

*EAST*

*ASIPP*

# Status of TRANSP Code at ASIPP and the Future Plan

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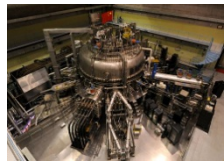
On behalf of the TRANSP users at ASIPP

Institute of Plasma Physics, Chinese Academy of Sciences

Hefei, Anhui, China



# Outline



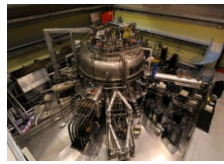
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## *ASIPP*

- Installation of TRANSP code at ASIPP
  - Hardware (SHENMA cluster)
  - Setting / Modification of scripts on SHENMA cluster
- Application
- Problems
- Future need and plan



# Outline



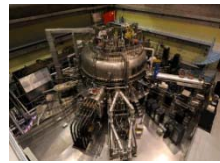
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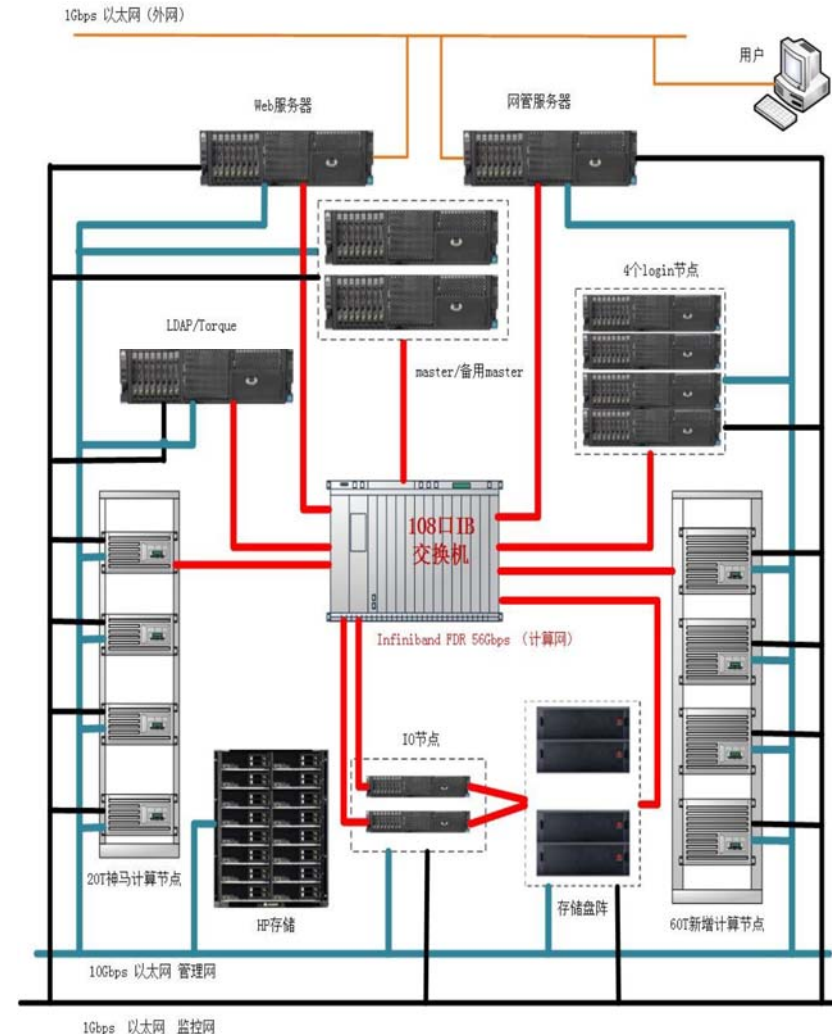
# Local Cluster --- SHENMA



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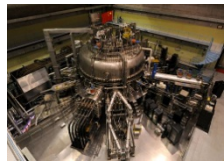
ASIPP

- 2808 cores, 80 TFLOPS theory computing capacity
  - 10 Sugon TC3600 blade servers
  - 61 Sugon TC4600 blade servers
  - 63 Sugon TC4600E blade servers
- Storage
  - 137T HP NAS storage
  - 14.4T Sugon parastor100 Lustre parallel file system storage
  - 160T DDN SFA7700 Lustre parallel file system storage





# Local Cluster --- SHENMA



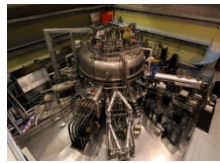
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## *ASIPP*

- Manager node: master/manager01
  - Manage the whole nodes and transfer the in-out network of cluster
- Log-in node: shenma162/163
  - Automatically assign the user to the lower load node
- Computing Network
  - Connected by Mellanox's 56Gb/s FDR InfiniBand Networking
- About 250 registered users and at least 30-50 logins everyday
- Two queues for job submission
  - parallel queue: parallel jobs
  - batch queue: serial jobs
- Many different compilers, MPI libraries and math libraries
- Use environment-module to manage the libraries
- Scientific codes on SHENMA
  - TRANSP, IMFIT, GYRO, BOUT++, ORBIT...



