PURESAFE
Preventing hUman intervention for IncREased SAfety inFrastructures Emitting ionizing radiation

MARIE CURIE ACTIONS

FP7 REA grant agreement 264336

Importance of PURESAFE for the FAIR facility

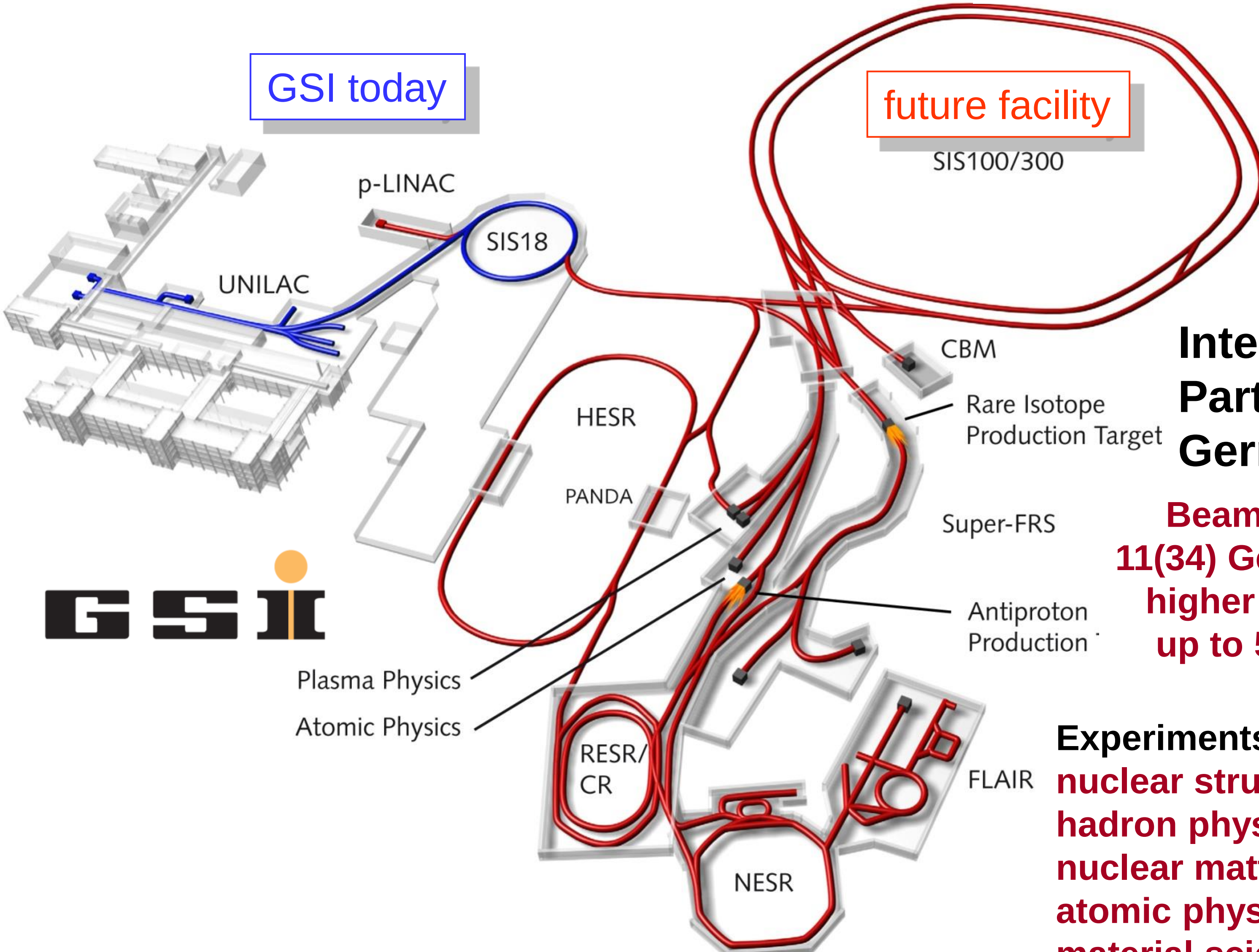
Helmut Weick, GSI
CERN Geneva, 19. Jan. 2015

- **Overview FAIR / Super-FRS**
- **Radiation Areas**
- **Robot Handling**
- **Engineering Management**

GSI

FAIR

FAIR - Facility for Antiproton and Ion Research



FAIR Gmbh

International Partners 9+2, Germany >50%

Beam energy up to 11(34) GeV/u ^{238}U, 27 GeV p
higher beam intensity up to 5x10^{11} U ions/s

