

### Highlights

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- Beam halo measurements using digital micro mirror device at Diamond Light Source
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### Dear friends of low energy antimatter and ion physics,

**Our Advanced School on Precision Studies will take place in Prague, Czech Republic between 23-27 March 2020.** The School will put research within AVA into a wider context, by also covering topics such as high energy physics experiments, atom interferometry and dark matter searches. All participants will get the opportunity to present their own research and I am sure that this will allow many interesting discussions. We have an exciting line-up of speakers confirmed and registration is available via the [event website](#). Early stage researchers from network partners, as well as from outside of AVA can apply for one of our scholarships. Deadline for registration, submission of abstracts, and application for one of the scholarships is 31 December 2019.

**This newsletter has a number of interesting research news from across our network and highlights some of the recent achievements of our Fellows.** 2019 has been an truly eventful year for our network, with the mid-term review early in the year, and the Symposium we held jointly with the [OMA](#) and [LIV.DAT](#) initiatives in the summer as real highlights. We have ambitious plans across our research projects for 2020, several high-profile events, and many collaborations planned between our Fellows. So the next year promises to be a very interesting one – as usual, our MIRROR will keep you informed about the latest news from the world of antimatter!



Prof. Carsten P. Welsch  
AVA Coordinator



## Research News

### Probing the link between antimatter and dark matter



BASE spokesperson Stefan Ulmer working on the experiment (Image: CERN)

**AVA Fellow [Markus Wiesinger](#), a member of the [BASE collaboration](#), co-authored a [paper](#) that was just published in one of the most impactful science journals – *Nature*.**

In the article, the BASE collaboration reports the first laboratory search for an interaction between antimatter and a candidate particle for dark-matter, the hypothetical axion. An interaction between the two would not only establish the origin of dark-matter, but would also revolutionise long-established certainties about the symmetry properties of nature.

[Dark-matter](#) and the [imbalance between matter and antimatter](#) are two of the biggest mysteries in physics and scientists are trying to find a connection between the two. If a relation were confirmed, it would present a huge progress in our knowledge and understanding of the fundamental laws of nature.

Working at [CERN's antimatter factory](#), the BASE team obtained the first laboratory-based limits on the existence of dark-matter axions. In their experiment, they assumed that axions prefer to interact with antimatter, rather than with matter and

looked for oscillations in the antiproton's "spin". An unexpectedly large axion–antiproton interaction strength would lead to variations in the frequency of this precession.

To measure this, the group around spokesperson Stefan Ulmer first confined antiprotons in a Penning Trap. From this cloud of antimatter particles, they then extracted a single antiproton into a high-precision multi-Penning trap to measure and flip its spin state. Over the course of three months, the researchers performed nearly one thousand high precision measurements. This allowed them to compare their experimental values with theoretical predictions.

Whilst the BASE researchers were not able to detect any variations in their measurements and hence no direct axion–antiproton interaction, they were able to put lower limits on the axion–antiproton interaction strength for a whole range of possible axion masses. Their results are a unique probe of new phenomena and could pave the way to an improved understanding of how our universe works.

Further information:

C. Smorra,..., M. Wiesinger, et al., "Direct limits on the interaction of antiprotons with axion-like dark matter", *Nature* **575** (2019)



