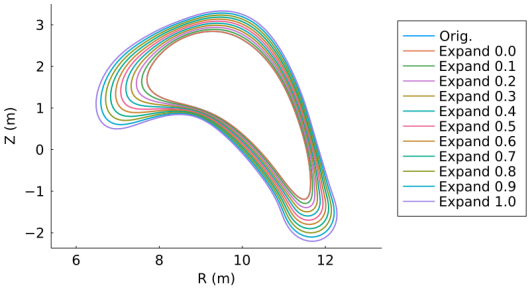
Exploring Divertor Expansion Parameters

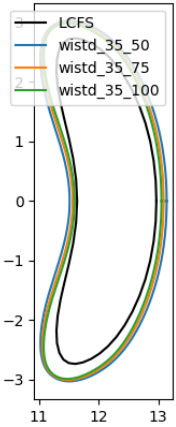
A. Bader, K. Garcia, H. Frerichs
Wistell Meeting 29 April

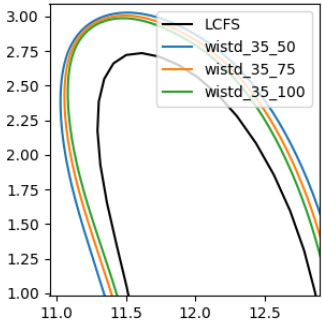
Non-uniform expansion - 3D

- Idea: use local magnitude of $|d\vec{\psi}/ds|$ as a scaling factor to expand more in regions where the flux surfaces have larger expansions inside the LCFS
- Use a local value of $\Delta^* = \Delta \left(\frac{|d\vec{\psi}_{\min}/ds|}{|d\vec{\psi}/ds|} \right)^{\alpha}$ from the boundary
- Close to the boundary this should mimic the most realistic expansion. Farther from the boundary it is less reliable

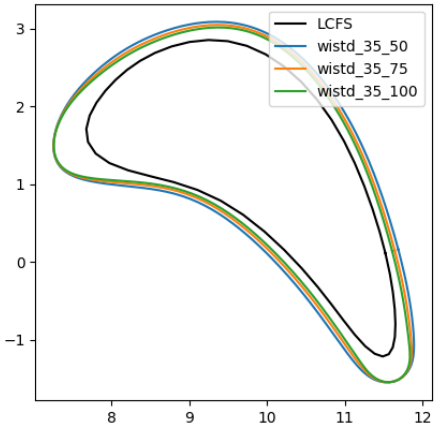


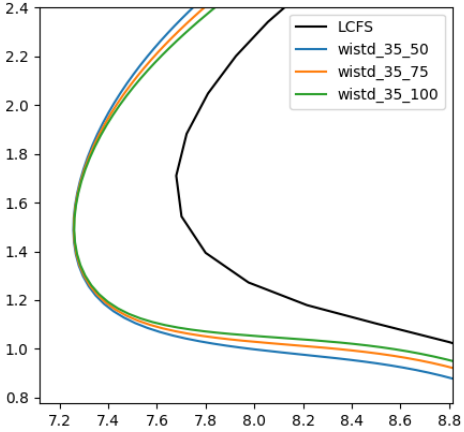
Changing expansion parameter (35 cm from LCFS)



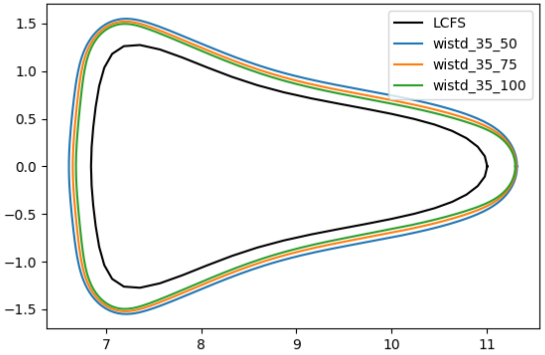


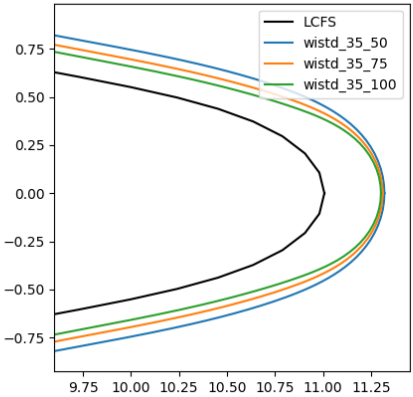
Changing expansion parameter (35 cm from LCFS)





