Nuclear Heating Profiles for ARIES-ACT-SiC Design

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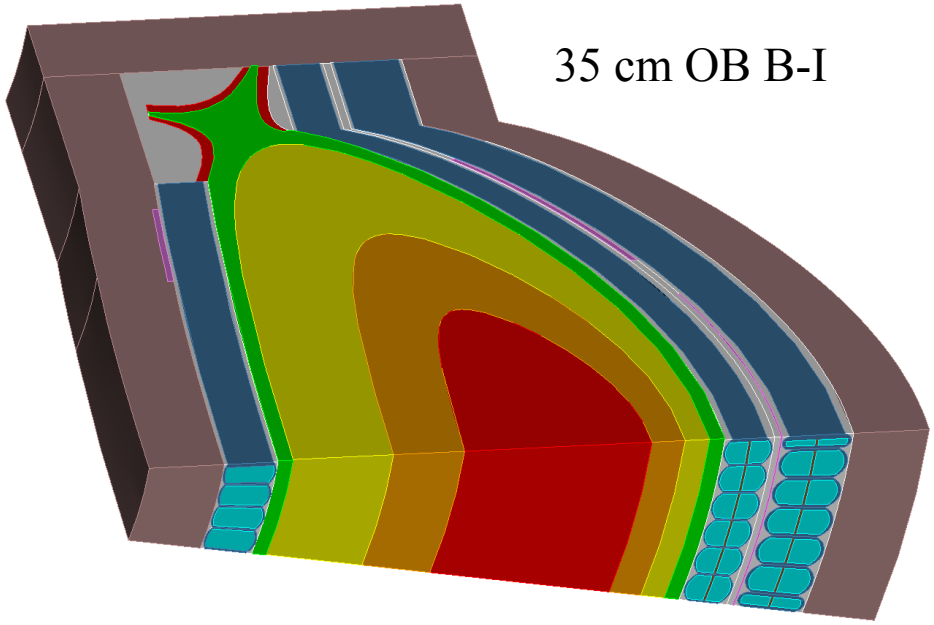
San Diego, CA

UCSD

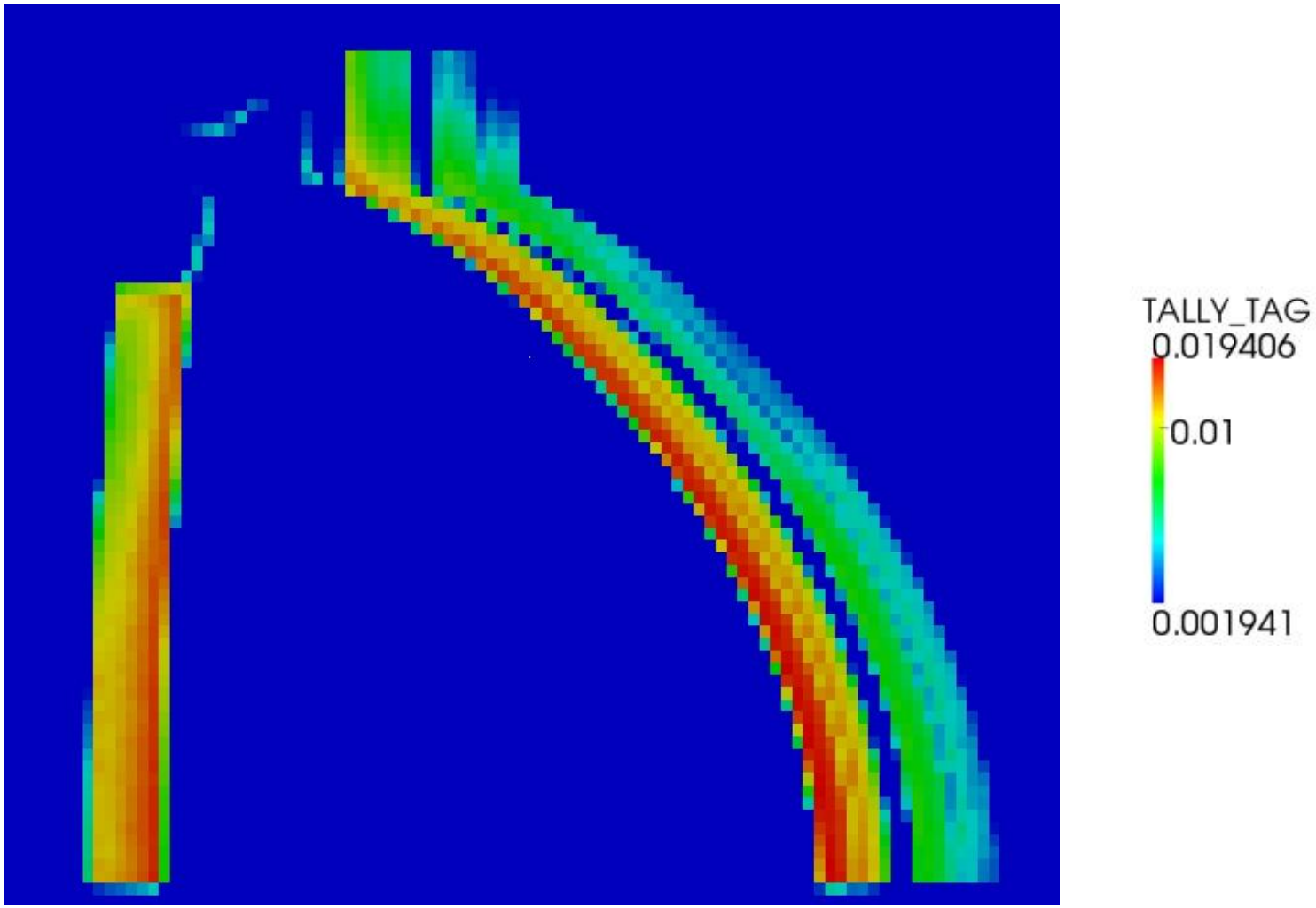
Key Parameters for 3-D Nuclear Heating Analysis



