

FAKT Workshop 2026: Particle Physics Retreat

Report of Contributions

Contribution ID: 1

Type: **not specified**

Geodesics in quantum gravity

Tuesday, 24 February 2026 11:50 (20 minutes)

We investigate the motion of test particles in quantum-gravitational backgrounds by introducing the concept of q-geodesics, quantum-corrected analogs of classical geodesics. Unlike standard approaches that rely solely on the expectation value of the spacetime metric, our formulation is based on the expectation value of quantum operators, such as the affine connection operator. This allows us to capture richer geometric information. We derive the q-geodesic equation using both Lagrangian and Hamiltonian methods and apply it to spherically symmetric static backgrounds obtained from canonical quantum gravity. Exemplary results include lightlike radial motion and circular motion with quantum gravitational corrections far above the Planck scale. This framework provides a refined description of motion in quantum spacetimes and opens new directions for probing the interface between quantum gravity and classical general relativity.

Author: KOCH, Benjamin**Co-authors:** RIAHINIA, Ali (TU Wien); Dr RINCON, Angel (Silesian University Czech Republic)**Presenter:** KOCH, Benjamin**Session Classification:** Talks

Contribution ID: 2

Type: **not specified**

Against the point-like nature of physical electrons

Tuesday, 24 February 2026 11:30 (20 minutes)

Experts in quantum field theory (QFT) generally answer the question of the “size of an electron” with “point-like”. On the other hand, QFT recognizes quantum effects, shielding by virtual particles, the so-called polarization cloud, which should describe the size of physical electrons. Scattering experiments with electrons, such as those carried out in high-energy experiments at particle accelerators, should be able to clarify whether physical electrons are really point-like, as claimed by experts and in textbooks. I show that both the formulas of QFT and the corresponding cross sections are consistent with an extent of the electron of the size of the classical electron radius. According to current knowledge, electrons have no substructure.

Author: FABER, Manfred

Presenter: FABER, Manfred

Session Classification: Talks

Contribution ID: 3

Type: **not specified**

Quantum Gravity in Static Spherically Symmetric Spacetime

Tuesday, 24 February 2026 12:10 (20 minutes)

A new canonical quantization framework for static spherically symmetric spacetimes is presented. For a proof-of-principle, the Einstein-Hilbert action is considered. We recover the classical solution and further investigate the quantum uncertainty relations arising among the geometric operators. Our analysis uncovers an intriguing relation to black holes and generalized uncertainty relations. Moreover, for a given cosmological constant Λ , we obtain upper and lower limit of the mass that is allowed, where they have a stunning relation to observed bounds for the known Λ .

Authors: RIAHINIA, Ali (TU Vienna); KOCH, Benjamin

Presenter: RIAHINIA, Ali (TU Vienna)

Session Classification: Talks

Contribution ID: 4

Type: **not specified**

News from NuPECC

Monday, 23 February 2026 14:10 (20 minutes)

I will report on what happened in NuPECC in the last year. One topic will be the Early Career Researcher Forum NuFFER which started officially in September 2025.

Author: WIDMANN, Eberhard (Austrian Academy of Sciences (AT))

Presenter: WIDMANN, Eberhard (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 5

Type: **not specified**

Early-career FAKT researchers in Austria

Monday, 23 February 2026 17:20 (10 minutes)

We discuss our recent efforts to bring together the Austrian community of early-career researchers (ECRs) within nuclear and particle physics. Moreover, we briefly introduce the ECFA ECR panel for which Austria nominates up to three members and outline its tasks and possible benefits for ECRs.

Authors: MANDL, Michael (University of Graz); WIELAND, Georg (University of Graz)

Presenter: MANDL, Michael (University of Graz)

Session Classification: Talks

Contribution ID: 6

Type: **not specified**

Continuum methods in Theoretical Particle Physics at the University Graz

Tuesday, 24 February 2026 10:00 (20 minutes)

I will give one of two overview talks about the current research conducted at the University Graz in the field of theoretical particle physics.

