

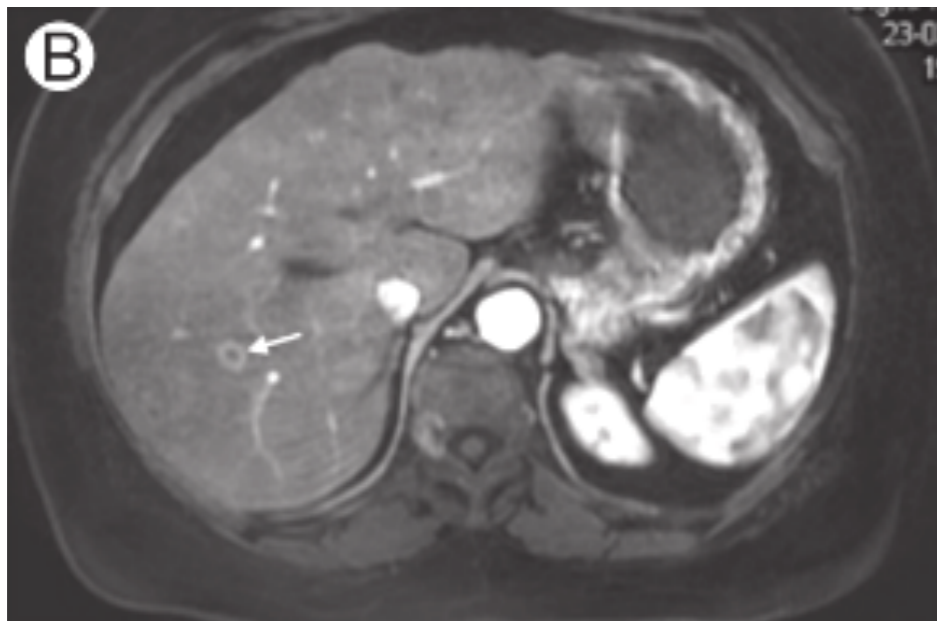
# **L'IRM et la séquence MP2RAGE pour la détection et la caractérisation rapide de métastases dans le corps entier**



**Thibaut FALLER, Aurélien TROTIER, Jean-Michel FRANCONI, Sylvain MIRAUX, Émeline RIBOT**

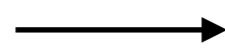
**Centre de Résonance Magnétique des Systèmes Biologiques**

# Avancées possibles pour l'IRM



*Karaosmanoglu et al. (2016)*

Contraste entre tissus



Détection de métastases



**Evolution d'un tissu**

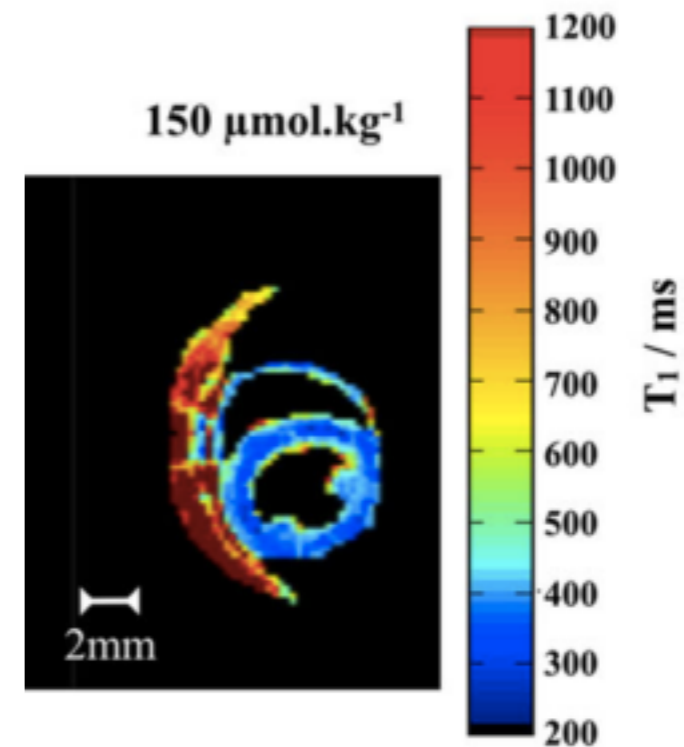
Quantification



Relaxation T1



Biomarqueur pour mesurer l'efficacité d'une thérapie



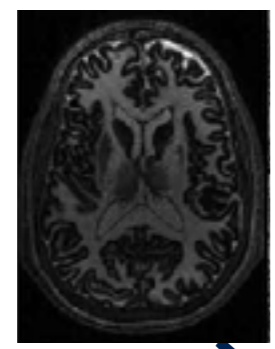
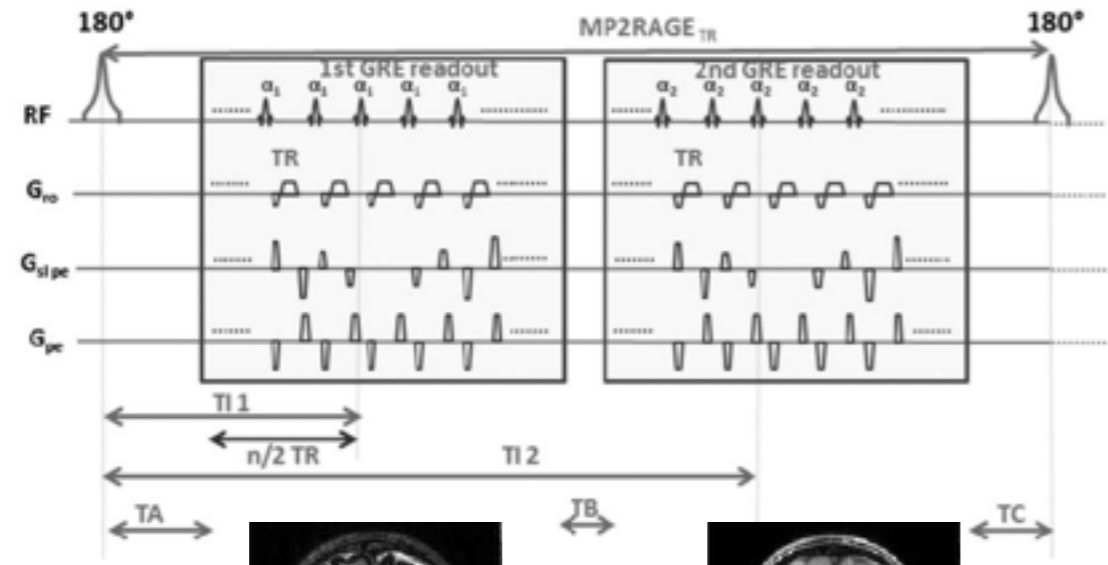
*Castets et al. (2015)*



