GA–A27050

DIII–D YEAR 2011 EXPERIMENT PLAN

by
DIII–D RESEARCH TEAM

MAY 2011

GENERAL ATOMICS

DISCLAIMER

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Work supported by
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GENERAL ATOMICS PROJECT 30200
MAY 2011

GENERAL ATOMICS

FOREWORD

This document presents the planned experimental activities for the DIII-D National Fusion Facility for the fiscal year 2011. This plan is part of a five-year cooperative agreement between General Atomics and the Department of Energy. The Experiment Plan advances on the objectives described in the DIII-D National Fusion Program Five-Year Plan 2009–2013 (GA-A25889). The Experiment Plan is developed yearly by the DIII-D Research Council and approved by DOE. DIII-D research progress is reviewed quarterly against this plan. The 2011 plan is for 14 weeks of tokamak physics research operations.

APPROVALS

Approved: ______________________ 29 April 2011
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DIII–D Program Director
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______________________ 20 May 2011
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1. SYNOPSIS OF THE 2011 DIII-D RESEARCH PLAN

1.1. INTRODUCTION

The 2011 Experiment Plan consists of 14 weeks of tokamak physics research operations. The 2011 campaign follows on very successful experimental campaigns carried out in 2009 and 2010. The 2009 campaign consisted of 16 weeks [2 weeks supported by the American Recovery and Reinvestment Act (ARRA)] followed closely by the 2010 campaign, which consisted of 17 weeks of operation (3 weeks supported by the ARRA). Experiments in 2009 and 2010 continued to exploit the new capabilities added during the 2005–2006 Long Torus Opening Activity (LTOA), including: 1) reorientation of the 210-degree neutral beam line to provide 5 MW of neutral beam power directed opposite from the remaining five sources, allowing balanced neutral beam injection up to 10 MW input power; 2) installation of an extended shelf in the lower divertor to allow pumping of high triangularity single-null and double-null plasmas; and 3) additional electron cyclotron heating (ECH) power and pulse length (~5 s, still in progress). In addition, several significant diagnostic upgrades were implemented prior to these campaigns including: 1) two simultaneous high framing rate infrared televisions (IRTVs) in the lower divertor [from collaborations with TEXTOR and Lawrence Livermore National Laboratory (LLNL)], 2) a new fast ion loss detector (FILD) for measuring the power lost in fast ions near the outer midplane, and 3) initial 2D scrape-off layer (SOL) and divertor flow measurements through a collaboration between LLNL and Australia National University.

The 14-week program plan for 2011 provides adequate experimental time for DIII-D to: (a) enable the success of ITER by providing physics solutions to key physics issues (highest DIII-D priority); (b) continue its leading roles in development of a physics basis for steady-state operation in ITER and beyond; (c) to advance the fundamental understanding of fusion plasmas along a broad front.

1.2. 2009, 2010 AND 2011 ITPA EXPERIMENTS

During the 2009 and 2010 campaigns, many experiments were conducted in support of physics areas identified by the International Tokamak Physics Activity (ITPA) working groups (Table I). These experiments continue to support long-term physics needs of ITER (Table II) in the 2011 experimental campaign.

Table I
DIII-D Conducted a Number of Experiments in 2009 & 2010 in Support of the International Tokamak Physics Activity (ITPA)

ID No.	Title	DIII-D Experiment
TC-4	H-mode transition and confinement dependence on ionic species	P_L-H vs helium purity from 40% → 5%, H-mode performance, pedestal and ELM characteristics in He vs D_2 plasma
TC-7	Ion temperataure gradient/trapped electron mode (ITG/TEM) transport dependence on T_i/T_e, q profile and rotation in L-mode plasmas	Dependence of multi-field turbulence properties and transport on T_e/T_i
TC-10	Experimental identification of ITG, TEM and electron temperature gradient (ETG) turbulence and comparison with codes (change of title)	Test of simulations in high confinement, quiescent regime, QH-mode
PEP-18	Comparison of rotation effects on Type I ELMing H-mode in JT-60U and DIII-D	Effect of edge rotation on pedestal height, ELM size and turbulence
PEP-19	Basic mechanisms of edge transport with resonant magnetic perturbations in toroidal plasma confinement devices	3D heat flux during resonant magnetic perturbation (RMP) ELM control
PEP-23	Quantification of the requirements for ELM suppression by magnetic perturbations from internal off midplane coils	RMP ELM suppression with no/low counter rotation
PEP-24	Minimum pellet size for ELM pacing	Pellet triggering physics
PEP-26	Critical edge parameters for achieving L-H transition	H-mode threshold power and performance, pedestal and ELM characteristics in D_2 plasma
PEP-27	Pedestal profile evolution following L-H transition	H-mode threshold power and performance, pedestal and ELM characteristics in D_2 plasma
PEP-28	Physics of H-mode access with different X-point height	H-mode threshold power and performance, pedestal and ELM characteristics in D_2 plasma
DSOL-9	^{13}C injection experiments to understand C migration	^{13}C injection preparation for oxygen bake
DSOL-12	Reactive wall cleaning	^{13}C injection preparation for oxygen bake
MDC-1	Disruption mitigation by massive gas jets See DSOL-11	Impurity injection into runaway electron beam
MDC-2	Joint experiments on resistive wall mode physics	Current driven resistive wall mode (RWM) feedback development, fishbone driven energetic particle interaction with RWMs
MDC-8	Current drive prevention/stabilization of NTMs	Tearing mode structure of 2/1 island in hybrid plasma
MDC-12	Non-resonant magnetic braking	Test neoclassical toroidal viscous (NTV) theory of non-resonant magnetic fields
MDC-14	Rotation effects on neoclassical tearing modes	Tearing mode structure of 2/1 island in hybrid plasma
MDC-15	Disruption database development	Impurity injection into runaway electron beam
MDC-16	Runaway electron generation, confinement, and loss	Runaway electron generation, confinement, and loss (Day 1 of 2)

EP-2	Fast ion losses and redistribution from localized Alfvén eigenmodes (AEs)	Fast-ion transport by many RSAEs and TAEs
IOS-2.2	Ramp-down from q_{95}=3	ITER rampdown scenarios beyond the baseline
IOS-3.1	Beta limit for steady state (SS) with ITER recommended q-profile.	Stationary fully noninductive operation
IOS-3.2	Define access conditions to get to SS scenario	Fully noninductive development
IOS-4.1	Access conditions for hybrid with ITER-relevant restrictions	Electron current (EC) + fast wave (FW) advanced inductive development, Day 1
IOS-5.2	Maintaining ion cyclotron resonance heating (ICRH) coupling in expected ITER regime	FW coupling development
IOS-6.1	Modulation of actuators to qualify real-time profile control methods for hybrid and steady state scenarios	Model based current profile control Day 1
DIAG-3	Resolving the discrepancy between electron cyclotron emission (ECE) and TS at high T_e	Investigate disagreements between Thomson scattering and ECE measurements in high T_e discharges
TC-2	Power ratio – hysteresis and access to H-mode with H~1	H-mode threshold power and performance, pedestal and ELM characteristics in D_2 plasma
TC-3	Scaling of the low-density limit of the H-mode threshold	H-mode threshold power and performance, pedestal and ELM characteristics in D_2 plasma
PEP-22	Controllability of pedestal and ELM characteristics by edge/electron cyclotron current drive/lower hybrid current drive (ECH/ECCD/LHCD)	Effect of collisionality and rotation on pedestal height, ELM size and turbulence
PEP-25	Inter-machine comparison of ELM control by magnetic field perturbations from midplane RMP coils	Effect of collisionality on pedestal height, ELM size and turbulence
DSOL-2	Injection to quantify chemical erosion	DiMES exposures with porous plug injector
DSOL-20	Transient divertor reattachment	Heat flux measurements of the divertor and SOL
DSOL-21	Introduction of pre-characterized dust for dust transport studies in divertor and SOL	DiMES exposures
MDC-17	Active disruption avoidance	Active control of locked modes
EP-3	Fast ion transport by small scale turbulence	Fast-ion transport by neoclassical tearing modes (NTMs) and at sawtooth crashes
EP-4	Effect of dynamical friction (drag) at resonance on nonlinear AE evolution	Fast-ion transport by many reverse shear AEs (RSAEs) and toroidally-induced AEs (TAEs)
IOS-1.2	Study seeding effects on ITER baseline discharges	Radiative divertor + RMP ELM suppression, reversed B_T
IOS-6.2	ℓ_i controller (I_p ramp) with primary voltage/additional heating	Improved startup scenarios for ITER
TC-10	Experimental identification of ITG, TEM & edge transport barrier (ETB) turbulence & comparison with codes (change of title)	Test of simulations in high confinement, quiescent regime, QH-mode
DSOL-22	Multi-code validation against experiment for improved detachment modeling	C-Mode heat flux comparison, divertor heat flux scaling

