

# Welcome

R. Assmann  
Head „Accelerator Operations & Development“

IFAST Workshop

2 Sep 2024

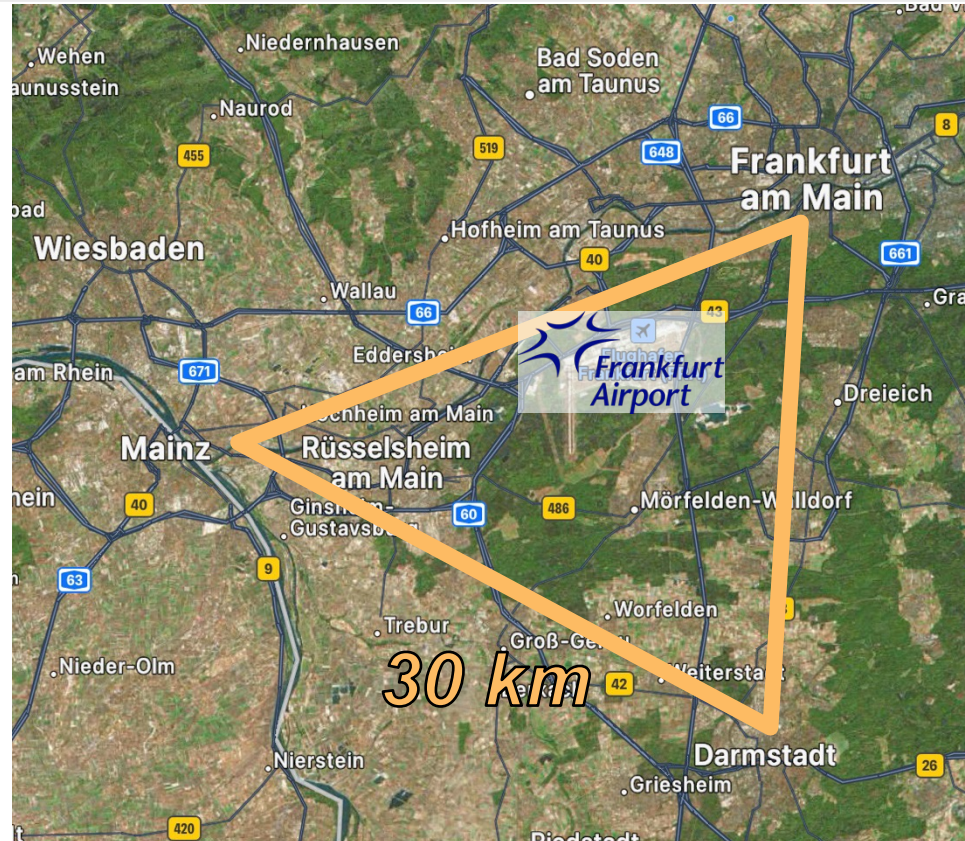
# Welcome to Germany

## Rhine-Main Triangle of Accelerators



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# Welcome to Germany Rhine-Main Triangle of Accelerators



Experimental Astrophysics

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

### FRANZ - Frankfurt Neutron Source

Project description:  
The FRANZ neutron source will use a 1000 MWth high-temperature gas-cooled reactor to produce a cold thermal neutron beam. The primary moderated neutron beam will be adjustable between 1.8 and 2.2 MeV. In addition, proton-induced experiments are planned, where different samples will be directly irradiated with the high-energy proton beam.

