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Energy Confinement Studies of Ohmically Heated Plasmas in TRIAM-1M

By Takaki HATAE, Takashi YAMAGAJO, Shoji KAWASAKI, Eriko JOTAKI, Takaaki FUJITA, Kazuo NAKAMURA, Yukio NAKAMURA and Satoshi ITOH

In TRIAM-1M, the power supply system was reinforced and the experiments in higher plasma current (up to 450kA) have been carried out. The energy confinement properties are studied via the measurements of the radial profiles of electron and ion temperatures and the line-averaged electron density $\bar{n}_e$.

It is found that the global energy confinement time τ_e increases from 5.8ms to 7.6ms as $\bar{n}_e$ increases from $5.2\times10^{19}m^{-3}$ to $6.5\times10^{19}m^{-3}$. This dependence of τ_e on $\bar{n}_e$ consists with the Neo-Alcator scaling law.

The ion thermal diffusivity is investigated by analyzing the ion power balance. The thermal diffusion coefficient is 2.7-5.0 times larger than the one calculated by the neo-classical theory.

Measurements of Radiation Losses in TRIAM-1M

By Akihiko MORI, Takashi YAMAGAJO, Shoji KAWASAKI, Eriko JOTAKI, Takaaki FUJITA, Kazuo NAKAMURA, Yukio NAKAMURA and Satoshi ITOH

In efforts to achieve a reactor grade plasma, it is unpleasant to lose the input energy from the plasma column through the radiation. Therefore, it is very important to grasp the characteristics of the radiation loss from the plasma.

In TRIAM-1M, the radiation losses were measured by the 1 channel metal-film bolometer and the total radiative power loss was estimated. The ratio of the total radiative power P_{rad} to the total input power P_{in} was estimated to be 50-70% in ohmically heated plasmas. On

the other hand, in lower hybrid current drive discharges, P_{rad}/P_{in} was estimated to be 35-50%.

Double Probe Measurements of the Edge Plasma in TRIAM-1M

by Mahiro YAMAGAMI, Shoji KAWASAKI, Eriko JOTAKI,
Takaaki FUJITA, Mizuki SAKAMOTO,
Kazuo NAKAMURA, Satoshi ITOH

The electron temperature, the electron density and the ion flux of the scrape-off layer (SOL) have been measured using a Langmuir double probe in TRIAM-1M. The correlation between the parameters of the SOL and those of the main plasma (Ohmic discharge) has been investigated. The electron density of the SOL is approximately proportional to the square of the line averaged electron density of the main plasma. The electron temperature of the SOL is approximately proportional to the square of the plasma current and inversely proportional to the square of the line averaged electron density of the main plasma. In the case that the toroidal field is 6T and the plasma current is 200kA, the electron temperature and the electron density at the last closed flux surface is estimated to be about 26eV and about 1.5×10^{18} m^{-3}, respectively.

Impurity Behavior in TRIAM-1M LHCD Discharge

By Masayuki TAKASHIRI, Kazuo NAKAMURA, Shoji KAWASAKI,
Eriko JOTAKI, Ken-ichi MAKINO,
Sanae-I. ITOH and Satoshi ITOH

This paper presents the spectroscopic studies of the long-duration discharge on the superconducting tokamak TRIAM-1M. Impurity behavior is studied by multi-channel vacuum ultraviolet monochromator system, which is capable to measure spatial and temporal evolution of impurities. Measurements are carried out for 10s discharges under the experimental condition of $B_T=7$T, $I_P=40$kA, $\bar{n}_e=2$.

$0\times10^{19}m^{-3}$ and $P_{RF}=140kW$.

In high-density lower hybrid current drive (LHCD) experiments, impurities of molybdenum, iron, chromium and oxygen are observed. Molybdenum is constituent of the limiters and iron and chromium are used as the first wall and the tip of the launcher. The main VUV spectral lines are MoXIV (373.7Å), FeXVI (360.8Å), CrXIII (328.3Å) and OVI (1032.0Å). From the intensities of these VUV spectral lines, we study the spatial and temporal evolution of the impurity ion densities. In the plasma center, ion densities of iron and chromium strongly increase toward the end of the discharge. Increase in molybdenum is small and oxygen remains almost constant during the discharge.

We estimate the spatial and temporal evolution of the effective ionic charge (Z_{eff}) from the rate equations including the transport. The lower bound of Z_{eff} value rises from 4 to 6 in the plasma center. The contributions from each element at the end of the discharge are 45% from Mo, 25% from Fe, 25% from Cr, and 5% from O.

Analysis of Poloidal Magnetic Field in TRIAM-1M

By Manabu TAKECHI, Kazuo NAKAMURA, Shoji KAWASAKI, Eriko JOTAKI, Ken-ichi MAKINO and Satoshi ITOH

The non-circular plasma experiment was carried out in TRIAM-1M. The purpose of this research is to measure the poloidal magnetic field and to determine the plasma parameters, such as poloidal beta and internal inductance of the plasma with non-ciucular cross-section. Determination of these parameters with high speed (on real time, if possible) is an urgent task. The analysis should be performed during a tokamak discharge. For this purpose, we chose the method to utilize an approximate Grad-Shafranov equilibrium solution. The poloidal magnetic field which is picked up by magnetic coils during the discharge is fitted to the approximate solution.