Table II
Many Experiments Planned During 2011 will Support the International Tokamak Physics Activity (ITPA)

ID No.	Title	DIII-D Experiment
TC-7	ITG/TEM transport dependence on T_i/T_e, q profile and rotation in L-mode plasmas	Investigate critical gradients and stiffness in ion and electron channels, with rotation
PEP-19	Basic mechanisms of edge transport with resonant magnetic perturbations in toroidal plasma confinement devices	Several experiments in the ELM control: 3-D field induced transport task force
PEP-23	Quantification of the requirements for ELM suppression by magnetic perturbations from internal coils	Several experiments in the ELM control: 3-D field induced transport task force
PEP-24	Minimum pellet size for ELM pacing	ELM pacing by pellets
PEP-25	Inter-machine comparison of ELM control by magnetic field perturbations from midplane RMP coils	Several experiments in the ELM control: 3-D field induced transport task force
PEP-34	Non-resonant magnetic field driven QH-mode	QH-mode with C-coil alone, I&C coils
PEP-35	Compatibility of ELM control for ITER and ITER-like pellet core fueling	Compatibility of fueling with ELM pacing
DSOL-20	Transient divertor reattachment	Detachment and flows
DSOL-24	Disruption heat loads	Rapid shutdown with massive impurity injection
MDC-1	Disruption mitigation by massive gas jets	Rapid shutdown with massive impurity injection
MDC-2	Joint experiments on resistive wall mode physics	Resistive wall mode (RWM) physics including rotation
MDC-8	Current drive prevention/stabilization of neoclassical tearing modes (NTMs)	NTM control: develop mirror steering algorithms for NTM control
MDC-14	Rotation effects on neoclassical tearing modes	Effect on NTMs by rotation
MDC-16	Runaway electron generation, confinement, and loss	Several experiments in the runaway electron dissipation and control task force
MDC-17	Active disruption avoidance	Disruption avoidance by ECH
EP-2	Fast ion losses and redistribution from localized AEs	Off-axis neutral beam injection (NBI) effect on AEs
EP-3	Fast ion transport by small scale turbulence	Effect of microturbulence on off-axis neutral beam current drive (NBCD) and fast ion confinement
IOS-3.2	Define access conditions to get to SS scenario	ITER baseline scenario with dominant electron heating
IOS-4.1	Access conditions for hybrid with ITER-relevant restrictions	High q_{min}>2 with off-axis NBI
IOS-5.2	Maintaining ICRH coupling in expected ITER regime	Fast wave coupling and assessment
DIAG-2	Environmental tests on first mirrors	Dimes erosion studies

1.3. 2011 MILESTONES

The 2011 experimental plan supports three DOE Milestones: Nos. 176–178. One of these milestones (176) is in support of the Fusion Energy Science (FES) Joint Research Target.

Milestone 176: ***Compare pedestal structure and turbulence with model predictions.*** **Supports FY2011 FES Joint Research Target (September, 2011).**

Theory and experiment show that the tokamak performance is strongly related to the height of the H-mode pressure pedestal. Higher pedestals enable improved core confinement and performance. A major goal of pedestal research at DIII-D and elsewhere is to identify the physics mechanisms that control the pedestal structure. This knowledge is needed to develop a predictive capability for the pedestal height in future machines and to identify ways to optimize the pedestal structure for integrated performance. Studies in DIII-D and elsewhere show that the size of the pedestal is limited by MHD stability, and these limits are well predicted by peeling-ballooning theory for finite-n ideal MHD modes. However, a full predictive capability for the pedestal height requires an understanding of the physics that sets the width or gradient of the pedestal pressure. There are a number of physics elements that might affect the width or gradient, including but not limited to ion orbit physics, micro-turbulence, plasma shape, atomic physics, radial electric fields, 3-D magnetic fields and rotation. DIII-D will perform experiments to identify physics parameters that play an important role in controlling the pedestal structure. These studies will be guided by theoretical models and will be used to test available models. Physics parameters of interest include ρ_*, collisionality, rotation, kinetic ballooning mode turbulence, and the neutral mean free path.

Joint Facility Research Target. Improve the understanding of the physics mechanisms responsible for the structure of the pedestal and compare with the predictive models described in the companion theory milestone. Perform experiments to test theoretical physics models in the pedestal region on multiple devices over a broad range of plasma parameters (e.g., collisionality, beta, and aspect ratio). Detailed measurements of the height and width of the pedestal will be performed augmented by measurements of the radial electric field. The evolution of these parameters during the discharge will be studied. Initial measurements of the turbulence in the pedestal region will also be performed to improve understanding of the relationship between edge turbulent transport and pedestal structure. A focused analytic theory and computational effort, including large-scale simulations, will be used to identify and quantify relevant physics mechanisms controlling the structure of the pedestal. The performance of future burning plasmas is strongly correlated with the pressure at the top of the edge transport barrier (or pedestal height). Predicting the pedestal height has proved challenging due to a wide and overlapping range of relevant spatiotemporal scales, geometrical complexity, and a variety of potentially important physics mechanisms. Predictive models will be developed and key features of each model will be tested against observations, to clarify the relative importance of various physics mechanisms, and to make progress in developing a validated physics model for the pedestal height. (September 2011).

Milestone 177: ***Begin physics experiments using 2MW off-axis neutral beam injection* (September, 2011).**

Adding capability for off-axis neutral beam injection expands the research capabilities of the DIII-D facility in a number of important directions related to Advanced Tokamak development, confinement and transport studies, and ITER design and operational issues. DIII-D plans to modify the 150° beamline to allow variable injection angles. Preparatory work on the conversion began in FY09, with the bulk of the hardware modifications scheduled for a single long-torus opening spanning FY10-11. Tasks for FY11 include:

Q1: Complete modification of 150° beamline internal components and vessel port modification. Begin reinstallation of beamline into machine hall.

Q2: Complete installation of beamline and hardware associated with beamline tilting. Demonstrate successful tilting of beamline with both beamline and DIII-D vessel under vacuum.

Q3: Complete beamline hardware checkout including reinstallation of ion source, and proper functioning of all support systems in both horizontal and elevated positions (vacuum, cryogenic, gas, water, I&C, and HV). Demonstrate successful injection of both ion sources on the off-axis beamline into the DIII-D vessel at both horizontal and elevated positions (10 ° or more).

Successful completion of the hardware tasks will enable DIII-D scientists to begin initial physics experiments in Q4 using at least 2 MW of beam power into the vessel with the modified beamline inclined at least 10 degrees to horizontal.

