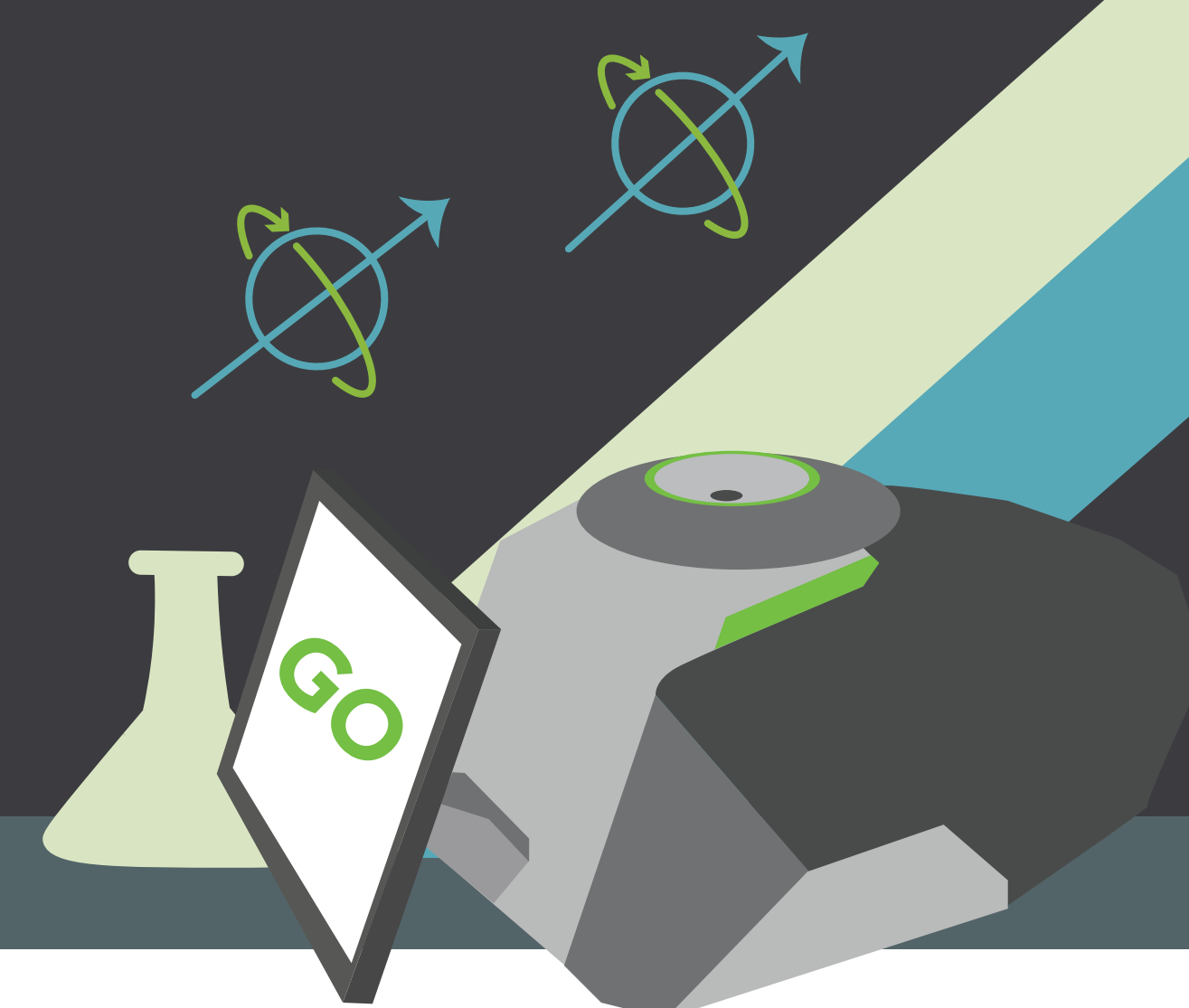
