

Ring Activities: Status and First experiments

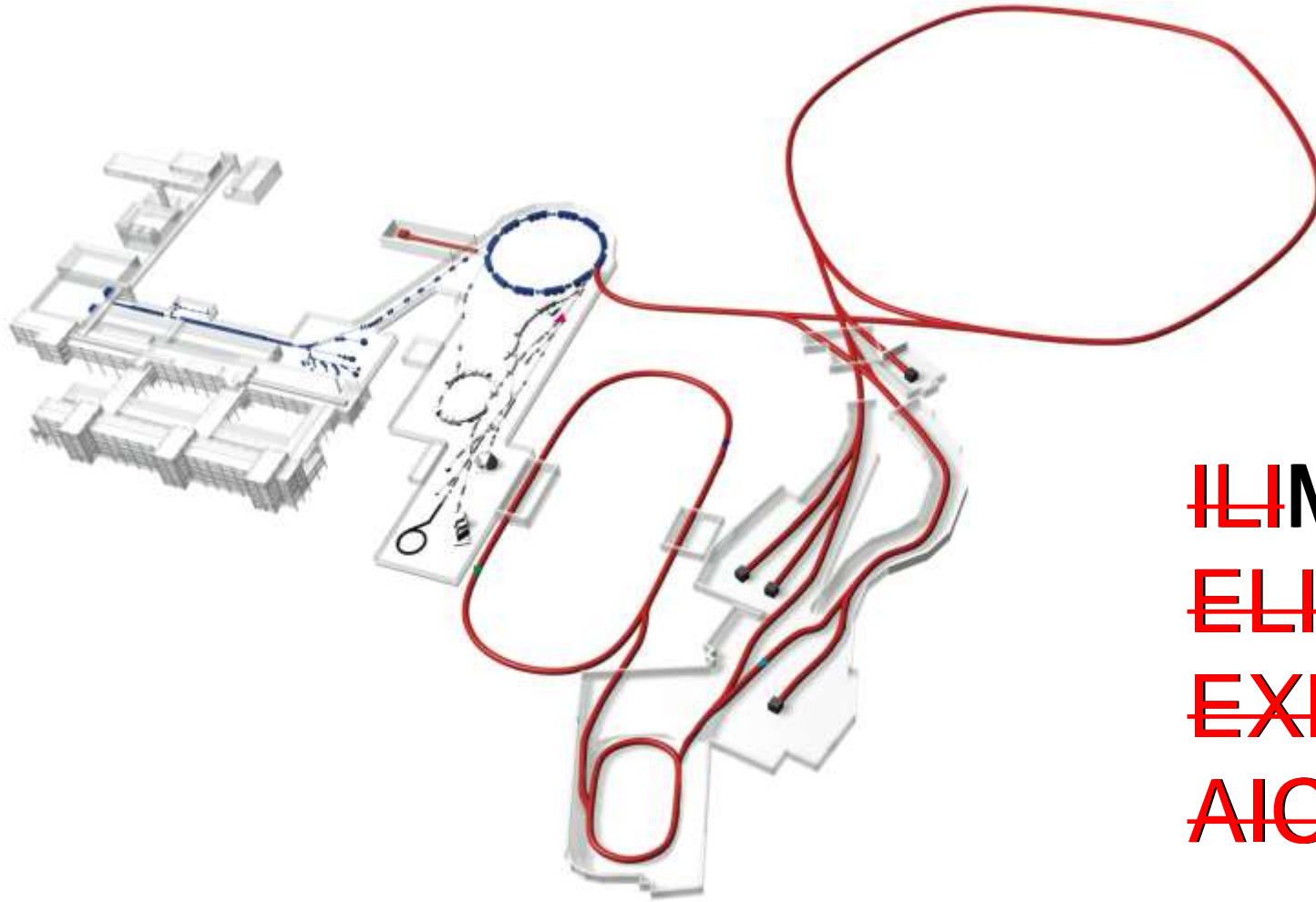
Yuri A Litvinov

GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

On behalf of the ILIMA, EXL, ELISE and AIC collaborations

International Conference on Science and Technology for FAIR in Europe 2014
13-17 October 2014
Worms, Germany

