**Questions and comments that require extended answers beyond the available time during the class L3-20151017:**

1. **How can we use gamma-ray from plasma as diagnostics?**

   Energetic photons of gamma-rays are observed to emit from the sun, lightening, distant galaxies, and high temperature plasmas, such as from JET discharges. Kiptily recently published a paper on the gamma rays identified on JET via spectroscopy [2005-Kiptily-EFDA-JET-PR(05)38, attached.]. They range in nuclear reaction energy production from -7.65 MeV to 19.81 MeV, involving proton, D, T, $^{3}$He, $^{4}$He, $^{9}$Be, $^{12}$C.

2. **Please explain the "bulk material properties change".**

   Bulk material properties refer to the "macroscopic" properties, such as specific weight, density, strength, hardness, ductility, electrical and thermal conductivities, melting temperature, boiling temperature, etc. These properties are determined empirically, and used in the material selections and designs of machines and components

3. **What is the purpose of impurity seeding?**

   An impurity atom refers to atoms of high atomic charge Z and mass A. Such an atom is a relatively efficient (to a low-Z atom such as Deuterium, which has Z = 1 and A = 2) emitter of photons (via the so-called "line radiation") when it becomes ionized. These photons are characterized by series of wavelengths (colors, visible and invisible) and can carry away the energies of the electrons that surround the nucleus of the atom.

   By introducing a small amount of such atoms (as in "seeds") into the plasma edge region, they would get ionized by the relatively hot electrons (a few to tens of eV in temperature), radiate in spectra of colored lights, and reduce the plasma temperature there. This would in turn reduce the plasma heat flux that reach the component surfaces, such as the divertor targets.