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SMR 1216 - 16

Joint INFM - the Abdus Salam ICTP School on "Magnetic Properties of Condensed Matter Investigated by Neutron Scattering and Synchrotron Radiation Techniques"

1 - 11 February 2000

ULTRAFAST MAGNETIC DYNAMICS

PART I

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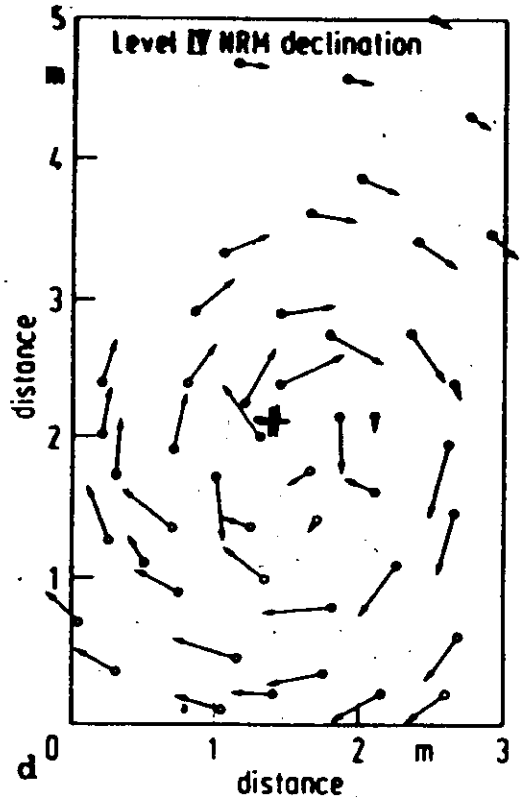
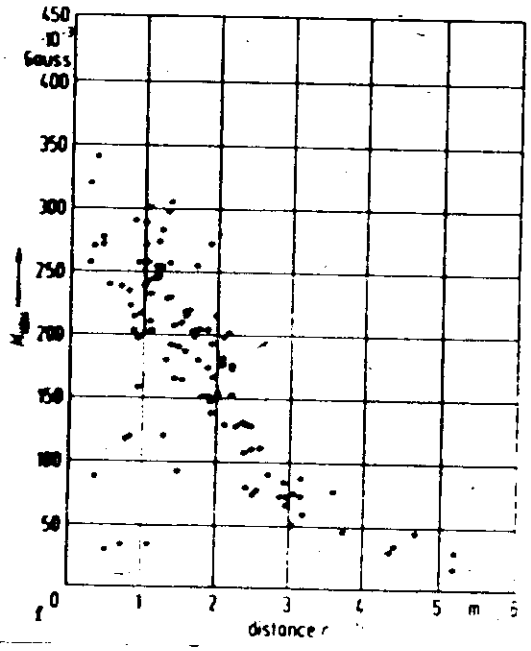
These are preliminary lecture notes, intended only for distribution to participants.



Natural Remanent Magnetization in Tertiary Basalt near Backenberg (Göttingen)



