AAPPS-DPP 2018 Plenary speaker Name: Prof. Katsumi Ida
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Rationale: Prof. Ida has opened the new field in experimental plasma physics, including the role of radial electric field in improved confinement, off-diagonal elements in momentum transport, intrinsic rotation, etc. These big branches of research, for which he has made a couple of reviews [6.1, 6.2, 6.3], have emerged from the seeds in 'Off-road' (Pioneer work) at the time of beginning to 'Main road' (mainstream research) in these days. Visiting these examples of previous successes, the very recent approaches to the abrupt events are discussed. This talk illustrates a state-of-the-art frontier for one of the most challenging researches, 'the trigger problem in abrupt events'. At the same time, it will stimulate the audience to obtain original ideas and to develop the seeds of originality. If it were selected as the plenary talk, it will surely make the conference exciting and authoritative.

Talk Title: Bifurcation phenomena in magnetic confinement

Short abstract: Various pioneer works of plasma physics in last 30 years is reviewed in this talk. The following findings are discussed: 1) radial electric field shear in H-mode pedestal, 2) curvature of radial electric field and temperature profile, 3) intrinsic torque for plasma rotation 4) hysteresis of flux-gradient relation in dynamic transport 5) bifurcation of magnetic island states 6) trigger problem for abrupt events. In several years after the finding, some of these topics already became a mainstream research and the others are becoming a state-of-the-art frontier research.

The mainstream research in plasma physics for nuclear fusion has been focused to find a scenario to produce and sustain the high density and high temperature in magnetically confined devices. Therefore the physics connection between the magnetic field structure and a performance of plasma in the steady state has been intensively studied. In contrast, the pioneer work has been done in the field of bifurcation phenomena due to a strong non-linear process in the high temperature plasmas. The most epoch making finding in the plasma physics in magnetically confined plasma was finding of the transition from low performance (L-mode) to high performance (H-mode) as a bifurcation phenomena [1, 2]. This is the bifurcation phenomena of transport at the plasma boundary and the high pressure gradient region, which is called pedestal, suddenly appears even for the constant heat flux in time. This finding provides at paradigm shift for nuclear fusion research, because the performance of the plasma in not only determined by the magnetic field structure and strongly affected by self-organization process in the plasma.

After the finding of the H-mode, there are various bifurcation phenomena reported both in the transport and MHD instability caused by a strong non-linear and self-organized process in the plasma. In the transport, bifurcation phenomena of transport state was also found interior plasma, which is called an internal transport barrier (ITB) [3, 4] and inside magnetic island [5]. The bifurcation phenomena was also found in the MHD instability, the topology of magnetic field shows the bifurcation phenomena between nested magnetic field state and stochastic magnetic state [6,7]. More recently the bifurcation phenomena was also found to play an important role in triggering the abrupt event [8, 9,10]. In this talk, pioneer work on plasma physics, which has became or will become a mainstream research, is reviewed.

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