# Status of TRANSP Code on SHENMA



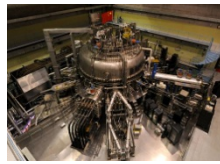
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## *ASIPP*

- Three versions
  - Public: daily use; update frequency: mid
  - Develop: receive update from PPPL; update frequency: high
  - Backup: for backup; update frequency: low
- Support MPI and multiple-user jobs
- Update TRANSP source code via PPPL SVN
  - Use legacy firewall authentication method: telnet
- New TRANSP manual in Chinese
- User training + Q&A
- 33 registered users for now
  - Several divisions of ASIPP
  - Three domestic universities



# Two Levels of Users Strategy



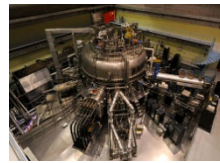
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*ASIPP*

- Common TRANSP user
  - In 'transp' group
  - Public version only
  - Full functional access of TRANSP capacity
  - No authorization of TRANSP source code access
- TRANSP administrator
  - In 'transpadmin' group, supreme to common user
  - Update and compile source code
  - Manage the three versions
- Data access
  - Users have their own \$RESULTDIR
  - Each user can read results from all users
  - Each user can only write/delete his/her own results



# Modification of Scripts



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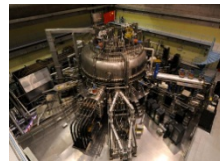
## ASIPP

Scripts	Orig. Text	Modification	Reason
transp/pubilc (modulefiles)	N/A	setenv SHENMA_HOST SHENMA	set hostname
pppl_trmpi_NxM.tcsh	set tokid =\$tok	cd .. set tokid = \$cwd:t cd -	get tokid and come back to wordir directory
	N/A	if (! \$?SHENMA_HOST) then if ( ! -d /local/\$username ) then mkdir /local/\$username endif .....	void to create 'local' directory on each node
prebuild	if( \$ntranspdir < 5 ) then	if( \$ntranspdir < 5 ) then	Only 3 directories were found See 'problem' part





# Modification of Scripts



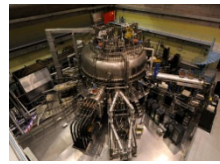
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## ASIPP

Scripts	Orig. Text	Modification	Reason
pppl_mpi_nubeam_NxM.t csh	N/A	if (\$?SHENMA_HOST) then set NO_MOVE = 1 endif	the shared filesystem is mounted do not create /move directory on each node
pppl_trmpi_NxM.tcsh	N/A	if (\$?SHENMA_HOST) then set NO_MOVE = 1 endif	
csh_nubeam_component csh_nubeam_server run_mpi_portlib_env_test run_shell_test runtrx pppl_mpi_nubeam_NxM.t csh pppl_trmpi_NxM.tcsh trmpi_mvnb	\$mpx .....	\$mpx -machinefile \$PBS_NODEFILE .....	make the jobs running parallel on muti-nodes  see 'problem' part



# Modification of Scripts



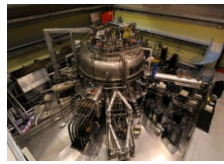
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## ASIPP

Scripts	Orig. Text	Modification	Reason
finishup/pppl_trmpi_Nx M.tcsh	if ( \$file == "\${runid}TR.DAT" ) then set action = move	if ( \$file == "\${runid}TR.DAT" ) then set action = copy cp \${runid}TR.DAT q\${runid}TR.DAT	delete the data and tmp_files in \$WORKDIR but keep the *TR.DAT file
	rm -r \$orig_dir/\${runid}*  echo " " echo " TRANSP exit status: \$rstat " echo " " exit \$rstat	rm -r \$orig_dir/\${runid}* mv \$RESULTDIR/*.DAT \$orig_dir/  cp q\${runid}TR.DAT \${runid}TR.DAT rm -rf q\${runid}TR.DAT rm -rf *.tcsh echo " " echo " TRANSP exit status: \$rstat " echo " " exit \$rstat	



