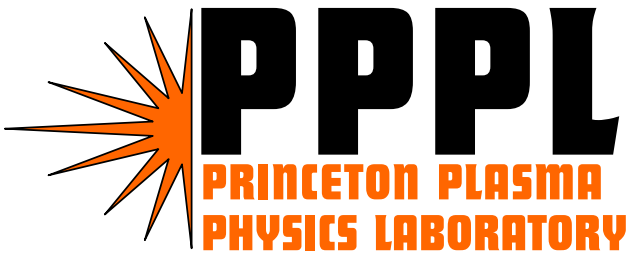
Fusion-born Alpha particle Ripple loss Studies in ITER

Gerrit J. Kramer

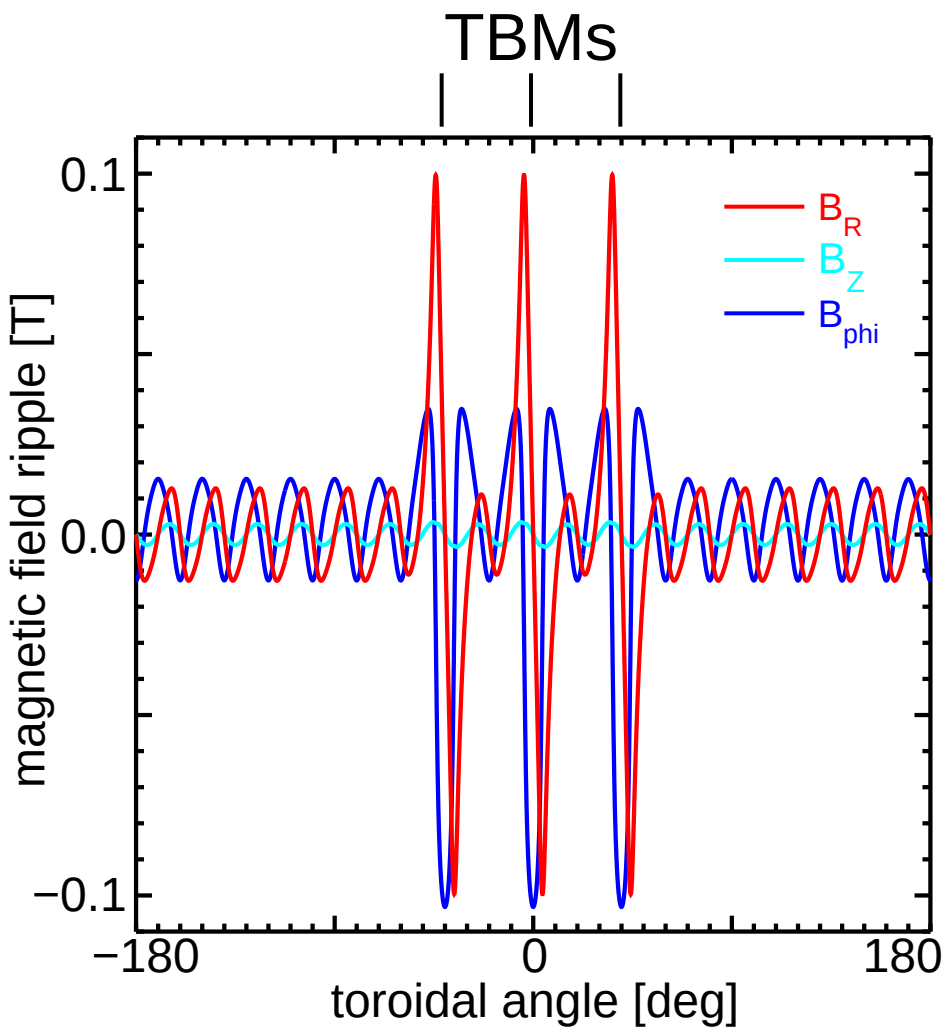
report to FP−SFG meeting, Dec 4 2008



TBMs modify the magnetic field ripple locally

- Test Blanket Modules, TBMs, are being designed for ITER for tritium breeding studies
- Three TBMs will be installed in mid−plane ports at −40, 0, and 40 degrees
- The TBMs contain a significant amount of feritic steel
- Therefore, they increase locally the low toroidal field ripple