## Beam halo measurements using digital micro mirror device at Diamond Light Source

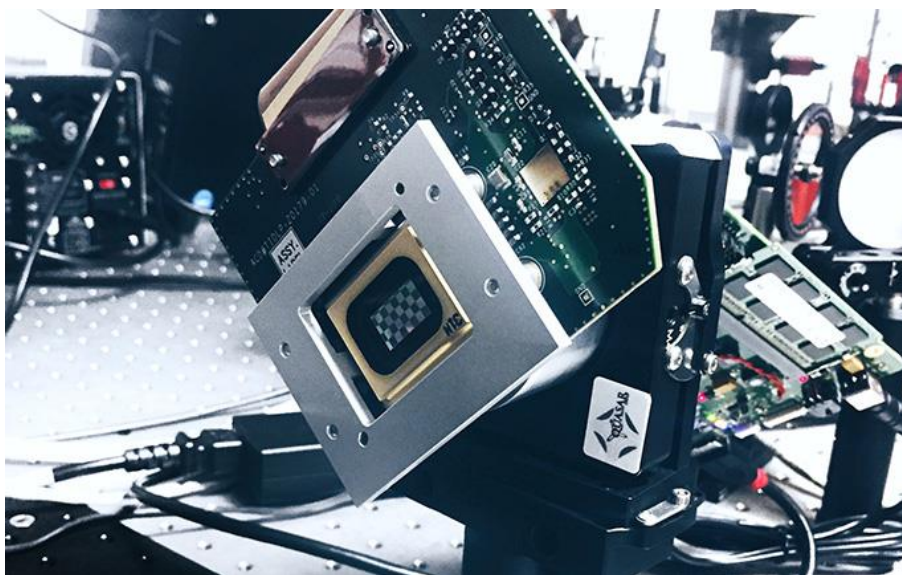
**A particular challenge in transverse beam profile monitoring at synchrotron light sources is the detection of beam halo particles.** This is due to the high intensity of the synchrotron light coming from the core of the beam overshadowing the much weaker signal coming from halo particles. Changes in beam halo are usually associated with emittance growth, particle losses and even damage to accelerator components. Thus, it is very important to have a method in place which allows non-invasive, high dynamic range measurements of full profile, including the halo.

AVA Fellow [Milena Vujanovic](#), who is based at the Cockcroft Institute/University of Liverpool, together with fellow QUASAR Group member, [Dr Joseph Wolfenden](#), designed and developed a monitor based on adaptive optics for high dynamics range measurements of beam halo. The core of this instrument is a digital micromirror device (DMD) to mask the intense beam core light. This allows to

measure the halo in more detail as the core signal no longer overshadows the signal. This technique was pioneered in the group and successfully demonstrated in previous proof-of-principle measurements - the study the researchers now conducted targets developing the monitor into an off-the-shelf device that can be used at accelerator facilities around the world.

In early September 2019, the monitor was installed at Diamond Light Source (DLS), the UK's national synchrotron light source in Oxfordshire. Joseph and Milena performed first beam halo measurements and successfully demonstrated a dynamic range of  $10^5$ , increasing the dynamic range of the camera by two orders of magnitude.

This opens exciting new opportunities to understand the dynamics of the stored beam, as well as the halo particles in much more detail. They are now working on further improvements of the system that shall provide an even higher dynamic range.



Digital micromirror device.



## Network News

### Challenges in experiment-machine interfacing takes AVA Fellows to Slovenia



Photograph of workshop participants.

**Antimatter experiments address some of the most fundamental questions in science by studying the building bricks of nature.**

Measurements are currently carried out at CERN in Geneva, Switzerland and include laser spectroscopy on antihydrogen as well as gravity measurements. These aim at finding differences in the fundamental properties of an antimatter particle and its matter counterpart. Any differences found would help understand the matter-antimatter asymmetry observed in the universe.

These challenging experiments are usually developed by international collaborations as stand-alone setups that take the antimatter particles from a much larger accelerator facility. This brings up many challenges in terms of efficiently interfacing the experiment with the wider accelerator control and data acquisition system.

COSYLAB, based in Ljubljana, Slovenia, is considered a world-leader in large research facilities control systems and hosted this 3rd AVA Topical Workshop. The 2-day event took place on 10-11 October 2019 and included invited talks

about past and current challenges in two of the world's premier research facilities: CERN in Switzerland and GSI/FAIR in Germany.

Professor Carsten Welsch, AVA Coordinator, started the workshop and said after having given a brief introduction of the AVA network: *"In this workshop, we would like to identify and share best practice amongst experimental groups that carry out measurements at the cutting edge of science and the machine designers and operators that provide the beam for the experiments. We would also like to clearly identify challenges in data exchange and analysis and try to find ways of how to overcome them."*

Dr Lajos Bojtár of CERN's Antiproton Decelerator (AD) control team then gave an invited talk on the first day about *Challenges in AD/ELENA operation* where he stressed to complexity of bring a high quality beam to the different antimatter experiments. He also gave examples of good practice in linking signals between an experiment and the machine control system.





