The NUSTAR facility
(NUclear STructure Astrophysics and Reactions)

e.g.
LASPEC
MATS

Low-Energy Branch

Pre-Separator

Main-Separator

High-Energy Branch

R³B: reactions

Production Target

SIS-200

Ring Branch

100 m
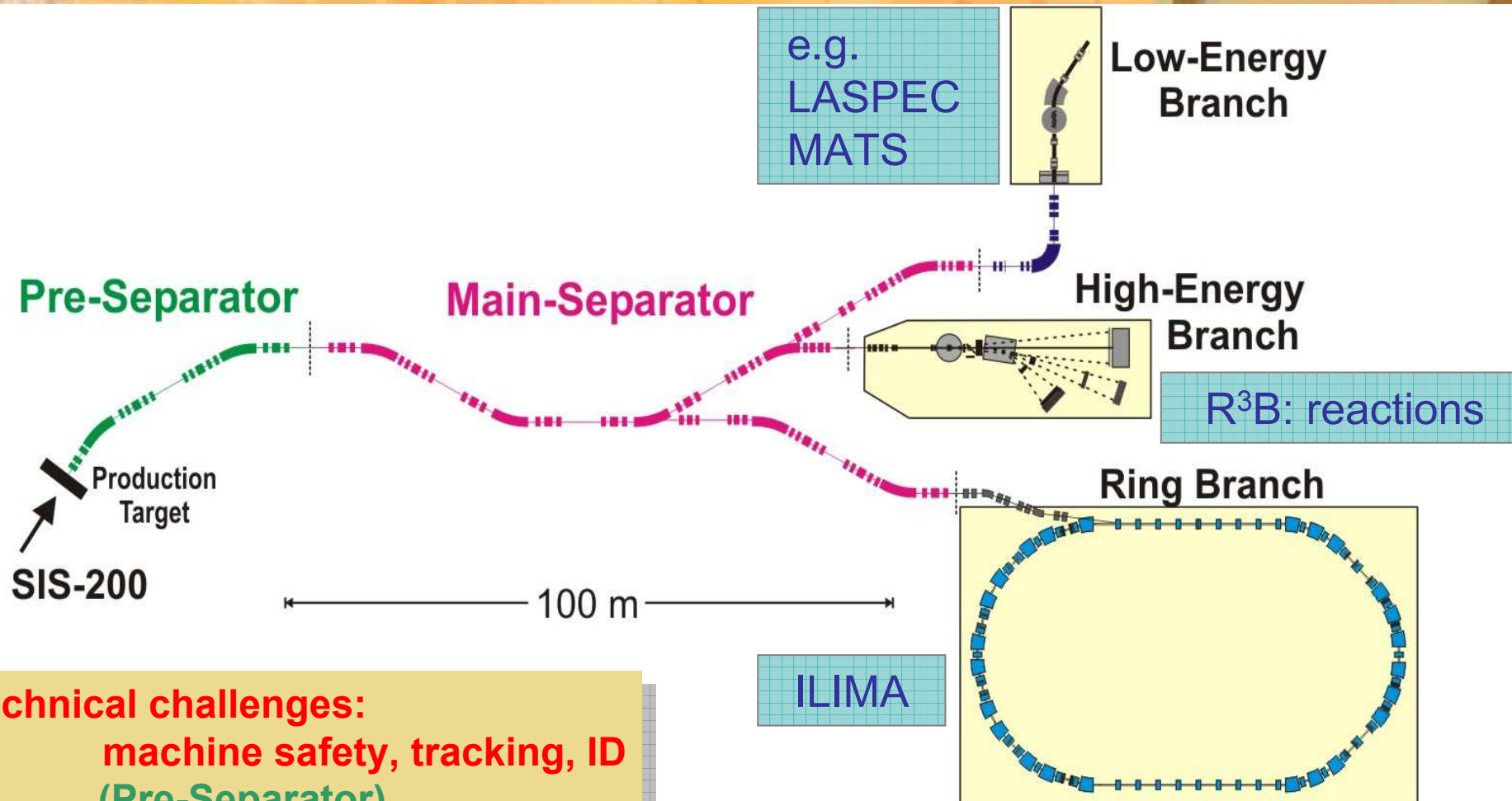
Technical challenges:
machine safety, tracking, ID
(Pre-Separator)

ILIMA

EXL   : hadron scattering
ELISe : electron scattering
AIC   : antiproton scattering

