Power loads to TDU

Yu Gao

2020.06.22

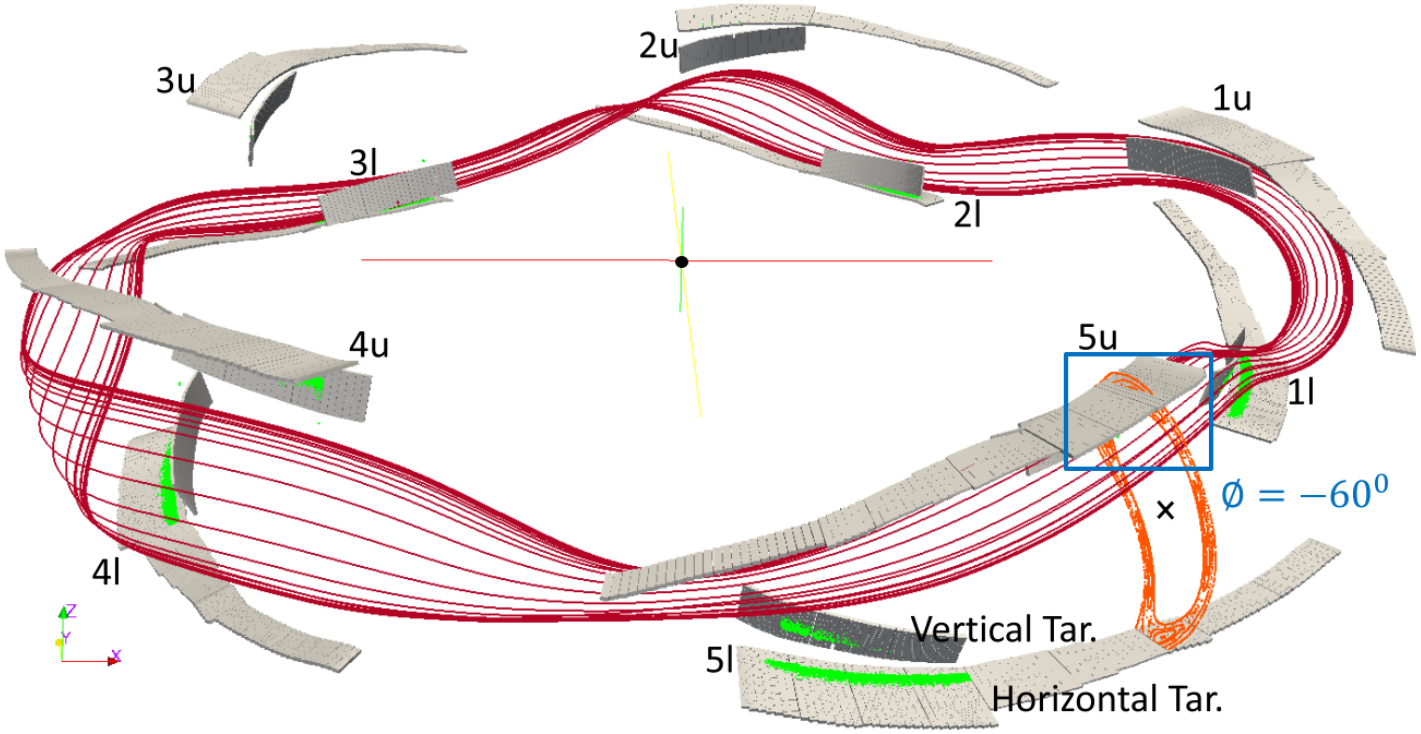
Joint TG divertor & PWI meeting

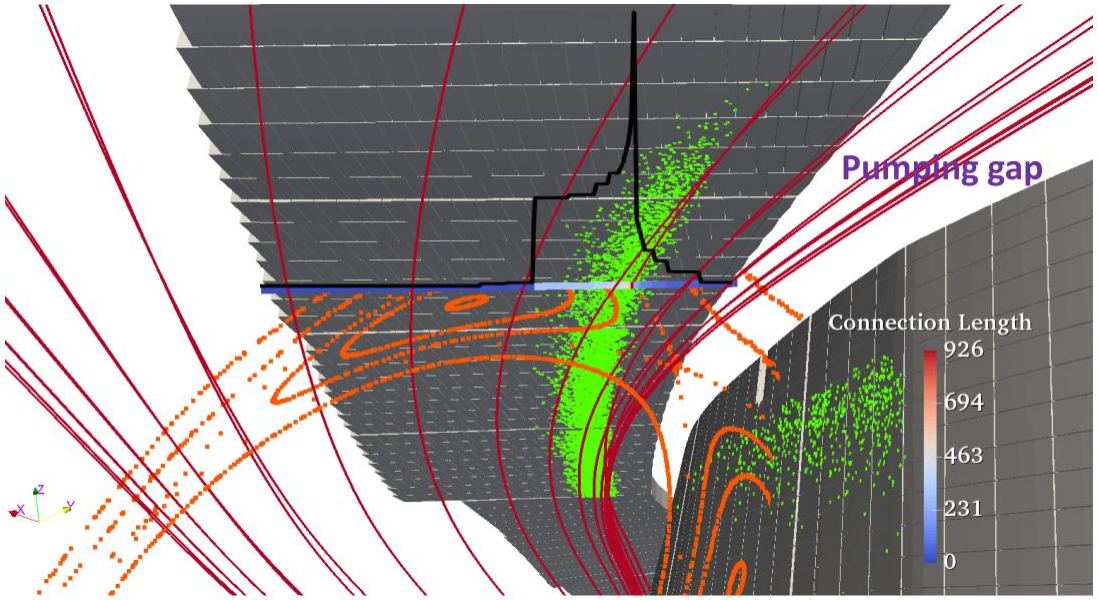
Outline

- Test Divertor Unit (TDU) and island divertor concept.
- Main configs. and the resulting strike lines.
- Thermography.
- Error fields correction.
- Iota correction.
- Toroidal current change boundary iota, moving strike line.
- Up-down asymmetry caused by E X B drifts.
- Counter streaming flows.

TDU and island divertor concept

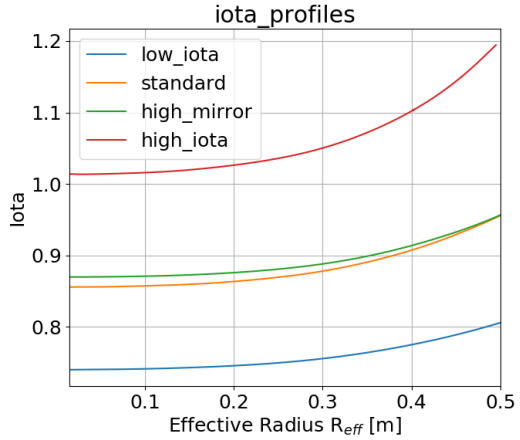
Feng Y. et al 2006 Nucl. Fusion 46 807

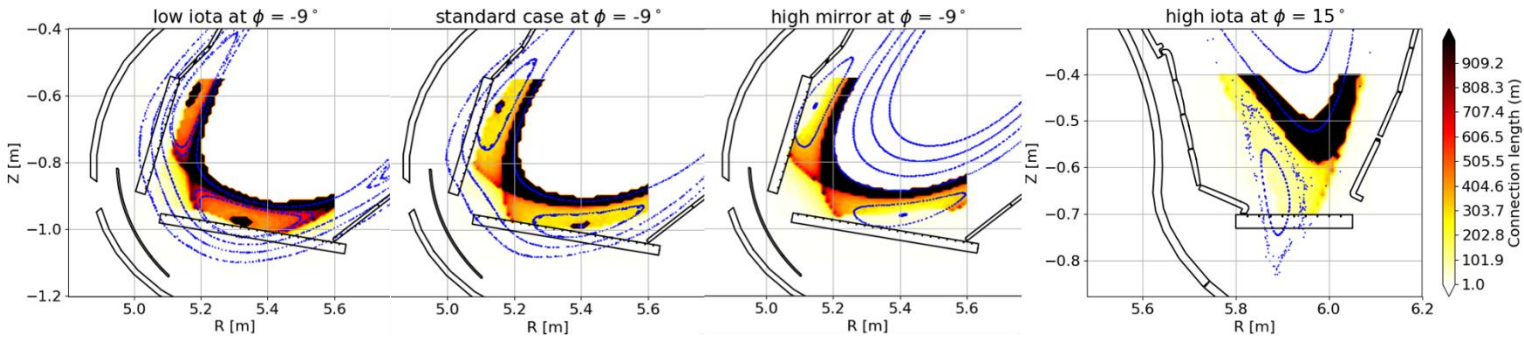




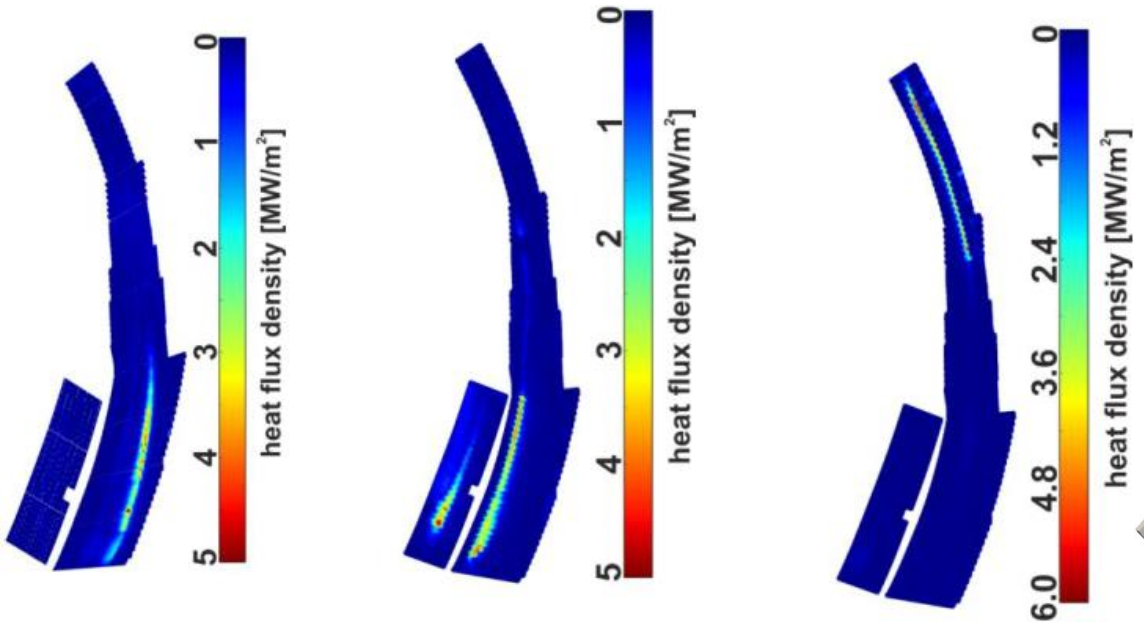
Gao et al Nucl. Fusion 59 (2019) 066007

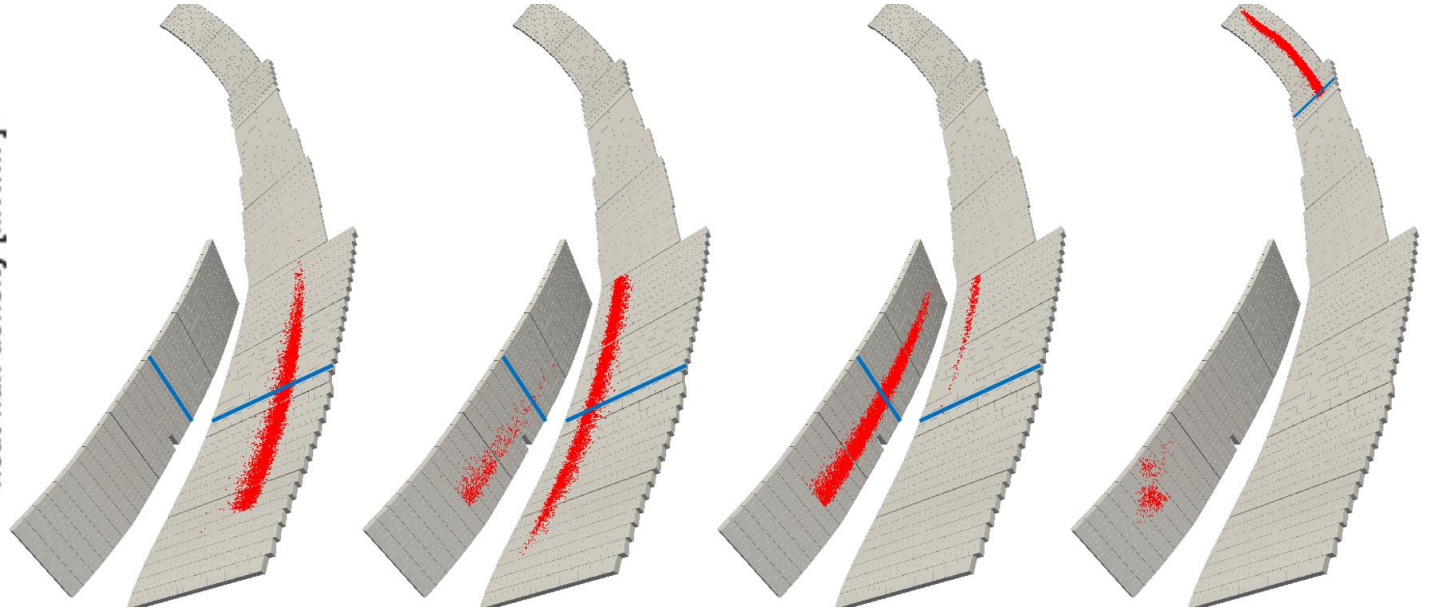
Main configs. and the resulting strike lines





