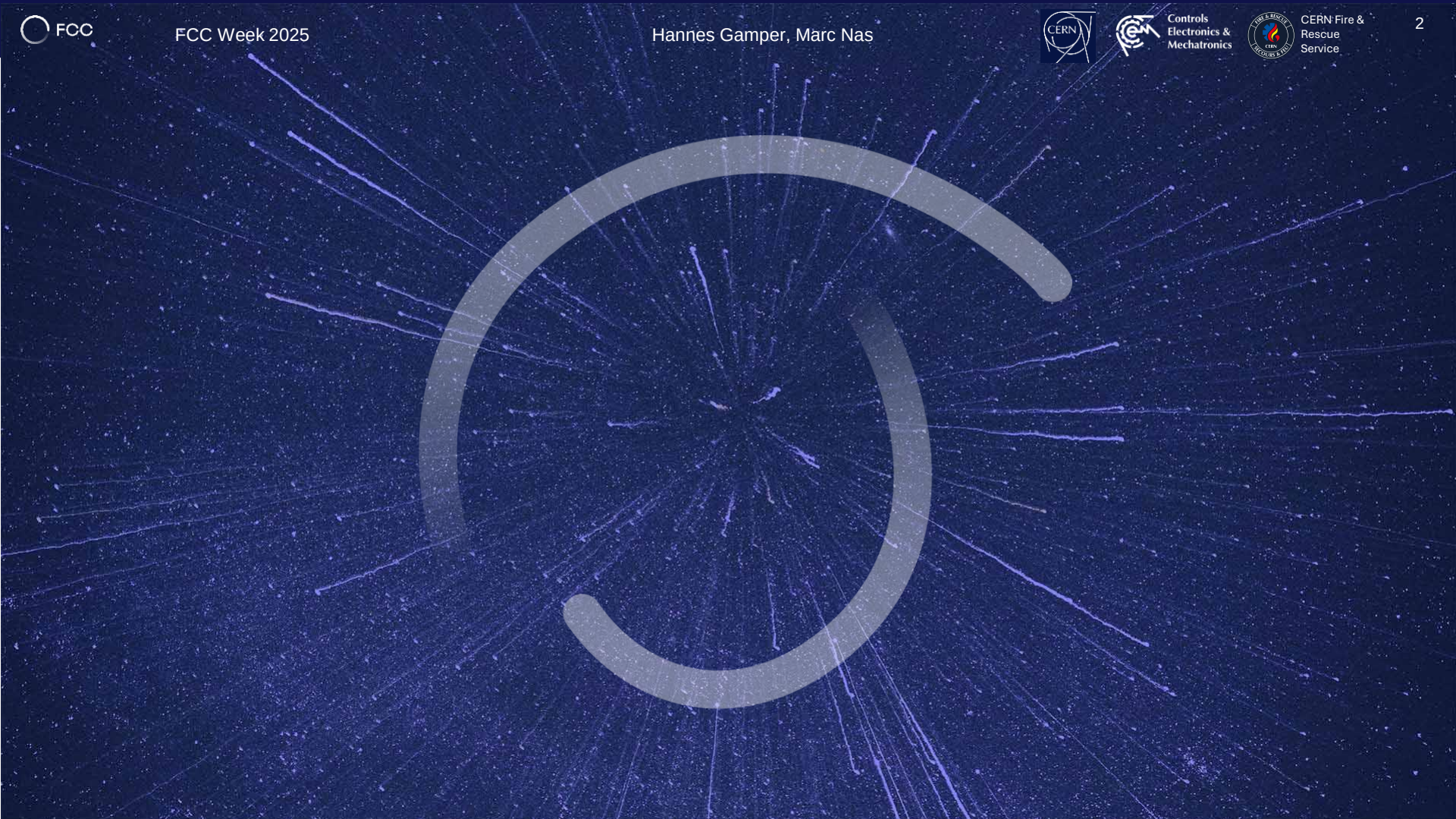
FUTURE
CIRCULAR
COLLIDER



Content

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CERN Fire & Rescue Service

ROBOTS IN 2035

A look into the future by Hannes Gamper

Robotics Evolution: What's Changing

Human-Robot Interaction

- Streamlined, intuitive situational awareness for rescue teams
- Efficient robot control

