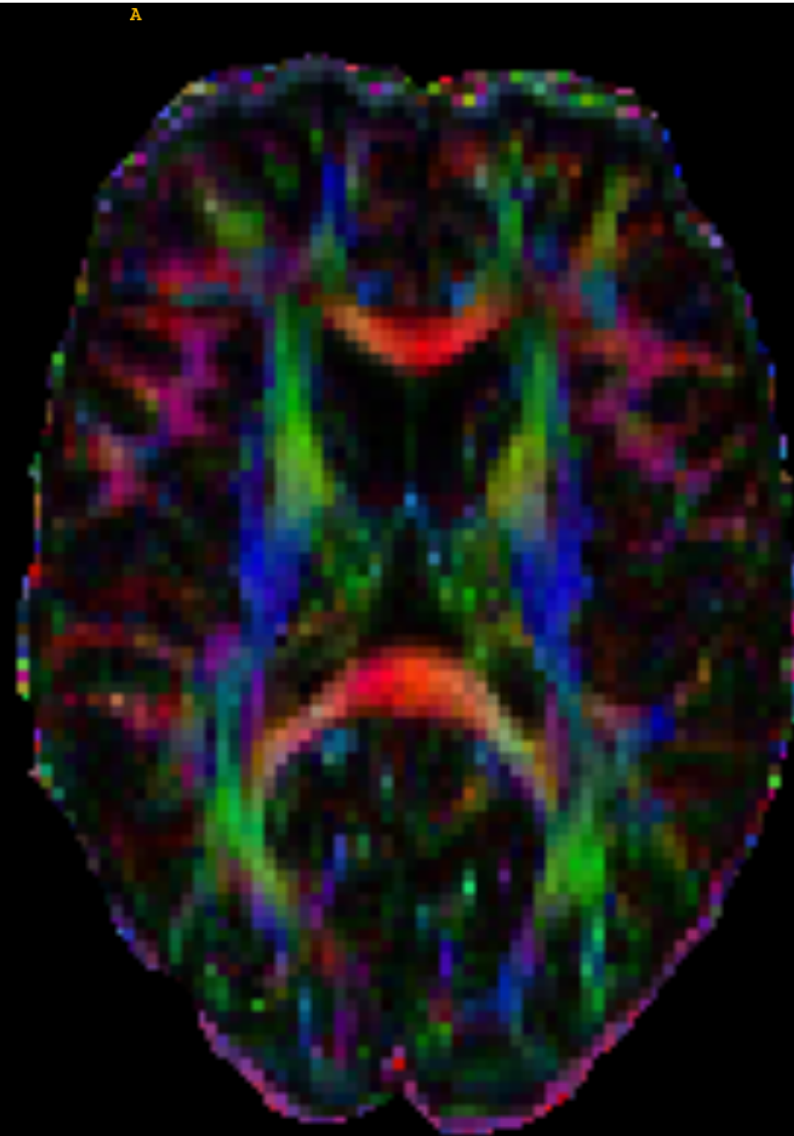
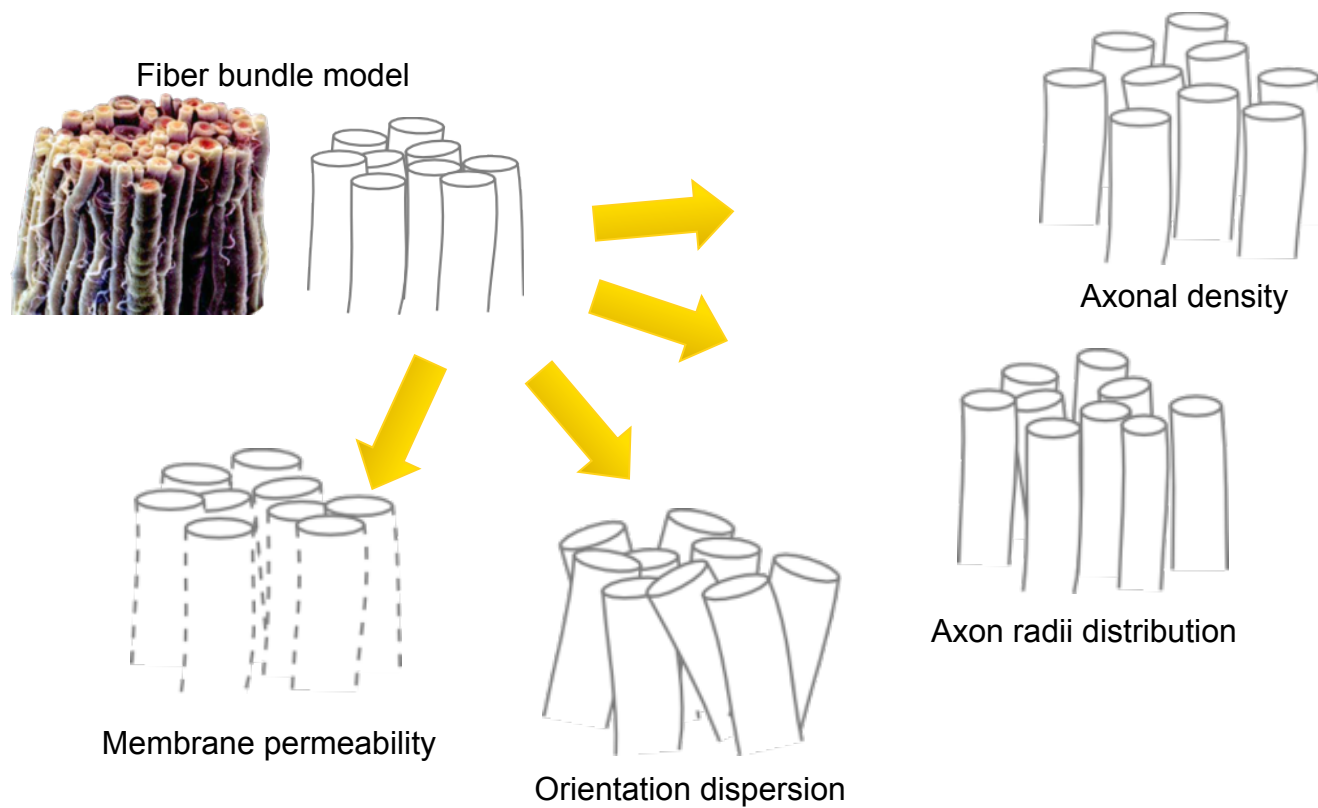


