Call for Proposals for 2012 KSTAR Experimental Campaign

March 10, 2012

1. Experimental Goals

In 2012, experimental focus of KSTAR will be placed on the study of pedestal behaviors with improved plasma performance and enhanced diagnostics for pedestal profiles and 2-D imaging.

In addition, other general experimental issues such as MHD, transport & turbulence, heating & current drive and plasma-wall interactions will be dealt with in accordance with the experimental proposals.

2. Operation schedule

Brief schedule of 2012 campaign is as follows.

- July : Completion of hardware installation in vacuum vessel
- July~ end of August :
  Vacuum pumping and leak detection
  Wall conditioning (baking the vacuum vessel and PFC)
  Magnet cool-down (300 K ~ 4.5 K)
  Discharge cleaning and diagnostic commissioning
- ~ early September :
  Magnet and power supply commissioning
  Magnetic diagnostics calibration
- Mid. September ~ November: Plasma experiments
- December : Closing the experiments and magnet warm-up

3. New Installations

- Heating System

1. One more NBI ion source will be added to the existing NBI beam tank. With this additional ion source, NBI heating power will be increased up to 3.5 MW
2. One lower hybrid system of 0.3 MW/2s @ 5 GHz will be available for LHCD study.
3. Deliverable power of 170 GHz ECH system is increased up to 0.8 MW

- Second ECEI system for 3D measurement
  Additional ECEI system will be installed at different toroidal location to get 3D Te image.

- RMP Power Supplies Upgrade
  Three independent DC power supplies for the RMP coils will be upgraded for n=1 and n=2 perturbation. The applicable maximum currents will be 4.0kA respectively.

- Impurity gas injection system
  Additional Ar gas will be available for impurity injection for SMBI and MGI

- Tungsten test tiles
  Four divertor tiles are replaced to tungsten for PWI study.

4. KSTAR Status

Planned Machine Operation Parameters

TF field	1.5~3.5 T (default 2.0 T at R= 1.80 m)
Plasma current	> 1.0 MA
Minor radius	0.3~0.5 m
Major radius	1.8 m
Line density	Up to $5x10^{19}$ m^3
Max PF flux	~ 8 Vs
Pulse length	> 10 s
Gas species	D(main), H(minority)
Base pressure	High 10^{-6} Pa
Plasma shape	D-shape (kappa ~ 1.8, delta ~ 0.8), DN & SN

Heating*

ECH	110 GHz, 400 kW, 2s 84GHz, 300kW, 2s 170 GHz, 800kW, 10s
LHCD	5 GHz, 300 kW, 2s
ICRH	30 MHz, ~1.0 MW, 10s
NBI	1.6 MW @ 100 keV, D_0, > 10s

* Deliverable power

Diagnostics Status	
Visible camera 1,2,3	Available, 210 fps, 380 fps, 2 kfps
mm-Wave interferometer	Available, Density Range:$5x10^{17}$ - $5x10^{19}$ m^{-2}
ECE radiometer	Available, 80 ch, 110 GHz -196 GHz, 100eV-5keV
Visible survey spectrometer	Available, 1 ch, 200-800nm
D-alpha monitor	Available, 30 ch, (Pol. 10ch, Tor. 20ch)
Filter scope	Available, 5 ch, (C, O, etc)
Resistive bolometer	Available, 5ch, 10^6 W/cm^2
Reciprocating probe	Available, 1 ch, scan: 5 cm, Te < 50eV, ne < $5x10^{17}$ m^{-3}
Fixed probe array	Available, 57 ch, poloidal profile of floating potential
Soft x-ray array	Available, 128 ch, 0.5 - 10 keV
X-ray pinhole camera	Will be available
Rogowskii coil	Available, 10kA -130kA
Flux loop	Available, 45 ch, 1-10V
Magnetic field probe	Available, 84 ch, 0.001- 0.03T
Locked mode coil /Saddle loop	Available, ~ 0.05 Wb
Diamagnetic loop	Available, 0.1- 10 mWb
Mirnov coil	Available, 500 kHz sampling (dB/dt)
XICS 1,2	Available, Te,Ti : 300eV – 4 keV; Vt 10 – 500 km/s
CES	Available ,100eV-20 keV, 4km/s ~ 500 km/s
Deposition Probe System	Available,
ECEI 1	Available, Dual poloidal images of Te. Vertical span = 30~90cm. Radial span (total) = 25~35cm, Radial range = 180+/-50cm. Bt range = 1.7~3.5T Sampling rate/span = 500kHz ~ 2MHz (10s~2.5s)
ECEI2	Available, Single poloidal image of Te (22.5 deg toroidally separated from ECEI1). Vertical span = 30~90cm. Radial span (total) = 10~15cm, Radial range = 180+/-50cm. Bt range = 1.7~3.5T Sampling rate/span = 500kHz ~ 2MHz (10s~2.5s)
MIR	Will be available,
Thomson	Will be available, core 4 & edge 13channel, 20eV~20keV
In-situ ellipsometry	In commissioning phase
BES	Will be available, 8 x 8 ch
FILD (Scintillator-based)	Will be available, PMT sampling: 500 kHz
CDG	Will be available,
IRTV for divertor	Will be available 0-1500 ℃
Edge reflectometer	Will be available, 2 ch, (Q, V bands, $0.2x10^{19}m^{-3}$
Imaging Bolometer	Will be available, 10^6 W/cm^2
FIR	Will be available, 1 ch, vertical, ne ~ 5 $x10^{19}m^{-3}$

