AAPPS-DPP 2018,
2nd Asia-Pacific Conference on Plasma physics
November 12-17, 2018

Summary of
Basic Plasma Session

Y. Kishimoto

Kyoto University, Japan

Basic Plasma Session : Large number of submission papers

- Basic plasma session includes wider areas, which is highly interdisciplinary.

Basic Papers' Statistics

Plenary:	5
Invited:	21
Oral:	10
Poster:	20
Total: 56	

- Complex(dusty) plasmas
- Quantum Plasmas
- Diagnostics/A&M
- Space Propulsion
- Wave propagation expts
- Ion sources
- Linear /Mirror machine expts (diag)
- Magnetic reconnection heating

BP in 1st Meeting
courtesy of A. Sen

→

Plenary : 4
Invited : 56
Oral : 15
Poster : 49

Total : 124

- Strongly coupled complex plasmas, dusty plasmas, quantum plasmas : 9
- Atomic and molecular process in plasmas : 15
- Non-neutral plasmas and beam plasmas : 5
- Plasma propulsion and discharge for industrial and medical applications : 10
- Plasma sources, electromagnetic waves and radiations, plasma heating : 5
- Simulation and computation of plasmas : 11
- Plasma diagnostics : 2

- Apologies for selective summary without covering all papers.

Basic Plasma Session : plenary and invited/oral

- Basic plasma session includes wider areas, which is highly interdisciplinary.

Basic

Monday (11.12) 22min x6	Tuesday (11.13)	Wednesday (11.14)	Thursday (11.15)	Friday (11.16)
B1-1:B-Hall14:00-15:50, Chair [Sen]. **Complex dynamics and structure from space/universe to laboratory plasmas**	**B1-3: 401, 14:00-16:12** Chair [Yagi] **Structure formation and control in confined plasmas and lasers**	**B1-4: 401, 14:00-16:12** Chair [A.A.Mamun] **Structure and dynamics in complex plasmas and surface plasmas**	**B1-5: 401, 14:00-16:12** Chair [Pu] **Discharge plasmas, surface and process plasmas and applications**	B1-6:B-hall 8:20-10:25 Chair [Aramaki] **Complex dynamics from space/ universe to laboratory**
B-I1 Hirohisa Hara	B-I12 Akihiro Ishizawa		B-I24 Masafumi Fukunari	B-I30 Yuichiro Ezoe
B-I2 Daniel Groselj	B-I13 Thanh Tinh Tran	B-I19 Chengran Du	B-I25 Anbang Sun	B-I31 Fuminori Tsuchiya
B-I3 Hiroaki Ohtani	B-I14 Lei Chang	B-I20 Mierk Schwabe	B-I26 Bornali Sarma	B-I32 Guiyu Liang
B-I4 Surabhi Jaiswal, dust and flow	B-I15 Kiyomasa Akaike	B-I21 Yan Feng	B-I27 Sanghoo Park	B-I33 Alexandre Escarguel
B-I5 Nareshpal Singh Saini, dust	B-I16 Meghraj Sengupta	B-I22 Amar Prasad Misra	B-I28 Hong-Yu Chu	B-I34 Daisuke Kuwahara
-	B-I17 Mitsutoshi Aramaki	B-I23 Thomas Trottenberg	B-I29 Keh-Chyang Leou	B-O12 Prabhakar Srivastav

B1-2:B-hall16:40-18:52 Chair [Kishimoto]. **Instability and transport, and structure formation in fusion and basic plasmas**		**Bunkyo-Poster 2: 14:00-18:50** 403, 406, 408, 409	**Bunkyo-Poster 3: 14:00-18:50** 403, 406, 408, 409
B-I6 Masatoshi Yagi		BP-1 ~26	BP-27 ~48 +PD
B-I7 Seikichi Matsuoka		1. Nonlinear dynamics and structure in high energy density plasma 2. Nonlinear wave dynamic and structure in plasmas 3. Stability and fluctuation in confined plasma 4. Quantum & dust plasma	1. Discharge plasma and jet, and application 2. Atomic process and plasma diagnosis 3. Plasma source, thruster/propulsion 4. Electromagnetic waves and radiations, innovative application
B-I8 Masaki Nishiura			
B-I9 Kenichiro Terasaka			
B-I10 Akio Sanpei advance diag			
B-I11 Wonho Choe : structure/dynamic			

B2-1: 402, 14:00-16:00 Chair [Kwo Ray Chu] **Plasma production and beam/radiation source for various applications**				**B2-6: 402, 8:20-10:20** Chair SH Chen] **Innovative approach of diagnostics and applications**
B-I35 Cormac Corr				B-I54 Shusuke Nishiyama
B-I36 Haruhisa Nakano				
B-I37 Jinjun Feng				B-I56 Tsun-Hsu Chang
B-O1 Kazunori Takahashi				B-O13 Tobias Dornheim (U30)
				B-O14 Hao-Wei Hu
B-O3 Jie Liu				B-O15 Toshiki Kato

B2-2: 402, 16:40-18:50 Chair [H. Hara] **Atomic physics and modeling in fusion and basic plasmas**	**B2-3: 402, 16:40-18:50** Chair [Du] **Structure and dynamics in complex and quantum plasmas**	**B2-4: 402, 16:40-18:50** Chair [Y. Todo] **Large scale fusion plasma simulation and methodology**	B2-5: 402, 16:40-18:50 Chair [Nishiyama] **Atomic physics and modeling in space and fusion edge-div. plasmas**
B-I38 Nobuyuki Nakamura	B-I42 Heremba Bailung	B-I46 Shinichiro Toda	B-I50 Hayato Ohashi
B-I39 Jun Xiao		B-I47 Haruki Seto	B-I51 Shinichi Namba
B-I40 Motoshi Goto fusion	B-I44 Punit Kumar	B-I48 Yuuichi Asahi	B-I52 Xi-Ming Zhu
B-I41 Shinichiro Kado fusion	B-I45 Sanat Kumar Tiwari	B-I49 Ding Li	B-I53 Toru Kawamura
B-O4 D. Chatterjee	B-O6 Daniel Cocks	B-O8 Volodymyr St. Mykhaylenk	
B-O5 M.S. Laishram (U30)	B-O7 Nimardeep Kaur	B-O9 Zongliang Dai	B-O11 Yuki Kunishima ??

Basic Plasma Session : Poster

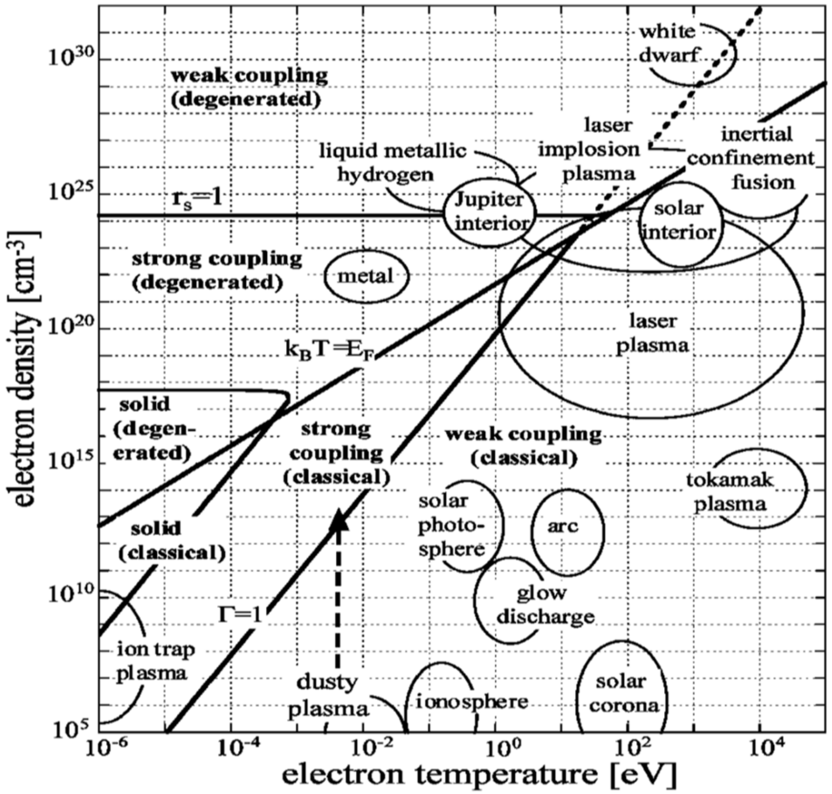
- Basic plasma session includes wider areas, which is highly interdisciplinary.

Basic poster

Nov. 14 (Wed) 14:00-18:50	Nov. 15 (Thu) 14:00-18:50
BP-1 O. Kamboj	BP-20 K. Rabadanov
BP-2 Z. Ehsan	BP-21 D. Bogdanov
BP-3 S. Mishra	BP-22 Y. Wang
BP-4 D. Chatterjee	BP-23 F. Gao
BP-5 K. SINGH	BP-24 S. Maenaka
BP-6 J. Chawla	BP-25 Y. Iwamoto
BP-7 P. Singhadiya	BP-26 CK Chen
BP-8 K. SINGH	BP-27 H. Truong
BP-9 T. Umeda	BP-28 R. Srivastava
BP-10 M. SINGH	BP-29 T. Okui
BP-11 A. Fukuyama	BP-30 S. Cousens
BP-12 N. Kasuya	BP-31 M. Fukuyama
BP-13 M. Sharma	BP32 T. Shugyo
BP-14 P. Kumar	BP-33 T. Furukawa
BP-15 J. PRAMANIK	BP-34 H. Nagai
BP-16 P. SETHI	BP35 K. Ueno
BP-17 S. SARDAR	BP-36 T. Sugawara
BP-18 T. DEKA	BP-37 P. Varshney
BP-19 Y. BAILUNG	BP-38 X. Mei
	BP39 R. Hara
	BP-40 R. Kumari
	BP-41 N. Pathak
	BP-42 R. Kaur
	BP-43 Y. Liu
	BP-44 Y. Liu
	BP-45 J. Xie
	BP-46 J. Rosato
	BP-47 J. LEE

Various plasmas in wide parameter region

- Basic plasma session includes wider areas, which is highly interdisciplinary.
- Plasma, highly nonlinear medium with the freedom interacting with electromagnetic field, exhibits extremely rich dynamics and structure in wider parameter regions, which are very complex while behave with a synchronized an/or coherent manner.

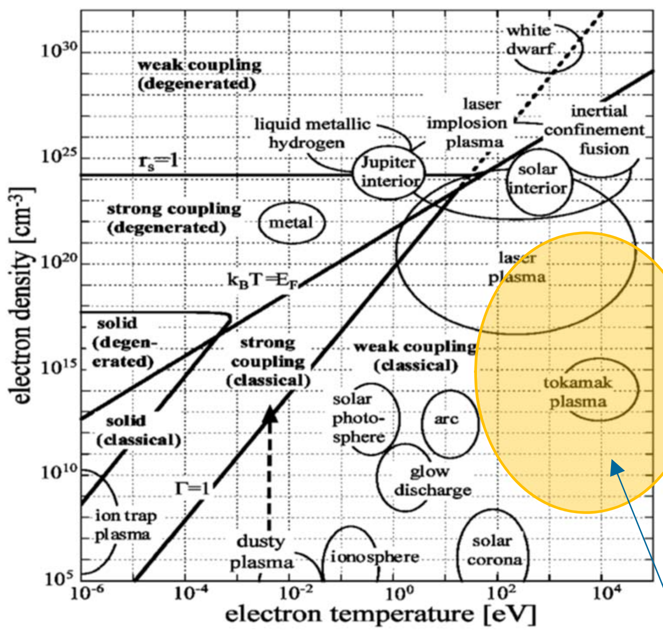


courtesy of H. Totsuji

- Key :
  Linear and nonlinear "structure" and "dynamics", and methodology identifying them

Various plasmas in wide parameter region

$T > T_F$: classical $\quad T_F > T$: quantum



$r >> \lambda_d$

Events dominant outside Debye sphere

$\Gamma << 1$

Infinitesimally small dissipation

low density high temperature plasmas

(Long range force dominant)

Vlasov-Maxwellian system

High temperature magnetically confined fusion plasmas

Dynamics and Structure

Various plasmas in wide parameter region

$$\lambda_d = \sqrt{\frac{\varepsilon_0 k_B T}{n(Ze)^2}} \qquad N_D = \frac{4\pi n \lambda_d^3}{3} \qquad \Gamma = \left(\frac{4\pi}{3}\right)^{2/3} \frac{(Ze)^2 n^{1/3}}{4\ \pi\varepsilon_0 k_B T} = \frac{1}{3N_D^{2/3}} \qquad r_s = \frac{1}{0.272} \frac{(Ze)^2}{a k_B T_F}$$

$\Gamma >> 1$

$r << \lambda_d$

Events dominant
inside Debye sphere

Dynamics and Structure

Atomic and molecular. collision, relaxation process
radiation process

- Strongly coupled state
(short range interaction)

Dust plasma, complex plasma,
Coulomb crystal

$\Gamma \sim 1$

"Medium coupling" state

Discharge and lightning event

$r >> \lambda_d$

Events dominant
outside Debye sphere

Infinitesimally small dissipation
low density high temperature plasmas

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Dynamics and Structure

Interaction among different kind of “dynamics” and “structure”, which are qualitatively different

$\Gamma >> 1$

$r << \lambda_d$

Events dominant inside Debye sphere

Interaction among different kind of “dynamics” and “structure” which are qualitatively different

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Dynamics and Structure

Atomic and molecular, collision, relaxation process radiation process

- Strongly coupled state (short range interaction)

Dust plasma, complex plasma, Coulomb crystal

Discharge and lightning event

New dynamics and structure

Infinitesimally small dissipation low density high temperature plasmas

(Long range force dominant)
Vlasov-Maxwellian system

High temperature magnetically confined fusion plasmas

Dynamics and Structure

Discharge and lightning event

$\Gamma >> 1$

$r << \lambda_d$

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Interaction among different kind of "dynamics" and "structure" which are qualitatively different

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Discharge and lightning event

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(Long range force dominant)
Vlasov-Maxwellian system

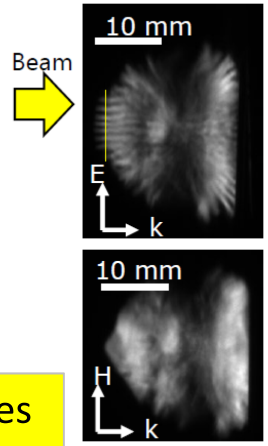
High temperature magnetically confined fusion plasmas

Dynamics and Structure

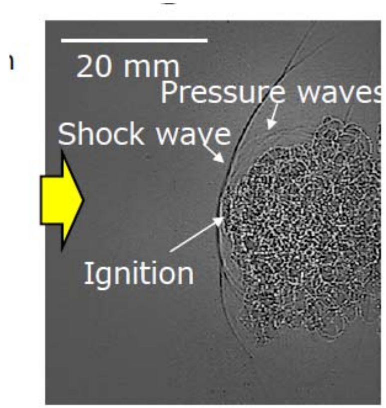
Discharge events dominated by atomic/molecular process

B-I24_Fukunari : Experimental investigation on millimeter-wave discharge induced in gas

- Emergence of fine fine filamentary structures,
- Complicated spatio-temporal structure, which character depends on “overcritical” and “subcritical# conditions for the incident beam intensity
- The gas discharge is ignited at the focal point of the parabolic mirror and is propagated to the mirror side.



