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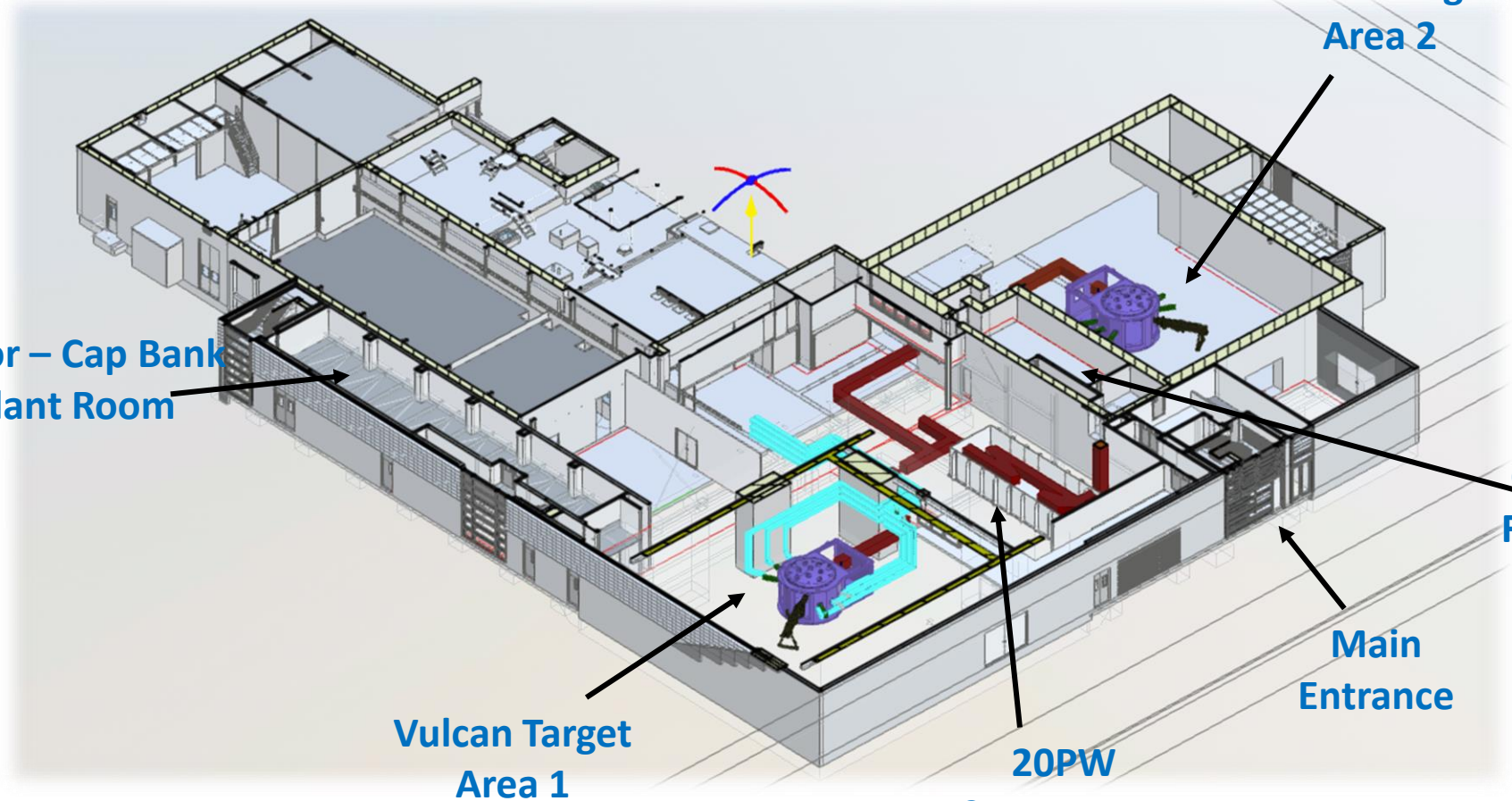
Overview of the forthcoming Vulcan 20-20 facility