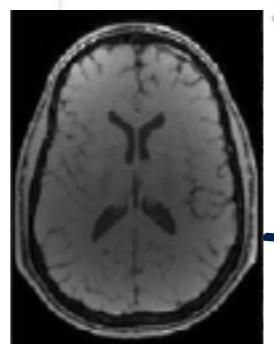
**2 Dimensions**  
**Longue ou imprécise**

# Séquence MP2RAGE

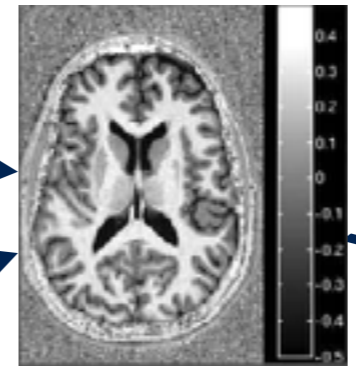
José Marques et al. (2009)



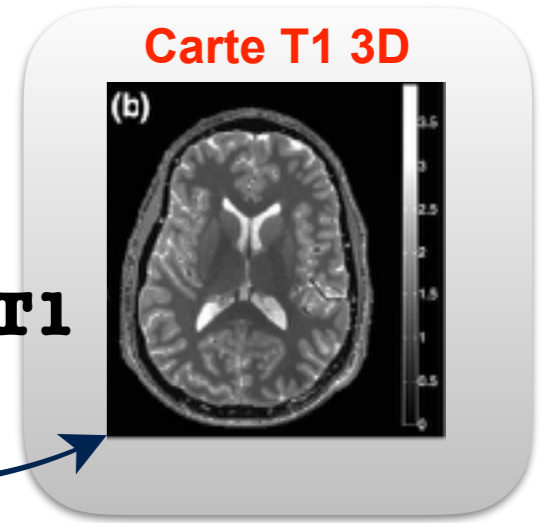
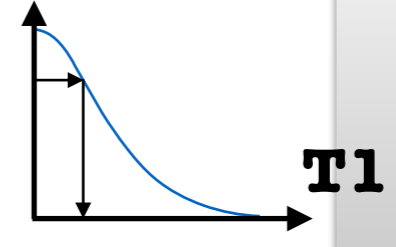
**Contraste T1 partiel**