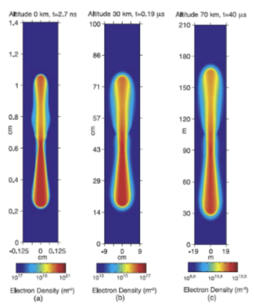
303 GHz

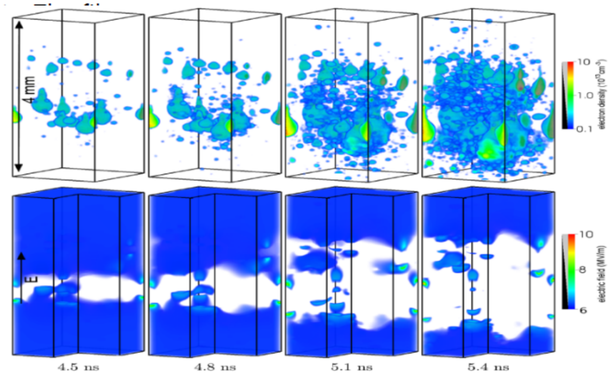


Shock wave generation at 28 GHz

B-I25_Sun : Understanding the start of pulsed discharges in atmospheric air with 3D particle simulations

- The inception processes of pulsed discharge (e.g. streamers) from a positive needle electrode were revealed
- Effects of the natural background ionization on streamer formation were investigated.





overlapping avalanches in an overvolted gap , splitting of positive streamers induced by external background ionization or magnetic field.

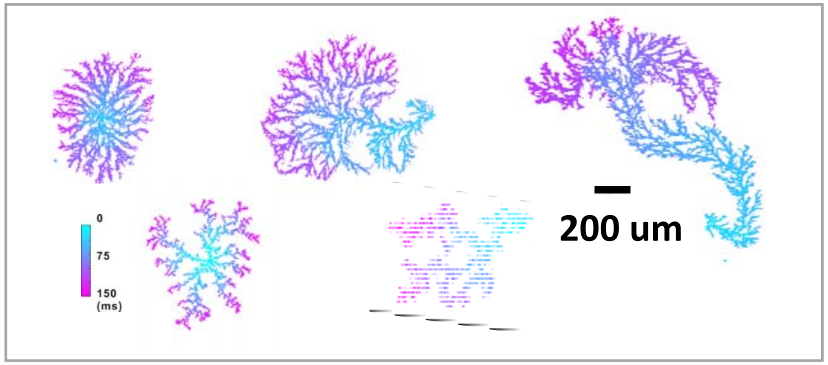
Mixture of elementary process between “deterministic” nature and “probabilistic” nature

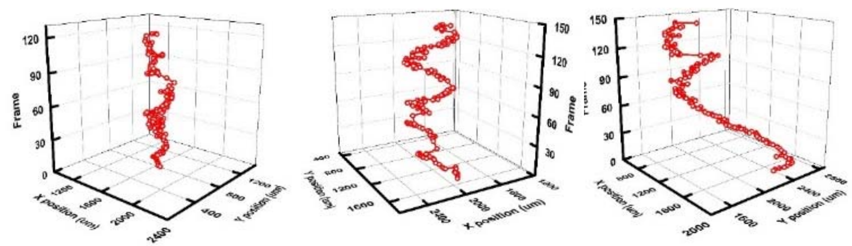
BP-20_Rabadanovi, BP-23_Gao, BP-24_Maenaka, BP25_Iwamoto, BP-26_Chen, BP-27_Truong

Discharge events dominated by atomic/molecular process

B-I28_Chu : Diffusion-limited aggregation-like patterns produced by atmospheric plasma jet

- Observations of diffusion-limited aggregation-like patterns by an atmospheric plasma jet.
- During the thin film removal process, fractal patterns on the substrate are emerged, exhibiting various structures like dense branching and tree-like patterns and found different growing sequences like fluctuating, oscillatory, and zigzag traces.
- The surface morphology reveals that the footprints of discharge are not **as random as expected**.





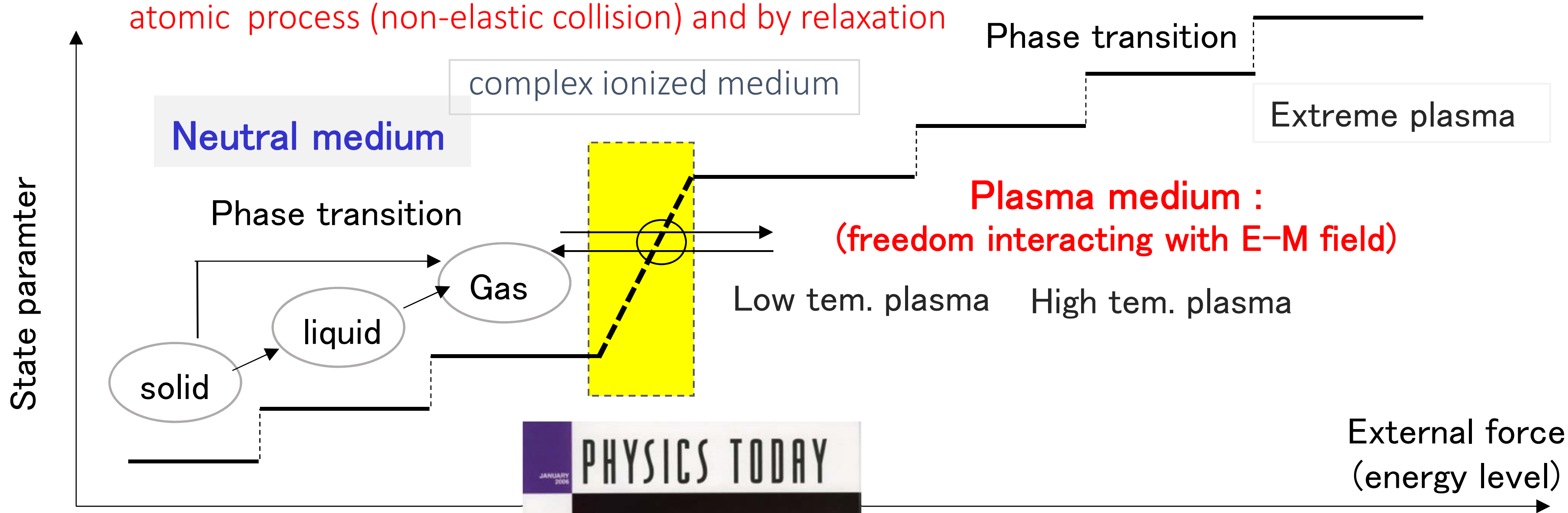
B-I26_Sarma : Characteristic behavior of plasma fluctuations inside plasma bubble in presence of magnetic field due to the formation of potential well

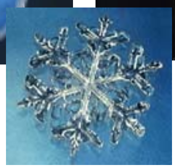
- Experimental observation has been carried out to see the effect of magnetic field and grid biasing voltage in presence of plasma bubble in a filamentary discharge magnetized plasma system.

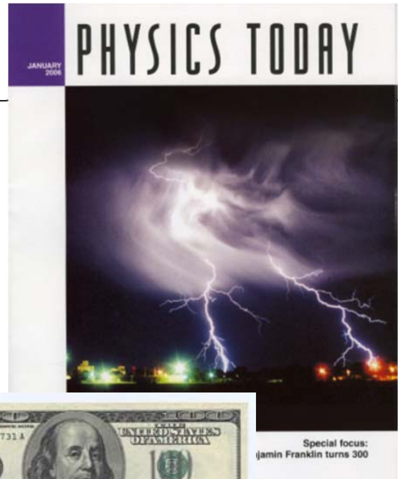
BP-20_Rabadanovi, BP-23_Gao, BP-24_Maenaka, BP25_Iwamoto, BP-26_Chen, BP-27_Truong

Structure and dynamics in plasma generation process

All plasmas are generated by complex molecular and atomic process (non-elastic collision) and by relaxation

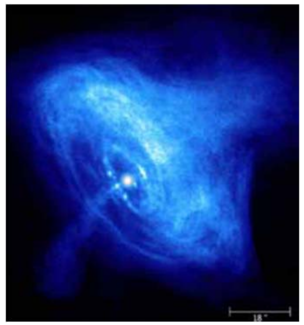






Benjamin Franklin
1706 - 1790

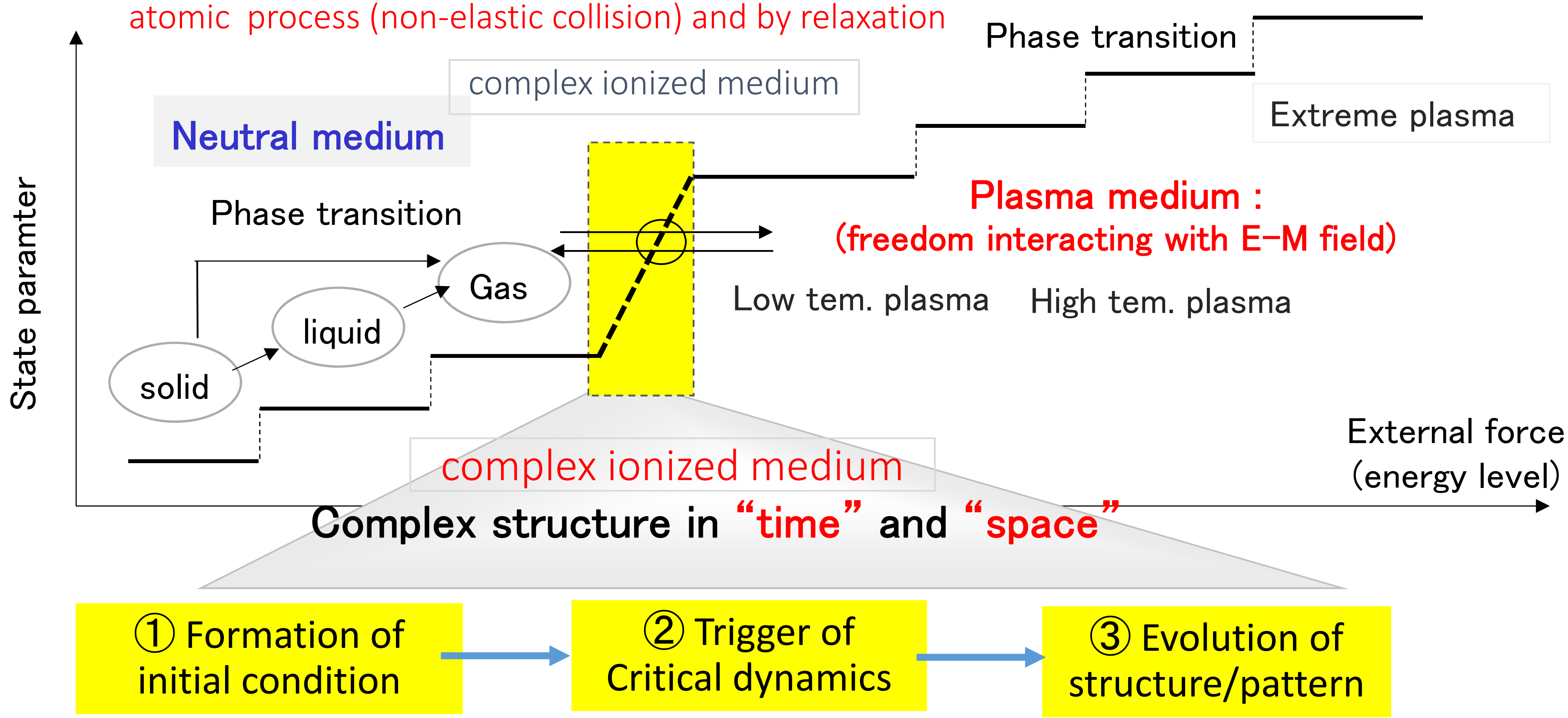
JT-60 HP plasma
Courtesy of JAEA



CLAB PULSAR
Courtesy of NASA

Structure and dynamics in plasma generation process

All plasmas are generated by complex molecular and atomic process (non-elastic collision) and by relaxation



