Quantum and Artificial Intelligence: New Jobs for Physicists in Emergent Industries

Thursday, 29.08.2019, Room G 60

Time	ID	Quantum and Artificial Intelligence: New Jobs for Physicists in Emergent Industries *Chair: Thilo Stöferle, IBM Rüschlikon*
14:00	**51**	**Introduction** *Thilo Stöferle*
14:10	**52**	**Benchmarking next-generation ion-trap quantum computers** *Max Hettrich, Thomas Monz, Alpine Quantum Technologies, University of Innsbruck* Individual charged atoms stored in ion-traps are one of the most promising architectures to build a scalable quantum computer. This presentation will provide an overview of current developments to realize high-fidelity control of an arbitrary subset of qubits in a quantum register, recent cross-verification of quantum computers across several architectures (including photons and superconducting qubits), adaptations to realize ion-trap technologies according to industry-standards, and an outlook on how to connect distant ion-trap quantum computers using a telecom-compatible photonic interface.
14:30	**53**	**Can AI pass the exam for human pilots?** *Luuk van Dijk, Daedalean AG* Daedalean set out to create a robotic pilot that can outperform the Human on every task as tested in the Commercial Helicopter Pilot skill test, on the principle that if you want to replace the human weaknesses by an automatic system, you have to outperform her on her strenghts first. This requires bringing modern robotics, computer vision and deep learning to the very conservative world of safety critical avionics. The author is a physicist with no formal training in the use or programming of computers who bluffed his way through a career in software engineering at Google and SpaceX before.
14:50	**54**	**Quantum Computing at Microsoft** *Damian Steiger, Microsoft* In the last decade multiple corporations have invested heavily in quantum technologies and in particular quantum computing. As such, the number of industry jobs for physicists working in this field has increased significantly. In this talk I will highlight some of the quantum-related thrusts at Microsoft Corporation. This includes building a scalable quantum computer, the development of a complete quantum stack, as well as a focus on quantum-inspired methods with the goal of delivering immediate quantum impact today. In parallel, I will share my personal experiences on how to jump-start a career in industry.

15:10	**55**	**AI assisted Scalable Knowledge Ingestion for Automated Discoveries** *Michele Dolfi, Peter W. J. Staar, IBM Research - Zurich Säumerstrasse 4, 8803 Rüschlikon* Over the past few decades, the amount of scientific articles and technical literature has increased exponentially in size. Consequently, there is a great need for systems that can ingest these documents at scale and make the contained knowledge discoverable. Unfortunately, both the format of these documents (e.g. the PDF format or bitmap images) as well as the presentation of the data (e.g. complex tables and figures) make the extraction of qualitative and quantitive data extremely challenging. In this talk, we will present our three pronged approach to this problem and show practical examples in the field of Material Science and Oil&Gas. We will start by introducing a scalable service [1] that is able to ingest documents at scale and exploits state-of-the art AI models to obtain very high accuracies. Next. we will show how the data contained in the ingested documents can be extracted using NLP methods. Finally, we will show how the extracted data can be efficiently queried using Knowledge Graphs and how one can obtain new insights from these graphs by applying advance analytics [2]. [1] *https://www.researchgate.net/publication/325359423_Corpus_Conversion_Service_A_Machine_Learning_Platform_to_Ingest_Documents_at_Scale* [2] *https://www.researchgate.net/publication/303551320_Stochastic_Matrix-Function_Estimators_Scalable_Big-Data_Kernels_with_High_Performance*
15:30	**56**	**Applying Quantum Computing to Quantum Chemistry** *Jan Reiner, HQS Quantum Simulations* Quantum computation promises exciting applications in the field of cryptography, self-learning methods and quantum simulations. Noisy small-scale quantum computers can already be used via cloud services provided by companies like IBM or Rigetti computing; and the technology is improving rapidly. HQS Quantum Simulations is a Karlsruhe-based start-up developing software for chemistry/material simulations that uses quantum computers. We aim to enable relevant utilization of (noisy) quantum computers as early as possible within the next few years, by combining high-end classical simulation methods with optimized quantum algorithms. In the presentation I briefly introduce HQS Quantum Simulations and the daily work there. I show how quantum computing can be applied to chemistry/material simulations, and discuss the possibilities and current state of quantum computing.
15:50	**57**	**Industrial AI at work: Cyber Physical Production Systems and Cognitive Services for Power Line Systems at Siemens Austria** *Herwig Schreiner, Siemens AG Austria* This talk shows two examples of applied Industrial Artificial Intelligence at Siemens Austria, which are already close to production quality and usage. They cover a broad range of AI techniques including both symbolic and data-driven AI concepts. Firstly, a cyber-physical production system with co-operating robots, optimal production planning and deductive reasoning for a so-called producibility check where the product steers its production. Secondly, an application with autonomously flying vehicles (drones) with high-resolution cameras and an image analytics algorithm with machine learning for anomaly detection to spot failures on power line systems. For such state-of-the-art multi-disciplinary applications new job profiles emerge. Talents understanding physics and informatics plus some background in data analytics and statistics are necessary to cope with those challenges.
16:10	**58**	**Sensing with Diamonds** *Gabriel Puebla-Hellmann, QZabre LLC* Using an atomic defect in diamond, an NV center, we can image miniscule magnetic fields and currents at the nm scale in the lab. Bringing this quanutm technology to a broader market in a turn-key system is the challenge now facing our start up, QZabre LLC. I will talk about our efforts and experiences in moving from research to product development.
16:30		***Coffee Break***

