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Memorandum

Date: 13/Nov/2007

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To: LEM group
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Maximum Entropy analysis of 10×10-mm^2 Ag on Ni, Comparison with WKM fits

Dima added to his report *Notes on Ti sputtered substrate used in 2007* [1] time domain fits with WKM on Ni and 10×10 mm^2 Ag/Ni that were measured in June 2007 to check the suitability of using Ni coated sample plates for LEM measurements on small samples ($\sim$ 1 cm^2). WKM and MaxEnt results are summarized in Tab. 1. MaxEnt figures are attached at the end of this report.

Table 1: Comparison of MaxEnt and WKM results, exponential damping rate λ, asymmetry A, "B-parallel" setup. MaxEnt parameter: fit range 0.02 - 8.0 μs, field range 100 - 400 G, 20ns binning, FFT 12 (40ns for Run 793, FFT 11).

	Run 793	Run 801	Run 809
comment	Ni plate, small opening, 258G MaxEnt: 3μs apod.	1-cm^2 Ag/Ni, 258G	1-cm^2 Ag/Ni, 136G
WKM	222(16)G / λ =5.5μs^{-1} A = 0.052(15)	246(14)G / 2.7(1.3)μs^{-1} 258.7(4)G / 0.04(4)μs^{-1} A_1 = 0.039(11) A_2 = 0.037(5)	149(49)G / 7.5(3.5)μs^{-1} 135.8(3)G / 0.02(2)μs^{-1} A_1 = 0.072(44) A_2 = 0.055(4)
MaxEnt	peaks at: 186 / 223 / 235 /267 G A = 0.013(2)	peaks at: 258 G, $\sigma = 1.1$ G ...224/233/267/278 G... outlier: 9.4 / 19.8 G A = 0.071(7)	peaks at: 136 G, $\sigma = 1.6$ G A = 0.063(2)

From WKM fits one may conclude that there is an additional, broad signal close to the external field present for the Ag/Ni sample at 258 G and 136 G. The Maximum Entropy analysis does not confirm the WKM fit with two lines close to/at the external field. From MaxEnt analysis the main conclusion is:

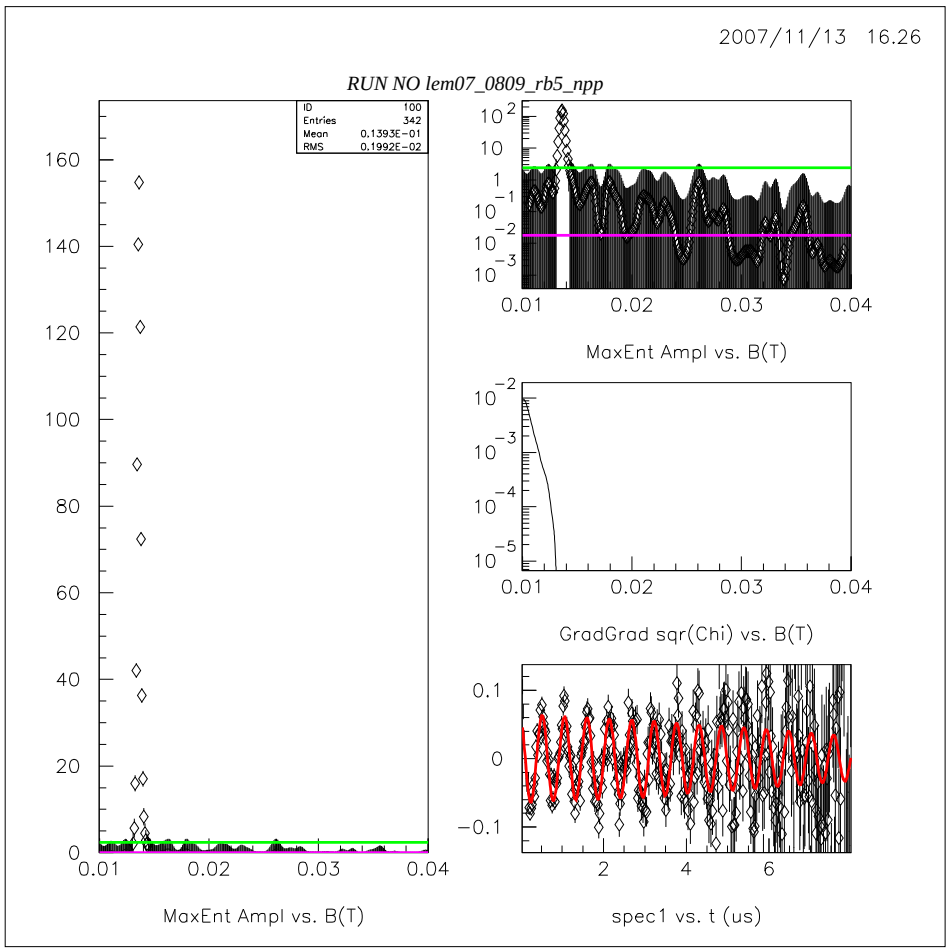
- The 136-G Ag/Ni run does not show additional, broad signal(s) as suggested by the WKM fit. The only "anomaly" appears to be the rather large width of 1.6 G of the Ag signal. Compare with Ag-coated sample plate, run lem05_1070 (WEW setup, 15kV settings, 20.6 keV): MaxEnt width is 0.91 G, WKM single-histogram fit yields 0.020(3) μs^{-1}. However, run 809 was measured at 4 keV implantation energy. Comparing with a 5.6-keV run on sample plate