Milestone 178: ***Explore relationship between ELM suppression and increased turbulence and particle transport due to 3D field effects* (December 2011).**

Investigate observed connections between applied 3D magnetic fields, density decrease, edge turbulence, and edge transport as related to RMP-mediated ELM suppression. Examine and analyze relevant data and conduct new experiments, as needed, using external 3D fields to vary the edge pressure gradient while using profile and fluctuation diagnostics to measure changes in ELM behavior, $E \times B$ flows, density and temperature gradients, stability, turbulence characteristics and flows, and fluctuation-driven edge transport. Compare measured effects with models for plasma response to 3D fields and changes to transport.

1.4. 2011 TASK FORCES AND WORKING GROUPS

The research campaign for 2011 is organized into the six physics groups making up the Experimental Science Division, with two additional task forces coordinated independently of that management structure (Fig. 1). Approximately 80% (41 days) of the time allocated in the 14-week experimental plan has been allocated to the physics groups, and their associated working groups. This reflects the broad base and scientific depth of the DIII-D experimental program. The remaining roughly 20% (10 days) is allocated to the task forces, which are more narrowly focused on critical, shorter term, issues, and to the Torkil Jensen Award experiments. The Torkil Jensen Award, up to one day of experimental run time per proposal, was established prior to the 2009 campaign to encourage submission of proposals for experiments that are focused on new research topics with the potential for exploring transformational physics using very innovative techniques.

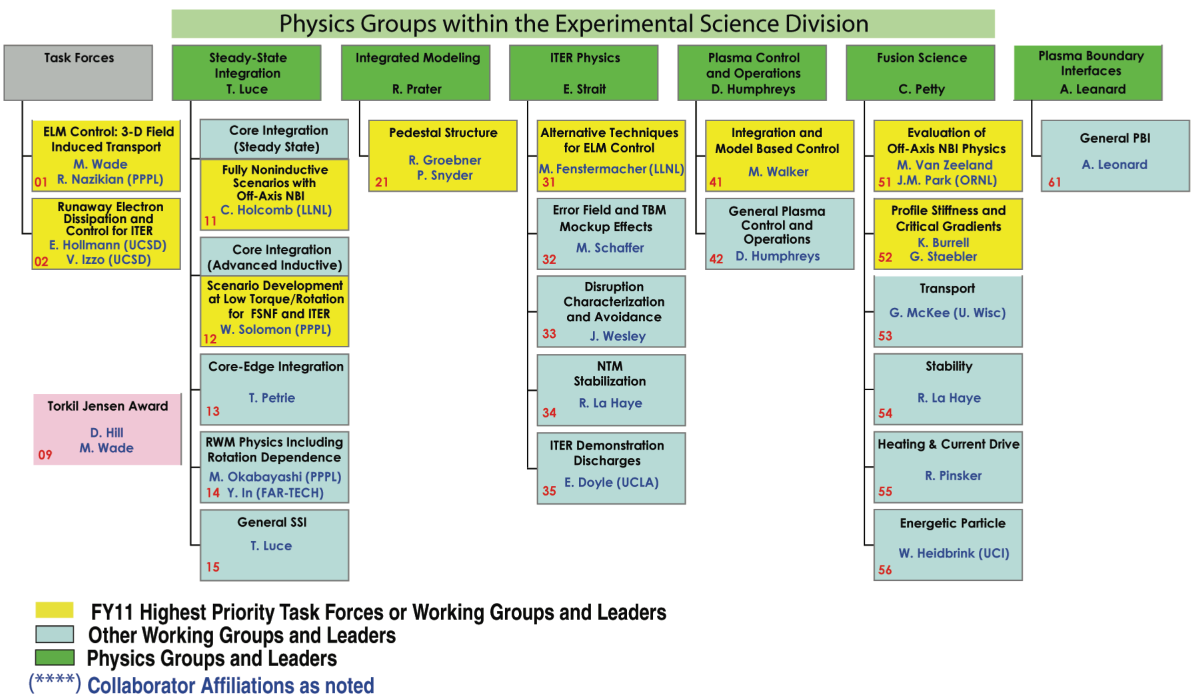

Fig. 1. The 2011 Experimental Campaign is organized into two task forces, the Torkil Jensen Award category, and 20 working groups within the physics groups of the Experimental Science Division. The task forces and working groups highlighted in yellow are considered high priority areas for the DIII-D program.

The two task forces and six working groups highlighted in yellow in Fig. 1 were identified by the Research Council as high priority research areas for the DIII-D program for the 2011 run campaign. The other working groups, shown in blue, were added in "bottom up" fashion through discussions within the physics groups. The high priority research areas are as follows:

- **ELM Control: 3-D Field Induced Transport**. Developing a solid physics basis for ELM control in ITER is a top priority for the DIII-D program. The goal of this task force will be to understand the edge transport in the boundary of the plasma as a consequence of the presence of 3-D fields, how that transport leads to ELM suppression, and how to extrapolate to ITER conditions. 3-D fields from both external coils and internal MHD are relevant. This effort will include evaluating the 3-D magnetic topology as necessary to understand the resulting transport and ELM suppression. This task force will have a very strong focus on coordinated analysis, including detailed characterization of the operating space, and analysis to compare with proposed models. Enhanced analysis should lead to specific, high leverage proposals that will provide new data on edge transport and ELM suppression. Close coordination and cooperation with theory is necessary. This effort should build on improved understanding of the plasma response to external magnetic field perturbations, recent analysis of edge fluctuation measurements and the edge electric field, the recent review of the physics of ELM control ("CP-coil Physics Review") and the internal workshop on "ELM Control Physics Hypotheses." This effort is organized as a Task Force under the Director of Experimental Science. Work in support of DIII-D 2011 Milestone 178 (which targets changes in transport associated RMP ELM control) falls within this Task Force.

- **Runaway Electron Dissipation and Control for ITER**. Disruption mitigation is a top priority for ITER, and DIII-D experiments this past year have produced exciting results related to control of runaway electrons generated during disruptions. The effort in 2011 will focus on (1) improved control of these runaway electrons and developing the physics basis for their safe, controlled dissipation; and (2) continued evaluation of mass delivery techniques. This effort is organized as a Task Force under the Director of Experimental Science.

- **Evaluation of Off-Axis NBI Physics**. Off-axis neutral beam injection on DIII-D brings important new capabilities for research in a number of areas, including current drive, stability, rotation, transport, and sustained advanced steady-state scenarios. Initial operation of this important new research tool will focus on validating the fundamental operating physics (e.g., deposition, heating, and current drive profiles), thereby enabling its use in a wide variety of experiments. Experiments on this topic should support DIII-D 2011 Milestone 177, and are organized under the Fusion Sciences area within the Experimental Science Division.

- **Profile Stiffness and Critical Gradients**. We have made significant progress on transport model validation with comparisons between GYRO/TGLF calculations and a wide range of local fluctuation and gradient measurements. The general subject of profile stiffness and the existence of critical gradients, which underlie many predictions of ITER performance, remains an important topic that may benefit from new experiments. Increased ECH power and off-axis neutral beam injection bring new capabilities for comparing theory and experiment in DIII-D. These activities are organized within the Fusion Science area of the Experimental Science Division.

- **Alternative Techniques for ELM Control**. Reliable alternative techniques for ELM control that do not require complex internal coils would be of great benefit to ITER and to magnetic fusion energy development. This effort should focus on pellet pacing, QH-mode, other ELM free or small ELM regimes, and possible other innovative ideas to control ELMs toward the development of a strong physics and operational basis for confident application to ITER. Experiments in this area should seek to develop this basis, and are organized under the umbrella of the ITER Physics area of the Experimental Science Division.

- **Pedestal Structure**. The edge-pedestal remains one of the largest unknowns for predicting ITER performance and ELM behavior. Experiments here will seek systematic tests of the physics which forms the basis of a variety of existing models of the edge pedestal structure in plasmas optimized for edge-pedestal measurements, using the full range of tools available to measure and control key parameters. Experiments are organized by a working group under the umbrella of the Integrated Modeling area of the Experimental Science Division. These experiments should provide the research required for DIII-D FY2011 Milestone 176 and support the FY2011 DOE FES Joint Research Target. Close interaction is expected with the theory community.

