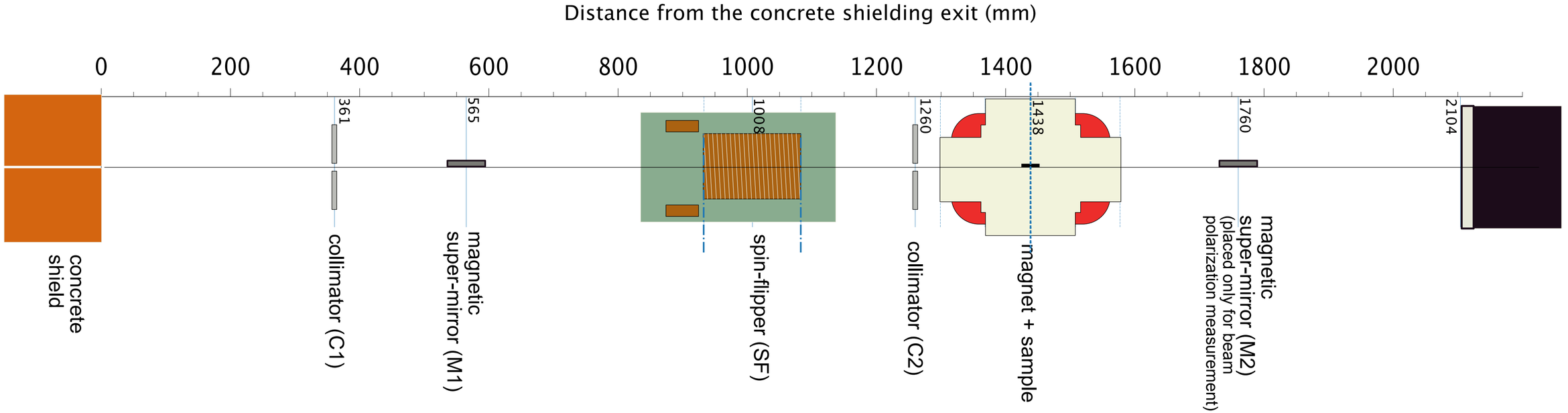
Difference in thickness of iron thin film

2021/07/13~17 BL05

Akatuka Hiroaki, HIguchi Takashi

Setup


Distance from the concrete shielding exit (mm)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
361
565
1008
1260
1438
1760
2104
concrete shield
collimator (C1)
magnetic super-mirror (M1)
spin-flipper (SF)
collimator (C2)
magnet + sample
magnetic super-mirror (M2) (placed only for beam polarization measurement)

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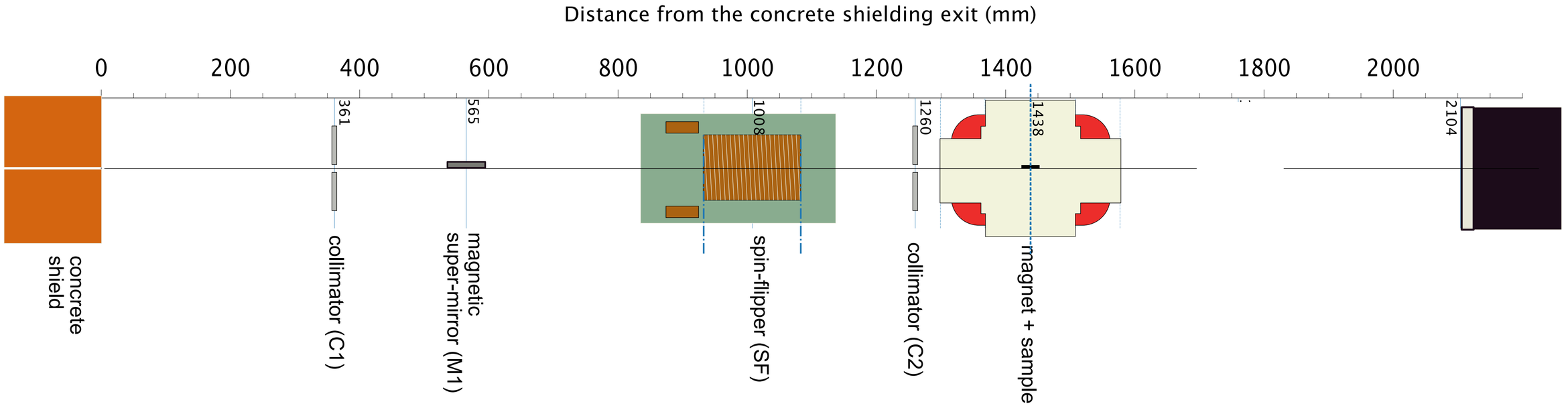
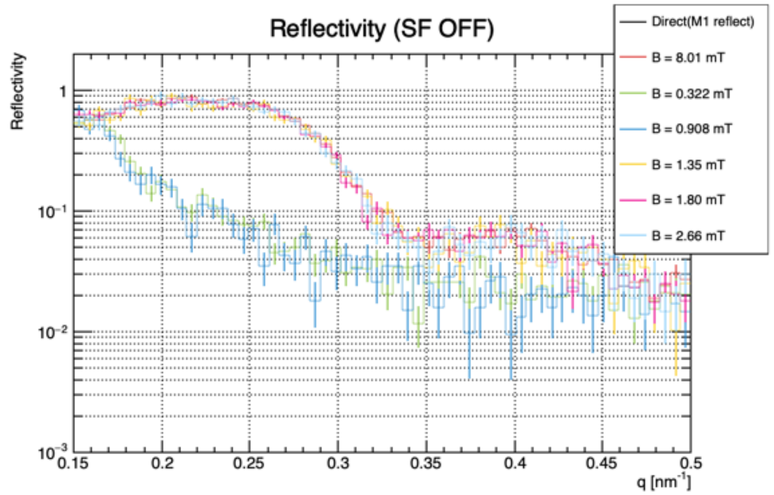
Setup (q-dependence of the polarization power)