shows that the line width increases with decreasing energy [what we've already observed several times at low fields ($<\sim$ 300 G)]: run lem05_1072 (15kV settings, 5.6 keV) has a MaxEnt width of 1.4 G, and WKM single-histogram gives 0.029(4) μs^{-1}. In both MaxEnt and WKM we have a consistent increase of 50% of line width when reducing the energy from 20.6 keV to 5.6 keV. This implies, that the MaxEnt width of 1.6 G of run 809 is "normal" for 4 keV implantation energy.

- The 258-G Ag/Ni data confirm the WKM fit, that there is not only one signal from the Ag present; however, the WKM fit predicts the additional line at B$<$ B$_{ext}$, whereas MaxEnt suggests one broad or two more narrow lines at B$>$ B$_{ext}$, plus additional lines at lower fields, which coincide with lines found by MaxEnt in the Ni experiment of run 793 – where the observed precession most probably originates from muons stopping in the radiation shield of the cryostat.
  One may conclude that the appearance of additional lines at 258 G in Ag/Ni is due to muons stopping in the cryo shield. Since at 258 G we have to apply a pretty large "pre-steering" by RA it appears to be reasonable that there is a larger fraction of muons sent into the cryo shield, compared to lower field measurements. If this is true, one should always find additional lines in the MaxEnt analysis of 258-G runs, "B-parallel" setup.

References:

[1] http://nemu.web.psi.ch/doc/LEM_Memo/fast_relaxation/Ti_2007.pdf.



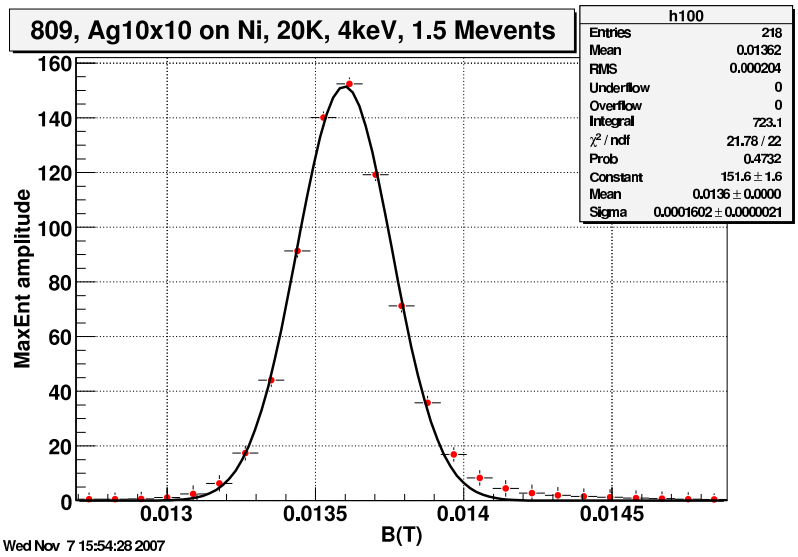


Figure 1: MaxEnt result of 10×10 mm^2 Ag/Ni, 4 keV, 136 G, Run lem07_0809. No apodization used. Fit range 0.02-8.0 μs, 20 ns binning, FFT 12.

