ss2012
PICシミュレーションによる
1次元、2次元無衝突衝撃波

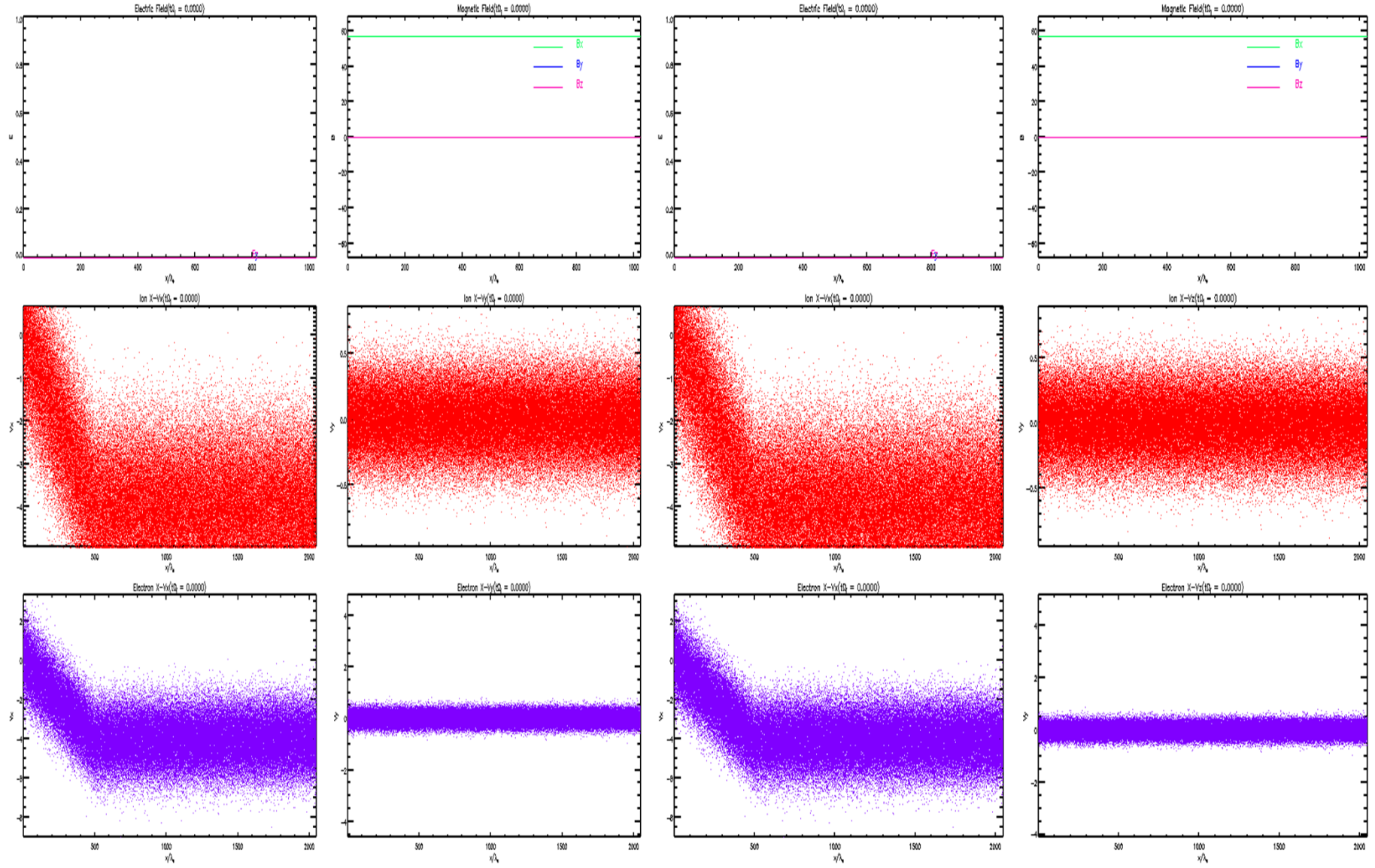
清水健矢
内野宏俊

1次元無衝突衝撃波

パラメータ

mi/me	**25**
ωpe/ωce	10
ΘBn	0,30,60,90
MA	10
βi	0.5
βe	0.5

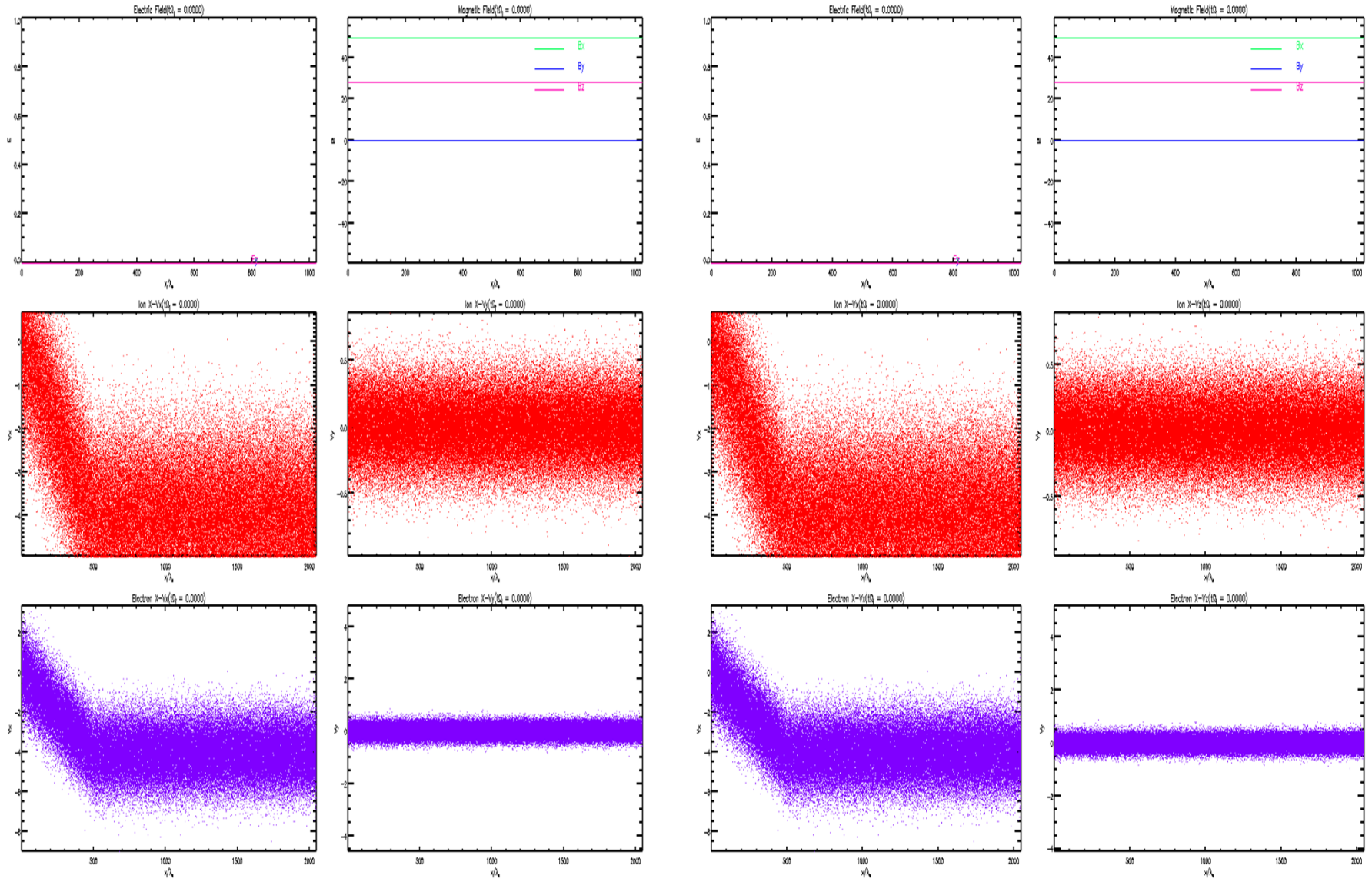
Θ=0


Electric Field(t/Ω_i = 0.0000)
Magnetic Field(t/Ω_i = 0.0000)
Bx
By
Bz
Ion X-Vx(t/Ω_i = 0.0000)
Ion X-Vy(t/Ω_i = 0.0000)
Ion X-Vz(t/Ω_i = 0.0000)
Electron X-Vx(t/Ω_i = 0.0000)
Electron X-Vy(t/Ω_i = 0.0000)
Electron X-Vz(t/Ω_i = 0.0000)
x/λ_i

y

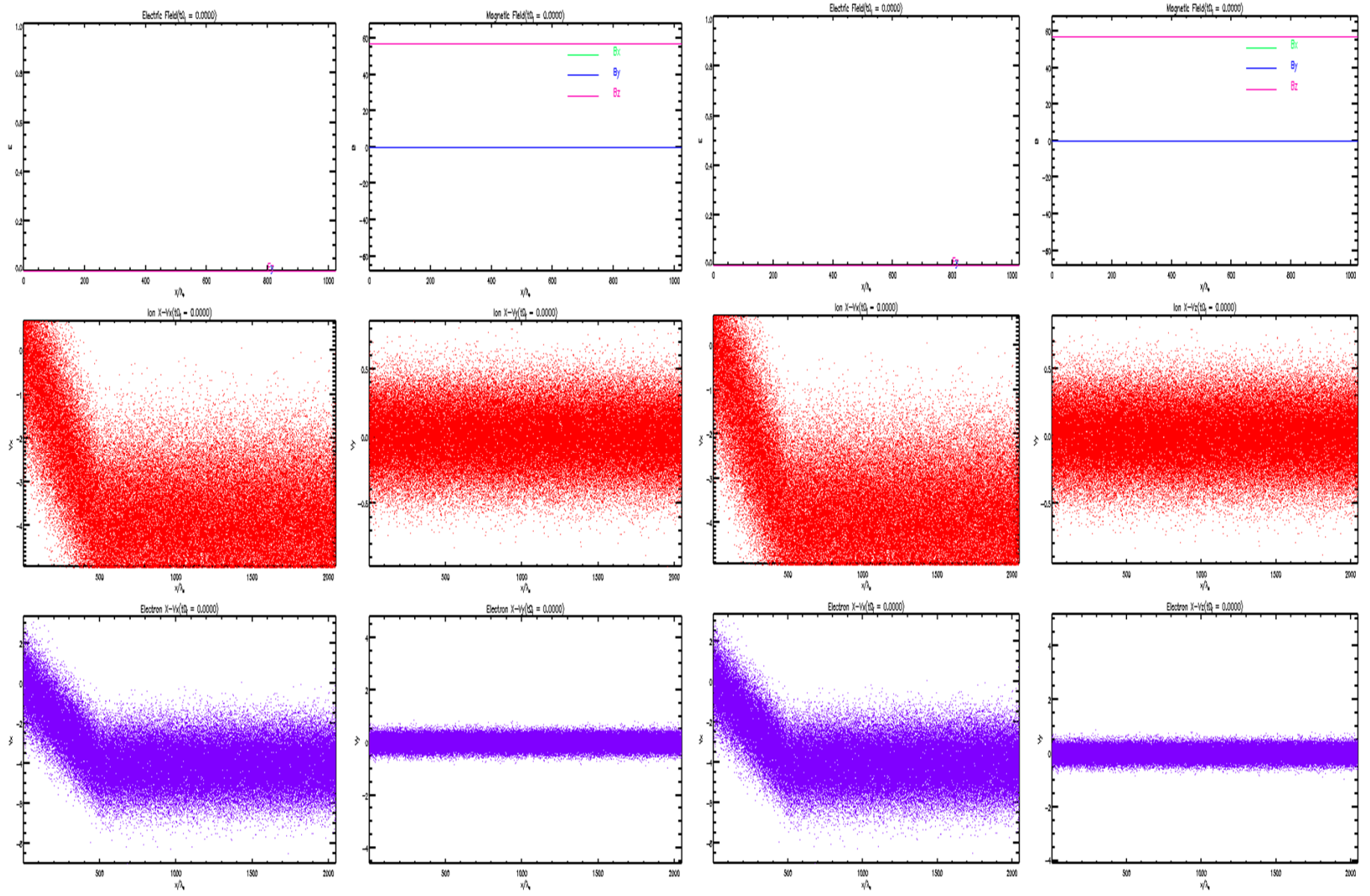
z

Θ=30


Electric Field(t0 = 0.0000)
Magnetic Field(t0 = 0.0000)
Bx
By
Bz
Ez
x/λ
Ion X-Vx(t0 = 0.0000)
Ion X-Vy(t0 = 0.0000)
Ion X-Vz(t0 = 0.0000)
Electron X-Vx(t0 = 0.0000)
Electron X-Vy(t0 = 0.0000)
Electron X-Vz(t0 = 0.0000)

y z

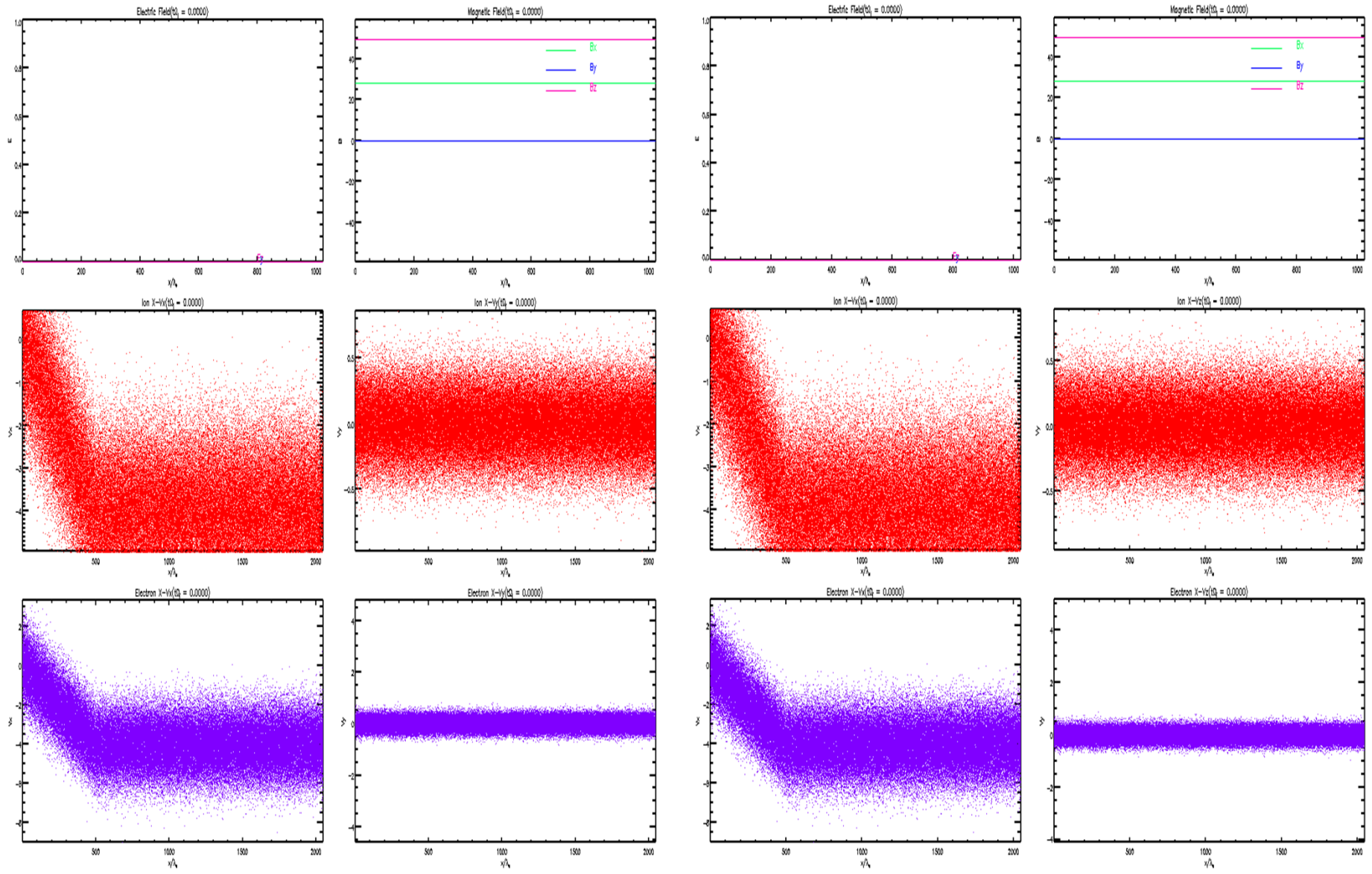
Θ=60


Electric Field(t0 = 0.0000)
Magnetic Field(t0 = 0.0000)
Bx
By
Bz
Ion X-Vx(t0 = 0.0000)
Ion X-Vy(t0 = 0.0000)
Ion X-Vz(t0 = 0.0000)
Electron X-Vx(t0 = 0.0000)
Electron X-Vy(t0 = 0.0000)
Electron X-Vz(t0 = 0.0000)
x/λ

