Time	
8:30-9:00	Registration & Welcome Note
9:00-9:20	Quantum Info – Englbrecht/ Innsbruck-TUM
9:20-9:40	Quantum Optics – Li / Hanover
9:40-10:00	Quantum Many Body – Mostaan / Munich
10:00-10:20	Quantum Computation - Lefterovici / Hanover
10:20-10:40	Coffee Break
10:40-11:00	Quantum Optics – Haase / Hanover
11:00-11:20	Quantum Optics – Tieben / PTB
11:20-11:40	Condensed Matter – Wang / Würzburg
11:40-12:00	Condensed Matter – Yi / PTB
12:00:12:20	Talk 10 (Special)
12:20-13:30	Lunch Break
13:30-16:00	Posters and Coffee
16:00-18:00	Lab Tours / Panel discussion
18:15	Final remarks and end of conference
18:30	Post Conference Dinner

Theory talks		
Matthias Englbrecht	Indistinguishability of identical bosons from a quantum information theory perspective	Using tools from quantum information theory, we present a general theory of indistinguishability of identical bosons in experiments consisting of passive linear interferometers followed by particle number detection. Our results do neither rely on additional assumptions on the input state of the interferometer, such as, for instance, a fixed mode occupation, nor on any assumption on the degrees of freedom that potentially make the particles distinguishable. We identify the expectation value of the projector onto the N-particle symmetric subspace as an operationally meaningful measure of indistinguishability, and derive tight lower bounds on it that can be efficiently measured in experiments. Moreover, we present a consistent definition of distinguishability and characterize the corresponding set of states. In particular, we show

		that these states are diagonal in the computational basis up to a permutationally invariant unitary. Reference: Matthias Englbrecht, Tristan Kraft, Christoph Dittel, Andreas Buchleitner, Geza Giedke, Barbara Kraus, arXiv:2307.06626
Rui Li	A new glimpse into double Bragg diffraction and beyond	In this talk, I will provide some new insights into a commonly-used tool in atom interferometry-the double Bragg diffraction (DBD). After reviewing the traditional treatment of DBD and its limitations, I will derive an effective two-level-system (TLS) hamiltonian for describing the so-called "quasi-Bragg regime" where most light-pulse atom interferometers are operating. With this effective hamiltonian, we will study the effects of polarization error and AC-Stark shift due to light-atom interaction. Furthermore, Doppler broadening effect can be easily included by extending our TLS to a three-level-system. Finally, we will design a beam-splitter via a detuning sweep and show its robustness against polarization error and asymmetric beam-splitting due to Doppler effect.
Nader Mostaan	A unified theory of strong coupling Bose polarons: From repulsive polarons to non-Gaussian many-body	We address the Bose polaron problem of a mobile impurity interacting strongly with a host Bose-Einstein condensate (BEC) through a Feshbach resonance. On the repulsive side at strong couplings, theoretical approaches predict two distinct polaron branches corresponding to attractive and repulsive polarons, but it remains unclear how the two are related. This is partly due to the challenges resulting from a competition of strongly attractive (destabilizing) impurity-boson interactions with weakly repulsive (stabilizing) boson-boson interactions, whose interplay is difficult to describe with contemporary theoretical methods. Here we develop a powerful variational framework that combines Gaussian correlations among impurity-boson scattering states, including

		up to an infinite number of bosonic excitations, with exact non-Gaussian correlations among bosons occupying an impurity-boson bound state. This variational scheme enables a full treatment of strong nonlinearities arising in the Feshbach molecule on the repulsive side of the resonance. Within this framework, we demonstrate that the interplay of impurity-induced instability and stabilization by repulsive boson-boson interactions results in a discrete set of metastable many-body bound states at intermediate energies between the attractive and repulsive polaron branches. These states exhibit strong quantum statistical characteristics in the form of non-Gaussian quantum correlations, requiring non-perturbative beyond mean-field treatments for their characterization. Furthermore, these many-body bound states have sizable molecular spectral weights, accessible via molecular spectroscopy techniques. This work provides a unified theory of attractive and repulsive Bose polarons on the repulsive side of the Feshbach resonance.
Andreea-Iulia Lefterovici	Realistic Runtime Analysis for Quantum Simplex Computation	In recent years, strong expectations have been raised for the possible power of quantum computing for solving difficult optimization problems, based on theoretical asymptotic worst-case bounds. However, the lack of sufficiently large quantum platforms to perform real world tests poses a crucial impediment for gauging and tuning the actual performance of quantum computers when solving instances of relevant size, the fundamental goal of Algorithm Engineering. In this paper, we present a quantum analog for classical runtime analysis when solving real-world instances of important optimization problems. To this end, we measure the expected practical performance of quantum computers by analyzing the expected gate complexity of a quantum algorithm. The lack of practical quantum platforms for experimental comparison is addressed by hybrid benchmarking, in which the algorithm is performed on a classical system, logging the expected cost of the various subroutines that are employed by the quantum

