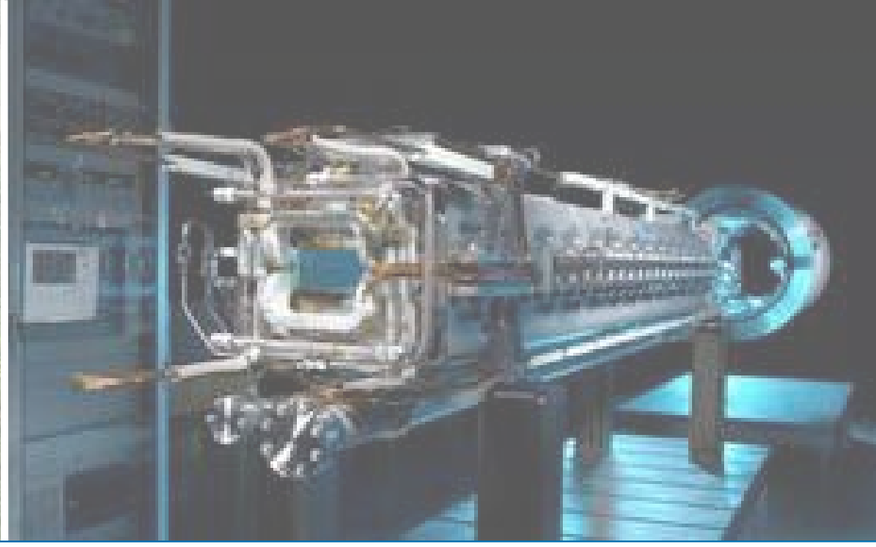

APPA Experiments at FAIR:

integration in the control system

A.Bräuning-Demian
for APPA collaborations,

with support from: A. Blazevic, Ch. Gräff, A. Kalinin, B. Merk, W. Nörthershäuser, N. Petridis, R. Pleskac, R. Sanchez, D. Winters…..

Finland France Germany India Poland Romania Russia Slovenia Sweden UK Czech Rep.

Outline

APPA at FAIR: who are we?

- Collaborations
- Working areas
- Setups / Experiments

What for do we need support?

- permanent and temporary component integration in the accel control system
- special information from the controls to be integrated in the experiment DAQ
- users access to the controls for optimisation
- implementation of special features
- assistance by configuration changes

What kind of support?

- specialized man power for design, implementation and commissioning
- specialized assistance by non standard applications
- starting with now, a permanent support will be needed

What I will not present today : a detailed list of activities and a time line.

We do have a catalogue draft which we can provide to help the evaluation of the needed resources.

Bringing APPA under control…….reloaded

Minutes Controls APPA cave

Anwesend: F. Hagenbuck, A. Krämer, R. Bär, D. Severin, A. Braeuning-Demian

Date: 25.08. 2017

Subject: For the beam transport and control along the two beam lines from APPA cave, the APPA collaborations propose to include the magnets, beam diagnostics and vacuum valves along the beam lines in the HEBT control system. For beam transport to the target points, placed at the end of the two beam lines, and the initial beam setting **the operators need access** to the above mentioned components. Therefore, the collaborations suggest integrating them in the accelerator/beam transfer lines control system. However, **local control over the beam is requested** also, for final settings and changes during the experiments without the intervention of the operators from the main control room.

For a decision concerning the feasibility (technical requirements and man power) following points still need some clarifications from the collaborations:

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APPA collaborations at FAIR

- **Who is APPA?**

  BIOMAT: Biophysics and Material science
  HED@FAIR: Plasma physics
  SPARC: Atomic physics

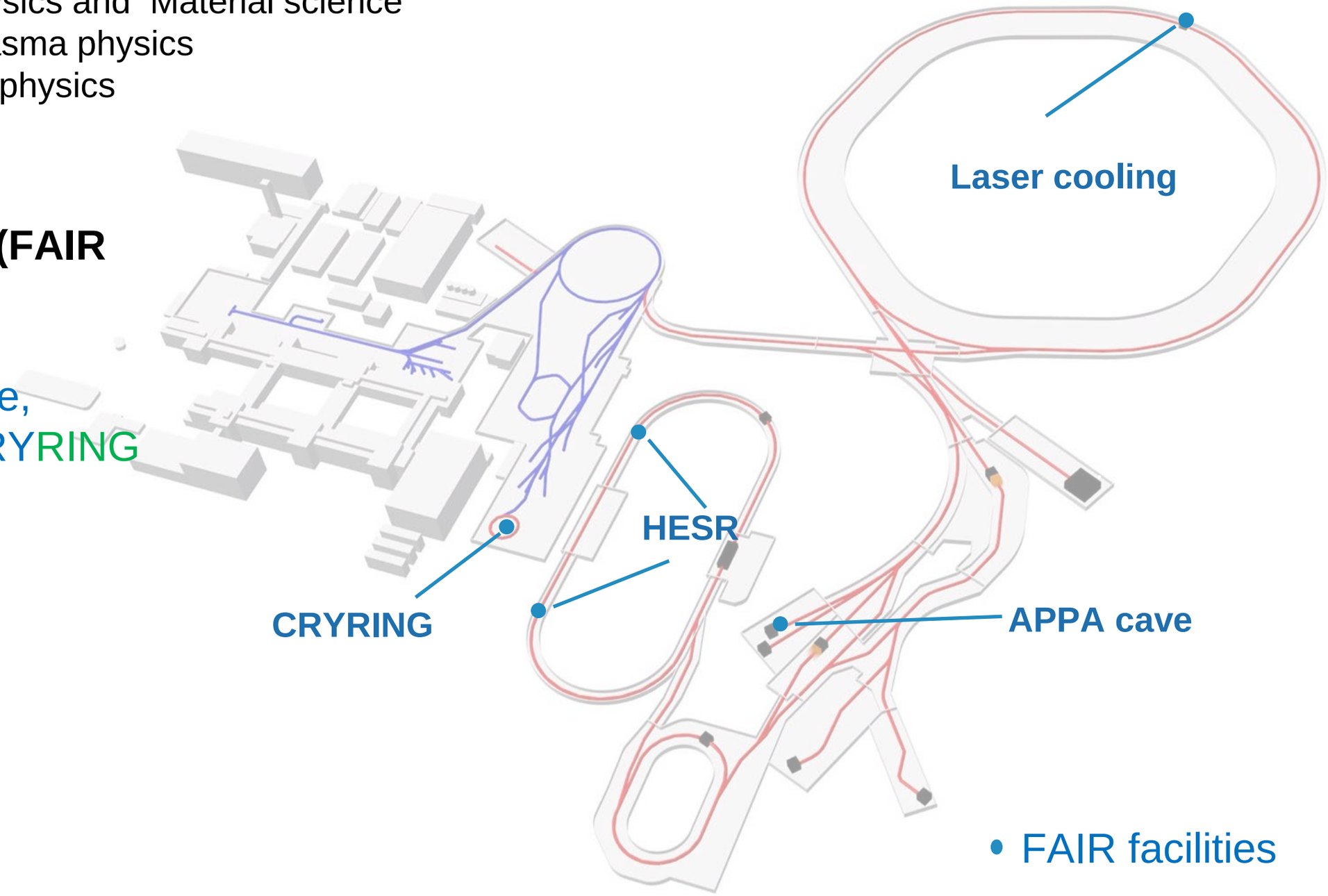
APPA collaborations at FAIR

- **Who is APPA?**
  BIOMAT: Biophysics and Material science
  HED@FAIR: Plasma physics
  SPARC: Atomic physics

- **Working areas (FAIR Green paper**)

