



Biophysics in Medicine



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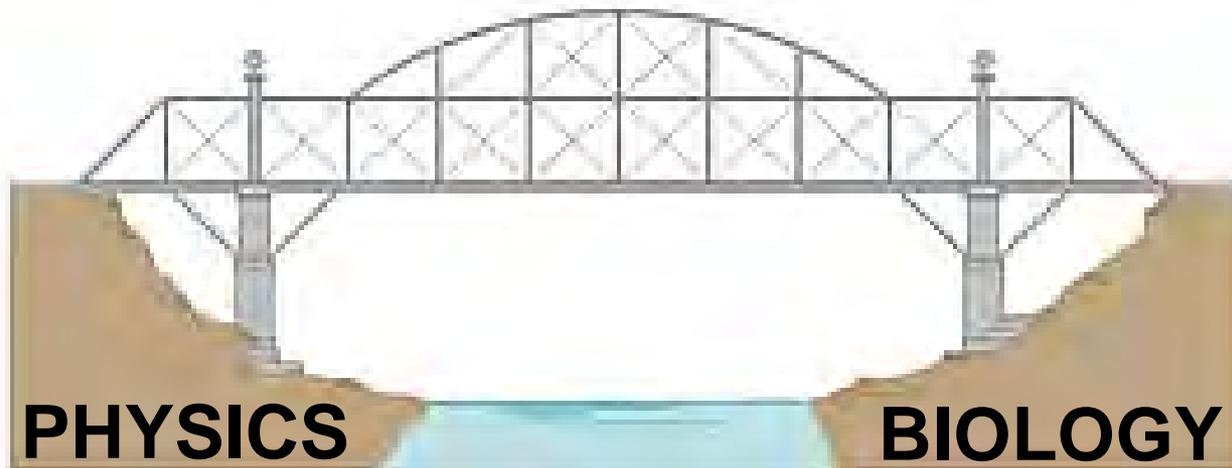
What is Biophysics

- Methods and theories from physics to study biological systems
- Goal to understand at a fundamental level the structure, dynamics, interactions, and ultimately the function of biological systems
- Biophysics seeks to explain biological function in terms of the physical properties of specific molecules

Interdisciplinary science

Medical Biophysics

- Principles and laws of the physics to describe and investigate biological processes for the purpose of medical application
- Collaboration between physics, biology, and the basic medical sciences to learn about diseases and their processes - diagnose and treatment



Biophysics applications

- Biophysics is a wellspring of innovation for high-tech economy
- The applications of biophysics depend on society's needs. (disease treatment - powerful vaccines)
- Biophysical methods serve everyday needs - from forensic science to bioremediation
- Medical imaging technologies including MRI, CT, PET scans, and sonograms for diagnosing diseases
- Treatment methods of kidney dialysis, radiation therapy, cardiac defibrillators, pacemakers, etc.

Historical Timeline of DMCB

**DEPARTMENT OF
MEDICAL PHYSICS
(1949)**

**DEPARTMENT OF
MEDICAL PHYSICS,
RADIOLOGY AND
NUCLEAR MEDICINE
(1971)**

**DEPARTMENT OF
PHYSIOLOGY AND
MEDICAL PHYSICS
(1975)**

**DEPARTMENT OF
MEDICAL BIOPHYSICS
(1991)**

**DEPARTMENT OF SKIN
AND VENEREAL
DISEASE, RADIOLOGY
AND NUCLEAR
MEDICINE AND
MEDICAL PHYSICS**

**DEPARTMENT OF
MEDICAL BIOLOGY
AND BIOPHYSICS**

**(2012)
DEPARTMENT
OF MEDICAL
AND CLINICAL
BIOPHYSICS**

1949

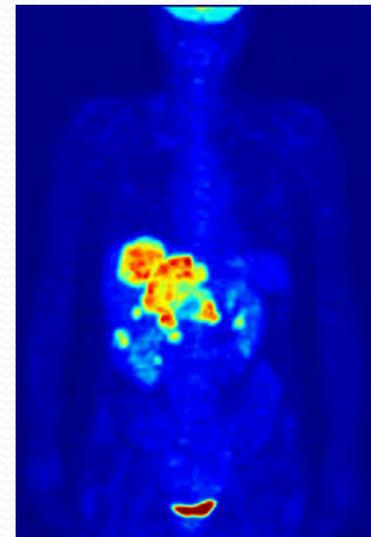
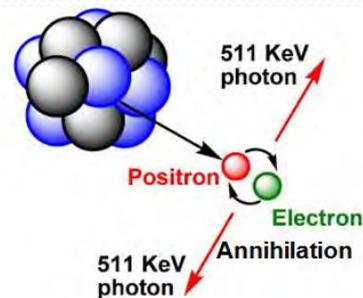
1973