5. **Task Force and Working groups**

To contribute to the dedicated mission of ITER related physics study, one task force will be organized for H-mode/pedestal studies. Four working groups will be managed for experimental proposals. About ten weeks will be available for plasma operation. Around three weeks will be assigned to plasma commissioning, three weeks for H-mode/pedestal and four weeks will be dedicated to other working groups.

Task Force

- H-mode/Pedestal: J. Y. Kim (Y. M. Jeon)
  - L-H transition
    - Trigger mechanism (ion-orbit loss, Reynolds stress, grad-Pi etc.)
    - Power threshold scaling (magnetic geometry, density, RMP effect etc.)
    - H-L back transition and hysteresis, including RMP effect
  - Pedestal build-up & structure
    - Pedestal gradient and width evolution
    - Pedestal width & height scaling
  - Pedestal stability & ELM characteristics
    - Attempts to various ELM types, including small ELM or ELM-free mode
    - ELM type dependence on various parameters (shape, collisionality, q_{95} etc.)
    - Nonlinear ELM behavior and filament structure
  - ELM control by using RMP
    - n=2 RMP effect (with larger IVC current)
    - n=1 RMP effect (more detailed study)
  - ELM control by using SMBI, vertical jogging, ECH/ECCD etc.
  - Attempts to improved H modes, such as QH mode

Working Groups

- MHD/EP : K.-I You (MHD: Jayhyun Kim, EP: Junghee Kim)
  - Sawtooth study/control
  - Tearing mode (classical/neoclassical) study/control
  - 3D field study
  - Disruption
  - Energetic particle driven mode study/control

- Transport & Turbulence : S. G. Lee (J. M. Kwon)
  - Understanding of momentum transport and toroidal plasma rotation
  - Understanding of particle and impurity transport
  - Determine thermal transport properties over a range of conditions
  - Turbulence measurements for comparison with theoretical model
  - LH Transition

- Heating and Current Drive : Y. S. Bae (S. J. Wang)
  - ICRF related
  - NBI related
  - ECH/CD related
  - LHCD related

- Plasma-Wall Interaction, Divertor & SOL: S. H. Hong
  - Wall conditioning with full-carbon wall and quantitative investigations of its effect
  - Quantitative measurements of erosion/deposition.
  - Dust detection/collection/ development of dust removal techniques.
  - PFC heat load analysis by thermocouples with IR camera
  - Particle balance measurements
  - Measurements of SOL parameters by FRP/fixed probe
  - Tungsten divertor block test

Schedule

- 15. March : Proposal Website Open
- 22. April : Proposal submission due
- 10 ~11 May : Research Forum @ NFRI
- 25 May : Proposal selection by KSTAR operation committee
- Middle of June: Finalize the experimental schedule

Proposal Submission

- Before submitting your proposal, please discuss with task force leader/ working group leaders or your personal contact at NFRI.

- It is recommended that proposals be submitted via website; http://webportal.nfri.re.kr. When connected, you can find a guideline for submission. The web page will be open on 15 March, 2012.