FAIR FV vs. MSV



~~IL~~IMA
~~EL~~ISE
~~EX~~L
~~AI~~G

ILIMA Set-Up at FAIR

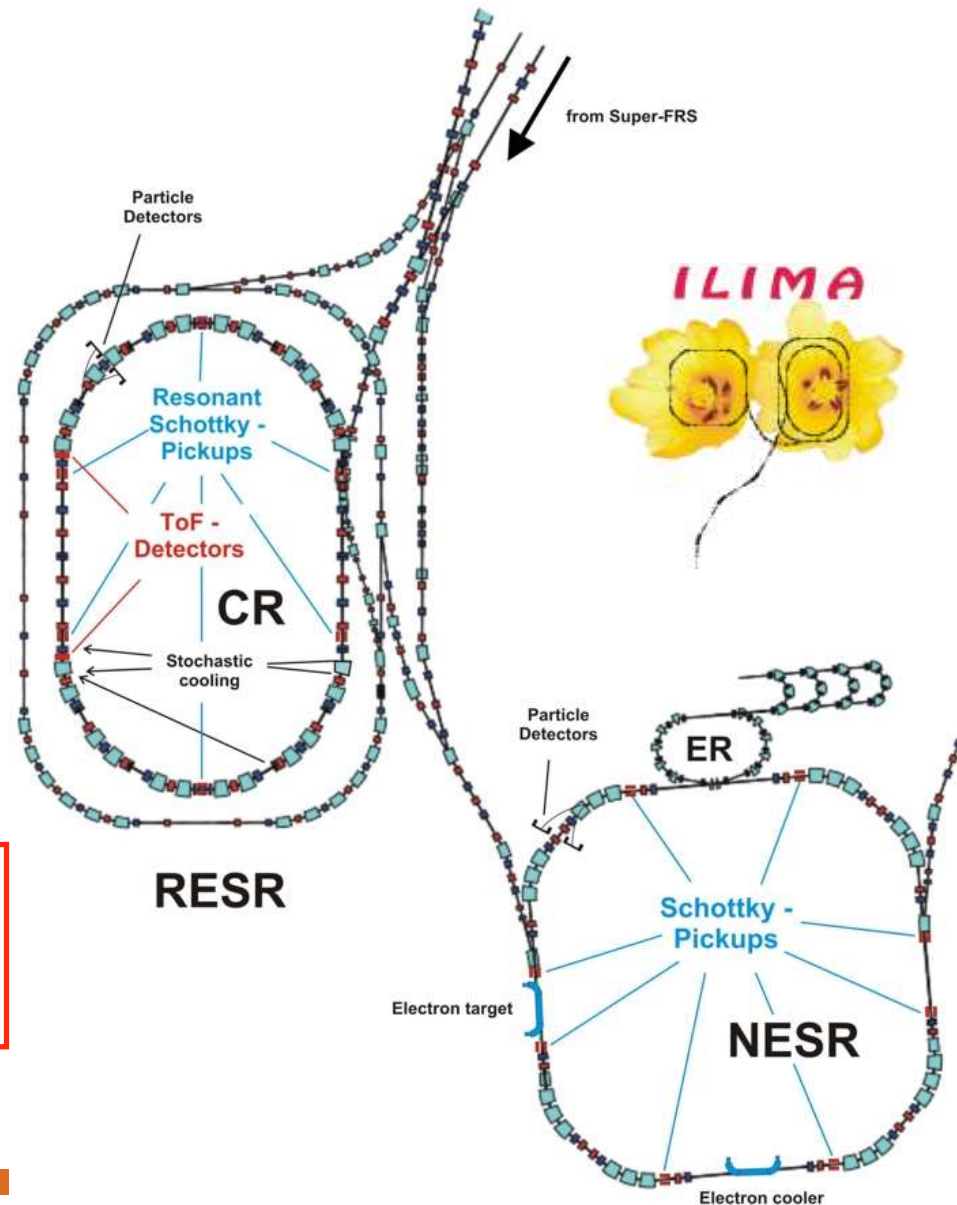
Isochronous Mass Spectrometry in the CR

$$\gamma \rightarrow \gamma_t$$

Schottky Mass Spectrometry in the CR & NESR

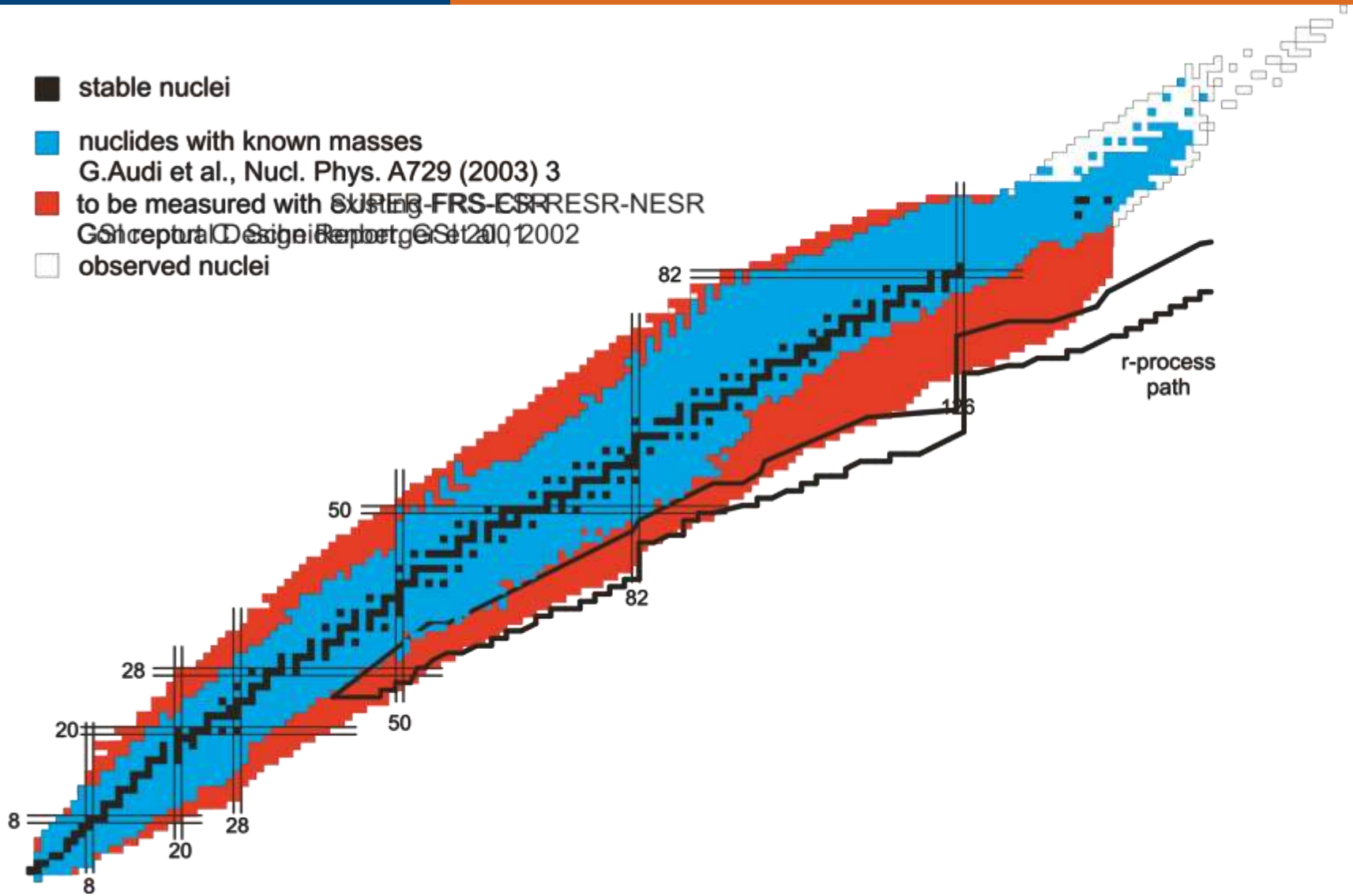
$$\frac{\Delta v}{v} \rightarrow 0$$

$$\frac{\Delta t}{t} = -\frac{\Delta f}{f} = \frac{1}{\gamma_t^2} \cdot \frac{\Delta(m/q)}{m/q} + \left(\frac{\gamma^2}{\gamma_t^2} - 1\right) \cdot \frac{\Delta v}{v}$$



Nuclides in reach with ILIMA

- stable nuclei
- nuclides with known masses
G.Audi et al., Nucl. Phys. A729 (2003) 3
- to be measured with SUPER-FRS-ESR
RESR-NESR
Conceptual Design Report GSI 2002
- observed nuclei



Beside the reaction microscope mentioned, novel instrumentations will be developed and used by the collaboration. These include micro-calorimeters and polarimeters for hard X-rays and spectrometers for electrons, positrons and ions. In addition, novel lasers and targets (gaseous, micro droplet, and superfluid targets) will be exploited. All these developments are also of particular relevance for future prospects of the SPARC physics programme which concentrates on storage rings and traps, and will become possible with Module 4. For the realization of this programme the ESR storage ring and the HITRAP facility need to be maintained in operation at GSI until they shall be surpassed by Module 4.

Green Paper

The Modularized Start Version

October 2009

Experimental Storage Ring ESR



ESR: B. Franzke, NIM B 24/25 (1987) 18

Stochastic cooling: F. Nolden et al., NIM B 532 (2004) 329

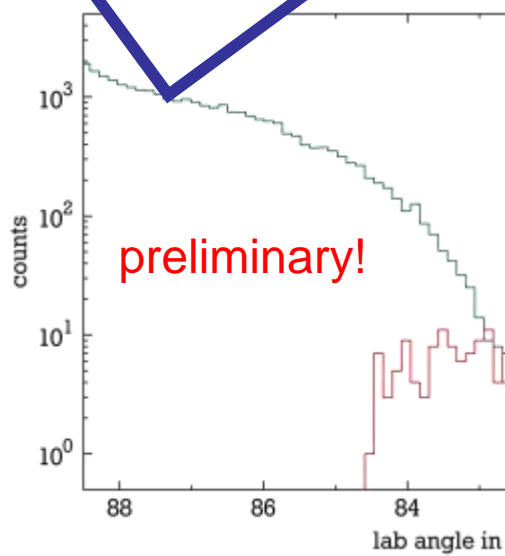
Electron cooling: M. Steck et al., NIM B 532 (2004) 357