1986

2012

Department of Medical and Clinical Biophysics

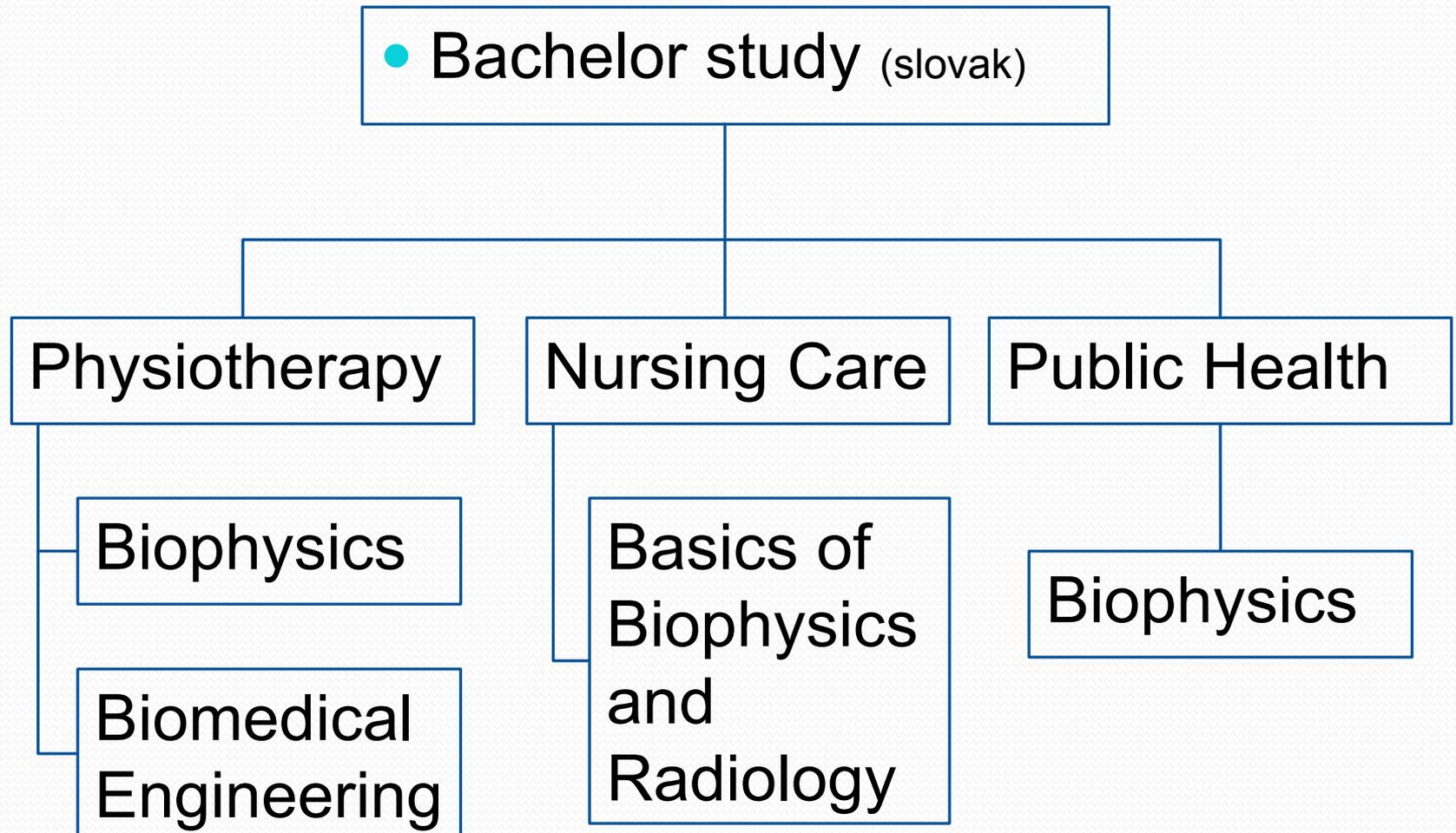
- Teaching gradually transformed in its development with main focus on medical instrumentation
- Leading-edge medical technology
- Exact approach to the knowledge of Biosystems



