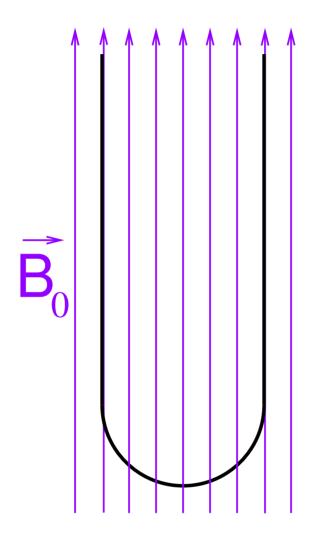
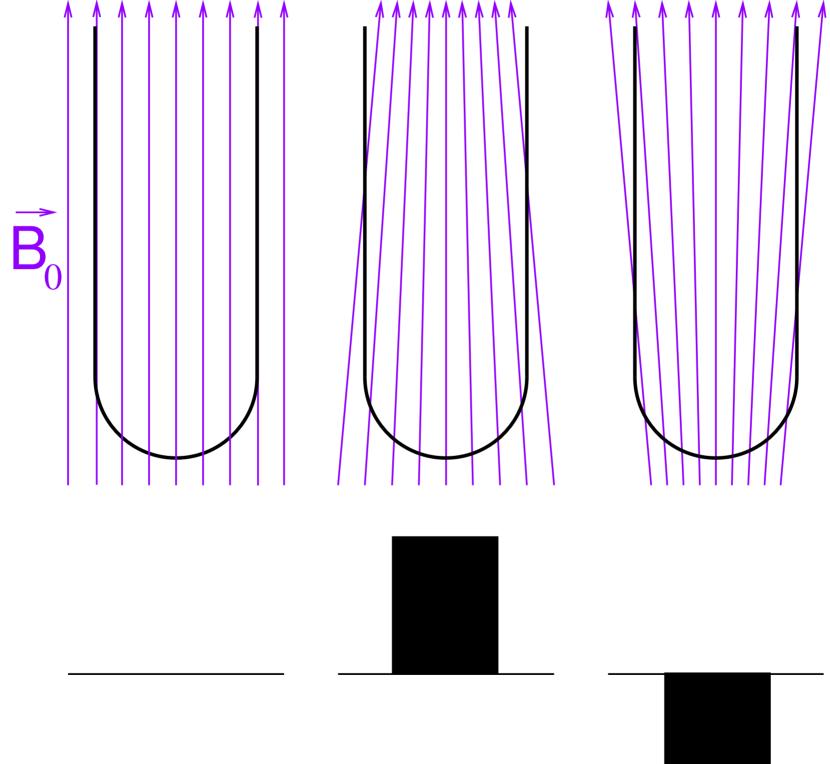
Lecture 13: Field gradients

Homogeneous field



Pulsed field gradients (G_z)