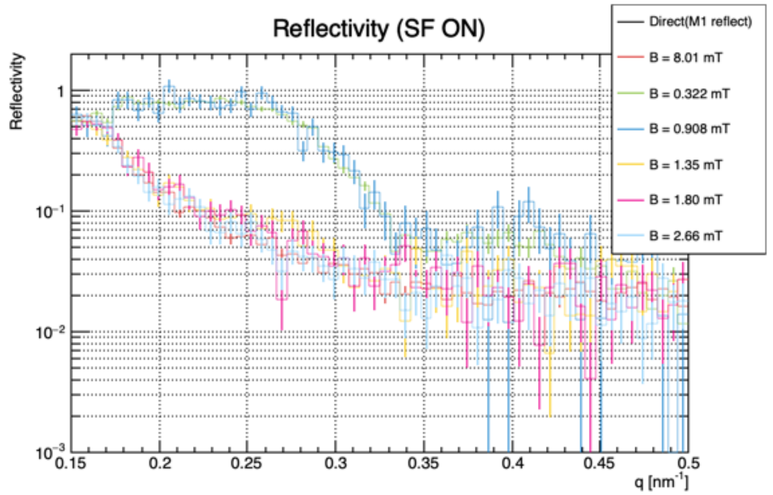


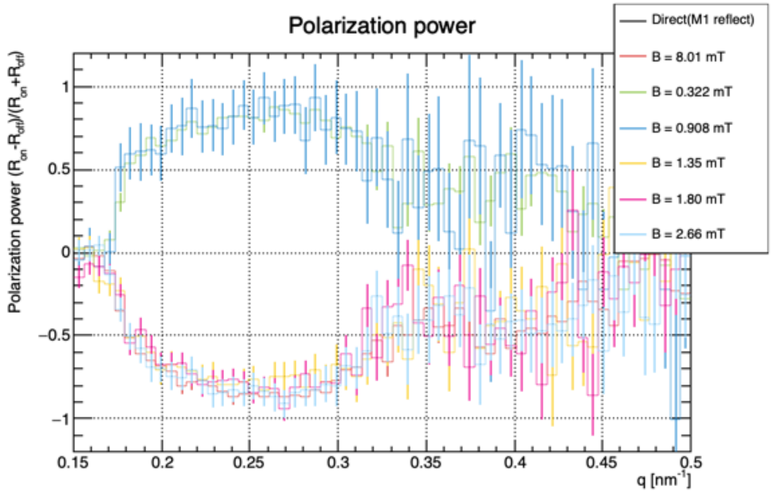
q-dependence of the polarization power (Fe 30nm)

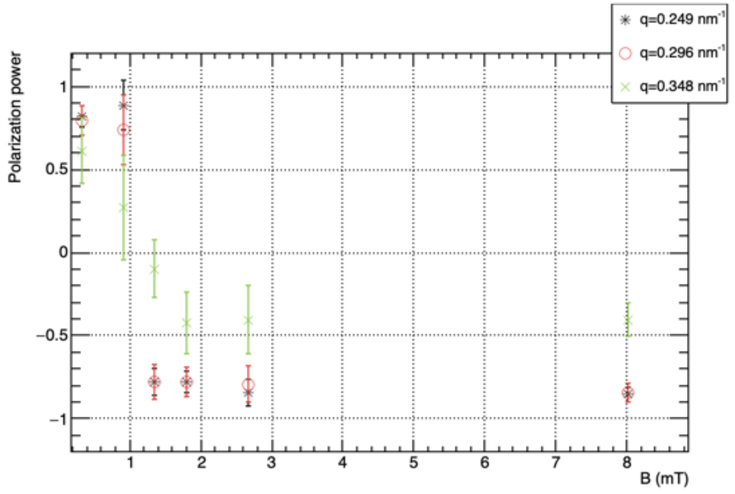
Color coding by the magnitude of the magnetic field applied to the sample

$$P = \frac{R_{\mathrm{on}} - R_{\mathrm{off}}}{R_{\mathrm{on}} + R_{\mathrm{off}}}$$