Pedersen et al Plasma Phys. Control. Fusion 61 (2019) 014035

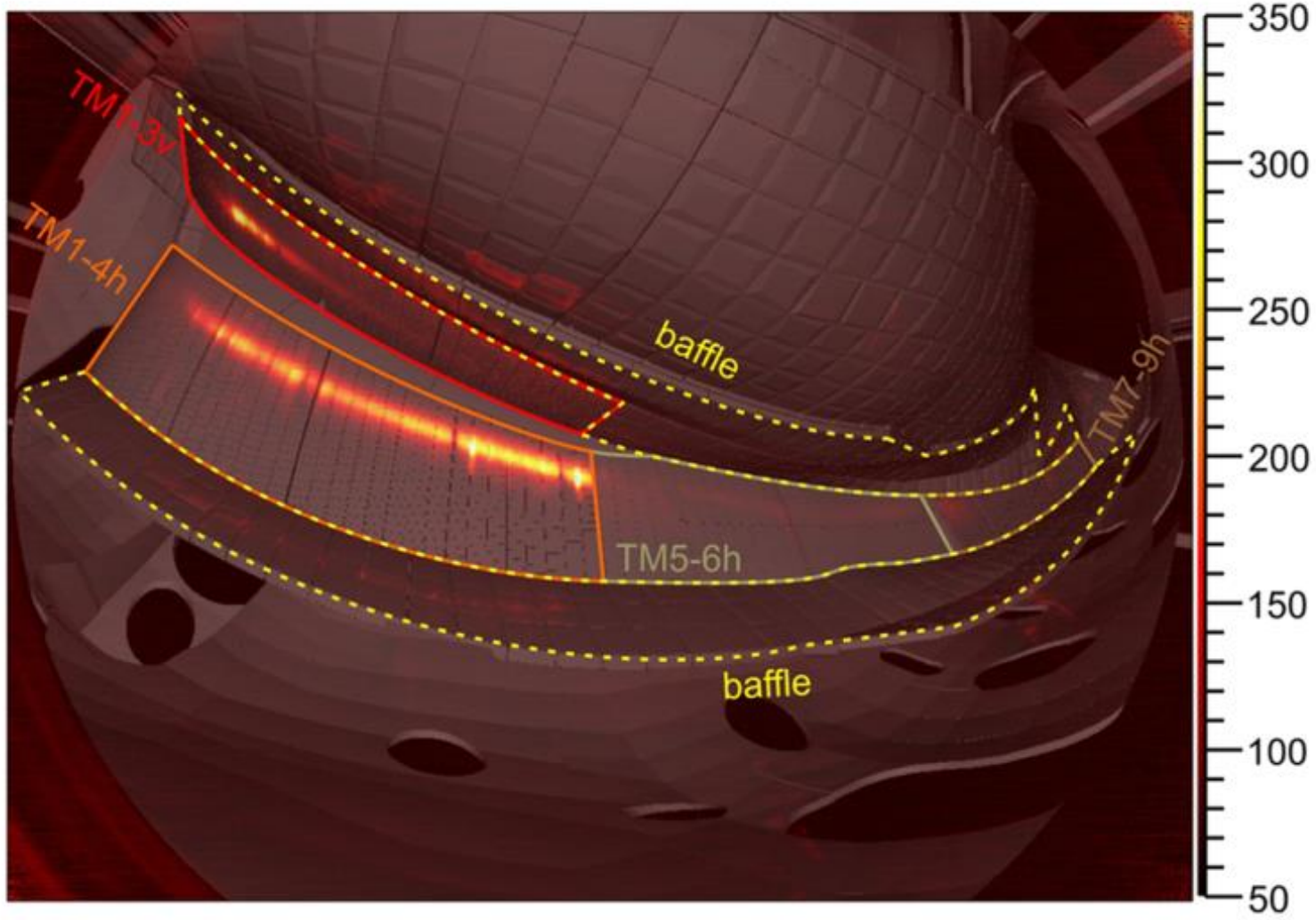


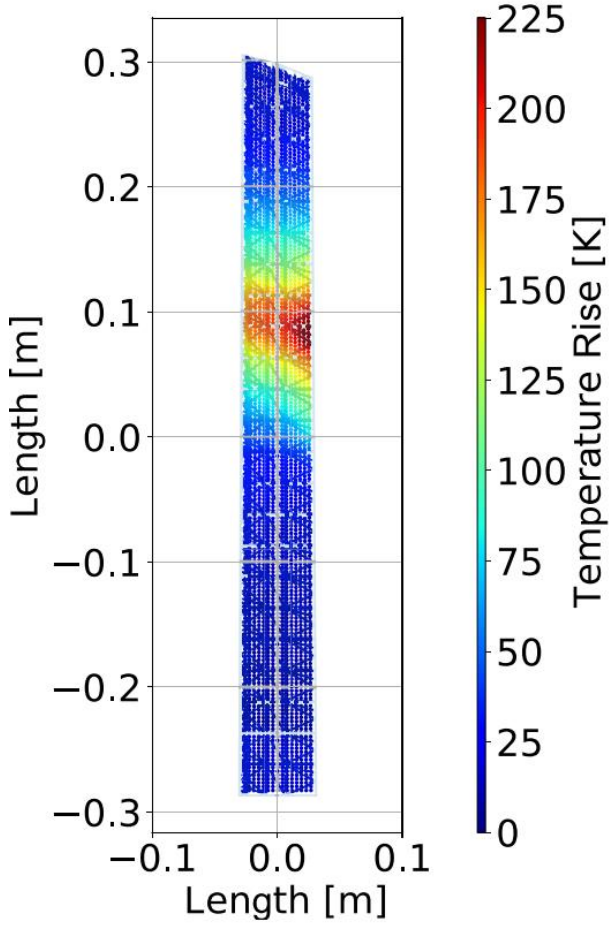


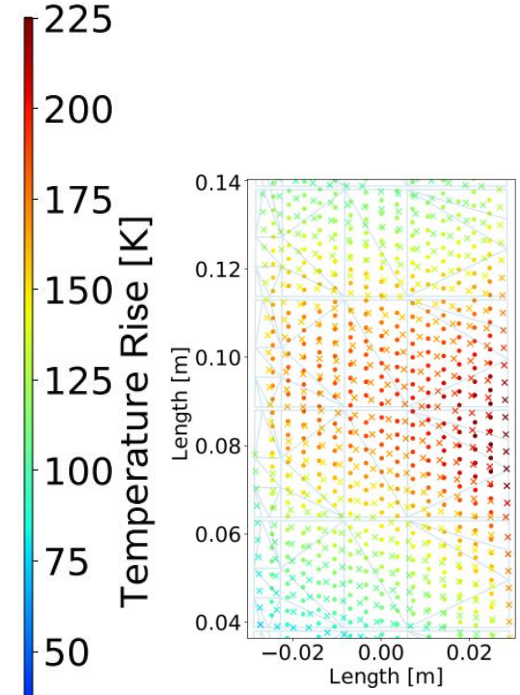
Jakubowski et al IAEAFEC 2018

Thermography

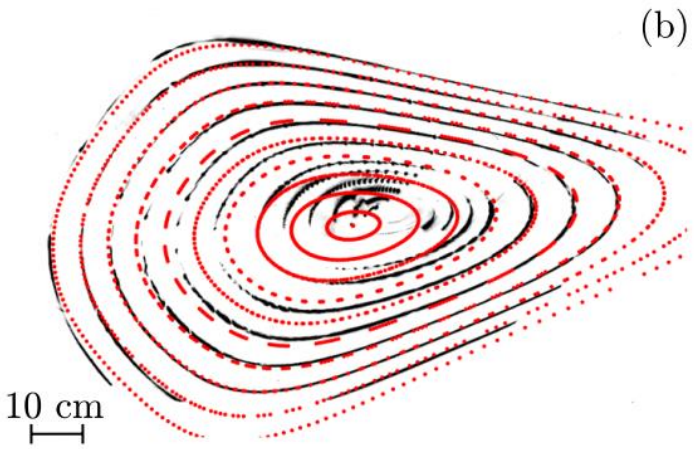
Jakubowski et al Rev. Sci. Instrum. 89, 10E116 (2018)
Puig Sitjes et al 2018 Fusion Sci. Technol. 74 116
Ali et al 2017 Phys. Scr. 2017 014074
Pisano et al 2018 Rev. Sci. Instrum. 89 123503
Gao et al Nucl. Fusion 59 (2019) 066007