Diamond Detectors

- current readout for single crystal (a few mm²)
- strip readout for polycrystaline diamonds (a few cm²)
- very good homogenity and radiation hardness
- price from a few 100 €/cm² to 1000 €/cm²
- readout electronics (in some m's distance)
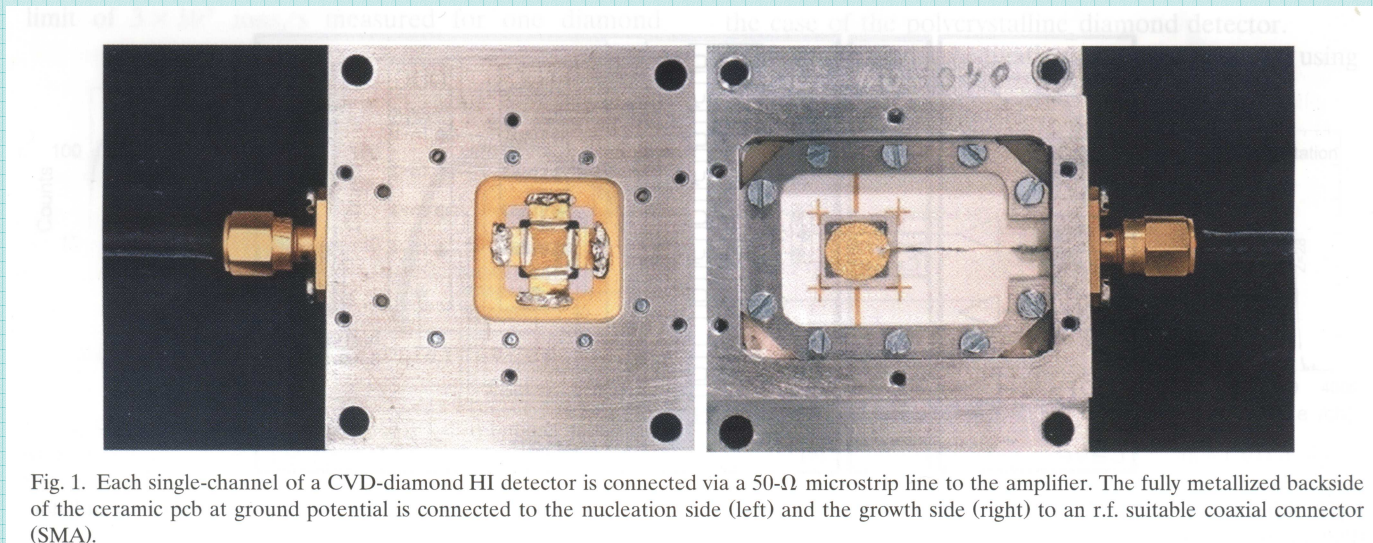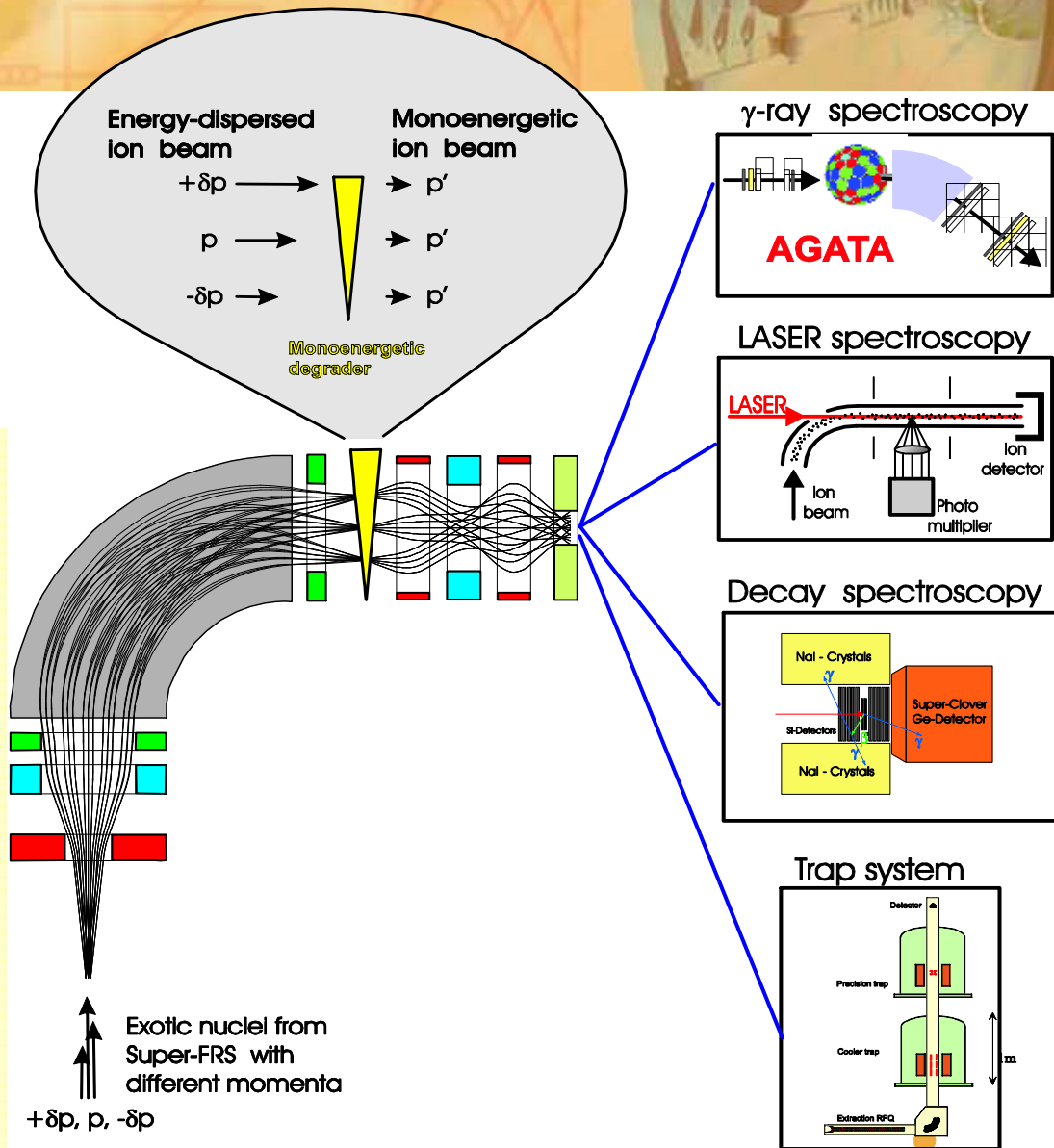- timestamp distribution throughout FAIR facility