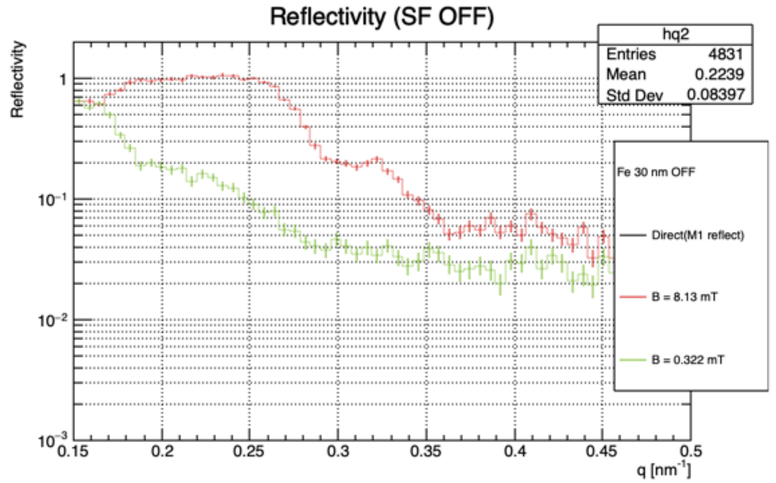


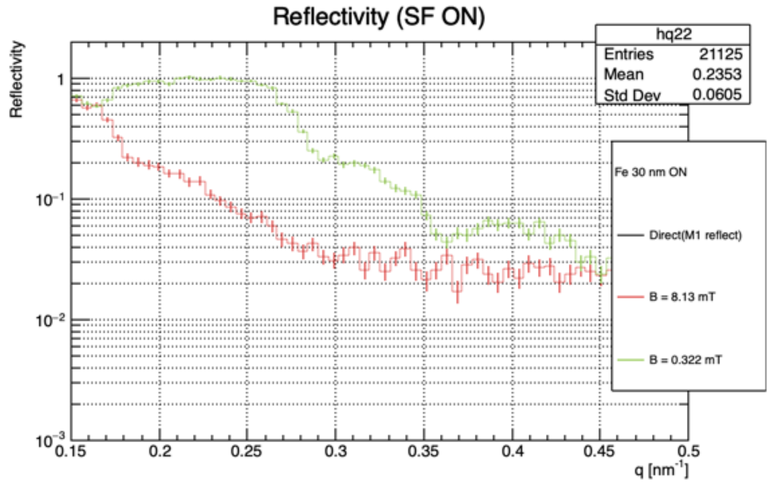


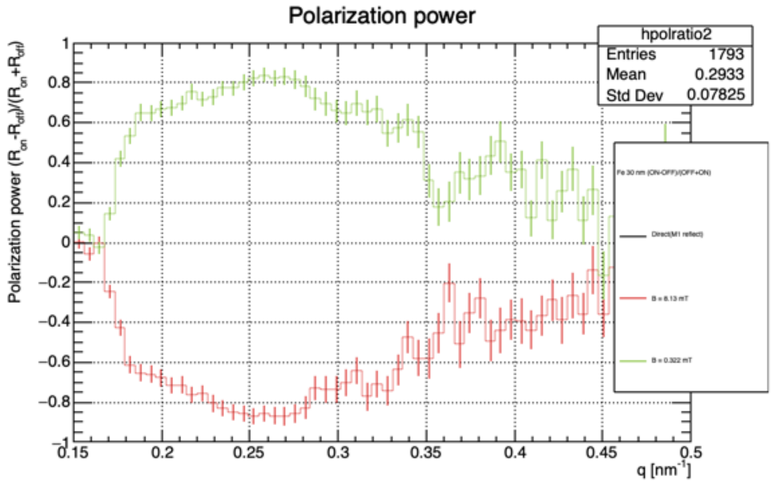


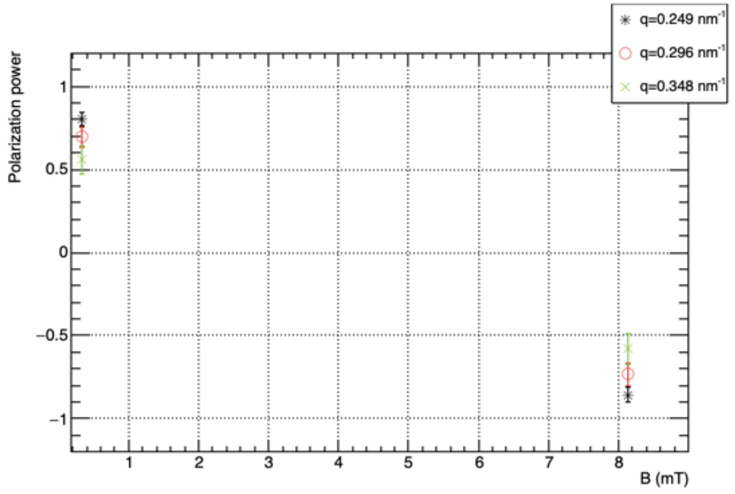
q-dependence of the polarization power (Fe 50nm)

