

SU2 Analysis of Flow Field Within the TUDa Transonic Compressor

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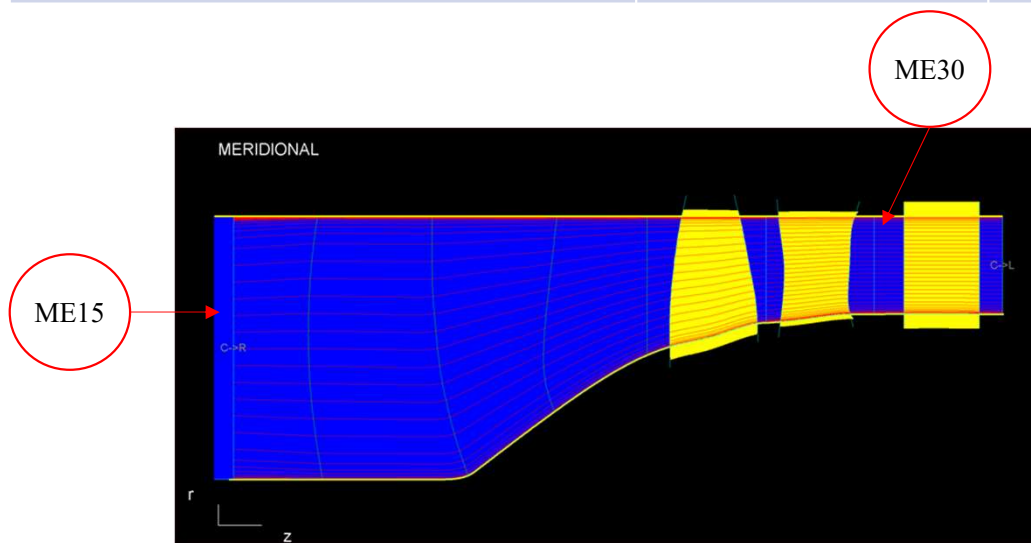
15 December 2021

1.Content

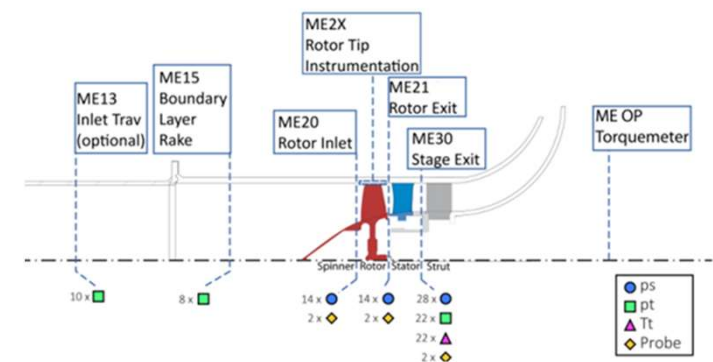
- Mesh and Solver Introduction
- Boundary conditions at the design speed and the part speed
- Results
- Conclusion

2.Mesh Introduction

	ROTOR	STATOR	OGV
Number of radial grid points	57	57	45
Total number of grid points	750188	369189	453777
Wall cell width	1e-5	1e-5	1e-5



Meridional view of the computational domain



2. Solver Introduction

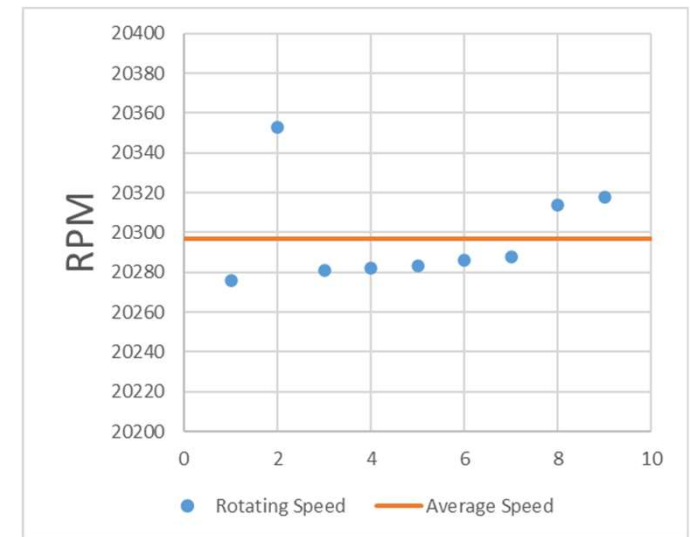
SU2 solver setting

Method & Model	Name
Numerical scheme	JST
JST dissipation coefficients	0.5, 0.05
Turbulence model	Shear Stress Transport
Time discretization	Euler implicit
Residual smoother	LU-SGS method
Rotor-stator interface model	Mixing-plane approach

3. Boundary Conditions(N100)

Table 1 Boundary condition at the design speed

Inlet Total Pressure(Pa)	Inlet Total Temperature(K)	Outlet Pressure(Pa)
98594	294.81	97295
98727	297.34	126330
98681	294.90	128180
98763	294.92	131890
98842	295.14	135110
98912	295.14	137250
98975	295.09	138510
99046	295.88	139380
99173	296.07	139430

