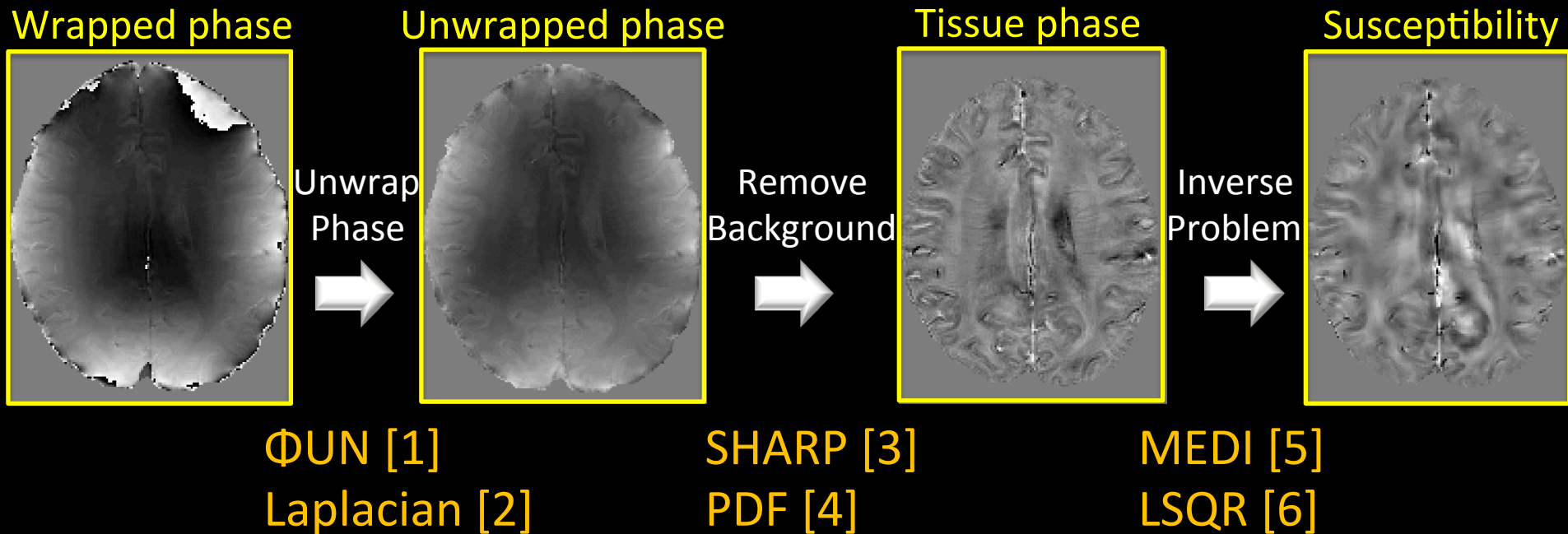# Single-Step QSM with Fast Reconstruction

B Bilgic, C Langkammer, LL Wald, K Setsompop

Martinos Center for Biomedical Imaging, Charlestown, MA

QSM Processing Pipeline

Wrapped phase

ΦUN [1]
Laplacian [2]

Unwrap
Phase →

Unwrapped phase

SHARP [3]
PDF [4]

Remove
Background →

Tissue phase

MEDI [5]
LSQR [6]

Inverse
Problem →

Susceptibility

[1] S Witoszynskyj, Med Img Analysis'09
[2] W Li, NIMG'11

[3] F Schweser, NIMG'11
[4] T Liu, NRM in Biomed'11

[5] L De Rochefort, MRM'10
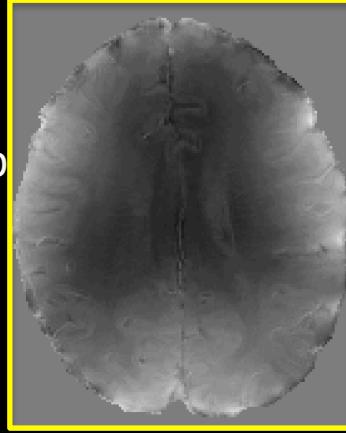[6] W Li, NIMG'11