y

z

Θ=90

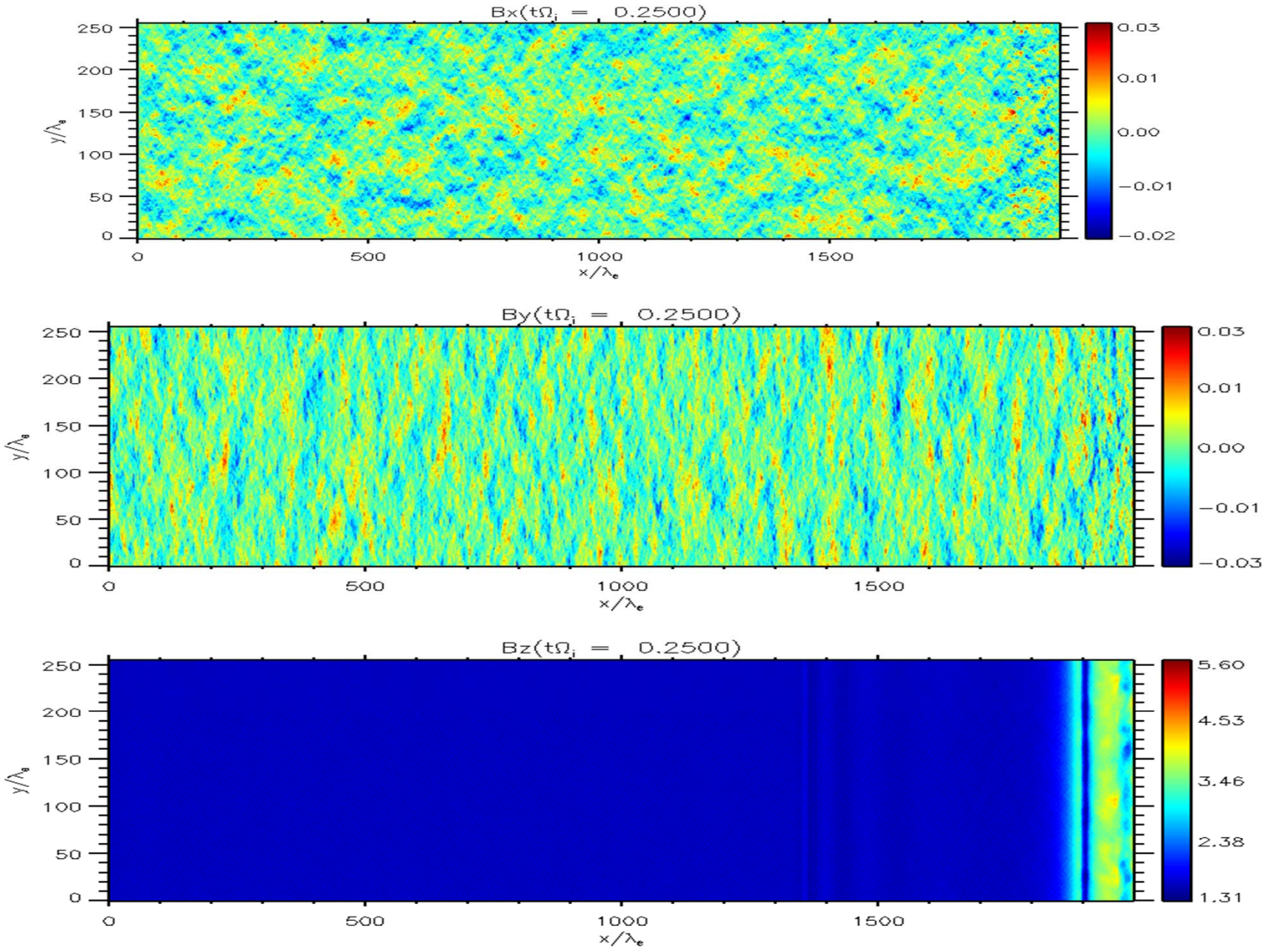

Electric Field(t0 = 0.0000)
Magnetic Field(t0 = 0.0000)
Bx
By
Bz
Ez
Ion X-Vx(t0 = 0.0000)
Ion X-Vy(t0 = 0.0000)
Ion X-Vz(t0 = 0.0000)
Electron X-Vx(t0 = 0.0000)
Electron X-Vy(t0 = 0.0000)
Electron X-Vz(t0 = 0.0000)
x/λ

y z

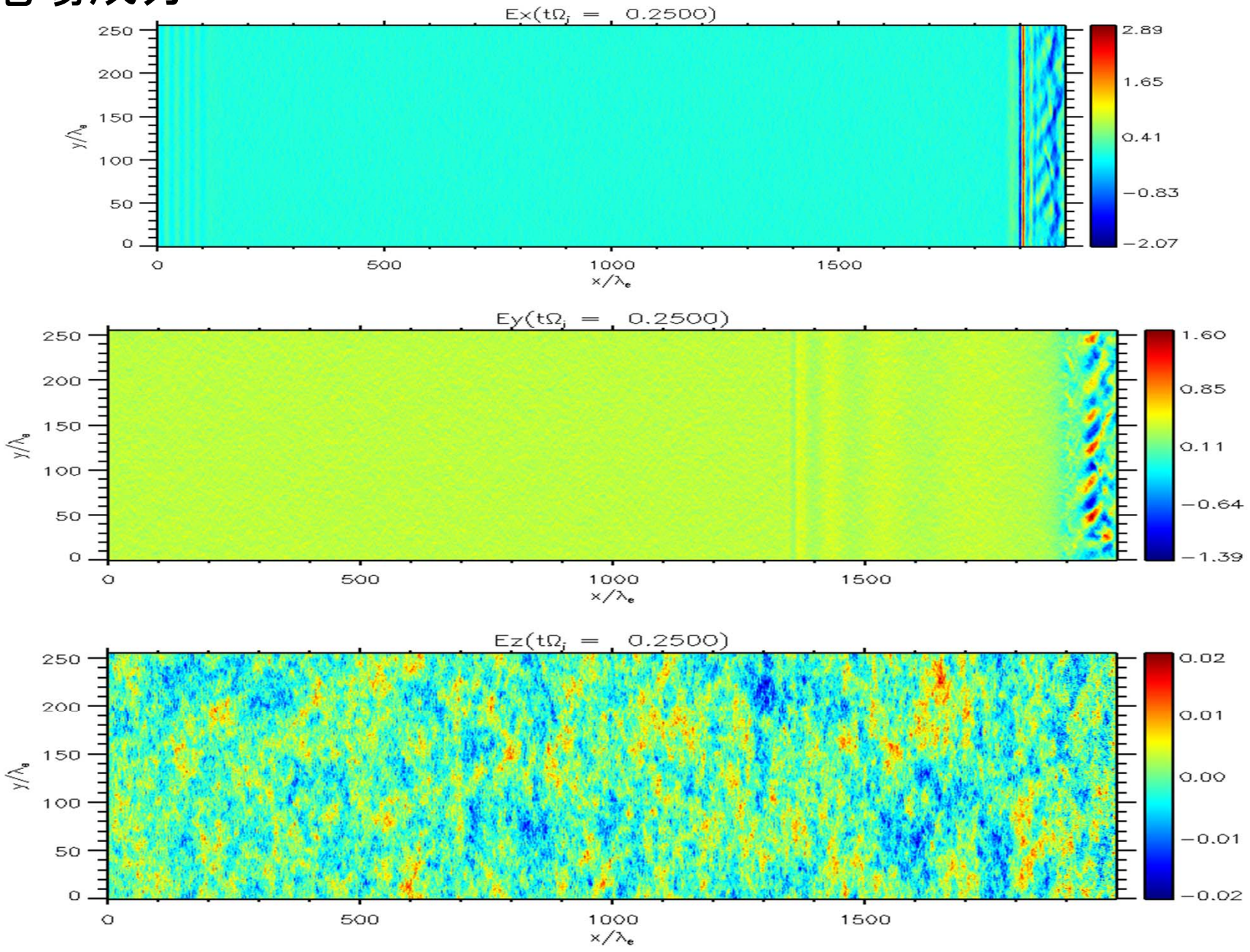
2次元無衝突衝撃波
y方向磁場、z方向磁場の時
パラメータ

mi/me	**25**
ωpe/ωce	10
MA	10
βi	0.5
βe	0.5

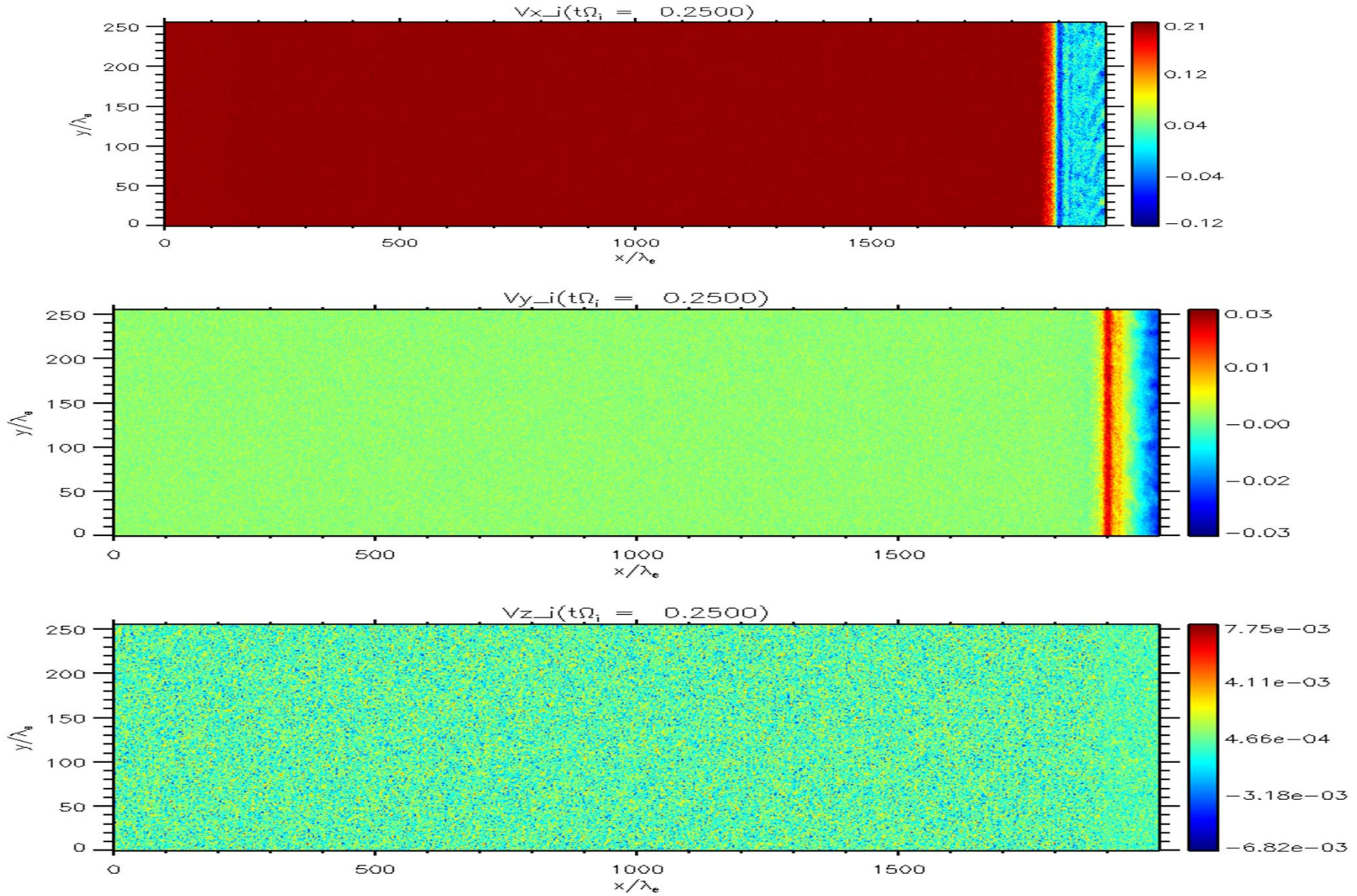
z方向磁場（面外磁場）があるときのの磁場成分



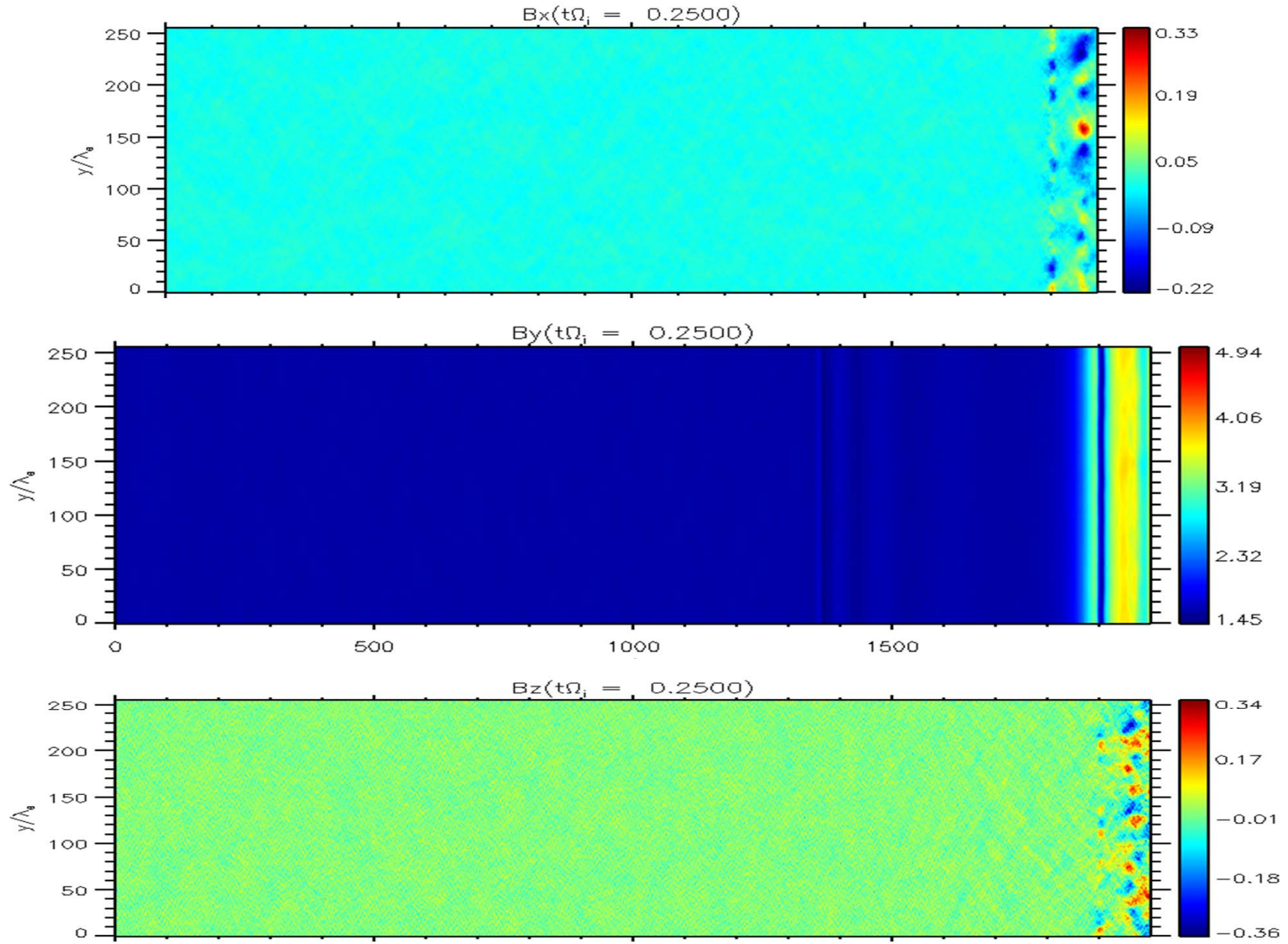
電場成分


Ex(tΩi = 0.2500)
2.89
1.65
0.41
−0.83
−2.07
Ey(tΩi = 0.2500)
1.60
0.85
0.11
−0.64
−1.39
Ez(tΩi = 0.2500)
0.02
0.01
0.00
−0.01
−0.02
y/λe
x/λe
0
50
100
150
200
250
500
1000
1500