Time : critical slowing down dynamics, phase transition, sudden explosive event

Space : non-diffusive and non-stationary dynamics, spiky structure, self-similarity and fractal nature

Dust plasma, complex plasma, Coulomb crystal

$\Gamma >> 1$

$r << \lambda_d$

Events dominant inside Debye sphere

$\Gamma \sim 1$

"Medium coupling" state

$r >> \lambda_d$

Events dominant outside Debye sphere

$\Gamma << 1$

Dynamics and Structure

Atomic and molecular. collision, relaxation process

radiation process

- Strongly coupled state

(short range interaction)

Dust plasma, complex plasma,

Coulomb crystal

Discharge and lightning event

Infinitesimally small dissipation

low density high temperature plasmas

(Long range force dominant)

Vlasov-Maxwellian system

High temperature magnetically confined fusion plasmas

Dynamics and Structure

Strongly coupled complex plasmas

$T_F > T$: quantum

$T > T_F$: classical

$\Gamma >> 1$

$r << \lambda_d$

Events dominant inside Debye sphere

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"Medium coupling" state

$T_F > T$: quantum

wave dynamics

- B-P07_Mamun : Solitary and Shock Waves in Dusty Plasmas, and Some Open Issues
- B-I42 Bailung : Experimental observation of cylindrical dust acoustic soliton in a strongly coupled dusty plasma
- B-I19_Du: Wave phenomena at the interface of a binary complex plasma: experiments and simulations
- B-I5 Saini:Effect of polarization force on nonlinear excitations in dusty plasmas
- B-I04_Jaiswal :Dynamical structure due to complex plasma flow past an obstacle
- B-O05_Laishram :Self-organized co-rotating dust vortices in complex plasmas

Crystalization dynmaics

- B-I20_Schwabe: Crystallization in 3D complex plasmas
- B-I21_Feng:Transport of magnetized 2D Yukawa liquids
- B-I45_Tiwari: Heating and collective effects in ultra-cold plasmas
- B-I23 Trottenberg : Momentum transfer and "force" from process plasmas to solid surfaces

B-O6 Cocks : Kinetic turbulence in space and astrophysical plasmas

Strongly coupled complex plasmas

$T_F > T$: quantum

In recent years, quantum effects have proved to play a crucial role in ultra-small electronic devices, laser plasmas and dense astrophysical plasmas

$\Gamma >> 1$

B-I22_Misra :Surface plasmons in a massless Dirac plasma in Graphene plasma

B-I44 Kumar : Two stream instability in magnetized quantum plasma with spin-up and spin-down exchange interaction

B-O07_Kaur: Study of nonlinear structures with relative density effects of spin-up and spindown electrons in a magnetized quantum plasma

$\Gamma \sim 1$

“Medium coupling” stat

B-O13_Dornheim : Ab Initio Quantum Monte Carlo Simulation of Warm Dense Electrons

Strongly coupled complex plasmas

$T_F > T$: quantum

In recent years, quantum effects have proved to play a crucial role in ultra-small electronic devices, laser plasmas and dense astrophysical plasmas

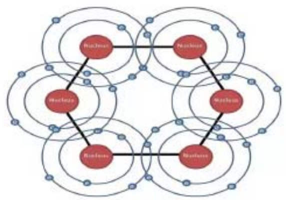
B-I22_Misra :Surface plasmons in a massless Dirac plasma in Graphene plasma

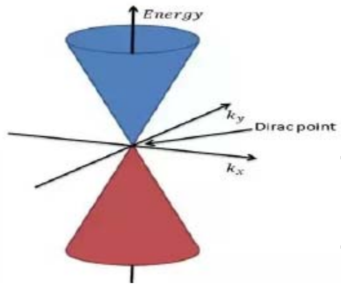
$\Gamma >> 1$

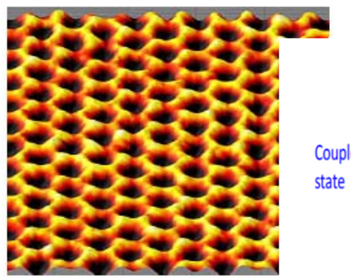
- Surface plasmons are shown to exist in a semi-bounded massless Dirac plasma that are relevant in doped graphene, superlattices, nanoribbons

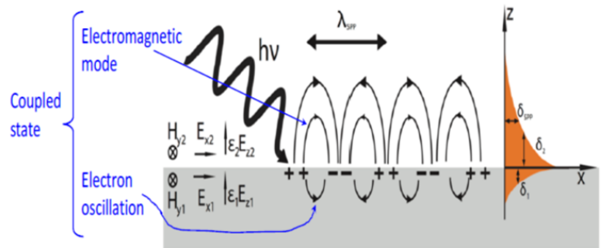
$r << \lambda_d$

Events dominant inside Debye sphere









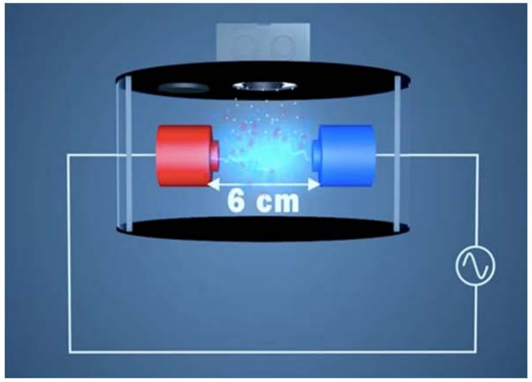
$\Gamma \sim 1$

“Medium coupling” state

- The surface plasmon in a massless Dirac plasma has several striking differences compared to that in a Fermi plasma.
- In contrast to Fermi plasmas, the surface plasma waves in massless Dirac plasmas propagate below the Dirac-plasma frequency, and is explicitly non-classical [PLA 382 (2018) 2133].

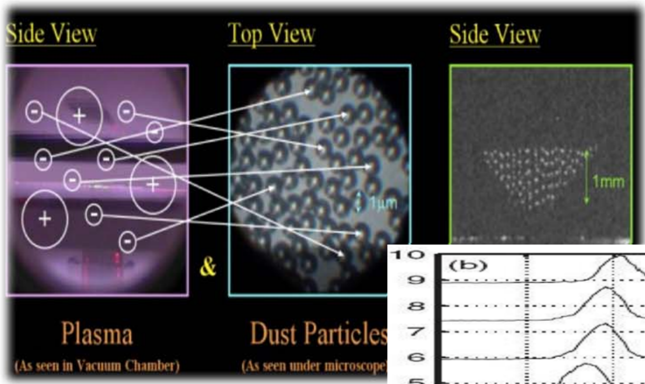
Dynamics and structure of strongly coupled dust plasma

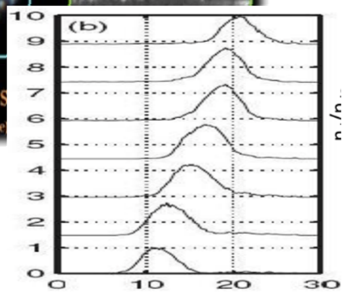
B-P07_Mamun : Solitary and Shock Waves in Dusty Plasmas, and Some Open Issues

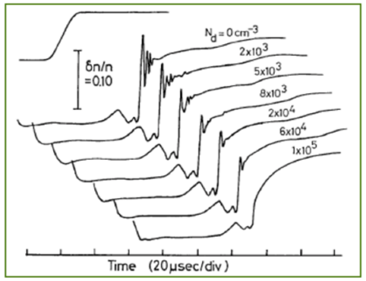


❖ DUSTY PLASMA

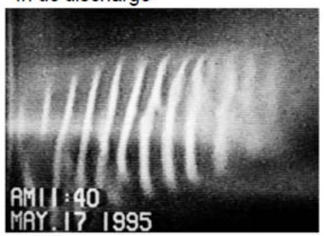
- **The plasma with charged dust particles is roughly known as a dusty plasma:**







In dc discharge



Barkan et al, POP 2, 3563 (1995)

- Dust acoustic waves
- Dust acoustic shock waves
- Dust lattice waves
- Dust acoustic rogue waves
- Dust-ion acoustic waves
- Dust acoustic vorticies
- Dust kinetic Alfven Solitary wave

- **The reductive perturbation method allows us to derive the MK-dV and MB equations:**

$$\frac{\partial y_j^{(1)}}{\partial T} + \frac{\nu}{2T} y_j^{(1)} + R_1 y_j^{(1)} \frac{\partial y_j^{(1)}}{\partial \xi} + \frac{\partial^3 y_j^{(1)}}{\partial \xi^3} = 0,$$

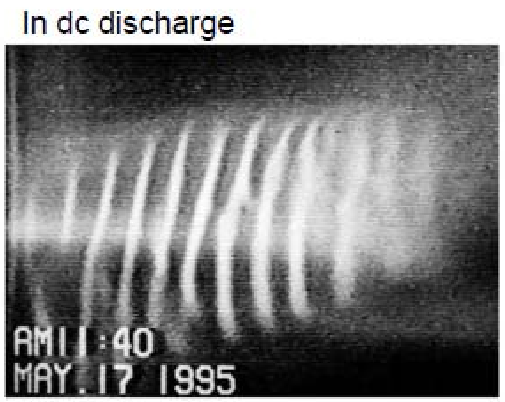
$$\frac{\partial y_j^{(1)}}{\partial T} + \frac{\nu}{2T} y_j^{(1)} + R_2 y_j^{(1)} \frac{\partial y_j^{(1)}}{\partial \xi} - \frac{\partial^2 y_j^{(1)}}{\partial \xi^2} = 0,$$

The effects of nonplanar geometry

Dynamics and structure of strongly coupled dust plasma

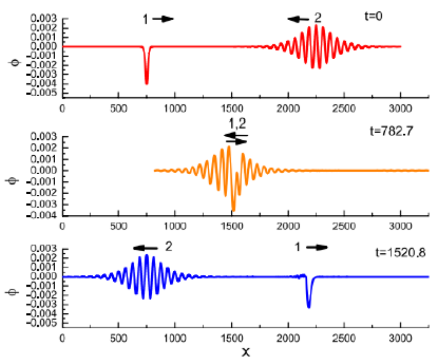
B-I19_Du: Wave phenomena at the interface of a binary complex plasma: experiments and simulations

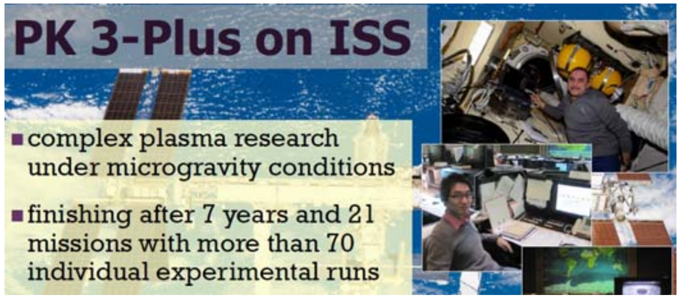
- A binary complex plasma is a weakly ionized gas containing electrons, ions, neutral atoms and small macroscopic particles, connecting to liquids and solids at the kinetic level

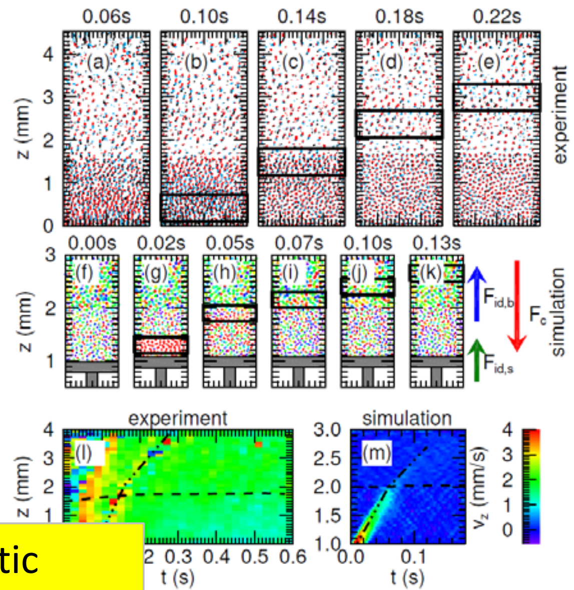


Barkan et al, POP 2, 3563 (1995)

Collision of Solitons







A series of experiments on self-excited waves and solitary waves in a binary complex plasma were performed in PK-3 Plus laboratory under microgravity conditions on board the International Space Station (ISS).