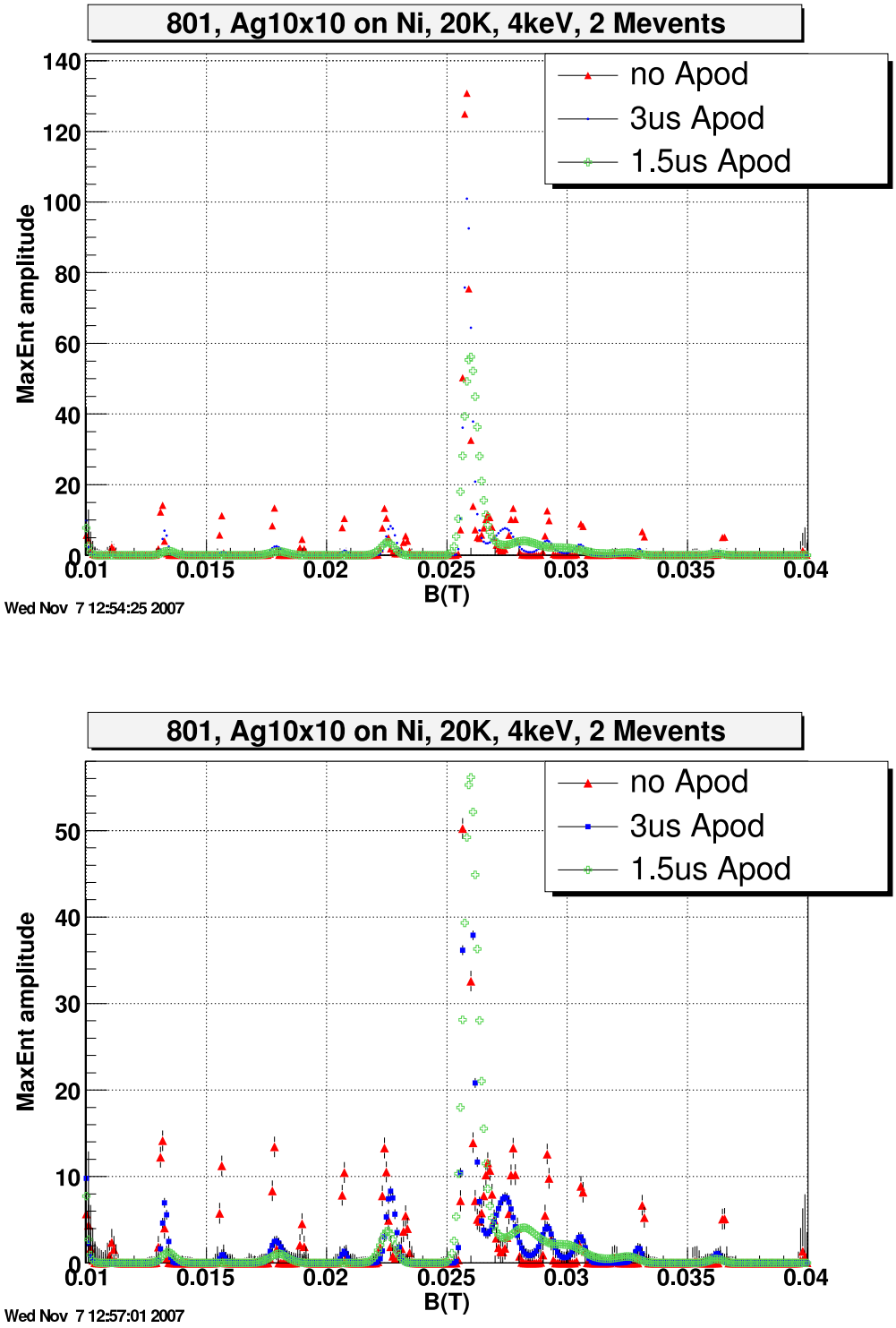


Figure 2: MaxEnt result of 10×10 mm^2 Ag/Ni, 4 keV, 258 G, Run lem07_0801. Comparison of different apodizations. Fit range 0.02-8.0 μs, 20 ns binning, FFT 12. The bottom figure is a zoom of the y-axis of the top figure.