# Outline



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# Experiment Data Analysis

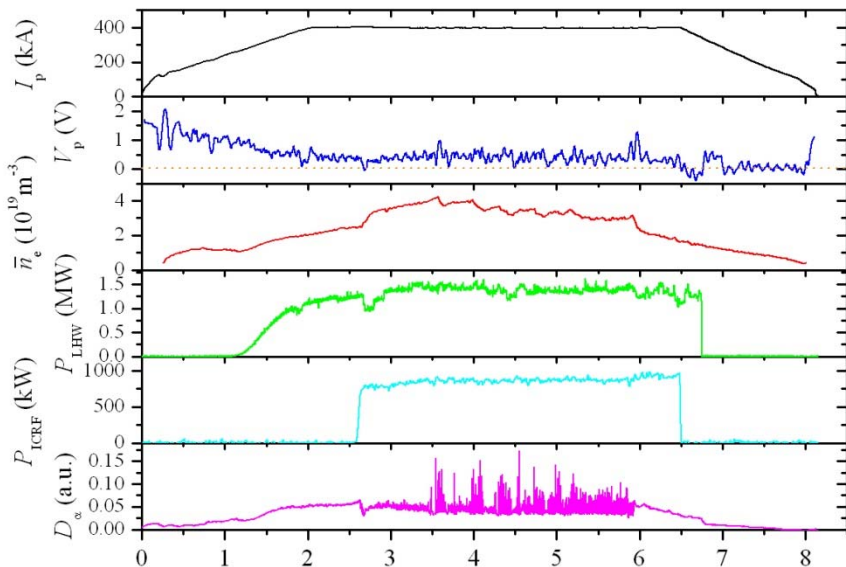


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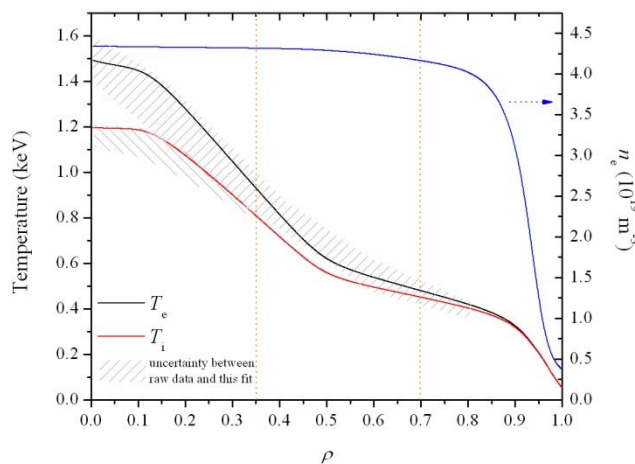
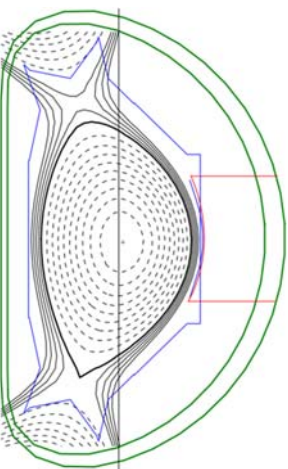
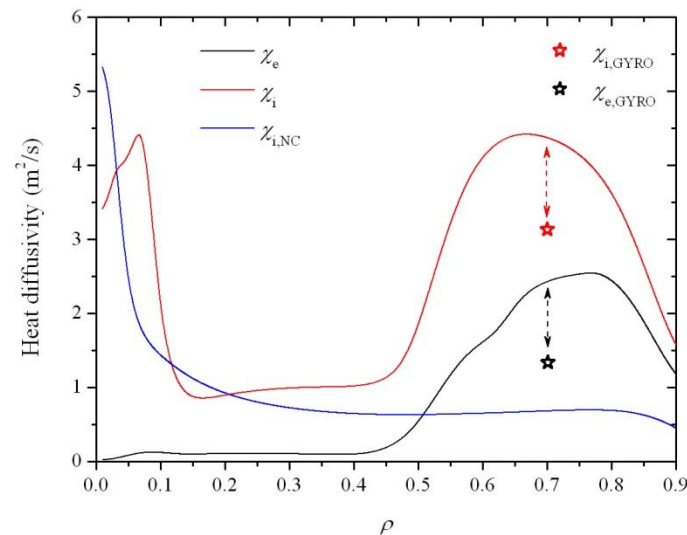
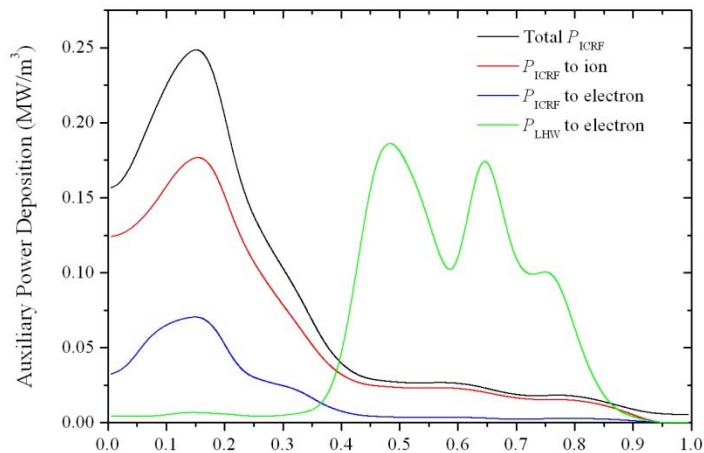
ASIPP

#38300

TRANSP power balance analysis for one time slice (3.9s)



Caveat:  
This fit was chosen to be the most step fit that can test gyrokinetic analysis on low and high transport level