3-D MCNP Model
(upper half of 1/32th Module
with 3 reflecting boundaries.
Same model as for TBR analysis
presented at 1/2012 ARIES meeting)

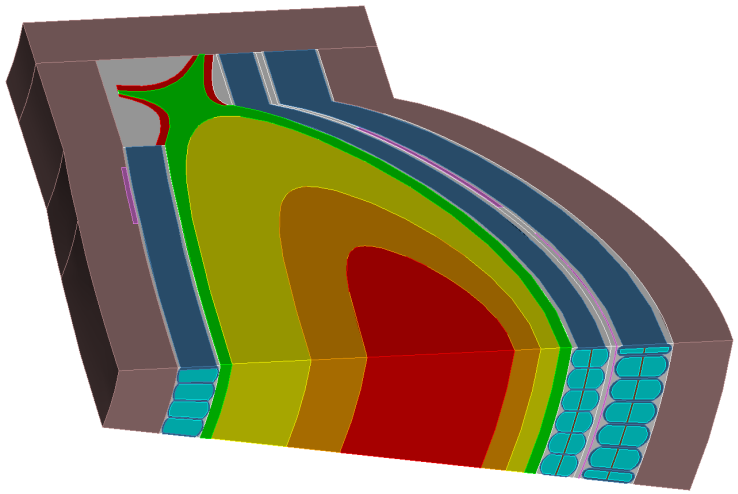
	ARIES-ACT-SiC
	Aggressive Physics
Fusion Power	1907.4 MW
	(1806.5 MW; June 2011 Strawman)
Major Radius	5.5 m
Minor Radius	1.375 m
Elongation	2.2

Nuclear Heating Profile



Nuclear Heating Distribution in Upper Half of 1/32th Module (1/64th of torus, as modeled)

Nuclear Heating (MW)	Inboard	Outboard	Divertor	Total
FW/Blanket	4.69	17.08	---	21.77
Divertor Plates	---	---	0.42	0.42
Stabilizing Shells	0.19	0.91	---	1.10
Shield	1.56	0.78	1.22	3.56
Total	6.44	18.77	1.65	26.86



