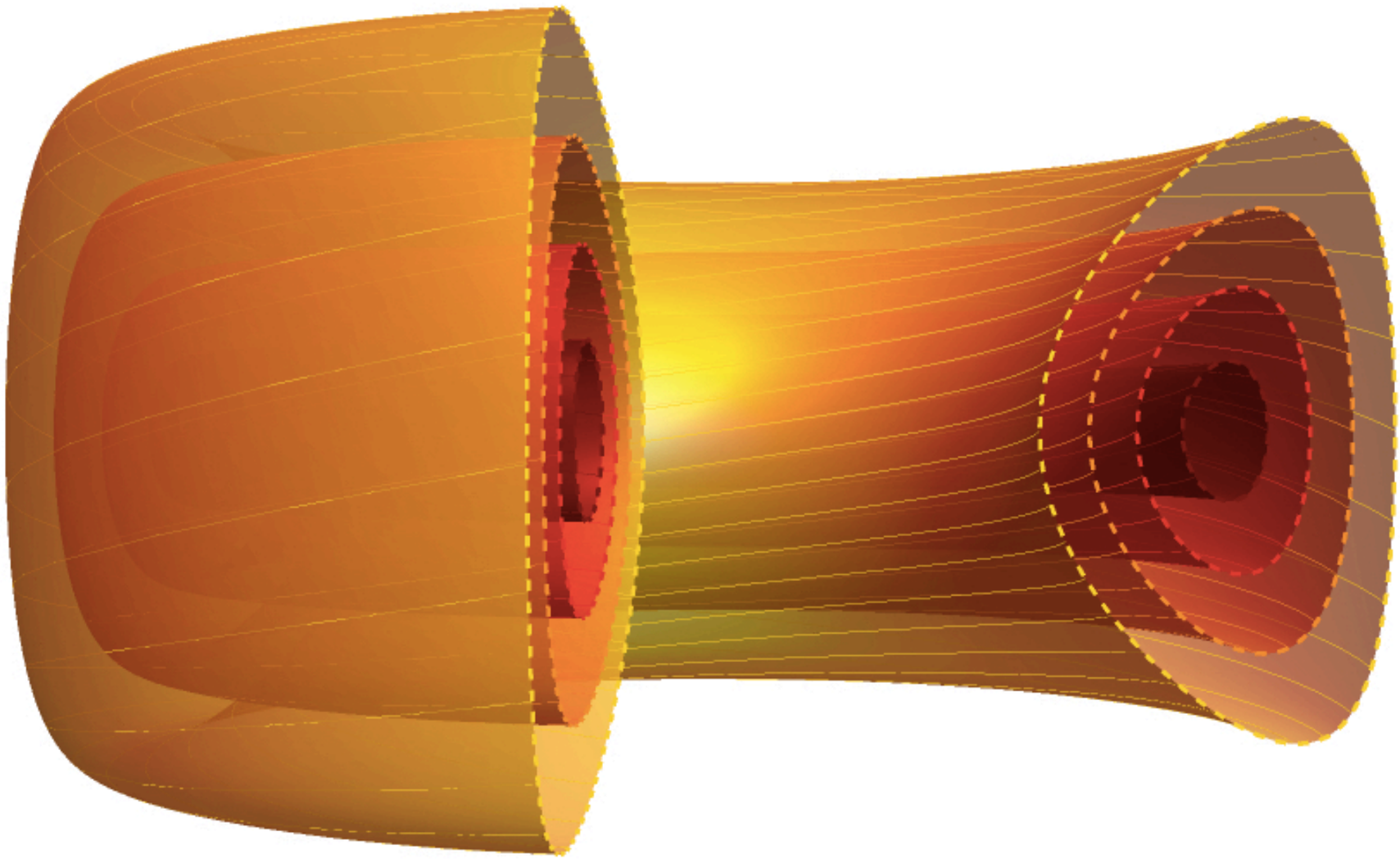
TSVV 2 progress and plans for 2022



Justin Ball and the TSVV 2 team

Thrust 5 and Flight Simulator Meeting