Towards compressed  
sampling for  
microstructure-enabled  
diffusion MRI

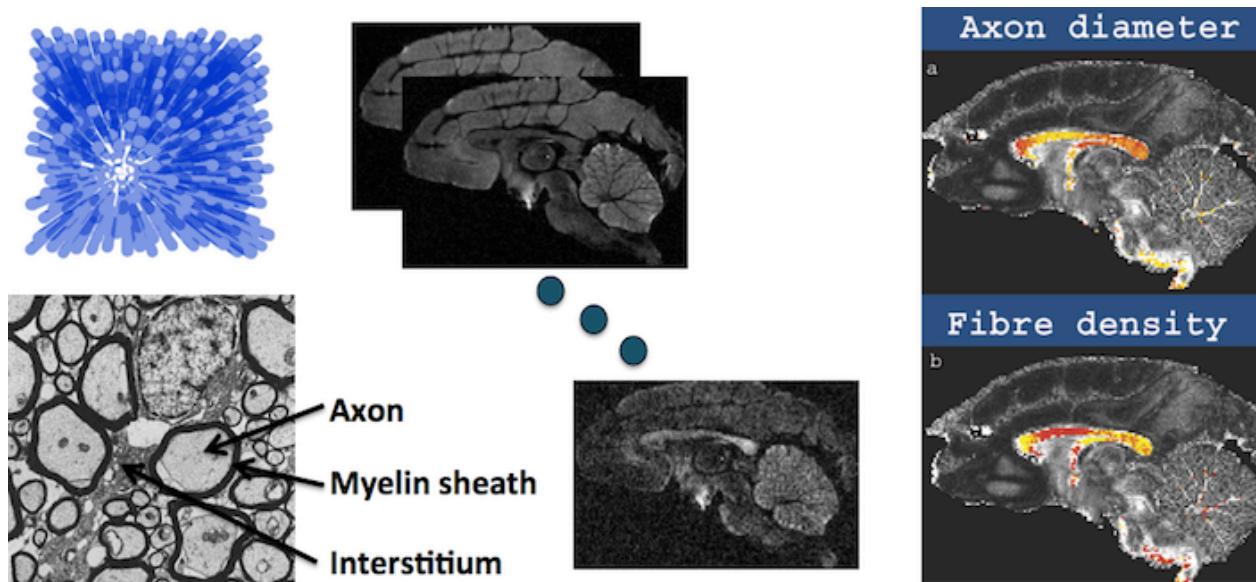


# Microstructure mapping in dMRI

## A biophysical model of brain tissue microstructure

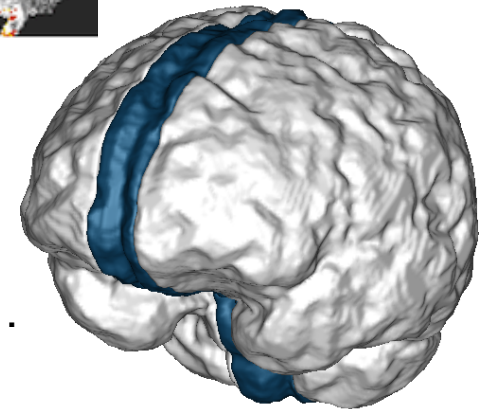


# Microstructure-enabled acquisitions are long



In-vivo acquisition is feasible<sup>1</sup>... but takes time!  
 (several 10s minutes for about 10% of the brain)