Lightning

$i = 50'000\,A$

$j = 10^5 \frac{A}{m^2}$

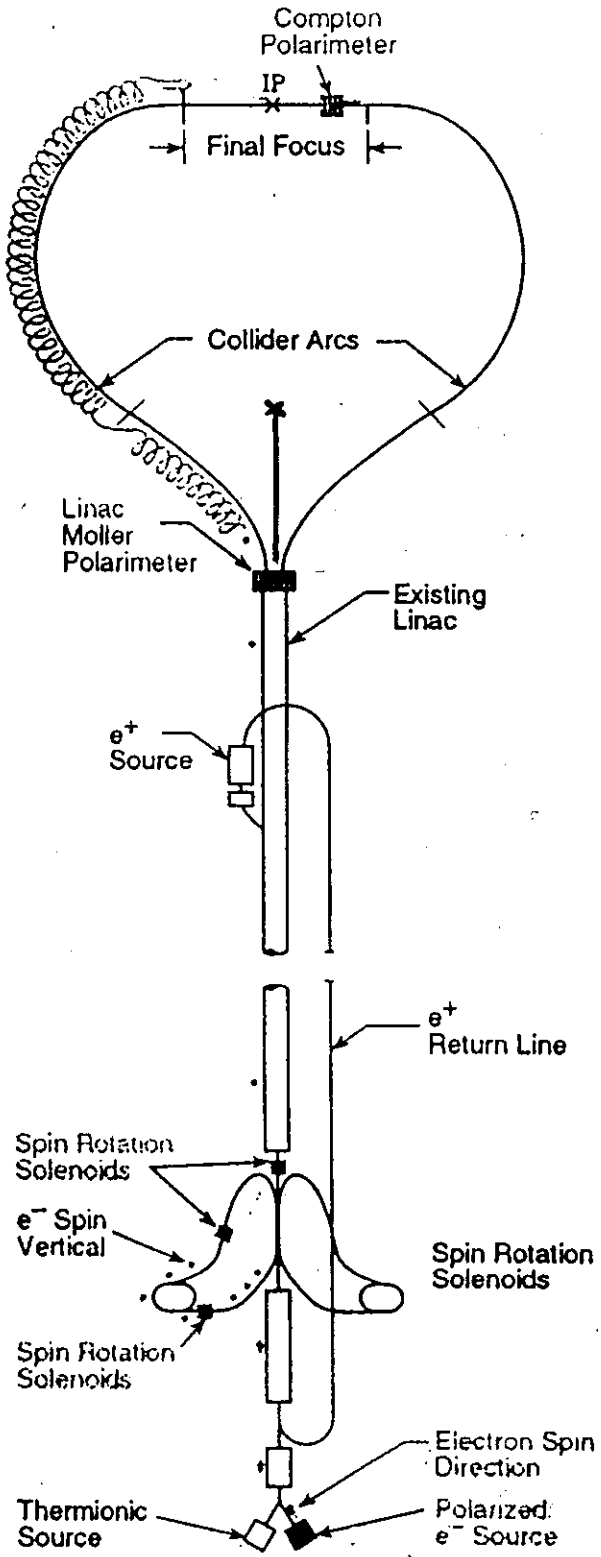
$\tau = 10^{-6}\,sec$

SLC

$i = 1000\,A$

$j \approx 10^{15} \frac{A}{m^2}$

$\tau = 10^{-12}\,sec$



"Electroweak" experiment