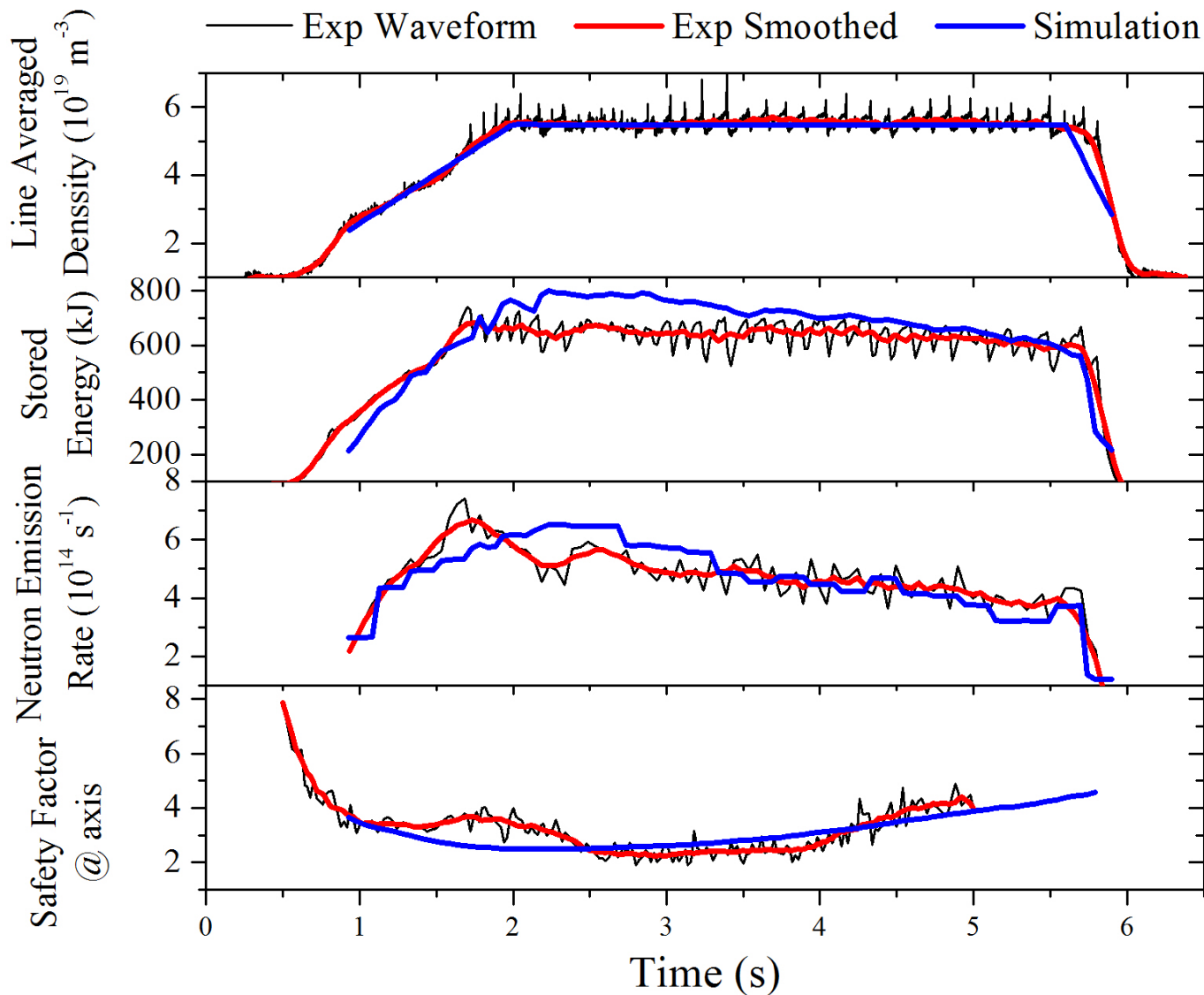


# Time History of Global Variables and Their Fits in Simulation – D3D#154732



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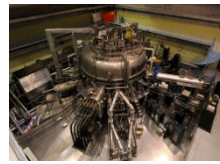
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- High  $\beta_p$  discharge in 2013 Joint Exp.
- Simulate nearly the whole discharge
  - GLF23 model
- Anomalous fast ion transport was employed
  - $1.2 \text{ m}^2/\text{s}$
- Main global variables were close to exp. results

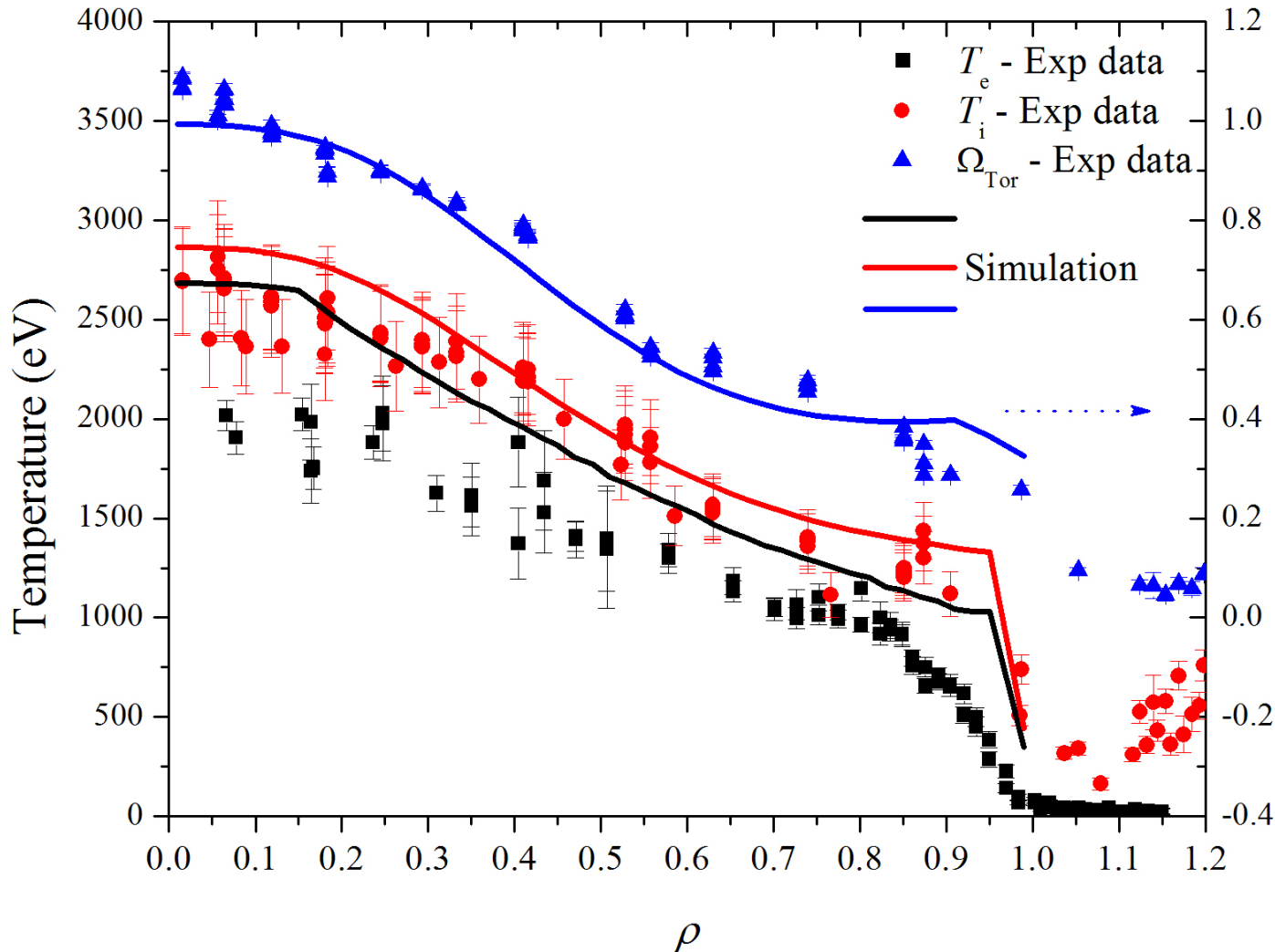


# Experimental Data and Simulation Results of Temperature and Rotation Profiles @ 3.0s



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- $1 < \chi_e < 2$  ( $\text{m}^2/\text{s}$ )
- Neoclassical level of  $\chi_i$  ( $\chi_i < \chi_{i\_NC}$ )
- Prandtl number is 0.3
- $T_e$  is not fitted well
- Simulated  $T_i$  and rotation is good
- The NTCC PEDESTAL module acts poorly
  - Requires a multiplier of 4-6