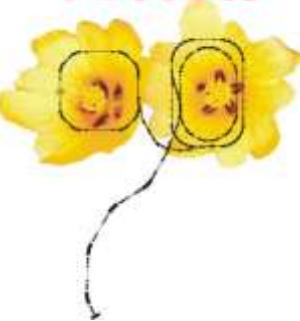
Intermediate storage requirements @ ESR

Elastic p-scattering

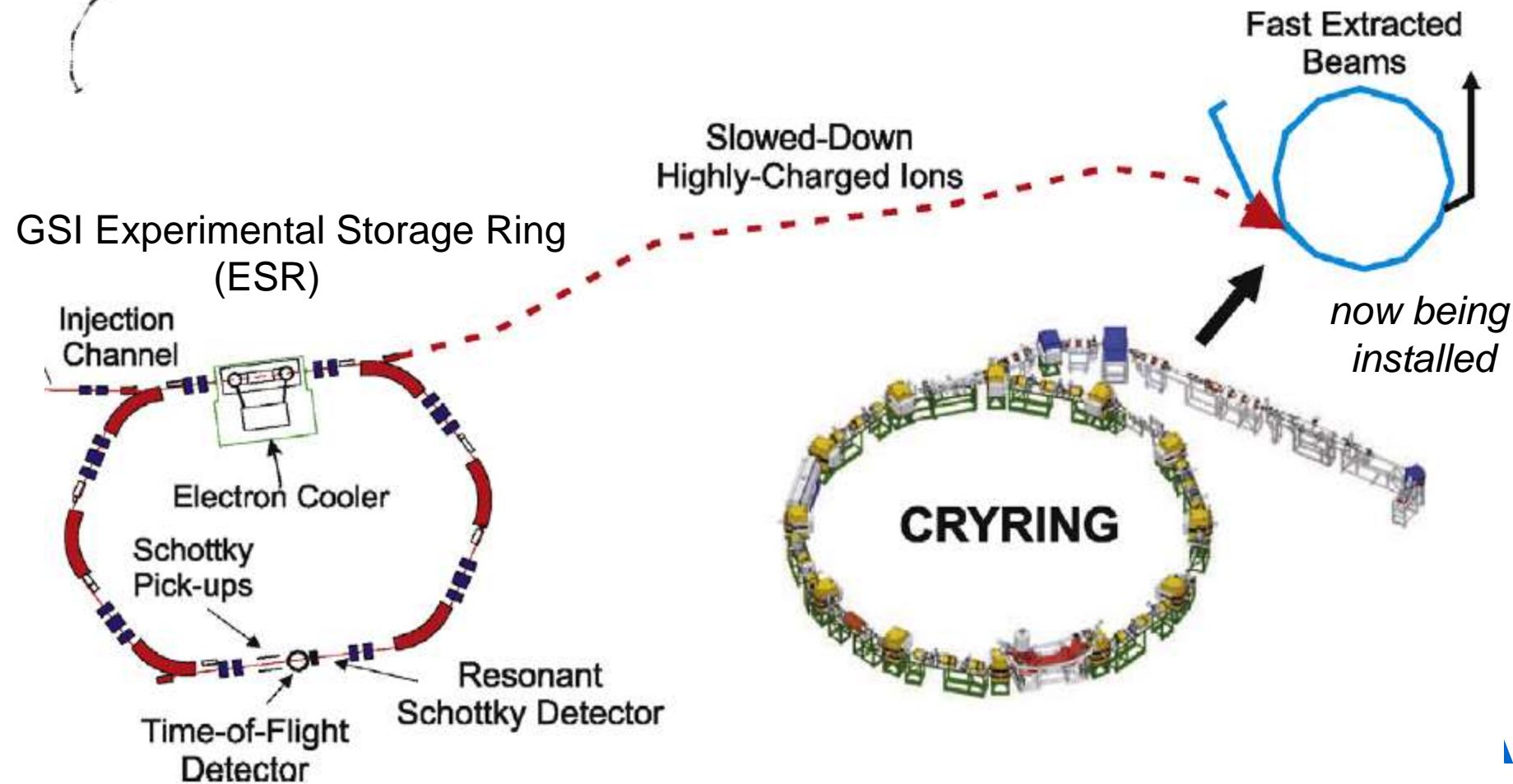


SUPER-FRS Intensities are required





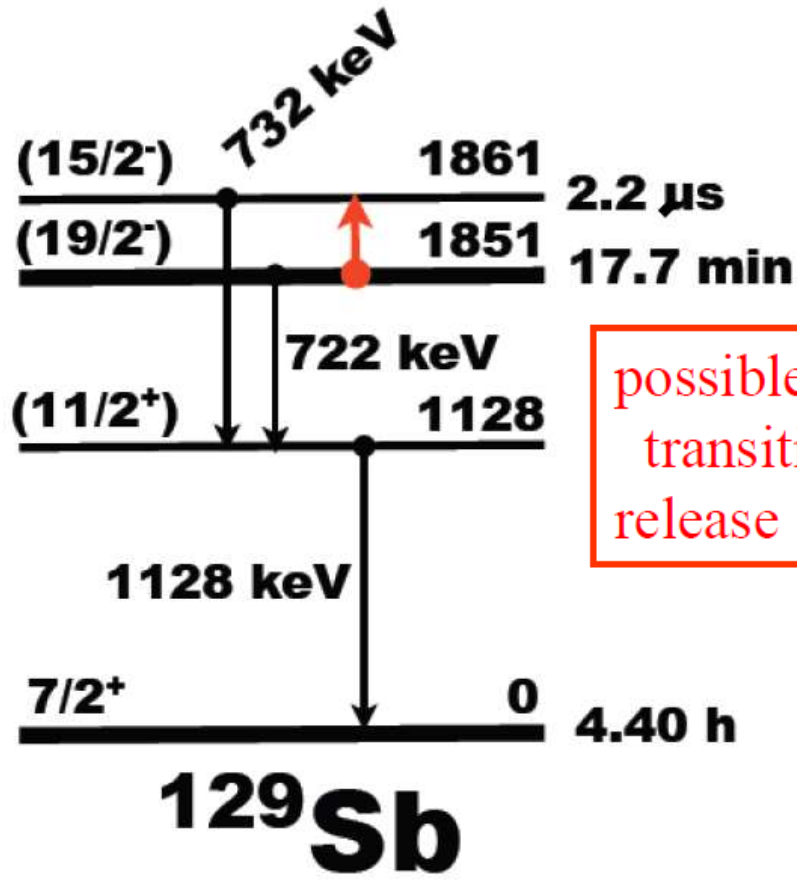
Possibility to prepare <math><100\text{ keV}</math> bare ions