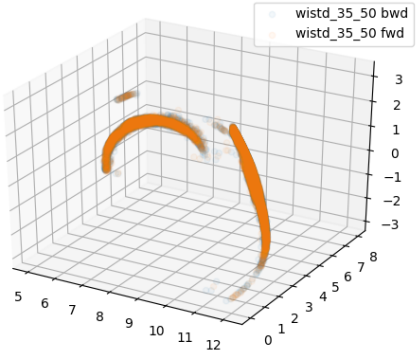
Changing expansion parameter (35 cm from LCFS)





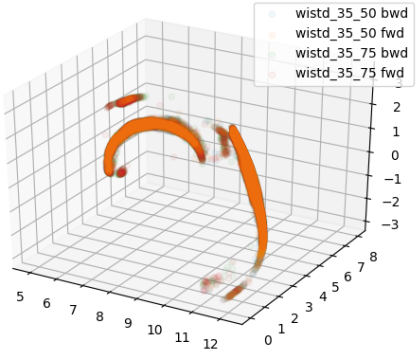
Calculate strike on wall with FLARE

Just α = 0.50



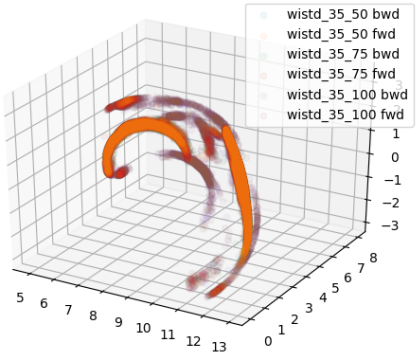
Calculate strike on wall with FLARE

α = 0.50 and α = 0.75

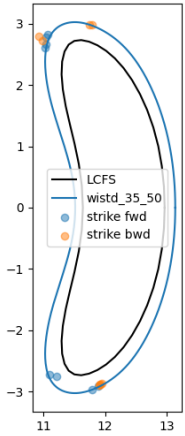


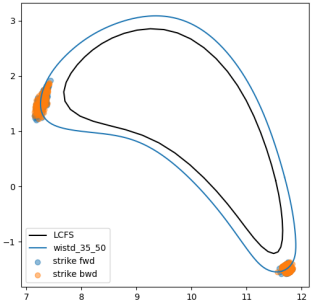
Calculate strike on wall with FLARE

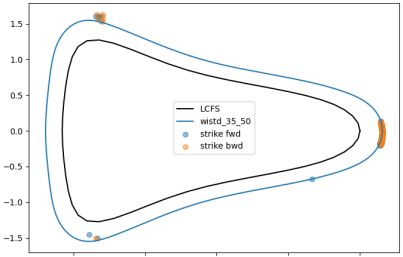
All αs



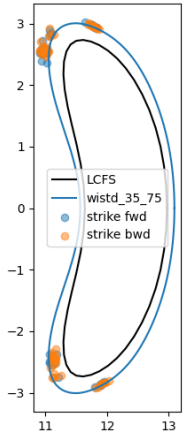
2D strike, r = 35cm, α = 0.50

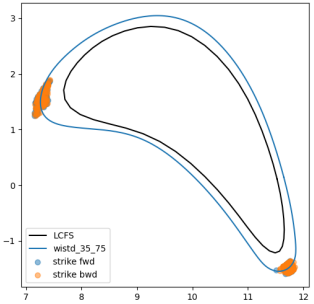


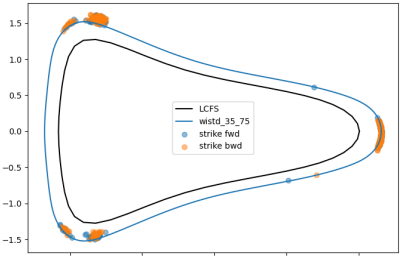




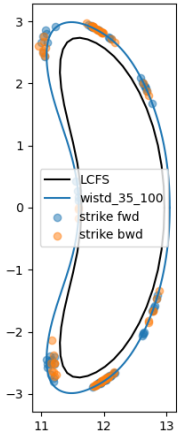
2D strike, r = 35cm, α = 0.75

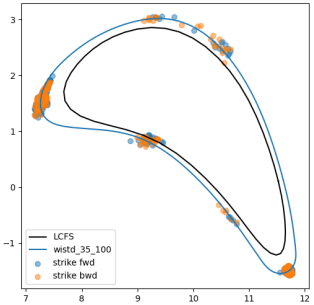


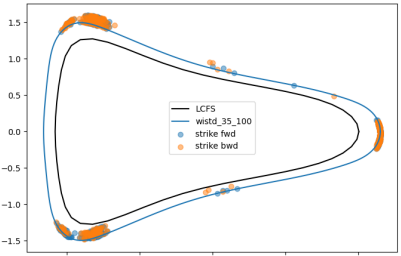




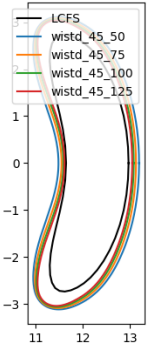
2D strike, r = 35cm, α = 1.00

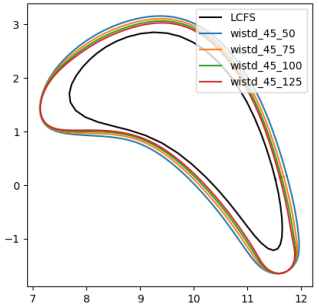