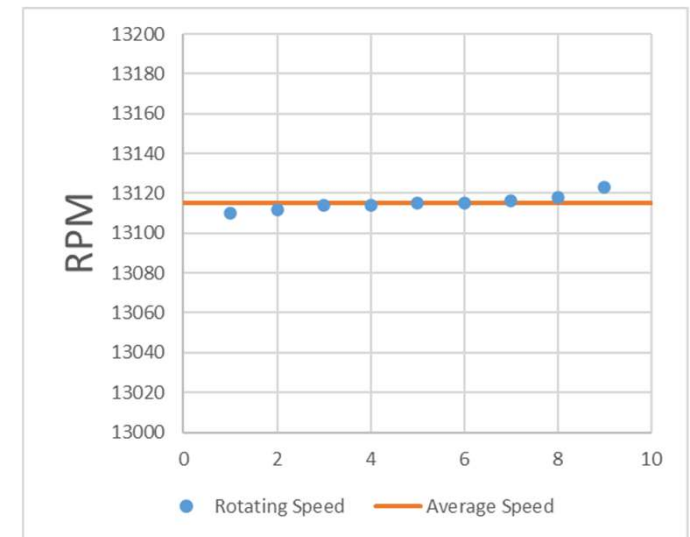


Rotating speed

3. Boundary Conditions(N65)

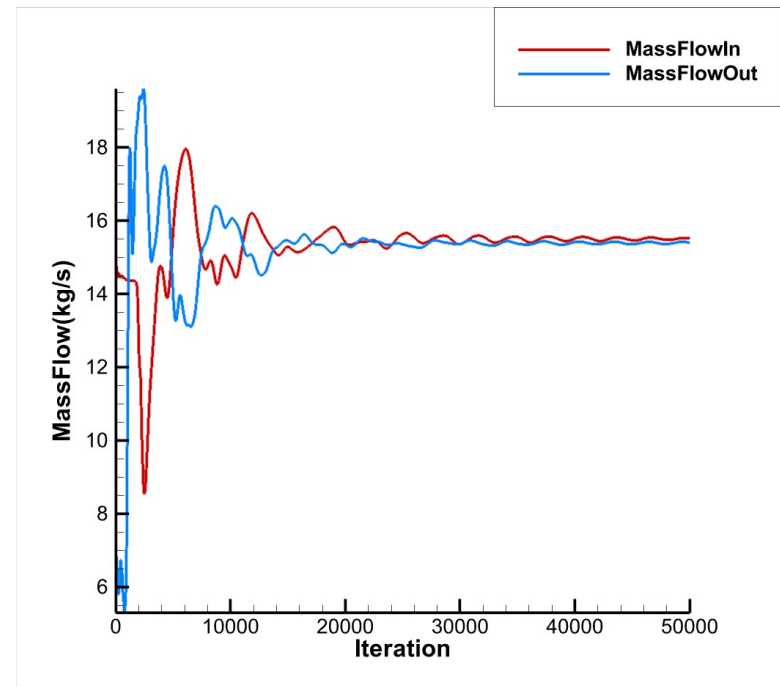
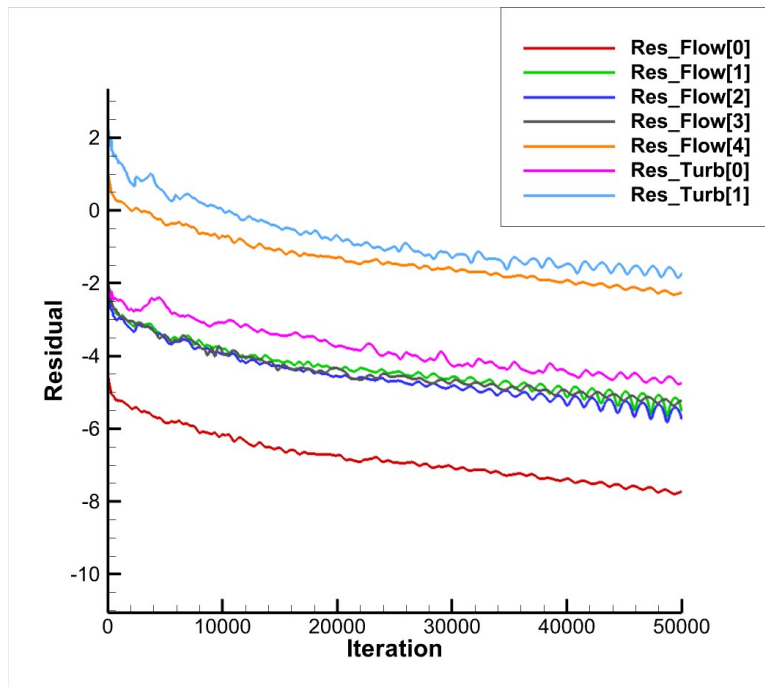
Table 2 Boundary condition at the part speed

Inlet Total Pressure(Pa)	Inlet Total Temperature(K)	Outlet Pressure(Pa)
98756	291.31	97798
98812	291.43	101770
98858	291.66	104770
98910	291.73	107260
98956	291.66	109440
98998	291.82	111360
99040	291.91	112820
99075	292.18	113800
99108	292.26	114050



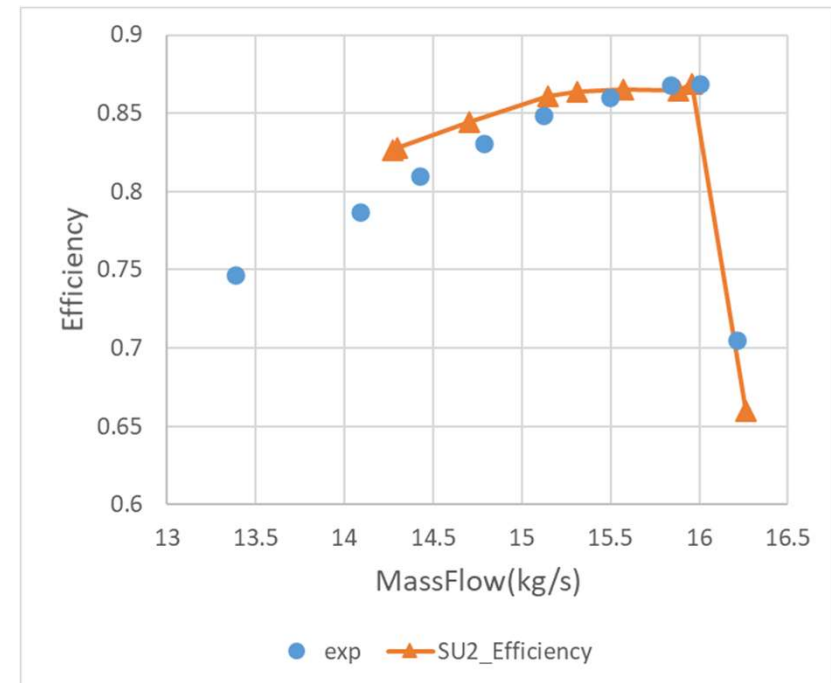
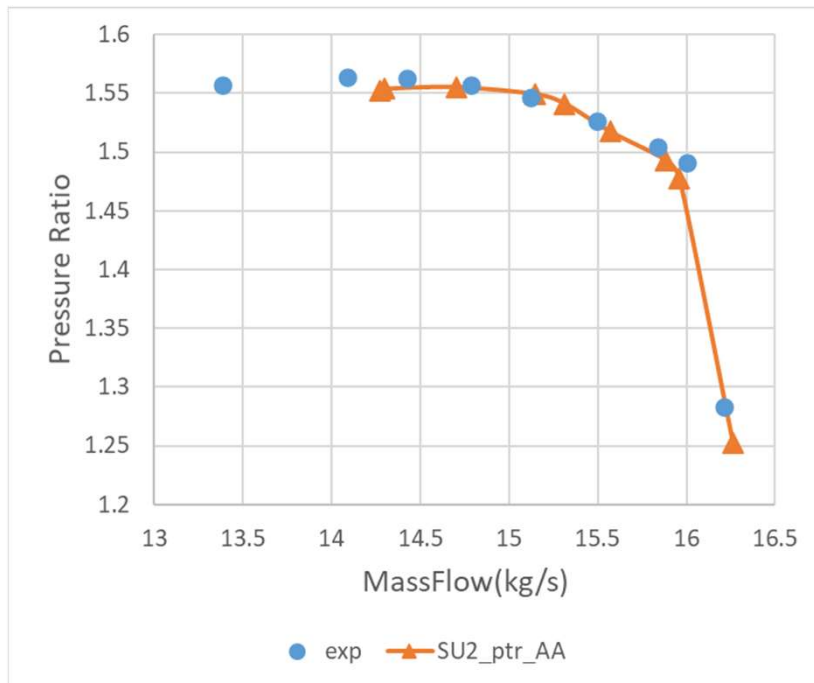
Rotating speed