@FAIR: APPA cave,
SIS100, HESR, CRYRING

Experimental areas for Day-1 experiments



- FAIR facilities

APPA collaborations at FAIR

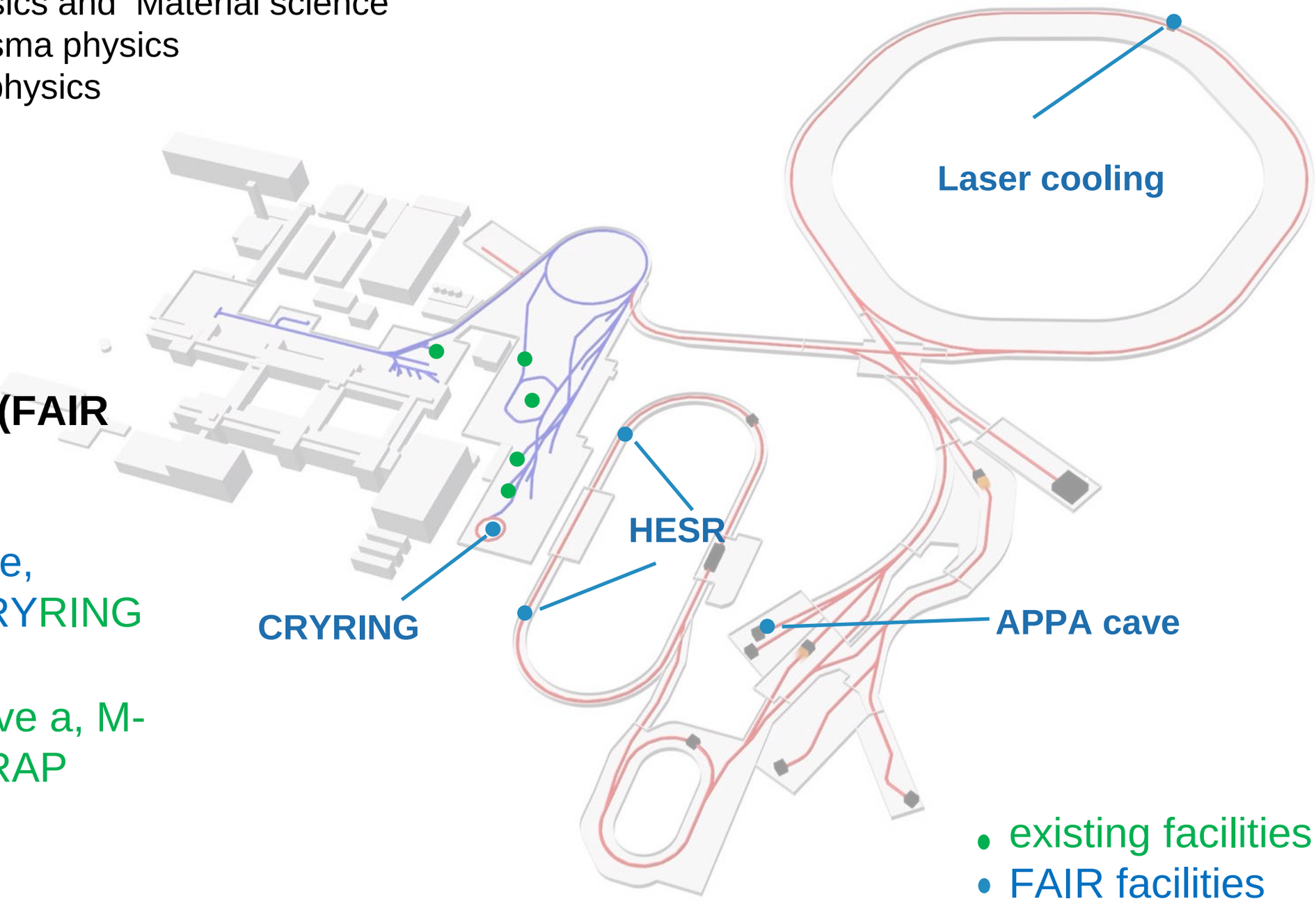
- **Who is APPA?**
  BIOMAT: Biophysics and Material science
  HED@FAIR: Plasma physics
  SPARC: Atomic physics

- **Working areas (FAIR Green paper)**

@FAIR: APPA cave, SIS100, HESR, CRYRING

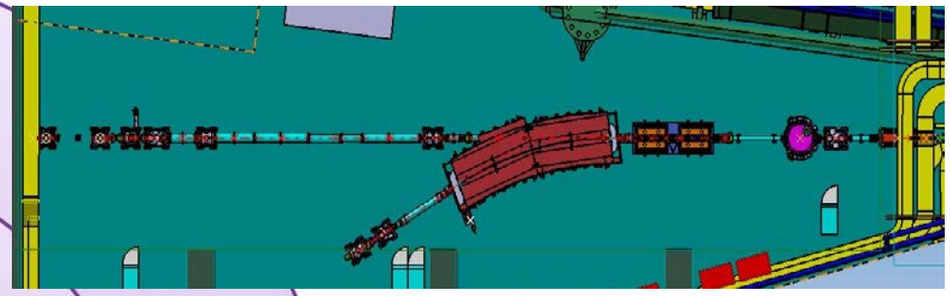
@GSI: cave M, cave a, M-branch, ESR, HITRAP

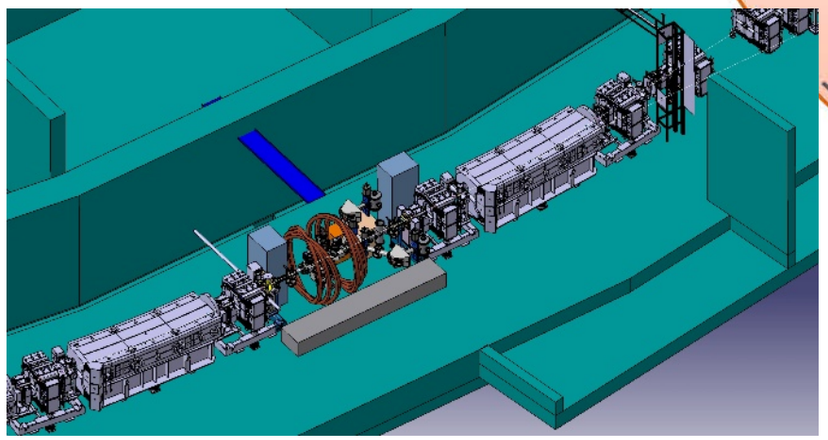
Experimental areas for Day-1 experiments