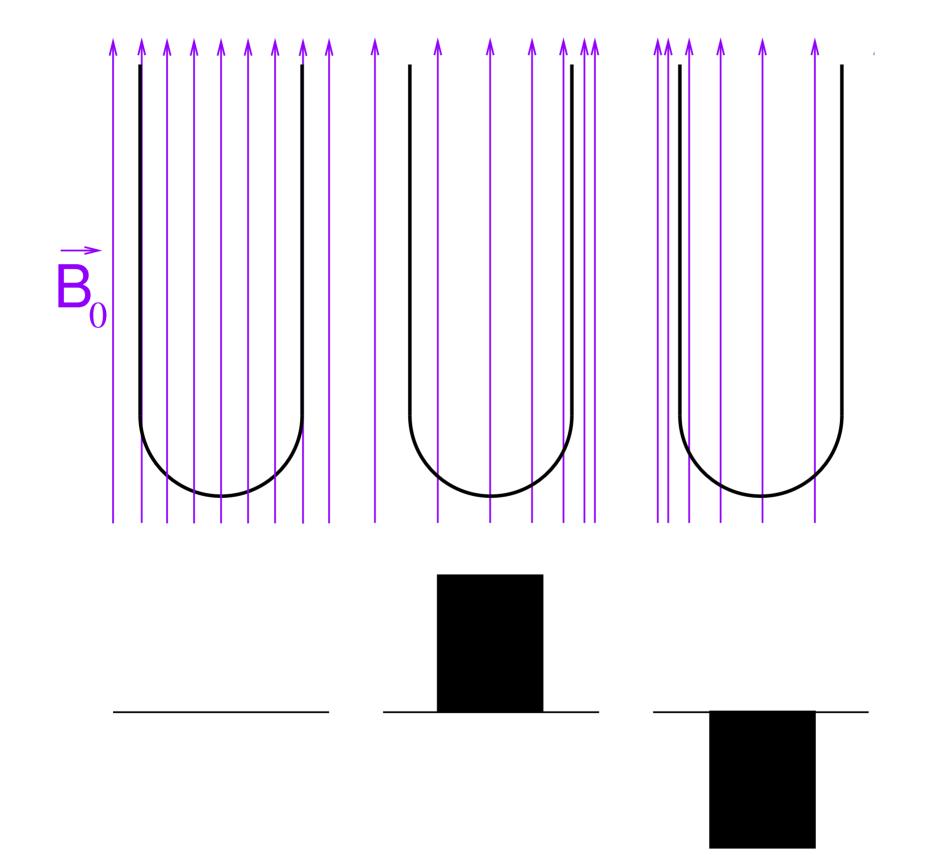
 $G_z = 0$ units

 $G_z = 1$ units

 $G_z = 2$ units

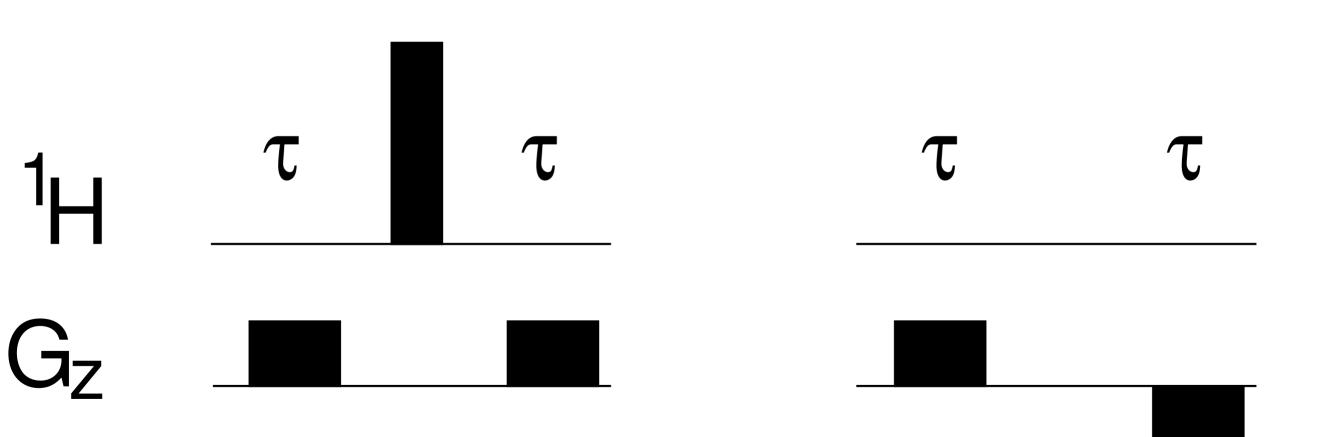
 $G_z = 4$ units

Pulsed field gradients (G_y)



Gradient echoes



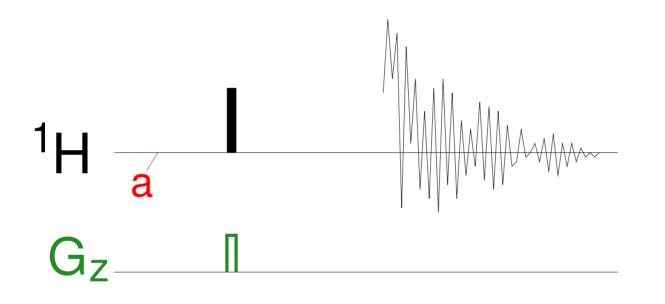


GRADIENTS AND MAGNETIC RESONANCE IMAGING

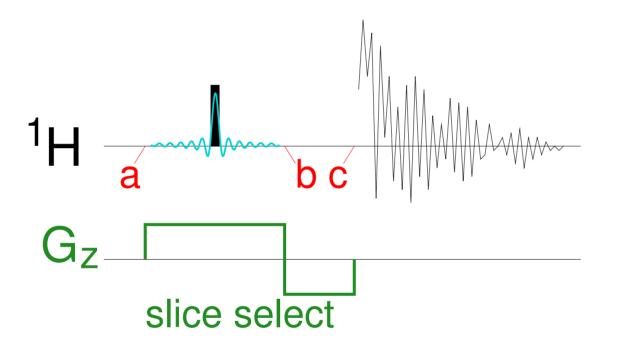
Lars G. Hanson Copenhagen University Hospital Hvidovre