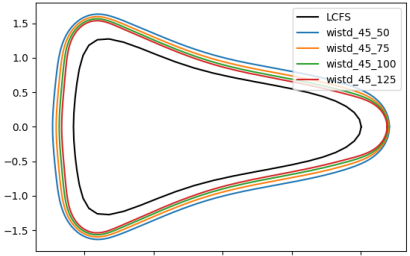




Repeat the same thing with surfaces 45 cm from LCFS

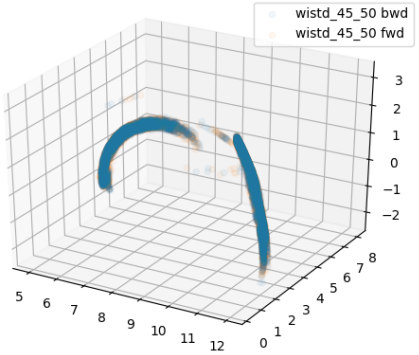






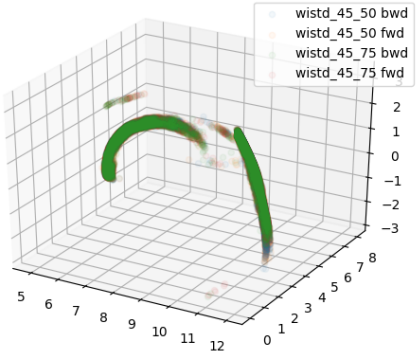
Calculate strike on wall with FLARE

Just α = 0.50



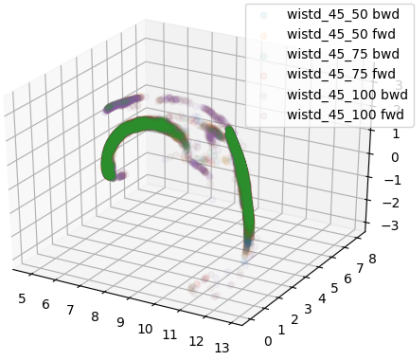
Calculate strike on wall with FLARE

α = 0.50 and α = 0.75



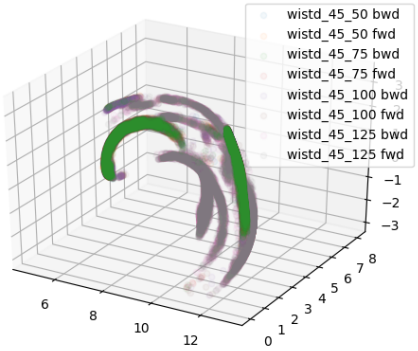
Calculate strike on wall with FLARE

α = 0.50, α = 0.75 and α = 1.00

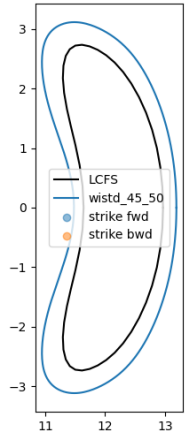


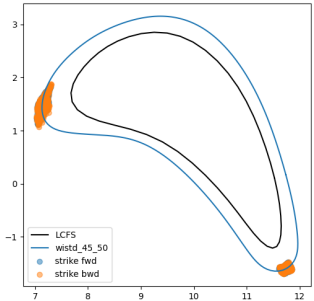
Calculate strike on wall with FLARE

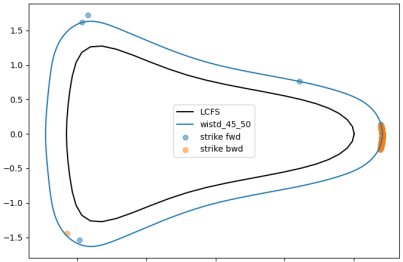
All αs



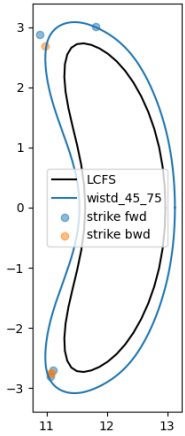
2D strike, r = 45cm, α = 0.50

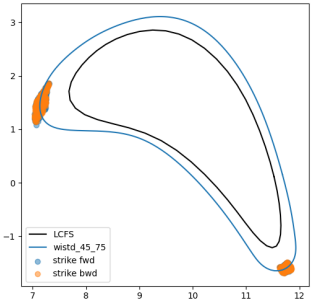


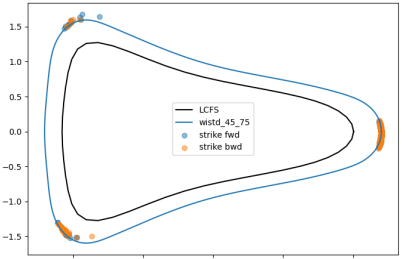




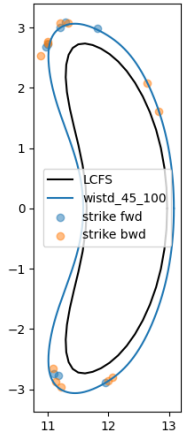
2D strike, r = 45cm, α = 0.75

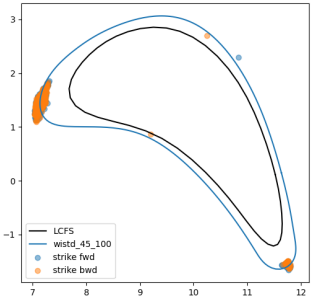


