

# **“Portable mass-spectrograph with linear segmented detector array”**

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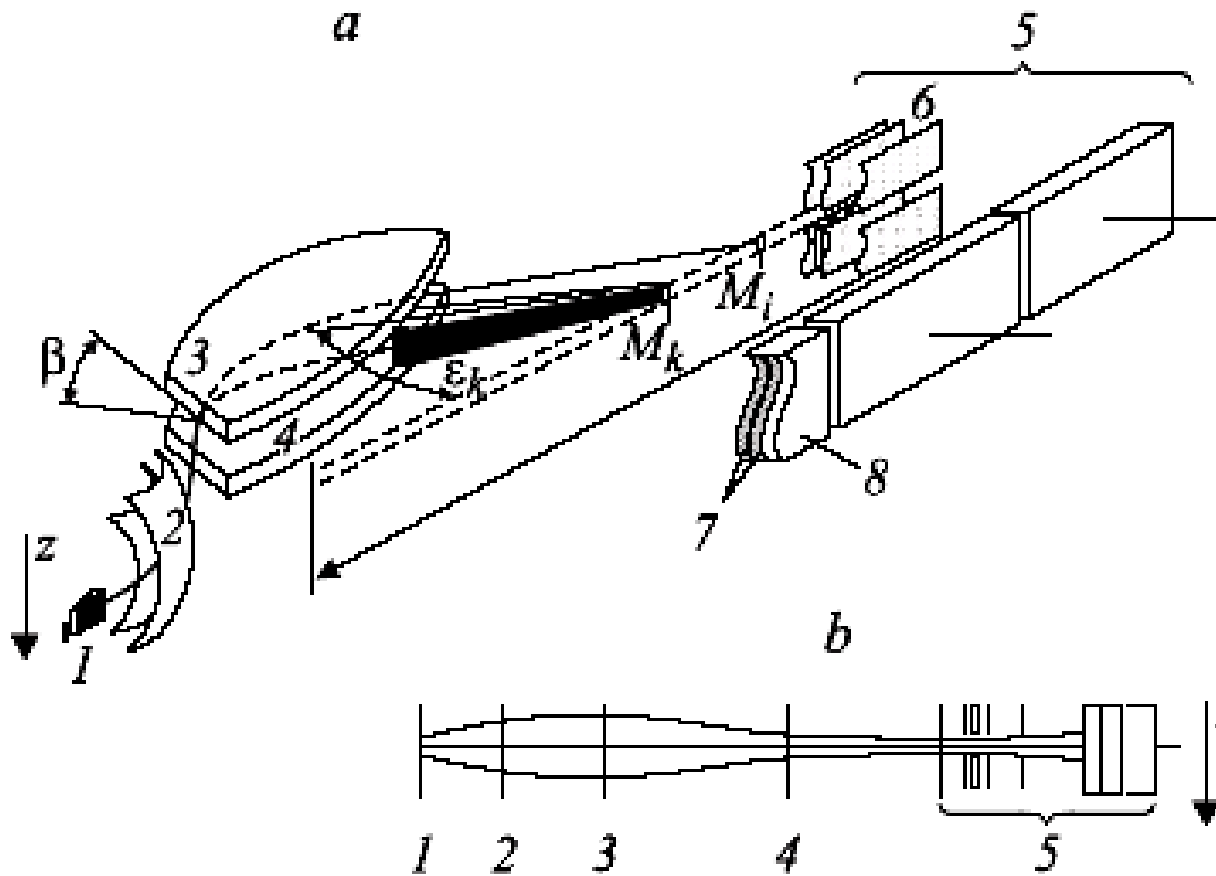
## Purposes

In this work, we consider the ion-optical scheme of a mass spectrograph with angular and energy focusing of ions that provides rapid recording of ion mass spectra over a wide mass range with the separating electric and magnetic fields of the mass analyzer remaining constant.