His talk was followed by a presentation given by AVA Fellows Adélaïde Grimaud, Markus Wiesinger and Amit Nanda. All three had worked together already the entire week as part of a secondment on the specific challenges and opportunities in their experiments. They summarized their findings and this provided an excellent basis for the discussions on day 2.

In the afternoon, COSYLAB led a hands-on LabView workshop. This was an expressed wish of the AVA Fellows and all participants benefited from the expert knowledge and perfect infrastructure at COSYLAB. They learned a lot about the challenges in efficient system integration and troubleshooting as they completed a range of exercise.

The second day was started by Dr Ralph Steinhagen of GSI/FAIR who talked about *Sustainable Accelerator System Integration and Control Room Operation*. Dr Steinhagen presented numerous examples from successful experiment integration and how data exchange between experimental groups and the machine control team

have allowed to improve both, experimental outputs and beam quality.

All participants then gave brief presentations about the specific tools and techniques they are using in their studies, as well as a summary of the challenges that they have been facing. They also made recommendations about future changes to current practice to improve beam control, data acquisition and analysis. Lively discussions throughout the day showed that there was a strong need for an informed roadmap describing best practice in these areas.

The workshop participants decided to now work on developing their findings into a joint article describing current practice and recommendations for future studies. This paper will be made available via the project and event pages once available.

All talks and further information can be found on the event website: <https://indico.cern.ch/event/835785>

Special thanks go to Adi, Andreja and Ivana, as well as all of COSYLAB's fantastic team for their support and help in organizing this event.

## AVA Steering Committee met in Vienna

**The AVA Steering Committee met in Vienna, Austria on 27-28 November 2019.** The group critically reviewed project progress to date and discussed the research and training aspects of each individual Fellow. It also reviewed the outcomes of all 2019 AVA events, and made plans for the future. This included finalizing the planning for the [AVA School on Precision Studies](#) in March 2020 and the AVA [conference](#) in September next year which will be held in Vienna as part of the established EXA conference series. The Committee also reviewed the various outreach events that have been organized by the network and individual partners and commended the Fellows for their engagement with the wider public.



The AVA Steering Committee.



## Upcoming AVA Event

### AVA International School on Precision Studies, March 2020

The AVA network is delighted to announce the 'International School on Precision Studies' which will take place in Prague, Czech Republic from 23-27 March 2020.

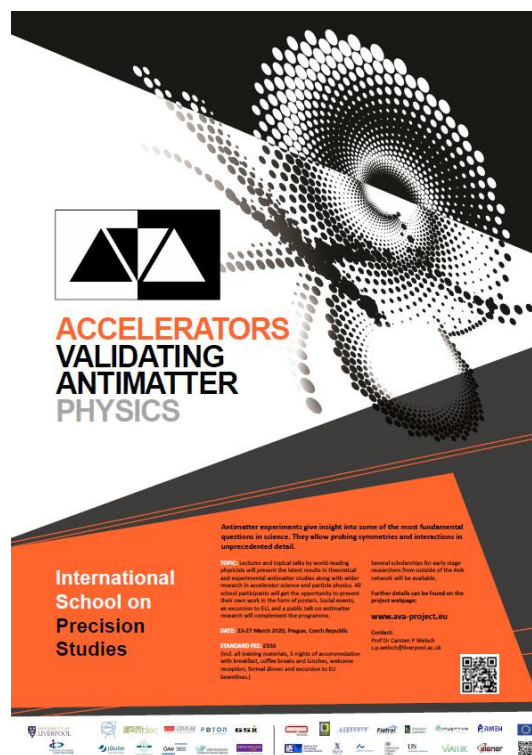
Lectures and topical talks will be presented by world-leading physicists. They will present the latest results in theoretical and experimental antimatter studies along with wider research in accelerator science and particle physics.

All school participants will get the opportunity to present their own work in the form of posters. Social events, an excursion to ELI Beamlines, and a public talk on antimatter research will complement the programme. **Registration deadline is 31 December 2019.**

**Several scholarships for early stage researchers from outside of the AVA network are available.**

Registration and more information:

<https://indico.cern.ch/event/854237/>



### International Conference on Exotic Atoms and Related Topics, September 2020

**AVA network will be co-organising the International Conference on Exotic Atoms and Related Topics – EXA2020 which will take place in Vienna, Austria, from 14-18 September 2020.**

It will be an excellent opportunity to showcase what the Network achieved as most of the research projects will be concluded or will be in their last stage. All AVA Fellows will attend and present their results and achievements.

