Target R&D plans and thoughts on target complex magnetization

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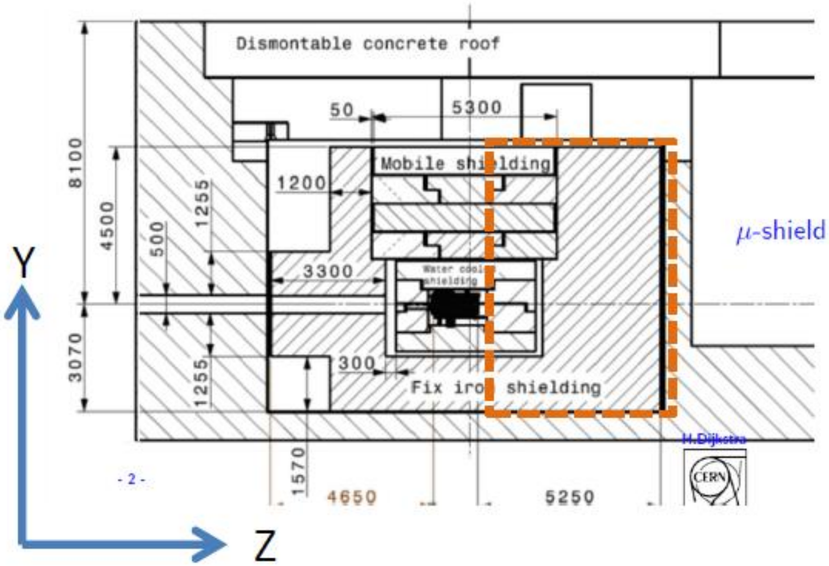
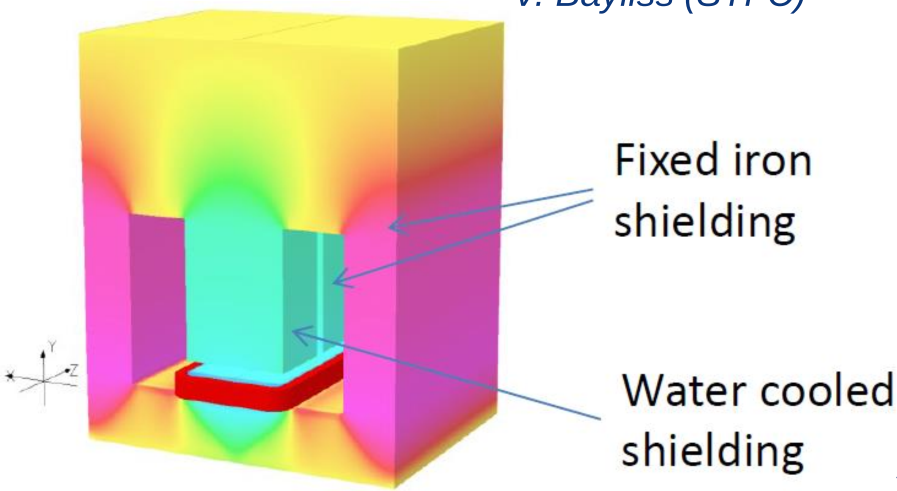
Comments on target region magnetization

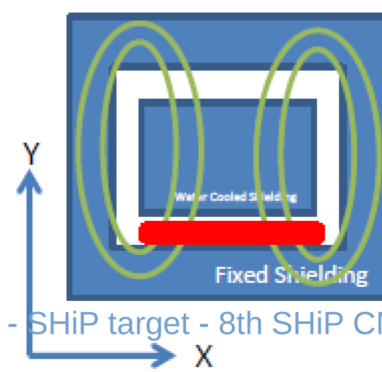
Magnetization of target region



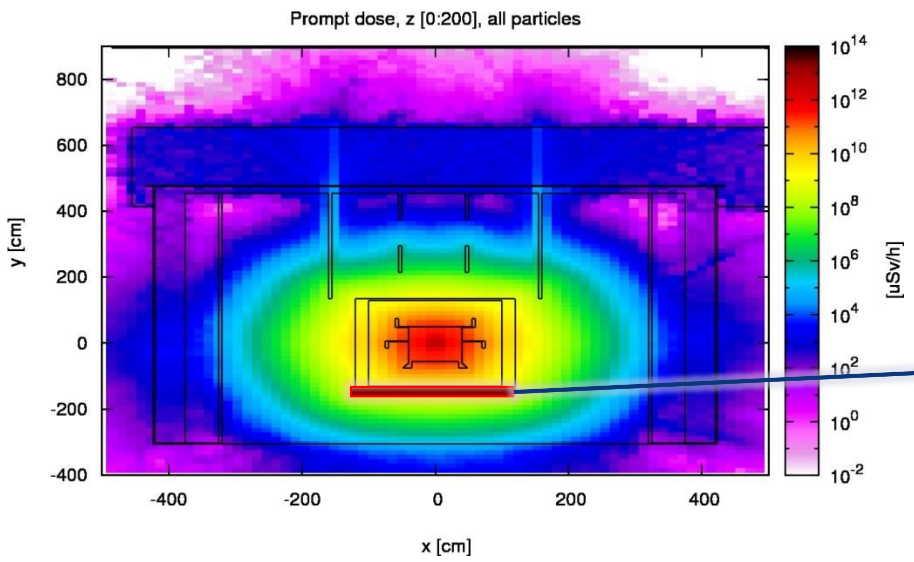
- SHiP has the idea of magnetizing the downstream proximity and hadron absorber
- Coil installed on the bottom of the target proximity shielding

