SMALL-SIZED NANOSECOND SOURCE OF POWERFUL WIDE-BAND VUV-UV RADIATION

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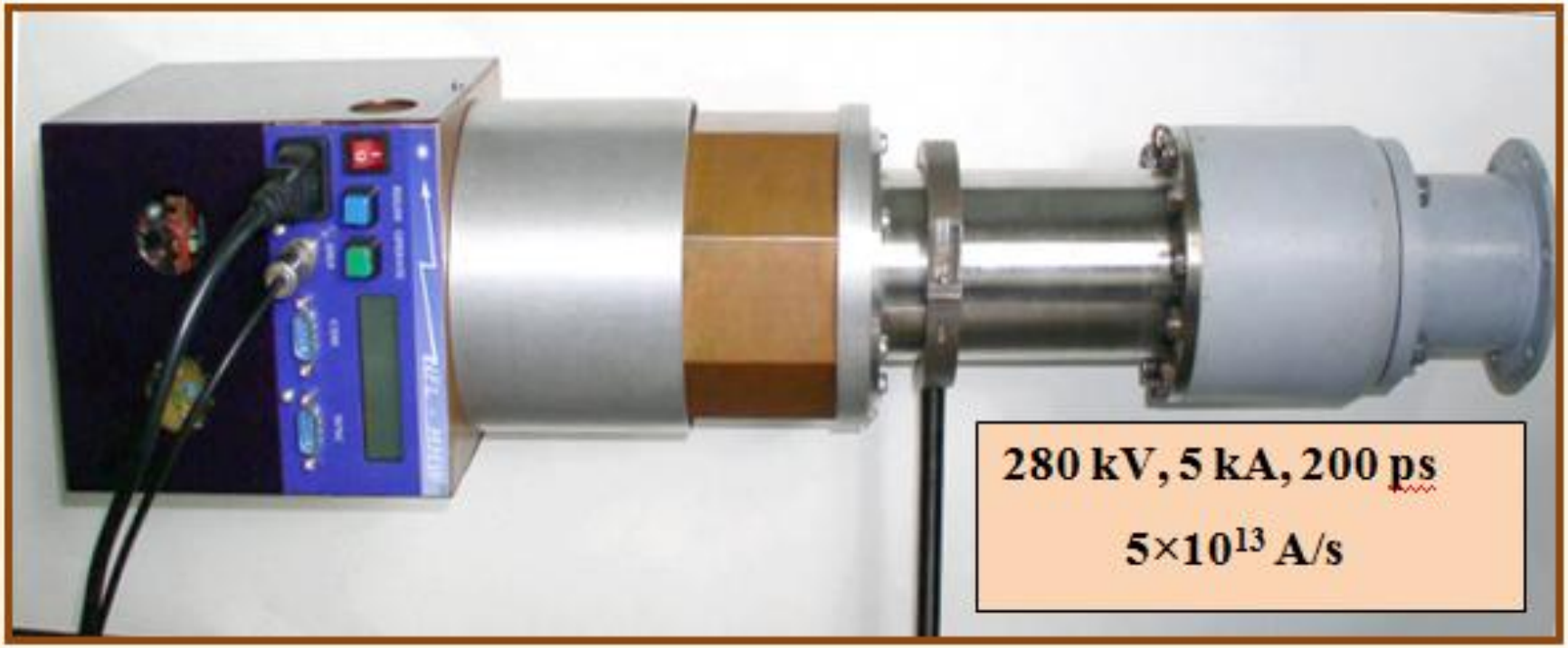
Facility appearance and principle parameters

