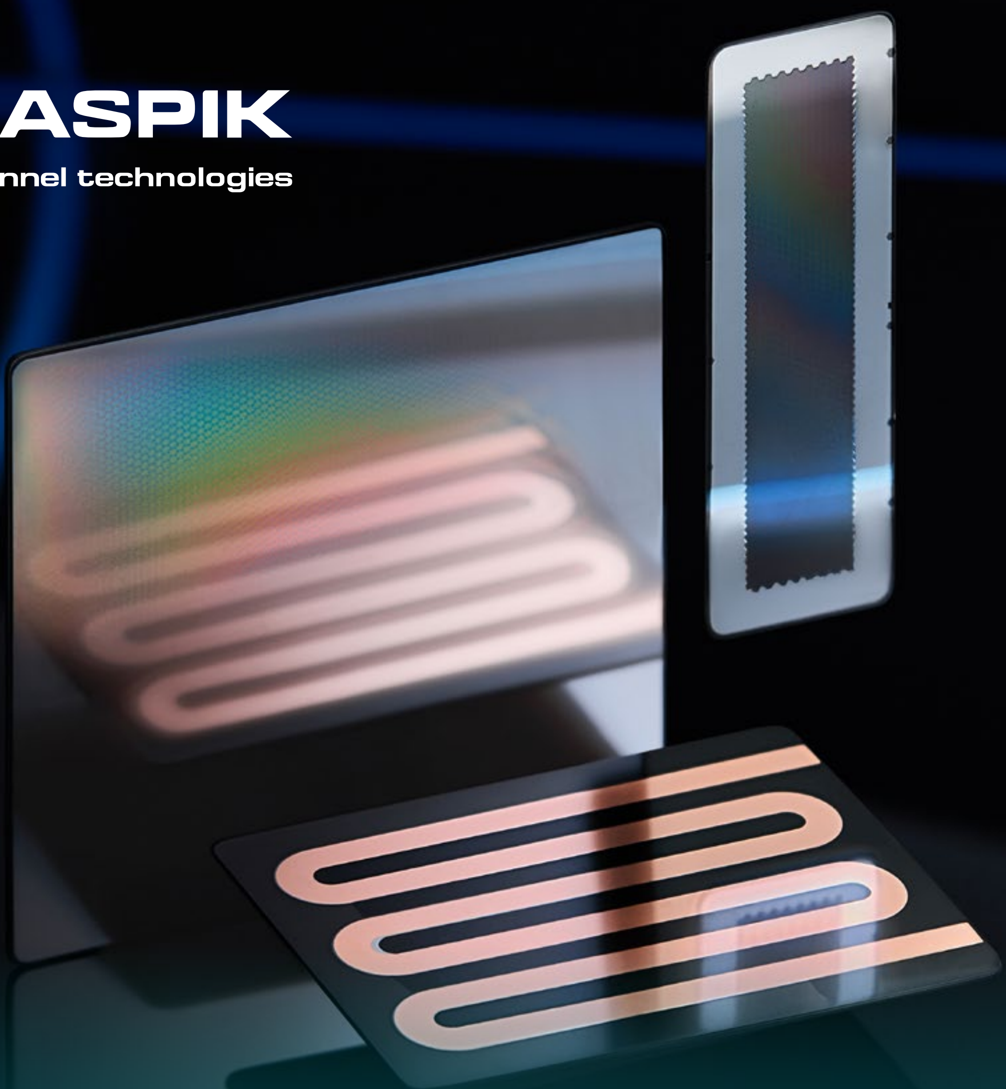
BASPIK
Microchannel technologies



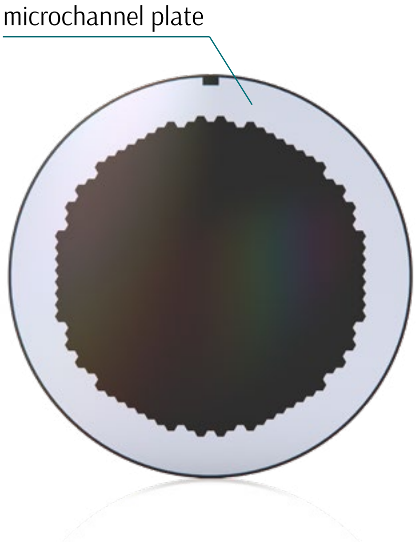
MICROCHANNEL ELECTRON MULTIPLIERS

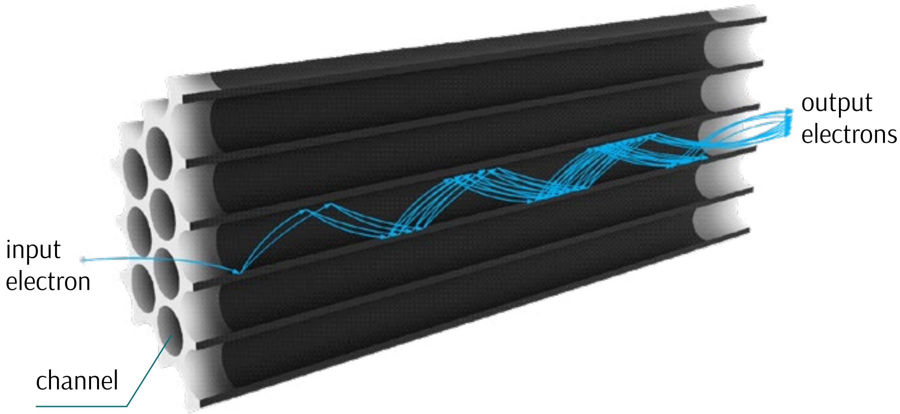
Design. Types. Application.

Microchannel Electron Multipliers (MEMs)

are a sort of microchannel plates (MCPs) — electronic products designed for detection and amplification of charged particles and radiation.

MCPs consist of millions of ultra-thin conductive glass capillaries, each acting as an independent secondary electron multiplier.