- **Fully Noninductive Scenarios with Off-Axis Neutral Beam Injection**. Off axis neutral beam injection will be an important new tool for developing and studying fully noninductive Advanced Tokamak discharges. Experiments in this area will begin to use this tool to optimize the evolution of the q-profile for self-consistent noninductive current drive in high performance plasmas. This research is organized as a Working Group within Steady-State Integration.

- **Scenario Development at Low Torque/Rotation for FNSF and ITER**. Anticipating operation of future devices having reduced momentum input from neutral beam injection, we will begin developing relevant operational scenarios for such tokamaks. Emphasis should be given to developing high performance scenarios without the assistance of NBI torque, potentially taking advantage of alternate techniques for driving plasma rotation. This research is organized as a Working Group within Steady-State Integration.

1.5. EXPERIMENTAL PROGRAM DEVELOPMENT

The 2011 experimental plan was compiled based on input and prioritization provided by the 2011 DIII-D Research Council (see page vii for list of council members for 2011). The Research Council develops a research plan on an annual basis based on the "DIII-D Five-Year Program Plan 2009-2013," January 2009, GA-A25889, with adjustments made for scientific and programmatic issues identified since that plan was written. As already stated, these deliberations consider the needs of ITER and ITPA, as well as input from the US Burning Plasma Organization.

In November 2010, a call for experimental research proposals towards the DIII-D objectives was issued and 542 proposals were received and presented at a community-wide Research Opportunities Forum (ROF; http://fusion.gat.com/global/Rof2011) on December 7-9, 2010. The overall interest of the general fusion community in research on DIII-D is exemplified by the large number of proposal submissions that were received from universities (172) and foreign labs (41), including 23 proposals received directly from the ITER International Organization (IO) in Cadarache, France. Remote participation, using H.323 video, was used in the plenary and most of the breakout sessions to allow participation by scientists at many remote locations in the US, including Princeton Plasma Physics Laboratory, Massachusetts Institute of Technology, and Oak Ridge National Laboratory, and internationally, including JET, ASDEX-Upgrade, JAEA, MAST, TEXTOR and the ITER IO. The interest shown in the DIII-D program is partly a result of DIII-D's commitment to domestic and international collaborations as well as its participation in the ITPA process and ITER Design Review. A listing of the proposals received at the ROF can be viewed at http://fusion.gat.com/global/Rof2011.

For 2011 the working groups reviewed these proposals and gathered additional ideas in response to results from the 2009-10 experimental campaigns. Reprioritization of the new set of remaining proposals was done within the working groups and an overall prioritized run plan proposal was prepared in each physics area and task force. These plans were then presented to the Research Council. Subsequently, the Research Council provided advice to the Director on the relative allocation of experimental time amongst the various areas. Based on this input, the Director established the experimental allocation for each program area.

1.6. RUNTIME ALLOCATION

The run time allocation for 2011 is based on a 14-week experimental campaign. To allow for contingency, experimental time has been allocated for 49.5 run days out of a possible 70 run days, with 14 days of contingency, 1.5 days of Torkil Jensen Award experiments and 5 days director's reserve. Additional detailed information can be found on the web, and related links: https://diii-d.gat.com/diii-d/Exp11.

The final run plan (Table III and Fig. 2) reflects the DIII-D Team's commitment to support ITER Urgent Design Issues, as identified by the ITPA, US BPO, the ITER Design Review Working Groups, and the ITER STAC. The plan is highlighted by experiments in support of urgent physics issues, including research results that may have an immediate impact on the ITER design itself. Experiments where DIII-D has unique capabilities to address these issues have been given highest priority.

A detailed breakdown of the priorities within the allocated days for the task forces, working groups and the Torkil Jensen award are given below.

- **Task Forces**

Task Force on ELM Control and 3D Field-induced Transport (5 days). ELM control remains a top priority for ITER and for the DIII-D program, and the Task Force is focused on developing sufficient physics understanding of RMP ELM suppression to extrapolate to ITER and inform ITER decisions. The initial allocation of five days for experiments related to the physics of ELM control via application of 3D field perturbations should be allocated to focused parameter scans for detailed comparison with models, as determined from recent analysis by the Task Force. The possibility for developing improved understanding via joint experiments with ASDEX-Upgrade, which recently confirmed ELM suppression by application of RMP fields should be exploited. Since analysis by the DIII-D ELM Control Task Force is ongoing, and since new data from ASDEX-Upgrade is still coming in, up to three additional days of Director's Reserve is being held for consideration of additional ELM control experiments this year. Results should inform an evaluation in 2012 on whether to propose additional non-axisymmetric coils in DIII-D.

Table III
Run Time Allocations for the 2011 Experiment Campaign

Area	Description	Plan (Days)	ITPA/IEA Experiments (Days)*	Area Leaders
Task Forces (reporting to Director of Experimental Science Division)				
ELM control and 3D field-induced transport	Develop sufficient physics understanding of RMP ELM suppression to extrapolate to ITER and inform ITER decisions.	5	5	**M. Wade** R. Nazikian
Runaway electron dissipation and control for ITER	Develop improved control of these runaway electrons, as well as to understand the physics basis for their safe and controlled dissipation after the disruptions	3.5	2	**E. Hollmann** V. Izzo
Torkil Jensen Award	Support experiments investigating potentially transformational physics using innovative techniques	1.5	0	**M. Wade**
Physics Groups (reporting to Physics Group Leaders)				
Steady-state integration	Develop the physics basis for steady-state operation in ITER and future devices	11	5	**T. Luce**
Integrated modeling	Experimental validation of complex theoretical models	4	1	**R. Prater**
ITER physics	Provide physics solutions to key design and operational issues for ITER	10	10	**E. Strait**
Plasma control and operations	Develop and deploy state-of-the-art plasma control systems for DIII-D	2	1	**D. Humphreys**
Fusion science	Advance basic fusion plasma science on DIII-D through test of basic theories, development of new measurement capabilities, and novel ideas	10	4	**C. Petty**
Plasma boundary interfaces	Develop an improved understanding of energy and particle transport in the plasma boundary through tests with applicable theories/models, characterization of the interaction of the plasma with material surfaces, the migration and retention of eroded materials and fuel in those surfaces, and the development of new measurement capabilities	4	2	**T. Leonard**
	Total allocated days	**51**	**30**	
	Director's reserve	**5**		
	Contingency	**14**		
	Available days	**70**		

*These are the number of days allocated for ITPA experiments and is consistent with Table II given that there are multiple experimental days for many ITPA areas (i.e., ID nos.).

ITER Physics	10
Steady State Integration	11
Fusion Science	10
Integrated Modeling and Pedestal Structure	4
Plasma Control and Operations	2
Runaway Electron Dissipation and Control for ITER	3.5
ELM control and 3D field-induced transport	5
Torkil Jensen Award	1.5
Director's Reserve	5

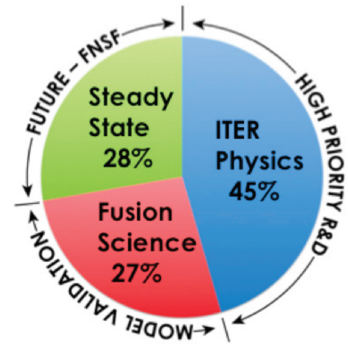

Fig. 2. The fractional allocation of 2011 Experimental Campaign run time into the three primary areas of the DIII-D program shows continuation of DIII-D's strong commitment to ITER related physics research.

