An overview of the HSQC

Transfer to ^{15}N

Transfer back to ^{1}H

Encode ^{15}N chemical shift for time t_1

Bodenhausen & Ruben

2D Time-Domain Data

t_1

t_2

The Spin Echo "averages" chemical shift evolution
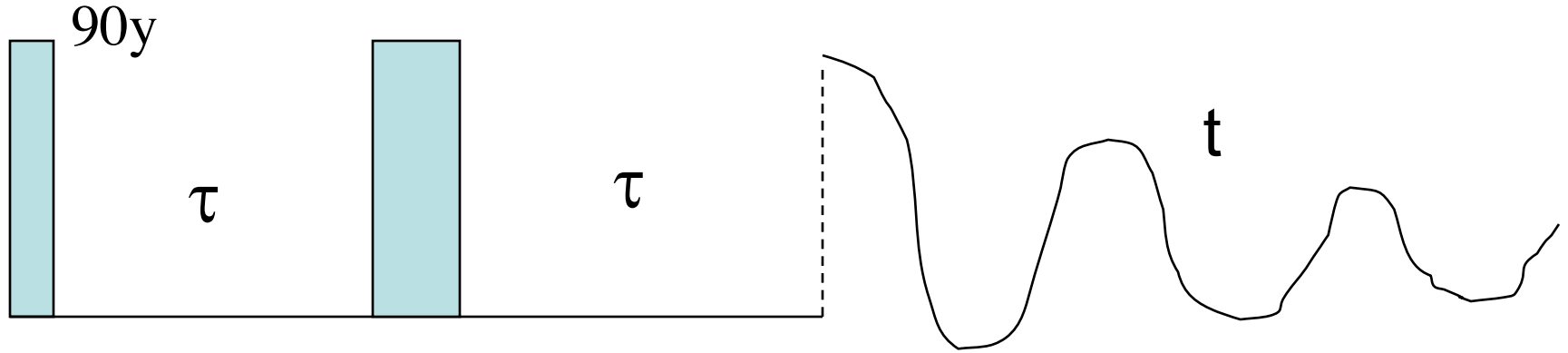

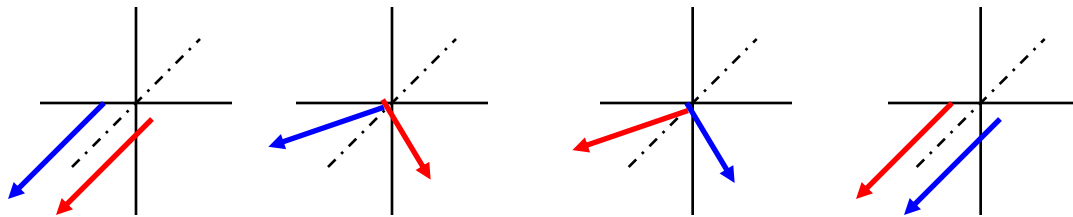τ   τ

t

Echo Forms After 2τ

ϕ $-\phi$
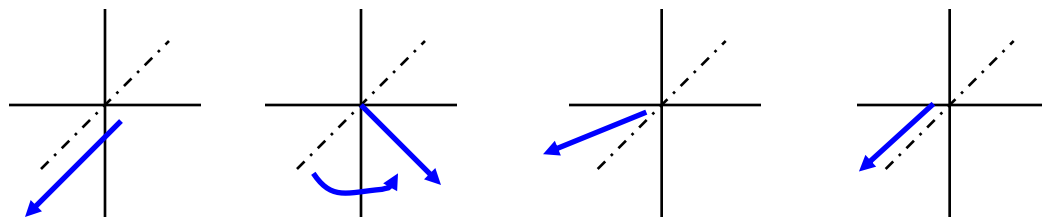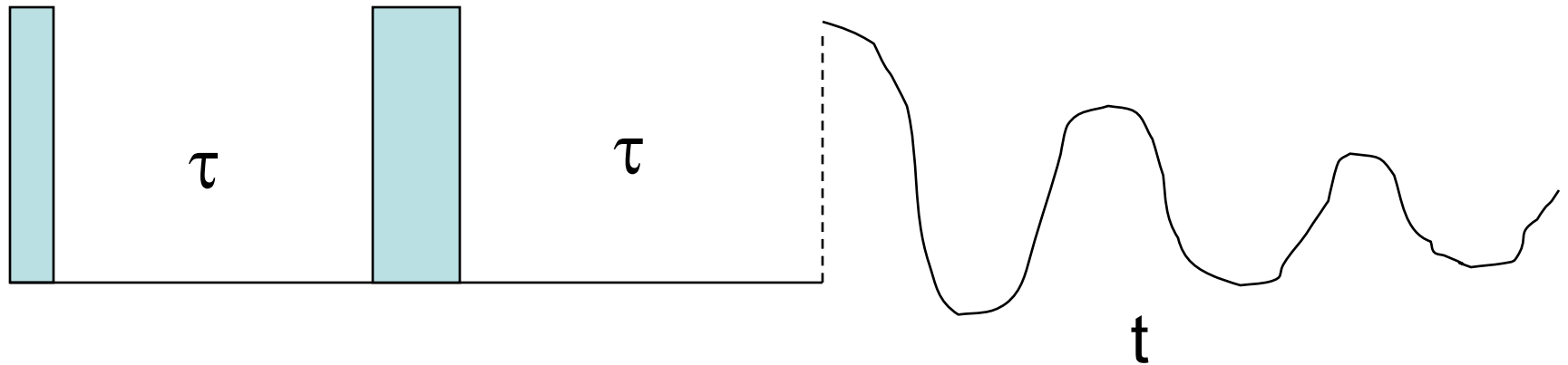
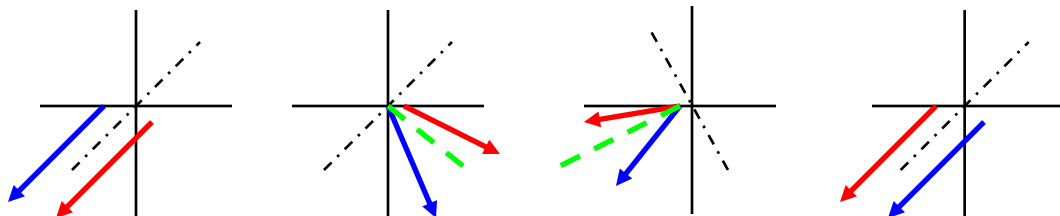$\phi=2\pi\tau\delta$