**Fort contraste exclusivement T1**



$$\frac{A * B}{A^2 + B^2}$$



**10 minutes**

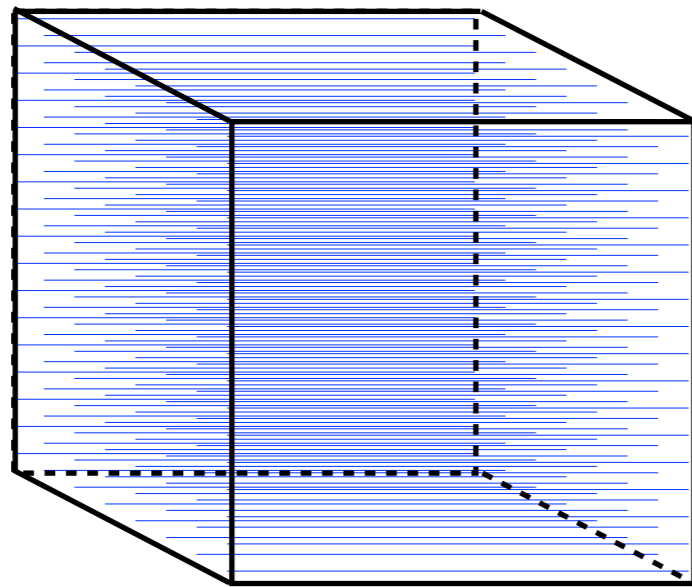


**Sensible au mouvement**  
**Temps d'acquisition long**

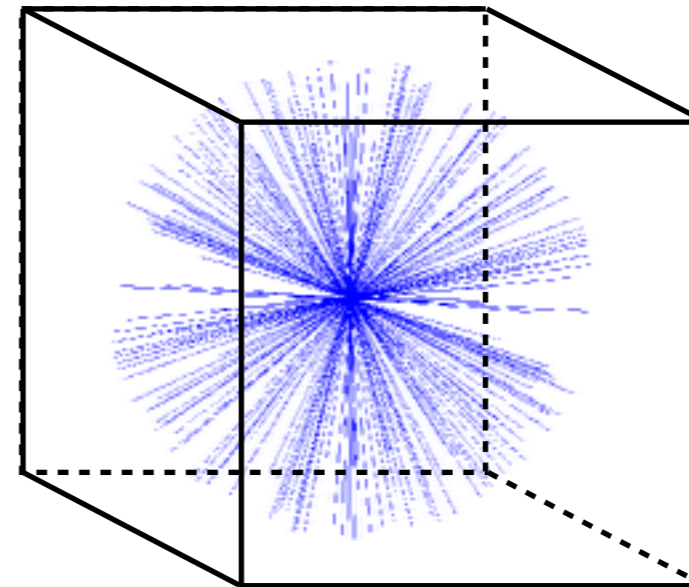


# MP2RAGE : changement d'encodage

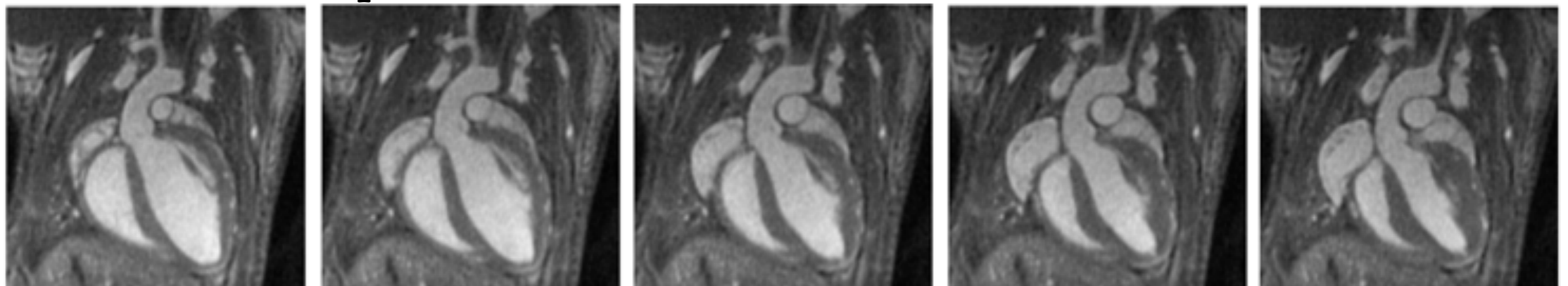
Enregistrement  
Cartésien



Enregistrement  
Radial



Phases cardiaques chez la souris

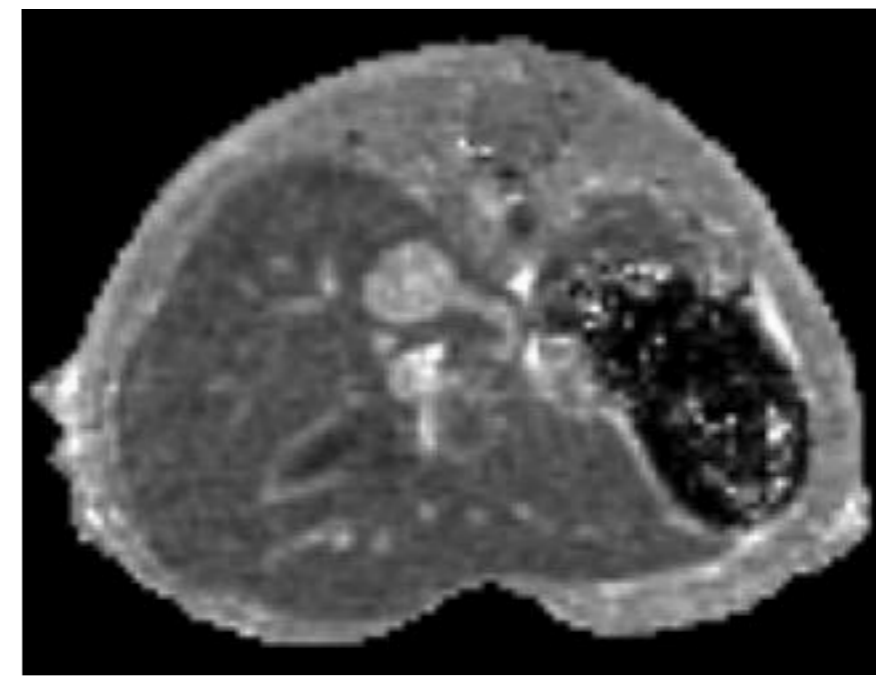
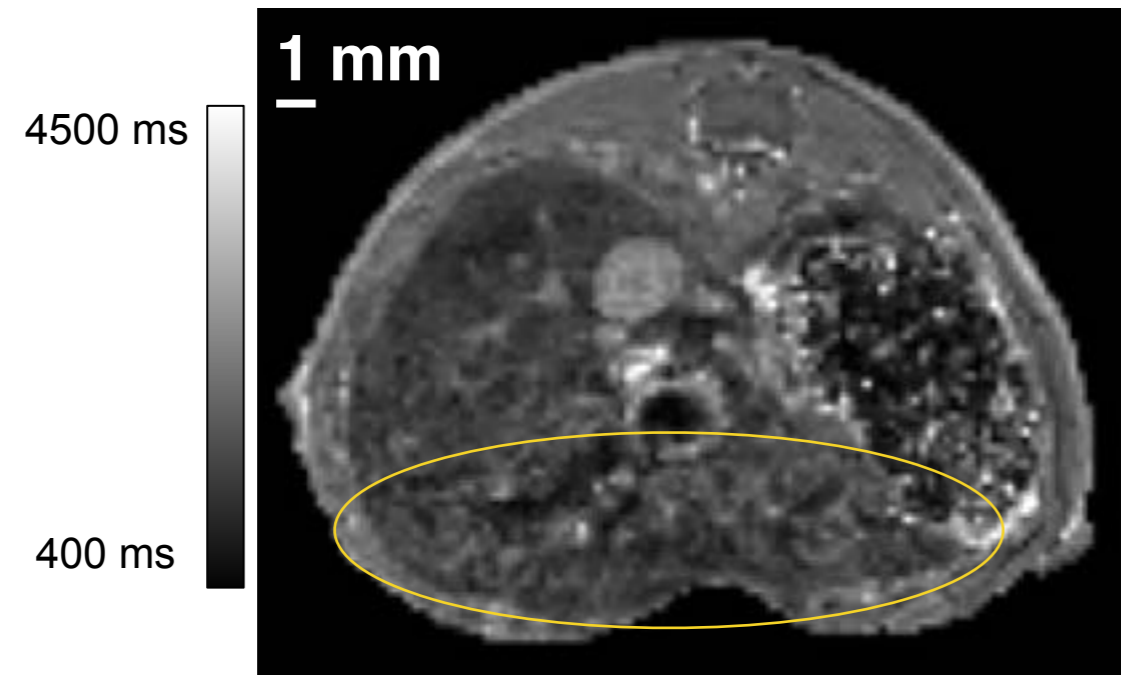


