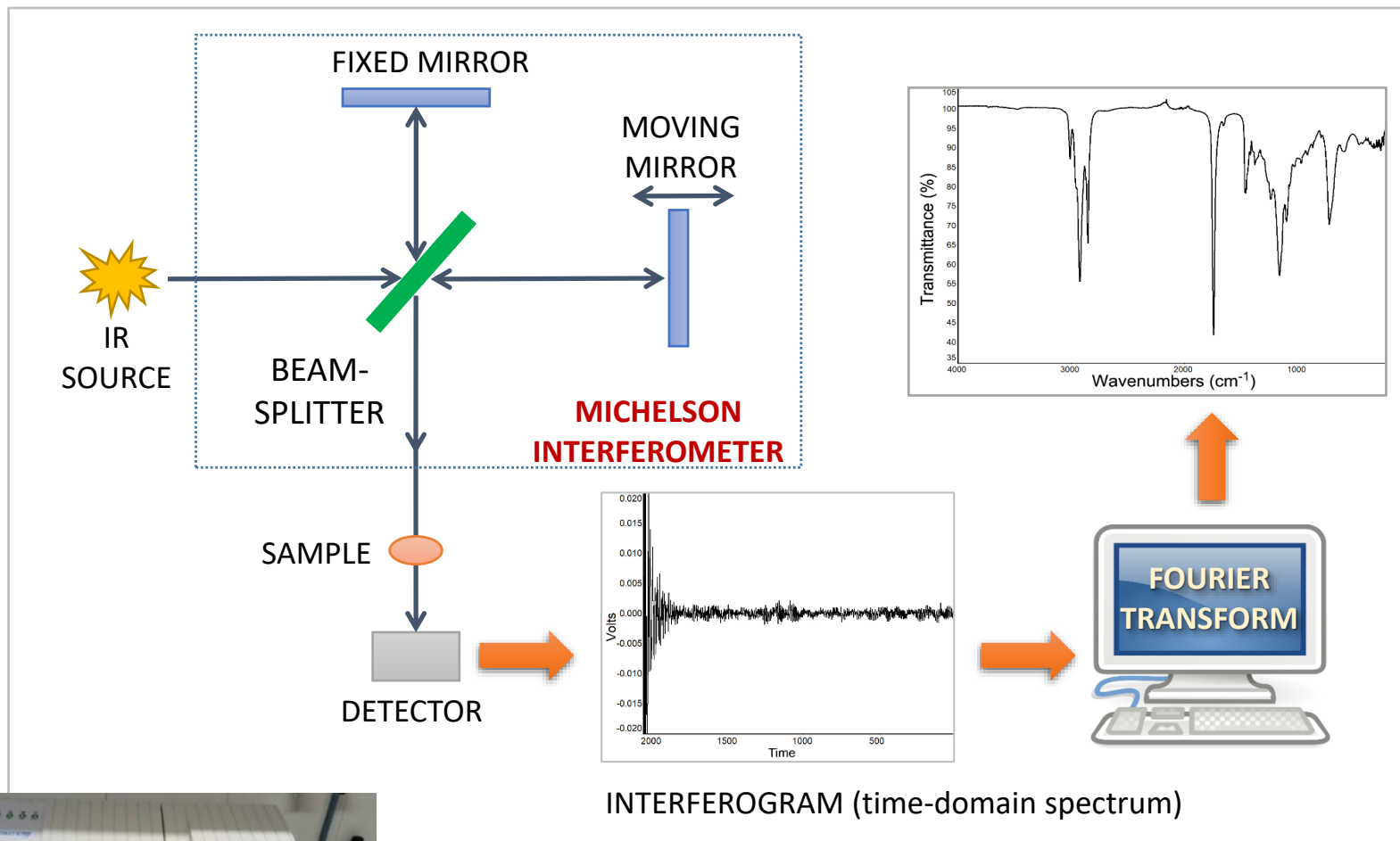


# **Infrared (IR) spectroscopy: basics of instrumentation**

**Prof. Ivo Leito**

# Fourier Transform IR spectrometer



## Advantages of the Fourier transform design:

- Maximum use of radiation (better SN ratio)
- Fast – spectral averaging is possible
- Accurate wavenumber scale