Stanford Linear Accelerator

Polar Kerr Loop of CoPt alloy CP13Q

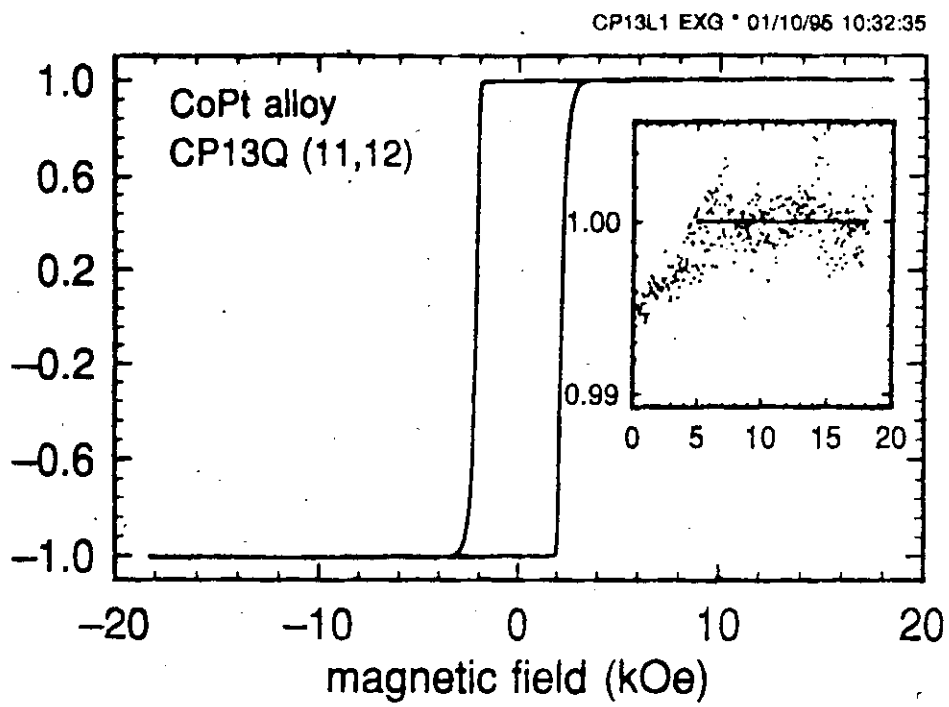
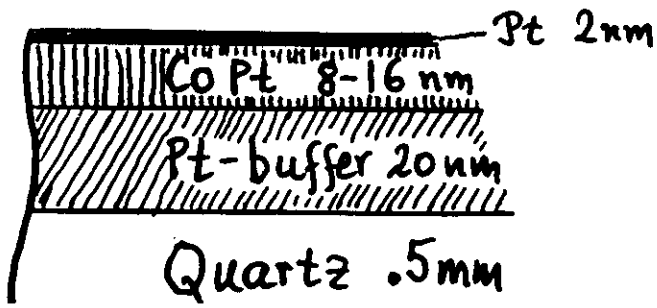
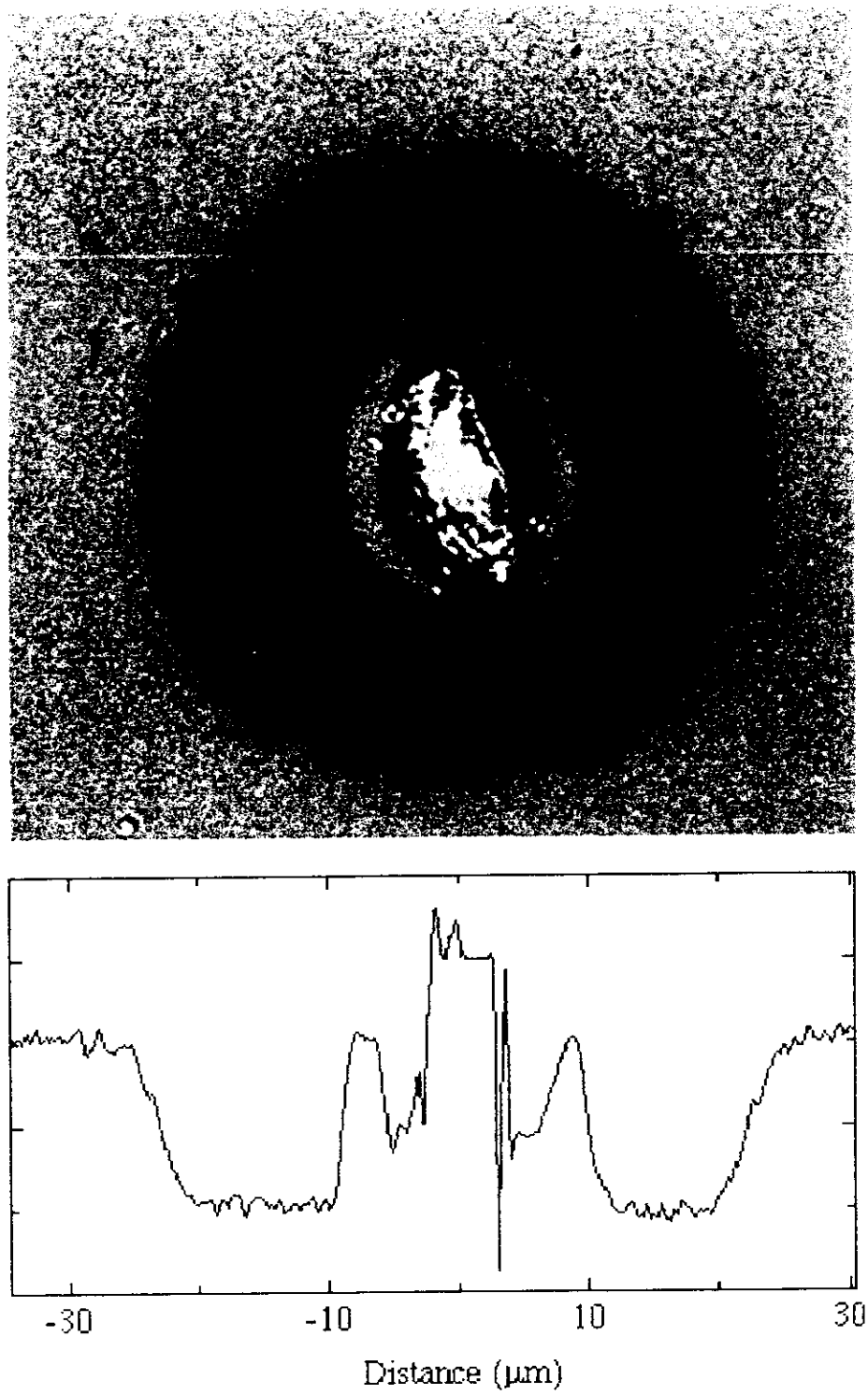
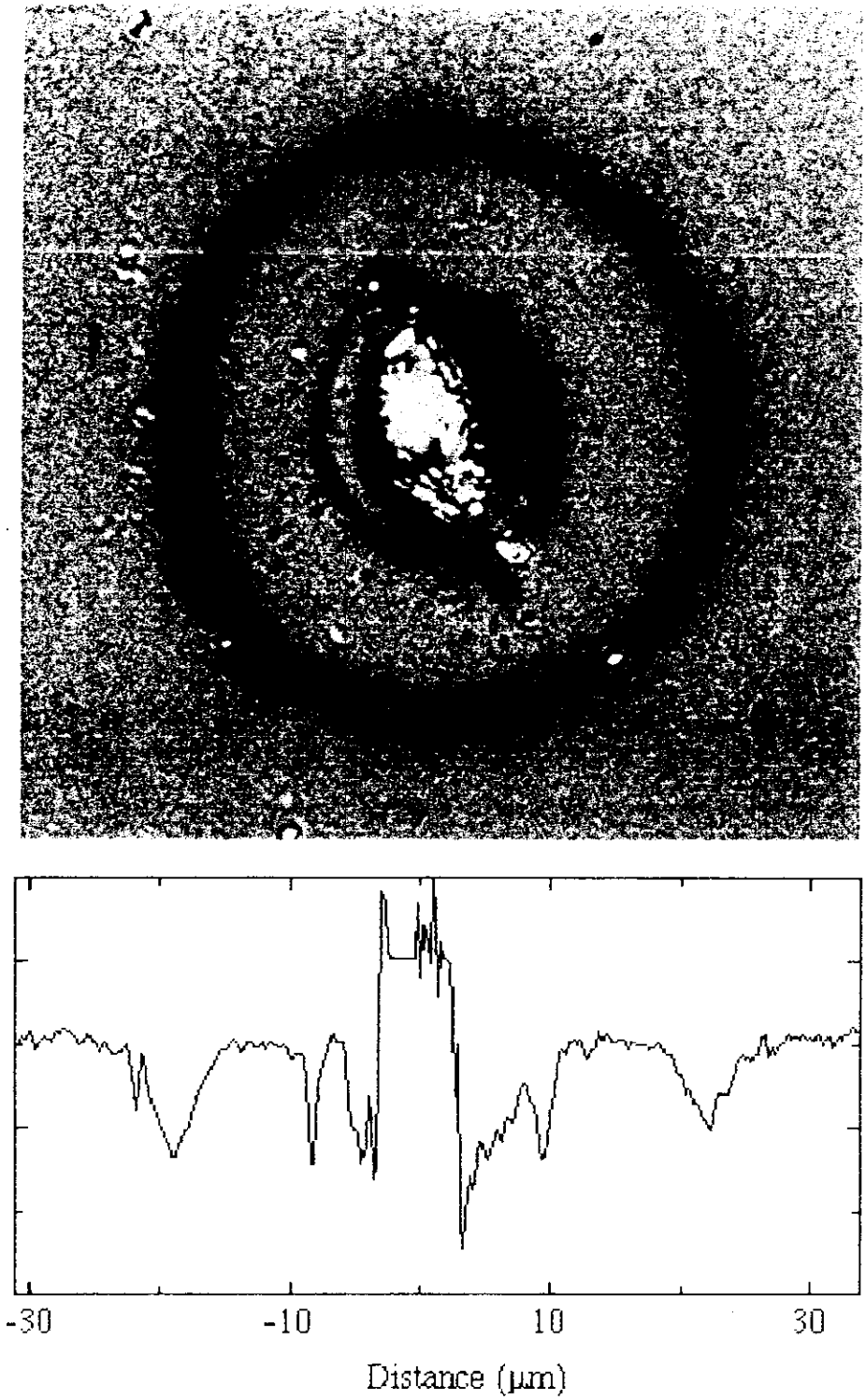