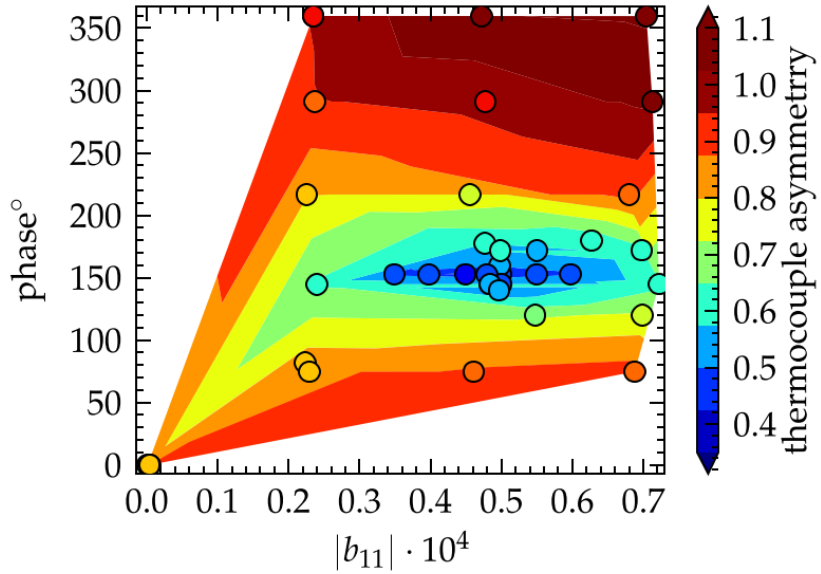


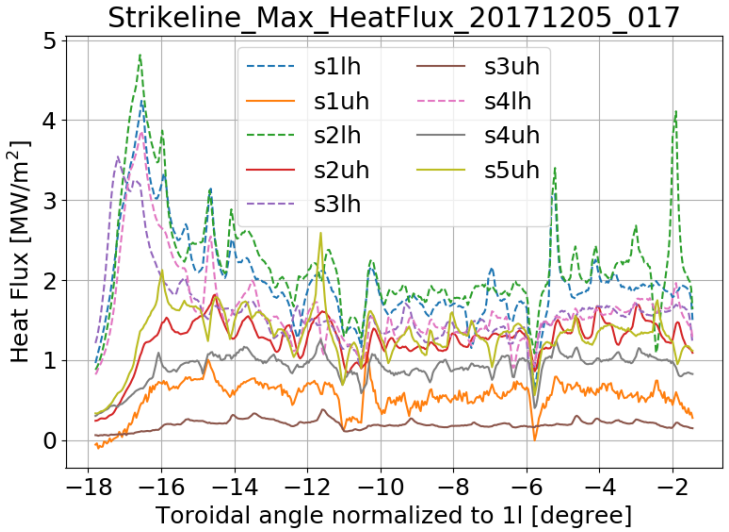


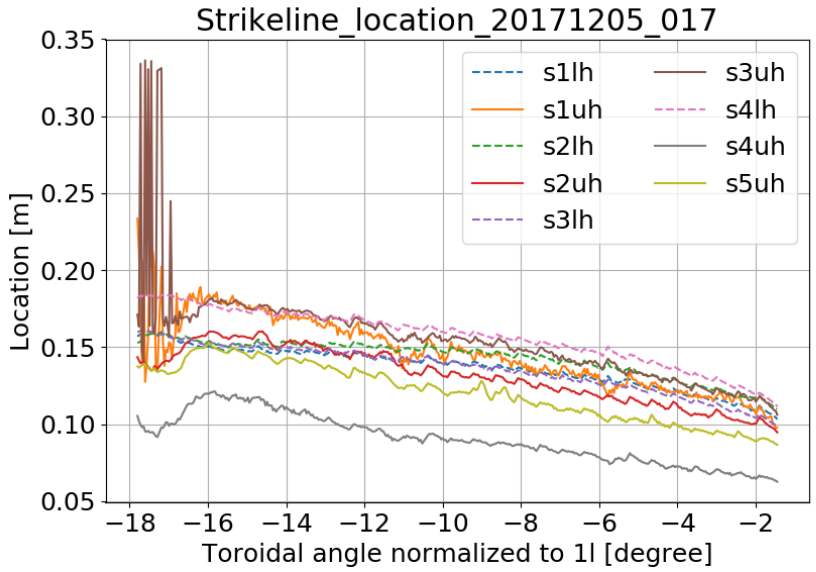


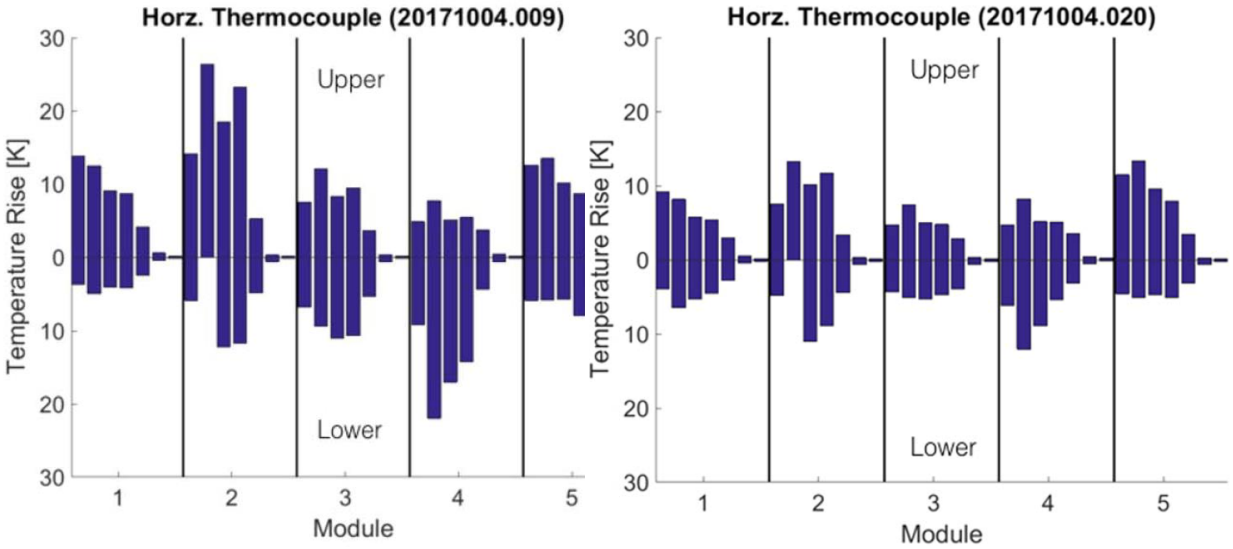
Error field correction











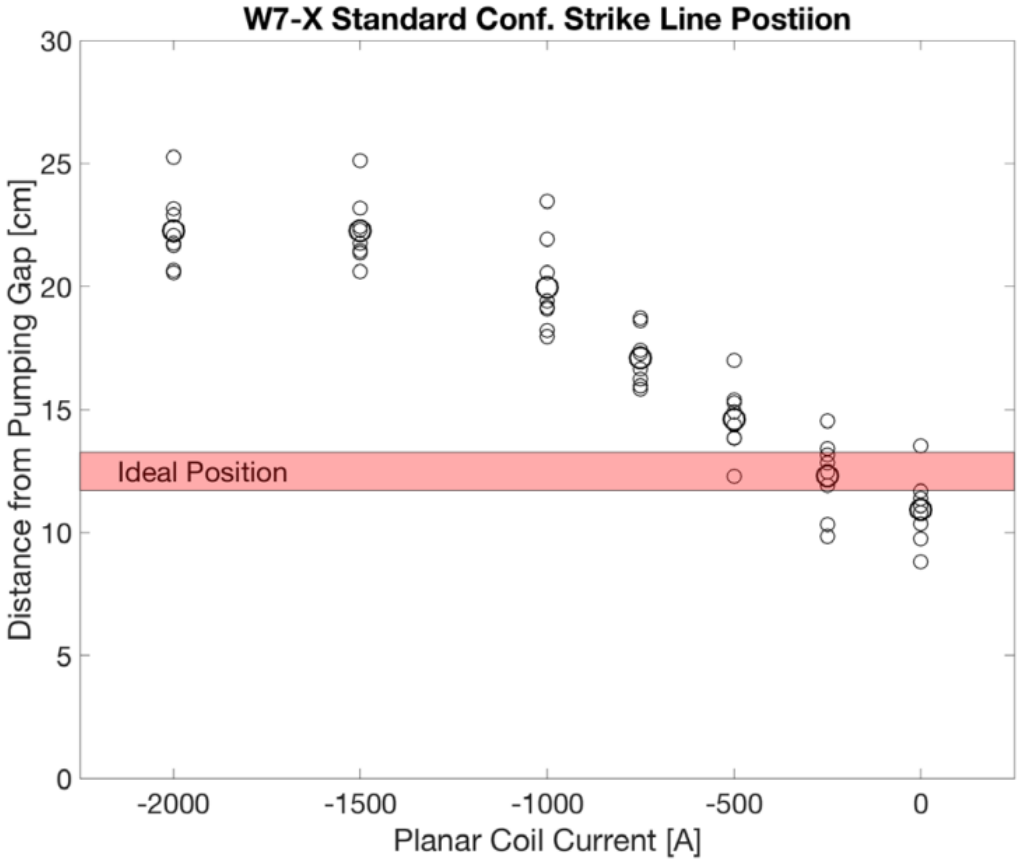
Bozhenkov et al Nucl. Fusion 59 (2019) 026004

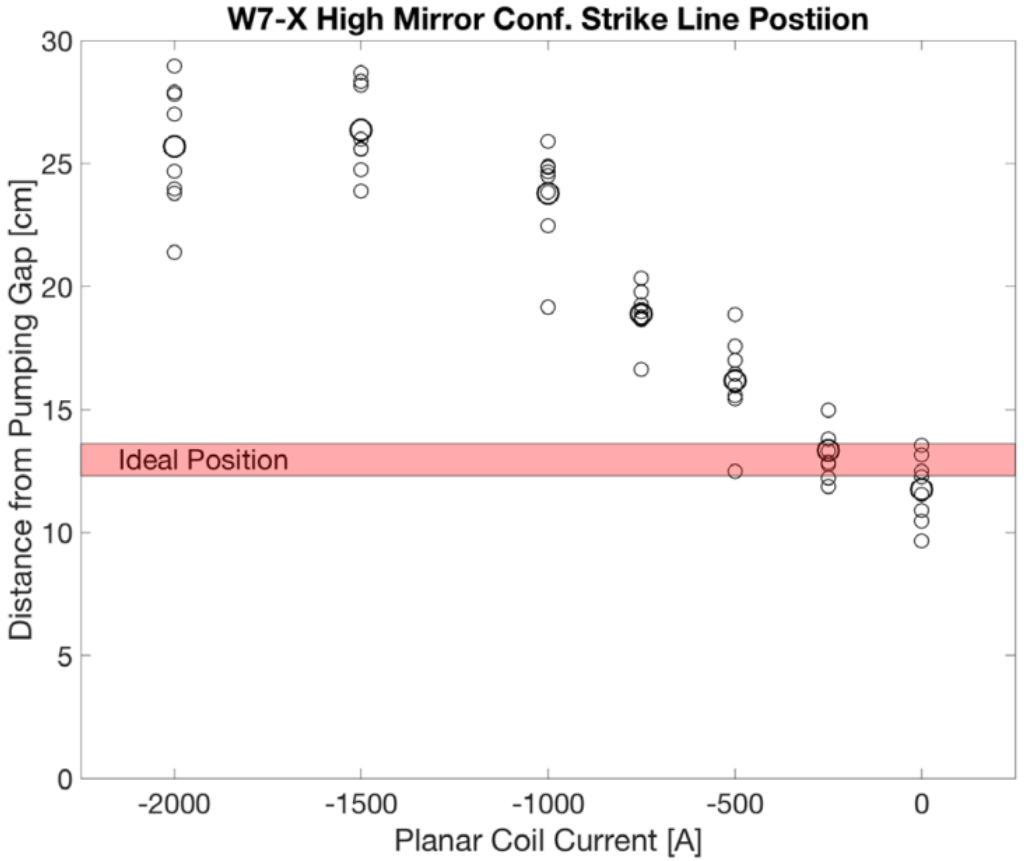
Lazerson et al Plasma Phys. Control. Fusion 60 (2018) 124002

https://wikis.ipp-hgw.mpg.de/PhysicsW7X/images/8/88/W7X_TrimCoilsScans_YuGAO.pdf

Iota correction

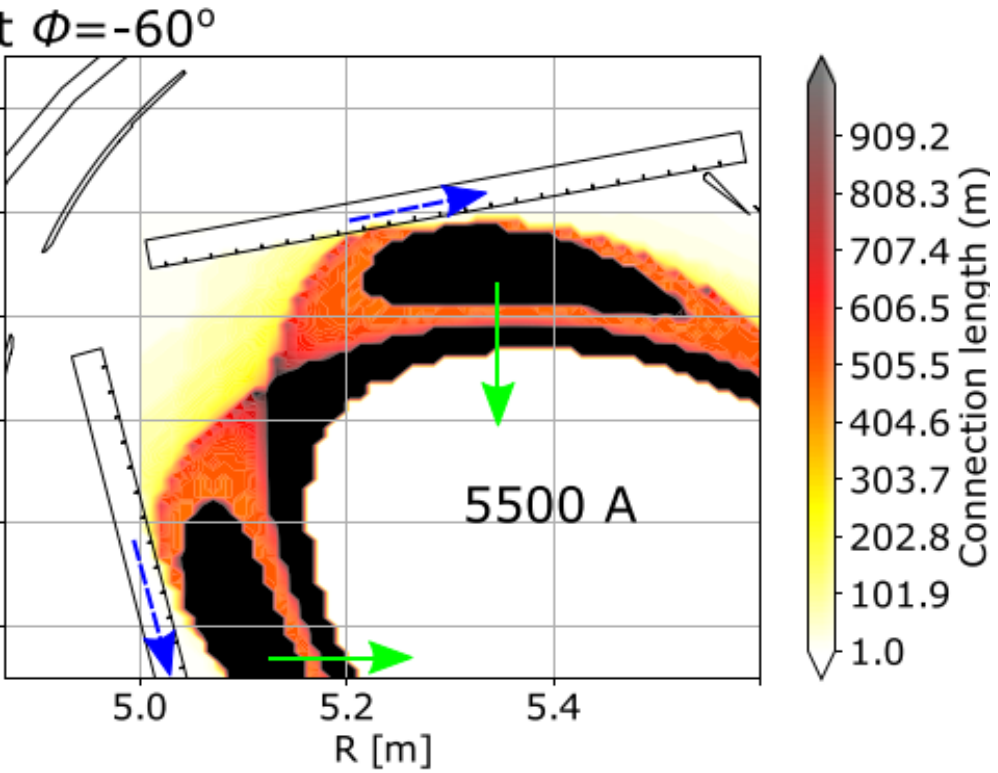
Lazerson Nucl. Fusion 59 (2019) 126004 (11pp)

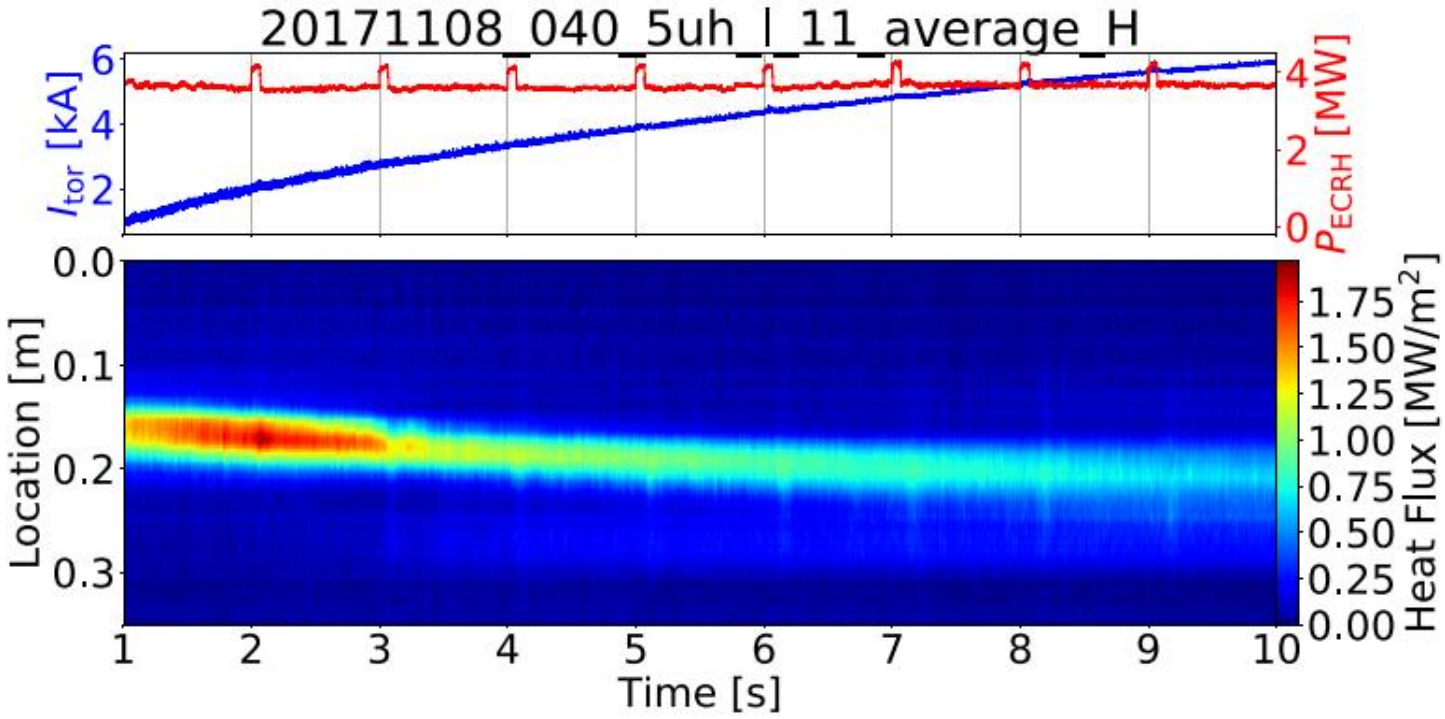




To avoid Abschirmhaus interaction, we have to run in increased iota configuraion
For std. OP1.2a Ipla = -700 A and OP1.2b Ipla = -500 A.