Results were presented at the IAEA conference on fusion−born particle losses by several groups



Magnetic field ripple at the low field side mid−plane (R=8.28 m Z=0.60 m)

table.ps

Comparison between fusion born alpha particle losses from different codes

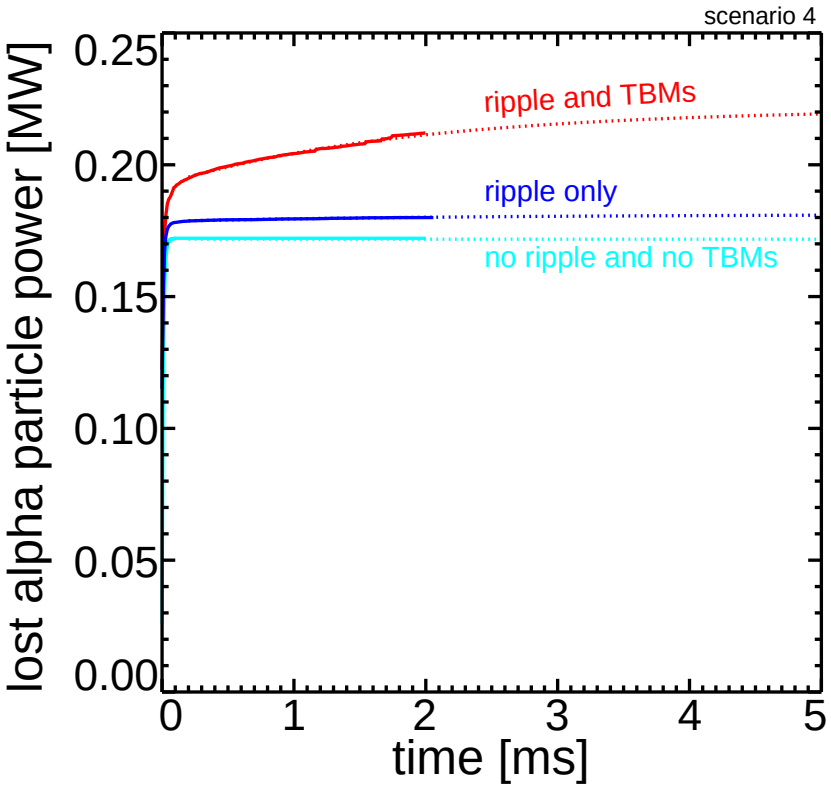
	alpha particle losses in [MW] from:			
scenario:	ASCOT	OFMC	ORBIT	SPIRAL
S2 no ripple	0.3	0.7	0.3	0.3
S2 ripple only	0.4	0.8	0.4	0.3
S2 ripple+TBMs	0.8	—	—	0.4
S4 no ripple	0.02	0.2	0.2	0.2
S4 ripple only	0.03	0.5	0.3	0.2
S4 ripple+TBMs	0.08	0.5−0.7	—	0.2