Author: HOFFER, Joshua (University Graz)

Presenter: HOFFER, Joshua (University Graz)

Session Classification: Talks

Contribution ID: 7

Type: **not specified**

Carroll physics and flat space holography

Tuesday, 24 February 2026 12:30 (20 minutes)

I review recent advances (since 2022) in understanding flat space holography using Carroll symmetries as the basic organizing principle. This brief review is based on a talk I gave at Strings 2025.

Author: GRUMILLER, Daniel

Presenter: GRUMILLER, Daniel

Session Classification: Talks

Contribution ID: 8

Type: **not specified**

Recent results and activities of the CMS group at MBI Vienna

Monday, 23 February 2026 16:40 (20 minutes)

In this talk we review recent results and ongoing activities of the CMS Data Analysis group at MBI Vienna.

Author: BENATO, Lisa (Austrian Academy of Sciences (AT))

Presenter: BENATO, Lisa (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 9

Type: **not specified**

Unbinned inclusive cross-section measurements with machine-learned systematic uncertainties

Monday, 23 February 2026 16:20 (20 minutes)

We introduce a novel methodology for addressing systematic uncertainties in unbinned inclusive cross-section measurements and related collider-based inference problems. Our approach incorporates known analytic dependencies on parameters of interest, including signal strengths and nuisance parameters. When these dependencies are unknown, as is frequently the case for systematic uncertainties, dedicated neural network parametrizations provide an approximation that is trained on simulated data. The resulting machine-learned surrogate captures the complete parameter dependence of the likelihood ratio, providing a near-optimal test statistic. As a case study, we perform a first-principles inclusive cross-section measurement of $H \rightarrow \tau \tau$ in the single-lepton channel, utilizing simulated data from the FAIR Universe Higgs Uncertainty Challenge. Results in Asimov data, from large-scale toy studies, and using the Fisher information demonstrate significant improvements over traditional binned methods. Our computer code “Guaranteed Optimal Log-Likelihood-based Unbinned Method”(GOLLUM) for machine-learning and inference is publicly available.

Our submission won first place ex aequo in the FAIR Universe Higgs Uncertainty Challenge and is available at <https://arxiv.org/abs/2505.05544>.

Author: Dr KRAUSE, Claudius (MBI Vienna (ÖAW))

Co-authors: LI, Ang (Austrian Academy of Sciences (AT)); GIORDANO, Cristina (Austrian Academy of Sciences (AT)); WANG, Daohan (HEPHY ÖAW); SCHWARZ, Dennis (Austrian Academy of Sciences (AT)); BENATO, Lisa (Austrian Academy of Sciences (AT)); SHOOSHTARI, Maryam (Austrian Academy of Sciences (AT)); SCHOEFBECK, Robert (Austrian Academy of Sciences (AT))

Presenter: Dr KRAUSE, Claudius (MBI Vienna (ÖAW))

Session Classification: Talks

Contribution ID: **10**

Type: **not specified**

RECFA Meeting in Vienna

Monday, 23 February 2026 15:10 (20 minutes)

Author: BERGAUER, Thomas (Austrian Academy of Sciences (AT))

Presenter: BERGAUER, Thomas (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 11

Type: **not specified**

Outer spaces: An interdisciplinary research and outreach event

Monday, 23 February 2026 17:30 (10 minutes)

Starting in the end of 2026, a 1.5 year large scale double exhibition will take place at the Kunsthaus Graz, in cooperation with physics, philosophy and arts groups at the University of Graz. It will connect to both particle physics and (quantum) gravity. This will give an overview of these activities, as well as offer opportunities for collaboration.