		versions. In particular, we provide a concrete analysis of quantum methods for Linear Programming, for which a recent paper by Nannicini has provided asymptotic speedup through quantum subroutines for the simplex method. We show that a practical quantum advantage for realistic problem sizes would require quantum gate operation times that are considerably below current physical limitations.
Experimental talks		
Jan Simon Haase	Interferometry with entangled atoms in space	Atom interferometers are high-precision measurement devices for the sensing of inertial moments as accelerations and rotations. A zero-gravity environment enables prolonged interrogation time and consequently a higher resolution. Therefore, space-borne atom interferometers promise unprecedented resolution for a wide range of applications from geodesy to fundamental tests. A fundamental limit for their precision is the Standard Quantum Limit (SQL), which determines a limit for the interferometric resolution. The SQL can only be surpassed by using entangled ensembles of atoms as a source for the interferometer. In the INTENTAS project (Interferometry with entangled atoms in space) it is planned to demonstration a compact source of entangled atoms in the Einstein-Elevator, a microgravity platform which allows zero-gravity tests for up to 4s. In this talk the scientific perspectives and the current status are presented. The planned experiments will pave the way to employ entangled atomic sources for high-precision interferometry in space applications.

Pablo Tieben	Multi-Phonon Excitation for Defect Identification in hBN	Single photon sources are a key requirement for various quantum technologies. Therefor novel emitters with more favorable emission characteristics are highly sought after. Color centers in hexagonal boron nitride have received increased attention in recent years due to their bright emission, featuring high single photon purity and narrow emission linewidths across the full visible spectrum. Despite all scientific effort, the exact atomic origin of these emitters remains unknown. Recently, single photon emission in the yellow spectral region has been connected to carbon-related defects. We perform photoluminescence emission and excitation spectroscopy on a large number of emitters in this region in order to determine the atomic structure out of several proposed carbon defects. Knowledge about the exact atomic nature and optical properties of these defects is paramount to make them a reliable resource for quantum technologies.
Yu Wang	Gd chains – towards Majorana fermions	Transition metal adatoms act as magnetic impurities that cause Yu-Shiba-Rusinov (YSR) bound states to form within the energy gap of s-wave superconductors. These bound states are localized at the impurity sites and can assemble into one-dimensional (1D) YSR chains that display zero-energy edge states that could be topologically trivial or non-trivial. This study focuses on investigating the impact of rare-earth-metallic species (REMs), specifically Gadolinium atoms as magnetic impurities on Nb(110) superconducting surface. This research reveals the presence of zero-energy states at the edges of chains as short as 5Gd, which may signify the first time that topologically non-trivial zero-energy edge states have been discovered from REMs.

Yefei Yin	Next generation of quantum Hall resistance standard based on epitaxial graphene	Epitaxial graphene on silicon carbide (SiC) is emerging as an excellent candidate for the next generation of quantum Hall resistance (QHR) standards [1-2], instead of GaAs based QHR, due to its unique electronic properties and large-scale integration for device fabrication. Epitaxial graphene is a promising material for realizing QHR standards that operate under relaxed conditions, above 4 K and below 5 T, with part per billion (1×10-9) accuracy. The bottleneck in achieving this goal is the reliable control of the carrier density, since as-grown epitaxial graphene already exhibits a high n-type carrier density of up to 1013 cm-2. By using the molecular dopant F4-TCNQ, the electron density can be reduced via a charge transfer mechanism [3]. However, precisely tuning the carrier density to the desired value in the n- and p-type regime is challenging and largely unexplored. Here we investigate the molecular doping of epitaxial graphene with F4-TCNQ doping stacks, which compensates for the high electron density of pristine epitaxial graphene [4]. The magnetoresistance measurements show that the carrier density is tuned in a wide range from intrinsic n- to p-type by molecular doping. The superior performance of our graphene QHR standard was characterized in a magnetic field up to 12 T at 4.2 K by high-precision measurements using a cryogenic current comparator (CCC) bridge. The quantum Hall resistance Rxy at filling factor 2 achieves the accuracy of part per billion (10-9) in a magnetic field from 4 T up to 12 T at 4.2 K, demonstrating the high quality and performance of graphene QHR devices doped with F4-TCNQ. By controllable F4-TCNQ doping, a series of graphene QHR devices with different carrier densities exhibit Rxy in accuracy of part per billion in a wide magnetic field. Moreover, the onset of accurate Rxy shifts to lower magnetic field as the carrier density decreases, revealing the quantized regime as a function of electron density and magnetic field. Furthermore, the current-dependent measurements prove that the graphene QHR can sustain a current of 233 µA without breaking the