Fig. 1. Each single-channel of a CVD-diamond HI detector is connected via a 50-Ω microstrip line to the amplifier. The fully metallized backside of the ceramic pcb at ground potential is connected to the nucleation side (left) and the growth side (right) to an r.f. suitable coaxial connector (SMA).
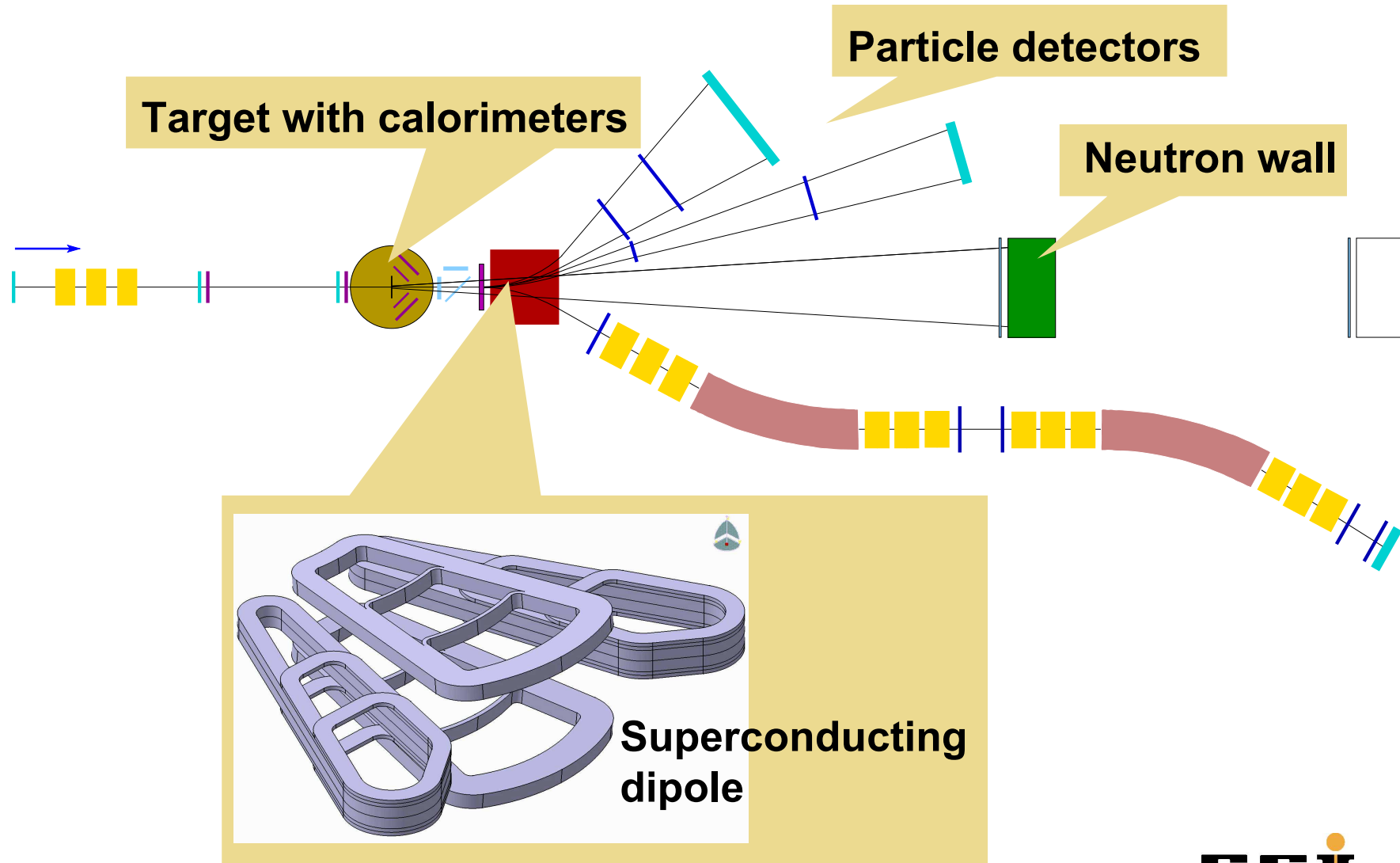
Low-energy branch