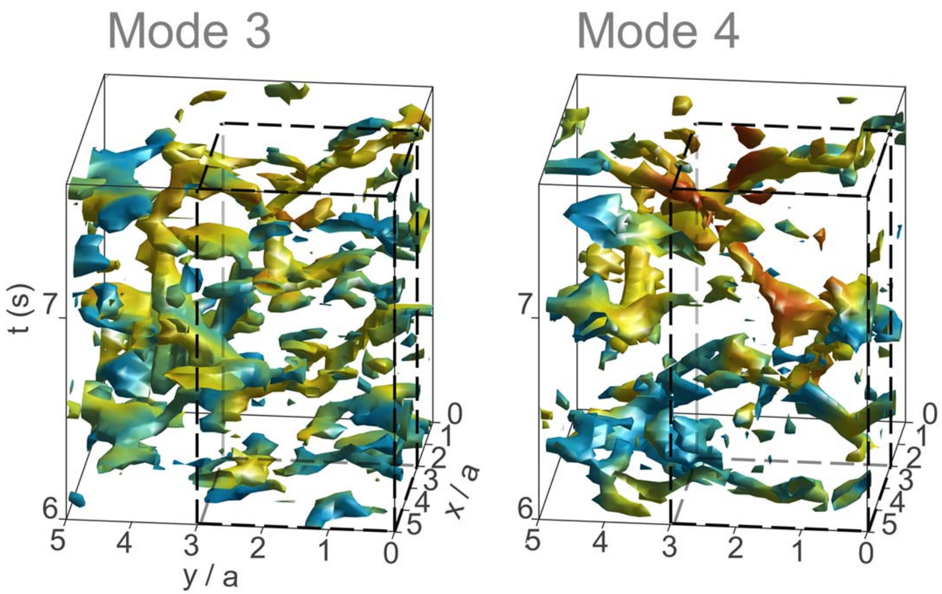
B-I20_Schwabe, Crystallization in three-dimensional complex plasmas in PK-3

B-I42 Bailung : Experimental observation of cylindrical dust acoustic soliton in a strongly coupled dusty plasma

Dynamics and structure of strongly coupled dust plasma

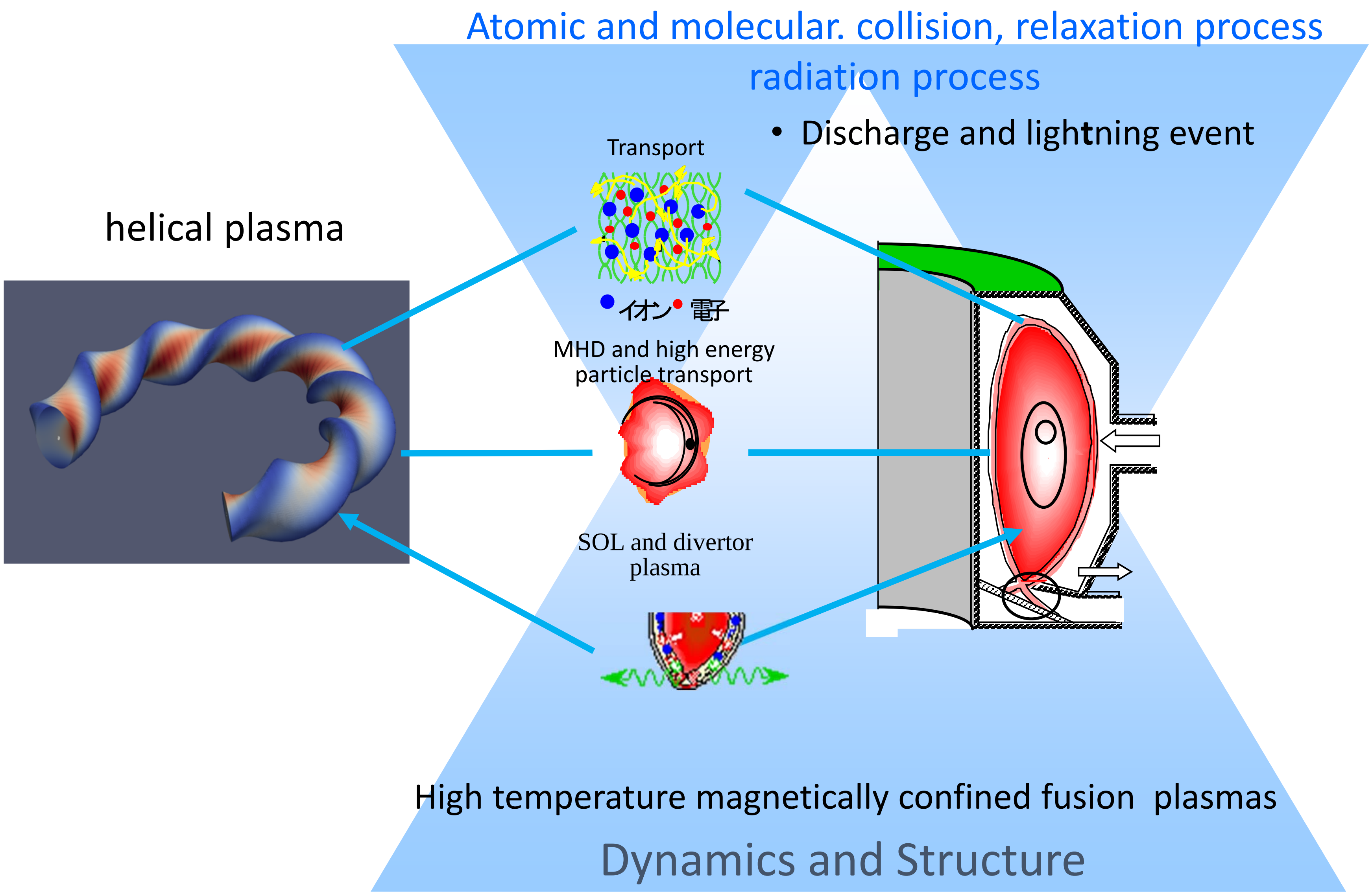
B-O14_Hu : Correlating multi-scale dynamics in 2D cold Yukawa liquids

- Successfully observe the coherent waveform dynamics of microscopic acoustic wave turbulence in cold 2D dusty plasma liquids through empirical mode decomposition.



Iso-phase surface of wave peak

Fusion Simulation and theory



Fusion Simulation and theory

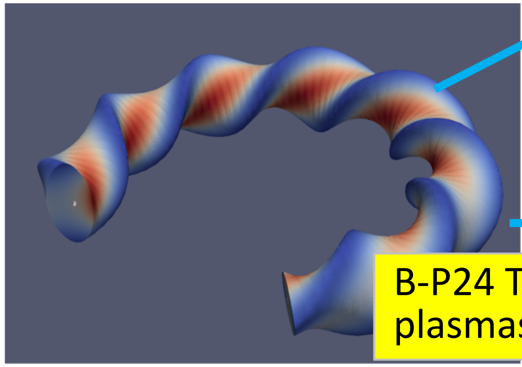
B-O09_Dai:GK simulation including the magnetic axis by using “field aligned coordinates” NLT ES

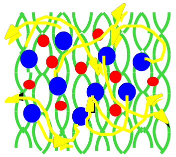
B-I48_Asahi: Benchmarking of flux-driven full-F gyrokinetic simulations GT5D and Gysela ES

B-I07_Matusoka : Gobal GK simulation in helical system GT5D-Helical ES-Neo

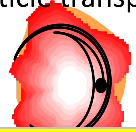
helical plasma

Tokamak plasma





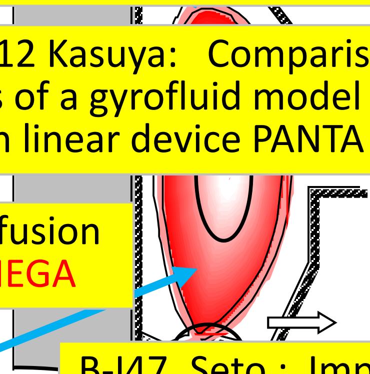
MHD and high energy particle transport



B-I12 Ishizawa: Multi-scale interaction with turbulence and MHD EM

B-I13 Tran: Multi-scale interaction with turbulence and flows ES

B-P12 Kasuya: Comparison of reduced sets of a gyrofluid model of ITG modes with linear device PANTA ES



B-P24 Todo: Energetic particle physics in fusion plasmas through computer simulation MEGA

plasma

B-I46_Toda : Predictive transport modeling in helical plasma

B-I47_Seto : Impact of nonlinear toroidally axisymmetric flow and field on ELM crash : BOU++ EM

B-I14 Chang : Gap eigen-mode using LPPD (Large Plasma Device)

B-I06_Yagi : NEXT (Numerical EXperiment Tokamak) and And BPSI (Burning Plasma Simu. Initiative)

B-I49_Li: Effects of High Magnetic Field on Transport

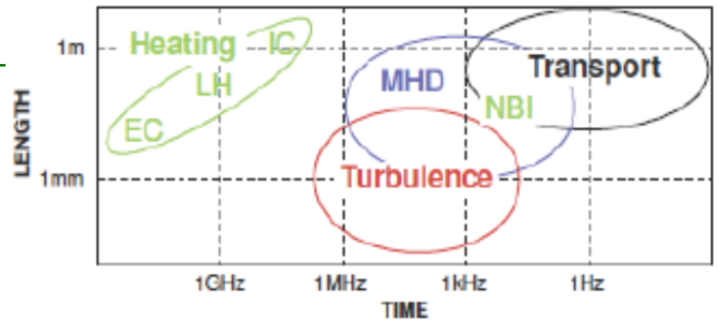
mics and Structure

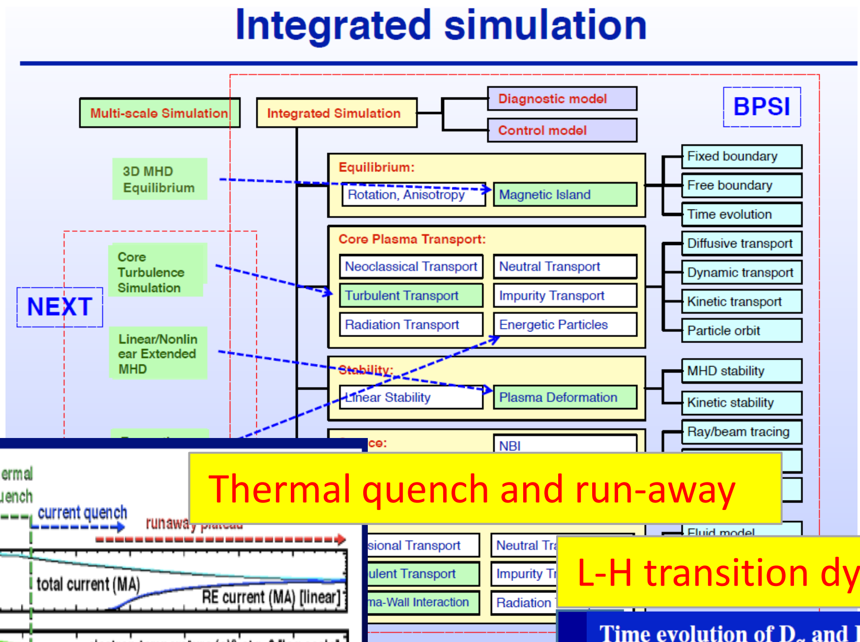
B-O8 : Mykhaylenko: Nonmodal of the current-driven instabilities

Fusion Simulation and theory

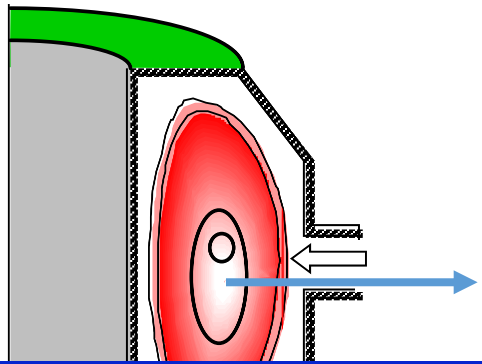
B-I06_Yagi : NEXT (Numerical EXperiment Tokamak) and
And BPSI (Burning Plasma Simu. Initiative)

