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Hans Ströher

**The FAIR-project at GSI**



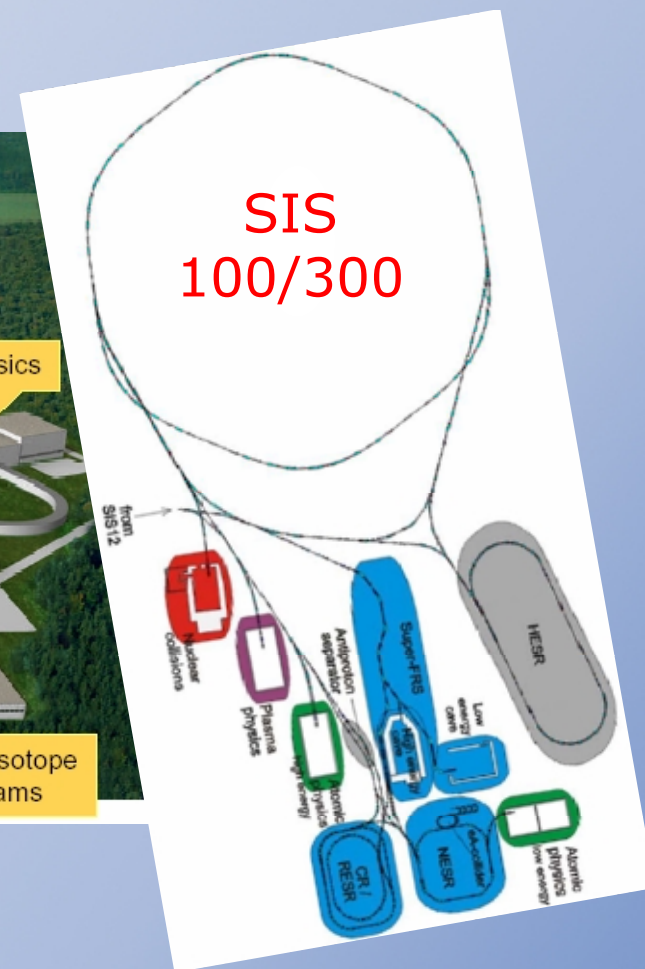
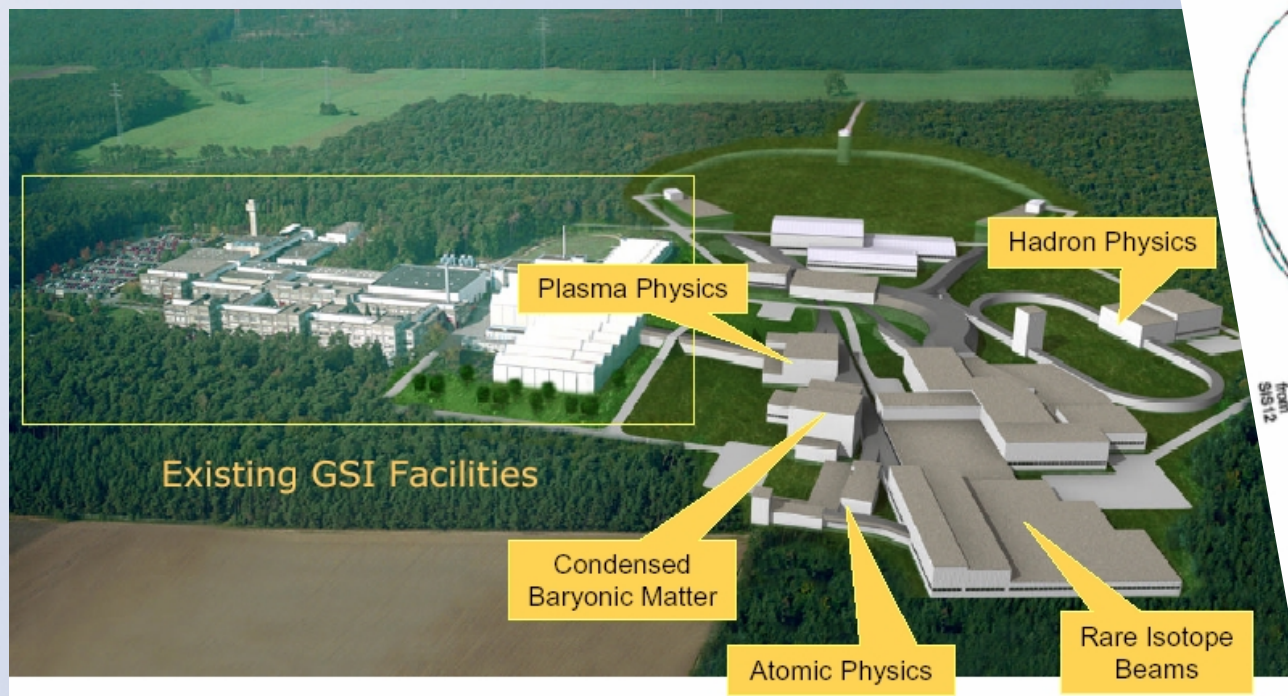
## NEW Facility