The scientific program comprises the following topics:

- Antihydrogen: CPT and gravity
- Leptonic atoms: QED and gravity
- Kaon-nucleon and kaon-nucleus interaction
- Low-energy QCD
- Precision experiments with atoms, neutrons and charged particles
- Hadron physics
- Future facilities and instrumentation



## Other Events

### 14th International Conference on Low Energy Antiproton Physics, August 2020



**Two years after the previous conference in Paris which was attended by 8 AVA Fellows, the 14th LEAP Conference will be held August 2020 at Berkeley.**

The LEAP conference has been held every two to three years since 1990 to discuss the latest findings and exchange information in interdisciplinary fields studying low energy antiprotons. LEAP actively stimulates dialogue between overlapping research fronts in the diversified field of antiproton physics

and related fields involving mesons, baryons and strangeness.

The field of low energy antiproton physics has made remarkable advances recently and AVA is an integral part of it. Many AVA fellows will attend and the network will deliver important results to the antimatter community.

More information:

<https://physics.berkeley.edu/...leap-2020>

### 30th International Linear Accelerator Conference, September 2020

**LINAC is a bi-yearly conference aimed at the linear accelerator experts and the 2020 edition will be hosted in the city of Beatles – Liverpool, England, 30 August - 4 September.** The main topics of LINAC2020 will cover the latest advances in research and developments on hadron and lepton linacs and their applications. The scientific programme will include invited and contributed talks, as well as poster sessions and an industry exhibition.

The complementary programme will also include:

- Social events that promote informal knowledge exchange
- Women in Science and Engineering event
- Excursion to the new CLARA Free Electron Laser test accelerator and the SRF cavity qualification facility available at STFC Daresbury Laboratory

There are a number of scholarship opportunities available to students and also sponsorship opportunities for those who would like to support the event and gain visibility.

More information:

<http://linac2020.org/>





## Fellows Activity

### AVA Fellow awarded First Prize at CI Postgraduate Conference 2019

**The 8th annual Cockcroft Institute Postgraduate Conference (CIPGC) was held on 30<sup>th</sup> October 2019 at the Merrison Lecture Theatre of Daresbury Laboratory.** It attracted 45 postgraduates and academics from all four CI Universities - Lancaster, Liverpool, Manchester, Strathclyde - and ASTeC. The CIPGC is an important annual event for all CI postgraduates and it provides a platform for them to network and present research results to their peers and experienced academics.

CI Director, Peter Ratoff opened the event, followed by Hywel Owen and Guoxing Xia who gave a brief introduction of the CI postgraduate training program and the event arrangements.

Ten presentations were given by PhD students on the progress of their research during the past year, covering a wide variety of research activities going on at CI. In addition to the presentations, a poster

session has been held, which gave senior postgraduate students the opportunity to introduce their research results to their peers and judging committee members.

AVA Fellow [Volodymyr Rodin](#) presented his work on beam tracking studies in ELENA transfer lines and AVA Fellow [Milena Vujanovic](#) gave a talk on beam halo measurements at Diamond Light Source using DMD.

A judging committee made up of academics from the CI partners marked each presentation based on their presentation style, technical content, research context and question handling. The overall quality of the presentations was very high.

We are delighted to announce that Volodymyr was awarded First Prize for his presentation.

