

# Single-color pump-probe setup at the NovoFEL facility for measuring the temporal dynamics of relaxation in Ge:As



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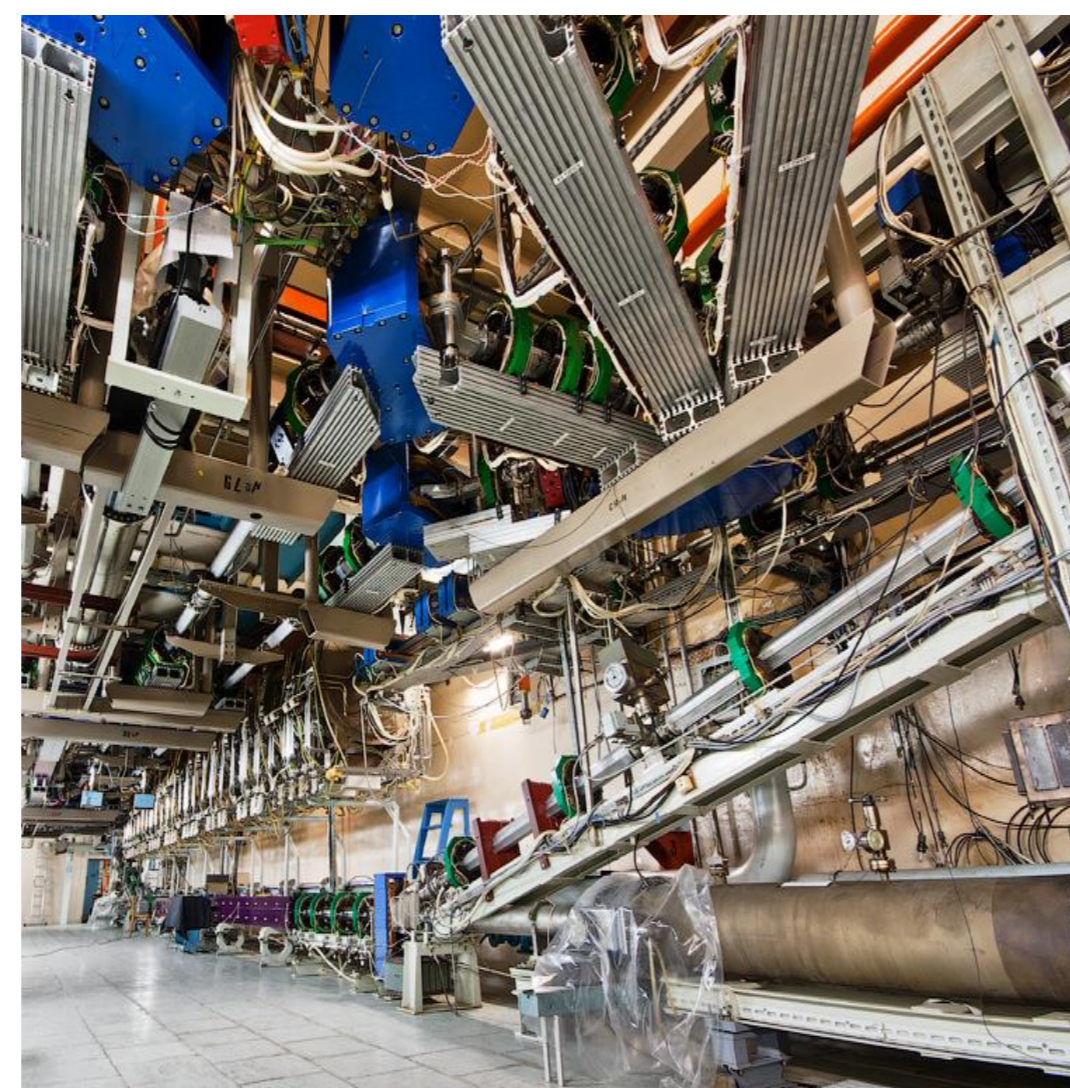
## Introduction

The short, narrow-band THz pulses produced by the Novosibirsk free electron laser (NovoFEL) in combination with a pump-probe experimental setup are a powerful tool to reveal information on the dynamics of resonant processes. In this work, we present our experimental setup and show some recent results on the relaxation of electronic impurity states in germanium at low temperatures.