- An “International Accelerator Facility for Beams of Ions and Antiprotons”:
  - top priority of german hadron and nuclear physics community (KHuK-report of 9/2002) and NuPECC
  - favourable evaluation by highest german science committee (“Wissenschaftsrat” in 2002)
  - funding decision from german government in 2/2003 – **staging** and at least **25% foreign funding**
  - to be build at GSI Darmstadt;  
should be finished in > 2011 (depending on start)

**FAIR**

(Facility for Antiproton and Ion Research)

# FAIR (GSI, Darmstadt, Germany)



- Proton linac (injector)
  - 2 synchrotrons (30 GeV p)
  - A number of storage rings
- **Parallel beams operation**

# FAIR

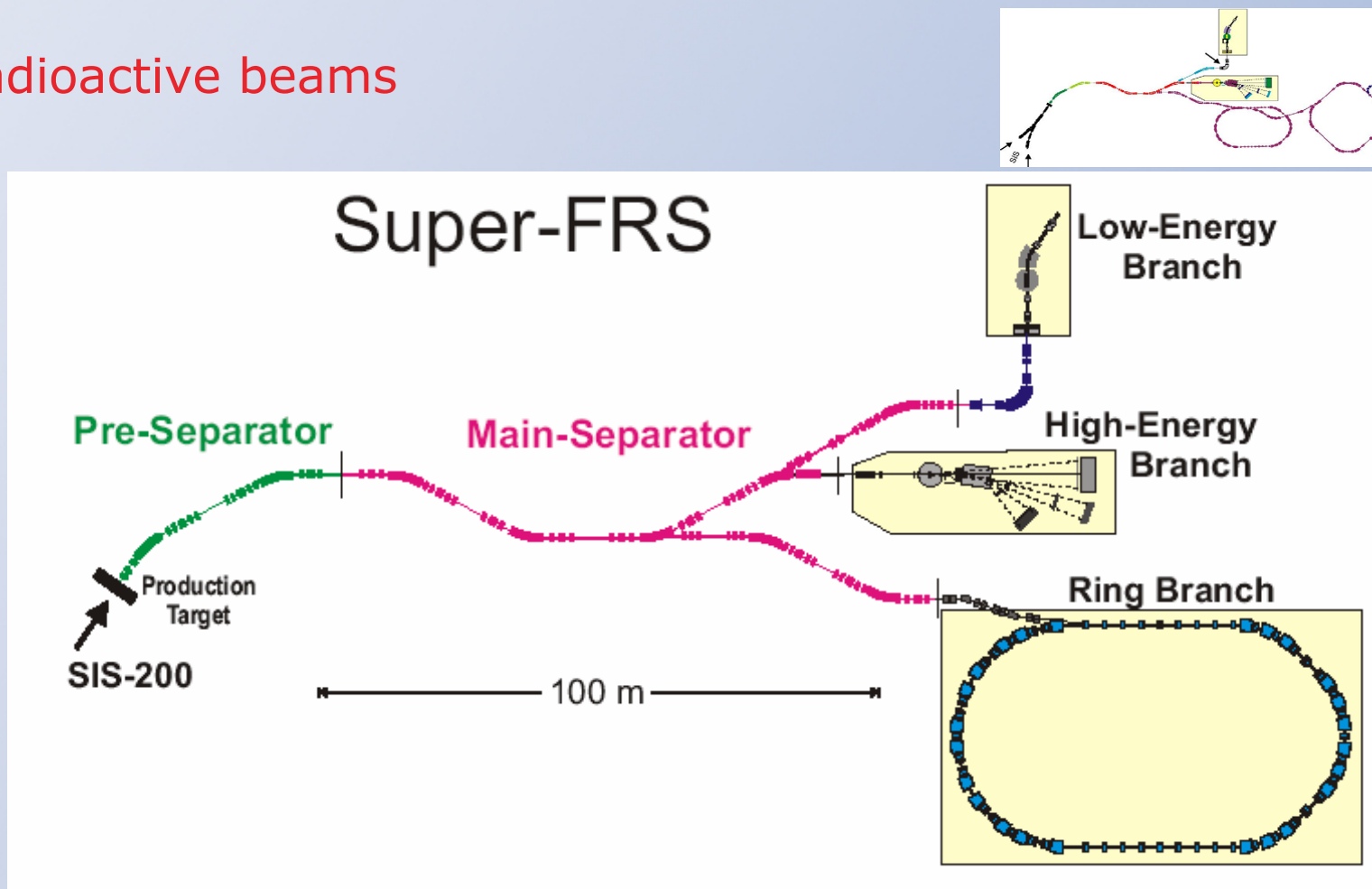
## Fields of research:

- a) Structure and dynamics of nuclei
  - Radioactive beams → Super-FRS
- b) Hadron structure and quark-gluon dynamics
  - Antiprotons (<15 GeV) → HESR, PANDA
- c) Nuclear matter and quark gluon plasma
  - Relativistic nuclear beams → CBM
- d) Plasma physics
  - Pulsed ion beams + high power laser
- e) Atomic physics
  - Highly charged ions → NESR

Recent call for **LoI**: ASSIA, CBM, FLAIR, PANDA, PAX, ...  
(can be downloaded from the GSI web-site:  
[www.gsi.de](http://www.gsi.de))

# FAIR Pillars (I)

Radioactive beams



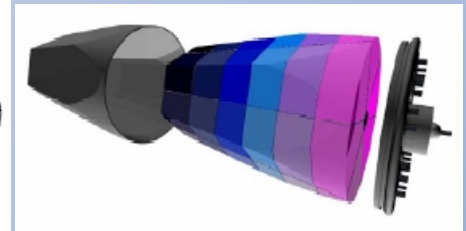
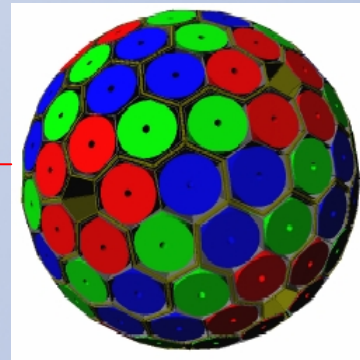
Projectile fragmentation and fission ( $B_p$ - $\Delta E$ - $B_p$  method)

# FAIR Physics (I)

... with in-flight **radioactive beams** (at Super-FRS):

a) **Low-energy** branch:

- $\alpha$ ,  $\beta$ ,  $\gamma$  decay spectroscopy
- $\gamma$  spectroscopy (**AGATA**)
- laser spectroscopy
- trap experiments



b) **High-energy** branch:

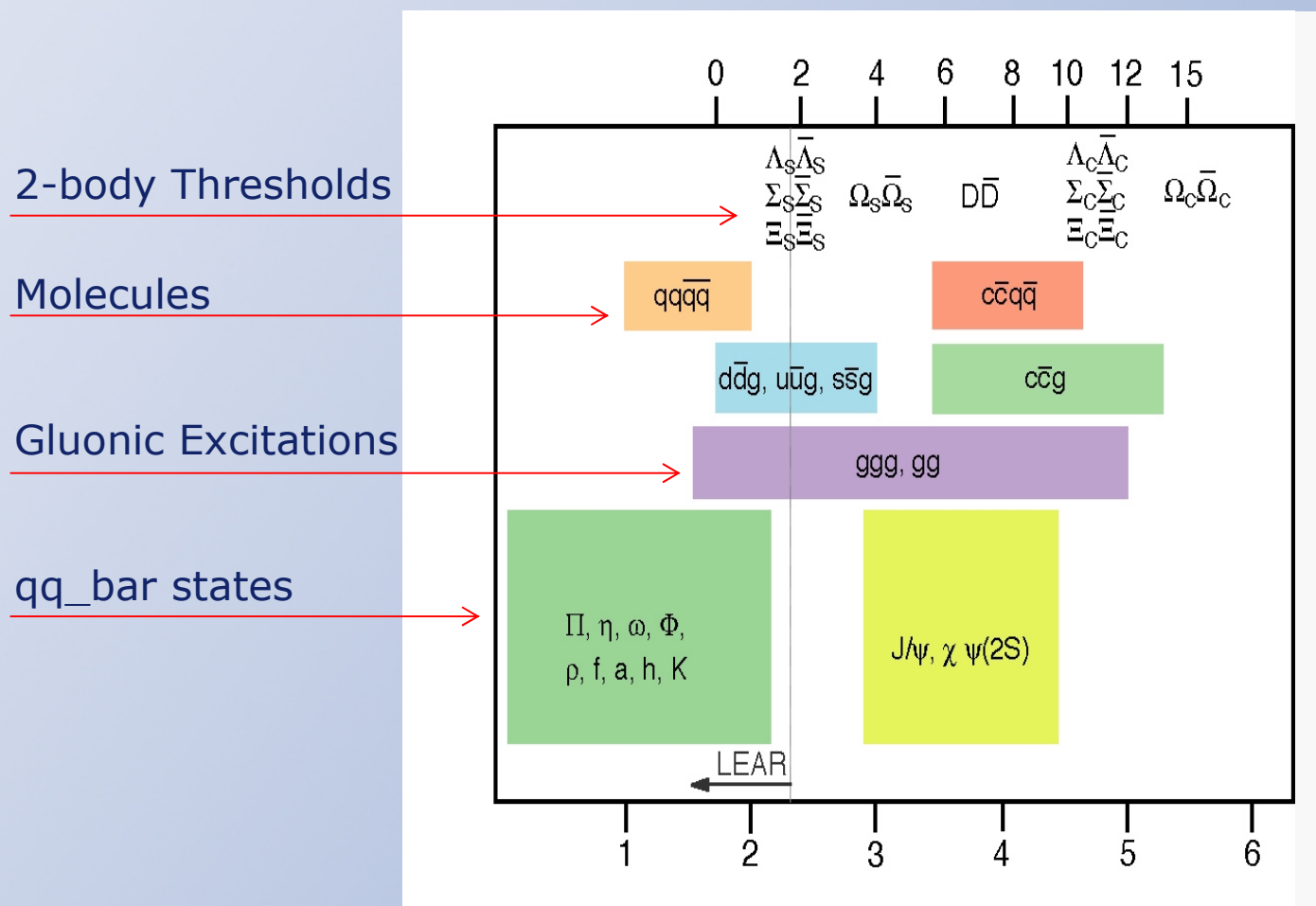
- knockout reactions
- (p,n) reactions
- electromagnetic excitations
- fission, (multi-)fragmentation, spallation

c) **Ring** branch:

- mass, lifetime measurements
- scattering of light hadronic probes
- electron scattering (**ELISE**)