1. H Zhang *et al*, Neuroimage 56:1301-1315, 2011.



# Standard pulsed-gradient diffusion weighting

Spins en mouvement



Pas de mouvement



# Standard pulsed-gradient diffusion weighting

Spins en mouvement

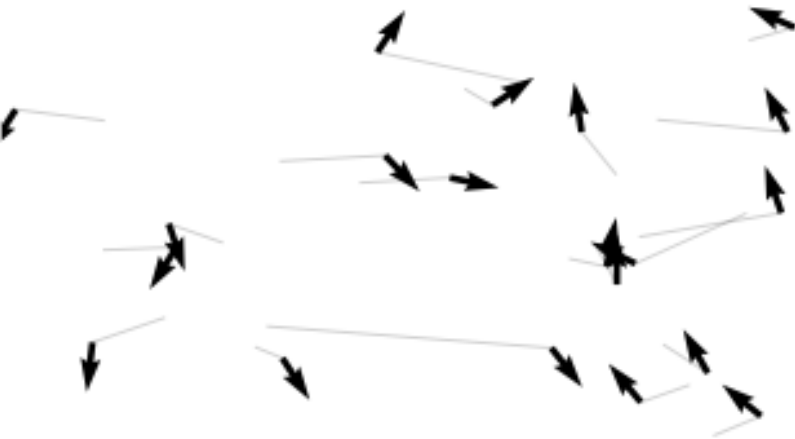


Pas de mouvement



# Standard pulsed-gradient diffusion weighting

Spins en mouvement



Pas de mouvement



# Standard pulsed-gradient diffusion weighting

Spins en mouvement

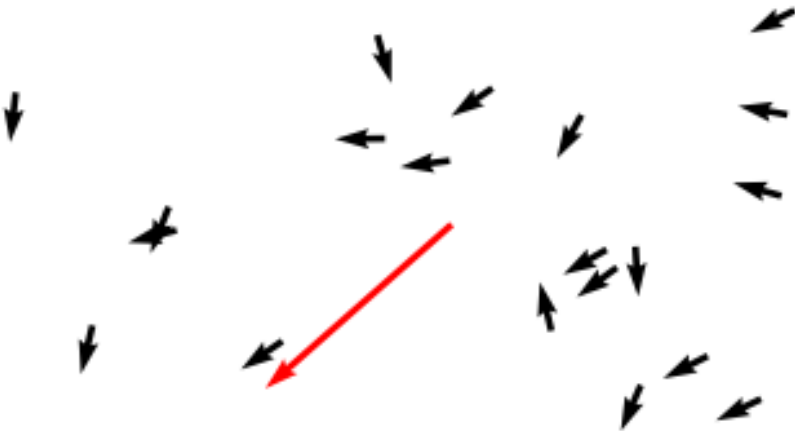