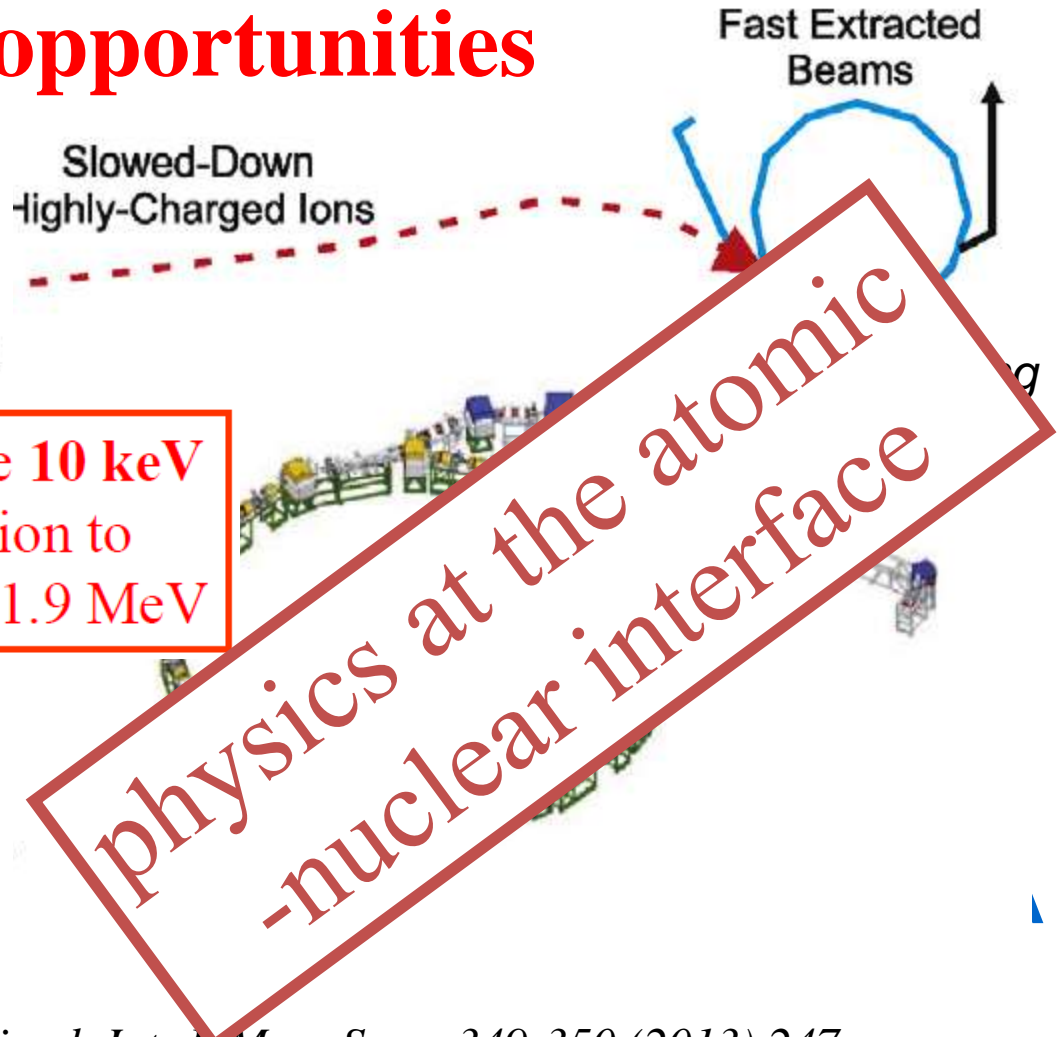


Possibility to prepare <100 keV bare ions

=> **NEEC opportunities**



possible 10 keV transition to release 1.9 MeV



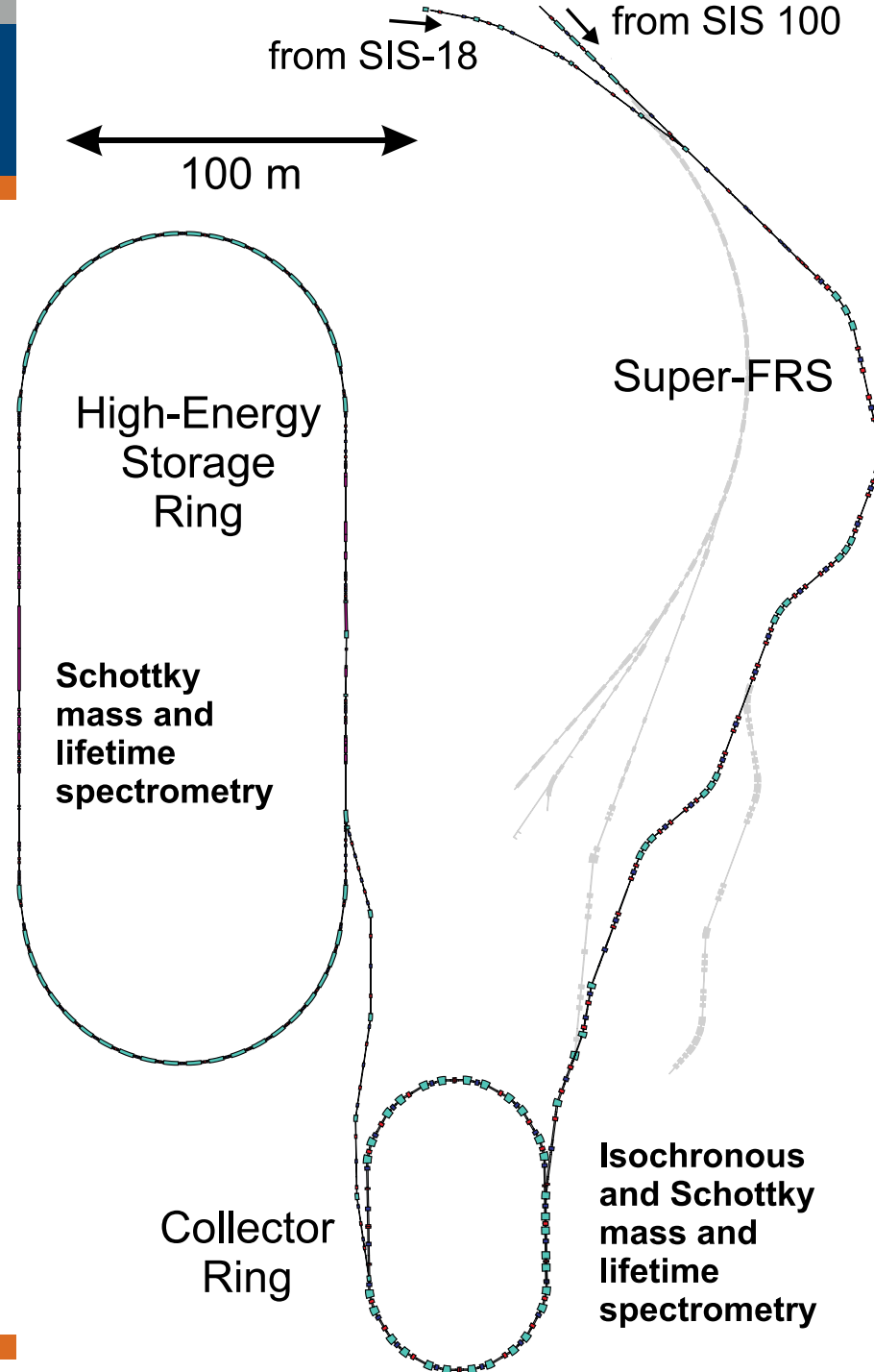
physics at the atomic-nuclear interface

HESR

SPARC Experiments at the HESR: A Feasibility Study



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for the SPARC Collaboration*
Christina Dimopoulou¹, Alexei Dolinskii¹, & Markus Steck¹



Physics cases

⇒ "Stellar lifetimes of SN isotopes" (Wed, 17:45) *Sorry for the house advertising...*

Mixed decay isotopes

<p>Al 26 6,35 s 7,16 · 10⁵ a β⁺ 1,2 γ 1809; 1130... β⁺ 3,2</p>	<p>Cl 36 3,0 · 10⁵ a β⁻ 0,7 ε; β⁺... no γ σ < 10</p>
<p>Mn 54 312,2 d ε ν 835</p>	<p>CR clocks</p>