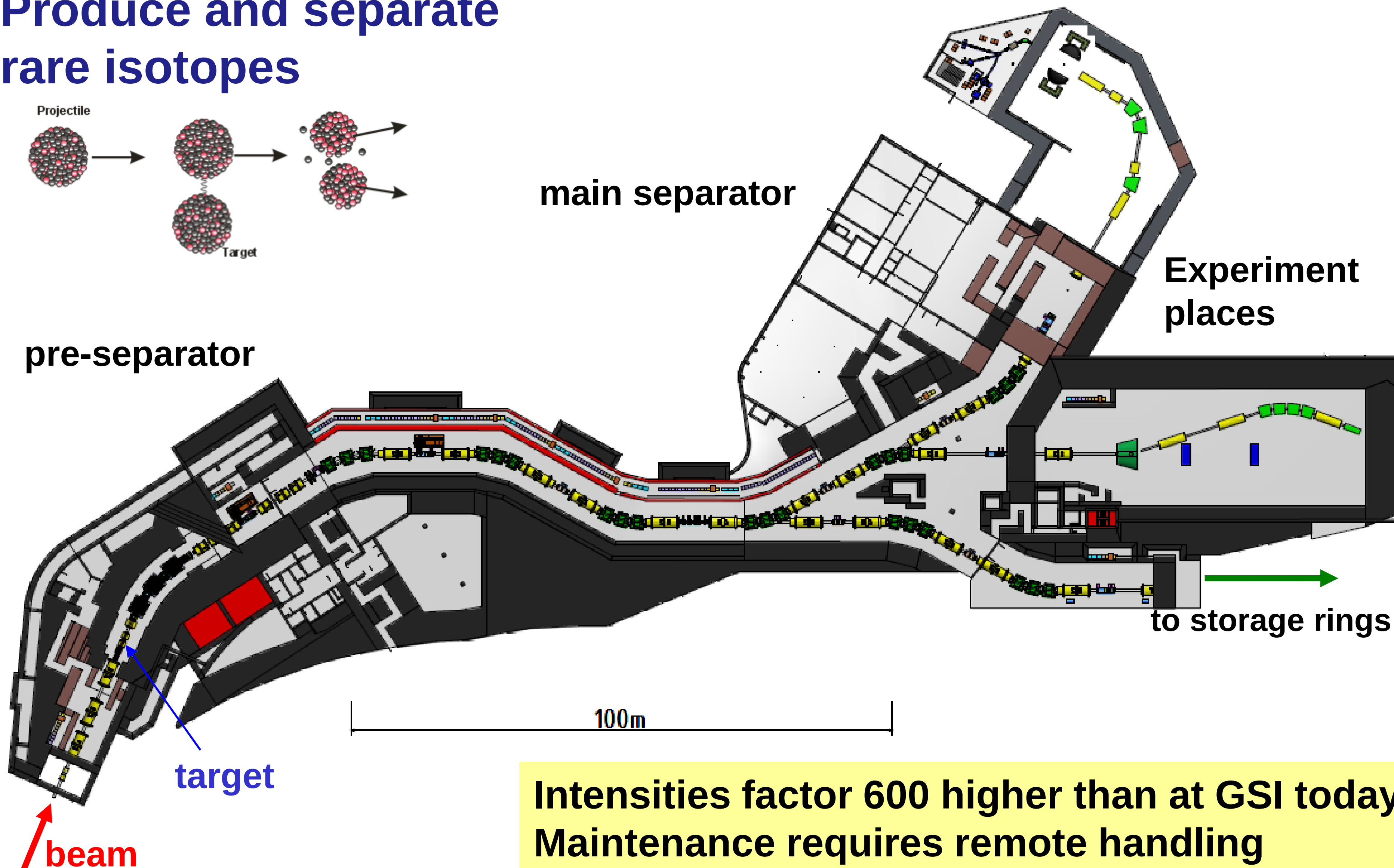
Experiments on:
nuclear structure, astro physics hadron physics, compressed nuclear matter, plasma physics, atomic physics, material science, bio physics

FAIR Construction Site

21.11.2014 (Photograph: Jan Schäfer for FAIR)