Task Force on Runaway Dissipation and Control for ITER (3.5 days). The recent demonstration of controlled dissipation of disruption-induced runaway electrons (RE) has significant implications for ITER. Three and one-half days are allocated for this task force for FY2011 to examine and improve active control (radial and vertical) of the runaways, exploring the effect of shape on RE stability and testing methods to enhance the safe dissipation of RE energy and current. Experimental time should also be used to explore techniques which can improve disruption mitigation by massive gas injection or offer alternative approaches such as shell pellets.

Physics Groups

ITER Physics Group (10 days). The DIII-D ITER Physics Group has identified a number of important research needs to support ITER. A total of 10 days is allocated in this area to address urgent issues for ITER. Alternate techniques for ELM control are specifically high priority and experiments should primarily address pellet pacing, along with some QH-mode development. The ITER TBM mock-up will be re-installed late in the year to allow completion of remaining experiments focused on n=1 error-field correction in H-mode plasmas. Experiments related to ITER scenarios should focus on specific ITER needs consistent with ITER priorities and DIII-D capabilities, such as development of real-time NTM control and evaluation of discharges with EC/ electron heating and T_e/T_i approaching unity. Opportunities to evaluate discharges with low momentum input should be coordinated with the SSI group.

Steady-State Integration Group (11 days). A total of 11 days is allocated for research in support of Advanced Tokamak development. Successful commissioning of the off-axis neutral beam will bring significant new capability for current profile control experiments to build upon recent results. Initial experiments confirming the physics validation of the off-axis NBI will be carried out under Fusion Science (see below). Time should be allocated to developing low-torque scenarios relevant to future burning plasma experiments and possible Fusion Nuclear Science Facilities which will rely on torque-free heating systems. At the end of this year there will be an assessment of the fast wave system with regard to present capabilities and future directions for providing electron heating in high performance plasmas. The responsibility for obtaining the data necessary to prepare for this assessment falls within the steady-state integration area, though experiments examining the interaction between the SOL and FW antenna should be carried out within Fusion Science (see below).

Fusion Science (includes research in support of Milestone 177) (10 days). Research within the Fusion Science area of the Experimental Science Division spans a very wide range of topics; virtually all research on DIII-D contains a strong fusion science component. This year, 10 days are allocated to Fusion Science. Early in the campaign, experiments to evaluate off-axis NBI physics (necessarily including fast-ion physics) should have priority. Tests of transport models, as related to profile stiffness and critical gradients, should also receive high priority. Proposed experiments to vary the fast wave coupling by changing the SOL conditions should focus on maintaining compatibility with high performance operation; active participation from the PBI group is essential to this effort. The primary responsibility for evaluating FW capability for heating high performance plasmas falls within steady-state integration.

Integrated Modeling (focus on MS 176 and Joint Research Target) (4 days). Four days in FY11 are allocated for experiments focused on Milestone 176 and the FY 2011 Joint Research Target on understanding the H-mode pedestal structure. Priority should be given to testing predictive models that have the potential of delivering definitive results on pedestal structure.

Plasma Control (2 days plus unspecified number of 2-hour shifts). Two days (+2 hr blocks on Thursday evenings) are allocated to plasma control experiments in 2011. As previously, plasma control has priority for the 2 hours on Thursday evening to develop control methodology for upcoming experiments and advancing integrated plasma control to enhance DIII-D capability. Experimental time should focus on addressing issues related to proposed upgrades for powered-VFI operation, characterizing disturbances as related to control boundaries in ITER-like plasmas, and continuing development of model-based profile control for advanced tokamak research.

Plasma Boundary Interfaces (4 days). Four days are allocated for boundary experiments in 2011. Priority should be given to experiments seeking to develop the physics basis for stable control of partially detached divertors for ITER and future high power devices such as FNSF or DEMO. The role of divertor geometry in setting the detachment threshold should be explored. Related experiments studying fundamental properties of the SOL plasma should also receive time, as appropriate considering diagnostic developments and ITPA needs. Research supporting development of plasma facing components should focus on measuring gross erosion of high-Z materials using DiMES.

The 14 run week experimental plan for 2011, summarized in Tables III and IV, consists of efforts in two task forces and six physics groups. The physics groups themselves are in turn made up of a total of 20 working groups (Fig. 1).

- **Torkil Jensen Award**

Torkil Jensen was an extremely productive physicist whose long career was marked by innovative work on a wide variety of fusion-related subjects brought forward with a strong sense of optimism and enthusiasm. The Torkil Jensen Award was created to inspire proposals from the broader fusion community for experiments with potential for transformational new results with high visibility or scientific impact. This year, the Torkil Jensen Award selection committee (Jerry Navratil, Miklos Porkolab, and chair Jim DeBoo) evaluated 12 proposals submitted prior to the start of the Research Opportunities Forum. While the committee noted that the overall quality of the proposals was very high, they were able to make a unanimous, strong recommendation for this year's winners:

George McKee – *Confinement Enhancement via Resonant Radial Field Amplification of the Geodesic Acoustic Mode* (1 day) and

Oliver Schmitz – *Bifurcated Helical Core Equilibrium at DIII-D* (0.5 day pending finalization of the run plan)

1.7. GOALS OF TASK FORCES AND WORKING GROUPS

The plans and goals for the task forces and various science areas are detailed in the following sections.

1.7.1. TASK FORCE ON 3-D FIELD INDUCED EDGE TRANSPORT AND ELM CONTROL (Leader: M. Wade Deputy: R. Nazikian)

1.7.1.1. Mission. Understand the magnetic topology in the presence of 3-D fields, how the transport in the boundary of the plasma responds as a consequence of the presence of 3-D fields, how that transport leads to ELM suppression, and how to extrapolate to ITER conditions.

1.7.1.2. Importance and Urgency. ITER needs to make a design decision in the next 1-2 years regarding the inclusion of ELM control coils to mitigate and suppress ELM activity. This decision requires a firm physics basis for the interaction of 3-D fields with plasma that extrapolates from current observations on DIII-D and AUG to ITER relevant parameters. In order to provide such a physics basis, DIII-D must undertake new experiments to fill vital gaps in the existing data and perform detailed physics analysis over a range of key plasma parameter required for extrapolation to ITER conditions.

1.7.1.3. Research Areas for 2011. This Task Force will focus on the following areas:

- Determine the magnetic topology and plasma response to the presence of externally applied non-axisymmetric fields.
- Investigate how external and internal non-axisymmetric fields change plasma transport (particle, energy and momentum).
- Explore how non-axisymmetric fields modify ELM stability.

1.7.1.4. New and/or Unique Tools.

- Combination of upper and lower internal perturbation coils (I-coils) capable of high frequency or high current operation with external error field correction coils (C-coils).
- Unique diagnostics, such as tangential soft x-ray imaging at the X-point region and above midplane magnetic probes, to measure plasma response including resonant field amplification and island formation.
- Application of state-of-the-art modeling tools such as MARS-F, PIES, M3DC1, ELITE, XGC0 and other codes to assess the plasma response to non-axisymmetric fields.

1.7.2. TASK FORCE ON RUNAWAY DISSIPATION AND CONTROL FOR ITER (Leader: E.M. Hollmann Deputy: V. Izzo)

1.7.2.1. Mission. Make recommendations to ITER on best approach for avoiding runaway electron-wall damage during disruptions or rapid shutdown.

1.7.2.2. Importance and Urgency. The possibility of localized wall damage due to runaway electron beams is one of the highest concerns of ITER. DIII-D solutions to this problem would affect ITER hardware decisions.

1.7.2.3. Research Areas for 2011. This Task Force will focus on the following areas:

- Reliable position and current control of large runaway electron beams with external coils.

- Dissipation of existing large runaway electron beams using massive impurity injection.
- Understanding runaway electron seed formation in rapid shutdown experiments.
- Collisional suppression of runaway avalanche by rapid shutdown with massive impurity injection.