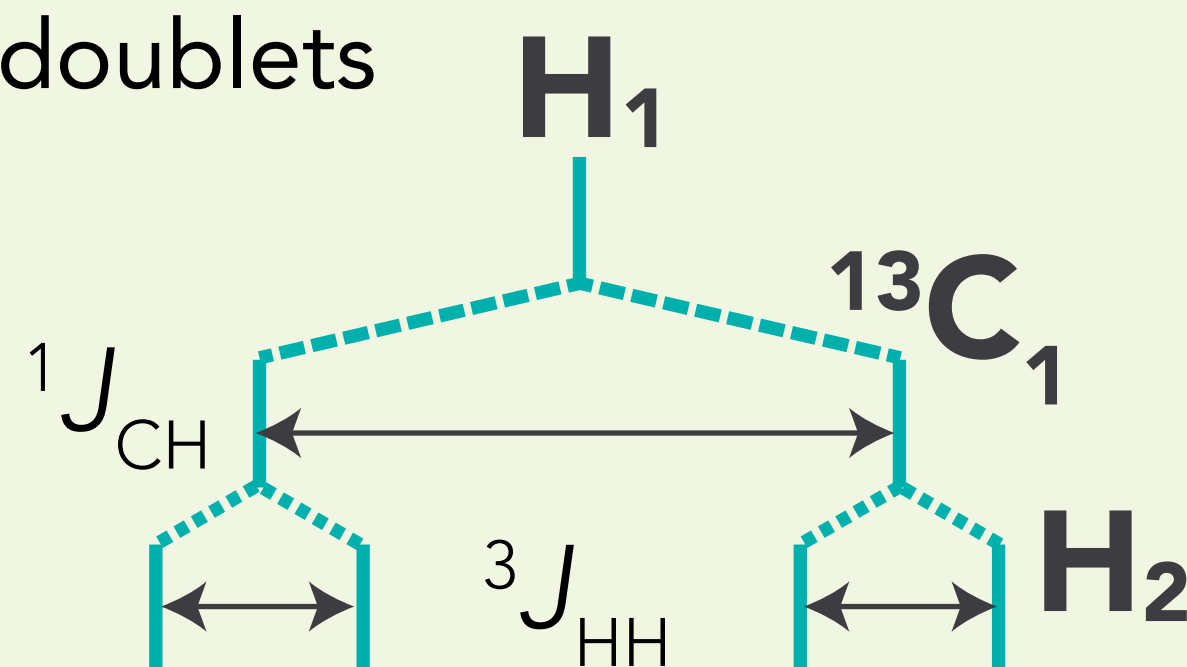


