TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Vorstellung der Lehre am Atominstitut – WS 2024/25

~14 Forschungsgruppen
~150 Mitarbeiter
~100 Studierende

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

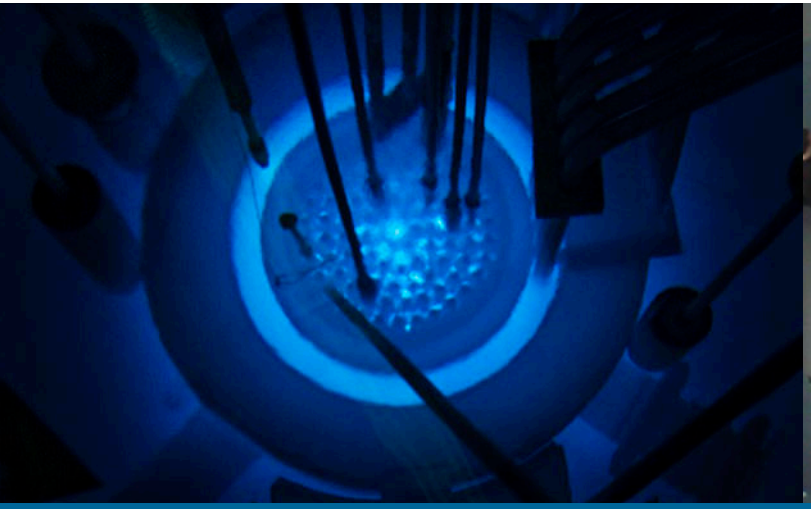
HEPHY

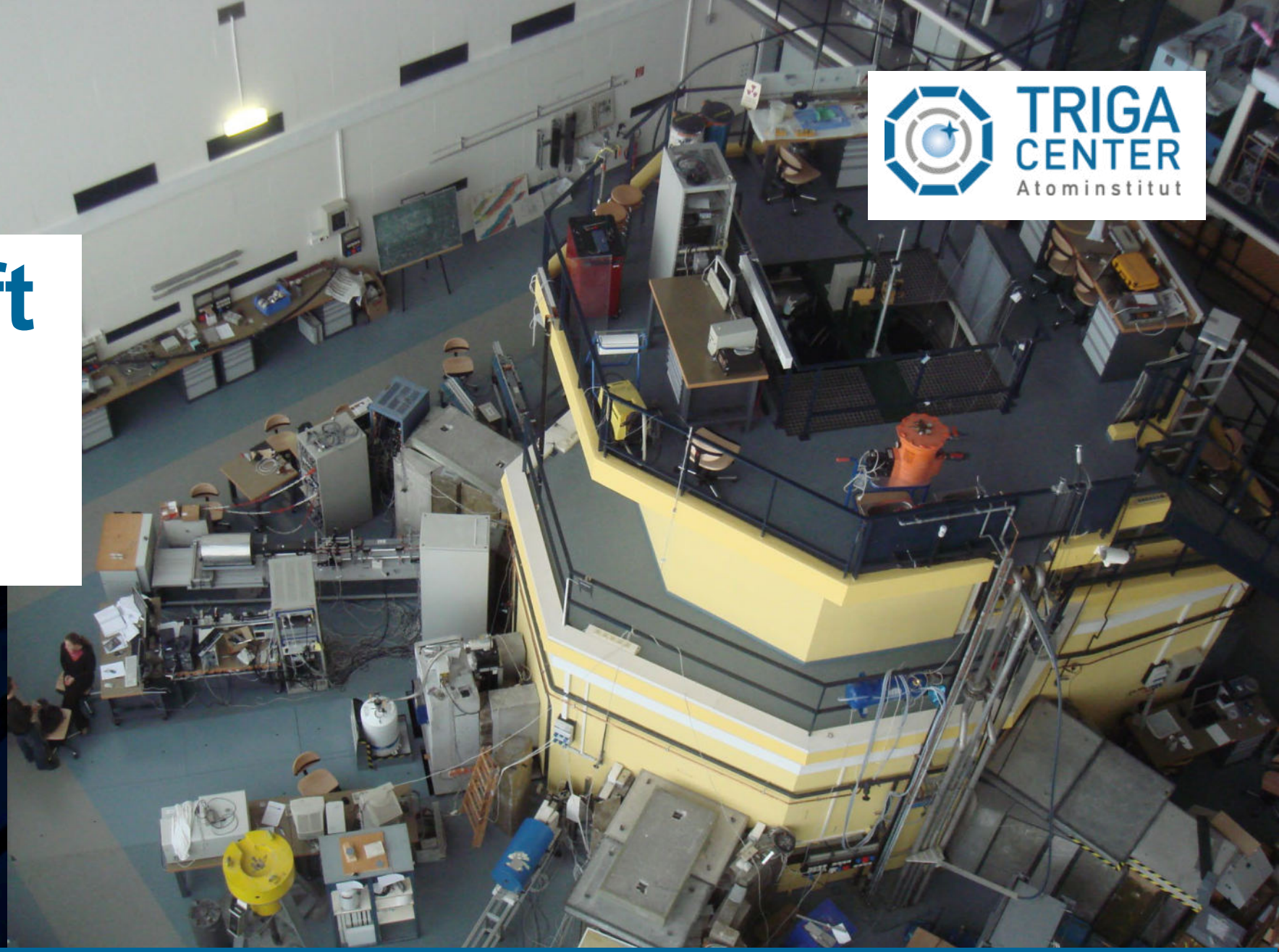
ATOMINSTITUT

TECHNISCHE UNIVERSITÄT WIEN

TRIGA CENTER Atominstitut

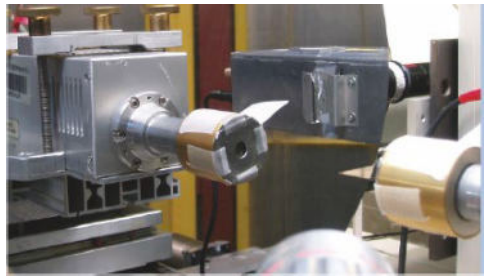
Wissenschaft
Ausbildung
Expertise



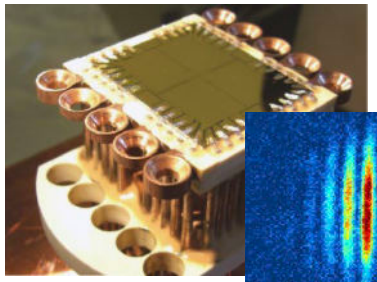


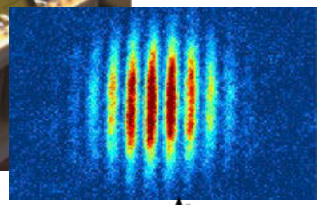
TECHNISCHE UNIVERSITÄT WIEN

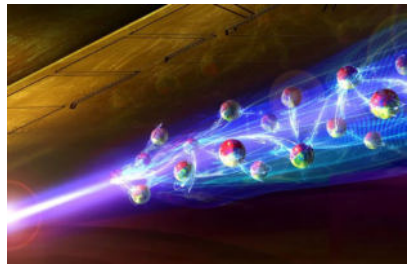
Strahlenphysik



Atomphysik & Quantenoptik

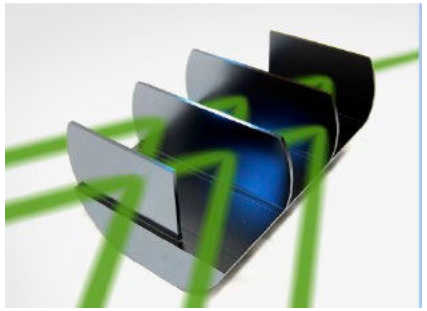




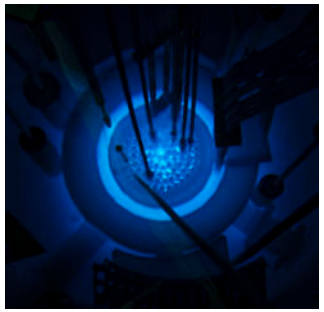


Atominterferometrie

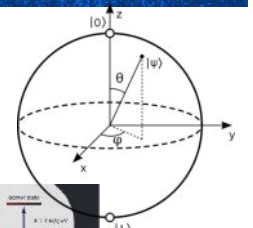
Neutronen- & Quantenphysik

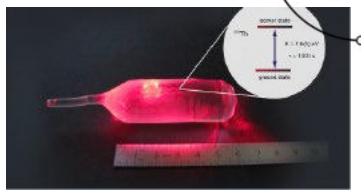


TRIGA Center

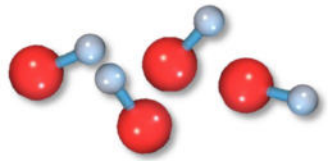


ATOMINSTITUT





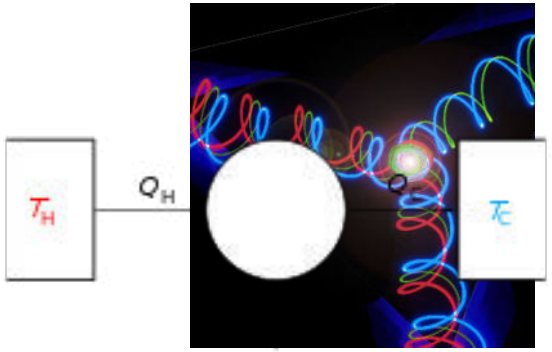
Quantenmetrologie



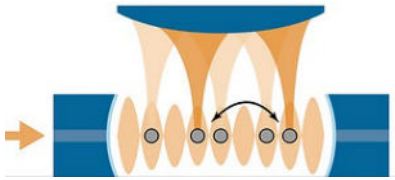
Kalte Moleküle & Quantentechnologie

Kern-, Teilchenphysik Dunkle Materie & Kosmologie

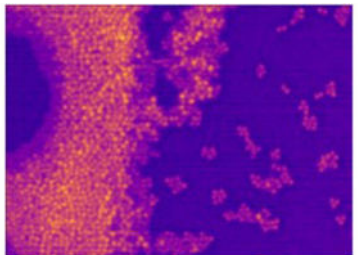
Tieftemperaturphysik & Supraleitung



QUanten Information & Thermodynamik



Experimentelle Quanteninformation



Quantenoptik & Sensorik

TECHNISCHE UNIVERSITÄT WIEN

Strahlenphysik

Atomphysik & Quantenoptik

Neutronen- &

TRIG
Cent

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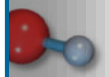


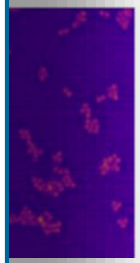
üle &
ologie

Kern-, Teil
Dunkle Materie &
Kosmologie

Tieftemperaturphysik
& Supraleitung

QUanten Information &
Thermodynamik

Experimentelle
Quanteninformation



Quantenoptik
& Sensorik

- Vorlesungen
- Praktika, Seminare
- Projekt- und Masterarbeiten

TECHNISCHE UNIVERSITÄT WIEN

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Nach der Vorstellung …

Fragen und Antworten bei Kaffee & Kuchen !

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Kern- und Teilchenphysik

Lehrveranstaltungen im Wintersemester 2024 / 2025

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Vortragende aus drei Instituten

Atominstitut

- M. Faber, A. Hirtl, H. Leeb, F. Reindl, E. Renner und J. Schieck
- M. Benedikt (CERN)

Institut für Hochenergiephysik (HEPHY) der ÖAW

- T. Bergauer, H. Eberl, L. Einfalt, M. Jeitler, J. Schieck, W. Waltenberger, C. Wulz

Stefan-Meyer-Institut (SMI) der ÖAW

- J. Marton

Fünf Forschungsbereiche

- Kernphysik und nukleare Astrophysik
- Feldtheorien und Hadronenphysik
- Experimentelle Teilchenphysik
- Medizinische Strahlenphysik
- Beschleunigerphysik

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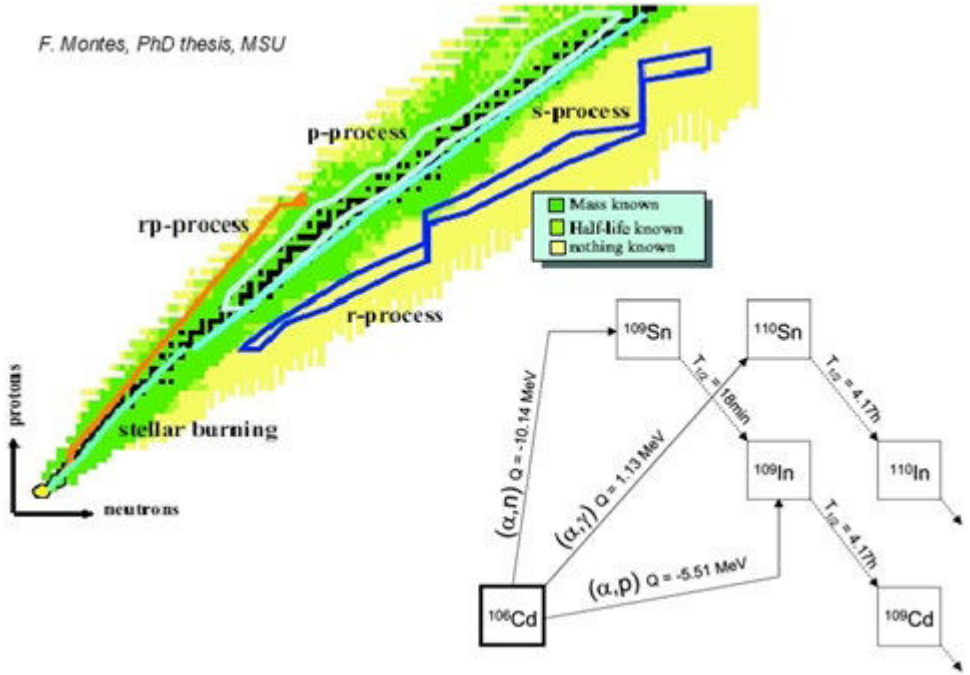
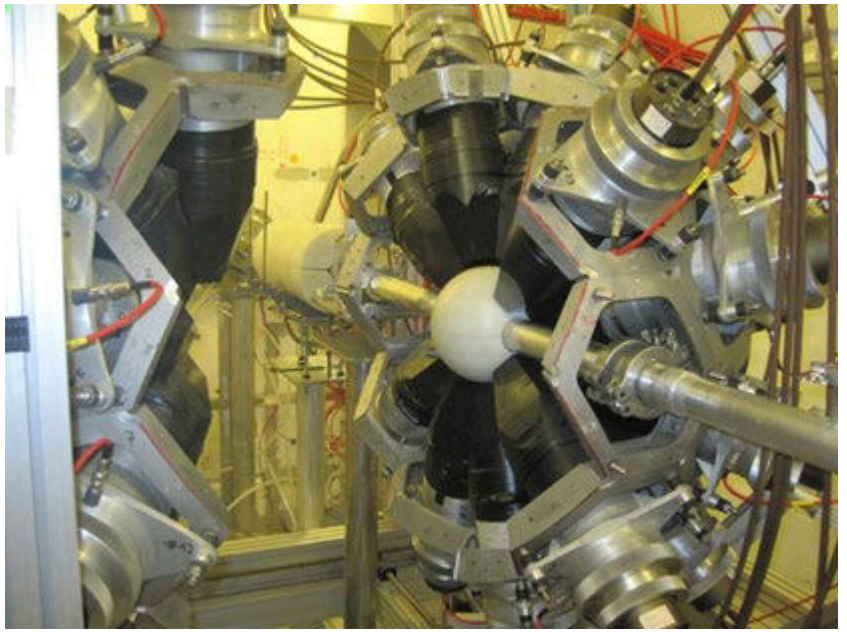
Kernphysik und nukleare Astrophysik (Leeb)

- Beschreibung von Kernreaktionen an den Grenzen der Stabilität, relevant für Astrophysik und nukleare Technologien
- Verbindung von Reaktionstheorie mit modernen Kernstrukturtheorien





WS'24: Aktuelle Kernstrukturmethoden (VO), Nukleare Astrophysik (VO)

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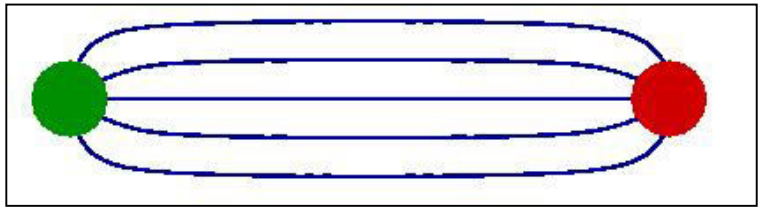
Feldtheorien und Hadronenphysik (Faber)

Hadronenphysik

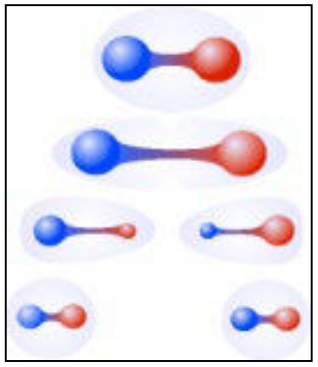
- Beschreibung exotischer Atome und Verständnis der Annihilation
- chirale Feldtheorie

Feldtheorien

- Verständnis der QCD bei niedrigen q-Werten (z.B. Confinement)
- Gittereichtheorien,Solitonmodell



Flußschlauch zwischen Quark-Antiquark aus QCD Gittereichrechnungen



Quark-Antiquark Wechselwirkung

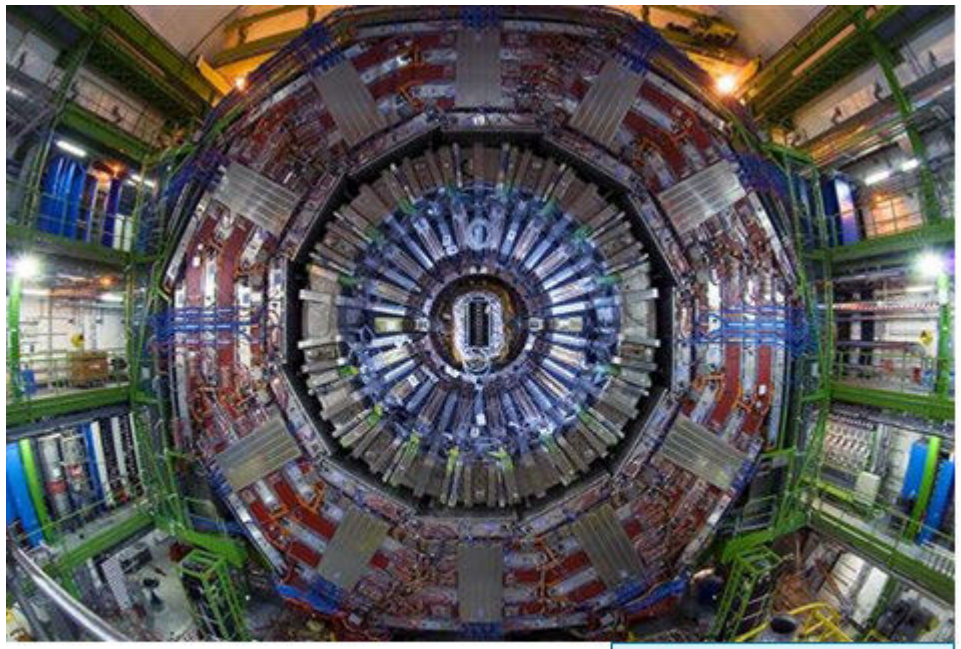
WS'24: Pfadintegrale in der Quantenmechanik und Quantenfeldtheorie (VO), Quantenchromodynamik 1

Experimentelle Teilchenphysik – HEPHY (Schieck u.v.a.)

- Verständnis des Standardmodells, Higgs-Teilchen, CP-Verletzung, Suche nach neuer Physik
- Suche nach Dunkler Materie
- Neutrinophysik
- Entwicklung von Detektoren

Experimente

- LHC@CERN, BELLE@KEK
- Suche nach dunkler Materie CRESST und COSINUS @LNGS
- Neutrinophysik
- NUCLEUS@CHOOZ



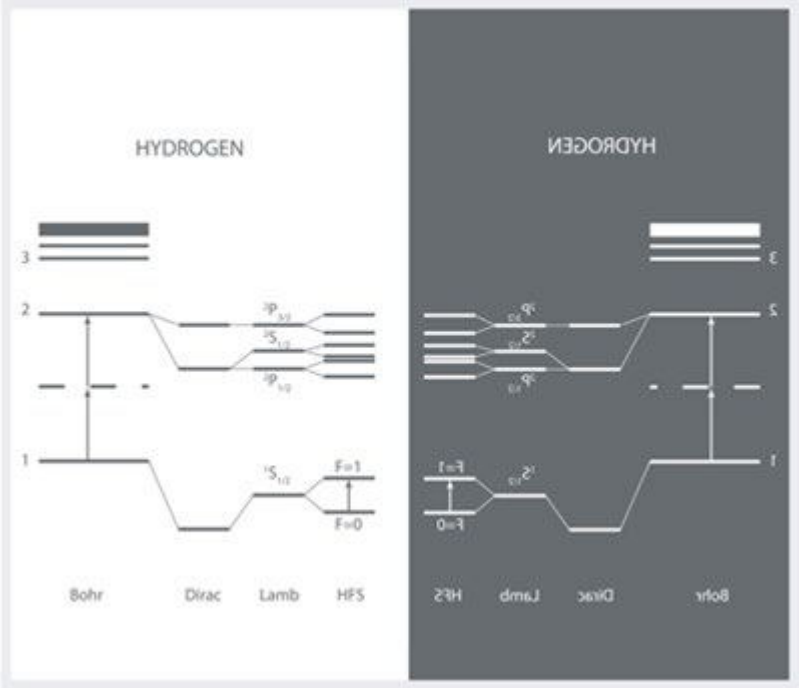
CMS Detektor

WS'24:

- Einführung in die Modelle der Elementarteilchenphysik (VO)
- Astro-Teilchenphysik (VO)
- Seminar über Atomare und Subatomare Physik (SE)
- Statistical Methods of Data Analysis (SV, UE)
- Suche nach der Dunklen Materie (VO)

Experimentelle Teilchenphysik – SMI (Marton u.v.a.)

- Antimaterie-Materie-Symmetrie
- Hadronenphysik– Untersuchung der starken Wechselwirkung mit Strangeness
- Exotische Atome



Experimente

- ASACUSA@CERN
- ALICE@CERN
- DAPHNE@LNF
- VIP2@LNGS

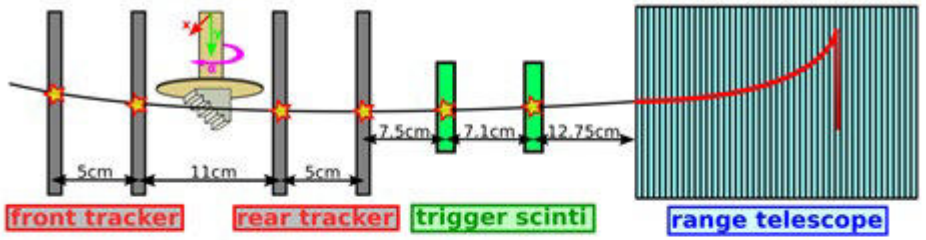
WS'24: Physics of Exotic Atoms (VO)

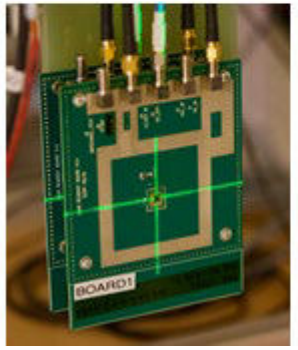
Medizinische Strahlenphysik (Bergauer & Hirtl u.v.a.)

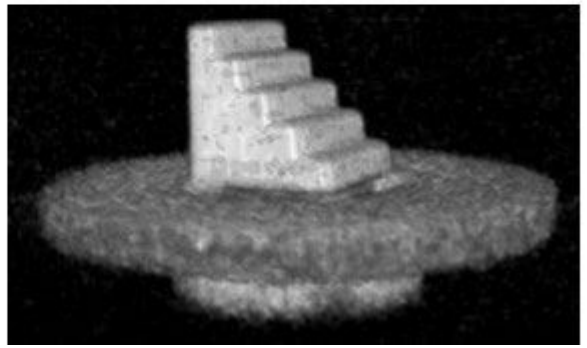
Experimente am Forschungs- & Therapiezentrum MedAustron

- Ionenbildgebung– pCT
- Anwendungen der Teilchenphysik in der Medizin
- Entwicklung von Teilchendetektoren

pCT set-up am MedAustron







WS'24:

- Seminar über medizinische Strahlenphysik und Ionentherapie (SE)
- Experimente am MedAustron Teilchenbeschleuniger - Angewandte Teilchenphysik und medizinische Physik (LU)

Beschleunigerphysik (Benedikt & Renner u.v.a.)