Spin-Echo Refocuses J and CS Evolution
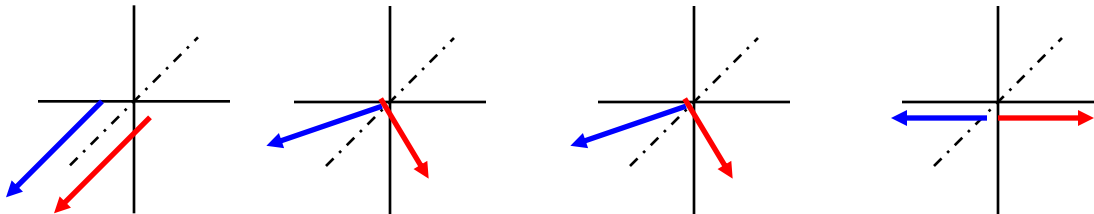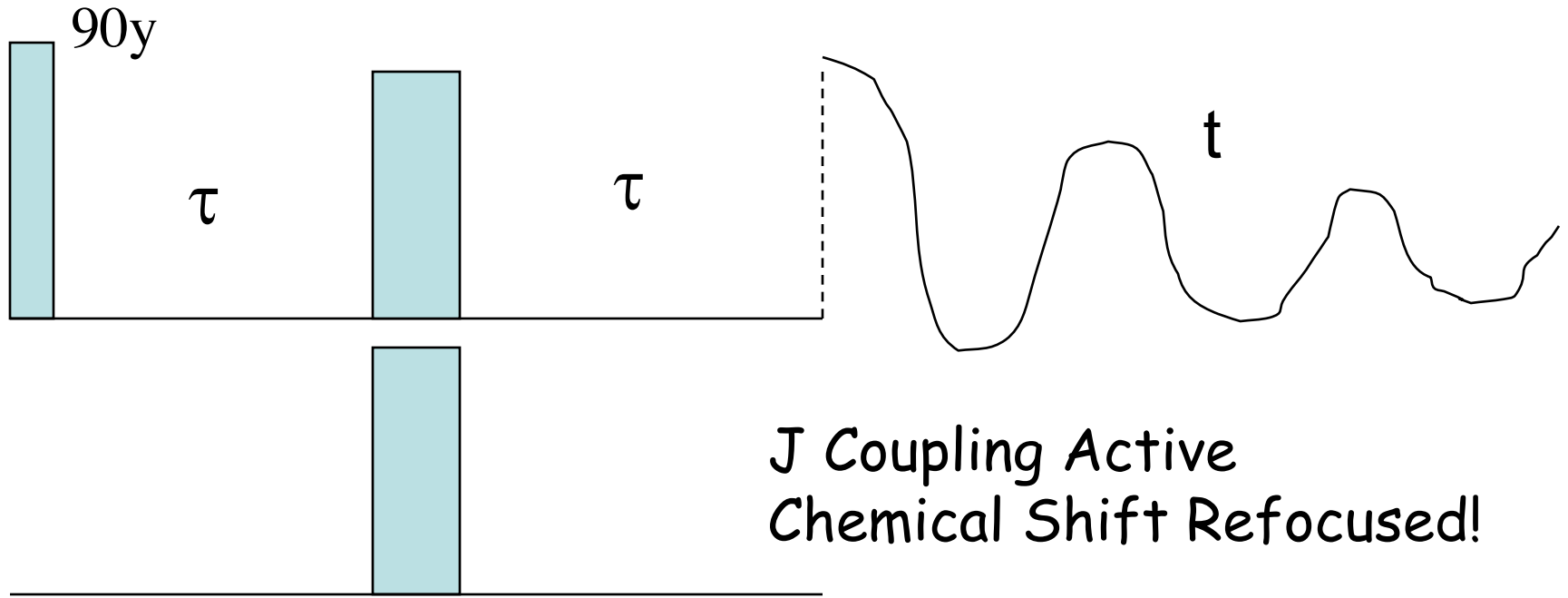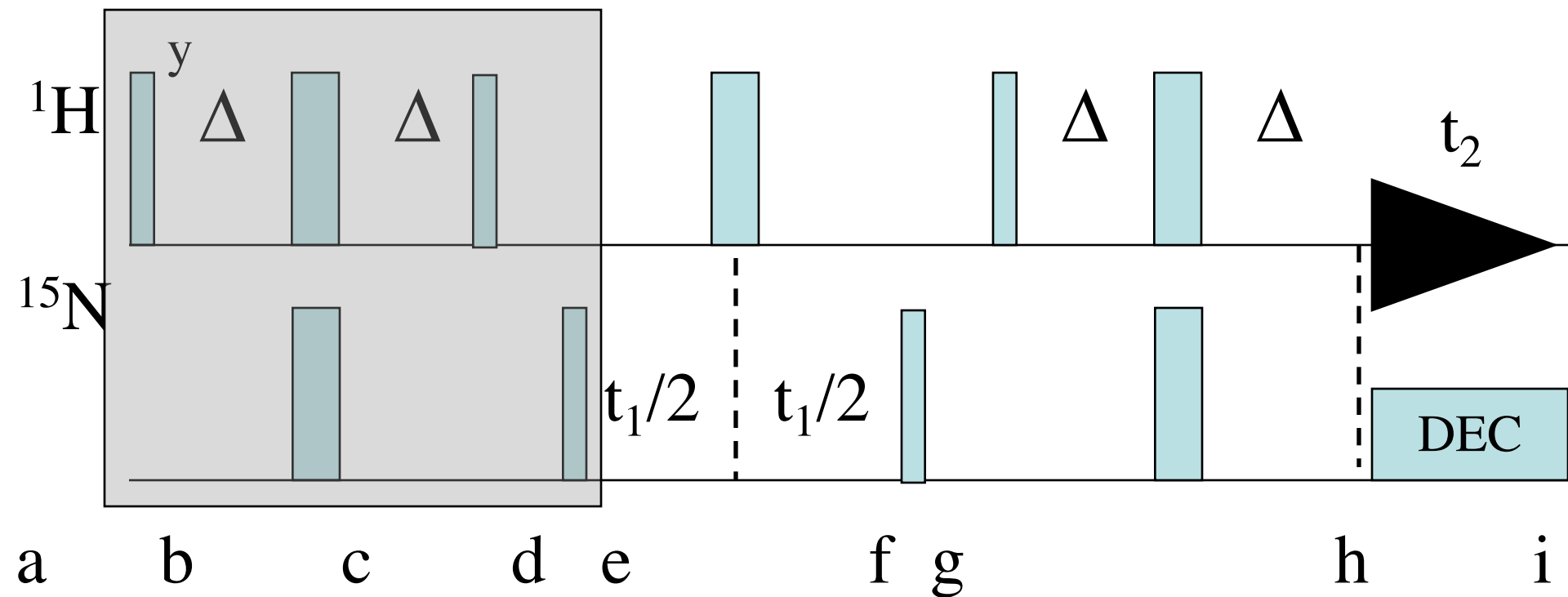

