

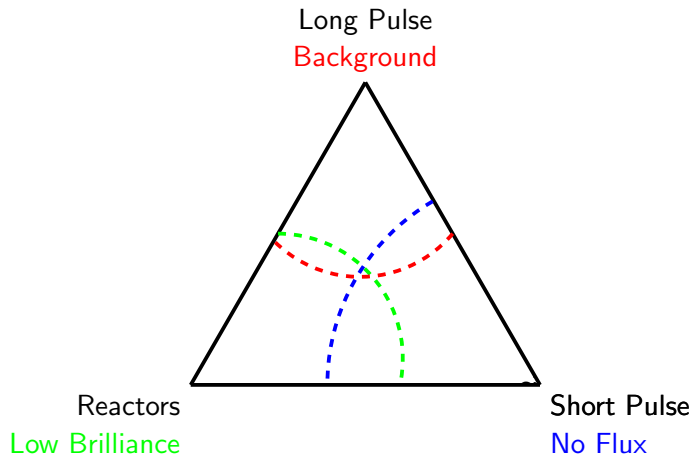
Bunker Project : Methods and Engineering considerations

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The quest for happiness



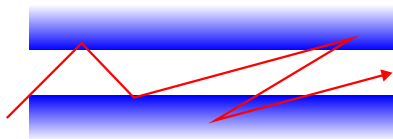
The Basic Background Problem

- ALL $>1\text{eV}$ neutrons can albedo transport.
- Acceptance is 50x / flux 100x greater than cold guide transported neutrons.

$$\phi_{out} = \phi_{init} \frac{K(A^{3/2})^{n-1}}{L_1^2(L_2L_3 \dots L_n)^M} \quad (1)$$

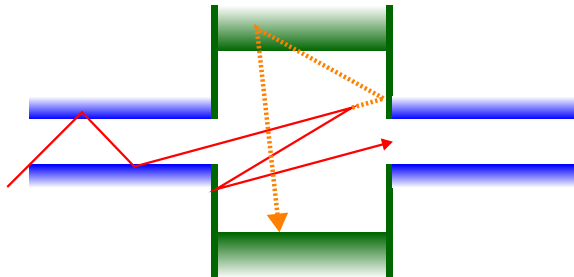
$$M = 3 - \cos(\text{bendAngle})$$

A simple 2x bend beamline at 150m can have S/N ratio of 1000!!!



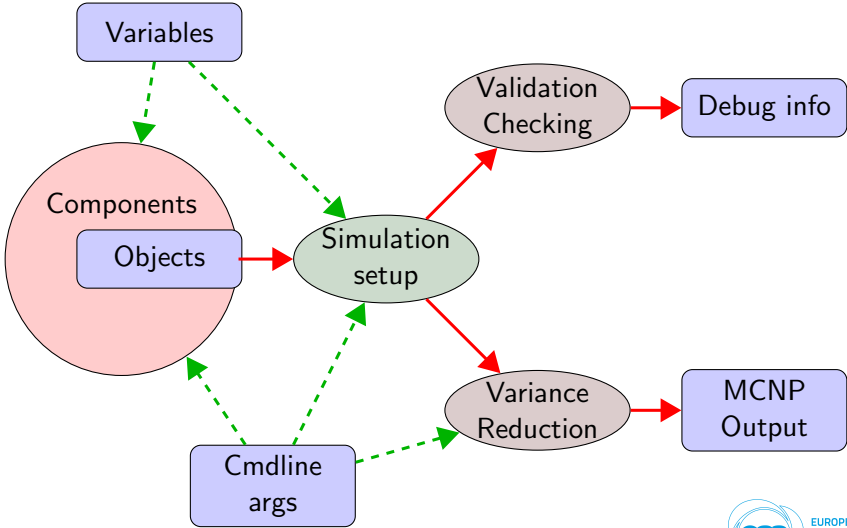
- Albedo transport dominates intermediate energy background.

The Basic Background Solution

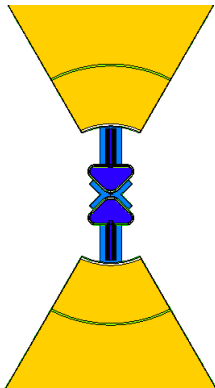


- Alternative voids/tight collimation improves the situation
- Voids need to be larger at the start / smaller towards the end
- The bunker is effectively a *super void*.