Color coding by the magnitude of the magnetic field applied to the sample



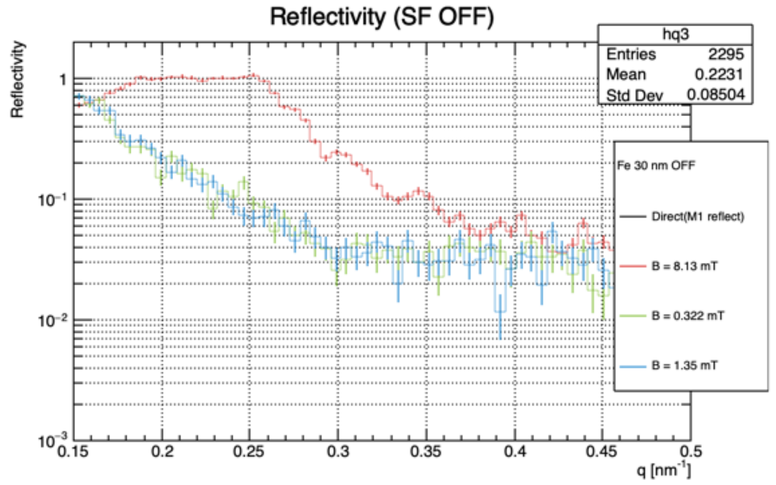


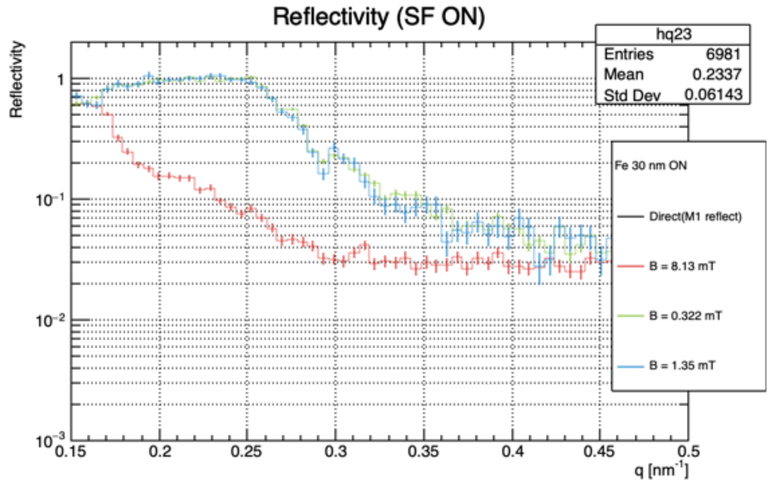


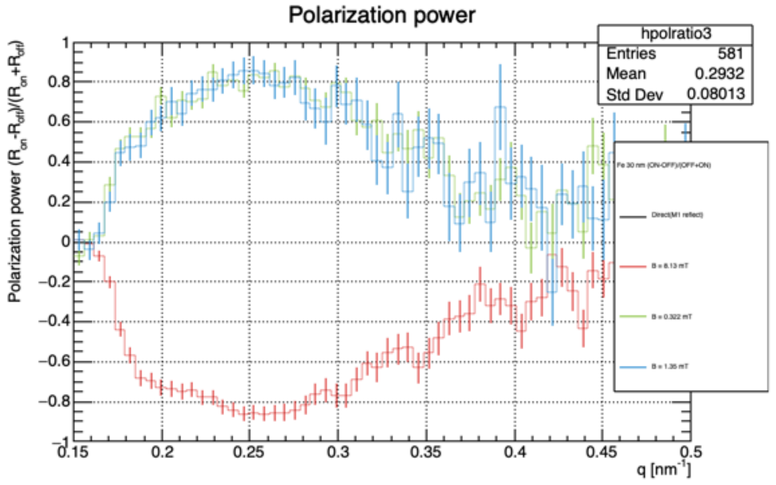


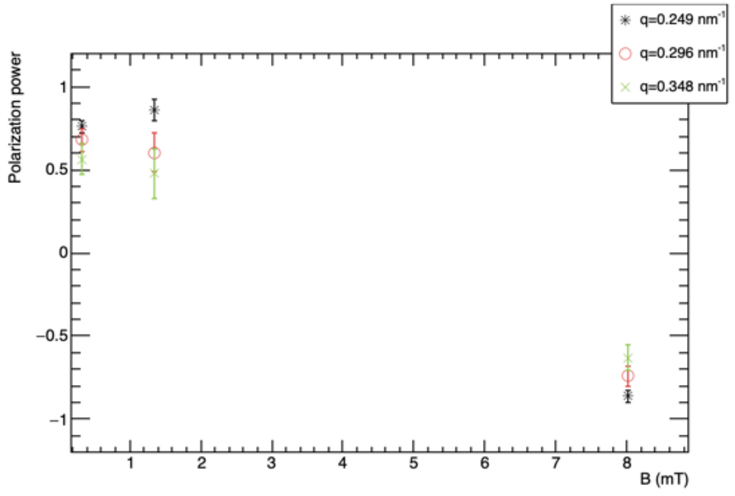
q-dependence of the polarization power (Fe 90nm)

