μSR data and search for spontaneous TRSB fields in $PrOs_4Sb_{12}$

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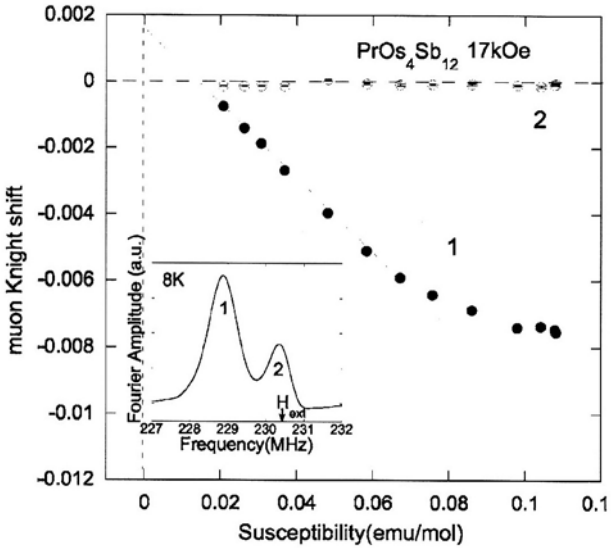
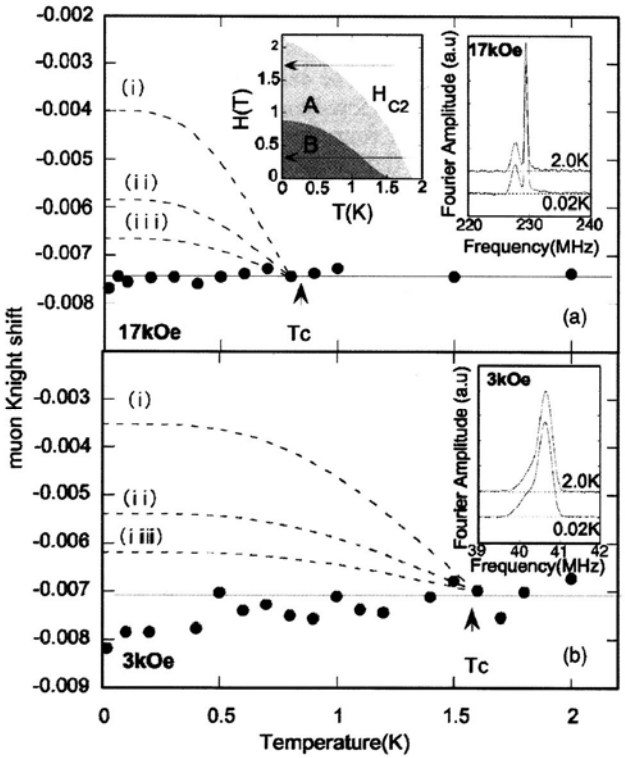
$PrOs_4Sb_{12}$

Muon Knight shift: indicates spin-triplet pairing



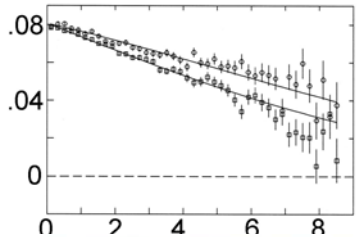
W Higemoto *et al*, PRB **75** 020510 (2007), fig 2



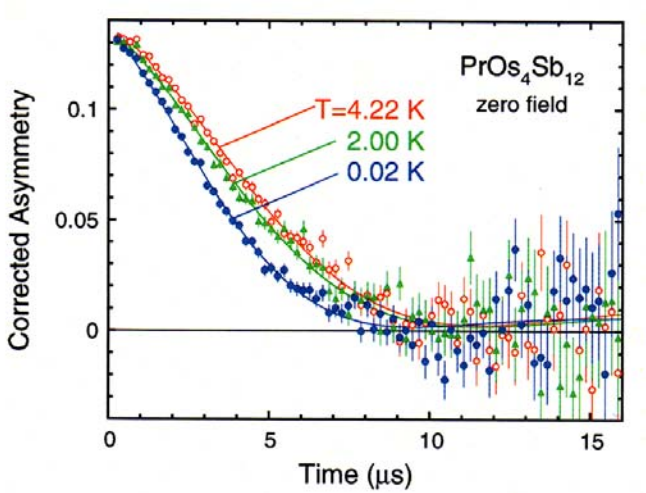
W Higemoto *et el*, PRB **75** 020510 (2007), fig 3

Evidence for TRSB in the superconducting state:

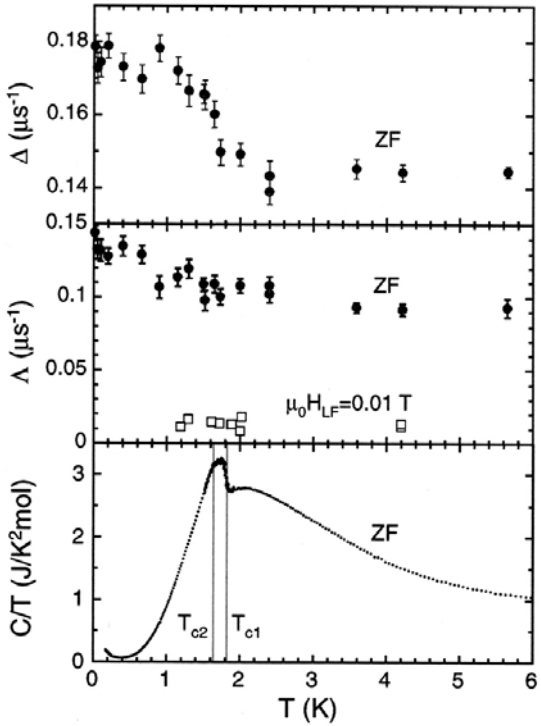
Sr_2RuO_4:



$PrOs_4Sb_{12}$:



Y Aoki *et al*, PRL **91** 067003 (2003), fig 1



Y Aoki *et al*, PRL **91** 067003 (2003), fig 2
figure modified from original

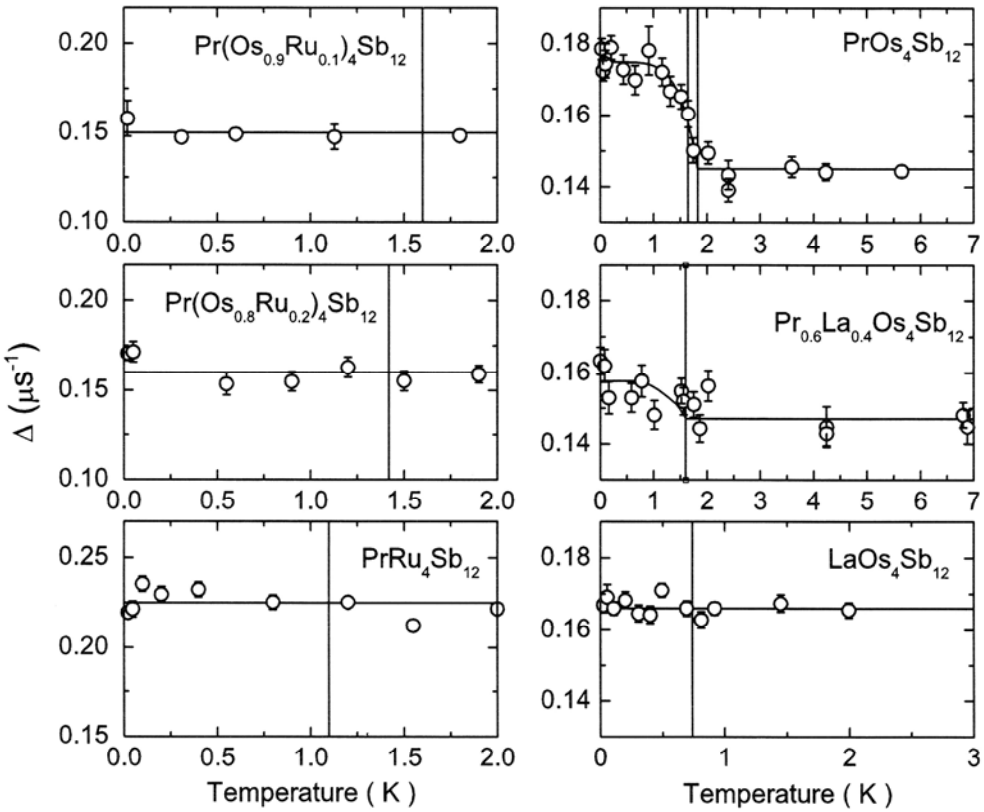
muon gyromagnetic ratio: .085 $\mu sec^{-1}G^{-1}$;
ie a 74μsec oscillation period at 1G.