		resistance quantization. Through repeated high-precision measurements, we have demonstrated that the graphene QHR standard maintains a quantization accuracy of 10-9 for more than 2 years. [1] A. Tzalenchuk et al., Nat. Nanotechnol. 5, 186, (2010) [2] F. Lafont et al., Nat. Commun. 6, 6806, (2015) [3] H. He et al., Nat. Commun. 9, 3956, (2018) [4] Y. Yin et al., Adv. Physics Res. 1, 2200015, (2022)

Theory Posters		
Alexander Fritzsche	Symmetry-Exploiting Quantum Computing Approach for Spin- ½ System Ground States	Determining the ground state and its energy of frustrated quantum spin systems poses a fundamental problem in the search of new exotic materials. Here, quantum computing provides promising pathways to overcome numerical limitations of classical methods. Faithful quantum state preparation on NISQ era devices, however, is challenging in practice. In this work, we present a quantum algorithm to compute the ground state energy of a 12-site Spin- ½ Kagome Heisenberg Antiferromagnet based on a Variational Quantum Eigensolver. By exploiting the symmetries of the underlying lattice, we design a highly scalable and generalizable ansatz to heavily reduce the number of variational parameters. Our approach to quantum state preparation, implemented on the IBM Quantum Falcon heavy-hex device with 16 qubits, features a novel error mitigation technique and provides the ground state energy with great accuracy. This work was awarded the second prize of the 2023 IBM Quantum Open Science Prize.
Kapil Goswami	Solving optimization problems with local light shift encoding on Rydberg quantum annealers	We provide a non-unit disk framework to solve combinatorial optimization problems such as Maximum Cut (Max-Cut) and Maximum Independent Set (MIS) on a Rydberg quantum annealer. Our setup consists of a many-body interacting Rydberg system

		where locally controllable light shifts are applied to individual qubits in order to map the graph problem onto the Ising spin model. Exploiting the flexibility that optical tweezers offer in terms of spatial arrangement, our numerical simulations implement the local-detuning protocol while globally driving the Rydberg annealer to the desired many-body ground state, which is also the solution to the optimization problem. Using optimal control methods, these solutions are obtained for prototype graphs with varying sizes at time scales well within the system lifetime and with approximation ratios close to one. The non-blockade approach facilitates the encoding o graph problems with specific topologies that can be realized in two-dimensional Rydberg configurations and is applicable to both unweighted as well as weighted graphs. A comparative analysis with fast simulated annealing is provided which highlights the advantages of our scheme in terms of system size, hardness of the graph, and the number of iterations required to converge to the solution.
Jaspar Meister	Dynamical simulation of quantum repeater satellite constellations	Quantum repeaters and satellite-based free-space optical links are complementary technological approaches slated to overcome the exponential photon loss occurring in optical fibers and thus allow quantum communication at global scales. Here, we analyze scenarios where these approaches are combined: satellites are used as quantum repeater nodes and are employed to distribute entangled photon pairs to far-away optical ground stations. The satellites have to mount optical communication terminals in order to allow the exchange of photonic states over free space, as well as quantum memories and optical Bell-state measurement setups to perform entanglement swapping. Here we report on the development of a full end-to-end simulator of quantum repeater satellite constellations, including detailed orbit dynamics, optical link quality evaluation, calculations of the downstream entanglement generation rate, latency and fidelity. Using only three satellites enables the distribution of entangled states at intercontinental distances; the small number of links in the repeater chain allows us to forgo entanglement purification altogether,