FRANKFURT

# Welcome to Germany Rhine-Main Triangle of Accelerators



## MAINZ

**Institut für Kernphysik**

**The Mainz Microtron MAMI**

The Mainz Microtron MAMI is an accelerator for electron beams run by the Institute for Nuclear Physics of the University of Mainz used for nuclear physics experiments. The operation principles including the first levels of operation were developed by Prof. Dr. Helmut Herminghaus in cooperation with Dr. Karl-Heinz Kaiser. It is setup as a multilevel racetrack microtron with a normal conducting linear accelerator. Since 1979 the accelerator has been available for experiments and has continuously undergone further development. With MAMI-C, the latest stage of development, polarized electron beams (polarization degree typical 80%) of more than 20  $\mu\text{A}$  beam current and unpolarized electron beams of up to 100  $\mu\text{A}$  can be accelerated to relativistic energies up to 1.5 GeV. MAMI is a so-called continuous wave accelerator. Thus, the electron beam is not macroscopically clustered in bunches as it is the case for most accelerators; on the contrary, the time structure of the

**PRISMA+**

**MESA - a new linear accelerator in Mainz**

The MESA particle accelerator

- Using the funding made available to the Cluster of Excellence "Precision Physics, Fundamental Interactions and Structure of Matter"
- (PRISMA+), Johannes Gutenberg University Mainz (JGU) is currently constructing a new electron accelerator on the Gutenberg Campus.
- The MESA accelerator and the key experiments will extend across several stories below ground including a new experimental hall



**Experimental Astrophysics**

**FRANZ - Frankfurt Neutron Source**

FRANZ is the only neutron source in Germany. It is a research reactor with a thermal power of 10 MW. The neutron source is used for neutron scattering experiments. The energy of the neutron beam can be adjusted between 1.8 and 2.2 MeV. In addition, proton-induced experiments are possible, where different samples will be directly irradiated with the high-energy proton beam.

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## FRANKFURT DARMSTADT

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**TECHNISCHE UNIVERSITÄT DARMSTADT**