TABLE I. Structural and magnetic parameters of the present CoPt alloy samples. The samples are chemically disordered and have Curie temperatures of $T_C \sim 300°C$. Second order anisotropy fields $H_{a,2} \approx 400$ kA/m were observed.

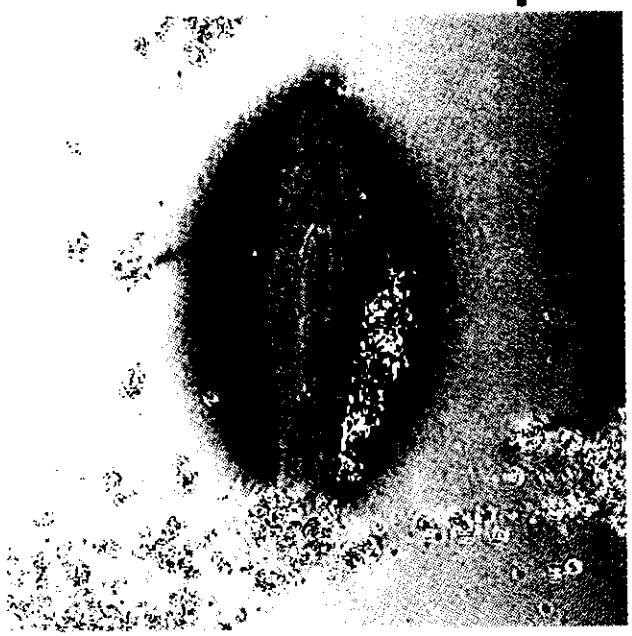
No.	alloy	t_{CoPt} (nm)	H_C (kA/m)	M_s (kA/m)	M_R/M_S (%)	H'_a (kA/m)
#1	$Co_{26}Pt_{74}$	8.0	117	375	99.0	1360
#2	$Co_{26}Pt_{74}$	12.5	178	408	99.0	1760
#3	$Co_{28}Pt_{72}$	16.0	178	460	99.5	1600