Energy-bunched

slowed-down and

stopped beams

- Decay spectroscopy

  (DESPEC)

- In-flight γ spectroscopy

  (3 – 100 MeV/u)   (HISPEC)

- Laser spectroscopy (LASPEC)

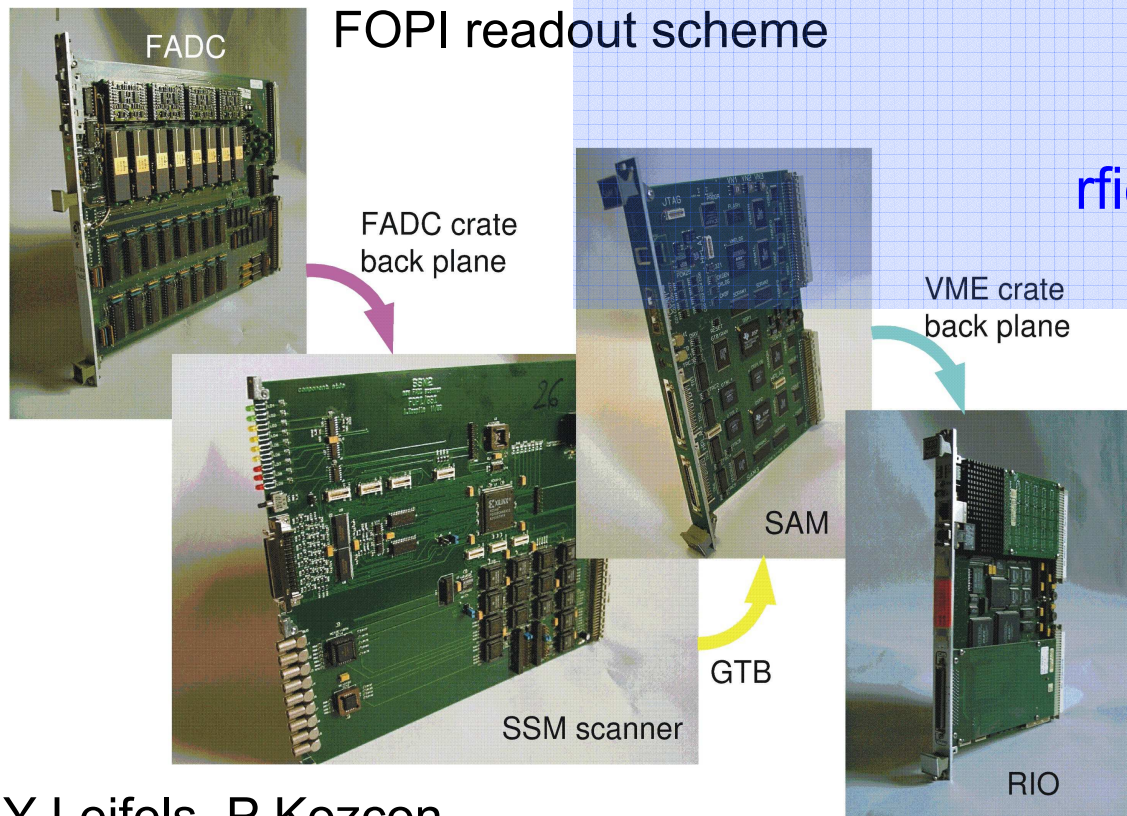- Ion traps   (MATS)

- Neutron capture   (NCAP)

Energy-dispersed ion beam → Monoenergetic ion beam

$+\delta p \rightarrow$ → p'

$p \rightarrow$ → p'

$-\delta p \rightarrow$ → p'

Monoenergetic degrader

Exotic nuclei from Super-FRS with different momenta
$+\delta p, p, -\delta p$

γ-ray spectroscopy

AGATA

LASER spectroscopy

Decay spectroscopy

Trap system

GSI

R3B:
Reactions with Relativistic Radioactive Beams

Particle detectors

Target with calorimeters

Neutron wall

Superconducting dipole

GSI

e.g.: MBS + SAM + (Tacquila, …)