Color coding by the magnitude of the magnetic field applied to the sample

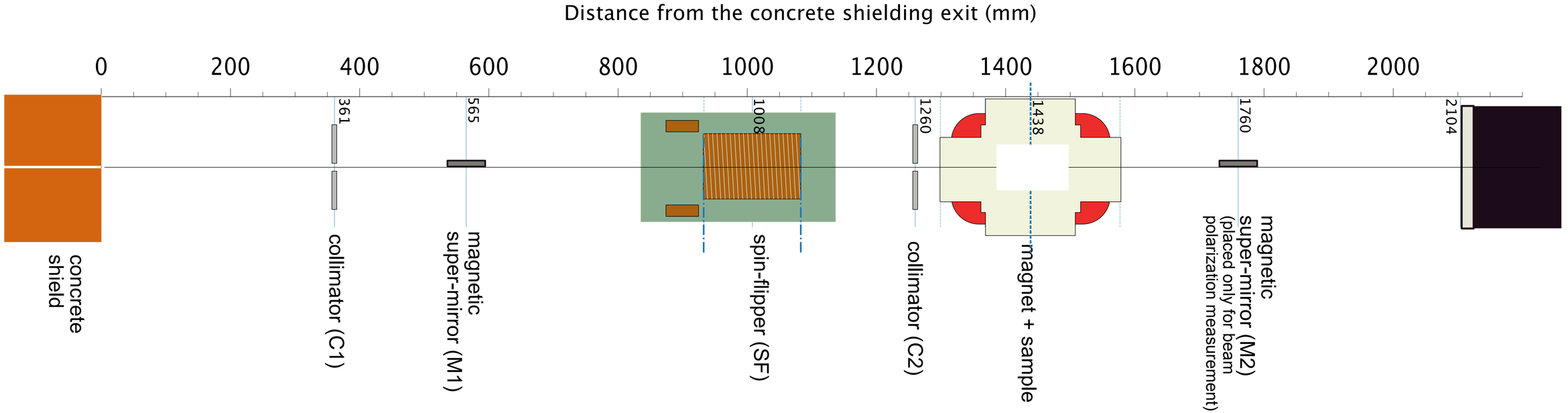




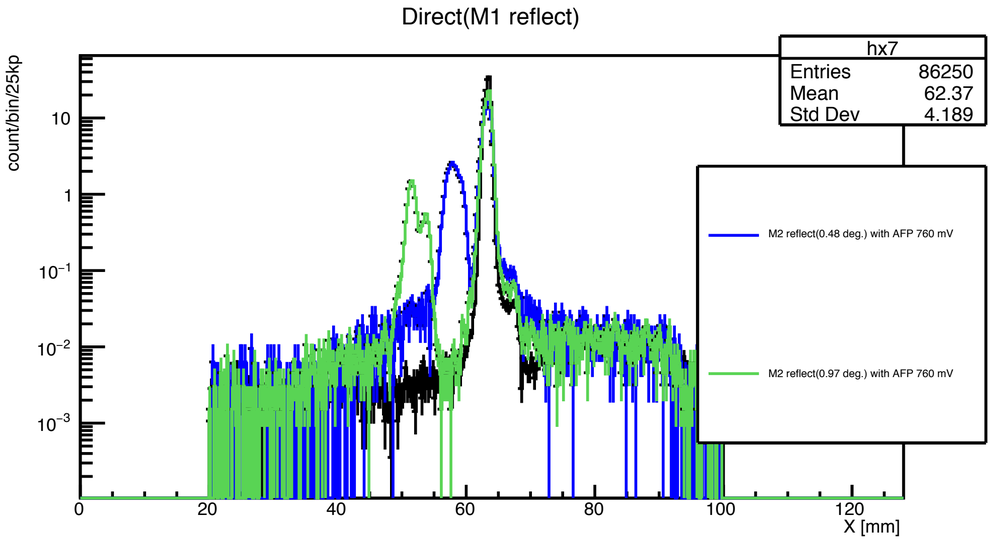


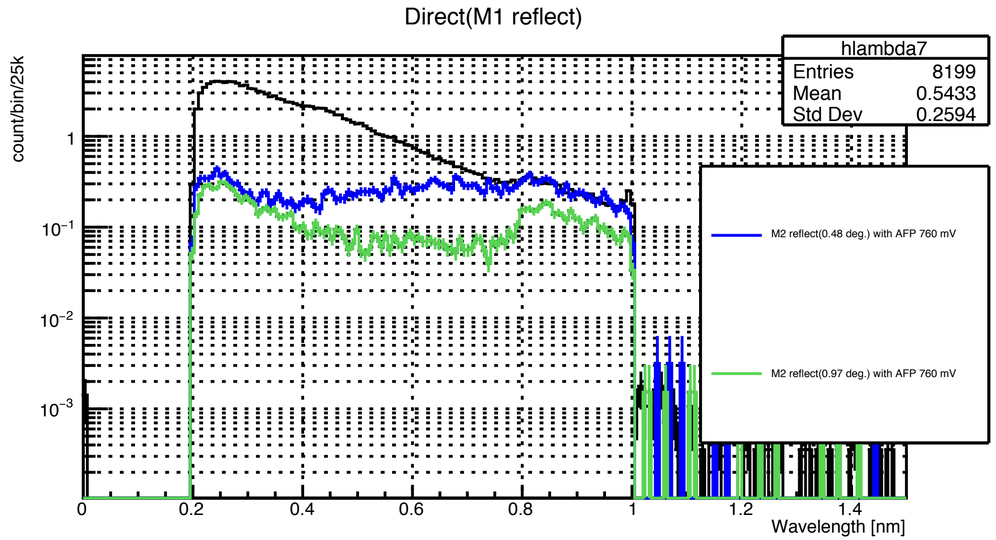


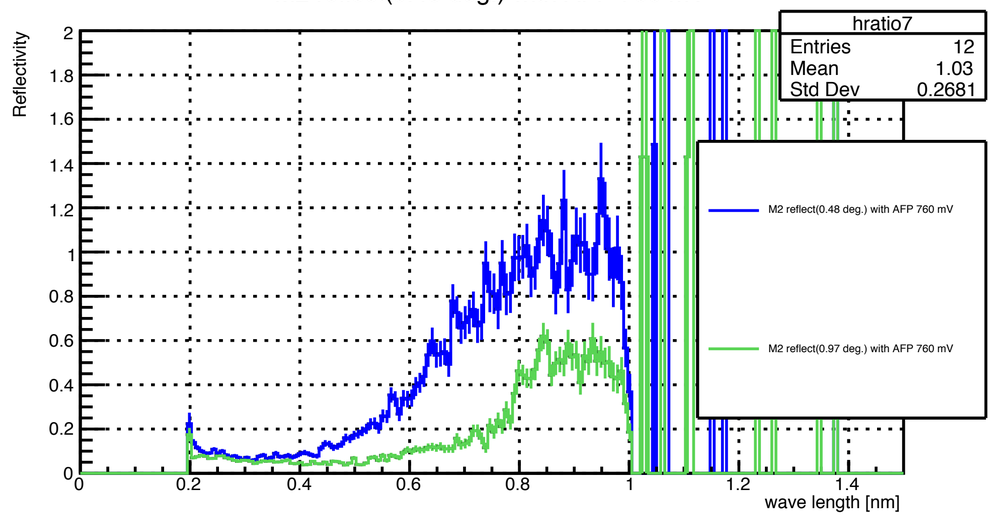
Setup (Comparison of incidence angles with different m2)

