

A detailed wireframe model of a particle accelerator ring, showing the complex structure of the ring and various components. The ring is composed of many parallel lines, creating a mesh-like appearance. It is shown in a perspective view, curving around the center of the slide.

Welcome to GSI!

Hartmut Eickhoff

EMMI Workshop on Plasma Physics
with Intense Heavy-Ion and Laser Beams
May 2-4, 2011

GSI Helmholtzzentrum für Schwerionenforschung

Heavy Ions-
Synchrotron

Storage Ring

Linear Accelerator



GSI – Some Facts and Figures:

- Founded: 1969
- v Shareholders: Bundesrepublik Deutschland, Land Hessen
- v Mission: Heavy Ion Research and Construction and Operation of Accelerators
- v Budget (2011): ca. 113 million €
- v Employees: approx. 1050
- v Scientific users: 1250; (approx. 1000 external)

GSI – Member of the Helmholtz Association (HGF)

- Helmholtz: Some Facts and Figures

- 17 Research Centres
- 245 Institutes
- 31.000 Employees
- 9.500 Scientists & Engineers
- 4.700 Doctoral Students
- Budget ca. 3.3 Billion Euro (including Third Party Funding)

Largest Research Organization in Germany

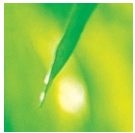


Research Areas in the Helmholtz-Association

- Program Oriented Research & Funding



Energy



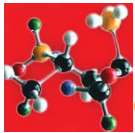
Earth and Environment



Health



Key Technologies



Structure of Matter



Transport and Space

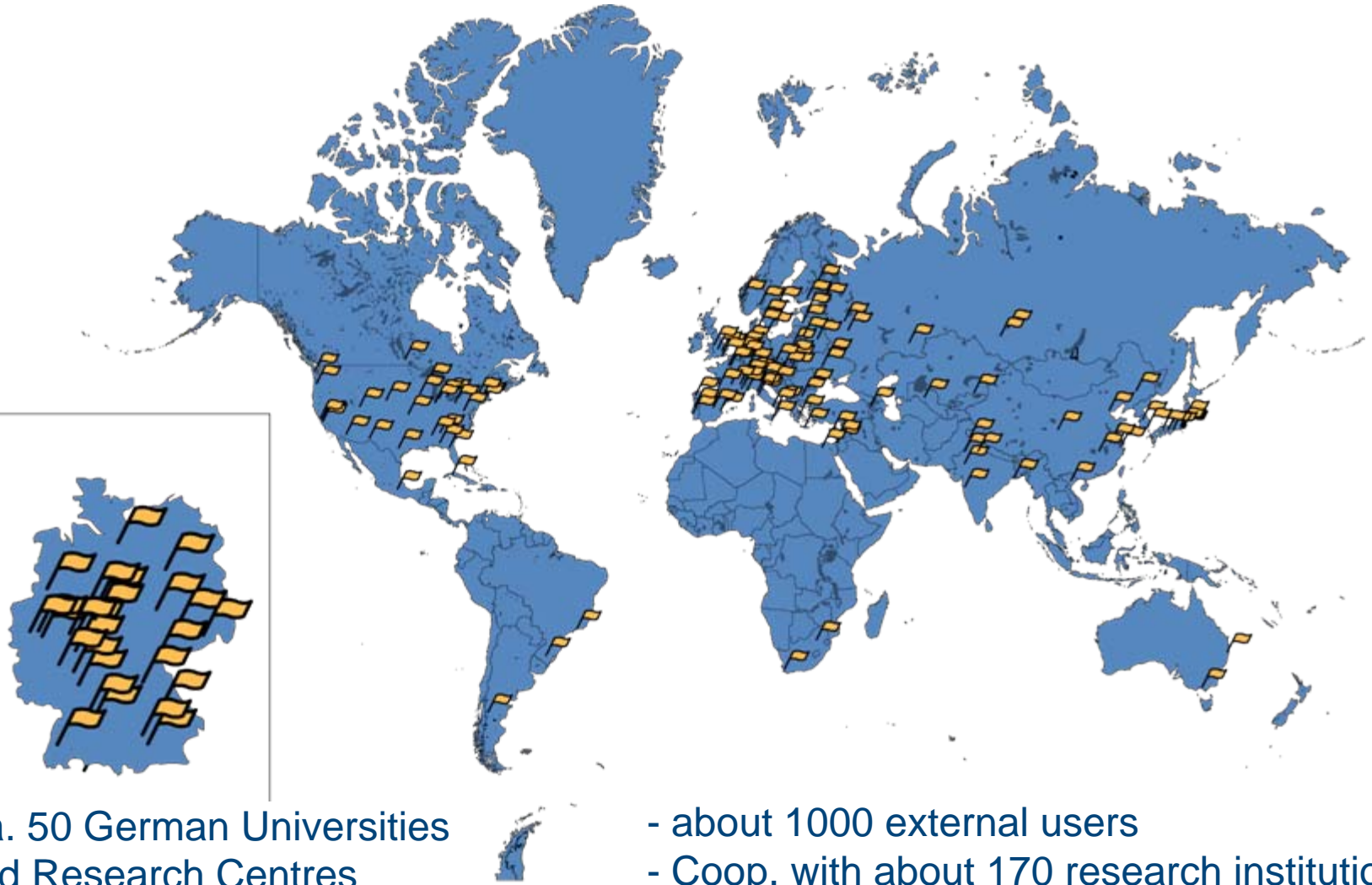


GSI: Brief History ... and Outlook into the Future



- **Founded in 1969:**
as large research infrastructure (Großforschungseinrichtung) to 'serve' the surrounding universities
- **Today:**
German 'National' Laboratory for Nuclear and Heavy-Ion Physics;
User Facility for European/International Users
- **Future:**
FAIR - International Facility for Antiproton and Ion Research

