C8953
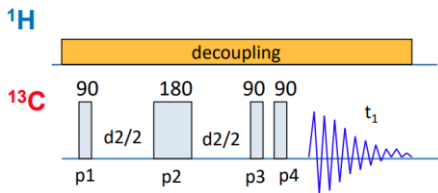# NMR structural analysis - seminar
INADEQUATE +
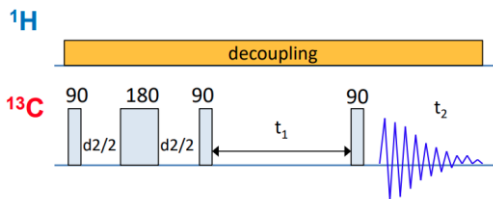## Stereochemistry

Michal Knor
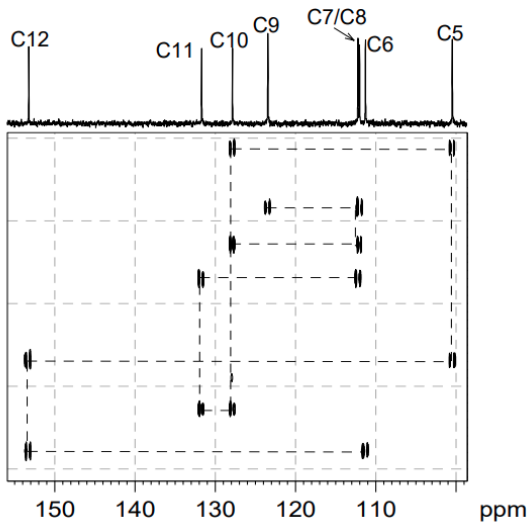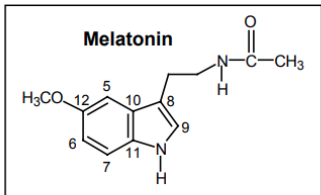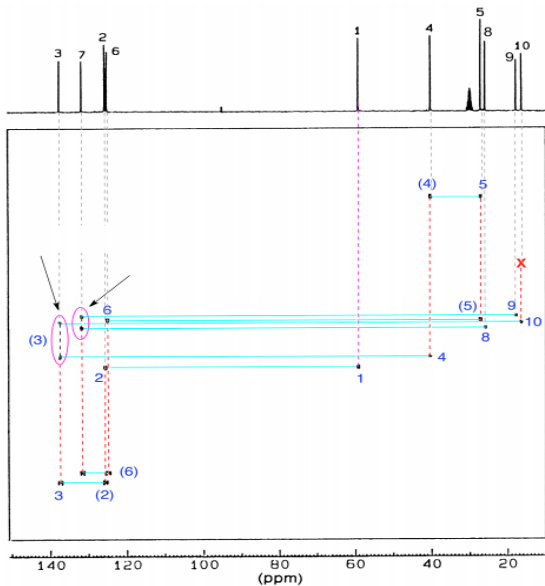437395@mail.muni.cz

May 5, 2021

INADEQUATE

1D INADEQUATE

2D INADEQUATE

- **Incredible Natural Abundance DoublE QUAntum Transfer Experiment**
- INADEQUATE experiments are mainly used for ^{13}C-^{13}C correlation spectra of natural abundance ^{13}C molecules
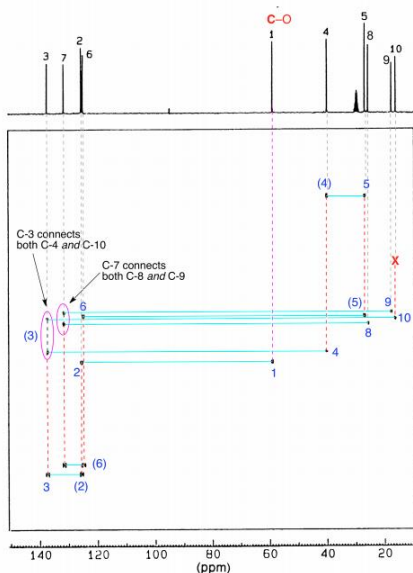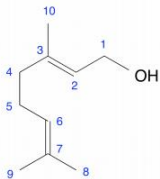- Low sensitivity

2D INADEQUATE - example

Determine the structure of $C_{10}H_{18}O$ using INADEQUATE exp.