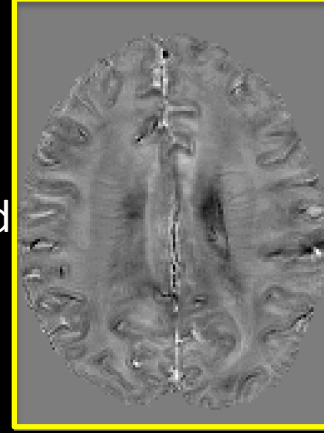# QSM Processing Pipeline

Wrapped phase

Unwrapped phase

Tissue phase
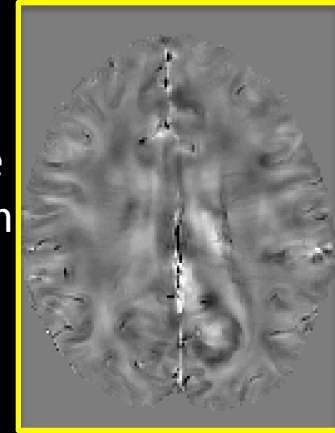

Susceptibility

Unwrap Phase →

Remove Background →

Inverse Problem →

SHARP
Truncation threshold

MEDI
Regularization parameter

QSM Processing Pipeline

Wrapped phase

Unwrapped phase
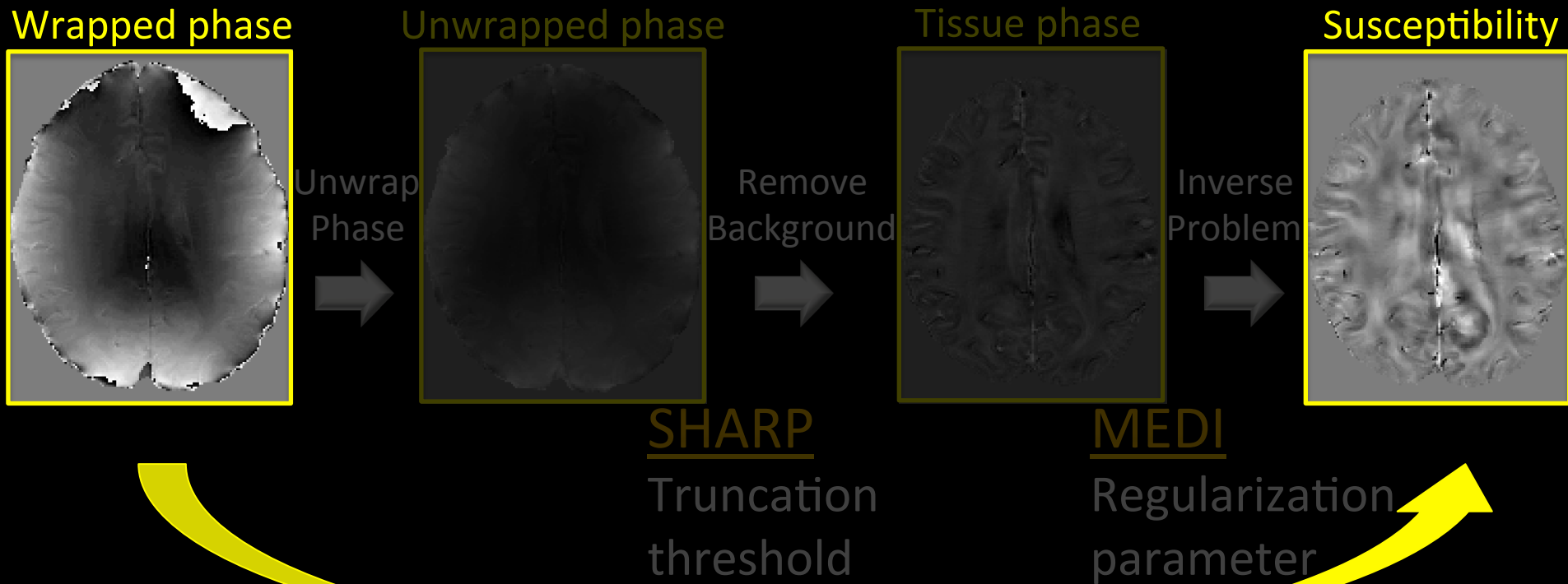
Tissue phase

Susceptibility

Unwrap Phase

Remove Background

Inverse Problem

SHARP
Truncation threshold

MEDI
Regularization parameter

Single-Step QSM [1-3]
Only one parameter

[1] K Bredies, ISMRM'14
[2] T Liu, ISMRM'14
[3] S Sharma, ISMRM'14
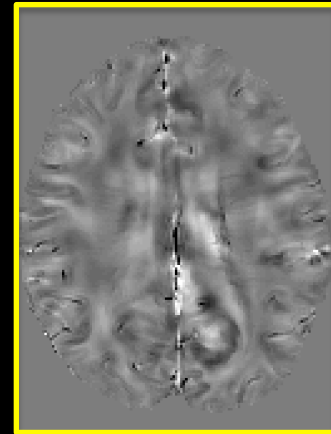
Single-Step QSM with Fast Recon