*Trotier et al. (2015)*

# MP2RAGE radiale : robuste au mouvement

MP2RAGE  
Cartésienne

MP2RAGE  
Radiale



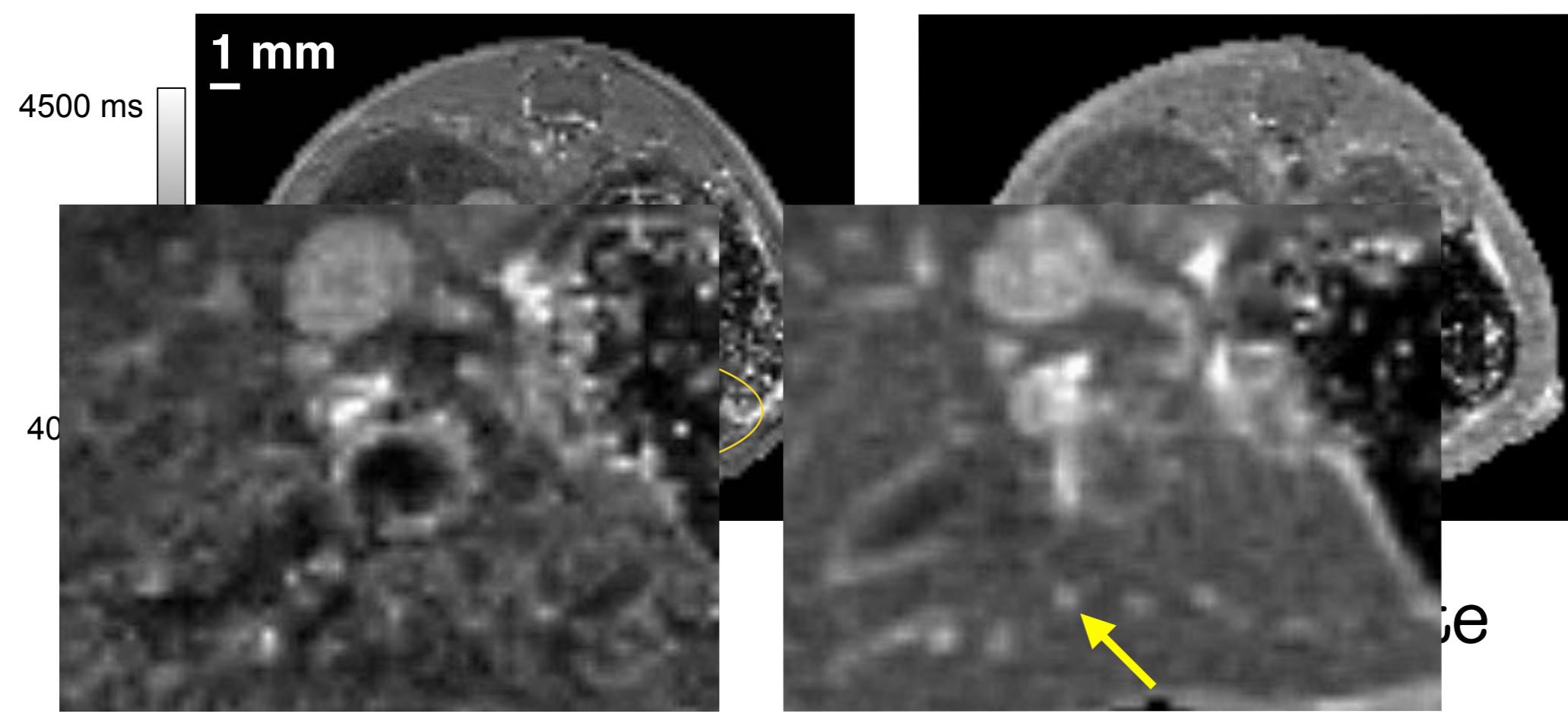
**✗** Image floue

**✓** Image nette

# MP2RAGE radiale : robuste au mouvement

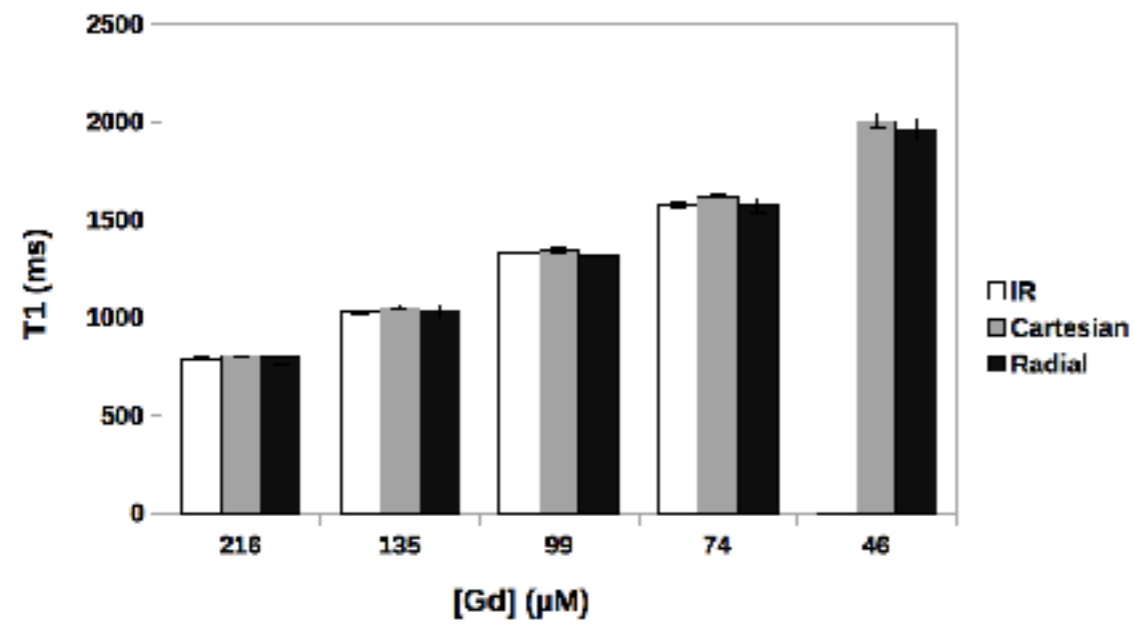
MP2RAGE  
Cartésienne

MP2RAGE  
Radiale

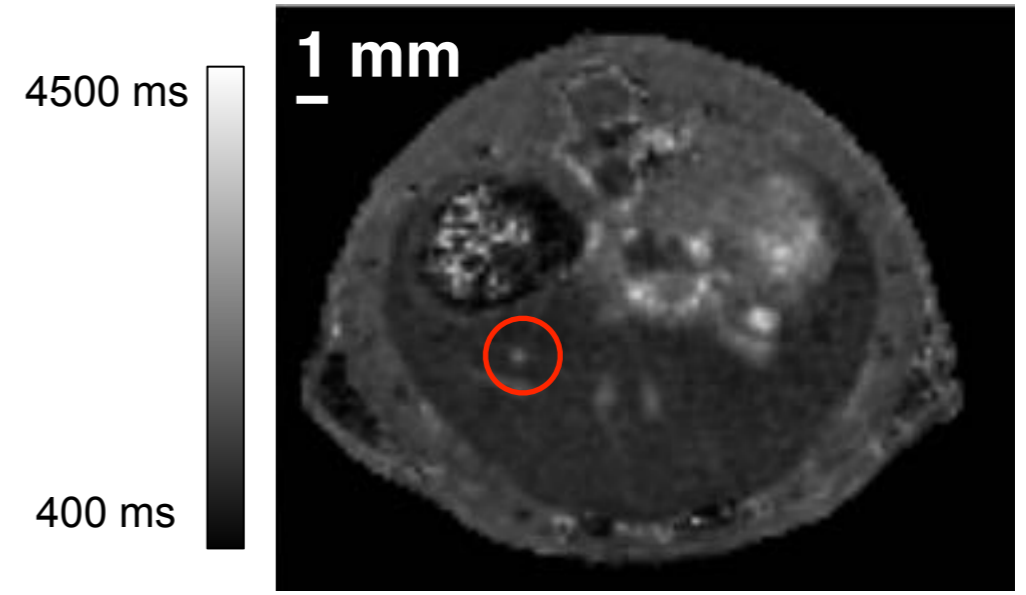