Pas de mouvement



# Standard pulsed-gradient diffusion weighting

Spins en mouvement

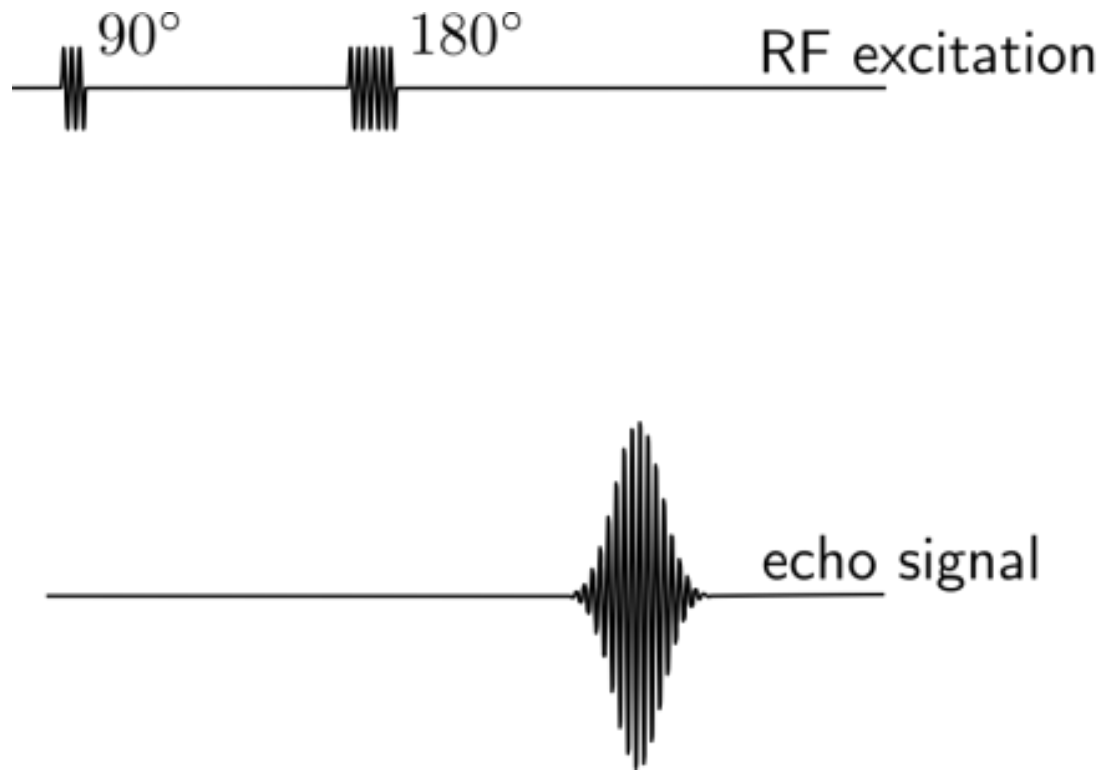


Pas de mouvement

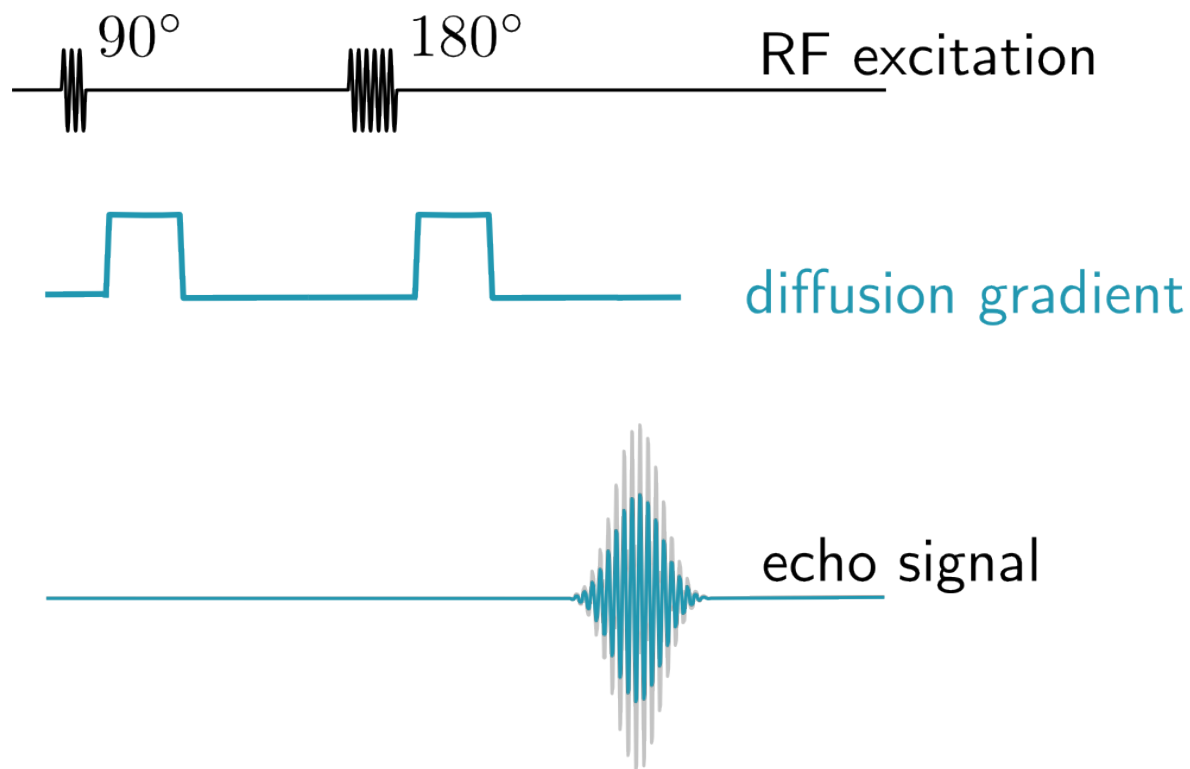




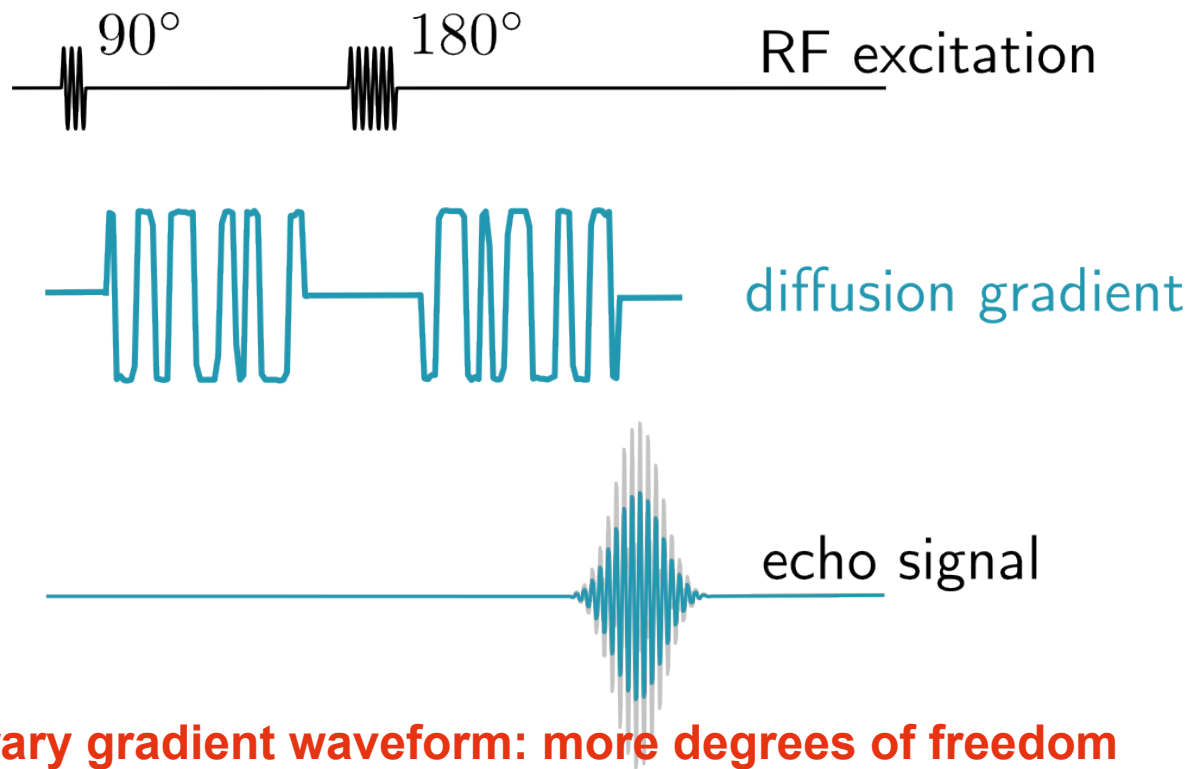