		resulting in a favorable entanglement swapping rate and state fidelity. We perform numerical simulations of time-varying satellite positions and compare the results to analytical estimates of the entanglement distribution rate based on the average values of the link parameters. The goal is to maximize performance through optimization of the orbits and other system parameters.
Daniel Molpeceres Mingo	Quantum Algorithms based on cooling	Abstract: The purpose of this work is to study different methods for nature-inspired algorithmic cooling of physical systems, which rely on energy transfer between the system and a cooled bath. These algorithms are suitable for preparation of QMB ground states, and are therefore an alternative to other well-known procedures such as variational or adiabatic cooling, which have their own limitations. The aim of the project is to develop this theory, and try to find in what regimes and systems it works best, such that it can be used as an alternative or in collaboration with the previous methods. We will focus on an analytical approach to an archetypic model of cooling in a free-fermion model wth hoppings in a 1D lattice and a certain distribution of ancillas per site, try to find regimes in which the system reaches the ground state, and then extrapolate what we learn from this model into a more general setting. The main questions to address in future research are how the performance changes with the errors that may appear in an experimental setting, such that these methods could be implemented in NISQ devices, and how we can generalize into more strongly-correlated systems.
Nepomuk Ritz	Real-frequency quantum field theory applied to the single-impurity Anderson model	A major challenge in the field of correlated electrons is the computation of dynamical correlation functions. For comparisons with experiment, one is interested in their real-frequency dependence. This is difficult to compute, as imaginary-frequency data from the Matsubara formalism require analytic continuation, a numerically ill-posed problem. Here, we apply quantum field theory to the single-impurity Anderson model (AM), using the Keldysh instead of

		the Matsubara formalism with direct access to the self-energy and dynamical susceptibilities on the real-frequency axis. We present results from the functional renormalization group (fRG) at one-loop level and from solving the self-consistent parquet equations in the parquet approximation. In contrast to previous Keldysh fRG works, we employ a parametrization of the four-point vertex which captures its full dependence on three real-frequency arguments. We compare our results to benchmark data obtained with the numerical renormalization group and to second-order perturbation theory. We find that capturing the full frequency dependence of the four-point vertex significantly improves the fRG results compared to previous implementations, and that solving the parquet equations yields the best agreement with the NRG benchmark data, but is only feasible up to moderate interaction strengths. Our methodical advances pave the way for treating more complicated models in the future.
David Gunn	Approximate and ensemble local entanglement transformations for multipartite states	Local Operations and Classical Communication (LOCC) provides a framework through which one can quantitatively analyse entanglement. However, for five or more parties, pure states are generically isolated - that is, almost all multipartite, pure states can neither be transformed nor reached via LOCC deterministically. Here, we consider physically motivated modifications to LOCC. Namely, we study a hierarchy of approximate transformations. Whereas this hierarchy collapses in the bipartite case, we show this does not happen in the multipartite setting, which is fundamentally richer. For example, we show that optimal approximate transformations are not generally deterministic and that there are approximate transformations with no deterministic transformations nearby.

Linh Manh Nguyen Tran	Quantum Deep Reinforcement Learning Benchmark Environments for Simple Robotic Behaviors	A well-known problem of Quantum Reinforcement Learning (QRL) is the successful proposals for solving benchmark tasks or demonstrating theoretical advantages over classical Reinforcement Learning (RL) algorithms. To address this, we present a selection of carefully collected benchmark environments trained with diverse reinforcement learning algorithms. These environments encompass both classical RL and QRL settings, chosen based on characteristics such as availability, accessibility, code quality, and documentation. Our focus is on navigation and manipulation domains, and we have curated four environments increasing in difficulty and complexity, starting with the relatively simple Cartpole and progressing to more challenging benchmark environments like Pendulum-swing up, Fetch Reach and Pull, and Turtlebot. To assess the effectiveness of RL classic and QRL methods, we have identified suitable metrics including cumulative reward, average reward, time to convergence, learning curve, policy quality, and sample efficiency. Moreover, we extend the scope of research by exploring the significance of architectural choices and observables for different RL agents, utilizing various RL algorithms such as PPO, DDPG, and the state-of-the-art RAINBOW algorithm. We build upon previous work that focuses on policy gradient RL algorithms and Q-Learning. In our implementation, we leverage Stable Baselines3, a robust RL library that integrates cutting-edge algorithms with Gym, offering an intuitive interface and efficient implementation. In summary, our open-source benchmark environment aims to facilitate the beginning and serve as a valuable reference for researchers in the field of QRL and quantum robotics.
Experimental Posters		
Saskia Bondza	Quantum Technologies for Optical Coherence Tomography	Optical coherence tomography (OCT) presents an indispensable, non-contact, high resolution 3D imaging technique. Its main application, retinal imaging, has helped to save the sight of millions of people worldwide. However, classical OCT seems to have reached its practical axial resolution limit at 1