# EAST Scenario Design (Prediction)



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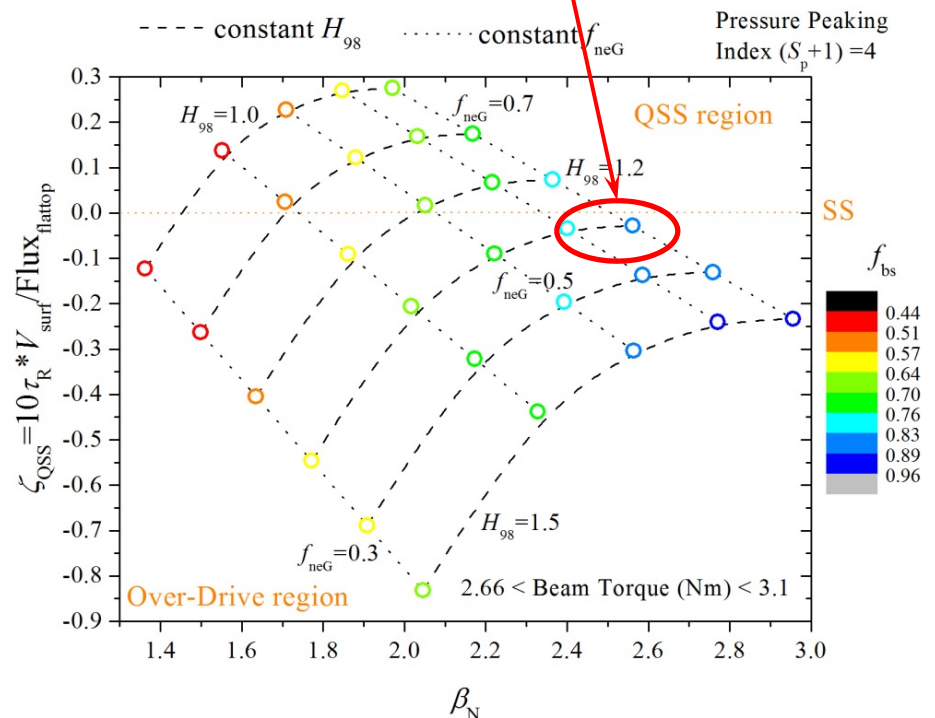
ASIPP

- On the basis of 0D analysis

- $I_p=500\text{kA}$ ,  $f_{neG}=0.7$  ( $n_e=5.5e19\text{m}^{-3}$ ),  $B_T=2.5@170\text{cm}$ , steady state scenario
- $I_p=800\text{kA}$ , quasi steady state / hybrid scenario

- Code components

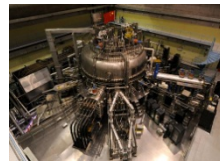
- PTRANSP (old style)
  - Use TSC output as fixed boundary
- TEQ
- NUBEAM
- TORIC
- LSC
- TORAY
- CDBM, MMM, GLF23





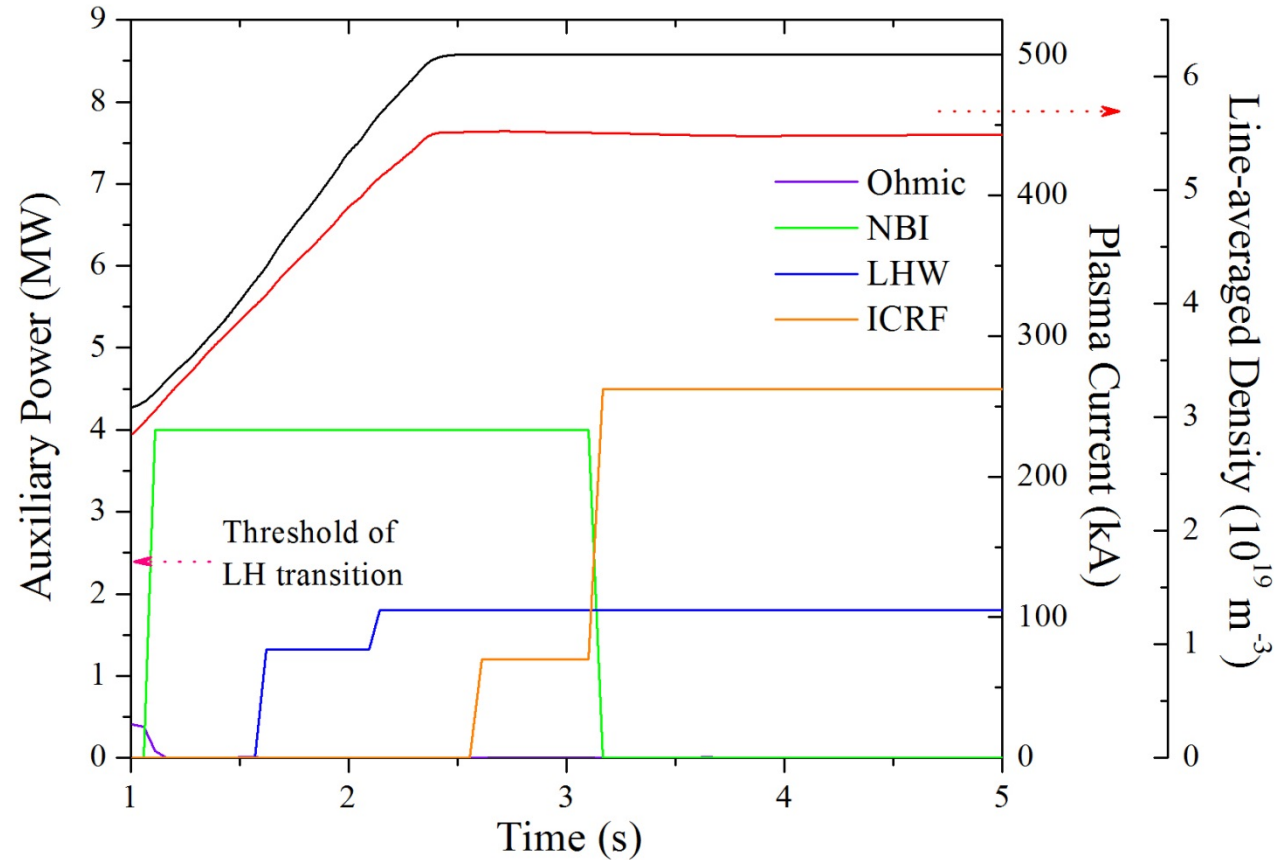
# EAST 1.5D Simulation: Strategy & Basic Waveform