# MP2RAGE radiale : Détection de métastases hépatiques

## Validation in vitro

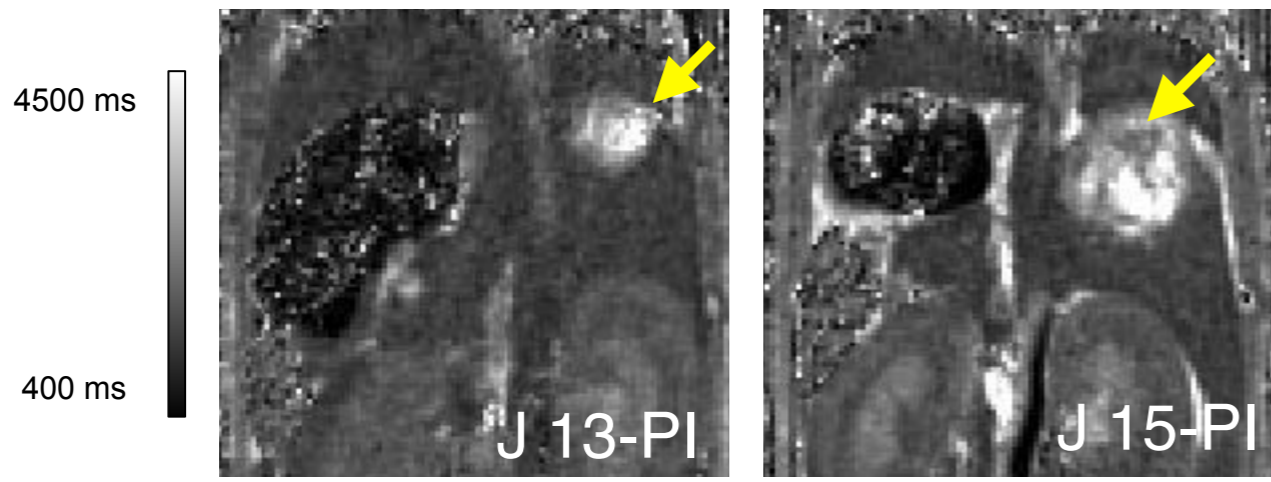


## Détection de métastases



$V_{meta} = 0,15 \text{ mm}^3$

## Caractérisation & Suivi longitudinal



$T1_{Foie} \approx 1100 \pm 300 \text{ ms}$

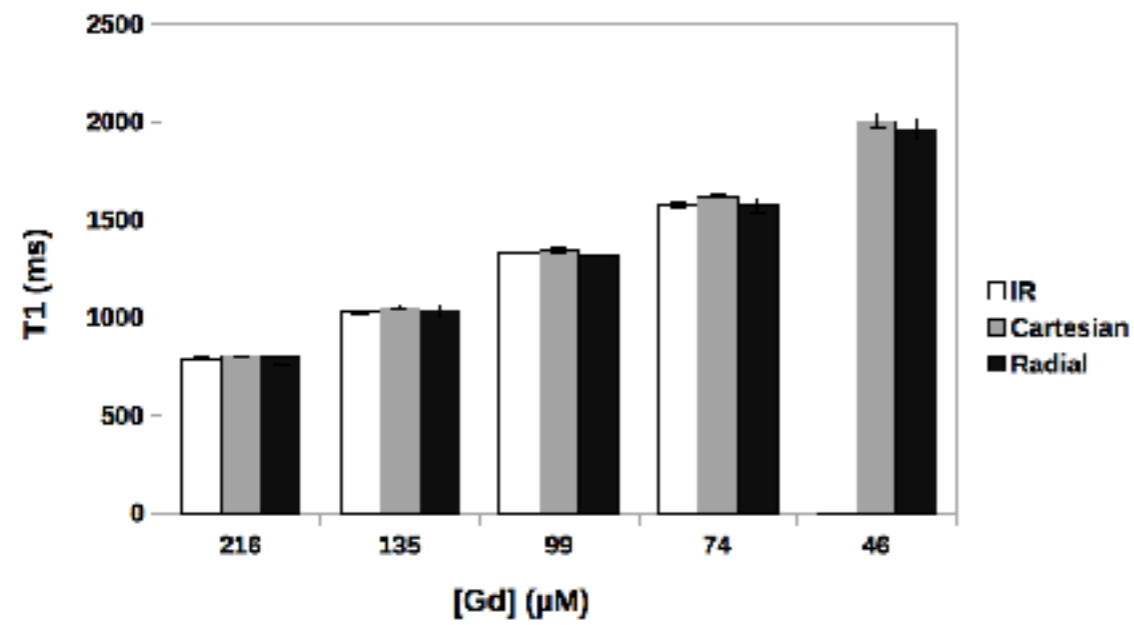
$V_{meta} = 50 \text{ mm}^3$   
 $T1_{Meta} \approx 1800 \pm 600 \text{ ms}$

