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VUV SOURCE FROM PULSED-LASER GENERATED PLASMA

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We describe a pulsed vacuum ultraviolet (VUV) source consisting of a plasma created by focusing a NdYAG laser beam into rare gases under moderate pressure, and we report on spectral and time properties of that source. Main features are : continuum emission in a large spectral range, with only few lines superimposed, good time characteristics of the pulses, stability, cleanliness , and relatively high repetition rate (20 Hz).

In the experiments presented here, the plasma is fired by focusing into neon, argon or krypton, under pressure 0.5 to 5 bar, the residual part (infrared + green) of a Q-switched NdYAG laser (YG 581-20 from Quantel). The available energy per 10 ns pulse is typically 330 mJ. The emission spectrum is observed at the exit slit of a VUV grating monochromator ASM 100 from Jobin-Yvon, and measured with the help of a MgF_2 windowed photomultiplier equiped with CsI or CsTe photocathode, or with a NO ionization chamber.

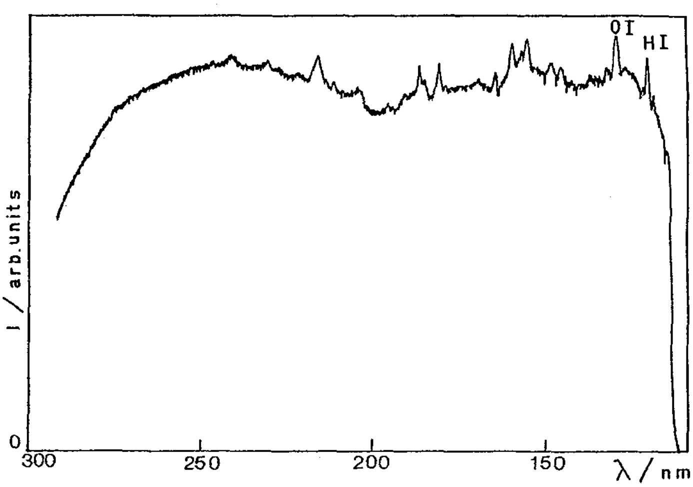

Fig 1 Emission spectrum from argon plasma, argon pressure: 2 bar; 110 nm< λ <160 nm : CsI photocathode 160 nm < λ < 300 nm : CsTe photocathode . Non referenced lines are principally from Ar II

The emission consists essentially in a continuum extending in the whole investigated spectral range (115-300 nm) except for the case of Kr, for which the cut-off at 128 nm is due to the absorption by the broadened first resonance line. A few broadened emission lines are superimposed onto the continuum, due to the singly ionized gas (especially in the case of argon) or, possibly, to neutral impurities (Fig. 1).

Emission intensity, corrected for detector response, reveals a maximum located near 175 nm for the three gases; so plasma temperature is estimated to be 16500 ± 500 K.

Dependence of emission intensity versus pressure or excitation energy is illustrated in Figs. 2 and 3.

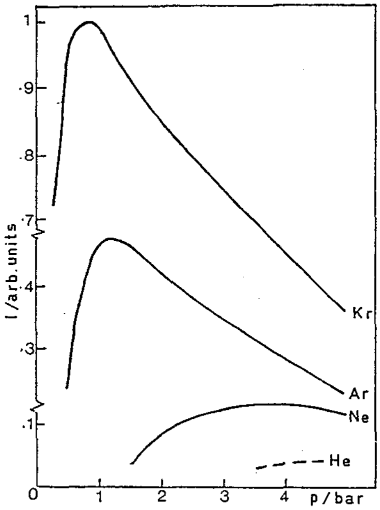

Fig. 2 Intensity of laser plasma emission vs gas pressure, laser pulse energy 330 mJ.

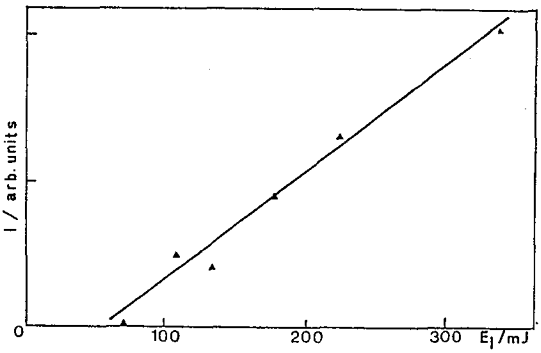

Fig 3 Intensity of laser plasma emission vs laser energy at an argon pressure of 1,2 bar

The maximum number of photons available at the exit slit of the monochromator around 175 nm (maximum of the emission) when firing with a 20 Hz, 300 mJ YAG laser is ≈ 5×10^8 photons $nm^{-1}s^{-1}$ with argon, and 10^9 photons nm^{-1} s^{-1} with krypton.

Fig. 4 gives typical curves of time behavior of the continuum emission.

Full time widths at half maximum (FWHM) are ≈ 20 ns, 30 ns and 40 ns for neon, argon and krypton respectively, including the laser time-width contribution.

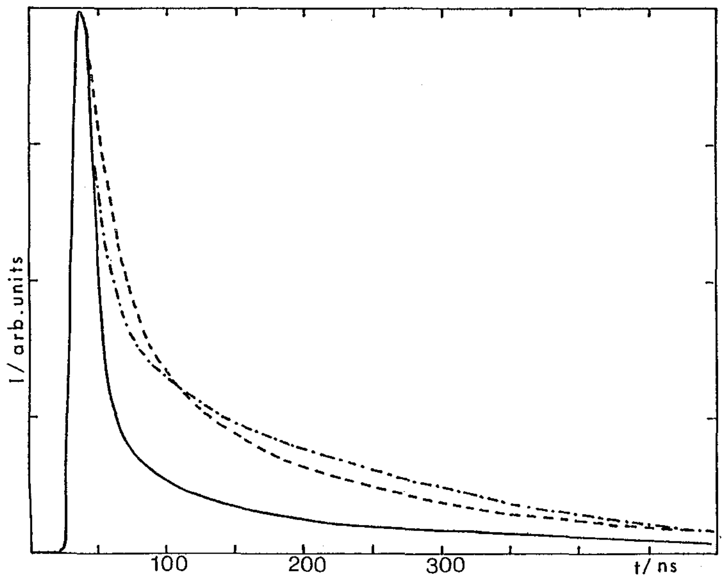

Fig 4 Time resolved vuv continuous emission near $\lambda \approx 154$ nm, full line: Ne, chain-dashed line : Ar, dashed line: Kr.

Advent of multikilohertz lasers (YAG, Copper...) of enough peak intensity is one possibility of improving the average intensity of such a source.