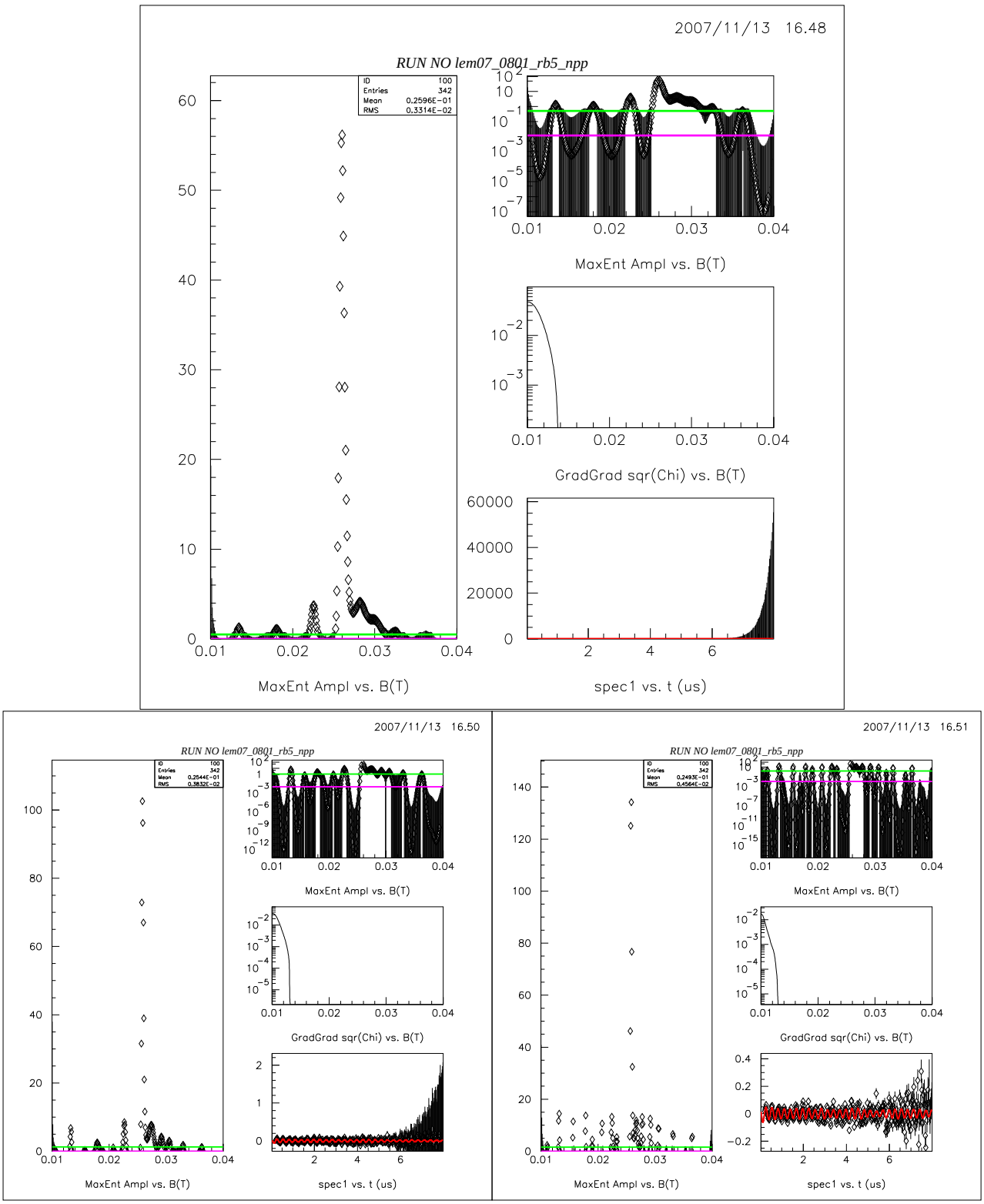


Figure 3: MaxEnt result of 10×10 mm^2 Ag/Ni, 4 keV, 258 G, Run lem07_0801. Comparison of different apodizations. Fit range 0.02-8.0 μs, 20 ns binning, FFT 12. Top: 1.5 μs apodization, bottom left: 3.0 μs, and bottom right: no apodization.