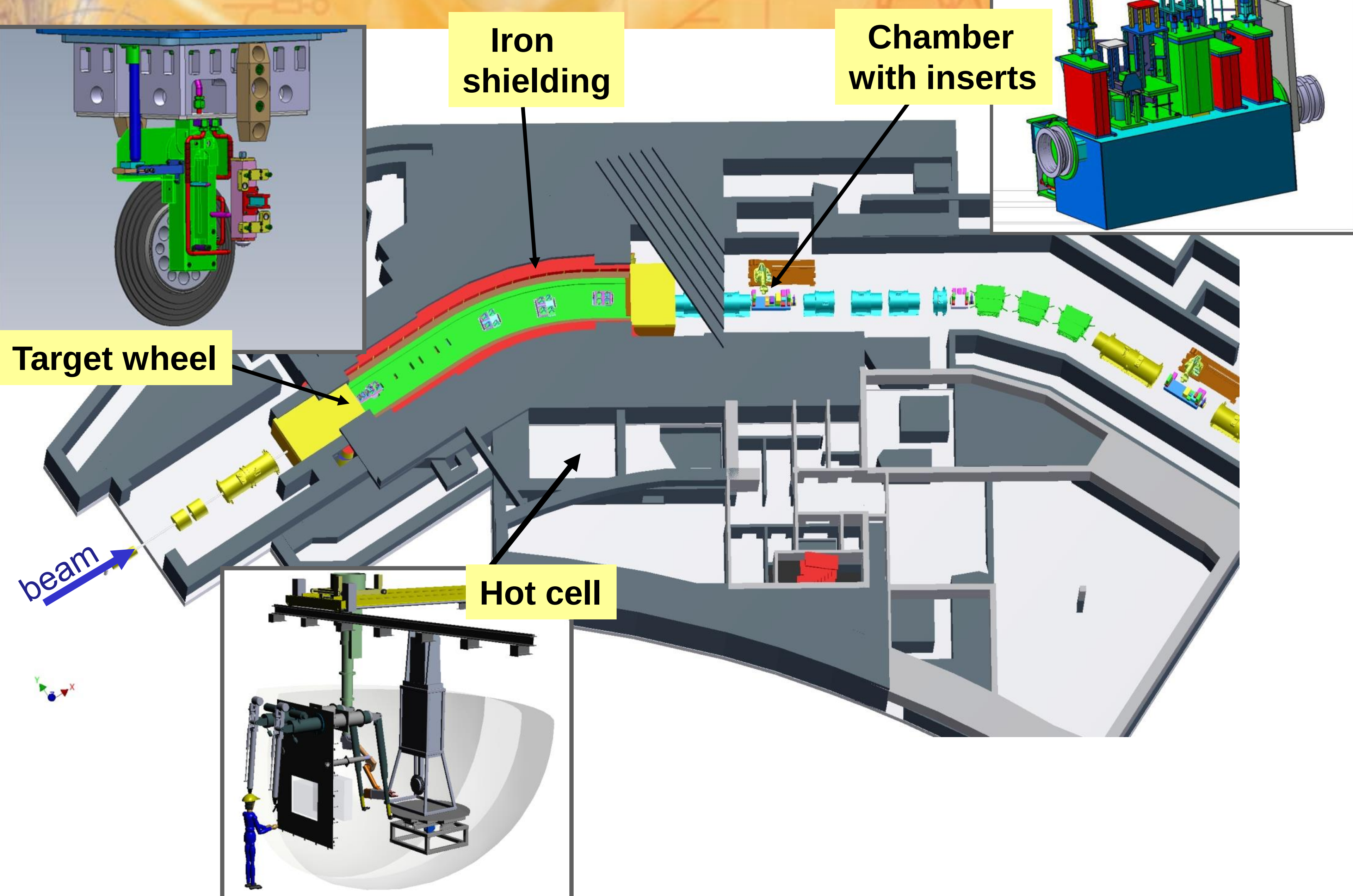
Super-FRS
- Overview -

Produce and separate rare isotopes



Intensities factor 600 higher than at GSI today.
Maintenance requires remote handling

Super-FRS, Target Building



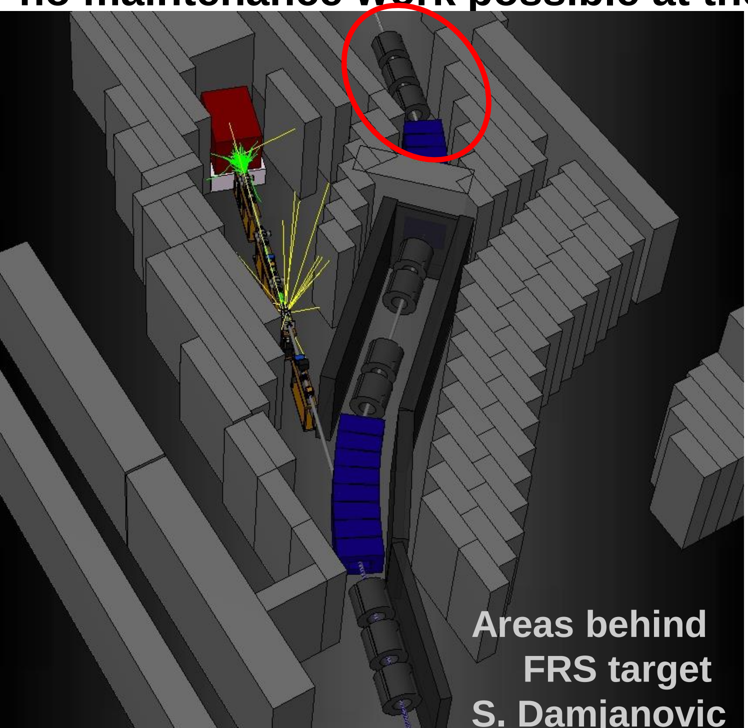
Radiation Areas Intervention Planning

Existing GSI:

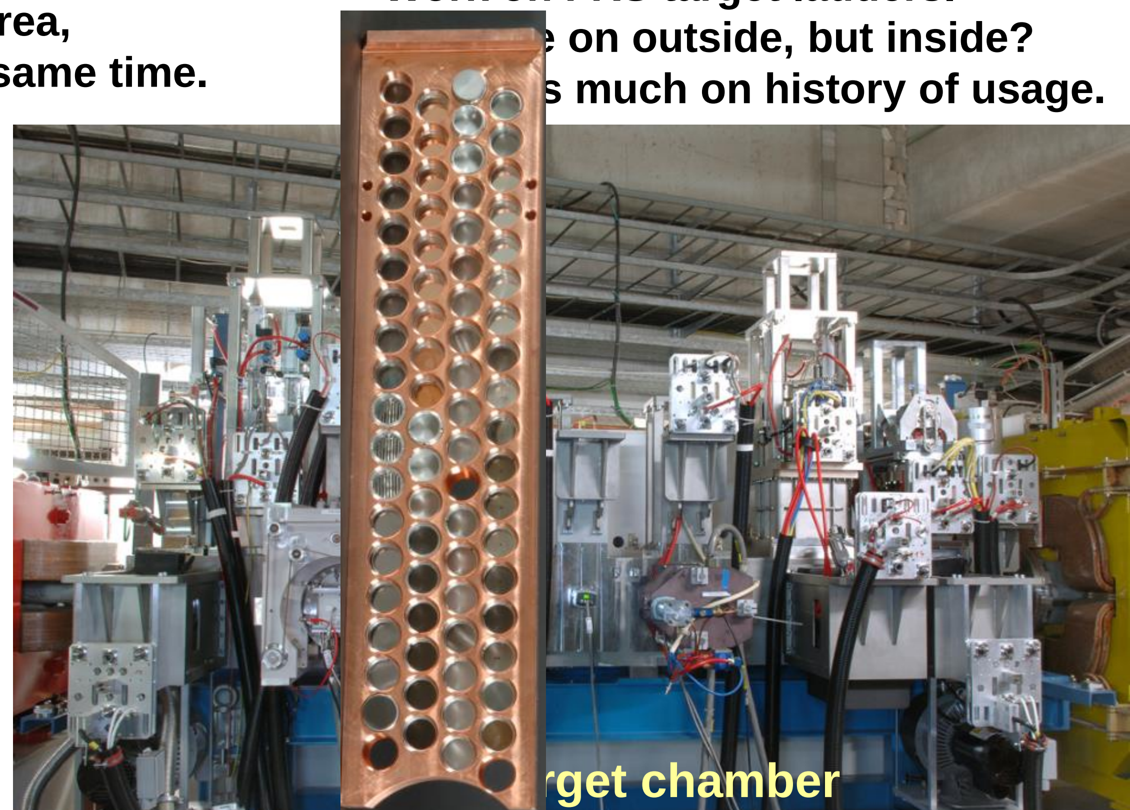
- **Grid of radiation monitors in the halls for prompt dose.**
- **Systematic tables of many measurement points along beamline, activation measured shortly after beam time and later, allows comparison with past and some extrapolation.**

Examples of more information needed:

Unforeseen beam losses before main beam dump
-> Too high radiation to neighboring area,
no maintenance work possible at the same time.



Work on FRS target ladders.
… e on outside, but inside?
… s much on history of usage.