Secondary CR
spallation products

Pure EC decay isotopes

<p>Ar 37 35,0 d ε no γ σ_{n, p} 69 σ_{n, α} 1970</p>	<p>V 49 330 d ε no γ</p>
<p>Cr 51 27,70 d ε ν 320</p>	<p>Mn 53 3,7 · 10⁶ a ε no γ τ 70</p>

<p>Ti 44 47,3 a ε γ 78; 68... D</p>	
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<p>Fe 55 2,73 a ε no γ τ 13</p>	<p>Co 57 271,79 d ε ν 122; 136; 14</p>
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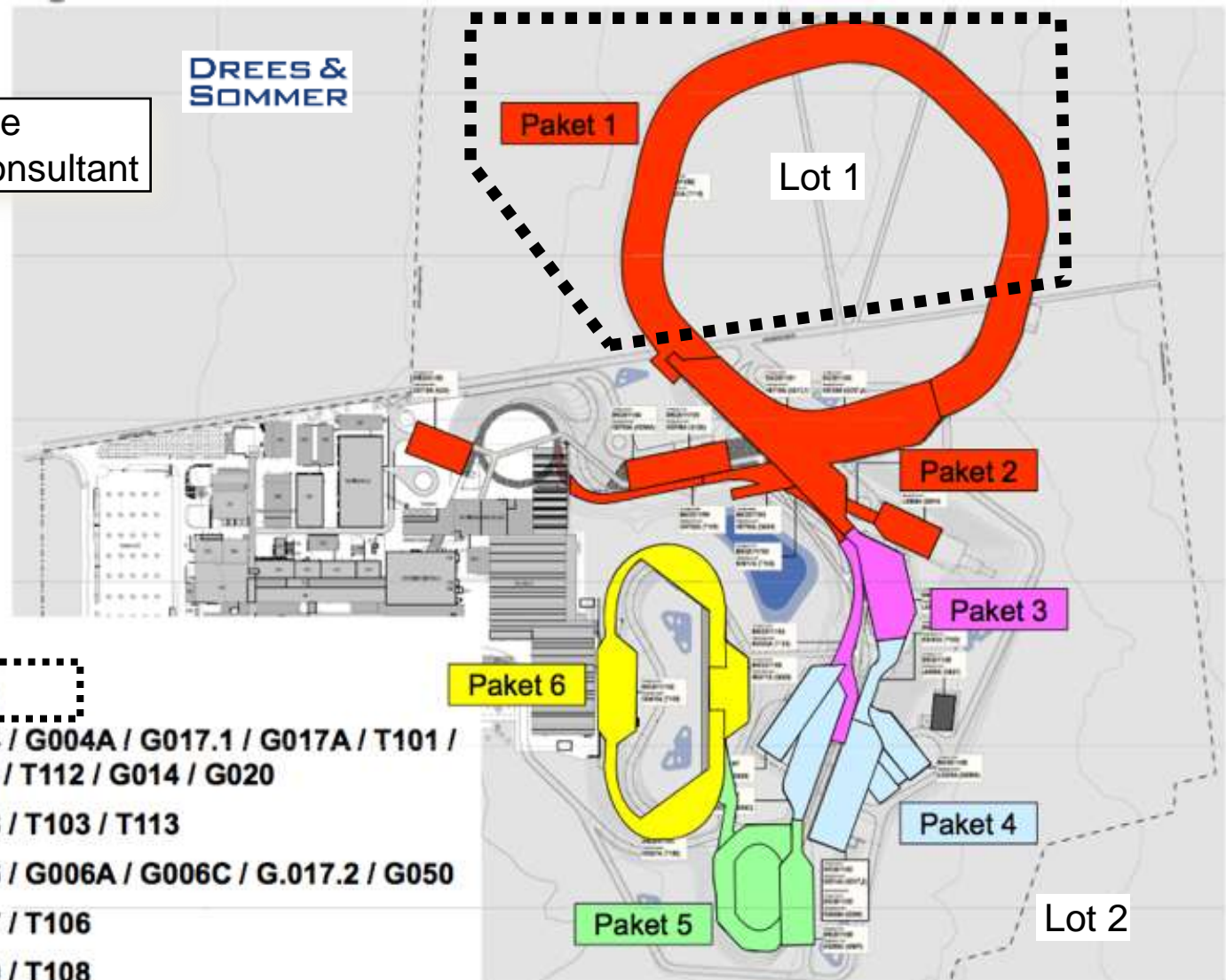
Primary SN isotopes

<p>Co 56 77,26 d ε; β⁺ 1,5... γ 847; 1238; 2598; 1771; 1038...</p>	<p>Ni 56 6,075 d ε; no β⁺ γ 158; 812; 750; 480; 270...</p>
<p>Ni 59 7,5 · 10⁴ a ε; β⁺... no γ; σ 77,7 σ_{n, α} 12,3 σ_{n, p} 1,34</p>	<p>SN isotopes</p>

Construction packages

DREES & SOMMER

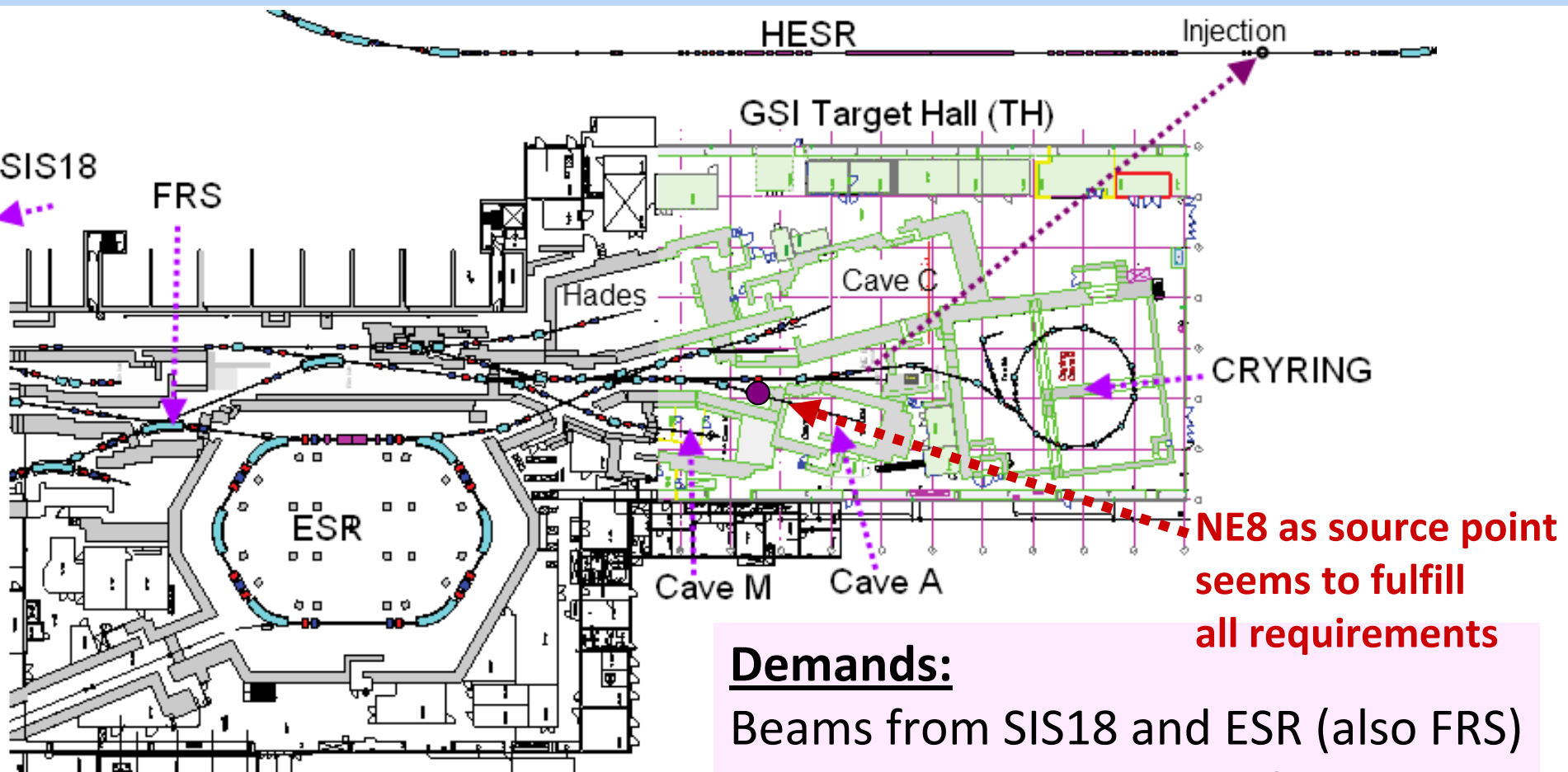
As suggested by the Project Steering Consultant