UK Fusion Consortium
27th March 2024

Ground/First Floor – Target & Laser Areas

- Ground Floor – Cap Bank
- 1st Floor – Plant Room



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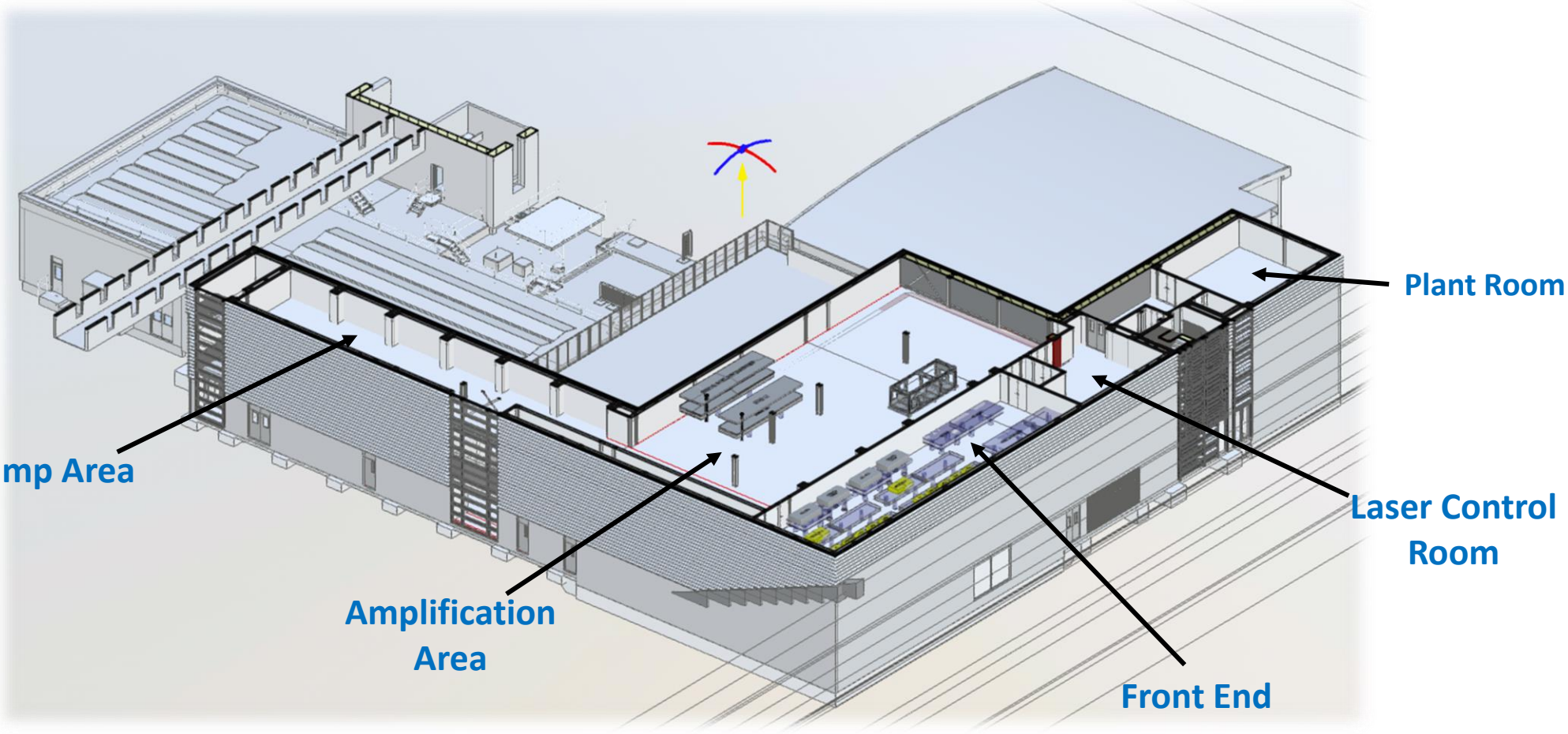
Second Floor – 20PW Laser Area