Multi-scal interaction

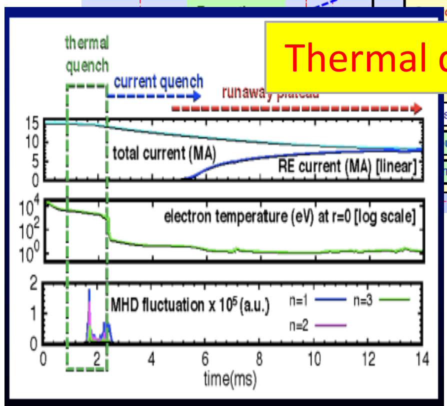


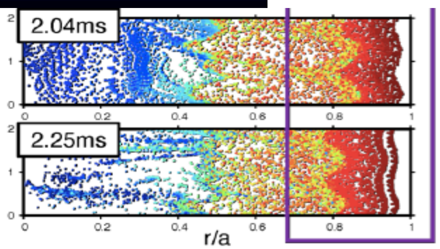


Tokamak plasma

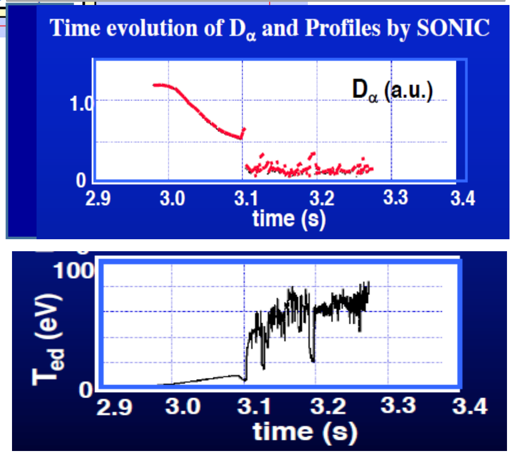


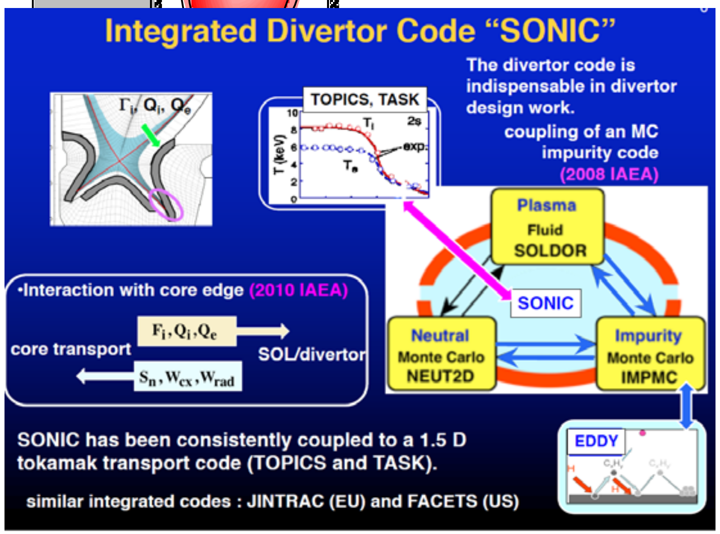
Thermal quench and run-away





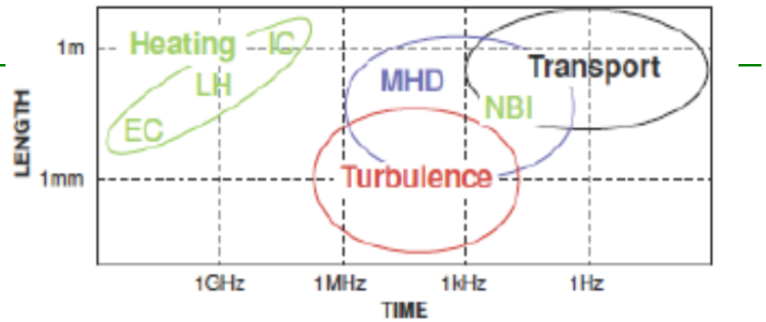
L-H transition dynamics





Fusion Simulation and theory

Multi-scal interaction

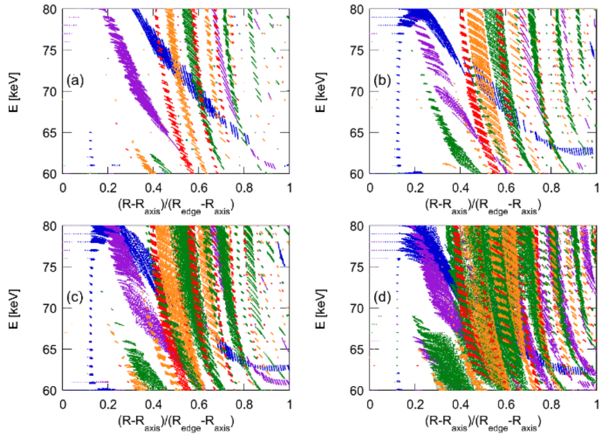


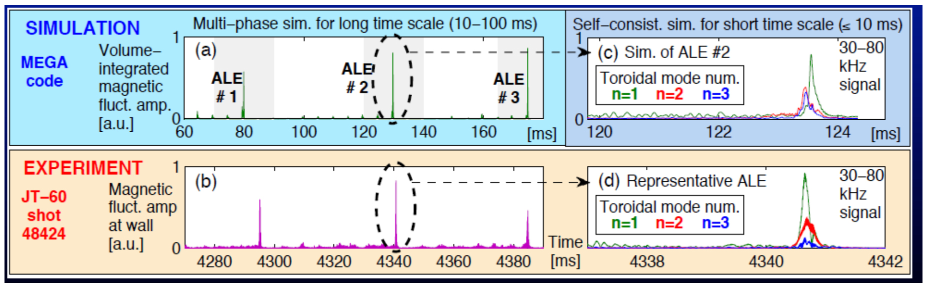
B-P24 Todo: Energetic particle physics in fusion plasmas through computer simulation MEGA

Global transport of EP due to EPs and Aes.

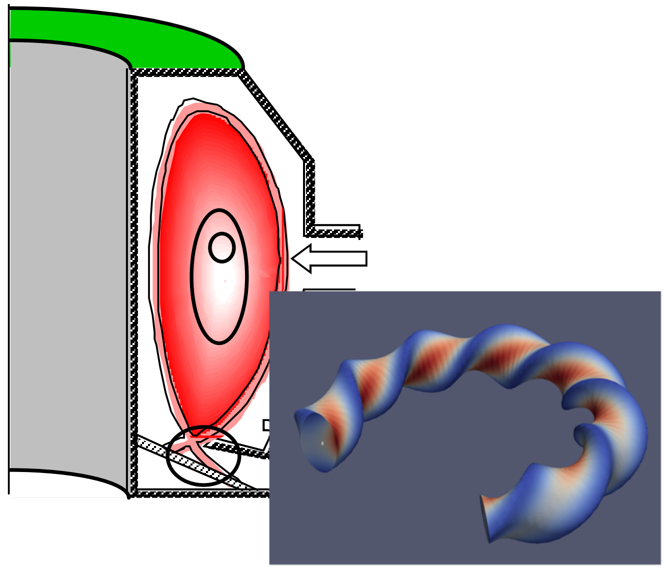
- Resonance overlap and overlap of higher-order islands

Hybrid simulation for EP and MHD





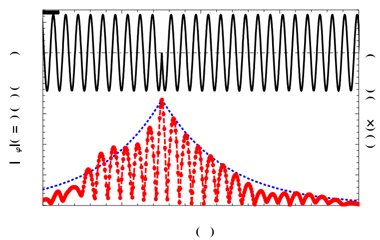
Tokamak plasma

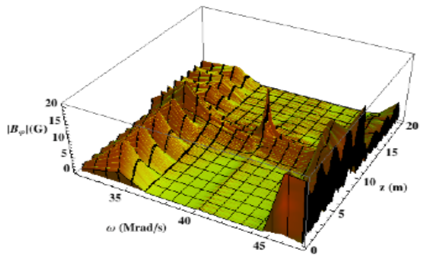


B-I14 Chang : Gap eigen-mode using LPPD (Large Plasma Device)

- Formation and interactions with energetic particles in fusion plasma

Hybrid simulation for EP and MHD





Fusion Simulation and theory

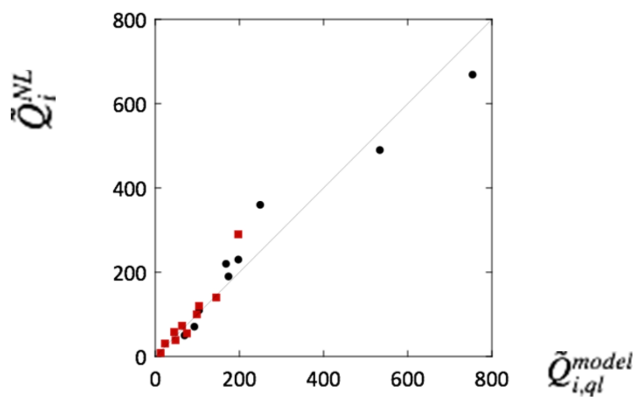
B-I46_Toda : Predictive transport modeling in helical plasma

- Reduced model, which can quickly reproduce the gyrokinetic turbulent transport coefficients or fluxes

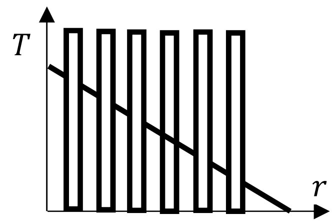
$$\tilde{Q}_e^{QL} = C_{Q_e} \int \frac{\tilde{Q}_e^{lin}}{<|\tilde{\phi}_{\tilde{k}_y}^{lin}|^2>} <|\tilde{\phi}_{\tilde{k}_y}^{NL}|^2>$$

$$\tilde{Q}_{e,ql}^{model} = C_{Q_e} \int \frac{\tilde{Q}_e^{lin}}{<|\tilde{\phi}_{\tilde{k}_y}^{lin}|^2>} <|\tilde{\phi}_{\tilde{k}_y}|^2>^{model}$$

$$<|\tilde{\phi}_{\tilde{k}_y}|^2>^{model} = \frac{C_{q1}\left(\tilde{\gamma}_{\tilde{k}_y}/\tilde{k}_y^{\,2}\right)^{\alpha_{q1}}}{C_{q2} + \tilde{\tau}_{ZF}^{\alpha_{ZF}} / \left(\tilde{\gamma}_{\tilde{k}_y}/\tilde{k}_y^{\,2}\right)^{\alpha_{q2}}}$$



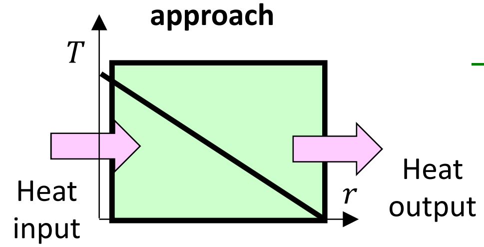
- **Local approach**



Solving local regions and connect with transport code

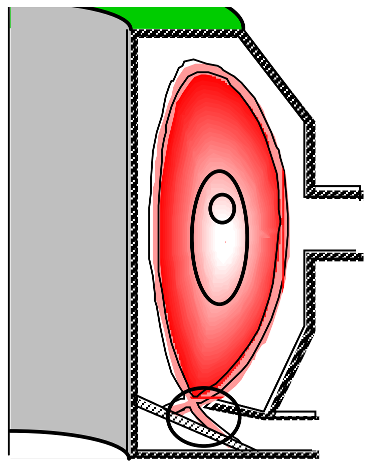
GKV (Jpn), GENE(EU), GYRO(US), GKW (US), GS2 (US)

- **global approach**



Solving globally as a whole system

Full global **:GKNET**, (JPN) GT5D (JPN), GYSELA (EU)



Fusion Simulation and theory

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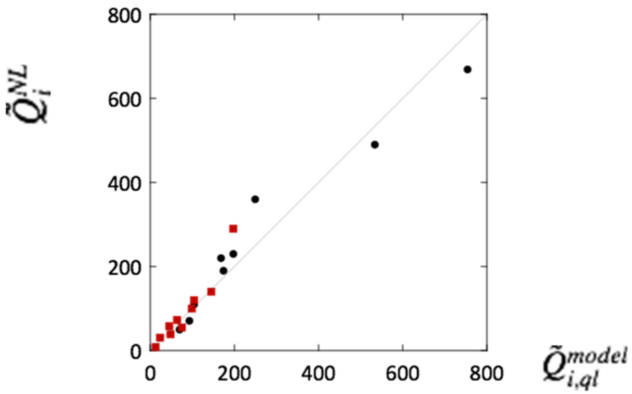
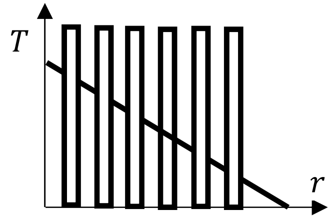


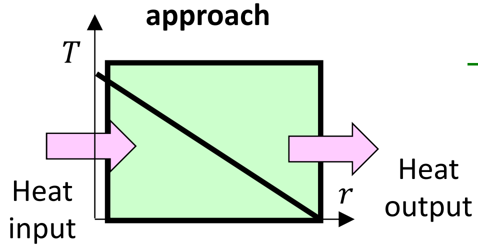
- **Local approach**



Solving local regions and connect with transport code

GKV (Jpn), GENE(EU), GYRO(US), GKW (US), GS2 (US)

- **global approach**



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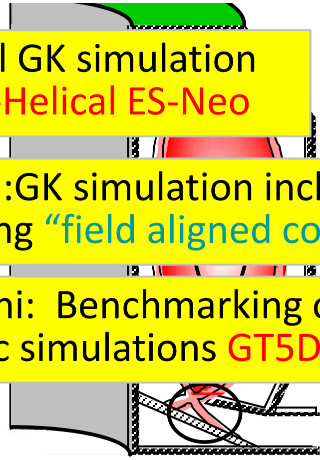

B-I07_Matusoka : Gobal GK simulation in helical system GT5D-Helical ES-Neo

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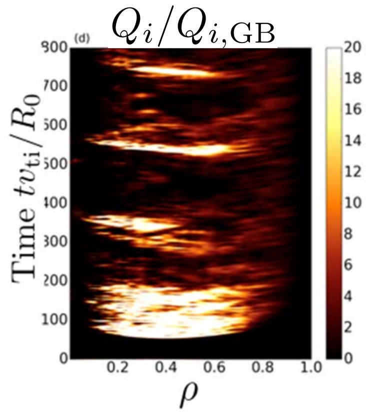
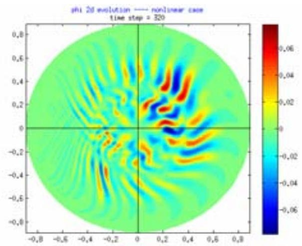
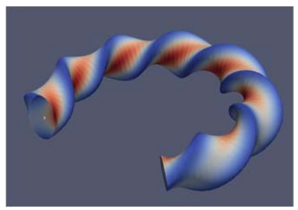