Robotics Evolution: What's Changing

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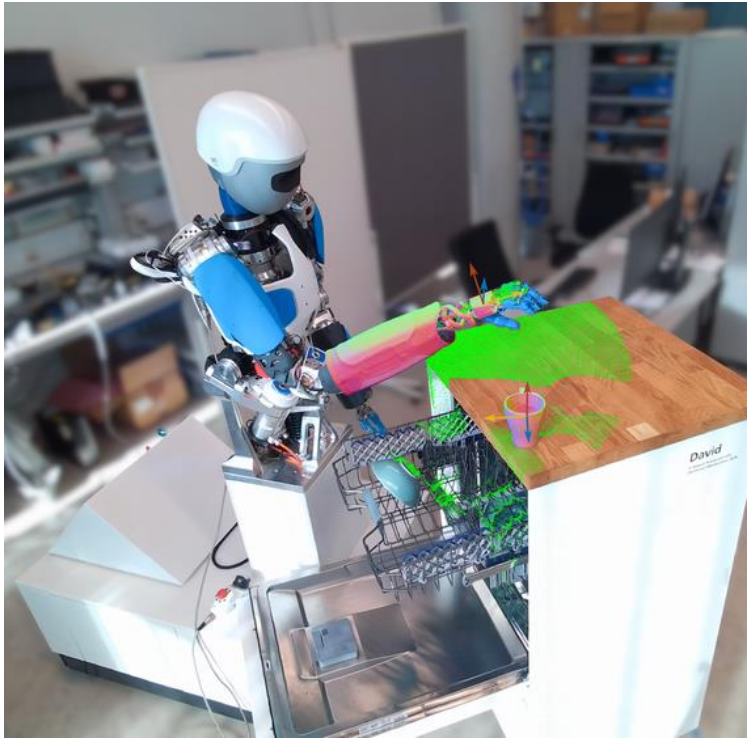
Cognition

- Automated launch of rescue robots with high level instructions



Robotics Evolution: What's Changing

Human-Robot Interaction

- Streamlined, intuitive situational awareness for rescue teams
- Efficient robot control

Cognition

- Automated launch of rescue robots with high level instructions

Swarm Robotics

- Redundant, disposable systems covering large areas

⇒ Robotic capabilities will increase significantly driven by advancements in AI

What type of Robots should we use for emergency response in 2035?

- Great universal machines
- Market estimated at 15 GCHF by 2030
- Solution to everything?

⇒ NO! Terrible at any single specific task!

What type of Robots should we use for emergency response in 2035?

Task: Move efficient over flat surfaces

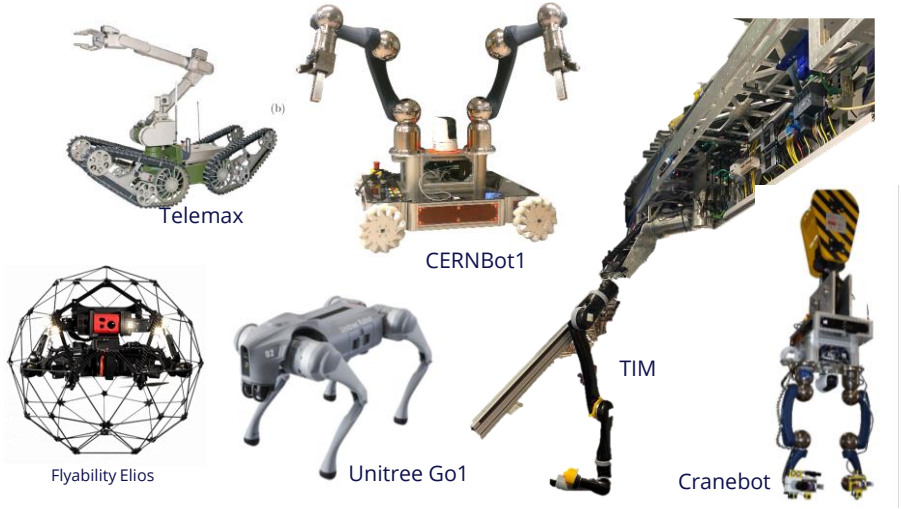
Task: High Precision, Reliable Operations