2D INADEQUATE spectrum of geraniol

Isomerism and NMR

- Functional groups (constitution) - chemical shift
- Position of substituents - HMBC, NOESY/ROESY
- Relative configuration on double bonds or rings - *J*-coupling, NOESY/ROESY
- Absolute configuration - application of Chiral Derivatizing Agents (CDA)

Relative stereochemistry on a ring: NOESY

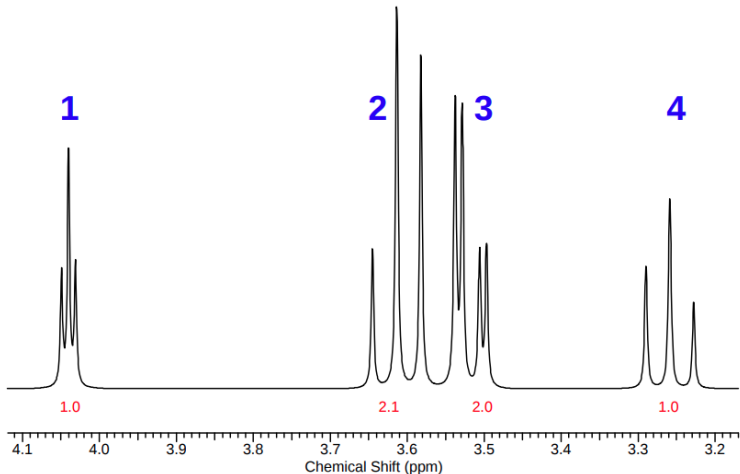Provide the complete assignment of ^{1}H resonances and determine the orientation of H5 and H6.
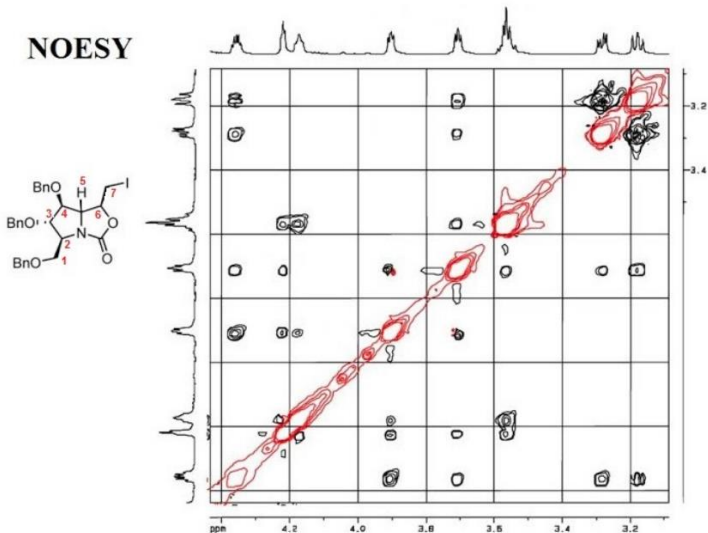
Relative stereochemistry on a ring: NOESY
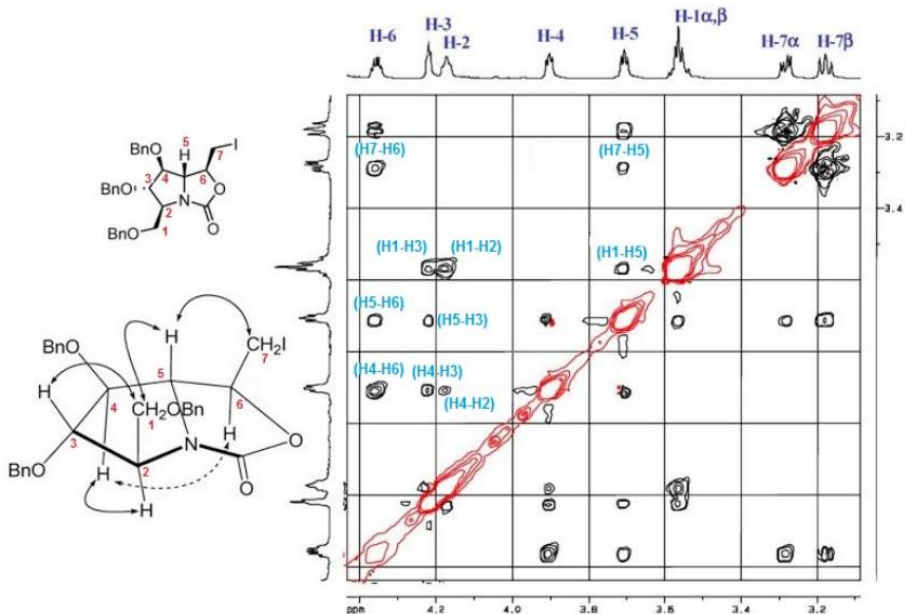
Interpretation of J-coupling