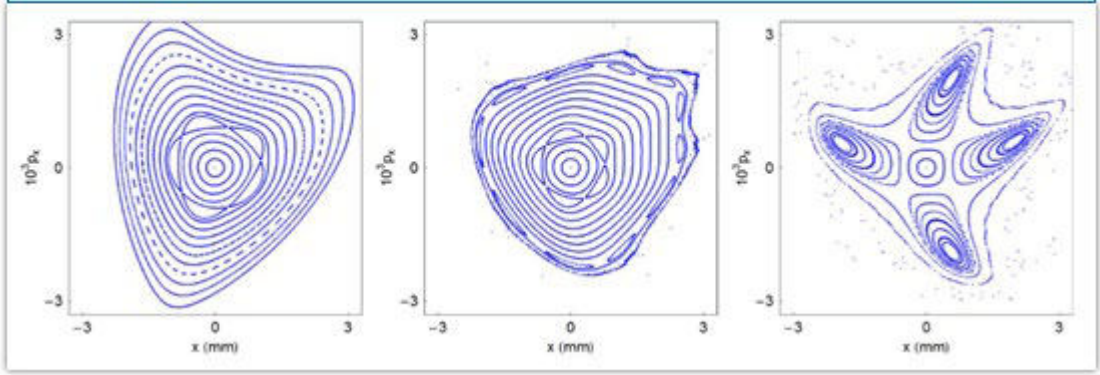
- Verständnis der Strahldynamik in Teilchenbeschleunigern
- Weiterentwicklung von Techniken zur Strahlmanipulation
- Planung und Realisierbarkeitsstudien zukünftiger Beschleunigeranlagen

Methoden & Framework

- Simulationen und/oder Messungen
- Arbeiten in Kollaboration mit oder an Beschleunigerzentren (MedAustron, CERN, …)

Medizinisches Synchrotron am MedAustron

Phasenporträt von Teilchen in einem Speicherring mit nicht linearen Magnetfeldkomponenten



H. BARTOSIK– FIRST TASTE ON NONLINEAR DYNAMICS

WS'24: Teilchenbeschleuiger (VO)

Übersicht der LVA (VO, UE, SE, LU)

LVA Name & Vortragende	LVA Nummer
Aktuelle Kernstrukturmethoden (VO), Leeb	141.B29
Astro-Teilchenphysik (VO), Jeitler, Wulz	142.094
Einführung in die Modelle der Elementarteilchenphysik I (VO, UE), Eberl	141.B00, 141.B01
Experimente am MedAustron Teilchenbeschleuniger - Angewandte Teilchenphysik und medizinische Physik (LU), Bergauer, Hirtl u.a.	141.A99
Nukleare Astrophysik (VO), Leeb	142.637
Pfadintegrale in der Quantenmechanik und Quantenfeldtheorie (VO), Faber	142.725
Physics of Exotic Atoms (VO), Marton	142.072
Quantenchromodynamik I (VO), Faber	142.197

Übersicht der LVA (VO, UE, SE, SV)

LVA Name & Vortragende	LVA Nummer
Seminar über Atomare und Subatomare Physik (SE), Leeb, Reindl, Schieck, Schwanda u.a.	142.069
Seminar über medizinische Strahlenphysik und Ionentherapie (SE), Hirtl	141.B19
Statistical Methods of Data Analysis (SV, UE), Narasimha, Reindl, Schreiner, Waltenberger	142.340, 142.351
Suche nach der Dunklen Materie (VO), Schieck	141.A49
Teilchenbeschleuniger (VO), Benedikt, Renner u.a.	141.944

TECHNISCHE UNIVERSITÄT WIEN

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Projektarbeiten (PR) & Bachelorarbeiten

- Unter Anleitung durchgeführte wissenschaftliche Arbeiten an aktuellen Forschungsprojekten eingebettet in aktive Forschungsgruppen
  - Dauer in Summe etwa 4 – 6 Wochen Vollzeit
- Beginn jederzeit nach Vereinbarung
  - Kontakt mit Betreuer bzw. Betreuerin der Projektarbeit
- Abschluss durch wissenschaftliches Ergebnis sowie schriftliche Dokumentation (Protokoll)

Machen Sie mit und kontaktieren Sie uns einfach!

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Projektarbeiten (PR) & Bachelorarbeiten

LVA Name & Vortragende	LVA Nummer
Projektarbeiten Angewandte Strahlenphysik, Hirtl u.a.	141.079
Projektarbeit Beschleunigerphysik, Benedikt, Renner	141.287
Projektarbeit Experimentelle Teilchenphysik, Krammer u.a.	142.039
Projektarbeit Kernphysik, Benedikt, Leeb	141.A22
Projektarbeit Methoden der Teilchenphysik, Schieck u.a.	141.A45
Projektarbeit Nukleare Astrophysik, Benedikt, Leeb	141.A21
Projektarbeit Starke Wechselwirkung, Faber	142.045
Projektarbeit Strahlenschutz und Dosimetrie, Hirtl u.a.	141.018
Projektarbeit Subatomare Physik, Faber, Marton	142.088

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Kontakt

Kernphysik und nukleare Astrophysik

- H. Leeb: helmut.leeb@tuwien.ac.at

Feldtheorien und Hadronenphysik

- M. Faber: manfried.faber@tuwien.ac.at

Experimentelle Teilchenphysik

- J. Schieck: jochen.schieck@tuwien.ac.at
- T. Bergauer: thomas.bergauer@oeaw.ac.at
- J. Marton: johann.marton@oeaw.ac.at
- F. Reindl: florian.reindl@tuwien.ac.at

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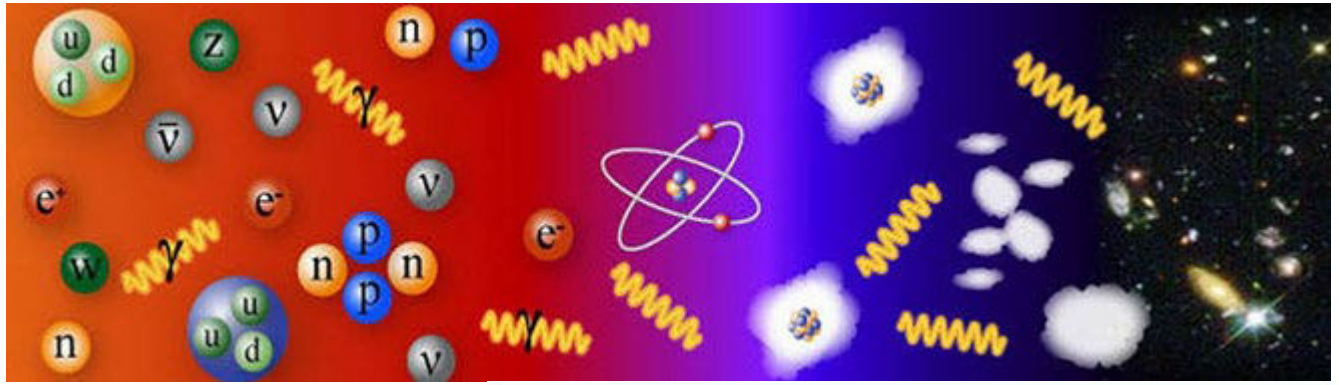
Kontakt

Medizinische Strahlenphysik

- A. Hirtl: albert.hirtl@tuwien.ac.at
- T. Bergauer: thomas.bergauer@oeaw.ac.at

Beschleunigerphysik

- E. Renner: elisabeth.renner@tuwien.ac.at



Vielen Dank für Ihre Aufmerksamkeit!

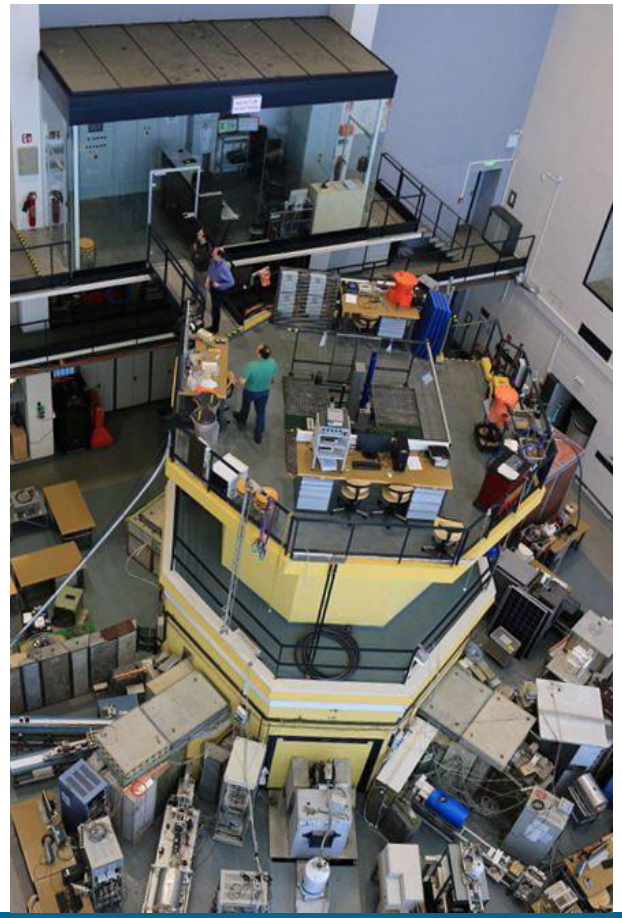
TECHNISCHE UNIVERSITÄT WIEN

TRIGA CENTER Atominstitut

TRIGA Center Atominstitut

Lehre am TRIGA Center Atominstitut

- Das TRIGA Center Atominstitut ist ein **Zentrum** des Vizerektorats Forschung, Innovation und Internationales



Leitung & Bewilligungsinhaber
Musilek

Reaktor-Betriebsleitung	Strahlenschutz	Nukleare Sicherheit	Security
Leitung: Villa Stv.: Bergmann	Leitung: Hainz Stv.: Musilek Veit-Öller	Leitung: Sterba Stv.: Welch	Leitung: Sterba Stv.: Villa Veit-Öller

TRIGA* Reaktor	CLIP**	Angewandte Radiochemie
Leitung: Villa Bergmann *Operateure:* Stummer Trunner	Leitung: Sterba Rosecker Welch *Labor:* Foster Nemetz	Leitung: Steinhauser *Labor:* Foster Nemetz

* Training, Research, Isotope Production, General Atomics / ** Center for Labelling and Isotope Production

TRIGA Reaktor

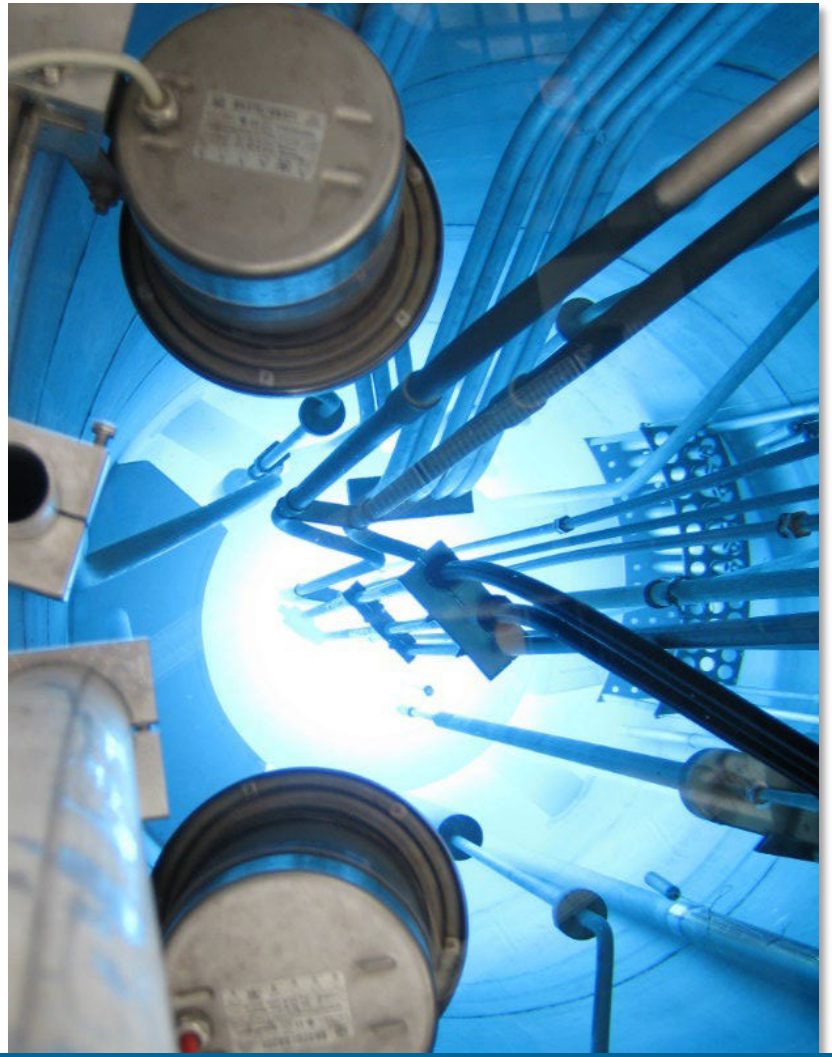
- Projektarbeiten
  - 141.080 Projektarbeit Reaktortechnik (8.0)
- Vorlesungen
  - 141.537 Reaktorphysik (2.0)
  - 141.308 Nuclear Engineering (2.0)
- Laborübungen
  - 141.A87 Praktische Übungen am Reaktor (4.0)

- Vortragende und Betreuer:

Mario Villa

Helmuth Böck

Robert Bergmann



Center for Labelling and Isotope Production

- Projektarbeiten
  - 141.167 Projektarbeit Radiochemie (8.0)
  - 141.016 Projektarbeit Archäometrie (8.0)
- Vorlesungen
  - 057.024 Radiopharmazeutische Chemie (2.0)
  - 141.399 Archäometrie (2.0)
- Laborübungen
  - 141.106 Archäometrie (2.0)
  - 141.600 Radionuklidbestimmung in Umweltproben (4.0)
- Vortragende und Betreuer:

Johannes H. Sterba

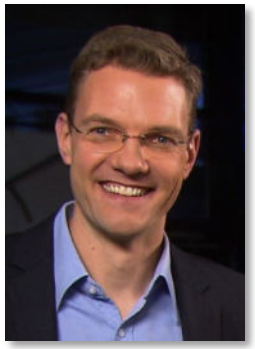
Jan Welch

Veronika Rosecker

Angewandte Radiochemie

- Projektarbeiten
  - 141.167 Projektarbeit Radiochemie (8.0)
  - 141.166 Projektarbeit Nukleare Umweltanalytik (8.0)
- Vorlesungen
  - 141.281 Radioökologie (2.0)
- Laborübungen
  - 163.008 Wahlübungen - Allgemeine Anorganische Chemie (4 od. 6 od. 8 SWS)

Vortragender und Betreuer:



Georg Steinhauser

Coming…, naja, soon?
SOON!

Strahlenschutz

- Projektarbeiten
  - 141.018 Projektarbeit Strahlenschutz und Dosimetrie (8.0)
  - 141.079 Projektarbeit Angewandte Strahlenphysik (8.0)
- Übungen
  - 141.075 Rechenmethoden des Strahlenschutzes I (1.0)
- Vorlesungen
  - 141.010 Technischer Strahlenschutz I (3.0)

- Vortragende und Betreuer:

Andreas Musilek

Dieter Hainz

Robert Bergmann

Monika Veit-Öller

TECHNISCHE UNIVERSITÄT WIEN

Wir freuen uns auf Ihre Teilnahme!

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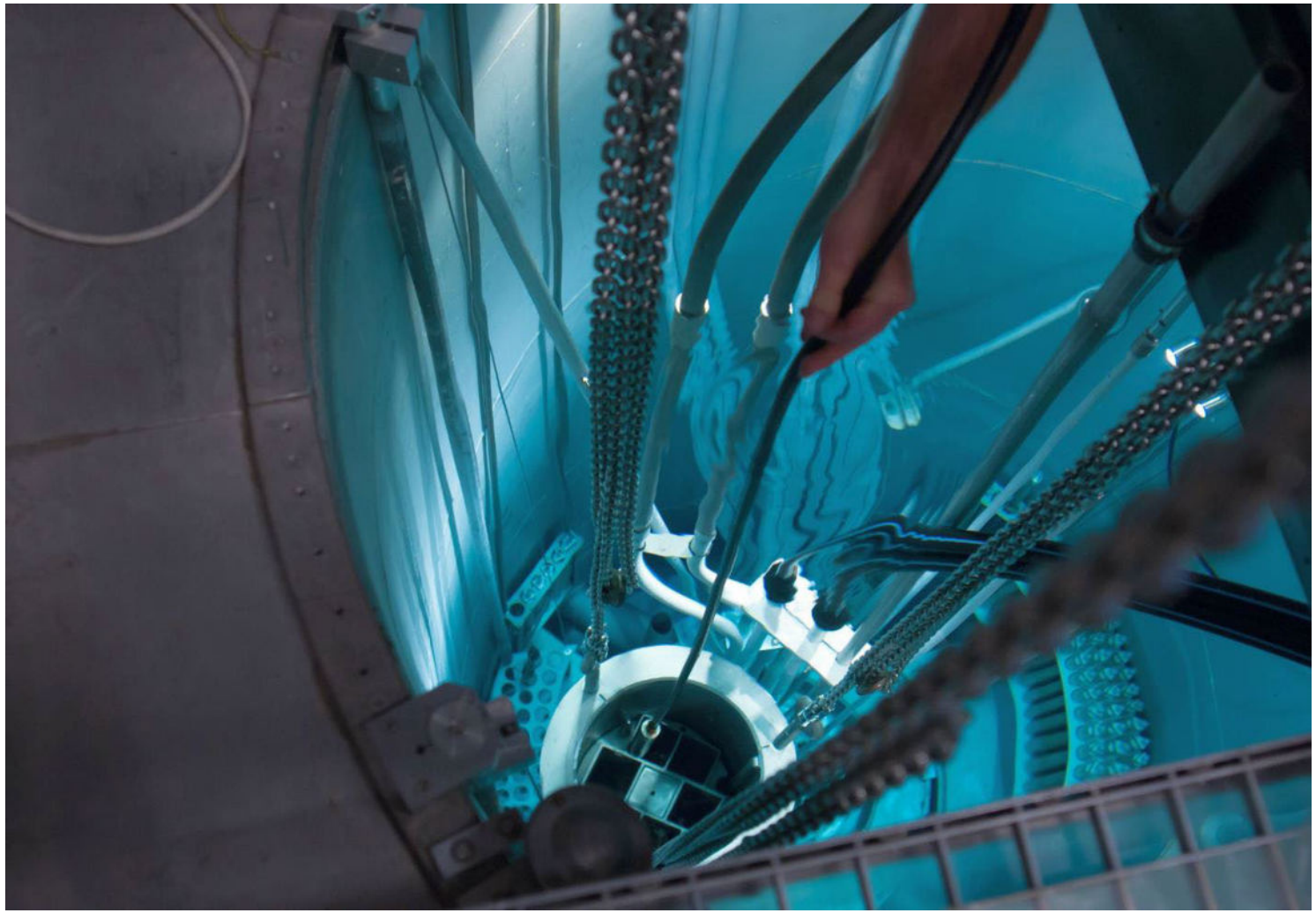

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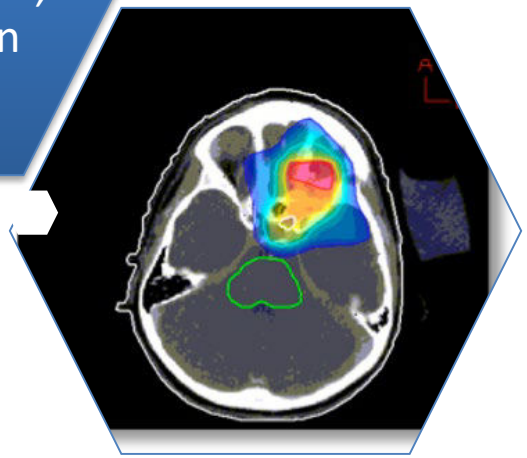
Strahlenphysik

ATOMINSTITUT

Leitung Christina Streli

Röntgenphysik

Medizinische Strahlenphysik, MedAustron



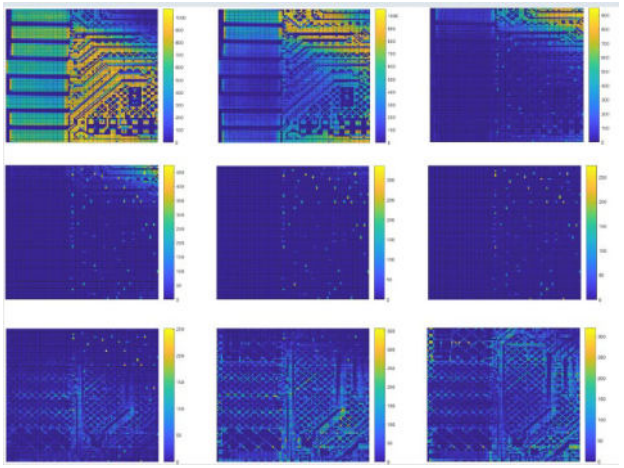
Röntgenspektrometrie:
Spurenelementanalytik im parts per billion Bereich

- Materialcharakterisierung
  - Charakterisierung von Implantaten in Silizium-Wafern
  - Charakterisierung ultradünner Schichten im Nanometer-bereich auf Silizium-Wafern
  - Spurenelemente im menschlichen Gewebe
  - Waferoberflächenanalytik

- Umweltanalytik
  - Flüssigkeiten: Nachweis von Blei im Trinkwasser
  - Spurenelementanalyse von Aerosolen in Luft

Röntgenspektrometrie:
Zerstörungsfreie ortsaufgelöste Elementverteilung

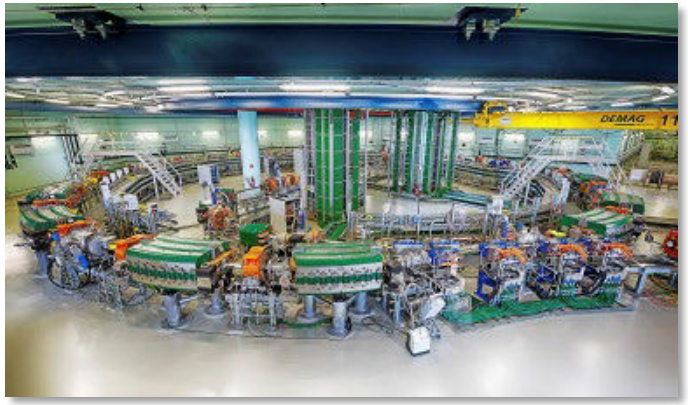
- Methodenentwicklung
  - 3D Element Imaging
  - Tiefenprofilanalytik im Nanometerbereich
  - Entwicklung von Spektrometer für spezielle Aufgabenstellungen



- Medizinische Strahlenphysik
  - Diagnostik
  - Nuklearmedizin
  - Strahlentherapie

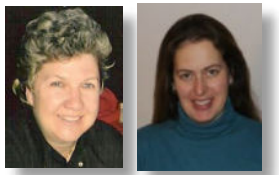
- MedAustron

  Internationales Tumortherapie- und Forschungszentrum mit Protonen und Kohlenstoffionen
  - Experimentelles Programm zur
    - Mikrodosimetrie
    - Bildgebung mittels Ionen – Protonen CT

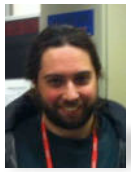


Strahlenphysik – gemeinsam mit XRC, KTP und TRIGA-Center

Strahlung vielseitig nutzen,
den verantwortungsvollen Umgang lehren!


C. Streli

K. Poljanc


D. Ingerle (XRC)


A. Hirtl (KTP)

XRC… Röntgenzentrum KTP…. Kern- und Teilchenphysik

VORLESUNGEN im WINTERSEMESTER 2024

141.944 VO Teilchenbeschleuniger (Benedikt, Renner, Poljanc)- siehe auch KTP

PROJEKT- UND BACHELORARBEITEN IM WINTERRSEMESTER 2024

141.110 PA Projektarbeit Elektronen- und Röntgenphysik (Streli u.a.)
141.153 PA Projektarbeit Röntgenanalytik (Streli u.a.)
141.018 PA Projektarbeit Strahlenschutz und Dosimetrie (gemeinsam mit TRIGA Center)
141.079 PA Projektarbeiten Angewandte Strahlenphysik (gemeinsam mit TRIGA Center)

TECHNISCHE UNIVERSITÄT WIEN

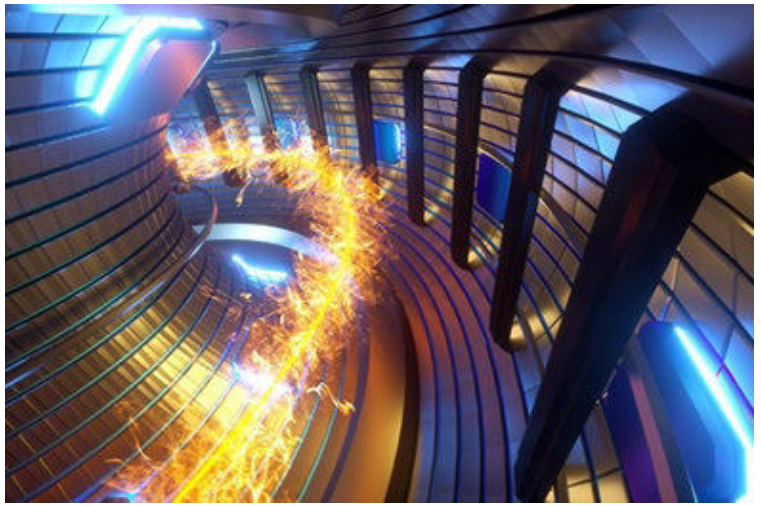
ATOMINSTITUT

Tieftemperaturphysik und Supraleitung

Michael Eisterer, Morteza Asiyaban, Alexander Bodenseher, David Hofmann, Florian Semper, Raphael Unterrainer

Unsere Themenschwerpunkte

- Magnetische Eigenschaften von Supraleitern
  - Neue Materialiuen, Anisotropie
- Stromtransport in Supraleitern
  - Flusslinienverankerung
  - Granularitätseffekte und Stromperkulation
- Strahlungsresistenz von Magnetmaterialien



In Zusammenarbeit mit

- CERN
- EUROfusion
- MIT
- Univ. Oxford, Cambridge
- …..