V. Bayliss (STFC)





RP consequences



- Take into account that radiation levels will be extreme during operation **~10^3 Sv/h** (~O(10 MGy/y))

- Residual dose rate of the coils shall be assessed for a final conclusion
- Material selection should target grades with low activation
  - Al and Al_2O_3 (coils & powering) are ok for operational RP and shall be considered as baseline, but will need to be validated by radioactive waste section at CERN
  - SS for high permeability material: low-Co steel (~0.05%) mandatory

Magnetization of target region (I/II)

- **Magnetizing proximity shielding ("Region 1") and hadron absorber ("Region 2") is supported and is felt realistic**
- Magnetizing the inner bunker container (where target is located, "Region 0") shall be excluded at this stage due to the presence of the target and related instrumentation
- Practically, the implementation of the magnet system will significantly increase the complexity of the target complex
- Integration of the system will be **challenging** – remote handling and manipulation aspects will be critical aspect to be analyzed early in the design
- **Reliability** is the key word: system must be able to withstand the high radiation environment during the whole lifetime of the experiment
  - Dose to personnel and radioactive waste generation!

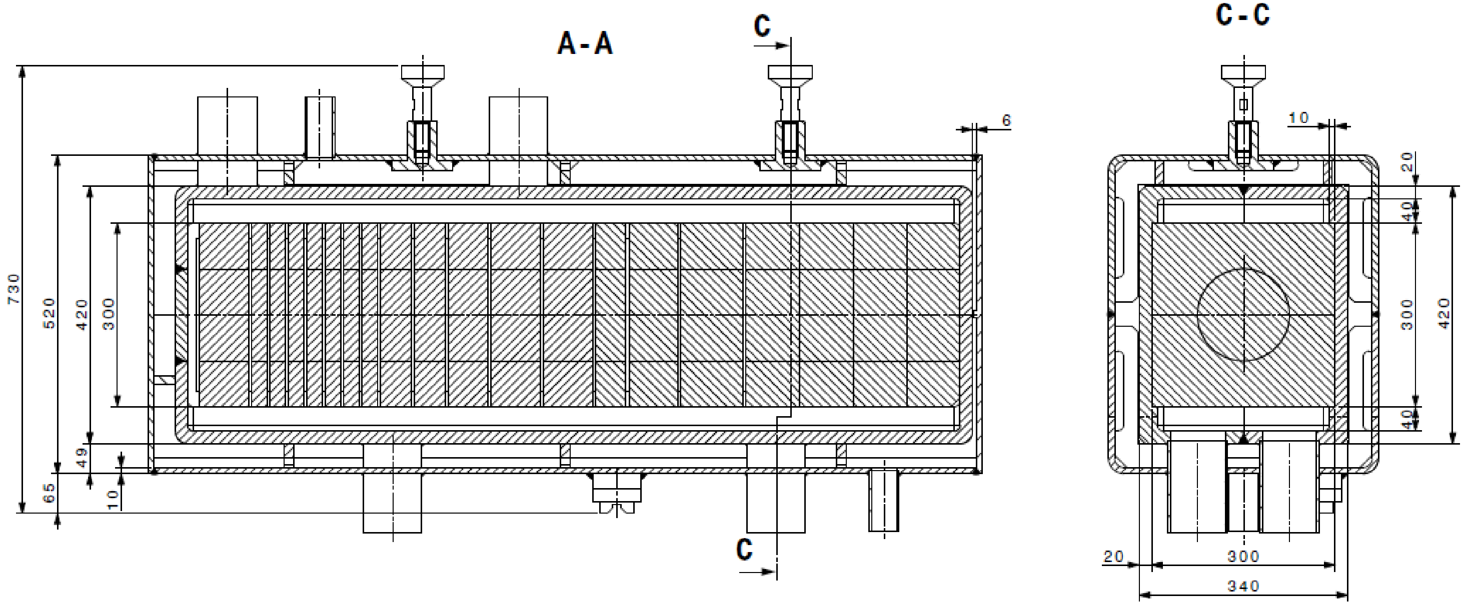
Magnetization of target region (II/II)

1. Clarify the amplitude of the magnet gap considered in the magnetic circuit, in order to perform a correct estimate of the required ampere turns
2. Compute the power losses of the coil, they will depend on the above, as well as on the coil size and material
3. The size of the coils should be determined
4. Establish a strategy for cooling, depending on the power losses (in thermal contact with the proximity shielding?)
5. It was felt important to introduce safety margins on the magnetic permeability used for the SS, taking into account that cast grades might be selected for cost reasons
6. The structural dimension of the shielding should be verified and could perhaps be optimized
7. The radiation protection effectiveness of the shielding has to remain similar to the non magnetized version in order to guarantee sufficient protection, avoid concrete activation and maintain the wished classification for the target hall