$V_{meta} = 100 \text{ mm}^3$   
 $T1_{Meta} \approx 2300 \pm 700 \text{ ms}$

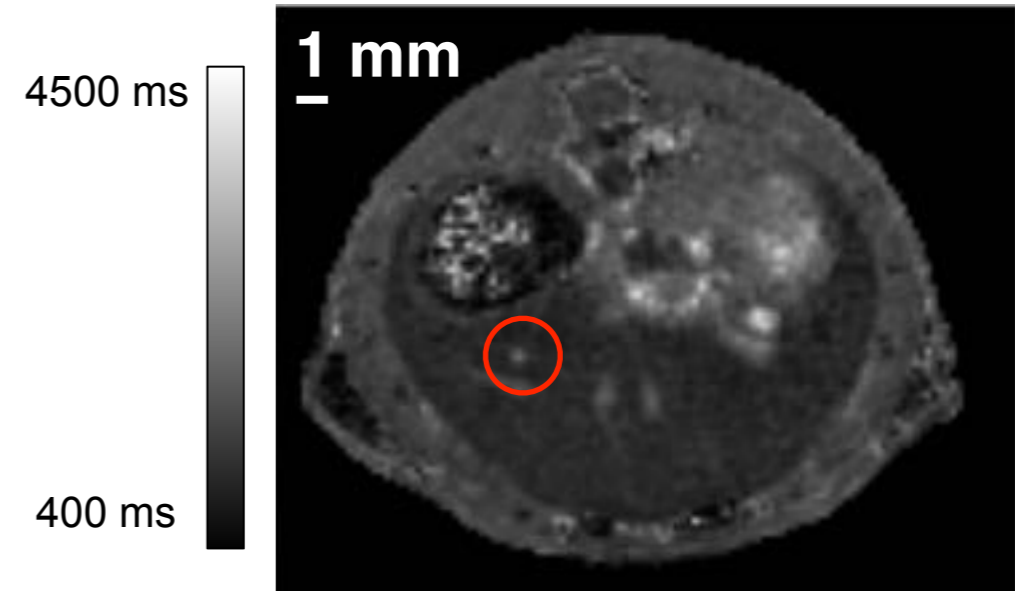


# MP2RAGE radiale : Détection de métastases hépatiques

## Validation in vitro

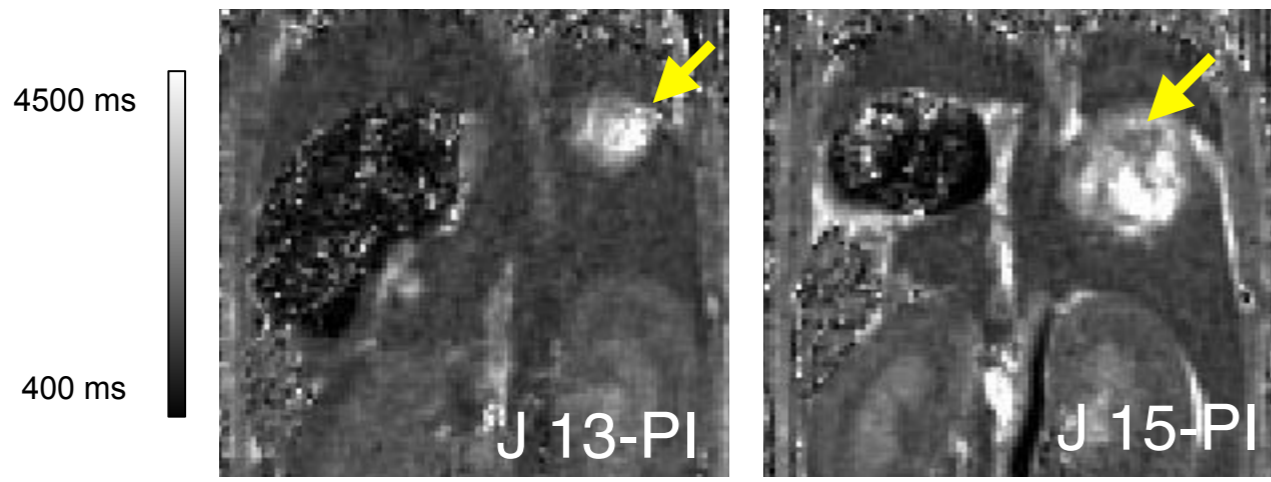


## Détection de métastases



$V_{meta} = 0,15 \text{ mm}^3$

## Caractérisation & Suivi longitudinal



$V_{meta} = 50 \text{ mm}^3$

$V_{meta} = 100 \text{ mm}^3$

$T1_{Meta} \approx 1800 \pm 600 \text{ ms}$

$T1_{Meta} \approx 2300 \pm 700 \text{ ms}$

$T1_{Foie} \approx 1100 \pm 300 \text{ ms}$

**15 minutes**  
**X Long**

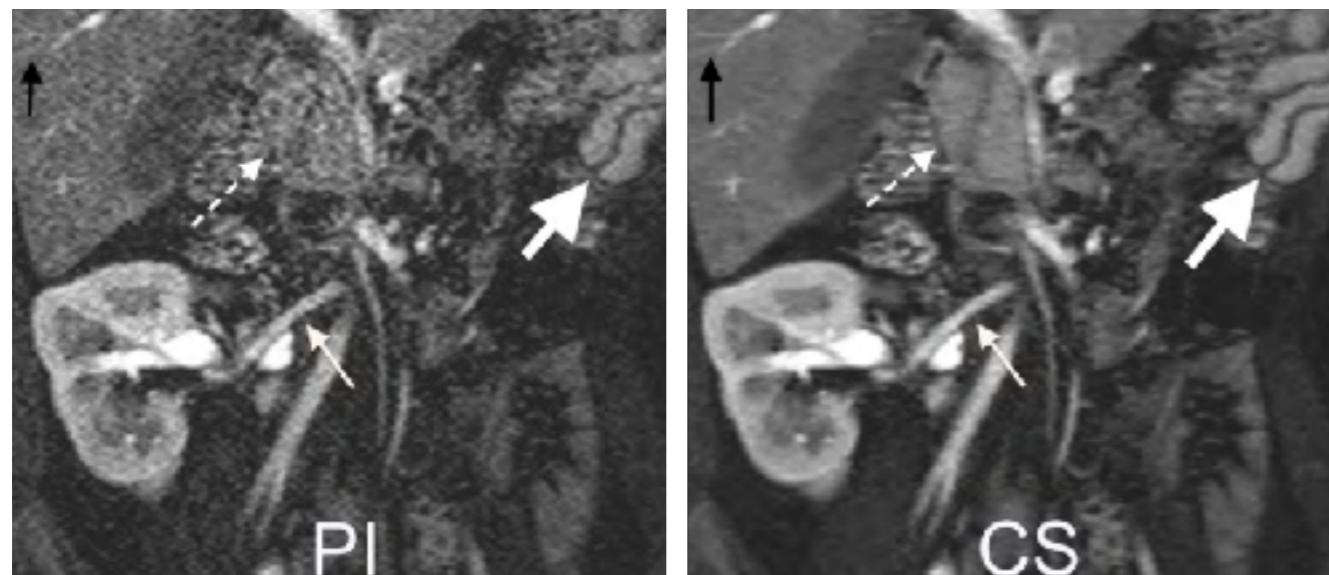
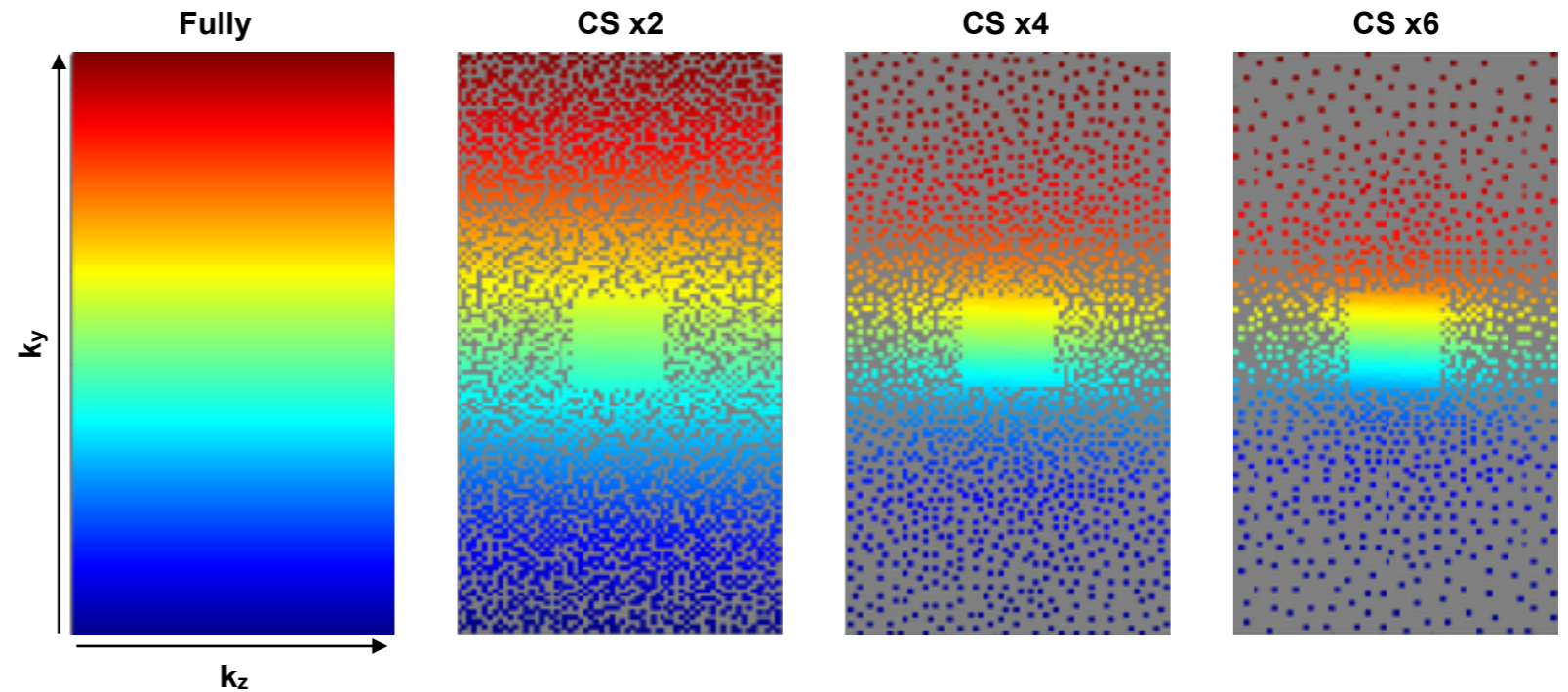