**Institute for Nuclear Physics**

**S-DALINAC**

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**S-DALINAC**

TECHNISCHE UNIVERSITÄT DARMSTADT

Institute for Nuclear Physics



# GSI and FAIR

*In the Heart of the Rhine-Main Triangle of Accelerators*

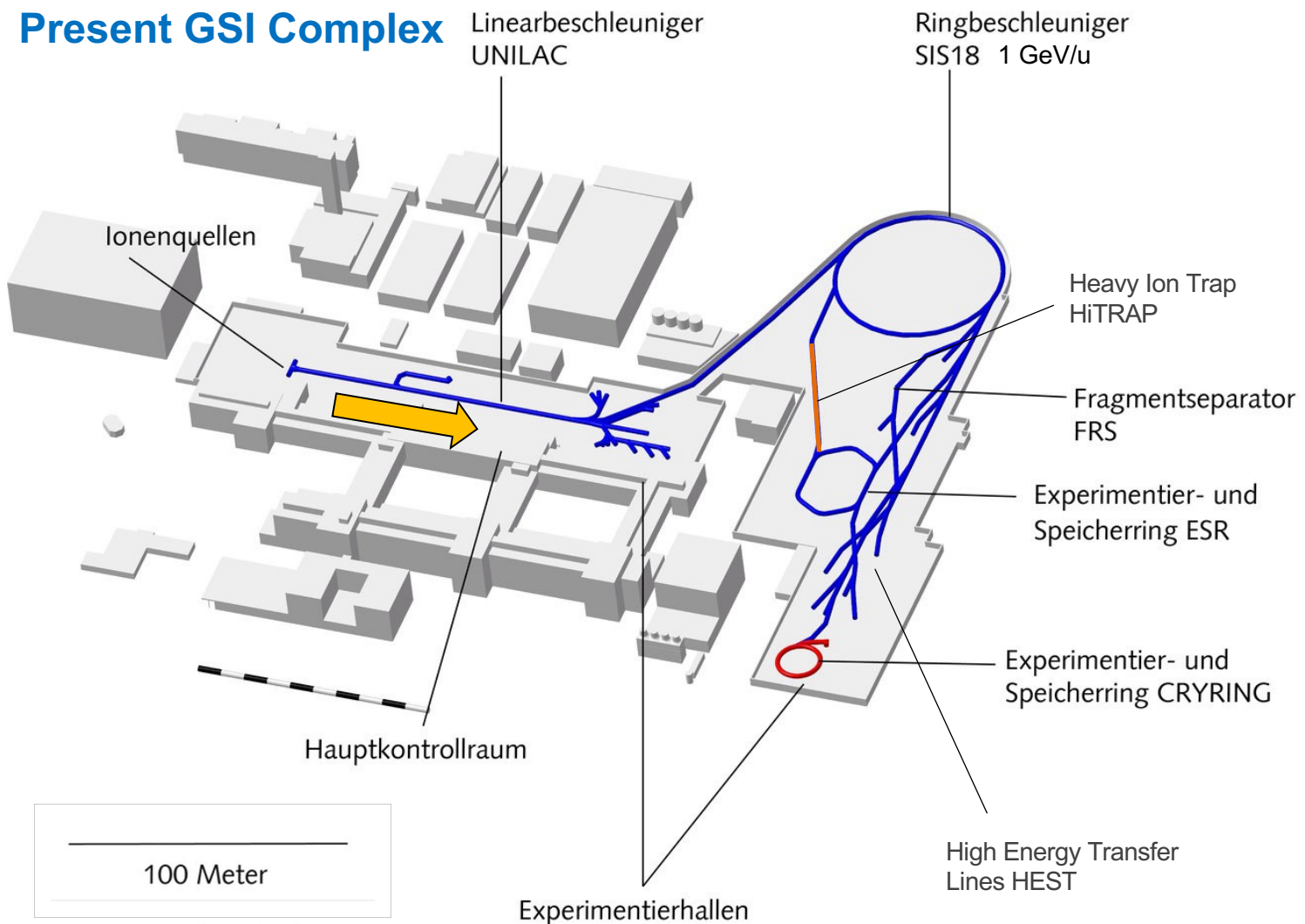


Aerial View on 25 Feb 2024





# Present GSI Complex



- **World-class ion accelerator facilities**
- Ion linac
- Storage ring
- Synchrotron
- Beam cooling
- Ion traps
- Decelerators
- **55 years and getting stronger**  
→ **plus FAIR**