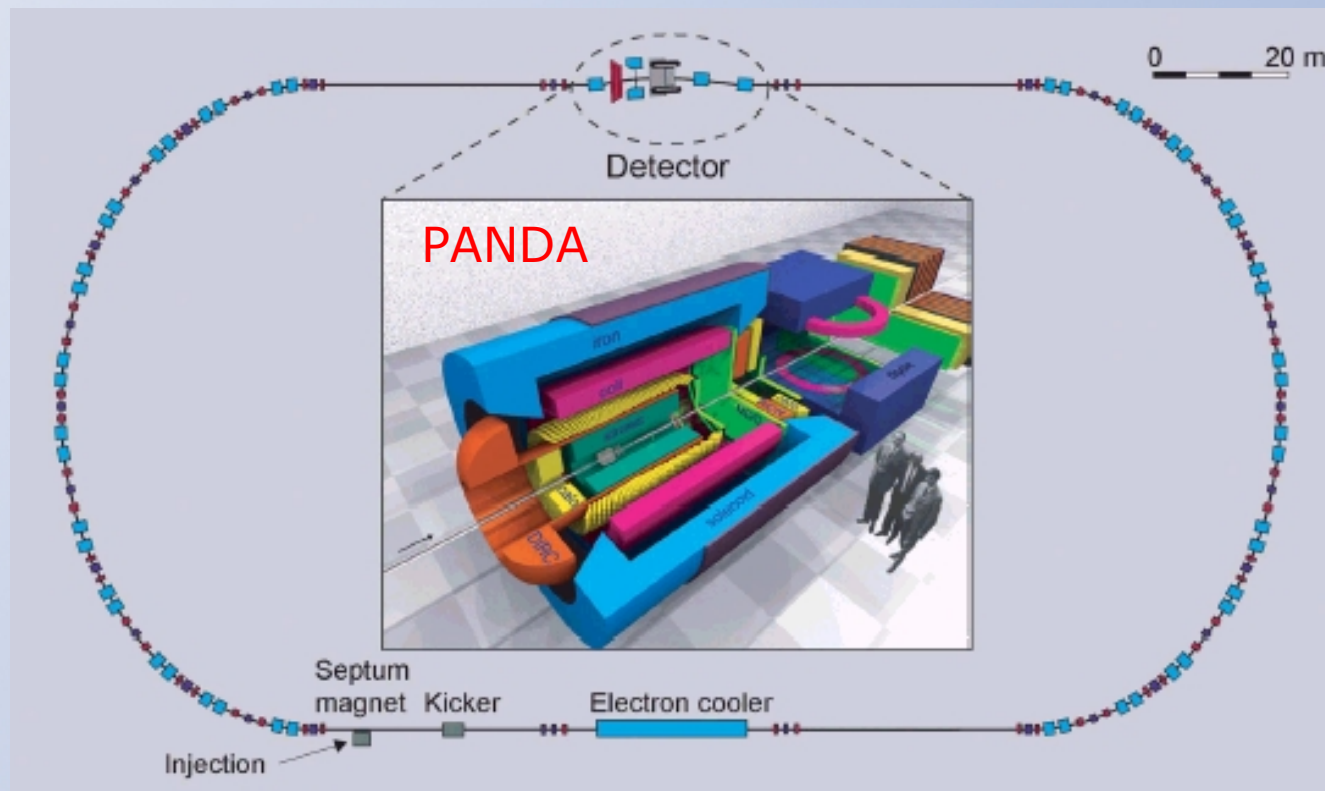
# FAIR Pillars (II)

## Antiproton beams



## FAIR Pillars (II)

... with HESR (and PANDA):



Momentum range:  $p = 1.5 - 15 \text{ GeV}/c$   