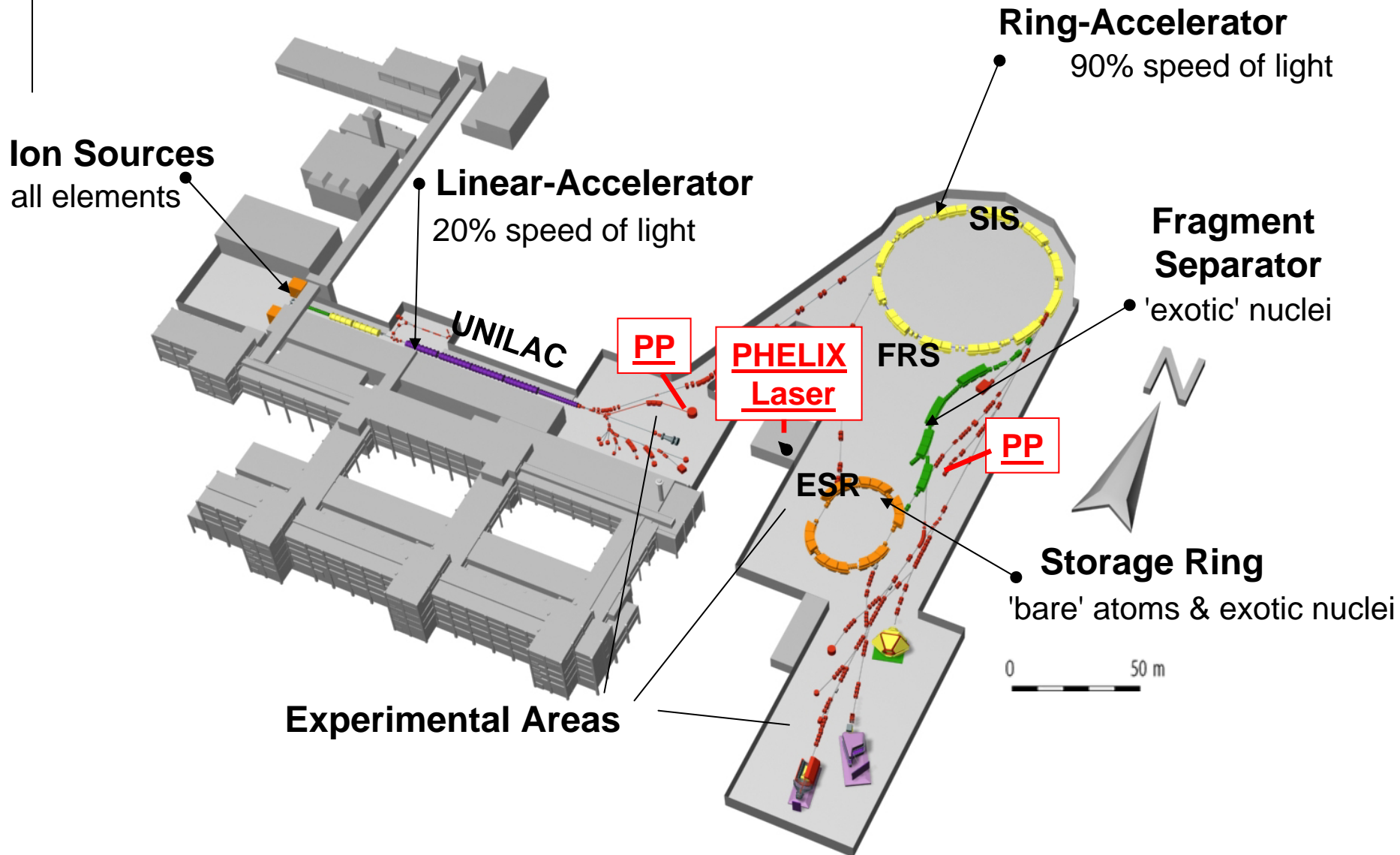
National and International Cooperation



Ca. 50 German Universities
and Research Centres

- about 1000 external users
- Coop. with about 170 research institutions from over 35 countries

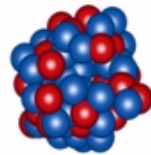
GSI Accelerator and Experimental Facilities



Overview of GSI main-research topics

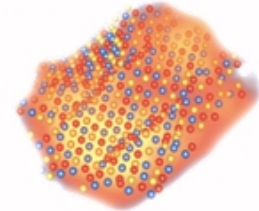
Nuclear physics

- Nuclear reactions
- Superheavy elements
- Hot condensed nuclear matter



Plasmaphysics

- Hot dense plasmas
- Ion-plasma interaction



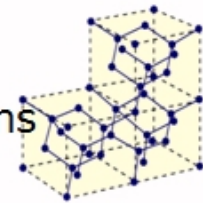
Biophysics und medical applications

- Radiobiologic effects of ions
- Tumorthrapy with ionbeams



Material-research

- Ion-solid matter interactions
- structure-investigations with ionbeams



Atomic physics

- Atomic reactions
- High resolution spectroscopy of charged ions



Accelerator technology and -physics

- linear and circular accelerators
- high current accelerator-physics



Example I: Search for super-heavy elements ...

- At GSI: Discovery of six new chemical elements with atomic numbers 107–112