CombLayer Process

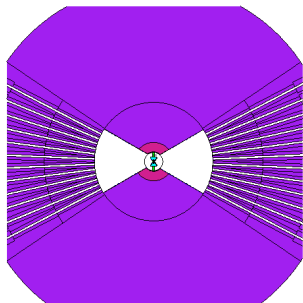


Butterfly Moderator

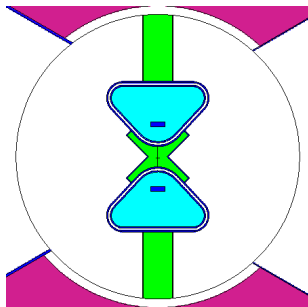


- The MCNP model that was produced for the neutronics doesn't run fast enough for shielding work
- Doesn't scale to larger models beyond the 2m line

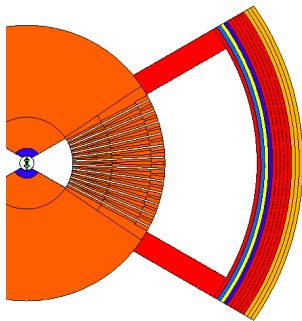
Guide Cut



Butterfly Cut

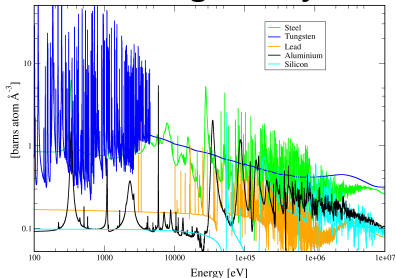


Lower A Bunker

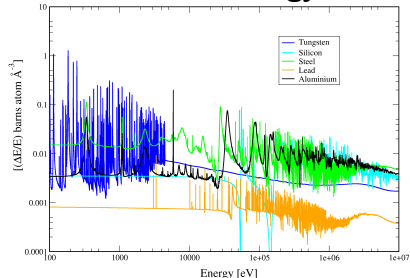


- Simple proto-bunker ready for beamline construction

Scattering Density

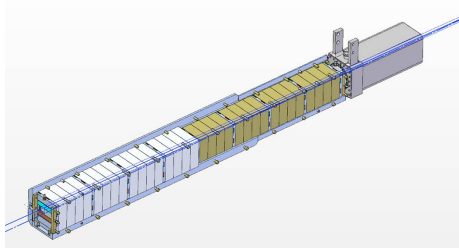


Mean Rate of Energy Loss



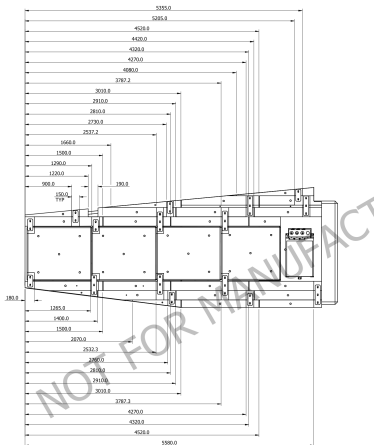
- Although W has the highest scattering cross section – energy loss rate is low.
- All elements show streaming towards the lower energy range of their resonance region.

Typical shutter to stop main beam

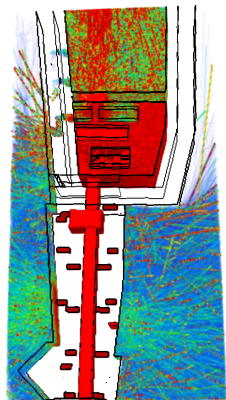
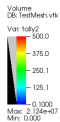


- The main beam must hit the main wall.
- The smallest heavy shutter for a spallation source is 2 metres of steel.
- The exit wall must be 2.5m long and **have no chopper within it.**

Engineering Reality

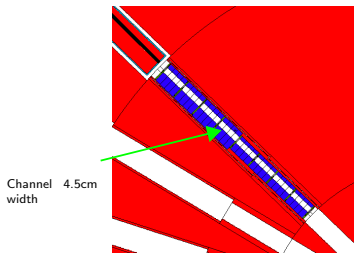


Monte-Carlo model



- Gaps that can form near channels are extremely consequential
- Gaps should ideally point to low scattering zones
- Let people know about your gaps/cut-throughs – **They can be modelled!**

Shutter Cut



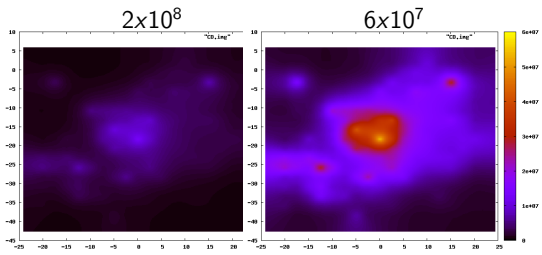
Bender Cut



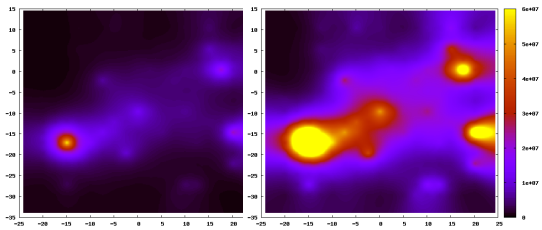
- The choice of a vertical / horizontal bend has a huge impact on the background.

Zoom Bender Orientation

Vertical



Horizontal



- Just starting the bender design
- It is critical this is right
- Cross instrument compromises are essential
- This has to be collaborative between engineering / neutronics