**Congratulations!**

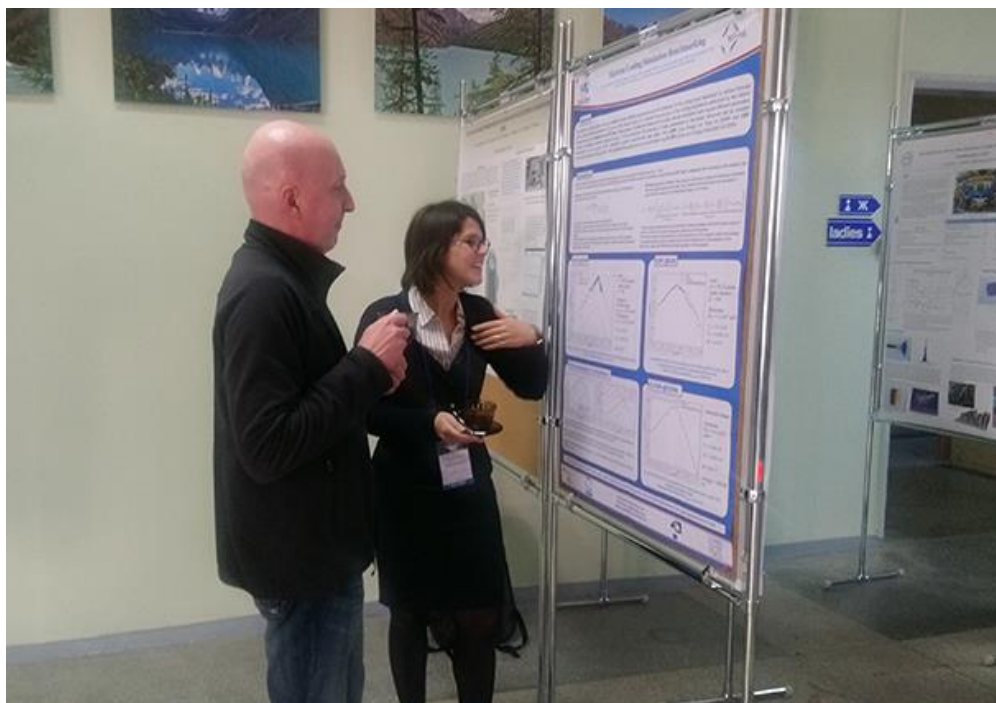


Volodymyr presenting his talk at CIPGC19.





## AVA Fellow presents research at COOL'19



AVA Fellow Bianca Veglia presented her latest research results at COOL'19.

**On September 23-27, the Budker Institute of Nuclear Physics (BINP) hosted COOL'19, the 12th, bi-annual, international workshop on beam cooling in Novosibirsk, Russia.** The institute is where Gersh Itskovich Budker invented the method of electron cooling in 1966 and later demonstrated its effectiveness in 1974. This year's workshop focused on the various aspects of the methods and techniques in the cooling of charged particle beams.

AVA Fellow Bianca Veglia presented her latest research results at the event. Her work describes the benchmarking of two electron cooling simulation programs with experimental data taken at the ESR and LEIR storage rings and includes simulation results of the expected performance of the newly installed ELENA electron cooler.

Beam cooling is essential to control the ion beam properties and to improve the beam quality by increasing the intensity and the lifetime for experiments and by counteracting on heating processes (such as deceleration and interaction of the beam with itself).

The workshop had numerous interesting talks about the development of new electron coolers for novel facilities (EICC in China, NICA in Russia) and presented new results from existing experiments that gave a wide overview on the horizon of beam cooling. The participants also visited the accelerators situated in the institute: ВЭПП-2000 (an electron-positron collider) and the local Free Electron Laser.

It was a stimulating and discussion-filled event that sparked new ideas and possible experiments.



## Beamline cryostat for precise current measurements presented at IBIC 2019

AVA Fellow **David Haider (GSI)** attended the **8<sup>th</sup> International Beam Instrumentation Conference (IBIC) in Malmö, Sweden**. The conference was hosted by the emerging European Spallation Source (ESS) in Lund, where an enormous civil construction site reveals the birthplace of Europe's next-generation accelerator facility for research with neutrons of unprecedented brightness. Experts from leading research facilities in the world gathered to present their latest developments and to engage in enthusiastic discussion of new ideas for characterizing particle beams.

In this intensive environment, David Haider presented a poster about the design of a cryogenic platform for the Cryogenic Current Comparator (CCC).