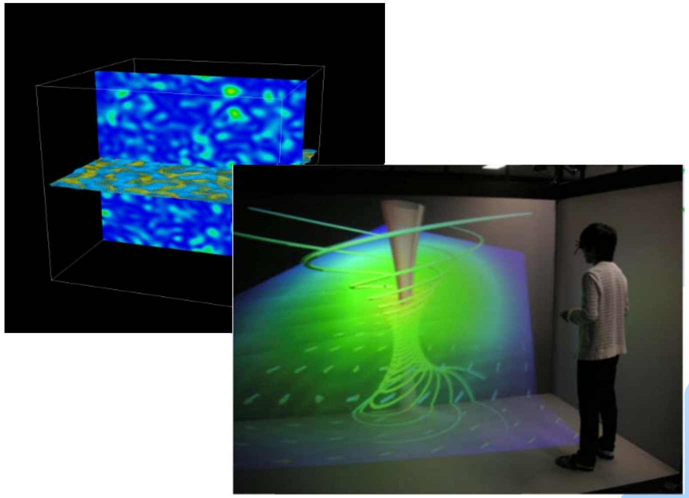


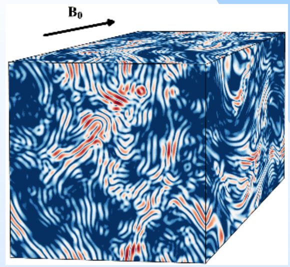


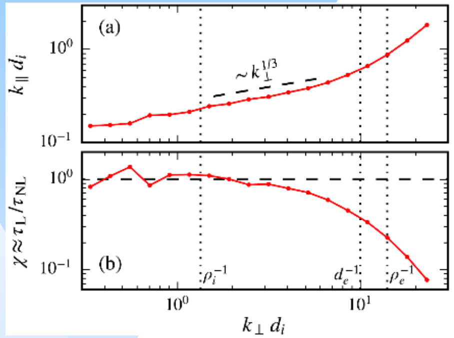
Space Astro-plasma simulation and methodology

B-I03_ Ohtani : Analyzation methodology of large-scale simulation using an in-situ visualization library “VISMO”, and virtual reality

An in-situ visualization library “VISMO”, which outputs the visualized results in the form of an image instead of raw data is developed.







- 3D fully kinetic PIC simulations (decaying & forced) of kinetic-scale space plasma turbulence + spacecraft data analysis
- We investigate the interplay between wavelike features and turbulent structure formation

B-I03_Groselj : Kinetic turbulence in space and astrophysical plasmas

High temperature magnetica

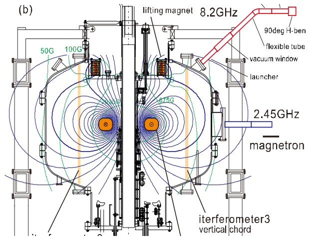
Dynamics and Structure

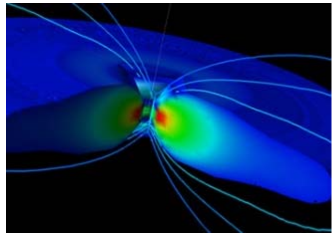
Advanced confined system : equilibrium and dynamics

B-I8 Nishiura : Understanding self-organized plasma transport in laboratory dipole magnetosphere, RT-1

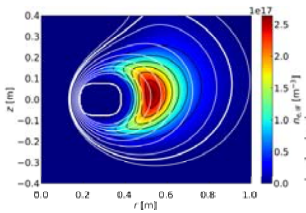
- Generation of the self-organized high beta plasma in the dipole magnetic field through transport.

RT-1

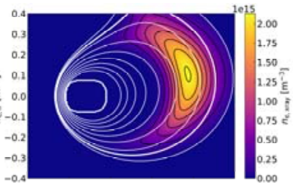




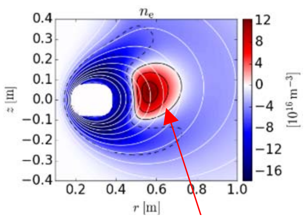
courtesy of Z. Yoshida



The reconstructed density at the peak exceeding the cut off of heating beams.



The high energy electrons forming a belt structure.

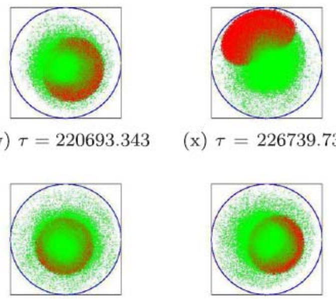


The area of density increase by a transport

B-I16 Sengupta : 3D Device Simulations of a toroidal pure electron plasma with a new PIC-MCC - PEC3PIC

- The dynamics of linear cylindrical trapped non-neutral electron clouds performed by Malmberg

- The toroidal alternative remains less intensely and studied modeled



(w) $\tau = 220693.343$ (x) $\tau = 226739.736$

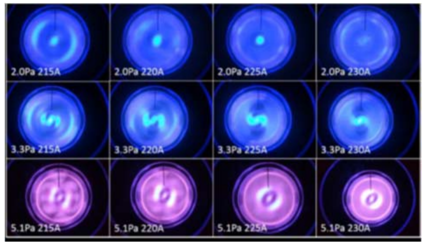
(cc) $\tau = 238832.522$ (dd) $\tau = 241855.719$

- The poloidal phase in which electron transport and loss occurs has been identified.
- Dynamics in a single diocotron period has been very closely examined to explain.

Advanced linear confined system

B-I9 Terasaka : Density and flow field structures of partially ionized plasma in laboratories

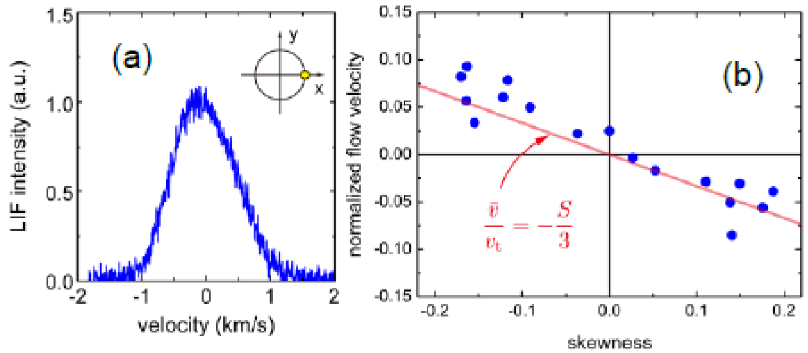
HYPER-II device1



various plasma structure associated with neutral depletion

- ✓ Atmosphere-ionosphere coupling
- ✓ Blob dynamics in laboratory plasmas

Asymmetry of velocity distribution takes place due to density inhomogeneity-induced flow

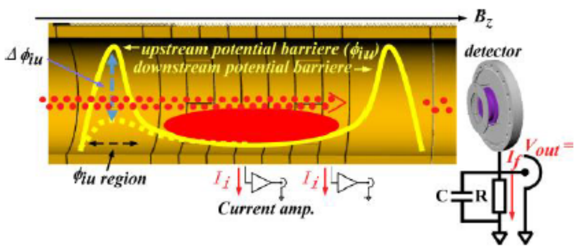


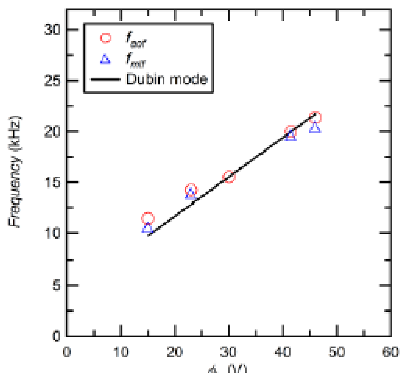
B-I15_Akaike : Experiments on ion leakage from BX-U linear trap during potential barrier closure

- Intermittent ion leakages in the Penning trap

Application of Penning trap : quantum computations, a measurement of the magnetic moment of the proton, and confinements of antimatter particles

1. Some ions acquire energies when the upstream potential barrier f_{iu} is closed.
2. Some ions are pushed out due to the axial oscillation of trapped ions.





Advanced linear confined system

B-O15_Kato : Control of diameters of Li+ and e- plasmas for testing two-fluid plasma state

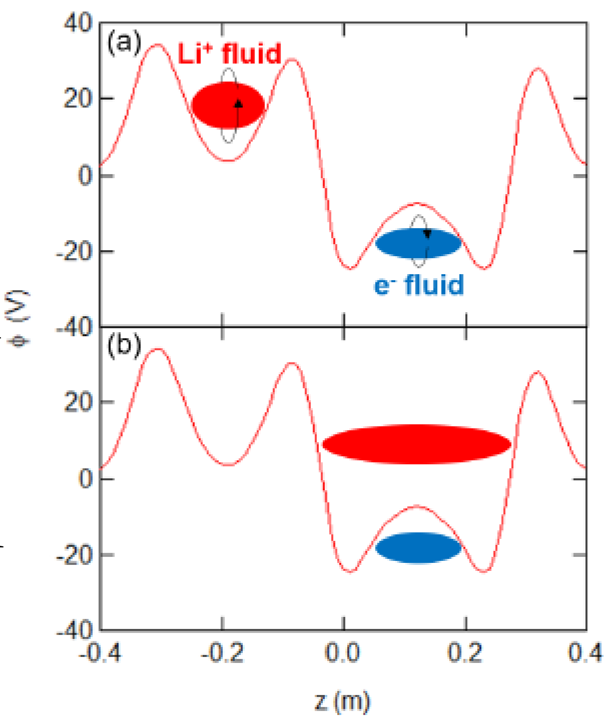
The plasma radius depends on the self-electric potential of the plasma.

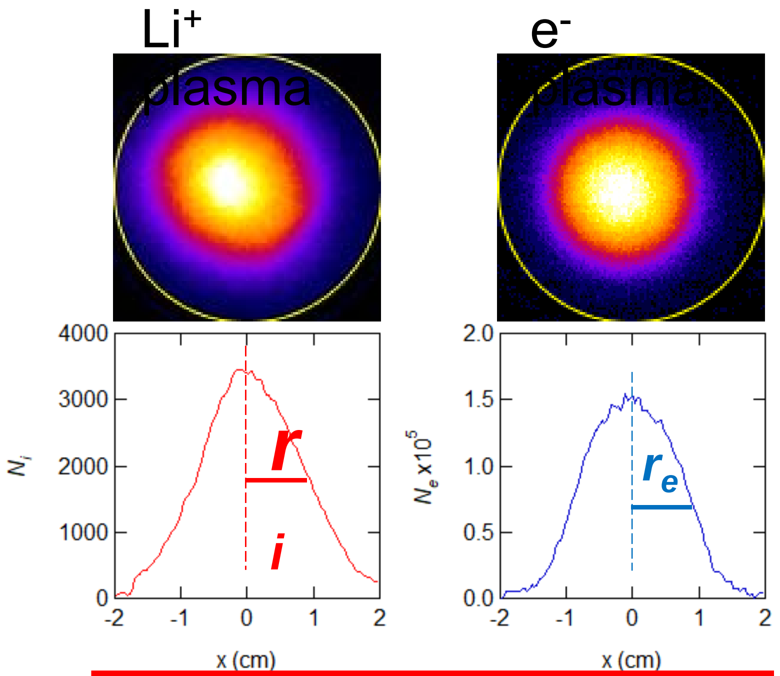
To increase the r_e to the r_i, we measured the r_e using the number of filaments and the initial energy of the e^- plasma as parameters.

BX-U linear trap

two-fluid plasma simulator

Relaxed into rotating thermal equilibria





r_i = 0.88 cm r_e = 0.90 cm

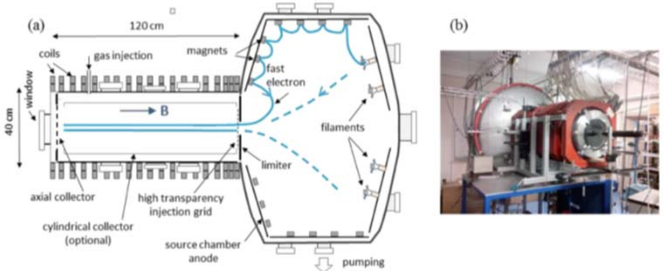
We will superimpose the Li^+ plasma on the e^- plasma of these parameters and observe the plasmas.

Advanced linear confined system

B-I33_Escarguel : Study of instabilities in cross-field plasma configurations

The "**MISTRAL**" experiment is dedicated to the study of magnetized plasma column instabilities.

Exp. Observations: m=1 and m=2 instabilities rotating around the central plasma column are observed in MISTRAL with rotation frequency ν_{mode} around a few kHz.



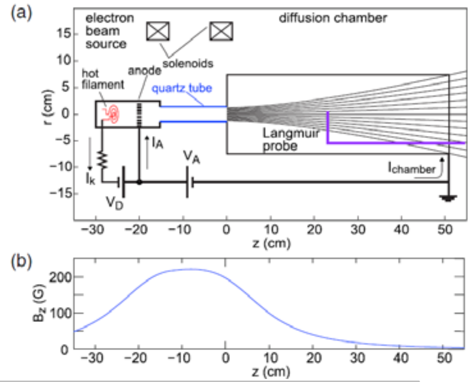
B-O12_ Srivastav: Temperature Fluctuation Measurement in Electron Temperature Gradient (ETG) turbulent plasma of Large Volume Plasma Device (LVPD)

- Electron temperature fluctuations have been measured in core plasma of Large Volume Plasma Device(LVPD) in the background of ETG turbulence using Triple Langmuir Probe (TLP) technique[1].
- Power spectra, phase angle and coherency are obtained for, δT_e and potential fluctuations, $\delta\phi$
- Radial Measurement of Phase angle is supported by theoretical model of ETG turbulence for $R \leq 50\ cm$
- Radial measurement of heat flux, q_{cond} is obtained by simultaneous measurement of fluctuations in T_e and ϕ_f which is in good agreement with theoretical estimation from ETG model equations

Plasma thruster and propulsion

B-O01_Takahashi : Adiabatic expansion of electrons in a magnetic nozzle

- Adiabatic expansion of electrons in a magnetic nozzle is demonstrated when all the electric field is removed.
- The magnetic nozzle acts as a nearly-perfect adiabatic wall and electron gas expanding in the magnetic nozzle does work on it.