		µm and further improvement is heavily impacted by dispersion. The SEQUOIA project develops sensing combining quantum OCT (QOCT) with artificial intelligence. A quantum benefit is expected by using entangled photon pairs instead of classical light, which allows for immunity against even-order dispersion and further promises a factor of two improvement in axial resolution. These photon pairs are produced by spontaneous parametric down-conversion. Controlling and entangling the photon pairs in additional quantum degrees of freedom such as orbital angular momentum may foster the robustness against noise and thus improve edge and surface profile recognition. Finally, machine learning techniques are applied for further noise reduction. Overall, this promises to demonstrate an OCT system with the highest resolution yet. Here, we will present an overview of the project giving insights into the ongoing research and development of quantum technologies for OCT. We will further show first results regarding the noise characterisation and stabilization of the supercontinuum source used in this project. It currently spans from 700 nm to 1400 nm and is analysed with respect to its application in QOCT and, more generally, as ultra-stable, broadband phase-coherent frequency comb.
Janina Hamann	A compact and robust fiber-based laser system for cold atom experiments in microgravity	Operating atom interferometers in space opens up the possibility of a further improved phase sensitivity due to prolonged interrogation times. Especially Bose-Einstein condensates (BEC) are suitable for zero-gravity interferometry due to their well-controlled spatial mode and slow expansion rate. To prepare cold atom experiments for space operation, microgravity facilities such as the Einstein-Elevator are used for ground testing. The generation and detection of a 87Rb BEC in the Einstein-Elevator requires a laser system with a high frequency stability and robustness to 5 g accelerations and vibrations. We design a fiber-based laser system with a tuneable offset frequency stabilization that uses telecom components to ensure robustness. The rugged fiber-based setup is housed in a 19" crate, where fiber-based modulators generate an adjustable offset for the 780 nm laser

		and additional sidebands at several GHz. An atomic reference module is used for modulation transfer spectroscopy (MTS) on 85Rb. We achieve a tuneable frequency stabilization with a frequency stability of 90 kHz that can perform frequency ramps of 300 MHz in milliseconds.
Zhe Liu	Controlling Positioning and On-Surface Folding of DNA-Origami Hybrid Nanostructures	DNA origami has proven to be a flexible platform for the precise organization of nanoscale objects, opening up a wide range of applications in biomedicine and nano-photonics. We have successfully demonstrated the self-assembly of plasmonic dimers using DNA origami, achieving high binding selectivity regardless of pattern dimensions on surface. Surface diffusion and concentration effects were explored, leading to the modification of a diffusion model that to explain experimental observations. The findings offer significant implications for the development of nano-electronics and nano-plasmonics. Additionally, investigations of on-surface folding of DNA-origami structures revealed a preference for folding helices processes, although bending was observed when controlled by the adsorption site geometry. This control over folding allowed for precise arrangement and manipulation of nanoscale objects, enhancing control over optical properties and opening avenues for tunable plasmonic nanostructures. This versatile platform also holds promise for tuning electronic, magnetic, or chemical properties in various applications.
Mario Montero	An Ytterbium source for a quantum-clock interferometer	TBA
Constantin Nauk	PTB's transportable Al+ ion clock - concept and current status	Optical atomic clocks achieve fractional systematic and statistical frequency uncertainties on the order of 10^{-18}. This enables novel applications, such as height measurements in relativistic geodesy with ∼ 1 cm resolution for earth monitoring. Towards this