exemplary

- Paket 1** T110
- Paket 2** G004 / G004A / G017.1 / G017A / T101 / T104 / T112 / G014 / G020
- Paket 3** G018 / T103 / T113
- Paket 4** G006 / G006A / G006C / G.017.2 / G050
- Paket 5** G007 / T106
- Paket 6** G009 / T108

Spatial conditions in the HEBT behind SIS18/ESR

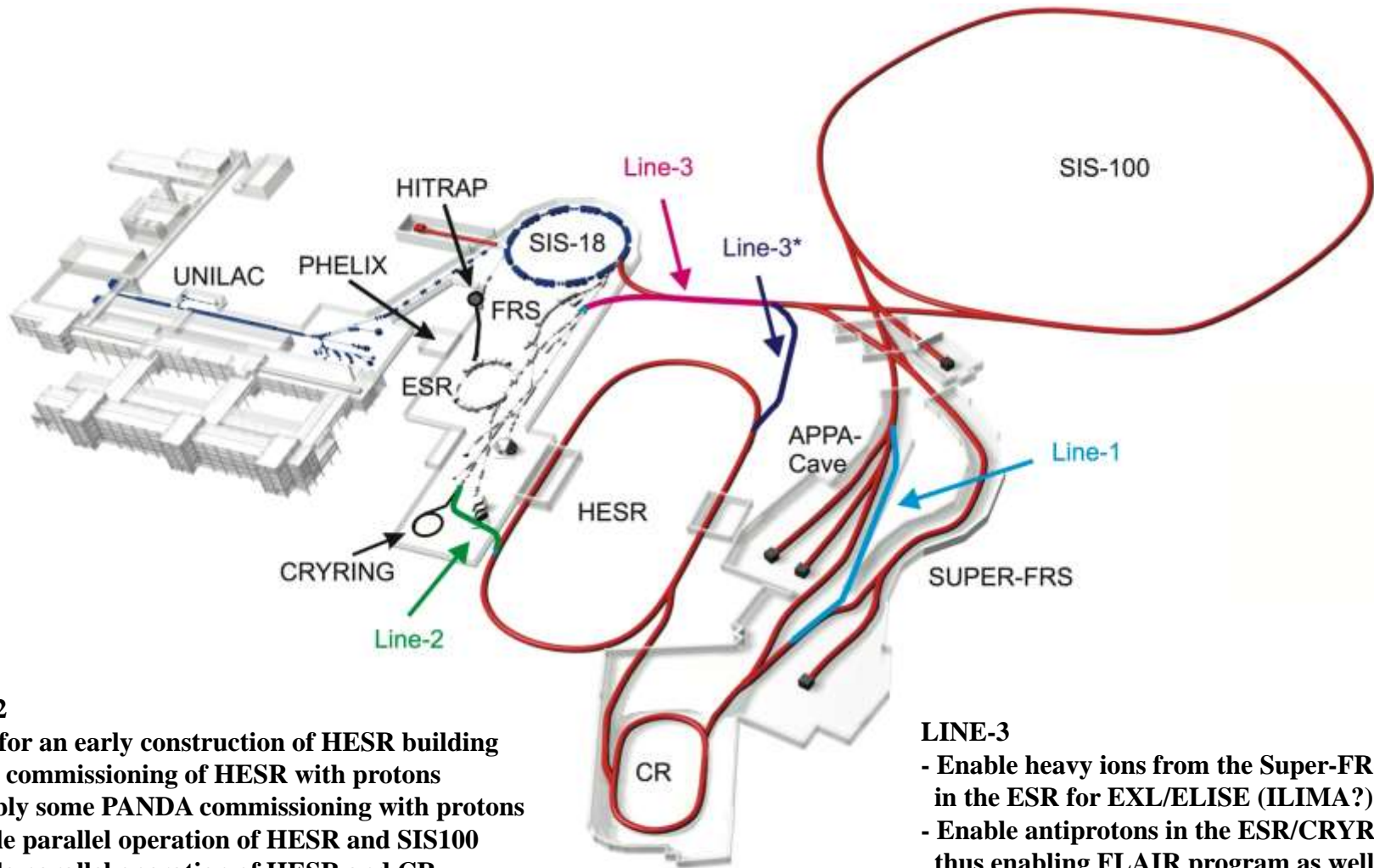


**NE8 as source point
seems to fulfill
all requirements**

Demands:

- Beams from SIS18 and ESR (also FRS)
- Existing caves still in use for expmts.
- Minimized costs
- Early realization (2017/2018)

Extensions of the MSV of FAIR



LINE-2

- Push for an early construction of HESR building
- Early commissioning of HESR with protons
- Possibly some PANDA commissioning with protons
- Enable parallel operation of HESR and SIS100
- Enable parallel operation of HESR and CR
- Realization of SPARC program at the HESR
- Realization of a part of ILIMA with ESR-HESR

LINE-3

- Enable heavy ions from the Super-FRS in the ESR for EXL/ELISE (ILIMA?)
- Enable antiprotons in the ESR/CRYRING, thus enabling FLAIR program as well as hadron physics with slow antiprotons