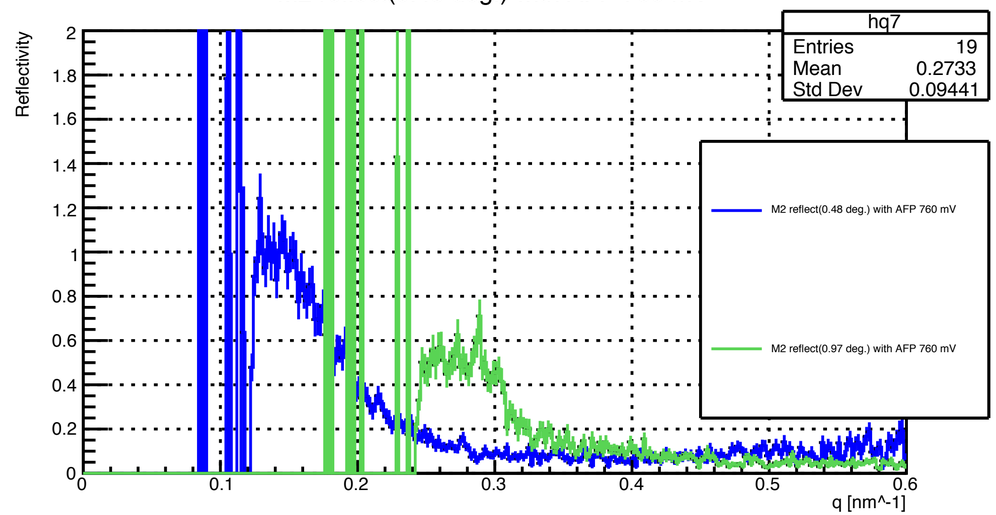


Comparison of incidence angles with different m2









Determination of peak position

Determine the peak from the average of the histogram over the selected range

範囲の選択の仕方によって

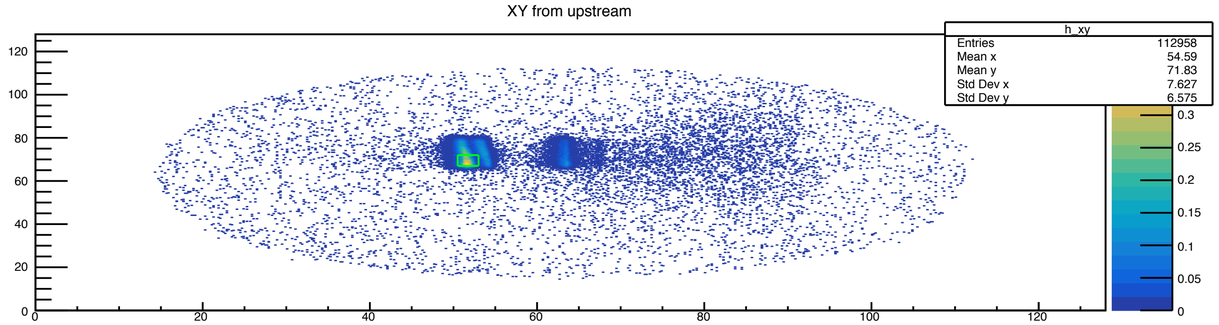
$\pm 1\,\mathrm{mm}$程度ずれてくる

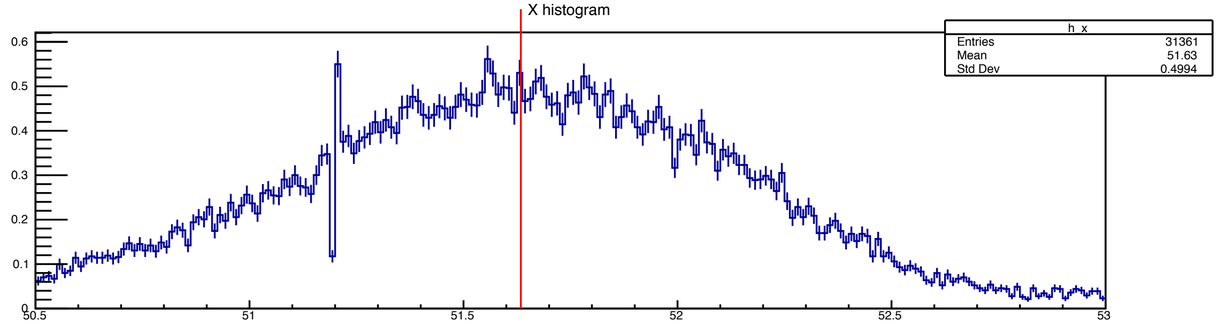
$$2\sin\theta_{m_2} \sim \frac{x_{\mathrm{peak}} - x_{\mathrm{direct}}}{x_{m_2 \sim \mathrm{det}}}$$

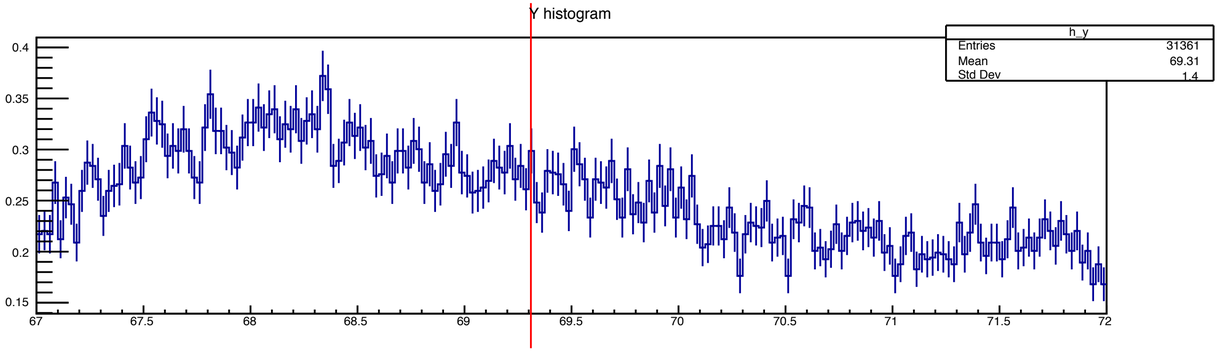
$$= \frac{\sqrt{1^2 + 1^2}}{344} = 0.0041$$

$$q_{\mathrm{error}_{\mathrm{max}}} = \frac{2\pi}{0.2} \times 0.0041 \sim \pm 0.13$$