J_{XH} only

J Coupling Refocused

J & CS

J Coupling & Chemical Shift Refocused

Double Spin Echo

90y

τ

τ

t

J Coupling Active
Chemical Shift Refocused!
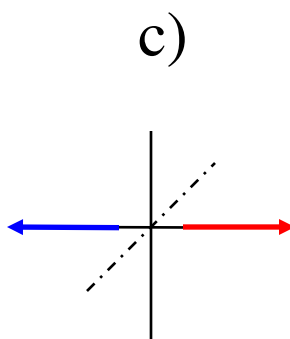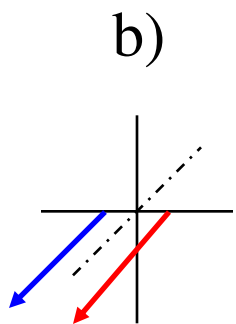
HSQC: guided tour

^1H

y

Δ Δ Δ Δ

t_2

^{15}N

$t_1/2$ $t_1/2$

DEC

a   b   c   d   e   f g   h   i

First transfer

$\Delta = 1/4J_{NH}$

a)

b)

c)   d)   e)

^{1}H   y Δ Δ

a   b   c   d

^{15}N   e
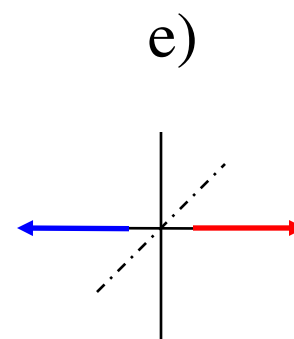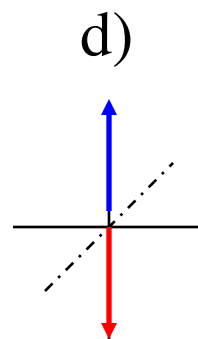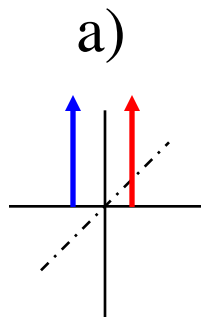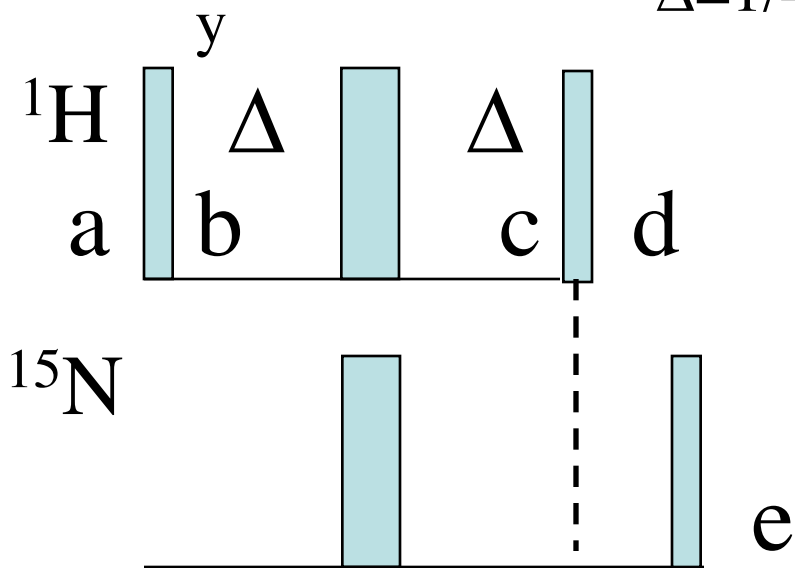
^{15}N transverse "antiphase" magnetization subject to ^{15}N chemical shift

Morris & Freeman, INEPT

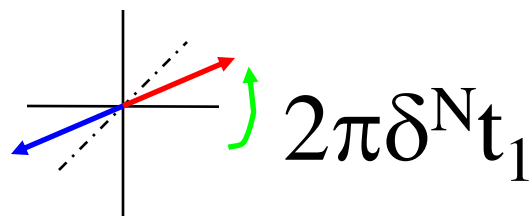# ^{15}N Chemical Shift Evolution

^{1}H

y

Δ Δ

^{15}N

t$_1$/2   t$_1$/2

Δ Δ

t$_2$

DEC

e   f g h   i   j

e)   f)   g)

$2\pi\delta^N t_1$

Detection

^{1}H $\quad$ y $\qquad$ Δ $\qquad$ Δ $\qquad\qquad\qquad$ Δ $\qquad$ Δ $\qquad$ t_2

^{15}N $\qquad\qquad\qquad\qquad$ $t_1/2$ $\quad$ $t_1/2$ $\qquad\qquad\qquad\qquad$ DEC

$\qquad\qquad\qquad\qquad$ e $\qquad\qquad\qquad$ f $\quad$ g $\quad$ h $\qquad\qquad$ i $\qquad\qquad$ j

i) $\qquad\qquad$ t_2 $\qquad\qquad$ j)