Toroidal current

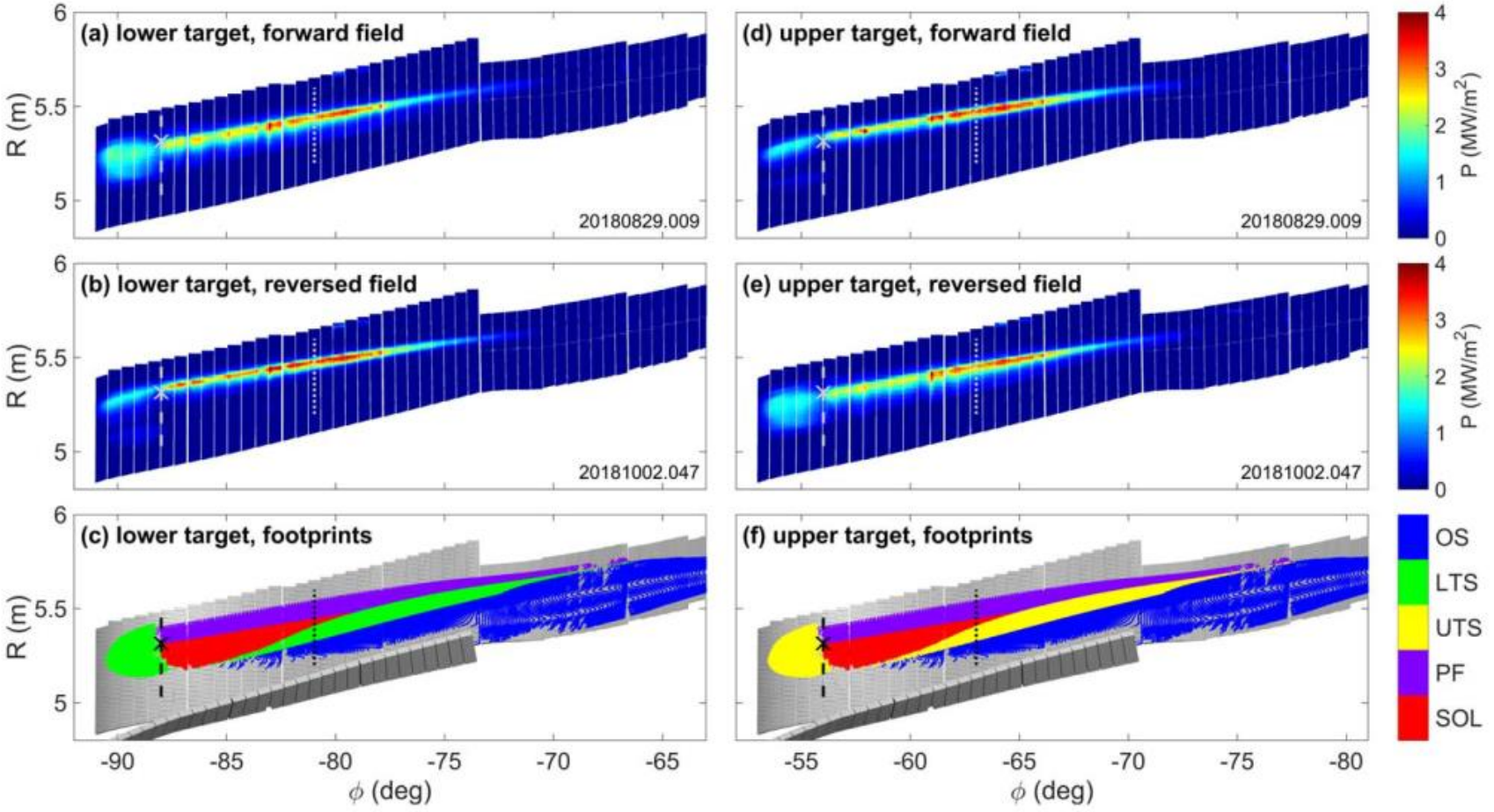


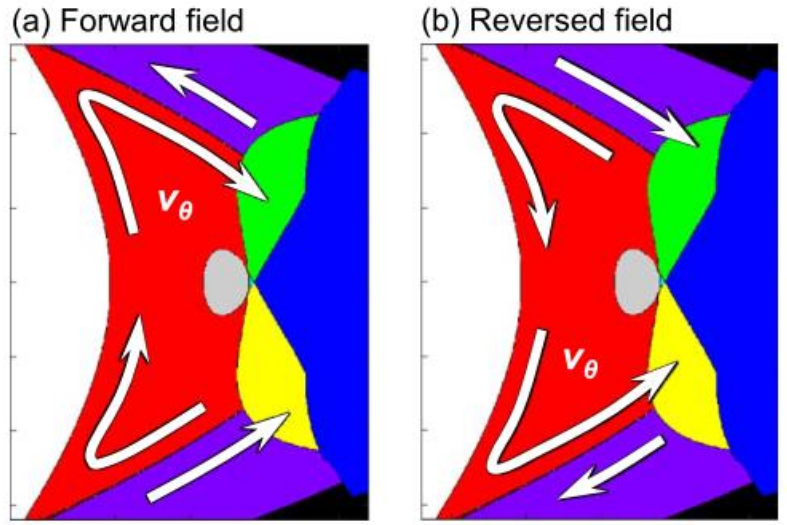


Gao et al Nucl. Fusion 59 (2019) 106015

Killer et al Plasma Phys. Control. Fusion 61 (2019) 125014 (9pp)

Up-down asymmetry

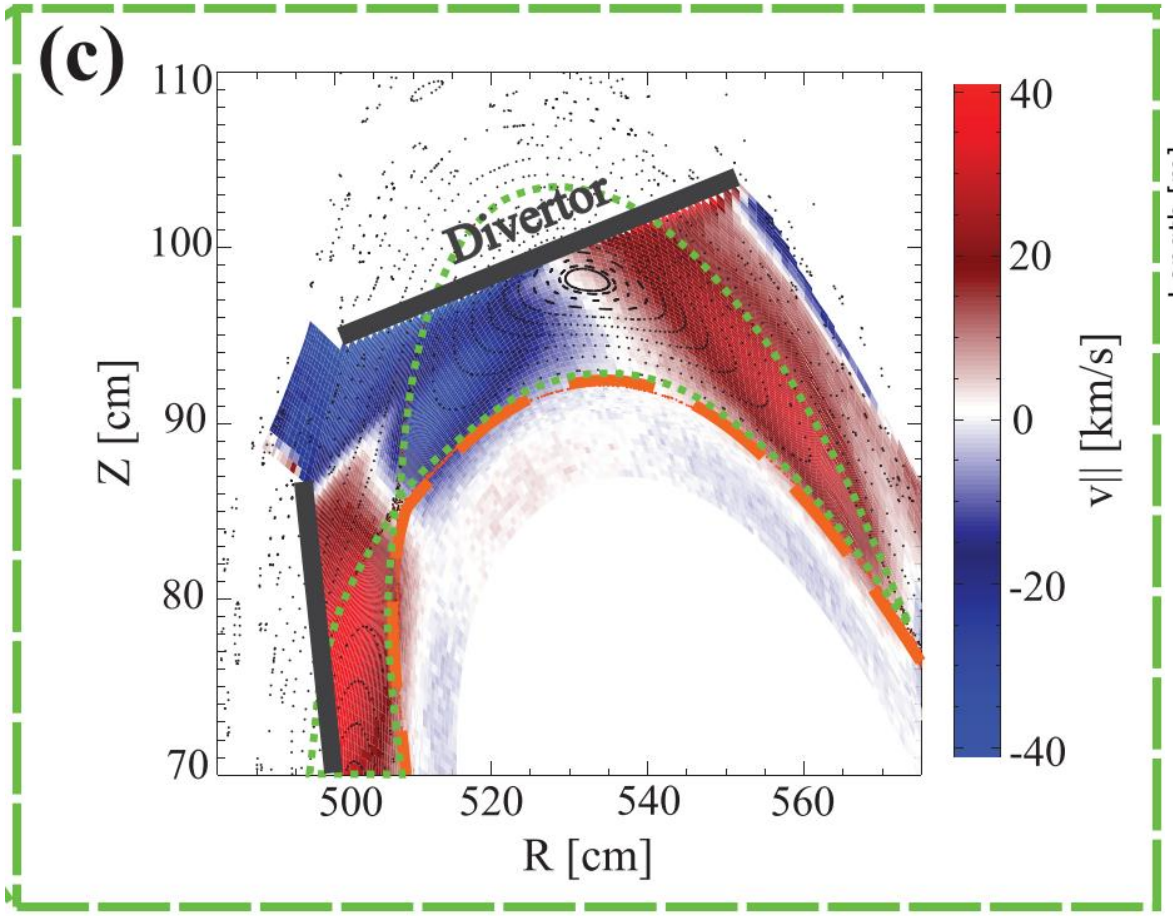




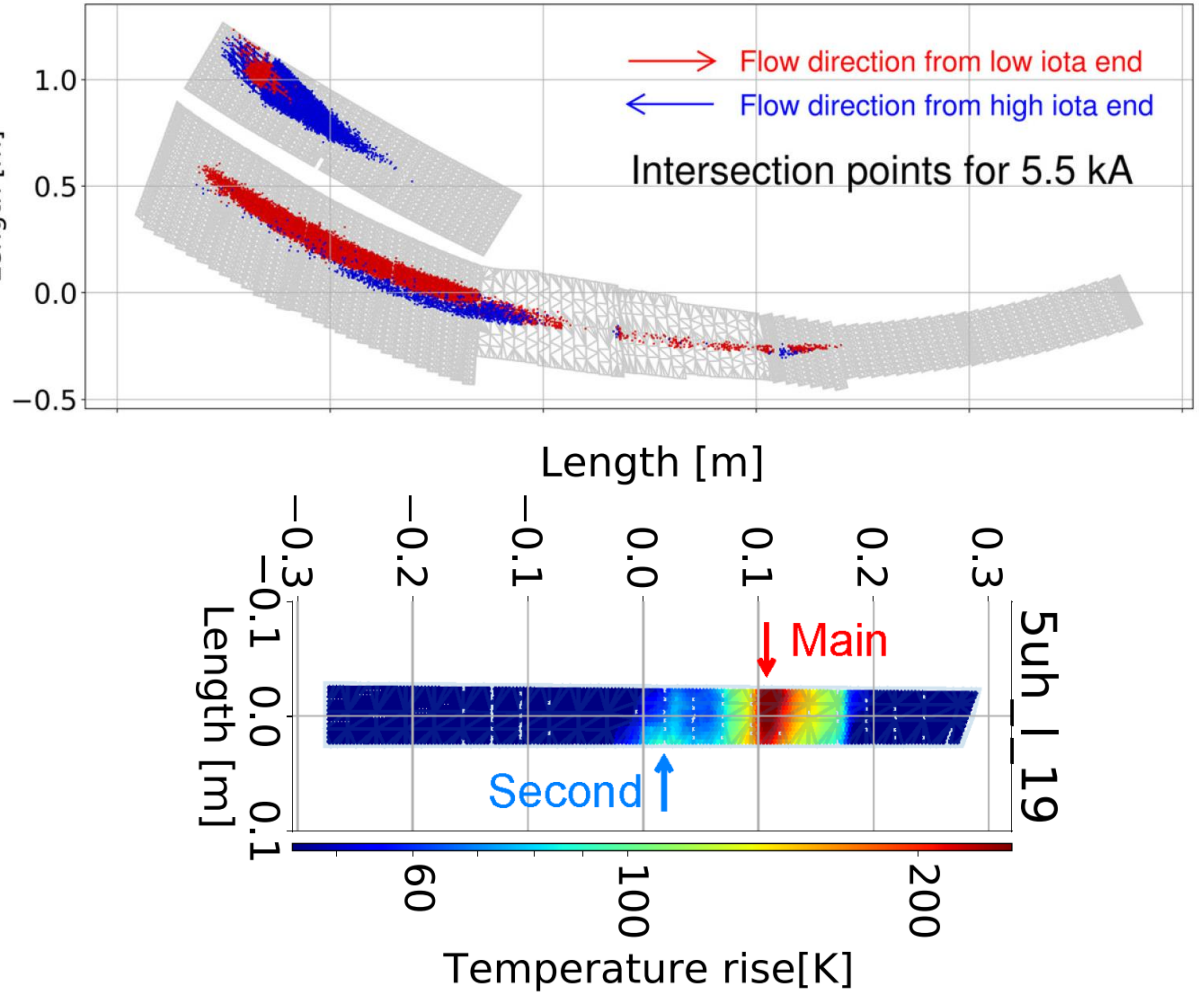
Hammond et al Plasma Phys. Control. Fusion 61 (2019) 125001
Gao et al 2020 Nucl. Fusion https://doi.org/10.1088/1741-4326/ab9aff

Counter streaming flows

Perseo et al Nucl. Fusion 59 (2019) 124003 (7pp)



Gao et al Nucl. Fusion 59 (2019) 106015
Gao et al 2020 Nucl. Fusion https://doi.org/10.1088/1741-4326/ab9aff
Mayer et al 2020 Phys. Scr. 2020 014035

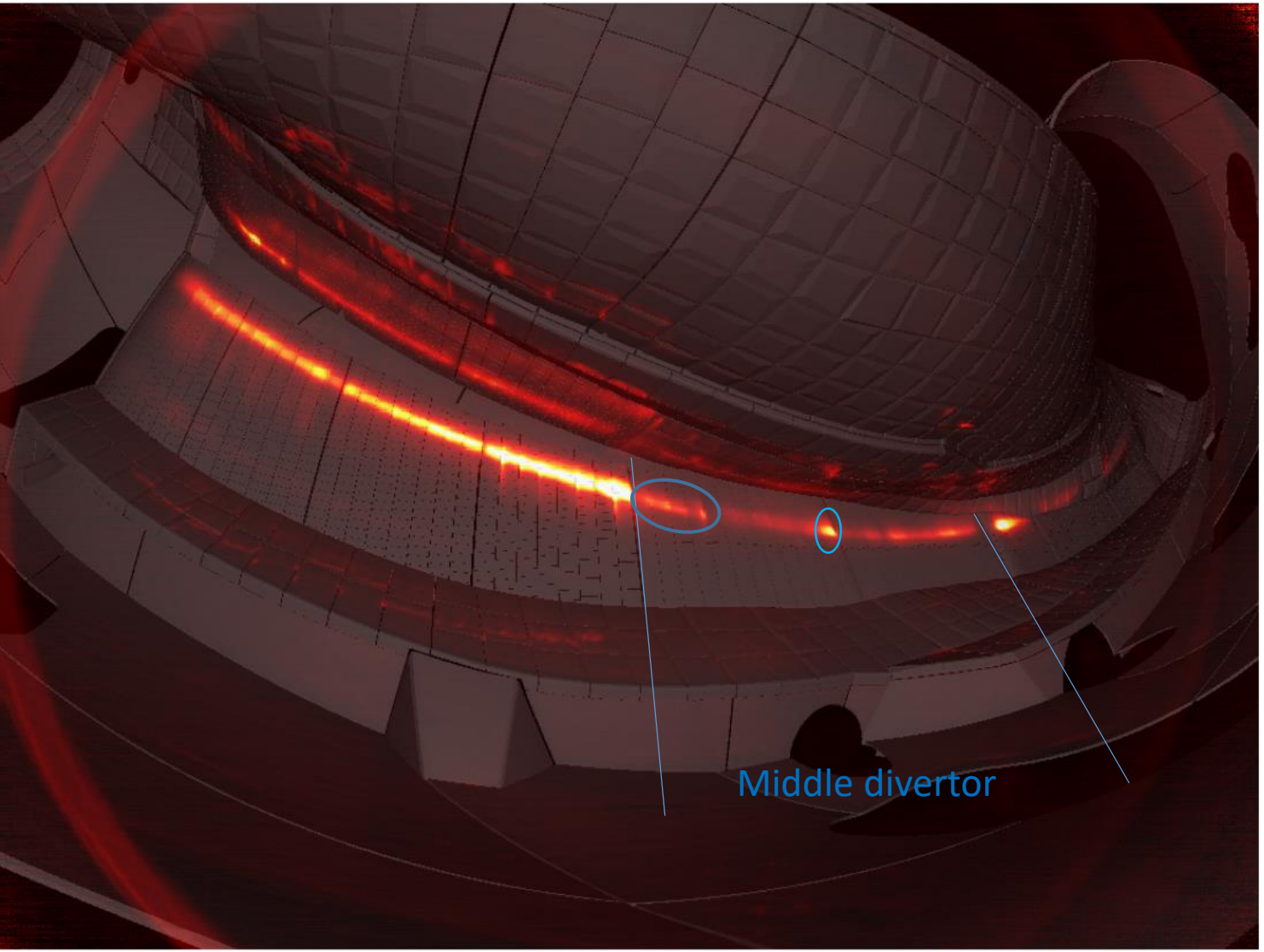


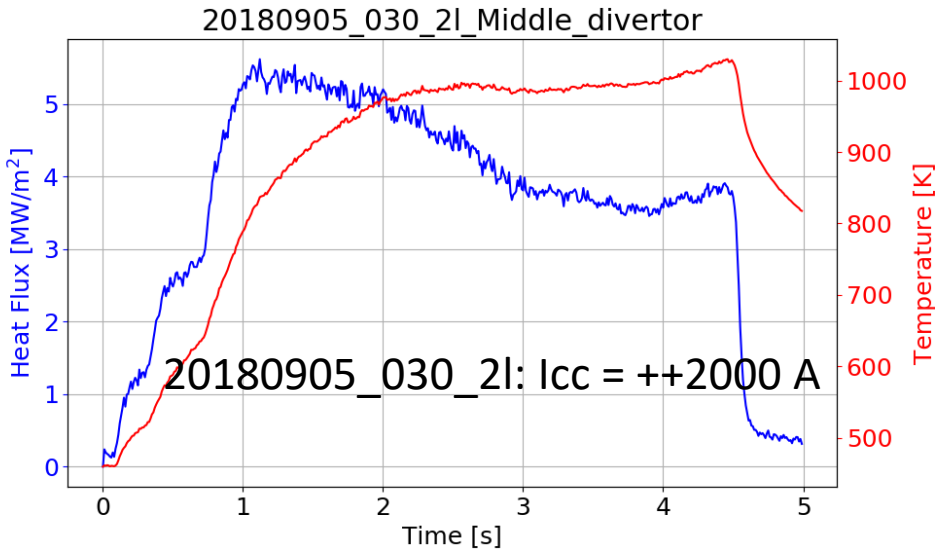
Some results about Middle divertor loads (preliminary)