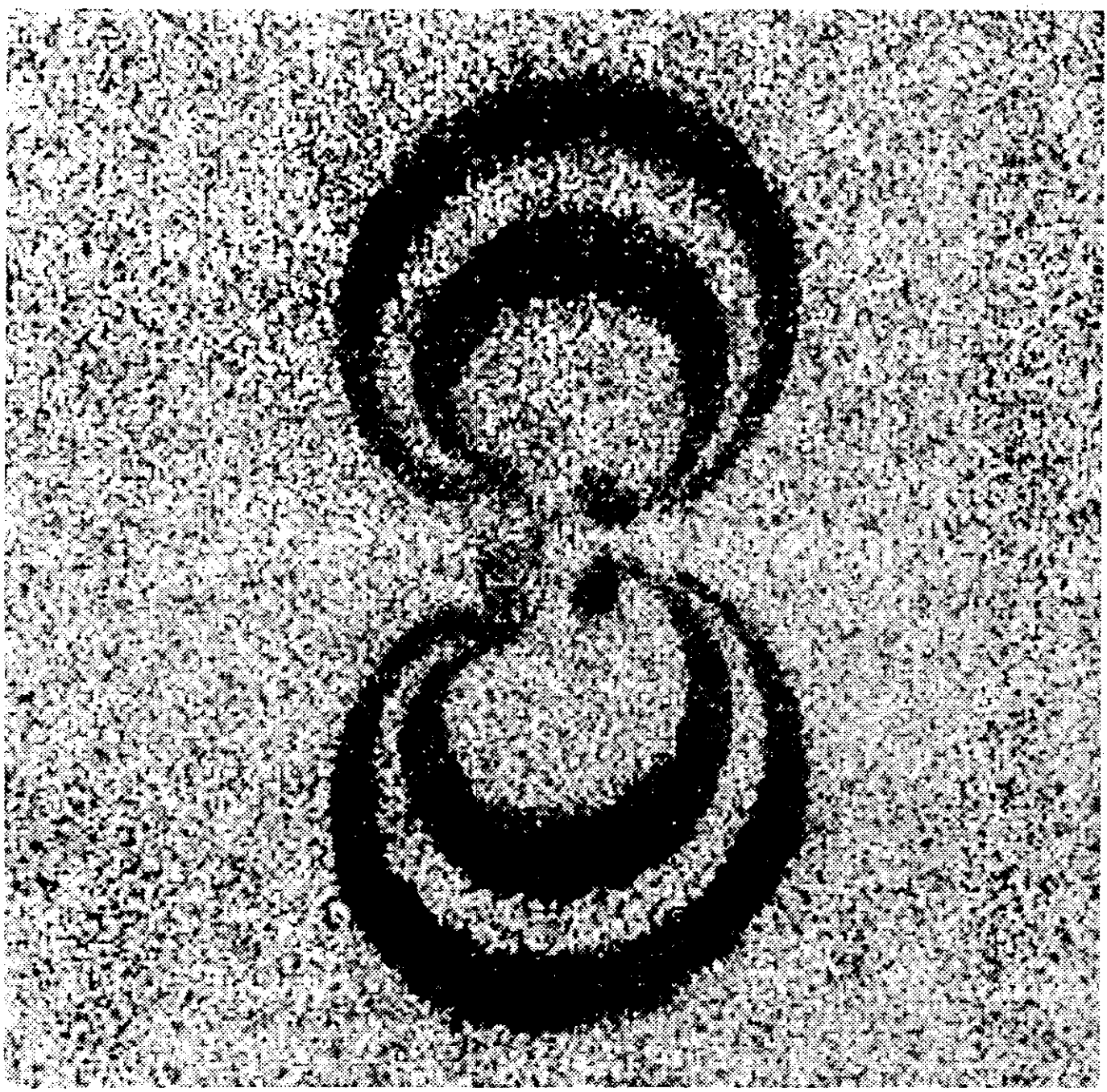

-30
-10
10
30
Distance (μm)

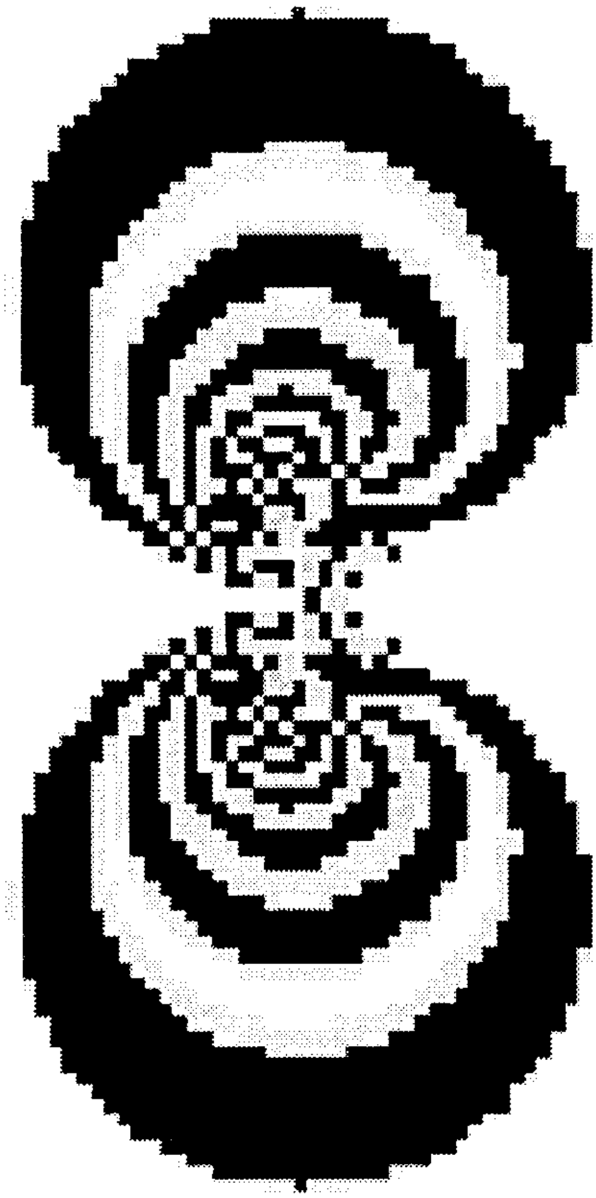

-30
-10
10
30
Distance (μm)

