# PHYSICS DESIGN OF CHS-QA BASED ON CHS EXPERIMENTS

**K. Matsuoka [1], S. Okamura [1], S. Nishimura [1], M. Isobe [1], C. Suzuki [1], A. Shimizu [2], A. Fujisawa [1], K. Ida [1], T. Minami [1], H. Iguchi [1], Y. Yoshimura [1], M. Osakabe [1], I. Nomura [1], S. Murakami [1], M. Yokoyama [1], N. Nakajima [1], T. Hayashi [1], K. Itoh [1], P. Merkel [3], M. Drevlak [3], C. Nührenberg [3], S. Gori [3], R. Zille [3], J. Nührenberg [3]**

*[1] National Institute for Fusion Science, Toki, Japan*
*[2] Nagoya University, Nagoya, Japan*
*[3] Max-Planck-Institute fuer Plasmaphysik, Greifswald, Germany*

CHS-qa, a quasi-axisymmetric helical device, has been designed as a post-CHS device in NIFS, the main purpose being to improve the neoclassical and anomalous transports of a helical plasma. In CHS, a variety of improved modes have been observed. On the basis of these improved modes further improvement of transports is to be pursued in CHS-qa by taking into consideration methods verified in other toroidal magnetic configurations, e.g. large velocity / radial electric field shear, and maximum J criterion. The toroidal viscosity is shown to be smaller by two orders than that of CHS and the poloidal viscosity, which is mainly determined by the aspect ratio with additional contribution from residual ripples, is also smaller by roughly l order than that of conventional helical system. The maximum J criterion is satisfied at the edge region in the vacuum configuration by the presence of small residual ripples and the region where the criterion is satisfied is extended to the core region due to the stellarator shear produced by the bootstrap current in a finite beta plasma. Design priority is put on the low aspect ratio ($A_p$ = 3.2) because of a large plasma volume: R = 1.5 m, a = 47 cm, B = 1.5 T, toroidal period number N = 2, 10 modular coils per period, 8 additional modular toroidal coils, 3 pairs of poloidal coils. Residual ripples can be controlled with these coils to keep flexibility in the experiments.