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Vulcan 20 – 20 Beamlines

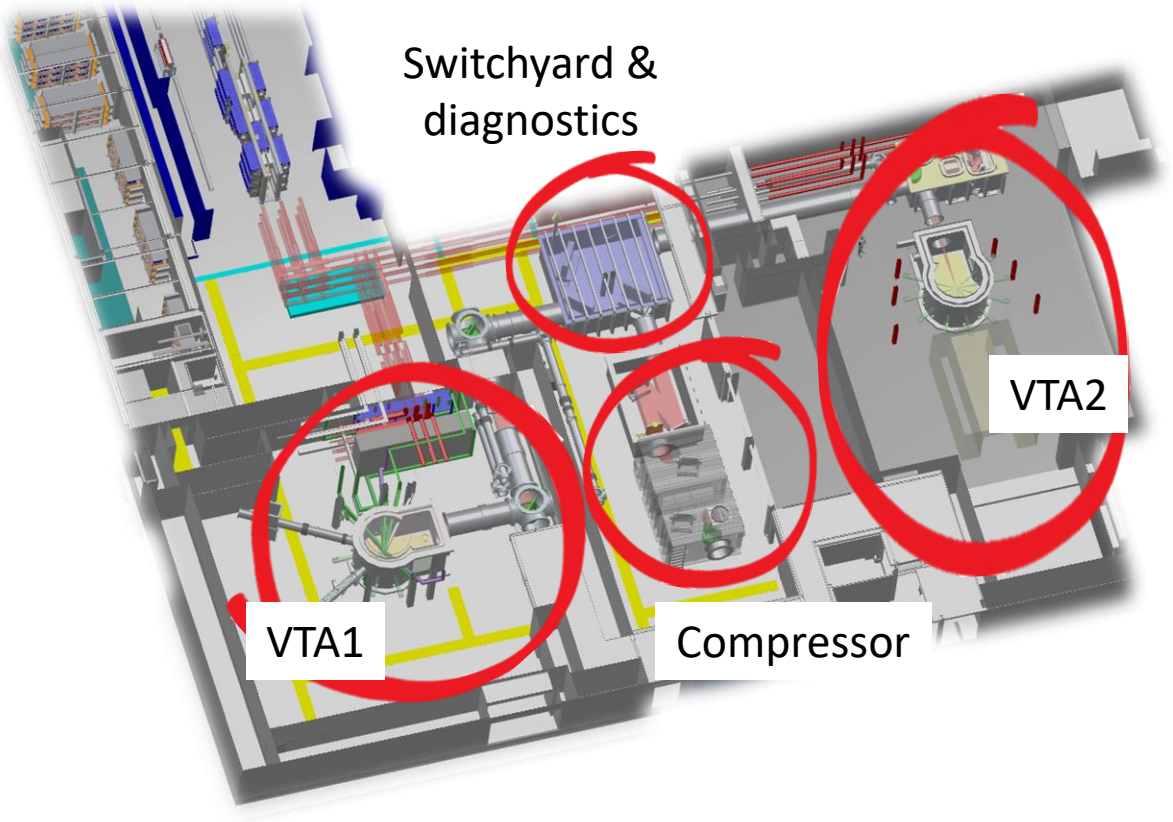
- Main beamlines:
  - 20PW: 400J, 20fs after compressor, rep. rate 5min → Round or square?
  - 6 Long pulses: 10kJ at ω, rep. rate 30min → Pulse shaping, broadband?
  - 2 Additional long pulses: ~3kJ at ω, rep. rate 5min

- Auxiliary beamlines:
  - VOPPEL: 30J in 30fs, rep. rate 5min
  - 100TW (TAW B8): 100J 1ps or 250J in 10ps before compressor, rep. rate 20min

Vulcan 20 – 20 Target Areas

- Vulcan Target Area 1 – VTA1:
  - 20PW large aperture area: f/3
  - Will be the first TA commissioned

- Vulcan Target Area 2 – VTA2:
  - 20PW long focus area with electron beam dump
  - Initial consideration is to use similar chamber as VTA1