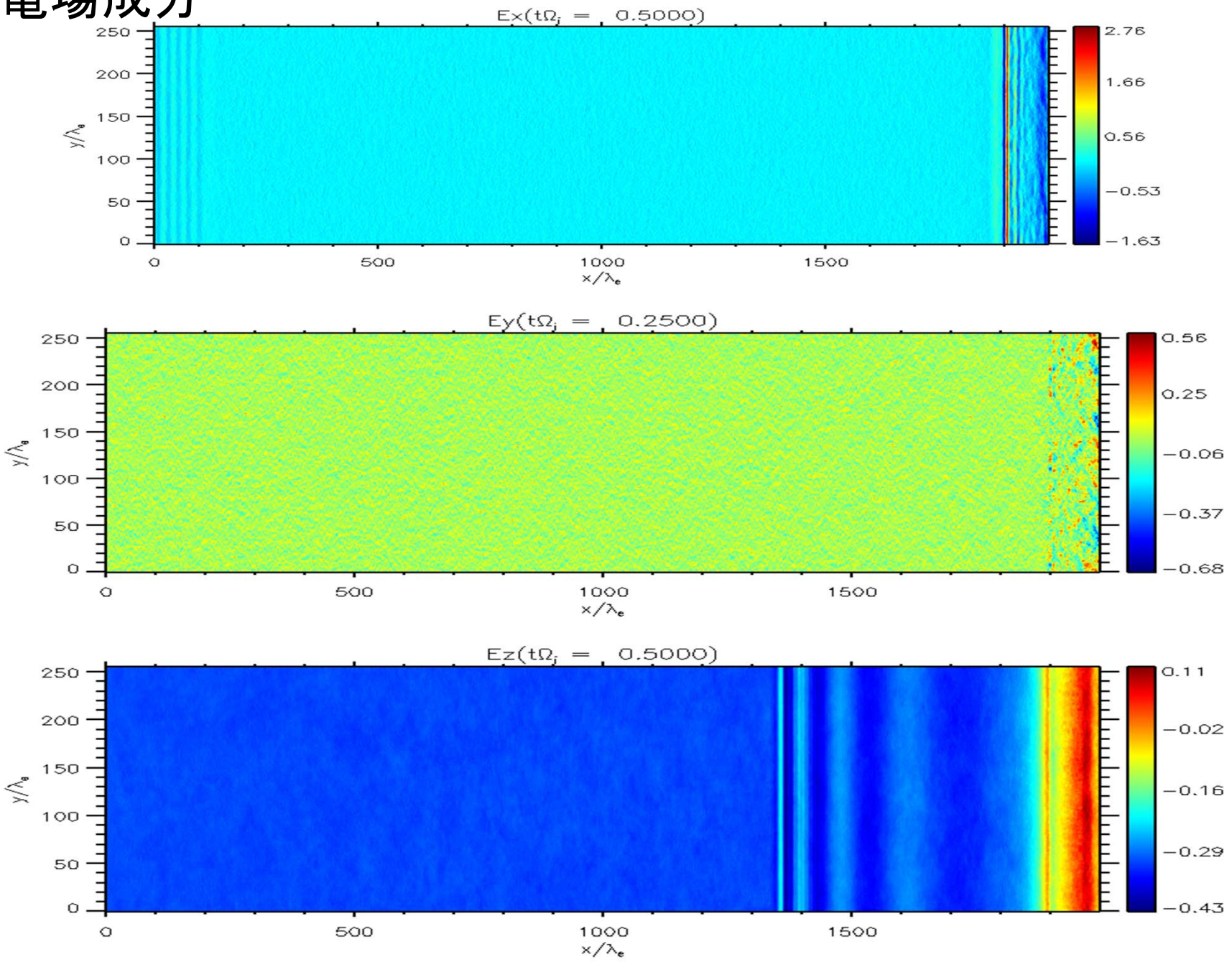
イオン速度成分


Vx_i(tΩi = 0.2500)
0.21
0.12
0.04
−0.04
−0.12
Vy_i(tΩi = 0.2500)
0.03
0.01
−0.00
−0.02
−0.03
Vz_i(tΩi = 0.2500)
7.75e−03
4.11e−03
4.66e−04
−3.18e−03
−6.82e−03
y/λe
x/λe
0
50
100
150
200
250
500
1000
1500

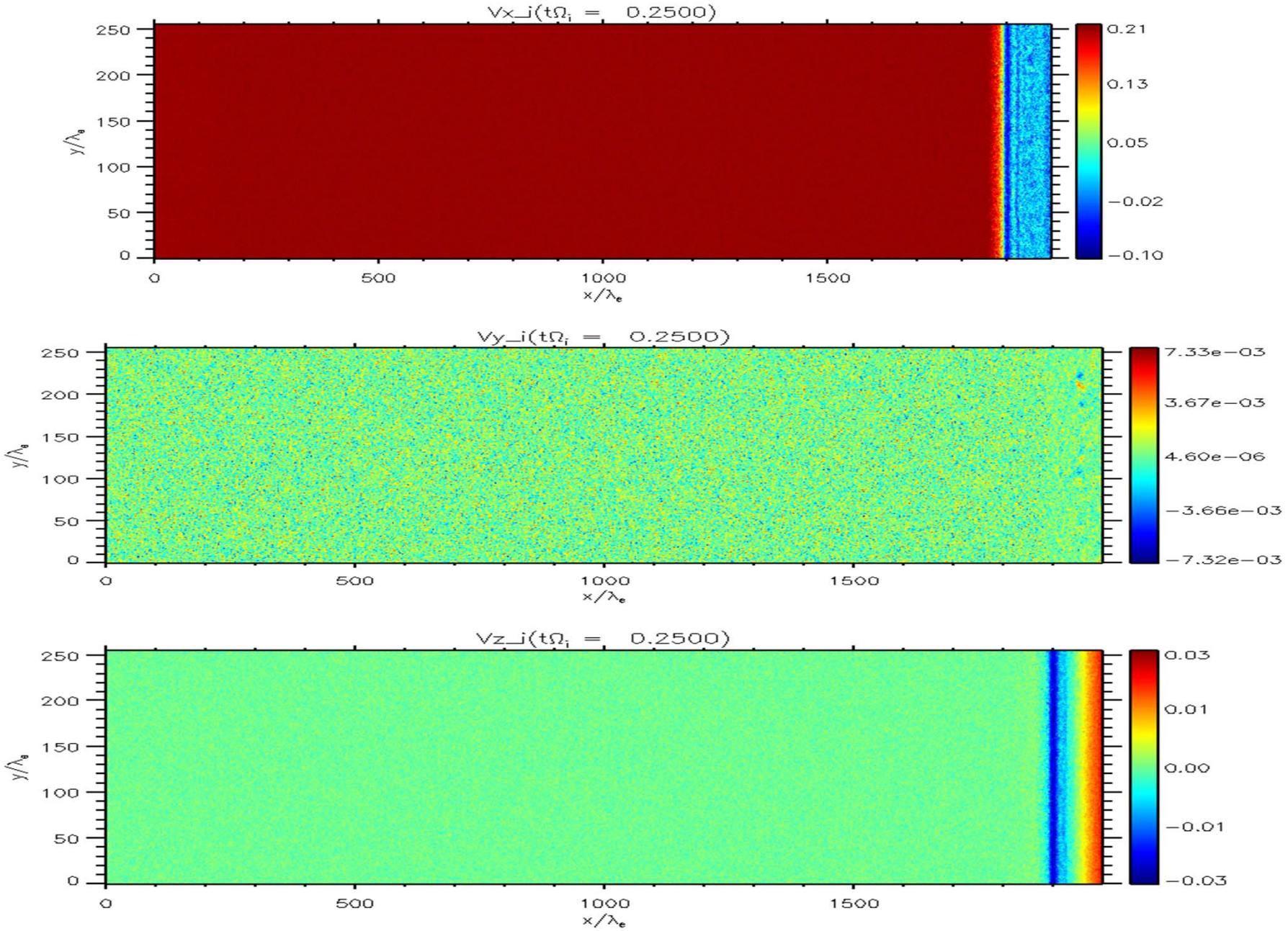
Y方向磁場（面内磁場）があるときの磁場成分

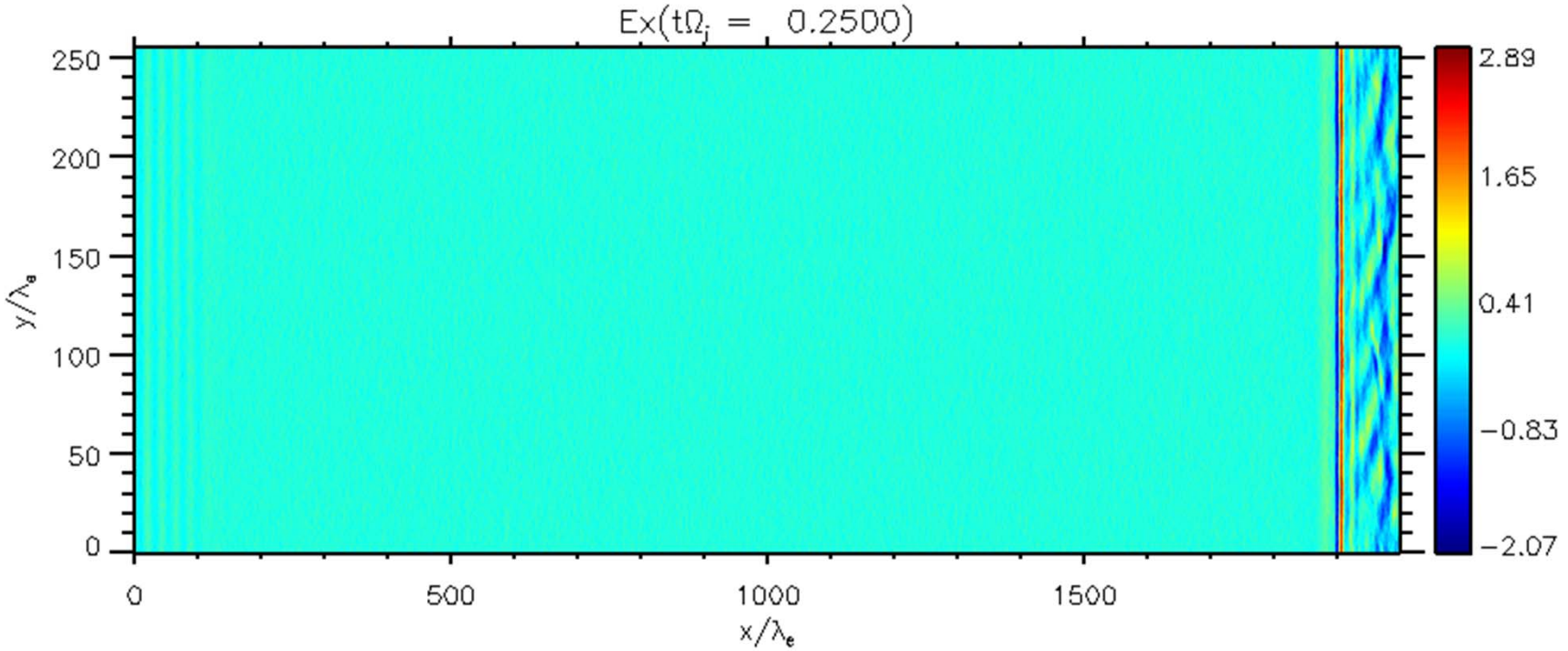


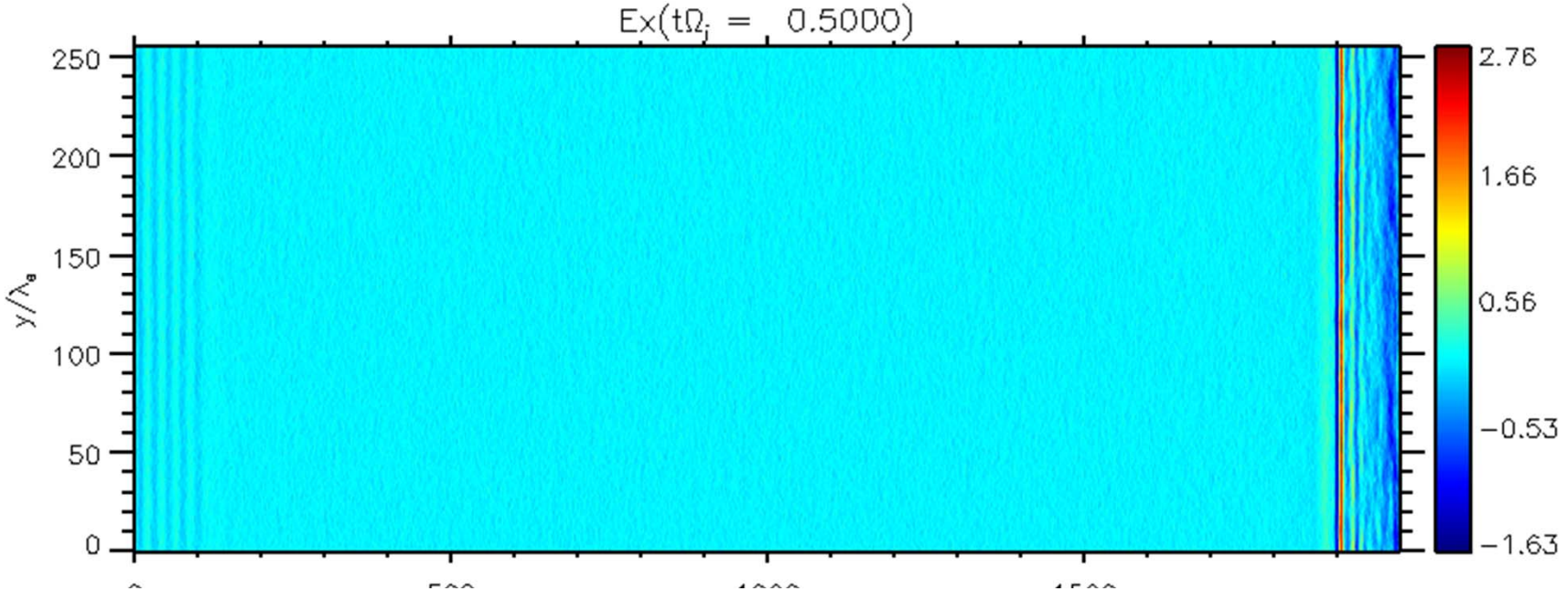
電場成分

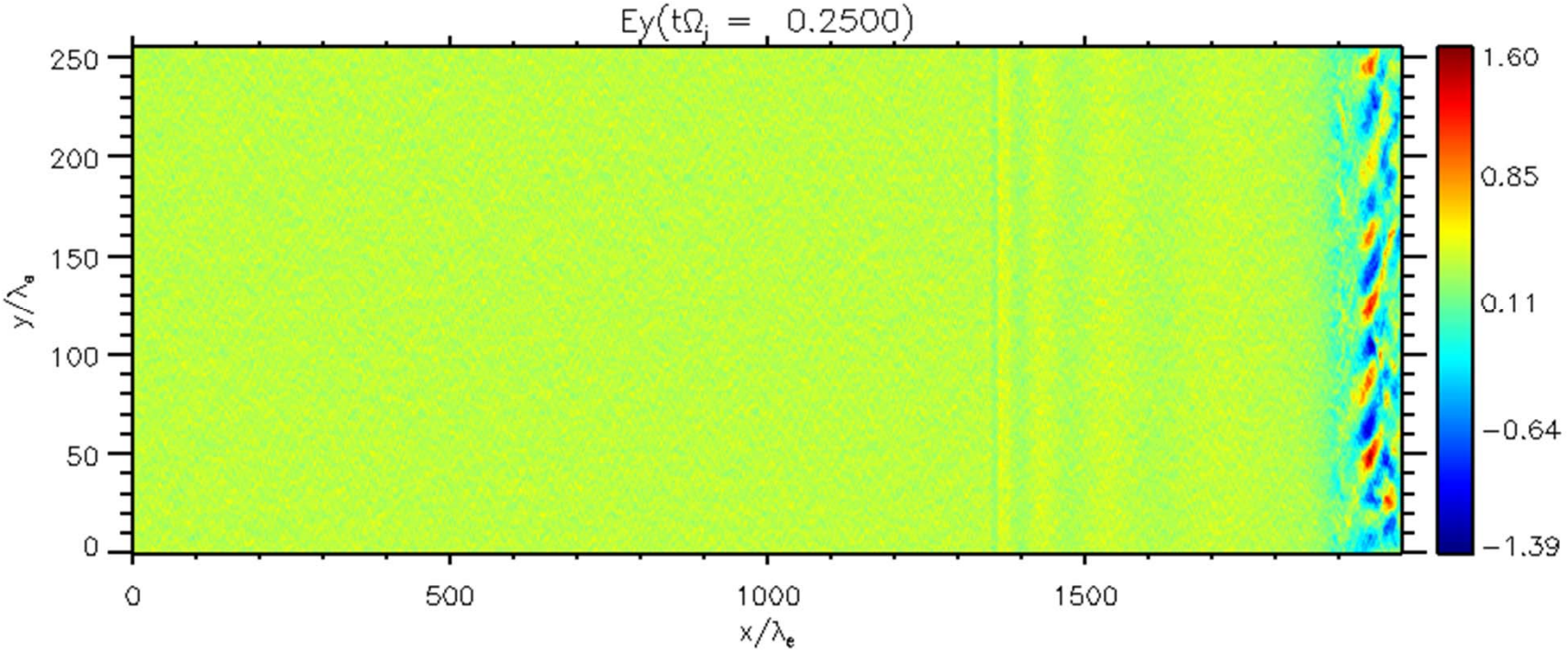

Ex(tΩi = 0.5000)
2.76
1.66
0.56
−0.53
−1.63
Ey(tΩi = 0.2500)
0.56
0.25
−0.06
−0.37
−0.68
Ez(tΩi = 0.5000)
0.11
−0.02
−0.16
−0.29
−0.43
y/λe
x/λe
0
50
100
150
200
250
500
1000
1500