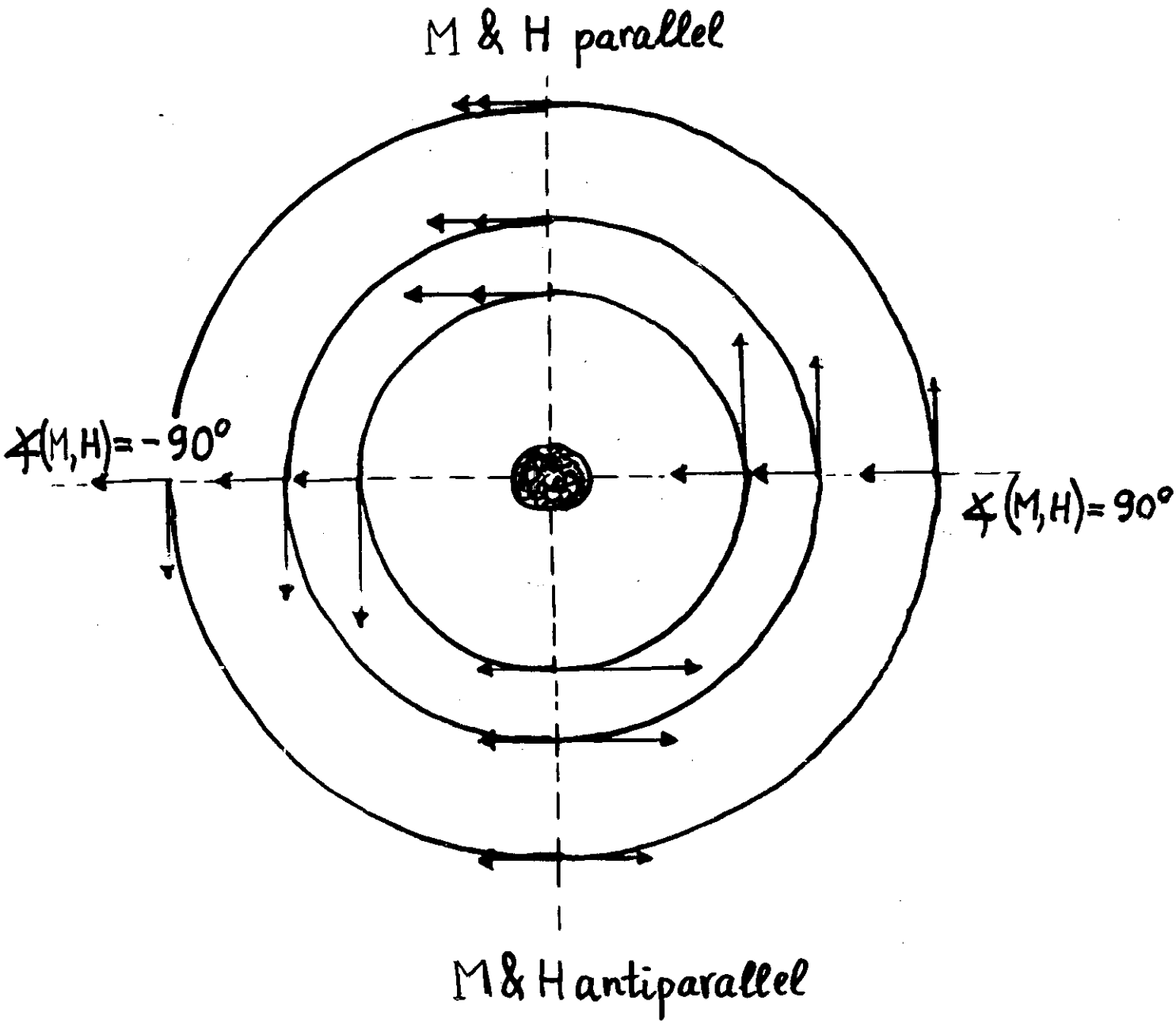
Micro Kerr Images
sample 10

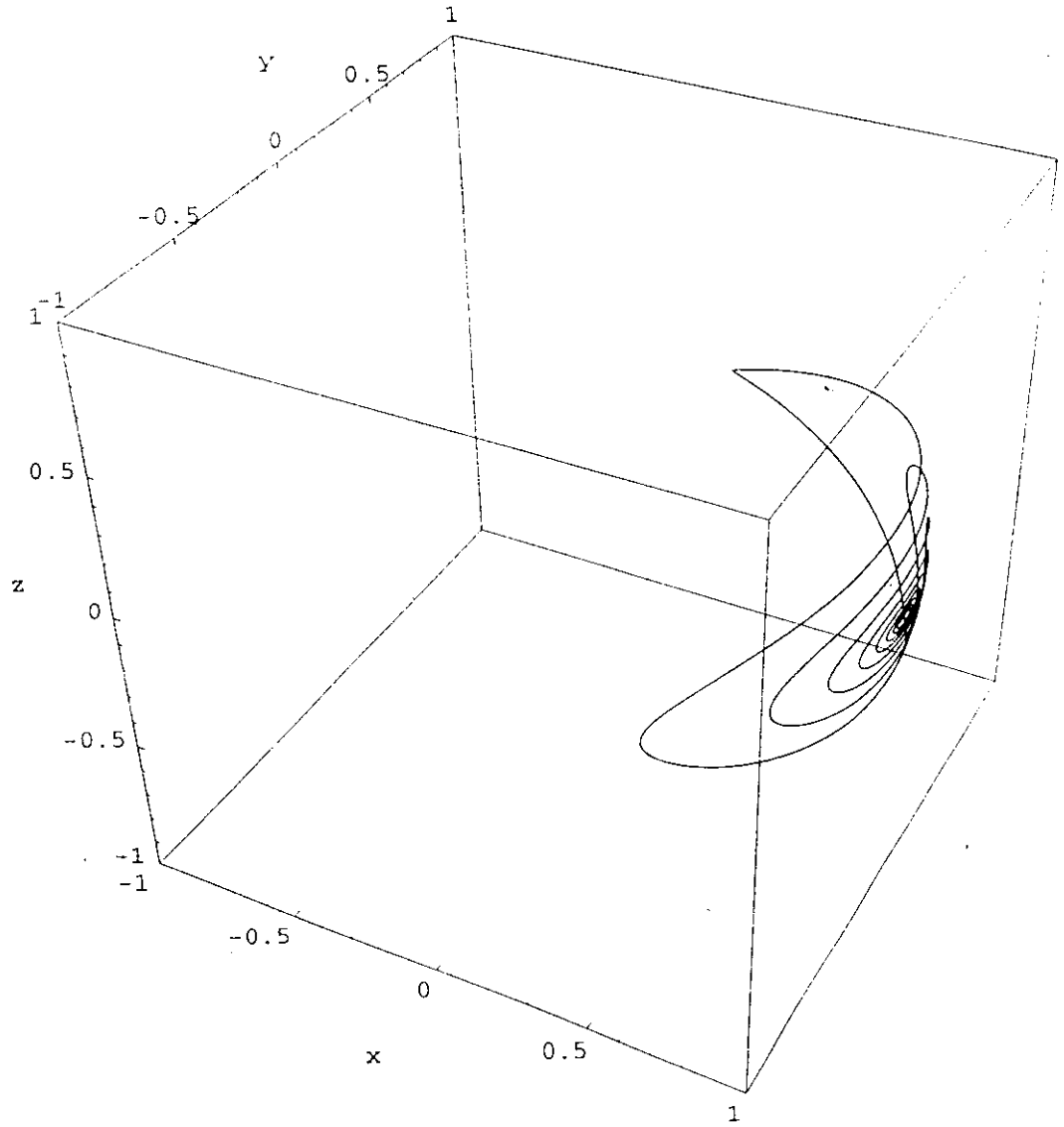


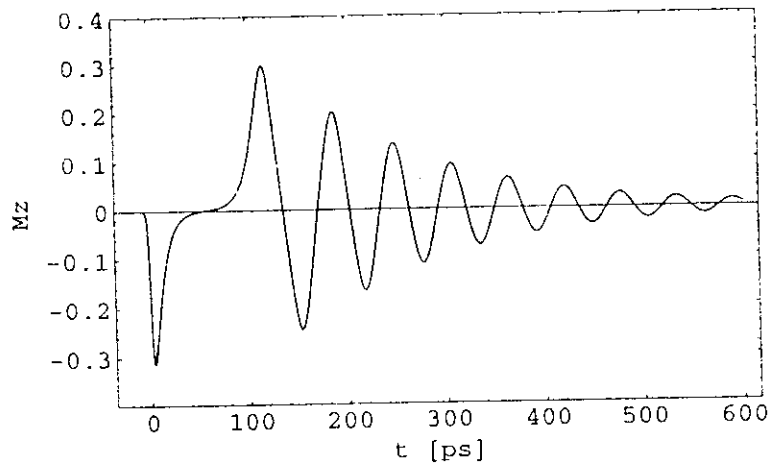
Jürgen Heidmann · October 26, 1994

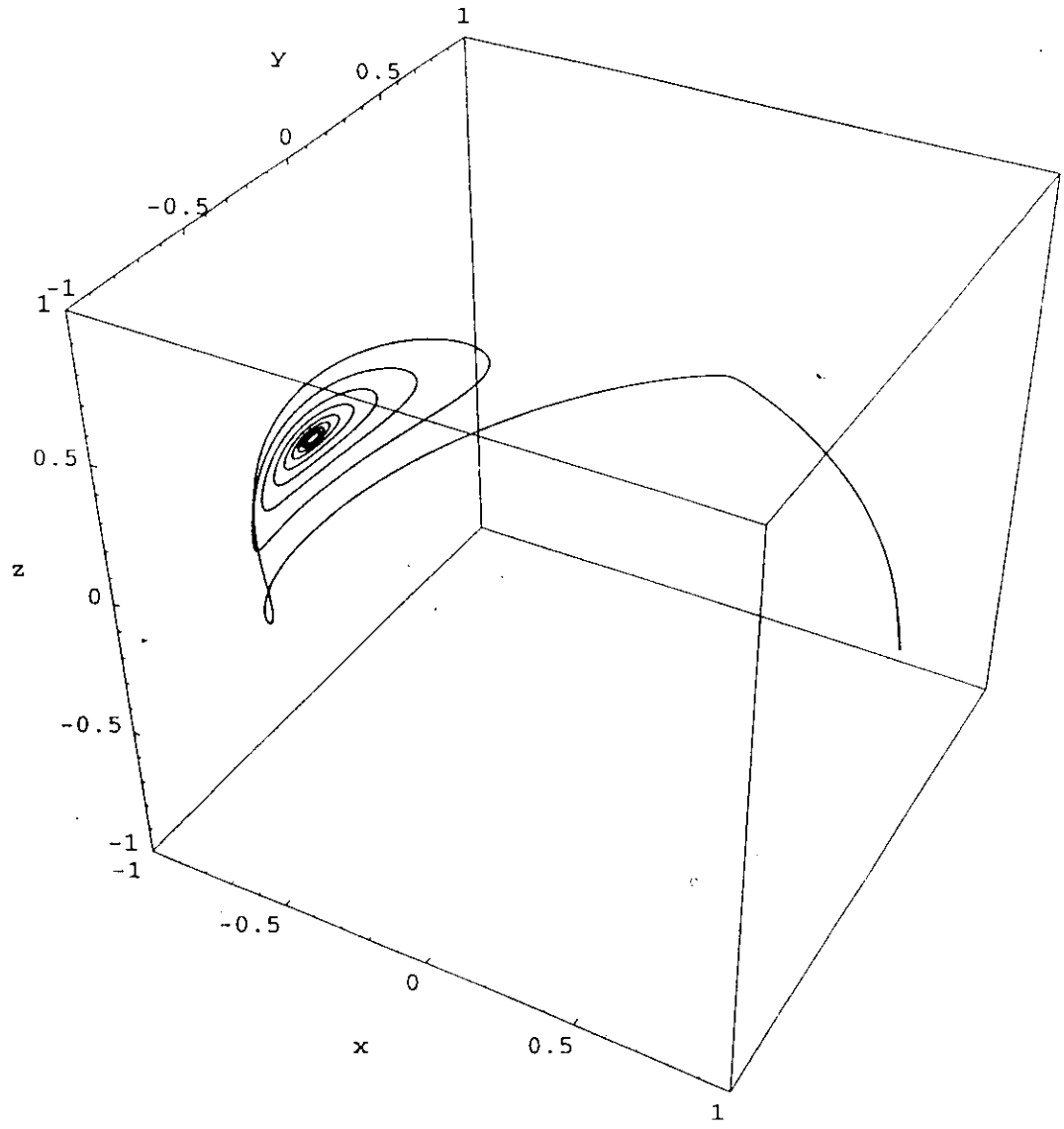


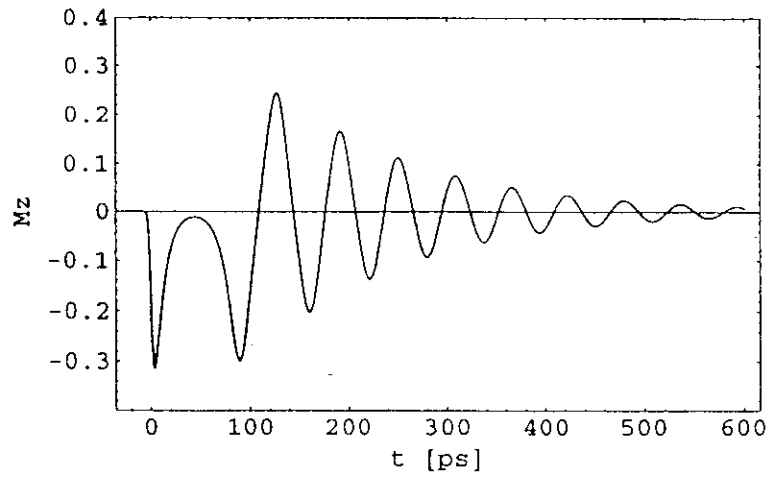