$\qquad\qquad\qquad\qquad\qquad\qquad$ $2\pi\delta^H t_2$

HSQC Signal

^1H

y

Δ Δ Δ Δ

t_2

^{15}N

$t_1/2$ $t_1/2$

DEC

a   b   c   d   e   f g   h   i   j
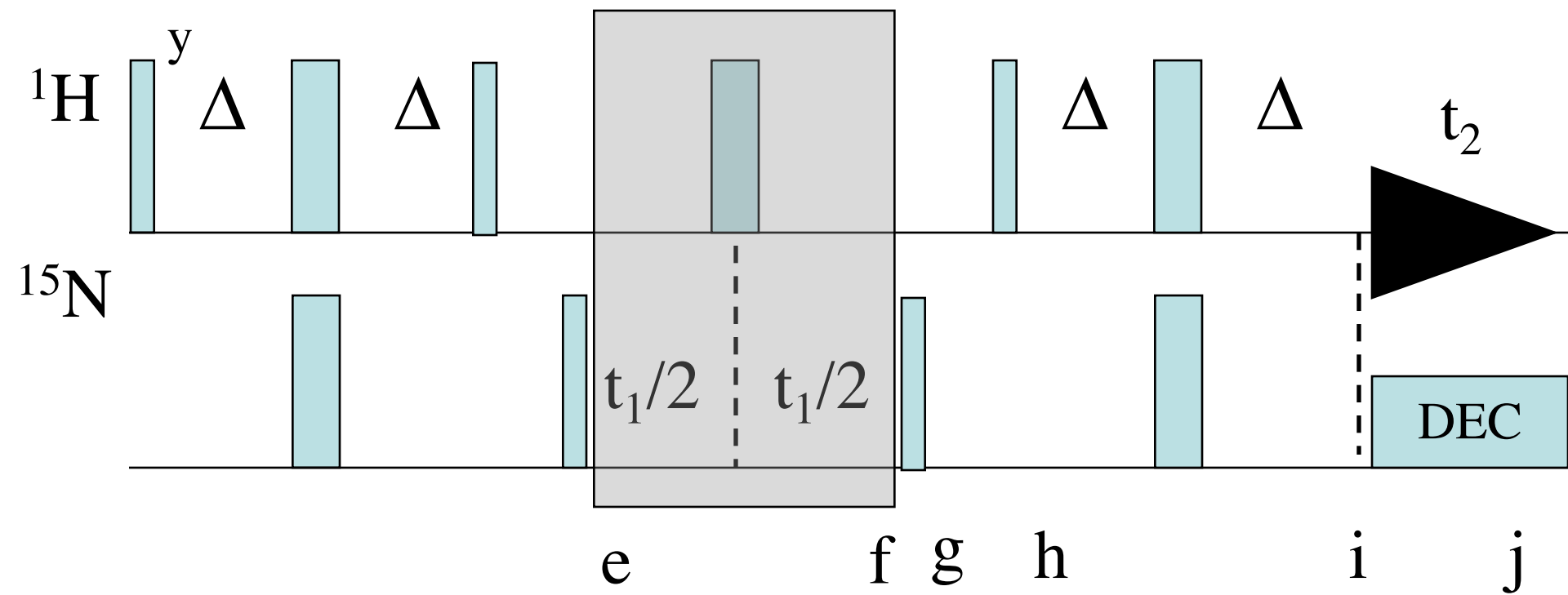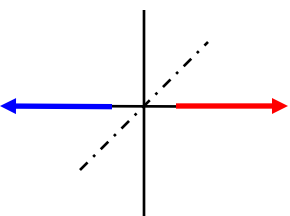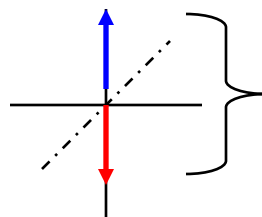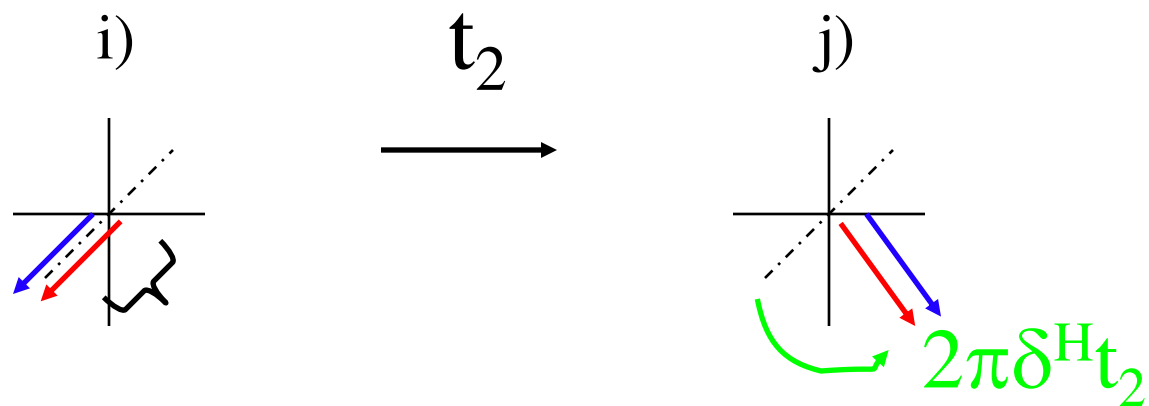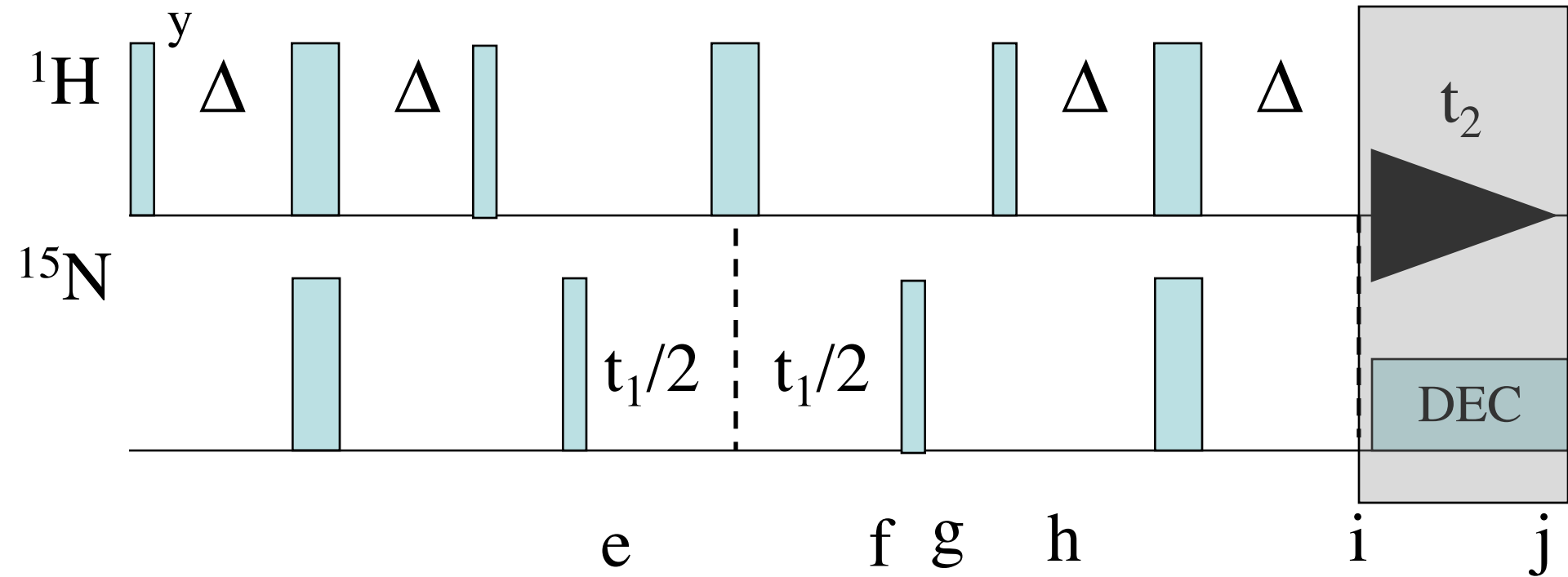