https://eprints.drcmr.dk/37/1/MRI_English_a4.pdf

Slice selection by G_z

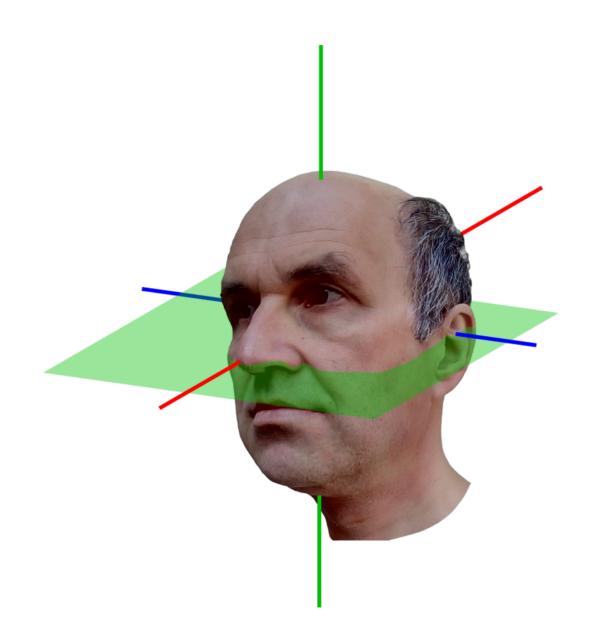


Slice selection by G_z

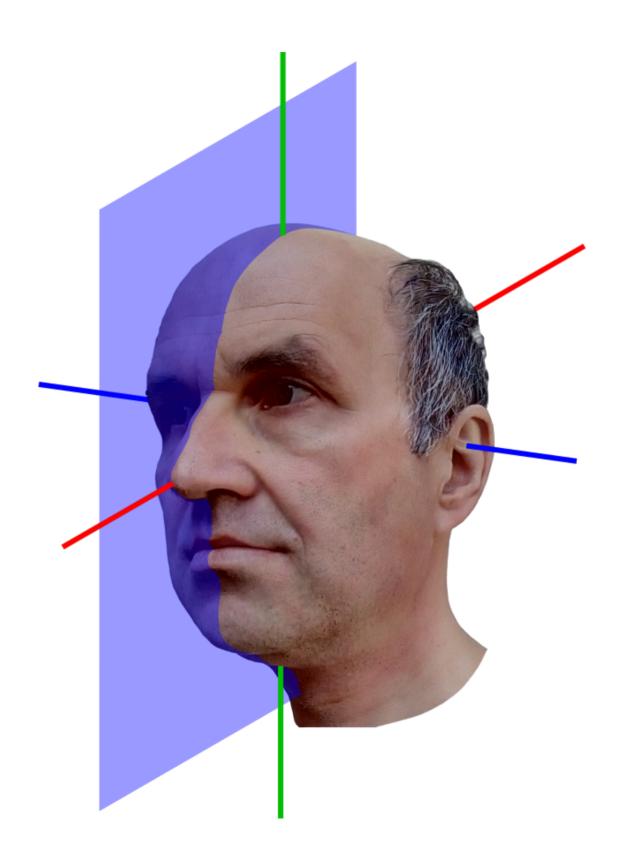


Selective pulse: amplitude modulation

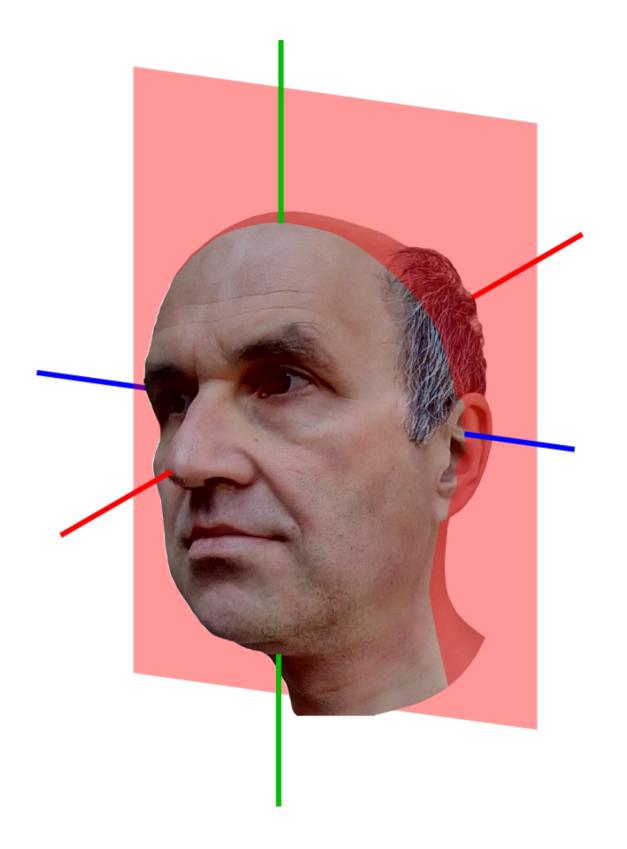
Axial slice selection by G_z



Sagittal slice selection by G_x



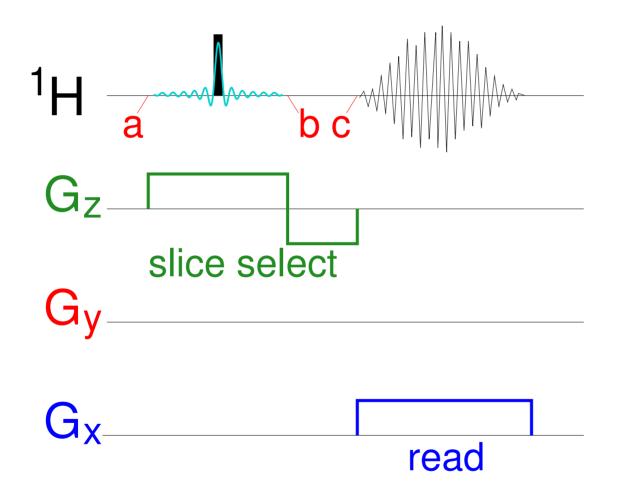
Coronal slice selection by G_y



Magnetization in the slice

 $\sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i$ * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * **XXXXX** **************** * * * * * * * * * * * * * * * * * *

1D imaging in the slice



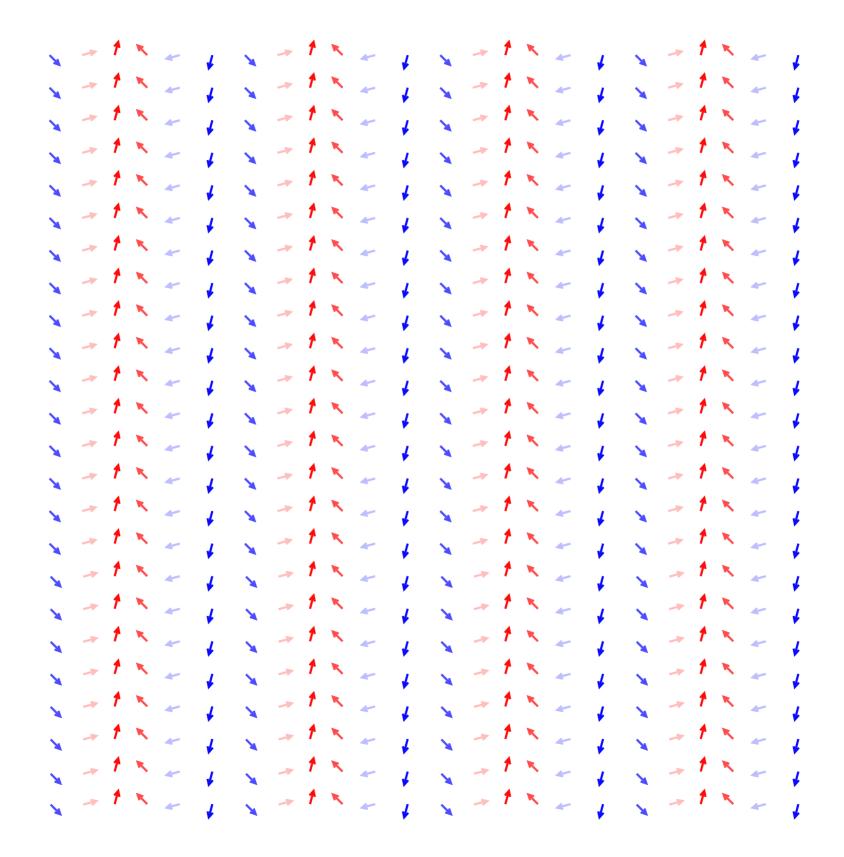
Magnetization in the slice with gradient G_x

*********** ----------~ * * * * * * * * * * * * * * * * x # # # # # # # # # # # ~ 1 × × > ~ L L L L Z **** * 7 X X > × ∠ ∠ ↓ ↓ ↓ ----X X > ----X X > ----**N N** * 1 X X > 1 1 1 1 1 **** * * × × × 4 4 4 4 4 ¥ × × ----X X > ¥ 🔌 * 1 X X > 4 4 4 4 **** * * X X > * * * * * X X > ----¥ ¥ > **** * * ¥ ¥ > ******** X X > 4 4 7 7 *** * * X X > * * * * * * -------X X > * * * ~~ / / / / / / X X X × × × *** * 1 * * * * * * * * * X X >