Teaching at DMCB - Objectives

- Access the basics of physics within most important diagnostic and therapeutic methods
- Access theoretical and practical knowledge to understand pathological phenomena in the human body at the molecular level, respectively at subatomic level after the interaction with the radiation
- Access the new knowledge in natural science

Teaching at DMCB



Teaching at DMCB

- Doctor study (slovak and english)

General Medicine

Medical
Biophysics

Clinical
Biophysics

Dental Medicine

Medical Biophysics
for Dental Medicine

Teaching at DMCB

- Medical Biophysics is compulsory subject in the 1st year of study at the Faculty of Medicine UPJS
- Practical exercises on Medical Biophysics is closely related to each subject

Research at DMCB

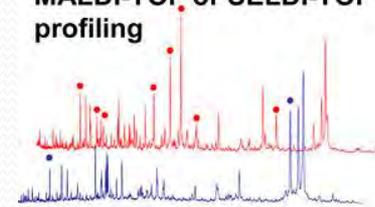
- Study the impact of **nonionizing electromagnetic field** on physiological and biochemical processes in cells
- Study of the **human proteome** by mass spectrometry to identify biomarkers for early disease detection

(MALDI-TOF/TOF, Quadrupole-TOF, Iontrap, QQQ)

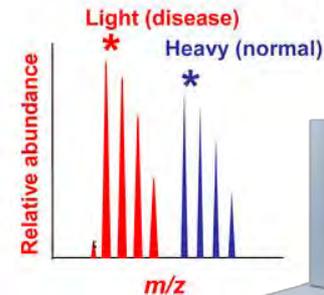
Proteomics workflow



MALDI-TOF or SELDI-TOF profiling



MS/MS Identification & Quantitation

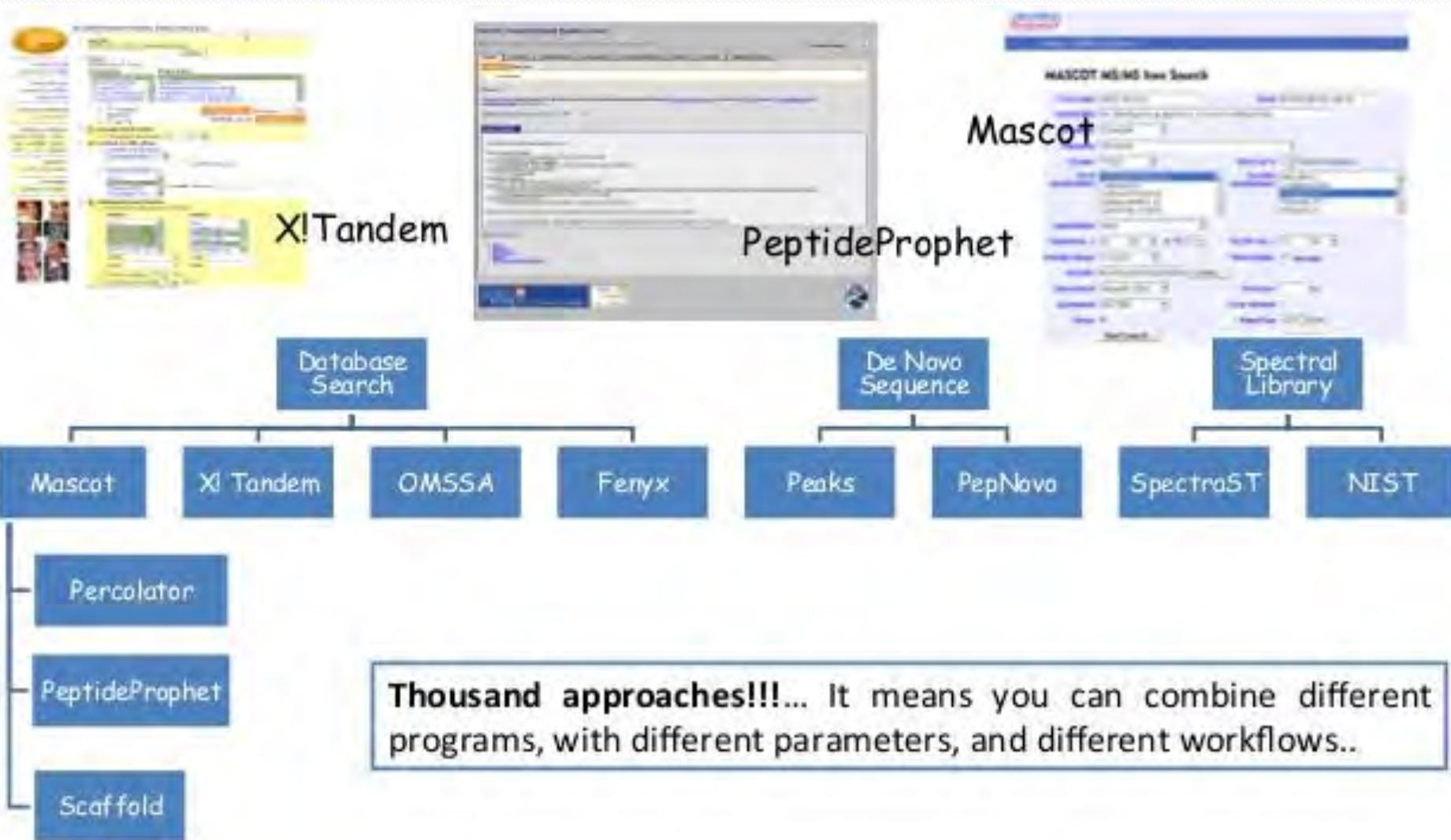


Assay development

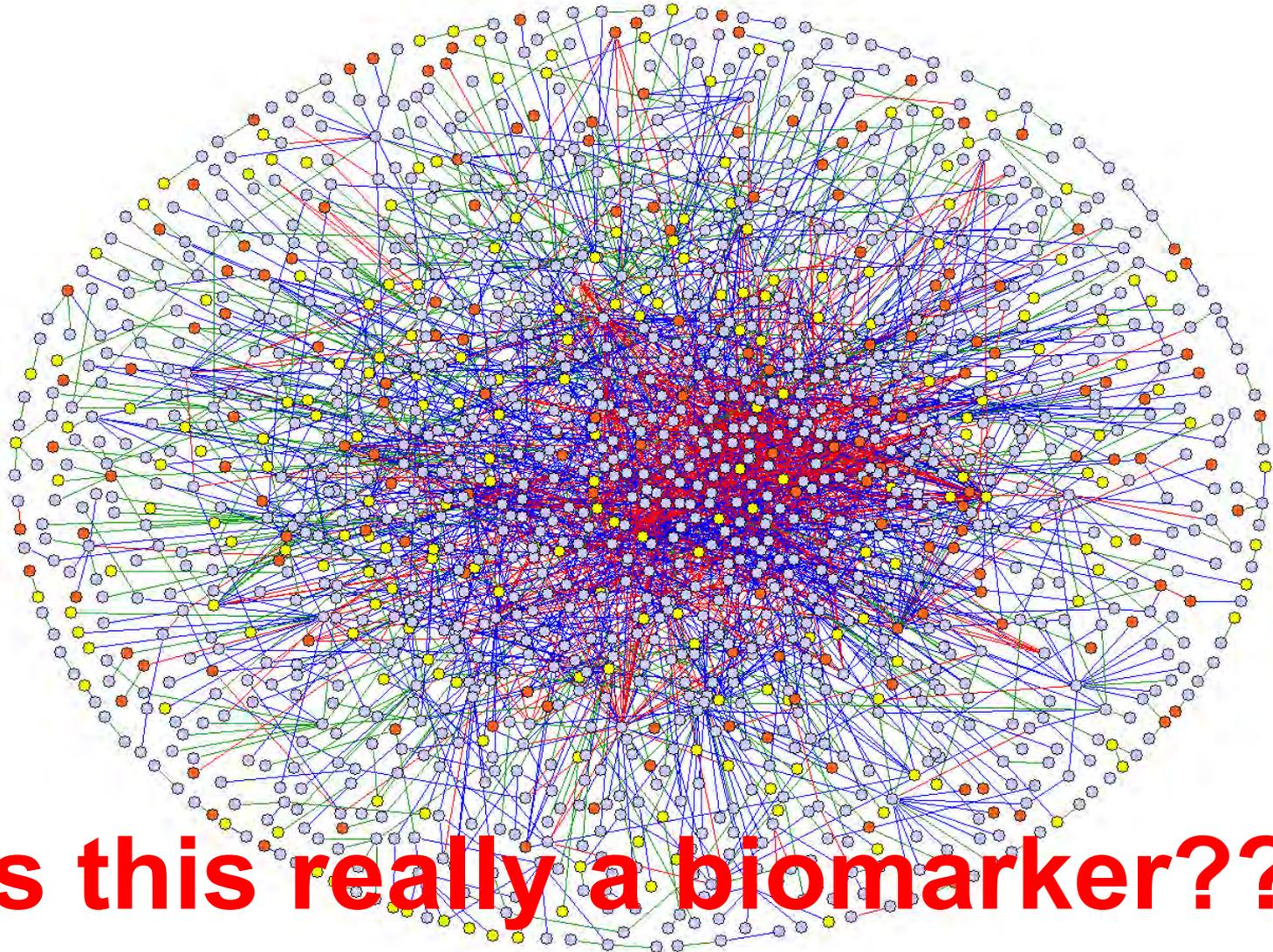
Sample separation

Biomarker discovery

Bioinformatics – Efficient Tool for Data Analysis



Proteine-proteine Interactions



Is this really a biomarker??

Proteomic areas of interest at DMCB