Presently: Hunting for Element 120!

| | | | | | | | | | | | | | | | | | | |
|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|
| I | | | | | | | | | | | VIII | | | | | | | |
| 1 H | | | | | | | | | | | 2 He | | | | | | | |
| 3 Li | 4 Be | | | | | | | | | | | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne | |
| 11 Na | 12 Mg | | | | | | | | | | | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar | |
| 19 K | 20 Ca | 21 Sc | 22 Ti | 23 V | 24 Cr | 25 Mn | 26 Fe | 27 Co | 28 Ni | 29 Cu | 30 Zn | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr | |
| 37 Rb | 38 Sr | 39 Y | 40 Zr | 41 Nb | 42 Mo | 43 Tc | 44 Ru | 45 Rh | 46 Pd | 47 Ag | 48 Cd | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe | |
| 55 Cs | 56 Ba | 57 La | 58-71 | 72 Hf | 73 Ta | 74 W | 75 Re | 76 Os | 77 Ir | 78 Pt | 79 Au | 80 Hg | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | 86 Rn |
| 87 Fr | 88 Ra | 89 Ac | 90-103 | 104 Rf | 105 Db | 106 Sg | 107 Bh | 108 Hs | 109 Mt | 110 Ds | 111 Rg | 112 | 113 | 114 | 115 | 116 | 117 | 118 |

119
?
120
?