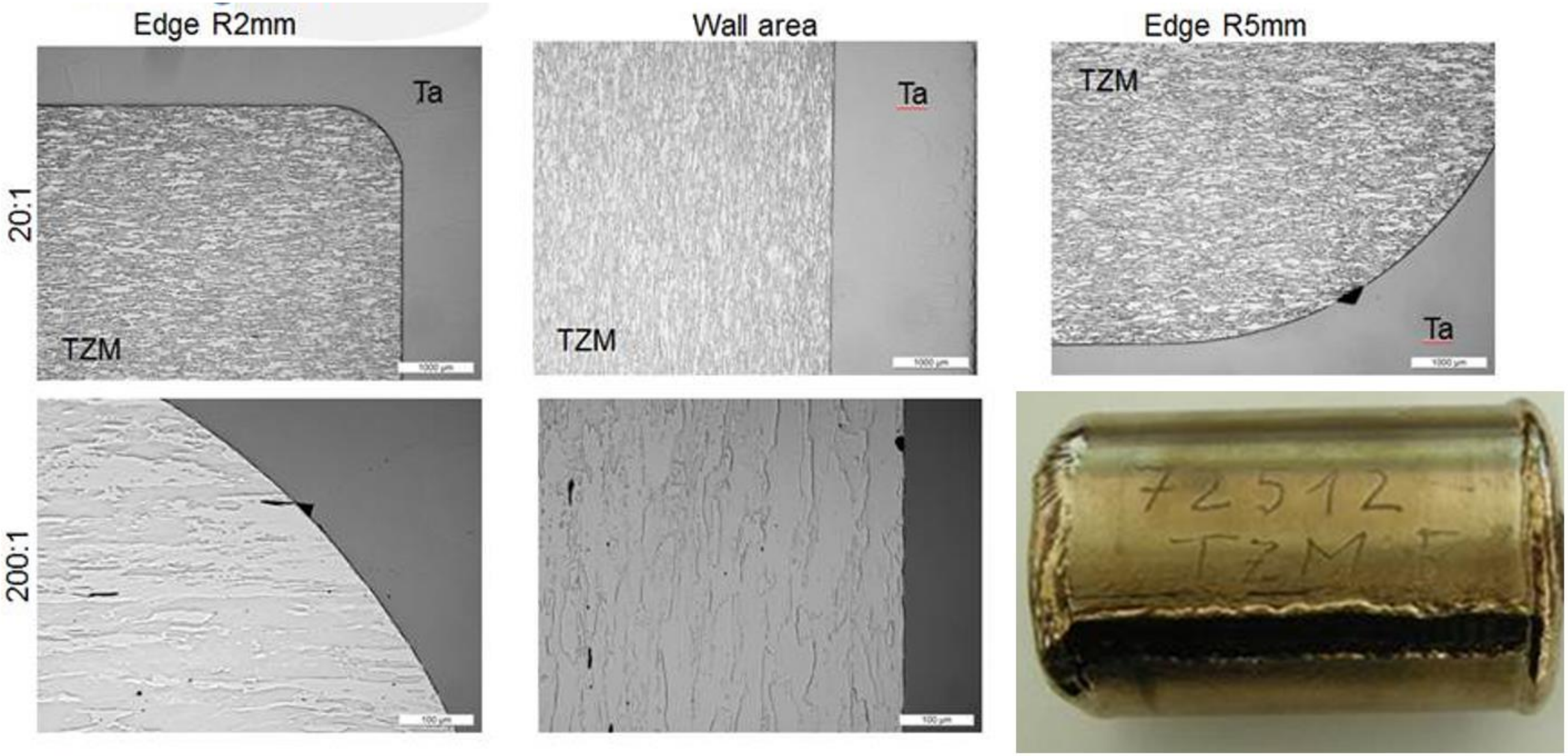
Target R&D plans

SHiP CDR target overview

- 10 λ_{int} long production target
- High-Z target, hybrid solution composed of TZM & pure W
  - 40x30 4m^2, segmented geometrically optimized target
  - 58 cm Ta-cladded TZM (13 layers) + 58 cm Ta-cladded W (4 layers)
- Water cooled (in CDR) to dissipate the ~320 kW average deposited power – O(85 mm) water gaps
- Double vessel – internal H_2O cooling, external He flow



Results with Ta-cladded TZM



- Work ongoing with external company – for the moment encouraging results
- R&D will be boosted from 2017

R&D items for the beam dump facility study

1. Detailed analysis of the assembly, configuration and fabricability of the **cladded refractory metal blocks**
2. Material **irradiation R&D**
3. Feasibility of **water-cooled cast iron blocks** with embedded SS pipes
4. Feasibility of the **target water cooling system** and pre-design validation + **ventilation system**
5. Study of a **He-cooled target**
6. Integration **studies for target complex** & transport/handling study
7. R&D for fully metal, high flow rate and pressure-compatible **water plugin**
8. R&D for **He-vessel circulation** and prototyping activities

Thanks