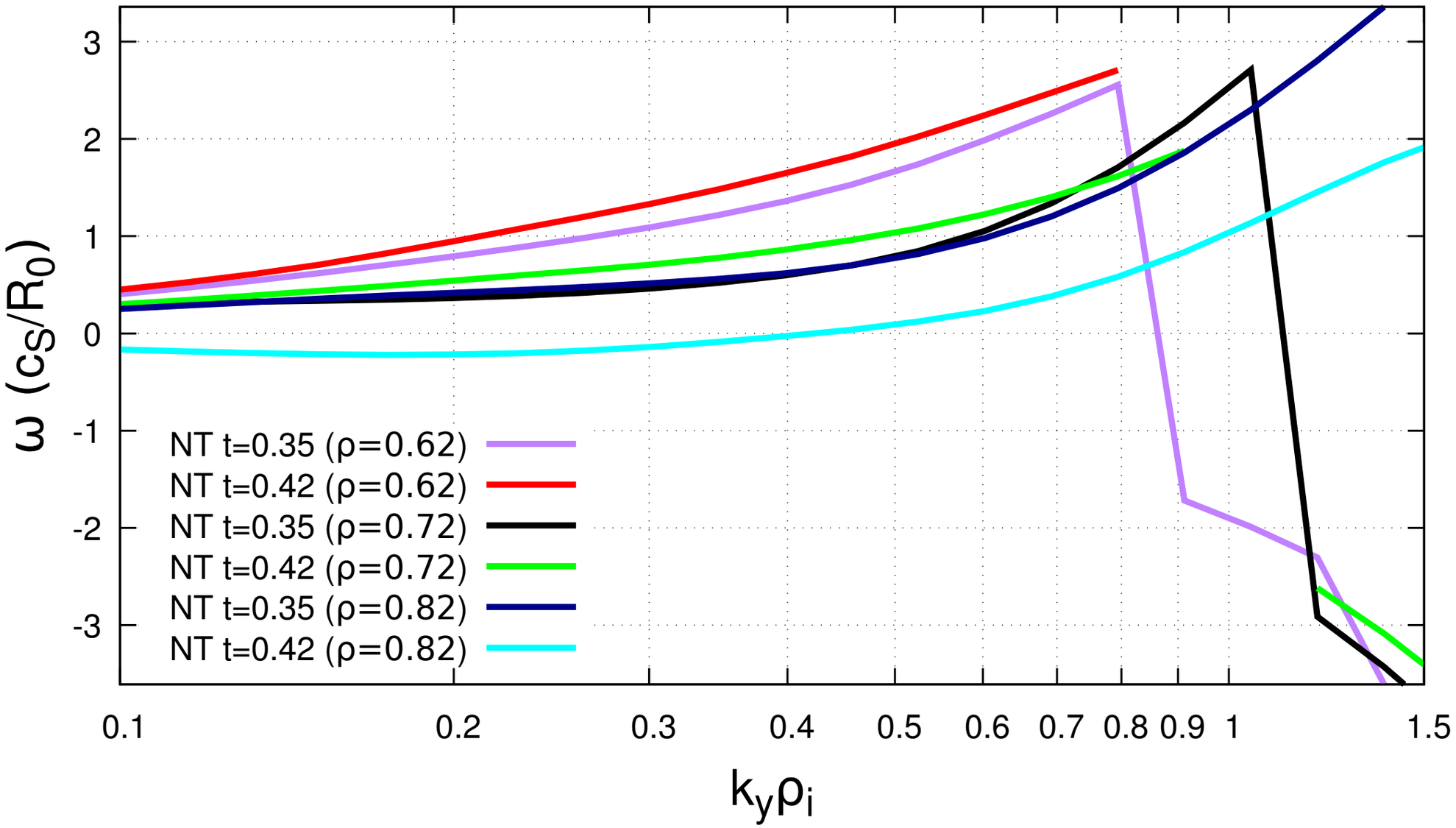
18 November 2021

Outline

- A few scientific updates since last meeting
- Plans for 2022
- Interfacing with DCT and the flight simulator