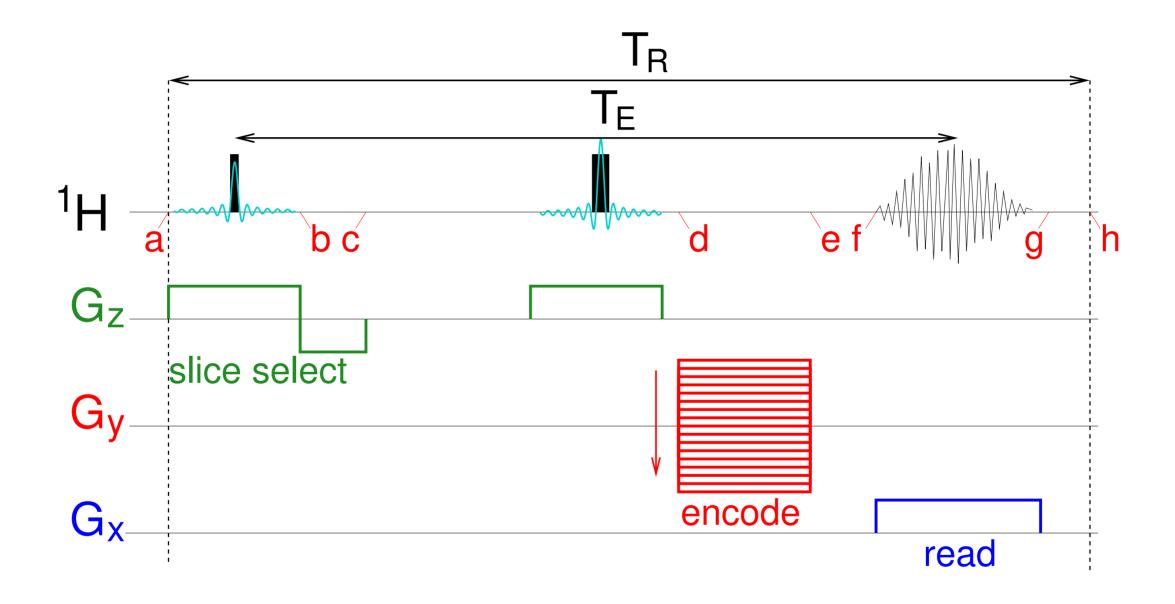
Magnetization in the slice with gradient G_x

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Magnetization in the slice with gradient G_x



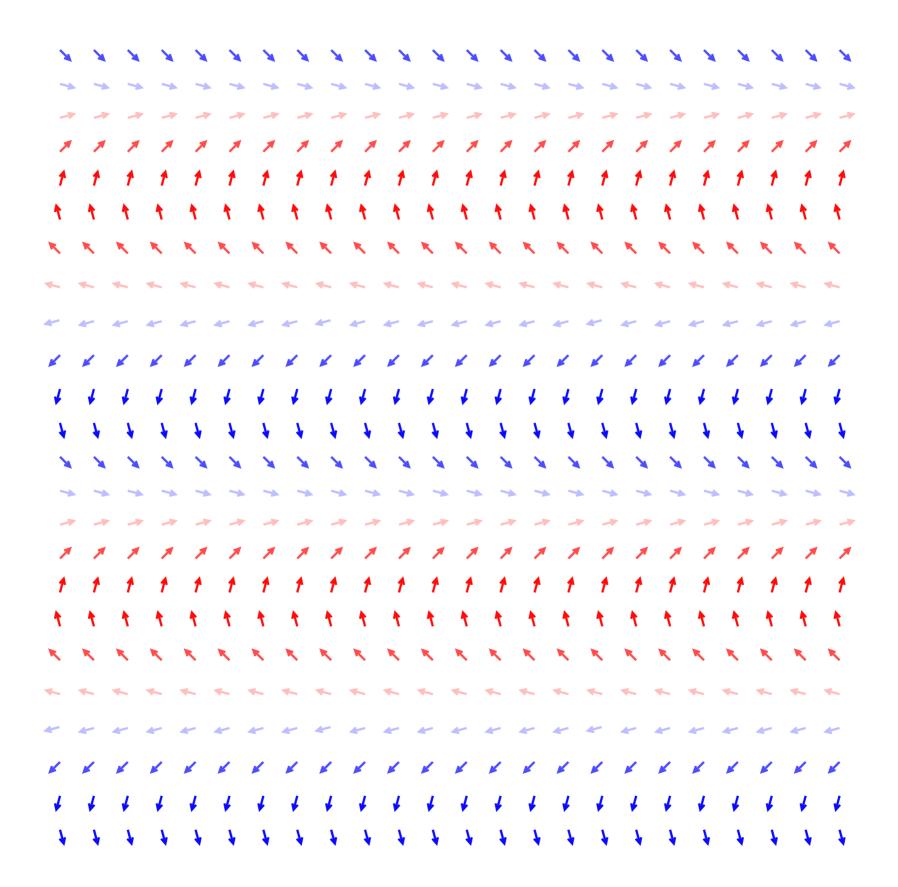
2D imaging in the slice



Magnetization in the slice with gradient G_y

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Magnetization in the slice with gradient G_y