# Did You Hear about Bohrium, Hassium, Meitnerium, Darmstadtium, Roentgenium, Copernicium?

**PERIODENSYSTEM DER ELEMENTE**

<div style="display: flex; justify-content: space-around; font-size: small;"> <span>Nicht-metalle</span> <span>Alkali-metalle</span> <span>Erd-alkali-metalle</span> <span>Über-gang-metalle</span> <span>Lantha-noide</span> <span>Acti-noide</span> <span>Metalle</span> <span>Halb-metalle</span> <span>Halo-gene</span> <span>Edel-gase</span> <span>Keine Daten aus Chemieexperimenten</span> </div>													13	14	15	16	17	18
1 <b>H</b> <small>Wasserstoff</small>													2 <b>He</b> <small>Helium</small>					
3 <b>Li</b> <small>Lithium</small>	4 <b>Be</b> <small>Beryllium</small>											10 <b>Ne</b> <small>Neon</small>						
11 <b>Na</b> <small>Natrium</small>	12 <b>Mg</b> <small>Magnesium</small>											18 <b>Ar</b> <small>Argon</small>						
19 <b>K</b> <small>Kalium</small>	20 <b>Ca</b> <small>Calcium</small>	21 <b>Sc</b> <small>Scandium</small>	22 <b>Ti</b> <small>Titan</small>	23 <b>V</b> <small>Vanadium</small>	24 <b>Cr</b> <small>Chrom</small>	25 <b>Mn</b> <small>Mangan</small>	26 <b>Fe</b> <small>Eisen</small>	27 <b>Co</b> <small>Kobalt</small>	28 <b>Ni</b> <small>Nickel</small>	29 <b>Cu</b> <small>Kupfer</small>	30 <b>Zn</b> <small>Zink</small>	31 <b>Ga</b> <small>Gallium</small>	32 <b>Ge</b> <small>Germanium</small>	33 <b>As</b> <small>Arsen</small>	34 <b>Se</b> <small>Selen</small>	35 <b>Br</b> <small>Brom</small>	36 <b>Kr</b> <small>Krypton</small>	
37 <b>Rb</b> <small>Rubidium</small>	38 <b>Sr</b> <small>Strontium</small>	39 <b>Y</b> <small>Yttrium</small>	40 <b>Zr</b> <small>Zirkonium</small>	41 <b>Nb</b> <small>Niob</small>	42 <b>Mo</b> <small>Molybdän</small>	43 <b>Tc</b> <small>Technetium</small>	44 <b>Ru</b> <small>Ruthenium</small>	45 <b>Rh</b> <small>Rhodium</small>	46 <b>Pd</b> <small>Palladium</small>	47 <b>Ag</b> <small>Silber</small>	48 <b>Cd</b> <small>Cadmium</small>	49 <b>In</b> <small>Indium</small>	50 <b>Sn</b> <small>Zinn</small>	51 <b>Sb</b> <small>Antimon</small>	52 <b>Te</b> <small>Tellur</small>	53 <b>I</b> <small>Jod</small>	54 <b>Xe</b> <small>Xenon</small>	
55 <b>Cs</b> <small>Cäsium</small>	56 <b>Ba</b> <small>Barium</small>	57-71 <b>*La-Lu</b> <small>*Lanthanoide</small>	72 <b>Hf</b> <small>Hafnium</small>	73 <b>Ta</b> <small>Tantal</small>	74 <b>W</b> <small>Wolfram</small>	75 <b>Re</b> <small>Rhenium</small>	76 <b>Os</b> <small>Osmium</small>	77 <b>Ir</b> <small>Iridium</small>	78 <b>Pt</b> <small>Platin</small>	79 <b>Au</b> <small>Gold</small>	80 <b>Hg</b> <small>Quecksilber</small>	81 <b>Tl</b> <small>Thallium</small>	82 <b>Pb</b> <small>Blei</small>	83 <b>Bi</b> <small>Bismut</small>	84 <b>Po</b> <small>Polonium</small>	85 <b>At</b> <small>Astat</small>	86 <b>Rn</b> <small>Radon</small>	
87 <b>Fr</b> <small>Francium</small>	88 <b>Ra</b> <small>Radium</small>	89-103 <b>**Ac-Lr</b> <small>**Actinoide</small>	104 <b>Rf</b> <small>Rutherfordium</small>	105 <b>Db</b> <small>Dubnium</small>	106 <b>Sg</b> <small>Seaborgium</small>	107 <b>Bh</b> <small>Bohrium</small>	108 <b>Hs</b> <small>Hassium</small>	109 <b>Mt</b> <small>Meitnerium</small>	110 <b>Ds</b> <small>Darmstadtium</small>	111 <b>Rg</b> <small>Röntgenium</small>	112 <b>Cn</b> <small>Copernicium</small>	113 <b>Nh</b> <small>Nihonium</small>	114 <b>Fl</b> <small>Flerovium</small>	115 <b>Mc</b> <small>Moscovium</small>	116 <b>Lv</b> <small>Livermorium</small>	117 <b>Ts</b> <small>Tenness</small>	118 <b>Og</b> <small>Oganesson</small>	
		*Lanthanoide	57 <b>La</b> <small>Lanthan</small>	58 <b>Ce</b> <small>Cer</small>	59 <b>Pr</b> <small>Praseodym</small>	60 <b>Nd</b> <small>Neodym</small>	61 <b>Pm</b> <small>Promethium</small>	62 <b>Sm</b> <small>Samarium</small>	63 <b>Eu</b> <small>Europium</small>	64 <b>Gd</b> <small>Gadolinium</small>	65 <b>Tb</b> <small>Terbium</small>	66 <b>Dy</b> <small>Dysprosium</small>	67 <b>Ho</b> <small>Holmium</small>	68 <b>Er</b> <small>Erbium</small>	69 <b>Tm</b> <small>Thulium</small>	70 <b>Yb</b> <small>Ytterbium</small>	71 <b>Lu</b> <small>Lutetium</small>	
		**Actinoide	89 <b>Ac</b> <small>Actinium</small>	90 <b>Th</b> <small>Thorium</small>	91 <b>Pa</b> <small>Protactinium</small>	92 <b>U</b> <small>Uran</small>	93 <b>Np</b> <small>Neptunium</small>	94 <b>Pu</b> <small>Plutonium</small>	95 <b>Am</b> <small>Americium</small>	96 <b>Cm</b> <small>Curium</small>	97 <b>Bk</b> <small>Berkelium</small>	98 <b>Cf</b> <small>Californium</small>	99 <b>Es</b> <small>Einsteinium</small>	100 <b>Fm</b> <small>Fermium</small>	101 <b>Md</b> <small>Mendelevium</small>	102 <b>No</b> <small>Nobelium</small>	103 <b>Lr</b> <small>Lawrencium</small>	