The beamline cryostat will allow for non-destructive beam current measurement with a precision of nano-ampere in the storage ring CRYRING at GSI. Apart from the poster session, the four days of the conference were filled with many interesting seminars and talks exploring the theory behind and the implementation of various detection methods in beam instrumentation. In the session dedicated to novel techniques, the application of machine learning algorithms on beam optimization was discussed which becomes more promising each year. An exhibition from several industrial partners that are each technology leaders in their field completed the program. On the final day, the Swedish national synchrotron radiation facility

MAX IV invited all participants on an extensive tour through their research institute to conclude the conference. Their safety officers eagerly anticipated the visit and tried to block all passages to the accelerator with exciting historic accelerator parts.

For more information:

<https://indico.esss.lu.se/event/1158/>

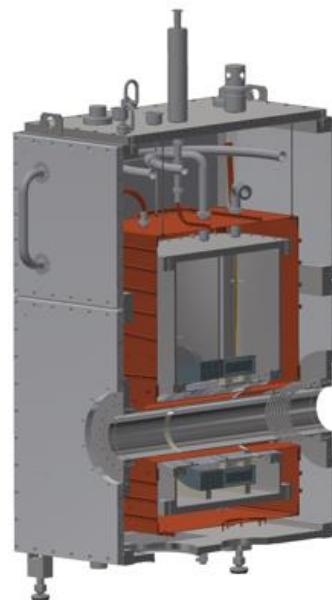


Image of cryostat rendering.

## Uncovering CERN's mysteries with Mattia and Bruno

On 14<sup>th</sup> and 15<sup>th</sup> September 2019, CERN opened its doors to the public and allowed people to experience two special days at the heart of one of the world's largest particle physics laboratories. The event takes place every few years and hosts several thousand visitors each time. During this edition, 75 000 people from all

over the world visited the Swiss laboratories and the event was run by more than 2000 volunteers. The scale of the event was so large that CERN had to shut down nearby roads and provided an entire bus network to transport people to nine sites in and around the 27-km accelerator ring.



Antimatter Factory hosted 2213 visitors with AVA Fellow [Mattia Fani](#) taking part in the event as a guide in the facilities during both days. Antimatter Factory includes six experiments and two deceleration rings – the Antiproton Decelerator and ELENA. They slow antiprotons down to speeds at which they can be confined and studied and physicist can then perform a range of experiments to compare the properties of matter and antimatter and to understand the origin of the Universe.



The Antimatter Factory Crew.

[Bruno Galante](#) actively participated in developing the EA (Experimental Areas) section's exhibition as well as the posters to introduce the section and the DEMO. He was based in the Preveessin side where all the sections composing the Beam Instrumentation group had their exhibitions. The aim was to highlight the research of each section with posters and with a particular demonstration showcasing one of the particle detectors developed within the section.

In Bruno's case, the DEMO consisted of a Cosmic Ray Telescope using a scintillating fiber monitor. This scintillating fiber monitor is normally used to detect and study particles coming from the secondary lines in the experimental areas but it can also be used to detect cosmic rays.



Bruno as a CERN guide.

It was very powerful to present it to visitors whilst it was working in a real time. This was a very successful event where Bruno had the chance to interact with people of different age, different background and in many cases different mother tongue.

Outreach and public engagement forms an important part of the activities in the AVA network. As part of the wider skills development, all AVA Fellows engage with a range of audiences to share their passion for science.



Antimatter Factory Crew at the end of the two days.





## Indrajeet Prasad introduced AVA & Marie Curie Fellowship to Czech students

Following his success with the [Instagram Channel](#), AVA Fellow [Indrajeet Prasad](#) also gave a presentation about Marie Curie Fellowship to students at the Czech Technical University (CTU) in Prague on 14 November 2019. This presentation was attended by Physics, Electronics & Electrical engineering Bachelor and Master students as well as some faculty members of CTU. The purpose of the presentation was to raise awareness about opportunities for Ph.D under Marie Curie research projects such as AVA as well as about the Erasmus Mundus Joint Master Degree program funded by Horizon 2020.

Indrajeet not only reached out to University Students, but a week later he also visited a high school in a small town in the north of Czech Republic where his host company FOTON s.r.o is based. The Presentation included information regarding EU funded opportunities for High School Pupils at present as well as their future career paths and opportunities towards science and research. This presentation was attended by last year's high school students along with their Physics teacher.