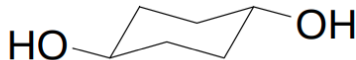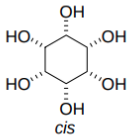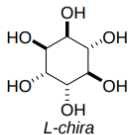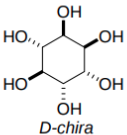**Unknown compound $C_6H_{12}O_6$ measured in D_2O**
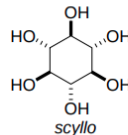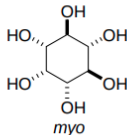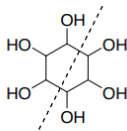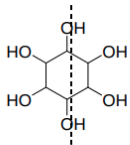
Detected J_{HH}-couplings: (2x2.8), (2x9.6), (2.8, 9.6), (2x9.6)

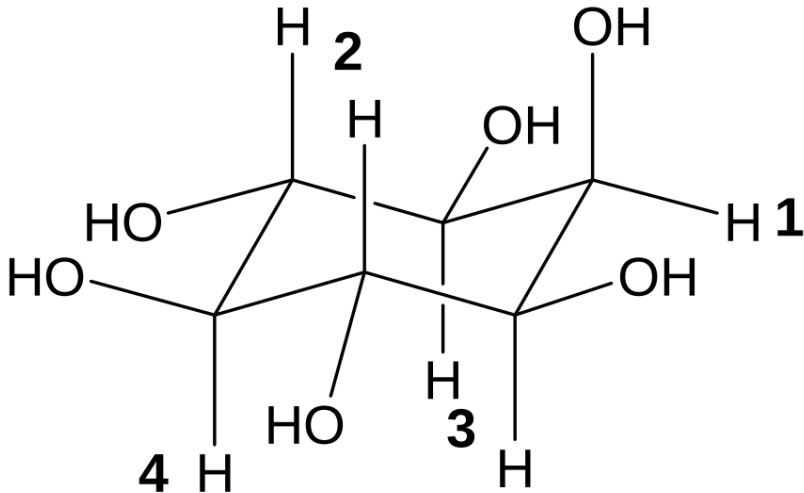1D ^{13}C NMR spectrum contains **4 signals in the range 71-75 ppm.**

Interpretation of J-coupling
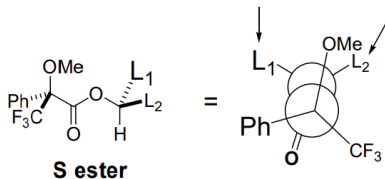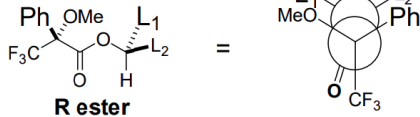
J_{HH}-couplings: (2x9.6), (2.8, 9.6), (2x9.6), (2x2.8)
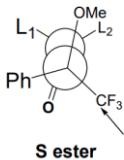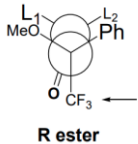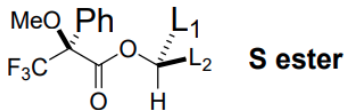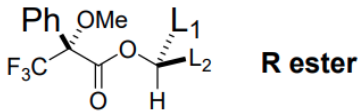