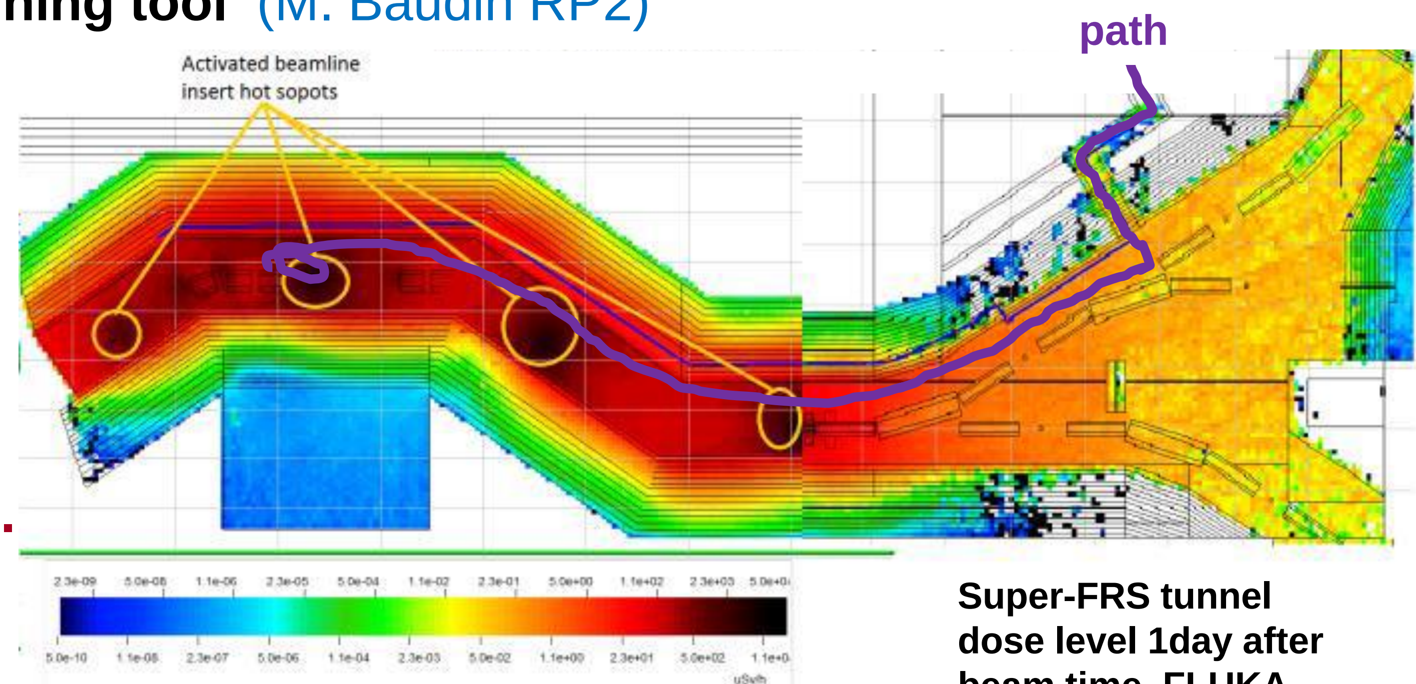
Radiation Areas Intervention Planning

FAIR requires more care and planning, also easier access to information.

Simulations can predict radiation levels, provided sufficient input.
Measurements are necessary, automated measurements helpful.
Intervention planning with dose prediction wanted.

→ **Combine information,**
Software for analysis and visualisation (T. Fabry RP13)
Integrate in planning tool (M. Baudin RP2)

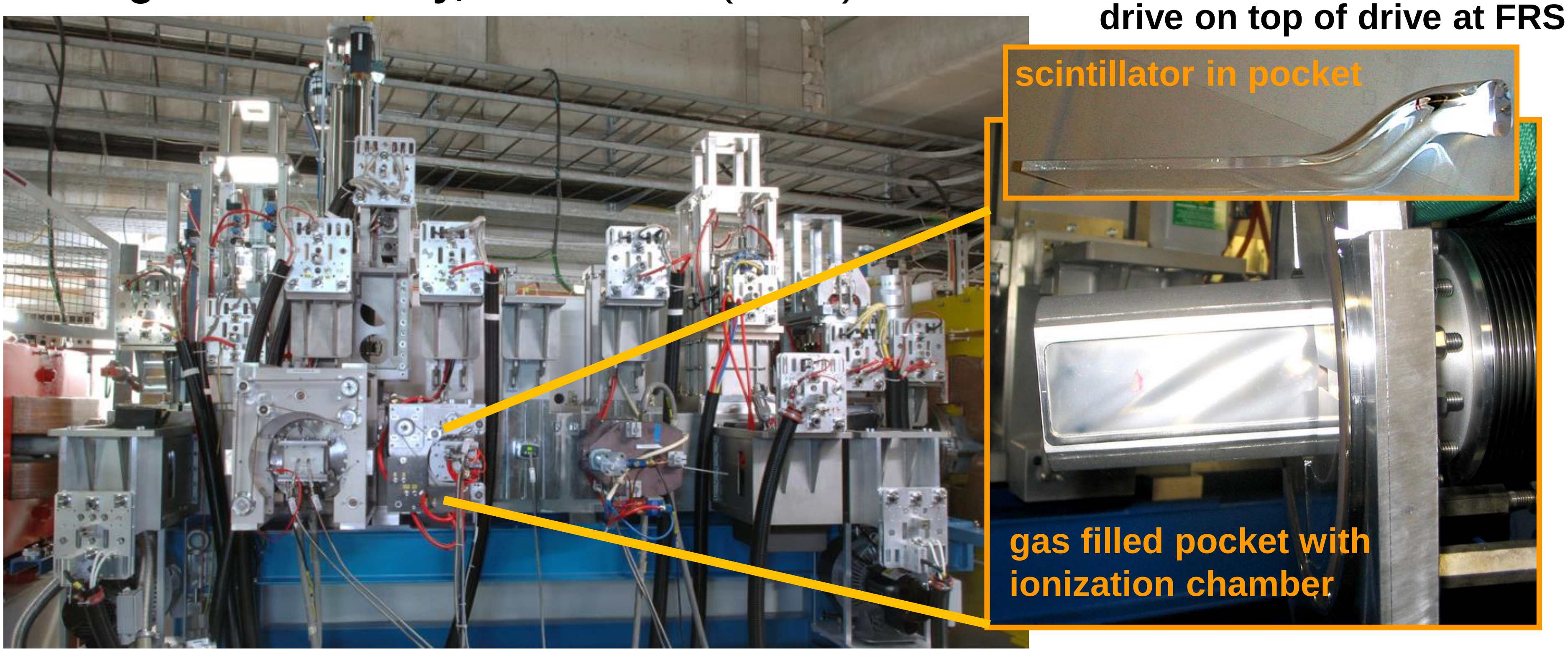
Full benefit requires data base of configuration materials, beams, and an evaluation including the tasks.