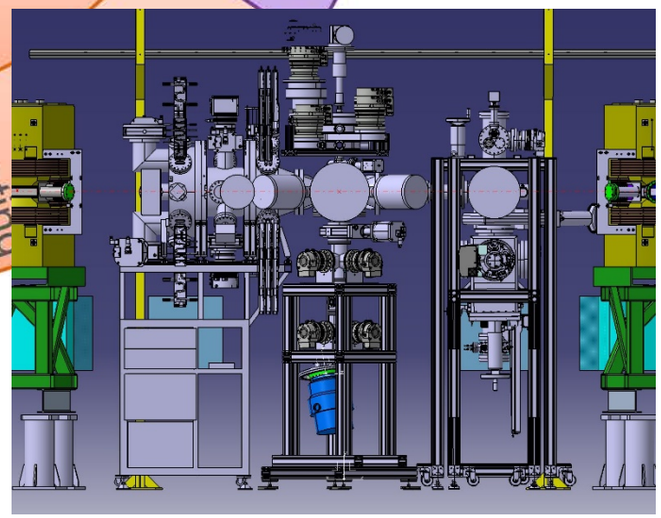


APPA Setups and Experiments

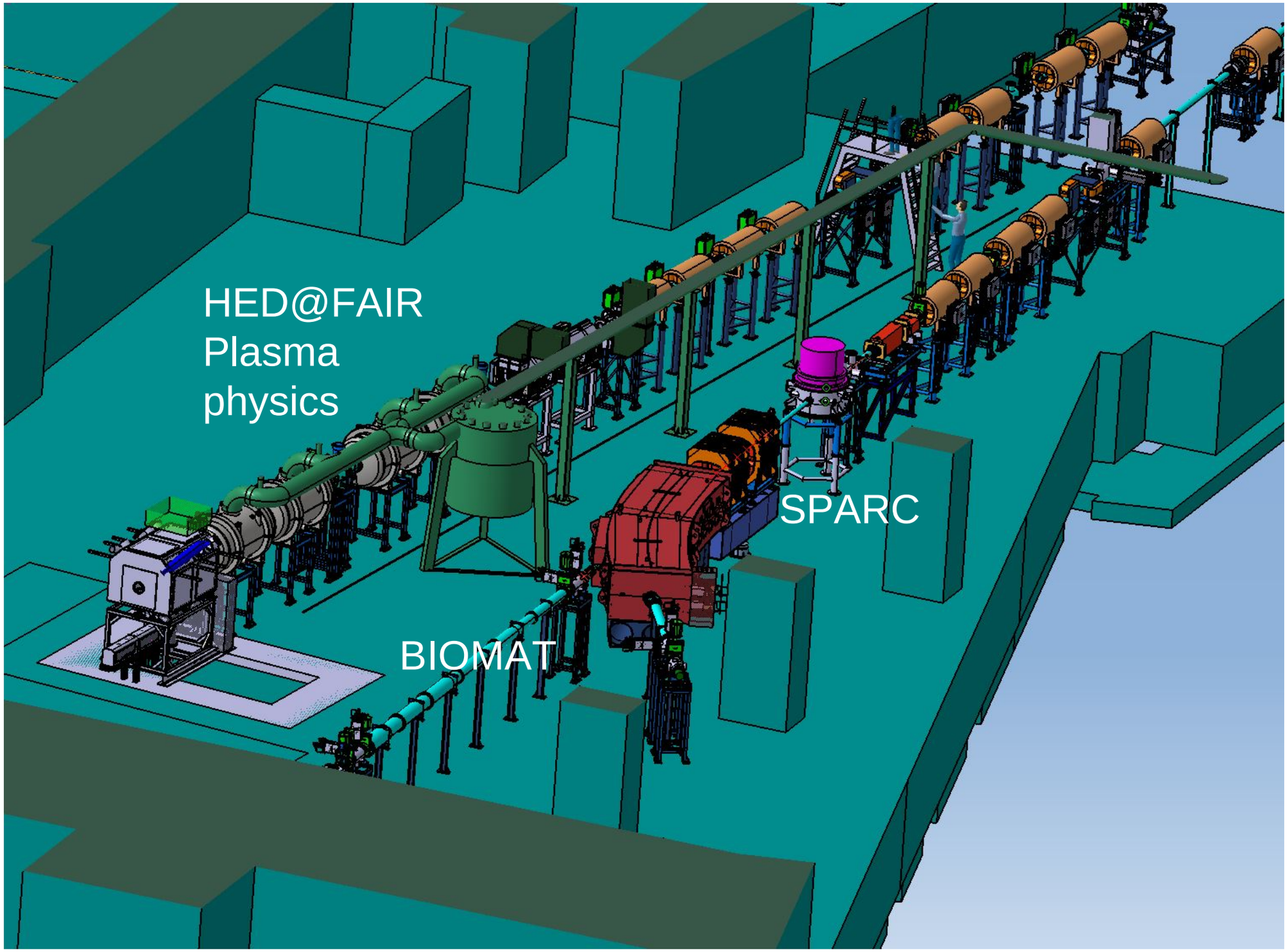
‘small’, variable setups





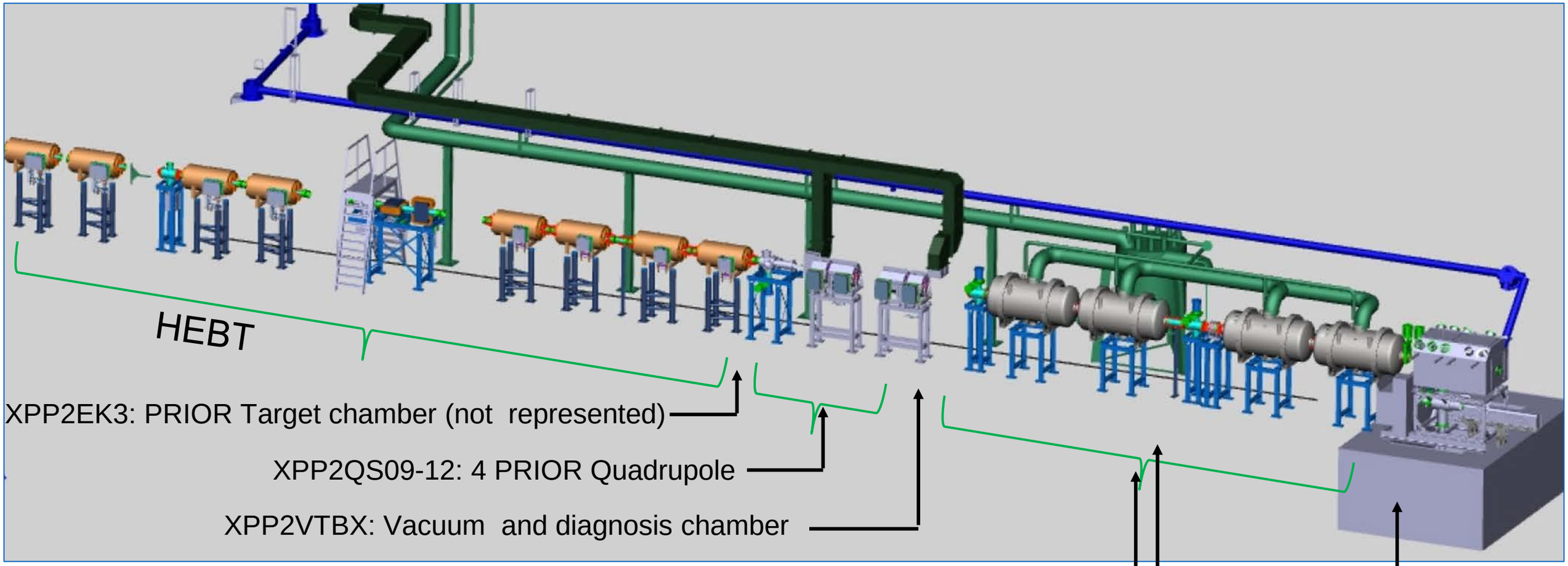


APPA cave area



- all collaborations
- two beam lines
- 5 target points
- variable setups
- no parallel operation
- beams from SIS18 and SIS100

