

# BGMG

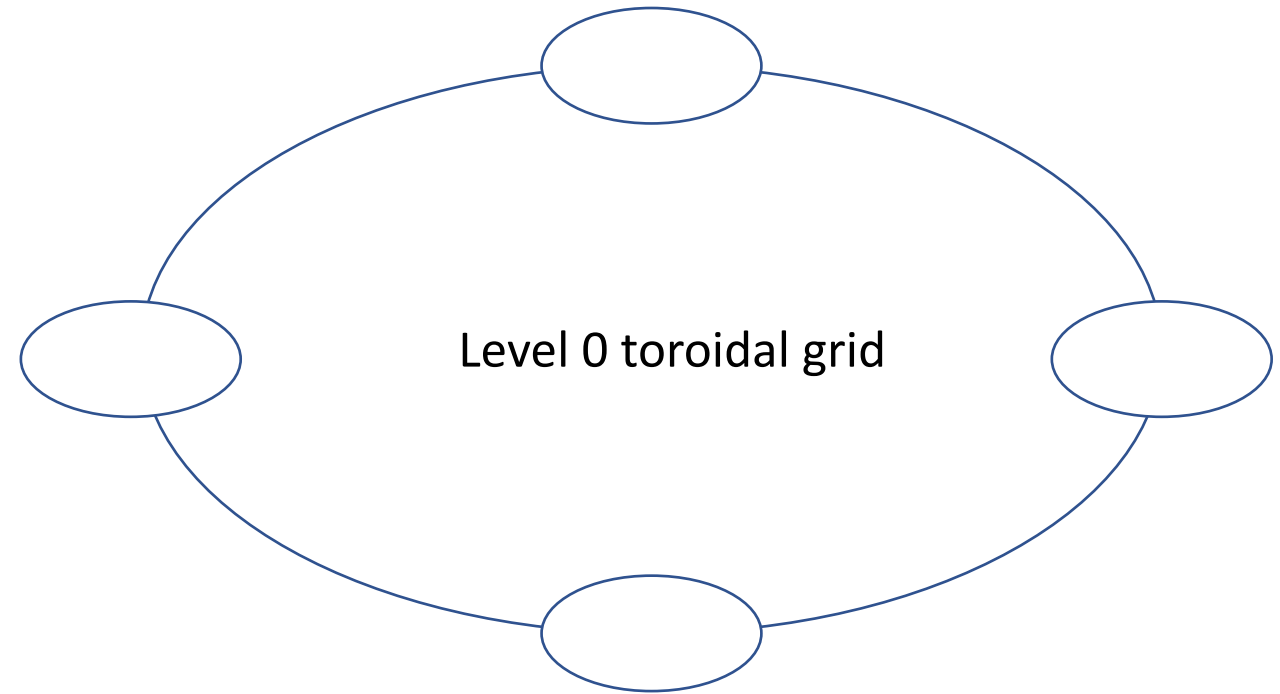
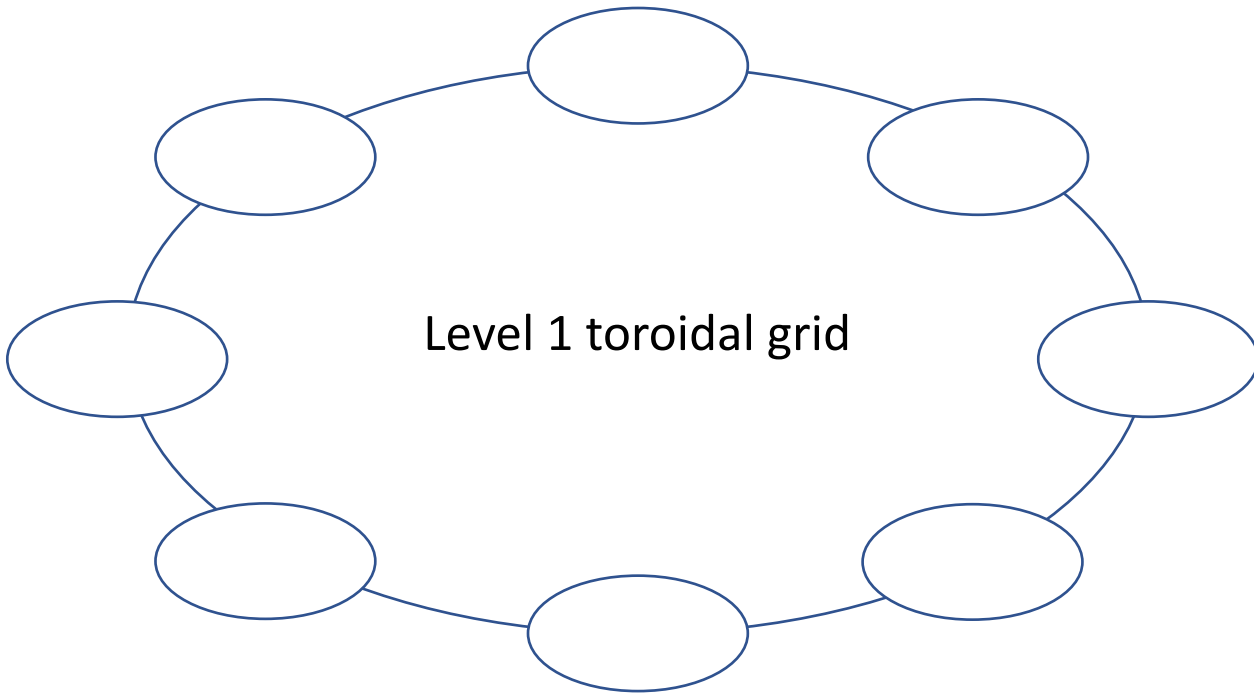
Block Geometric Multigrid

