Contribution ID: **94** Type: **Invited**

Full suppression of runaway electrons by magnetic perturbation during disruptions

Energetic runaway electrons generated during the plasma disruption could result serious damage to plasma-facing components. The next generation fusion machines, like ITER and DEMO, will need a reliable method for controlling or suppressing runaway electrons. Previous experimental results show that the massive gas injection can't provide enough impurities to achieve robust runaway suppression due to low gas mixture efficiency and extreme high Rosenbluth density for runaway avoidance.The transport of runaway electrons is affected by the magnetic perturbation. Robust runaway suppression has been reached on J-TEXT with mode penetration or mode locking by the application of resonant magnetic perturbation (RMP) with m/n=2/1 before the thermal quench. The strong stochastics in the whole plasma cross section expel out the runaway seed and results in runaway free disruptions on J-TEXT. It is found that hydrogen supersonic molecular beam injection has the capacity to eliminate RE current by provoking magnetic perturbations which increase RE losses rapidly. This provides alternative runaway suppression during disruptions for large scale tokamak.

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Track Classification: Mitigation