The HED beam line



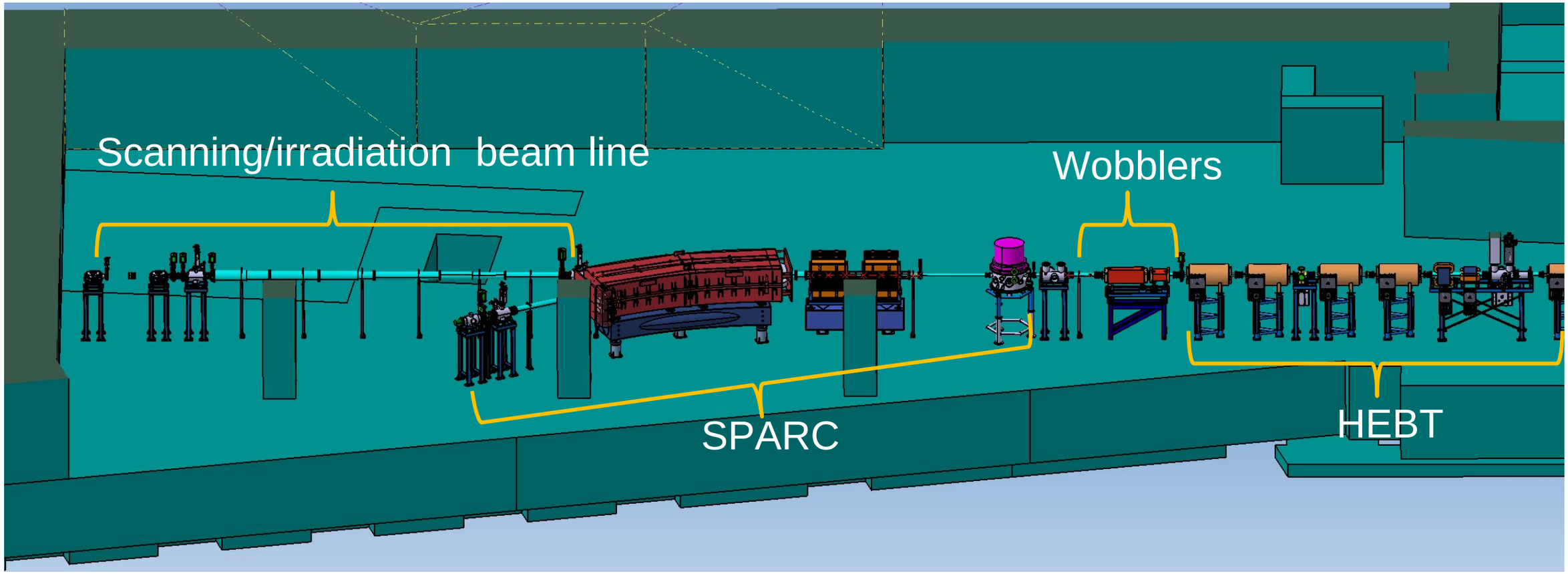
HED beam line control requirements

System	Component	Room
Beam transport	• 4 nc Quadrupole • 4 sc Quadrupole + Feedbox und Quenchprotection • 5-6 Valves	Control from HKC Control room HED
Beam Diagnose	• 2 Screens • 2 FCT	Control from HKC Control room HED
Vacuum control	• 2 Turbo-/Rough pumps Beam line • 5 Turbo-/Rough pumps form the Cryostat und Feedbox • 3 Turbo-/Rough pumps target chamber • Vacuum gauges	Control from HKC Control room HED
Timing and Timing Laser	• 1 Trigger 50 μs vor Ionenstrahl in TK, $\Delta t \leq 1$ ns • 1 periodisches Signal, f = 50 hz, 100 ms vor Strahl, Δt = 0,1 ns • 1 periodisches Signal, f = 0,5 (+-10%) Hz, 400 μs von Ionenstrahl in TK, $\Delta t \leq 0,5$ ns • 1 Triggersignal 4 μs von Ionenstrahl in TK, $\Delta t \leq 0,5$ ns	Control room HED
Work protection	• Interlock signals for cave and laser protection system	Control room HED

Specials:

- variable setup
- control also local, in the HED own control room
- Special beam manipulations
- stringent timing requirements

SPARC-BIOMAT beam line



- magnets, FAIR standard and non standard
- beam diagnostics
- valves
- vacuum pumps
- stepping motors
- compressed air actuators

Control:
standard and special request
for the different experiments

Biophysics – BIOMAT

General requirements

- (standard) beam diagnostic components included in the accelerator control system (BIOMAT beamline)
- (standard) vacuum components included in the accelerator control system (BIOMAT beamline)
- possibility to connect/disconnect components defined in the accelerator control system (BIOMAT beamline)
  - request on high flexibility of the BIOMAT beamline, especially at its end in the target area
  - on average, it happens once a year
- FAIR timing system (BIOMAT control room)
- analog signals from accelerator (BIOMAT control room, digital → analog signal)
- access to database of the accelerator control system (necessary for advanced analysis of experimental data)

Special requests

- beam on/off request (BIOMAT control room)
- fast cutoff of the beam delivery (BIOMAT control room)
- spill-start/spill-stop analog signal (BIOMAT control room; digital → analog signal)
- scanning of the beam (BIOMAT beamline + BIOMAT control room + FCC)
  - own scanning control system communicating with the accelerator control system
  - scanners are fully controlled by user himself including switching them on/off
- double-scattering system included in the accelerator control system (BIOMAT beamline + BIOMAT control room)

Biophysics - Cave M + Cave A

General requirements

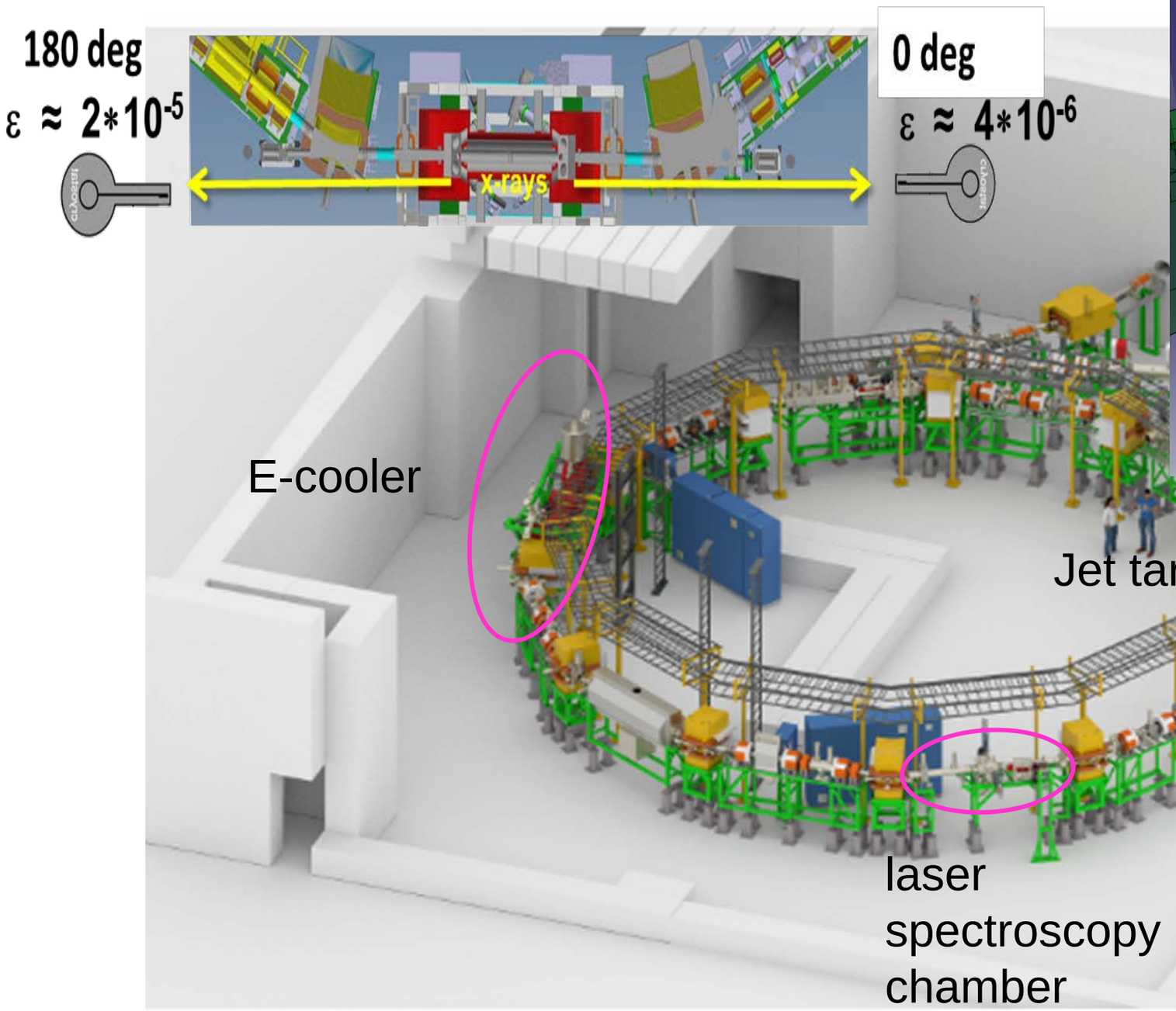
They are exactly the same as those for BIOMAT facility.