Fits: $P_\mu = e^{-\Lambda t} G_{KT}(\Delta, t)$

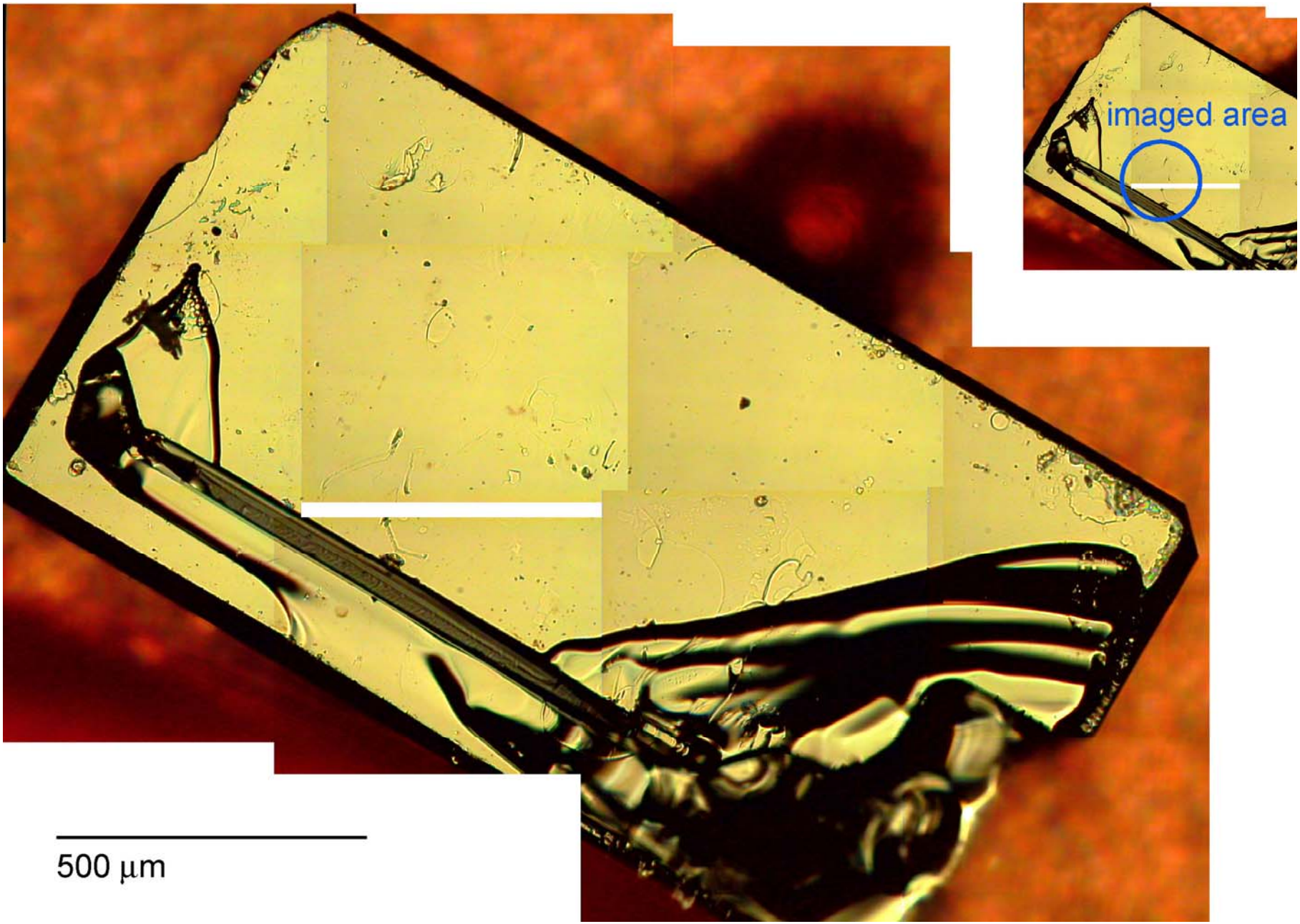
$$G_{KT} = \frac{1}{3} + \frac{2}{3}\left(1-\Delta^2 t^2\right)\exp\left(-\frac{1}{2}\Delta^2 t^2\right)$$

Field distribution is more Gaussian than Lorentzian

TRSB vanishes quickly with Ru substitution, more slowly with La substitution:



L Shu *et al*, JMMM **310** 551 (2007), fig 2


imaged area
500 µm

Moler group data: scanning 3μm squid.