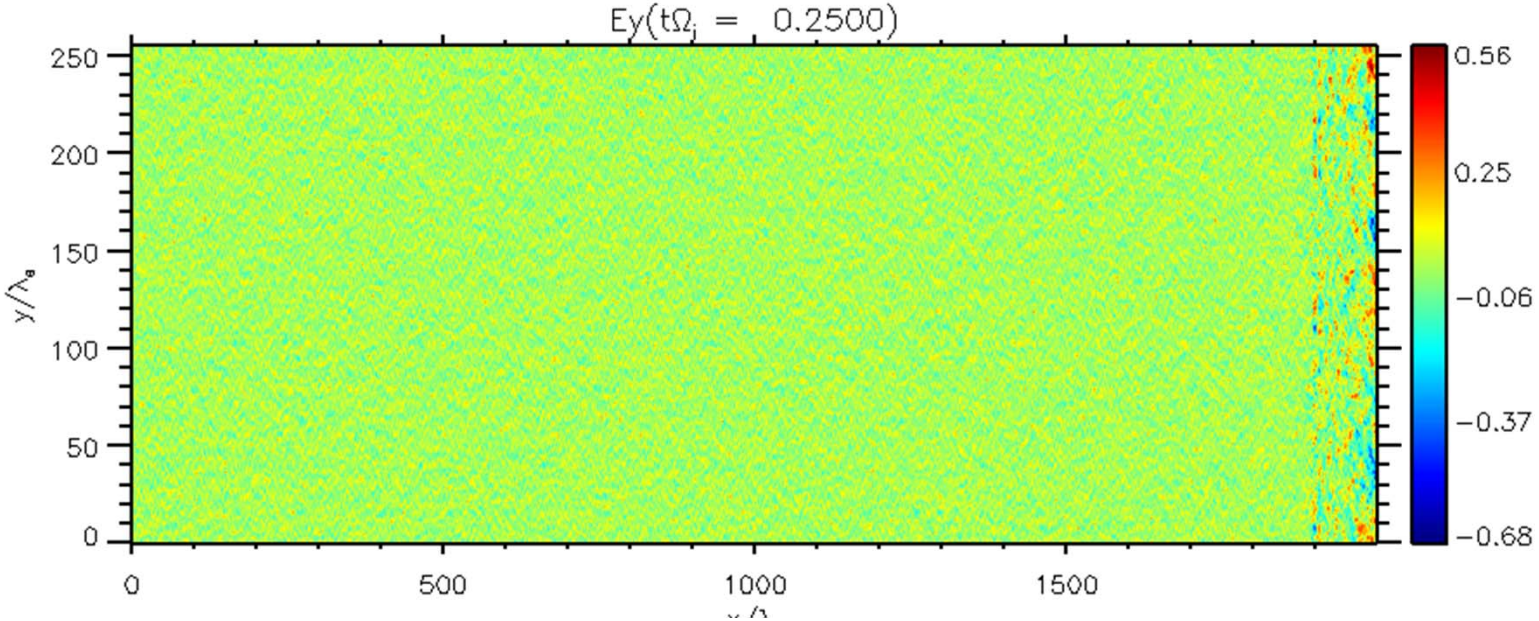
イオン速度成分

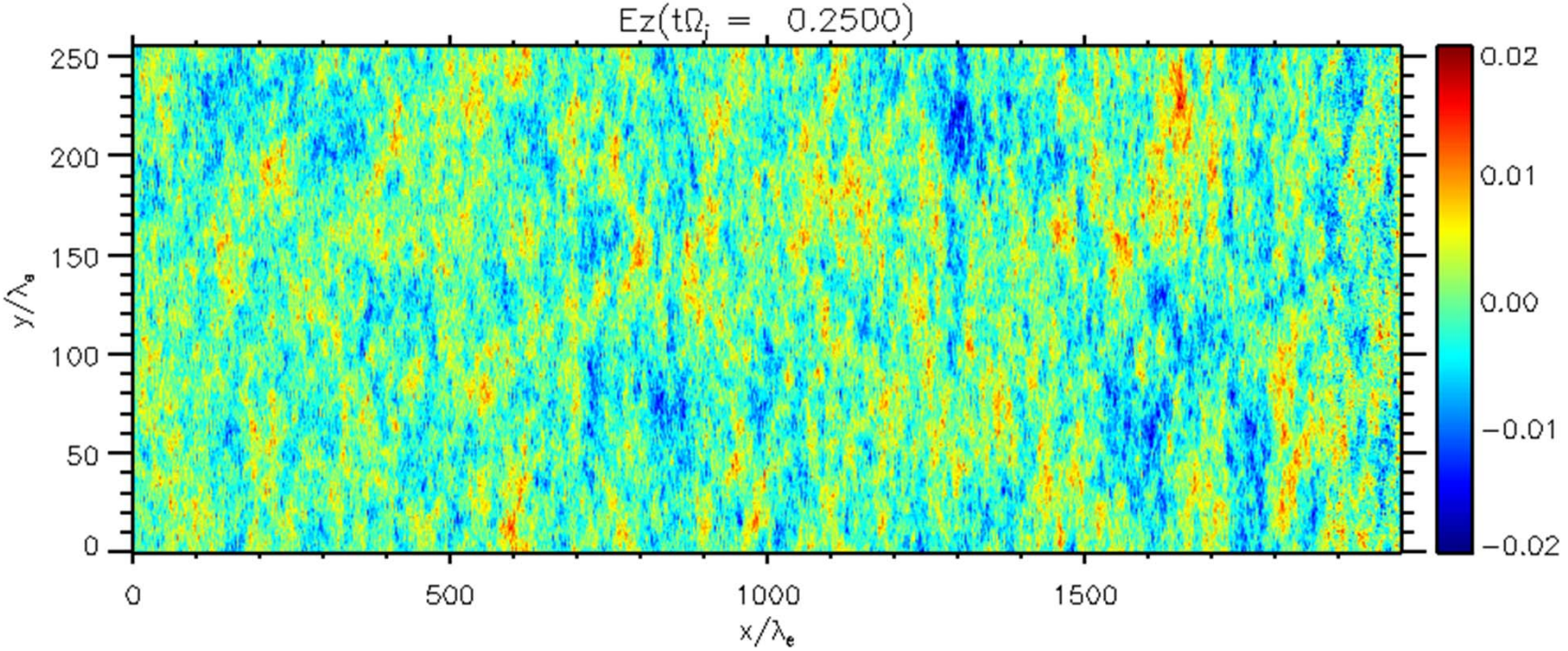

Vx_i(tΩi = 0.2500)
Vy_i(tΩi = 0.2500)
Vz_i(tΩi = 0.2500)
y/λe
x/λe
0
500
1000
1500
50
100
150
200
250
0.21
0.13
0.05
−0.02
−0.10
7.33e−03
3.67e−03
4.60e−06
−3.66e−03
−7.32e−03
0.03
0.01
0.00
−0.01
−0.03

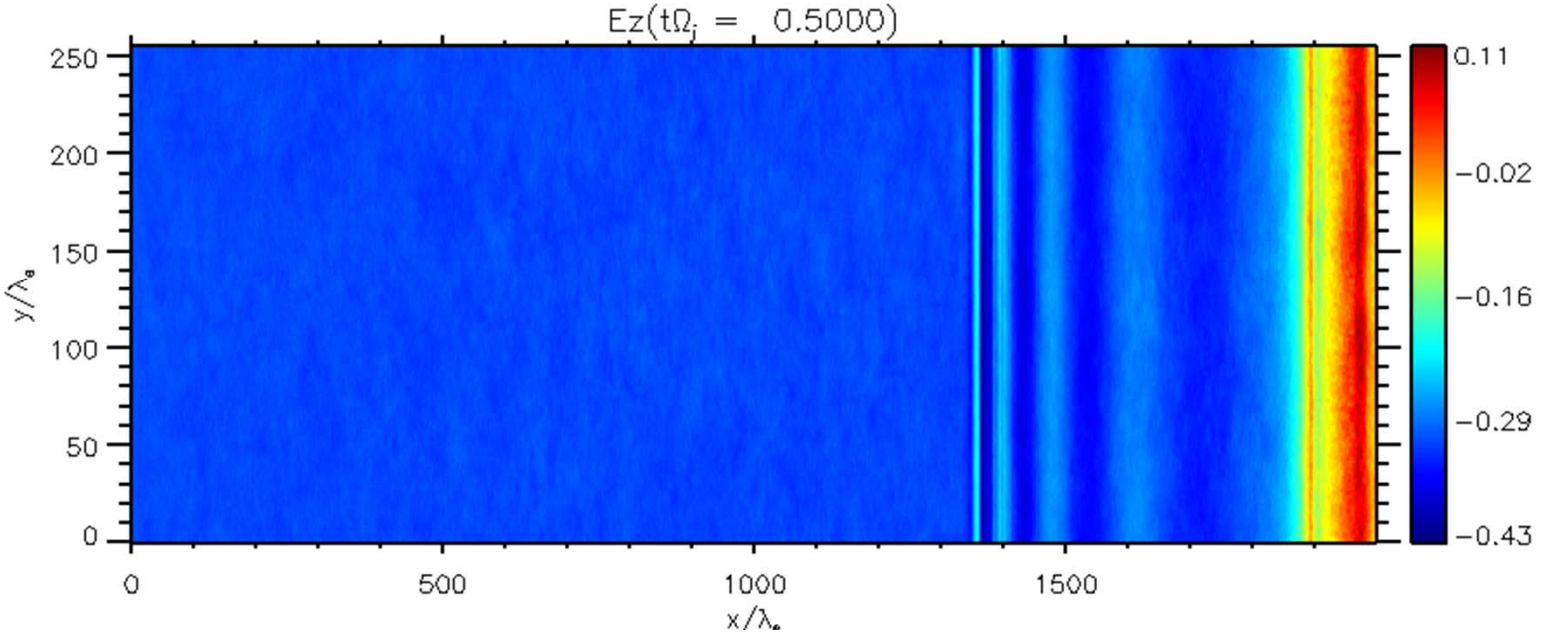

Ex(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
2.89
1.65
0.41
−0.83
−2.07

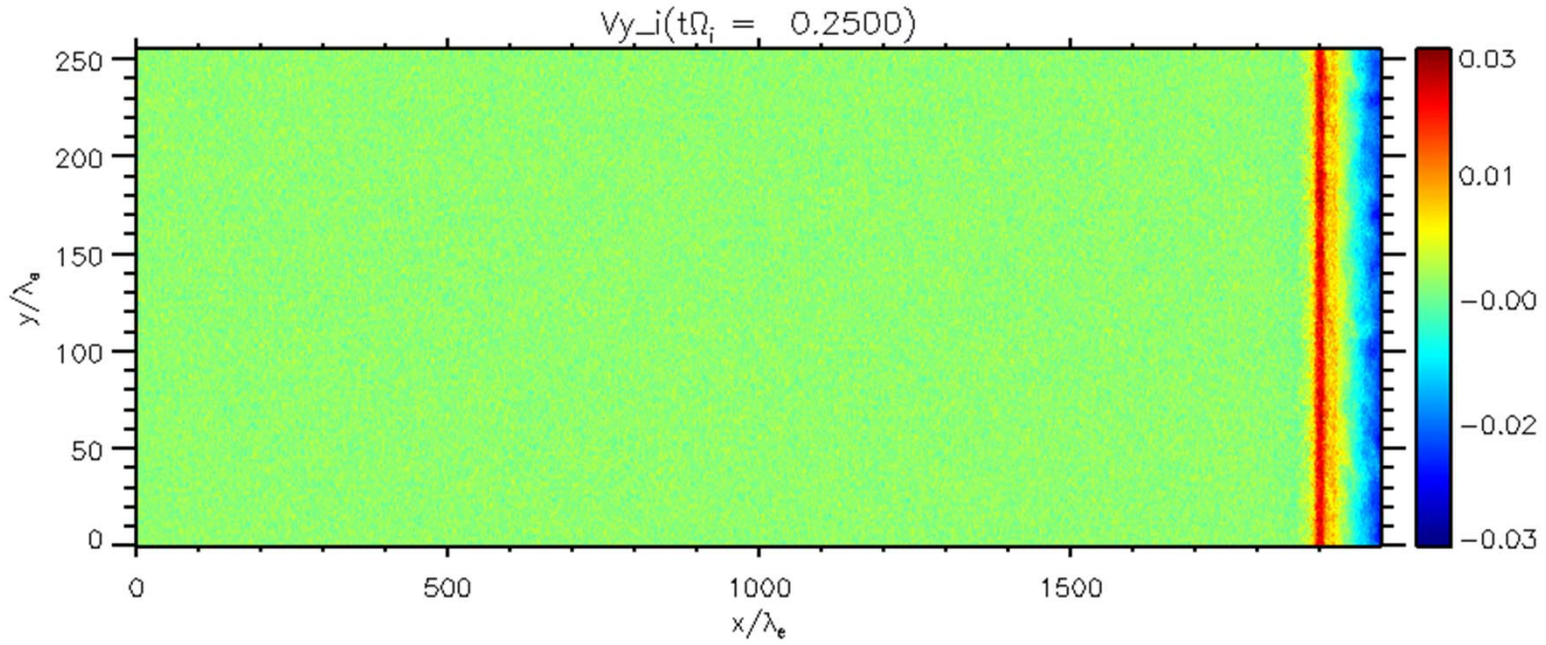

Ex(tΩi = 0.5000)
250
200
150
100
50
0
y/λe
2.76
1.66
0.56
−0.53
−1.63

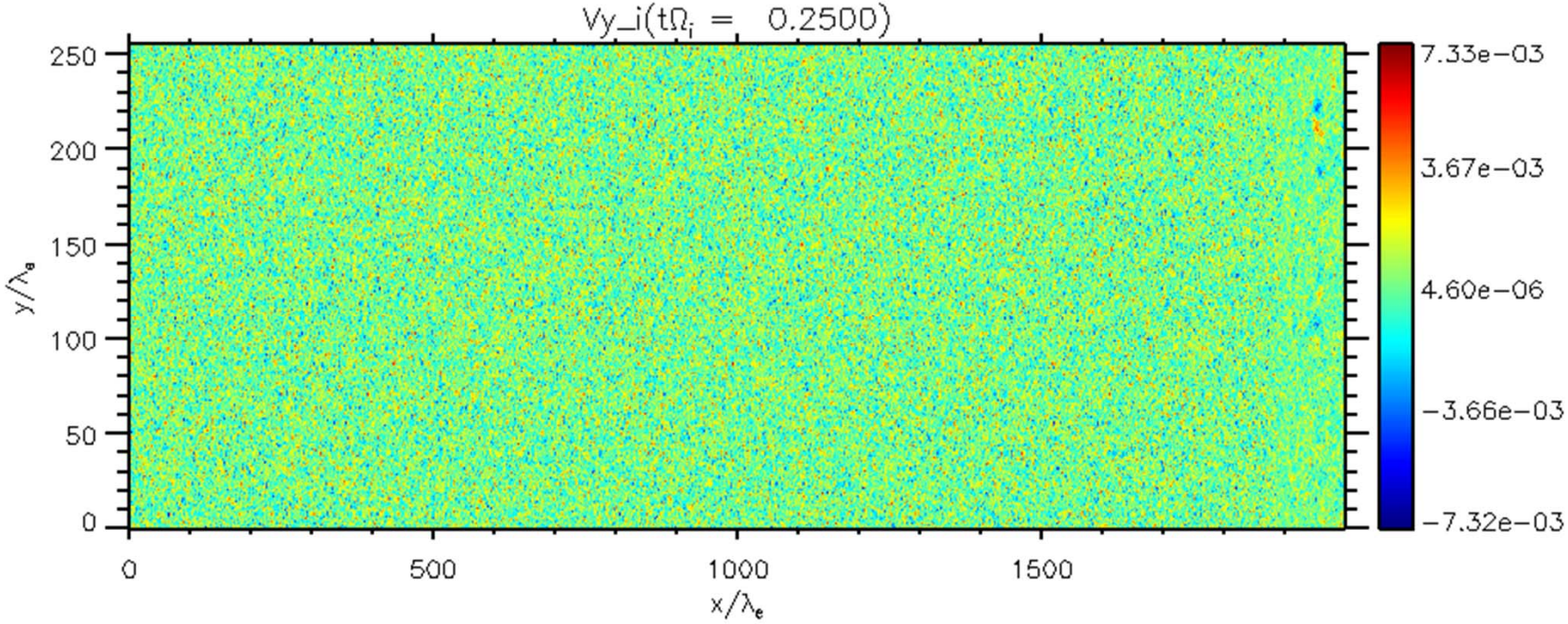

Ey(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
1.60
0.85
0.11
−0.64
−1.39