B-I34 Kuwahara : Study of Helicon Plasma Thruster using Internal Gas Feeding Method

1. To improve the performance of Helicon plasma thruster, New neutral particle feeding method for neutral depletion problem has been proposed.
2. Supersonic Gas Puffing (SSGP) method is under constructing.
3. Internal Feeding Tube (IFT) method has been proposed to investigate behaviors of localized neutral particle distribution.
4. Future works
    - Measurement of neutral particle velocity distribution function.
    - Plasma experiment using SSGP method.

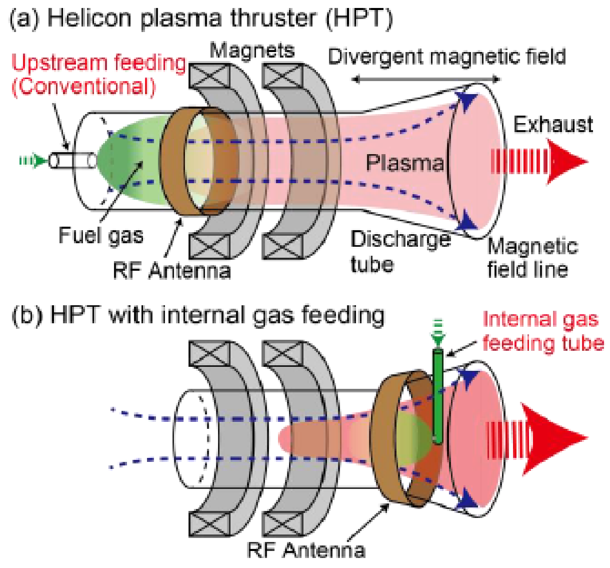


Figure 1 Concept of conventional helicon plasma thruster and HPT with internal gas feeding.

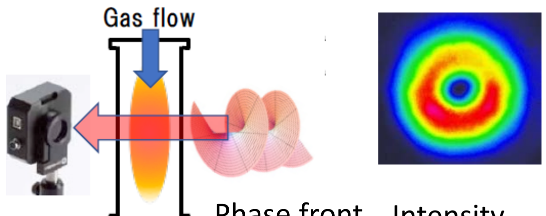
Electromagnetic waves and radiations, plasma heating

B-O03 Liu : Faraday rotation and polarization-modulated intense laser pulses in a field-ionizing gaseous medium, IAPCM

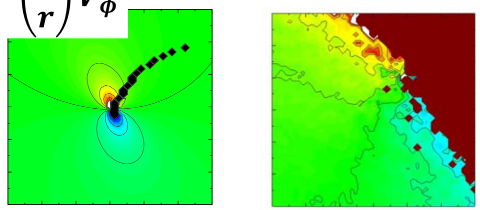
- Intense linearly polarized laser through an ionizing gaseous medium with an axial strong magnetic field
- The laser polarization is dramatically modulated, showing complicated Lissajous curves, which is utilized for strong magnetic diagnosis, laser intensity calibration, the generation of polarization-modulated light sources.

B-I17 Aramaki : Development of Optical Vortex Doppler Spectroscopy: Azimuthal doppler shift and phase gradient

- The topological light sources, Optical Vortex, have been developed by controlling the spatial structure of phase and polarization of the laser beam.
- The spectroscopic method sensitive to the flow perpendicular to the propagating direction of light, which is not detectable by the conventional Doppler spectroscopy, can be achieved.
- The phase distribution of the optical vortex was observed by the interference method



$$\delta_{OV} = -kV_z - \left(\frac{l}{r}\right) V_\phi$$



Phase Gradient   Doppler Shift

B-I37_Feng : Study of 140GHz and 170GHz gyrotrons for fusion plasma

B-I56_Tsun-Hsu Chang : High-alpha and low-spread electron beam for terahertz gyrotrons

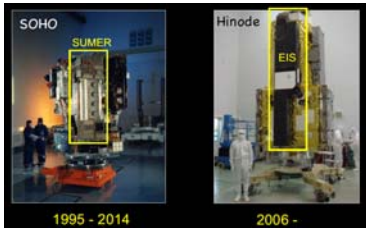
Plasma spectroscopy

B-I01_Hara : Plasma dynamics in the solar corona revealed from emission line spectroscopy

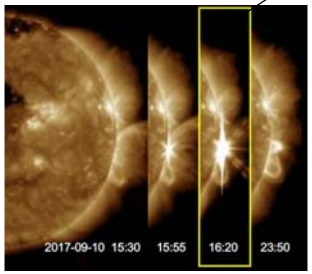
B-I38_Nakamura : Collisional and radiative processes of highly charged iron ions studied with an electron beam ion trap (EBIT)

B-I39_Xiao : Fusion related Tungsten Spectroscopy studies at Shanghai EBITs

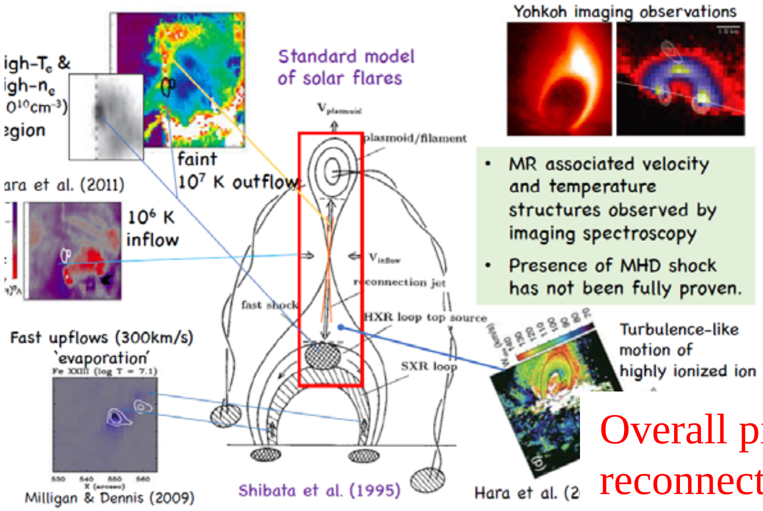
- Significant development of EUV and UV fast imaging spectrometers resolving faint and small



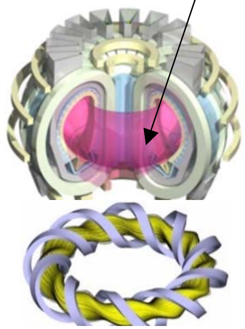
SOHO Hinode



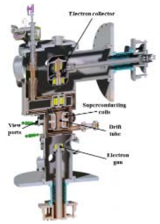
Identified Dynamics in Solar Flares



Overall picture of solar flares by resolving reconnection inflow and outflow, plasmoid, MHD shock

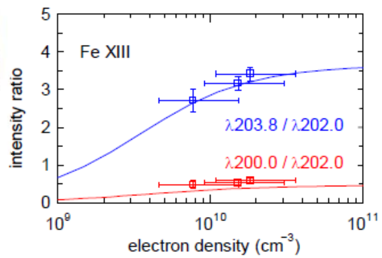


oBIT (EBIT)

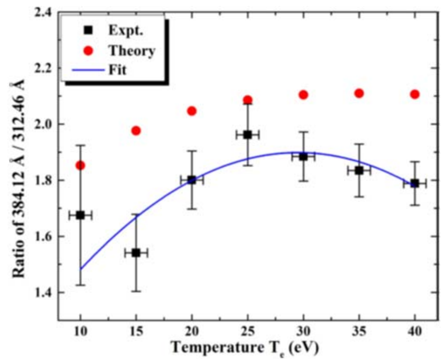


Shanghai EBIT

- The model spectra examined by laboratory benchmark spectra with a well-defined condition.



B-I38_Nakamura

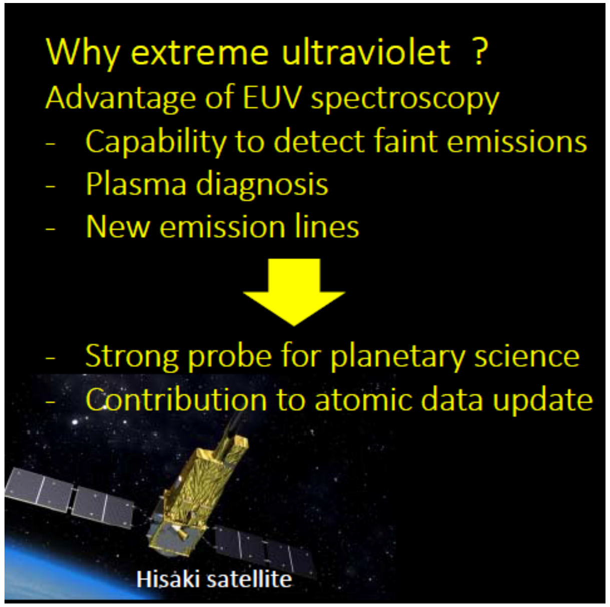


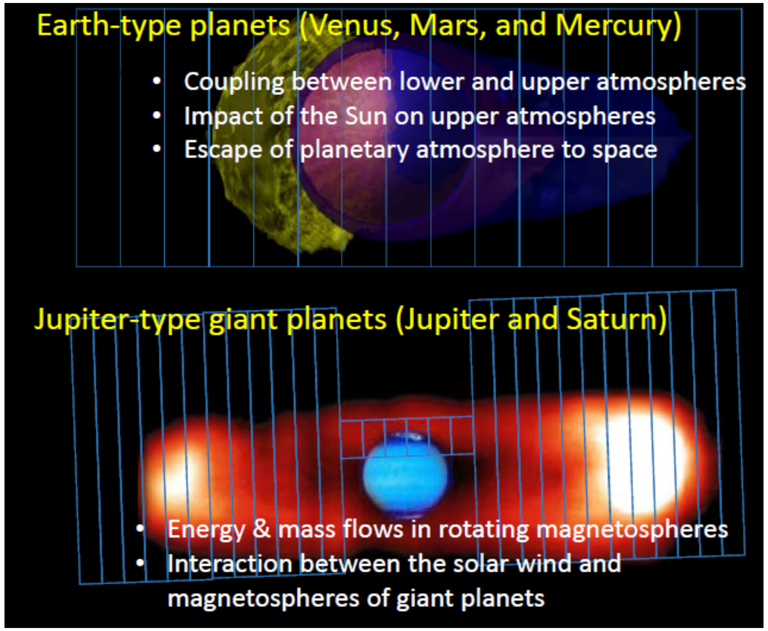
B-I39_Xiao

Plasma spectroscopy

B-I31_Tsuchiya : Remote sensing of planetary and satellite atmospheres and aurorae through ultraviolet UV spectroscopy

- Extreme ultraviolet (EUV) spectroscopy is a useful to probe magnetospheres, ionospheres and exospheres of planets and satellites in the solar system.
- Dynamic behaviors of the Jovian magnetosphere and the Venusian upper atmosphere recently obtained from observations with an EUV spectroscope onboard an earth orbiting satellite HISAKI are shown.
- The HISAKI satellite is the first EUV spectroscope satellite whose scientific targets are dedicated for the solar system planets and satellites.
- The high-sensitivity observation of EUV spectra from gasses around the planets is useful for not only the planetary science but identification of new energy levels of ions.