## ASIPP



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- $I_p = 500\text{kA}$ ,  
 $B_{T0} = 1.9/2.3\text{T}$ ,  
 $f_{neG} \sim 0.6$
- 2-5s short-pulsed NBI preheating
- LHCD assisted current ramp up
- ICRH in current flattop (high density)





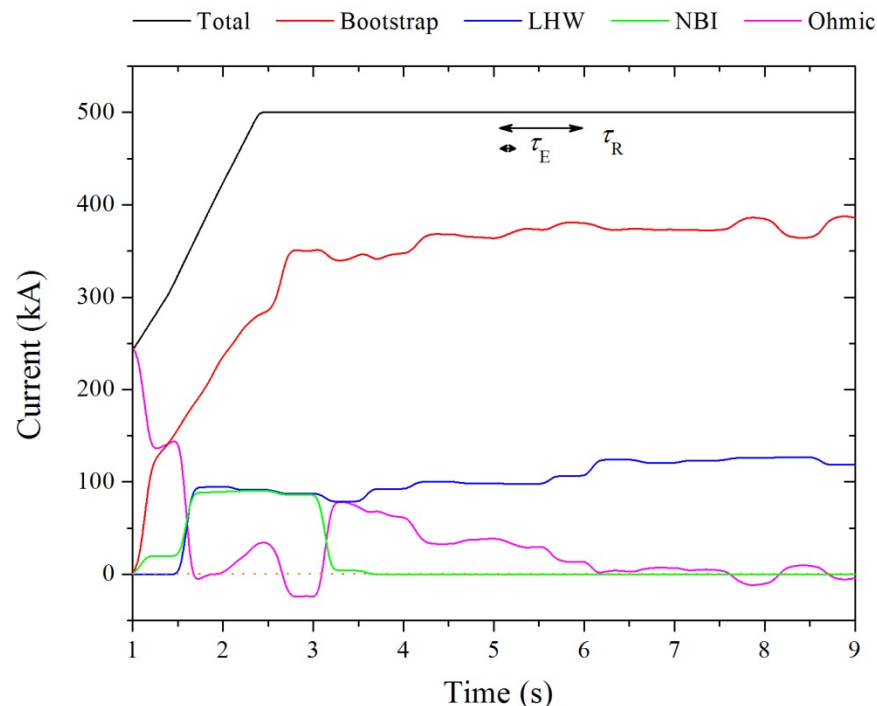
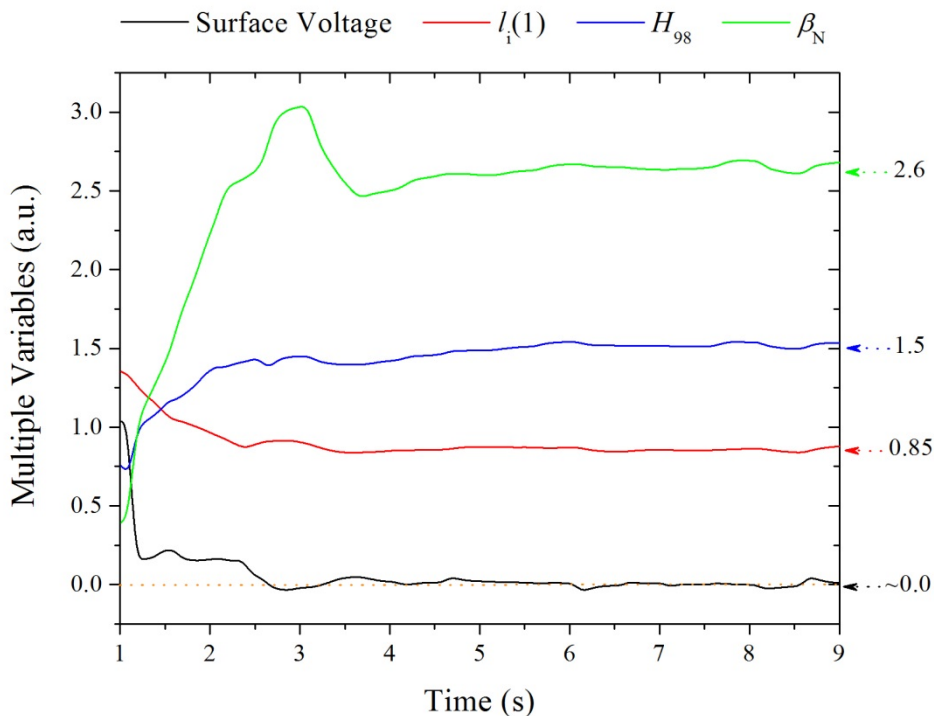


# EAST 1.5D Simulation: Plasma Performance

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- Absorbed Power:  $P_{ICRF}=4.5\text{MW}$  (H minority heating),  $P_{LHW}=1.5\text{MW}$
- assuming similar H factor as DIII-D/EAST joint experiment
- $f_{bs} \sim 75\%$ ,  $f_{ni} \sim 100\%$
- Ohmic current need  $3\tau_R$  to relax and is stable around zero, after turning off NBI
- $\tau_R \sim 1\text{s}$ ,  $\tau_E \sim 0.1\text{s}$