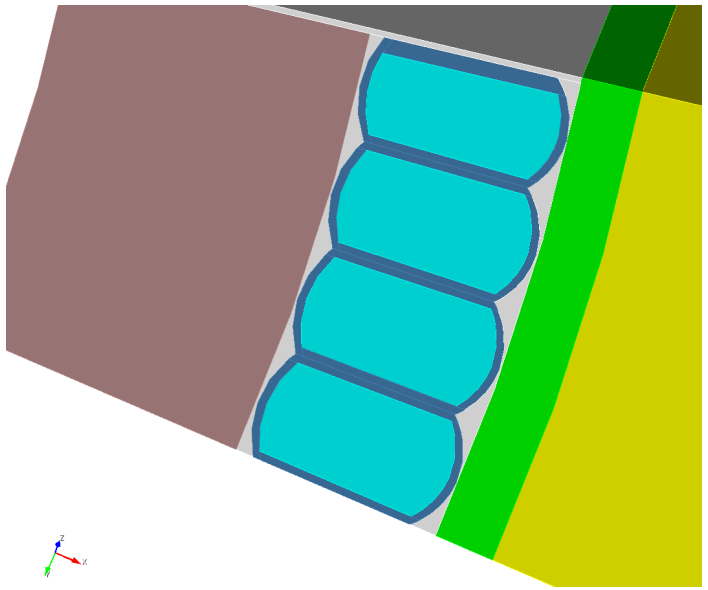
Nuclear Heating Distribution in 1/16th Module

Nuclear Heating (MW)	Inboard	Outboard	Divertor	Total
FW/Blanket	18.77	68.31	---	87.08
Divertor Plates	---	---	1.69	1.69
Stabilizing Shells	0.75	3.65	---	4.40
Shield	6.26	3.10	4.90	14.25
Total	25.78	75.07	6.59	107.43

Breakdown of Inboard Nuclear Heating (1/16th IB Module)

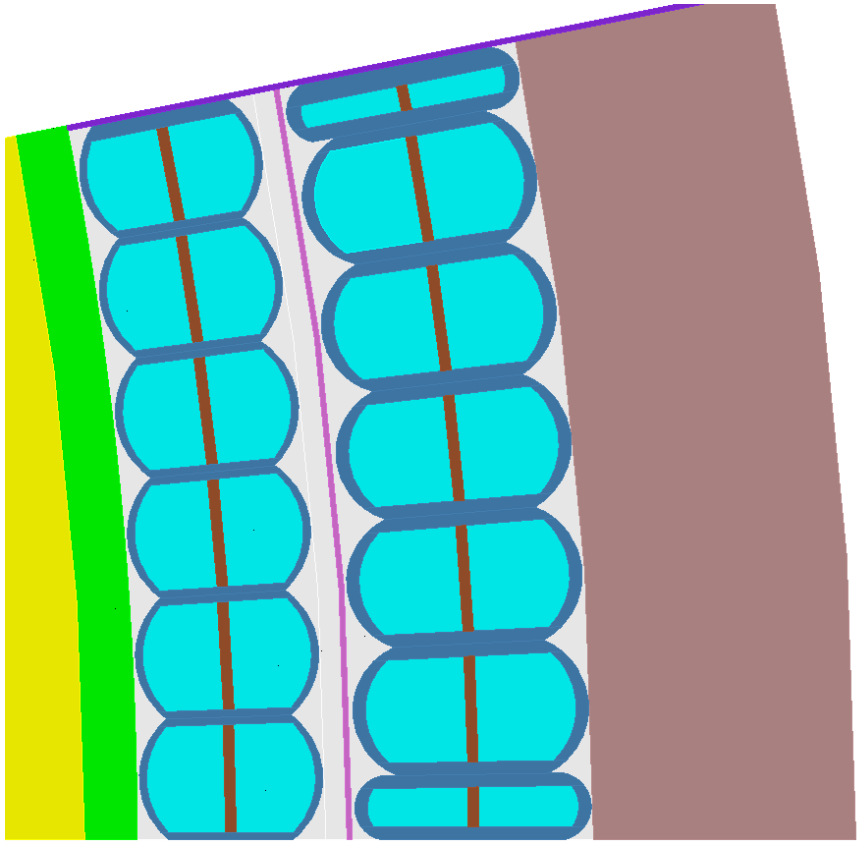
Inboard Nuclear Heating (MW)