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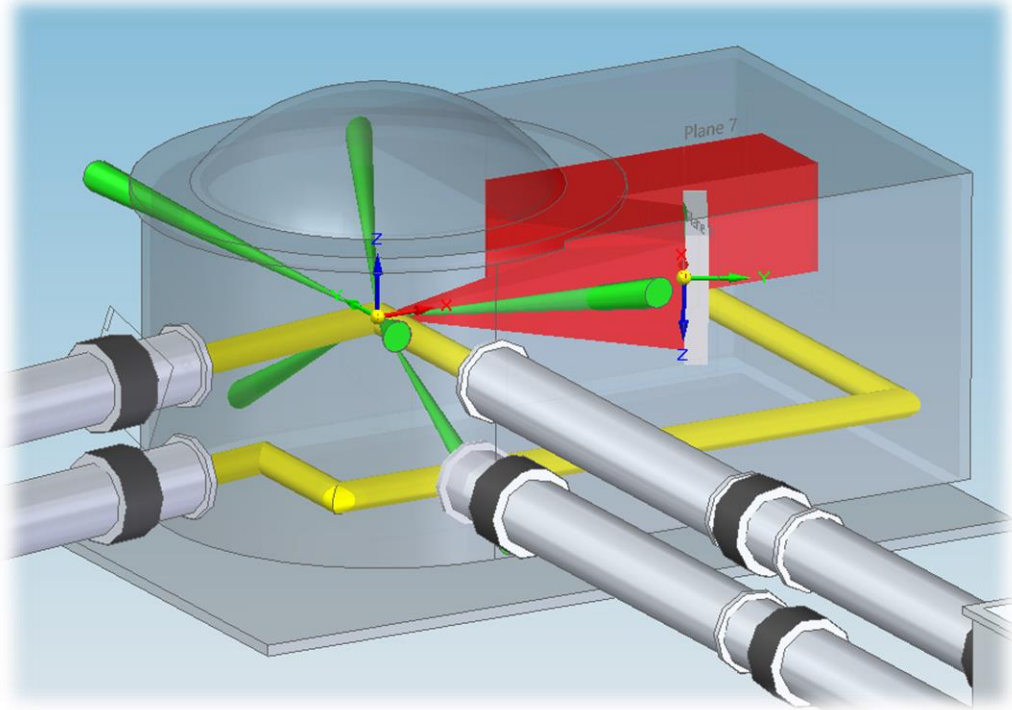
Vulcan Target Area 1

- Three section chamber:
  - Cage: to host the 20PW beam transport and focusing optic
  - Cylinder: enable walking in while maintaining symmetry
  - Dome: spherical symmetry around TCC



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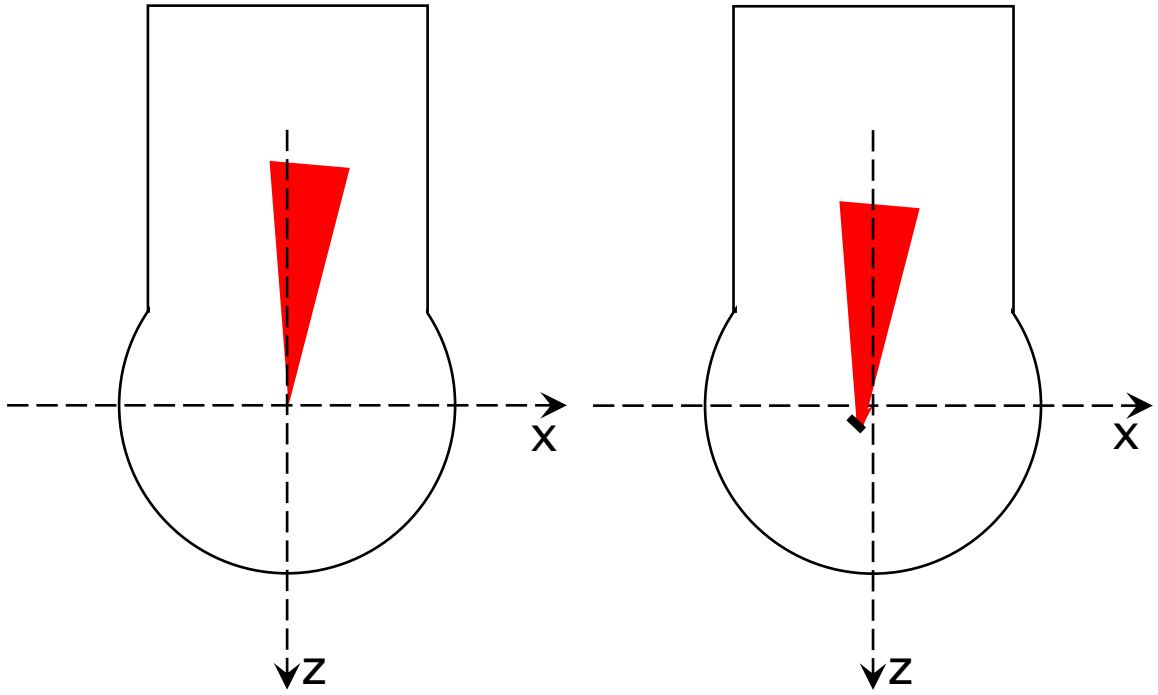
20PW

