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**Improved confinement MST RFP plasmas with hot ions and high density**

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In MST plasmas with improved confinement, we have achieved for the first time a large ion temperature, reaching at least 1 keV. This is achieved with the capture of ion heat generated during magnetic reconnection. In separate discharges, we have quadrupled the plasma density by injecting deuterium pellets. This has also resulted in an increased ion temperature and in the largest beta yet observed in the RFP during improved confinement. Fluctuation reduction via auxiliary current drive in MST has previously resulted in a ten-fold improvement in the total energy confinement time and a doubling of beta. However, this improvement was due solely to a large increase in the electron temperature, $T_e$, exceeding 1 keV. Essentially no change in the ion temperature, $T_i$, was observed. We can now reliably trigger magnetic reconnection (large fluctuation) events that generate many MW of global ion heating power, driving $T_i$ to well over 1 keV and, according to the neutron flux, creating a population of fast ions. Reducing fluctuations soon after such events allows sustainment of the large $T_i$, with a several-fold reduction in thermal ion energy transport. Improved confinement plasmas were previously limited to relatively low density in order to prevent the destabilization of edge-resonant tearing modes. The four-fold density increase (up to 4 x $10^{19}$ $m^{-3}$) with pellet injection occurs without triggering these modes, due, we believe, to the central deposition of particles without the edge cooling that accompanies gas puffing. With pellet injection, there is still a substantial increase in $T_e$, and this is largely matched by an increase in $T_i$, yielding a record total beta of 26%. Work supported by USDOE and NSF.