# Notes on beamsplitters in the interferometer of FT-IR spectrometer

<b>Parameters</b>	<b>CsI windows</b>	<b>KBr windows</b>
Wavenumber region	Down to 200 cm <sup>-1</sup>	Down to 400 cm <sup>-1</sup>
Hygroscopicity	Very hygroscopic	Less hygroscopic than KBr
Hardness	Soft	Reasonably hard

# Notes on detectors of FT-IR spectrometers

Parameters	Deuterated Triglycine Sulphate (DTGS)	Mercury Cadmium Telluride (MCT)
Wavenumber region	DTGS: 12000 – 350 $\text{cm}^{-1}$ DLaTGS: 6400 – 200 $\text{cm}^{-1}$	11 700 – 600/ 400 $\text{cm}^{-1}$
Sensitivity	Less sensitive	Up to 10 times more sensitive than DTGS
Signal to noise ratio	Satisfactory	Good
Needs cooling?	No	Yes (at liquid nitrogen temperature)
Time of measurement	Slow	Ca 3-4 times faster than DTGS
Price	Inexpensive	Several times higher than DTGS
Usage	Ordinary FT-IR spectrometers	High-end FT-IR spectrometers, microspectrometers

# FT-IR sampling techniques

Classical techniques	Modern techniques
<p data-bbox="73 304 821 358"><b>Transmission spectroscopy</b></p> <ul data-bbox="73 396 884 1053" style="list-style-type: none"><li data-bbox="73 396 772 451">• <b>KBr pellet method is used</b><ul data-bbox="112 486 884 865" style="list-style-type: none"><li data-bbox="112 486 884 589">– Sample is powdered with the KBr and pressed into pellet.</li><li data-bbox="112 615 884 718">– Solids and liquids can be analysed</li><li data-bbox="112 743 884 798">– Qualitative analysis</li><li data-bbox="112 823 884 865">– Problems with small samples</li></ul></li><li data-bbox="73 919 280 973">• Liquids</li><li data-bbox="73 1009 266 1063">• Gases</li></ul>	<p data-bbox="929 304 1773 415"><b>Attenuated Total Reflectance FT-IR (ATR-FT-IR) spectroscopy</b></p> <ul data-bbox="929 432 1798 736" style="list-style-type: none"><li data-bbox="929 432 1358 486">• Contact technique</li><li data-bbox="929 498 1396 552">• Easy, fast, universal</li><li data-bbox="929 564 1740 618">• Qualitative and quantitative analysis</li><li data-bbox="929 629 1280 684">• Small samples</li><li data-bbox="929 695 1798 736">• Paints, varnishes, fibres, polymers, etc</li></ul> <p data-bbox="929 772 1460 826"><b>Reflection techniques</b></p> <ul data-bbox="929 843 1798 1018" style="list-style-type: none"><li data-bbox="929 843 1450 898">• Non-contact technique</li><li data-bbox="929 909 1348 963">• Big energy losses</li><li data-bbox="929 975 1798 1018">• Paints, varnishes, fibres, polymers, etc</li></ul> <p data-bbox="929 1053 1541 1108"><b>FT-IR microspectroscopy</b></p> <ul data-bbox="929 1125 1798 1299" style="list-style-type: none"><li data-bbox="929 1125 1387 1179">• Very small samples</li><li data-bbox="929 1190 1348 1245">• Imaging, mapping</li><li data-bbox="929 1256 1798 1299">• Paints, varnishes, fibres, polymers, etc</li></ul>

# Summary

- Almost all contemporary IR spectrometers are **FT-IR spectrometers**
  - Good SN ratio, fast, accurate wavenumber scale
- Instruments for different applications can be equipped with **different components**
  - E.g. DTGS detector for ordinary measurements, MCT detector for demanding measurements
- **Diverse sampling techniques** are available for use of FT-IR