© GSI Helmholtzzentrum für Schwerionenforschung GmbH | Superschwere Elemente - Chemie | 05-2023

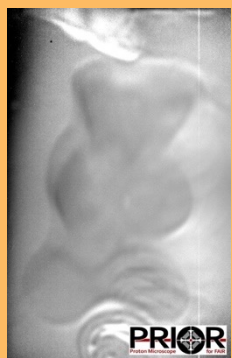
- Use ion beams from accelerators to **discover new heavy elements!**
- Study **properties** of heavy elements!
- How did our universe form from the big bang?
- Where do heavy elements on earth come from (not from the sun)?
- New push from gravitational wave detectors
  - detection of neutron star collisions
  - forming of heavy elements observed in nature

# Dual Ion Beam for Tumor Therapy (new, world-wide first)



Carbon used for tumor irradiation. Helium penetrates through body and is used for real time imaging.

▪ <b>Ion mass</b>	He + C ( 5-20% He)
▪ <b>Ion charges</b>	$4\text{He}^+$ und $^{12}\text{C}^{3+}$ from $\text{CH}_4$
▪ <b>Energy</b>	225 MeV/u
▪ <b>Beam intensity</b>	$10^8$ , Slow extraction
▪ <b>Stability</b>	No variation of He, C and O
▪ <b>Contamination of <math>^{16}\text{O}^{4+}</math></b>	As low as possible



## Possible contrast at low-density differences

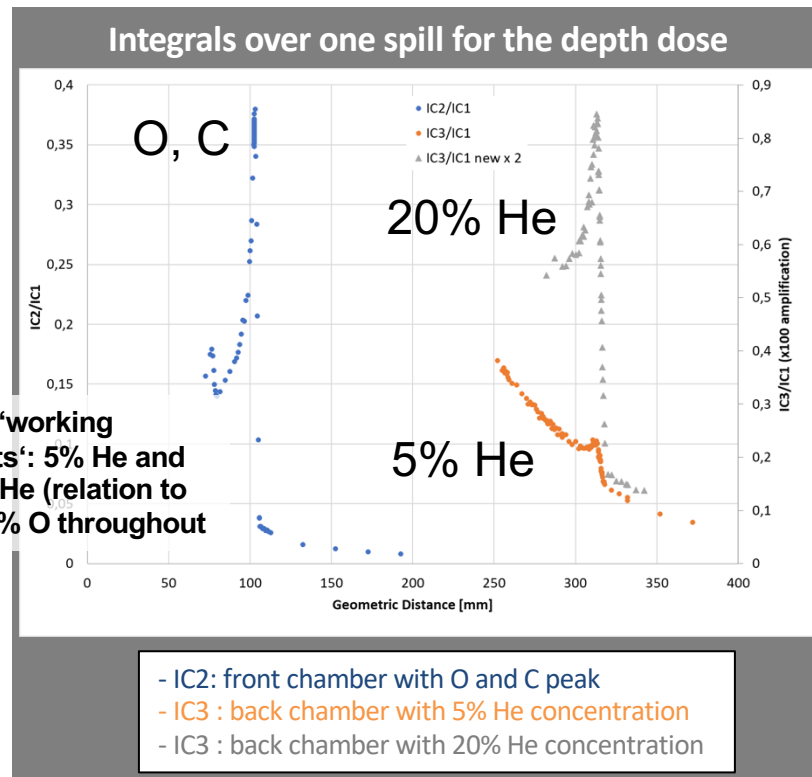
A gummy bear in addition to other density calibration targets in a gelatin block (edge length 6 cm), can be imaged exclusively with the helium portion of the beam.