4.1 Solution Convergence(N100)



Convergence histories at the peak efficiency point of the design speed

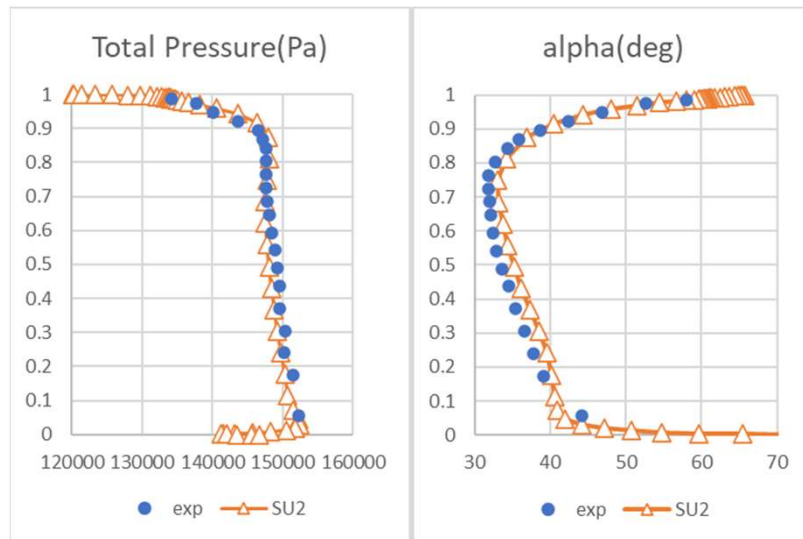
4.1 Overall Performance(N100)



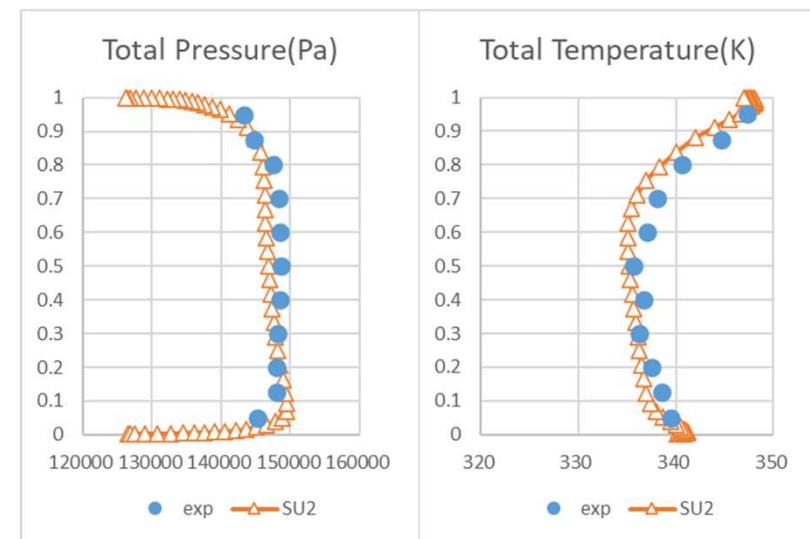
Overall performance at the design speed

4.1 Radial Profiles (N100)

	EXP	SU2
Mass Flow Rate(kg/s)	16.00	15.96
Pressure Ratio	1.4909	1.4706
Efficiency	0.86919	0.86890



Peak Efficiency(ME21 rotor outlet)

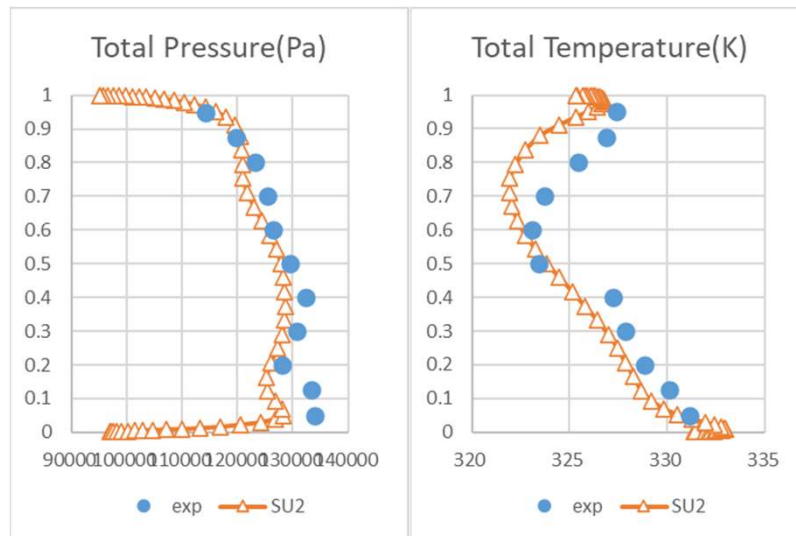


Peak Efficiency(ME30 stator outlet)

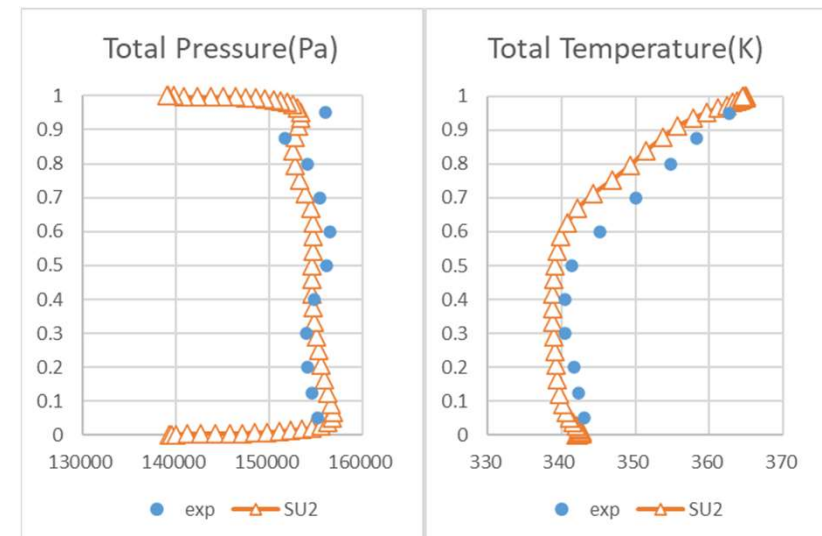
4.1 Radial Profiles (N100)