Yu Gao

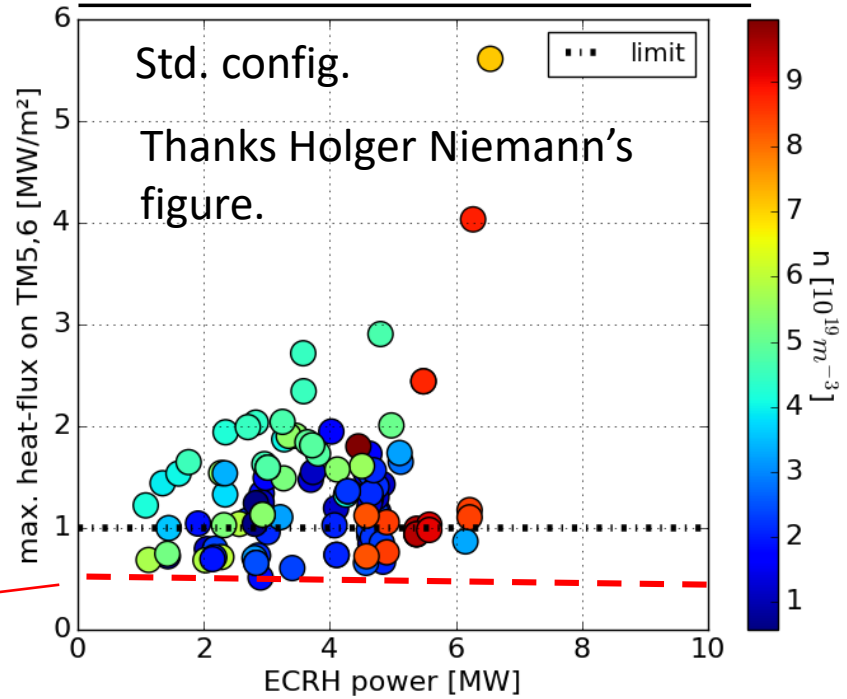
2020.06.22

TG edge & divertor meeting



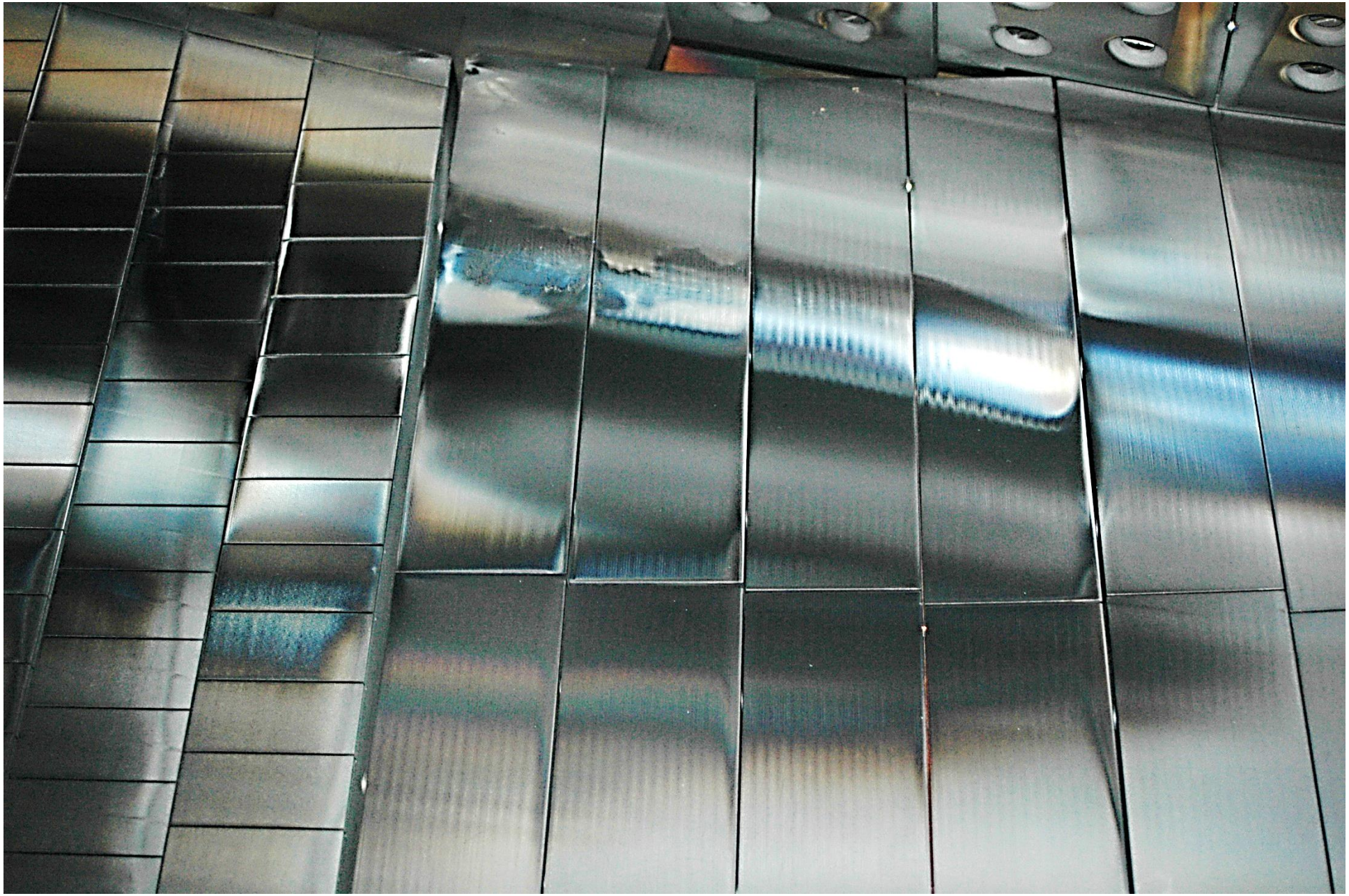


Maximum heat-flux on TM5+6

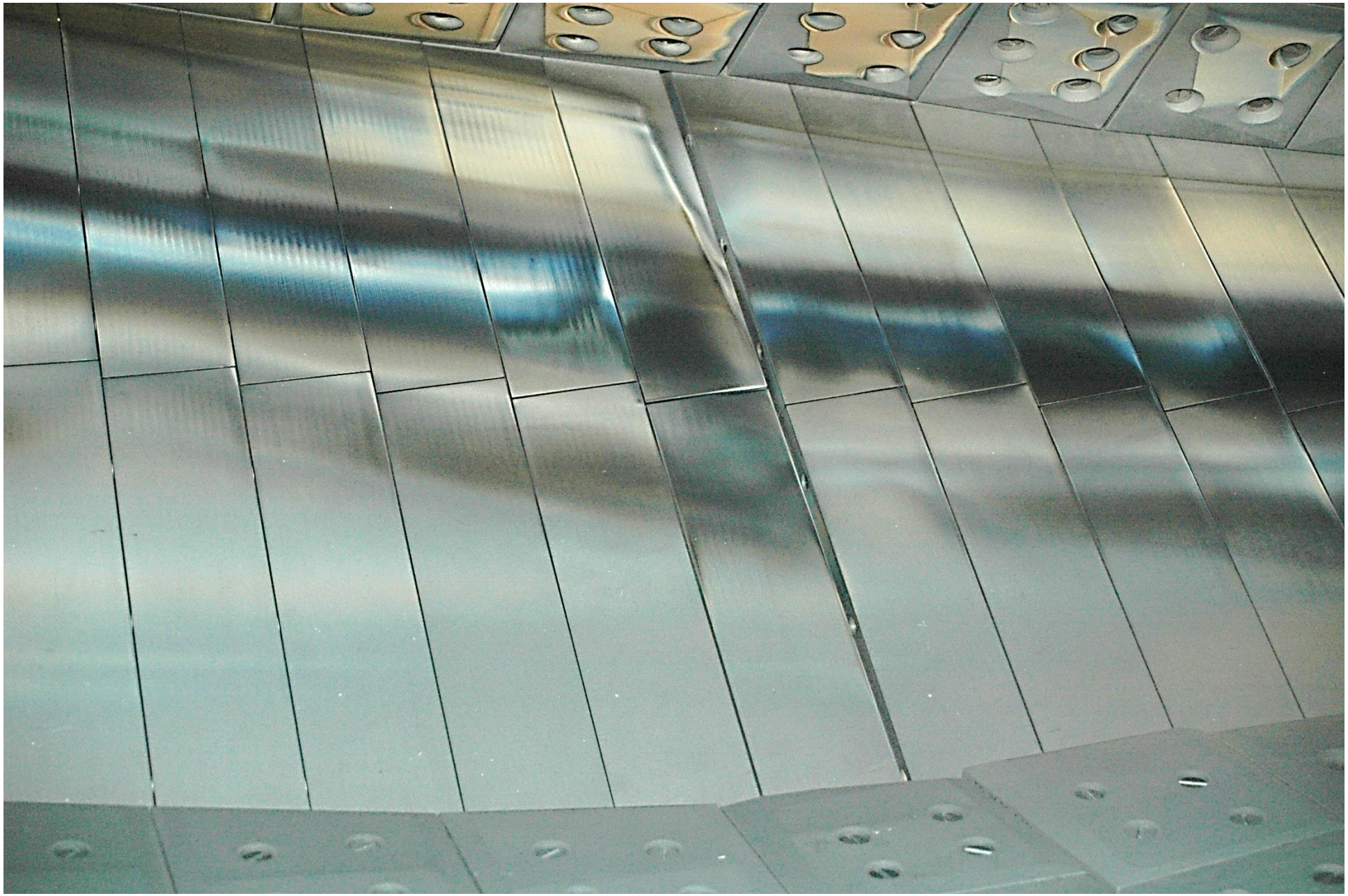


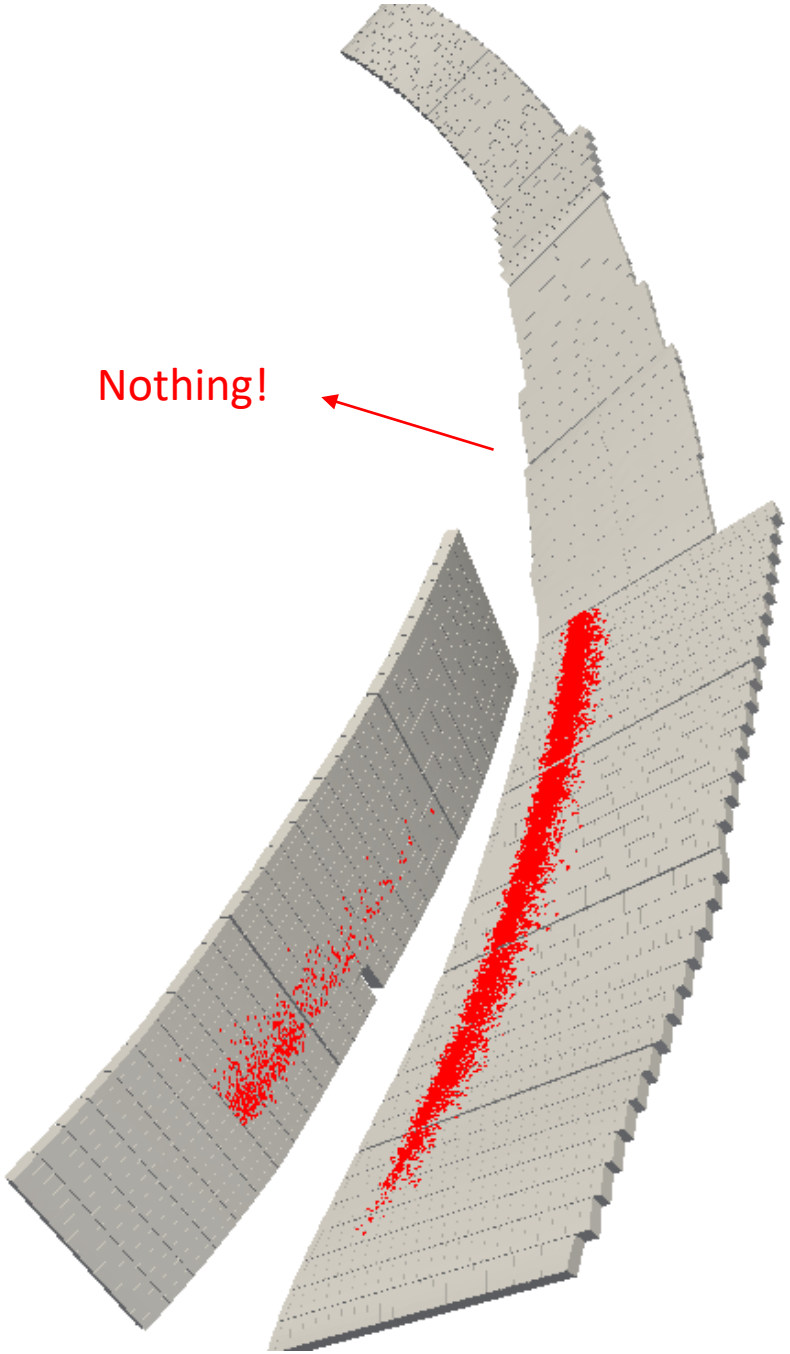
Middle divertor are thin graphite not the thick CFC used in high loaded area.
From OP the thermal upper limit for the middle divertor might be the same as other baffle tiles, i.e. < 0.5 WM/m^2?
Can not run any discharge w.o. detachment?!!

