Course #2568: "Basic principles in molecular imaging for medical diagnostics through magnetic resonance physics"

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- **3 point KI Course   Weeks 12-13 (March 16 – March 26, 2015)**

How can mathematics and physics be applied to improve medical diagnostics and thus help our patients?

Today in clinical practice, we use a great many types of advanced equipment that register data for us. However, without mathematical interpretation these data would be completely incomprehensible. This Course focuses upon magnetic resonance (MR) phenomena, including Magnetic Resonance Imaging (MRI) and particularly Magnetic Resonance Spectroscopy (MRS) that provide, respectively, an anatomical image of the scanned area and spectra of metabolites present in the scanned tissue. When combined they yield MR spectroscopic imaging (MRSI). For oncology, these methods are used widely in diagnostics, as well as for image-guided surgery, radiation therapy and for follow-up. This Course will provide the student with an appreciation of how improvements in the current data interpretation of MRS and MRSI can enhance the resolution and diagnostic accuracy, and thus better detect and correctly diagnose early cancers and other major illnesses.   We thereby pose the question: what *could* MRS and MRSI offer to medical diagnostics?   In other words, have these modalities realized their potential in the battle against the scourge of cancer and other major illnesses? It is here that this Course differs fundamentally from many other Courses on MR. Not only is the answer a resounding "*no*", but the focus is not upon upcoming technological, i.e. hardware, advances, important as these may be.   Rather, the student – including the clinician and clinical researcher, is invited to join in the exploration of what mathematical advances in signal processing could offer for molecular imaging through MRS and MRSI.

A background in physics and mathematics will be helpful, but is not required. **The most important prerequisite for the Course is intellectual curiosity and strong motivation to apply that for the benefit of patients.**

Welcome!

The Course is planned to take place from 13:00 to 17:00 starting Monday, March 16 through Thursday March 19 and Monday March 23 through Thursday March 26, 2015. **Location**: **Main lecture hall, CCK**.
The lectures are planned to be held Monday March 16 through Monday March 23.

1. Introductory lecture: Molecular imaging through MR physics/an overview
2. Basic principles of magnetic resonance imaging and magnetic resonance spectroscopy (MRS).
3. Fundamentals of signal processing for medical applications
4. Magnetic resonance spectroscopic imaging (MRSI), safety considerations in MR.
5. Review and future perspectives: Advances in signal processing for MR physics

On Tuesday, March 24 there will be a special, intensive open-ended question and answer/discussion session. Oral practice examination March 25 and final written examination March 26.

It is our experience that students who attend the lectures, review the handouts and complete the reading and homework, actively participate and attend the practice oral examination will be able to handle the written examination in a satisfactory manner.

Literature and other teaching material

Belkić Dž, Quantum Mechanical Signal Processing and Spectral Analysis, Institute of Physics Publishing, (2004).

Belkić K. Molecular Imaging through Magnetic Resonance for Clinical Oncology, Cambridge International Science Publishing, (2004).

Belkić Dž, Belkić K. Signal Processing in Magnetic Resonance Spectroscopy with Biomedical Applications, CRC Press Taylor & Francis Group (2010).

Belkić Dž, Belkić K (editors) Magnetic Resonance Imaging and Spectroscopy, Reference Book within the 11 Volume Comprehensive Biomedical Physics, Elsevier (2014).

McRobbie DW, Moore EA, Graves MJ, Prince MR. MRI from picture to proton, Cambridge University Press, (2003)

The Course is open to PhD students as well as to physicians, other health professionals and post-doctoral fellows.

There are still a few places open.

Please contact Professors Dževad Belkić or Karen Belkić if you would like to enroll: Dzevad.Belkic@ki.se, Karen.Belkic@ki.se (517 72494, 517 72184)