	EXP	SU2
Mass Flow Rate(kg/s)	16.21	16.26
Pressure Ratio	1.2828	1.2356
Efficiency	0.70506	0.65962

	EXP	SU2
Mass Flow Rate(kg/s)	14.43	14.30
Pressure Ratio	1.5626	1.5552
Efficiency	0.80993	0.82776



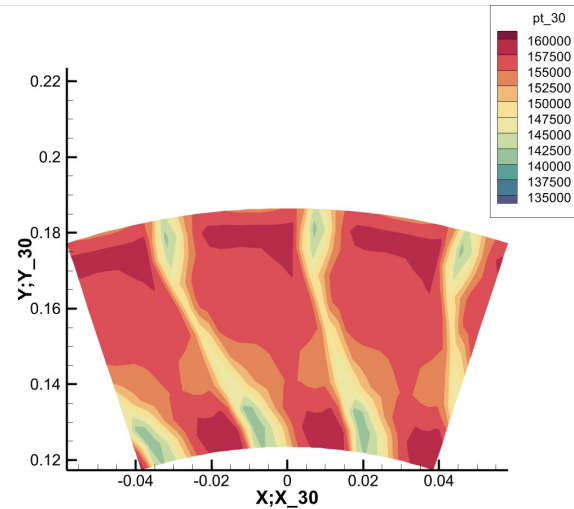
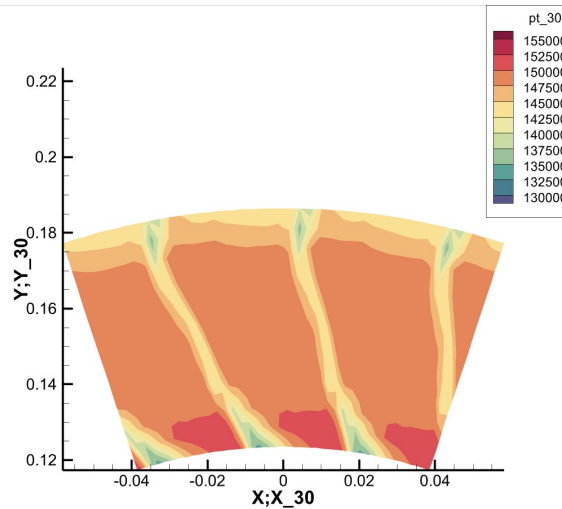
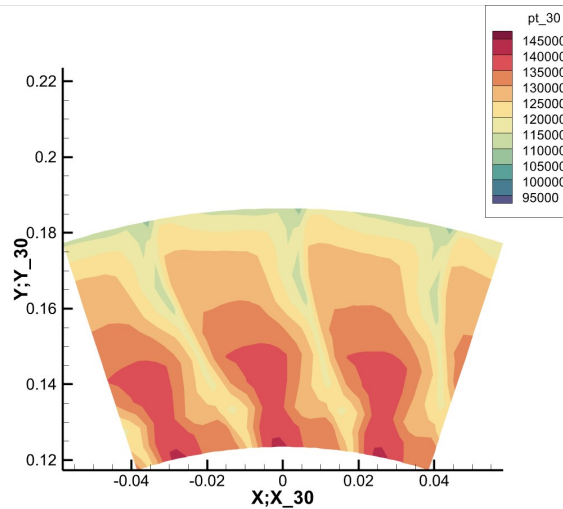
Near Choke



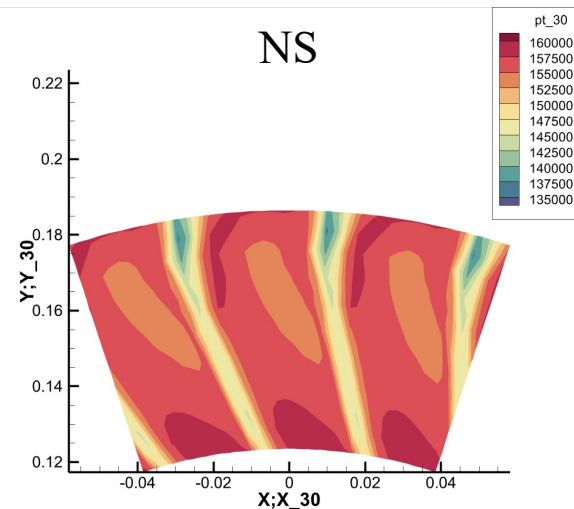
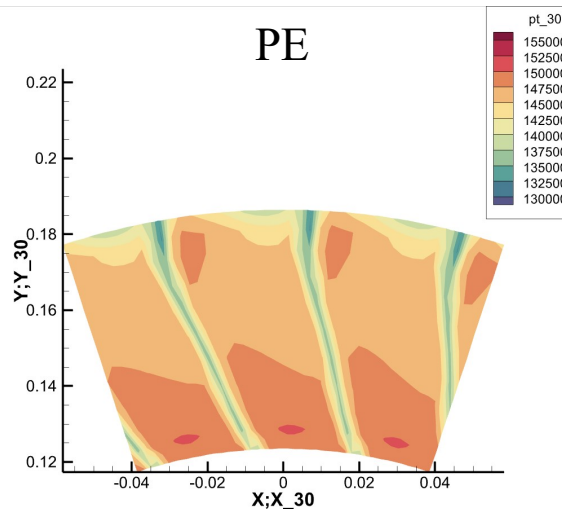
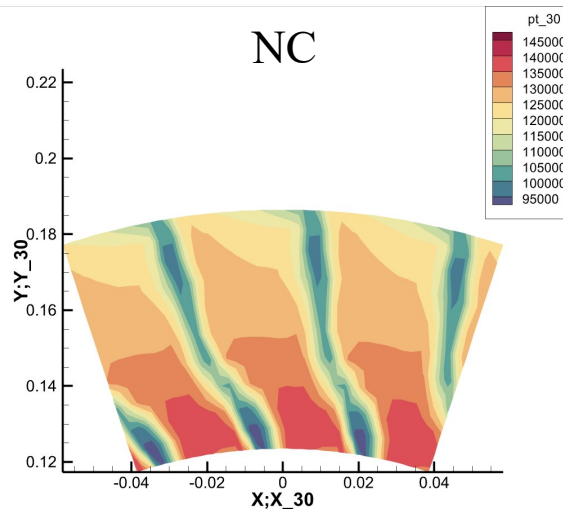
Near Stall