- Analysis of leukocytes isolated from the patients with breast cancer after each chemotherapy cycle / Analysis of MCF7 breast cancer cell line
- Analysis of cancer tissues after surgery extraction
- Stem cells proteome analysis for the future developments of desired therapeutic methods as well their inspection for malignant transformation
- Influence of non-ionizing electromagnetic field onto differentiation process of stem cells.
- Proteome analysis of leukocytes from patients with rheumatoid and juvenile arthritis.

Publication outputs of DMCB - 2016

- Automation of static and dynamic non-dispersive liquid phase microextraction. Part 1: Approaches based on extractant drop-, plug-, film- and microflow formation, Michal Alexovič, Burkhard Horstkotte, Petr Solich, Ján Sabo, *Analytica Chimica Acta*, ISBN 0003-2670, Vol. 906 (2016), s. 22 - 40
- Automation of static and dynamic non-dispersive liquid phase microextraction. Part 2: Approaches based on impregnated membranes and porous supports., Michal Alexovič, Burkhard Horstkotte, Petr Solich, Ján Sabo, *Analytica Chimica Acta*, ISBN 0003-2670, Vol. 907 (2016), s.18 - 30
- Circulating endothelial-derived apoptotic microparticles and insulin resistance in non-diabetic patients with chronic heart failure, E. Alexander Berezin, A. Alexander Kremzer, Giovanni Cammarota, Anthony Zulli, Daniel Petrovic, Nieves Martell-Claros, Ján Sabo, Peter Kružliak, *Clinical Medicine and Laboratory Medicine*, ISSN 1259-1267, Vol. 54, no. 7 (2016), s. 1259-1267