Author: Prof. MAAS, Axel Torsten (University of Graz)

Presenter: Prof. MAAS, Axel Torsten (University of Graz)

Session Classification: Talks

Contribution ID: 12

Type: **not specified**

Overview of the activities of the groups of Axel Maas, Simon Plätzer, and Denes Sexty

Tuesday, 24 February 2026 10:20 (20 minutes)

This presentation will present a status report on the work of the groups of Axel Maas, Simon Plätzer, and Denes Sexty at the University of Graz, which uses a combination of numerical and analytical techniques to address key questions about how fundamental matter interacts. We are interested in using these non-perturbative techniques to provide input for phenomenology and experiment. To fully bridge the gap between theory and experiment, we simulate hadronization using Monte-Carlo techniques. Lattice simulations enable research into the phases of Quantum Chromodynamics at finite chemical potential, crucial for our understanding of Nuclear Physics, the Standard Model, and general quantum field-theoretical predictions. We are further interested in the more profound, partly philosophical questions: how a force could look that unifies the very different forces of the Standard Model into a single grand unifying theory and quantum gravity, and, more generally, what symmetries, gauge invariance, and quantum field theory mean for our understanding of the world.

Author: MARTINS, Sofie (University of Graz)

Presenter: MARTINS, Sofie (University of Graz)

Session Classification: Talks

Contribution ID: 13

Type: **not specified**

High-frequency readout enables unprecedented time-of-flight techniques in high-energy physics and medical applications with SiPMs, scintillators, and SiC detectors

Tuesday, 24 February 2026 09:40 (20 minutes)

The ability to measure the arrival time of particles is important in many applications, including those in high-energy physics, industry, and medicine. For instance, single optical photon detection and time tagging are used in light detection and ranging (LiDAR) systems for the automotive industry, as well as in optical tomography and fluorescence lifetime measurements in medicine. In these fields, silicon photomultipliers (SiPMs) have demonstrated excellent single-photon-counting and time-resolution capabilities. Coupling inorganic scintillators to SiPMs extends this concept to time-tagging gamma and X-ray photons in time-of-flight (TOF) positron emission tomography (PET) and computed tomography (CT), as well as minimum ionizing particles in high-energy physics experiments and particle beams in radiotherapy. The continuous development of SiPMs (e.g., high photon detection efficiency, UV detection, and low dark count rates) has made it possible to explore new and well-established scintillator materials and efficiently utilize various fast emission mechanisms for the first time.

This talk will provide an overview of advancements in high-frequency (HF) readout, which is used to gauge the timing limits of SiPMs for single-photon detection, e.g. in the UV, visible and IR range. Coupling SiPMs to inorganic scintillators enables the detection of minimum ionizing particles with exceptional time resolution and is already being used in the upgrade of the CMS barrel timing layer. Furthermore, HF readout and special cross-luminescence scintillators with ultra-fast sub-nanosecond emission have the potential to enable real-time, high-rate beam monitoring in hadron therapy via PET techniques. We also show that HF readout can be used for fundamental studies of the intrinsic features of novel semiconductor detectors. For example, it is possible to measure the electron and hole saturation drift velocities in silicon carbide (SiC). HF readout can also help to achieve a deeper understanding of radiation damage in such detectors when combined with two-photon absorption (TPA) measurements. The talk will conclude with a summary and an outlook on future research directions.

Author: GUNDACKER, Stefan (Austrian Academy of Sciences (AT))

Co-author: MBI DETECTOR DEVELOPMENT GROUP

Presenter: GUNDACKER, Stefan (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 14

Type: **not specified**

$\Lambda_c(2595)$ at Belle II: Extending Event Generation with HERWIG

Tuesday, 24 February 2026 11:10 (20 minutes)

The Belle II detector is a general-purpose spectrometer built around the interaction point of the asymmetric-energy electron–positron collider SuperKEKB, located in Tsukuba, Japan.

While Belle II is best known as a B-factory, the production rate of charm–anticharm quark pairs at SuperKEKB is slightly higher than that of B -meson pairs.

To date, charm and light quark fragmentation at Belle II has been simulated using PYTHIA 8. However, the implementation of Pythia at Belle II does not account for excited charm baryons. As a result, the development of alternative strategies for studying these baryons has become increasingly important.