Heteronuclear J-Coupling on benchtop NMR



Peak area of ^{13}C satellites in ^1H NMR

doublet of doublets



δ (100 MHz, D_2O) = 1.34 (dd, $^1J_{\text{CH}} = 125.2$ Hz, $^3J_{\text{HH}} = 6.2$ Hz) ppm

$n+1$

Simplified Splitting and Multiplicity rule (for nuclides with spin of $1/2$)
where n = number of equivalent neighboring nuclei

$$\frac{1.1}{2} = 0.55$$

The peak areas of both satellite doublets corresponds to the signal split by proton and carbon-13

Emergence of ^{13}C satellites in ^1H NMR

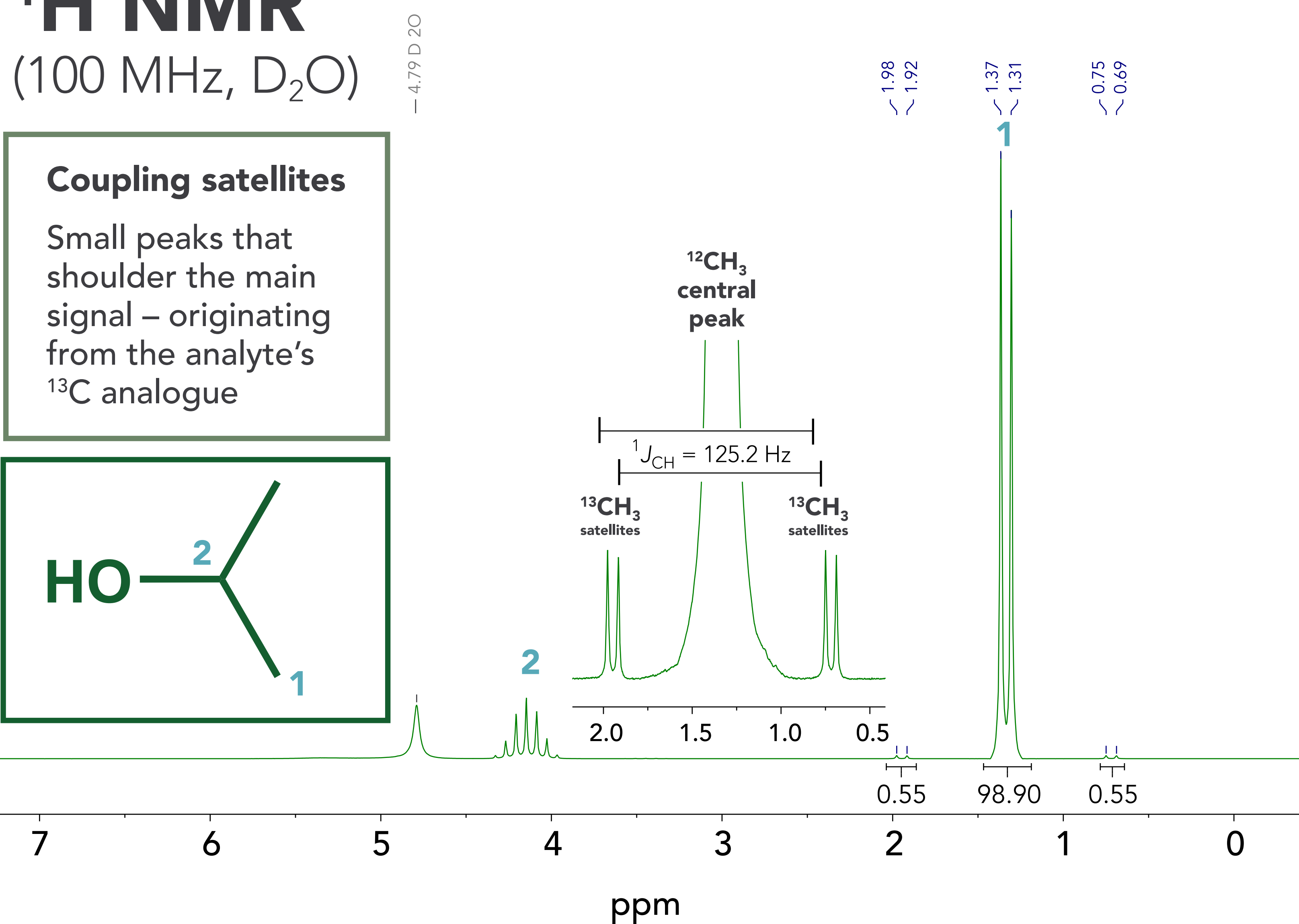
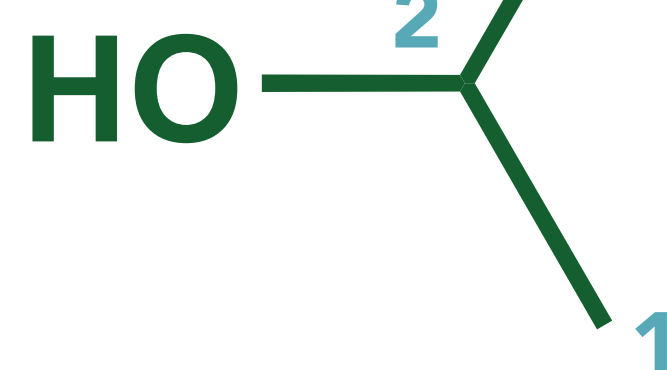
In ^1H NMR spectrum of isopropanol we observe the homonuclear $^3J_{\text{HH}}$ coupling, which leads to the splitting pattern of the methine (septet) and methyl (doublet) signals. Due to the isotopic ratio of carbon, 98.9% of the protons in isopropanol will be bonded to carbon-12, which is an NMR silent isotope, and no heteronuclear coupling will be observed. However, 1.1% of the methyl protons are attached to ^{13}C , resulting in $^1J_{\text{CH}}$ heteronuclear coupling, which splits the signal further into a doublet of doublets around the central doublet.

Isopropanol ^1H NMR

(100 MHz, D_2O)

Coupling satellites

Small peaks that shoulder the main signal – originating from the analyte's ^{13}C analogue



Nuclide Properties

^{12}C

^{13}C

^{14}C

Natural Abundance

98.89%

1.11%

$\sim 1 \times 10^{-12}\%$

Nuclear Spin, I

0

$1/2$

0

NMR active

X

✓

X