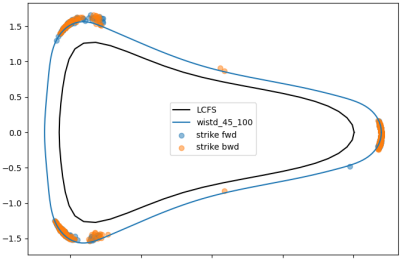




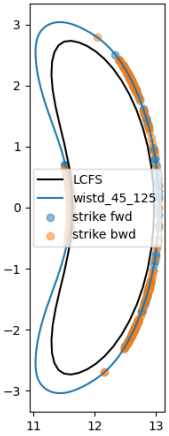
2D strike, r = 45cm, α = 1.00

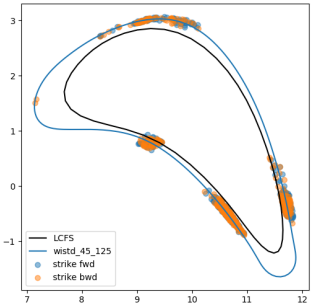


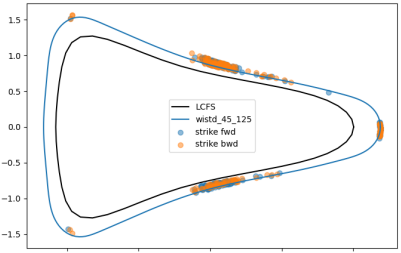




2D strike, r = 45cm, α = 1.25







Possible approach to divertor design

- Step 1: Figure out maximum allowable distance in divertor regions between LCFS and coil/vessel boundaries
- Step 2: Set Δ to this value and choose α such that the strike points remain in the desired divertor region
- Step 3: Ensure that all points are still inside coils. If not, then reduce Δ and repeat

Conclusions

- For a given maximum expansion, Δ, there is a maximum value, α, above which the strike lines will intersect away from the divertor plates
- This sets some basic limit to how much we can expand in the divertor regions, additional expansion will intersect the sides of the divertors, rather than the back wall