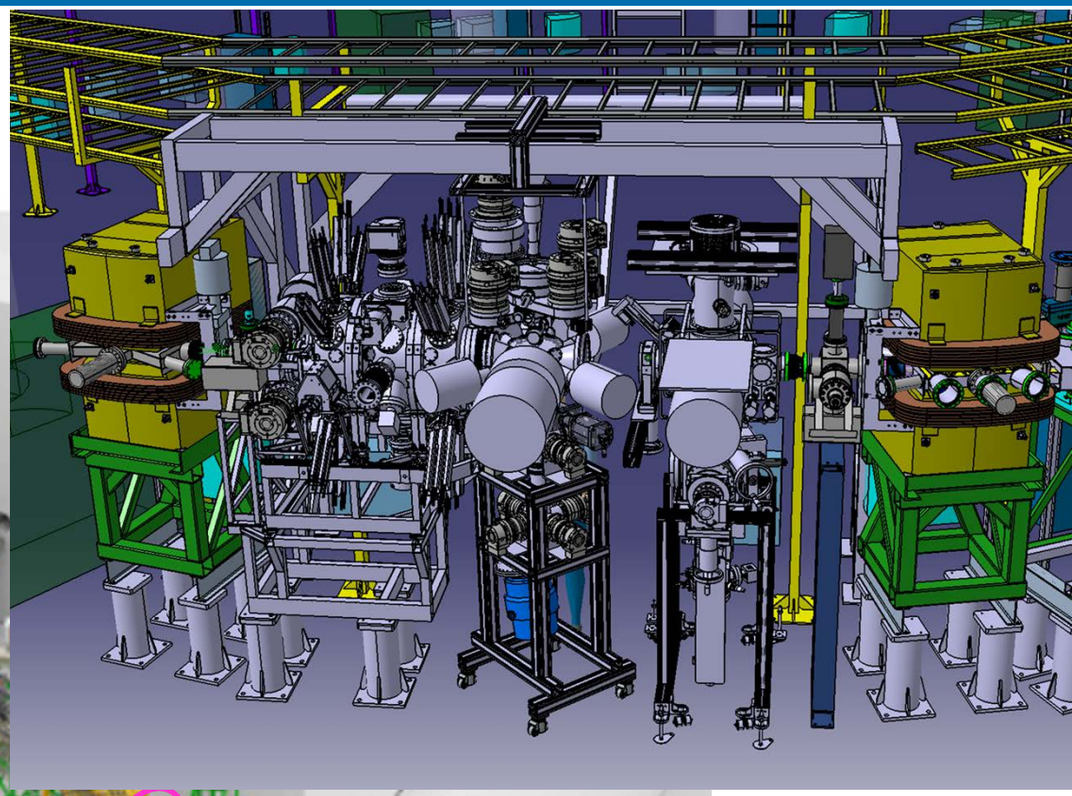
Special requests

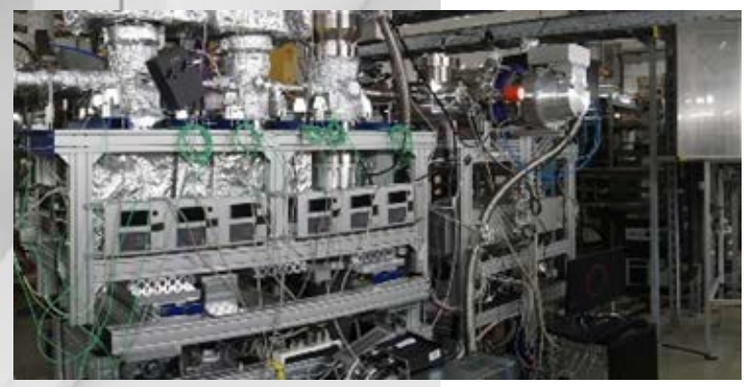
They are exactly the same as those for BIOMAT facility ***except for these two differences****:*

- ✓ *there is no double-scattering system in cave M / cave A*
- ✓ *scanning control system in cave M / cave A: a simplified 2D-table with set values for beam energy and intensity implemented into the accelerator control system*
  - ➢ *scanners are fully controlled by user himself - own scanning control system*

CRYRING


180 deg
ε ≈ 2*10-5
x-rays
0 deg
ε ≈ 4*10-6
E-cooler
Jet target
laser
spectroscopy
chamber