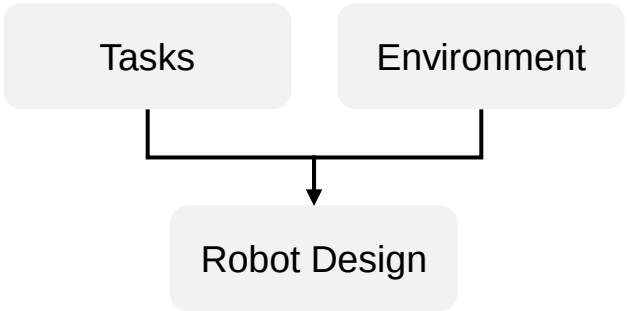
=> The choice on robotic systems for FCC is not trivial!

What type of Robots should we use for emergency response in 2035?

- We need to identify the most efficient and robust solutions for the FCC complex.
- Different areas/needs, different solutions.

⇒ **RAMP Work Package!**
See presentation today at 15:53.





Adapt the Environment for Robots in 2035?

- Or simply throw robots at the problem? No!
- The most advanced robotic system will be inefficient if environment is not adapted
- Think automation first, then robotics

⇒ Considering robotic operations during the machine design will always increase efficiency and reliability!
⇒ Balance between robotic complexity and machine adaptation efforts need to be found.