Magnetization in the slice with gradient G_y

* * * * * * * * * * RRRRR KK 1 1 KK * * • • • 1 • 1 • 1 • • * * * * * * *

Combination of gradients G_x and G_y

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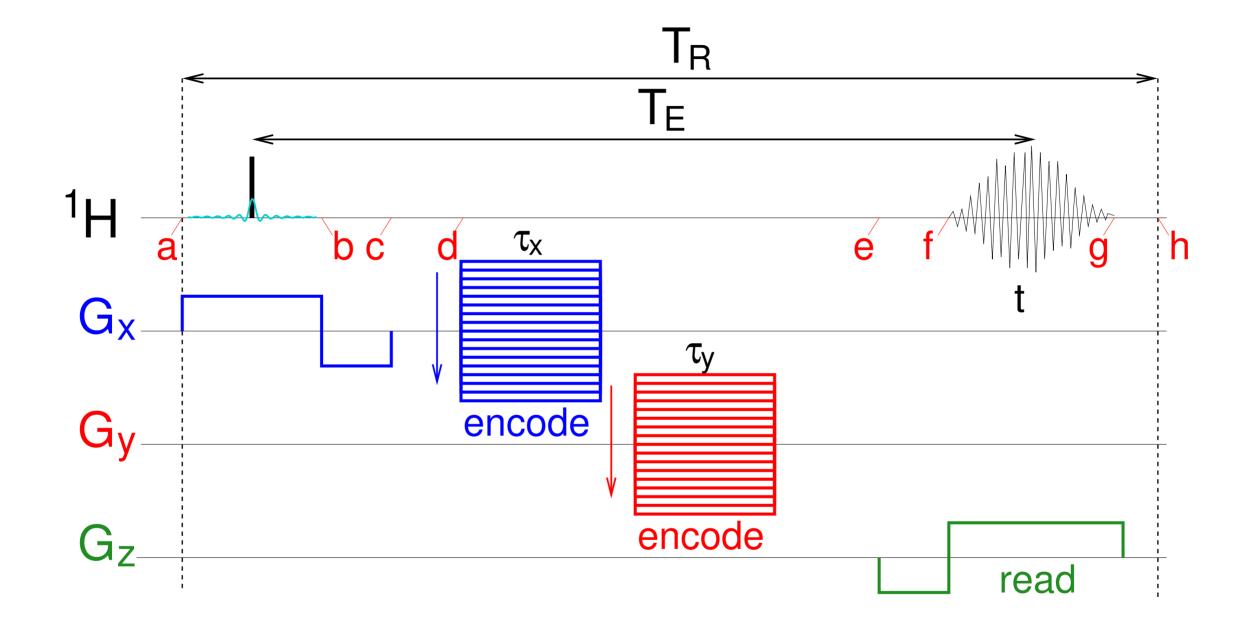
Combination of gradients G_x and G_y

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Combination of gradients G_x and G_y

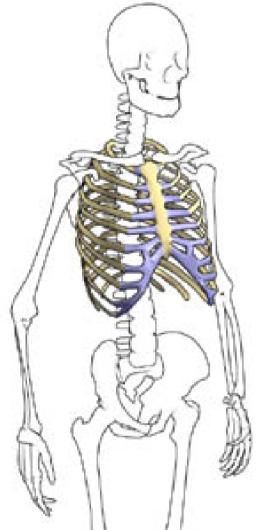
NAN PRATITY NE PRAFILLY -----tttttt exxxx axxxx axxx axxx -----

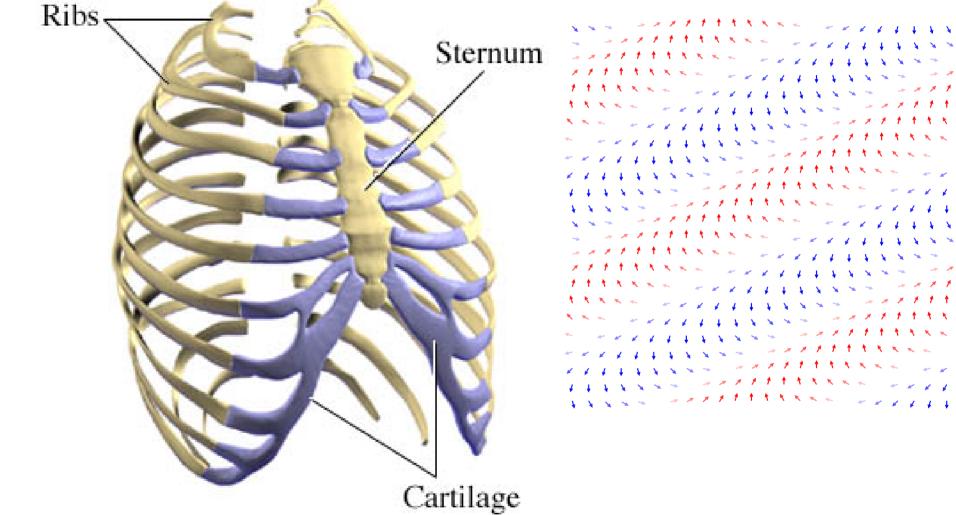
3D gradient echo imaging



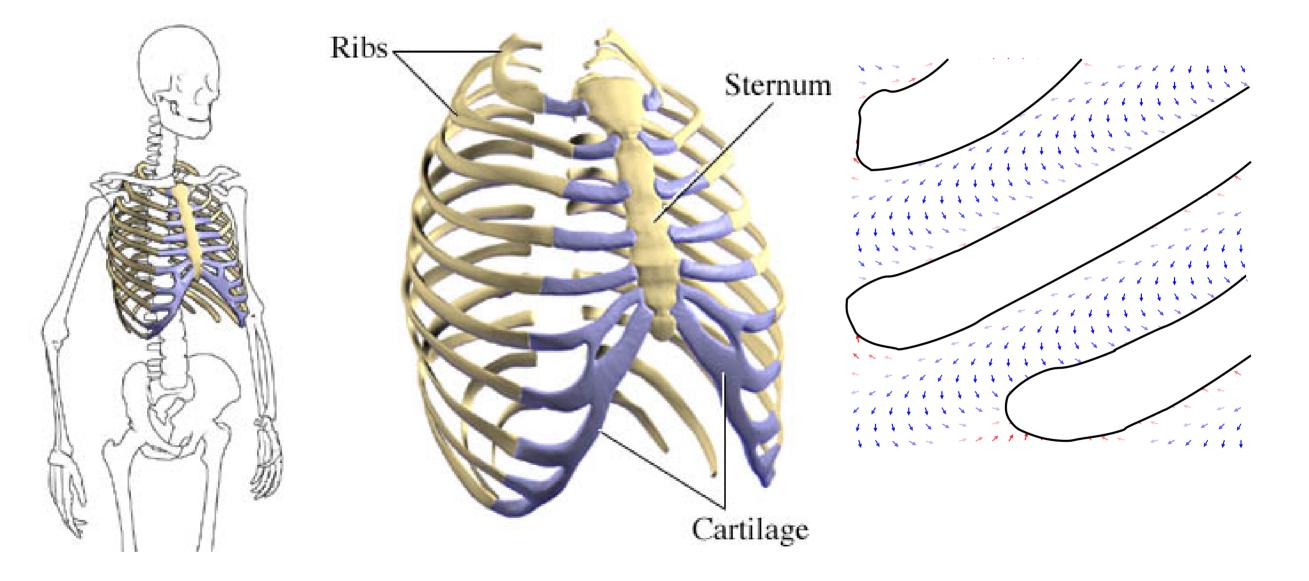
High resolution in all dimensions More time consuming