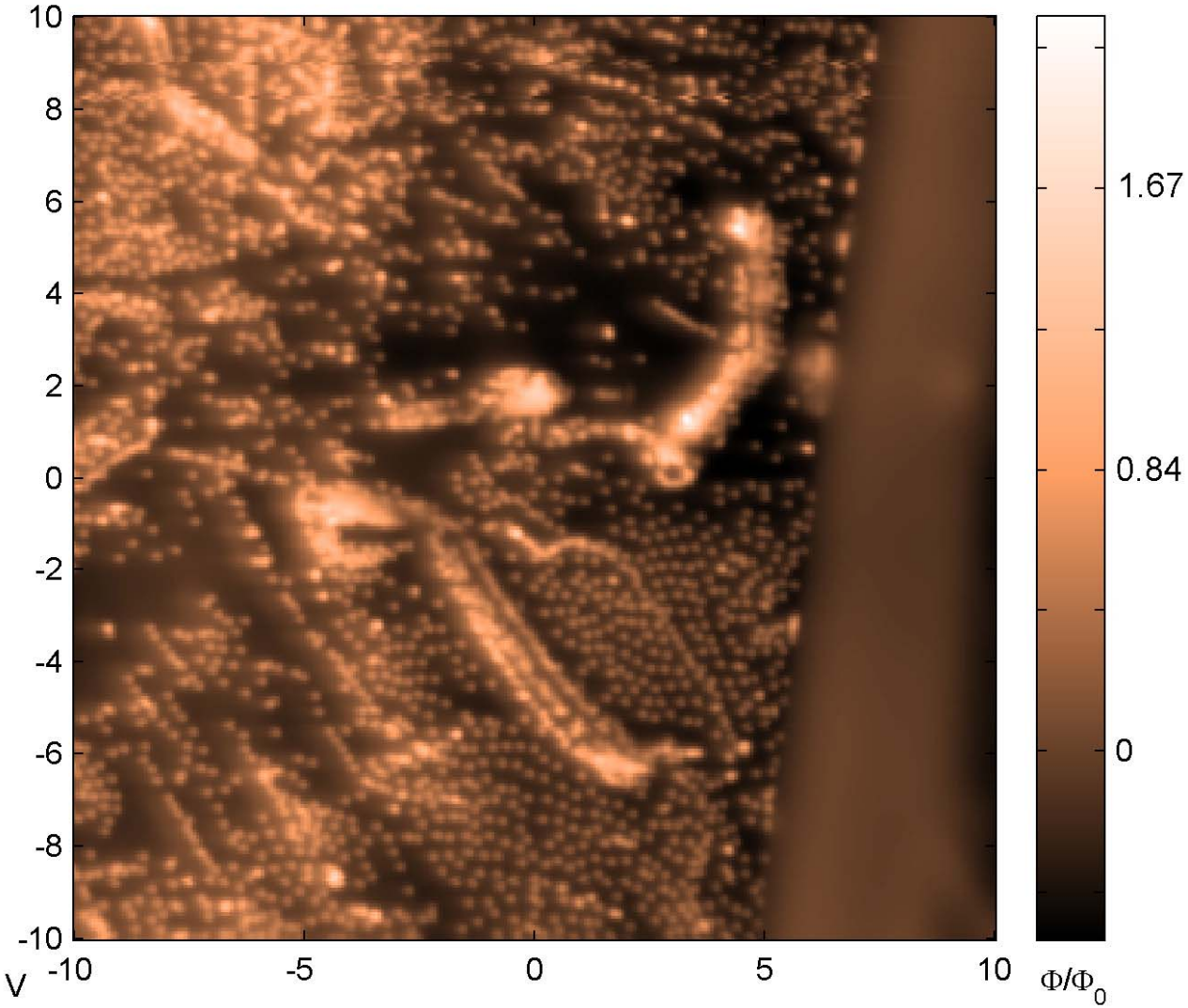
z-bender calibration: 1V is approx. 2μm on a side.
x,*y* benders: 10V is approx. 140μm.

071013A
lift height: 0.2V
applied field:
  cooling: +760mG
  scanning: 0

scan area: approx.
  290μm on a side

lift height:
~400nm

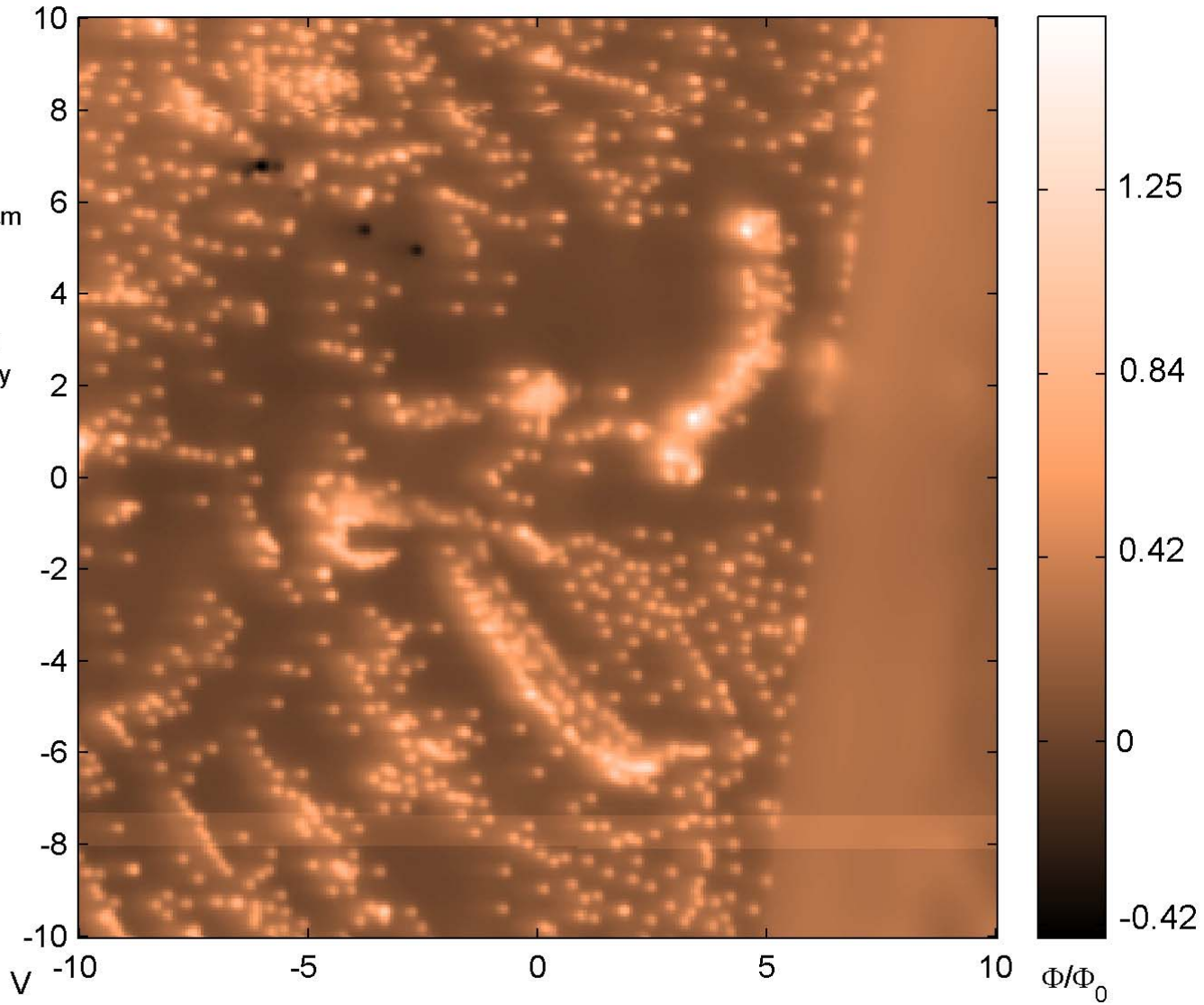
(pickup loop size:
3um diameter)