4.1 Outlet Total Pressure(N100)

experiment

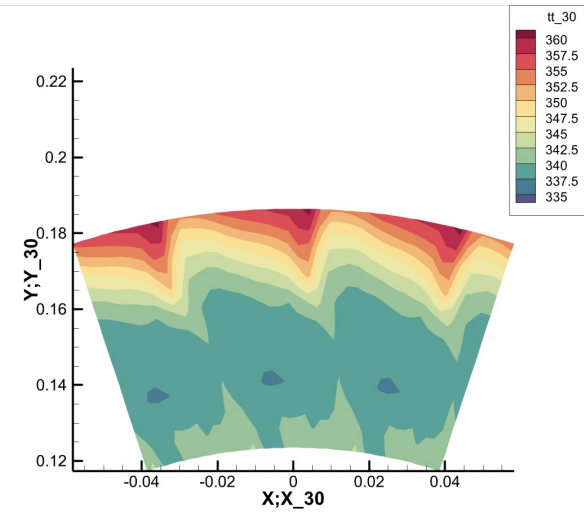
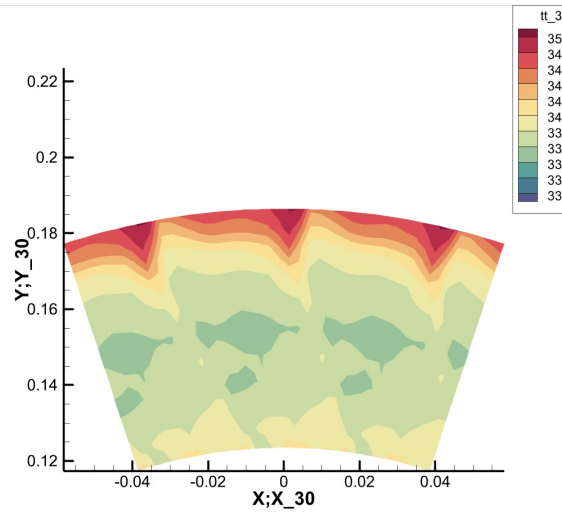
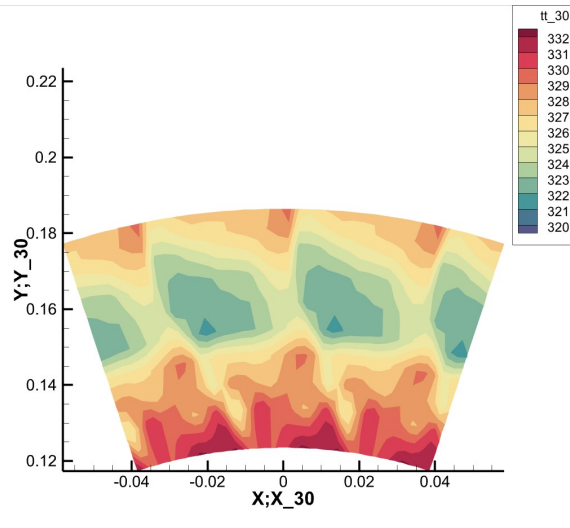


SU2

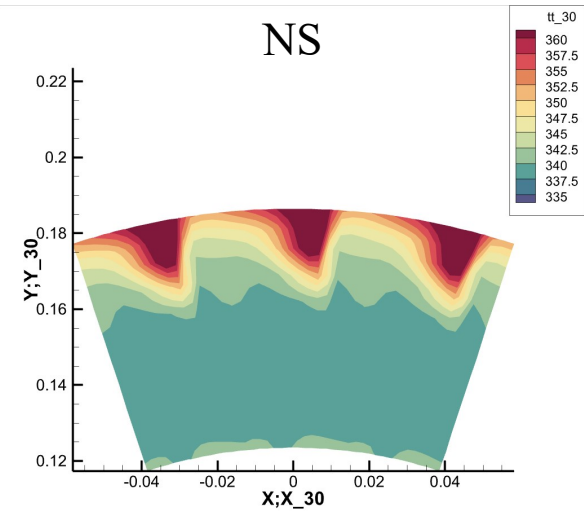
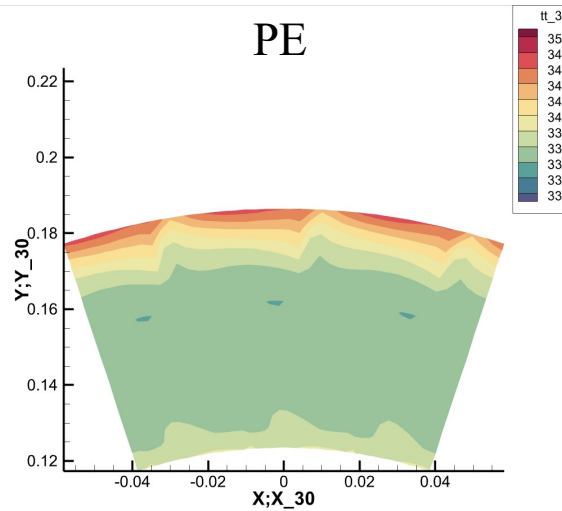
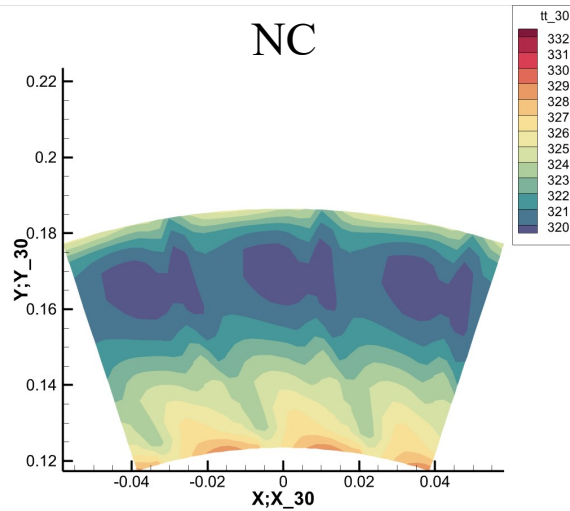