The MEMs comprise a group of special MCPs developed for series production based on customer requirements for a combination of geometric, structural and electrical parameters.

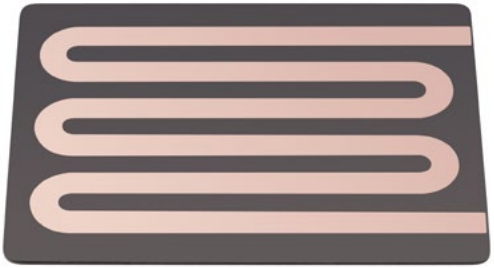
As part of application devices, MEMs solve the task of:

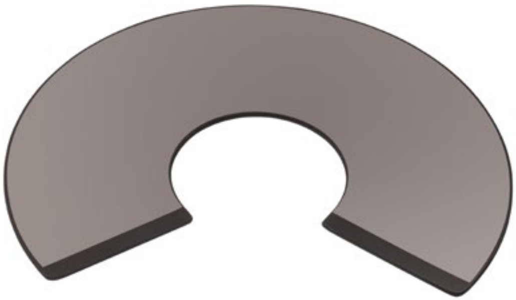
1) amplification of weak signals

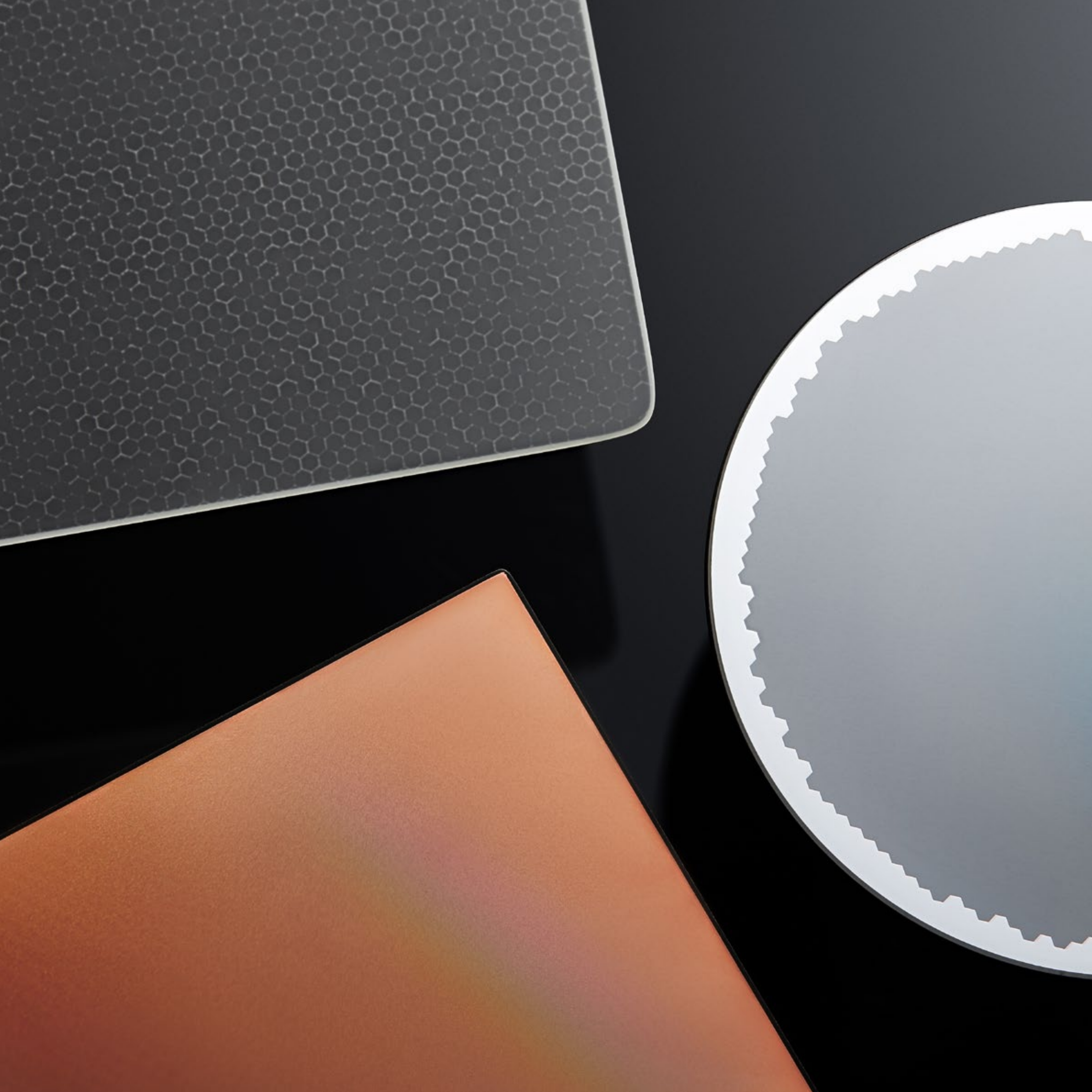
2) detection of particle coordinate parameters