071012B
lift height: 0.2V
applied field:
+304mG, cooling
and scanning.

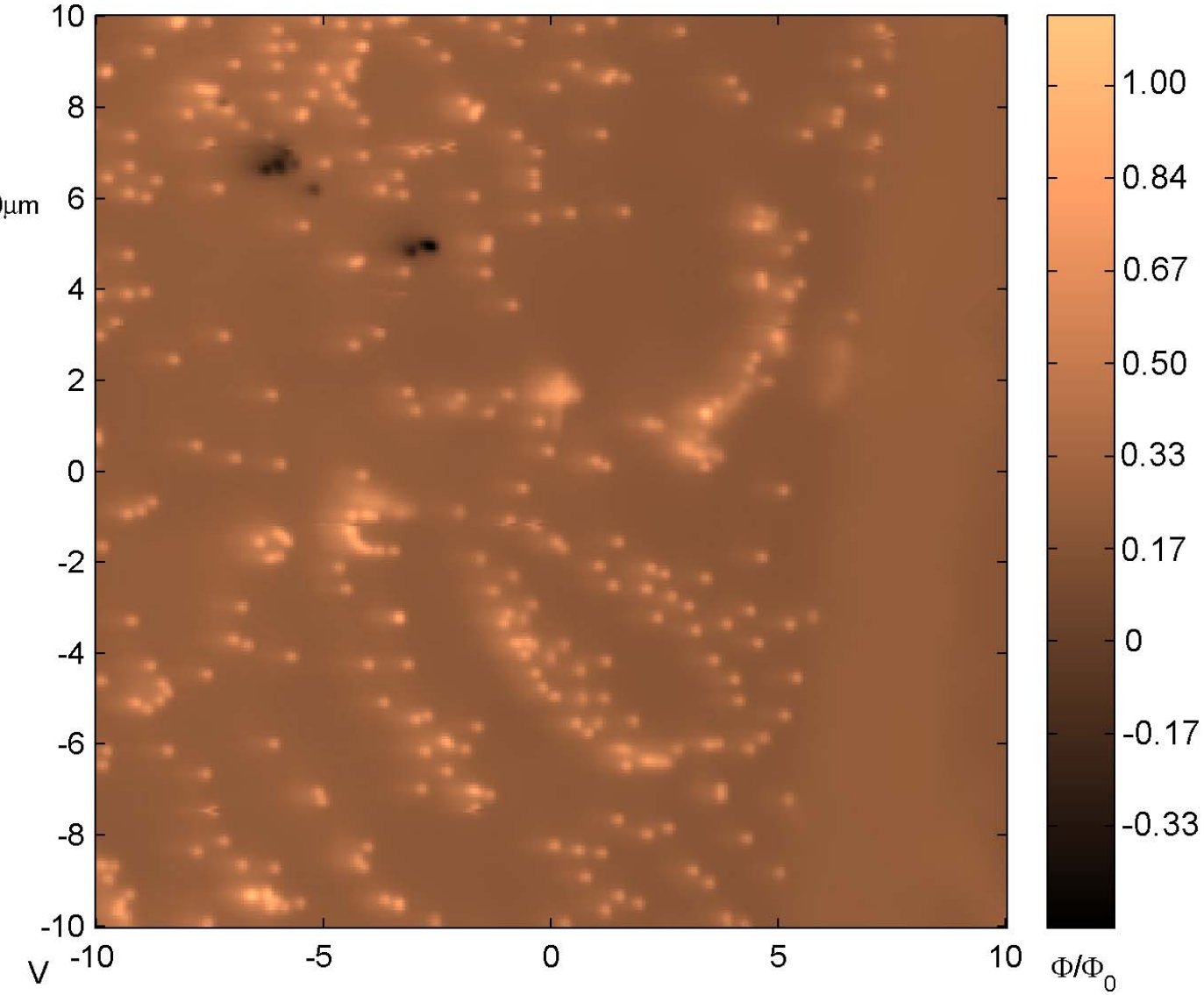
scan area: approx. 290μm
on a side.

strip around V_y=-8V:
Squid lost lock. Pasted
from 071012C; offset by
$0.1\Phi_0$ for contrast.