- Fruit peel polyphenols demonstrate substantial anti tumour effects in the model of breast cancer, Peter Kubatka, Andrea Kapinová, Martin Kello, Peter Kružliak, Karol Kajo, Desanka Výbohová, Silvia Mahmood, Radoslav Murín, Viera Tischlerová, Ján Mojžiš, Anthony Zulli, Martin Péč, Maria Adamkov, Monika Kassayová, Bianka Bojková, Nadežda Stollárová, Dušan Dobrota, *European Journal of Nutrition*, ISSN 1436-6215, Vol. 55, no. 3 (2016), s. 955-965
- Young Barley Indicates Antitumor Effects in Experimental Breast Cancer In Vivo and In Vitro, Peter Kubatka, Martin Kello, Karol Kajo, Peter Kružliak, Desanka Výbohová, Karel Šmejkal, Petr Maršík, Anthony Zulli, Gabriela Gönciová, Ján Mojžiš, Andrea Kapinová, Radoslav Murín, Martin Péč, Marian Adamkov, Roland. M. Przygodzki, *Nutrition and Cancer*, ISSN 1532-7914, Vol. 68, no. 4 (2016), s. 611-621

Research grants at DMCB

- Research Centre for innovative therapeutic approaches in Molecular Medicine, ITMS 26220220163
- Research Center for Applied Biomedical Diagnostics, ITMS 26220220143
- Centre of Excellence for Research on determinants of health, with a focus on group of marginalized and immunocompromised people (CEMIO), ITMS 26220120058
- Centre of Excellence for electromagnetic fields in medicine (CEEPM), ITMS 26220120067
- Probiotic microorganisms and bioactive substances of natural origin for a healthier population in Slovakia, ITMS 2620220220104



Európska únia
Európsky fond regionálneho rozvoja



Agentúra
Ministerstva školstva, vedy, výskumu a športu SR
pre štrukturálne fondy EÚ

Podporujeme výskumné aktivity na Slovensku/
Projekt je spolufinancovaný zo zdrojov EÚ.