Super-FRS tunnel dose level 1day after beam time, FLUKA

Open the Black Box

Most interesting things are mounted inside vacuum chambers.
Super-FRS will use at many positions inserts into the beam:
shaped energy degraders, many different tracking detectors.
Drawings exist, but not close to device, interaction can be unclear.
Visualize also things not directly visible (e.g. radiation).
→ **augmented reality,** H. Martinez (RP11)



Use of Robotics

Industrial standard robots are available at large variety, with low price compared to specially constructed manipulators.

Speed is less an issue - repetitions are few, time limited by other things

Mobility is important - get robot out off prompt radiation
- service many positions, monitor large areas

Controls are important - communication in heavily shielded tunnels,
- autonomous motion can help, but for rare use also manual remote control possible
- position adjustment in environment

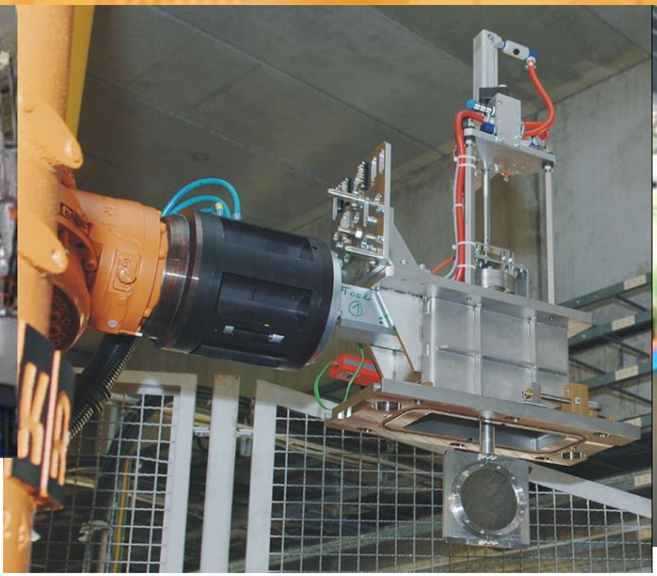
Tools - for normal robots devices must be adapted
- detailed intervention / handling planning needed
- teaching

Maintenance – maintain robot itself (modular ?),

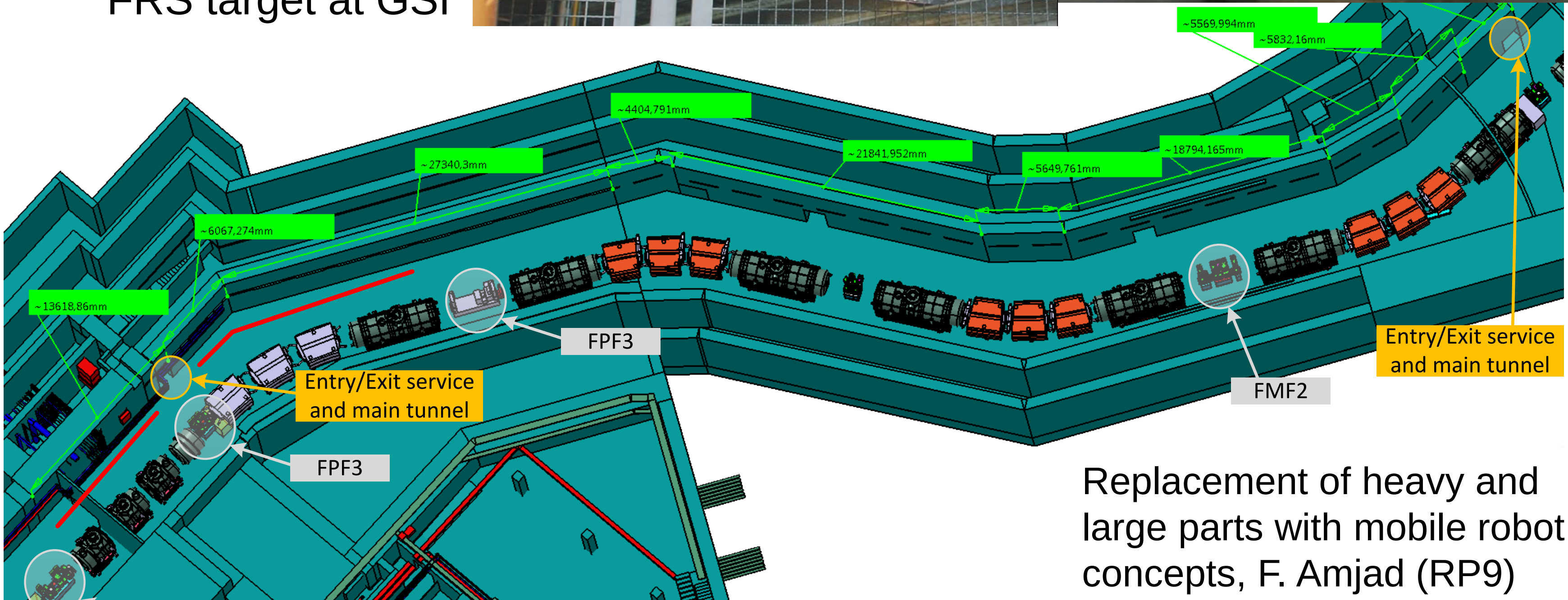
Safety - power management, rescue scenarios