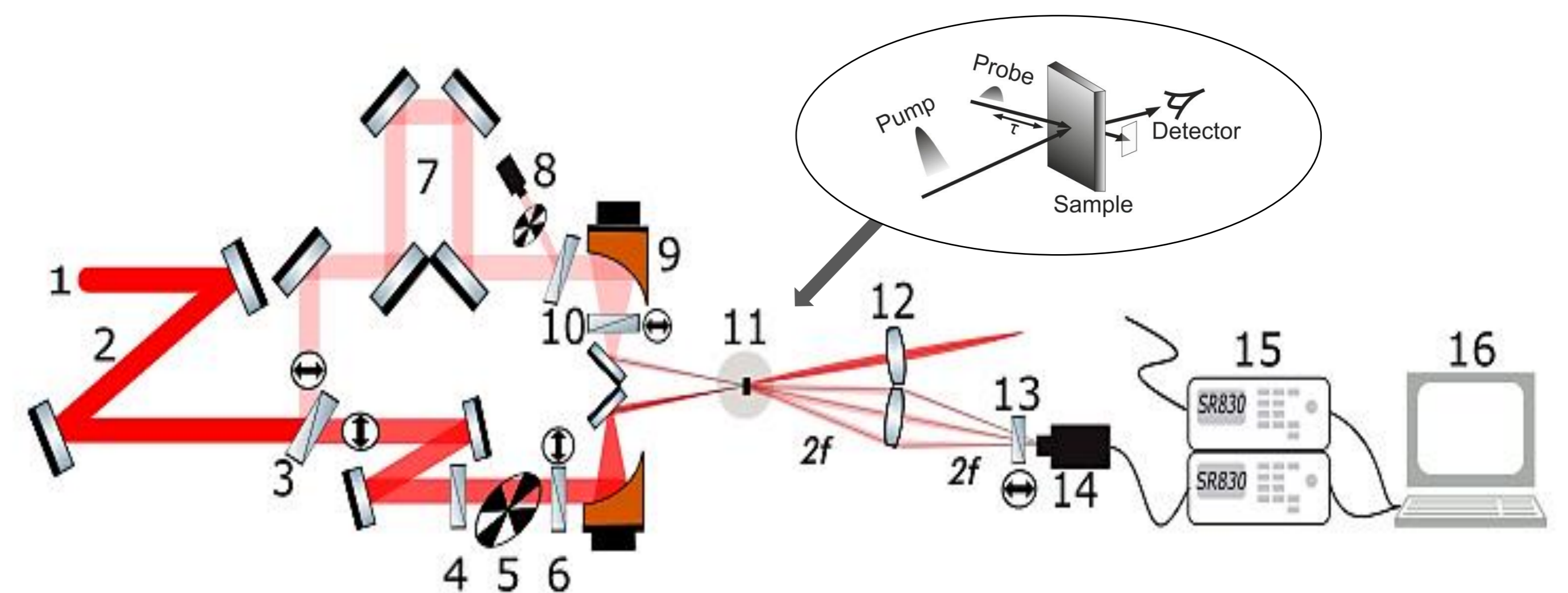
## Novosibirsk free electron laser facility

Laser beam main characteristics:

- **Monochromatic** radiation tunable within ranges **5-20, 40-80, 100- 240  $\mu\text{m}$**
- Relative linewidth: (0.3 – 1)%
- Beam divergence:  $4 \cdot 10^{-3}$  rad
- Complete spatial coherence
- Linear polarization degree: not less than 99.6%