In this presentation, I discuss the role of the $\Lambda_c(2595)$ as a possible entry point to improving our understanding of the excited spectrum of charm baryons, and I summarize our progress toward implementing Herwig as a Monte Carlo generator for this purpose within the Belle II software framework.

Author: BRITO RICAURTE, Cristhian Xavier (Austrian Academy of Sciences (AT))

Co-author: SCHWANDA, Christoph

Presenter: BRITO RICAURTE, Cristhian Xavier (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 15

Type: **not specified**

Status update on the delivery of mixed ion beams at medical synchrotron facilities

Monday, 23 February 2026 16:00 (20 minutes)

Irradiation with mixed helium-carbon ion beams is a promising proposal for online monitoring in carbon ion therapy. Over the past two years, newly developed beam manipulation schemes have enabled us to generate and deliver these novel beams to the MedAustron research irradiation room for first research projects in accelerator physics, detector development, and medical physics.

This talk provides a status update on these recent developments. Firstly, we report on improved control of the injection and slow extraction settings to flexibly tailor the inter- and intraspill helium-to-carbon ratio. Building on this, a novel non-invasive method for quantifying the ion composition in the synchrotron based on RF frequency acquisition is introduced. Finally, we report on first experience of using this novel beam for ion imaging experiments, using both clinical detector systems as well as a time-of-flight ion CT. The talk will also include a brief outlook on additional accelerator physics research activities of TU Wien at MedAustron, such as the development of multi-energy extraction.

Authors: RENNER, Elisabeth (Technische Universität Wien (AT)); ULRICH-PUR, Felix (TU Wien); KAUSEL, Matthias (MedAustron, TU Wien)

Co-authors: Mr HIRTL, Albert; SCHMITZER, Claus (MedAustron); HANDERKAAS, Harald (TU Wien); FUCHS, Hermann (Medical University of Vienna); HOLZFEIND, Katrin; KELLETER, Laurent (MedAustron); GREVILLOT, Loic (MedAustron); BERGAUER, Thomas (Austrian Academy of Sciences (AT)); JIA, Yihan (MedAustron)

Presenter: ULRICH-PUR, Felix (TU Wien)

Session Classification: Talks

Contribution ID: 16

Type: **not specified**

An overview on CRESST & COSINUS experiments

Tuesday, 24 February 2026 09:00 (20 minutes)

CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) and COSINUS (Cryogenic Observatory for Signatures seen in Next-generation Underground Searches) are cryogenic dark matter experiments operated at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy. Both aim to detect dark matter–nucleus interactions using scintillating calorimeters equipped with transition edge sensors (TESs) to measure phonon signals at millikelvin temperatures, complemented by the detection of scintillation light for efficient background discrimination.

CRESST continues its effort to further lower the energy threshold, a task made increasingly challenging by a low-energy excess—an exponential background whose origin remains unknown. COSINUS is preparing to begin data taking this year, aiming to address the long-standing question of whether the signal observed by the DAMA/LIBRA collaboration could have a dark matter origin.

This talk will present an overview of both experiments, the latest results since the last meeting, and future goals.

Author: VALDENNAIRE, Danae Danielle (Austrian Academy of Sciences (AT))

Presenter: VALDENNAIRE, Danae Danielle (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 17

Type: **not specified**

The NUCLEUS and CRAB experiments: Low-energy signal detection with cryogenic calorimeters

Tuesday, 24 February 2026 09:20 (20 minutes)

Coherent elastic neutrino-nucleus scattering (CEvNS) occurs within the Standard Model of particle physics when a neutrino interacts with a nucleus as a whole. The coherence condition, which is fulfilled for neutrino energies below 50 MeV, leads to a large interaction cross section, making CEvNS an excellent precision probe of the Standard Model.

The NUCLEUS experiment aims to detect CEvNS using gram-scale CaWO_4 and Al_2O_3 cryogenic calorimeters. The experiment will be deployed this year at the commercial nuclear power plant in Chooz, France, at distances of 70 m and 102 m from the reactor cores. The excellent energy resolution of a few eV, and the resulting low noise threshold, enable the detection of nuclear recoils induced by MeV-scale neutrinos for the first time, allowing a detailed study of the CEvNS interaction.