Lehrveranstaltungen

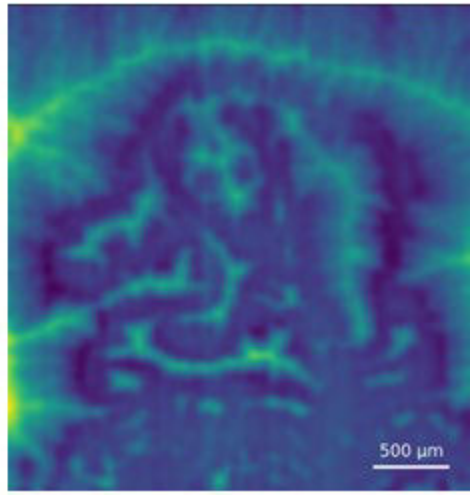
- 141.685 VO Supraleitung
  (Vorbesprechung 4.10., 16:15h, Sem.R. DB gelb 05 A)
- 141.058 SE Low Temperature Physics Seminar
  (Vorbesprechung 9.10., 16:15h, Atominstitut)

Bachelor-, Projekt-, Masterarbeiten:

- Messen, Daten interpretieren
- Experimentelle Auf-/Umbauten
- Prozesssteuerung
- Numerische Modellierung

Methoden

- Magnetisierungsmessungen: SQUID, Vibrationsmagnetometer
- Resistive Messungen (bis 1000 A, 17 T)
- Raster-Hallsondenmikroskopie



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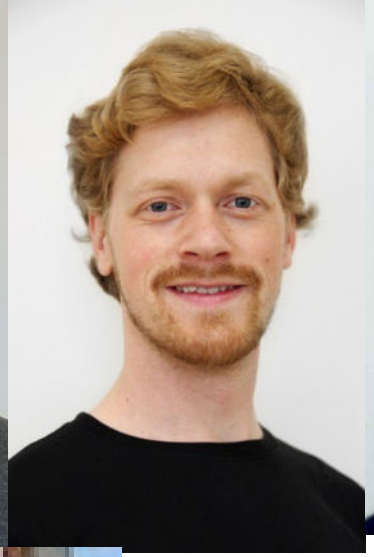
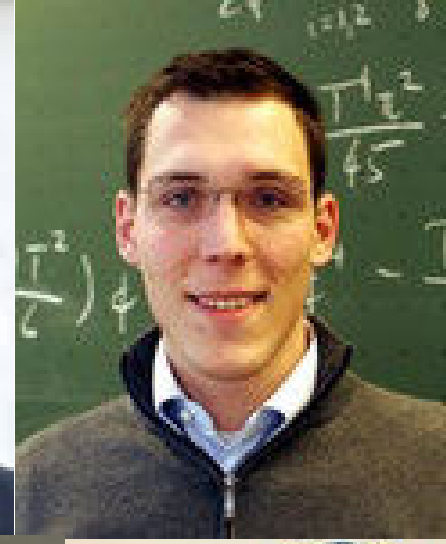
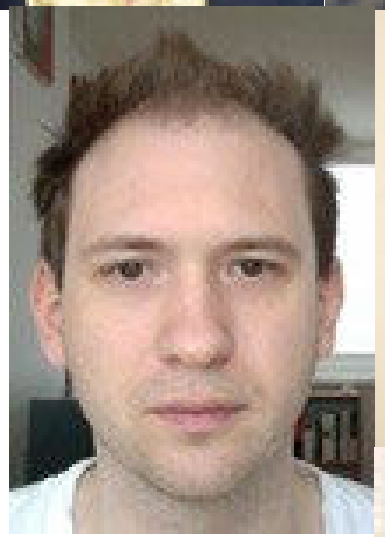
Neutronen- und Quantenphysik





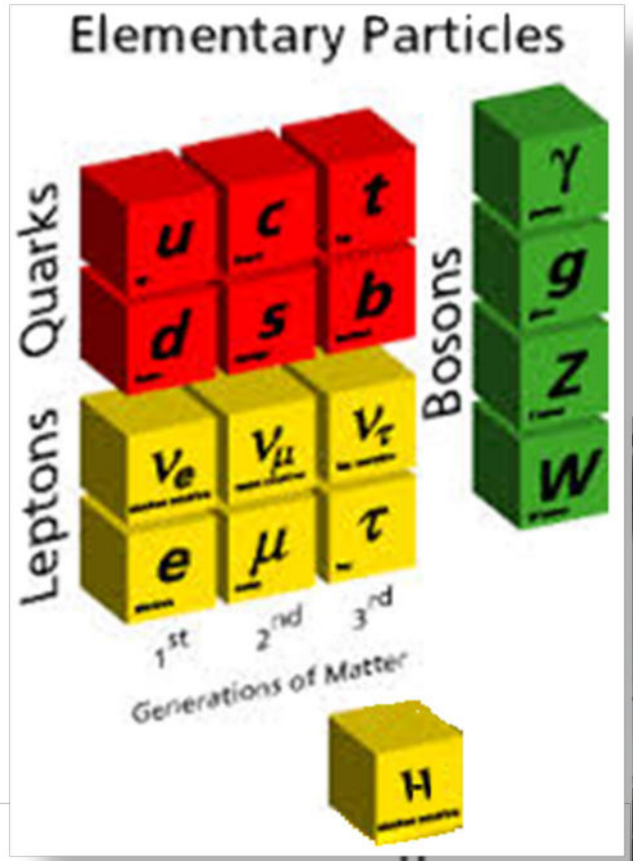

Neutronen- und Quantenphysik@ATI



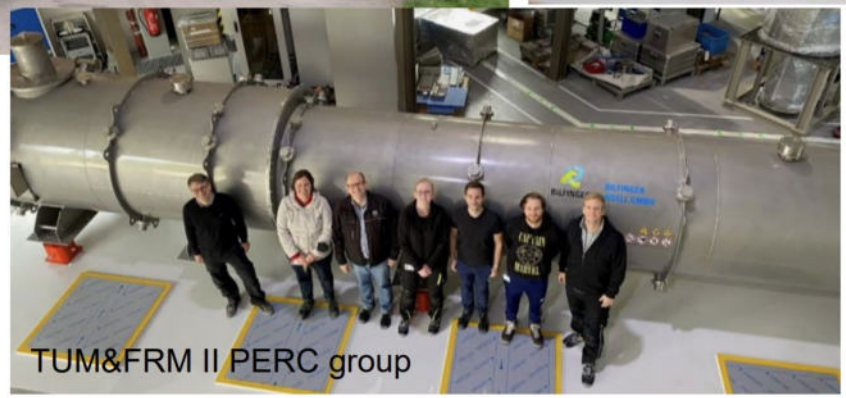


H. Abele, J. Bosina, Y. Hasegawa, E. Jericha, C. Käding,
B. Koch,M. Pitschmann, I. Pradler, R. Sedmik,
S. Sponar, M. Suda, M. Zawisky

Beta decay & PERC @ FRM2 / Munich



Delivery of the Magnet System PERC



September 2021

Delivery on 3 trucks
Unloading with 3 mobile cranes

https://youtu.be/1LCj3SLxSvI

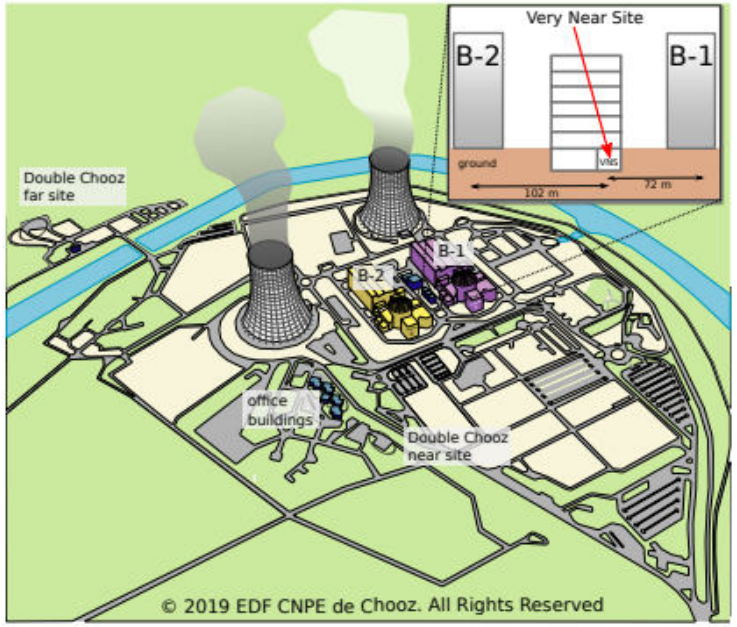
Spokesperson: B. Maerkisch, TU München, Time & Project Manager: E. Jericha, TU Wien

Research: Irina Pradler

NUCLEUS @ Chooz

- Exploring CEvNS with NUCLEUS at the Chooz Nuclear Power Plant
- The coherent cross-section is boosted by a factor of N^2 , and can exceed the cross-section of the standard neutrino detection methods, such as inverse beta-decay (IBD), by more than two orders of magnitude

- Max-Planck-Institut fur Physik, IRFU, CEA, Universite Paris Saclay, Astro Particule et Cosmologie, Universite Paris Diderot, CNRS/IN2P3, CEA/Irfu, Observatoire de Paris, CIUC, Departamento de Fisica, Universidade de Coimbra, Physik-Department, Technische Universität München, Institut für Hochenergiephysik der Osterreichischen Akademie der Wissenschaften, Atominstitut, Technische Universitat Wien, A-1020 Wien, Austria Electricit´e de France, Centre nucleaire de production d´electricite de Chooz, Service Automatismes-Essais



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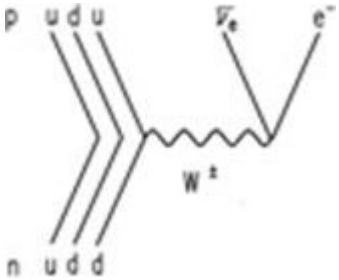
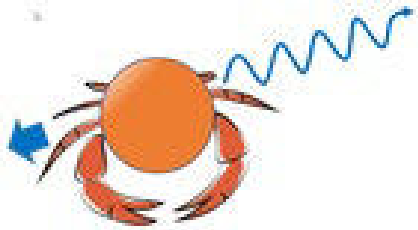
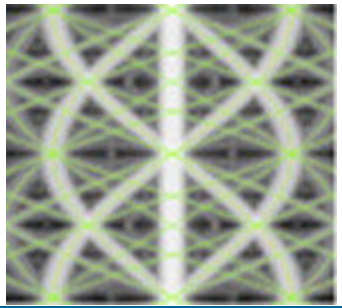
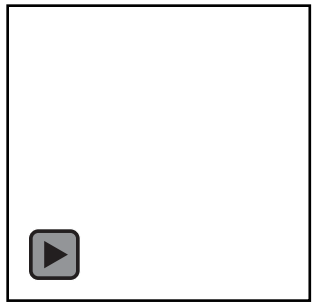
Forschungsschwerpunkte

- Präzisionsexperimente zur Teilchenphysik
- Gravitationstests durch Quanteninterferenz
- Grundlegende Tests der Quantenmechanik
- Interferenzexperimente mit Neutronen
- Neutronenradiographie und 3D-Computertomographie
- Polarisierte Neutronen, Entwicklung neutronenoptischer Methoden
- UltraSANS, magnetische Mikrostrukturen
- Stellare Nukleosynthese, neue Konzepte in der Kerntechnik
- Charakterisierung kryogener Teilchendetektoren









The cosmological constant – dark energy

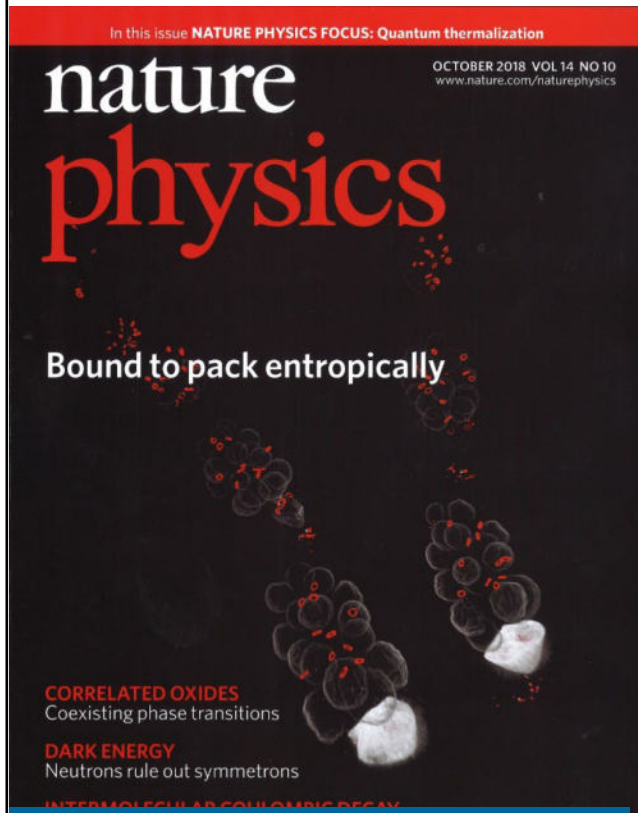
TECHNISCHE UNIVERSITÄT WIEN

Gravity Resonance Spectrocopy
- most precise measuring technique
- rely on frequency measurements
- Transitions between energy states

dark enery field provoke energy shifts

Neutrons rule out Dark Energy
Symmetrons

non-Riemann Gravity
entropic force



The quantum vacuum

$$U(\nu,T) = \left(1/2 + \frac{1}{e^{h\nu/kT}-1}\right) h\nu$$

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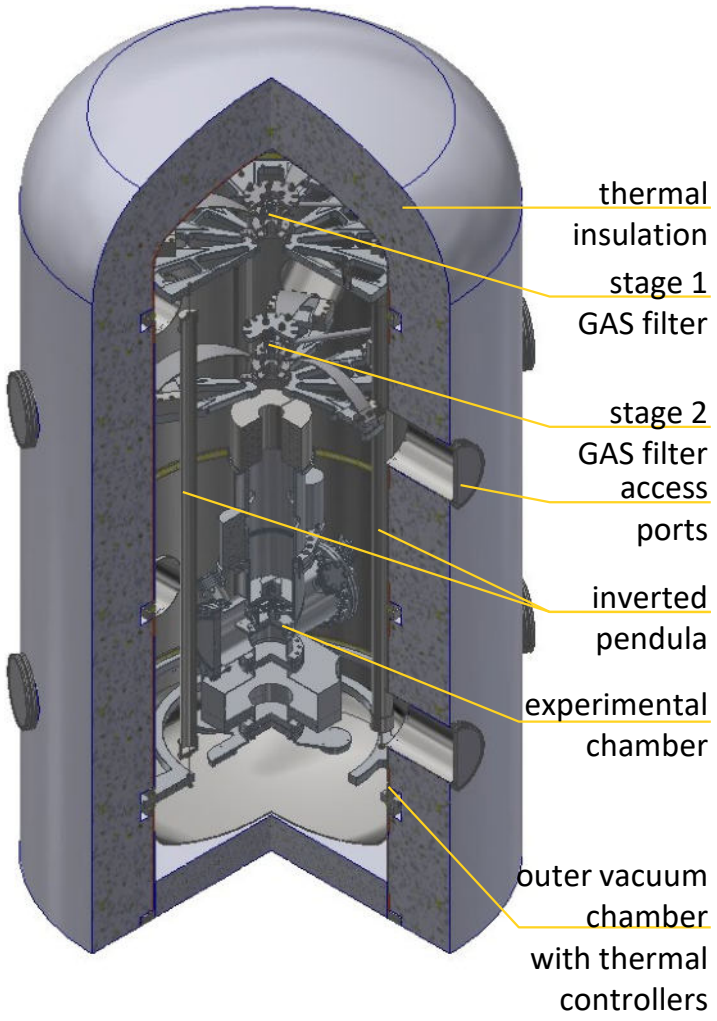
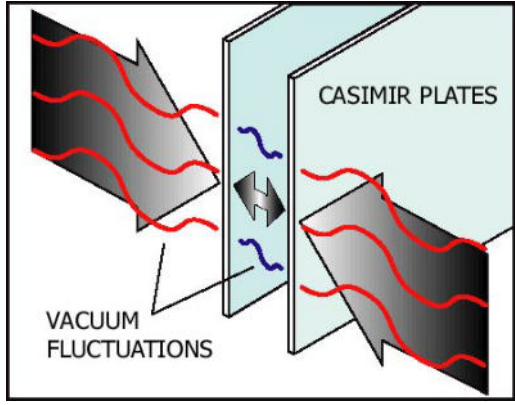
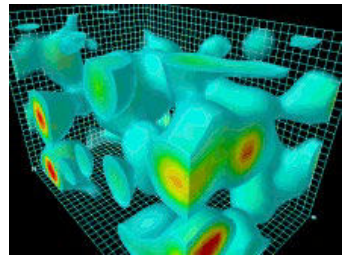


- Quantum Theory: ∞
- QM + Cutoff **10^{93}kg/m^3**
- Special Relativity **Zero**
- Cosmology **6 x 10^{-27} kg/m^3**



- Vacuum = potential Energy (GR)
  + vacuum fluctuations
  + cosmological constant
  ~ Zero



Research: René Sedmik

Quantum Computing with a Neutron

Hartmut Abele, Hansjörg Dittus,

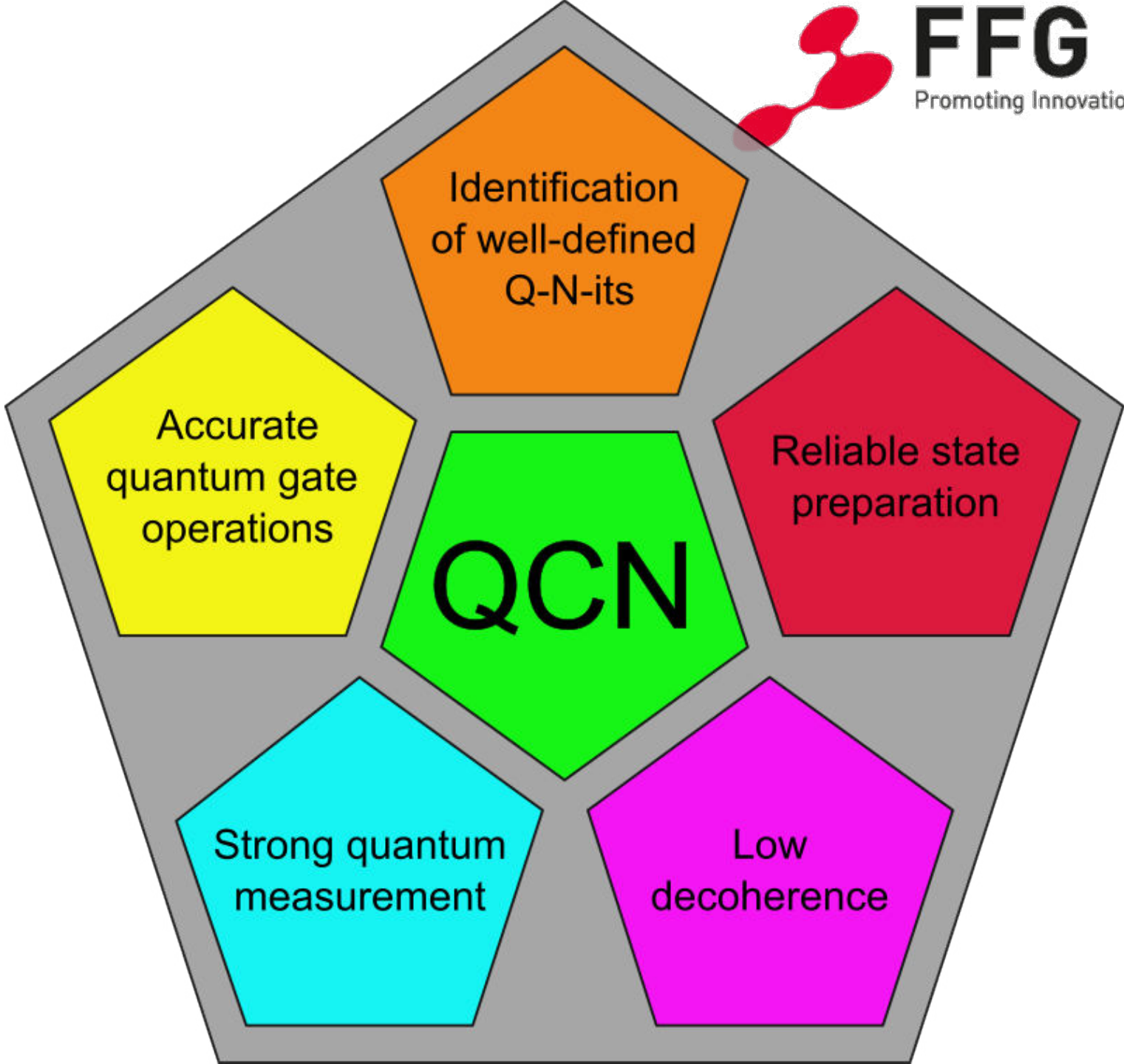
Markus Huber

TU Wien

Tobias Jenke, ILL

Skyler Degenkolb, U Heidelberg

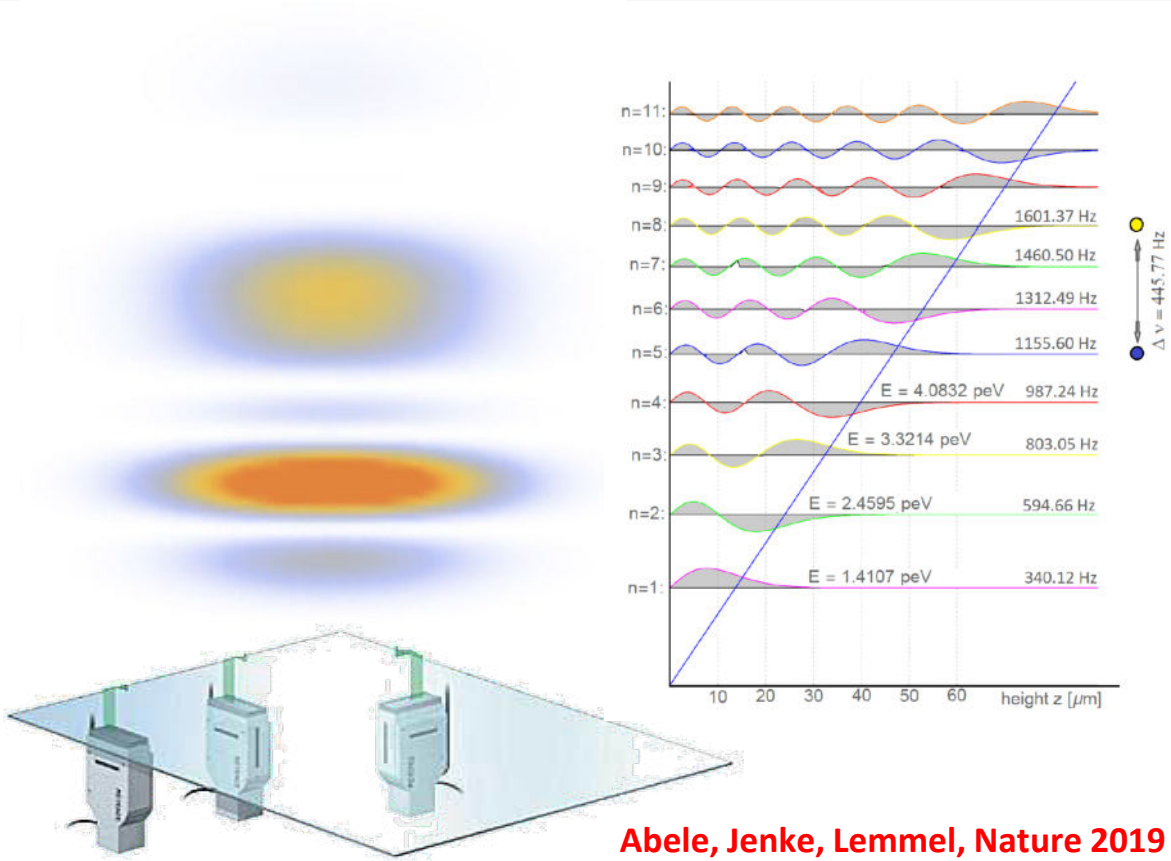
Beatrix Hiesmayr, U Wien



QCN: Quantum Computer based on a single neutron

1

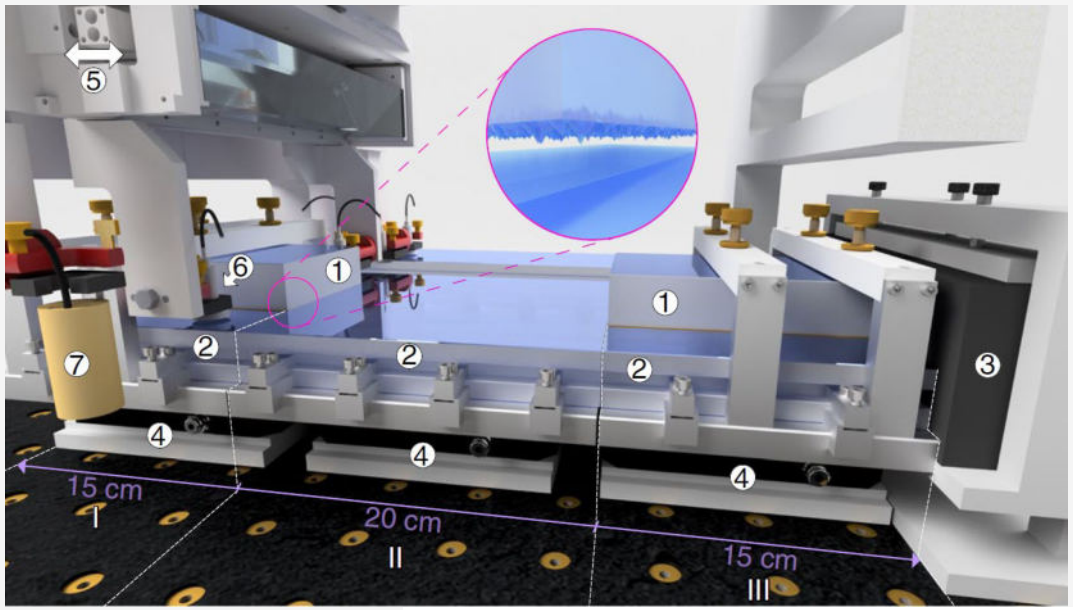
- A simple gravitationally interacting quantum system, **a neutron with mass and spin**
  - falling in the Earth's gravity potential
  - and **a neutron reflector, made out of glass**



Abele, Jenke, Lemmel, Nature 2019

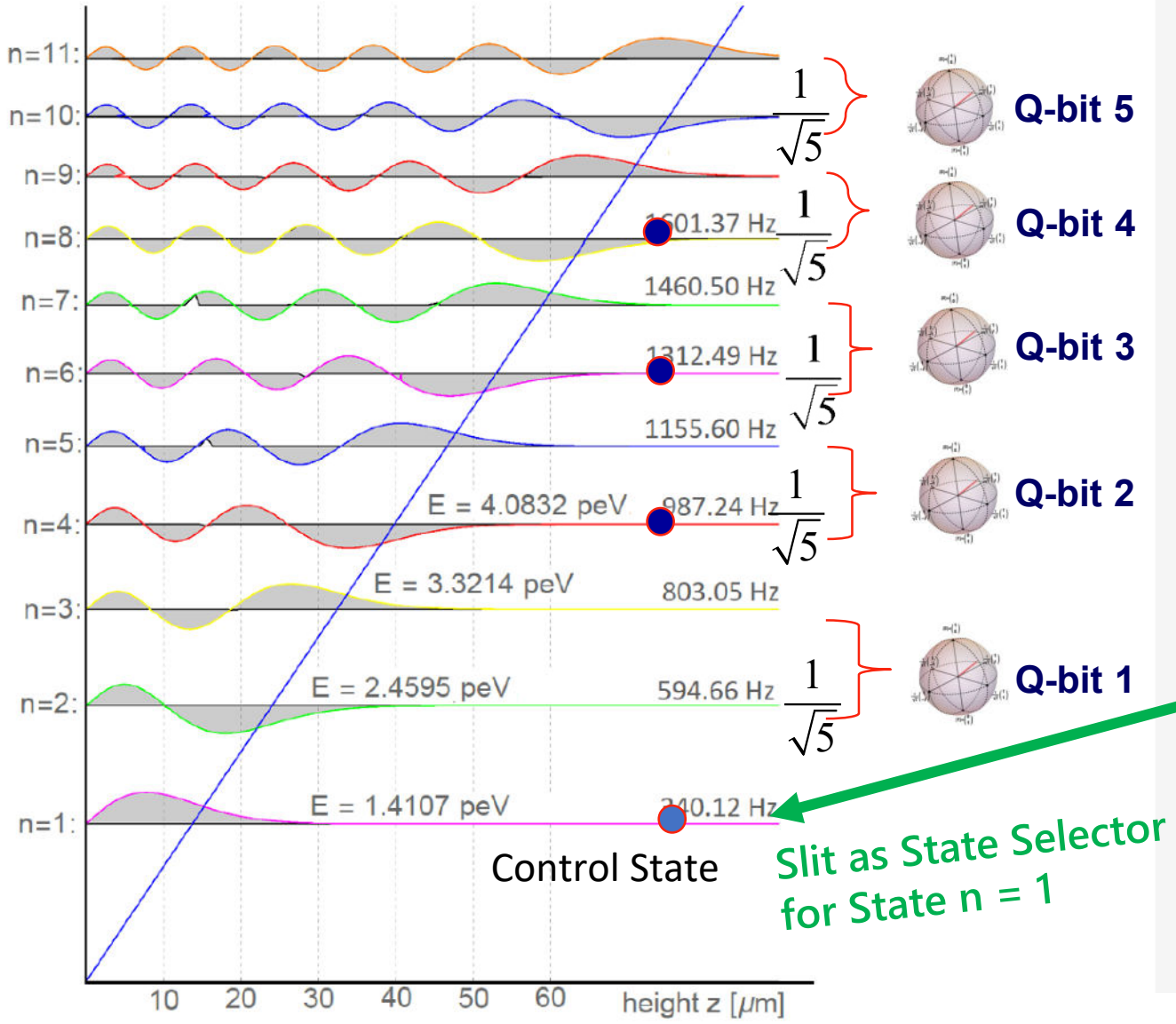
2

- a **Rabi** spectroscopy setup
  - Resonant transitions with X, Y, Z gates on the **Bloch sphere**
  - Addressing Airy-quantum states in the linear gravity potential