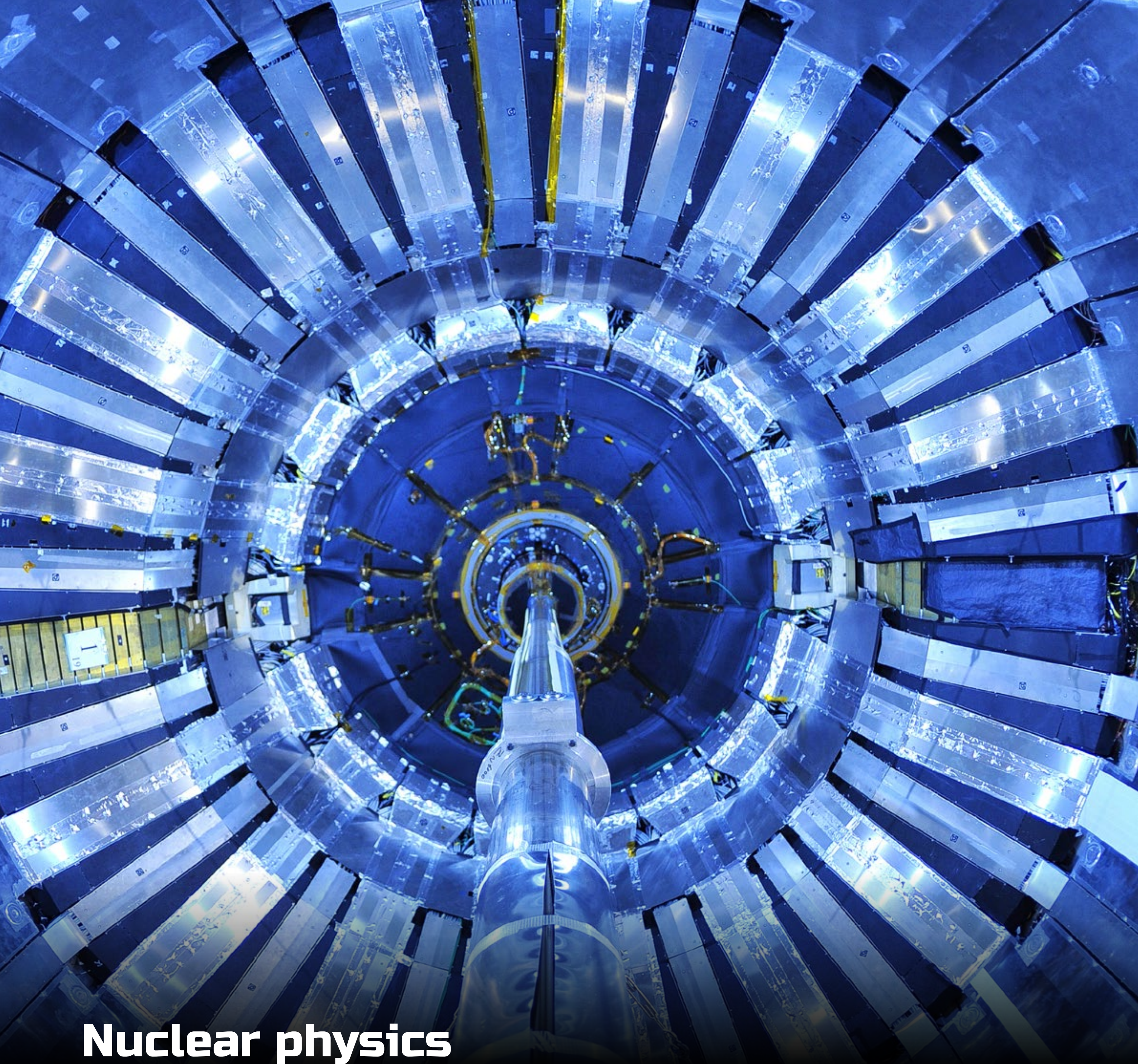
Advantages:

- fast response and gain
- increased active area
- low power consumption
- stable operation under exposure to magnetic fields









Nuclear physics

Applications:

Nuclear physics

- Radiation detection in intensive magnetic fields
- Molecular beam experiments to study the potentials of intermolecular interactions
- Isotope analysis
- Spectroscopy
- Atomic collision physics experiments
- Research on high-energy differential ion and neutral particle scattering
- Nuclear physics research

Application devices

Hadron Colliders:

- LHC: ATLAS, ALICE, LHCb
- FAIR: PANDA (barrel & endcap DIRCs)

Electron-positron colliders:

- Super KEKb: Belle II (TOP)
- VEPP-2000: Spherical Neutral Detector (Aerogel Shifter Photomultipliers)
- KEDR (Aerogel Shifter Photomultipliers)

Electron-ion Colliders (EPIC, EIC):

- Dual RICH, modular RICH, DIRC

Neutrino and Broad Atmospheric Showers observatories:

- JUNO: WCD (Water Cherenkov Detector)
- LHAASO: WCDA (Water Cherenkov Detector Array)


Medical diagnostics

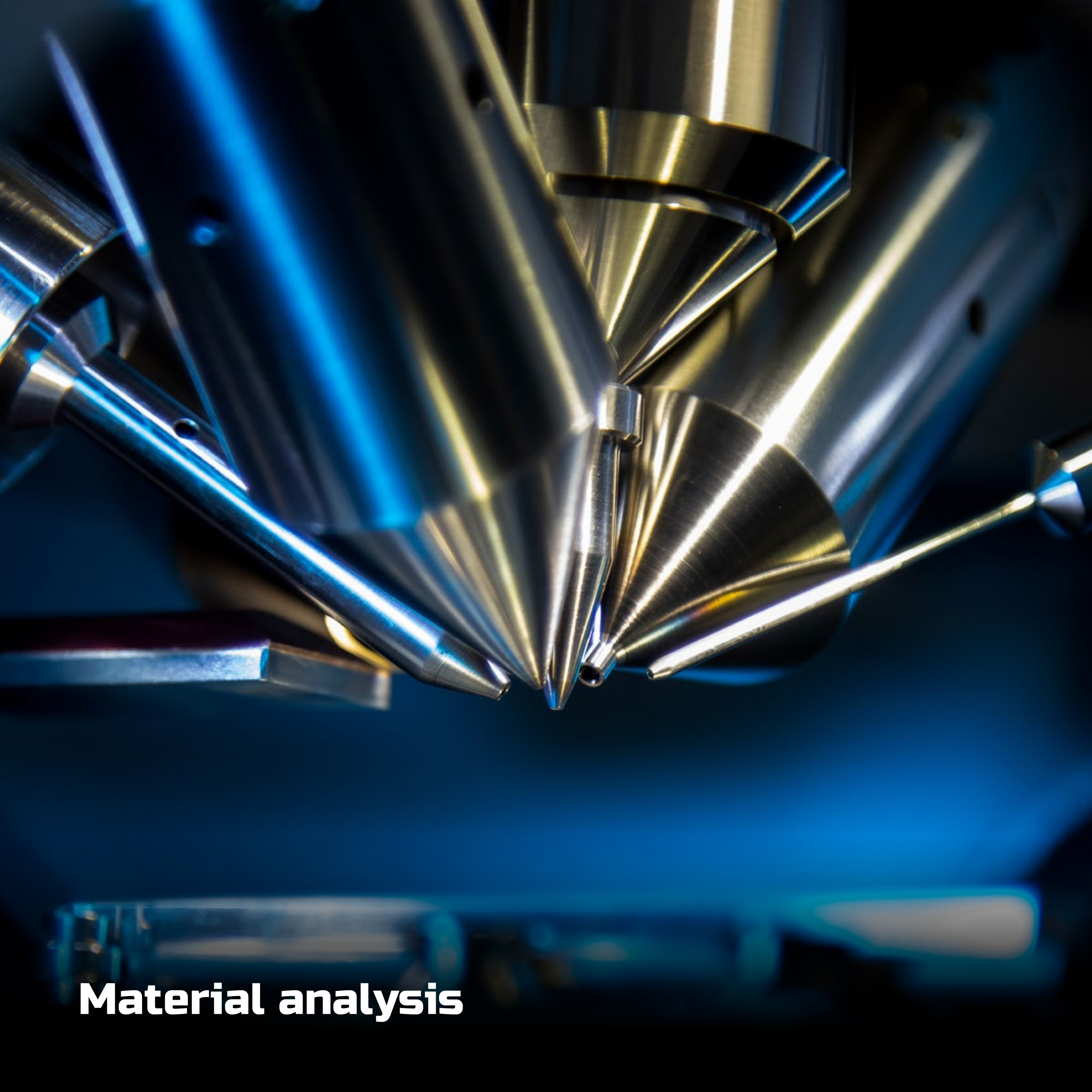
Applications:

Medical diagnostics

- Low-dose X-ray analysis
- Research of dynamics of visceral organs by obtaining a two-dimensional image of the subject
- Gas analysis for dangerous viral and bacterial infections
- Time-of-flight mass-spectrometry for new drug development and biomolecule recognition
- Control of ion beam profile in accelerators in radiation therapy

Application devices

- Time-of-flight mass spectrometers
- Gaz analyzers
- Positron Emission Tomography (PET) machines
- Fluorescence detectors
- Radiation detectors of Low-dose X-ray analysis


Material analysis

Applications:

Material analysis

- **Nondestructive analysis of three-dimensional compositions for the evaluation of semiconductor and nanostructural devices**
- **Microscope scanning in semiconductor manufacturing technology**
- **Surface elementary composition analysis**

MCP-detectors offer many advantages (detection speed and accuracy) and are widely used to characterize materials in both gaseous and solid states.

For these purposes non-destructive and destructive analyses of substances such as determining the physical nature and amount of material in a non-invasive way using active and passive methods (e.g., based on gamma-ray spectroscopy) are used. In this case, imaging and quantification of the materials microstructure on an atomic scale is achieved.

Applications of MCP detectors include alloy development in metallurgy (atomic emission method), semiconductor manufacturing (time-of-flight mass spectrometry for parameter measurements), forensic analysis, food analysis, and agricultural monitoring of the germinating ability of various seed cultures.

Application devices

- Detectors for nondestructive analysis
- Atomic Probe Tomography machines
- X-ray Photoelectron Spectrography machines

Space research

Applications:

Space research

- **Global real time monitoring of the Earth's surface from satellites in geostationary and highly elliptical orbits**
- **Searching of space debris**
- **Solar wind particle detection**
- **UV and X-ray detection**
- **Rare event detection**
- **Identification of the isotopic composition of solar and galactic particles in telescopic systems**

Microchannel plate photon counting detectors have been successfully used in a large number of space missions. Their advantages include high reliability, low power consumption, light weight, immunity to space radiation environment, solar blindness and high temporal and spatial resolution.

Application devices

Detectors for space missions:

- Solar Probe+
- The Whole Sky Monitoring
- WSO-UV
- Indo-Russian SING spectrometer project
- Lobster Eye X-Ray Exploration Satellite


Biological security

Applications:

Biological security

- **Fluorescence microscopy**
- **Air environment monitoring**
- **Spectroscopy**
- **LIDAR**
- **Cherenkov radiation detection**

Modules and electronic assemblies based on MCPs form part of a number of devices used for complex analysis of various biomaterials for protection against natural and industrial disasters.

For instance, mass spectrometers and ion microscopes are used for studying air and water samples. The purpose of the study is to identify pathogenic microbes, microorganisms, harmful impurities in the environment, including drinking water and waste water to prevent mass contamination. Devices with MCP are part of an instrumental laboratory complex for combinatorial targeted chemical analyses aimed at food control, identification and characterization of proteins/peptides, multilateral metabolomic studies, forensic analyses.

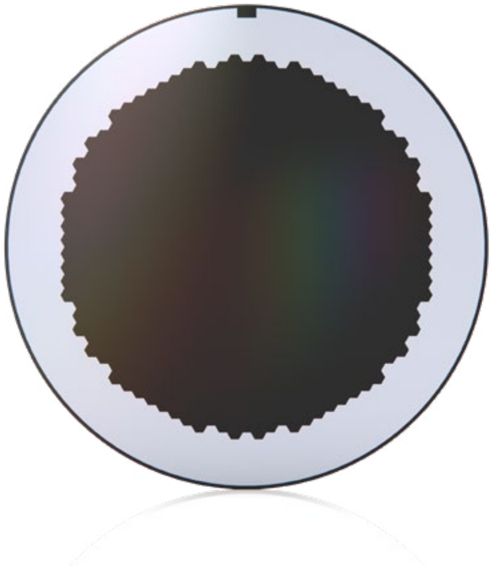
Application devices

- Cherenkov detectors
- Fluorescence microscopy
- Lidars
- Time-of-flight Mass Spectrometers
- Gas Analyzers