# Compressed Sensing (CS)

IRM : Information redondante

Données

Vitesse



Bruit

Détails

Vasanawala et al. (2011)

# MP2RAGE CS (Cartésienne)

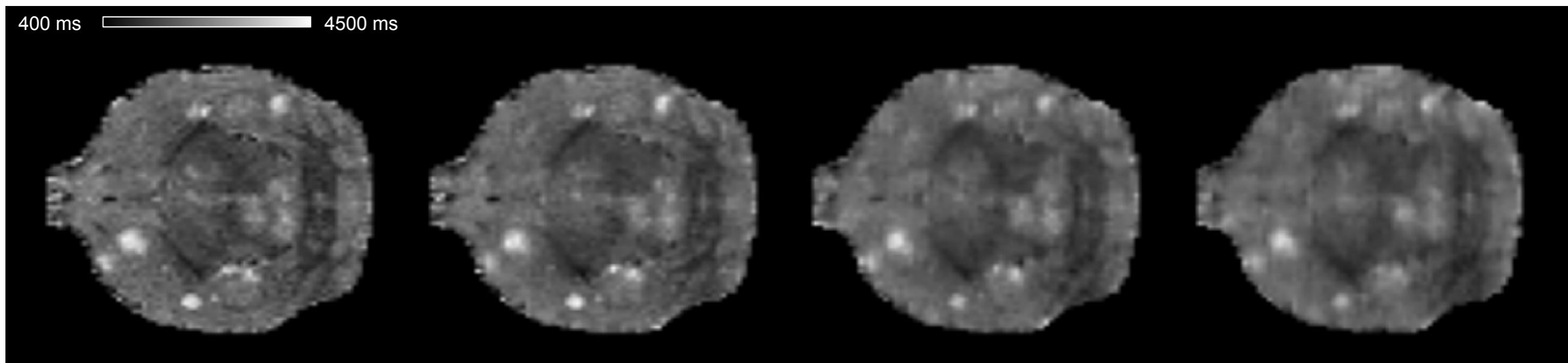
✓ Acquisition accélérée

Ref.

Acc. x2

Acc. x4

Acc. x6



6min 30s

3min 15s

1min 38s

1min 05s

# MP2RAGE CS (Cartésienne)

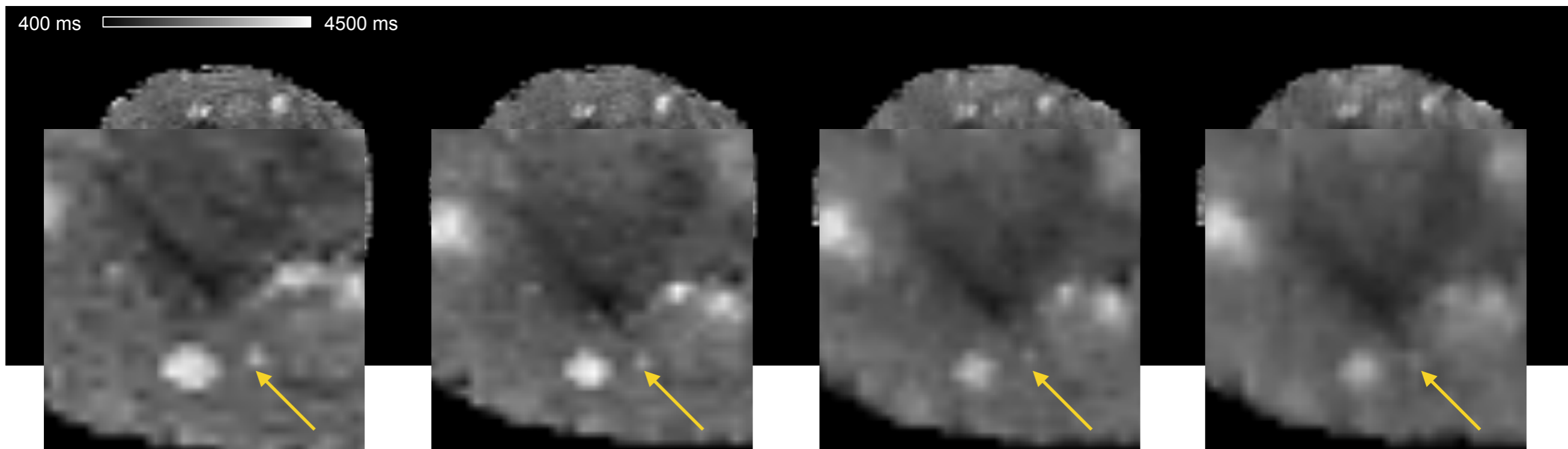
✓ Acquisition accélérée

Ref.