03/23/2015

TRANSP User Group (TUG) Meeting 2015  
Princeton Plasma Physics Laboratory, March 23-24, 2015

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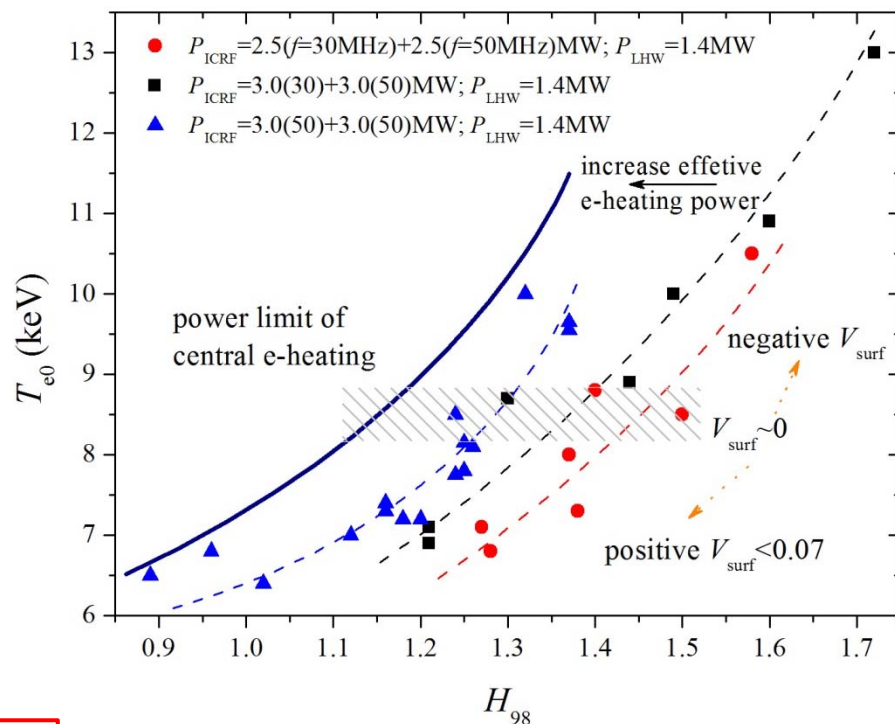
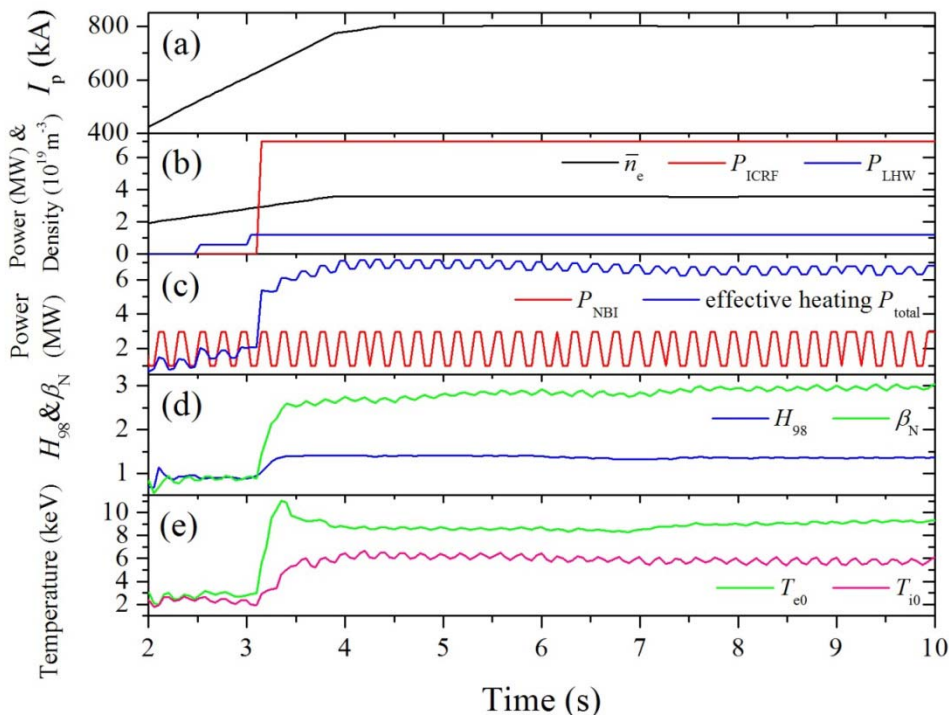


# 8.5keV High Temperature Plasma



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$H_{98} \sim 1.35$ ,  $T_{e0} \sim 9.3 \text{ keV}$ ,  $T_{i0} \sim 6 \text{ keV}$ ,  $\beta_N \sim 3.0$ ,  $V_{\text{surf}} \sim 0.02$

- One of EAST scientific goal
- High heating power, relatively low density
  - Still need  $n_e \geq 3.5 \times 10^{19} \text{ m}^{-3}$
- $I_p = 800 \text{ kA}$ ,  $B_{T0} = 2.3 \text{ T}$ ,  $n_e = 3.5 \times 10^{19} \text{ m}^{-3}$ ,  $P_{\text{total}} = 11 \text{ MW (max)}$

Rely on high heating power, good confinement and effective e-heating



# Primary Components of TRANSP that are Being Used

## ASIPP



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- Auxiliary heating modules
  - NUBEAM
  - TORIC
  - LSC
  - TORAY
- NTCC/Sauter module
- FRANTIC
- Old-style prediction (not modern PTRANSF)
- TEQ
- Transport models
  - Chang-Hinton model
  - GLF23
  - MMM
  - Horton ETG
  - DRBM
  - PALEO
  - CDM3

Some other code users need  
TRANSP output:

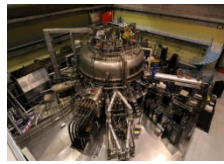
TORIC

ORBIT

Fast ion simulation (FIDA diag.)