Gyrokinetic core turbulence study continues…

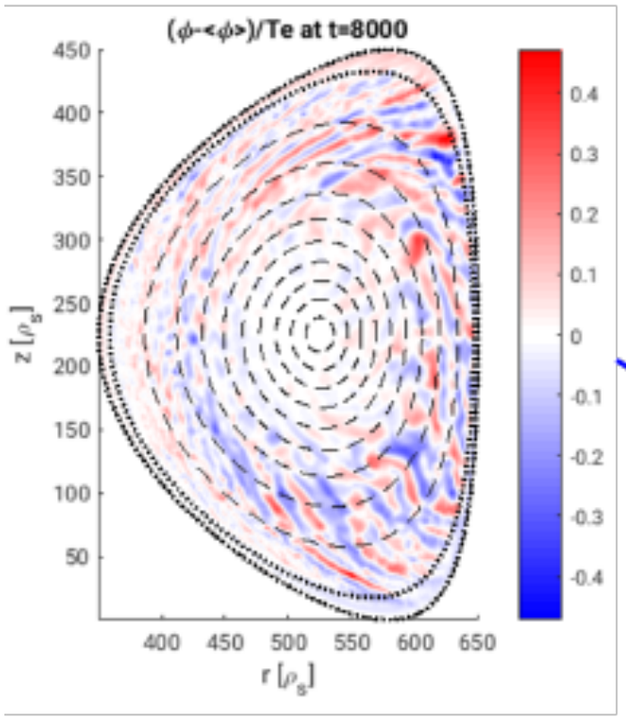
- Preliminary local analysis of DIII-D NT equilibria has begun, which indicates that ITG turbulence is dominant