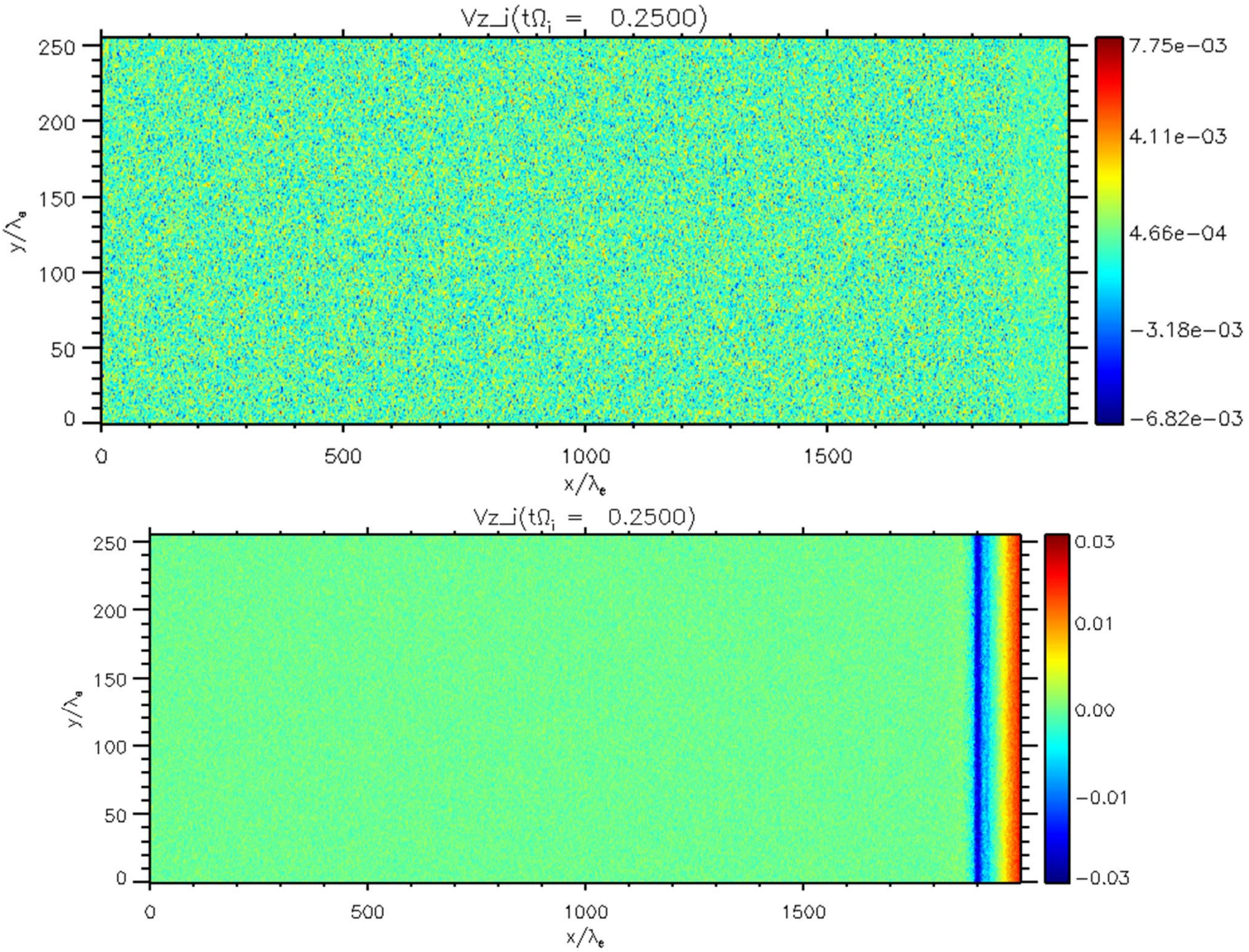

Ey(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
0.56
0.25
−0.06
−0.37
−0.68

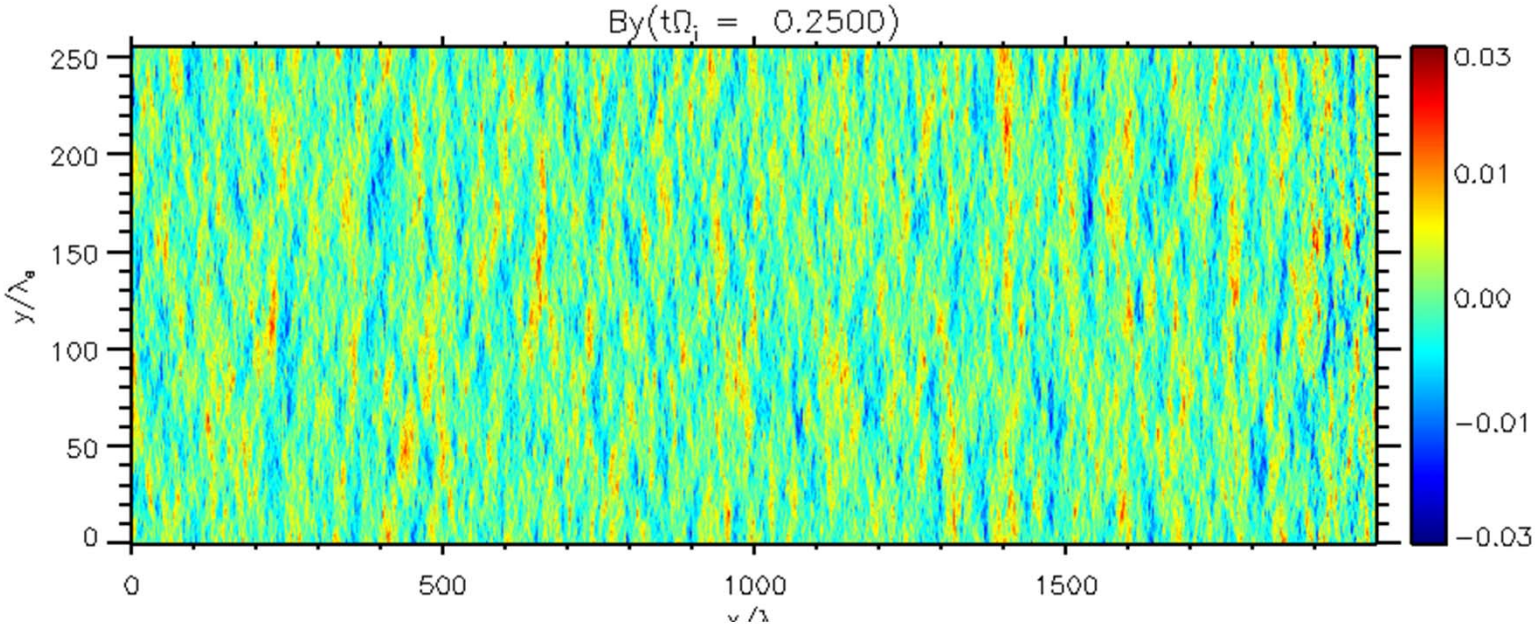

Ez(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.02
0.01
0.00
−0.01
−0.02

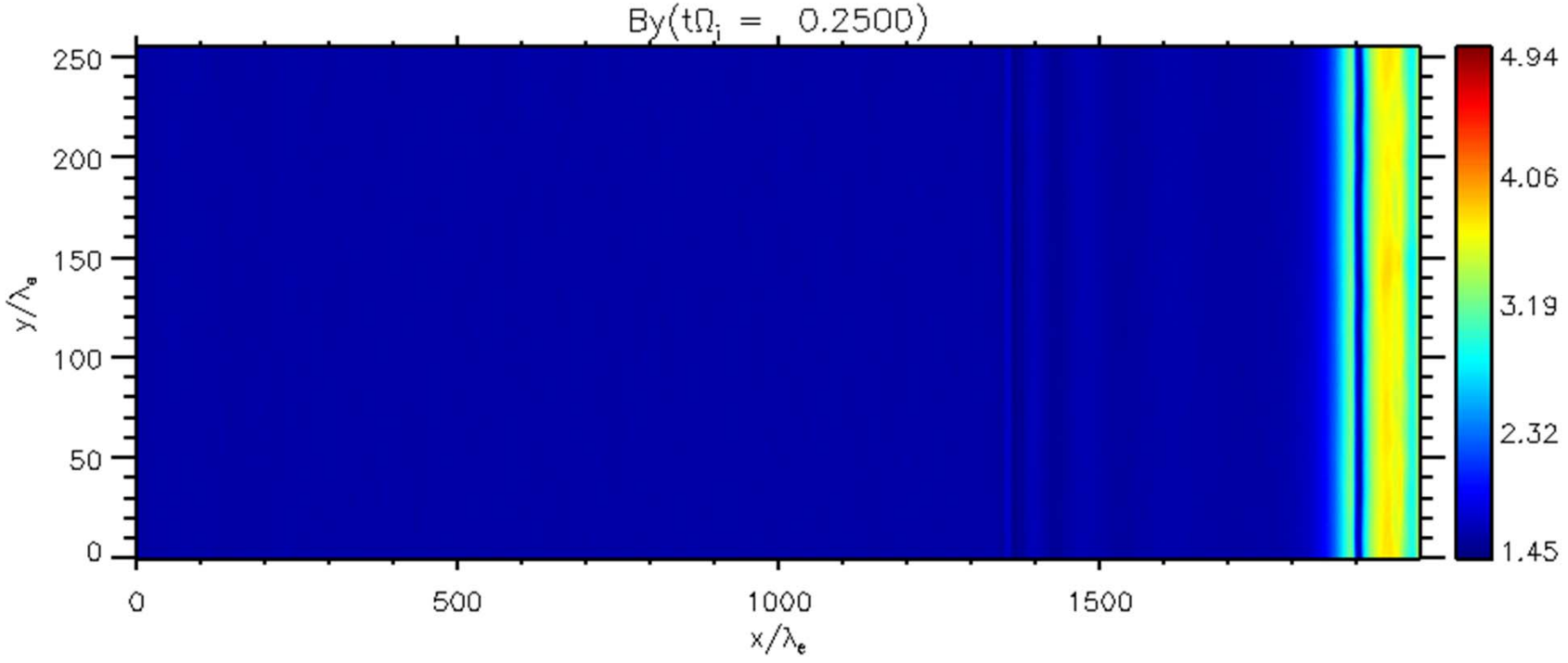

Ez(tΩi = 0.5000)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.11
−0.02
−0.16
−0.29
−0.43

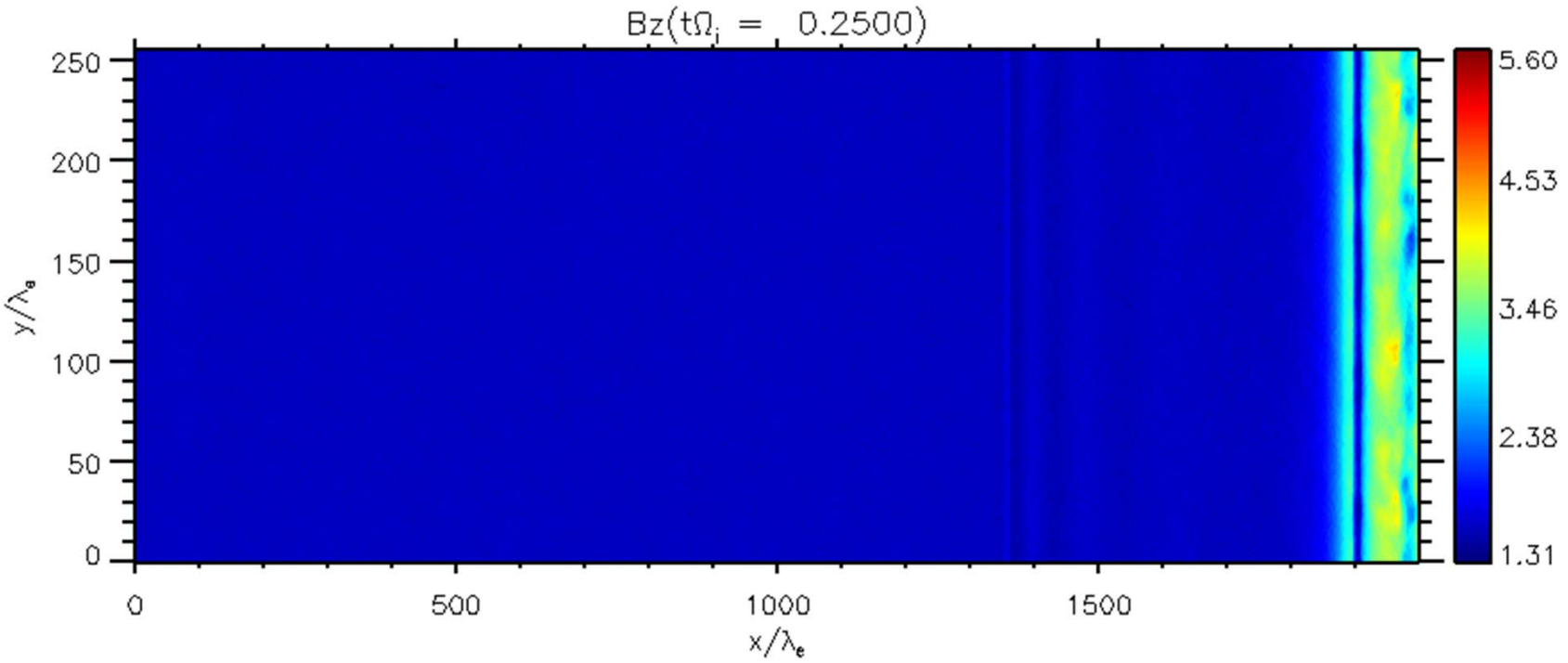

Vy_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
0.03
0.01
−0.00
−0.02
−0.03

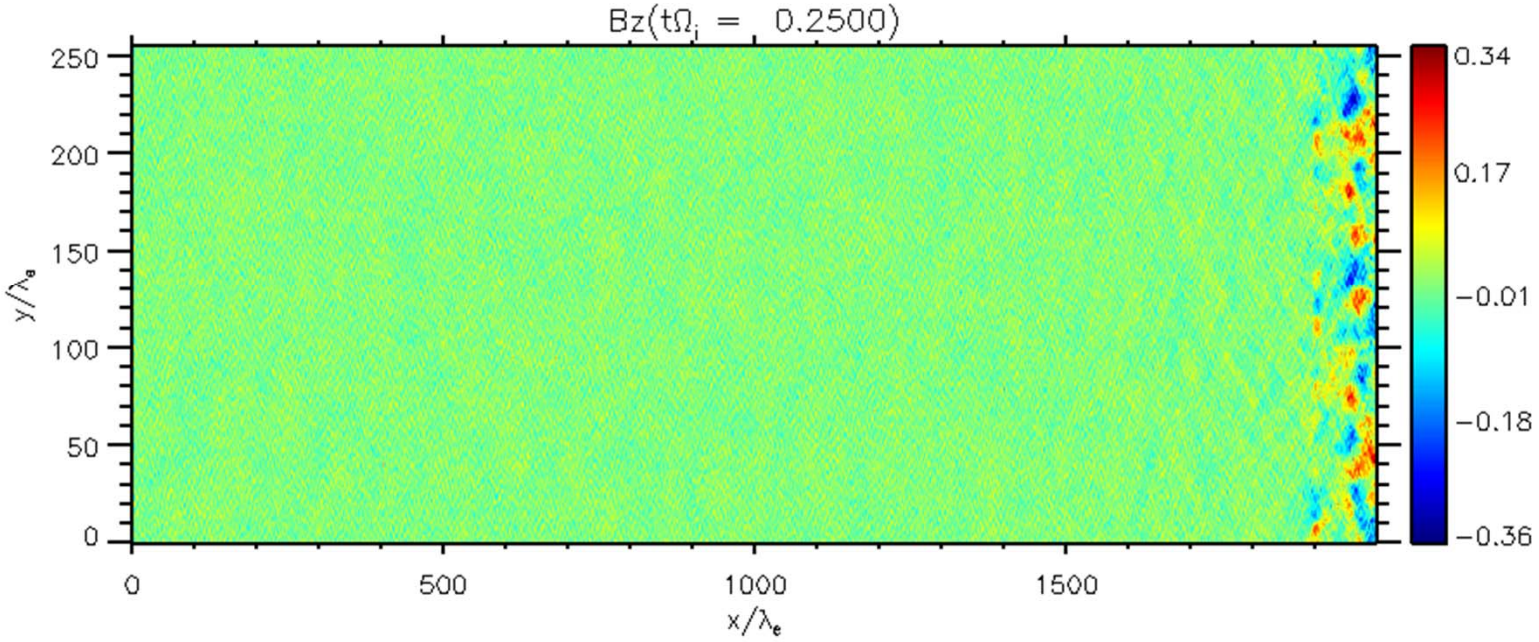

Vy_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
7.33e−03
3.67e−03
4.60e−06
−3.66e−03
−7.32e−03

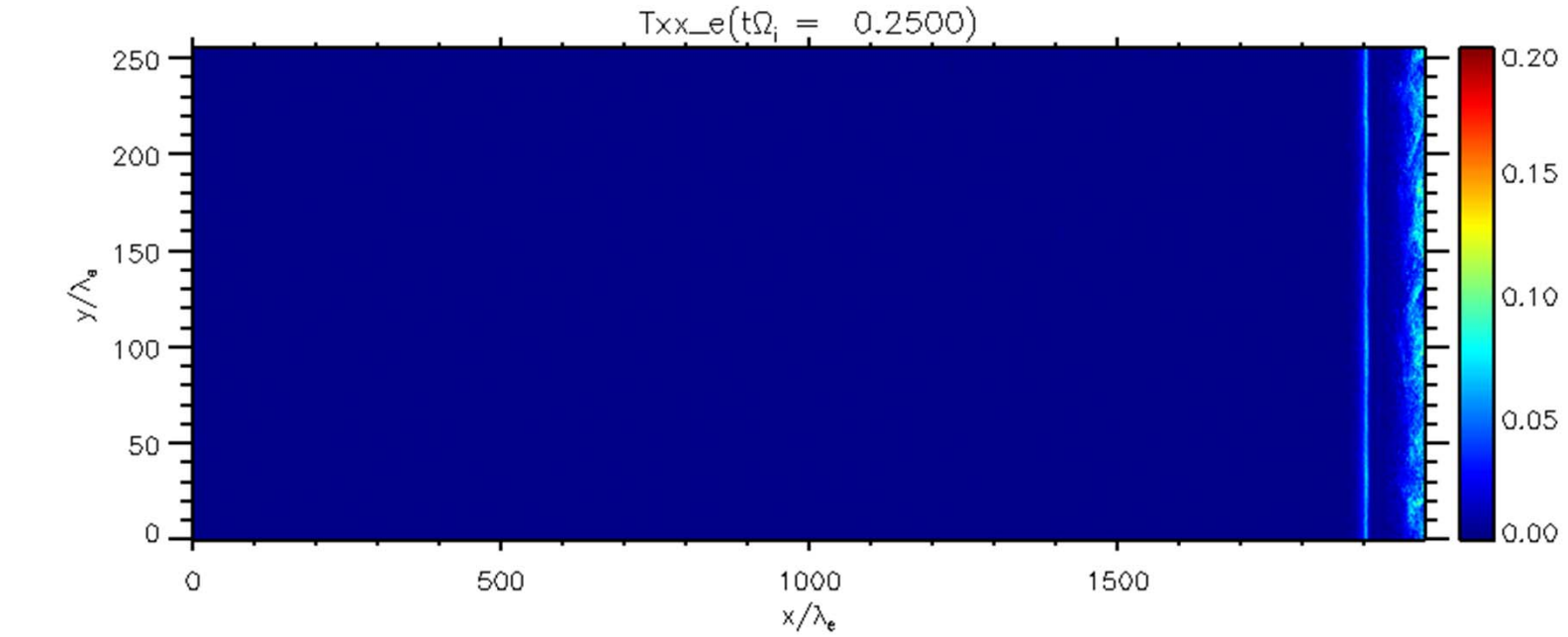

Vz_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
7.75e−03
4.11e−03
4.66e−04
−3.18e−03
−6.82e−03
Vz_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
0.03
0.01
0.00
−0.01
−0.03