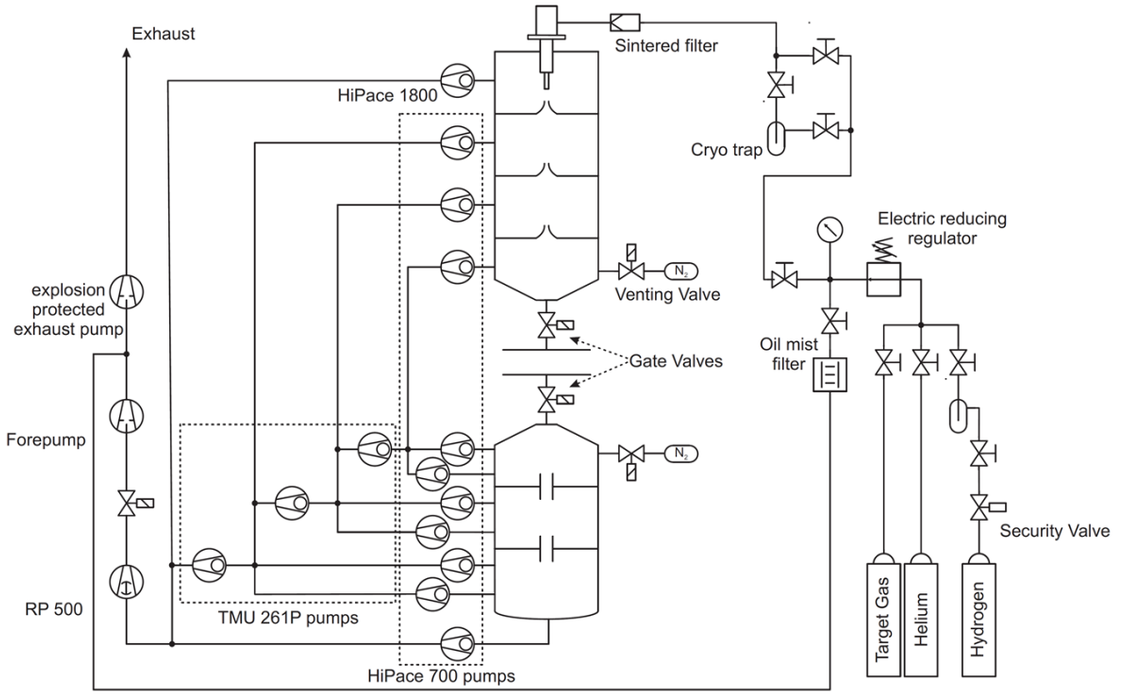
In-ring Experimentes

- variable setups, at different positions in the ring
- integrated in the ring
- detection system which are decoupled from the ring
- any change in the setup means intervention in the ring vacuum
- laser systems coupled to the ring
- the operation of the experiment is closely connected with the beam manipulation in the ring; some experiment component must be ‘touched’ by the control system at a defined time.
- user’s own control systems needs signals from the machine

+ once some functionalities defined for one ring they can be transferred to the next storage ring

Internal Jet Target at Storage Rings

- 14 turbomolecular pumps
- 1 roots pump and 2 fore-pumps
- 10 pressure gauges
- 4 vacuum valves (gate and
- venting valves)
- 10 gas-line-valves
- 4 stepping motors
- 2 pressure-regulators
- 2 manometers
- temperture controller
- target-switch (on/off)



Internal Target Station: Requirements for Controls

Vacuum Controls

Measurement of 12 input channels (analog signals) – inlet and dump chamber, fore-vacuum, in-ring vacuum
Control of 2 gate valves protecting the in-ring vacuum, control of 2 venting valves
Control of the gas line hydrogen security valve
Control of the start-up and close-down sequence of the target station vacuum
A detailed functional description will be provided by the target group

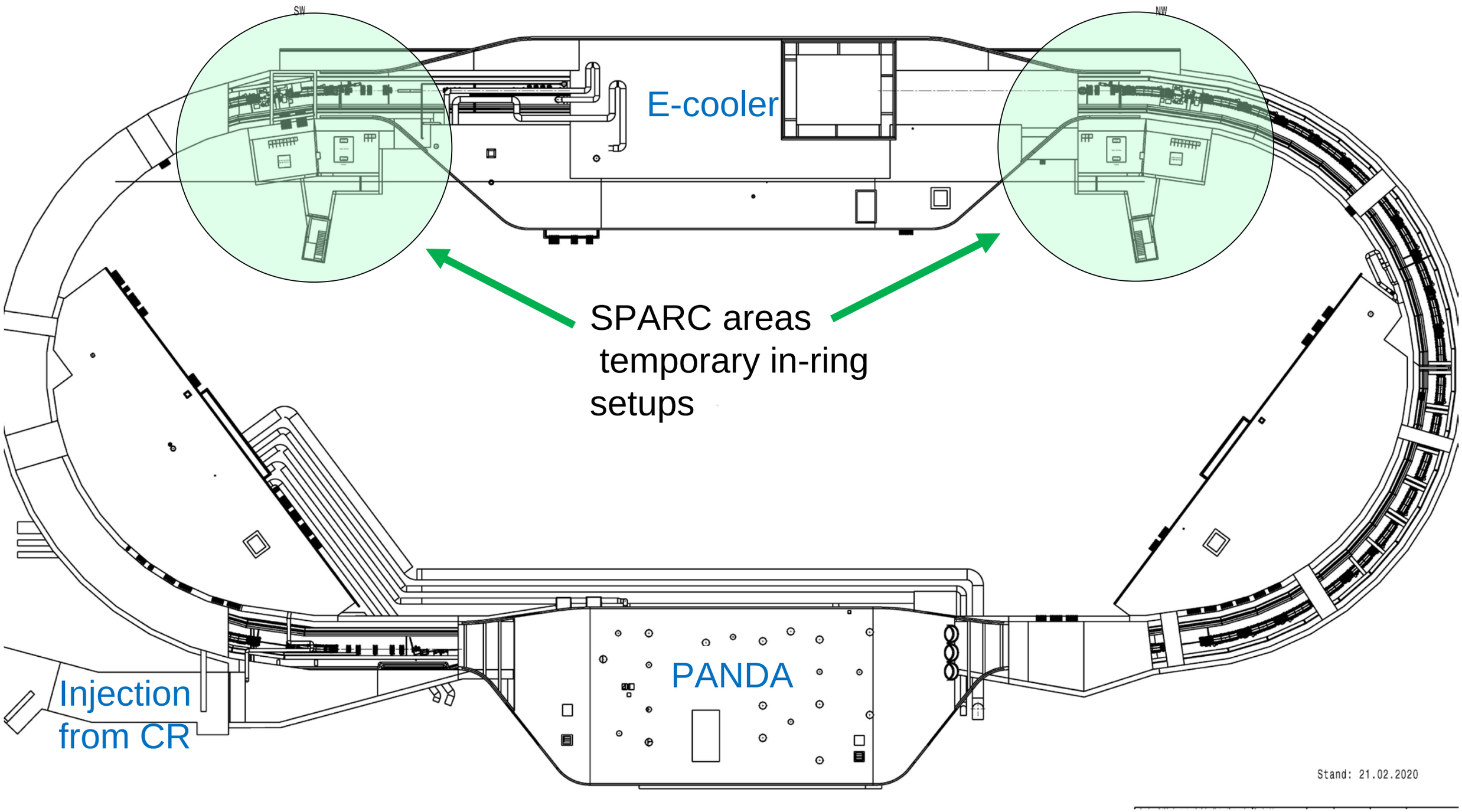
SCU unit: target parameters

The input of the vacuum controls is needed (current values)
Control of the temperature controller (external company: Lakeshore) - measurement and control of the temperature
Control of 2 pressure regulators (analog signal, 2-10 V)
Measurement of 6 temperature sensors (cooling water, control cabinet – analog in 0-2 V)
Control signal ‚target on/off‘ within the FAIR control system (timing)
Control of a flowmeter device (already implemented)
Control of 10 gasline valves (pressurized air, on/off, analog signal)