In this talk, I will outline the physics potential of CEvNS and describe the current status of the NUCLEUS experiment, including the performance benchmarks achieved during commissioning at the Technical University of Munich prior to deployment at the reactor site.

A prerequisite for a precision measurement of CEvNS is an accurate calibration of the nuclear recoil energy scale in the 100 eV range. This can be achieved with CRAB (Calibrated nuclear Recoils for Accurate Bolometry). The CRAB experiment is located at the TRIGA research reactor in Vienna. Nuclear recoils produced by the capture of thermal neutrons from the reactor beam line are detected using cryogenic calorimeters of a design similar to those employed in NUCLEUS. I will present the current status of the experiment and discuss the first physics results that demonstrate the precision potential of the method.

Author: HAKENMUELLER, Janina Dorin (Austrian Academy of Sciences (AT))

Presenter: HAKENMUELLER, Janina Dorin (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: **18**

Type: **not specified**

FAKT Matters

Monday, 23 February 2026 13:30 (40 minutes)

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Authors: REINDL, Florian (Vienna University of Technology (AT)); EICHMANN, Gernot

Presenters: REINDL, Florian (Vienna University of Technology (AT)); EICHMANN, Gernot

Session Classification: Talks

Contribution ID: 19

Type: **not specified**

Current research topics of the particle group at University Vienna

Monday, 23 February 2026 17:00 (20 minutes)

Author: HOANG, Andre (Austrian Academy of Sciences (AT))

Presenter: HOANG, Andre (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: **20**

Type: **not specified**

FAKT Discussion

Monday, 23 February 2026 18:00 (1 hour)

General discussion

Contribution ID: 21

Type: **not specified**

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Monday, 23 February 2026 17:40 (10 minutes)

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Author: GRUMILLER, Daniel

Presenter: GRUMILLER, Daniel

Session Classification: Talks

Contribution ID: 22

Type: **not specified**

Results of Strategy Update

Monday, 23 February 2026 14:30 (20 minutes)

Author: PLATZER, Simon (University of Graz (AT))

Presenter: PLATZER, Simon (University of Graz (AT))

Session Classification: Talks

Contribution ID: 23

Type: **not specified**

Initiative to Physics at future colliders (HL-LHC)

Monday, 23 February 2026 14:50 (20 minutes)

Author: PLATZER, Simon (University of Graz (AT))

Presenter: PLATZER, Simon (University of Graz (AT))

Session Classification: Talks

Contribution ID: 24

Type: **not specified**

Networking to strengthen communication and public relations work in particle physics

Monday, 23 February 2026 17:50 (10 minutes)

The presentation provides an overview of the activities of the International Particle Physics Outreach Group (IPPOG) and the European Particle Physics Communication Network (EPPCN). It offers insights into the diverse outreach programs of various institutes and provides opportunities for networking and joint projects and activities between institutes in order to significantly increase the visibility of our current and future research topics among the general public.

Presenter: KRAMMER, Natascha (Austrian Academy of Sciences (AT))

Session Classification: Talks

Contribution ID: 25

Type: **not specified**

Advancing NNLO accuracy in Monte Carlo generators for final-state jet processes

Tuesday, 24 February 2026 08:40 (20 minutes)

I will present recent developments aimed at extending Monte Carlo event generators to include processes with final-state jets while preserving next-to-next-to-leading order (NNLO) parton-level accuracy. I will discuss the resummation of one-jettiness for the Z+jet process at the LHC. I will then present a general implementation of fully differential NNLO QCD corrections for both colour-singlet and colour-singlet+jet processes at hadron colliders, based on a nonlocal subtraction approach derived from the fixed-order expansion of the resummation formula.

Author: BROGGIO, Alessandro

Presenter: BROGGIO, Alessandro

Session Classification: Talks