M & H parallel
∠(M,H) = -90°
∠(M,H) = 90°
M & H antiparallel

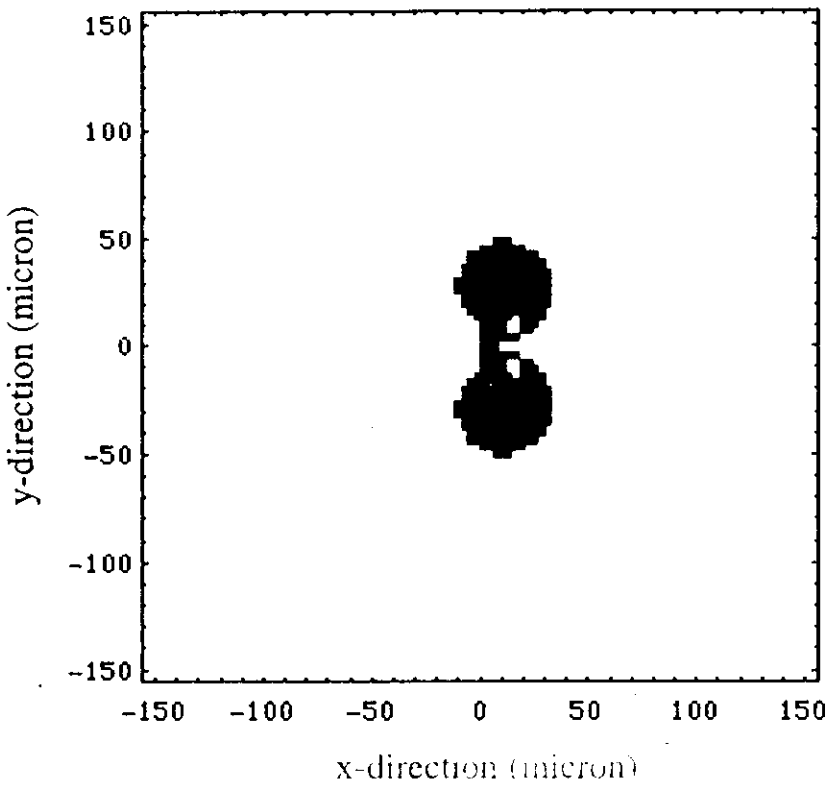

y
1
0.5
0
-0.5
-1
1
0.5
z
0
-0.5
-1
-1
-0.5
0
0.5
1
x


0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
Mz
0
100
200
300
400
500
600
t [ps]