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EMERGENCY RESPONSE

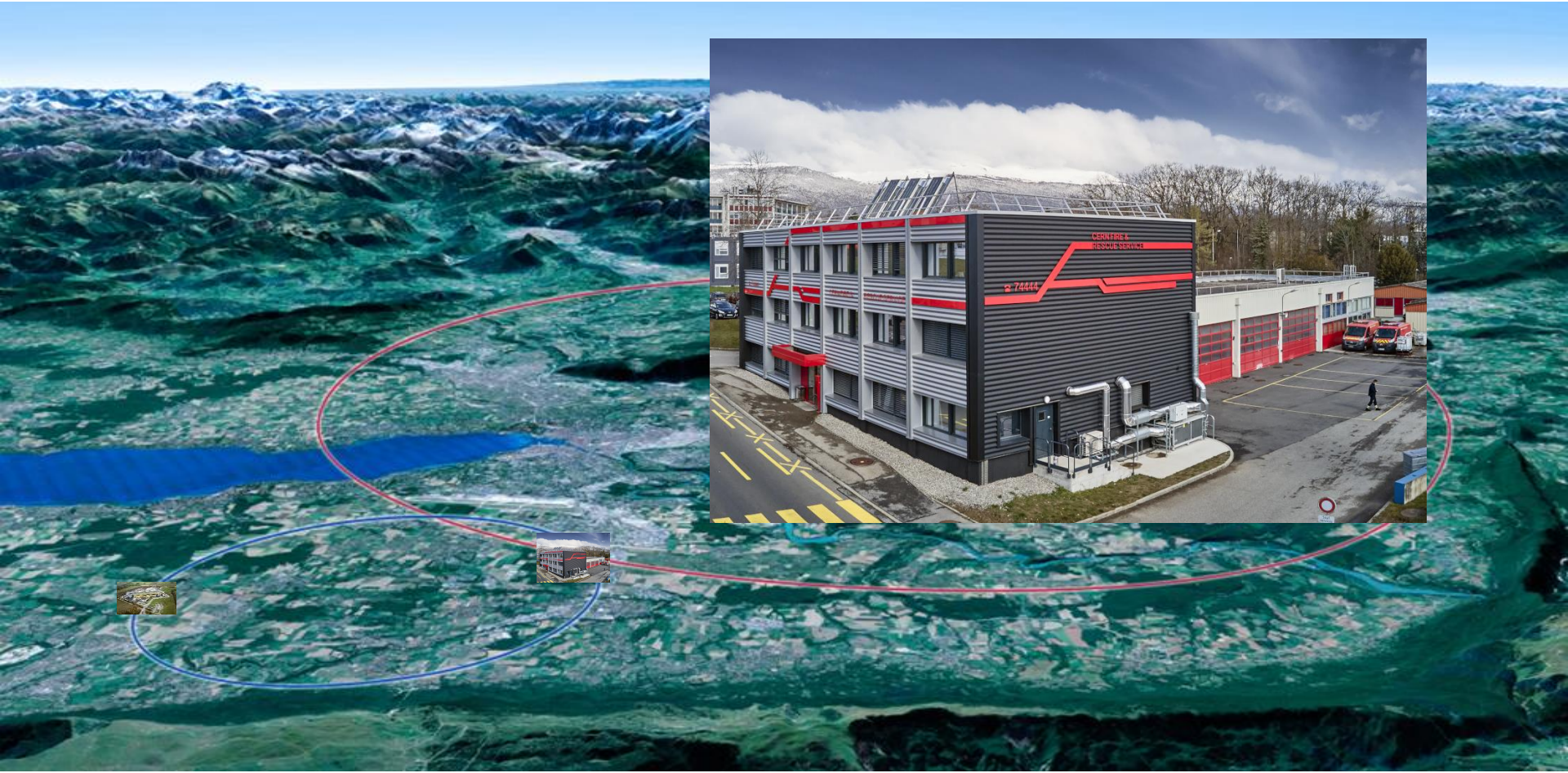
Current concept by Marc Nas

Emergency Response

Current concept

1. Detection
2. Alert
3. Evacuate
4. Emergency Response Fire Engine
   - Fire station Meyrin
     - 24/7
     - 10-12 persons
5. Host states Assistance
   - SIS Geneva
   - SDIS01 Departement de l’Ain
   - Brigade Sanitaire Cantonale

Image: flat-icons


CENTRE
RISQUE SERVICE
74444

Emergency Response

Current concept

1. Evolved over time and covers response to LHC
2. Response time: max 30 min (Meyrin-CMS)

Image: eaglenationonline

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EMERGENCY RESPONSE IN FCC

A Paradigm shift?