 $5 \times 10^{10}$  stored antiprotons



## FAIR Physics (II)

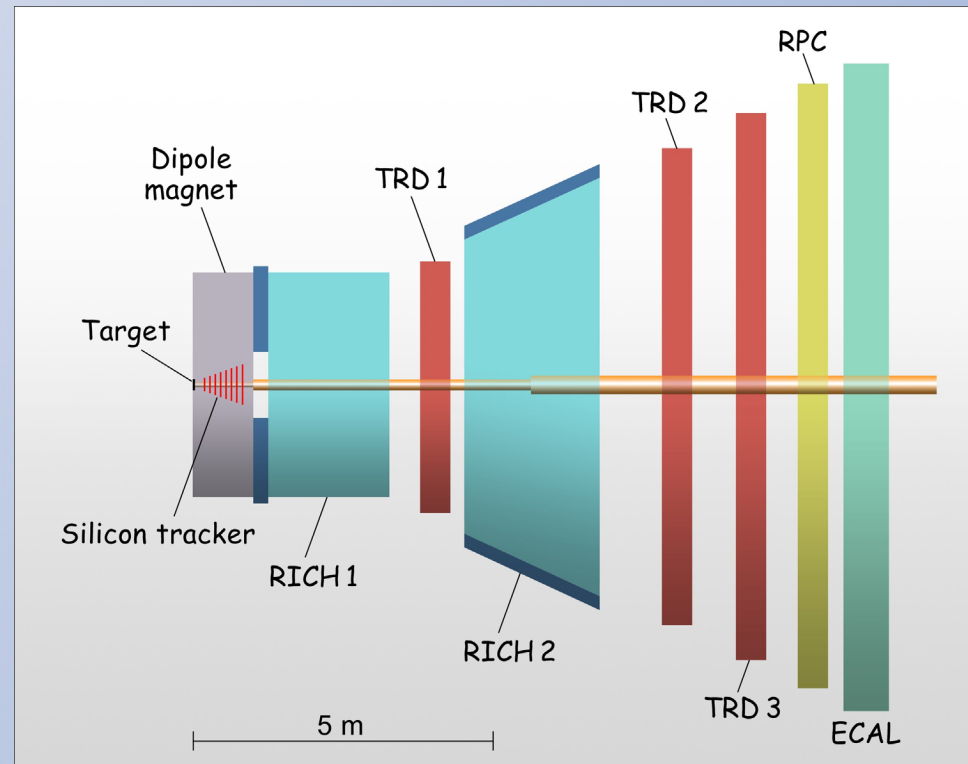
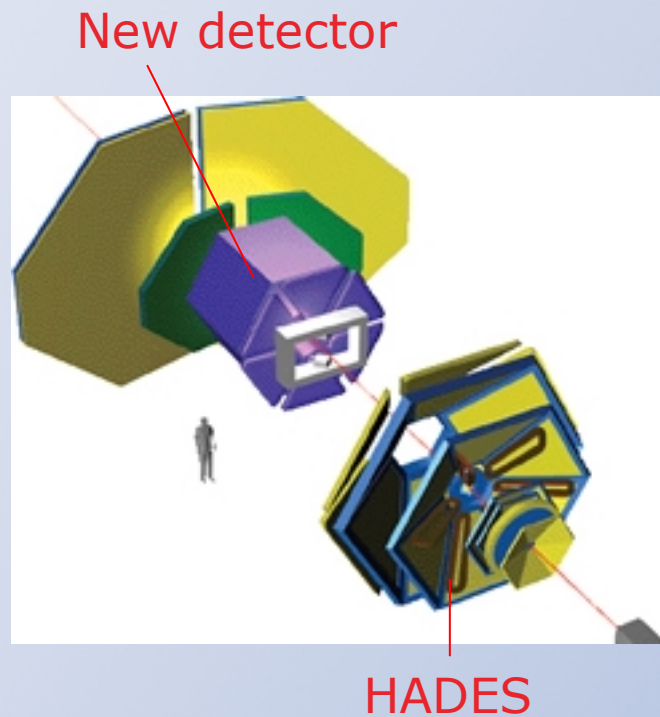
... with cooled internal **antiproton beams** at HESR:



- Charmonium spectroscopy
  - Gluonic excitations (charmed hybrids, glueballs)
  - Charm in Nuclei
  - (Double) Hypernuclei
  
  - GPD 's from  $p\bar{p}$  annihilation
  - D meson spectroscopy
  - CP violation in strange and charm sector
- Key observables: Charmonium, D mesons

# FAIR Pillars (III)

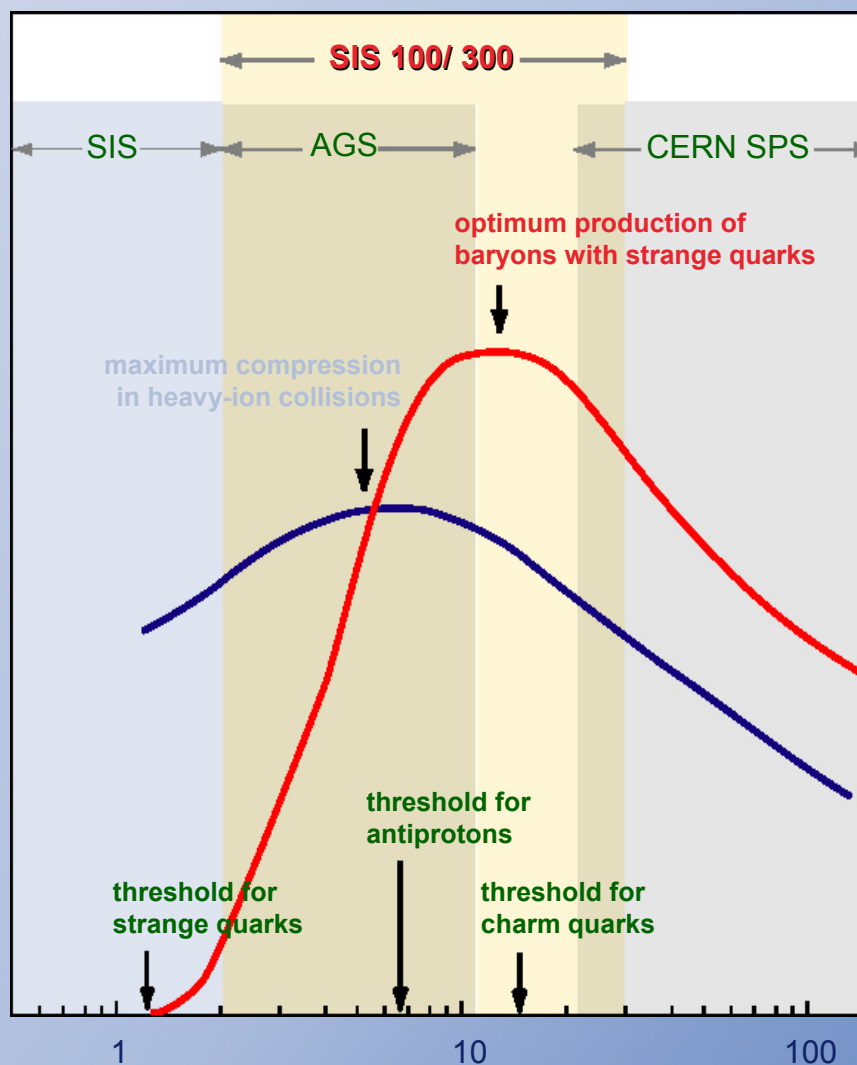
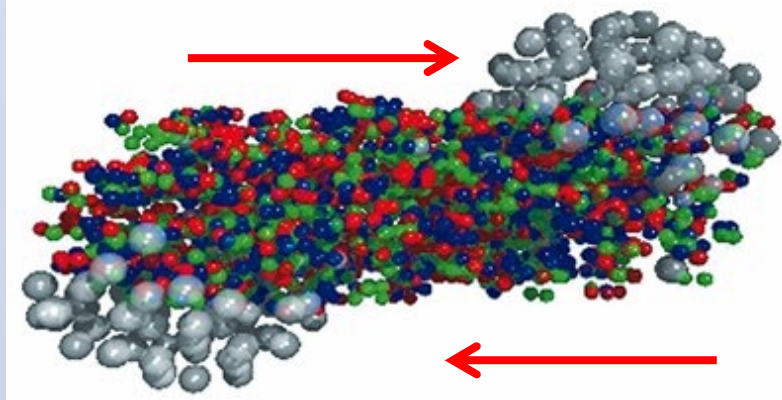
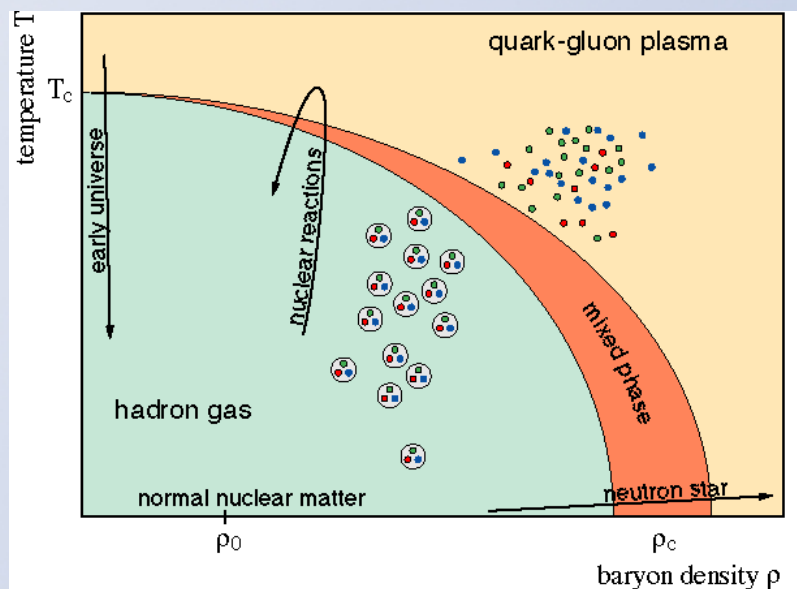
## Nuclear collisions



Moderate temperatures and very high baryon densities  
(5-10  $\rho_0$ )

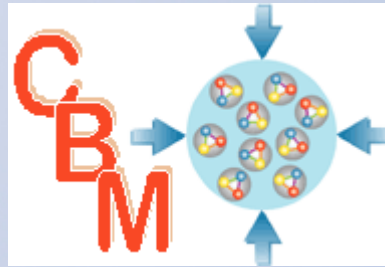
# FAIR Physics (III)