Wrapped phase

Single-Step QSM
Only one parameter

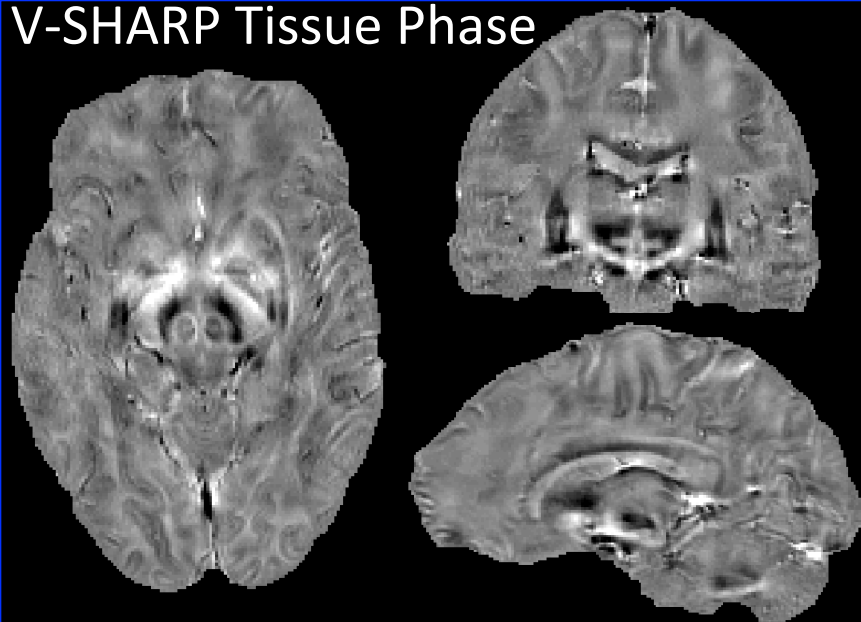**Susceptibility**

Our contributions:

- Fast recon using Preconditioned Conjugate Gradient (PCG)

- Variable size SHARP kernels to reduce loss of cortical phase

- Better mitigation of dipole artifacts than our L2 solver [1]

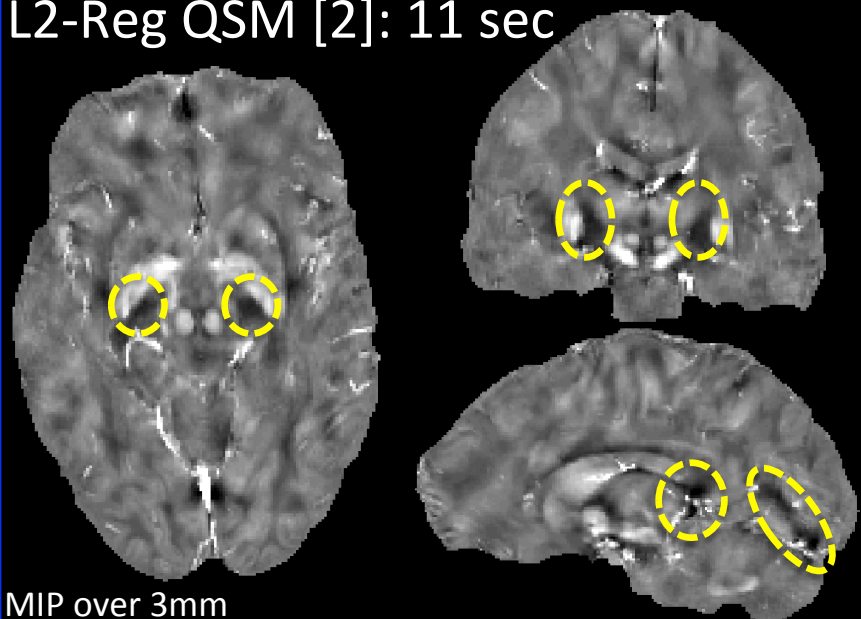- Rapid data acquisition using 3D-EPI [2] and Wave-CAIPI [3]

[1] B Bilgic, MRM'13
[2] B Poser, NIMG'10
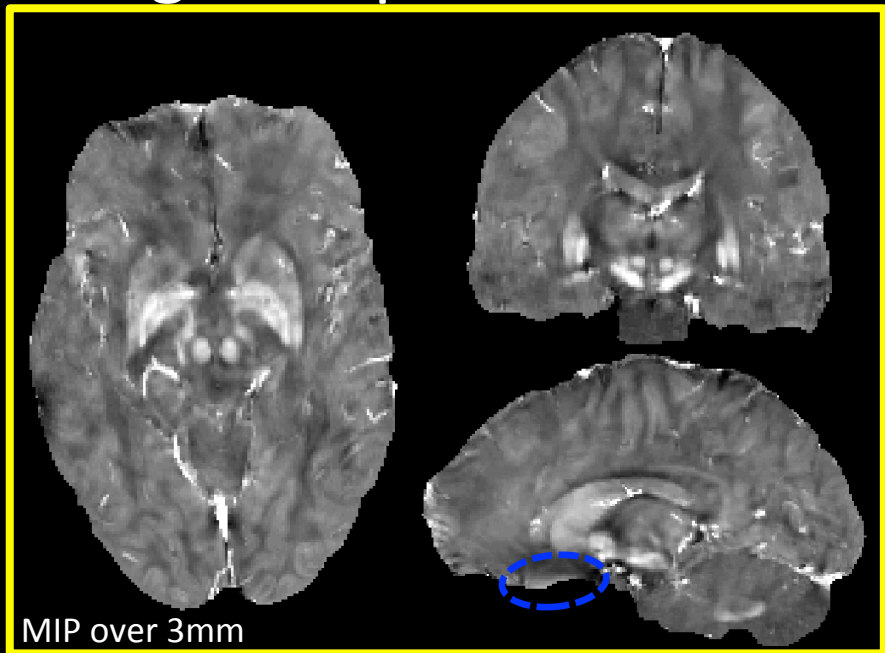[3] B Bilgic, MRM'14