# Outline



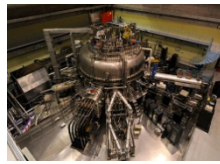
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# Problems



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## ASIPP

- Compiling issue

- Error message: “prebuild -E- Some directories missing - problem with ckdirs ??”

In \$CODESYSDIR/csh/prebuild, orig. text:

```
“ set ntranspdir=`find $TRANSPROOT/codesys -name transp -type d | wc -l`  
if( $ntranspdir < 5 ) then  
    echo $ERRSTRING Some directories missing - problem with ckdirs ??  
    exit  
endif ”
```

Only 3 directories were found: \$CODESYSDIR/marker/transp;

- \$CODESYSDIR/marker/transp
- \$CODESYSDIR/make/transp
- \$CODESYSDIR/source/transp

Solution: 5 -> 3, error message disappears

- Error message: “f951: error: unrecognized command line option “-fcheck=bounds,mem” ”

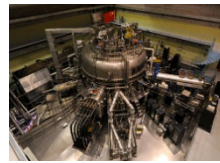
In \$CODESYS/csh/Default\_options, orig. text:

```
“set f90debug = "$fcmd -c -g -ffpe-trap=invalid,zero,overflow -fcheck=bounds,mem -fdollar-ok  
$debug_options $fpic_flag“ “
```

Solution: “set f90debug = "\$fcmd -c -g -ffpe-trap=invalid,zero,overflow -fbounds-check -fdollar-ok  
\$debug\_options \$fpic\_flag“ “



# Problems



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## ASIPP

- **Compiling issue**

- Error message:

- ” ?makelink: source for plasma\_state\_test should be in plasma\_state\_modify or freeshare libraries, not source/plasma\_state\_test/plasma\_state\_test.f90

- ?makelink: source for ps\_momtest should be in plasma\_state\_modify or freeshare libraries, not source/plasma\_state\_test/ps\_momtest.f90

- makelink -l- Time0.652u 1.392s 0:02.34 87.1% 0+0k 0+48io 0pf+0w

- make: \*\*\* [make/plasma\_state\_modify/plasma\_state\_modify.mk] Error 1 ”

- Solution: remove ‘plasma\_state\_modify’ directory

Will the solutions have bad influence on compiling results?

- **MPIRUN issue**

- Add “export MPI\_CMD=‘mpirun -machinefile \$PBS\_NODEFILE’ ” into module file/.bashrc to simplify the scripts modification in multiple scripts

- **Error in multi-node TRANSP runs**

- Error message:

- “wrstf tr\_replace\_dir 38300A34\_rs\_save 38300A34\_rs\_inPr returned status = 11

- %bad\_exit: generic f77 error exit call (errset\_mpi status 999?)

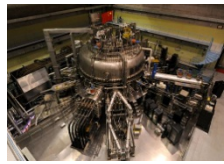
- wrstf -- rename to save failed! “

- Possible reason: conflict in writing tmp files

- Possible solution: move \$TMPDIR from a shared directory to each node



# Problems



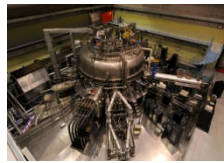
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## *ASIPP*

- The calculated results by LSC code are sometimes not stable
- TRANSP runs halt when ADAS options is on
  - `LEV_NBIDEP=2 + NSIGEXC=3`
  - No very specified error message
- The process of variable data extraction is complicated
  - In RPLOT, option 2/3, plot each variable, save, transform data structure for each file, then plot together
- ELVIS seems to be slow in SHENMA



# Outline



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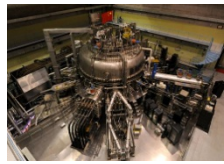
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# Future Need and Plan



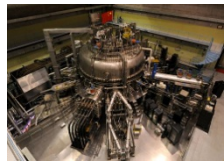
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## *ASIPP*

- More advanced (better) user strategy
- MPI TRANSP support  $M*N$  cores
  - $M=1\sim 32$
  - $N=1,2,4,8, (16,32)$
  - There are 16/32 cores in each node (different queues)
- Instead of `pppl_trmpi_NxM.tcsh`, create new `qsub` script for SHENMA, like `nersc_qsub`
- TRANSP connection to MDSplus server
  - Read experimental data
  - Result storage
- Experimental data access and structure transformation (other data structure to UFILE) via scripts



# Future Need and Plan



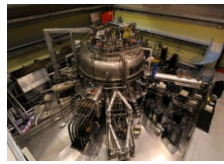
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## *ASIPP*

- New lower hybrid wave module
  - LSC is old and 'dead' code
  - Try GENRAY / GENRAY+CQL3D
  - LSC now supports multi-antenna + multi-frequency simulation, then GENRAY?
- Better pedestal model
  - EPED?
- Try NEO module
- Try modern PTRANSP namelist options (new ptsolver)
- Try PTRANSP + TSC simulation (iteration)
- Involve PTRANSP in CFETR physics design
  - Add CFETR into TOKID list
- An index of existed / submitted TRANSP runs
- Better way of PPPL firewall authentication



# Final Remarks



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## *ASIPP*

- A TRANSP copy had been installed on local cluster (SHENMA) at ASIPP
- There are already 33 registered users from 4 institutes/universities
  - More potential users
  - Amateur, need more training
- The application of TRANSP on EAST includes
  - Experiment analysis
  - Scenario design (prediction)
- Some technical issues and future need may require the help from PPPL side



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Thank you !