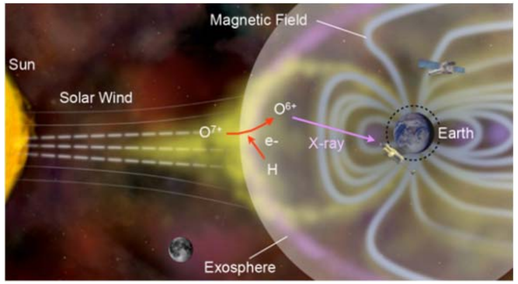
Plasma spectroscopy

BI-32_Liang : X-ray and extreme-ultraviolet spectroscopy in astrophysical and laboratory

Charge-exchange X-rays are important tracer for missing baryons in hot outflows

Charge-exchange spectroscopy in comets/planets/SNRs

X-ray aurorae in planet will post insights on the dynamics and large-scale structure of solar-wind interaction with planetary atmospheres, as well as the mass-loss of planets; an important tracer for the feedback of Sne



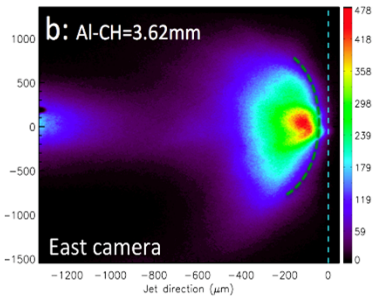
- **Charge-exchange X-ray model in astrophysics**

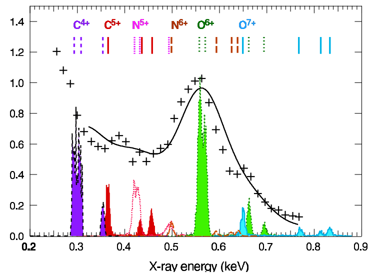
  Present the progress of CX model in astrophysics

- **Laboratory study for the charge-exchange emission in astrophysical plasma**

① CX emissions on EBIT with magnet-mode

② CX contributions in the laser-produced outflow interaction with obstacles

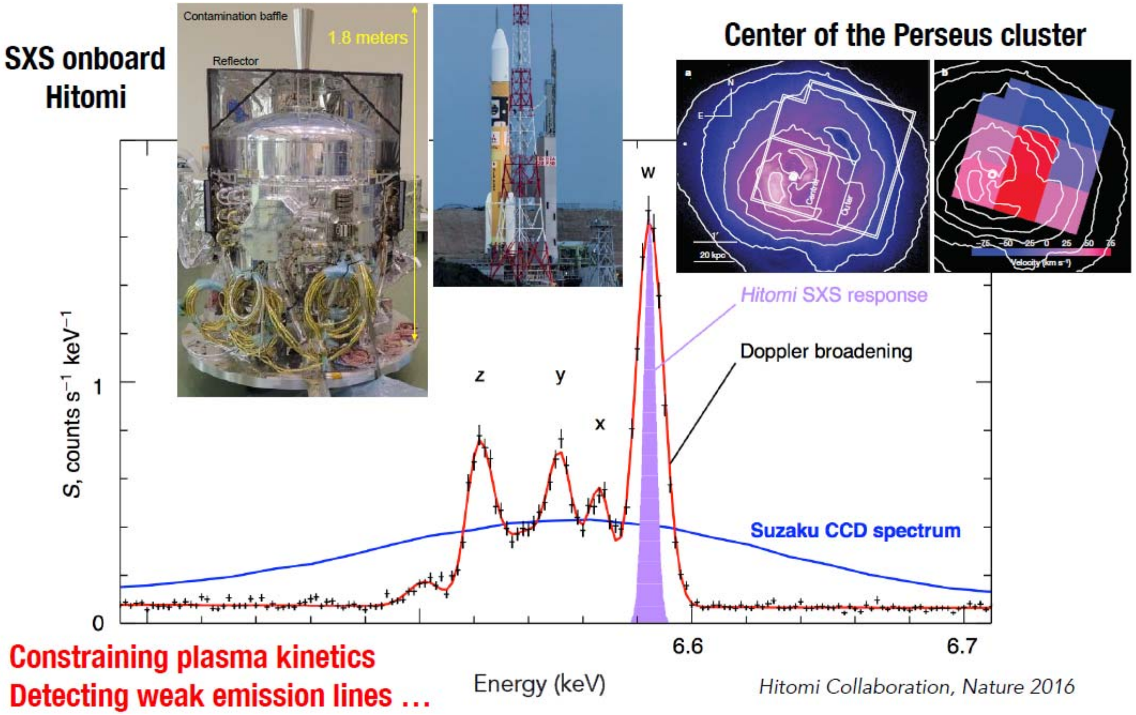




Plasma spectroscopy

B-I30_Ezoe: High Resolution X-ray Spectroscopy of Astrophysical Plasmas with X-ray Microcalorimeters

- For the high spectral resolution X-ray spectroscopy of cosmic sources, non-dispersion energy resolution of ~5 eV in FWHM at 6 keV was achieved with an X-ray micro-calorimeter onboard the Japanese Hitomi satellite in orbit.
- The Hitomi SXS provided us with high resolution spectra of astrophysical plasmas. For example, as shown in figure 2, dynamics of plasma in the core of the Perseus cluster and the origin of the plasma from abundance ratios were successfully constrained with the highest accuracy ever achieved. The X-ray microcalorimeter worked in space as we expected3-4.



Plasma spectroscopy

B-I41 Kado : Study of thermal non-equilibrium to equilibrium features in fusion edge and laboratory discharge low-temperature Plasmas

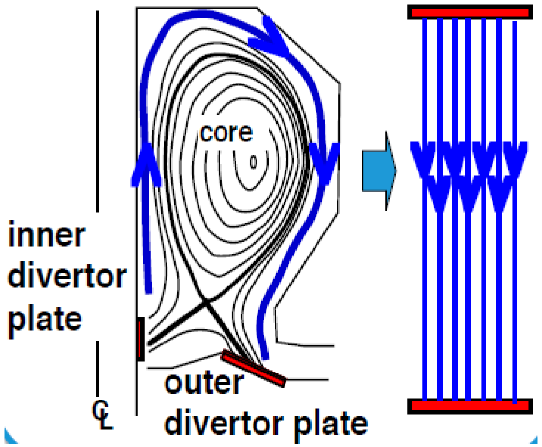
MAP-II diverter simulator

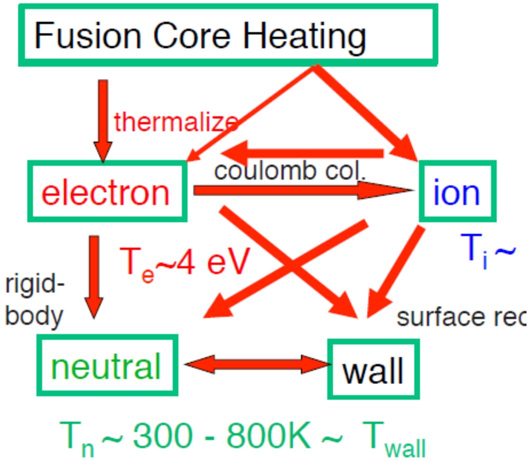
Ionizing Helium Plasma | Recombining Plasma

$T_e > T_i > T_n$
4 0.4 0.05 eV

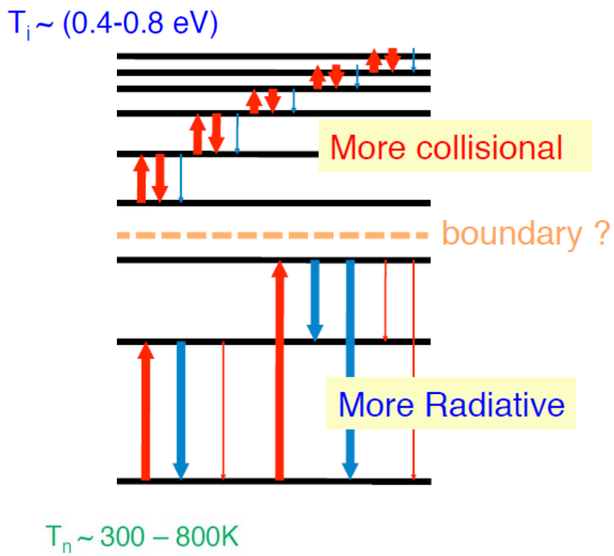
$T_e \sim T_i \sim T_n \sim 0.06$ eV

- Atomic/molecular process during thermalization /equivalation process





[Shikama, Kado et al., POP16, 033504 (2009)]

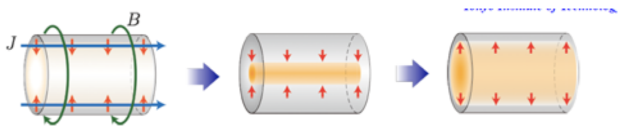


Plasma spectroscopy

- EUV resource for next generation semiconductor lithography,
- Water window soft X-ray (λ = 2.34 – 4.38 nm) for using Laser-produced plasma sources for biological imaging application

DPP (discharged-produced-plasmas) vs. LPP (laser produced Plasma)

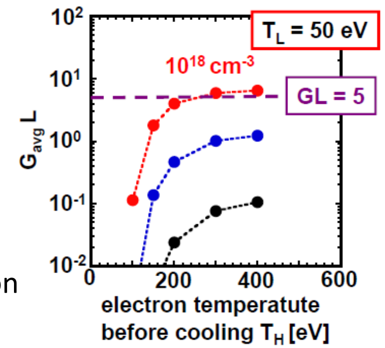
B-I53 Kawamura : Lasing potential of extreme-ultraviolet (EUV) light of nitrogen with a recombining plasma scheme



1) To get GL ≥ 5:

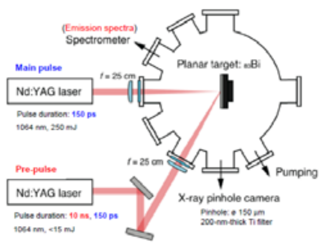
2) Saturation of amplification:

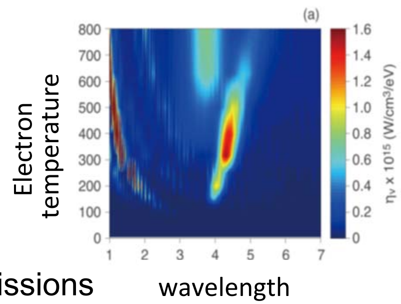
3) Radiation transport calculation



B-I50_Ohashi : Characteristics of water-window soft X-ray emission from bismuth plasmas

$_{83}$Bi LaserProduced Plasma



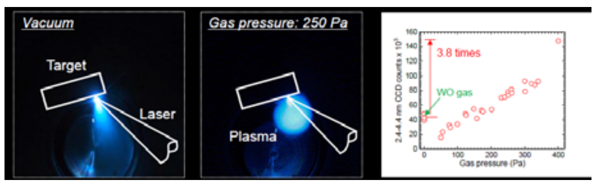


Optimum conditions for WW emissions

150 ps pulses with the separation time of **7–10 ns.** The max. number of photons : **3.8 x10^{14} photons/sr for** source size : **30 x 60 μm^2**

B-I51_Namba : Anomalous enhancement of water window X-rays emitted from laser produced Au plasma under low-pressure nitrogen atmosphere

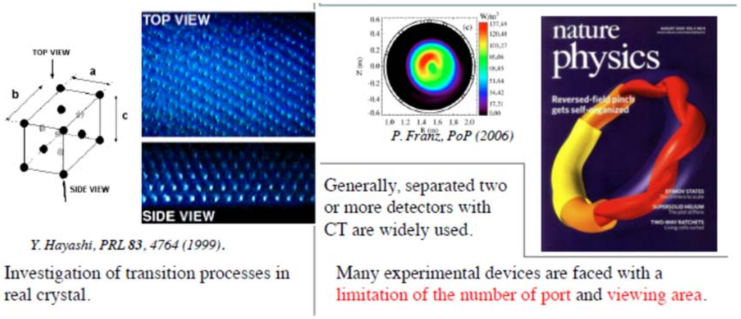
Gold slab targets



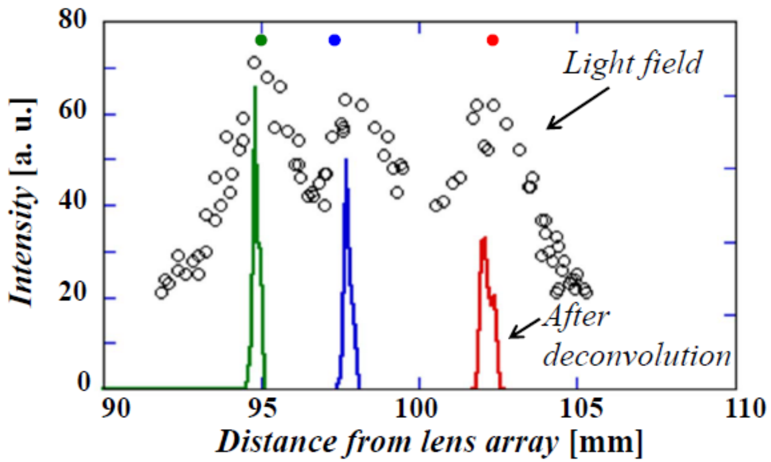
- Introduction of nitrogen significantly enhanced the WW X-ray yield emitted from Au plasmas.

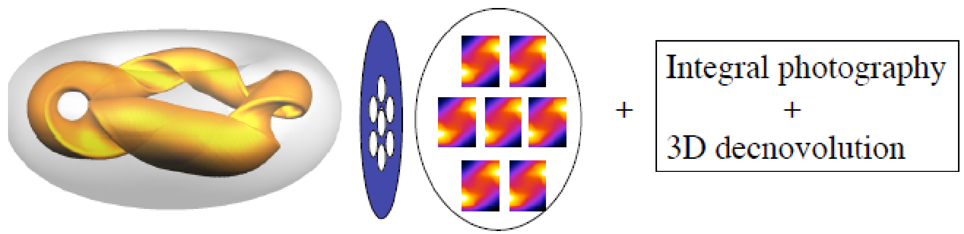
Advance diagnosis

BI-10_Sanpei : Reconstruction of three-dimensional emissivity structure with integral photography technique



- A new 3D reconstruction method has been proposed.
- Multi-lens imaging system is expanded to 3D imaging system with integral photography and Lucy-Richardson-deconvolution.





3D position of light source is reconstructed from an image obtained from one port with proposed method in calculation and verification experiment.

Concluding Remarks

- Basic plasma session includes wider areas, which is highly interdisciplinary.
- Plasma, highly nonlinear medium with the freedom interacting with electromagnetic field, exhibits extremely rich dynamics especially through the interaction between ideal plasma dynamics over Debye length and those inside it, including atomic and molecular dynamics and also radiation processes.
- Significant progresses have been made not only in physics but also in diagnostics techniques resolving fine scale and rapid structure and dynamics.
- Many smaller and medium scale devices play an critically important role in understanding key complex processes.
- Efficient integration of fundamental disciplines across different fields may be a key in the basic plasma session.