Indrajeet presenting to High School Students.





## Partner News

### Much to learn, you still have

**These are the famous words of Jedi master Yoda to Count Dooku when he faces his old Padawan in *Attack of the Clones*.** Based on these words, Liverpool University held a special event about the *Physics of Star Wars* to explore what is science and what is fiction in the famous movies. Hundreds of local high school students, university students and staff came on campus on 20<sup>th</sup> November 2019 and learned how world of Star Wars is connected with current antimatter research and accelerator-based science in general.



Light side vs. dark side.

*Physics of Star Wars* took place in the award-winning Central Teaching Laboratory, which was turned into a teaching space from a galaxy far, far away. The event started with an engaging lecture by AVA Coordinator Professor Carsten Welsch who immersed the participants into the Star Wars universe. He said: *"I selected iconic scenes from the movies that everybody will immediately recognise, and used real-world physics to explain what is possible and what is fiction. However, this short scene from 'Star Wars' was just the introduction, the appetizer, to make the participants curious and discuss science. I then linked what I had just shown in the film to our current research."* After the lecture, everyone was able to explore the science of Star Wars themselves through a range

of hands-on experiments that were prepared by staff and students of Liverpool University, including several AVA Fellows.



Star Wars-themed hands-on activities.

Just like the imbalance between the Light Side and the Dark Side, scientists within the AVA [Marie Skłodowska-Curie](#) innovative training network are trying to solve the question of why there is an imbalance between matter and antimatter in the universe. Why the universe we see today is made entirely out of matter, remains one of the greatest mysteries of modern physics. The event participants learned about how antimatter particles are trapped and prepared for precision experiments via optical and mechanical Paul traps.

They were also shown how particle [accelerators are used to produce antimatter](#) in a laboratory environment and how this allows probing the fundamental laws of nature. The AVA Fellows explained how they study the detailed properties of these exotic particles, for example how they react to the gravitational field of the Earth and how they interact with matter particles.

Many other exciting developments, including novel plasma accelerating techniques, medical accelerators and upgrades to the world's largest particle accelerator were discussed at this unique event which was deemed a roaring success.



The day was an excellent example of how Star Wars fiction can inspire and train the next generation of researchers.

Yoda also said to Count Dooku *"This is just the beginning!"* and this is no doubt true in the case of

science as well: Many more researchers will be needed in the future and *Physics of Star Wars* helped fascinate many more.



This is not an official Disney/Lucasfilm event, but planned, organised and run by Liverpool staff and students. The kind permission of Lucasfilm to use film excerpts as part of the seminar is acknowledged.

## Etienne Touzain takes over as new head of Bergoz Instrumentation

**Since its foundation in 1981 AVA Partner Bergoz Instrumentation has been the worldwide leader in high precision current transformers within the particle accelerator sector.** Last September 2018, the founder Julien Bergoz retired and the new owner, Etienne Touzain, has taken over this great small company!

More than 38 years of experience and know-how has led Bergoz to be recognized by the scientific community as experts in providing non-destructive diagnostic solutions for low current particle beams. Bergoz beam instrumentation is able to measure DC and AC currents, small charges, from single pulse to continuous wave beam, as well as chopped DC and macropulses. Bergoz is fully integrated, meaning that it has its own R&D and manufacturing capabilities, giving the company freedom and flexibility for collaborating with

institutes and industries. Their accelerator landscape is fundamental physics and material science, covering all kind of accelerators such as FCC, cyclotron, synchrotron light sources, FEL, XFEL, neutron spallation, and laser plasma wakefield, but the medical accelerator sector, with proton or ion beams, is particularly relevant.

Bergoz's product range fits the measurement needs of medical accelerators or can be customized for them. For any technical advice, please visit the website [www.bergoz.com](http://www.bergoz.com) or write to [info@bergoz.com](mailto:info@bergoz.com).



## 'Physics Girl' visits CERN Antimatter Factory

**Physics Girl** is a YouTube Channel created by Dianna Cowern that adventures into the physical sciences with experiments, demonstrations, and cool new discoveries.