Cronenberg, Abele, Nature Physics 2018

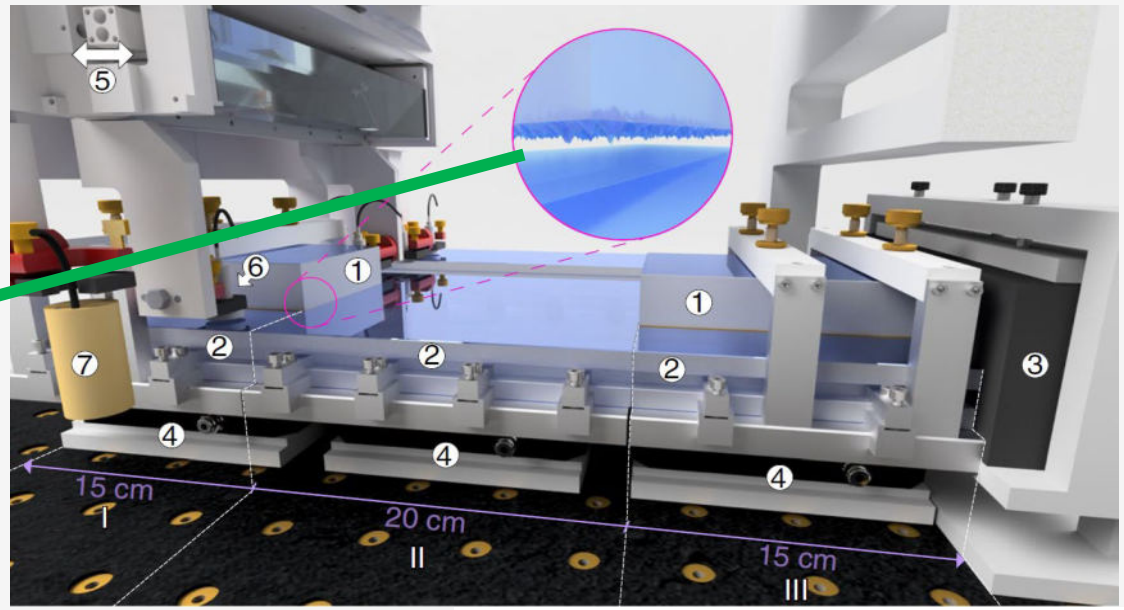
QCN: Multi State Logic



Slit as State Selector for State n = 1

2

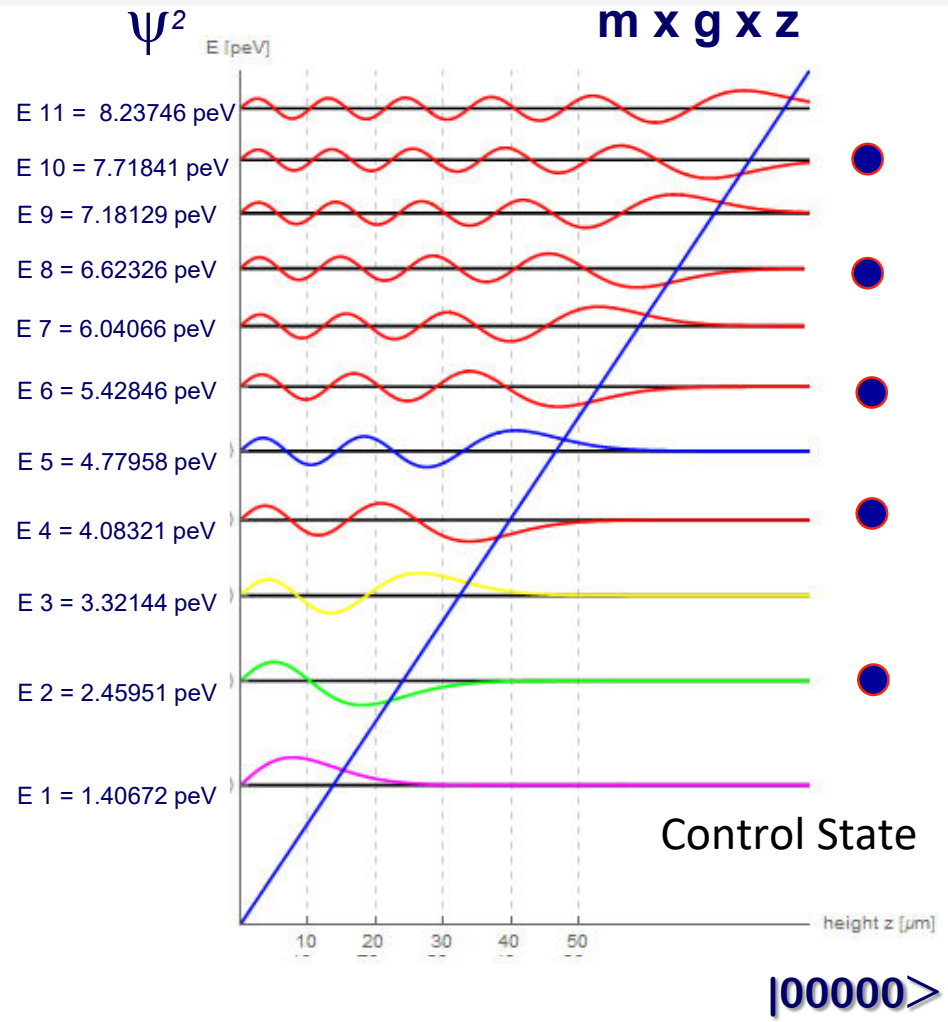
- a **Rabi** spectroscopy setup
  - Resonant transitions with X, Y, Z gates on the **Bloch sphere**
  - Addressing Airy-quantum states in the linear gravity potential

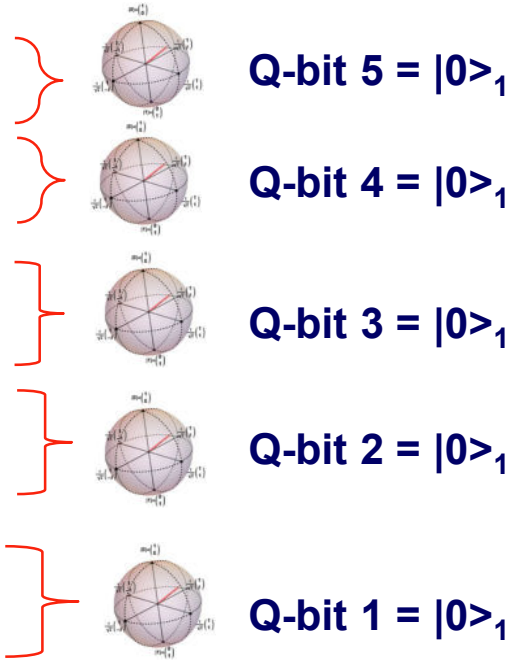


Cronenberg, Abele, Nature Physics 2018

5 Qubit – System (Q-2-ist) $2^5 = 32$

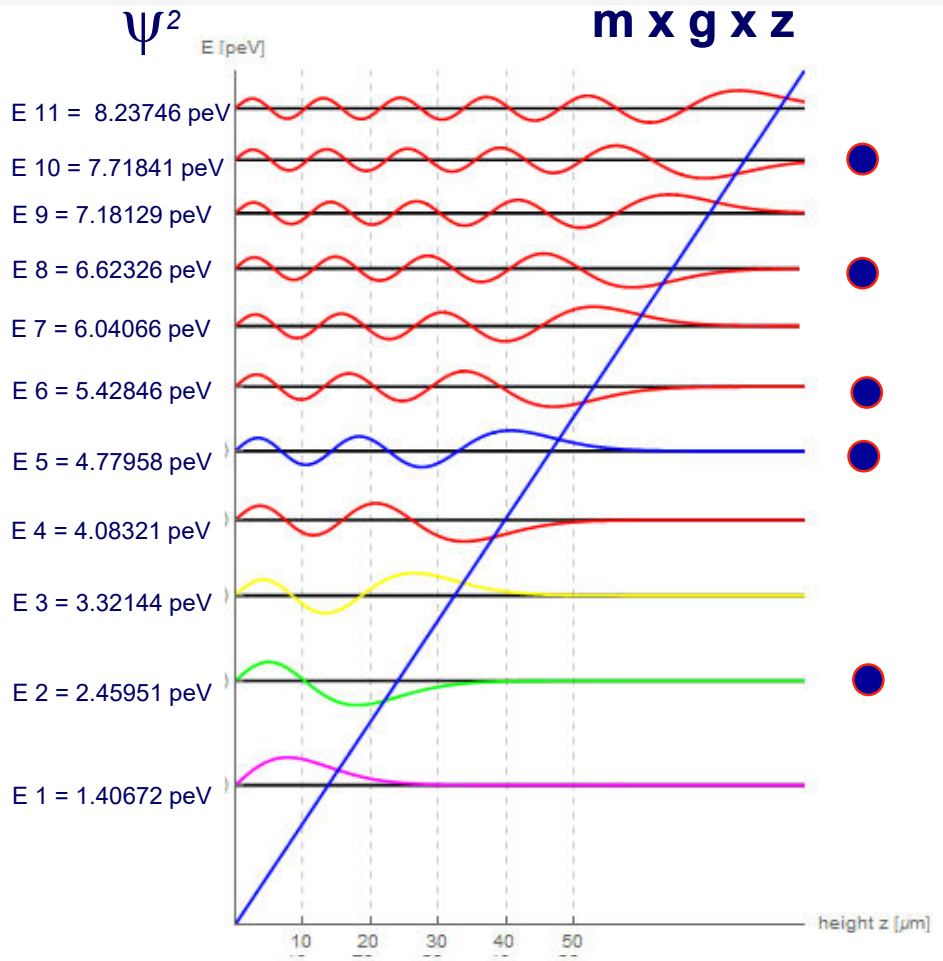
$$\Delta E = \hbar\omega$$

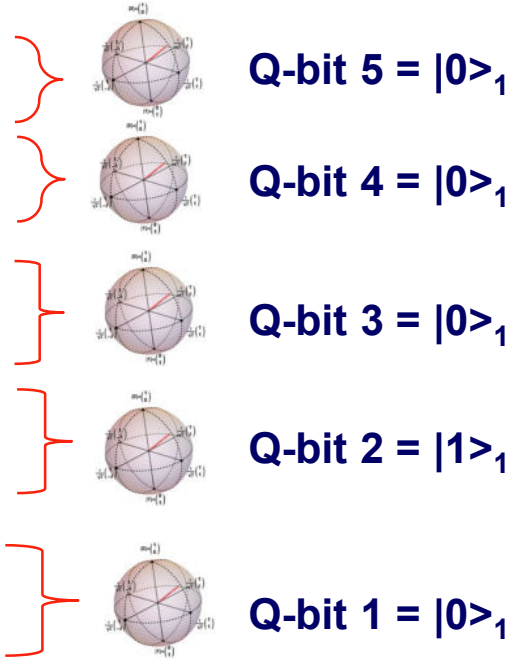




5 Qubit – System (Q-2-ist)

$$\Delta E = \hbar\omega$$





Q-bit 5 = $|0\rangle_1$

Q-bit 4 = $|0\rangle_1$

Q-bit 3 = $|0\rangle_1$

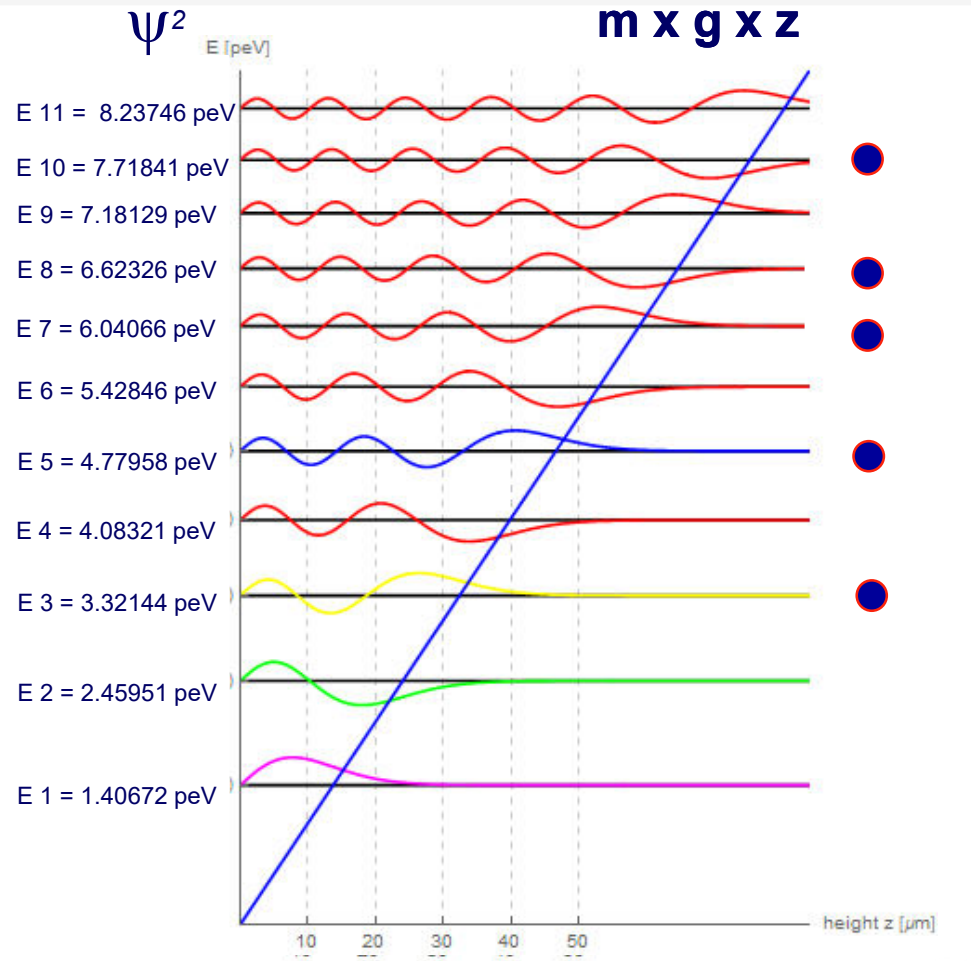
Q-bit 2 = $|1\rangle_1$

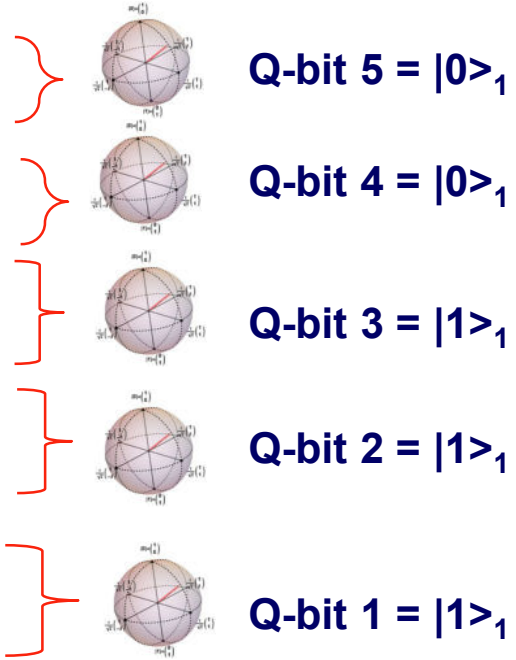
Q-bit 1 = $|0\rangle_1$

$|00010\rangle = 2$

5 Qubit – System (Q-2-ist)

$$\Delta E = \hbar\omega$$





Q-bit 5 = $|0\rangle_1$

Q-bit 4 = $|0\rangle_1$

Q-bit 3 = $|1\rangle_1$

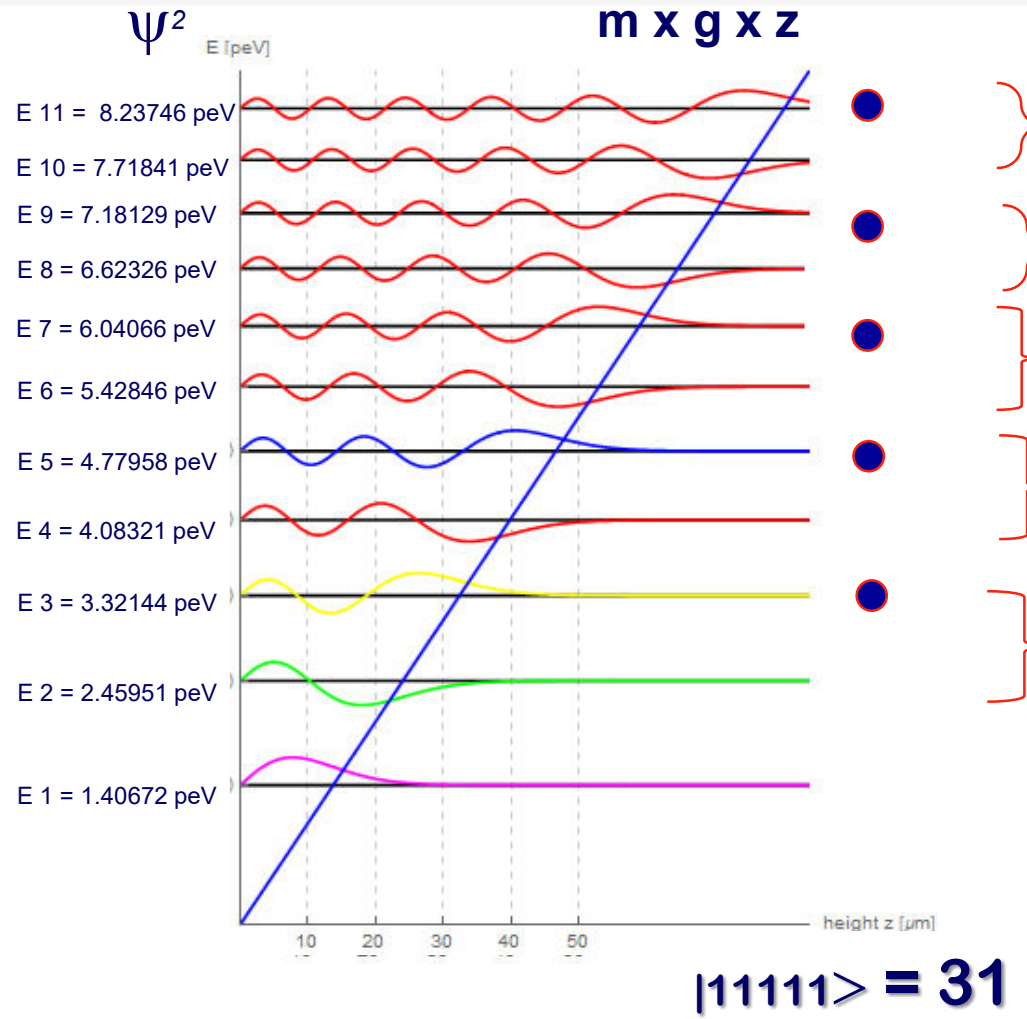
Q-bit 2 = $|1\rangle_1$

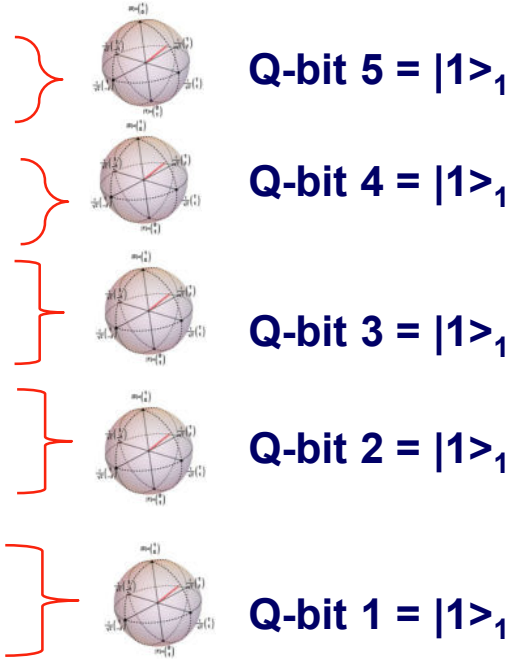
Q-bit 1 = $|1\rangle_1$

$|00111\rangle$ = 7

5 Qubit – System (Q-2-ist)

$$\Delta E = \hbar\omega$$





Q-bit 5 = $|1\rangle_1$

Q-bit 4 = $|1\rangle_1$

Q-bit 3 = $|1\rangle_1$

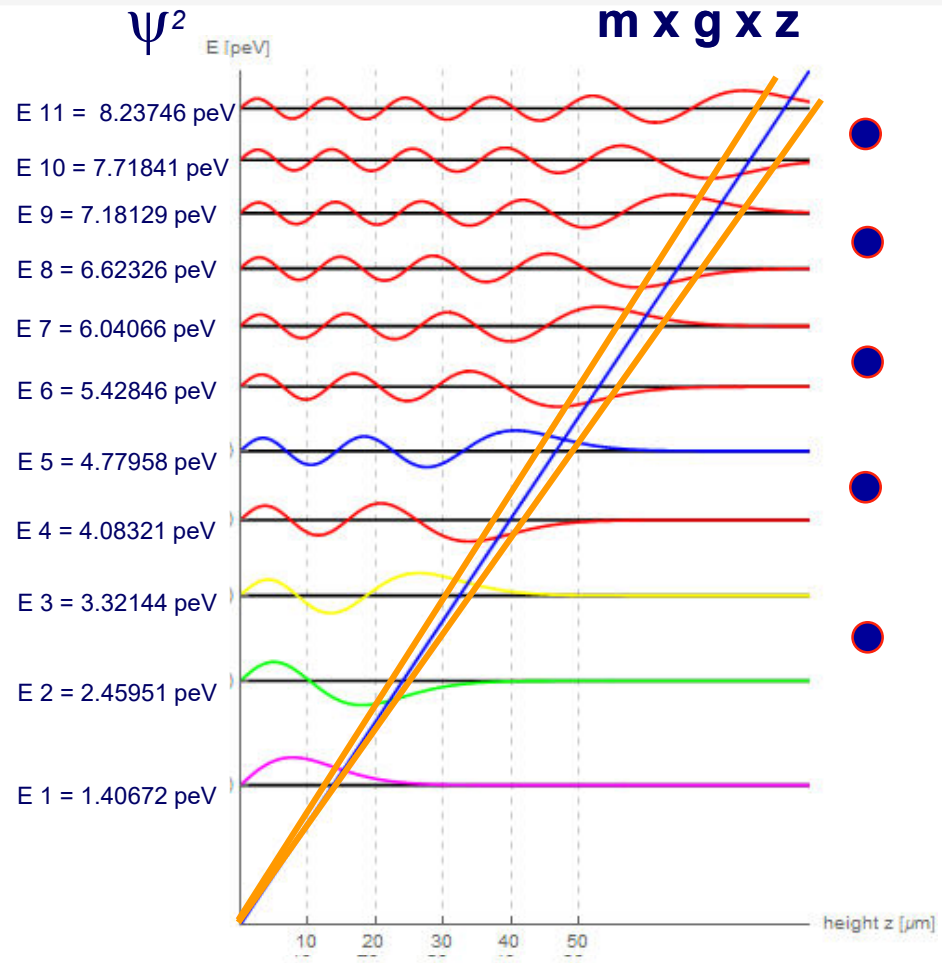
Q-bit 2 = $|1\rangle_1$

Q-bit 1 = $|1\rangle_1$

$|11111\rangle$ = 31

GHZ with 5 Qubit – System (Q-2-ist)

$$\Delta E = \hbar\omega$$



|GHZ> = |00000> - |11111>

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Vorlesungen

141.B16	**Gravitation and Cosmology I**	Abele, Pitschmann
142.081	**Biological and Medical Applications of Nuclear Physics I**	Badurek
141.234	**Fundamental Physics with Coherent X-Rays and Neutrons**	Hasegawa
142.318	**Neutronen- und Kernphysik**	Jericha
138.057	**Festkörperspektroskopie**	Jericha, Reissner
141.A16	**Quantentechnologie I**	Sponar