Emergency Response in FCC

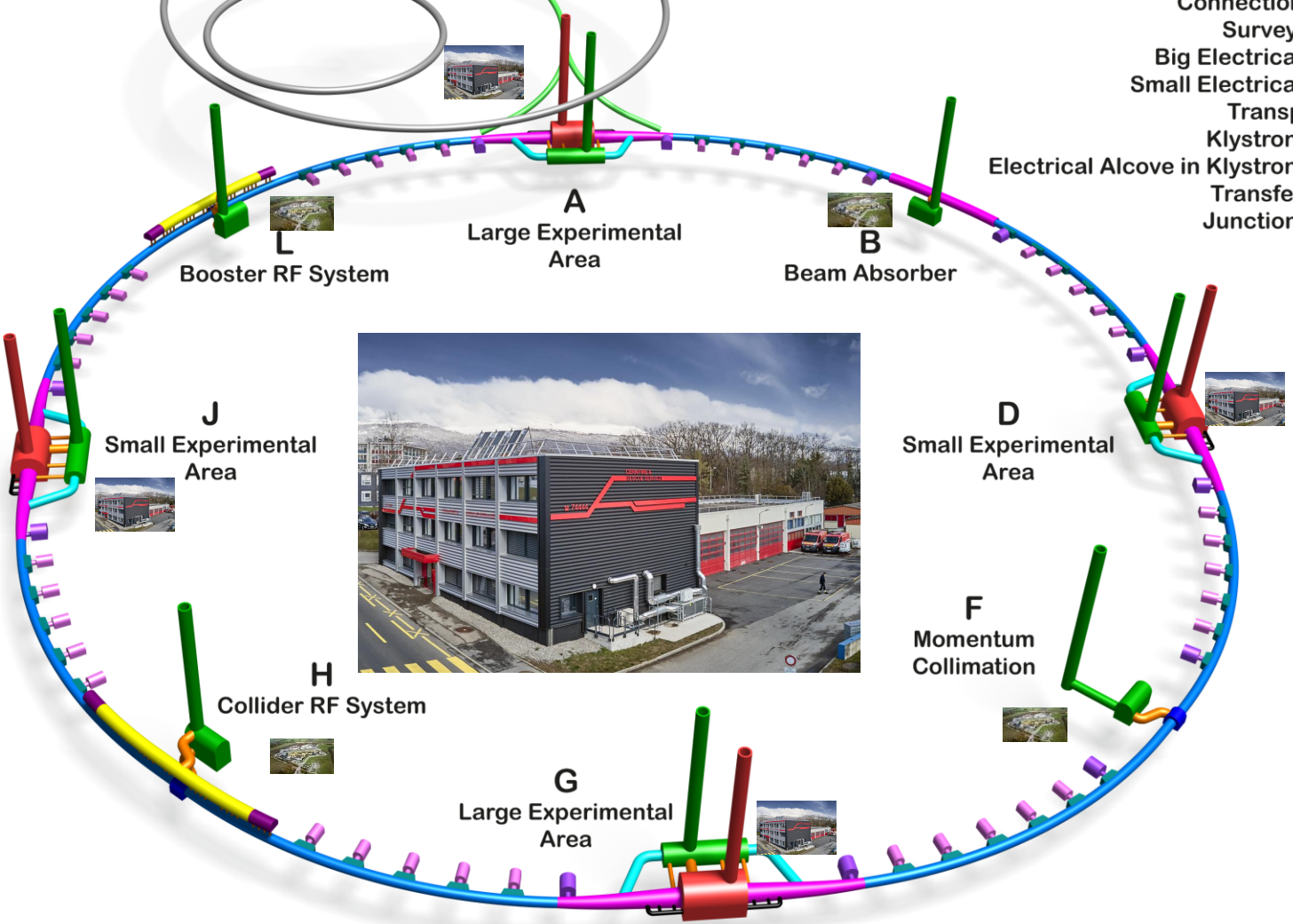
Based on Current response model

Response time (40min@best)
- Several CFRS fire/ambulance stations

Host states assistance
- SIS
- SDIS01
- SDIS74
- BSC

Image: canva

Connection Tunnel
Survey Gallery
Big Electrical Alcove
Small Electrical Alcove
Transport Bay
Klystron Gallery
Electrical Alcove in Klystron Gallery
Transfer Tunnel
Junction Cavern



A
Large Experimental Area

B
Beam Absorber

D
Small Experimental Area

F
Momentum Collimation

G
Large Experimental Area

H
Collider RF System

J
Small Experimental Area

L
Booster RF System

[Not to scale]

Emergency Response in FCC

Adapted response model

Detection and Early warning

Self sufficiency workers in FCC
1. First actions
2. Evacuate

Emergency response
1. Situational awareness and Quick response/intervention by Robots (<10minutes)
2. Intervention by Robots (Knock-down)
3. Final Emergency response: Human Response

    Local, French, Swiss, Fire, Rescue, Volunteer, Career, CFRS

Air transport

Image: artificial lawyer

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SAFETY SCENARIOS IN FCC

An example

An example

1. Fire detected in collider tunnel: run mode

Compartments
Smoke extraction
Surveillance and Emergency Shuttle (SES)
Firefighting Robots