M. Endler,
C. Biedermann
et al.

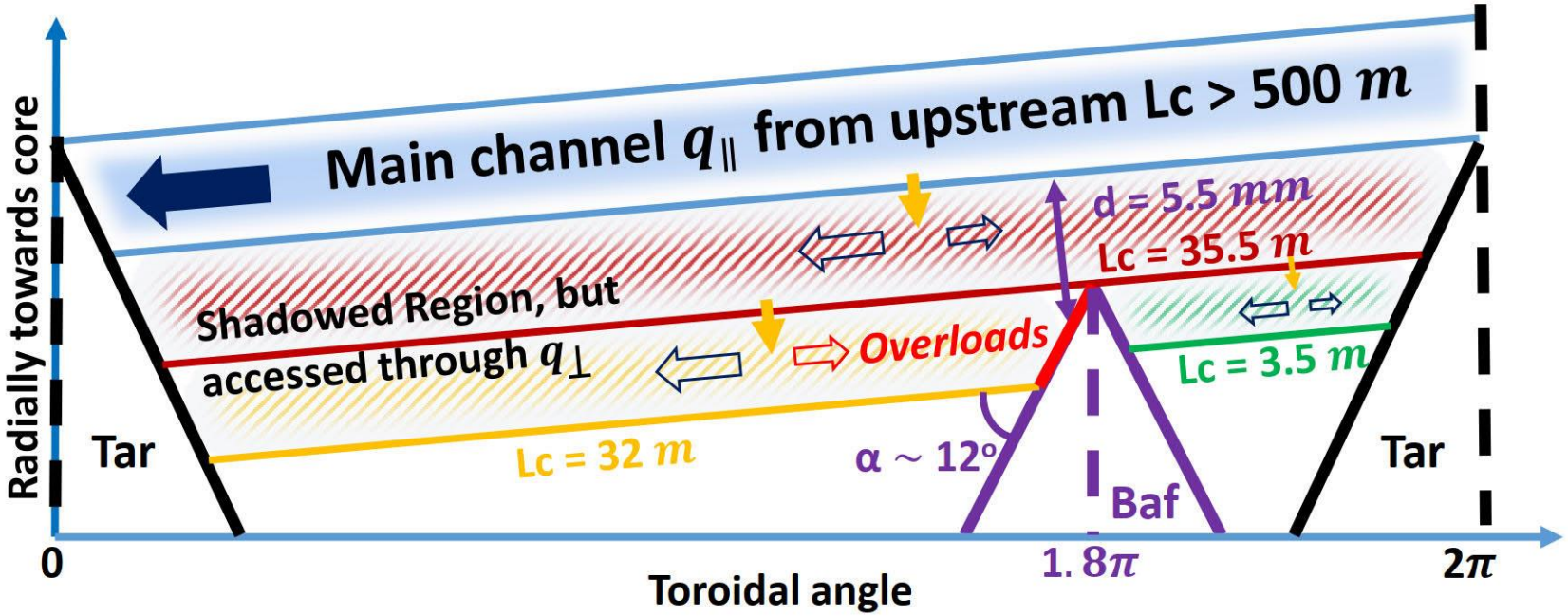


M. Endler,
C. Biedermann
et al.





Pedersen et al 2019 Nucl. Fusion, 59 (9), 096014 (2019).



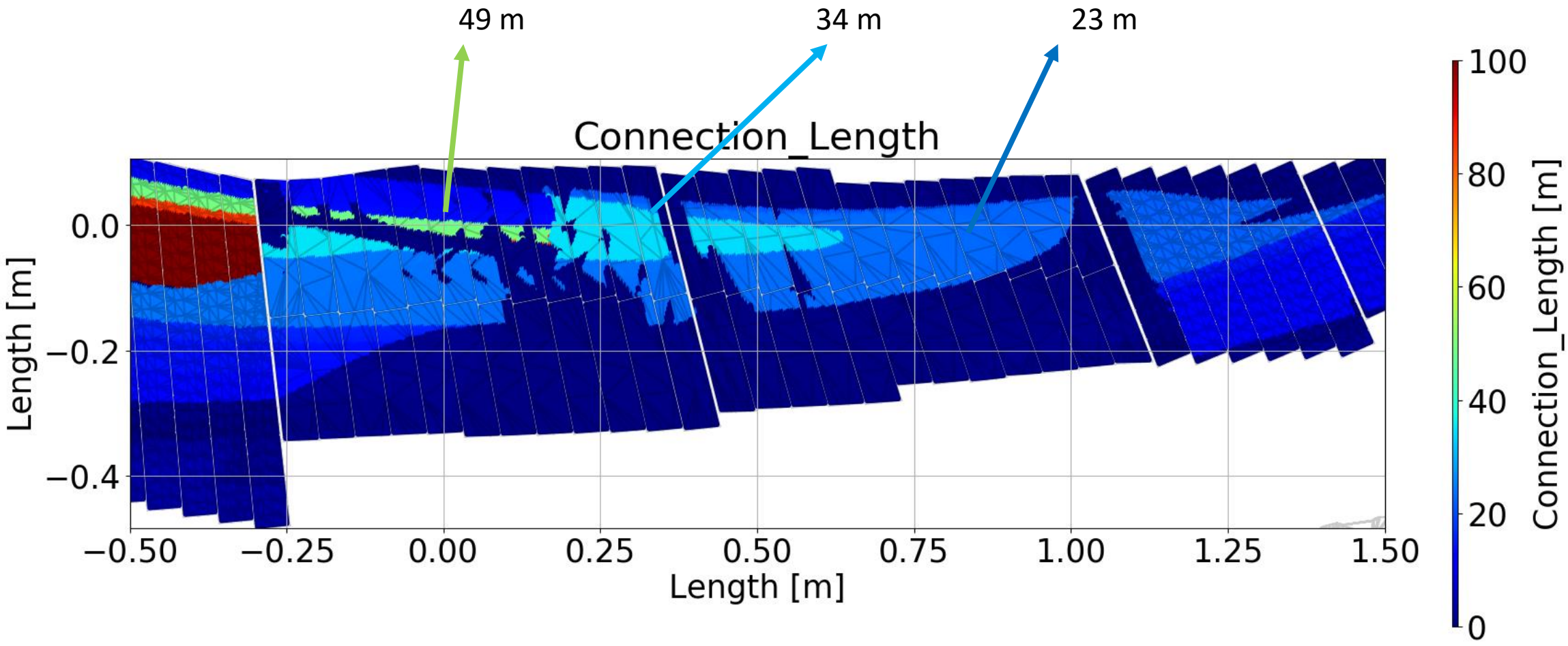
Gao et al 2020 *Nucl. Fusion* https://doi.org/10.1088/1741-4326/ab9aff

Reversed flow missing in diffusive field line tracing code (confirmed).

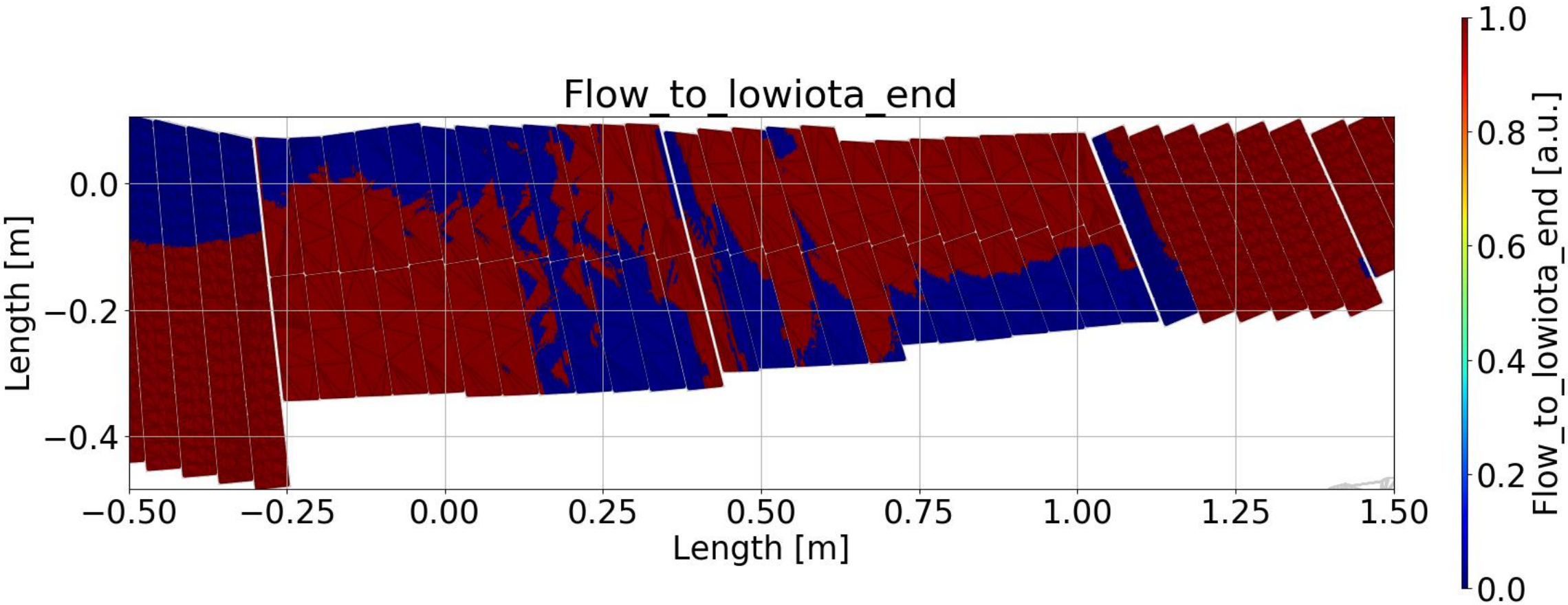
Non-uniform D?

……

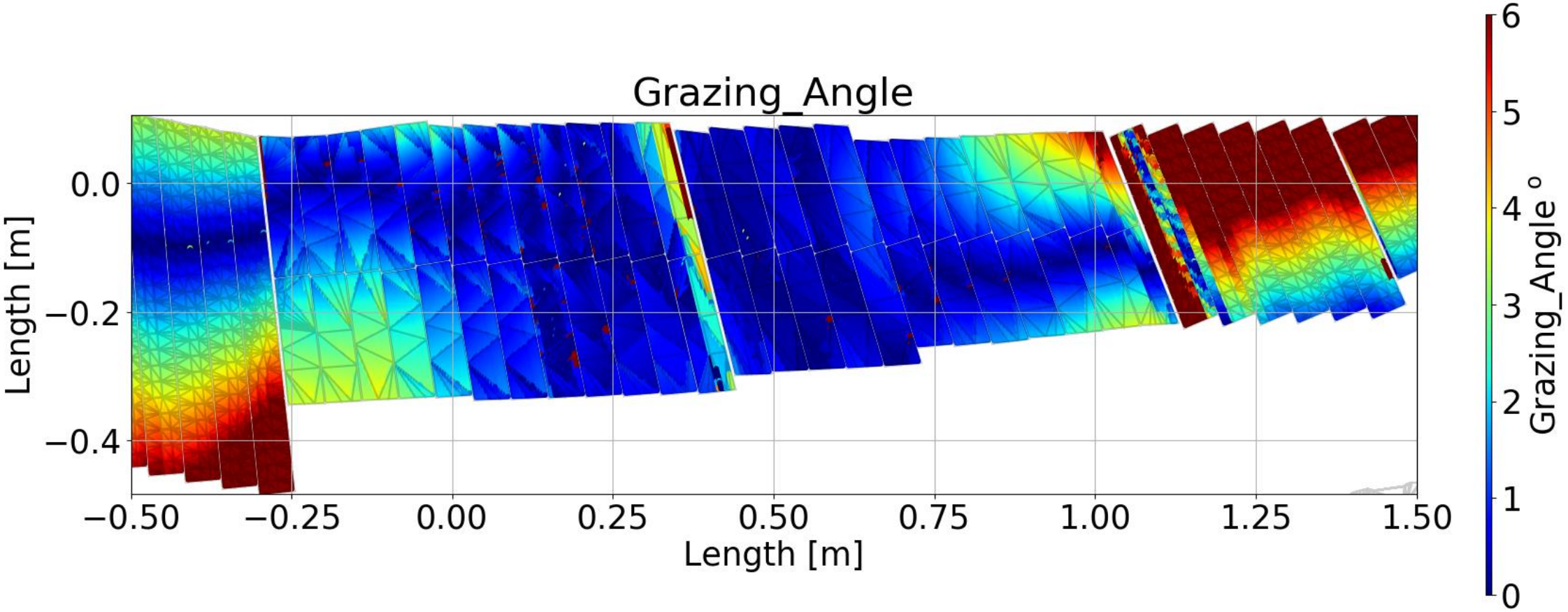
Std.