### Measured ion contributions to image:

$^{12}\text{C}^{6+}$ : 0.167%

$4\text{He}^{2+}$ : 99.833%

*Measurements with a matrix IC detector (also time-resolved) and films providing location information collected as well.*



# The Green IT Cube on the GSI site

## “Accelerator” for Artificial Intelligence



Startseite > Rhein-Main > Darmstadt

### Neuer Supercomputer in Darmstadt: Beschleuniger für Künstliche Intelligenz

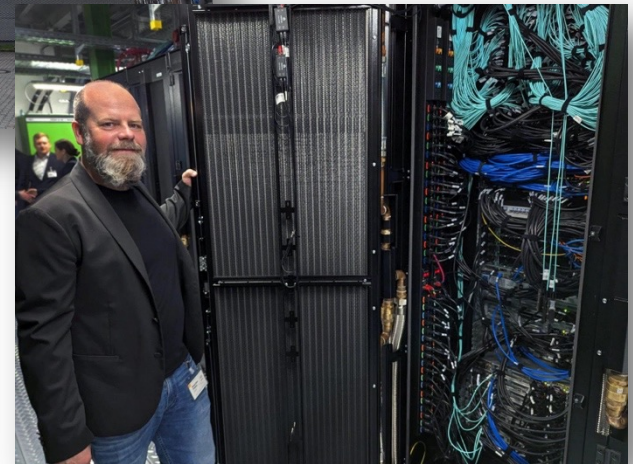
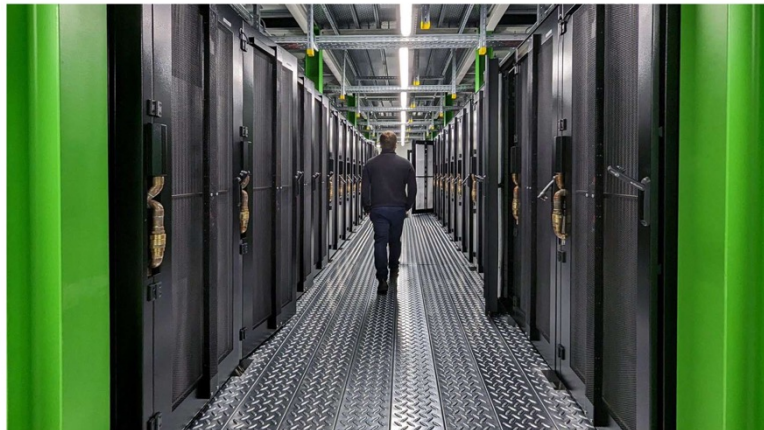
22.03.2023, 15:47 Uhr

Von: [Claudia Kabel](#)

Kommentare

Drucken

Teilen



# FAIR 3.3 b€ facility being completed!

## Beam commissioning planned in 2027/28



## DARMSTÄDTER ECHO



**Mehr Polizeipräsenz bewirkt Angst**  
Studie: Bürger fühlen sich durch Streifen eher verunsichert. ▶ MEINUNG & ANALYSE/HINTERGRUND

**Alles da für die Reiseapotheke**  
Apotheker sehen die Lage entspannt, aber der Mangel ist nicht ganz vorbei. ▶ SEITE 21

D2107 | Nr. 179 | 80. Jahrgang | W/M, Postfach 3120, 55021 Mainz



[www.echo-online.de](http://www.echo-online.de)