071012A
lift height = 0.25V
applied field:
cooling: +114mG
scanning: 0

scan area: approx. 290μm
on a side.

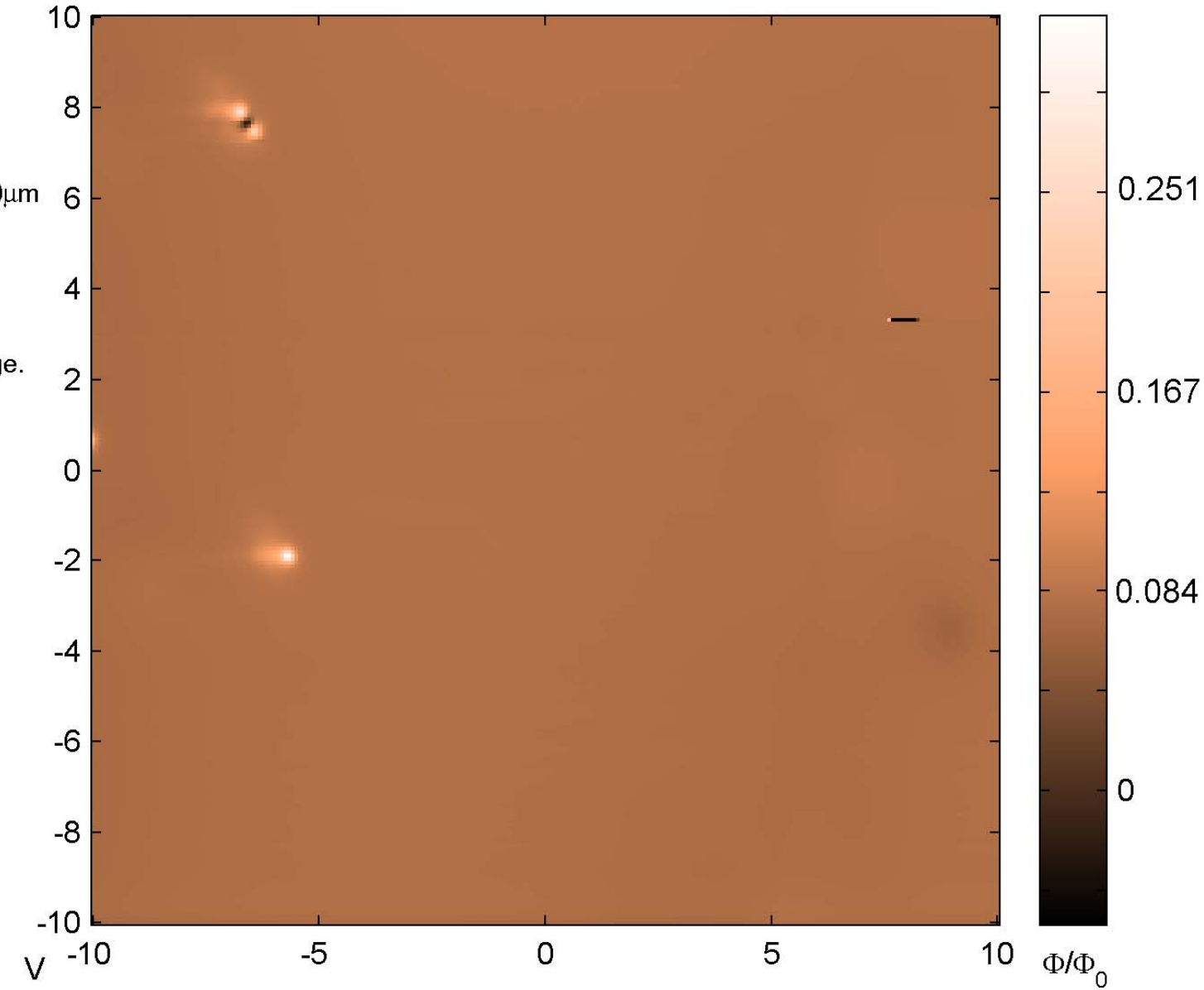


071011D
lift height: 0.4V
applied field:
cooling: +19mG
scanning: +18mG

Scan area: approx. 290μm on a side.