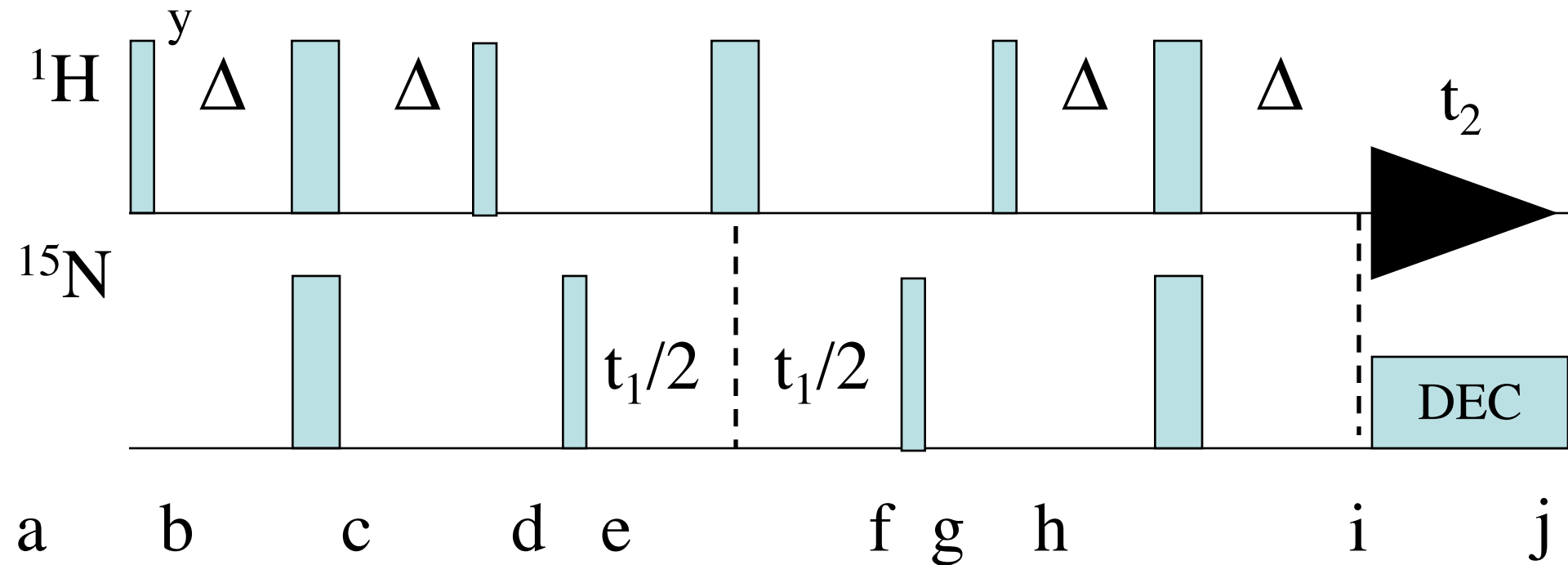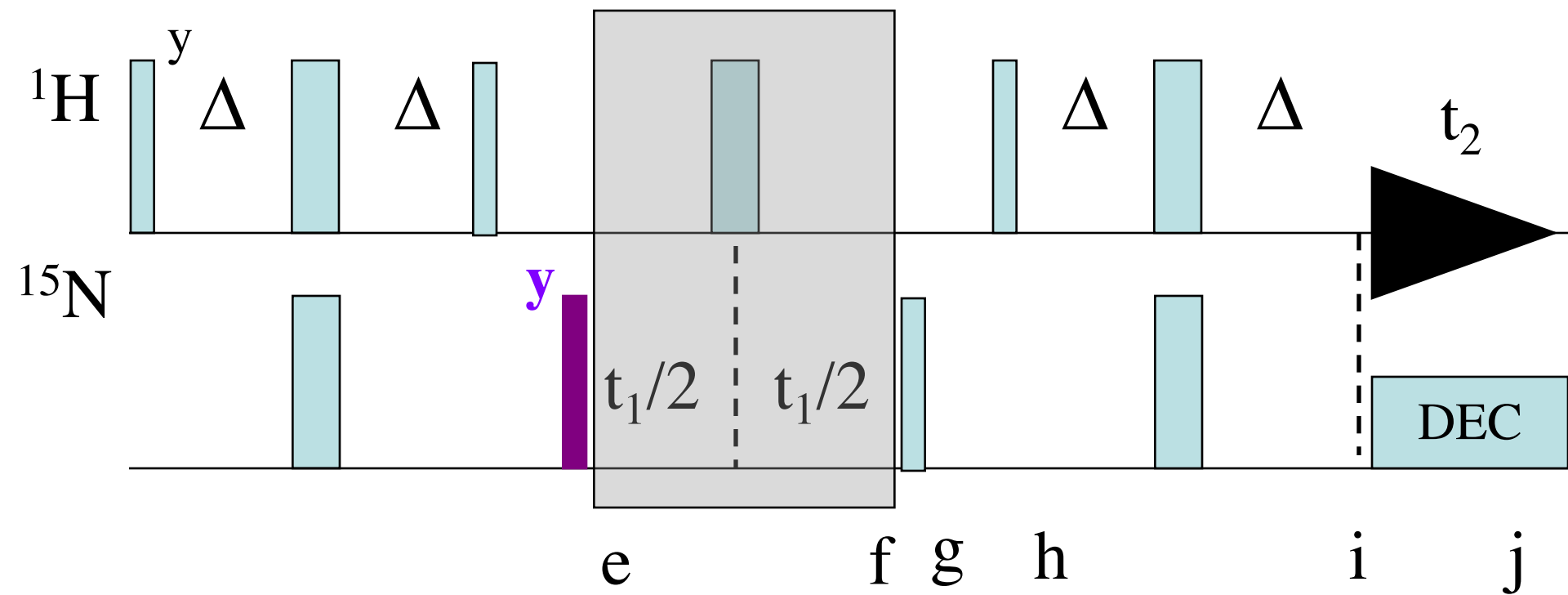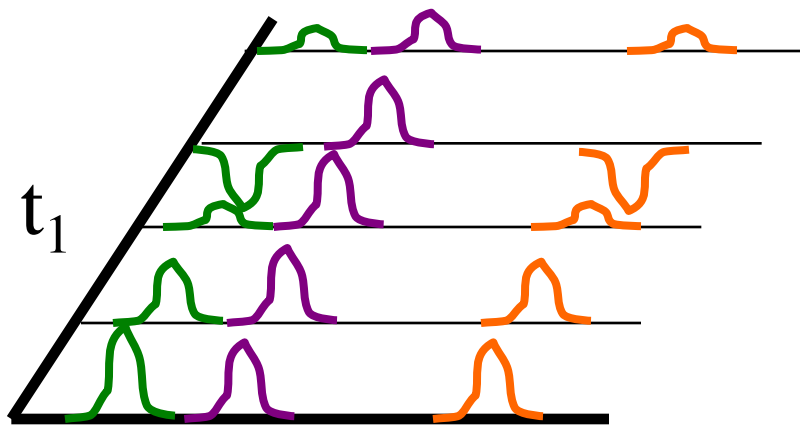
Obtaining the Sine Component
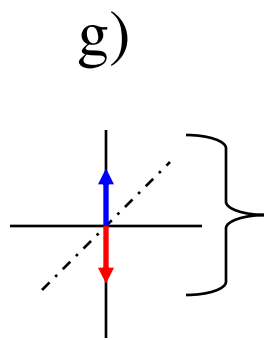