First realization of an RIB electron collider setup at the ESR

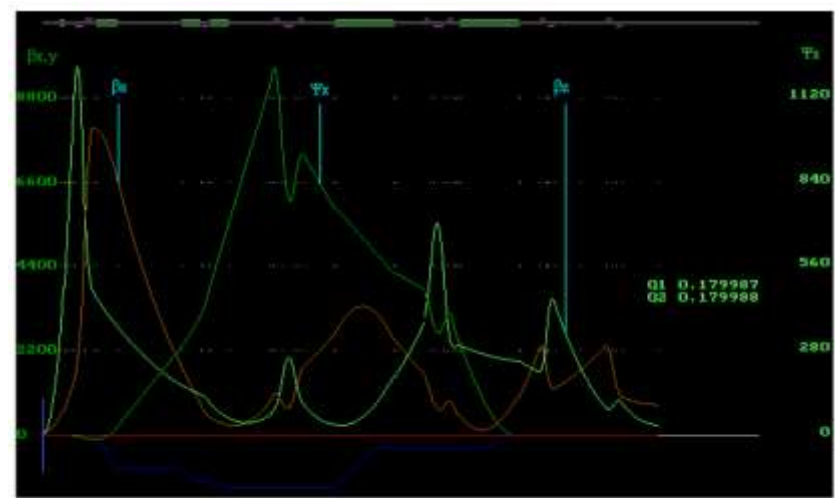
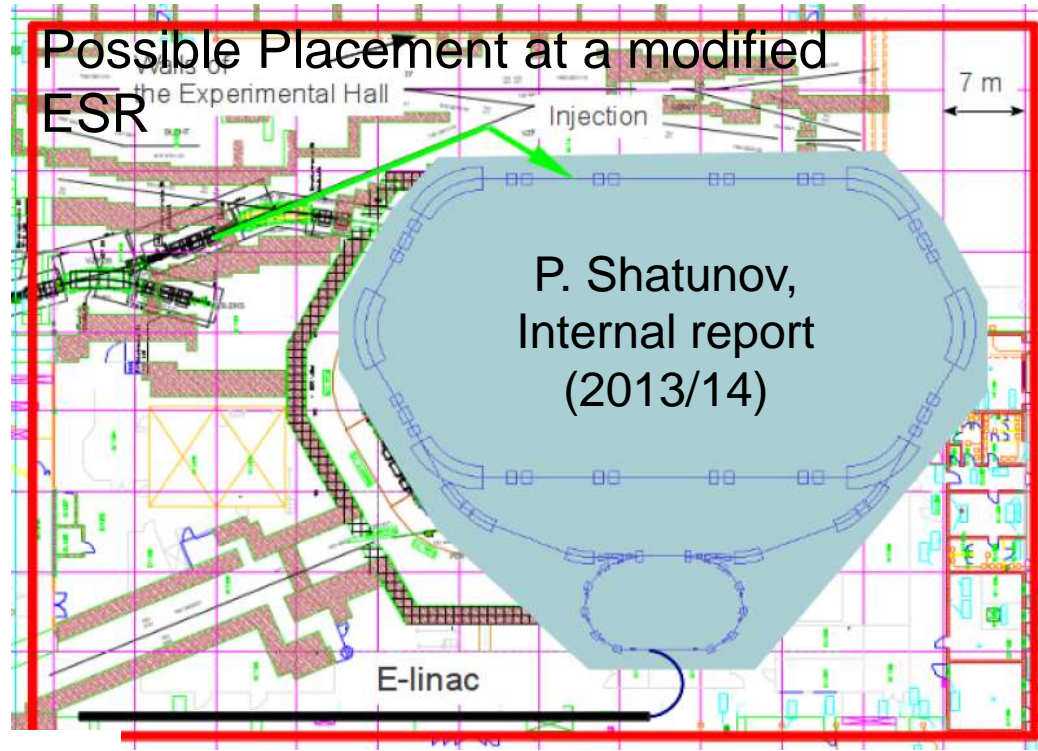
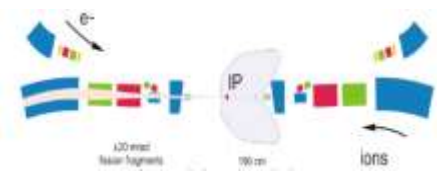
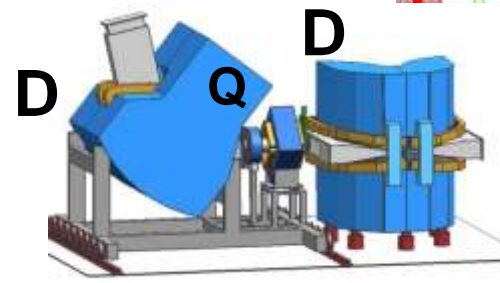


Figure 9. Beta (β , cm) and dispersion (Ψ , cm) functions of stretched ESR (1 half) in the collider mode.



GPA Berg et al.,
 NIM **A640** (2011) 123
 NIM **A659** (2011) 198



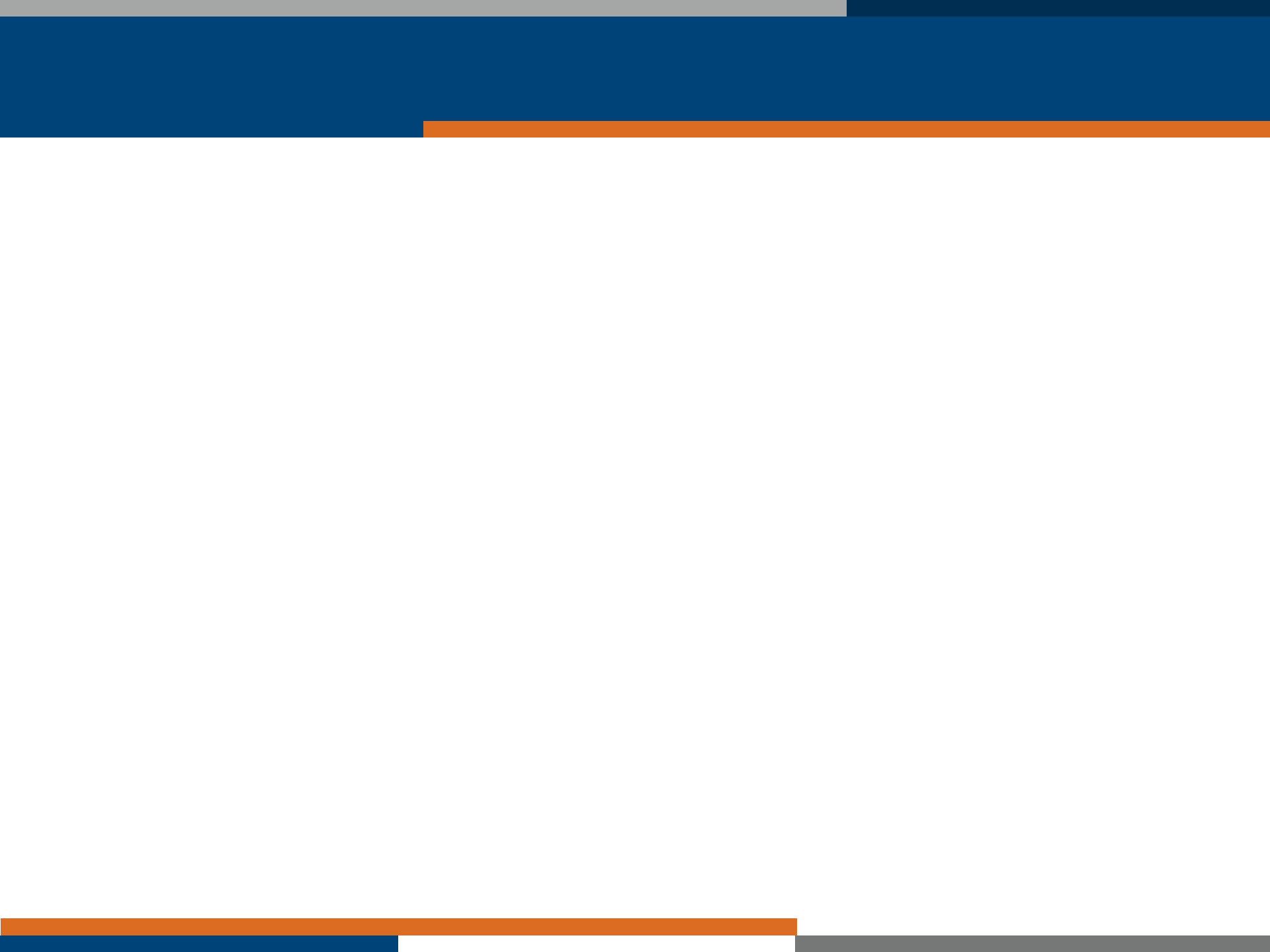
ELISe Collaboration
 NIM **A637** (2011) 60