Standardized systems are to be realized

FOPI readout scheme

**multiprocessor
digital signal processing
rfio to disk array or tape robot**

FADC

FADC crate
back plane

VME crate
back plane

SAM

GTB

SSM scanner

RIO

Y.Leifels, P.Kozcon

GSI

Ring Branch

Collector Ring
bunch rotation
adiabatic debunching
fast stochastic cooling
isochronous mode

from Super-FRS

e,pbar storage ring

NESR
electron cooling
experiments

AIC, ELISe

ILIMA

EXL

RESR
deceleration (1T/s) to 100 - 400 MeV/u
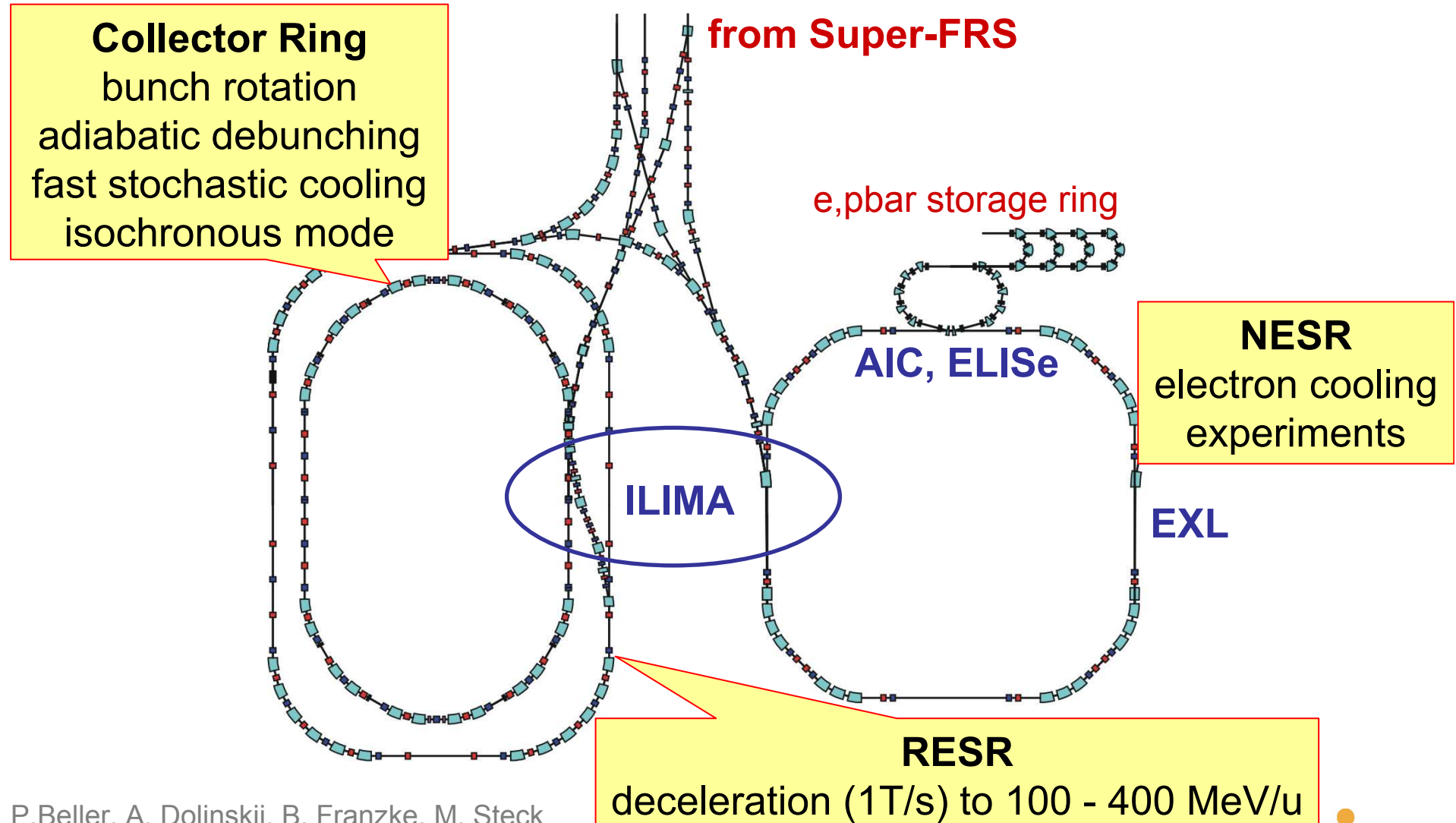
P.Beller, A. Dolinskii, B. Franzke, M. Steck

