



# Study of the dynamics of size of particles during trinitrotoluene detonation by VEPP-4M synchrotron radiation

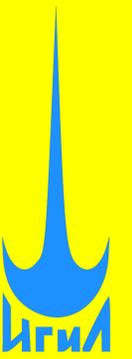
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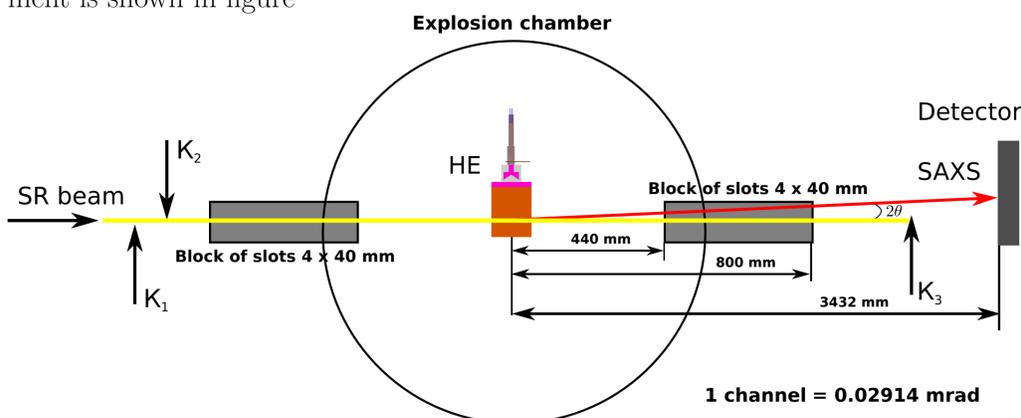


## Abstract

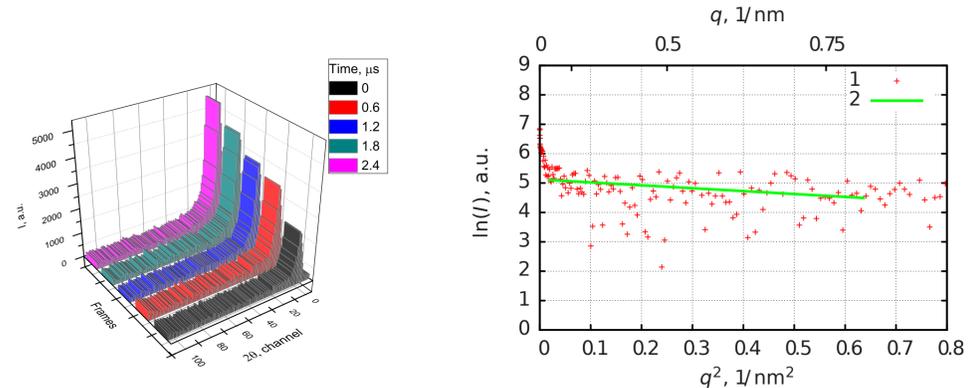
This poster presents experimental data on measuring distributions of small-angle X-ray scattering (SAXS) during cast trinitrotoluene (TNT) detonation of 30 and 40 mm in diameter. The work was carried out at the SYRAFEEMA (Synchrotron Radiation (SR) Facility for Exploring Energetic Materials) station at the accelerator complex VEPP-4M (Budker Institute of Nuclear Physics). This new station give much higher SR intensity than similar station on VEPP-3 accelerator complex. It allowed us to X-ray examination of explosive charges of larger diameter (till 40 mm) and increase in the mass of the charges studies by ten times till 200 grammes.