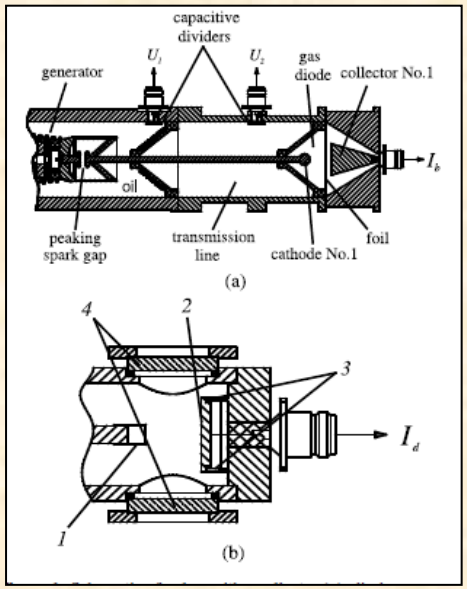


Formulation of the problem

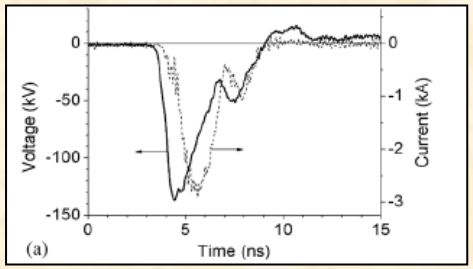
- Study of VUV-UV plasma radiation of a sub-nanosecond high-voltage discharge in atmospheric pressure xenon with a modified design of the electrode array
- Comparison of the radiative characteristics of this discharge and the atmospheric pressure discharge sustained by the RADAN-220 nanosecond high-voltage facility (HCEI, Tomsk)

Scheme of the experimental setup

I



II



I. The design of the electrode array of the source of VUV radiation based on the RADAN-220 facility

II. Waveforms of the voltage across the gap and discharge current. Input discharge energy ~1J

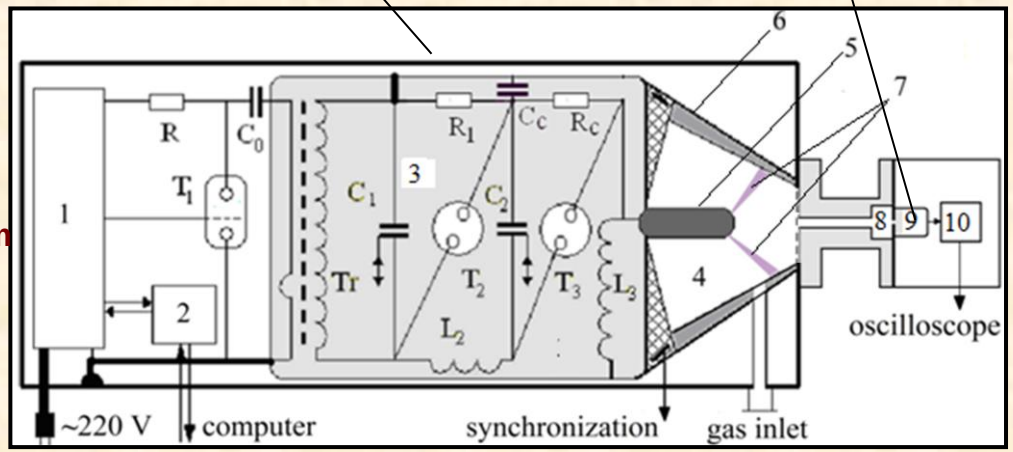
(Baksht E H et al, 2009 J. Phys. D: Appl. Phys. 42 185201)

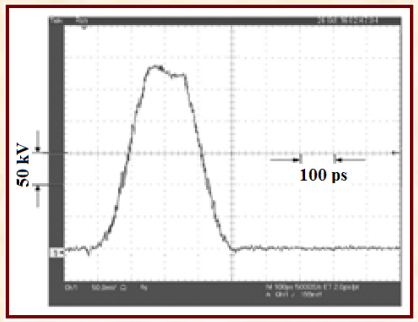
Two-stage Tesla-Marx generator
Pulse parameters:
length 0.1–1 ns,
current 5 kA,
voltage 150–300 kV,
repetition rate 0.1–12.5 Hz
input discharge energy 0.3 J