4.1 Outlet Total Temperature(N100)

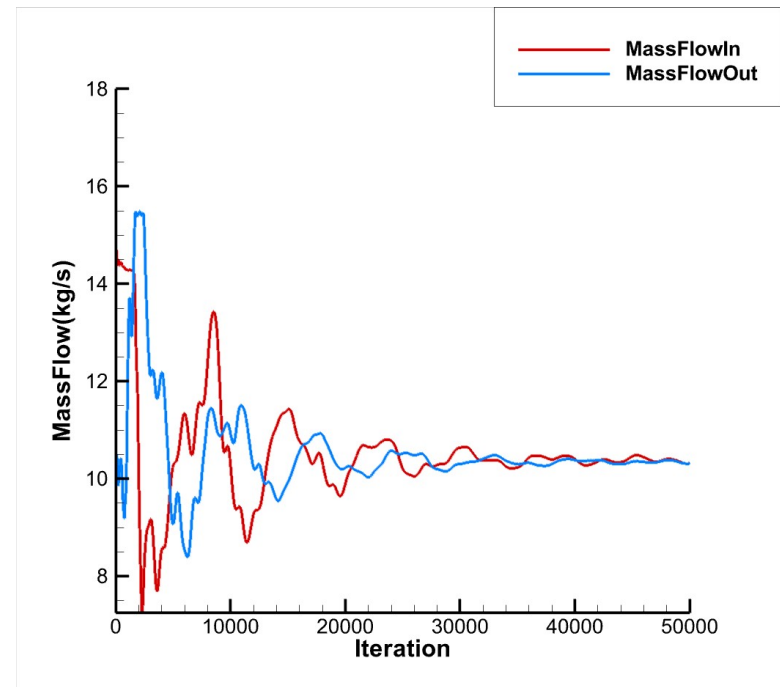
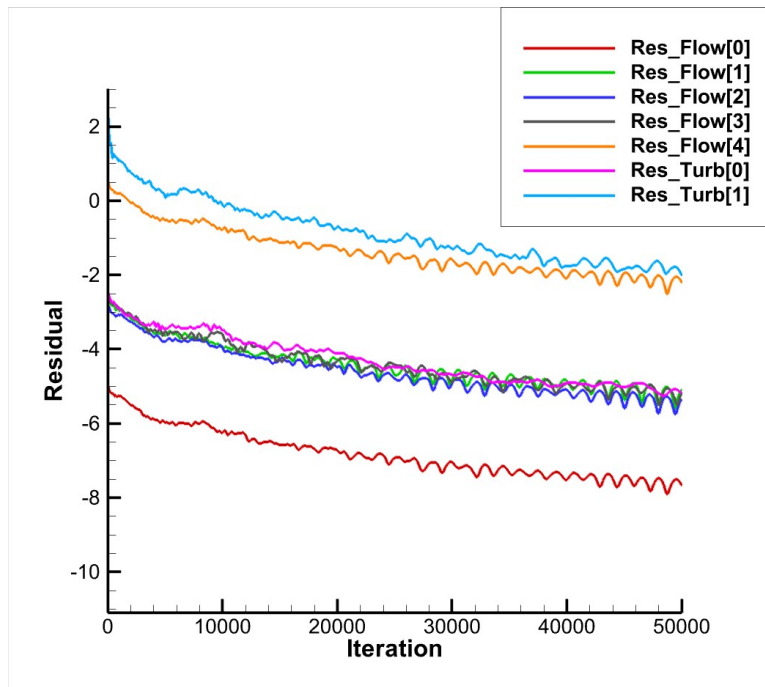
experiment



SU2

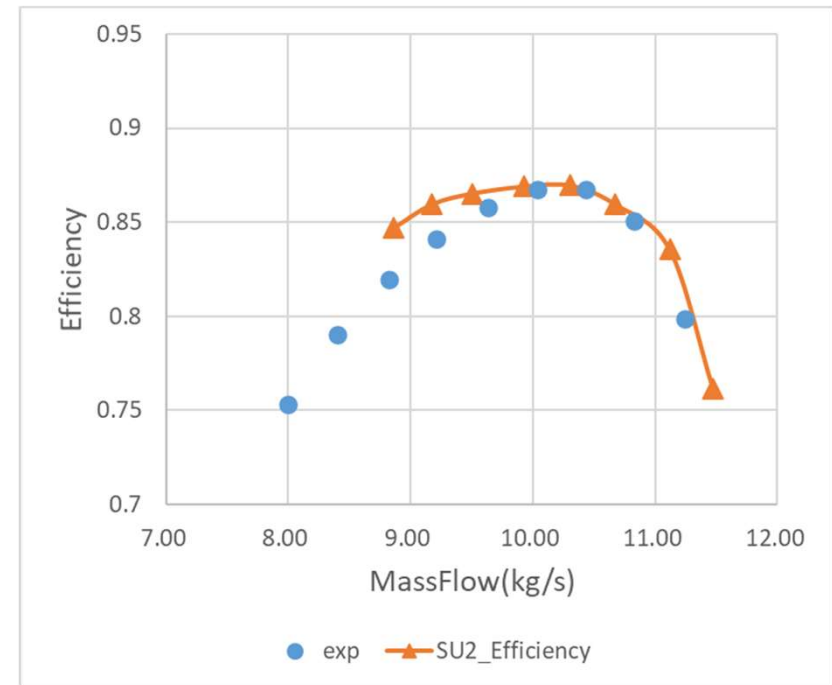
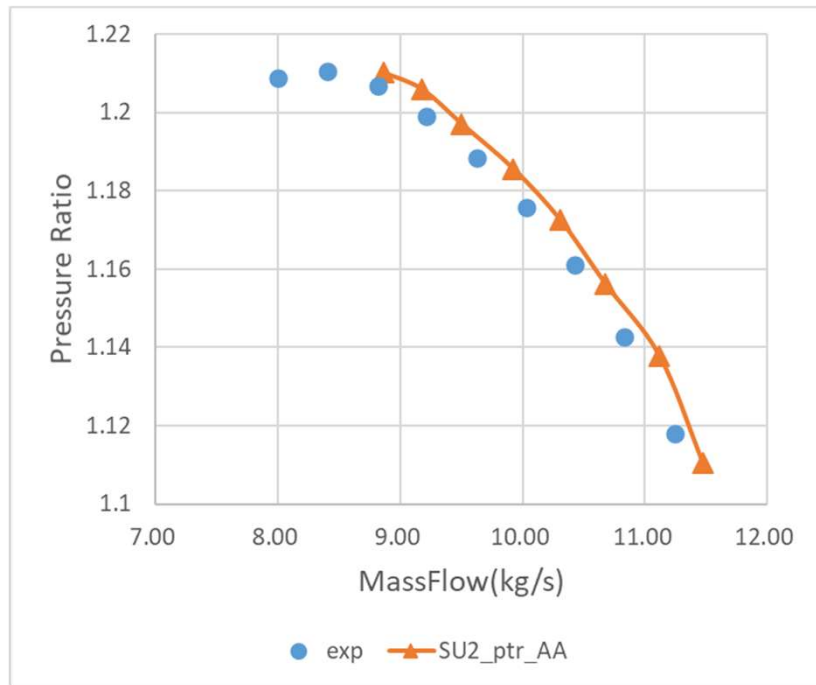