A band around V_y=3V where the lock point jumped has been corrected in this image.

lift height: ~800nm



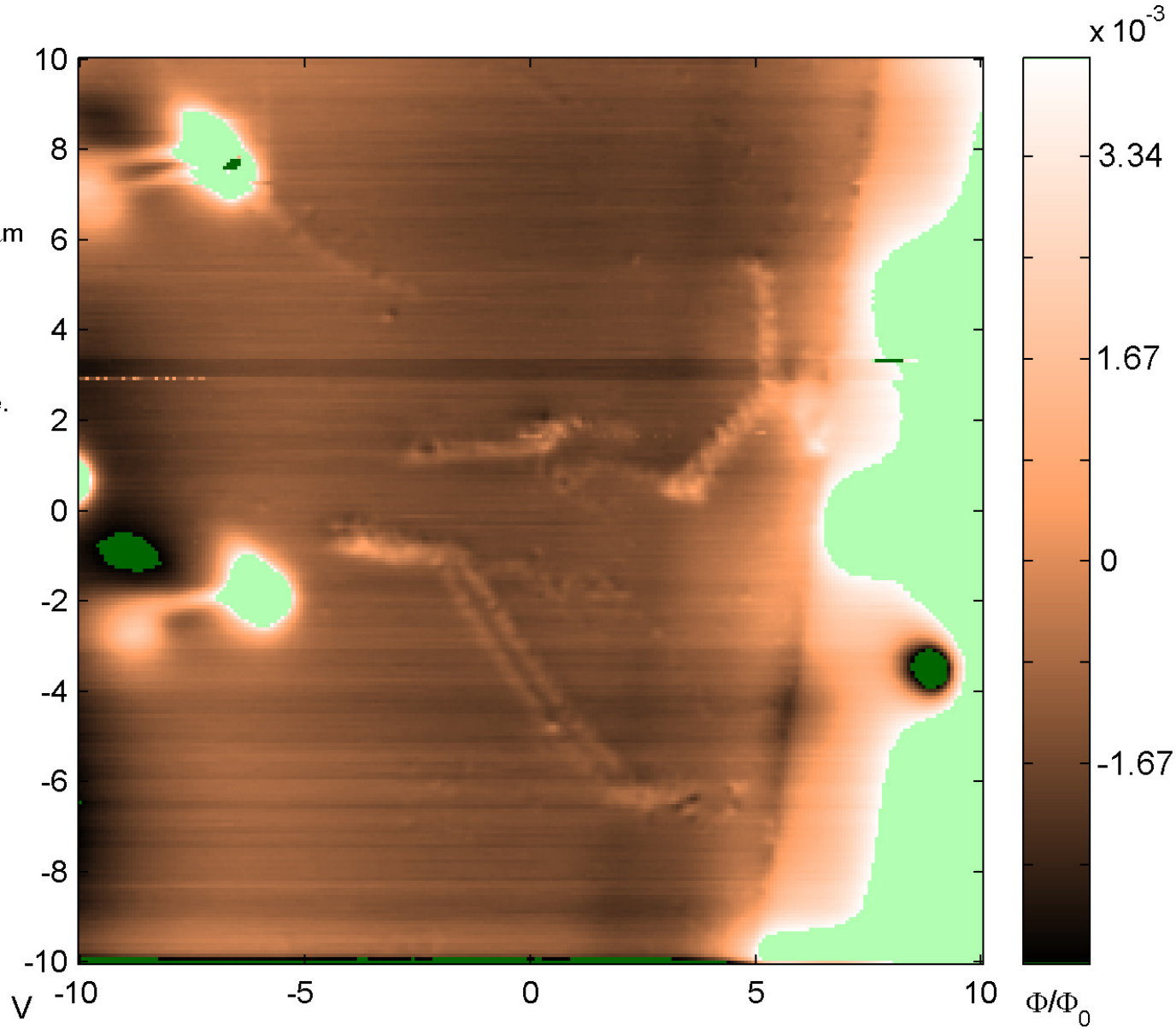
071011D
lift height: 0.4V
applied field:
cooling: +19mG
scanning: +18mG

Scan area: approx. 290μm on a side.

A band around V_y=3V where the lock point jumped has been corrected in this image.

Subtracted quad fit:
1.12E-4 x - 0.15E-4 y
-6.3E-7 x^2 + 2.5E-7 xy
+0.2E-7 y^2

lift height: ~800nm



071011A and 071011B
lift height: 0.2V
applied field:
+20mG, cooling and scanning

squid bias current reversed between these two images.