# Number of iterations

	BJ	BGMG
Regtests/pellet	98	8
Regtests/RMP_nonlin	1523	46
128K/Run02 (16 planes)	171	26
m3dnl_fat/Jin-3	153	41
NSTX-U/L06-560	843	3
Stellarator (tsteps=11)	Diverged	35

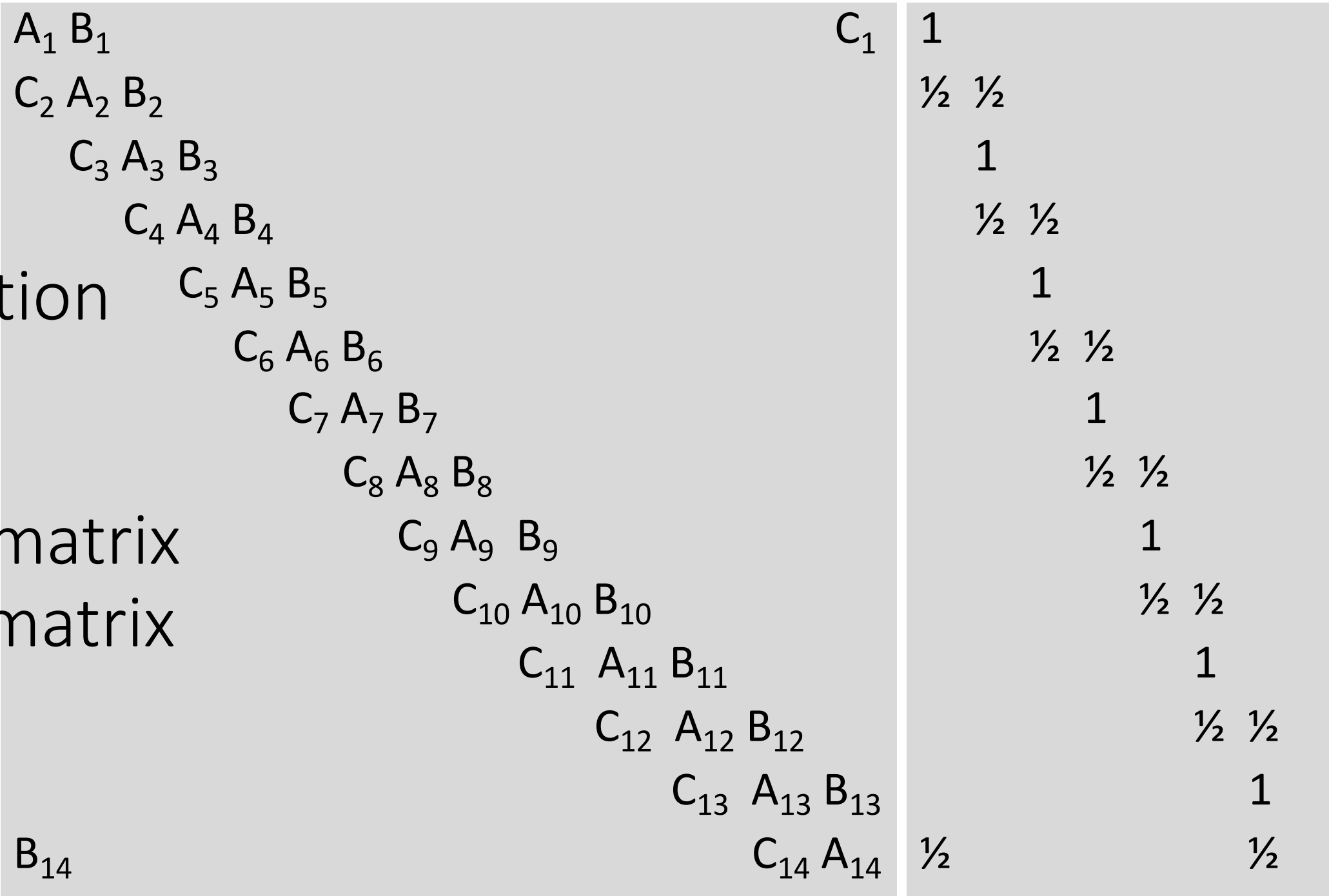
nplane	BJ	BGMG
08	12.641	20.044
16	21.670	39.031
24	31.481	42.157
32	44.813	50.468
40	52.822	53.908
48	61.813	70.604
56	77.059	82.523
64		
72	100.27	106.06
80	111.89	163.21
88		
96	135.01	220.36
112		
120		
128	186.36	397.72