GSI

EXL
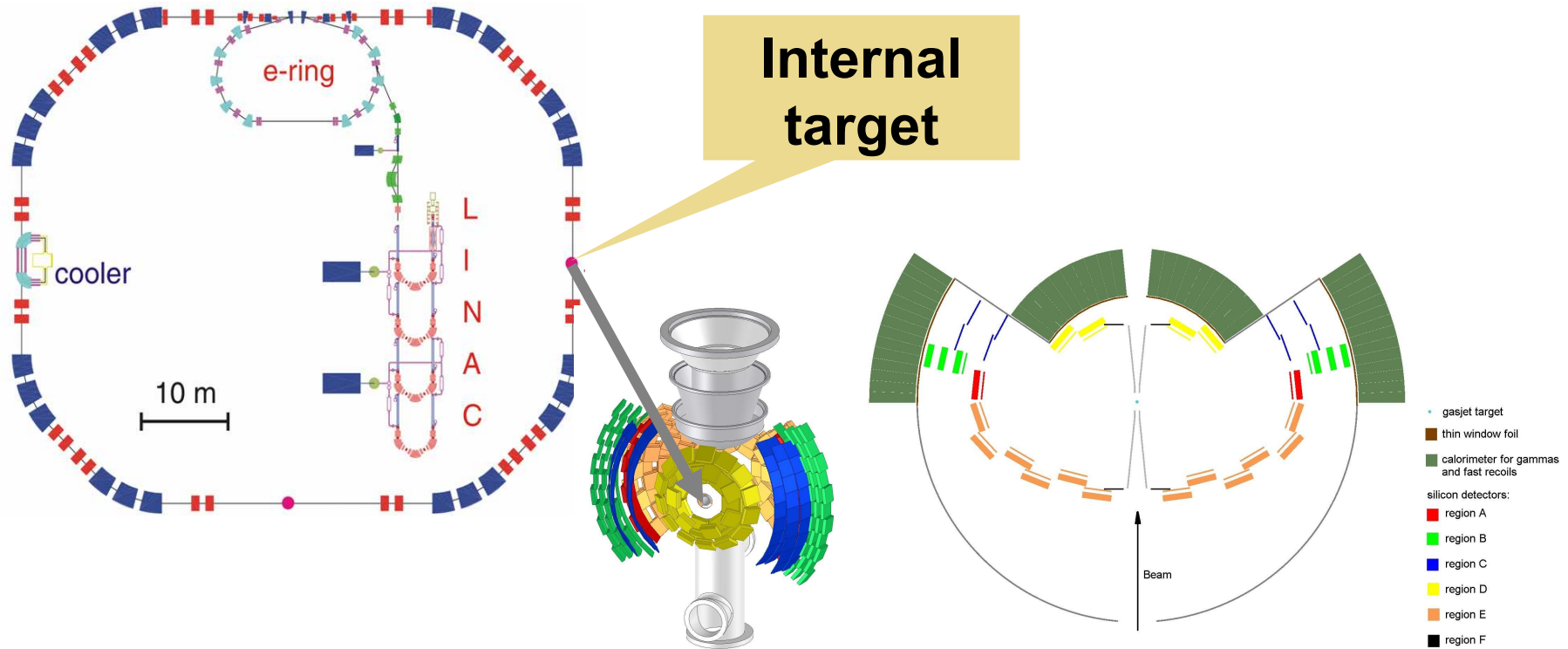
Internal target

NESR

- **Target-Recoil and Gamma Detector**
- **around internal target**

- gasjet target
- thin window foil
- calorimeter for gammas and fast recoils

silicon detectors:
- region A
- region B
- region C
- region D
- region E
- region F

Beam

Recoil and Gamma Array

10 cm

gasjet target

thin window foil

scintillator hodoscope
for γ-rays and fast recoils

silicon detectors:

region A

region B

region C

region D

region E

Beam
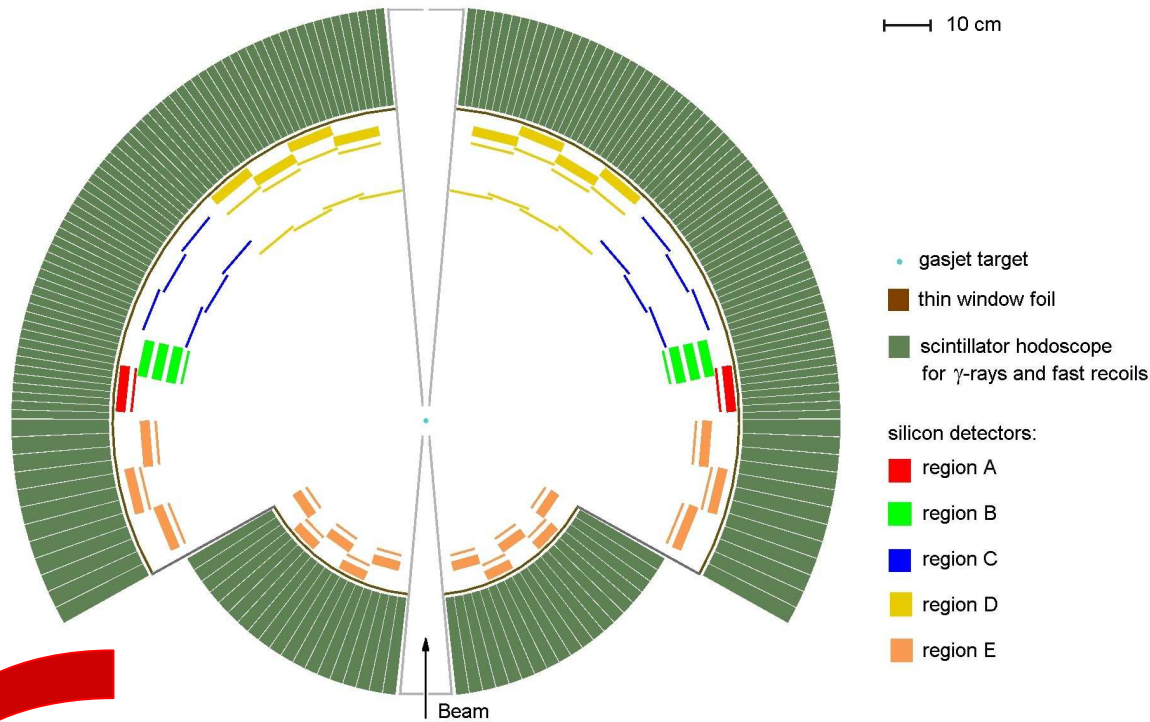
Si DSSD ⇨ **ΔE, x, y**
300 μm thick, spatial resolution
better than 500 μm in x and y,
ΔE = 30 keV (FWHM)

Thin Si DSSD ⇨ **tracking**
<100 μm thick, spatial resolution
better than 100 μm in x and y,
ΔE = 30 keV (FWHM)

Si(Li) ⇨ **E**
9 mm thick, large area
100 x 100 mm^2,
ΔE = 50 keV (FWHM)