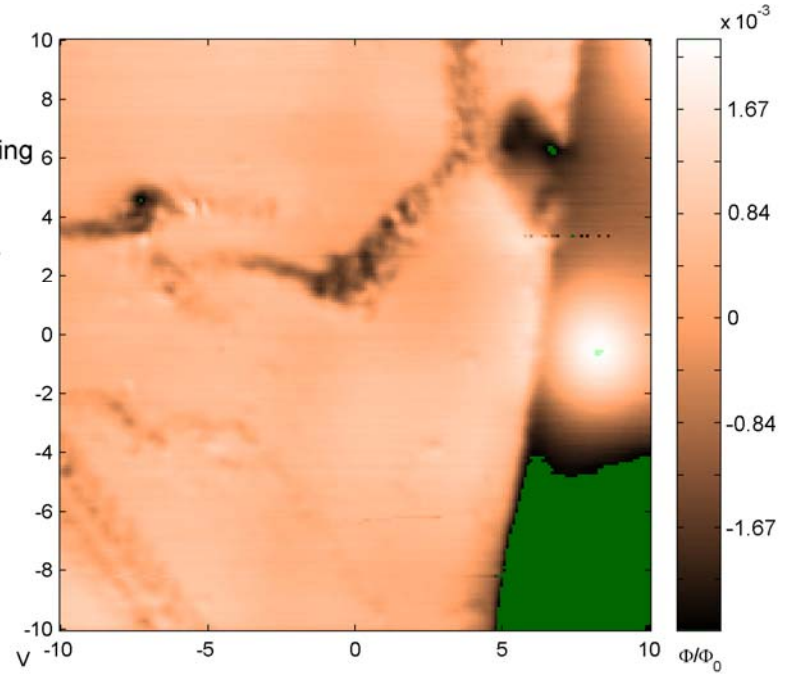
scan area: approx 140μm on a side.

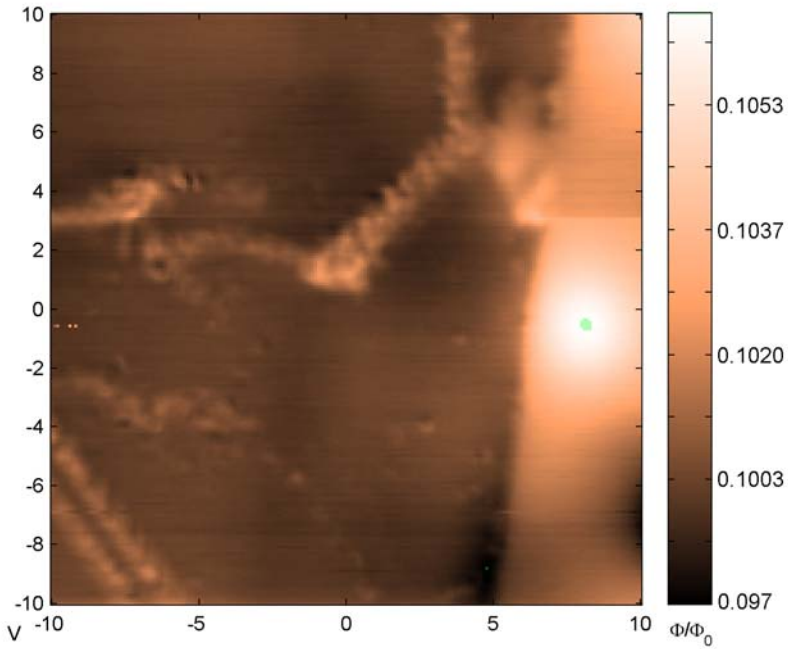
071011B: squid lost lock for V_y>3V; this portion pasted in from 071011C.

aubtracted quad fits:
071011A:
0.01E-4 *x* - 0.95E-4 *y*
-0.84E-7 x^2 + 0.21E-7 *xy*
+0.85E-7 y^2

071011B:
-0.12E-4 *x* + 0.71E-4 *y*
+0.17E-7 x^2 + 0.26E-7 *xy*
-1.11E-7 y^2

lift height: ~400nm



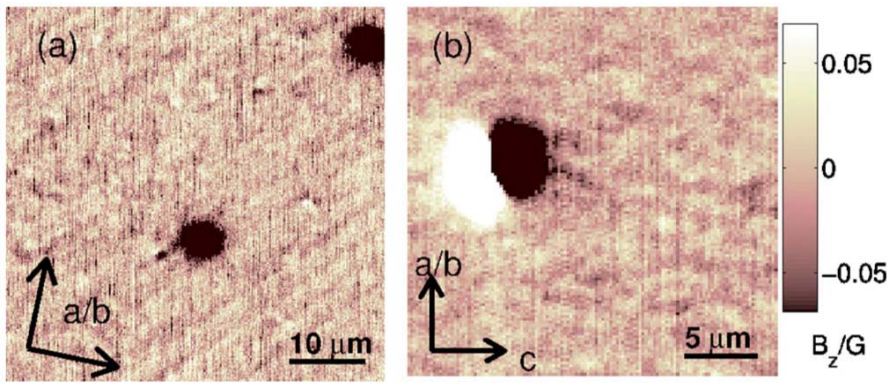


Main point:
There is a second material showing few to several G-scale fields in muSR but nothing in scanning magnetic imaging!

(1) Should we keep looking for edge magnetization and domain walls?

(2) Could the muSR signal have a different origin than chiral domains?

Scanning 0.5μm Hall probe images of $ErNi_2B_2C$



H Bluhm *et al*, PRB **73** 014514 (2006)