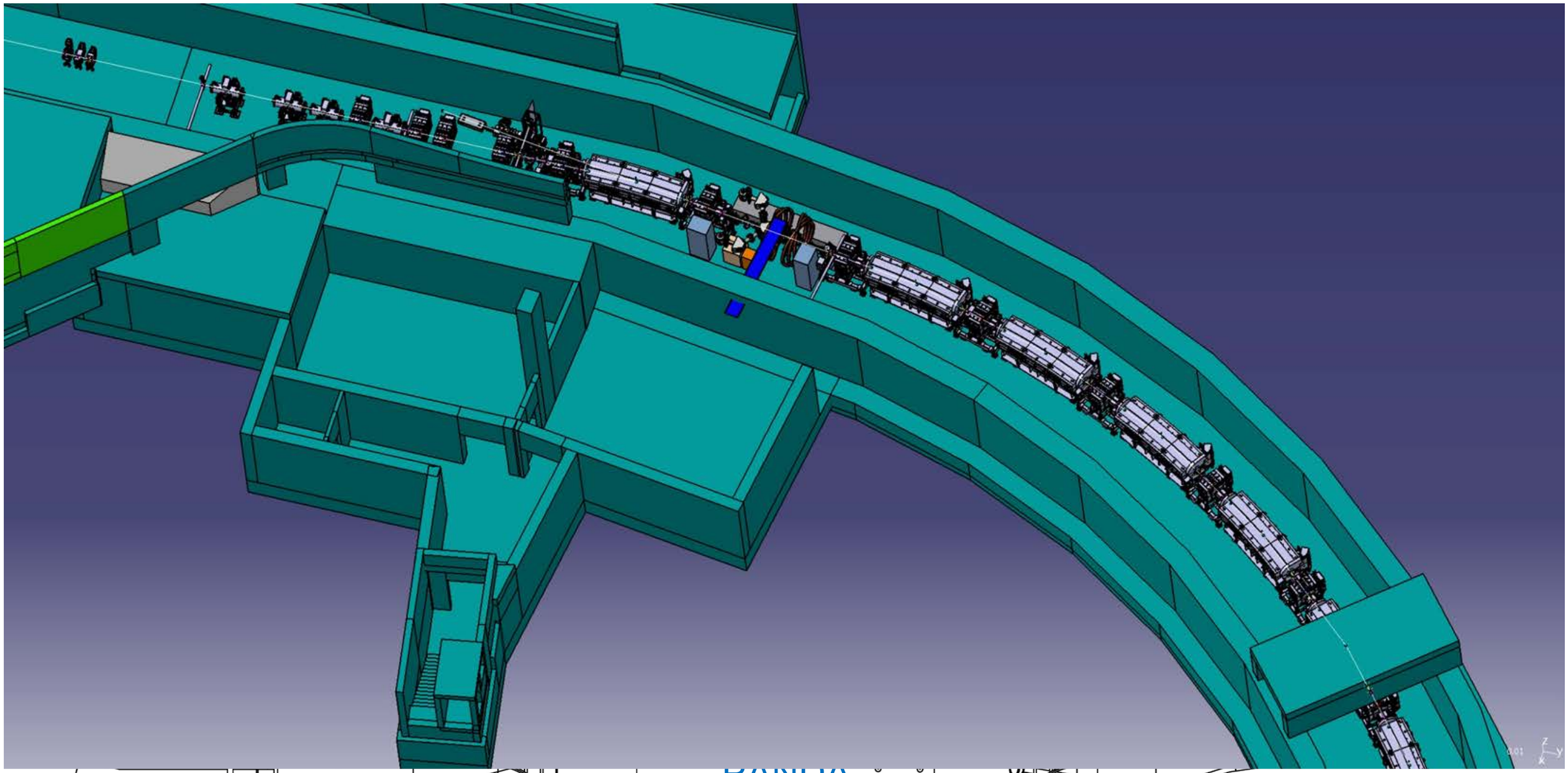
Cosylab controllers

Control of 4 stepping motors (Beam Diagnostics Department)