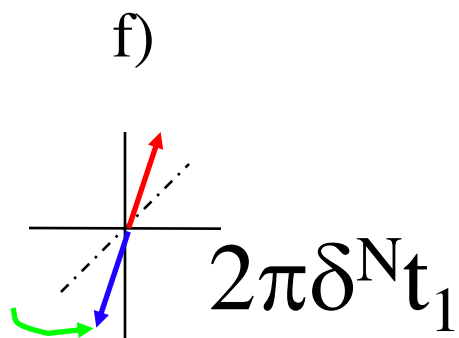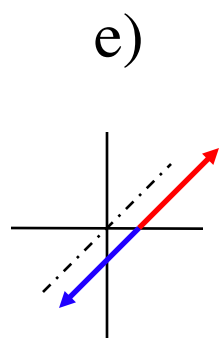
States, Ruben, Haberkorn
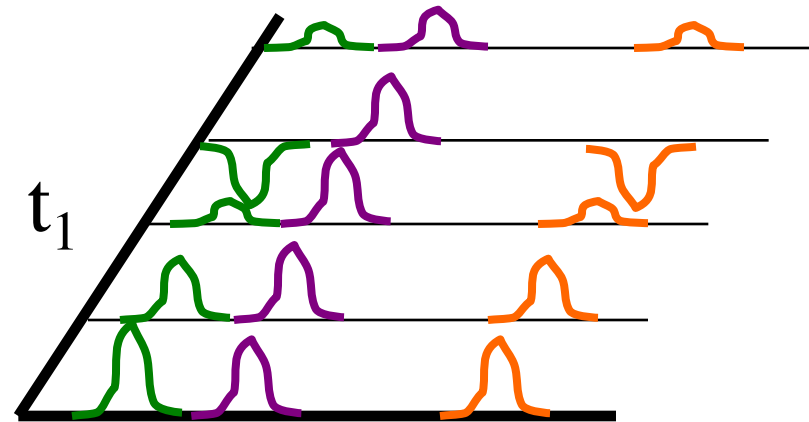
After Obtaining Im Part of Indirect Dimension . . .