Remote Handling in Open Tunnel

robot at existing
FRS target at GSI



example:
Kuka Titan on mobile platform



Replacement of heavy and
large parts with mobile robot,
concepts, F. Amjad (RP9)

Many steps solved/ to be solved before

IMoro as test device, safe path planning with obstacles (R. Oftadeh, RP14)
autonomous positioning for better precision (M. Aref, RP10)

Communication with WLAN relais
on robots, (R. Parasuraman RP6)

Power management (RP 6, 8,14)

Teaching in tunnel is difficult but needed after changes,
manual control with sensors, haptics for collision avoidance,
study latency, dexterity (E. del Sol RP15, A. Owen-Hill RP12)

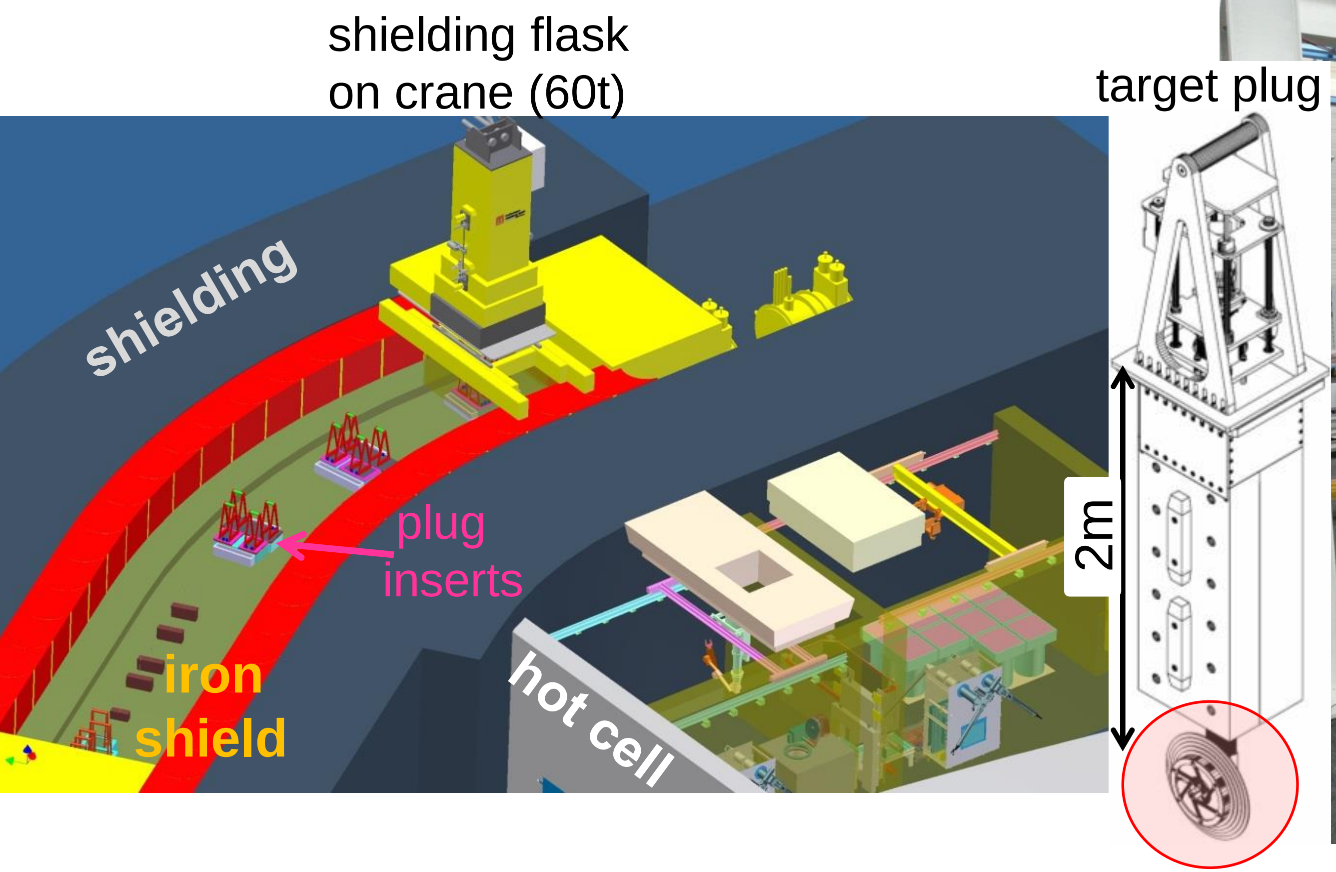
Wide spread need for smaller surveillance robot.
Tasks: Visual inspection, dose rate measurements, leak testing ...