35 cm Thick IB Blanket:	
1.4 cm FW	0.92
≤ 32.2 cm LiPb Breeding Zone	16.07
1.4 cm Back Walls	0.17
1.4 cm Side Walls	1.61
4 cm VS Shell	0.75
IB Shield	6.26
Total	25.78



Breakdown of Outboard Nuclear Heating (1/16th OB Module)

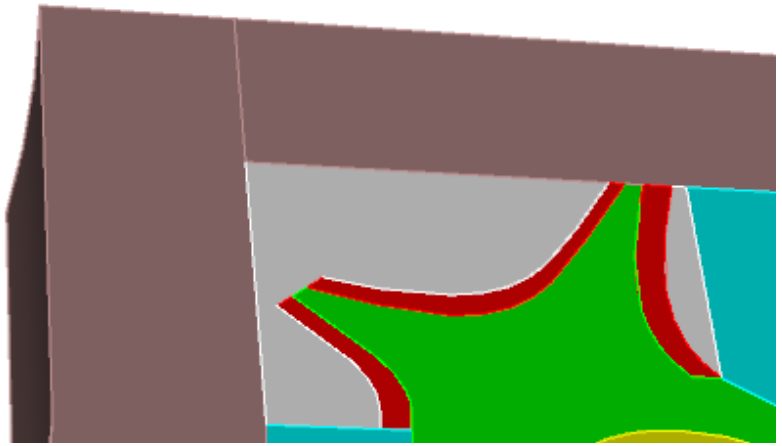
Outboard Nuclear Heating (MW)	
35 cm Thick OB-I Blanket:	
1.4 cm FW	2.37
≤ 32.2 cm LiPb Breeding Zone	43.51
2 cm SiC Reinforced Walls	2.37
1.4 cm Back Walls	0.52
1.4 cm Side Walls	3.96
Stabilizing Shells:	
1 cm Kink Shell	0.90
4 cm VS Shells	2.75
45 cm Thick OB-II Blanket:	
2.4 cm FW	0.77
≤ 40.2 cm LiPb Breeding Zone	12.13
2 cm SiC Reinforced Walls	0.25
2.4 cm Back Walls	0.23
2.4 cm Side Walls	2.21
OB Shield	3.10
Total	75.07



Breakdown of Divertor Nuclear Heating (1/16th Div Module)

Divertor Nuclear Heating (MW)

Upper Divertor:	
7.7 cm W-based Divertor Plates:	
Inner Plate	0.27
Dome	0.30
Outer Plate	0.27
Divertor Shield	2.45
Lower Divertor:	
7.7 cm W-based Divertor Plates:	
Inner Plate	0.27
Dome	0.30
Outer Plate	0.27
Divertor Shield	2.45
Total	6.59



Total Nuclear Heating in all Modules

Nuclear Heating (MW)	Inboard	Outboard	Divertor	Total
FW/Blanket	300.32	1093.02	---	**1393.34**
Divertor Plates	---	---	27.05	**27.05**
Stabilizing Shells	12.00	58.42	---	**70.42**
Shield	100.11	49.61	78.32	**228.04**
Total	**412.43**	**1201.06**	**105.37**	**1718.85**

Energy Multiplication (M_n) = 1718.85 / (1907.4 x 0.8)
= 1.126

Thermal Power Split between He and LiPb Coolants

Thermal Power (MW_{th})	He	LiPb	Total
Surface Heating	295*	111*	**406**
Recovered Power from Div Pumping	17*	---	**17**
Recovered Power from Blanket Pumping	---	6*	**6**
FW/Blanket	---	1452	**1452**
Divertor	27	---	**27**
Shields	240	---	**240**
Total	**579** (27%)	**1569** (73%)	**2148**

* Jan 2012 Strawman

He : LiPb power ratio = 27 : 73 for SiC design