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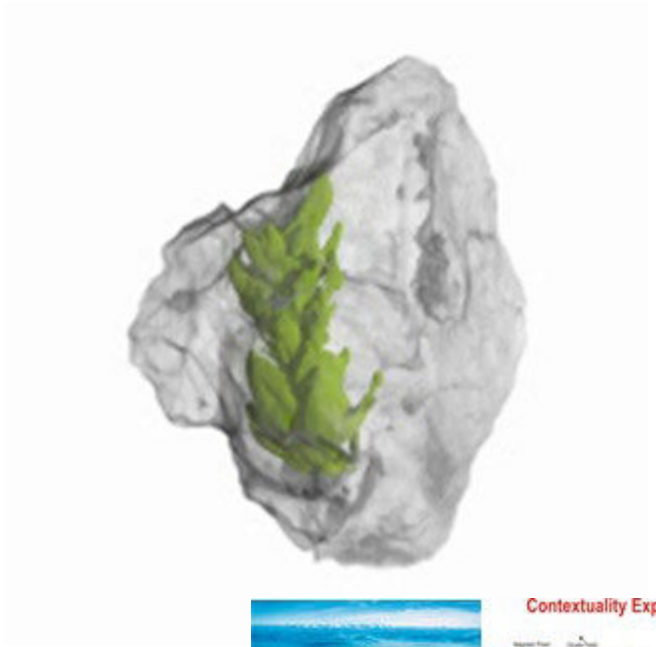
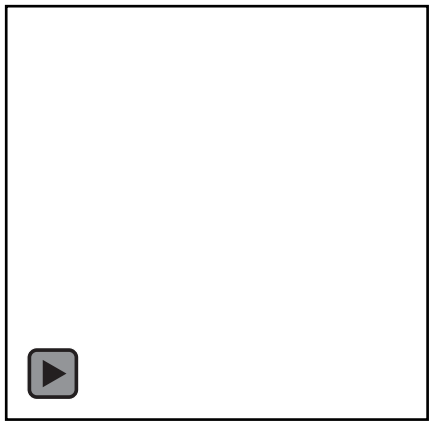
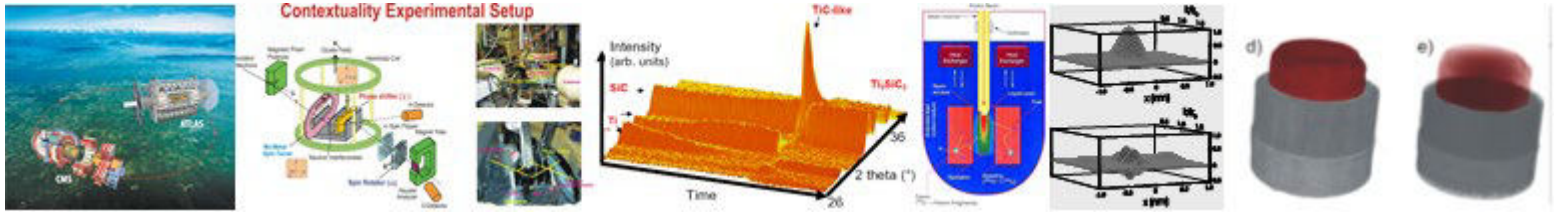
Praktika

141.A78 **Praktikum aus Neutronenphysik**



Abele, Hasegawa, Jericha, Sponar, Zawisky





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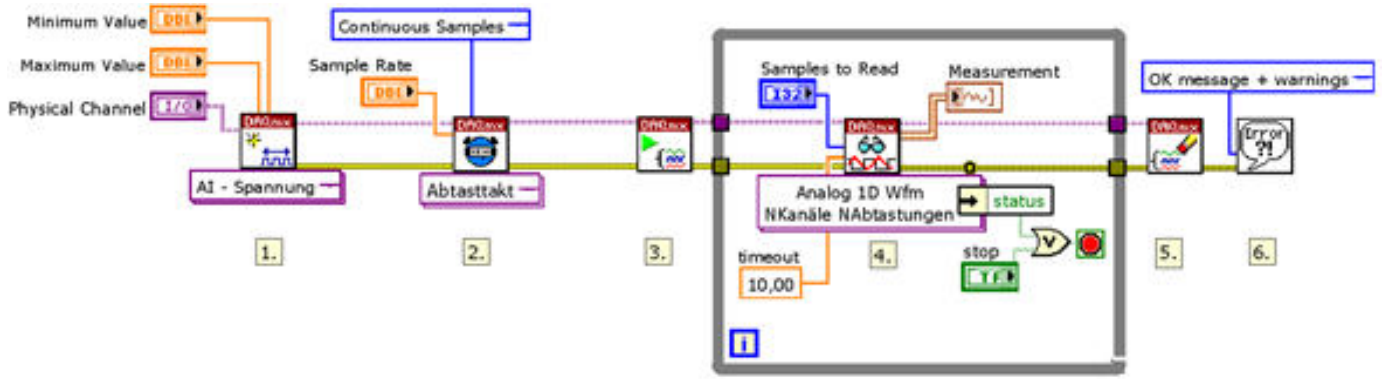
Praktika

141.A78 **Praktikum aus Neutronenphysik**	Abele, Hasegawa, Jericha, Sponar, Zawisky
141.A76 **Graphical Programming and Experiment Control**	Jericha
141.A86 **Quantenphysik**	Schumm, Sponar *et al.*



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Seminare

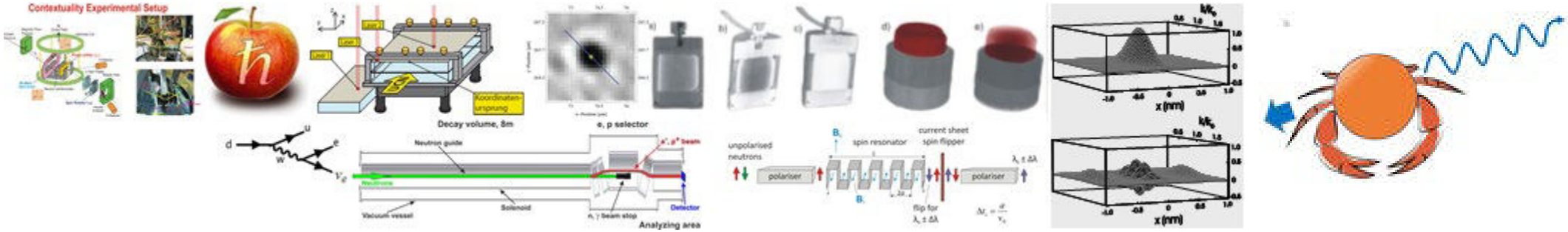
141.543	**Neutronen- und Festkörperphysik – *„Freitagseminar“***
141.B11	**Advances in Quantum Science and Quantum Technology**
142.069	**Seminar über Atomare und Subatomare Physik**

„Frühstücksseminar" der Neutronengruppe

jeden Donnerstag um 09:30 im ATI Essraum

Projektarbeiten / Bachelorarbeiten

141.026 **Projektarbeit Neutronenoptik**	Hasegawa, Sponar
141.102 **Projektarbeit Neutronenphysik**	Abele, Hasegawa, Zawisky, Suda, Summhammer
141.A95 **Projektarbeit Gravitation und Quantenmechanik**	Abele, Pitschman, Sedmik
141.A96 **Projektarbeit Schwacher Wechselwirkung**	Abele, Jericha
142.025 **Projektarbeit Nukleare Festkörperphysik**	Jericha, Badurek
142.026 **Projektarbeit Experimentelle Hadronenphysik**	Jericha, Abele, Zawisky

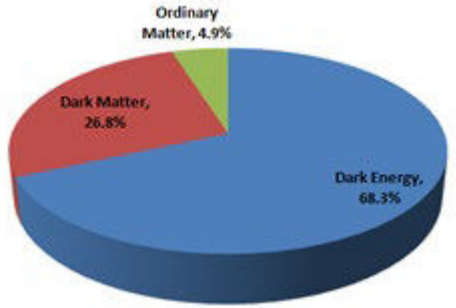


TECHNISCHE UNIVERSITÄT WIEN

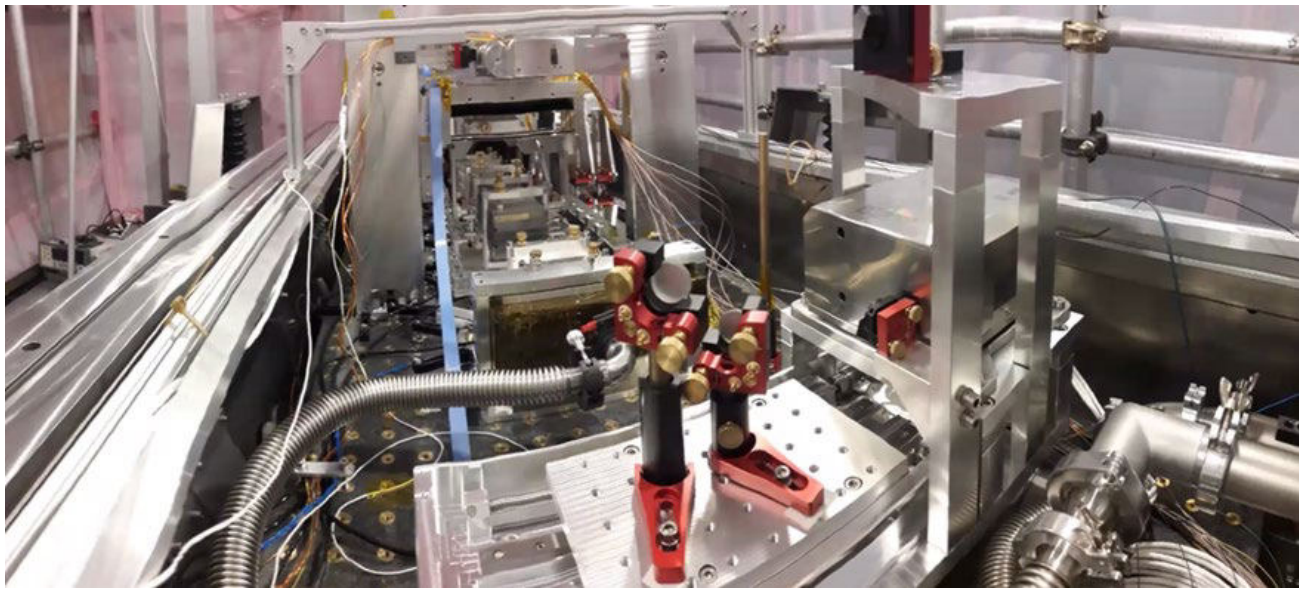
ATOMINSTITUT

PA/BA Gravitation & Quantenmechanik

*q*BOUNCE - ILL Grenoble + ATI Wien



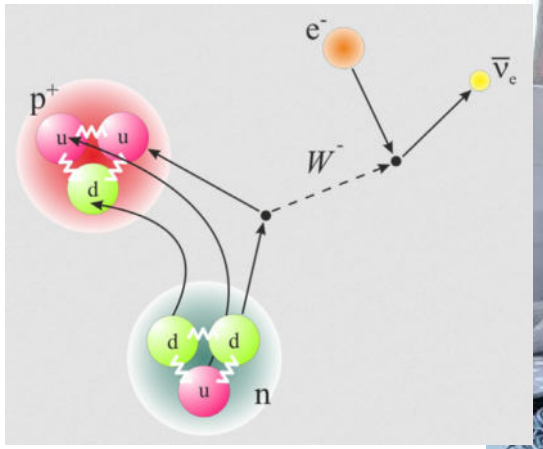
- Quantum states in the gravitational potential
- Potential to probe Dark Energy theories
- Preparation of neutron‘s charge measurement
- Instrument control in the submicron regime
- Origin of gravitation, non-Riemann gravity, entropic force



hartmut.abele@tuwien.ac.at

PA/BA Schwache Wechselwirkung

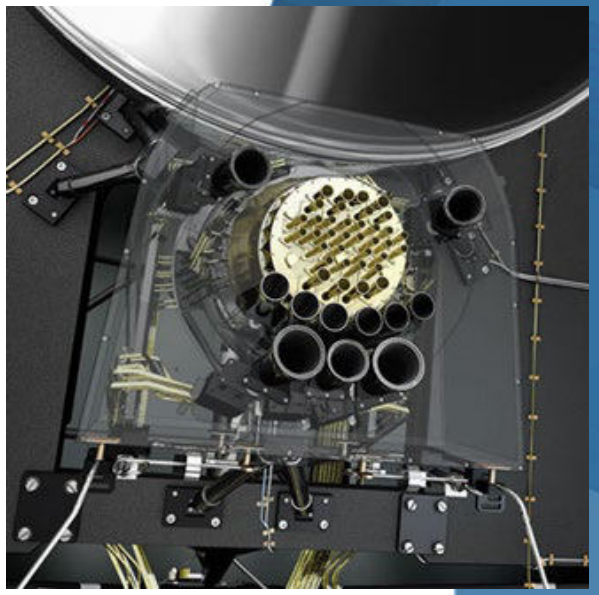
FRM II: Neutron Beta Decay & High Precision Experiments, PERC

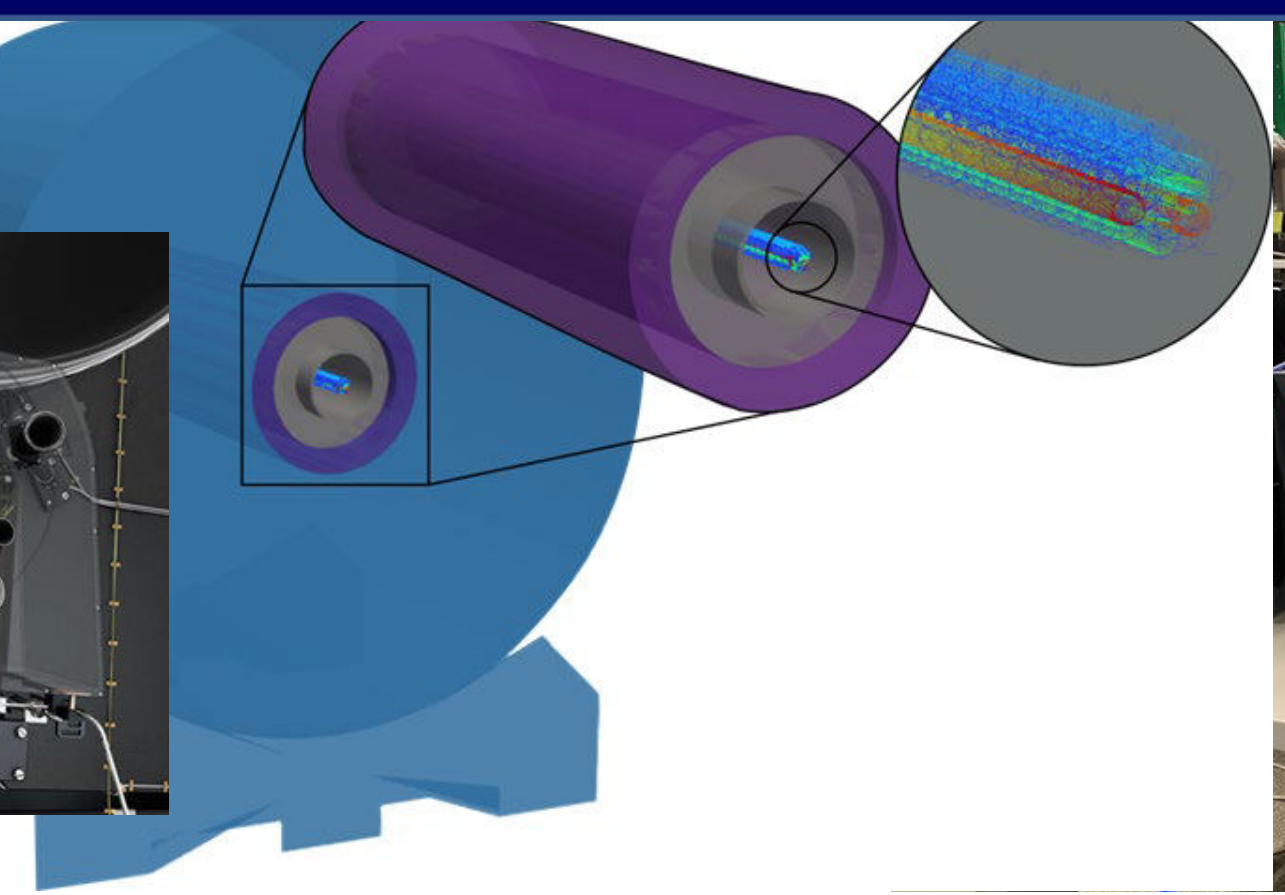


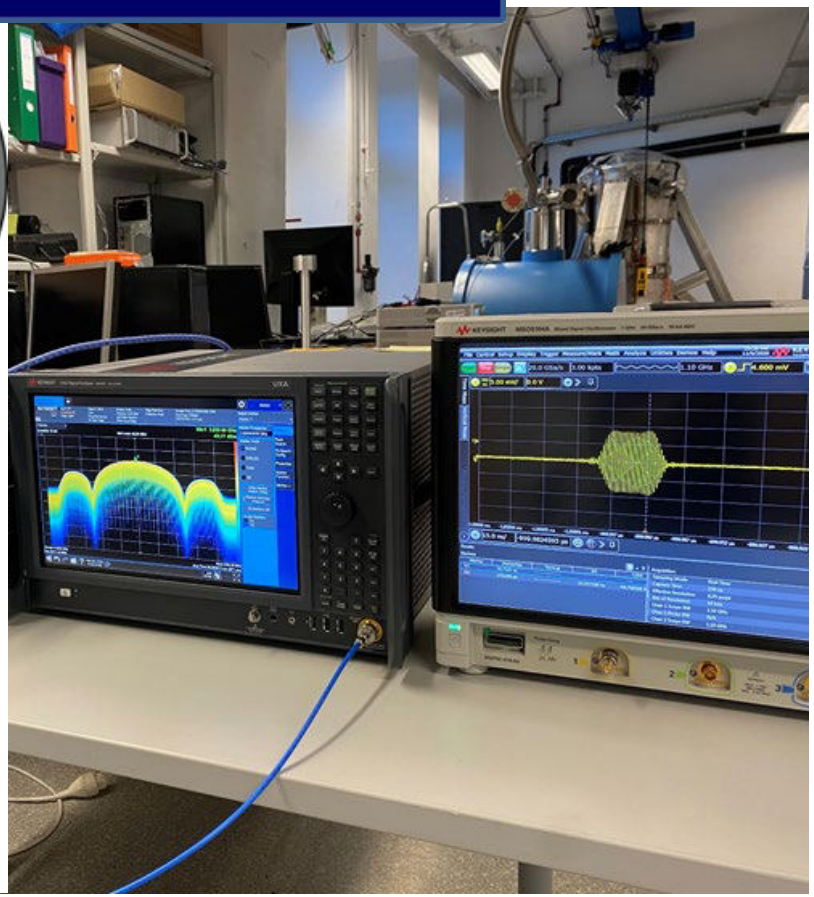
Spokesperson: B. Maerkisch, TU München,Time& Project Manager: E. Jericha, TU Wien

PA/BA Schwache Wechselwirkung

ATI: Beta Zerfall der Neutronen, CREScent - cyclotron radiation of electrons







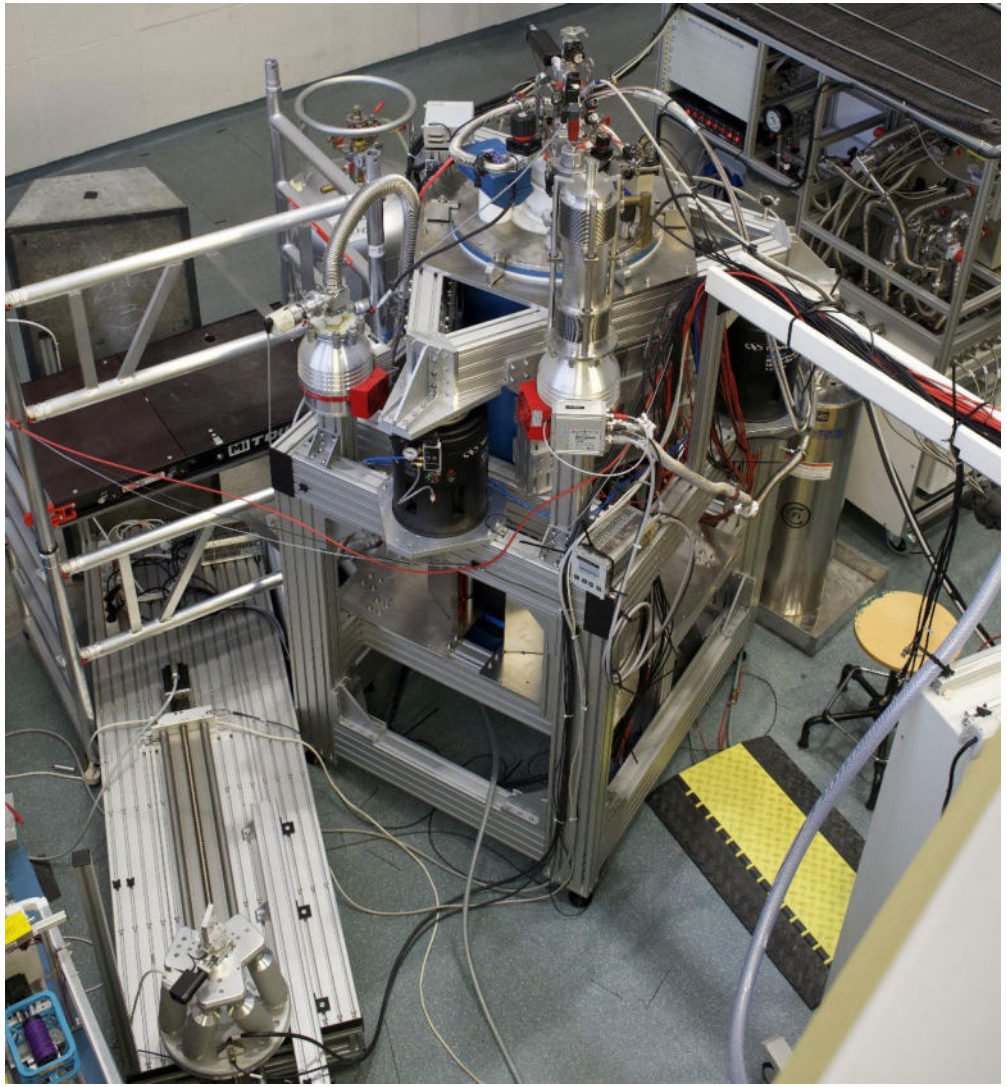
hartmut.abele@tuwien.ac.at

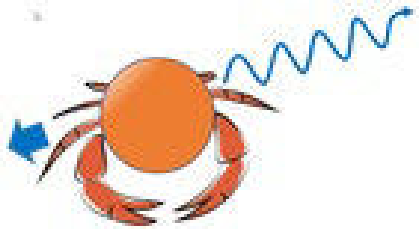
erwin.jericha@tuwien.ac.at

TECHNISCHE UNIVERSITÄT WIEN

PA/BA Nukleare Festkörperphysik

ATOMINSTITUT





ATI: CRAB

Kalibrierung von bolometrischen Detektor-Kristallen mit Neutronen für

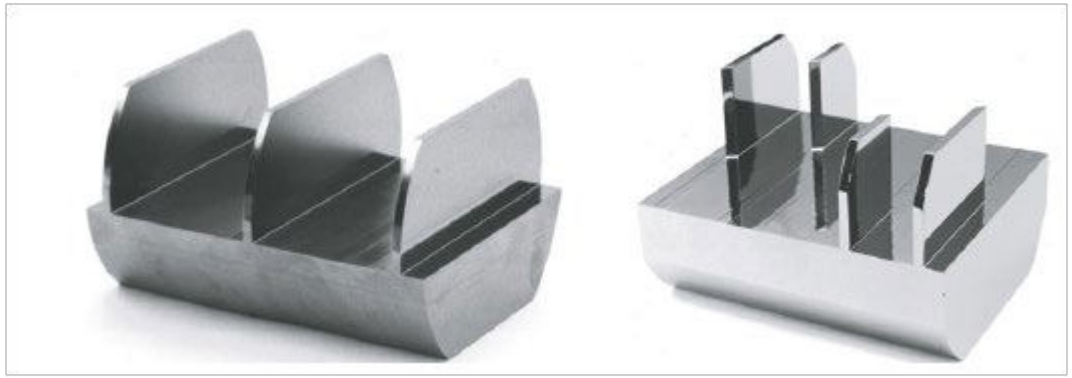
- die Detektion von Neutrinos und
- die Suche nach Dunkler Materie

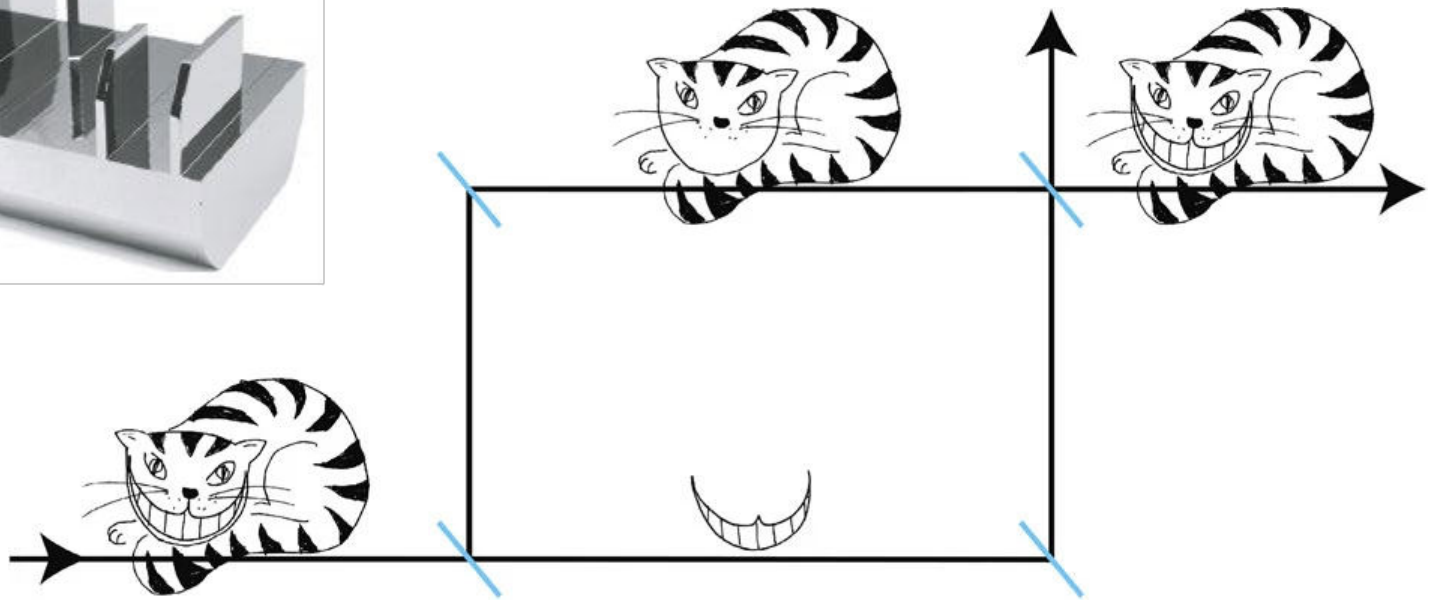
erwin.jericha@tuwien.ac.at

hartmut.abele@tuwien.ac.at

PA/BA Neutronenoptik

ILL Grenoble und ATI: Neutroneninterferometrie





TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

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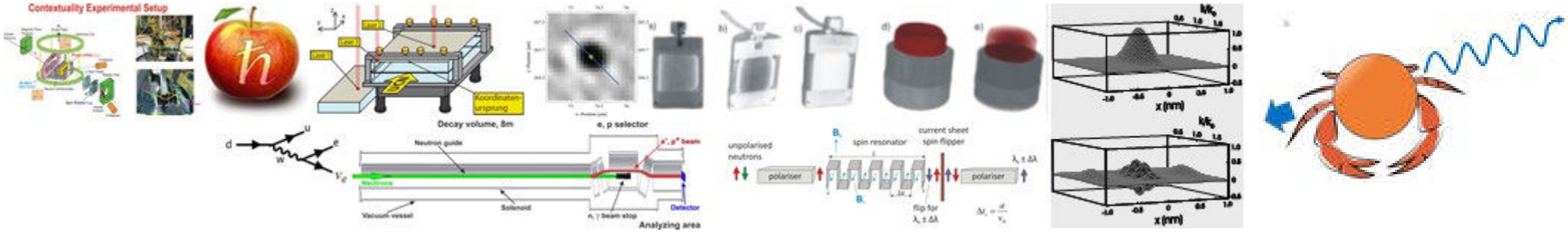


TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

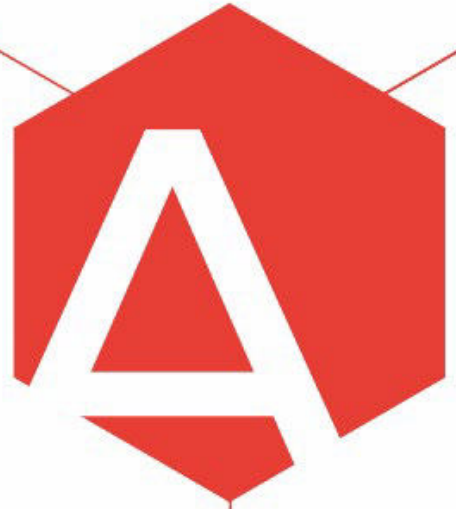
Quantum Science & Quantum Technology

• Atom- und Quantenphysik	J. Schmiedmayer
• Atominterferometrie	Ph. Haslinger
• Experimentelle Quanteninformation	J. Leonard
• Festkörperquantenoptik und Nanophotonik	S. Skoff
• Kalte Moleküle und Quantentechnologien	T. Langen
• Quanteninformation & Thermodynamik	M. Huber
• Quantenmetrologie	T. Schumm

VCQ - Vienna Center for Quantum Science & Technology

www.vcq.at

quantA



Quantum Science Austria

Markus Aspelmeyer
Francesca Ferlaino
Johannes Fink
Tracy Northup

Armando Rastelli
Hannes Pichler
Jörg Schmiedmayer
Gregor Weihs

universität innsbruck

Institute of Science and Technology Austria

JOHANNES KEPLER UNIVERSITÄT LINZ

TECHNISCHE UNIVERSITÄT WIEN

ÖSTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN

universität wien

Quantum Science Austria

quantA

universität innsbruck

Gregor Weihs
Tracy Northup
Hannes Pichler

ISTA Institute of Science and Technology Austria

Johannes Fink

JKU JOHANNES KEPLER UNIVERSITÄT LINZ

Armando Rastelli

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

Jörg Schmiedmayer

universität wien

Markus Aspelmeyer

ÖAW ÖSTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN

Francesca Ferlaino

Base:
Intelectual and experimental infrastructure built by > 60 Quantum PI's in Austria organised in ESQ

34 ERC, 21 START, 6 Wittgenstein, many SFB, FG, DK ....
many Prizes: Nobel, Wolf, Breakthrogh, Dirac Medal ....

Goal:
Secure Austria's excellence at the forefront of (fundamental) quantum science

- Push the frontiers of quantum science
- Attack big questions using synergies in
- Strengthen basic research as the motor for future innovation
- Educate quantum researchers and train the future quantum workforce
- Establish a single go-to place for all things quantum

Overaching principle: Open to ALL quantum researches

TECHNISCHE UNIVERSITÄT WIEN

Starting this Semester
New english language Master

quantA

Quantum Information Science and Technology
QIST

Spanning 3 faculties @ TU-Wien

- Computer Science
- Electrical engineering
- Physics

Goal: Prepare for the 2nd quantum revolution

from **basic science** ⇒ **technology** ⇒ **quantum industry** and **start-ups**

TECHNISCHE UNIVERSITÄT WIEN

Quantum Information Science and Technology (QIST)

quantA

	Electrical engineering	Computer Science	Physics
1. Semester	**Basic courses** in the 3 Foundations of Quantum Information Technology		
	Quantum Technology and Devices: Techniques and Platforms	Quantum Computing, Complexity theory and Algorithmics	Quantum Physics: Basic concepts and Foundations
	In each of the three fields there course will have an up-skilling component to bring students from other fields up to speed and a core course component to teach the essential foundations and skills to master the advanced courses in the following 3 semesters. Mixture of lectures and practical exercises		
2. + 3. Semester	**Advanced courses** in the 3 pillars of QIST		
	Quantum Technology and Devices 6,0 – 18,0 ECTS	Quantum Information and Computing 6.0 - 18.0 ECTS	Quantum Physics 6.0 - 18.0 ECTS
	Scientific courses/work: seminar (3,0 ECTS), lab courses (5,0 ECTS), project work (10,0 ECTS)		
	+ 9,0 ECTS free elected courses and transferable skills		
4.	**Master Project**		

Quantum S&T – Lectures

Series of lectures (some in a 4-semester curriculum)

• **Quantum Optics**	Eliza Agudelo +	I & II	141.A10 141.A11	WS 2025 SS 2026	
• **Quantum Technology**	T. Schumm, R. Sponar P. Haslinger, T. Langen, J. Schmiedmayer,	I & II	141.A16 141.A17	WS 2024 SS 2025	
• **Atoms - Light - Matter Waves**	P. Haslinger , T. Langen, J. Schmiedmayer		141.212	WS 2024	
• **Macroscopic quantum Systems**	P. Haslinger, T. Langen, J. Schmiedmayer		141.231	SS 2025	
• **Advanced Topics in Quantum Information**	Dakic, Haslinger, Kofler, Küng, Ringbauer		141.310	WS 2024	on-line
• **Atomic/Molecular Physics - Metrology**	T. Schumm		141.A35	WS 2025	
• **Quantum Information Theory**	M. Huber, N. Friis	I & II	141.282 141.300	WS 2024 WS 2025	
• **Quantum Thermodynamics**	M. Huber, P. Erker		141.B22	SS 2025	
• **Quantum Computing Architectures**	N. Friis, not yet in TISS			SS 2025	
• **Quantum Communication and Security**	G. Murta, not yet in TISS			SS 2025	
• **Quantum Metrology**	N. Friis, not yet in TISS			WS 2025	
• **Einführung in die exp. Quantenphysik mit Qubit Systemen**	S. Sponar		141.280	WS 2025	
• **QIST: Quantum Physics: Basic Concepts and Foundations**	E. Agudelo + …	VU 7.0	194.169		
Up-Skilling		VU 3.0	194.171		

Quantum S&T – Seminars

students & postdocs

- **Advances in Quantum Science and Quantum Technology** — 141.B11 — Wednesdays 16:15
  Atominstitut : Helmut Rauch Hörsaal

- **Journal Club Quant-Physics** — 141.309 — Tuesday 14:00
  Atominstitut : ZE Gebäude, 1.Stock, Seminarraum

external speakers

- **Neutron, Solid-State and Quantum Physics** — 141.543 — Fridays 10:00
  Atominstitut : Helmut Rauch Hörsaal

- **VCQ Colloquium: Complex Quantum Systems** — 141.271 — Mondays 17:00
  Lise-Meitner Hörsaal, Boltzmanngasse 5, 1090 Wien
  17:00 Get-together with coffee and snacks!
  17:30 VCQ Student talk
  17:45 VCQ Colloquium Talk

TECHNISCHE UNIVERSITÄT WIEN

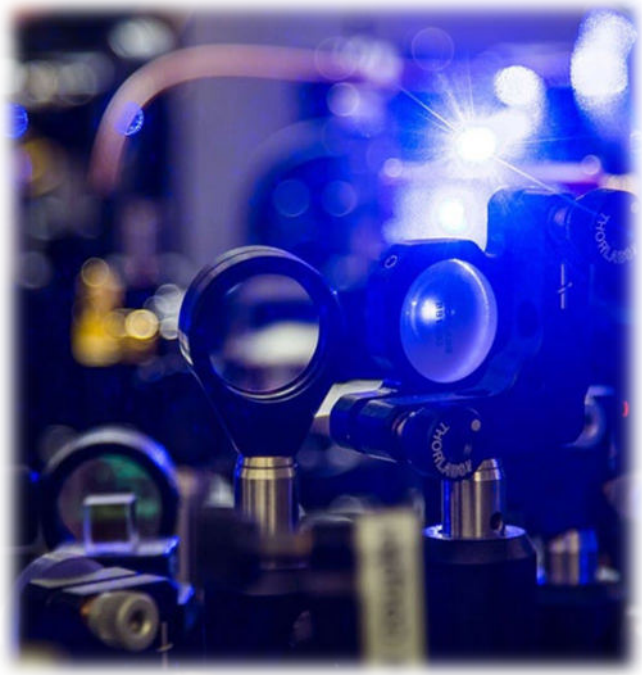
Quantum Praktikum

ATOMINSTITUT

Praktikum: Quantenphysik

4 ECTS **141.A86**

Abele, Haslinger, Langen, Manz, Schachinger, Schmiedmayer, Schneider, Schumm, Sponar



Lab course where you can experience first hand the basic phenomena of Quantum Physics.
Brand-new setups, one afternoon each, small teams

Sign up for labs by mail to: barbara.stros@tuwien.ac.at
Please sign up before 10.10.2024

- Verschränkte Photonen / Bell-Ungleichung
- HeNe-Laser
- Kernspinresonanz (NMR)
- Laserspektroskopie von Rubidium
- Topological phases with neutrons (am Reaktor, ATI)
- Interferenz am Doppelspalt mit einzelnen Elektronen (am USTEM)

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

United Nations proclaimed **2025**

as the

International Year of Quantum Science and Technology

☺ stay tuned ☺

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Atom- und Quantenphysik

S. Erne, I Mazets, M. Prüfer, Elena Rodchenko
J. Schmiedmayer

WITTGENSTEIN FWF Der Wissenschaftsfonds. FFG erc + ISOQUANT SFB1225 VCQ Vienna Center for Quantum Science and Technology quantA

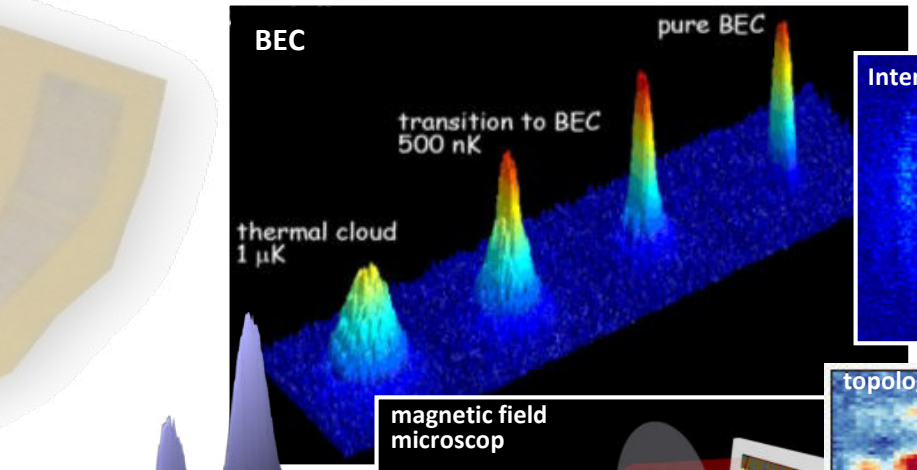
TECHNISCHE UNIVERSITÄT WIEN

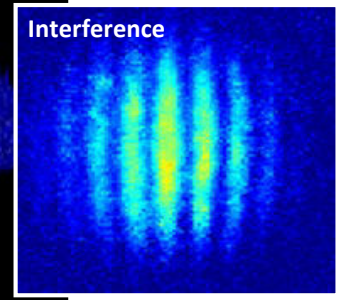
Research Focus

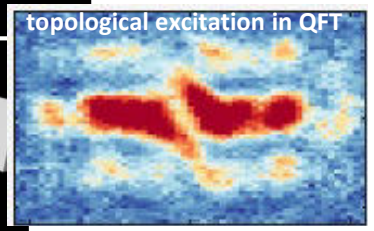
Understanding and Implementing Quantum Physics

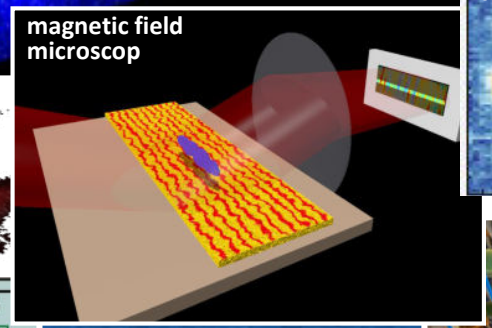
ATOMINSTITUT

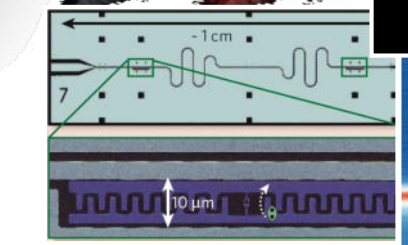
- fundamental research
  - quantum degenerate Bose and Fermi gases
  - coherence, de-coherence
  - quantum simulations, quantum field theories
  - emergence in quantum physics
- applications in devices
  - hybrid quantum circuits
  - quantum memory
  - metrology and sensors
- technologies
  - lasers, optics
  - imaging and image processing, AI
  - super conductivity and cryogenic technology
  - experimental control and active feedback
  - nano fabrication and micro optics
  - numerical modelling

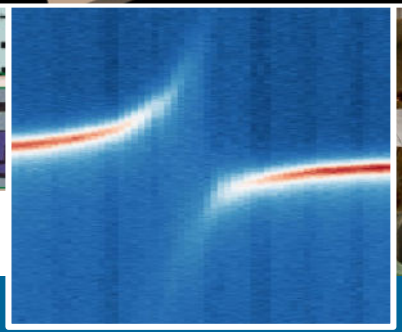


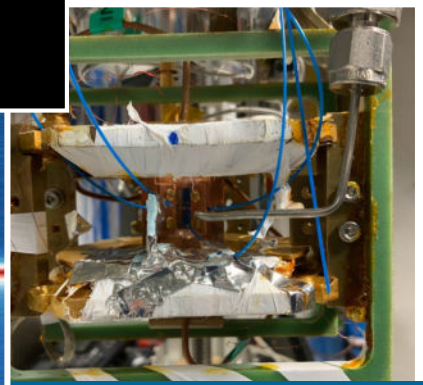












TECHNISCHE UNIVERSITÄT WIEN

Teaching

Lectures + Praktikum

ATOMINSTITUT

141.212 Atoms - Light - Matter Waves

Ph. Haslinger, T. Langen, J. Schmiedmayer

The lecture will give an **introduction to the physics of ultra-cold atoms and molecules**: atom interacting with light fields, laser cooling, magneto-optical trapping, atom and ion trapping, cooling and trapping of molecules, evaporative cooling, introduction to Bose-Einstein condensation. Applications such as **matter-wave optics** and **interferometry** will also be discussed.

location: **Atominstitut,** seminar room

language: english

format: 3 blocks (two afternoons with coffee break) + student seminars
First Block (tentative): **5. and 6. November 14 – 18 Atominstitut**

exam: after each block, the student will be given an article to read and review.
final: 2 page term paper + presentation of a rescent publication
tentative date off first lecture: Mi. 13. March 2024 14 – 16 Atominstitut

To arrange dates and times: please register at: schmiedmayer@atomchip.org or Tim.Langen@tuwien.ac.at

141.A12 Fundamental experiments on quantum physics

Praktikum

contact: barbara.stros@ati.ac.at

Teaching

Projektarbeit, Bachelor / Master

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Projektarbeit 141.214: Ultracold Atoms and Spectroscopy

students gain hands-on experience on...

laser physics, high-resolution spectroscopy, feedback and frequency stabilisation, acusto-optics, polarization vacuum technology, laser cooling and trapping, digital imaging and image analysis, quantum degenerate gases, numerical methods to solve problems in ultra cold quantum matter

contact: maximilian.pruefer@tuwien.ac.at, rugway.wu@tuwien.ac.at, sebastian.erne@tuwien.ac.at **und** schmiedmayer@atomchip.org

Projektarbeit 141.216: Quantum Technology

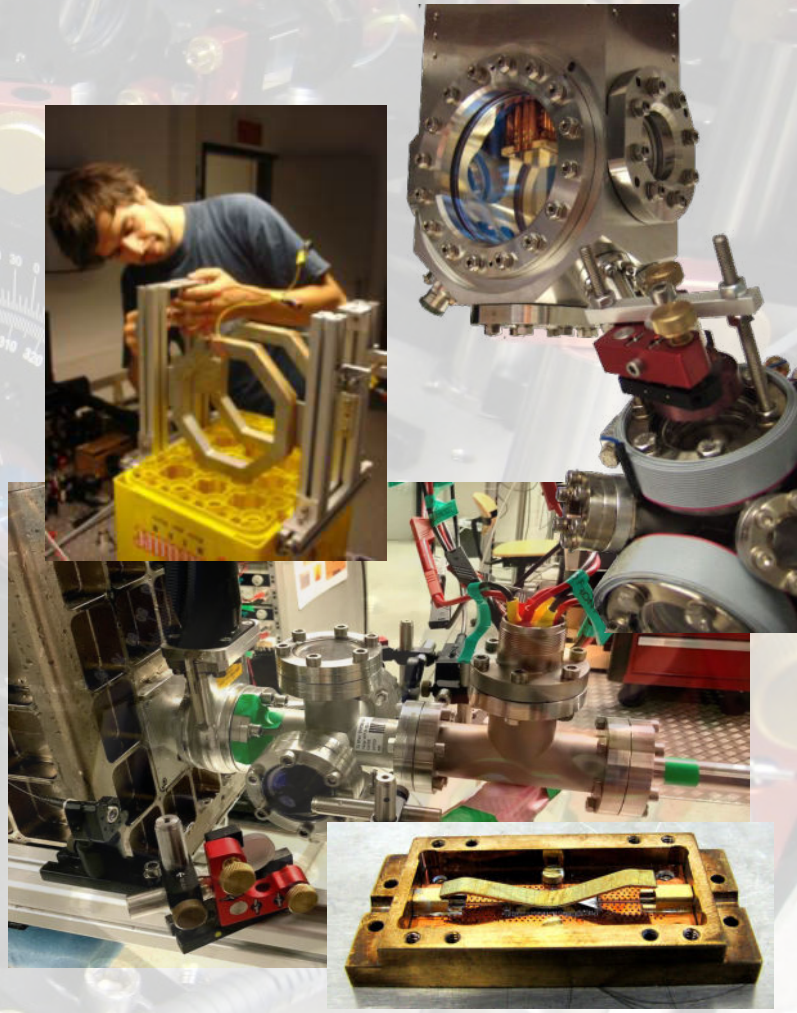
merging microfabrication, optics, superconducting quantum citrcuits and AMO physics

hands-on experience on...

Nano fabrication, micro optics, single photon optics and detectors,
micro wave engineering, micro wave resonators, superconducting quantum circuits
cryogenics, quantum electronics

contact: elena.redchenko@tuwien.ac.at **und** schmiedmayer@atomchip.org

format: teams of 1-2 select with their mentor a project connected to our experiments
⇒ 4 weeks full time in the lab + presentation of results in the group meeting



TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

AQUTEM

FFG

Atom-Interferometry

ESQ
Discovery

Quantum Electron Optics
Philipp Haslinger
(Michael Seifner)

quantA

Start

www.haslingerlab.com

FWF
Der Wissenschaftsfonds.

VCQ
Vienna Center for Quantum Science and Technology

Quantum Praktikum

Praktikum: Quantenphysik

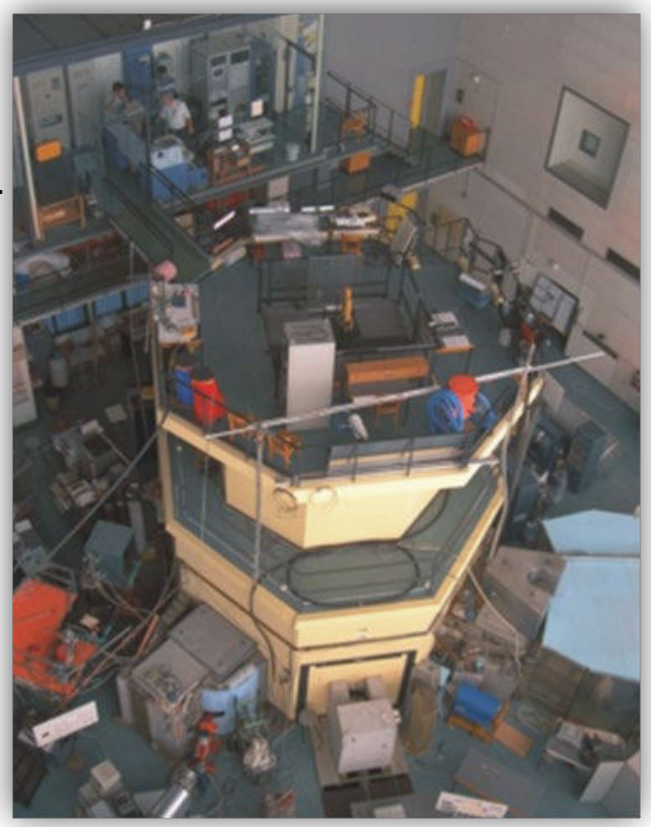
4 ECTS **141.A86**

Haslinger, Sponar, Manz, Schachinger, Schumm, Schmiedmayer, Abele, Schneider

Lab course where you can experience first hand the basic phenomena of Quantum Physics.
Brand-new setups, one afternoon each, small teams

Sign up for labs by mail to: barbara.stros@tuwien.ac.at
Please sign up before 10.10.2024

- Verschränkte Photonen / Bell-Ungleichung
- HeNe-Laser
- Kernspinresonanz (NMR)
- Laserspektroskopie von Rubidium
- Topological phases with neutrons (am Reaktor, ATI)
- Interferenz am Doppelspalt mit einzelnen Elektronen (am USTEM)

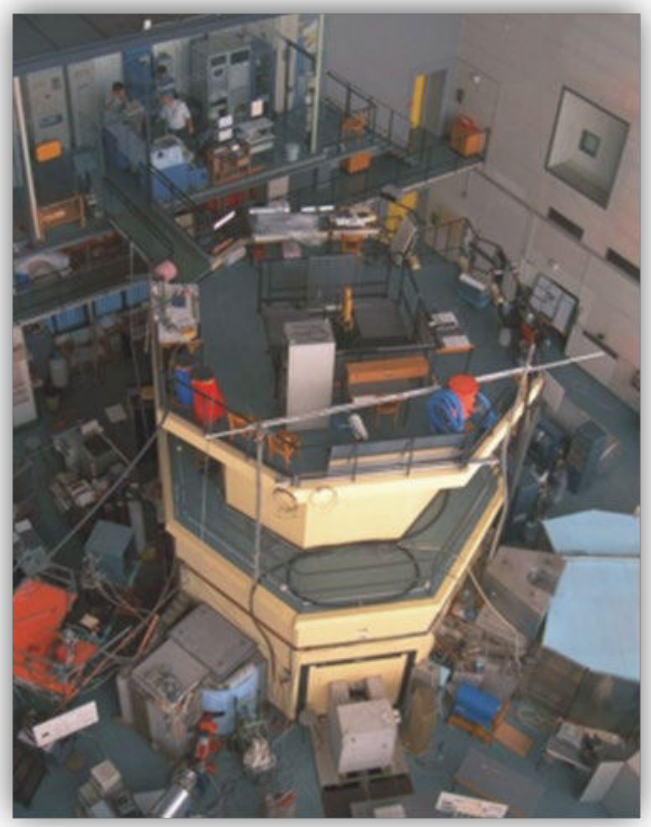


Advanced Topics in Quantum Information

5 ECTS **141.310**

Martin Ringbauer, Uni Innsbruck
Johannes Kofler, JKU
Richard Küng, JKU
Borivoje Dakic, Uni Wien
Philipp Haslinger, TU Wien

Only online!