Microchannel electron multiplier (MEM) 50-8

Parameter, unit	Rimmed MEM 50-8
MEM longitudinal dimension, mm	⌀ $50_{-0,2}$
MEM cross sectional dimension, mm	-
Active area dimensions, mm min	41.5
Solid rim width*, mm min	2.0
Thickness, mm	0.47 to 0.53
Channel diameter, µm	7.5–11
Channel pitch, µm max	13
Channel bias angle, degrees	4–9
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times 10^8$ Ohm	0.05–10
Dark current density, A/cm^2 max	1×10^{-13}
Testing voltage, V max	1350

* possible manufacturing without solid rim border



Detectors with MEM (MCP) 50-8

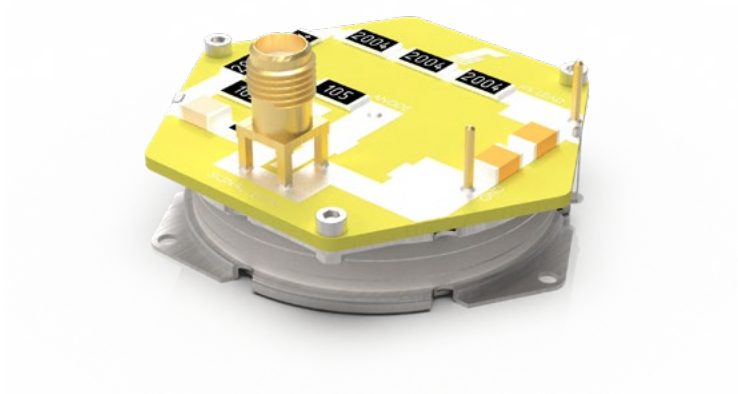
Time-of-Flight Detectors (TOF detectors)

The time it takes the ion to travel from the test sample to the detector depends on the mass number of the ion. Using this principle time-of-flight mass spectrometry detects incoming ions by measuring the time it takes the ion to travel from the ion sources to the detector. Time-of-flight mass spectrometers must have fast response and must detect ions with high efficiency. Therefore, these detectors mainly use MEMs (MCPs).

It consists of a chevron stack of two MCPs, an anode and ceramic-to-metal fittings.

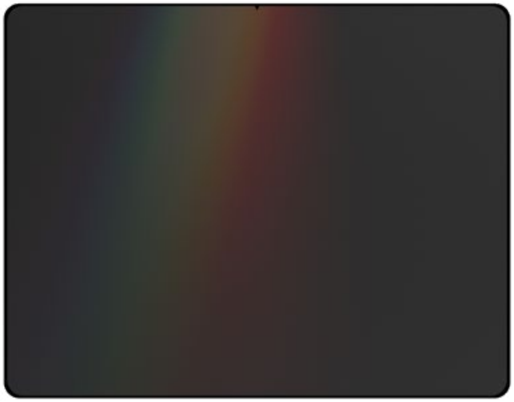
The detector can be vacuum heated at 300°C and operated in any position.

TOF detectors can be designed with a voltage divider on a printed circuit board for the detection of charged particle fluxes as part of a mass spectrometer.



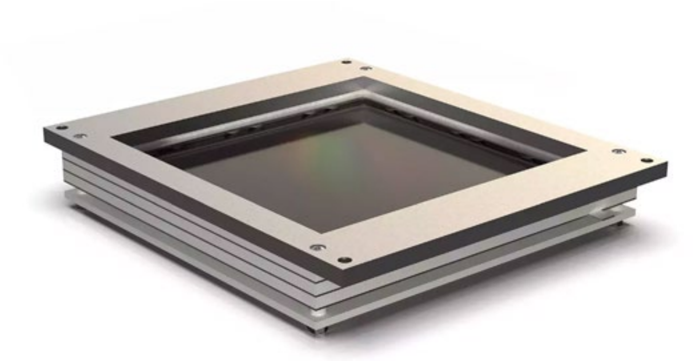
Microchannel electron multiplier (MEM) 43×63

Parameter, unit	MEM 43×63
MEM longitudinal dimension, mm	62.8 to 63.0
MEM cross sectional dimension, mm	42.8 to 43.0
Active area dimensions, mm min	39.0×59.0
Thickness, mm	0.6 to 0.85
Channel diameter, µm	9 to 12
Channel pitch, µm max	15.0
Channel bias angle, degrees	6 to 10
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times 10^8$ Ohm	0.2 to 10
Dark current density, A/cm^2 max	1×10^{-13}
Testing voltage, V max	1320



Detectors with MEM (MCP) 43×63

Open type detectors based on MEM (MCP) Chevron Stack and Phosphor Screen



The detector is intended for charged particle fluxes detection and visual observation of fast processes as a part of scientific instruments.

Main application – nuclear physics (fundamental research).