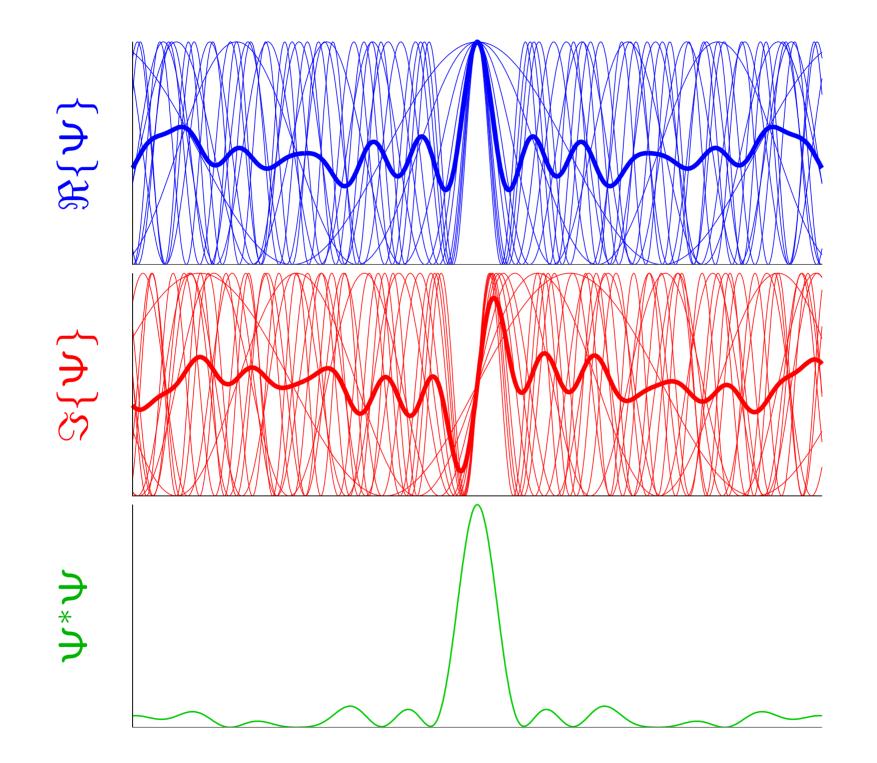
Regular patterns create signal

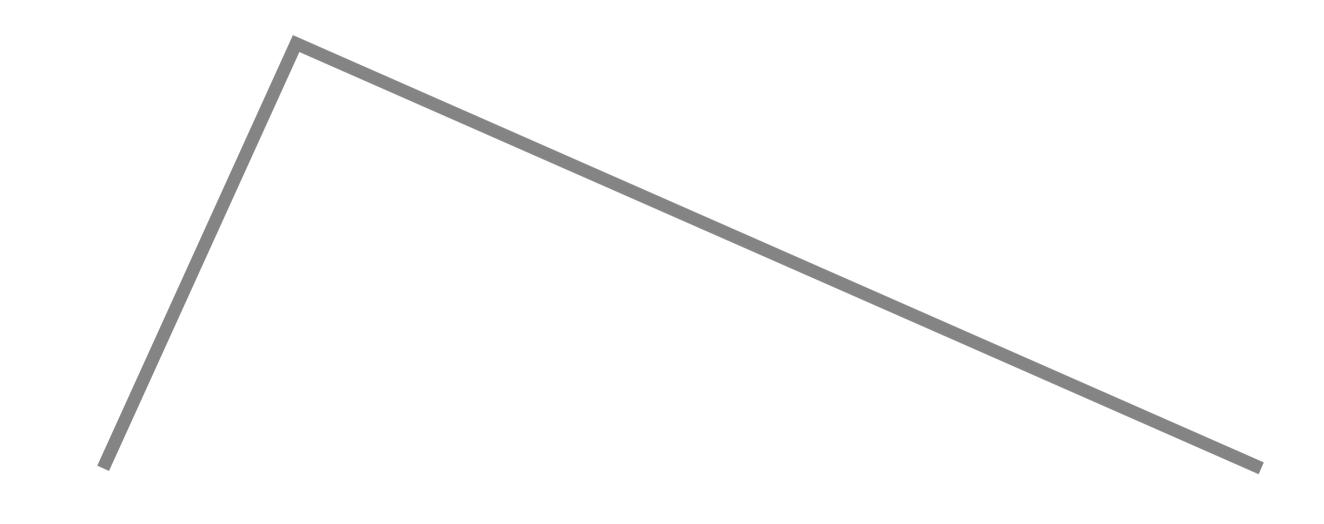


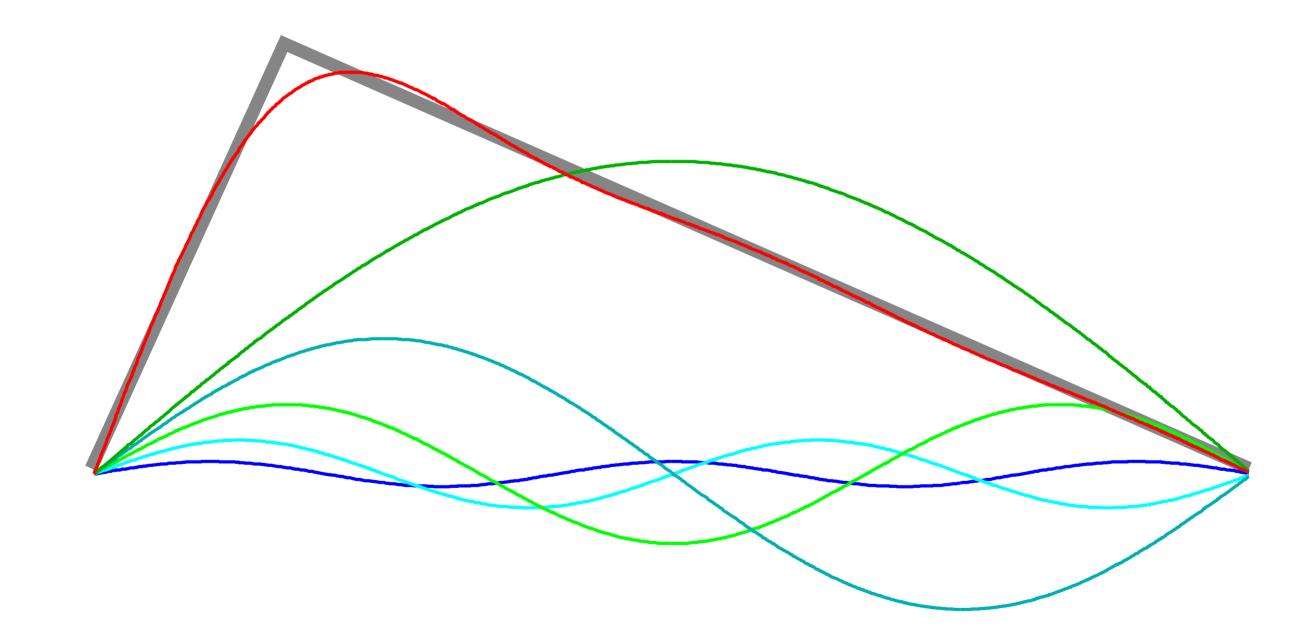


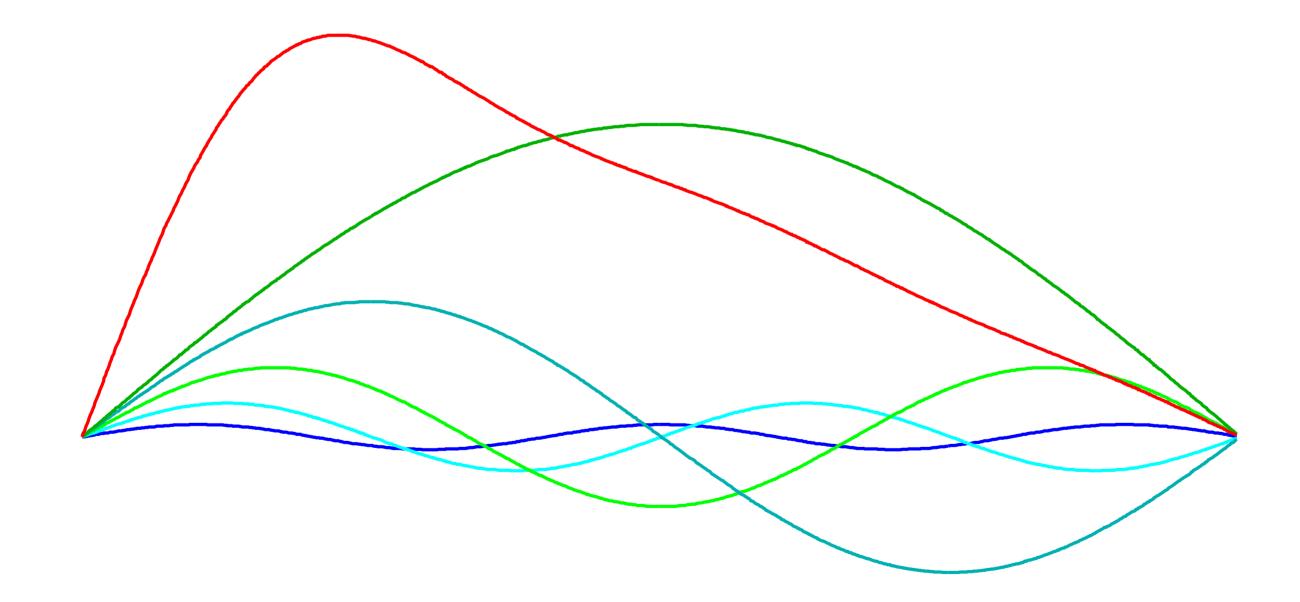
Regular patterns create signal











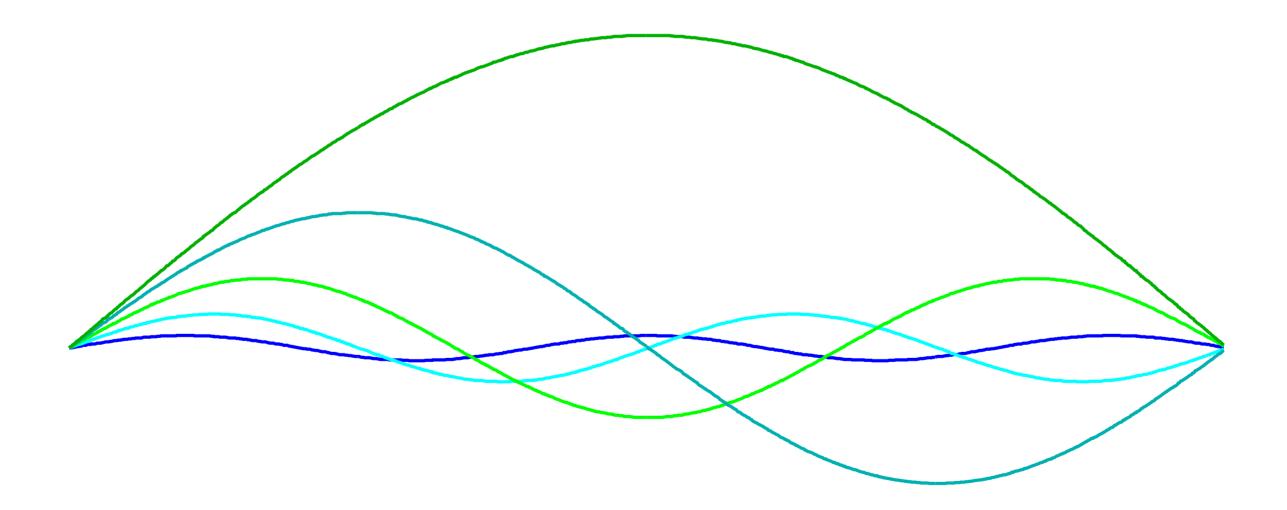


Image reconstruction

• resembles diffraction methods (crystallography)

wavelength of the phase patterns generated by gradients

 wavelength of the radio waves is irrelevant (but starts to interfere at high field, where it approaches the body dimensions)