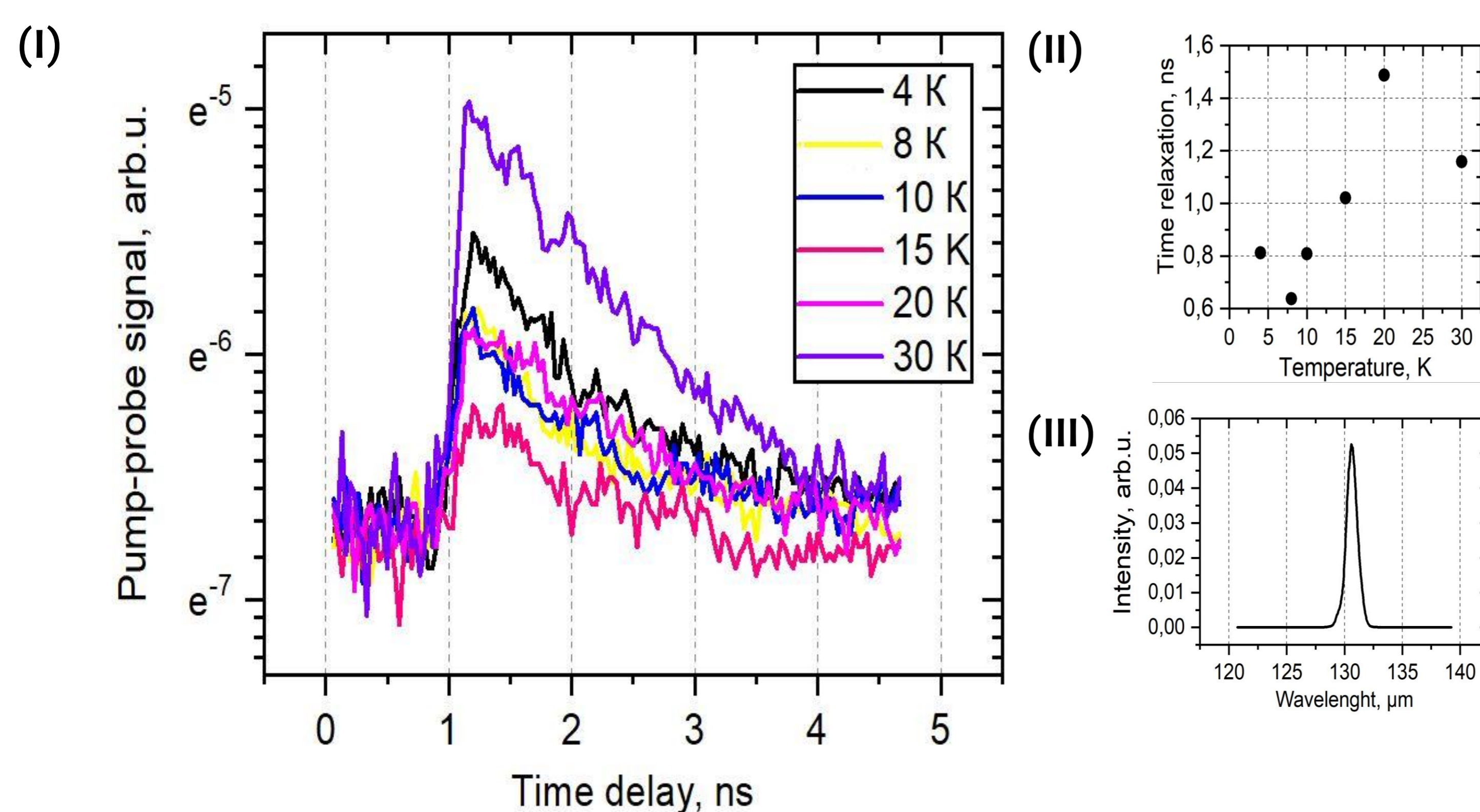
## Schematic of single-color pump-probe setup