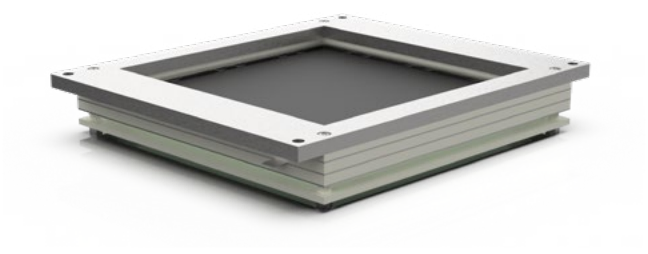
Task – creation of advanced systems for diagnostics, monitoring, and control of charged particle beams. Using a large area MCP detector, non-destructive high-speed spatial and temporal monitoring of the ion beam profile generated inside the synchrotron can be performed.

Other applications – diagnostic systems for dealing with low-intensity beams (radiation therapy, radiation resistance of electronic components, radiobiological investigation, etc.).

Microchannel electron multiplier (MEM) 54×54

Parameter, unit	MEM 54×54
MEM longitudinal dimension, mm	54.4 to 54.6
MEM cross sectional dimension, mm	54.4 to 54.6
Active area dimensions, mm min	52.5×52.5
Thickness, mm	0.370 to 0.410
Channel diameter, µm	5.5–6.5
Channel pitch, µm max	8.0
Channel bias angle, degrees	6–10
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times 10^8$ Ohm	0.03–0.1
Dark current density, A/cm² max	1×10^{-13}
Testing voltage, V max	1350

Detectors with MEM (MCP) 54×54



1. Detectors Based on MEM (MCP) Chevron Stack and Phosphor Screen

The detector is intended for charged particle fluxes detection and visual observation of fast processes as a part of scientific instruments.

Main application – nuclear physics (fundamental research).

Other applications – diagnostic systems for dealing with low-intensity beams (radiation therapy, radiation resistance of electronic components, radiobiological investigation, etc.).

2. Fast multianode photomultiplier tube

Advantages:

- Time resolution down to several picoseconds
- Spatial resolution down to several micrometers
- Single electron sensitivity

Application:

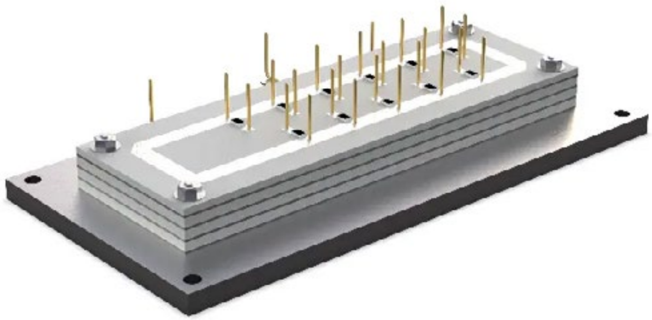
- Particle and radiation detectors in charged particle accelerators, neutrino physics, nuclear physics, astrophysics
- Positron emission tomography
- Image conversion and intensification in medical, navigation and military equipment
- Scanning systems for security purposes
- Detection of radiation and search for radioactive materials

Microchannel electron multiplier (MEM) 20×90

Parameter, unit	MEM 20×90
MEM longitudinal dimension, mm	89.8 to 90.0
MEM cross sectional dimension, mm	19.8 to 20.0
Active area dimensions, mm min	15.0×85.0
Solid rim width*, mm min	2.0
Thickness, mm	0.6 to 0.825
Channel diameter, µm	9 to 12
Channel pitch, µm max	15.0
Channel bias angle, degrees	6 to 13
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times10^8$ Ohm	0.1 to 1
Dark current density, A/cm^2 max	1×10^{-13}
Testing voltage, V max	1350

* possible manufacturing without solid rim border

Detectors with MEM (MCP) 20×90



Position-sensitive multianode detector

Open ceramic-to-metal detector based on two MCPs and a multisection anode.

Using MEMs in such systems provides high spatial resolution and compactness of the device.

Advantages:

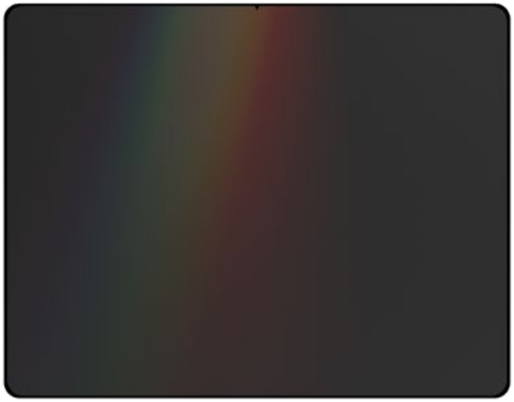
- high temporal resolution
- single charged ion detection efficiency which is close to 80%
- ability to measure spatial characteristics with an accuracy of tenths of a millimeter
- high radiation stability

The gain of a chevron stack of two microchannel plates can range from 10^6 to 10^8, which allows a wide range of standard electronics to be used without the use of specific signal premultipliers.