4.2 Solution Convergence(N65)



Convergence histories at the peak efficiency point of the part speed

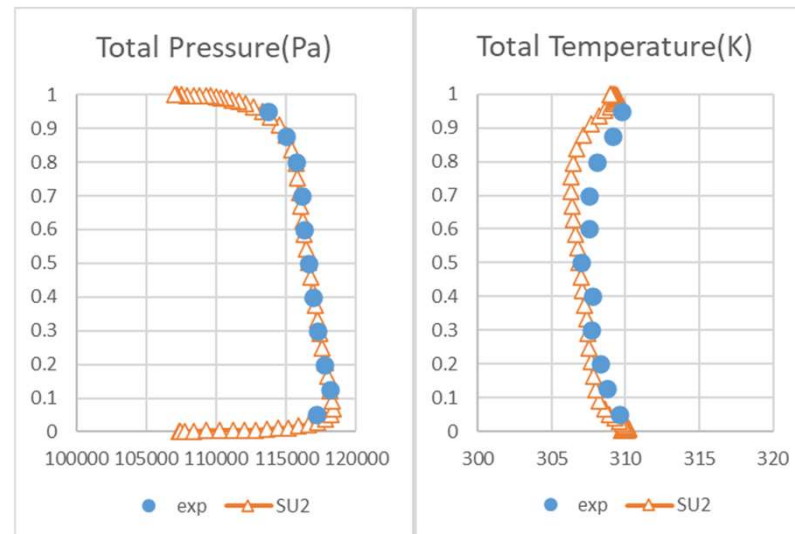
4.2 Overall Performance(N65)



Overall performance at the part speed

4.2 Radial Profiles(N65)

	EXP	SU2
Mass Flow Rate(kg/s)	10.43	10.31
Pressure Ratio	1.1611	1.1725
Efficiency	0.86769	0.86975

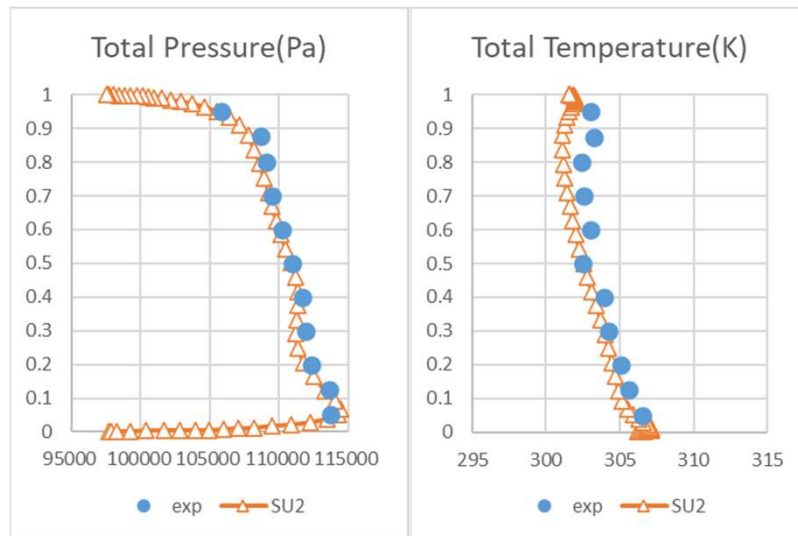


Peak Efficiency

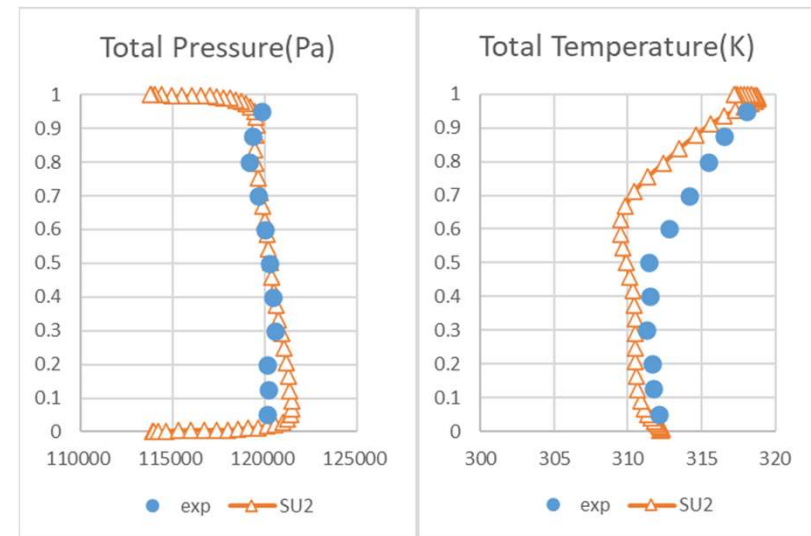
4.2 Radial Profiles(N65)

	EXP	SU2
Mass Flow Rate(kg/s)	11.25	11.47
Pressure Ratio	1.1180	1.1106
Efficiency	0.7986	0.7614

	EXP	SU2
Mass Flow Rate(kg/s)	8.82	8.86
Pressure Ratio	1.2068	1.2101
Efficiency	0.81993	0.84705