Acc. x2

Acc. x4

Acc. x6



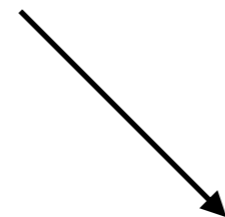


## Conclusion

### Développement de 2 nouvelles séquences :

MP2RAGE Radiale

Moins sensible  
au mouvement



MP2RAGE CS

Plus rapide

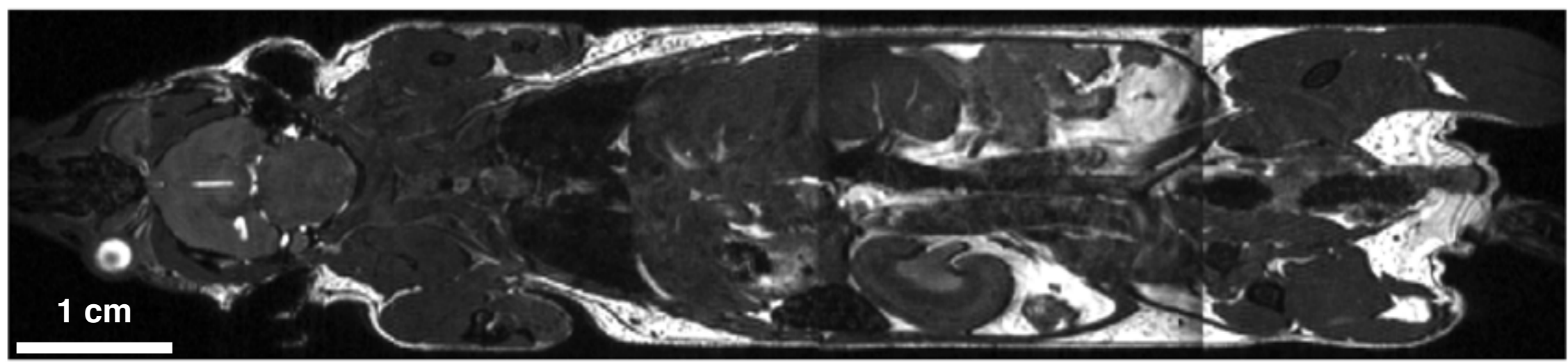


Détection et caractérisation  
de petites métastases

# Perspectives

## MP2RAGE radial + CS

Imagerie pré-clinique

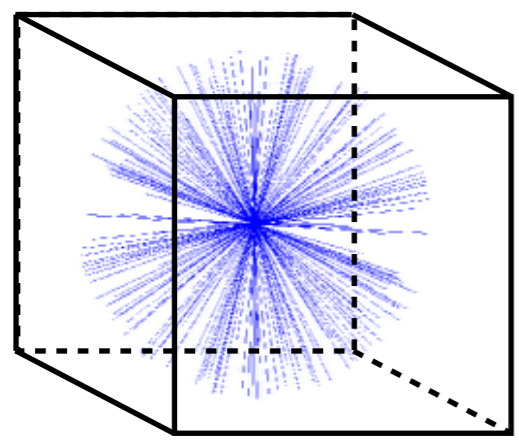


Imagerie clinique

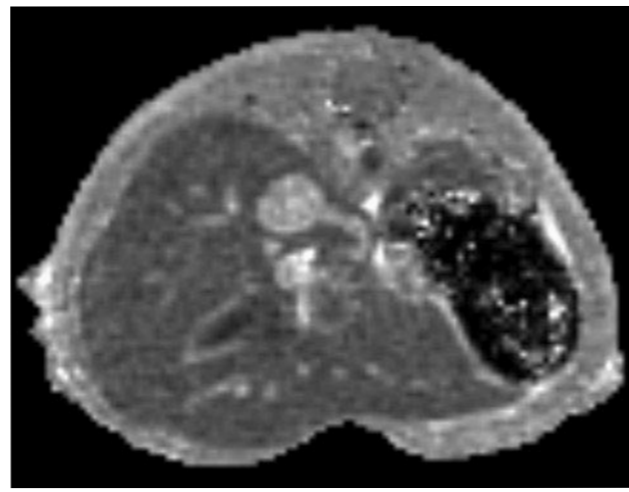


Aide au diagnostique  
Adaptation de thérapie

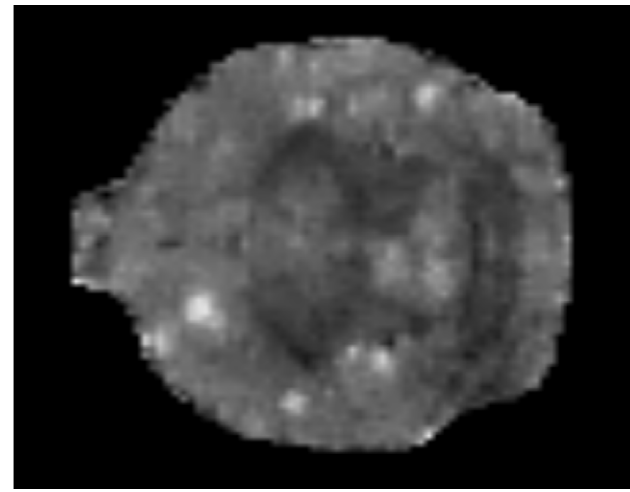
# Merci pour votre attention !



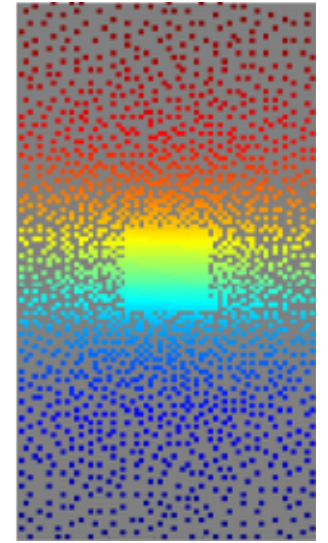
400 ms  4500 ms



400 ms  4500 ms



CS x4



## Avez-vous des questions ?