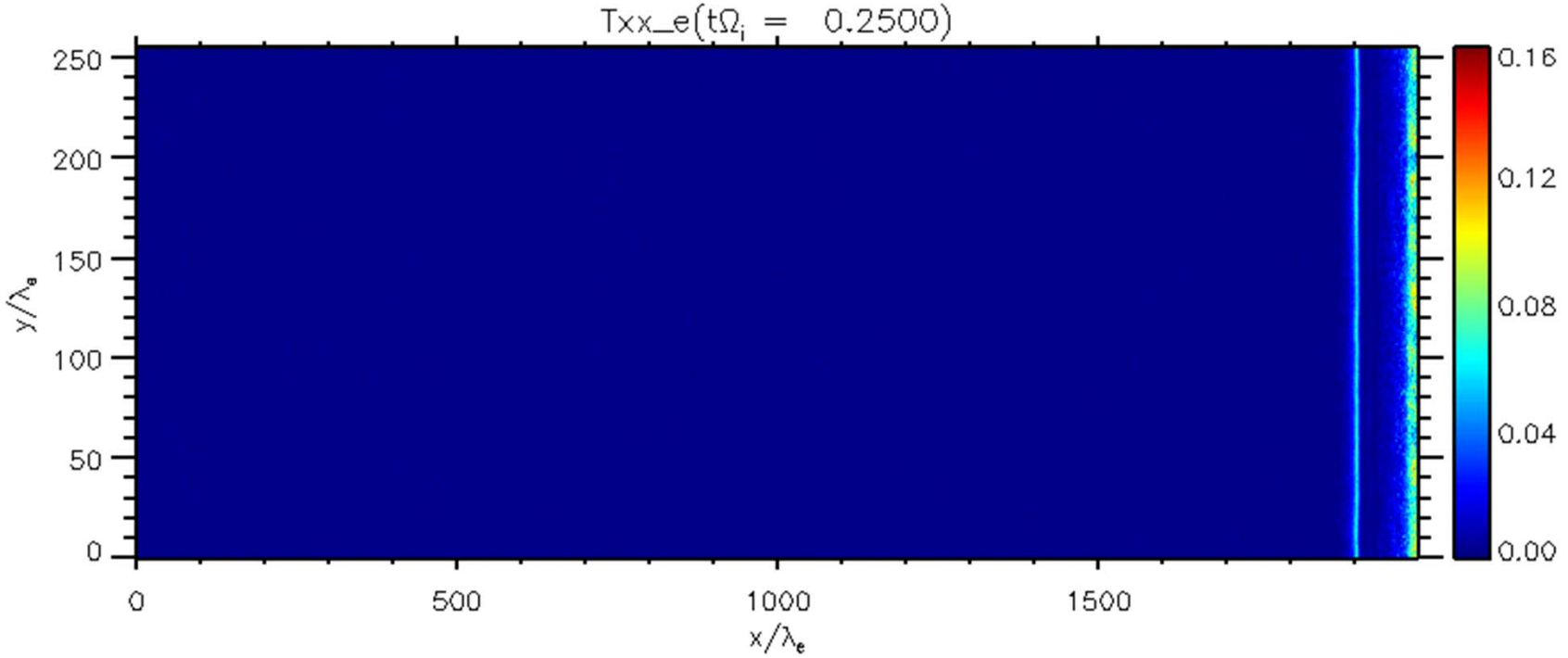

By(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
0.03
0.01
0.00
−0.01
−0.03

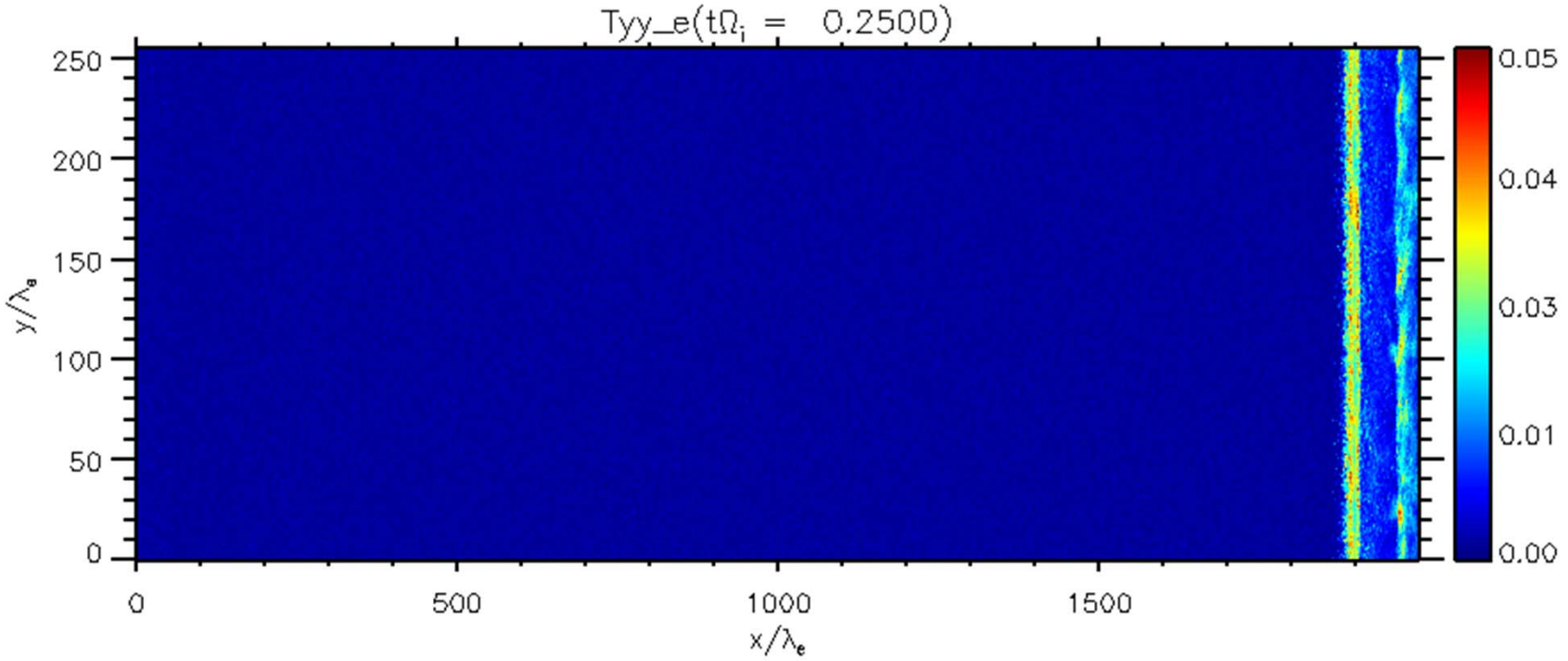

By(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
4.94
4.06
3.19
2.32
1.45

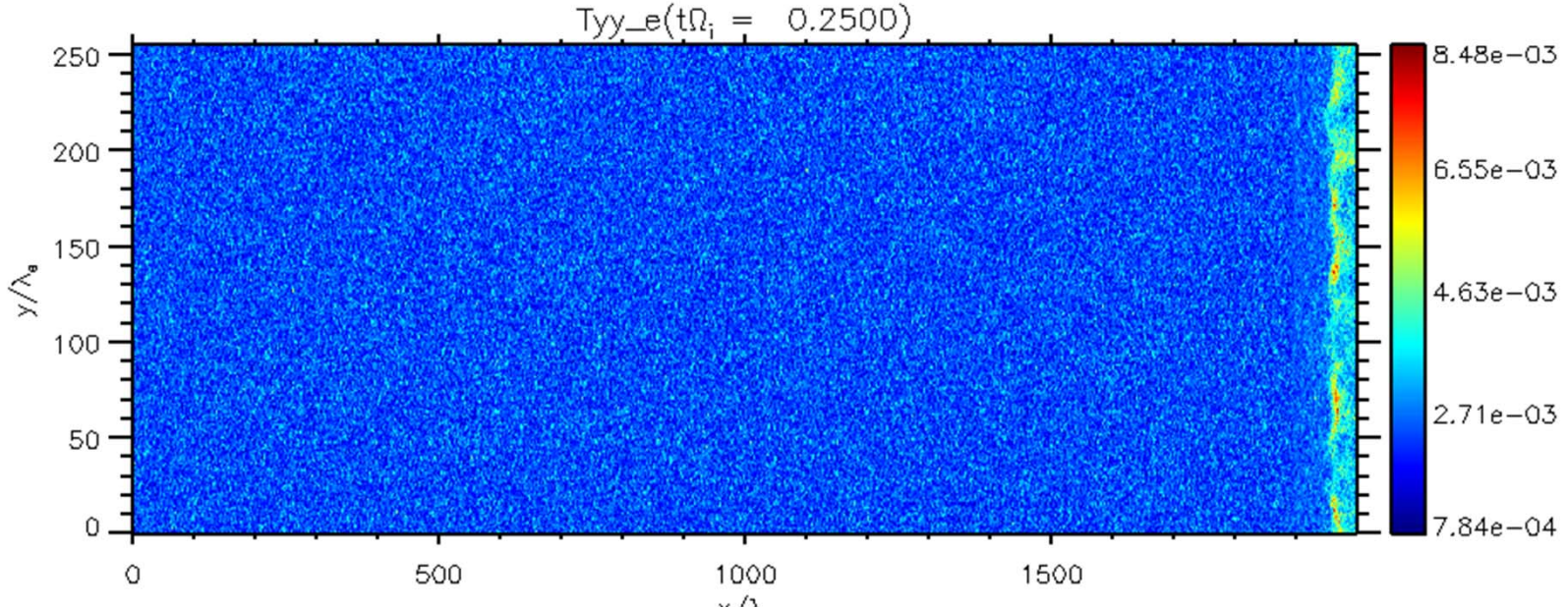

Bz(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
5.60
4.53
3.46
2.38
1.31

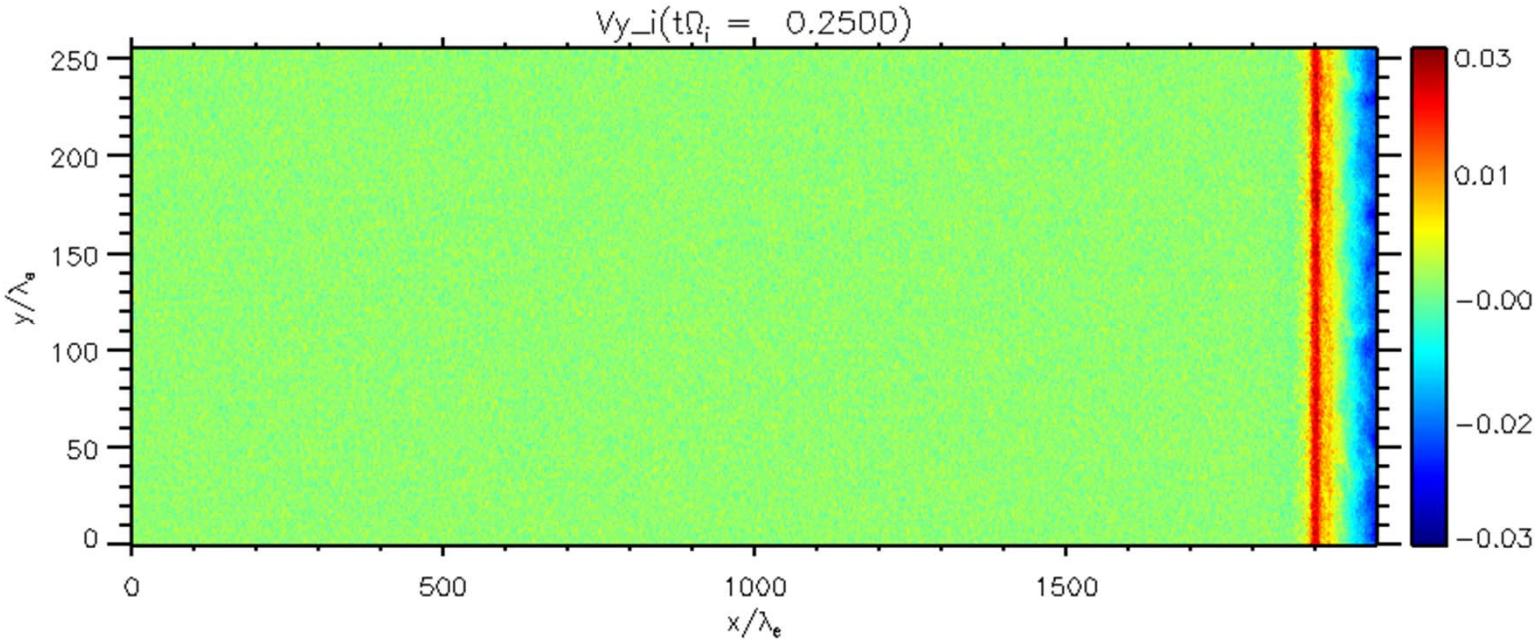

Bz(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.34
0.17
−0.01
−0.18
−0.36

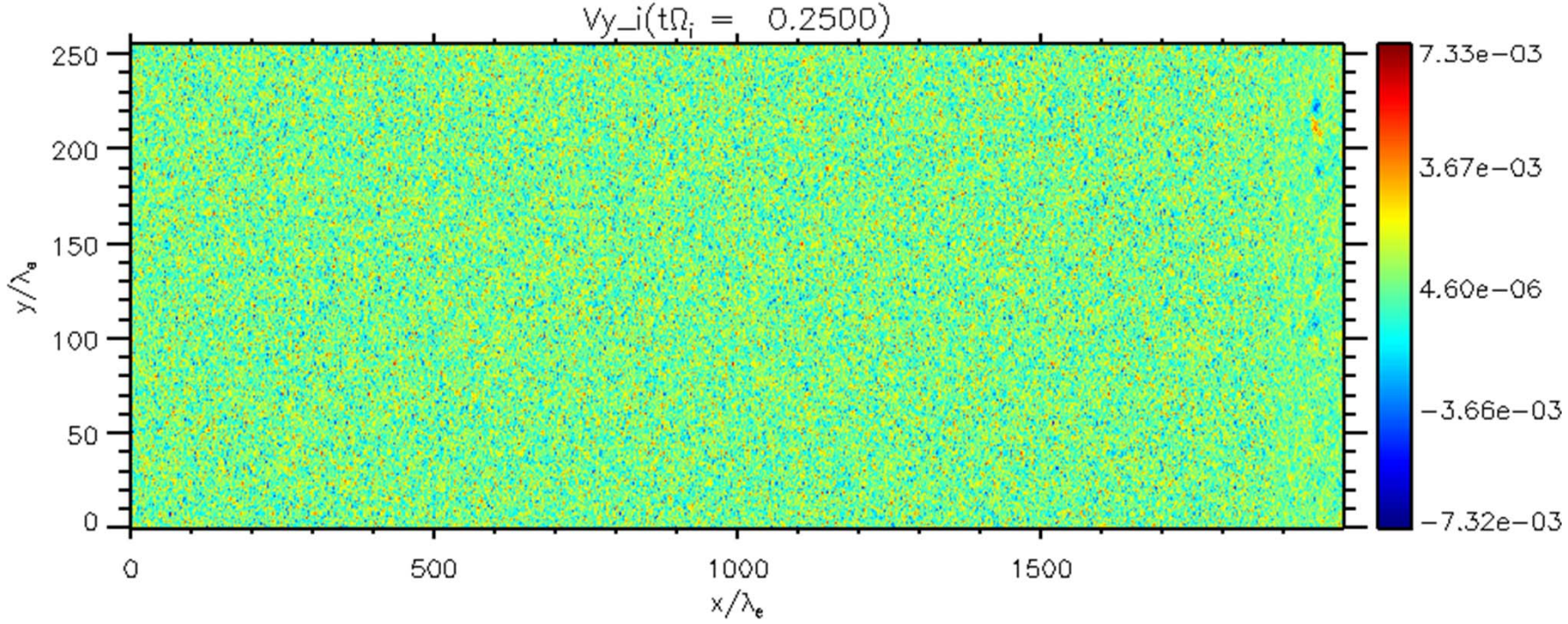

Txx_e(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.20
0.15
0.10
0.05
0.00