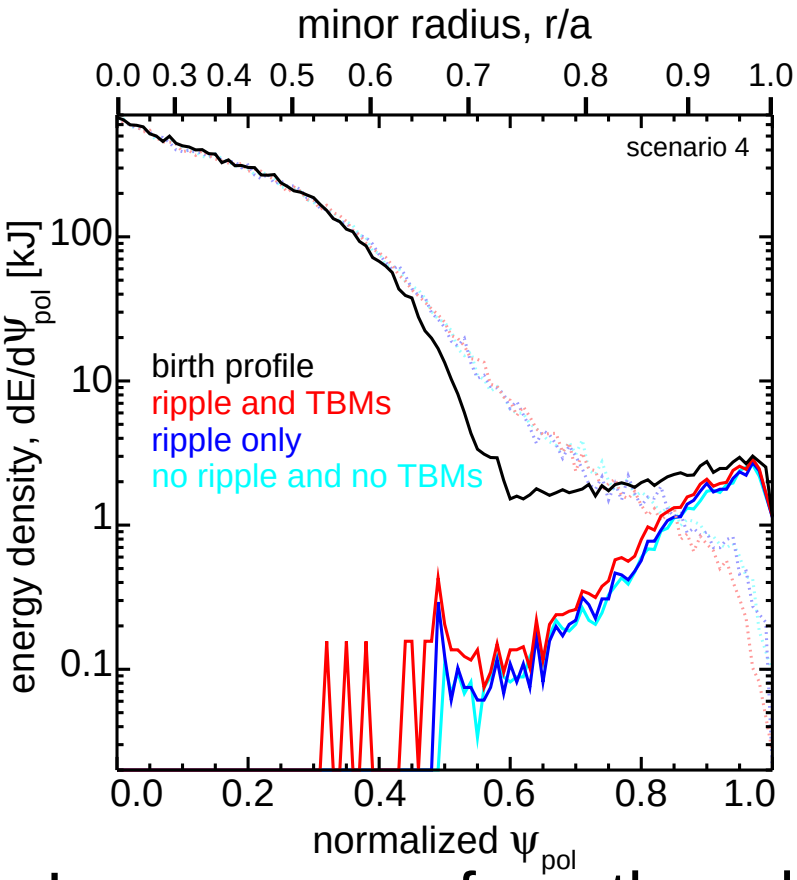
The ASCOT results are from T. Kurki−Suonio et al.
The OFMC results are calculated by K. Shinohara et al.

- In general a reasonable agreement between the different codes
- Very low losses for ASCOT S4 might be due to birth profile

losses.ps

Fusion−born alpha particle losses occur on a fast time scale and come from the edge