どのようにピークを決定すべきか？







$$q = \frac{4\pi \sin\theta}{\lambda}$$

$\lambda(0.2 \sim 1\,\mathrm{nm})$

磁場測定と業者の測定と比較

妥当性を検証？

- 業者の測定

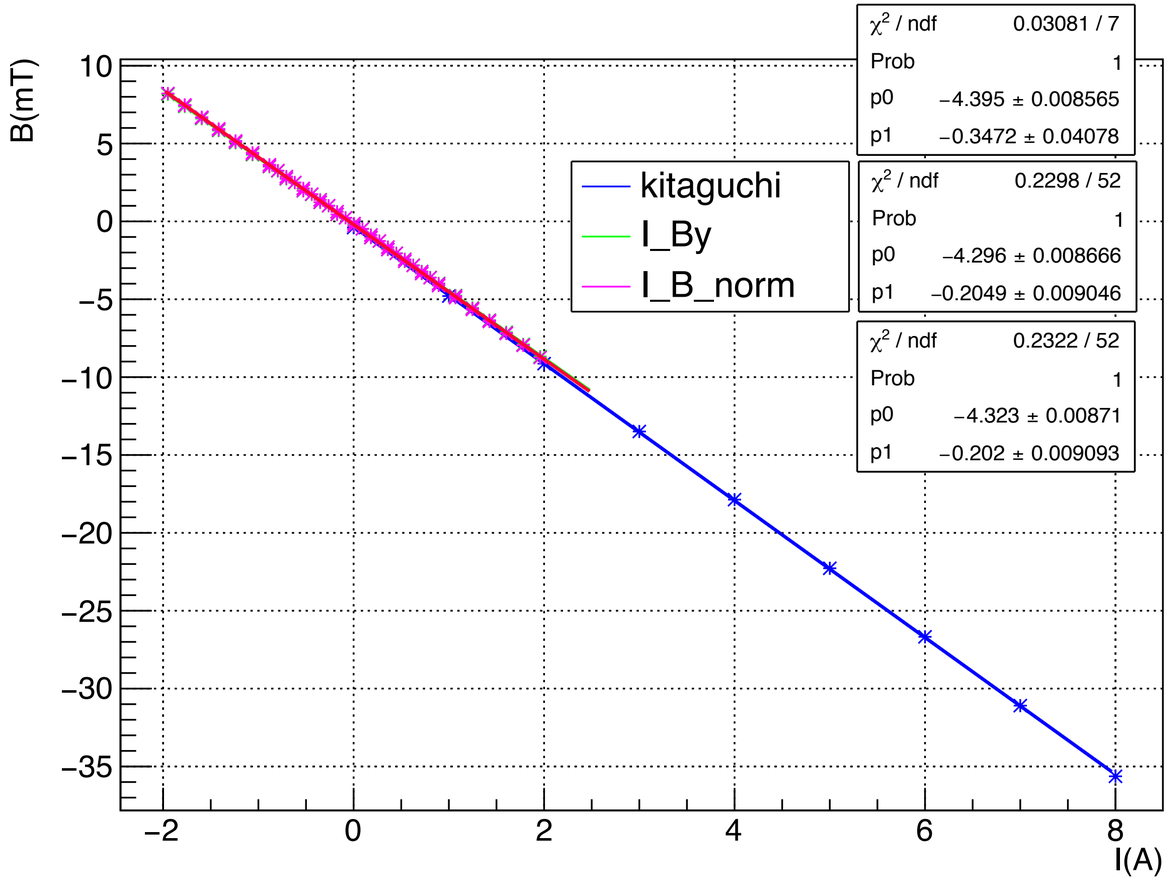
$$B_{\mathrm{kitaguchi}}(\mathrm{mT}) = -4.395(9)\frac{\mathrm{mT}}{A}I_{\mathrm{real}} - 0.34(4)$$

- 今回の測定(y方向)

$$B_{y}(\mathrm{mT}) = -4.296(9)\frac{\mathrm{mT}}{A}I_{\mathrm{real}} - 0.205(9)$$

- 今回の測定(ノルム)

$$B_{\mathrm{norm}}(\mathrm{mT}) = -4.323(8)\frac{\mathrm{mT}}{A}I_{\mathrm{real}} - 0.202(9)$$