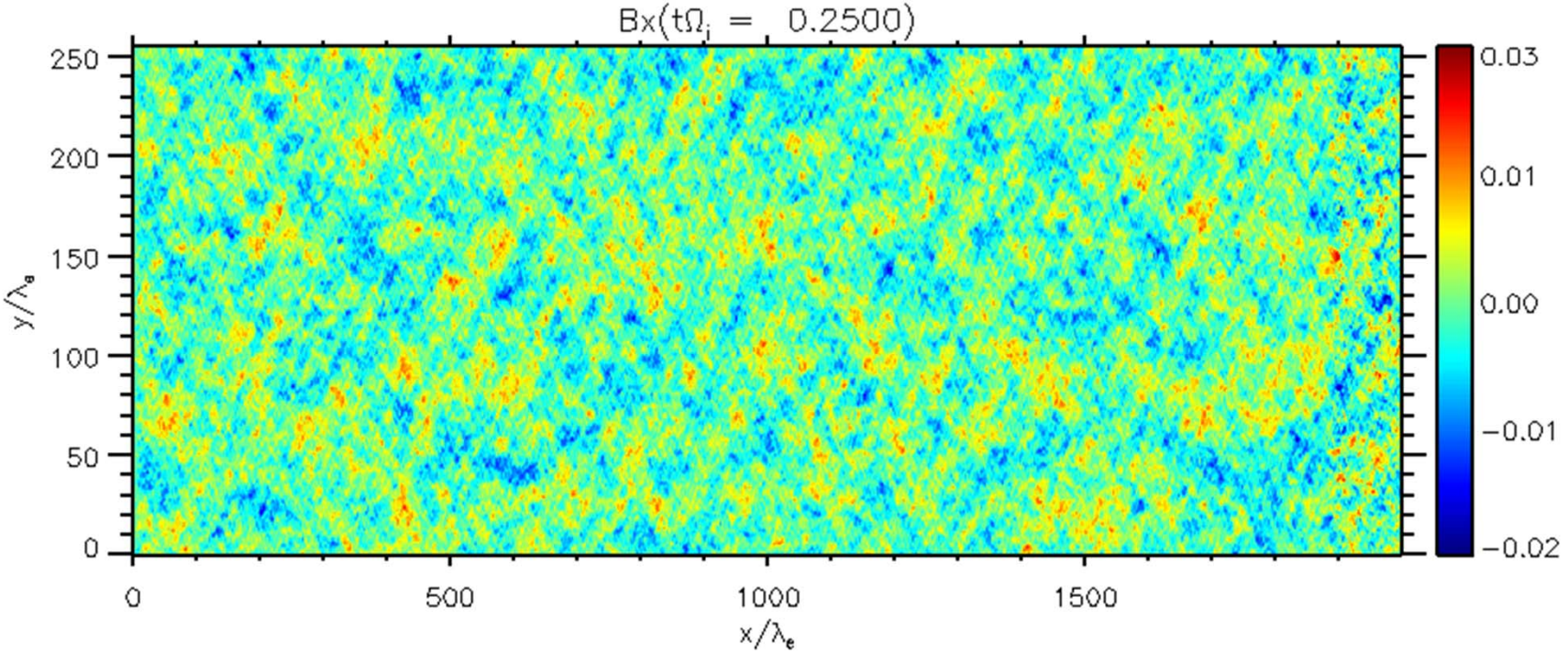

Txx_e(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.16
0.12
0.08
0.04
0.00

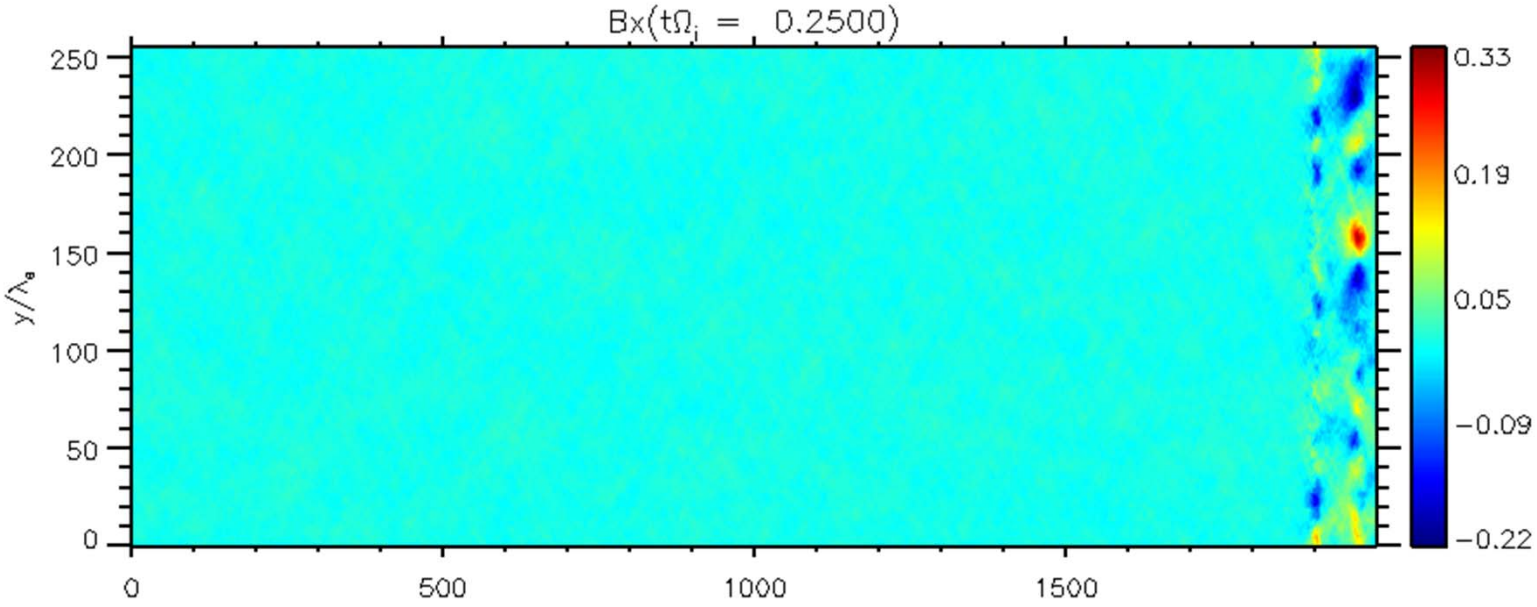

Tyy_e(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.05
0.04
0.03
0.01
0.00

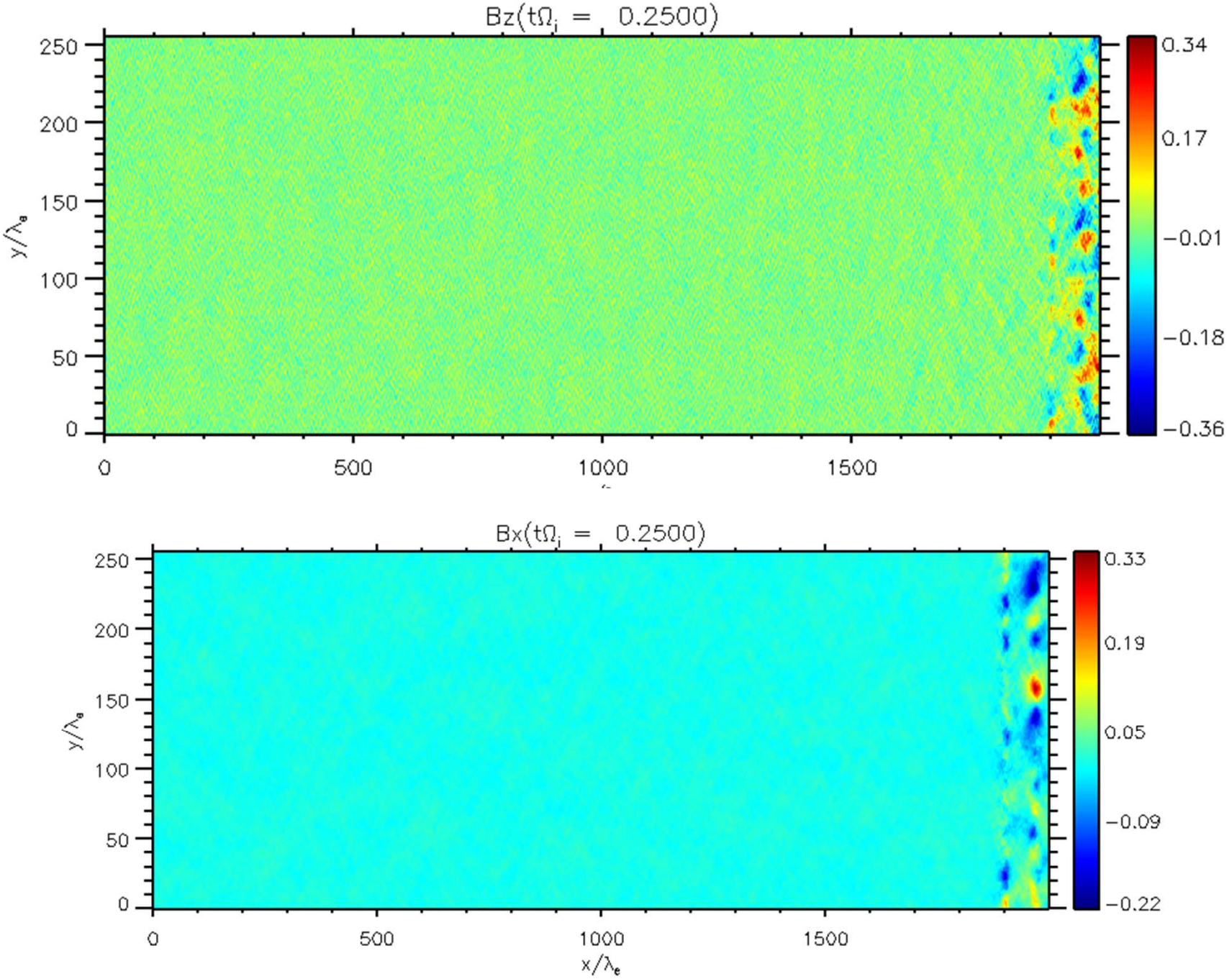

Tyy_e(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
8.48e-03
6.55e-03
4.63e-03
2.71e-03
7.84e-04

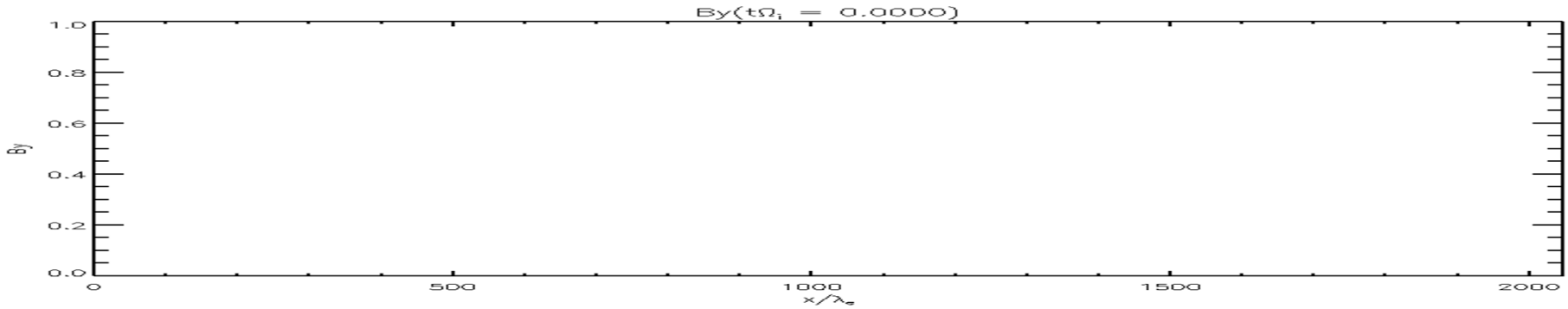

Vy_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
0.03
0.01
−0.00
−0.02
−0.03

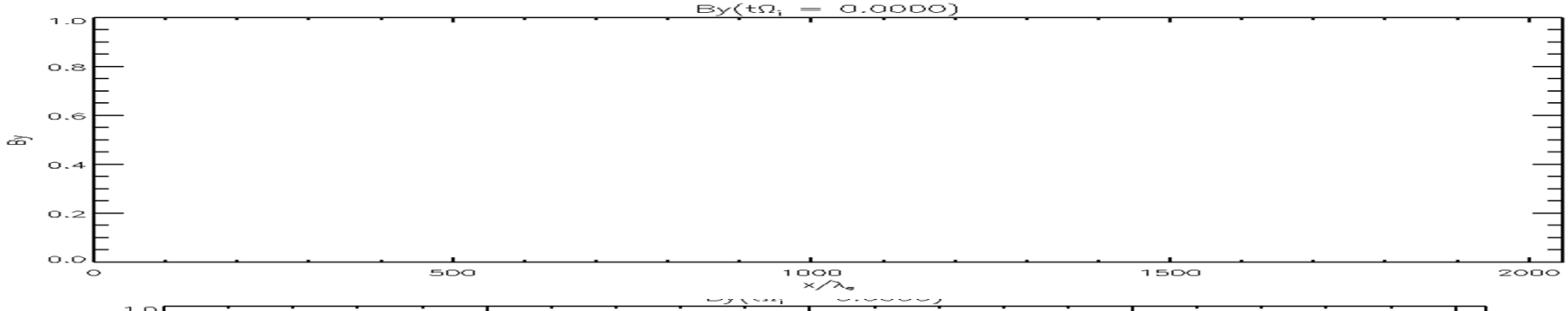

Vy_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
7.33e−03
3.67e−03
4.60e−06
−3.66e−03
−7.32e−03

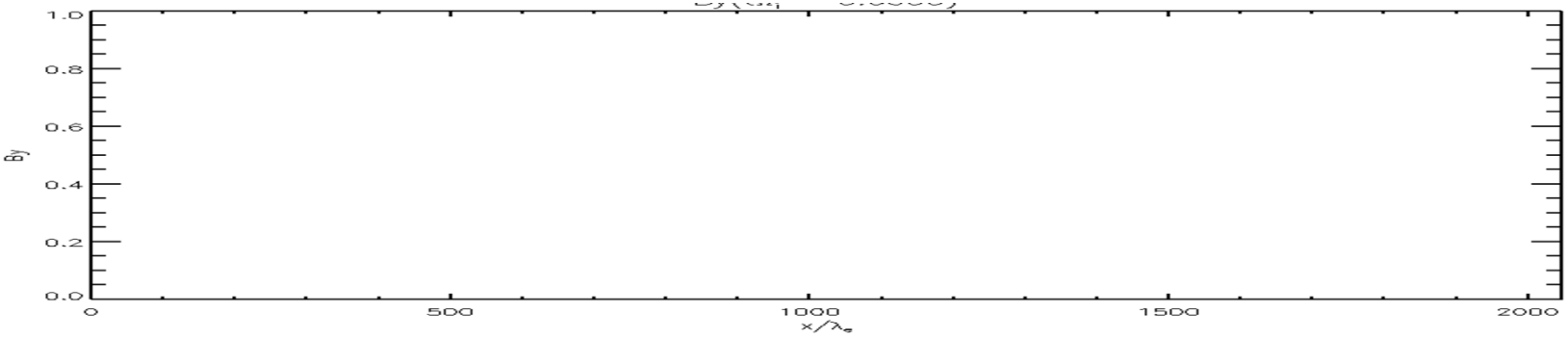

Bx(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.03
0.01
0.00
−0.01
−0.02

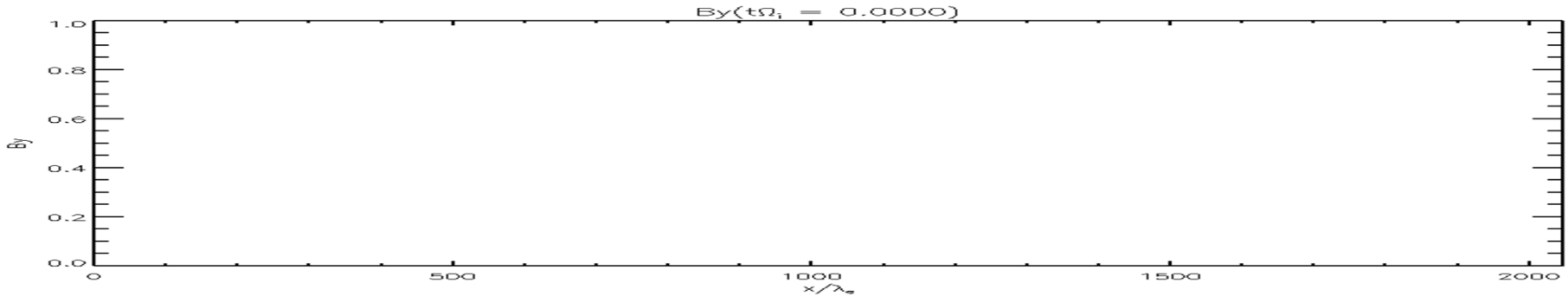

Bx(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
0.33
0.19
0.05
−0.09
−0.22