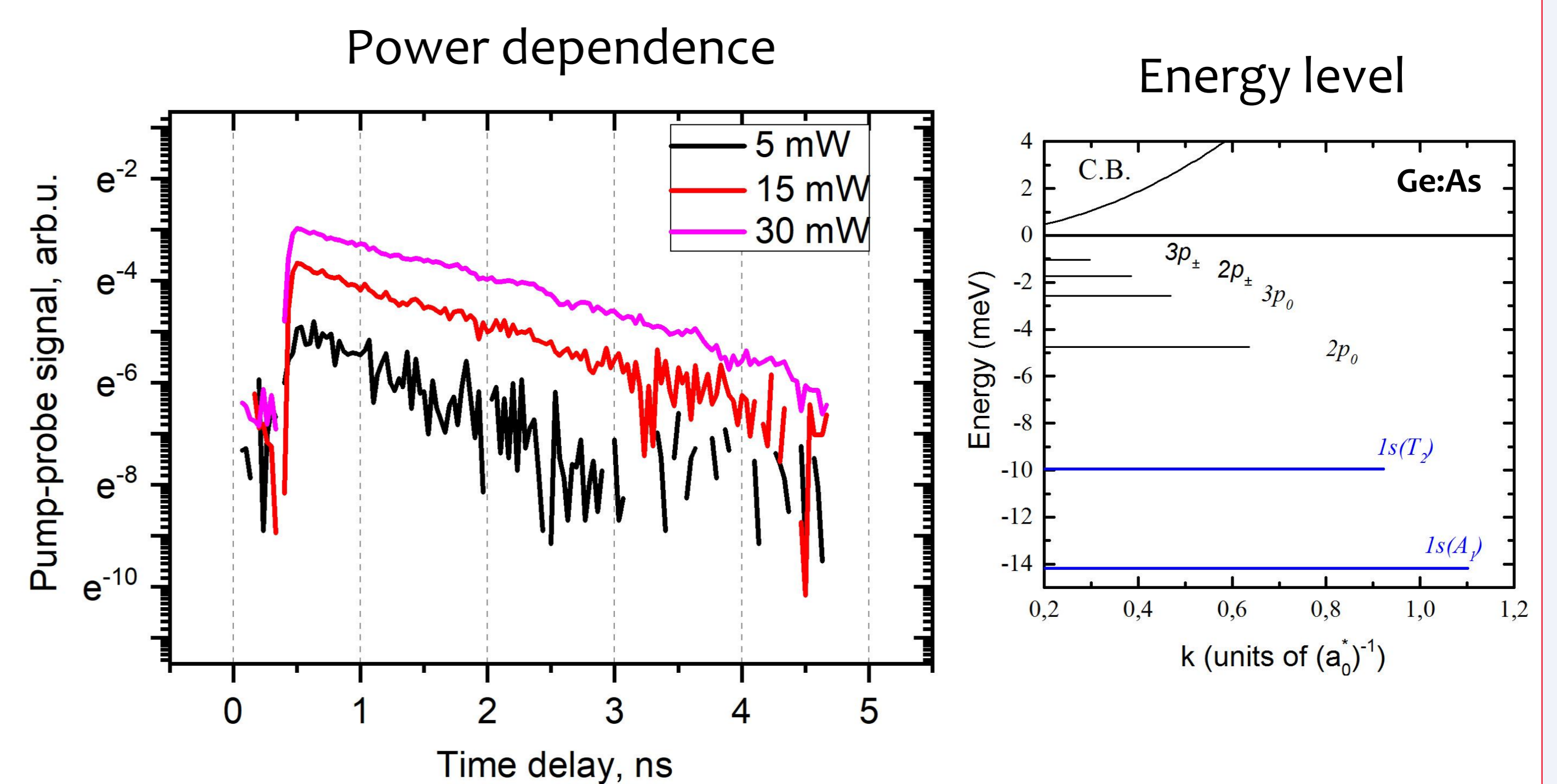
■ pump beam      ■ probe beam

1 – laser beam; 2 – correction line; 3 – free standing wire grid polarizer; 4,6 – photolithographic polarizer; 5 – chopper at 15 Hz frequency; 7 – optical delay line; 8 – detection of the power reference channel, which consists of a polarizer, a modulator, and a detector; 9 – copper parabolic mirror  $f = 250$  mm; 10 – photolithographic polarizer; 11 – sample into liquid-He flow cryostat; 12 – TPX lens  $f = 150$  mm at  $2f$  distance; 13 – photolithographic polarizer; 14 – Golay cell; 15 – Synchronous detector SR-830; 16 – computer.

## Pump-probe measurements at NovoFEL



- I) Temperature dependence  
 II) Time relaxation vs. temperature. Up to 10, relaxation time does not change  
 III) NovoFEL spectrum at the wavelength of  $\lambda = 131 \mu\text{m}$



## Results

	$\lambda = 131 \mu\text{m}$	$\lambda = 140 \mu\text{m}$	$\lambda = 150,7 \mu\text{m}$
$P_{\text{pump}}$ , mW	25	17	12
$P_{\text{probe}}$ , mW	1,1	1	0,4
$\tau$ , ns	$0,317 \pm 0,0058$	$1,39 \pm 0,068$	$0,83 \pm 0,024$
Transition	$1s \rightarrow 3p_{\pm}$	$1s \rightarrow 2p_{\pm}$	$1s \rightarrow 2p_0$

Welcome for collaboration!

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