# Arbitrary diffusion gradient encoding



# Arbitrary diffusion gradient encoding



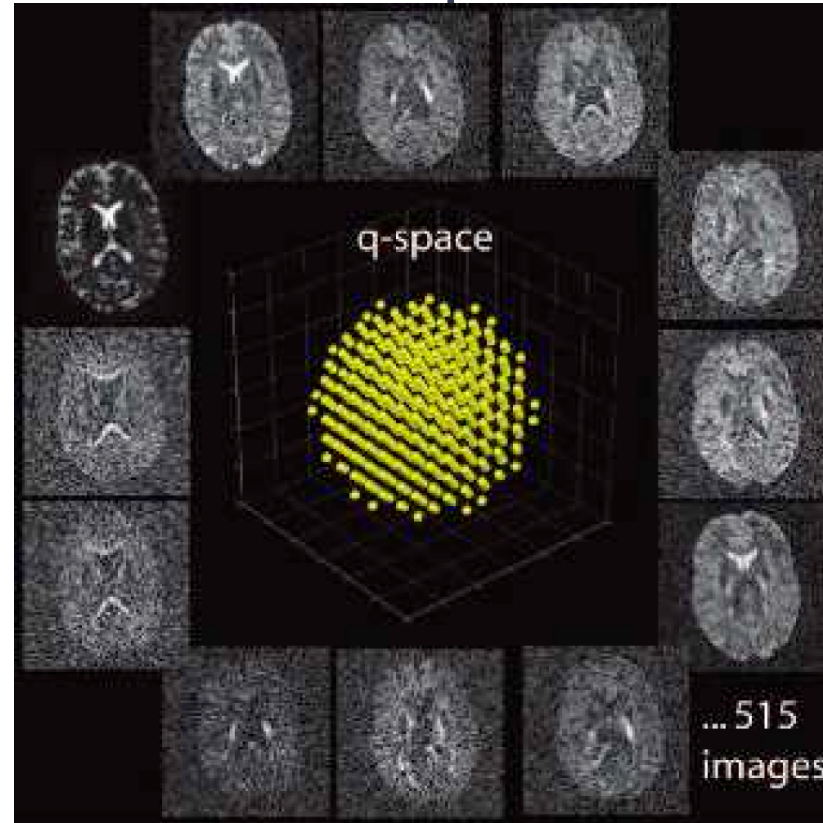
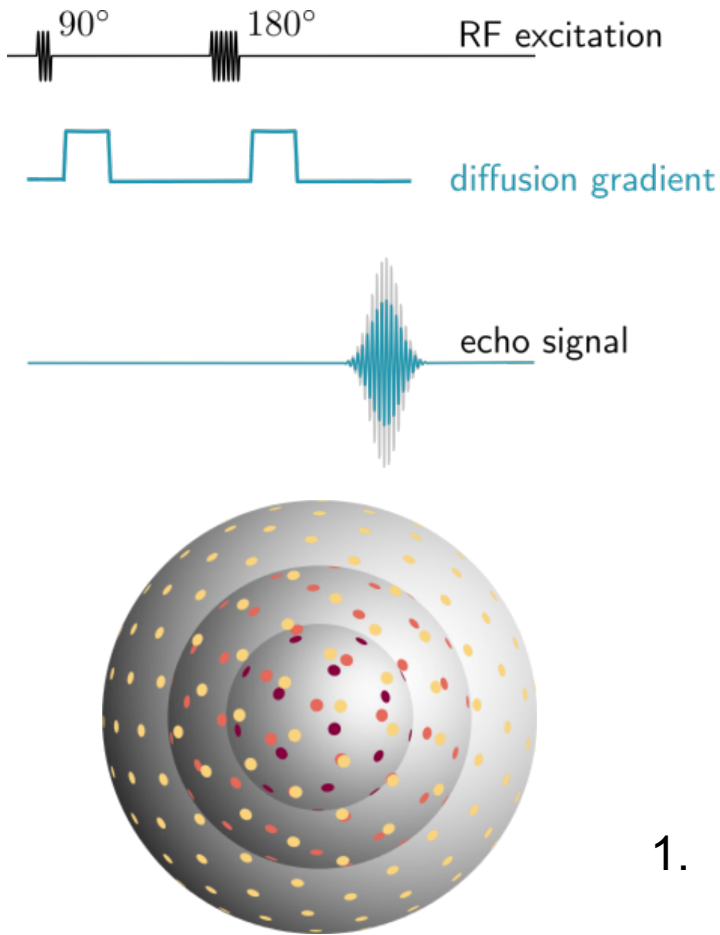
# Arbitrary diffusion gradient encoding