# BGMG



# Interpolation Matrix

1 : block matrix  
 $\frac{1}{2}$ : block matrix



# memory issue I

30

P0

P1

P2

P3

8

8

7

7

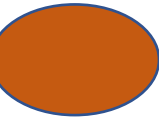
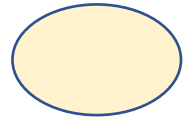
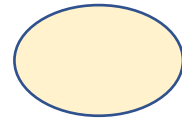
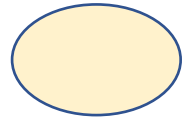
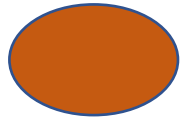


8

7

8

7



# memory issue II

Interpolation  
Matrix

1 : block matrix

$\frac{1}{2}$ : block matrix

1									
$\frac{1}{2}$	$\frac{1}{2}$								
	1								
	$\frac{1}{2}$	$\frac{1}{2}$							
		1							
		$\frac{1}{2}$	$\frac{1}{2}$						
			1						
			$\frac{1}{2}$	$\frac{1}{2}$					
				1					
				$\frac{1}{2}$	$\frac{1}{2}$				
					1				
$\frac{1}{2}$								1	
								$\frac{1}{2}$	$\frac{1}{2}$

# Optimization: Tune BGMG parameters

- Smoother
- Loose convergence criterion on the coarse grid



# Stellarator Cases from Adelle

/scratch/gpfs/adellew/m3dc1/stellarator/matt/old/e6a3dt5\_12K\_d6k6

(64 planes, dt=0.1, diverged at its=14, face=12813)

/scratch/gpfs/adellew/m3dc1/stellarator/matt/new/test\_amu

(64 planes, dt=0.5, diverged at timestep=5, face=12813)

/scratch/gpfs/adellew/m3dc1/stellarator/wistell/fixed\_boundary/e6a3dt1\_12K\_d6k6

(64 planes, dt=0.1, diverged at timestep=1, face=12813)

# Optimization: loose convergence criterion

- `-hard_mg_coarse_ksp_type fgmres`
- `-hard_mg_coarse_pc_type bjacobi`
- `-hard_mg_coarse_pc_bjacobi_blocks 12`
- `-hard_mg_coarse_sub_pc_type lu`
- `-hard_mg_coarse_sub_pc_factor_mat_solver_type superlu_dist`
- `-hard_mg_coarse_sub_ksp_type preonly`
  
- `-hard_mg_coarse_ksp_max_it 3`
- `-hard_mg_coarse_ksp_max_it 2`
- `-hard_mg_coarse_ksp_max_it 1`

ksp\_max\_it effect: qa\_high\_beta (AW)

bj	bgmg	bgmg max_it=3	bgmg max_it=2	bgmg max_it=1
31	171	48	54	47

Time in seconds

I have tested several cases. One performs better at 3; One at 2; One at 1.  
So I have set 3 as the default in regtest runs.

ksp\_max\_it effect: **nstx\_120446** (SJ)

<b>bj</b>	<b>bgmg</b>	<b>bgmg max_it=3</b>	<b>bgmg max_it=2</b>	<b>bgmg max_it=1</b>
<b>101</b>	<b>x</b>	<b>103</b>	<b>100</b>	<b>207</b>

Time in seconds

Total wtime=30min. bgmg could not complete one time step.

But, it outperforms bj at max\_it=2.

So I have set 3 as the default in regtest runs.

# Further study

- bgmg  $\leadsto$  nplanes
- bgmg  $\leadsto$  poloidal grid refining
- bgmg  $\leadsto \kappa$

bgmg starts to win  
from nplane=40

bj and bgmg timing (s) NSTX 120446 v.s. nplanes