Time	ID	*Chair: Andreas Fuhrer, IBM Rüschlikon*
17:00	**59**	**Zurich Instruments and the Race for the Quantum Computer** *Jan Benhelm, Zurich Instruments AG* Zurich Instruments AG was founded in 2008 as a spinoff of ETH Zurich's Physics Department. Since then the company has grown to more than 70 people in 6 countries and serves advanced research laboratories with best-in-class measurement instruments. After successfully disrupting the lock-in amplifier market, Zurich Instruments started to engage in quantum computing about 3 years ago. Today Zurich Instruments aims at establishing the first commercial quantum computer control system in the world. The presentation tells the story of how things happened, the challenges the company is facing today and how you fit in.
17:20	**60**	**Quantum and AI research: challenges for physicists at Bosch** *David Reeb, Robert Bosch GmbH* Being a theoretical physicist by training, I will retrace my path from quantum information theory as a postdoc in academia to machine learning research in the corporate world at the Bosch Center for Artificial Intelligence. I will describe research challenges that await physicists in the corporate research division at Bosch, in the fields of both quantum technologies and machine learning.
17:40	**61**	**Quantum Technologies: from basic research to industry** *Stephan Ritter, TOPTICA Photonics AG* Quantum effects not only provide deeper insights into fundamental physics, but can also be exploited to advance a broad range of technologies. TOPTICA Photonics is deeply rooted in the quantum technology community, developing and manufacturing high-end laser systems for scientific and industrial applications. I will present opportunities and challenges TOPTICA faces by providing enabling technologies for quantum technologies and give examples of TOPTICA's direct involvement in this field, e.g. the development of an optical atomic clock. My own career path reflects the entanglement between academic research and industry, as my curiosity for quantum effects and enthusiasm for technology took me from research on quantum effects at ETH Zurich and MPQ Garching to become TOPTICA's Application Specialist for Quantum Technologies.
18:00	**62**	**Pathways for quantum researchers to industry** *Frank Ruess, Google* The commercial potential of artificial intelligence and the promise of quantum computing has increasingly opened the door for researchers to step outside the academic world to apply their skills at global tech companies and startups. I will give a brief overview of typical entry points, roles and topics and open up the forum for a Q&A session.
18:20		***END***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***