H. Simon ● ELISe: potential paths ...

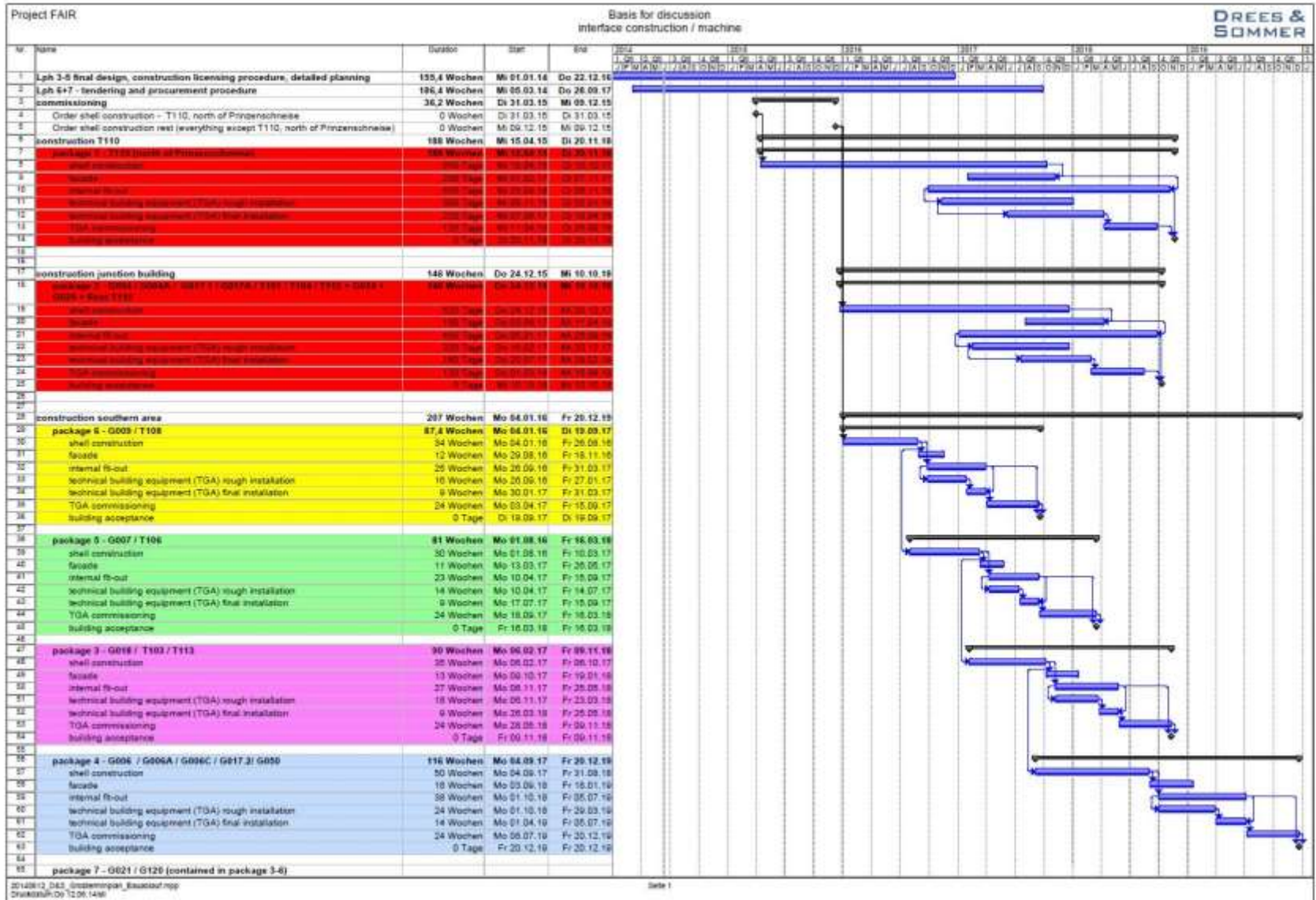






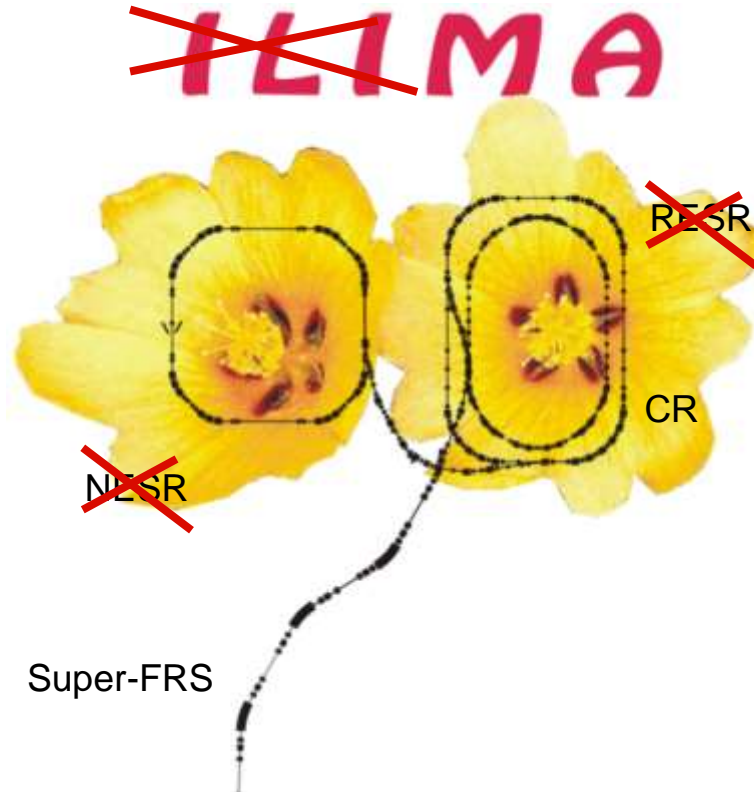
Construction timeline

exemplary (realistic: Dresd 12.5.2014)



Isomeric Beams, Lifetimes

FAIR - CORE Facility



FAIR - Modularized
Start Version (MSV)

FAIR - CORE Facility



ILIMA (Isomeric Beams, Lifetimes, Masses)

FAIR - MSV



MA (Masses)

Multiple Resonant Schottkies



LIMA (Lifetimes, Masses)

ILIMA @ HESR



ILIMA (Isomeric Beams, Lifetimes, Masses)

ILIMA @ CR, HESR, ESR and
CRYRING



Extended ILIMA even beyond original LOI

NESR? → Experiments with isomeric beams with ELISE and EXL setups