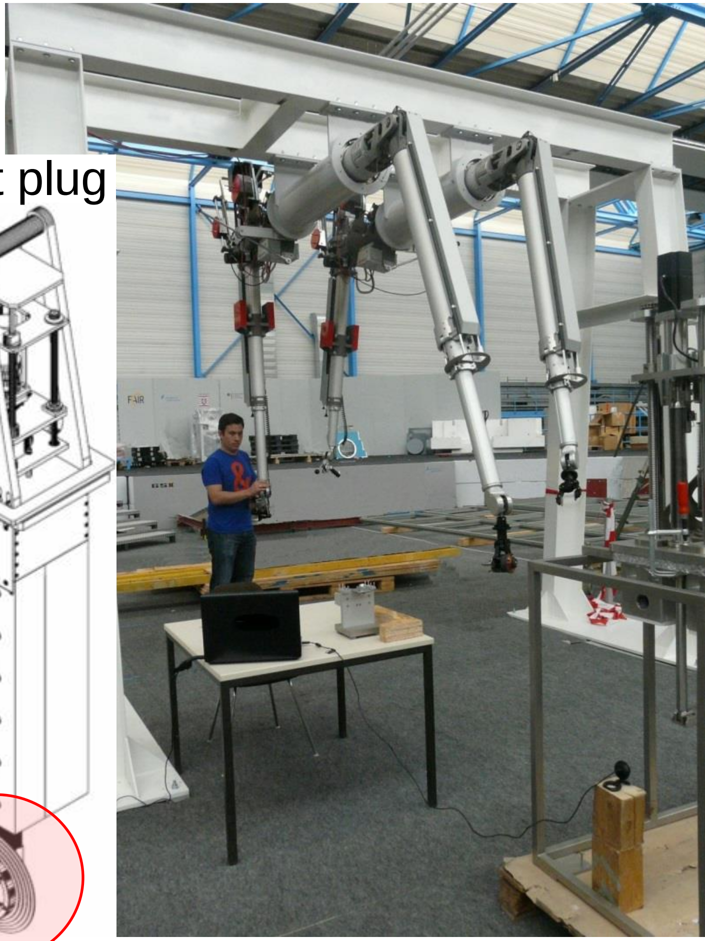
Not only radiation is hazardous environment,
Super-conducting magnets at current are pressure
vessels with a lot of energy stored.

Here also modular concepts can be important (P. S. Pagala, RP8)

The safe approach with shielding plugs minimize RH at beamline place, RH in hot cell

target area: from beamline to hot cell





develop design/techniques for manipulators and robots (L. Orona RP7)

Engineering Management

Accelerator facilities are a different kind of product. Interaction of many:

Civil construction ←→ Accelerators ←→ Experiments ←
→ Safety/approving authorities ←→ Funding Agencies

Our OpenSE draft demands definition of Project Team
and of the Stakeholders. That is now the case for FAIR@GSI,
more after merger of GSI and FAIR.
OpenSE also comes with systems engineering guidelines.
Many technical guidelines exist for FAIR, but only directly on equipment.

In Puresafe **RAMS** (Reliability, Availability, Maintainability, Safety**)**
is one of the words used most .
Configuration management (CM) (M. Niknam RP5),
Risk management (D. Imran Khan RP1),
Product Life Cycle Management (PLM) (M. Lintala RP4), information
"CM and PLM were added very late in the (FAIR) project" ,Oliver Kester, 16.1.2015 **(project leader)**
Maturity models like CM^3 can help to define goals.

Innovation model, (J. Hyppölä RP3), analysis in EU projects and big facilities

Summary / Conclusion

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FAIR is still under construction, for some key parts of remote handling R&D is still going on.

Learned extended possibilities in planning and visualisation.

Large information gain in field of robotics.
Possibility of more future collaboration with experts.

Engineering management was so far involved only as example, but can also benefit.

ESRs are a gain for all of us.