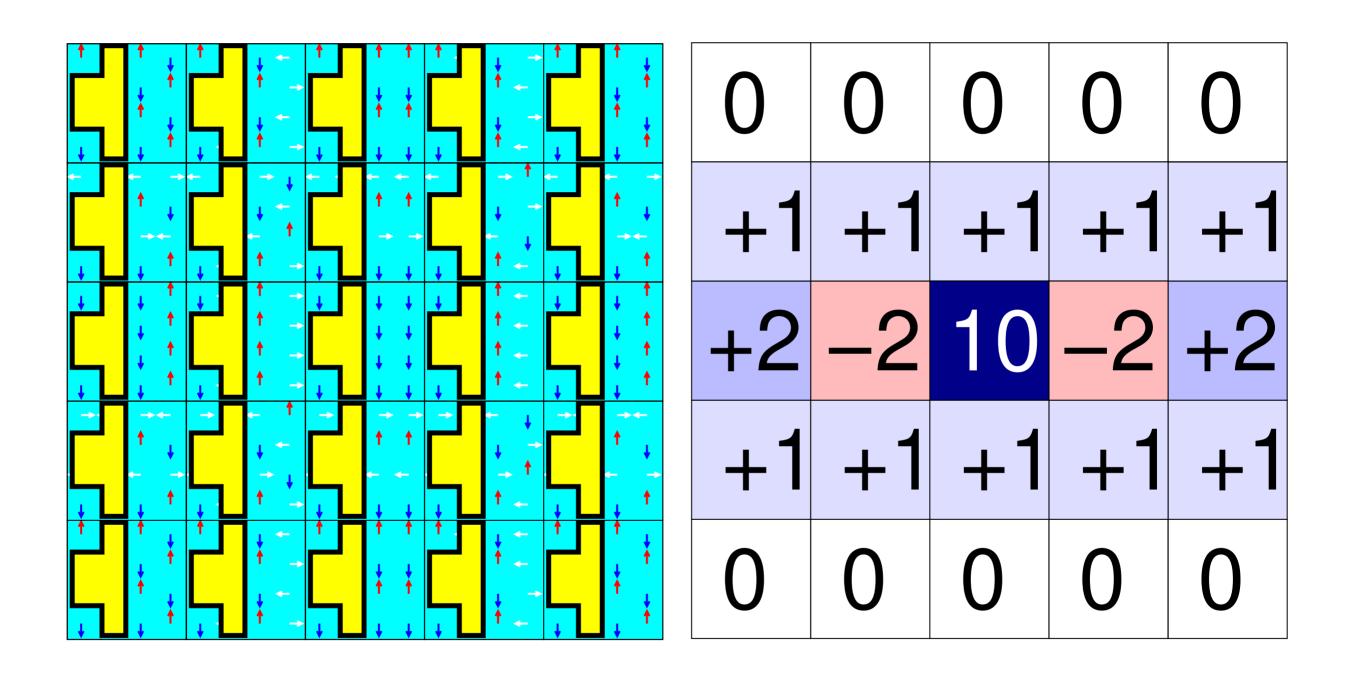
 Ω assumed to be identical differences must be corrected to avoid artifacts

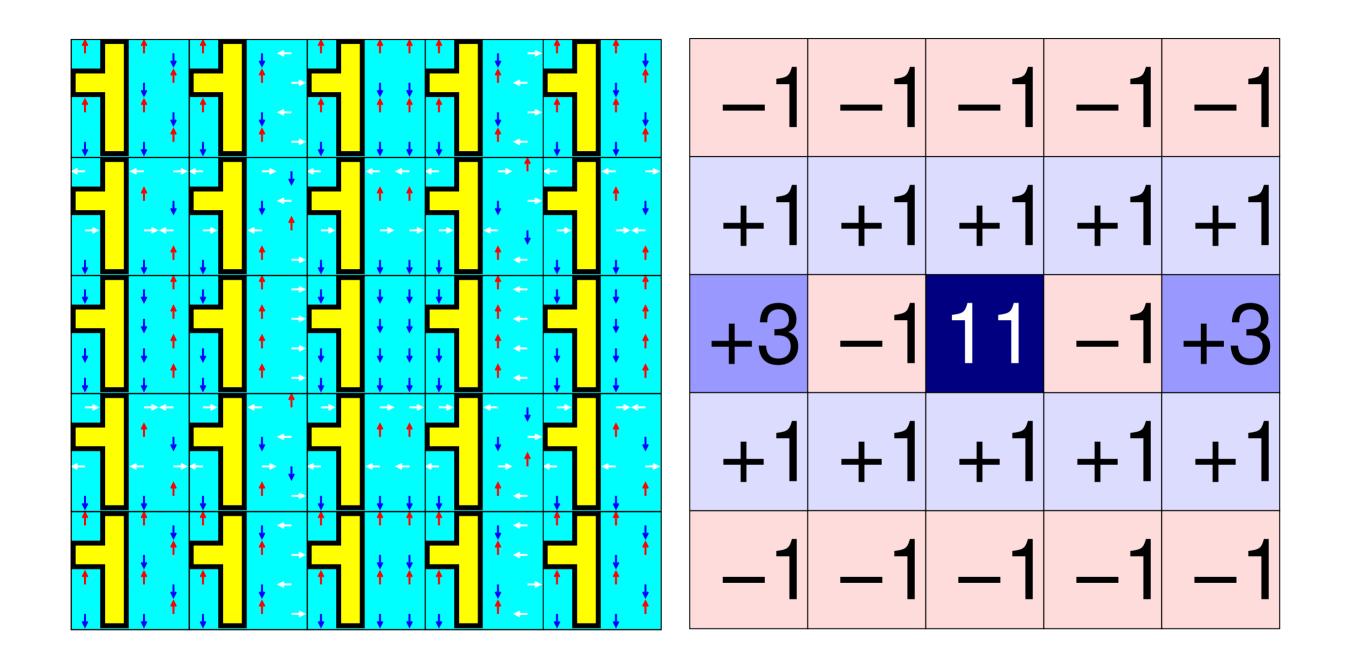
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| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 0 | 0 | 0 | 0 | 0 |
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| | | * *
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| | | | 0 | 0 | 0 | 0 | 0 |





See Figure 15 in

https://eprints.drcmr.dk/37/1/MRI_English_a4.pdf