Samstag, 3. August 2024 Preis 3,30 Euro



NEU: E-Paper am Sonntag  
Kostenlos für Abonnenten



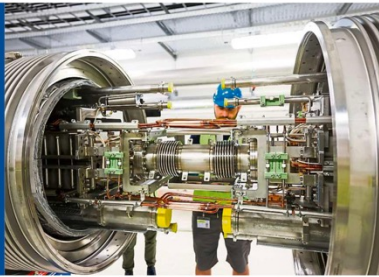
[epaper.echo-online.de](http://epaper.echo-online.de)

**WETTER**  
Wochenendwetter  
Samstag Sonntag

### Fair-Ring bekommt Innenleben

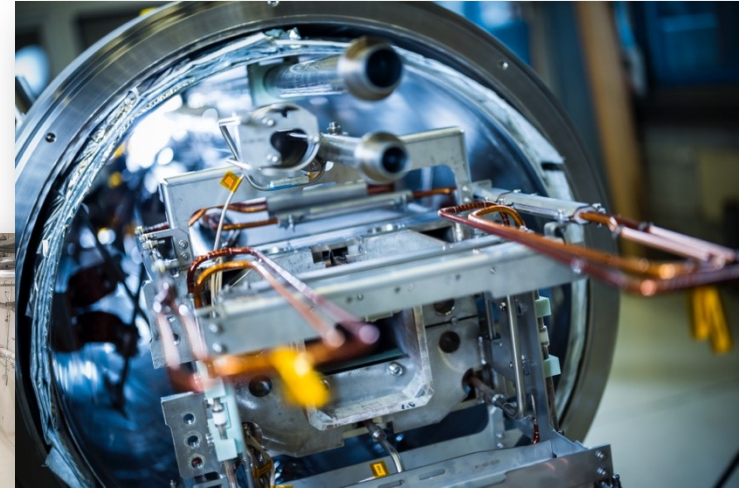
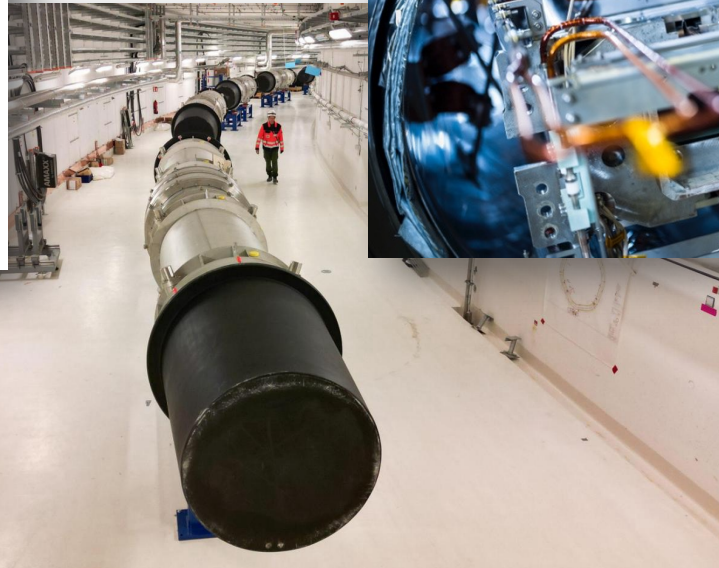
Der Teilchenbeschleuniger-Tunnel ist fertig betoniert, jetzt läuft der Einbau der Technik auf der Riesen-Baustelle im Wald bei Wobau. Derzeit lässt ein Kran die jeweils drei Tonnen schweren Magnete ab, die die Ionen Teilchen im Rundkurs halten sollen. ▶ SEITE 9

foto: Guido Schick



### Demokraten votieren für Harris

WASHINGTON (dpa). US-Vizepräsidentin Kamala Harris hat sich bei einer Online-Abstimmung der Demokraten die notwendige Mehrheit der Delegierten gesichert, das beschließen mehrere US-Medien, darunter die „Washington Post“ und der Sender CNN, unter Berufung auf die Spitze der Demokratischen Partei. Harris tritt damit bei der Wahl im November gegen den republikanischen Ex-Präsidenten Donald Trump an. Die Demokraten hatten ihre Kandidaten wegen Protesten für den Druck von Wählern in bestimmten Bundesstaaten vorgezogen – vor Beginn der Parteilage in Chicago vom 18. bis 22. August. Gestern hatte das Votum über eine Online-Plattform der Partei begonnen, bei der die Parteimitglieder aus allen Bundesstaaten ihre Stimmen abgeben konnten. Die Abstimmung