## Objectives

- the optimization of the design of a portable mass spectrometer with the curved exit boundary of the magnet and a spherical electrostatic capacitor for z-focusing of an ion beam
- application of an original linear segmented detector array (LDA) to increase dynamic range and sensitivity of an instrument

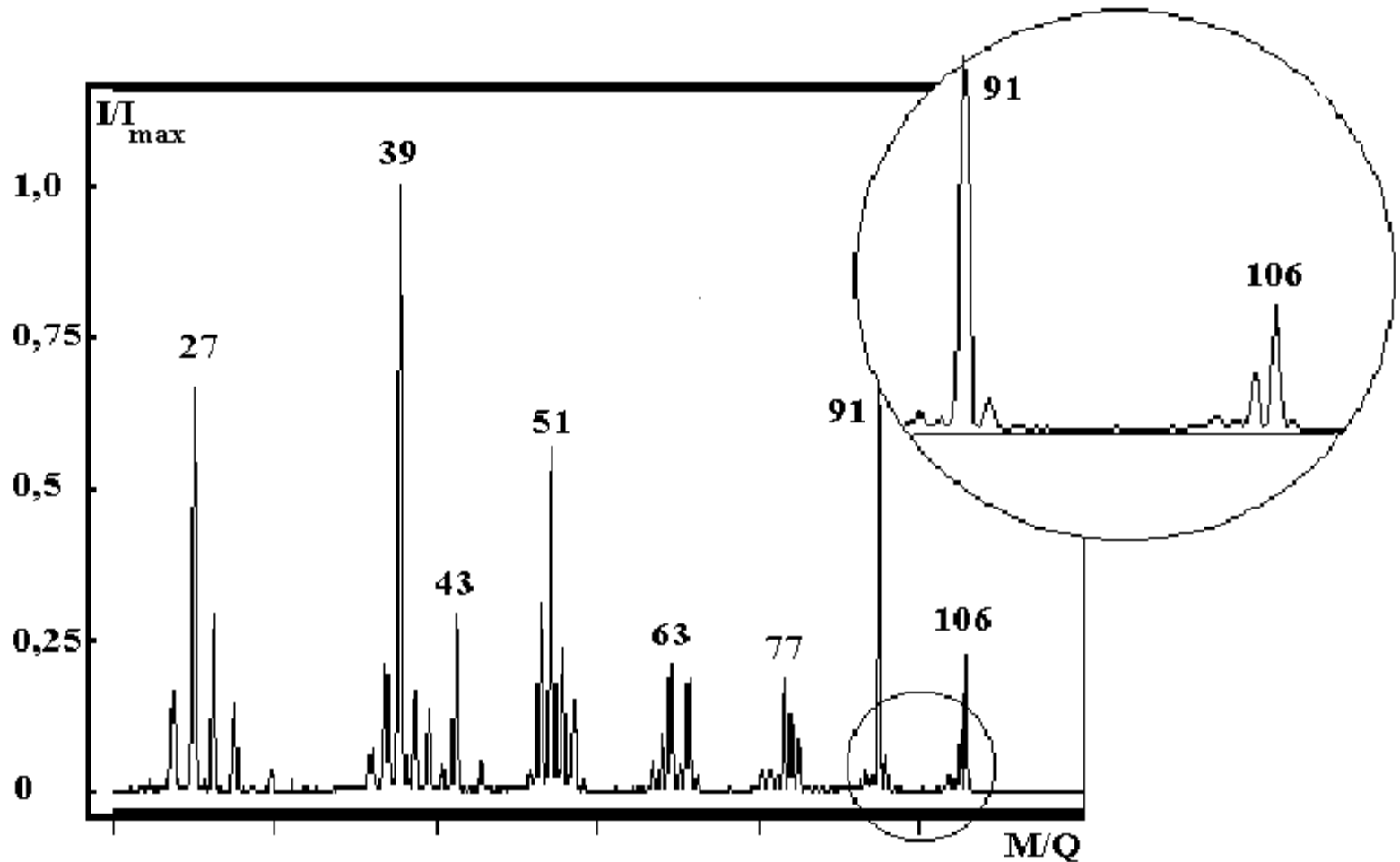
# Mass analyzer scheme for optimal detector performance



- (1)- ion source,
- (2)- electrostatic capacitor,
- (3, 4)- magnets,
- (5)- detector:
- (6)- electrostatic filter,
- (7)- chevron assembly of microchannel plates,
- (8)- collector.

