Radiative plasmas at the edge and their basic properties.

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Plasma radiation plays important role in temperature balance and stability of plasmas at the edge of fusion devices like tokamaks and stellarators. For example, Microfaceted Asymmetric Radiation From the Edge (MARFE), and detached plasma regimes are associated with radiation. Analogical situations appear in current quench after disruptions as well during noble gas injection proposed for current event mitigation in ITER. As it well known, radiation-condensation instability determining MARFE formation may be observed. The sound branch also may be destabilized by radiation.

The basic properties of radiative plasmas are discussed in the current presentation. Radiation losses in pure fully ionized plasmas are small in comparison with flows associated with heat conductivity. However, radiation of multi-electron impurity ions is significant, even if the impurity concentration is small. It depends strongly on the Impurity Distribution Over Ionization States (IDOIS). In many theoretical papers the impurity behavior is simplified drastically. (See, for example, the review paper [1]). Particularly, the coronal equilibrium is assumed, and thermal forces are ignored. The current presentation is devoted to recent investigations showing these assumptions to be not valid for a most part of situations in experiments and nature. (See review paper [2]). Many interesting effects taking into account the finite relaxation time of IDOIS and thermal forces have been found. In particular, the anomalous sound damping due to the internal friction, decompression shocks (Ref [3]), slow thermal waves (Ref. [4]), and self-sustained thermal oscillation are discussed in the current presentation.

Usually, opacity effects are negligible. However, plasmas are opaque in clouds surrounding pellets and noble gas jets. As a consequence, radiation is trapped inside the cloud; the temperature of the cloud is significantly higher than the temperature estimated with the assumption of plasma transparency. Experimental results have been explained taking into account opacity effects (Ref. [5]). Opacity effects in processes of current decay after noble gas injection and disruption also are discussed in the current presentation.

REFERENCES

- [1] Meerson, B., Rev. Mod. Phys., (1996), **68**, 215.
- [2] Morozov, D.Kh., Herrera, J.J.E. Plasma Phys. Rep, (1998), **24**, 347.
- [3] Morozov D.Kh., Pekker M. Physical Review E, (2001), **64**, 016416-1 - 016416-5.
- [4] Morozov, D.Kh., and Herrera, J.J.E.. The Physical Review Letters, (1996), **76**, 760.
- [5] D.Kh. Morozov, V.I. Gervids, I.Yu. Senichenkov, I.Yu. Veselova, V.A. Rozhansky, and R. Schneider. Nuclear Fusion, (2004) **44**, 252.