Contacts

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Memorandum for participation in the KSTAR experiment

1. Scope and requirements for participation in KSTAR joint experimental research

○ KSTAR joint experiment research

- As the KSTAR device is utilized as a joint experimental device in which both domestic and international researchers participate, the purposes of the KSTAR device are to resolve salient issues of the world fusion community and to raise the capability of domestic fusion research through it.
- The KSTAR device offers the joint researchers all the required circumstances for the joint experiments to fulfill these purposes.
- The joint researchers can participate in experiments and analyze the obtained data. Furthermore, they can develop, install, and operate equipment such as diagnostics for creative research.

○ Requirements for participation in joint experimental research

- Basically, the KSTAR device supports the collaboration of both domestic and international researchers as much as possible.
- It shall conclude a Memorandum of Understanding (MOU) with each collaborating institution in order to assure the quality of the experiment operations and the outcome of research.
- International and domestic collaborating institutions can also participate in the KSTAR joint experiments.

○ Process of participation in joint experiments

- The following two items should be submitted to the NFRI in proposal form
  A detailed plan of the joint experiments.
  Names of participating researchers and a list of required resources.
- The KSTAR administrative committee shall review the submitted proposals, coordinate the KSTAR operation schedule, and assign the resources. If necessary, the committee can request another relevant department to analyze and review the proposals.

2. Support to conduct the KSTAR joint experimental research

○ Support from NFRI

- NFRI offers all available conveniences to external collaborators for successful research.
- Basically, NFRI pays all the expenses accompanied with operation and management of the KSTAR device and the equipment.
- NFRI properly offers the offices and use of internet and telephones which are needed for the long-term stay of external collaborating researchers for the performance of their assignments.

○ Support from joint research institutions

- Responsibility for payment of personnel expenses such as salary, research expenditures, travel expenses, living expenses, and insurance of the researchers who participate in the joint experiments belongs to the assigned institution.
- Basically, all expenses related to installation and development costs of equipment accompanying the joint experiments belong to the relevant research funds and the assigned institution, provided that the expenses concerning the interface to the KSTAR device and the equipment can be supported by NFRI in accordance with the mutual agreement.
- In the case of computers and software required for joint research, the assigned institution provides them as a rule, provided that NFRI's internal resources can be shared depending on the researcher's participation or assignment details.

3. Safety supervision of KSTAR joint experiments

○ Access to KSTAR experimental equipment and safety supervision

- During the visits, the participants of joint experiment research are under an obligation to fulfill the NFRI regulations for the security of the KSTAR device and safety supervision.
- NFRI shall offer the orientation required for use of KSTAR research equipment such as electrical, fire, and radiation safety and network security. The external researchers should participate in this orientation.
- As a rule, the researchers and the assigned institution are responsible for all personnel and/or financial losses derived from carelessness of the joint researchers.

○ Quality assurance of the installation of joint experiment equipment

- For installation and utilization of the equipment developed for joint research, it is necessary to have the review and approval of NFRI's quality control. The external researchers are required to cooperate with this review.
- As a rule, the equipment installed on KSTAR for joint research is open to other researchers who participate in KSTAR joint experimental research.

4. Outcome management of KSTAR joint experimental research

○ Management of experimental data

- All raw data from the experiment belong to NFRI in principle.
- All experimental data from joint research are available to the other KSTAR joint researchers.

○ Conference presentations and submission of papers of the results of joint experimental research

- The right of a joint researcher to be the first author has to be respected for the results of KSTAR joint experimental research.
- The experimental data and the analyzed results from joint experimental research should be investigated and approved through NFRI's courtesy review prior to public disclosure in addition to the review process of the researcher's group and assigned institution.
- Although the research is related to the KSTAR device, the research equipment and analysis resources are mainly offered by external institutions, so that the relevant courtesy review can be performed by the relevant institution. (Even in this case, the results from experiments are supposed to be reported to the KSTAR administrative committee without undue delay.)

○ Right of intellectual property derived from the results of joint experiments

- In principle, NFRI has joint ownership on the right of intellectual property such as patent applications and merchandising of the results from joint experimental research.
- The partition of the right of intellectual property can be coordinated according to the national R&D regulations and mutual agreement between the relevant institutions.