Spectral Investigation of Photoionized Plasmas Induced by Nanosecond Pulses of Extreme Ultraviolet (EUV)

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Abstracts: *Investigations of plasma produced by photoionization of gases by nanosecond EUV pulses are presented. EUV radiation is generated using laser plasma sources based on a gas puff target, irradiated with nanosecond laser pulses from a Nd:YAG laser. Spectral measurements in EUV/VUV ranges have been performed. The results of the studies are presented.*

Plasma of different form is a common state of matter in Space. One of these forms is a photoionized plasma created by irradiation of interstellar gas with extreme ultraviolet (EUV) radiation. Spectral investigation of EUV photoionized plasma provides information concerning the irradiating sources. Laboratory studies of photoionized plasmas can assist with interpretation of similar plasmas existing in Space. This kind of investigation is called laboratory astrophysics and experiments concerning photoionized plasmas created in accretion discs were performed using high energy density (HED) facilities: high power Z-pinch or high power laser systems.

Similar experiments have been recently performed in our laboratory using laser plasma EUV sources. EUV beams were formed with the use of a grazing incidence axisymmetrical ellipsoidal mirror focusing radiation to a spot with a diameter of about 1 mm. Two kinds of laser plasma sources with different parameters of EUV beams were employed. First of them was based on a compact 0.8 J Nd:YAG laser allowing to obtain EUV fluence in the focal spot of approximately 50 mJ/cm^2. The second one was based on a 10 J Nd:YAG laser system and providing about 5 times higher EUV fluence. In both cases photoionized plasmas were created by irradiation of different gases injected into the focus region synchronously with the EUV pulses. Spectra in the EUV/VUV range were measured using a grazing incidence, flat-field spectrometer (McPherson Model 251), equipped with a 450 lines/mm toroidal grating. The spectra for various gases irradiated with EUV pulses at different parameters were registered. Significant differences between spectra, corresponding to the same gases, obtained for different irradiation conditions, were revealed. The atomic processes dominating in the photoionized plasmas and responsible for the spectral differences were qualitatively discussed.