## Nucleus-nucleus collisions



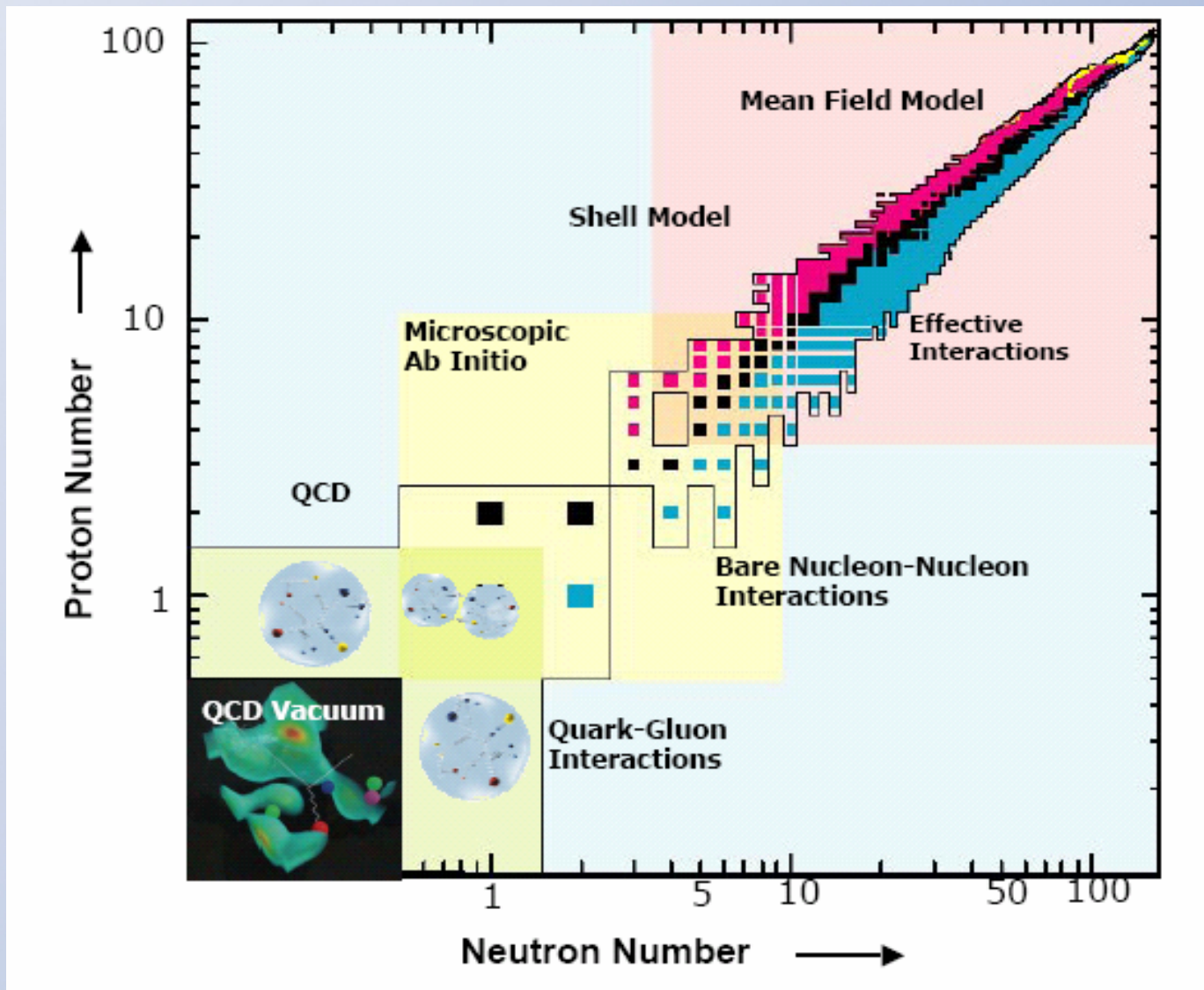
## FAIR Physics (III)

... with **nucleon-nucleon collisions** at CBM:



- In-medium properties of hadrons
  - Chiral and deconfinement phase transition at high  $\rho_B$
  - Critical point of strongly interacting matter
  - Nuclear equation-of-state at high densities
  - New states of matter at highest baryon densities
- Key observables:  
 $\rho$ ,  $\omega$ ,  $\phi$ , Charmonium, D mesons, multi-strange baryons, direct photons

# FAIR Summary



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The End