1.7.2.4. New and/or Unique Tools.

- Unique large shattered cryogenic deuterium pellet injector.
- Fabrication and injection of customized shell pellets for rapid shutdown.
- New runaway electron diagnostics (multiple fast cameras, HXR scintillator array, CdTe detectors).

1.7.3. ITER PHYSICS (Leader: E.J. Strait)

The ITER Physics group provides a home for several issues of importance to ITER, as well as a point of contact for future ITER physics needs. ELM Control for ITER is the high priority physics topic in this area.

1.7.3.1. Mission. Provide physics solutions to key design and operational issues for ITER.

1.7.3.2. Importance and Urgency.

- Short-term research is needed to address short-deadline urgent issues, identified during the ITER design review.
- Several other issues have been identified that can be addressed in the medium-term and still have impact on the ITER design.

1.7.3.3. Research Areas for 2011. This physics group is organized into the following working groups:

- **Alternative Techniques for ELM Control (high priority research topic).** Evaluate ELM control techniques other than resonant magnetic perturbations (RMP), using the same "ITER operation" constraints as for RMP experiments. The primary focus will be on high-frequency pellet injection for ELM pacing, and QH-mode in low torque plasmas. Preliminary exploration of I-mode may also be done.

- **TBM Mockup and Error Field Effects**. Develop improved physics understanding of the plasma response to error fields, and their control in DIII-D and ITER. The focus in 2011 will be to test the ability of n=1 compensation fields to ameliorate TBM-caused braking and confinement reductions in H-mode plasma, and to begin development of improved error field correction using multiple coil sets.

- **NTM Stabilization**. Establish a physics basis for NTM stabilization in ITER. Validate model predictions for NTM stabilization by modulated and continuous ECCD. Develop methods for control of locked tearing modes. Experiments in 2011 will develop NTM control using real-time steering of ECCD mirrors.
- **Disruption Characterization and Avoidance.** Characterize disruption heat and electromagnetic loads and their asymmetries for extrapolation to ITER, and develop operation free of disruptions. Experiments in 2011 will focus on disruption postponement/avoidance by localized EC heating or current drive, possibly with applied non-axisymmetric magnetic perturbations.
- **ITER Demonstration Discharges**. Develop improved basis for projections to ITER through direct comparison of the four primary ITER scenarios on a single present device. Explore performance optimization methods for ITER scenarios. Experiments in 2011 will focus on baseline scenario performance with dominant electron heating and Te/Ti near unity.

1.7.4. STEADY-STATE INTEGRATION (Leader: T.C. Luce)

Assessment of steady-state current profiles for optimum performance is the high priority research topic in this physics area. Noninductive scenarios with off-axis neutral beam injection and low torque scenario development for ITER and FSNF are the topics for the two high priority working groups this year.

1.7.4.1. Mission. Develop the physics basis for steady-state operation in ITER and future devices.

Demonstrate stationary high-performance inductive and noninductive solutions that would satisfy the objectives of future fusion devices. Develop sufficient physics understanding for projection and optimization of similar scenarios for existing and future tokamaks.

1.7.4.2. Importance and Urgency. Steady-state scenarios will likely be required in a future fusion-based power plant. In a shorter term, this effort should build a basis for steady-state scenarios in ITER, FDF, and DEMO. The urgency comes from a need to specify appropriate actuators to achieve steady-state ITER operation.

1.7.4.3. Research Areas for 2011. This physics group is organized into the following working groups:

- **Noninductive Scenarios with Off-Axis Neutral Beam Injection (high priority).** Use the new off-axis neutral beam injection capability to expand the range of achievable q-profiles and evaluate their potential for fully noninductive, high performance operation. This year the goal is to use the off-axis beams to produce and maintain discharges with $q_{min}>2$ with broader current and pressure profiles, increased confinement time, higher normalized beta, and higher noninductive current fraction than previously obtained.

- **Low Torque Scenario Development for ITER and FSNF (high-priority).** Develop the advanced inductive scenario to be fully compatible with low torque operation, including during the startup phase. This will begin to address several key issues, including documenting access to, as well as the performance and stability of, advanced operating modes in more ITER and reactor-relevant regimes.

- **Core-Edge Integration**. Explore how high performance AT-class H-mode plasmas respond to heat flux reduction methods involving ELM suppression by RMP and radiative divertor. Evaluate how the variation in the length of outer divertor leg and the radial placement of the outer divertor separatrix affect overall plasma performance and divertor heat flux at the outer target.

- **RWM Physics**. The first priority for RWM study is to clarify the RWM kinetic stabilization effect, whose impact is reduced with reversed B_T, as well as with off-axis NBI. The experimental results will allow us to directly compare a few leading theoretical models of kinetic effects not only for steady-state high-beta plasmas but also for ITER and beyond. The normal B_T operation might be needed for confirming the results.

- **Application of Fast Waves (FW) to Advanced Inductive Discharges**. Maximize the FW power level that can be coupled to the core of AI discharges, with the goal of demonstrating levels exceeding 3 MW. Search for conditions of maximum antenna loading while maintaining high β_N and confinement.

1.7.4.4. Unique Tools.

- High power ECH/ECCD (six gyrotrons at start of campaign) for off-axis current drive.
- The pumped divertor regions facilitate particle control in plasma shapes optimized for high β.
- The internal I-coil and external C-coil for simultaneous error field and RWM control.
- Counter-NBI, provided by the rotated 210° beamline, allows control of applied torque decoupled from heating power, facilitating low-rotation studies.
- Off-axis NBI provided by the 150° beamline allows off-axis neutral beam current drive.

1.7.5. FUSION SCIENCE (Leader: C.C. Petty)

1.7.5.1. Mission. Advance the fundamental science understanding of fusion plasmas, especially in areas where DIII-D has unique capabilities or high leverage.

1.7.5.2. Importance and Urgency. Understanding of the physics underlying the behavior of fusion plasmas is critical in building a predictive capability for the design and operation of future devices.

1.7.5.3. Research Areas for 2011. This physics group is organized into the following working groups. Although the topical science areas of previous years are each represented by a working group within Fusion Science, much of the work that would have previously been in these areas is now done elsewhere in the program. The overall emphasis on science in the DIII-D program is not diminished, rather it permeates the entire DIII-D research program.

- **Evaluation of Off-Axis NBI Physics (high priority)**. Test the deposition profile, fast ion confinement (including effect of microturbulence), and current drive profile for the off-axis beam, and compare to theoretical models. This work supports Milestone 177.
- **Profile Stiffness and Critical Gradients (high priority)**. Goal is to test the stiffness and critical gradients predictions in the TGLF code against experimental data from DIII-D and (possibly) other tokamaks. Both the ion and electron channels will be studied in separate experiments.
- **Transport**. The goal of the DIII-D Transport Topical Area is to develop a fundamental and comprehensive understanding of turbulence and transport

behavior in magnetically confined plasmas, with a long-term goal of developing a predictive capability for turbulent transport. Progress in this area is closely coupled with development of theory-based turbulent transport models in the Profile Stiffness and Critical Gradients Working Group and the Integrated Modeling Physics Research Area.

- **Stability**. The goal of the DIII-D Stability Topical Area is to establish the scientific basis to predict and control macroscopic instabilities. This work is coupled with associated stability work in the other Physics Research Areas.
- **Heating and Current Drive**. The goal of the DIII-D Heating and Current Drive Topical Area is to develop comprehensive, predictive models for NBCD, ECCD, and FWCD. In addition, research on the self-generated bootstrap current is in this topical area. This group, in combination with the Steady State Integration Physics Area, is aiding the Fast Wave assessment in September of 2011.