***pin*-diode**
(λ = 0.12 –650 nm, τ ≈ 1 ns)

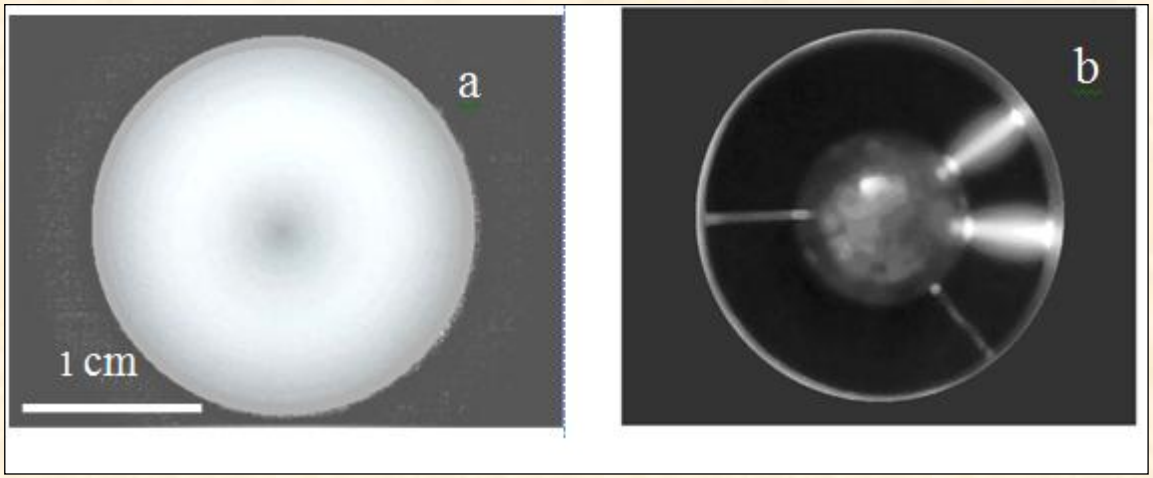
40 cm

10 cm

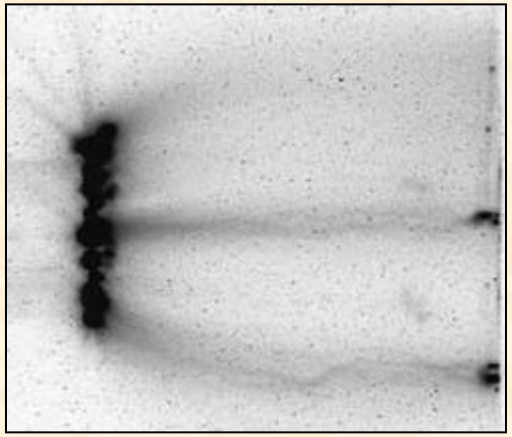




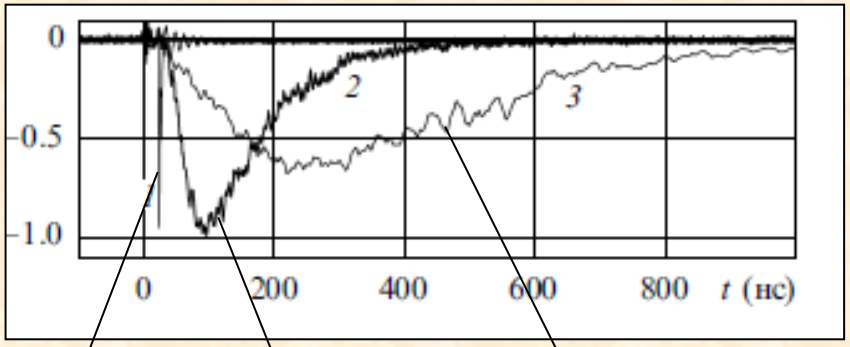
Waveforms of the voltage across the gap



The end view of the discharge in the volume (a) and streamer (b) modes in the UV spectral range (λ = 320 - 420 nm)



The side view in the visible range of the discharge in the volume mode at the RADAN-220 facility (*E.Kh. Baksht et al, Quantum Electron. 36 576 (2006*)