- Two interaction configurations:
  - Direct Irradiation
  - Plasma mirror
    1. Improve contrast
    2. Control geometry



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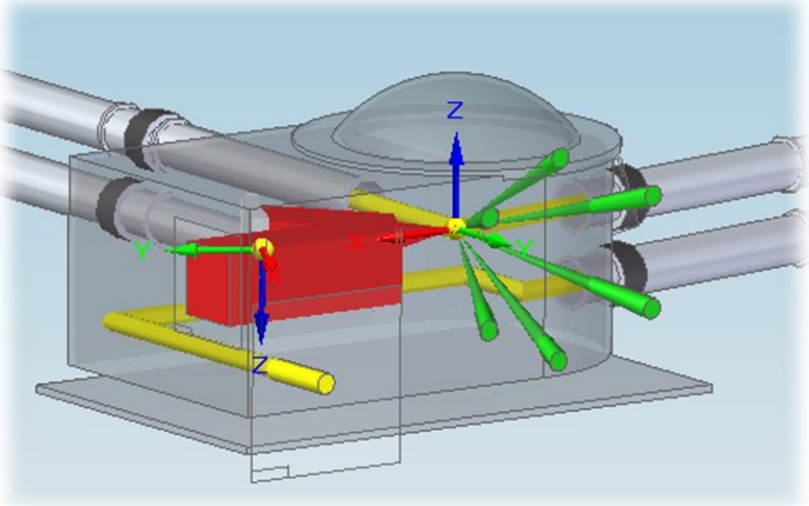
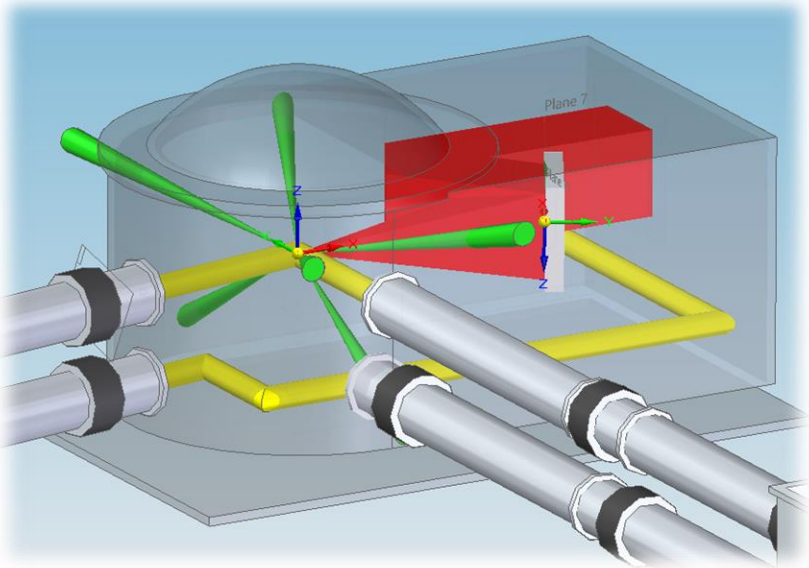
Long pulses

- Two interaction configurations:
  - Single cone
    1. Maximise absorption
    2. Symmetrical irradiation
    3. Leave the horizontal plane clear for diagnostics
  - Double cone
    1. Symmetrical irradiation
    2. Drive face-on irradiation
  - Two additional beams, in the centre of each cone