Field of application – in mass-spectrometers for medical diagnostics, pharmaceuticals, biosafety, oil and gas industry, nuclear energetics.

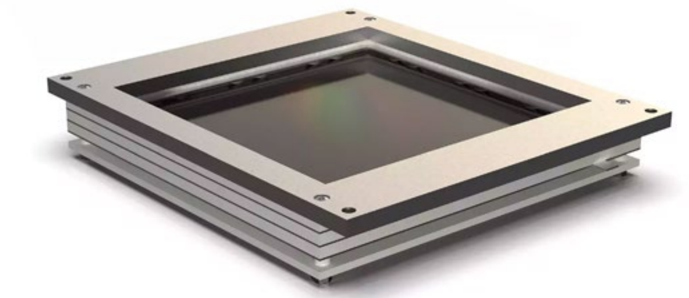
Microchannel electron multiplier (MEM) 70×90

Parameter, unit	MEM 70×90
MEM longitudinal dimension, mm	89.65 to 90.00
MEM cross sectional dimension, mm	69.80 to 70.00
Active area dimensions, mm min	66.0×86.0
Thickness, mm	0.6 to 1.1
Channel diameter, µm	9 to 12
Channel pitch, µm max	15.0
Channel bias angle, degrees	6–10
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times 10^8$ Ohm	0.2–10
Dark current density, A/cm^2 max	1×10^{-13}
Testing voltage, V max	1350



Detectors with MEM (MCP) 70×90

Open type detectors based on MEM (MCP) Chevron Stack and Phosphor Screen



The detector is intended for charged particle fluxes detection and visual observation of fast processes as a part of scientific instruments.

Main application – nuclear physics (fundamental research).

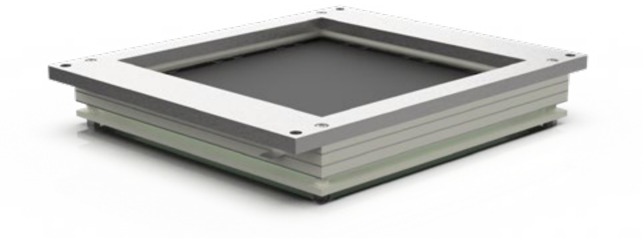
Task – creation of advanced systems for diagnostics, monitoring, and control of charged particle beams. Using a large area MCP detector, non-destructive high-speed spatial and temporal monitoring of the ion beam profile generated inside the synchrotron can be performed.

Other applications – diagnostic systems for dealing with low-intensity beams (radiation therapy, radiation resistance of electronic components, radiobiological investigation, etc.).

Microchannel electron multiplier (MEM) 100×100

Parameter, unit	MEM 100×100
MEM longitudinal dimension, mm	99.5 to 100.0
MEM cross sectional dimension, mm	99.5 to 100.0
Active area dimensions, mm min	96.0x96.0
Thickness, mm	0.6 to 1.0
Channel diameter, µm	9 to 12
Channel pitch, µm max	15.0
Channel bias angle, degrees	6 to 10
Supply voltage corresponding to gain of 10^4, V max	1200
Gain non-uniformity over the active area, % max	10
Electrical resistance at 800 V supply voltage, $\times 10^8$ Ohm	0.2 to 10
Dark current density, A/cm^2 max	1×10^{-13}
Testing voltage, V max	1350

Detectors with MEM (MCP) 100×100



1. Detectors Based on MEM (MCP) Chevron Stack and Phosphor Screen

The detector is intended for charged particle fluxes detection and visual observation of fast processes as a part of scientific instruments.

Main application – nuclear physics (fundamental research).

Other applications – diagnostic systems for dealing with low-intensity beams (radiation therapy, radiation resistance of electronic components, radiobiological investigation, etc.).

2. Fast multianode photomultiplier tube

Advantages:

- Time resolution down to several picoseconds
- Spatial resolution down to several micrometers
- Single electron sensitivity
- Integration and assembly in large area systems (up to several square meters)

Application:

- Particle and radiation detectors in charged particle accelerators, neutrino physics, nuclear physics, astrophysics
- Positron emission tomography
- Image conversion and intensification in medical, navigation and military equipment
- Scanning systems for security purposes
- Detection of radiation and search for radioactive materials

Custom order

If you have a specific R&D request or want to change some MEM's parameters, feel free to contact us.

Baspik Technology Centre scientific and production facilities allow to fulfill individual MEM-orders with the required technical parameters in a relatively short time.

We can also customize MCP-detector according to your specific requirements.

To place an order please visit our website **baspik.com** and fill in the request form or just email **market@baspik.com**

BASPIK

Microchannel technologies

44 Nikolayev Str., building 6, Vladikavkaz,
Republic North Ossetia-Alania, Russian Federation
Tel/fax: +7 8672 24-19-61 • E-mail: market@baspik.com

baspik.com