myo

scyllo

muco
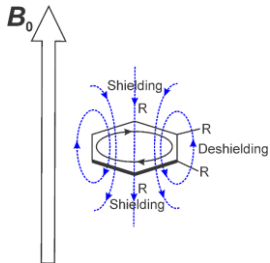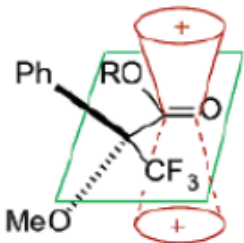
neo

allo

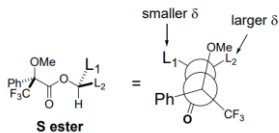epi

D-chira
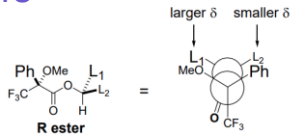
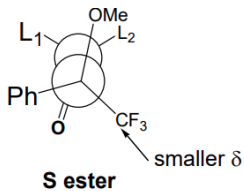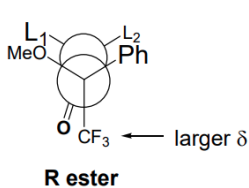L-chira

cis
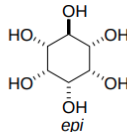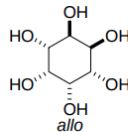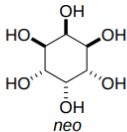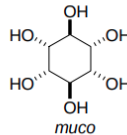
Interpretation of J-coupling: MYO isomer

J_{HH}-couplings: (2x9.6), (2.8, 9.6), (2x9.6), (2x2.8)

Determination of the absolute configuration of stereogenic centers
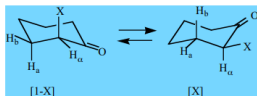
Determination of the absolute configuration of stereogenic centers

Determination of the absolute configuration of stereogenic centers

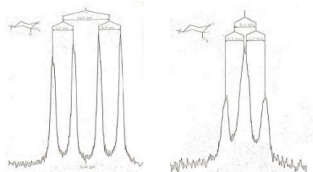### CALCULATING CONFORMATIONAL FREE ENERGY USING COUPLING CONSTANTS

Average $J_{H\alpha Hb} = J_{aa}[X] + J_{ee}[1-X]$

Average $J_{H\alpha Ha} = J_{ae}[X] + J_{ea}[1-X]$

The values of J_{aa}, J_{ee}, J_{ae} and J_{ea} are determined from Conformationaly rigid cyclohexanone systems
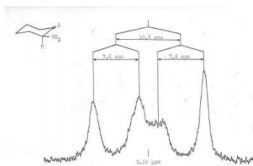
NMR OF 4-t-BUTYL-2-NITROCYCLOHEXANONE

$J_{aa} = 12.6$ Hz
$J_{ae} = 5.7$ Hz

$J_{ea} = 5.2$ Hz
$J_{ee} = 4.3$ Hz

NMR OF 2-NITROCYCLOHEXANONE

Average $J_{H\alpha Ha} = 10.6$
Average $J_{H\alpha Hb} = 7.6$

CALCULATING THE CONFORMATIONAL FREE ENERGY OF 2-NITROCYCLOHEXANONE USING COUPLING CONSTANTS
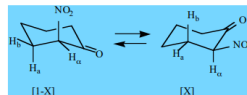
Average $J_{H\alpha Hb} = J_{aa}[X] + J_{ee}[1-X]$
10.6 = 12.6 [X] + 4.3 [1-X]
X = 0.76

K = [X]/[1-X] = 0.76/0.24 = 3.17
$\Delta G^{\#}$ = -RTlnK = -(2.3)(2)(298)log3.17 = 0.73kcal/mol