Bohrium

Hassium

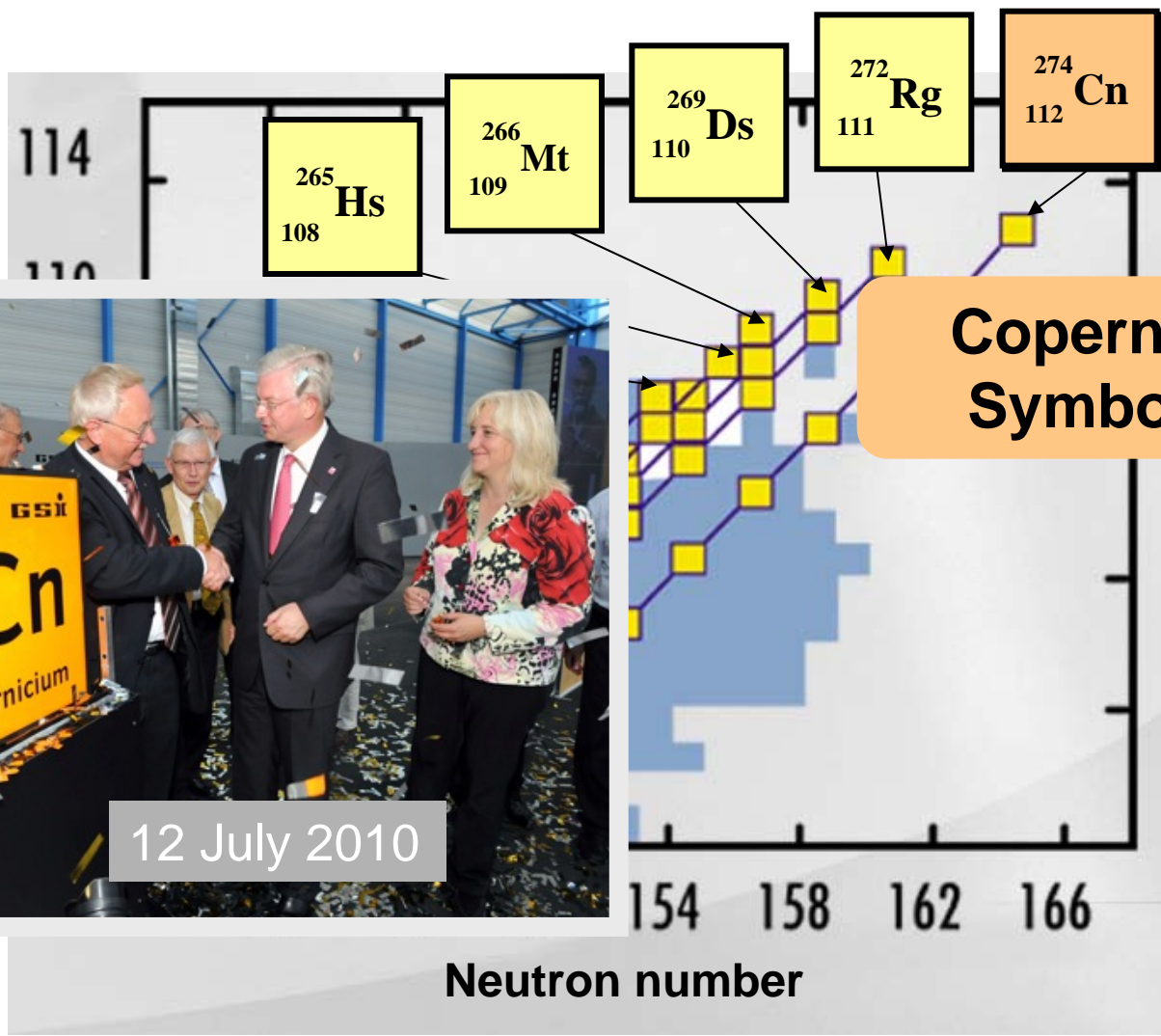
Meitnerium

Darmstadtium

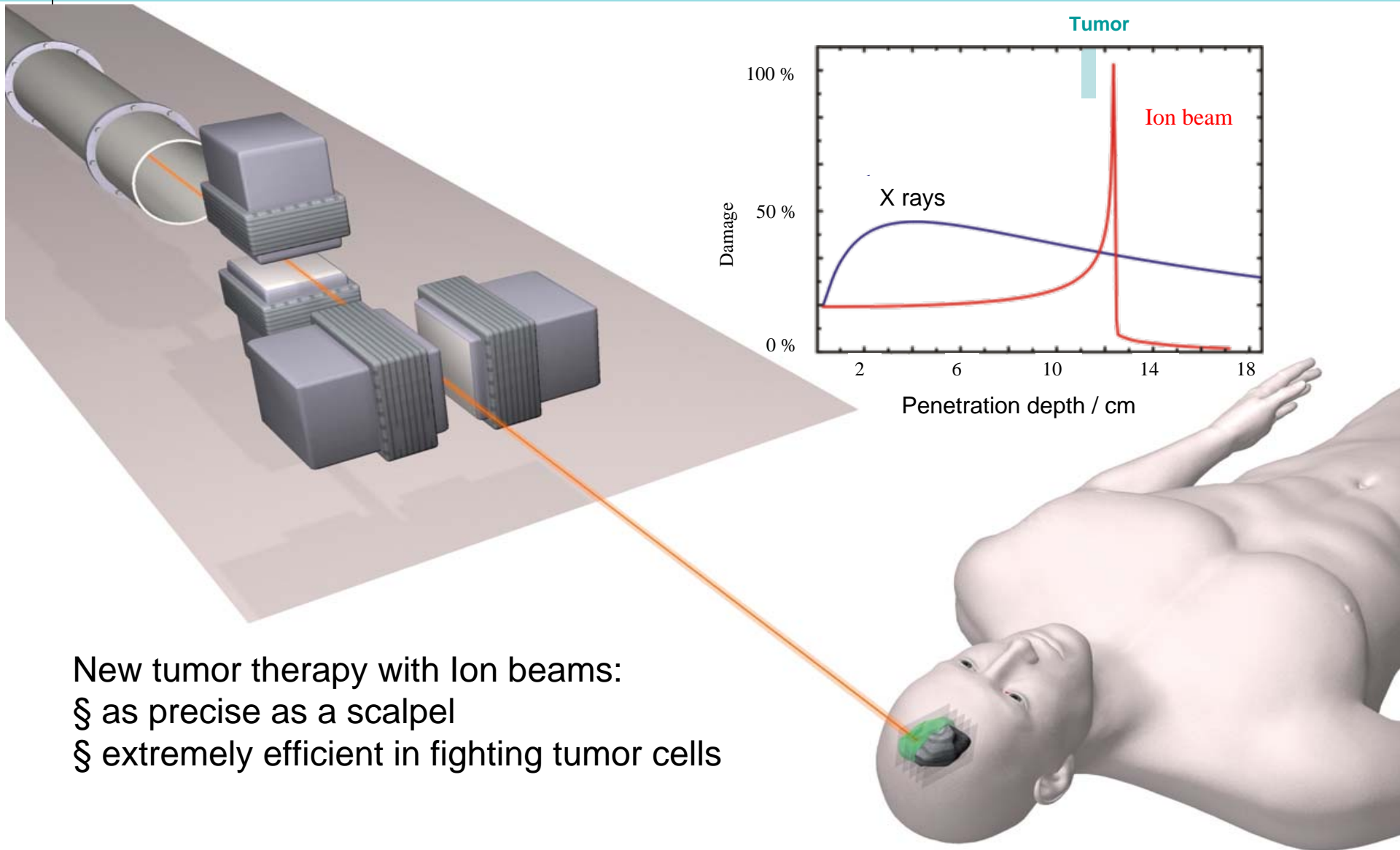
Roentgenium

Copernicium

Naming of Element 112: Copernicium



Example II: Cancer Therapy with Ion beams...



New tumor therapy with Ion beams:
§ as precise as a scalpel
§ extremely efficient in fighting tumor cells

From Clinical Studies at GSI... ... to Standard Medical Application

Pilot phase at GSI



- from 1997 to 2008
- more than 450 patients
- **tumor control rate 80 % - 90 %**
- **almost no side-effects**
- accepted by health insurers

Heidelberg Ion Therapy HIT



- **start of patient treatments: Nov. 2009**
- **first clinical ion beam unit in Europe**
- three treatment stations
- Goal: 1000 patients per year
- standard medical treatment

- Cooperation and License Contract with Siemens Medical Solutions
- Additional ion beam therapy clinical facilities under construction:
Marburg-Gießen, Kiel, Shanghai ...