		goal, we set up a transportable clock based on the 1S0 → 3P0 transition in 27Al+. A co-trapped 40Ca+ ion allows state detection and cooling via quantum logic spectroscopy and sympathetic cooling. We present the design and the current status of the transportable apparatus, review the recent development of the laser systems and show particularly the performance of the UV clock laser setup operating at 267.4nm with a fractional frequency uncertainty of 10−16 at 1 second.
Martin Quensen	Multipartite Hong-Ou-Mandel Effect with Ultracold Atoms	The original Hong-Ou-Mandel experiment [1] showed that two single-photon states, which enter a 50:50 beamsplitter simultaneously, always emerge together in the same output port. This effect lies at the heart of quantum optics, as it describes the interference of single, indistinguishable particles. Observing it in a physical system demonstrates control at the single-particle level in terms of state preparation and detection. The phenomenon of Hong-Ou-Mandel interference can be extended both towards states of massive particles as inputs to the beamsplitter [2] and towards the interference between multiple particle pairs at once. Here, we employ spin-changing collisions in a Bose-Einstein condensate of Rb-87 to generate coherent superpositions of multiple twin-atom pairs [3]. We use a detection setup based on a magneto-optical trap that can accurately count the total atom number of up to several hundred particles. With an adapted version of this setup, featuring the simultaneous detection of three output modes, we directly observe the generation of up to seven simultaneous twin-atom pairs. Using our dynamic, low-noise microwave source [4], we demonstrate single-atom resolved Rabi transfers [5] suitable for 50:50 beamsplitter coupling. The realization of the Hong-Ou-Mandel experiment in our setup will pave the way for employing core features of highly entangled states to probe the fundamentals of quantum optics with massive particles, as well as for realizing Heisenberg-limited atom interferometry with mesoscopic states of matter. [1] C. K. Hong, Z. Y. Ou, and L. Mandel, Measurement of subpicosecond time intervals between two photons

		by interference, Phys. Rev. Lett. 59, 2044 (1987). [2] Lopes, R., Imanaliev, A., Aspect, A. et al. Atomic Hong–Ou–Mandel experiment. Nature 520, 66–68 (2015). https://doi.org/10.1038/nature14331 [3] B. Lücke et al. ,Twin Matter Waves for Interferometry Beyond the Classical Limit. Science 334, 773-776(2011). DOI:10.1126/science.1208798 [4] Bernd Meyer-Hoppe et al., Dynamical low-noise microwave source for cold-atom experiments. Rev. Sci. Instrum. 1 July 2023; 94 (7): 074705. https://doi.org/10.1063/5.0160367 [5] M. Hetzel et al., Tomography of a number-resolving detector by reconstruction of an atomic many-body quantum state". arXiv:2207.01270. (2022)
Till Rehmert	Towards high precision quantum logic spectroscopy of single molecular ions	High precision spectroscopy of trapped molecular ions constitutes a promising tool for the study of fundamental physics. Possible applications include the search for a variation of fundamental constants and measurement of the electric dipole moment of the electron. Compared to atoms, molecules offer a rich level structure, permanent dipole moment and large internal electric fields which make them exceptionally well- suited for those applications. However, the additional rotational and vibrational degrees of freedom result in a dense level structure and absence of closed cycling transitions. Therefore, standard techniques for cooling, optical pumping and state detection cannot be applied. This challenge can be overcome by quantum logic spectroscopy, where a well-controllable atomic ion is co-trapped to the molecular ion, both coupled strongly via the Coulomb interaction. The shared motional state can be used as a bus to transfer information about the internal state of the molecular ion to the atomic ion, where it can be read out using fluorescence detection. Using a Ca ion, we implemented a quantum logic scheme to detect population transfer on a co-trapped spectroscopy ion, induced by a far detuned Raman laser setup. We present the latest progress of the experiment, aiming at high precision quantum logic spectroscopy of single molecular ions.

Alexander Wilzewski	Precision Spectroscopy of highly charged ions with sub-Hz uncertainty	Highly charged ions (HCI) are promising candidates for a next generation of optical clocks with applications for frequency metrology and tests of fundamental physics. Typically, the megakelvin environment in which HCI are produced does not allow for high precision spectroscopy. In our experiment, HCI are extracted from an electron beam ion trap (EBIT) and transferred to a linear Paul trap. There, a single HCI is confined together with laser cooled beryllium ions for sympathetic cooling. After preparation of an HCI-Be+ two-ion ion crystal, we employ quantum logic techniques for further cooling as well as readout of the HCIs internal state. This enabled us to construct the first optical clock based on an HCI. By comparison to the established Yb+ clock at PTB, we measured the absolute frequency of Ar13+ with a fractional statistical uncertainty of 1x10-16 and a systematic uncertainty of 3x10^-17. Recently, we applied the developed techniques to determine the isotope shift of a narrow M1 transition in five stable even isotopes of Ca14+. This can be used for the search of a hypothetical fifth force coupling neutrons and electrons and to probe fundamental physics in combination with existing data of the clock transition in Ca+. Here, we present improved constraints on such a hypothetical coupling based on the results of recent isotope shift measurements in Ca14+.