1.7.5.4. New and/or Unique Tools.

- DIII-D's uniquely comprehensive diagnostic set facilitates detailed fusion science studies. New diagnostics include the FILD-2, Flex-BES, main ion CER, and a camera/intensifier for visible light imaging.
- Unique capabilities to vary shape, heating location and mix, and density. The off-axis beam and real time steerable ECH launchers are an important enhancement to our ability to vary the heating profile

1.7.6. INTEGRATED MODELING (Leader: R. Prater)

1.7.6.1. Mission. The experimental validation of complex theoretical models.

1.7.6.2. Importance and Urgency. Understanding of the physics underlying the behavior of fusion plasmas is critical in building a predictive capability for the design and operation of future devices. This understanding will be embodied in codes representing complex physical models. Experimental validation is a critical step in preparing these codes for use as predictive tools.

1.7.6.3. Research Areas for 2011. This physics group for 2011 has two working groups because the work on pedestal structure physics previously done in a task force is now handled by this physics area:

- **Pedestal Structure Physics**. The experimental plan will focus on meeting milestone 176 and the FY2011 Joint Research Target on Pedestal Physics. Experiments will be performed to test models for several physics processes, which have been proposed by theory to be important in controlling pedestal structure.

- **Integrated Modeling**. Integrated modeling of simulated alpha heating in an ITER demonstration discharge.

1.7.6.4. Unique Tools.

- All of the tools listed for Fusion Science are applicable.
- In addition, close collaboration with the GA Theory Group and other modelers is important for this effort.

1.7.7. PLASMA CONTROL AND OPERATIONS (Leader: D. Humphreys)

1.7.7.1. Mission. Develop and deploy state-of-the-art plasma control systems for DIII-D. Study control issues for ITER and beyond.

1.7.7.2. Importance and Urgency. Studies of control physics (e.g. plasma disturbances) that determine the limits and robustness of control are of critical short-term importance to ITER and may have impact on the design of that device. Work in model-based control should have impact on the DIII-D program within the next two years. Development of new approaches to control of the shaping coils will improve our ability to develop and control new sets of plasma conditions. Development of model-based profile control algorithms will improve access to and sustainment of steady state plasma regimes.

1.7.7.3. Research Areas for 2011. This physics group is organized into the following working groups:

- **General Plasma Control and Operations.** Develop and demonstrate improved control approaches for DIII-D. Study control physics with high priority on ITER short-term control needs.

- **Model-based Integrated Control**. Develop model-based, highly-integrated multivariable plasma control for routine operation in DIII-D. Develop model-based profile control.

1.7.7.4. New and/or Unique Tools.

- Unique DIII-D Plasma Control System and Tokamak Systems Toolbox (Matlab code suite) for control design and simulation.

1.7.8. PLASMA BOUNDARY INTERFACES (Leader: T. Leonard)

1.7.8.1. Mission. Provide physics understanding of SOL plasma, divertor plasma and plasma materials interaction toward solutions of steady state and transient heat and particle flux issues for ITER and future high power tokamaks.

1.7.8.2. Importance and Urgency. Determining and understanding the physics of SOL plasma, divertor plasma and plasma materials interactions is critical for the design and operation of ITER and future devices.

1.7.8.3. Research Areas for 2011. This physics group is organized into the following working groups:

- **Physics Divertor Detachment and Plasma Flows**. Test models of detachment onset and the interaction of plasma flows with attached and detached divertor plasmas. Explore configurations with potential for enhanced divertor detachment and heat flux spreading control.
- **Thermal Transport in the Plasma Boundary.** Develop understanding of the heat transport in the plasma SOL and divertor toward predictive capability for ITER including fluctuation driven transport in the SOL. Examine the SOL transport and profiles that lead to the observed scaling of divertor heat flux width.
- **Hydrogen Retention**. Measure the campaign-integrated retention of deuterium trapped in re-deposited carbon for a row of lower divertor tiles. Determine the rate of eroded carbon and retained deuterium normalized by the ion flux to plasma facing components
- **High-Z Material Erosion**. Measure the gross and next erosion rate for high-Z materials, Mo or W, using the DiMES facility. Compare the results with models for gross and net erosion.

1.7.8.4. New and Unique Tools

- 2D profile of SOL and divertor carbon flow velocity using a new coherence imaging diagnostic
- Improved divertor Thomson scattering with a new higher power and higher frequency laser
- Measurement of divertor heat flux toroidal asymmetries with an additional IR camera at a second location.
- New divertor Langmuir probes in the inboard lower divertor.

1.8. DETAILED LIST OF SCHEDULED EXPERIMENTS

Table IV lists the experiments that will be scheduled during the 2011 experimental campaign (as of April 11, 2011).

Table IV
Detailed list of Experiments for the 2011 Experiment Campaign

Expt	Title	Area	SL
2011-01-01	3-D field induced transport-Day 1*	ELM control: 3-D field transport	Wade, M.
2011-01-02	3-D field induced transport-Day 2*	ELM control: 3-D field transport	Wade, M.
2011-01-03	3-D field induced transport-Day 3*	ELM control: 3-D field transport	Wade, M.
2011-01-04	3-D field induced transport-Day 4*	ELM control: 3-D field transport	Wade, M.
2011-01-05	3-D field induced transport-Day 5*	ELM control: 3-D field transport	Wade, M.
2011-02-01	Runaway electron plateau position control	Runaway electrons control	Eidietis, N.
2011-02-02	Massive impurity injection into RE plateau	Runaway electrons control	Wesley, J.
2011-02-03	Rapid shutdown with massive impurity injection	Runaway electrons control	Wesley, J.
2011-02-04	Effect of initial target plasma shape on RE formation/loss	Runaway electrons control	Humphreys, D.
2011-09-01	Confinement enhancement via resonant radial field amplification of the GAM	Torkil Jensen award	McKee, G.
2011-09-02	Bifurcated helical core equilibrium	Torkil Jensen award	Schmitz, O.
2011-11-01	q_{min}>2 with off-axis beams Day 1	Fully noninductive scenarios with off-axis NBI	Holcomb, C.
2011-11-02	q_{min}>2 with off-axis beams Day 2	Fully noninductive scenarios with off-axis NBI	Holcomb, C.
2011-11-03	q_{min}>2 with off-axis beams Day 3	Fully noninductive scenarios with off-axis NBI	Holcomb, C.
2011-12-01	Low torque advanced inductive startup	Scenario development at low torque	Solomon, W.
2011-12-02	Advanced inductive beta limits at low torque	Scenario development at low torque	Solomon, W.
2011-15-01	Fast wave heating of advanced inductive plasmas Day 1	General SSI	Pinsker, R.
2011-15-02	Fast wave heating of advanced inductive plasmas Day 2	General SSI	Pinsker, R.