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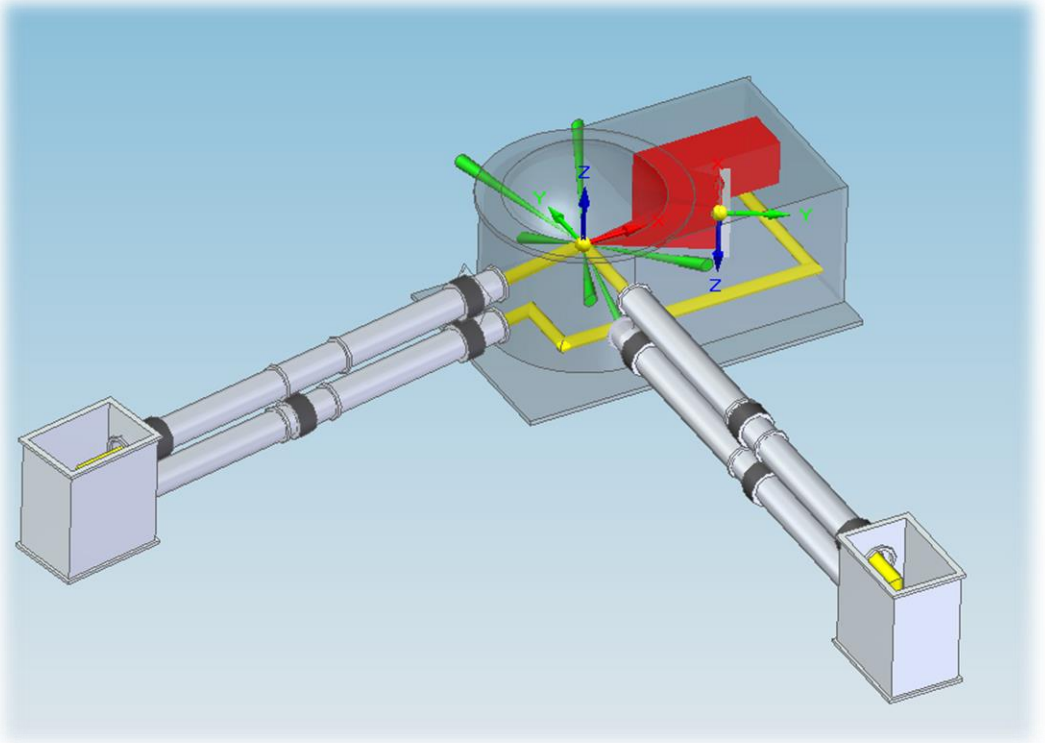
VOPPEL

- Two geometries:
  - Counter-propagating with 20PW
  - Perpendicular to 20PW
  - Both configurations will offer focal offset to install magnet



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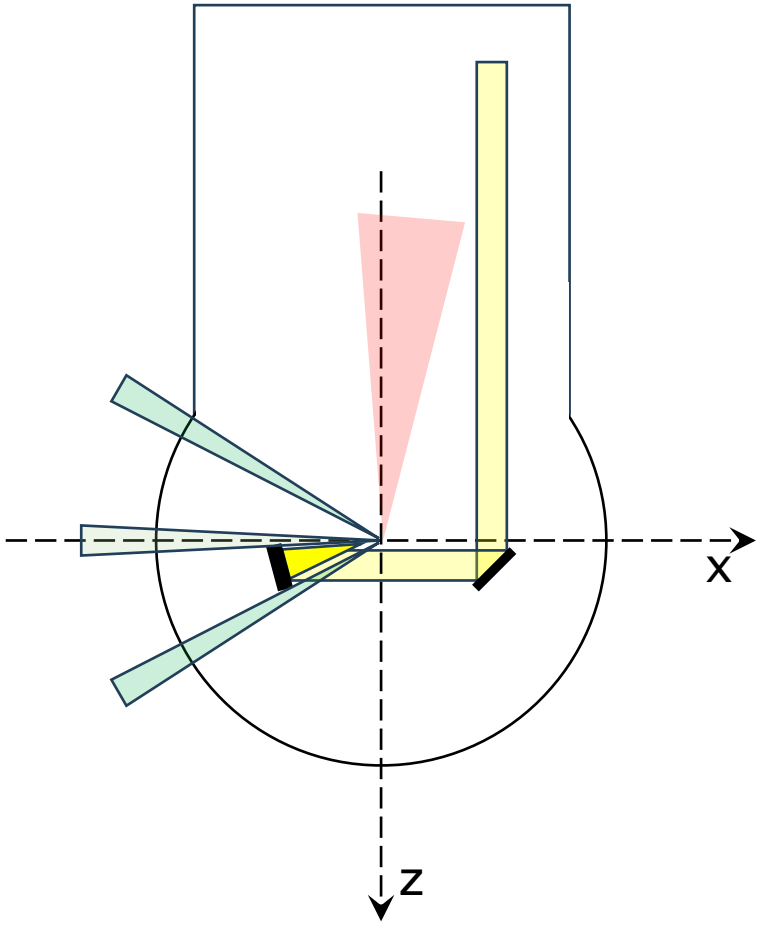
100TW