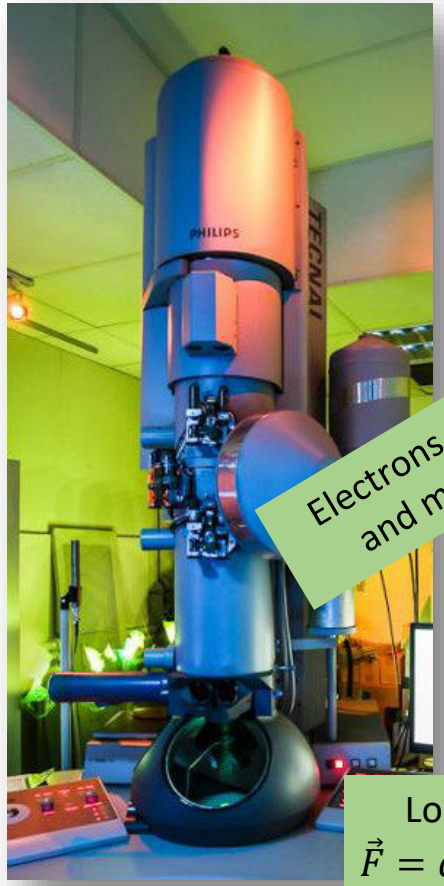


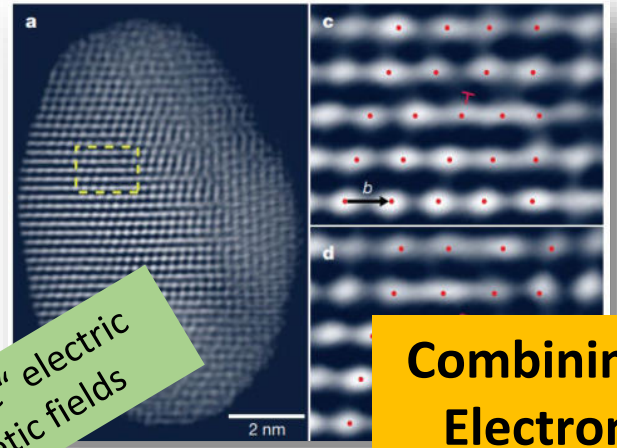
Key topics will be addressed across different Austrian universities.
Planned topics include **quantum information and entanglement** (UNI Wien), **quantum computing** (UIBK), **(quantum) machine learning** (JKU), **quantum sensing** (TU Wien).
Every Monday at 13:45 - 16:15

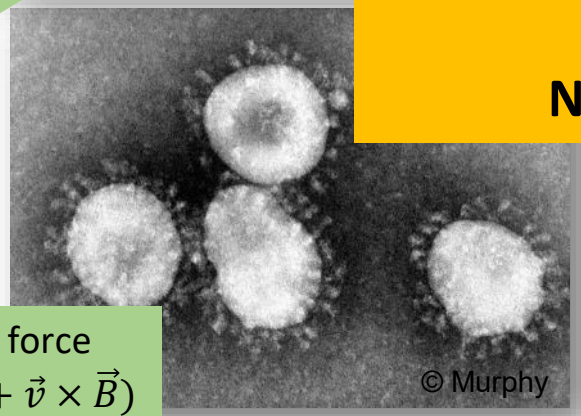
Start: 7.10.
https://jku.zoom.us/j/94585100483?pwd=RSwaalmtBo4c8OMFgAvSm2cyGzslLt.1

Electron Microscopy @ USTEM

Electron Microscopy
”There’s plenty of room at the bottom”





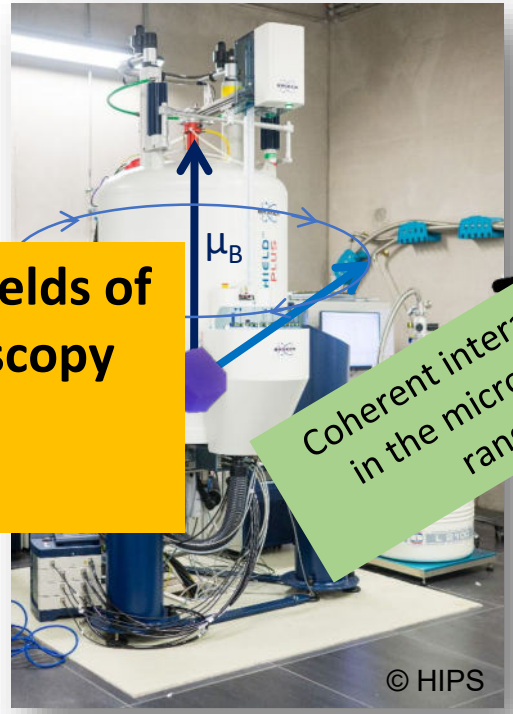


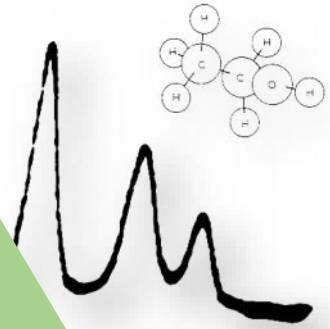
Electrons „see“ electric and magnetic fields

Lorentz force
$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

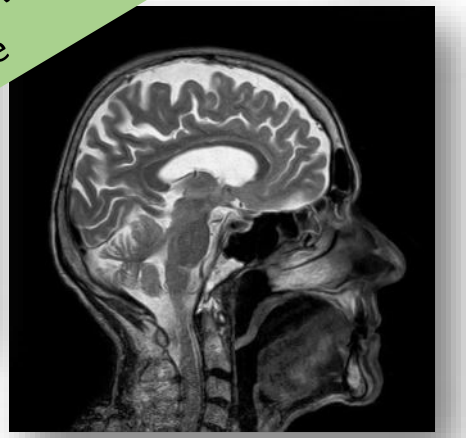
Combining the Fields of Electron Microscopy and NMR/ESR

Electron Spin Resonance (ESR)
Nuclear Magnetic Resonance (NMR) Spectroscopy





Coherent interaction in the microwave range

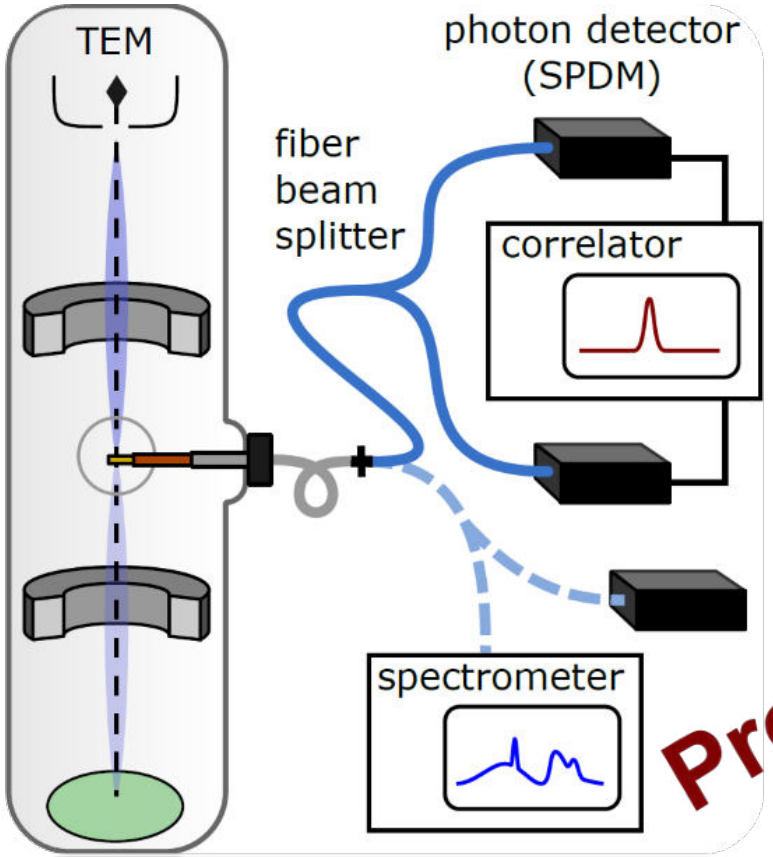


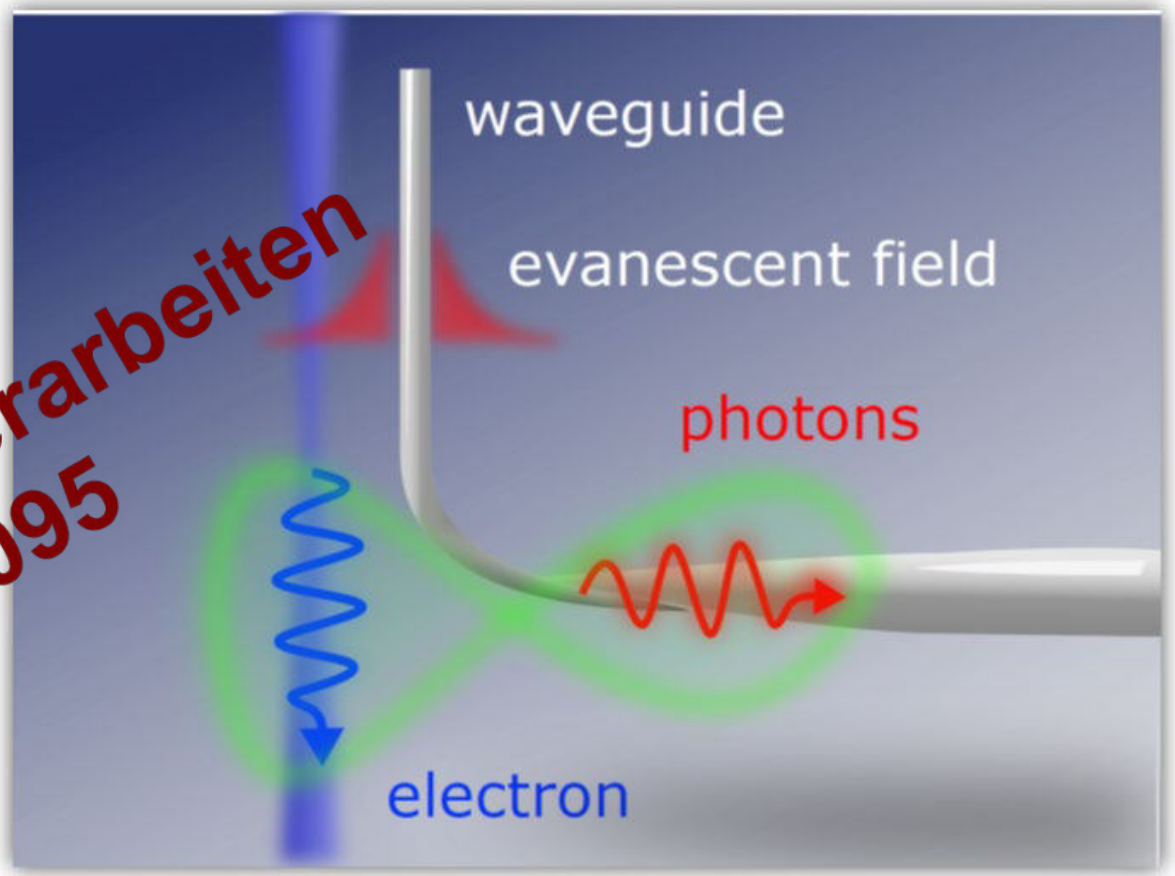
Subatomic resolution at the femtosecond range
→ but radiation damage and spectroscopically poor

+

High spectral sensitivity and non-invasive
→ but limited spatial resolution

Correlated Electron – Photon Pairs
Electron microscopy





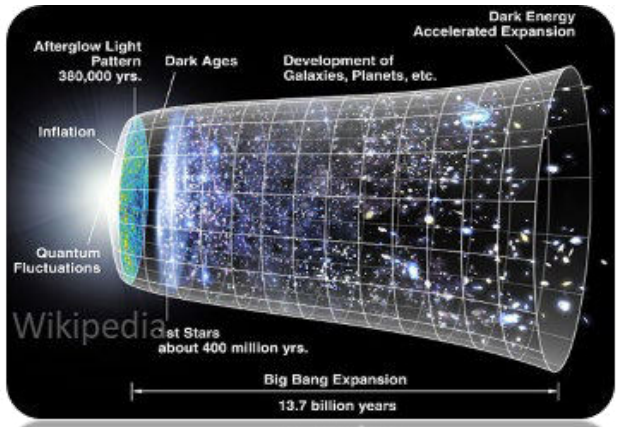
Projekt/Masterarbeiten
141.095

FWF
Der Wissenschaftsfonds.

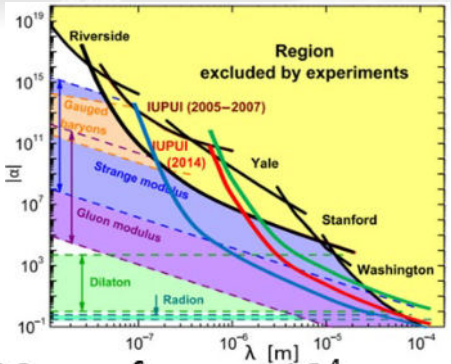
Lattice Atom Interferometry

Philipp Haslinger

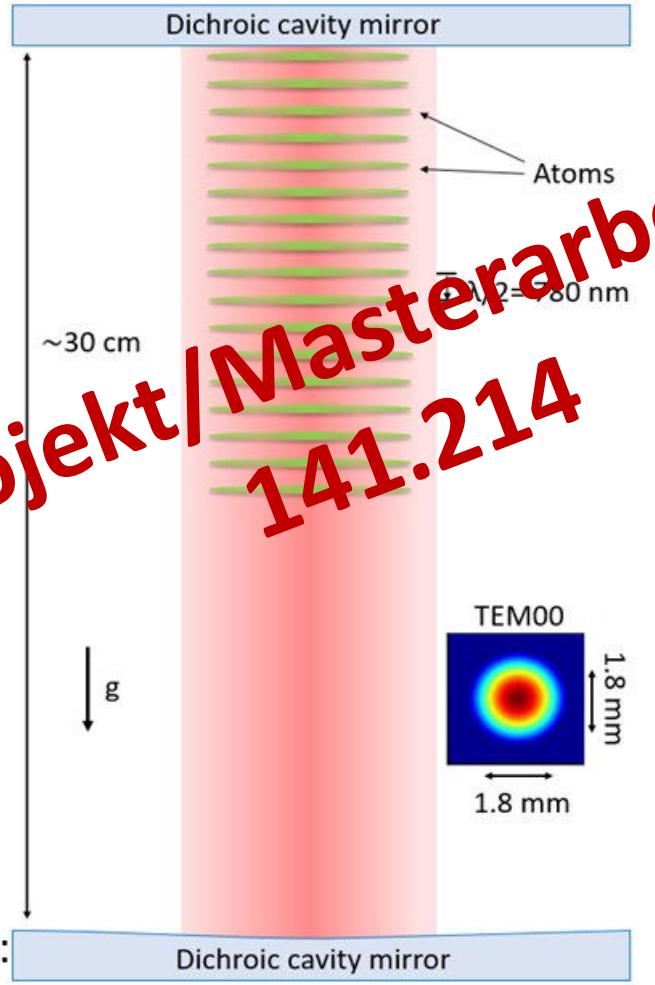
The Dark Universe



- Discover or rule out many models



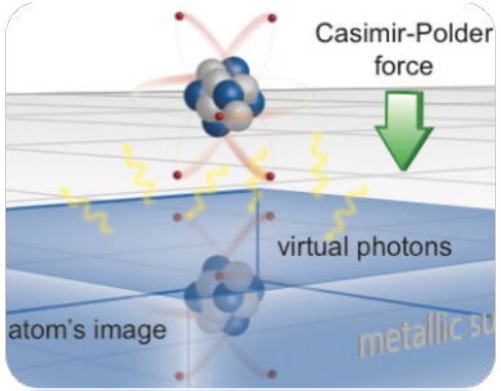
- At 10 µm, forces $>10^4$ x gravity possible
- Sense effects beyond the standard model: string theory...



Projekt/Masterarbeiten 141.214

Light-Induced Interaction

- Mechanical effects of thermal light
- BEC, Ultracold gasses, astrophysics,...



- Interaction from quantum fluctuations
- Temperature & spatial dependence

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www.haslingerlab.com
philipp.haslinger@tuwien.ac.at

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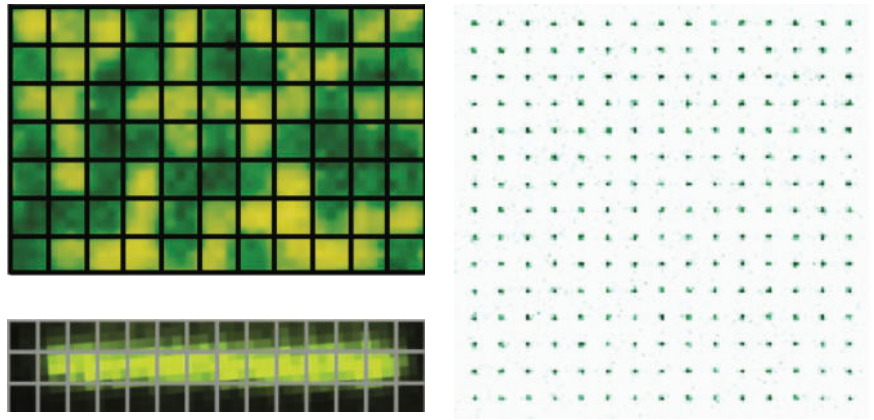
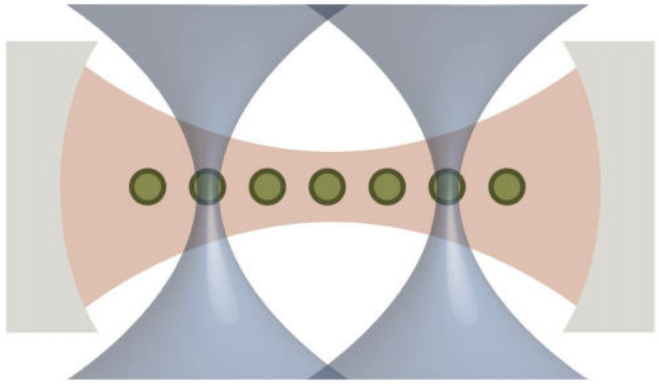
Experimental Quantum Information

Building quantum systems atom by atom



Neutral atoms: a leading platform for quantum simulation/computation

- Perfect isolation
- Unmatched size & scalability
- Accessible length- and time scales
- Single-qubit control & readout



Build a next-generation quantum processor:

- Quantum gas microscopy
- Optical tweezers
- Strong light-matter coupling
- Non-local entanglement

Contact:
julian.leonard@tuwien.ac.at
www.quantuminfo.at

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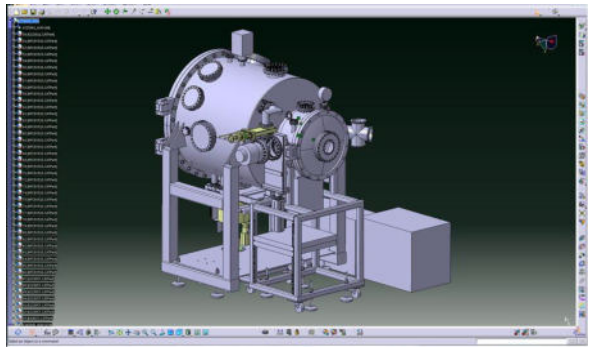
Student projects

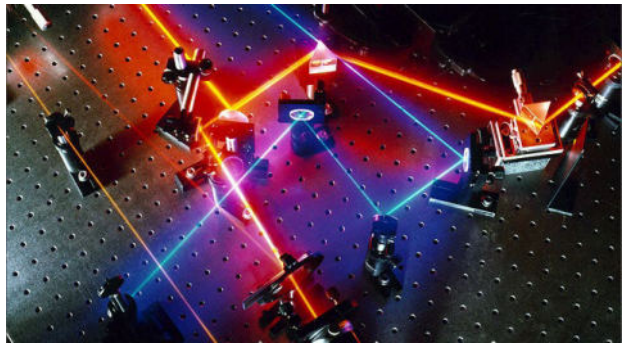
ATOMINSTITUT

Bachelor-/Projekt-/Masterarbeiten

Various topics, e.g.:

- build new laser setup
- develop software/hardware to control a quantum processor
- construct an ultra-high vacuum system





Contact:
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www.quantuminfo.at

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Solide-State Quantum Optics and Nanophotonics

Sarah Skoff

www.skofflab.com

FWF Der Wissenschaftsfonds.

FFG Promoting Innovation.

Funded by the Austria Research Promotion Agency

VCQ Vienna Center for Quantum Science and Technology

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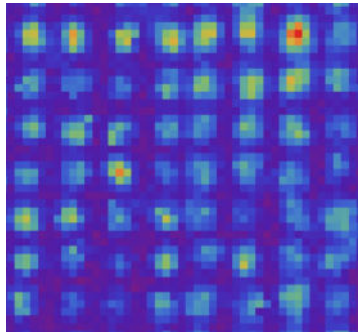
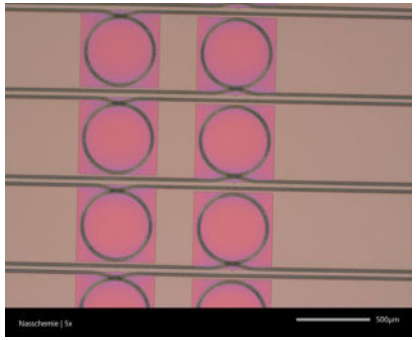
Research

ATOMINSTITUT

New quantum technologies based on quantum emitters in solid-state materials (e.g. 2D materials) and nanophotonics

- Implementing **strong light-matter interactions** on the level of **single photons** and **single quantum emitters**
- Developing new technologies **for photonic quantum networks**





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Research

ATOMINSTITUT

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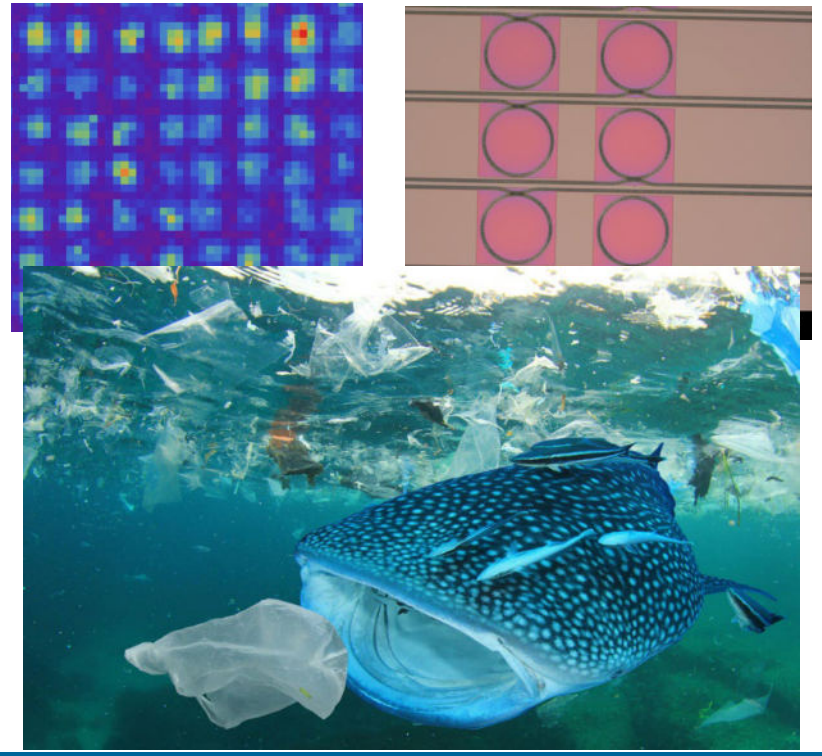

picture from WWF

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Research

ATOMINSTITUT

New quantum technologies based on quantum emitters in solid-state materials (e.g. 2D materials) and nanophotonics

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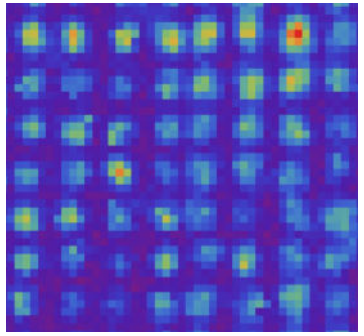
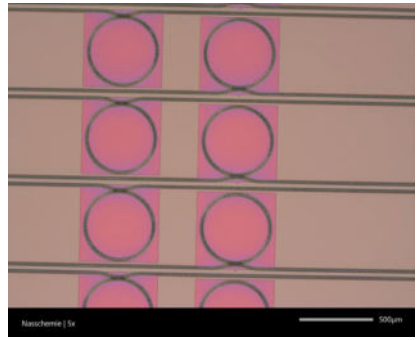
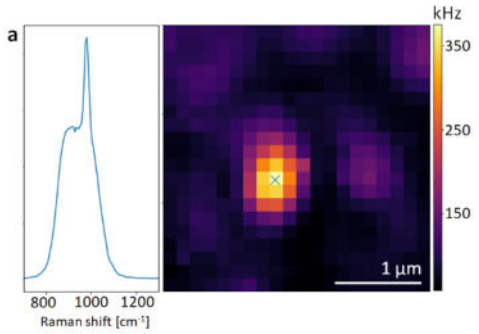
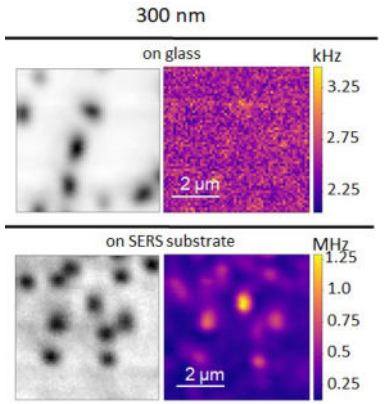




Nanophotonic platforms for precision sensing

- **Detection and spectroscopy** of nanoparticles**,** in particular **nanoplastic** via **nanophotonic platforms**, such as **plasmonic** substrates.