Higher sensitivity to microstructure parameters

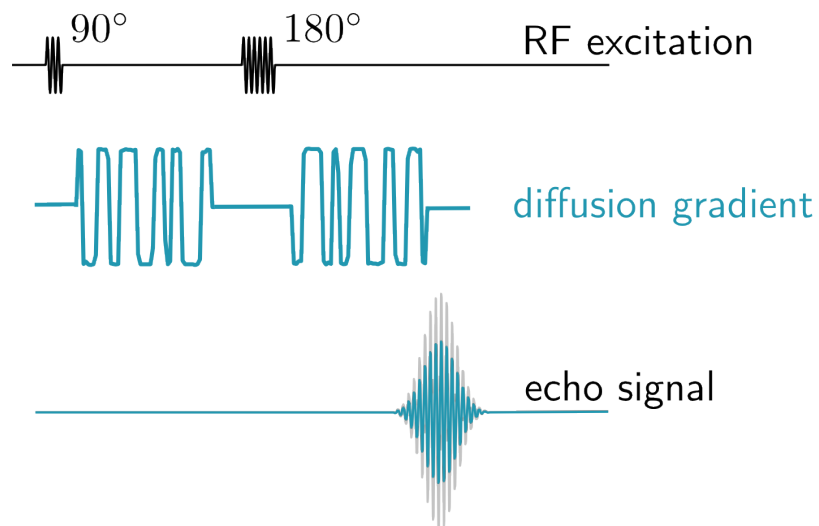
1. I Drobnjak *et al*, J Magn Reson, 206:41-51, 2010

# Subsampling standard PGSE sequence



1. E Caruyer *et al*, Magn Reson Med, 69(6), 2013
2. S Merlet *et al*, MedIA 17(7), 2013.

# Subsampling arbitrary gradient space



## How to represent the gradient waveforms?

- Use a set of functions (e.g. orthogonal basis / dictionary)

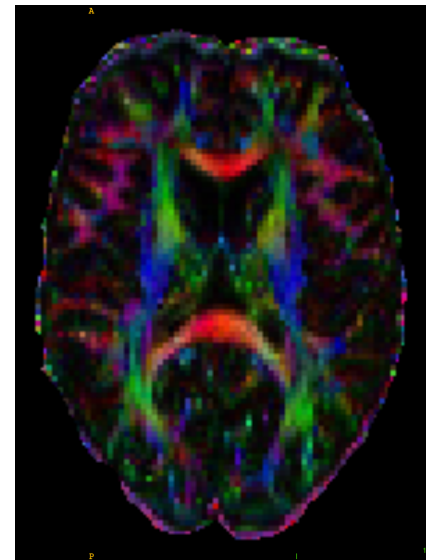
## How to evaluate the efficiency of a set of gradients?

- Learn sparsity patterns in the diffusion-attenuation signal
- Use off-the-shelf bases of functions, learn/train dictionary

# Implementing arbitrary gradient waveforms

## Implement arbitrary gradient encoding

- Sequence in development at Neurinfo, tested on a 3T Verio [Elise Bannier]
- Master research agreement with Siemens [Marc Lapert]
- To be implemented on a Prisma scanner



# Thanks!

- Raphaël Truffet, MSc student
- Élise Bannier, PhD
- Christian Barillot, PhD
- ...and many others!