## Experimental setup

The SAXS measurements were carried out at SYRAFEEMA station on the VEPP-4M. For dynamic experiments on registration SAXS, the scheme of measurement is shown in figure



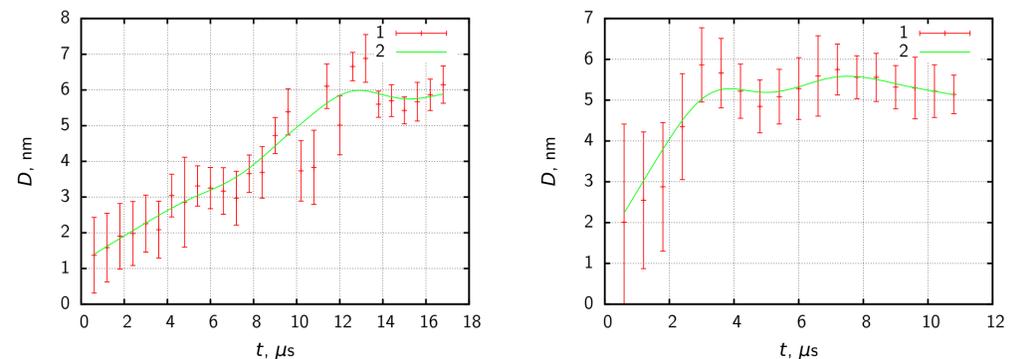
## SAXS measurement experiments



Left: SAXS data during TNT detonation in the first 2.5  $\mu\text{s}$  for one experiment. Right: 1 – SAXS data for TNT detonation at 6  $\mu\text{s}$  behind the front, 2 – Guinier approximation.

## Experimental results

The SAXS dynamics in detonation of cast TNT charges (of different diameter) was measured. Dynamics of the average size of the condensed carbon nanoparticles behind a chemical reaction zone recovered from SAXS distributions in the Guinier approximation.



Average size of carbon particle versus time in detonation of a cylindrical TNT charge of 40 mm diameter (left) and 30 mm diameter (right): 1 – experimental data, 2 – smooth spline.

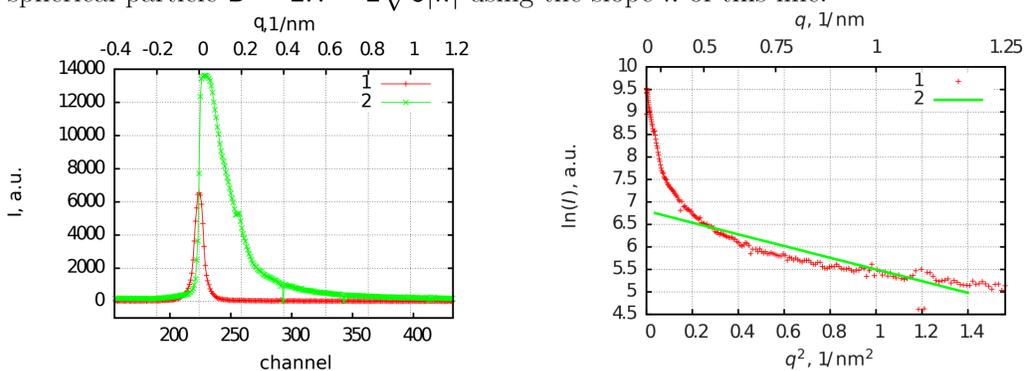
We observe, that the time of nanoparticles growth behind the chemical reaction zone depends on size of initial charge. It increase with increase in diameter of charge.

## SAXS measurement experiments

The size of the scattering centers were determine using the Guinier approximation

$$I(q, R) = I_0 \exp(-q^2 R_g^2 / 5)$$

Taking the logarithm of the intensity  $\ln(I(q, R)) = \ln(I_0) - q^2 R^2 / 5$ , we obtain a function which decreases linearly versus  $q^2$ . We can determine the size of the spherical particle  $D = 2R = 2\sqrt{5|k|}$  using the slope  $k$  of this line.



Left: Setting: 1 – attenuated straight beam, 2 – scattering on particles of ultra-fine diamonds (UFD).

Right: The dependence of  $\ln(I)$  vs.  $q^2$ : 1 –  $\ln(I)$ , 2 – approximation by straight line for UFD ( $k \approx -1.4$ ,  $D \approx 5.4$  nm).

## Acknowledgments

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## SR Explosion Group

<http://ancient.hydro.nsc.ru/srexpl>

Presentation:



Poster:

