

CH-401

**Advanced nuclear magnetic resonance**

Emsley Lyndon

Cursus	Sem.	Type
Chemistry	BA6	Obl.
HES - CGC	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
<b>Hours</b>	<b>2 weekly</b>
Lecture	2 weekly
<b>Number of positions</b>	

**Summary**

Principles of Magnetic Resonance Imaging (MRI) and applications to medical imaging. Principles of modern multi-dimensional NMR in liquids and solids. Structure determination of proteins & materials. Measurement of molecular dynamics. Principles of Hyperpolarization.

**Content**

- Projections of objects using magnetic field gradients.
- Image reconstruction by back-projection and by Fourier transformation.
- Contrast based on relaxation, diffusion, and contrast agents.
- Functional imaging.
- Imaging of flow and angiography.
- Advanced multi-dimensional correlation methods in magnetic resonance. Applications to protein structure determination and to determination of metabolism.
- Principles of multiple-pulse solid-state NMR. Applications to materials science.
- Principles of Nuclear Hyperpolarization and applications to imaging and spectroscopy.

**Learning Prerequisites****Required courses**

None

**Recommended courses**

Structural Analysis (CH-314)

**Important concepts to start the course**

Basic physical, organic, inorganic and biological chemistry

**Learning Outcomes**

By the end of the course, the student must be able to:

- Assess / Evaluate the meaning and limitations of MRI pictures
- Assess / Evaluate an approach to structure determination of molecules by NMR

- Design an NMR based approach to characterising materials
- Hypothesize how to produce hyperpolarized nuclear spins

### Teaching methods

Lectures based on popular textbooks with ample addition of illustrations through recent applications and case studies.  
Regular exercise classes.

### Assessment methods

Written Examination

### Supervision

Assistants                      Yes

### Resources

#### Notes/Handbook

On Moodle

#### Moodle Link

- <https://go.epfl.ch/CH-401>