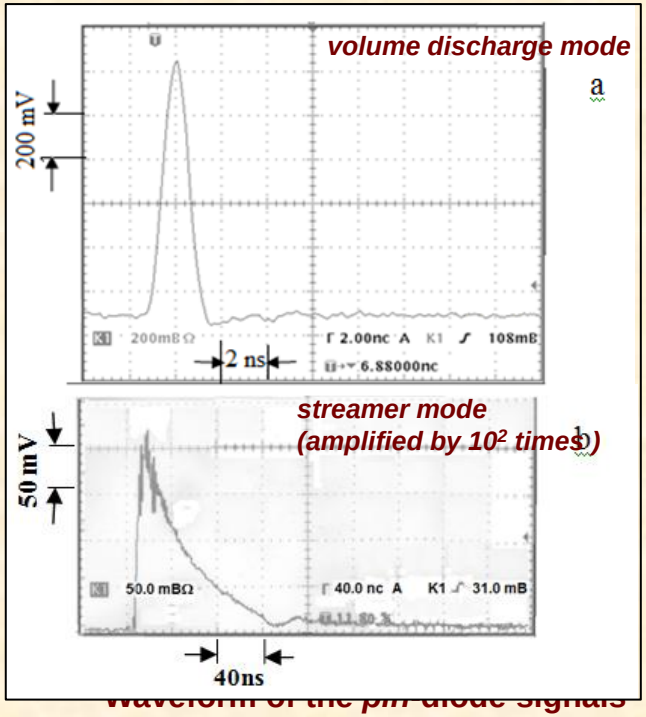


discharge current pulse

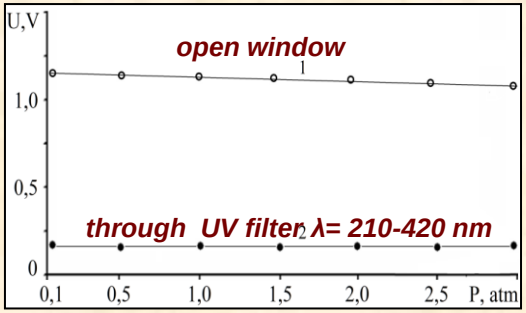
discharge radiation intensity at a wavelength of λ = 172 nm at a xenon pressure of 1.2 atm

radiation intensity at a xenon pressure of 0.3 atm *amplified by 10 times*.

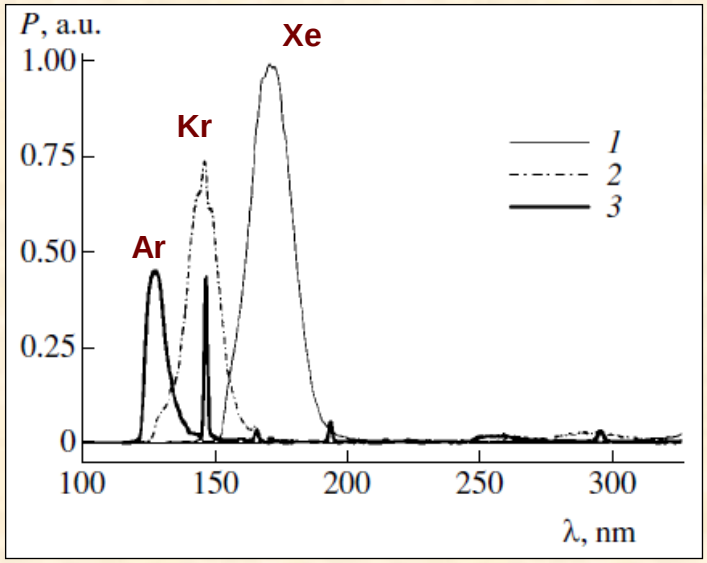
RADAN-220 facility (*E.Kh. Baksht et al, Quantum Electron. 36 576 (2006*)



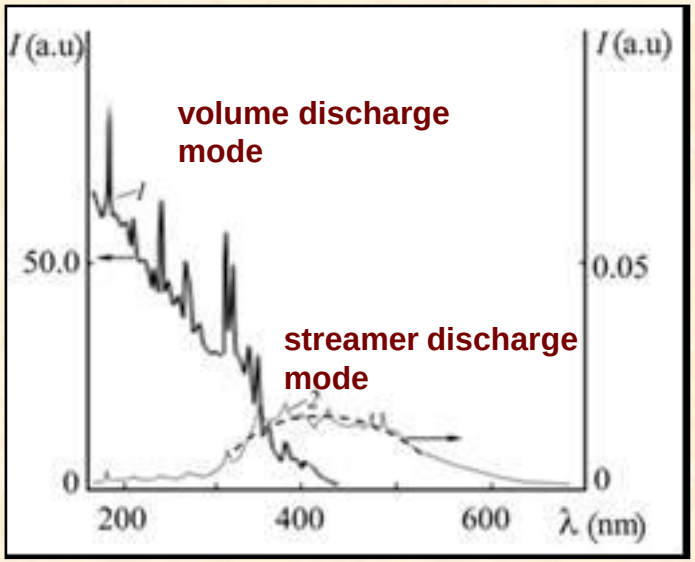
Waveform of the pin diode signals



Dependence of the intensity of VUV-UV radiation of a volume mode discharge in Xe on the pressure of the gas