49 m
34 m
23 m
Connection_Length
Length [m]
0.0
−0.2
−0.4
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Length [m]
100
80
60
40
20
0
Connection_Length [m]

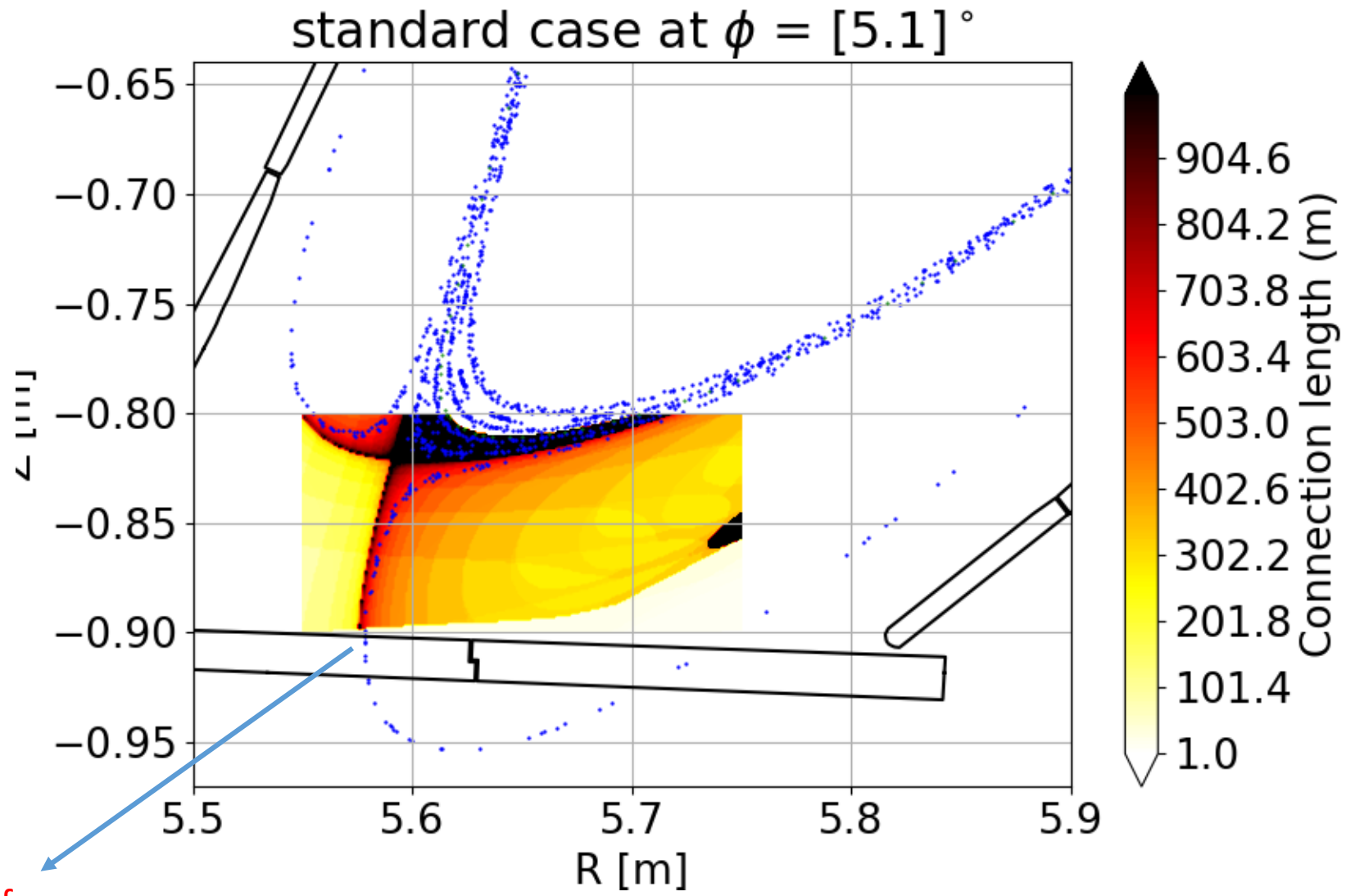
Std.


Flow_to_lowiota_end
Length [m]
0.0
−0.2
−0.4
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Length [m]
1.0
0.8
0.6
0.4
0.2
0.0
Flow_to_lowiota_end [a.u.]

Std.

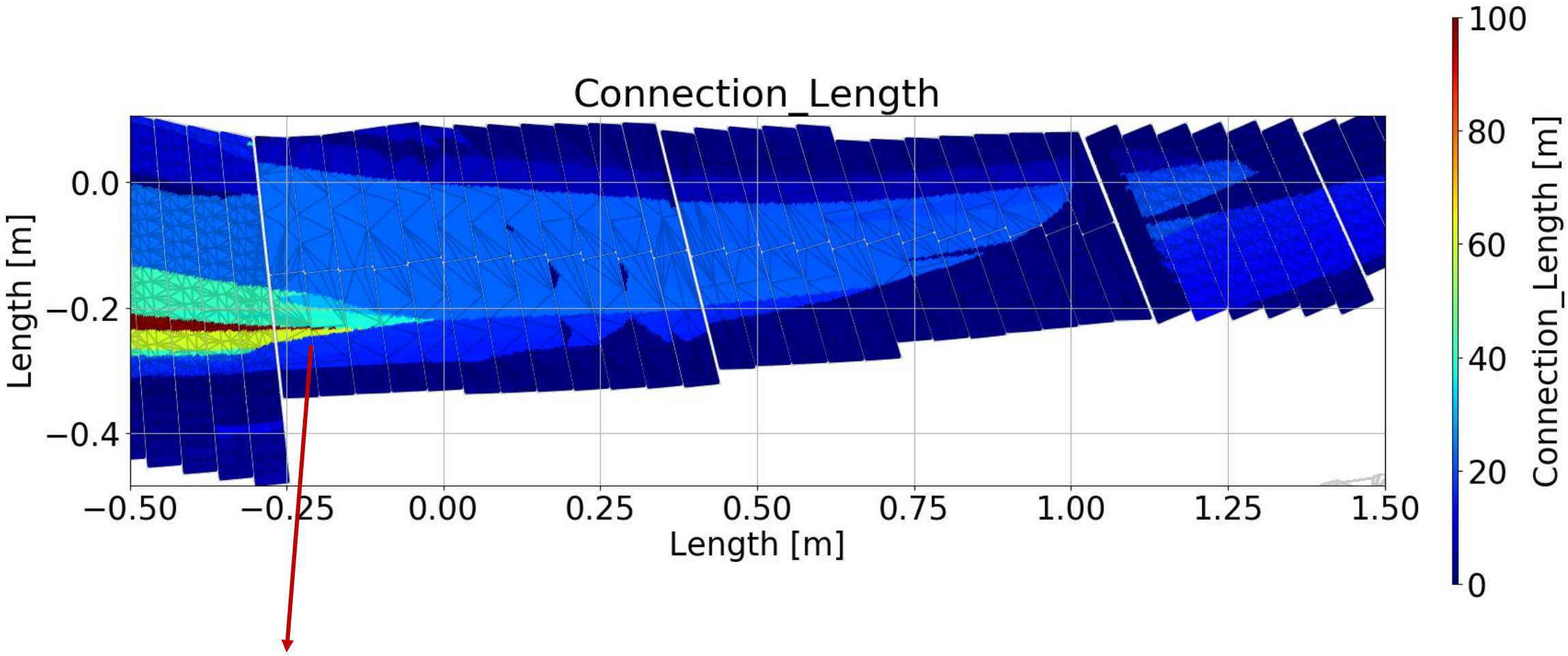

Grazing_Angle
Length [m]
0.0
−0.2
−0.4
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Length [m]
Grazing_Angle °
6
5
4
3
2
1
0

Std.



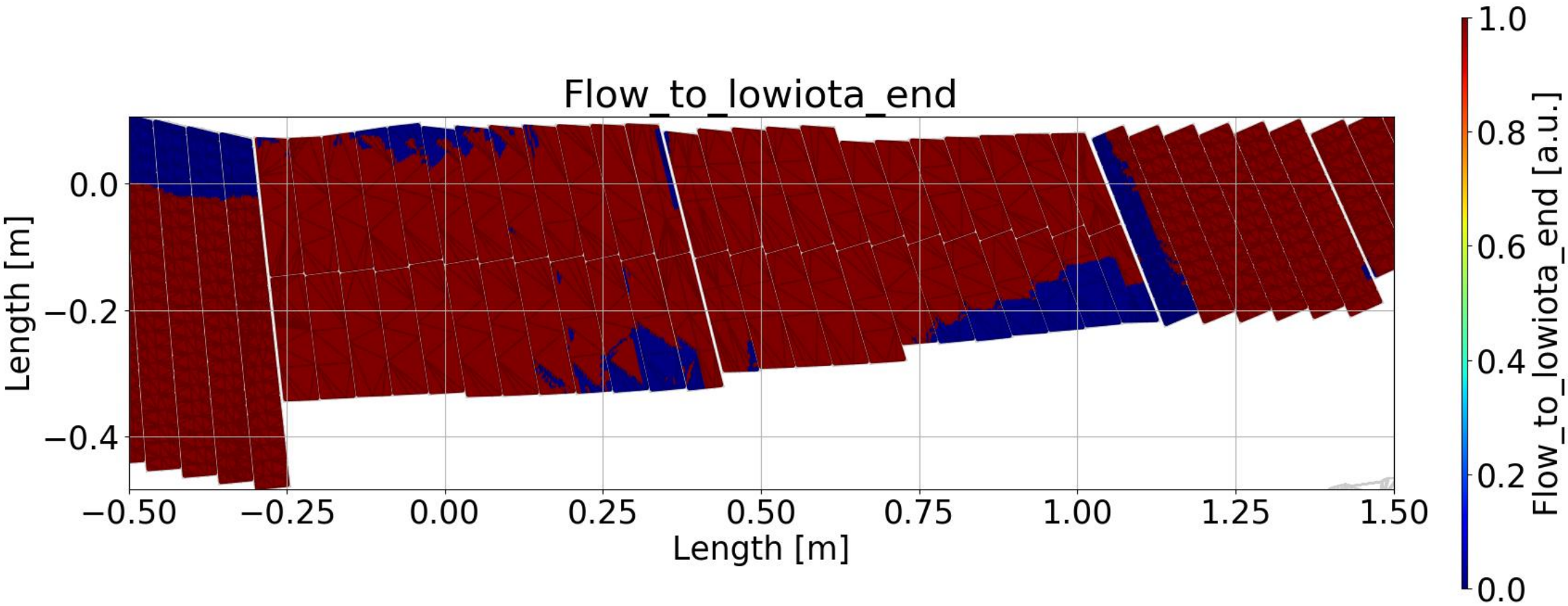
5 mm away from sep.
again.

Low iota config.

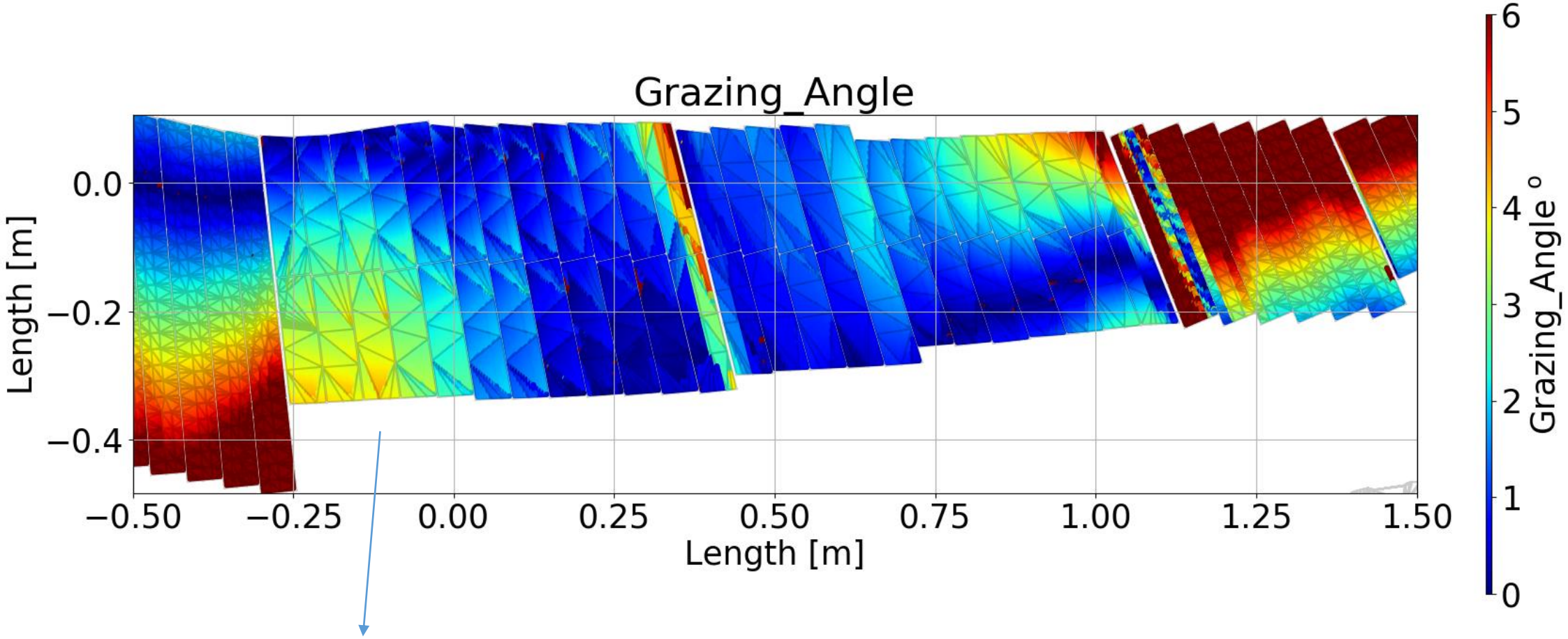


A region with Lc > 100 m.

Low iota config.