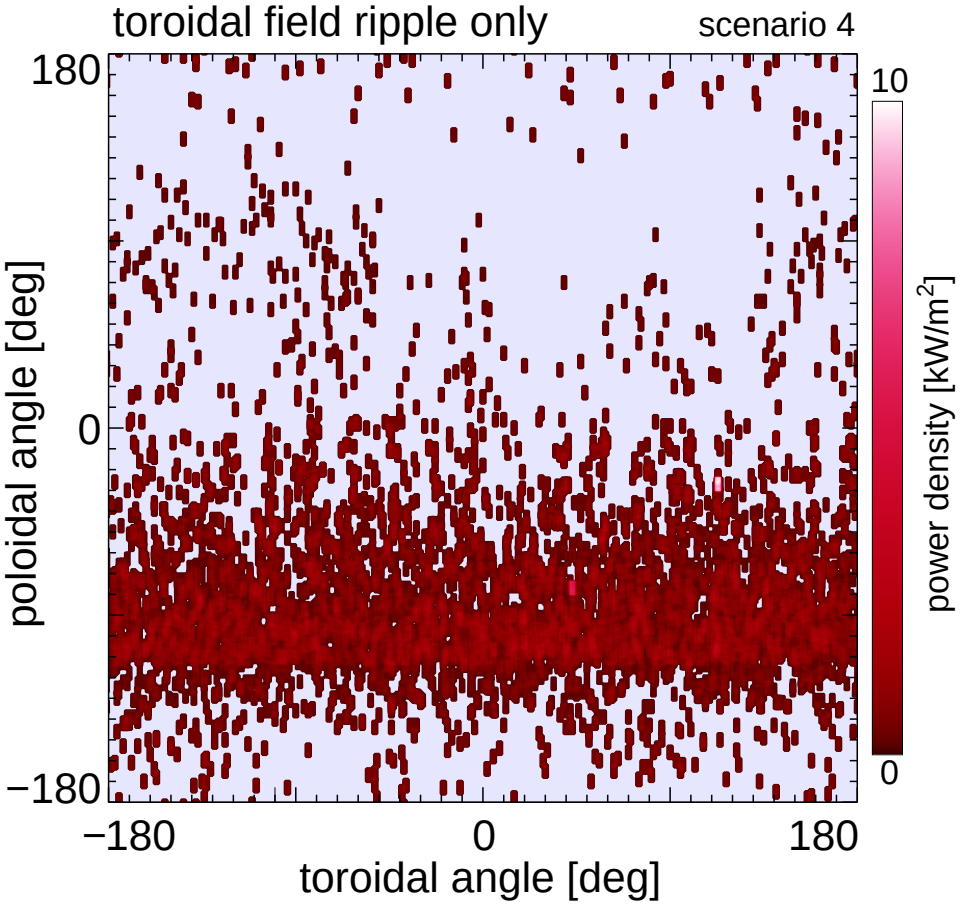


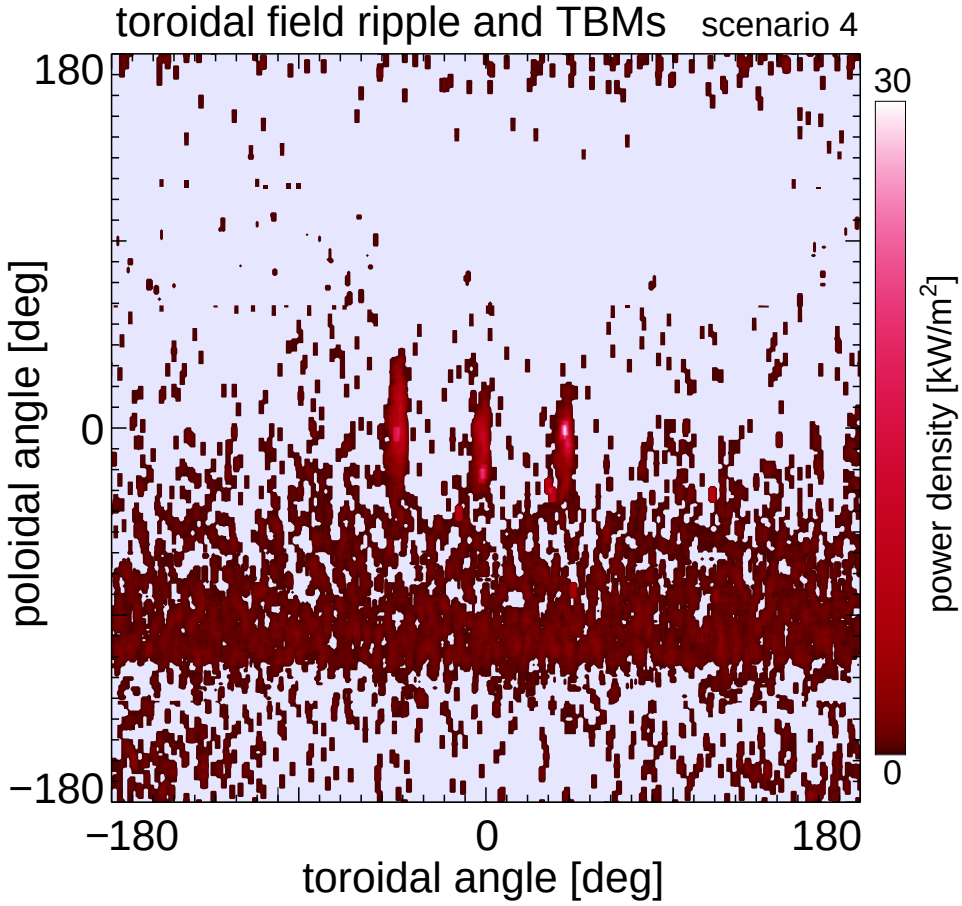


- Losses occur on a ms time scale
- Slowing−down time for 3.5 MeV alpha particles is > 1 sec
- The addition of TBMs increase the losses by ~20 %

- Losses come from the edge
- Trapped particles are lost
- With TBMs te losses extend to half the minor radius

hot spots are created when TBMs are inserted





- Without TBMS losses are concentrated in the divertor
- Max. heat load: 10 kW/m^2

- With TBMs losses occur mainly in front of the TBMs
- Max. heat load: 30 kW/m^2

- The ITER wall can handle heat load of up to 500 kW/m^2
  - The first wall was approximated by the last closed flux surface

Further work

- So far only ITER scenarios 2 and 4 fronm the ITER database were investigated
  They suffer from highly peaked birth profiles
- Use broader profiles from P−TRANSP simulations
- The calculated losses and heat loads are lower bounds:
  MHD activity (TAEs,etc.) can broaden the profiles
- Benchmark the various loss codes against each other properly