Y
1
0.5
0
-0.5
-1
1
0.5
z
0
-0.5
-1
-1
-0.5
0
0.5
1
x


0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
Mz
0
100
200
300
400
500
600
t [ps]

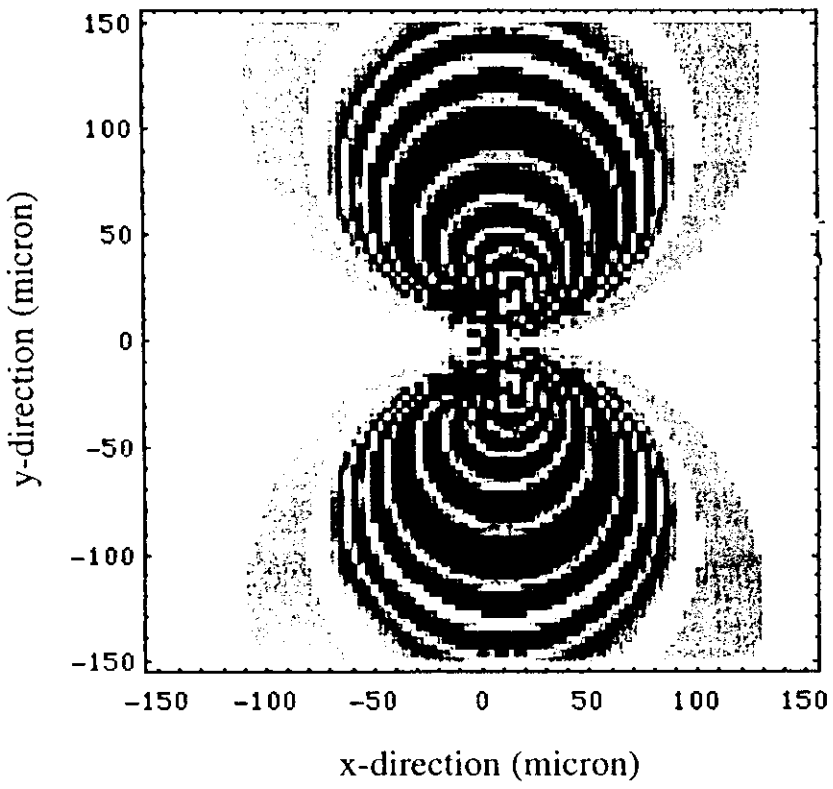
Calculation



σ_x = 3.8 μm
σ_y = 0.8 μm
σ_z = 600 μm
σ_t = 2 ps
$N_0 = 1*10^{10}$

H_k = 2100 Oe
H_D=18000 Oe

α=0.5



σ_x = 3.8 μm
σ_y = 0.8 μm
σ_z = 600 μm
σ_t = 2 ps
$N_0 = 1*10^{10}$

H_k = 2100 Oe
H_D=18000 Oe

α=0.01

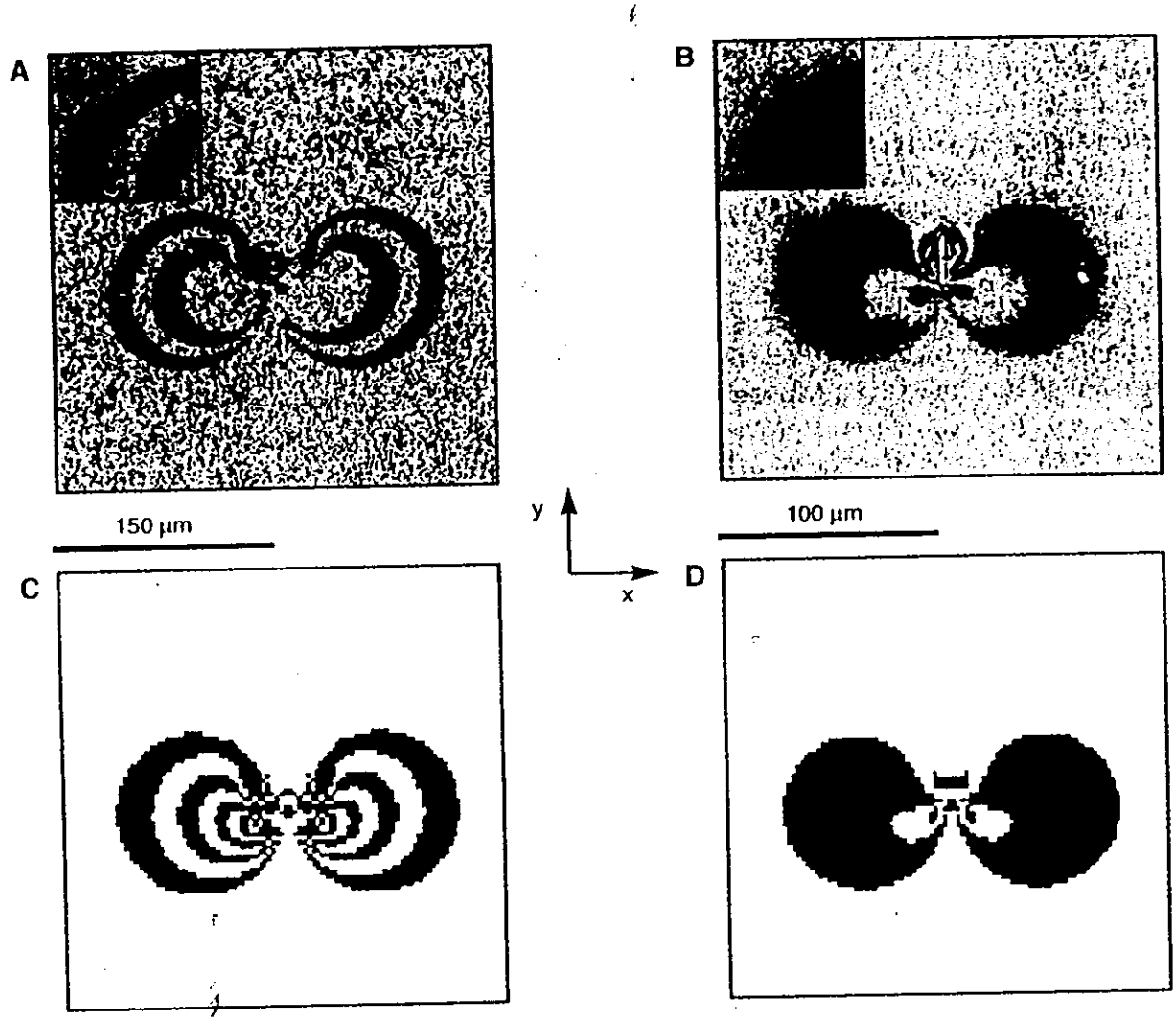
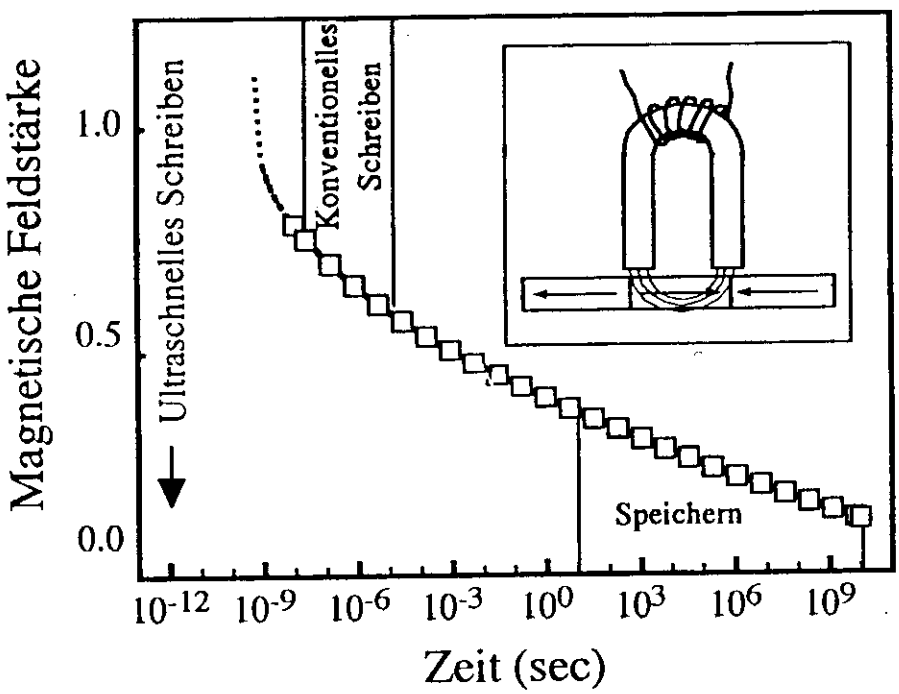
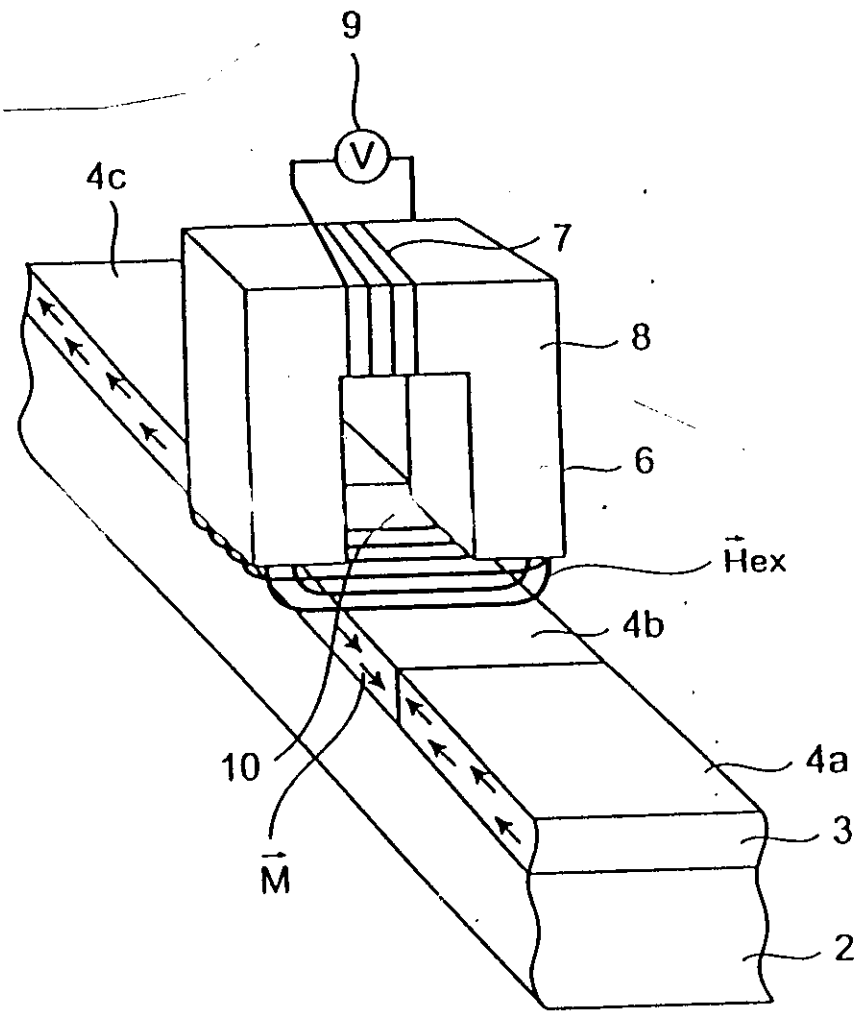


Fig. 1. (A and B) Magnetization pattern written into uniaxial cobalt films with a single electron pulse of σ_t = 4.4 ps duration. The images were measured with spin-SEM. The samples were premagnetized along the $-x$ direction. In the white areas, the magnetization points along the $-x$ direction; in the black areas it has been reversed to the $+x$ direction. (A) Image of Co I. The inset shows zig-zag domain walls separating areas of opposite $\vec{M}$. The contour lines of the pattern approximately represent lines of constant angular momentum transferred by the field pulse. (B) Image of Co II. The inset shows a gradual transition between areas of opposite $\vec{M}$. (C and D) Magnetization patterns calculated for the two different films using the LL equation with M_S = 1360 kA/m. (C) The parameters for Co I are H_A = 168 kA/m and α = 0.037, (D) whereas for Co II we use H_A = 160 kA/m and α = 0.22. The difference from (A) is caused by the increase of α.


Magnetische Feldstärke
1.0
0.5
0.0
Ultraschnelles Schreiben
Konventionelles Schreiben
Speichern
10^{-12} 10^{-9} 10^{-6} 10^{-3} 10^{0} 10^{3} 10^{6} 10^{9}
Zeit (sec)


9
V
4c
7
8
6
$\vec{H}$ex
4b
4a
10
3
$\vec{M}$
2