She recently visited the Antimatter Factory at CERN to find out more about the creation of antimatter, the antiproton decelerator (AD) and current antimatter experiments.

Watch the video:

[Why This Stuff Costs \\$2700 Trillion Per Gram - Antimatter at CERN](#)



Why This Stuff Costs \$2700 Trillion Per Gram - Antimatt...

2.2M views • 3 weeks ago

## Vacancies

**CIVIDEC offers a 6-month Marie Curie Fellowship.** In collaboration with the current AVA Fellow, you will be investigating the application of a diamond membrane detector for Antimatter research. You will study the interaction mechanisms of antimatter with matter, the design of an ultra-thin, vacuum compatible diamond membrane detector, and the related front-end electronics for antimatter research. Strong programming skills are required for this role which offers an exciting perspective towards a permanent position in the company. The usual MSCA rules and mobility requirements apply. To find out more and apply, please contact [office@cividec.at](mailto:office@cividec.at).

**PhD vacancies at the University of Liverpool.** The [QUASAR Group](#) offers PhD opportunities in the areas of developing a *Supersonic Gas Jet for the High Luminosity LHC* and *Machine Learning in Secondary Emission Monitor Optimization*. Both projects will be realized in close collaboration with CERN. To find out more and apply, please contact [Prof Carsten P Welsch](#).

## Selected Publications

**'Measurement of Ultralow Heating Rates of a Single Antiproton in a Cryogenic Penning Trap'**, M. J. Borchert, **M. Wiesinger**, et al., Phys. Rev. Lett. 122, 043201 (2019).  
<https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.043201>

**'Noninvasive 3D Field Mapping of Complex Static Electric Fields'**, Andreas Kainz,...,James R. Hunt, Javier Resta-Lopez, **Volodymyr Rodin**, Carsten P. Welsch, et al., Phys. Rev. Lett. 122, 244801 – Published 21 June 2019 <https://doi.org/10.1103/PhysRevLett.122.244801>

**'Velocity-selected production of  $2^3\text{S}$  metastable positronium'**, C. Amsler,..., **M. Fani**, et al. (AEgIS Collaboration), Phys. Rev. A 99, 033405 (2019) <https://doi.org/10.1103/PhysRevA.99.033405>

## News from FAIR

### 50 years GSI, five decades of cutting-edge research: anniversary of foundation date



The GSI Helmholtzzentrum für Schwerionenforschung is celebrating 50 years of existence this year – five decades of research history with outstanding scientific successes and discoveries. During this time, GSI has developed from a national research institute with worldwide collaborations into an international campus with global relevance. Now, it is the 50<sup>th</sup> anniversary of the founding day of GSI, 17 December 1969.

GSI has been carrying out cutting-edge research for 50 years now, and the FAIR project is currently shaping the future. With FAIR, the international dimensions of research will be significantly expanded. Researchers from all over the world will be able to conduct world class science on the Darmstadt campus and explore the universe in the laboratory. For the anniversary day, there is the opportunity to travel back in time by [photo slider](#) on the GSI and FAIR homepage: an interactive past-today-show in which the images virtually overlap and thereby illustrate how things used to look like on campus in the past and how they look like today. The results provide exciting insights, for example into the linear accelerator, the control room or the experimental halls.





## AVA Events

23 <sup>rd</sup> - 27 <sup>th</sup> March 2020	2 <sup>nd</sup> AVA School on Precision Studies, Prague, Czech Republic
14 <sup>th</sup> – 18 <sup>th</sup> Sept 2020	EXA/AVA Conference, Vienna, Austria

## Other Events

10 <sup>th</sup> – 15 <sup>th</sup> May 2020	IPAC20, Caen, France
2 <sup>nd</sup> – 7 <sup>th</sup> Aug 2020	LEAP2020, Berkley, California, USA
30 <sup>th</sup> Aug - 4 <sup>th</sup> Sept 2020	LINAC2020, Liverpool, UK

## Notice Board

**DEADLINE FOR THE NEXT NEWSLETTER CONTRIBUTIONS: 5<sup>th</sup> March 2020**

*Wishing you a wonderful  
Holiday Season and a  
Happy New Year!*



[www.ava-project.eu](http://www.ava-project.eu)

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