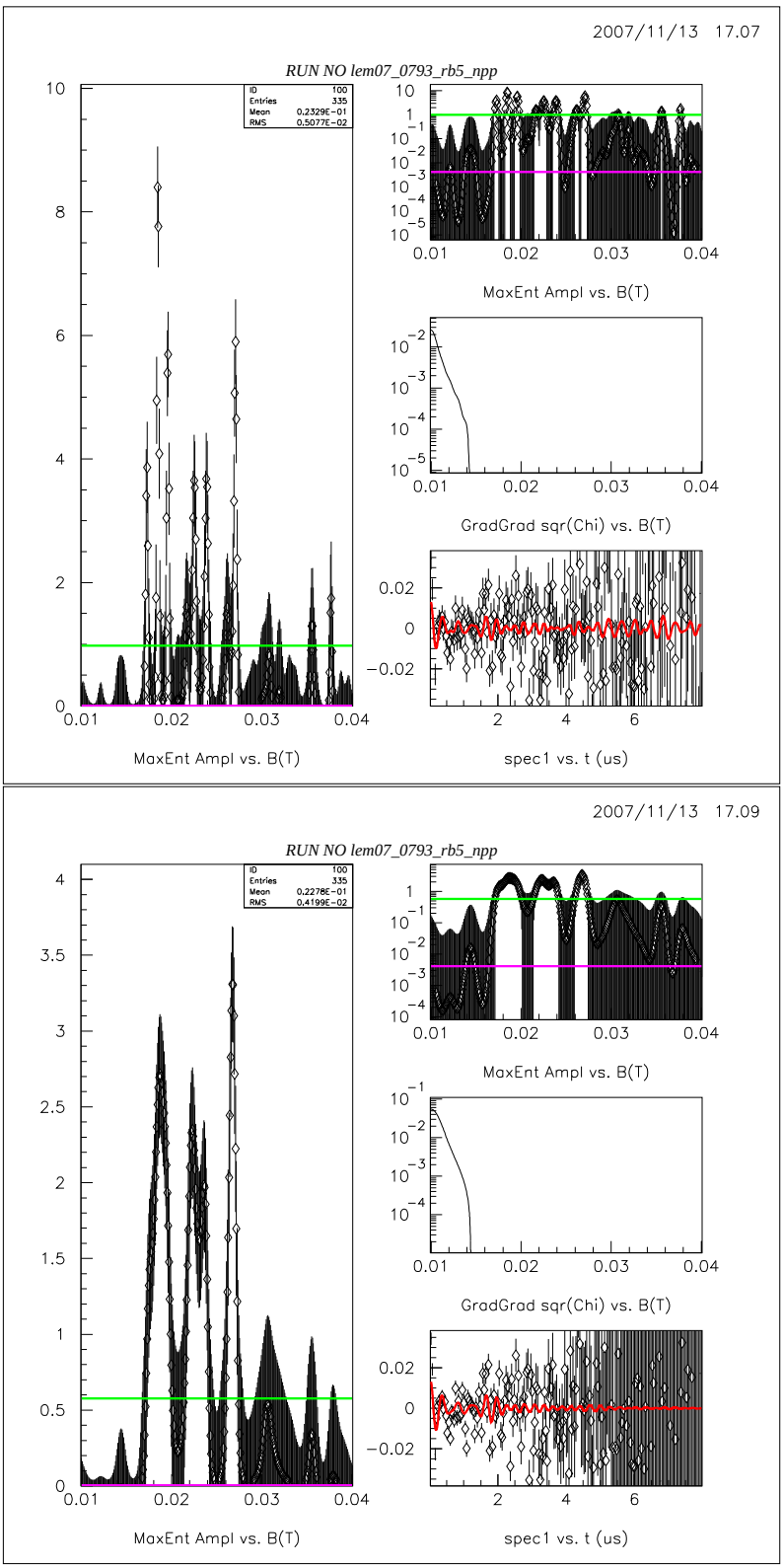


Figure 4: MaxEnt result of Ni, small cryo shield opening, 4 keV, 258 G, Run lem07_0793. Top: no apodization, bottom: 3.0 μs apodization. Fit range 0.02-8.0 μs, 40 ns binning, FFT 11.