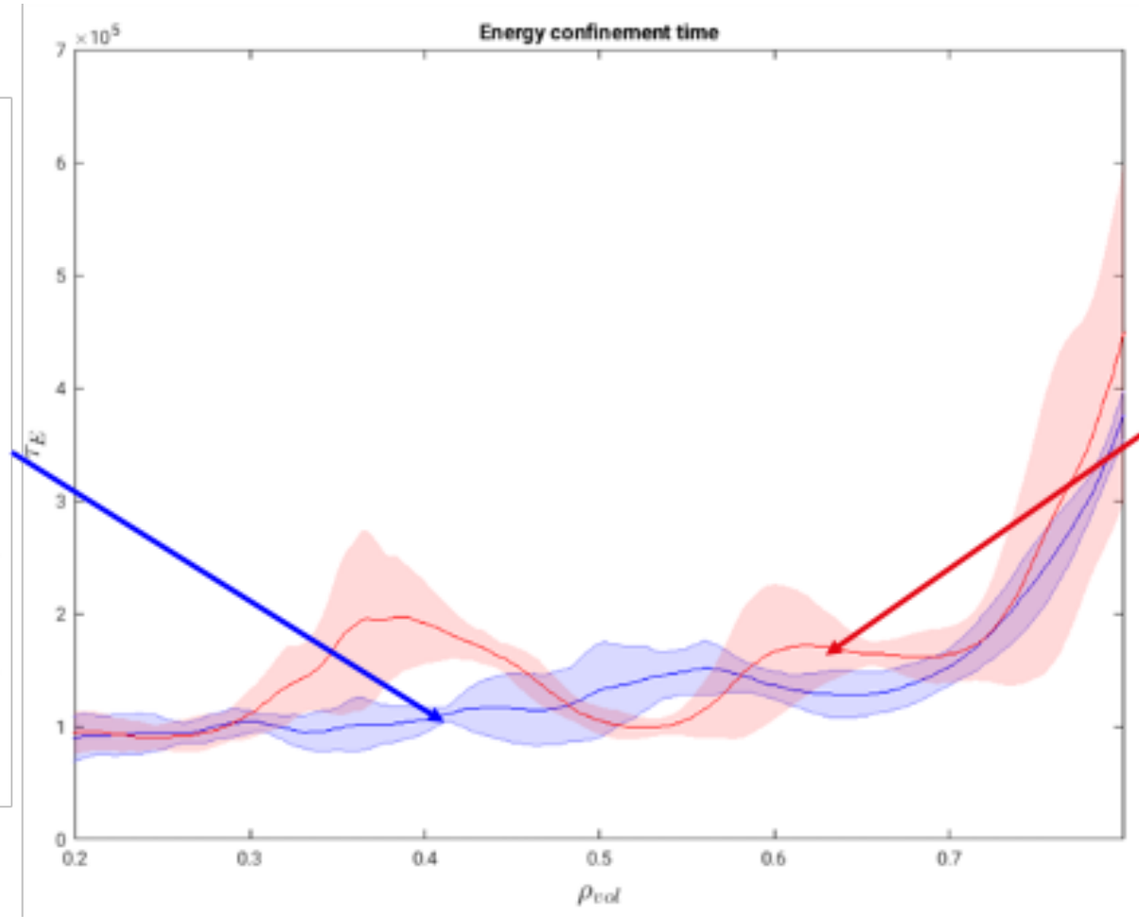


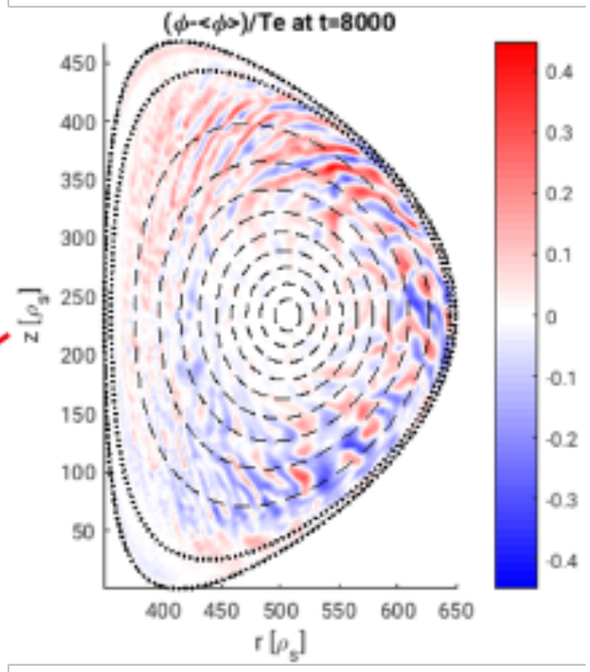
Gyrokinetic core turbulence study continues…

- Steady-state global ORB5 simulations using kinetic trapped electrons now observe a confinement improvement from NT

- Issues remain, but an important step in establishing consistent results with local studies







Plans for 2022

Turbulence:

Milestone	Description	Participants	Target date
M1.1.3	Perform comprehensive study of critical gradient and stiffness as a function of minor radius using local GK simulations	J. Ball	3.2022
M1.2	Integrate findings from the ERG on global flux driven GK simulations of TCV-like NT discharges (including impurity transport) into this TSVV; specifically comparing trends against the GENE results when possible	P. Donnel, J. Ball	8.2022
M1.3.1	Perform GBS simulations to understand the effect of plasma triangularity on single-null configurations with no neutrals	M. Giacomin	3.2022
M1.3.2	Perform GBS simulations to understand the effect of plasma triangularity on double-null configurations with no neutrals	M. Giacomin	12.2022

MHD:

M2.1.2	Study ideal n=0, n=1 MHD stability with KINX	A. Merle	12.2022
M2.2.1	Use HYMAGYC to investigate kinetic corrections to MHD	G. Fogaccia	3.2022
M2.3.1	Influence of NT on the stability limits of tearing modes and NTMs with XTOR-K	H. Luetjens	3.2022

Fast particles:

M5.1.2	Model energetic particle-driven modes using LIGKA	M. Vallar	12.2021
M5.1.3	Model the impact of energetic-particle driven modes on fast ion confinement	M. Vallar	12.2022
M5.2	Fast ion confinement studies with XTOR-K	H. Luetjens	12.2022

Plans for 2022

Experimental validation:

Milestone	Description	Participants	Target date
M3.2	Validation of trends from GK codes (local and global) using well-diagnosed TCV experiments	J. Ball, O. Sauter, P. Donnel	12.2022
M3.3	Validation of SOLEDGE2D-EIRENE SOL simulations with experimental data (i.e. matching experimental observables by tuning cross-field diffusivities)	P. Innocente	6.2022
M3.4	Comparison of fast particle confinement and fast particle-driven modes between simulation and well-diagnosed TCV experiments	M. Vallar	6.2022
M3.6.1	Validation of KINX global stability analysis against TCV experiments	A. Merle	6.2022