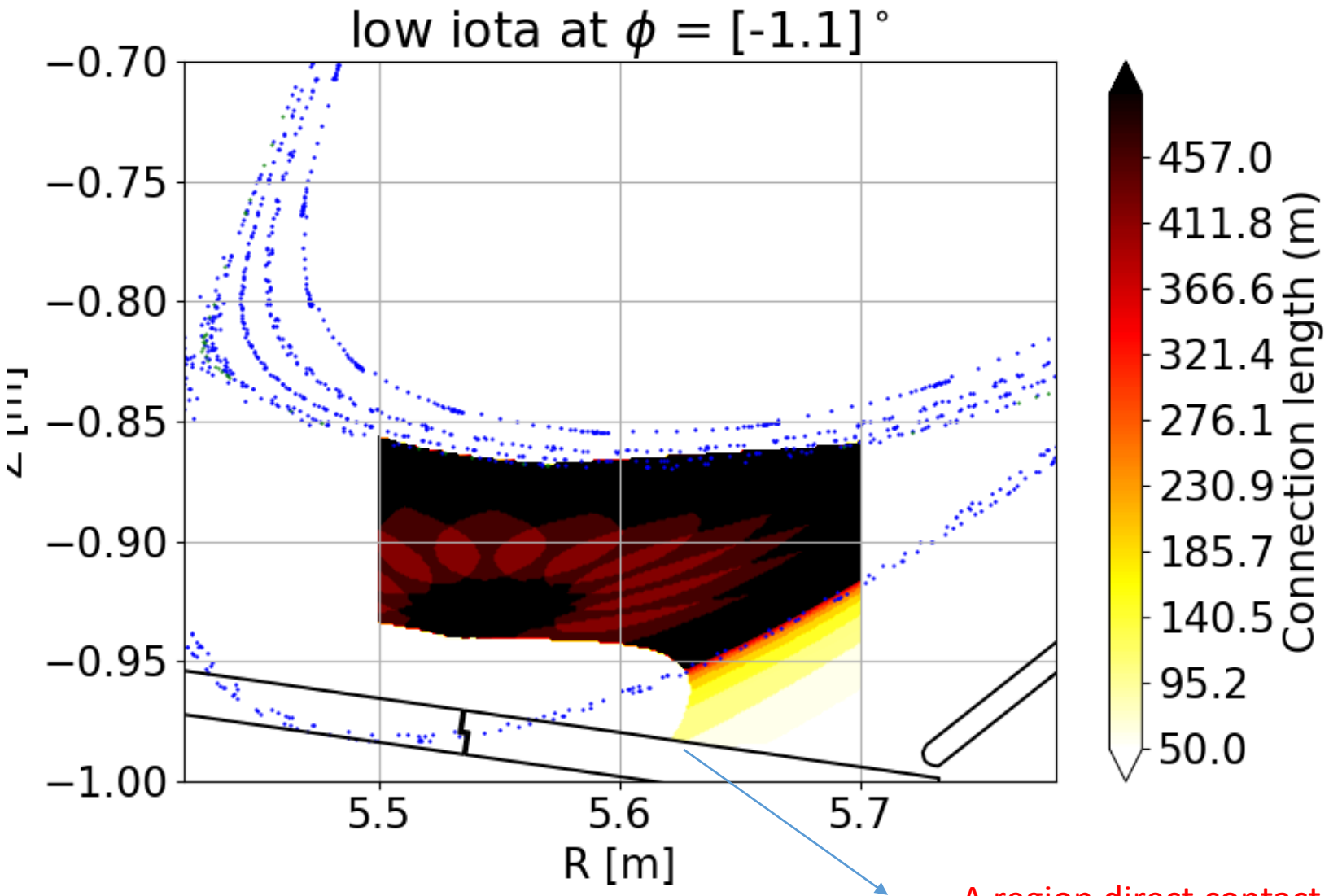


Low iota config.



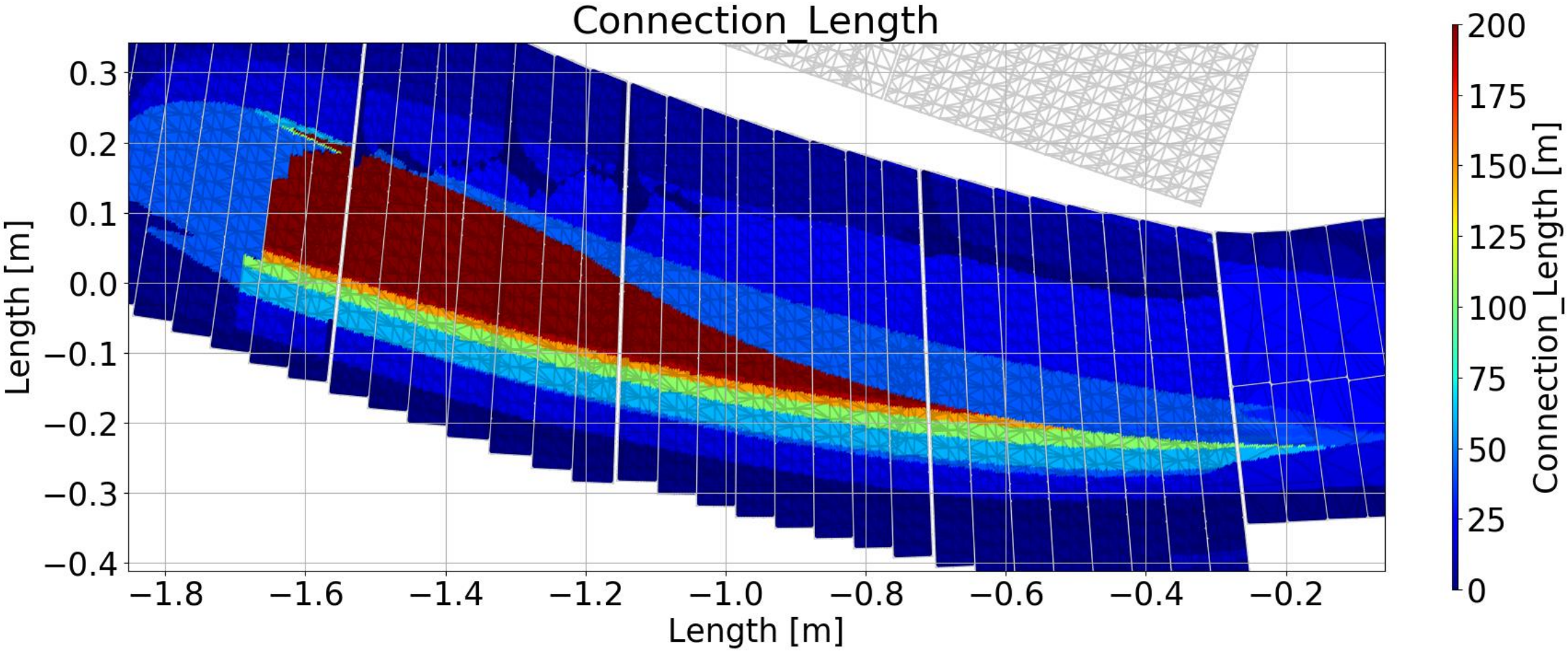
Large grazing angle

Low iota config.



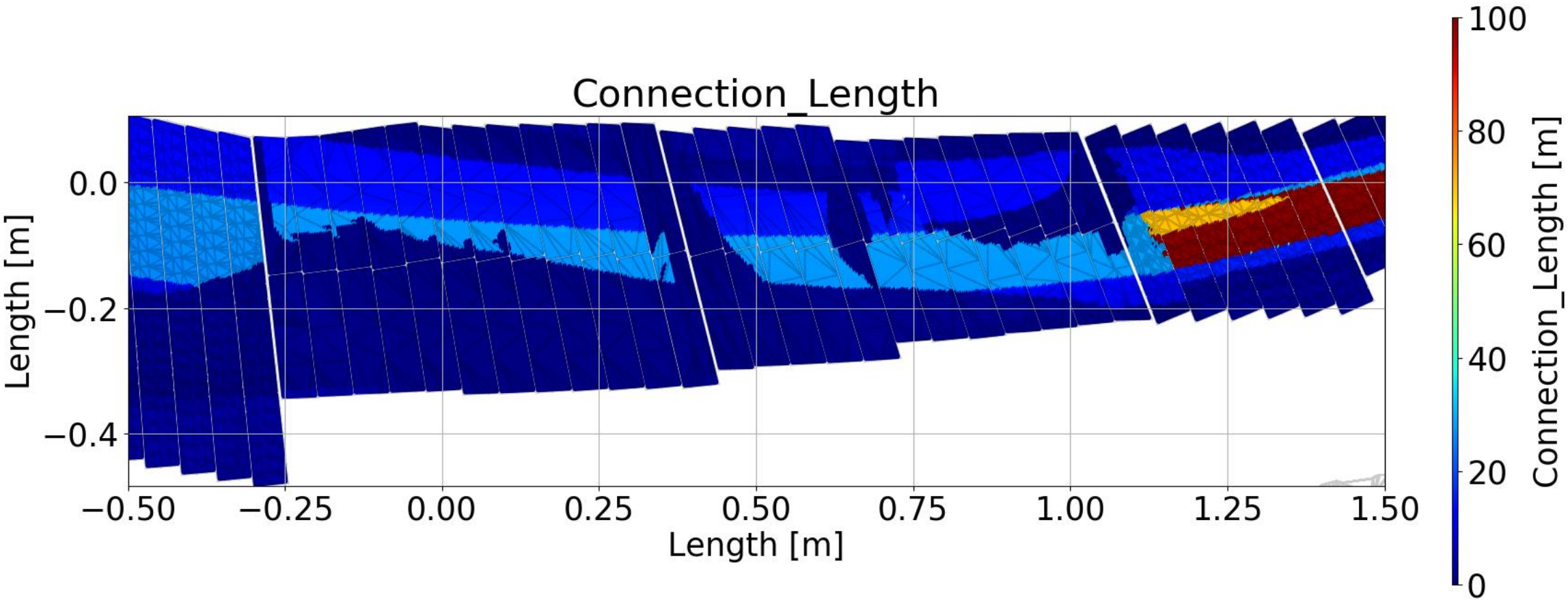
A region direct contact of > 100 m field line.

Low iota config.



It is a belt of private flux region (green).

High iota config.



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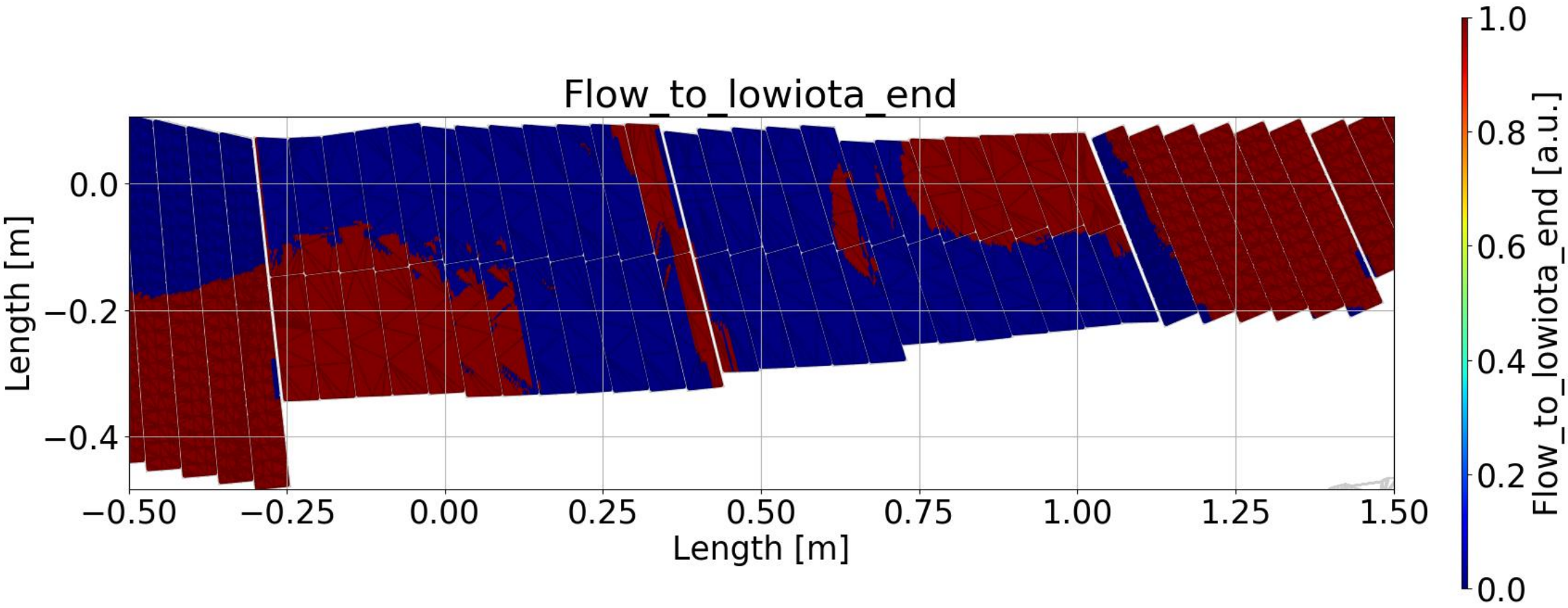
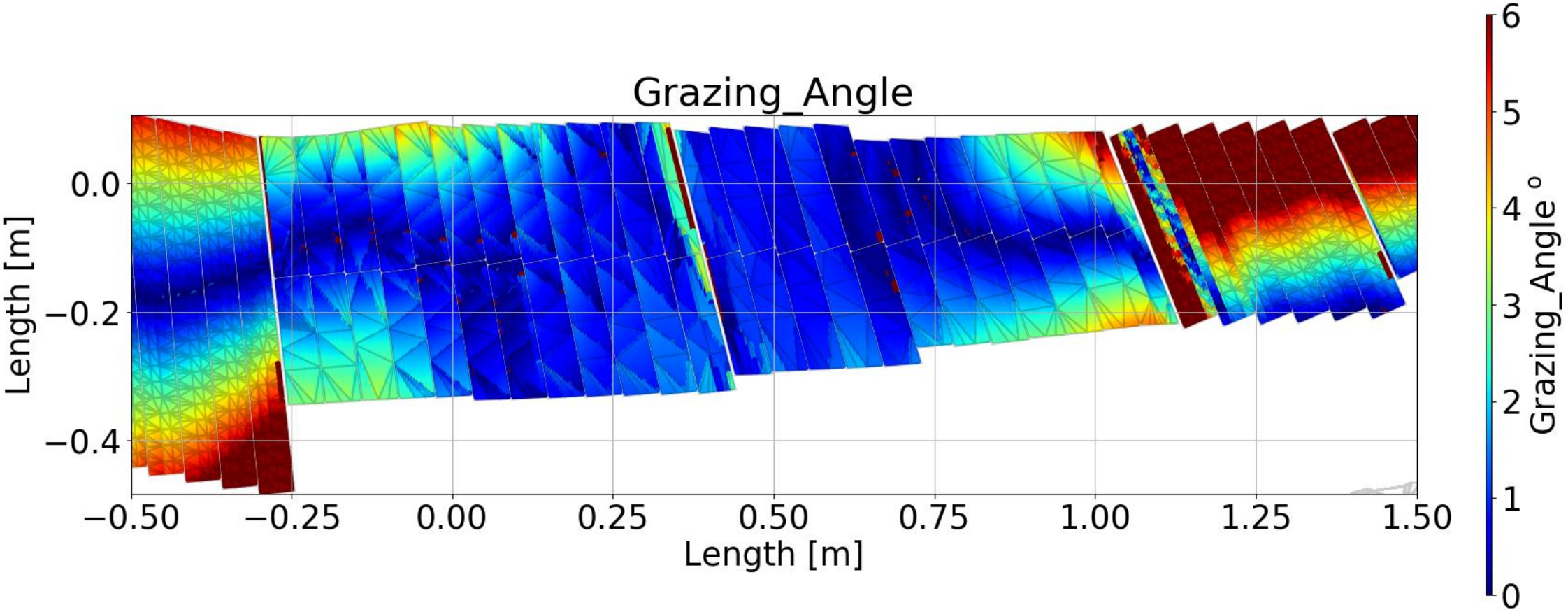


High iota config.



High iota config.