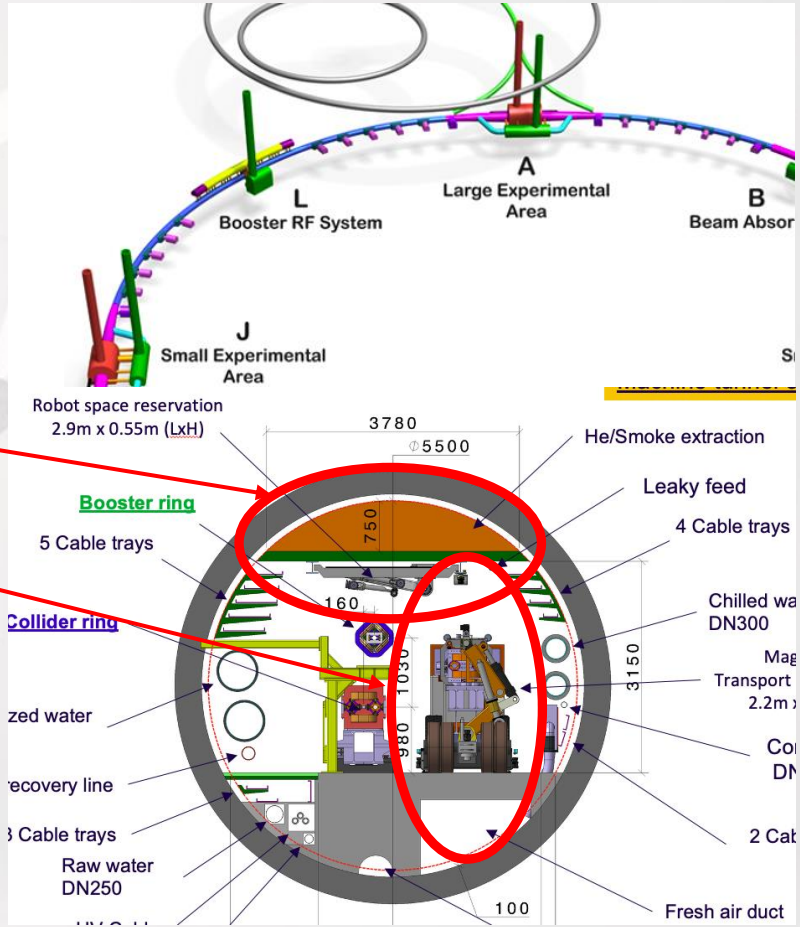


Image: ra2studios

Fire Scenarios

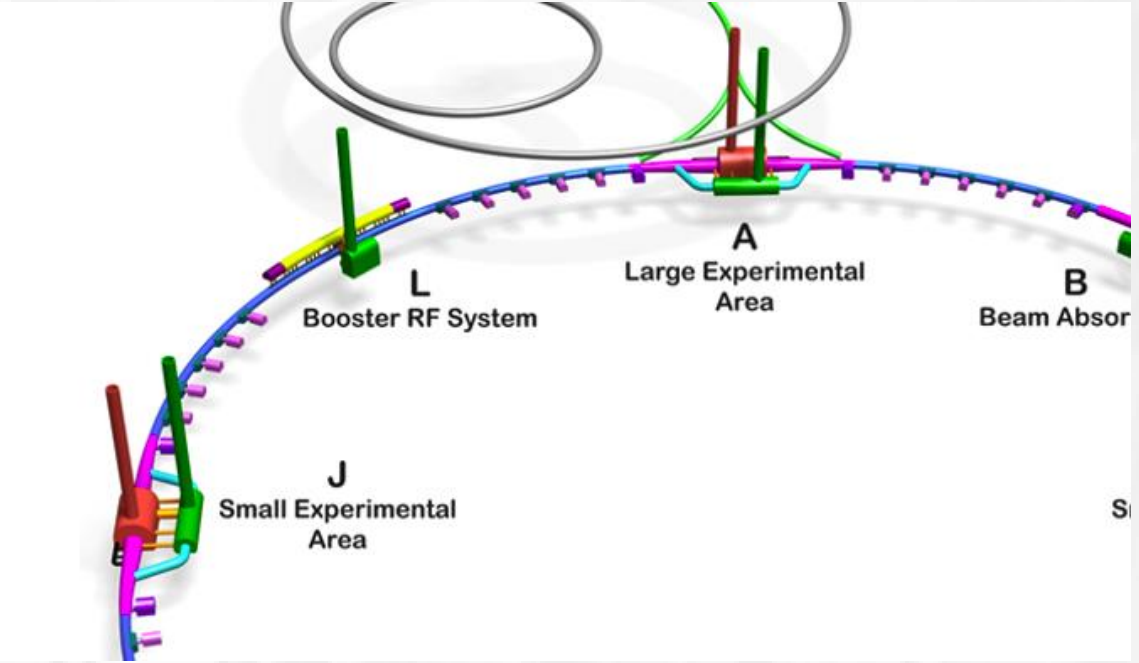
2. Additional

Collider tunnel
- Alcoves

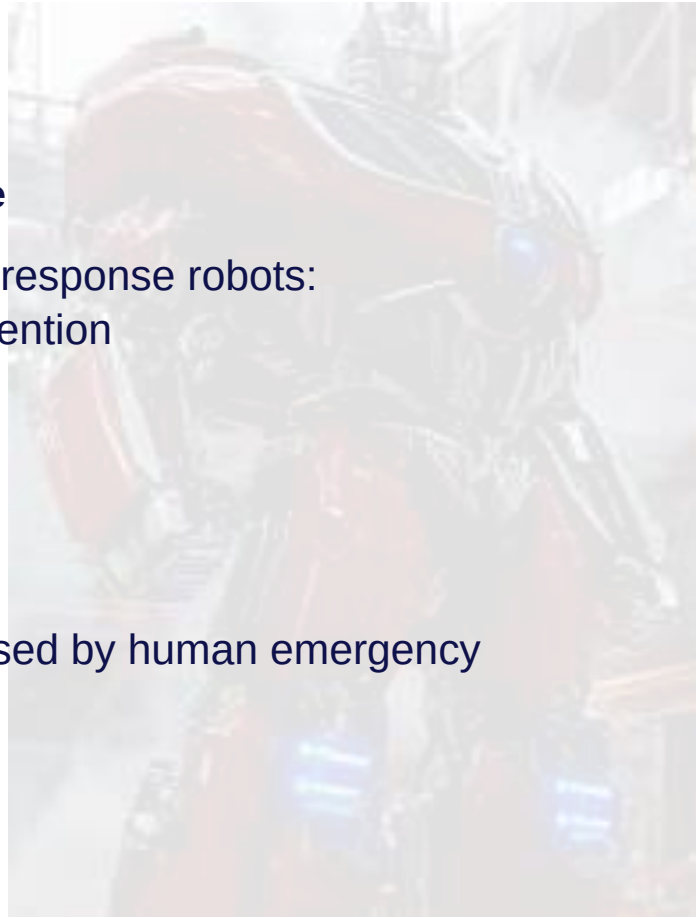
Underground areas
- Experimental points
- Radiofrequency points
- Technical Access

Surface infrastructure

Construction phase
Installation phase



Means for Fire Scenarios



Technological solutions to cover underground infrastructure

- Rail mounted SES for Situational Awareness and fire response robots:
  - limited payload → quick response/rapid intervention
- Ground mobile fire response robots:
  - high payload → knock down possible
- Fixed installations:
  - rapid intervention → knock down possible

- Equipment strategically pre-positioned, ready to be used by human emergency responders

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SUMMARY

By Hannes Gamper and Marc Nas

Summary

Focus from now until 2048 and beyond

First initiatives at HSE-CFRS
Collaboration with BE-CEM-MRO
Provides safety for personnel and responders
- Fast, robust, credible and sustainable
- Safety and Emergency response needs to be integral part of FCC system design

RARE: Robot Assisted Response to Emergencies
- Hybrid robot/human in combination with CFRS and Host States

Different Technological solutions needed for different areas
Automated/AI driven dispatch of robot-responders

FUTURE WORK

Future work

Evolution of response

Define Expectations emergency response: time, capability, result
- Medical, Fire, Environment, Operational continuity

Set Requirements Different Phases
- Construction, Installation, Operation

Define Safety scenarios

Design and Integrate SES and 2nd tier robot response in FCC

Prepare
- Internally
- External partners; existing and new

Create Roadmap CFRS

Image: robohub

CFRS IS PREPARING NOW

For the future……Circular Collider


FIRE BRIGADE


GE-40577

Thank you for your attention.

Do you have questions?