t_1

F_2

H^N

t_1
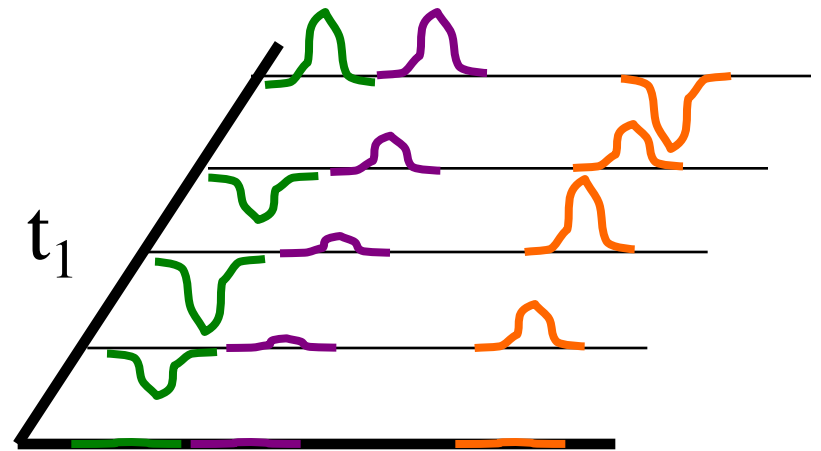
F_2

H^N

2D Fourier Transform: FT Direct Dimension

FT Direct Dimension

t_1

F_2

H^N

Re $S(t_1, \nu_2)$ is absorptive.
But unable to discriminate sign of δ^N

Some data shuffling then 2D FT =the HSQC Spectrum