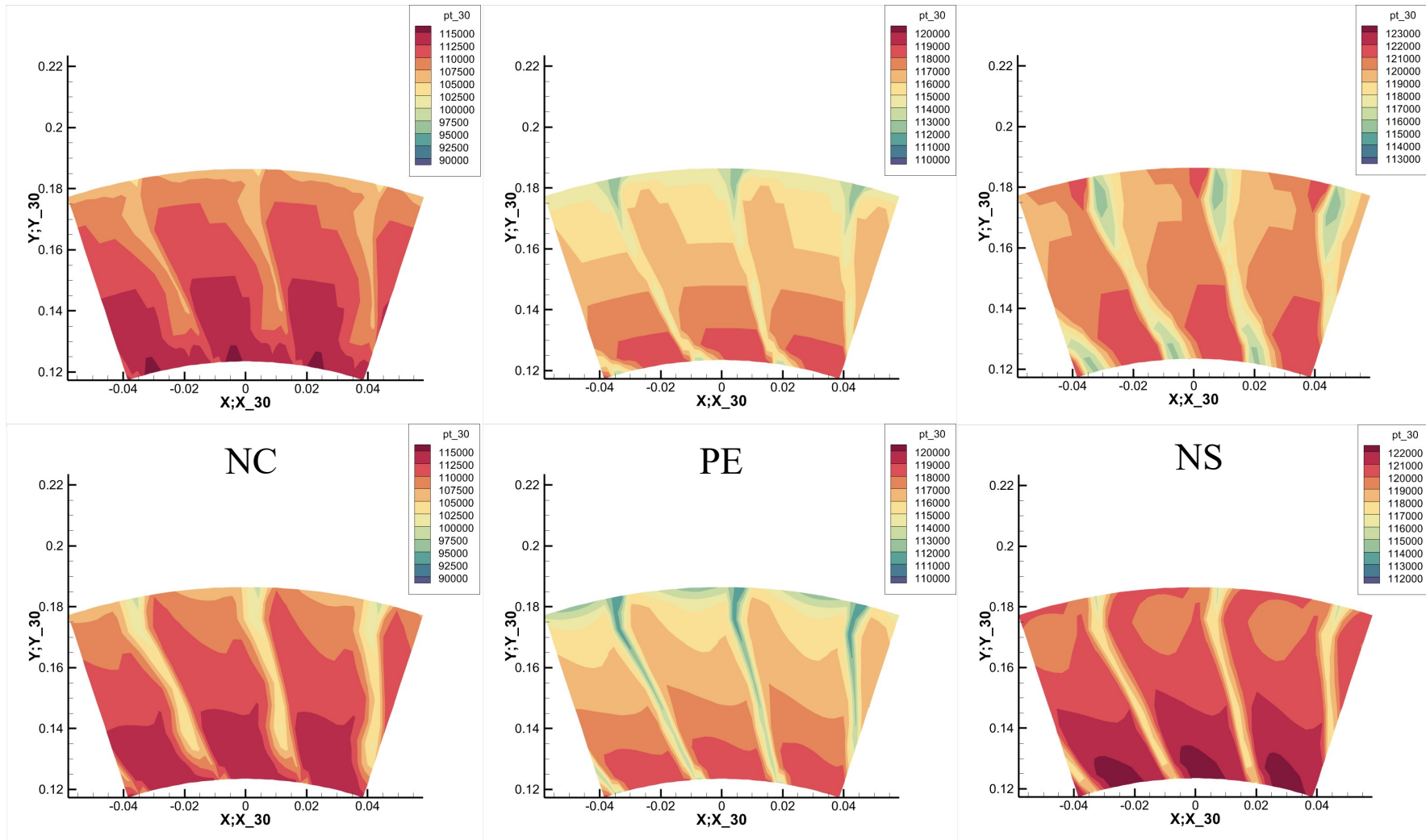
Near Choke



Near Stall

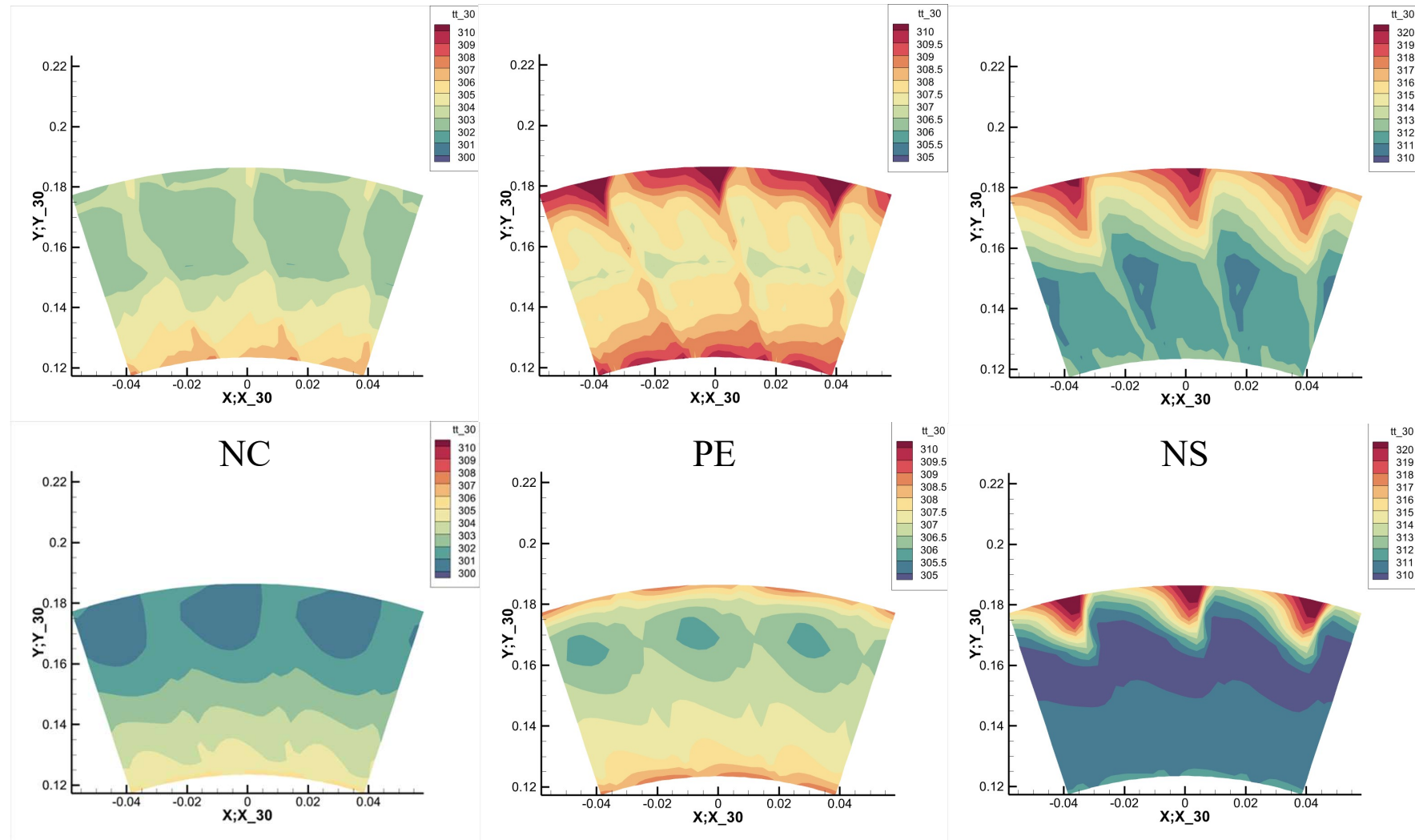
4.2 Outlet Total Pressure(N65)

experiment



4.2 Outlet Total Temperature(N65)

experiment



5 Conclusion

- The calculated overall performance has good agreement with the experiment data at the design speed and the part speed.
- In general, the calculated radial profiles agree with the measurement data, though there is a bigger discrepancy at the part speed than at the design speed.
- The calculated total pressure contours agree well with the experimental data, while there is marked discrepancy in the calculated total temperature contours.

Thank you!