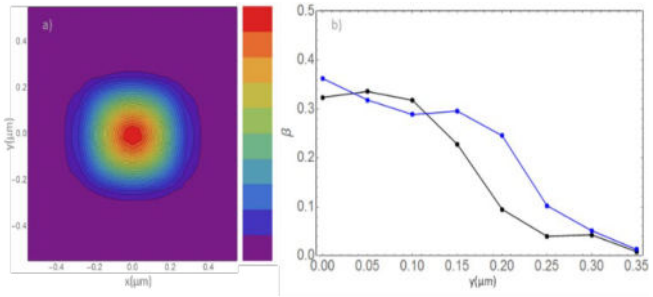
Teaching

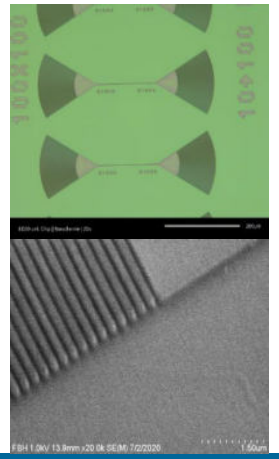
Bachelor-, Project- and Masterprojects (141.095, 141.A13):

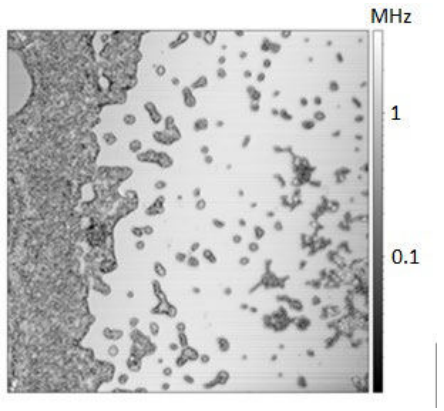
Please contact:
sarah.skoff@tuwien.ac.at

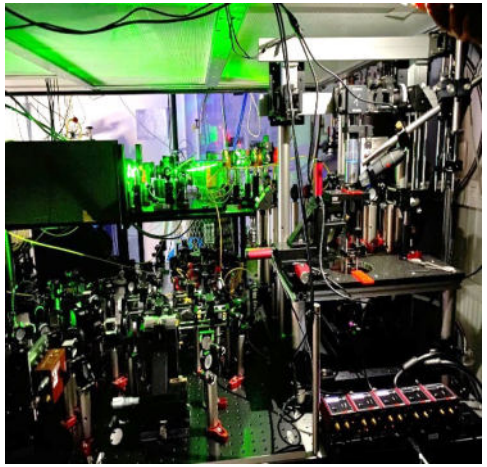
- **Participation in current research projects in the lab**
- Topics: quantum emitters in hexagonal boron nitride, detection of nanoplastic, …

- **Smaller self-contained projects on nanophotonics and spectroscopy**
- Topics: simulation of nanophotonic components (FDTD),
  characterisation of waveguide structures, homebuilt diode lasers, laser locks,…









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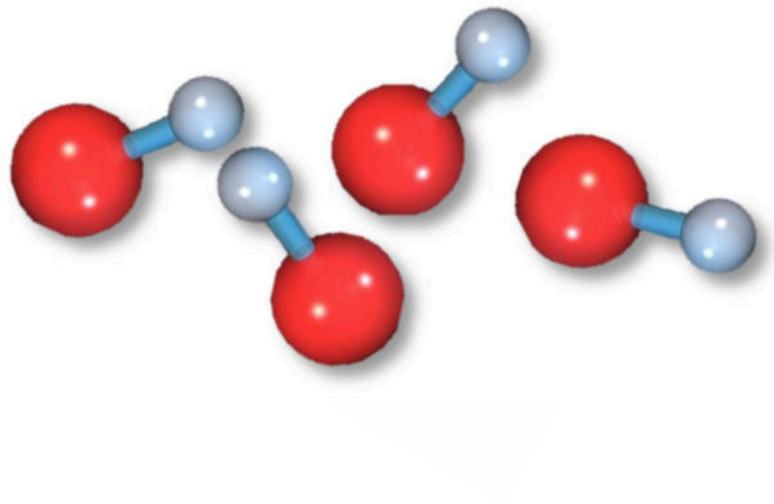
Kalte Moleküle und Quantentechnologie

Von kalten Atomen zu Molekülen



Elementare Bausteine chemischer Reaktionen
z.B. Experimente mit genau zwei Molekülen

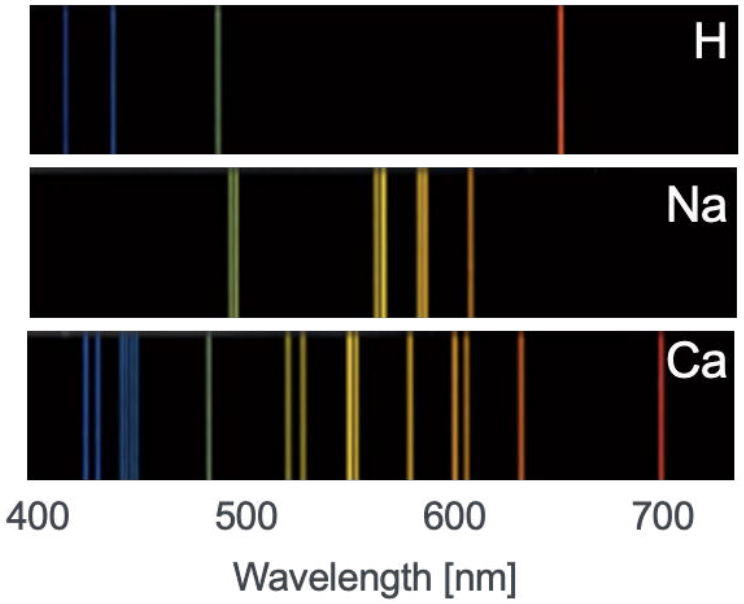
Neue Materiezustände mit Dipol-Dipol Wechselwirkung
z.B. Suprafestkörper - fest und (supra)flüssig gleichzeitig

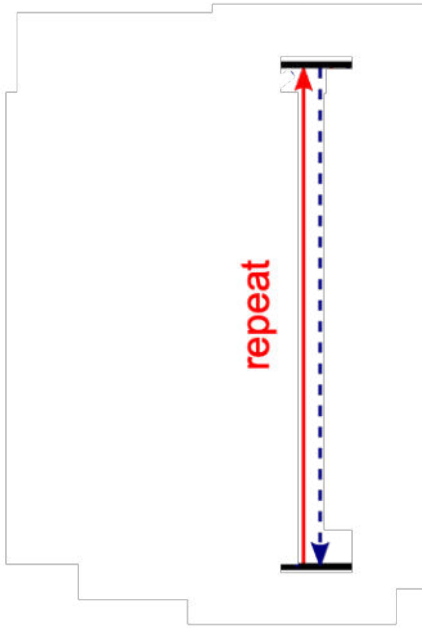
Hochpräzise Sensoren für fundamentale Physik:
z.B. für Physik jenseits CERN / LHC „on a tabletop“

Benötigt: Kühlmethoden wie bei Atomen!

Laserkühlung

Atome / Ionen:
(relativ) einfache Struktur

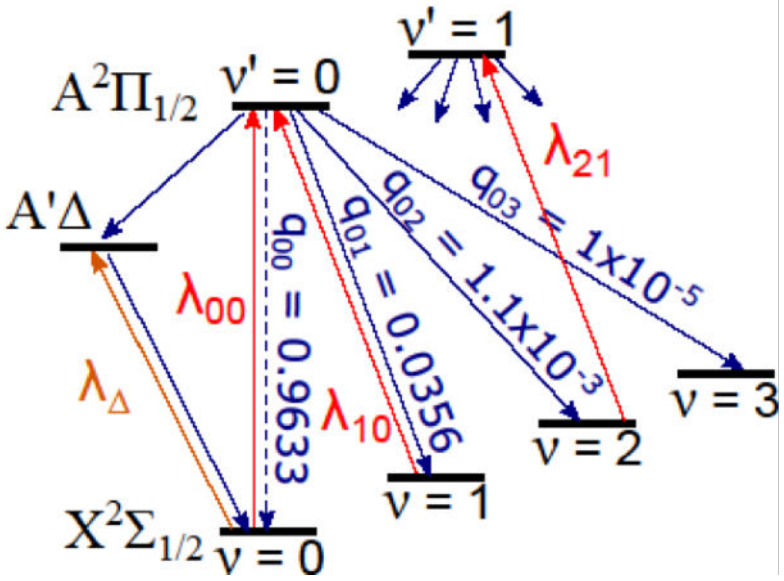




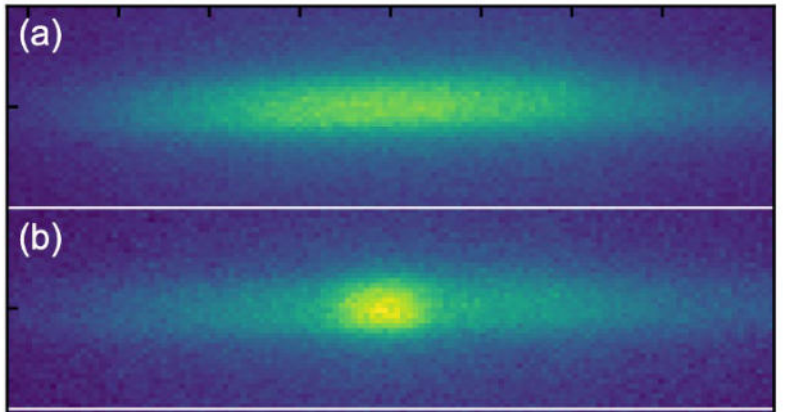
- Kühlung durch Streuung vieler Photonen
- Geschlossene Übergänge in Atomen leicht zu realisieren

Laserkühlung für Moleküle

Moleküle:
Vibrationen, Rotationen, ...



Beispiel aus unserer Forschungsgruppe:
Bariumfluorid (BaF)

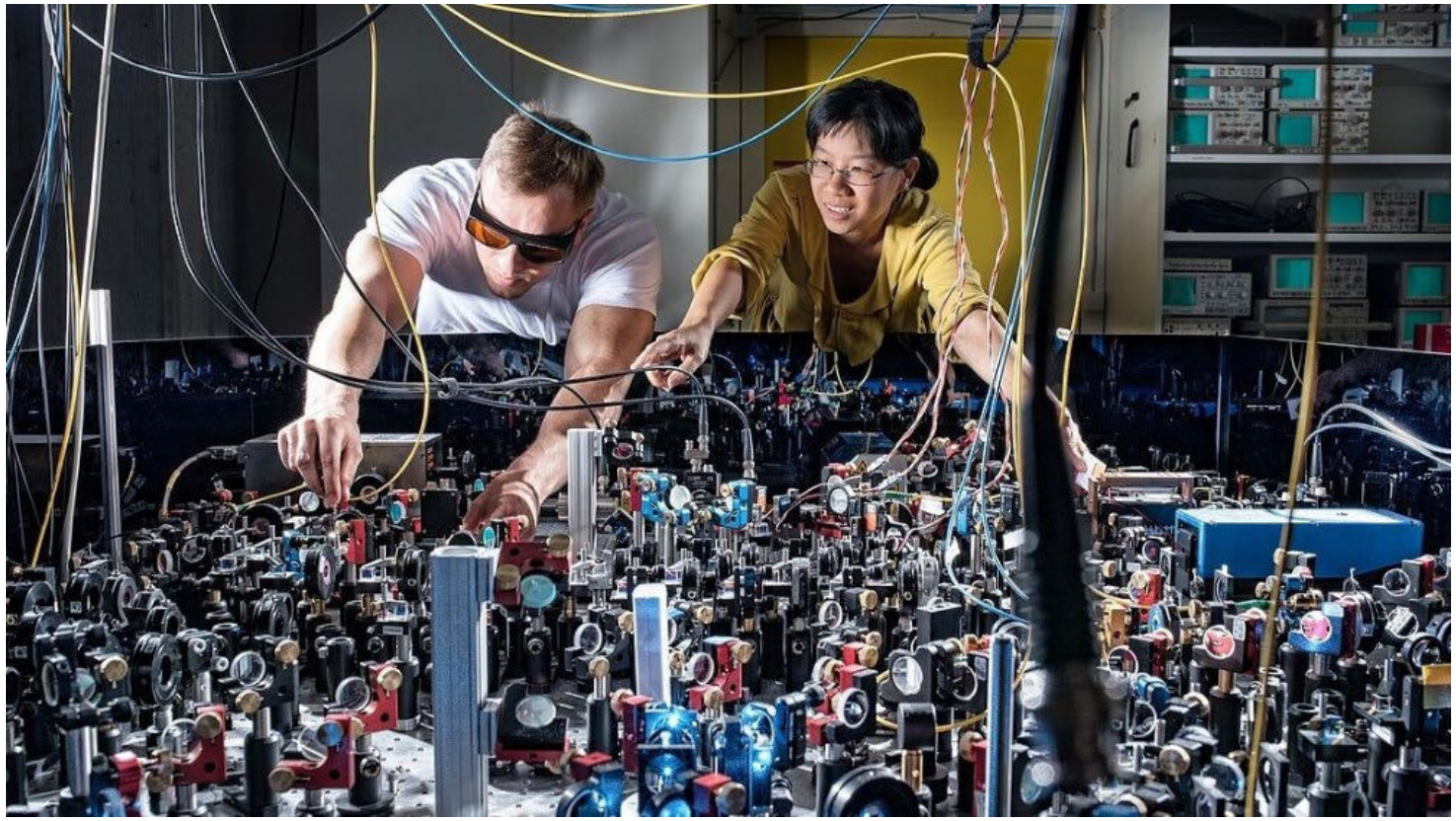


Wichtig für zukünftige Präzisionsmessungen!

Neu: Laserkühlung trotzdem möglich für viele Spezies (seit ~ 10 Jahren)

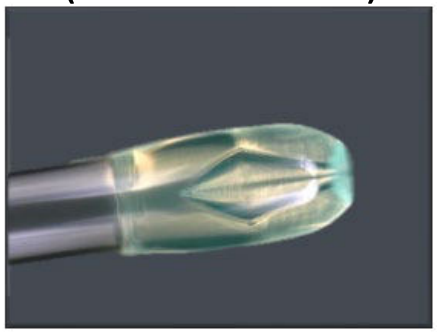
Quantentechnologien?

Aufbauten sind sehr komplex, teuer, sperrig ...



Miniaturisierung &
Kommerzialisierung

Integrierte Optiken
(z.B. 3D Druck)



125um

Join us!

Die erste Experimente sind vor Kurzem
aus Stuttgart ans ATI übersiedelt ...

- **141.305 Projektarbeit / BSc Arbeit**
  „Ultracold Molecules“ bzw. „Ultrakalte Moleküle”
- **141.212 Vorlesung “Atoms - Light – Matter Waves”**
  (Atomstruktur, Licht-Materie-Wechselwirkung,
  Interferometrie, Laserkühlung, Cavity-QED, etc.)
- **Vorlesung „Ultracold quantum matter“**
  (voraussichtlich ab 2025)

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Quantum Optics & Quantum Information

ATOMINSTITUT

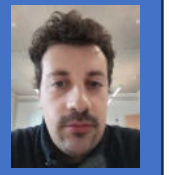
Entanglement & Quantum Computing Theory

Nicolai Friis

Quantum Foundations & Cryptography

Gláucia Murta

Quantum Information & Many-Body Physics



Theoretical Quantum Optics

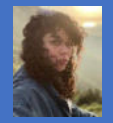
Eliza Agudelo

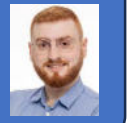
Quantum Information & Thermodynamics

Marcus Huber

Relativistic Quantum Physics & Thermodynamics

Max Lock





Quantum Clocks & Information Processing

Paul Erker

TECHNISCHE UNIVERSITÄT WIEN

Teaching

ATOMINSTITUT

Lehre 24W & 25S


Marcus Huber


Nicolai Friis


Eliza Agudelo


Gláucia Murta


Paul Erker

141.282 **Quantum Information Theory I** (VO, 3.0 ECTS)
141.B22 **Quantum Thermodynamics I** (VO, 3.0 ECTS)
141.A10 **Quantum Optics I** (VO, 3.0 ECTS)
141.XXX **Quantum Communication & Security** (VO, 3.0 ECTS)
141.XXX **Quantum Computing Architectures** (VO, 3.0 ECTS)
141.309 **Journal Club Quant-Ph** (SE, 3.0 ECTS)
141.B11 **Advances in Quantum Science and Quantum Technology** (SE, 2.0 ECTS)
194.169 & 194.171 **Quantum Physics: Basic Concepts and Foundations** (VU, 7.0 + 3.0 ECTS)

WEB: https://www.quitphysics.info

@quit_physics

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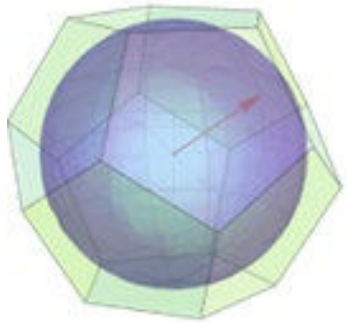
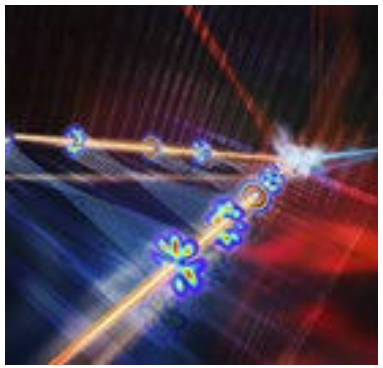
Quantum Information in Complex Quantum Systems



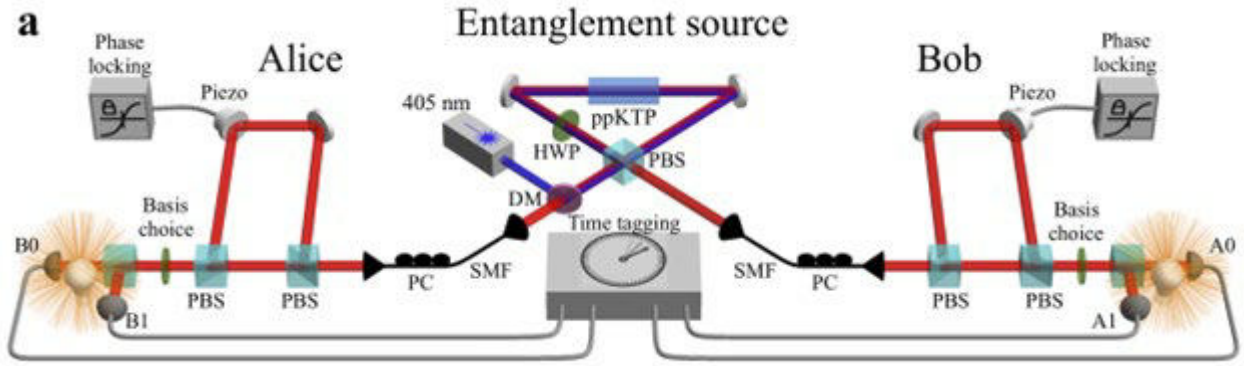
- Bloch representation & entropy characterisation
- Entanglement in high-dimensional systems
- Multipartite entanglement beyond LOCC
- Device-independent characterisation
- Entanglement in quantum networks

Quantum Cryptography

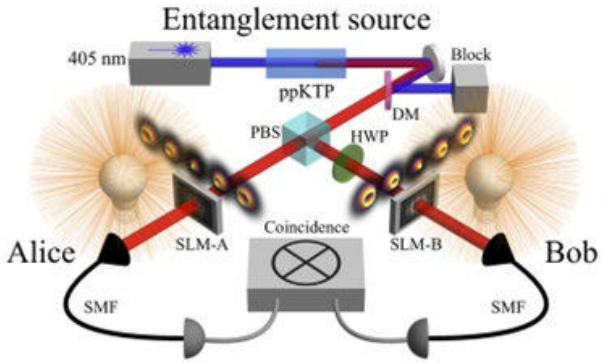
- High-dimensional protocols
- Quantum communication beyond QKD
- Modeling realistic channels
- Multipartite key distribution
- Device-independent cryptography

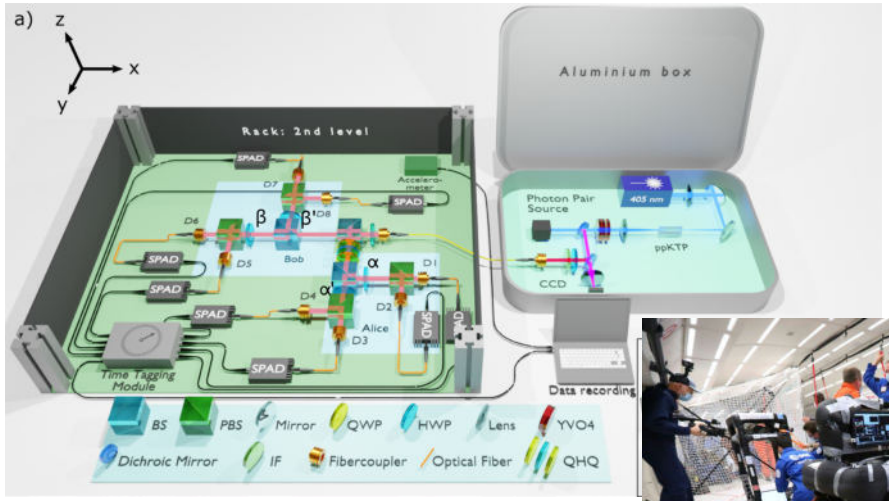


Quantum Photonics



- Energy-time entangled photons
- Spatial modes of light: entanglement and measurements
- Channels: free space & multicore fibres





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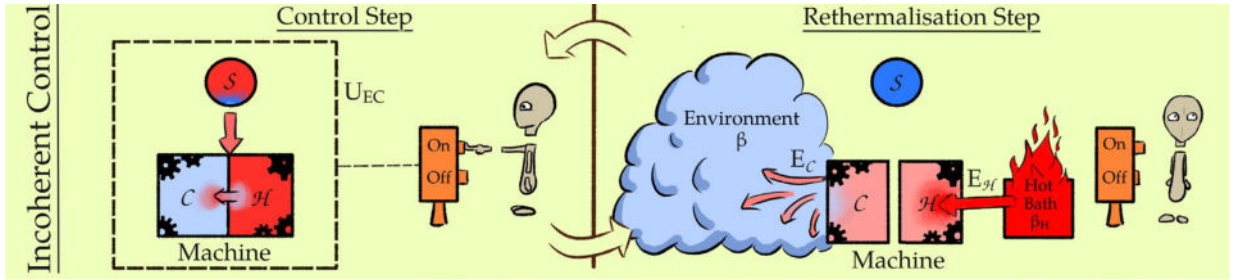
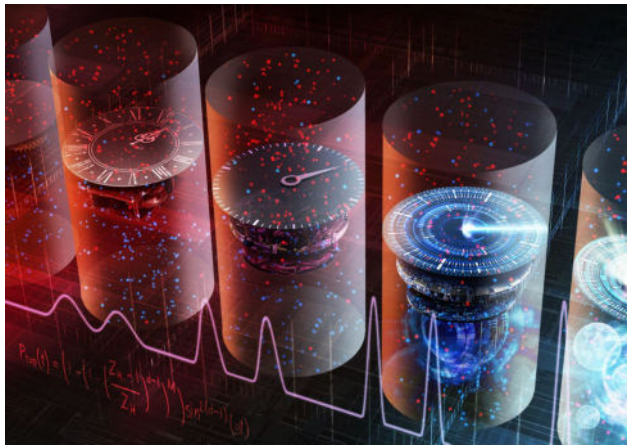
Quantum Thermodynamics

Fundamental Thermodynamics

- Foundation of physics: ultimate limits to knowledge & acquisition of information
- Thermodynamic protocols: cooling on a quantum computer & limits to correlations
- Entropy, clocks, and the arrow of time
- Thermodynamics & complexity





Applied Thermodynamics

- Modeling realistic thermal machines
  (open quantum systems & many-body theory)
- Quantum Field Thermal Machines (with Jörg Schmiedmayer)

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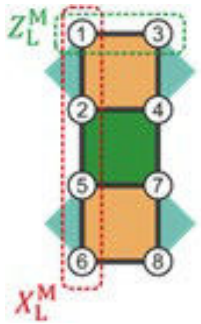
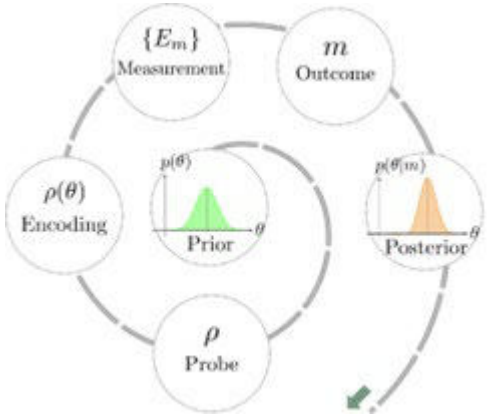
Quantum Technologies



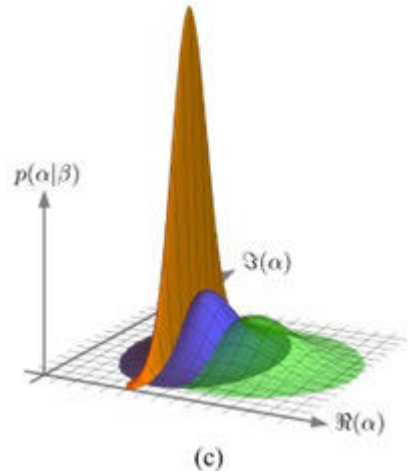


Quantum Computing Theory

- High-dimensional quantum-computing architectures
- Quantum error correction
- Black-box subroutines
- Implemention (theory) in quantum-optical systems

Quantum Optics Theory

- Gaussian and non-Gaussian states of light
- Correlations & entanglement in CV systems



Quantum Metrology

- Bayesian and frequentist estimation techniques
- Metrology for error mitigation in quantum networks
- Fundamental limits to thermometry

TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

Quantum-Metrology

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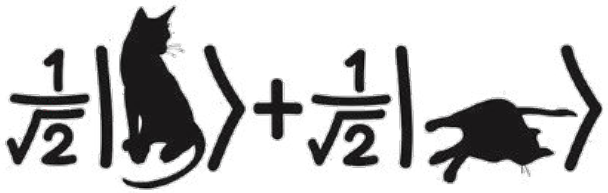
Funded by the Austria
Research Promotion Agency

Research Focus

Precision measurements based on quantum effects:

- „superposition-based“ quantum sensors

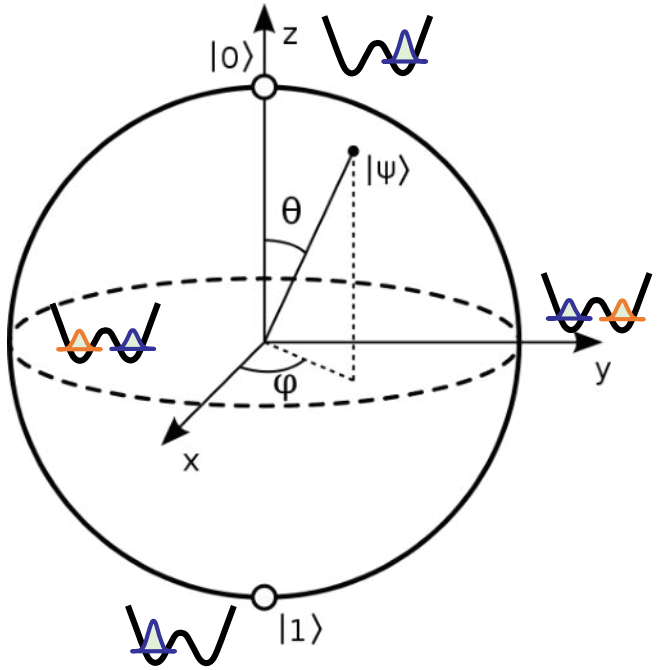


„Internal“ state superpositions

- atomic clocks (MW, optical, UV...?)
- applications in navigation, communication, geodesy…
- fundamental research: interaction constants, dark matter…
- **research project:** a nuclear clock with Thorium-229

„External“ state superpositions

- de-localized wave functions of matter
- matter wave interferometry
- measurements of tilt, rotation, accelleration
- fundamental research: quantum-classical boundary
- **research project:** Caesium-BEC-interferometer

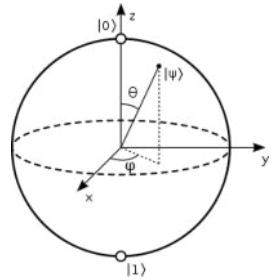


Teaching

Lectures

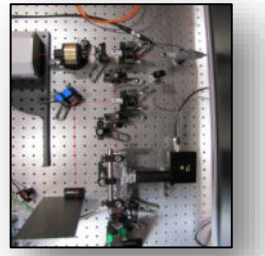
141.A35 Atomic/molecular physics - metrology Wednesday 10:00-12:00 Sem. DB gelb 07

- introduction to atomic and molecular physics
- metrology applications: spectroscopy, clocks, gravimetry
- mandatory for Master Energie + Messtechnik, everybody welcome!!!



141.A16 Quantentechnologie I Wednesday 15:00-17:00 Sem. DB gelb 03

- Grundlagen der Quanteninformation (**S. Sponar**)
- Quantenmetrologie, Atomuhren, Frequenzkamm (Schumm)



Projektarbeiten (also suited for bachelor projects)

141.A27 Atomic clocks and quantum metrology

- hands on projects embedded into research group
- topics: lasers, spectroscopy, experimental control, programming…

book early!

contact: Thorsten.Schumm@tuwien.ac.at