V-SHARP Tissue Phase

3D-EPI [1]
1mm iso @ 3 Tesla
T_{acq} = 1min

Single-Step QSM: 40 sec
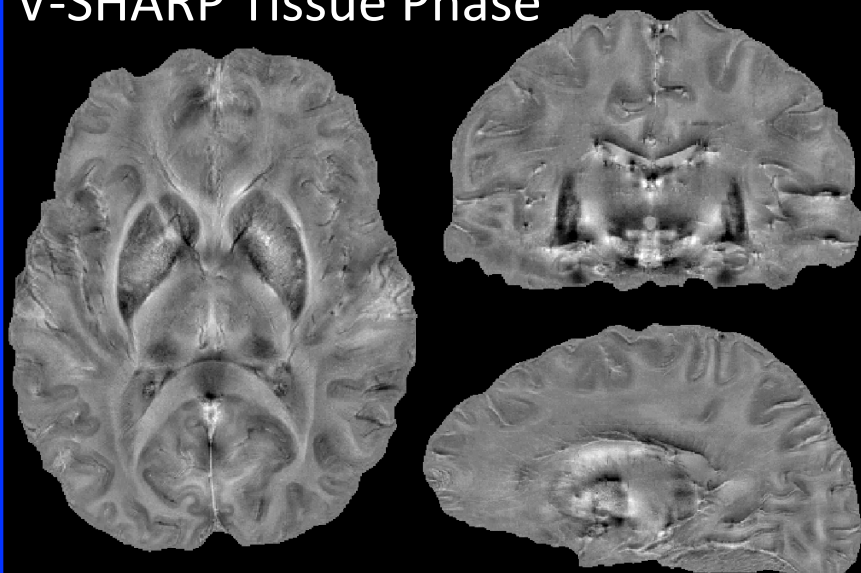
L2-Reg QSM [2]: 11 sec
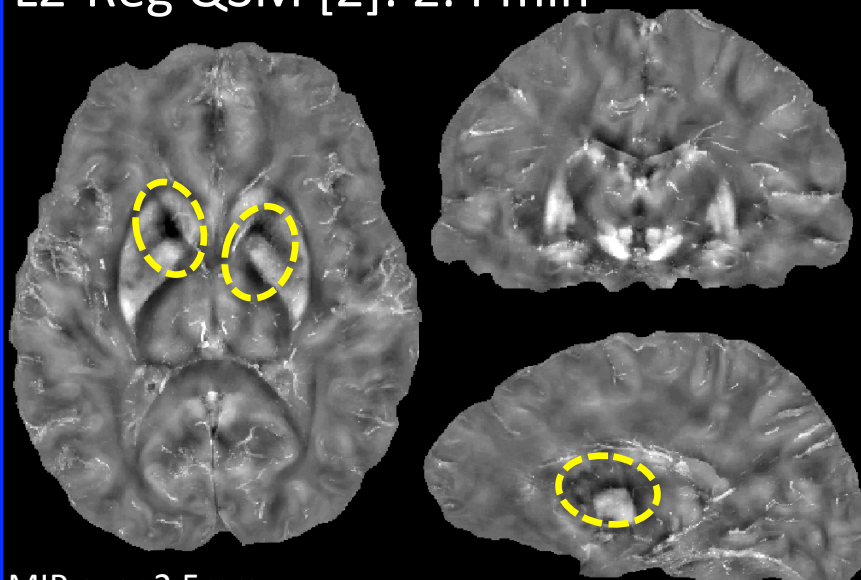
MIP over 3mm

MIP over 3mm

[1] B Poser, NIMG'10
[2] B Bilgic, MRM'13

V-SHARP Tissue Phase

Wave-CAIPI 3D-GRE [1]
0.5mm iso @ 7 Tesla
T_{acq} = 5min

L2-Reg QSM [2]: 2.4 min

MIP over 2.5mm

Single-Step QSM: 7.8 min

MIP over 2.5mm

[1] B Bilgic, MRM'14
[2] B Bilgic, MRM'13