Mesoscale anomalies in the western North Pacific derived from satellite observation data

By Shigeru AOKI and Shiro IMAWAKI

Geosat radar altimeter data during the first year (1986-1987) of the Exact Repeat Mission are analyzed to estimate anomalies of the sea surface dynamic topography (SSDT) for the western North Pacific and to study the distribution of the eddy kinetic energy (K_e) and propagation characteristics of the anomalies. SSDT anomalies are evaluated with sea level data from tide gauges at 12 islands mostly in the tropical North Pacific; the rms discrepancy is about 6cm, and the correlation coefficient between the two is 0.76. K_e is large in the Kuroshio stationary meander region and Kuroshio Extension region, in agreement with previous studies. In the interior region of the subtropical gyre is found a zonal tongue of large K_e at around 20-23°N, extending from the western boundary to the date line. The sea surface temperature (SST) derived from NOAA satellite radiometer data as well as SSDT is examined to detect popagation characteristics of the anomalies. Westward propagation is dominant both in SSDT and SST anomaly fields at mid-latitudes. The longitude-time lag cross-correlation diagrams reveal the coincidence of SSDT and SST anomalies statistically, which suggests baroclinic form of the anomalies. Westward phase speeds derived separately from diagrams for SSDT and SST anomalies coincide well with each other, and the coincidence is especially good in the eastern region (160°-180°E). In the eastern region, observed westward phase speeds of anomalies are roughly equal to theoretical speeds of the baroclinic first-mode long Rossby waves, with exception of slightly higher speeds at around 30° and 35-36°N. In the western region (140°-160°E), observed phase speeds decrease with increasing latitudes like the baroclinic long Rossby waves, but the observed speeds are generally higher than the theoretical ones. This discrepancy is difficult to be explained with the Doppler-shift by the upper layer mean current.

An Exprimental Study of the Interaction Between Swells and Wind Waves — The effects of swells on the wind-wave energy —

By Junko SAKAI, Tadao KUSABA and Akira MASUDA

Experiments in a wind-wave tank were carried out to investigate the effects of mechanically generated long waves upon short wind-wave energy. It was confirmed that the growth of wind-wave energy was reduced by regular waves and that regular waves of higher wave slope

enhanced the effect of supression, which was discovered experimentally by Mitsuyasu (1966) and explained theoretically by Phillips and Banner (1974). However, a serious quantitative discrepancy was found between the theory of Phillips and Banner and the present experiment. In addition, the theory predicts the dependence of wind-wave energy on the fetch or wind speeds, while the experiment didn't show such a tendency.

Next, the wind-wave energy was found proportional to the fetch as in the fetch relationships without regular waves. The rate of increase in the wind-wave energy itself, however, was lowered by the presence of regular waves. On the other hand, regular waves had no significant influence on the fetch relation for the spectral peak frequency.

Finally, the change of variance of surface elevation due to wind waves, i.e. the wind-wave energy, with the phase of regular waves was experimentally investigated. The wind-wave energy increased (decreased) near the crest (trough) of regular waves in consistent with the theory of Longuet-Higgins and Stewart (1960). Experimental results agreed well with theoretical estimation also in a quantitative sense for low wind speeds, whereas the former was greater than the latter by a factor of three for high wind speeds. Presumably this discrepancy comes from that wind waves in the experiment differs from irrotational gravity waves in the theory.

Mechanisms of the Southward Translation of Meddies

by Jun TAKAHASI, Katsuto UEHARA and Akira MASUDA

Meddies are warm and saline anticyclonic eddies with a radius of about 30 km that are found at the depth of the Mediterranean Outflow in the Eastern North Atlantic. Detailed hydrographic observations have revealed that meddies move southward or southwestward at the average speed of 1.3 cm/sec. A new mechanism is proposed for this curious translation of meddies, on the basis of the *pseudo-topographic β effect* induced by the surface southward mean current, which causes the eastward thickening of the mid-layer that captures meddies. This mechanism is examined with a reduced-gravity model that assumes no eddy motion except in the layer of meddies. Numerical experiments show that this mechanism alone explains a third of the observed velocity of the southward translation of meddies. This conclusion is supported by a simple argument of the dispersion relation of waves

controlled by the pseudo-topographic β as well as the planetary β. In addition, a three-layer quasi-geostrophic model is applied to the evolution of a meddy that is accompanied by coherent eddy motion both in the surface and deep layers. The experiment shows that combined effects of nonlinearity and pseudo-topographic β produce the southward translation of a meddy almost in agreement with the average translation of meddies. Reexamination of previous hypotheses suggests that a single mechanism is unlikely to be responsible for the large southward motion of meddies.

Motion Analysis of a Double-Articulated Tower in Regular Wave and Current

By Hiroyuki ARAKAWA

An estimation of motion of a double-articulated tower in regular waves and current is presented. Without current, we carried out the calculation by neglected the constant component in the velocity of fluid particle and compared with the experimental results. A very good agreement is show for the amplitude of pitch motion except for the resonance around. The contribution to pitch motion due to constant component in the velocity of fluid particle is negligible even in the case with current.