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## Beam commissioning planned in 2027/28



Frankfurter Allgemeine

Startseite Politik Wirtschaft Finanzen Feuilleton Karriere Sport Gesellschaft Stil Rhein-Main Technik **Wissen** Reise

## Physik & Mehr




ATMOSPÄRE

### Was passiert mit verglühtem Raumfahrtmaterial?

Immer mehr Raketen schicken immer mehr Hardware ins All, die schließlich in der Erdatmosphäre verglüht. Was weiß man eigentlich über die Auswirkungen der Substanzen, die dabei entstehen?

Ulf von Rauchhaupt




QUANTENINTERNET AM START

### Erster deutscher Quantensatellit ist gestartet

Das Abhören vertraulicher Nachrichten soll auch in Europa bald ein Ende haben. Jetzt ist der erste deutsche Quantensatellit gestartet. Er wird abhörsichere Quantencodes zur Erde schicken.

Manfred Lindinger



FORSCHUNGSANLAGE FAIR

### Beschleunigung bis fast auf Lichtgeschwindigkeit

Der Bau der Forschungsanlage FAIR in Darmstadt schreitet voran: Im 17 Meter tiefen Tunnel werden Magneten eingesetzt, die als Antriebskraft dienen.

Jan Schiefenhövel

hessenschau

Video & Podcast Wetter Verkehr Ort oder Thema suchen

Start Regionen Politik Gesellschaft Wirtschaft Kultur Sport Panorama Freizeit


hessenschau.de > Panorama > Megaprojekt in Darmstadt: Bau des Teilchenbeschleunigers Fair geht in entscheidende Phase

### Megaprojekt in Darmstadt

## Bau des Teilchenbeschleunigers Fair geht in entscheidende Phase

In Darmstadt entsteht eine gigantische Forschungsanlage, die das Universum neu ergründen soll. Mit dem Einbau der Hightech-Komponenten erreicht der Teilchenbeschleuniger Fair jetzt seine entscheidende Phase.

Veröffentlicht am 02.08.24 um 17:14 Uhr



Techniker arbeiten auf der Baustelle des Teilchenbeschleunigers Fair an einem Dipolmagneten. Damit werden Teilchenstrahlen auf ihre gewünschten Bahnen gebracht. Bild © picture-alliance/dpa

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☰

Frankfurter Allgemeine

Startseite Politik Wirtschaft Finanzen Feuilleton Karriere Sport Gesellschaft Stil Rhein-Main Technik **Wissen** Reise

## Physik & Mehr

Rhein-Main

FORSCHUNGSANLAGE FAIR

### Beschleunigung bis fast auf Lichtgeschwindigkeit

Von Jan Schiefelhövel 02.08.2024, 16:45 Leszeit: 2 Min.



INGSANLAGE FAIR

### unigung bis fast auf schwindigkeit

Forschungsanlage FAIR in Darmstadt  
ran: Im 17 Meter tiefen Tunnel werden  
ngesetzt, die als Antriebskraft dienen.

hövel

hessenschau

Video & Podcast Wetter Verkehr Ort oder Thema suchen

Start Regionen Politik Gesellschaft Wirtschaft Kultur Sport Panorama Freizeit


hessenschau.de Panorama Megaprojekt in Darmstadt: Bau des Teilchenbeschleunigers Fair geht in entscheidende Phase

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Wishing you (us) inspiring physics & more