- No defined configuration:
  - Provide more freedom for application
  - Periscope the beam up and OAP as last optic
    1. Source generation
    2. Interaction beam



Target Area Diagnostics and Detectors

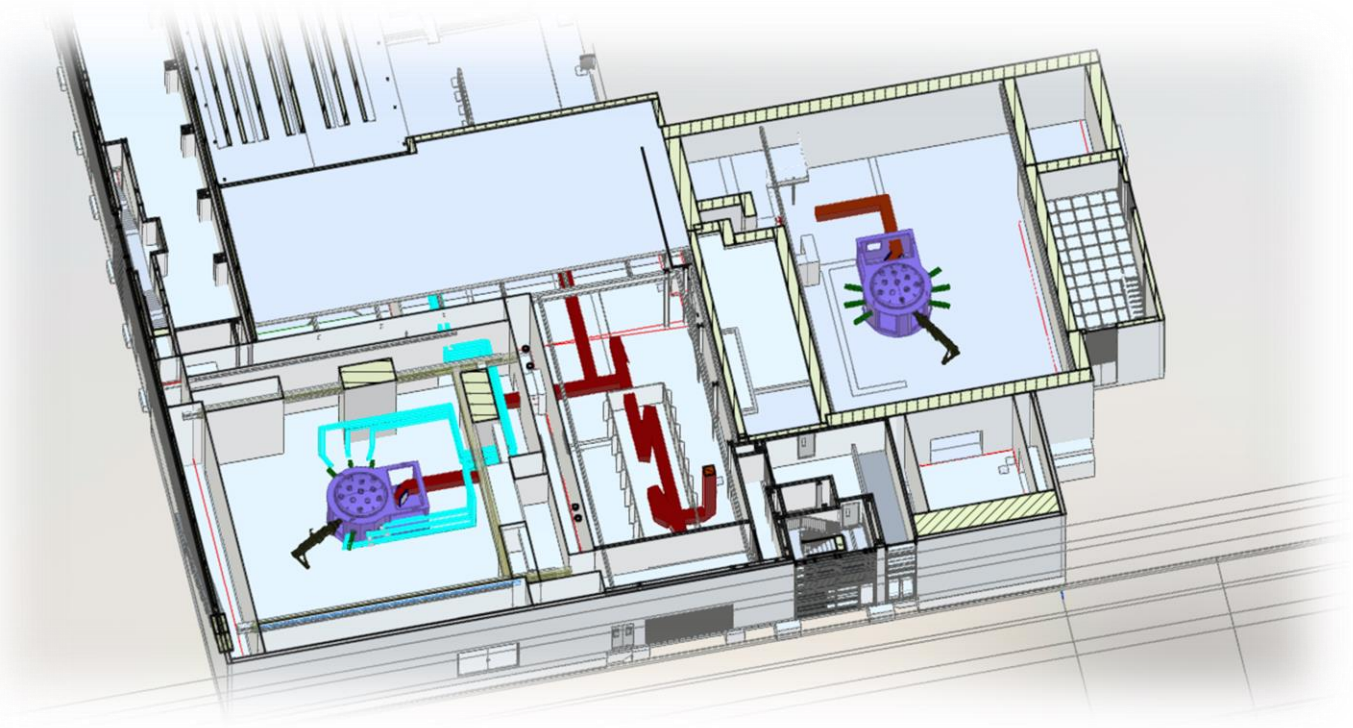
- Deployment of specific diagnostics - priorities determined from user consultations
- Designs for TIM compatible diagnostics

As things stand:

- Need to identify gaps in diagnostic suite for the new science made available by Vulcan 20-20
- Make use of existing diagnostics used on Vulcan and Gemini
- Adaption of diagnostics for higher shot rate – move away from film-based detectors
- Diagnostic development for EPAC offers opportunity for similar suitable solutions for Vulcan 20-20

Project Timescales

- Building work starts January 2025 and ends mid 2026
- Installation of kit will start in the second half of 2026
- Front end commissioning work to start early 2028
- Progressive commissioning of the facility afterwards
- Facility opened for access mid 2030



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Thank you

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CLF central laser facility