research associate in sensor and diagnostic technologies. You will work with industry partners to identify technical requirements and apply the sensor and detector technologies research and knowledge that have been developed across the nuclear, particle and accelerator clusters in the Department of Physics. By performing applied R&D, the post holder will develop innovative solutions for major challenges and problems facing industry. The ability to communicate effectively within a large multi-national collaboration is essential.

[Apply now!](#)

News from FAIR

International group of experts presents final report on the FAIR project

A team of high-level external experts was headed by the British physicist Lyndon Evans, who is an expert in the field of particle accelerators and was project leader for the construction of the large particle accelerator LHC at CERN, the European Organization for Nuclear Research. The committee, which consisted of particle accelerator experts, scientists, and construction project managers, has been assessing the project since November 2018 by means of accurate detail work, partly in subgroups focusing on specific aspects.

The report of the committee of experts has confirmed that the scientific program of FAIR is outstanding at the global level. The group of experts rated the FAIR project as a top international science project for decades, offering world class opportunities and outstanding potential for groundbreaking discoveries.

The full report is available [online](#).



Visualization of the future FAIR accelerator facility.

AVA Events

24 th - 27 th June 2019	Advanced Researcher Skills and Technology Transfer Workshops, Liverpool, UK
28 th June 2019	Symposium: Accelerators for Science and Society, ACC Liverpool, UK
9 th – 10 th October 2019	3 rd Topical Workshop on Machine-Experiment Interface, Cosylab, Slovenia
March 2020	2 nd AVA School on Precision Studies, Prague, Czech Republic
September 2020	EXA/AVA Conference, Vienna, Austria

Other Events

1 st – 3 rd July 2019	ENLIGHT Annual Meeting and Training, Caen, France
4 th – 6 th September 2019	International Conference on Medical Accelerators and Particle Therapy, CNA, Seville, Spain

Notice Board

This newsletter will be published on a quarterly basis. Help us keep it interesting by providing your news and updates.

DEADLINE FOR THE NEXT NEWSLETTER CONTRIBUTIONS: 15th September 2019



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