Reduced modeling:

M6.1	Detailed verification of TGLF SAT1 vs GK simulations and optimization of TGLF settings for standard DTT NT case and extreme NT DTT case	A. Mariani	3.2022
M6.2.1	Conduct encompassing linear and nonlinear gyrokinetic GENE flux-tube studies of PT and NT scenarios, specifically looking at saturation physics and nonlinear coupling, with a special focus on experimental cases	M. Pueschel	3.2022
M6.2.2	Test quasilinear gyrokinetics-based transport models for these cases against nonlinear scalings, and improve the models where necessary	M. Pueschel	12.2022

Extrapolation to reactor scales:

M4.1	TGLF integrated modeling of reactor-relevant DTT NT and present-day NT experiments to compare the effect of NT. In case no adaquate TGLF setting is found, one can try to feed GK-deduced diffusivities into a transport code.	P. Mantica	12.2022
M4.3.1	Perform electromagnetic local GK simulations to test impact at high β	J. Ball, M. Pueschel	12.2022

Interfacing with DCT and the flight simulator

- In many ways, a whole device modeling/flight simulator for negative triangularity would be a simplification (e.g. no L-H transition, nor large pedestals)

- Given the current state of research of negative triangularity, there remains a lot of work
  - Just started developing/verifying reduced models for negative triangularity

- At the moment, the biggest priority is good communication with negative triangularity work within the DEMO design team

All done.

TCV experimental equilibria

Comp. Num.	Description	Constants of comparison	Discharge	Time (sec)	elong	delta	betaN	P_nbi (kW)	q95	Ip (kA)	<ne> (x10^19 m^-3)	Comments
1	Diverted, PT	q95, betaN	69515	1.02	1.43	+0.29	0.97	636	3.17	242	4.0	not great q95 match
1	Diverted, NT	q95, betaN	69340	0.58	1.42	-0.28	0.97	362	2.94	218	3.3	with Langmuir probes
2	Diverted, PT	q95, ne, Pheat	69515	1.02	1.43	+0.29	0.97	636	3.17	242	4.0	not great q95 match
2	Diverted, NT	q95, ne, Pheat	69271	1.60	1.42	-0.27	1.59	612	2.90	217	4.4	-
3	Diverted, PT	Ip, betaN, ne	69508	1.49	1.43	+0.28	1.12	735	3.31	217	4.0	-
3	Diverted, NT	Ip, betaN, ne	69340	0.58	1.42	-0.28	0.97	362	2.94	218	3.3	with Langmuir probes
4	Limited, PT	Ip, betaN, ne	69511	1.50	1.34	+0.35	1.25	1030	3.38	228	3.4	-
4	Limited, NT	Ip, betaN, ne	69273	0.85	1.29	-0.29	1.30	475	2.85	228	3.4	-
5	Limited, PT	Ip, Pheat	69511	1.50	1.34	+0.35	1.25	1030	3.38	228	3.4	-
5	Limited, NT	Ip, Pheat	69273	1.70	1.26	-0.26	2.02	1020	2.79	226	4.6	-
-	Diverted, PT	-	69515	1.58	1.43	+0.34	1.84	1020	3.29	239	7.1	in H-mode; no CXRS so Ti=Te
-	Diverted, NT	-	69340	1.60	1.40	-0.27			2.92	217	5.4	with Langmuir probes

The team

CEA	H. Luetjens
DIFFER	M. Pueschel, J. Citrin
ENEA	G. Fogaccia, P. Innocente, P. Mantica, A. Mariani, G. Vlad
EPFL	J. Ball, P. Donnel, M. Giacomin, A. Merle, O. Sauter, M. Vallar, P. Ricci

- Two personnel changes
  - M. Giacomin is graduating and will be replaced by K. Lim (Nov. 1st)
  - P. Donnel relocated and was replaced by G. Di Giannatale (Sept. 1st)