SPARC at HESR



SPARC at HESR

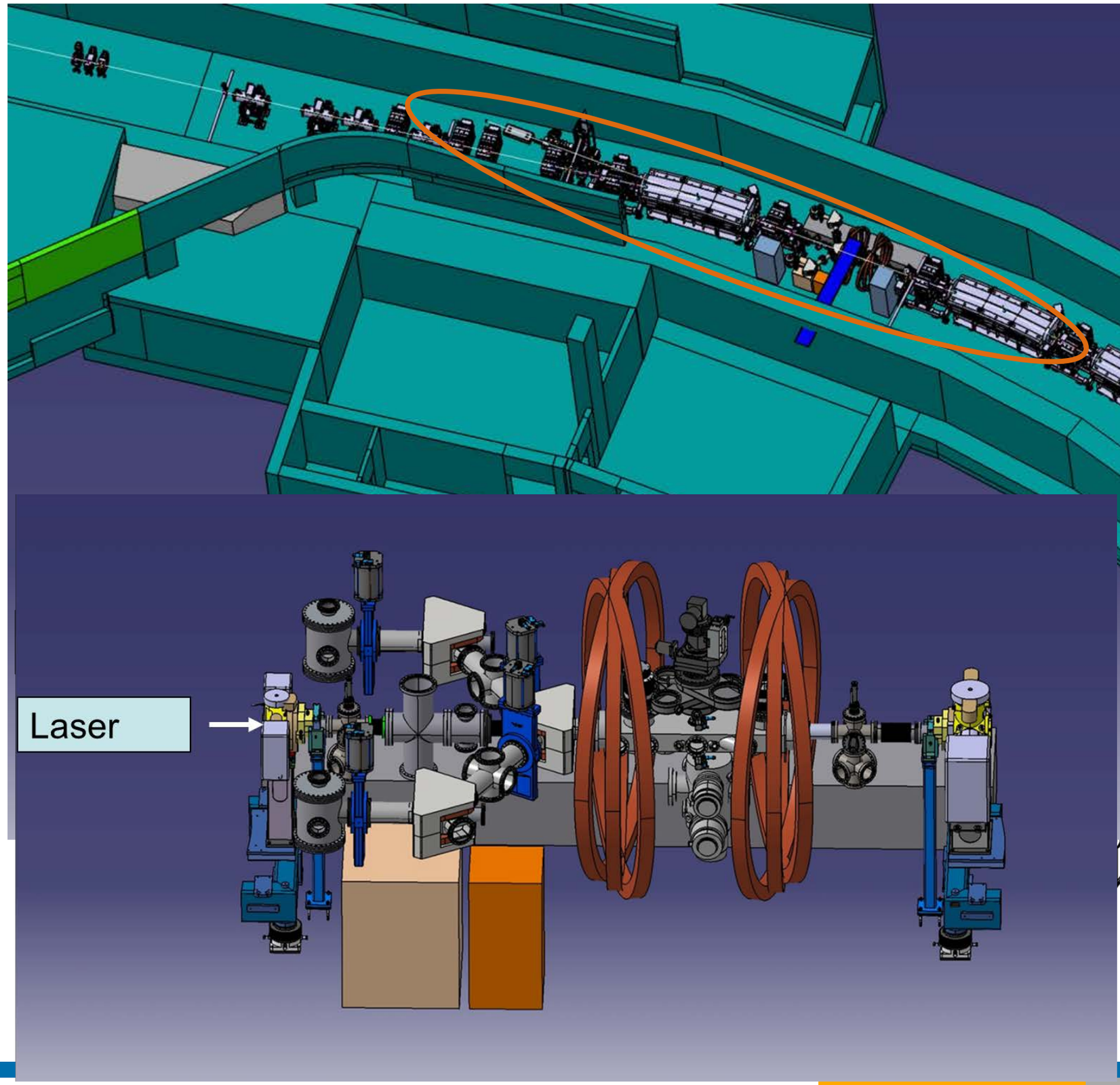


Injection from CR

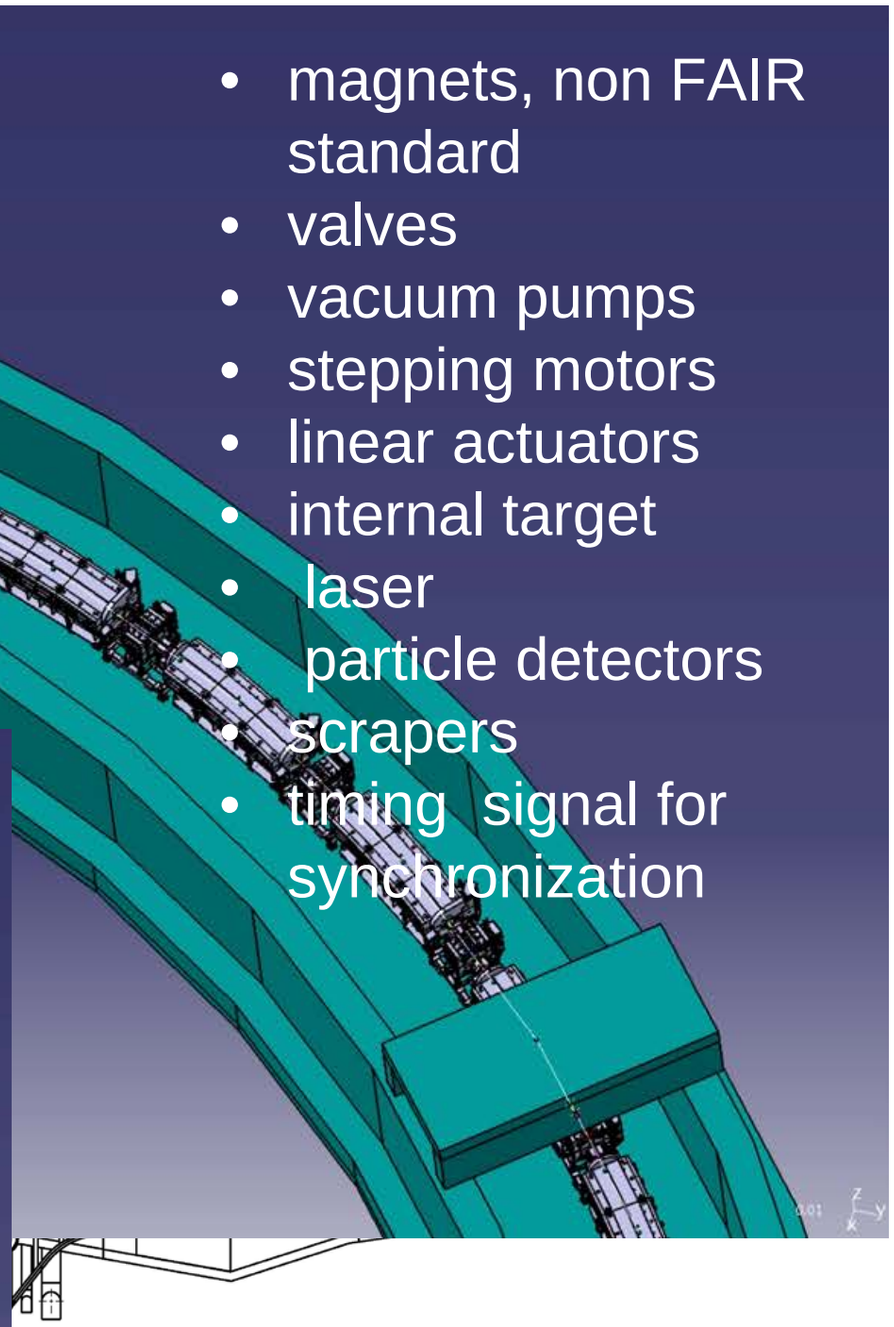
PANDA

Stand: 21.02.2020

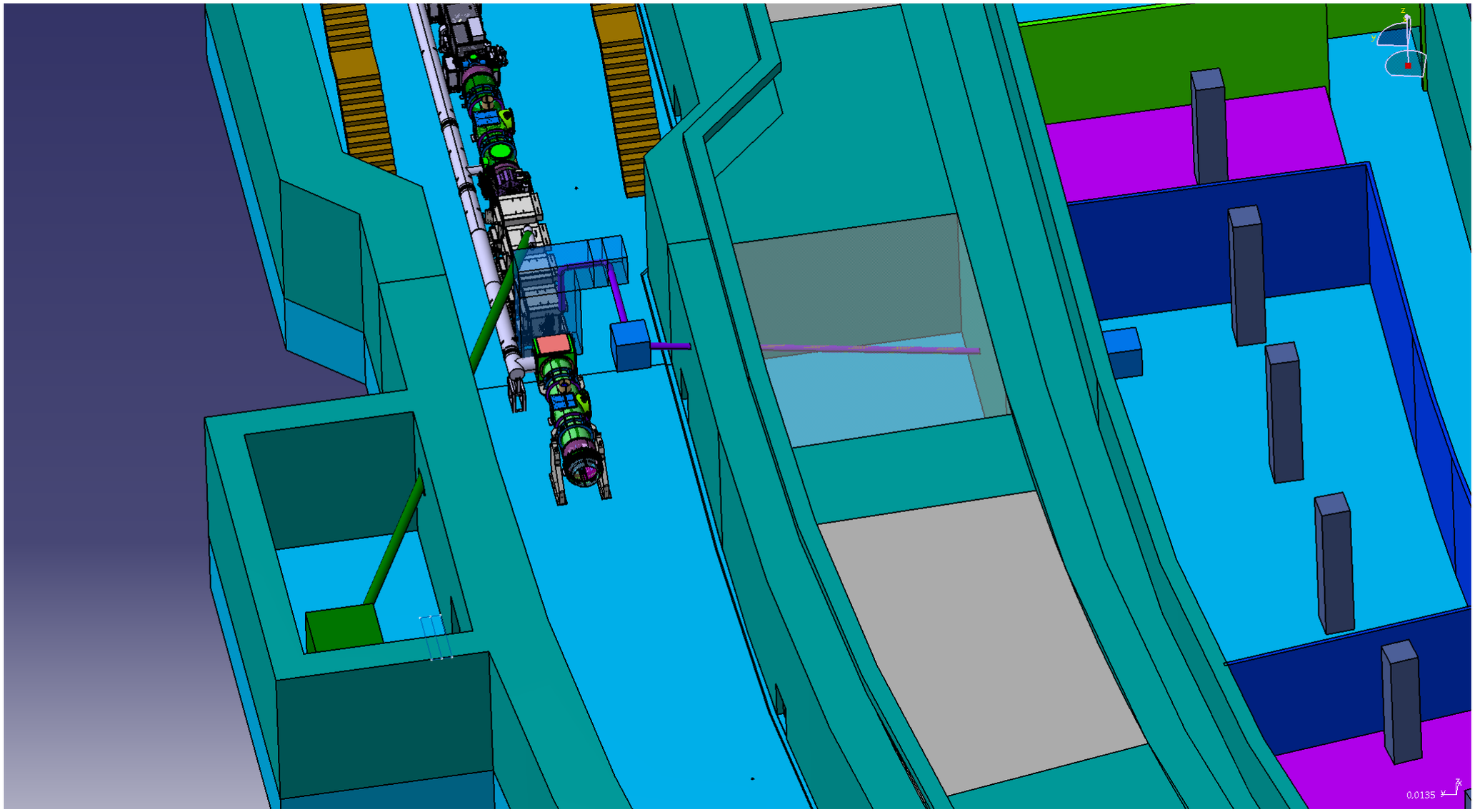
SPARC at HESR: variable, non permanent setup



- magnets, non FAIR standard
- valves
- vacuum pumps
- stepping motors
- linear actuators
- internal target
- laser
- particle detectors
- scrapers
- timing signal for synchronization



SPARC at SIS100: Laser cooling



Will be discussed with the SIS100 control system

Summarizing….

- the large experiment diversity of APPA experiments will be reflected also in the implementation of the control for the beam setting, experiment components control, aces to setting data and selected parameters

- the collaborations are ready to provide more detailed information about their special needs

- a discussion about the technical and resourced-based feasibility of our request is needed

- the prioritisation and the time line for the realisation depend on the civil construction time line and can be only partially specified today

- a close exchange between the users and the control groups, as already practiced in FIAR Phase zero is highly desired from our side