2011-15-03	SSI managers reserve Day 1+	General SSI	Luce, T.
2011-15-04	SSI managers reserve Day 2+	General SSI	Luce, T.
2011-15-05	SSI managers reserve Day 3+	General SSI	Luce, T.
2011-15-06	SSI managers reserve Day 4+	General SSI	Luce, T.
2011-21-01	Test models for limiting pedestal gradients (KBM)	Pedestal structure	Snyder, P.
2011-21-02	Test models for limiting pedestal gradients (ETG, Paleo)	Pedestal structure	Groebner, R.
2011-21-03	Test role of neutral fueling vs density pinch in density pedestal with opaque SOL	Pedestal structure	Leonard, A.
2011-21-04	Test role of neutral fueling vs density pinch in density pedestal with dimensionless match to C-Mod	Pedestal structure	Hughes, J.
2011-21-05	Are HFC modes a signature of linear KBM physics?	Pedestal structure	Zheng, L.
2011-21-06	Group leader reserve	Pedestal structure	Groebner, R.
2011-31-01	QH-mode with C-coil alone, I & C-coils	Alternative techniques for ELM control	A. Garofalo
2011-31-02	QH-mode at ITER conditions	Alternative techniques for ELM control	K. Burrell
2011-31-03	ELM pacing by pellets	Alternative techniques for ELM control	Baylor, L.
2011-31-04	Compatibility of fueling with ELM pacing	Alternative techniques for ELM control	Commaux, N.
2011-31-05	Group leader reserve	Alternative techniques for ELM control	Fenstermacher, M.
2011-32-01	TBM n=1 error compensation in H-mode	Error field and TBM mockup effects	Schaffer, M.
2011-32-02	Error field correction with multiple poloidal harmonics	Error field and TBM mockup effects	Schaffer, M.
2011-33-01	Disruption avoidance by localized ECH	Disruption characterization	Wesley, J.
2011-34-01	NTM control: Check out real-time mirror steering	NTM stabilization	Welander, A.
2011-34-02	NTM control: Develop mirror steering algorithms	NTM stabilization	Welander, A.
2011-35-01	ITER baseline scenario with dominant electron heating	ITER demonstration discharges	Jackson, G.
2011-41-01	Current profile control	Integrated and model-based control	Walker, M.
2011-42-01	Disturbance controllability	General plasma control	Humphreys, D.
2011-42-02	Powered VFI	General plasma control	Walker, M.

2011-51-01	Off-axis beam checkout and classical beam ion confinement	Evaluation of off-axis NBI physics	Heidbrink, W.
2011-51-02	Off-axis NBCD measurement	Evaluation of off-axis NBI physics	Park, J.M.
2011-51-03	Effect of microturbulence on off-axis NBCD and fast ion confinement	Evaluation of off-axis NBI physics	Pace, D.
2011-52-01	Investigate stiffness in the ion channel as a function of toroidal rotation	Profile stiffness and critical gradients	Burrell, K.
2011-52-02	Investigate critical gradient and stiffness in the electron channel	Profile stiffness and critical gradients	DeBoo, J.
2011-53-01	L-H transition trigger physics: density and q_{95} scaling mechanisms	Transport	McKee, G.
2011-53-02	Collisionality dependence of turbulence and particle transport	Transport	Zeng, L.
2011-54-01	Characterizing sawtooth physics	Stability	Tobias, B.
2011-54-02	Sawteeth control physics	Stability	La Haye, R.
2011-55-01	Enhancement of FW antenna loading with puffing	Heating and current drive	Pinsker, R.
2011-56-01	Off-axis NBI with Alfvén eigenmodes	Energetic particles	VanZeeland, M.
2011-61-01	DIMES high Z erosion	Plasma boundary interface	Leonard, A.
2011-61-02	SOL heat flux	Plasma boundary interface	Leonard, A.
2011-61-03	Detachment and flows	Plasma boundary interface	Leonard, A.
2011-61-04	Divertor geometry	Plasma boundary interface	Leonard, A.

*This task force is involved in detailed coordinated analysis of previous data and detailed experiments within this area will be decided later into the 2001 experimental campaign.

+Further detailed experiments within this area will be determined after analysis of results from initial experiments.

1.9. THE 2011 OPERATIONS SCHEDULE

The operations schedule is designed for efficient and safe use of the DIII-D facility. Fourteen calendar weeks of plasma physics operations are scheduled for the fiscal year 2011. FY2011 operations are scheduled to start on May 9 and end on September 23, 2011.The operations schedule is shown in Fig. 3. Operations in 2011 are carried out 5 days per week for 8.5 hours, except for the three operations weeks in June 2011 during which the tokamak will be run for 11.5 hours per day (8:30 am to 8:00 pm). The 2011 operations schedule can be viewed at http://d3dnff.gat.com/Schedules/fy2011Sch.htm.

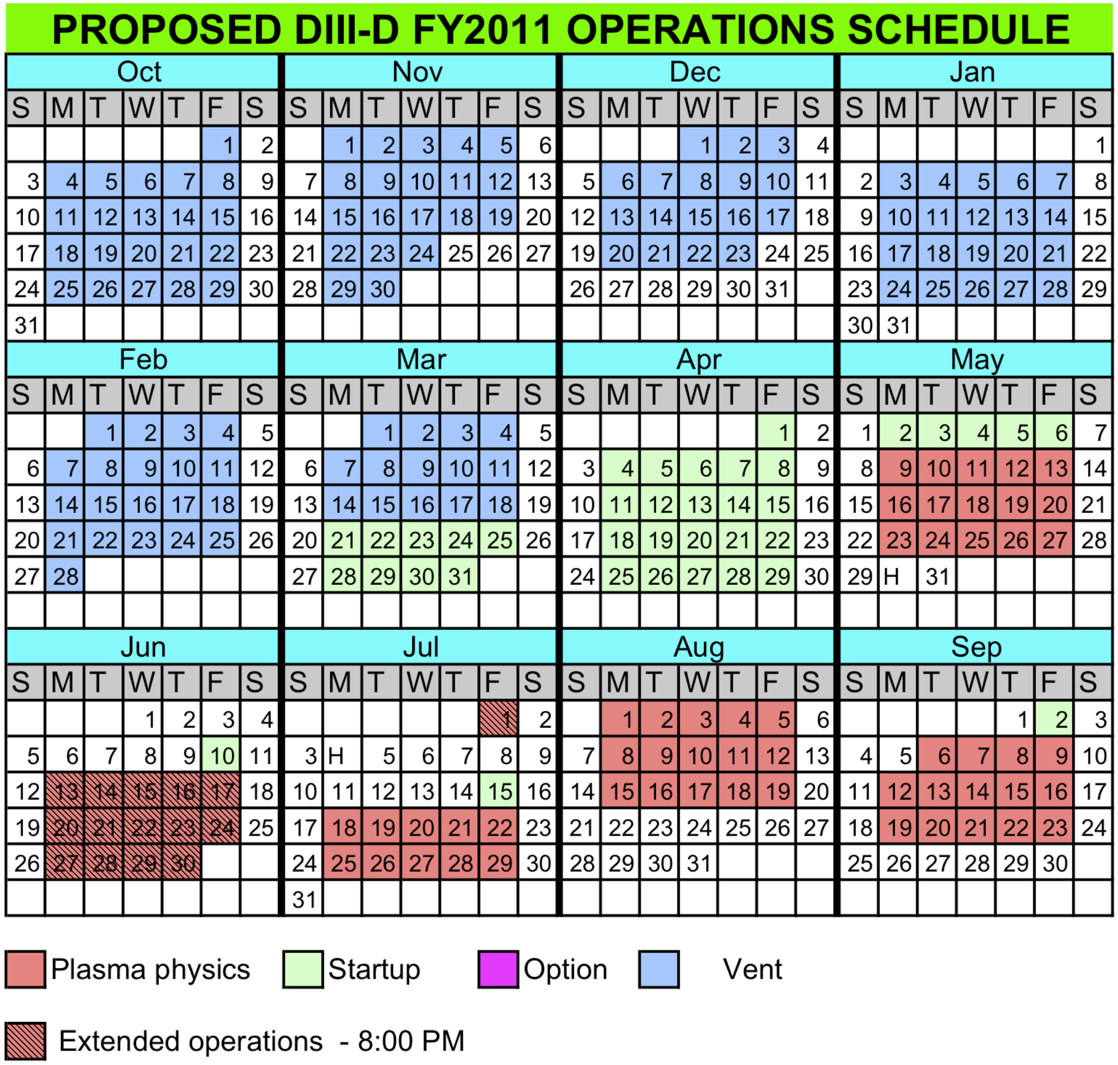

Fig. 3. DIII–D master schedule FY2011 (14-week plan).

In addition to operating the tokamak, maintenance has to be performed and new hardware is being installed to enhance DIII-D capabilities. The schedule calls for these maintenance activities to be carried out during the weeks that the tokamak is not operating.

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