CsI crystals ⇨ **E, γ**
High efficiency, high resolution,
20 cm thick

GSI
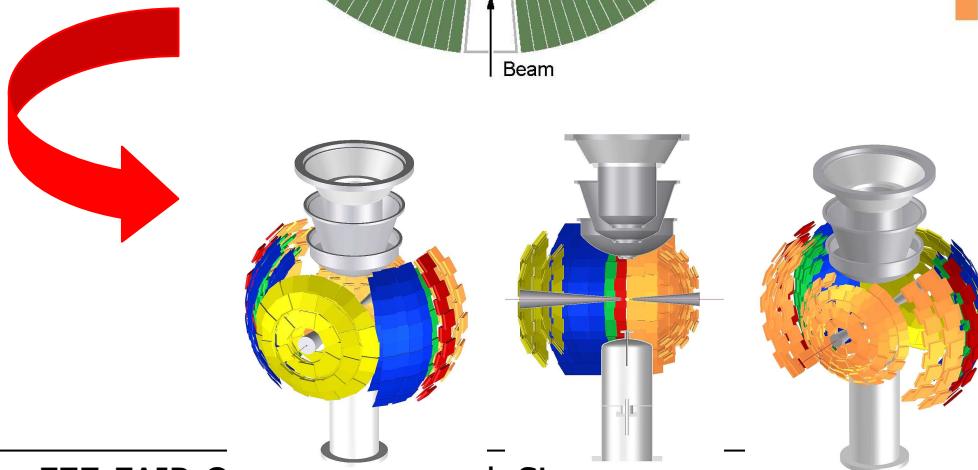
NUSTAR / 457 collaborators

NUSTAR/STORIB

NUSTAR/R³B

- GHz sampling
- slow control coupling
- PSD …

- triggered
- coupling to SuperFRS

NUSTAR/LEB

- decay studies
- slow control coupling
- MHz sampling + PSA
- …
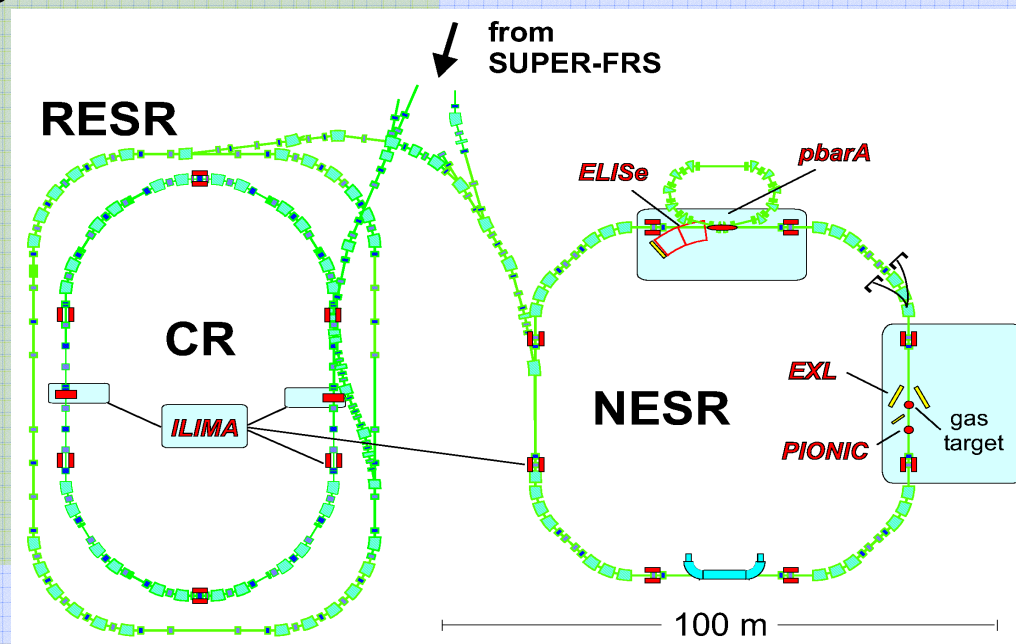
→ *Common DAQ developments*

What should a common DAQ provide ?

- **DAQ system:**

  Generalized readout scheme for triggered and ‚triggerless' systems, FEE ‚templates'

- **Framework** → Interoperability between experiments

- **Event format** → Common Analysis Clients

- **Taping/Mass Storage**

GSI

FEE, FEC requirements …

- Synchronisation of standalone DAQ systems along the beam line
- Time distribution system (TDS)

- Firmware upload scheme
- Slow control
- Feedback loops

- Monitoring ! (Increasing complexity, no connectors, …)
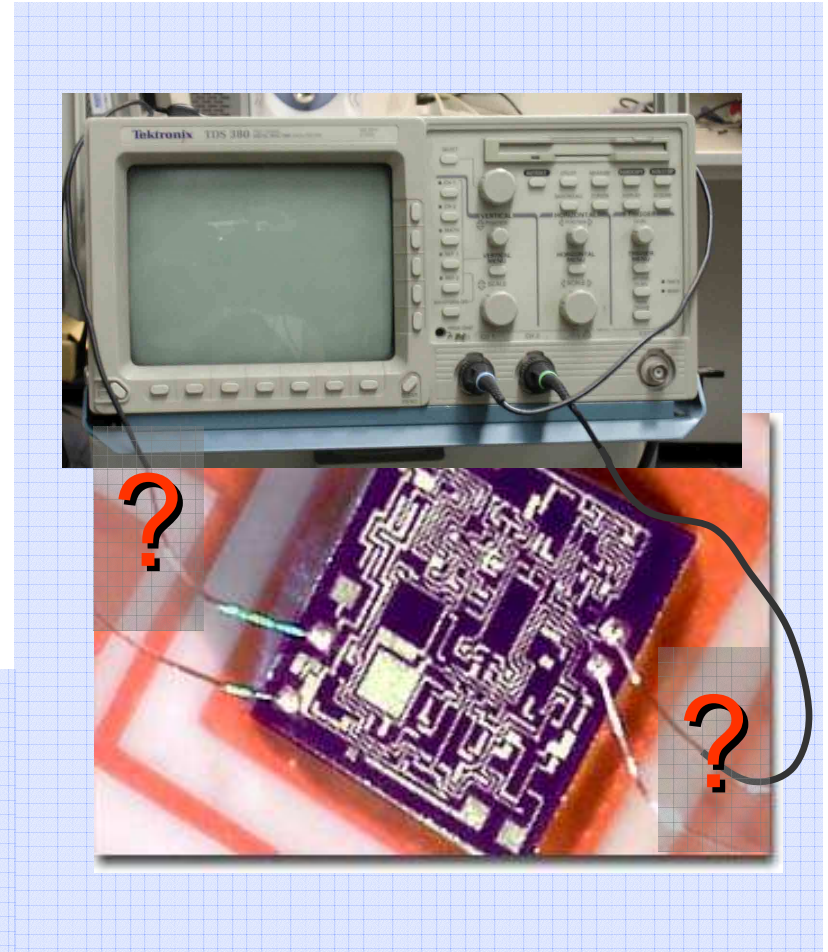
Discussion topics

a. FEE: various detector types

b. FEE: spectroscopy (dynamic range)

c. FEE: trigger schemes

d. common infrastructures ?

   e.g.: FAIR wide time distribution system

→ common developments ?

FIN