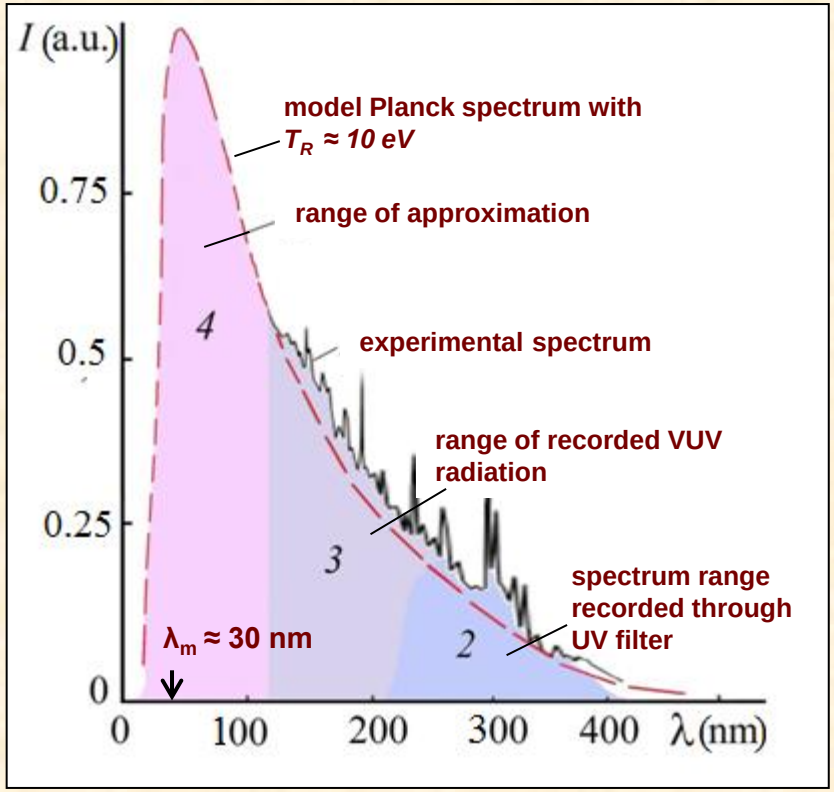


Emission spectra of the discharge at a pressure of a working gas of 1.2 atm.



Discharge emission spectra at a pressure of 1 atm in the VUV-UV wavelength range

RADAN-220 facility. (**E.Kh. Baksht et al. Tech. Physics Letters , 2006, 32(10), 847)**



The emission spectra of the discharge at a Xe pressure of 1 atm.

Radiative characteristics of the given discharge in a volume mode and the discharge sustained by the RADAN-220 facility

		RADAN-220 facility	Discharge under studies
discharge characteristics	pulse voltage (kV)	≤ 250	280
	pulse current (kA)	3	5
	pulse length, FWHM (ns)	2	0.2
	electrode array design	cathode: foil tube ∅6 mm, thickness 0.1 mm – anode: foil or grid plate	hemispherical cathode ∅ 9 mm – conical anode
	Input energy (J)	1	0.3
radiation pulse parameters	length, FWHM (ns)	130	1
	peak radiation power (MW)	0.3	12
	full radiation energy (mJ)	45	10
	spectrum shape	Band λ_{max} = 172 nm $\Delta\lambda$ (FWHM) = 18 nm	Plank distribution (presumably), T_R = 10 eV, λ_{max} = 30 nm, $\Delta\lambda$= 10 - 420 nm

Conclusions

- The use of a high-voltage discharge pulse (280 kV) with a duration of about 200 ps, as well as a hemispherical cathode and conical anode, in the volume discharge in elevated-pressure xenon (0.1–3 atm.) leads to the emission of broadband radiation in the wavelength range of 110–420 nm.

- The emission spectrum can be fitted by the Planck spectrum with a maximum at λ = 30 nm, extending mainly in the range 10-400 nm, which indicates the formation of a new (presumably thermal) mechanism of discharge plasma radiation.

- The duration of the radiation pulse does not exceed 1 ns, and when the energy consumed by the discharge in single pulse is about 0.3 J, the total radiation power in the indicated spectral range reaches 12 MW.

Thank you for attention!