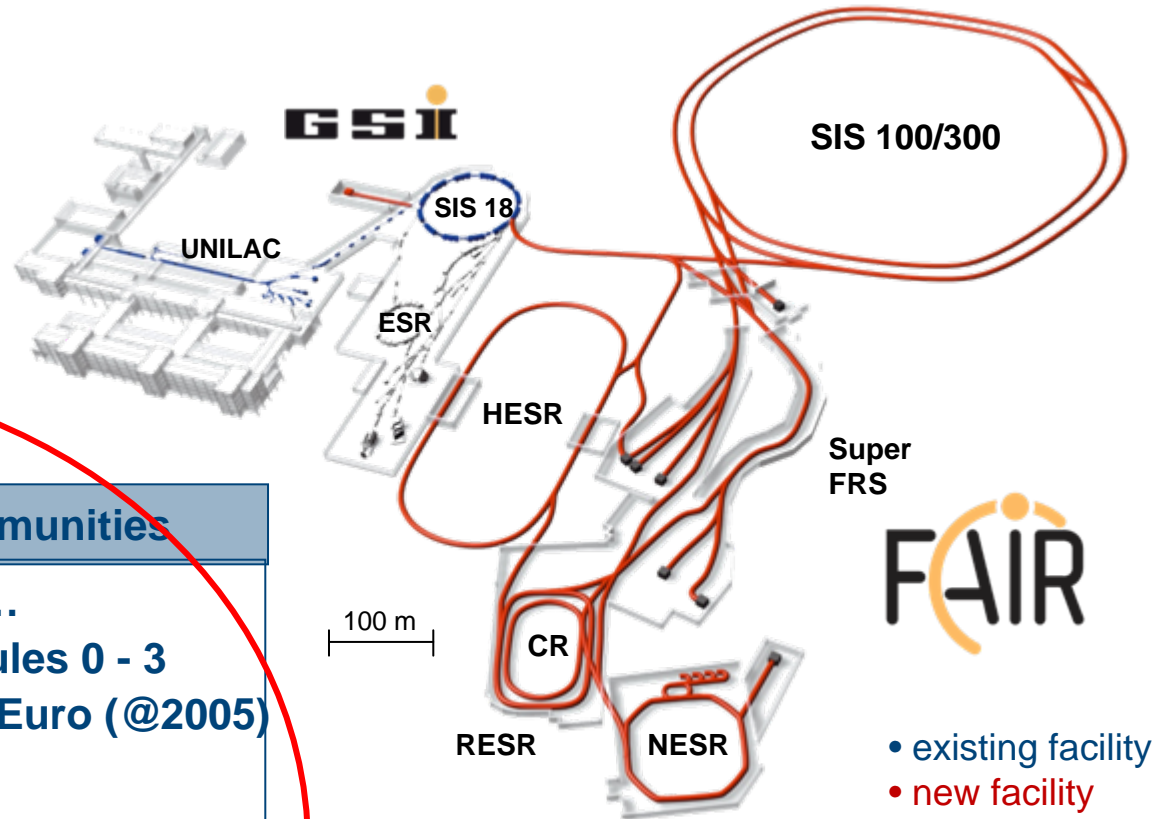
The present Main Project: FAIR

Added value

- § Beam intensity by a factor of 100 - 10000
- § Beam energy by a factor of 20
- § Anti-matter beams
- § Unique beam quality
- § Parallel operation

Construction, cost, scientific communities

- § Construction in modules 0 – 5, ...
- § Modularized Start Version: Modules 0 - 3
- § Construction cost: 1.027 Billion Euro (@2005)
- § Scientific Pillars:
 - APPA: Atomic Physics, **Plasma Physics**, Applic.
 - CBM: Compressed Baryonic Matter
 - NuSTAR: Nucl Structure & Astrophysics
 - PANDA: Hadron Structure & Dynamics
- In total: 2500 – 3000 Users



Funding (Construction)

- § 65 % Federal Republic
- § 10 % State of Hessen
- § 25 % International Partners

Signing Ceremony of FAIR international Convention



04.10.2010 Castle Biebrich, Wiesbaden

Signing Countries:

Finland, France, Germany, India, Poland, Romania, Russia, Slovenia and Sweden

FAIR in 2020



Thank You!



Austria



China



Finland



France



Germany



Greece



India



Italy



Poland



Romania



Russia



Slovakia



Slovenia



Spain



Sweden



Great Britain



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Research with Heavy Ion Beams



From

fundamental research into the
Structure of Matter and
Evolution of the Universe

to

applications and
transfer of technologies



FAIR Status

**The International FAIR Company was founded
on October 4, 2010**

**The Modularized Start Version (Cost = 1027 M€)
is financed by firm funding commitments
of the FAIR Partners.**

! Now we can and must start !