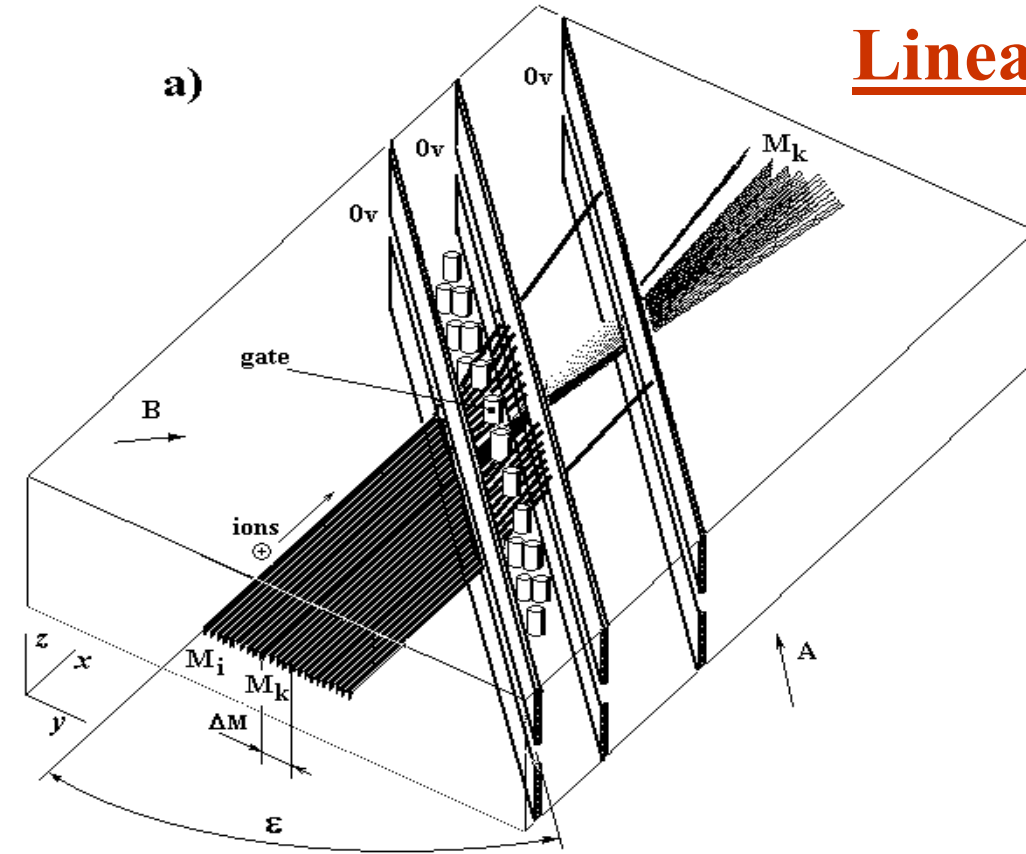
**Mass spectrometer with z-focusing: a) – general view, b) – cross-sectional view of an ion beam in z -direction**

## Results of an experiment for MS prototype



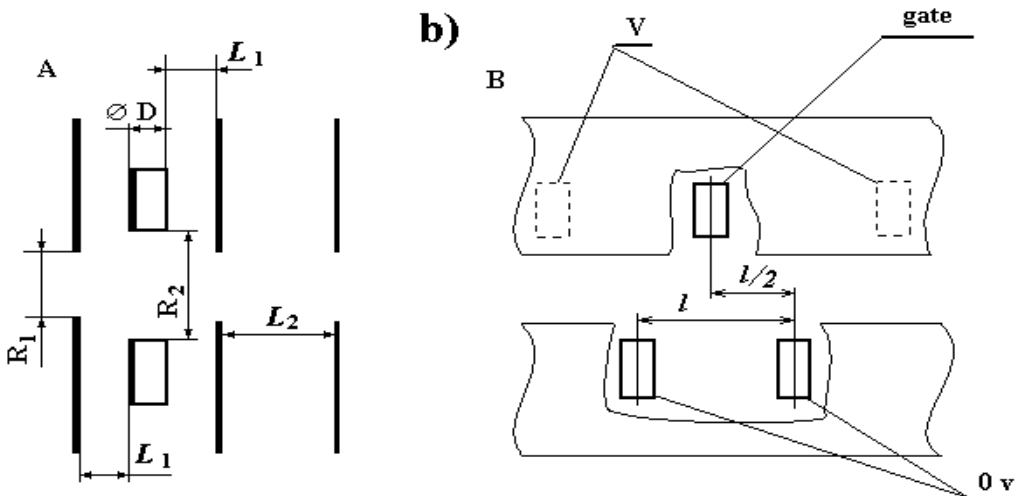
**Mass spectrum of o-xylene obtained with the analyzer of prototype of the mass spectrograph operating in scanning mode (ionization by 70 eV electron impact in ion source)**

# Linear segmented detector array



## Electrostatic filter section:

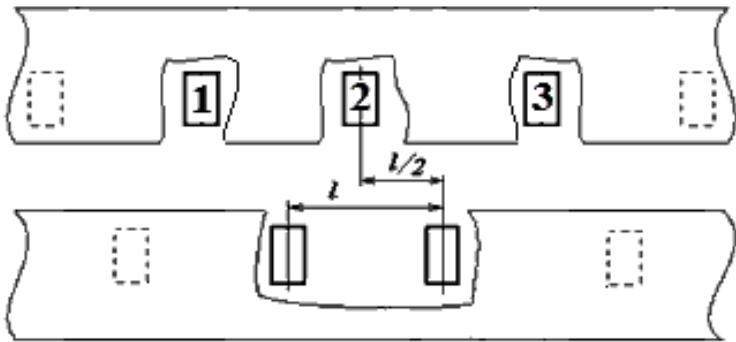
a) general view and ion trajectories (simulation with SIMION7 software),



b) design viewed from A and B.

# Data of experiment for LDA

$E = 570 \text{ eV}$



top row:  $V = -200 \text{ V}$

bottom row:  $V = 0 \text{ V}$

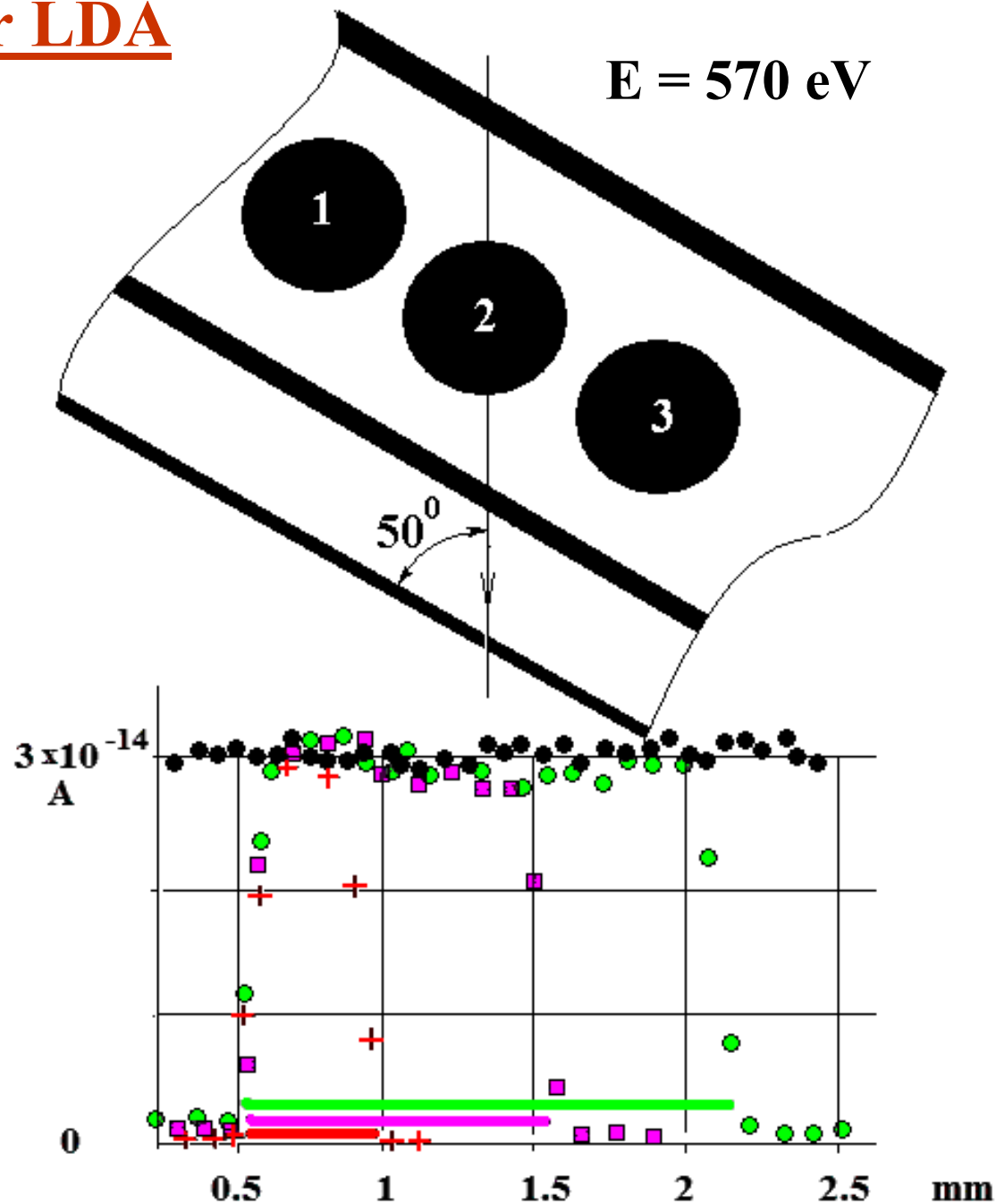
gates (1;1-2;1-2-3),  $V = 0 \text{ V}$

+    □    ●  
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$l = 1.4 \text{ mm}$ ;  $L_1 = 1.1 \text{ mm}$ ;

$L_2 = 3 \text{ mm}$ ;  $R_1 = R_2 = 1 \text{ mm}$ ;

$D = 0.6 \text{ mm}$ .



## Conclusions

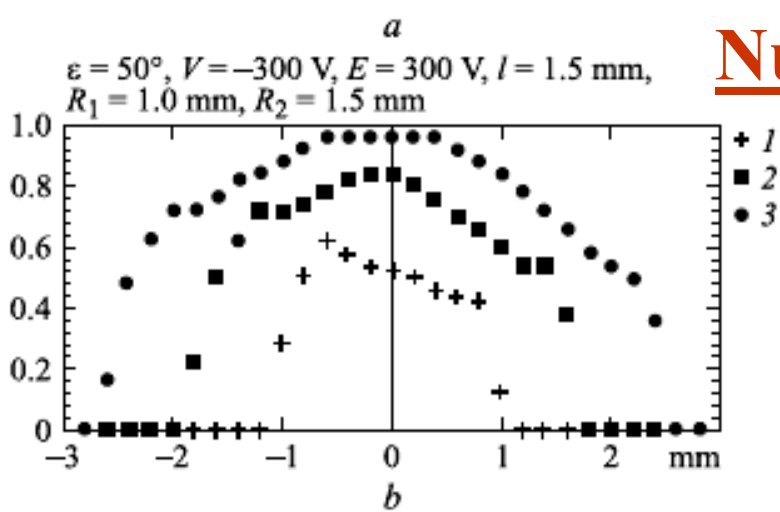
We considered an ion-optic scheme for a portable mass spectrograph that supplies high dynamic range (up to  $10^7$ ) and simultaneous recording of partial spectra.

### **Main features of the instrument:**

- Magnet with small sector angle ( $\sim 50^\circ$  for heavy mass) and curved exit boundary moves the focus line far from the field and supplies high mass dispersion
- Spherical electrostatic capacitor allows embedding of multichannel linear segmented detector in the instrument due to z-compression of the ion beam
- Multichannel linear segmented detector allows measuring a number of compounds interdependently under permanent analyzing electrical and magnetic fields (E&H).

**Field of application:** fast monitoring of the sample composition

# Numerical simulation of a detector



## Response of the multichannel system

**Abscissa:** x-coordinate of ions at inlet

**Ordinate:** ratio of number of ions at outlet to number of ions at inlet