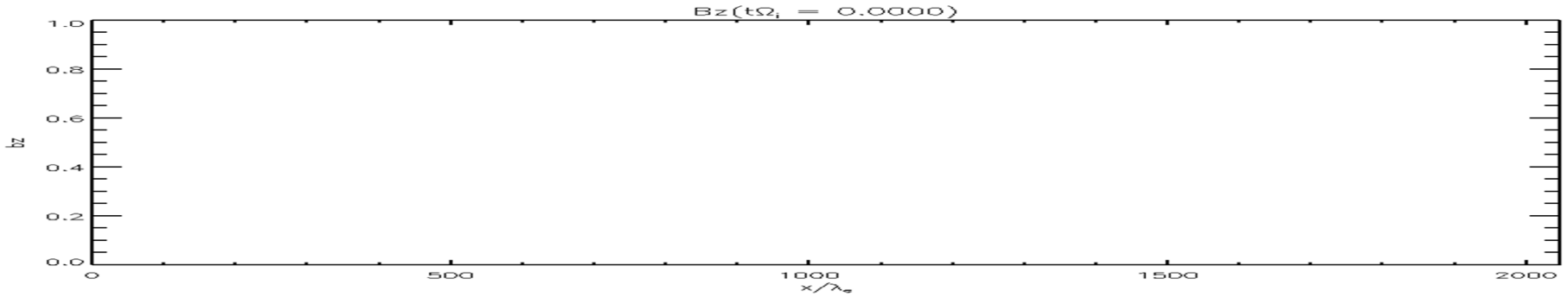

Bz(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
0.34
0.17
−0.01
−0.18
−0.36
Bx(tΩi = 0.2500)
250
200
150
100
50
0
y/λe
0
500
1000
1500
x/λe
0.33
0.19
0.05
−0.09
−0.22

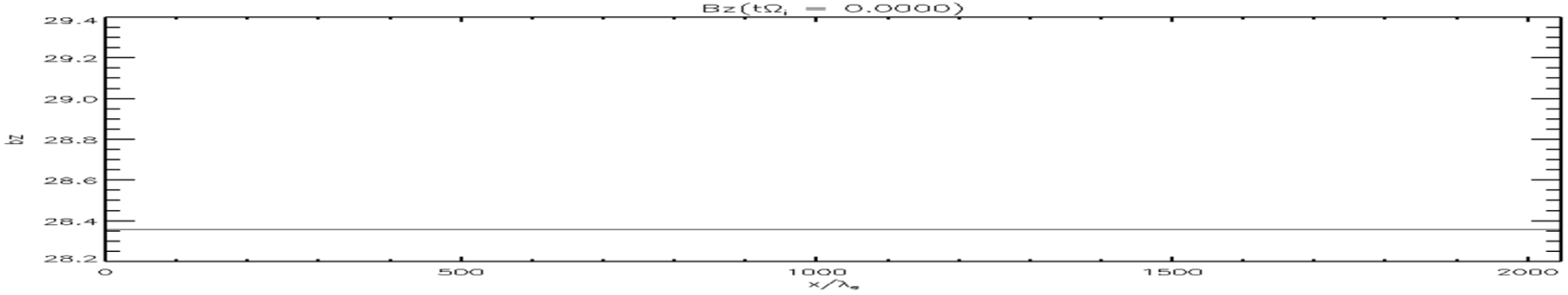

By(tΩi = 0.0000)
By
x/λe
0.0
0.2
0.4
0.6
0.8
1.0
0
500
1000
1500
2000

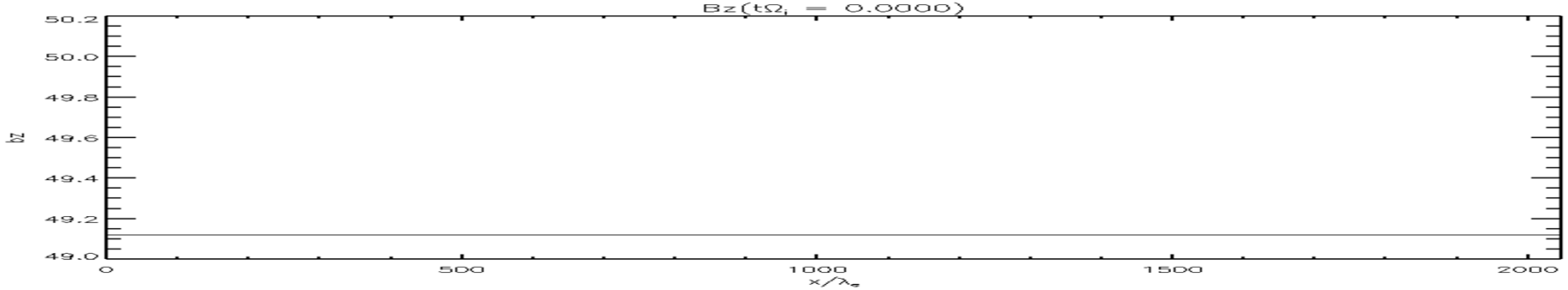

By(tΩi = 0.0000)
By
x/λe
0.0
0.2
0.4
0.6
0.8
1.0
0
500
1000
1500
2000

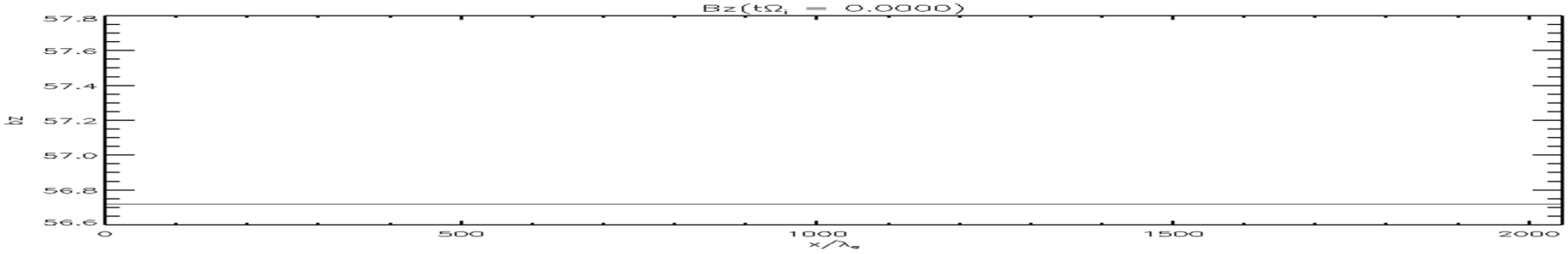

By
x/λe
0.0
0.2
0.4
0.6
0.8
1.0
0
500
1000
1500
2000

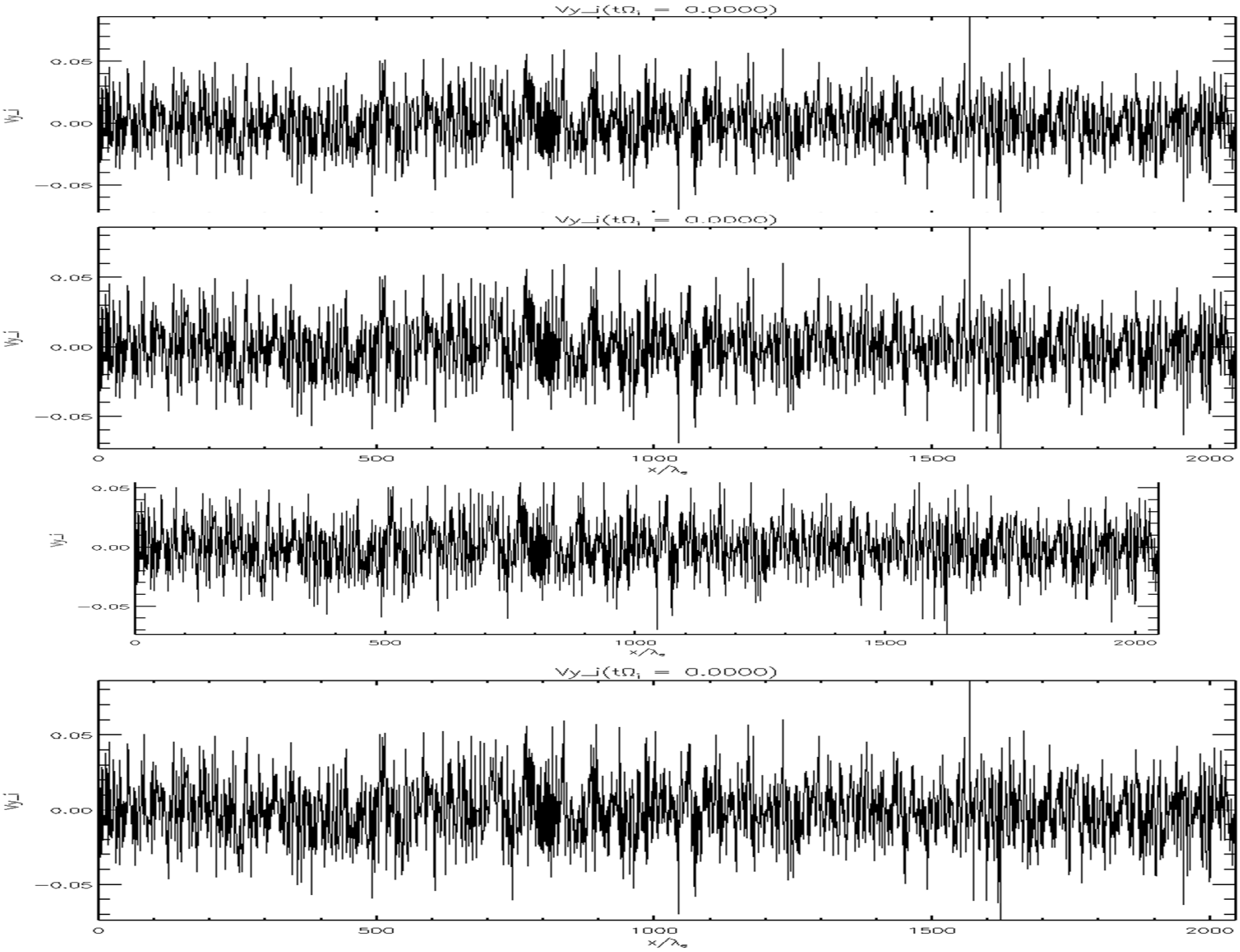

By(tΩi = 0.0000)
By
x/λe
0.0
0.2
0.4
0.6
0.8
1.0
0
500
1000
1500
2000

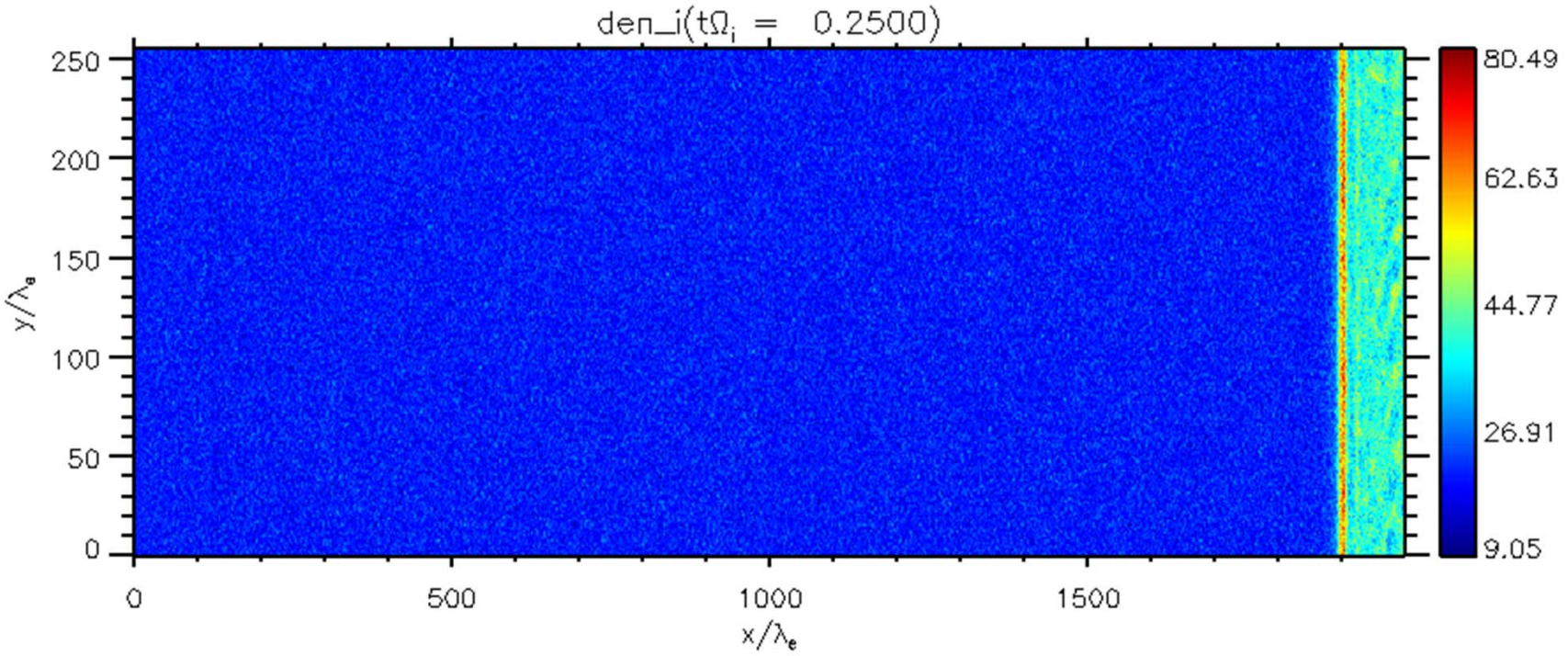

Bz(tΩi = 0.0000)
Bz
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
2000
x/λe

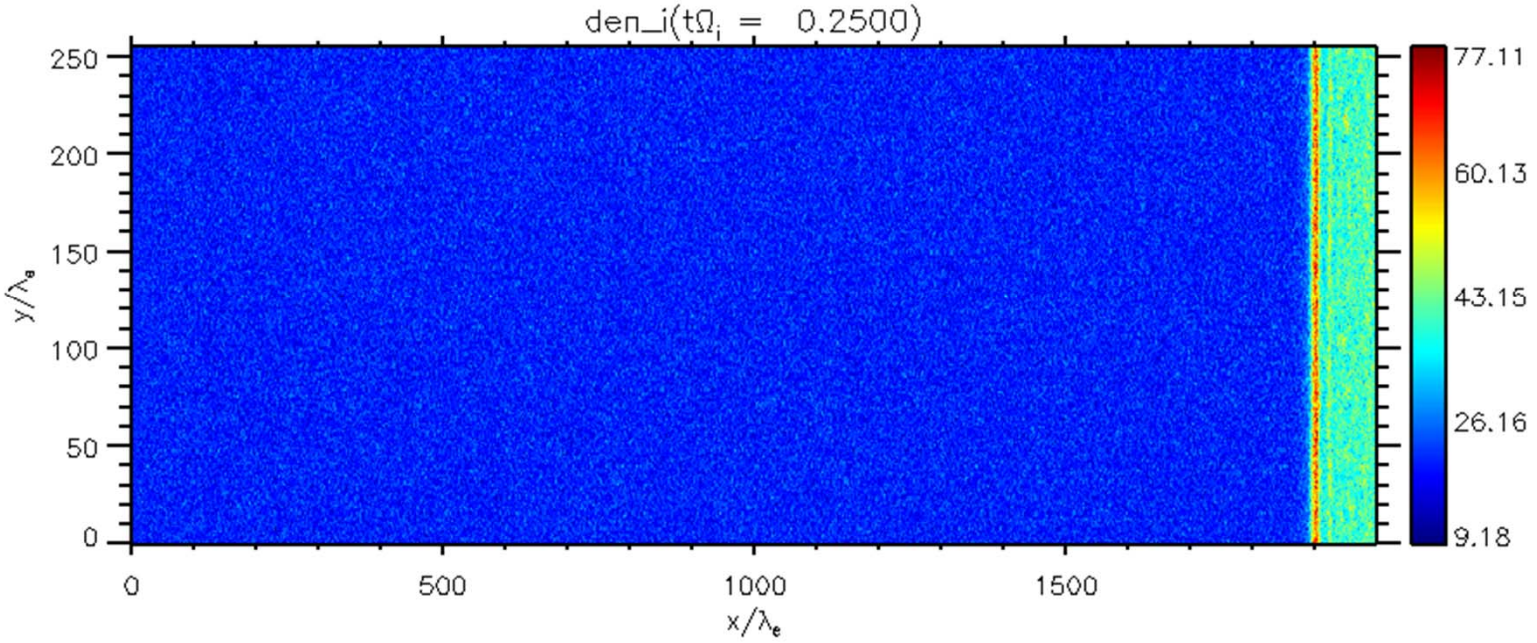

Bz(tΩi = 0.0000)
Bz
29.4
29.2
29.0
28.8
28.6
28.4
28.2
0
500
1000
1500
2000
x/λe


Bz(tΩi = 0.0000)
Bz
50.2
50.0
49.8
49.6
49.4
49.2
49.0
0
500
1000
1500
2000
x/λe


Bz(tΩi = 0.0000)
Bz
57.8
57.6
57.4
57.2
57.0
56.8
56.6
0
500
1000
1500
2000
x/λe


Vy_i(tΩ_i = 0.0000)
Vy_i
0.05
0.00
−0.05
0
500
1000
1500
2000
x/λ_e


den_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
80.49
62.63
44.77
26.91
9.05


den_i(tΩ_i = 0.2500)
250
200
150
100
50
0
y/λ_e
0
500
1000
1500
x/λ_e
77.11
60.13
43.15
26.16
9.18