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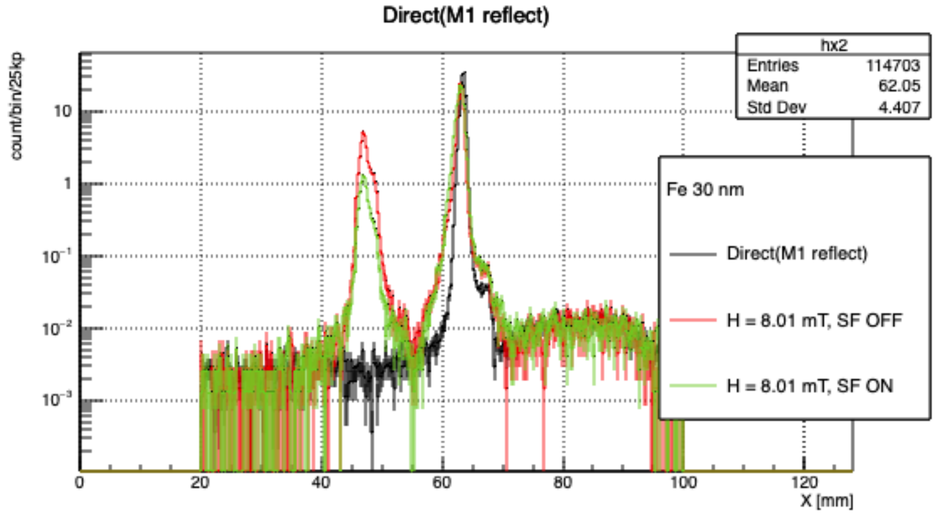
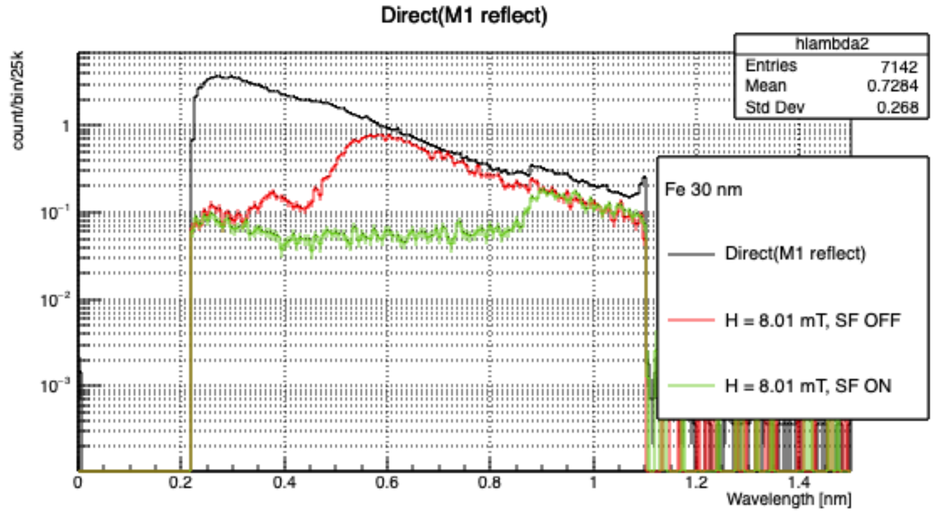
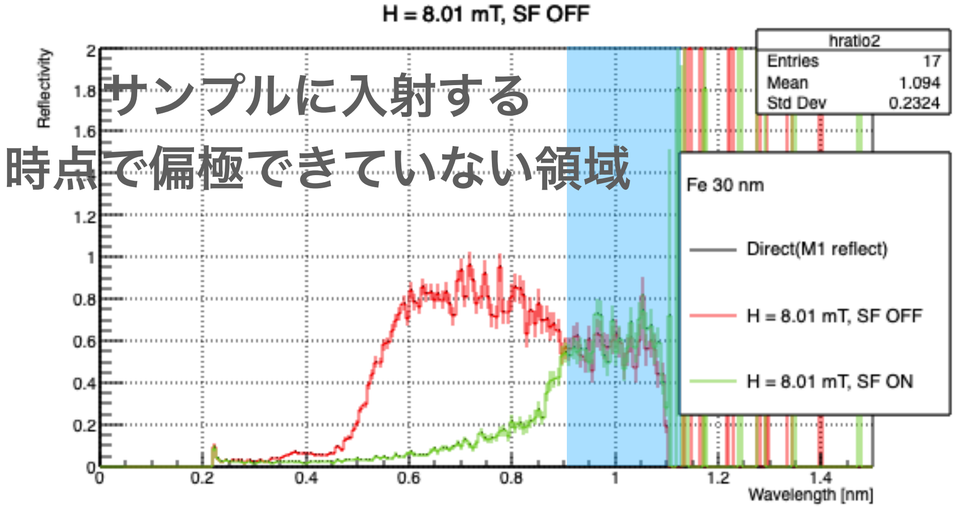
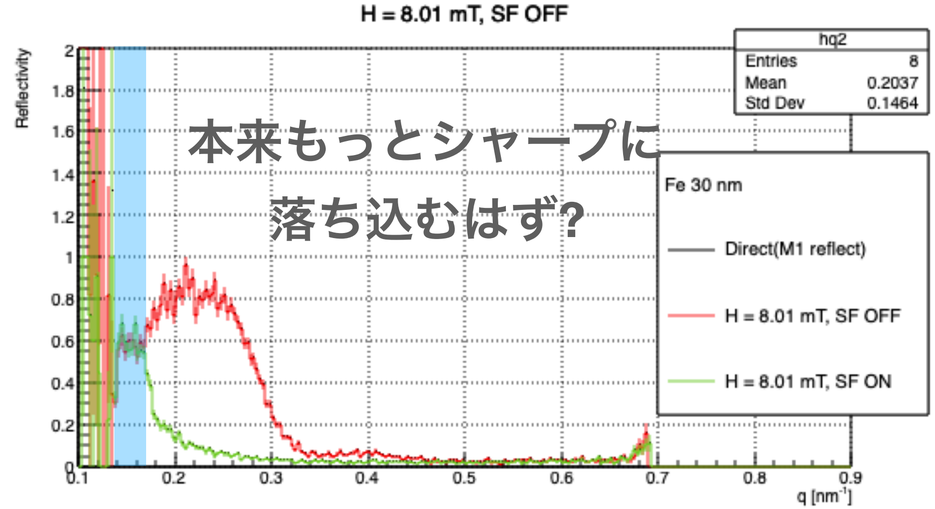
sample 30 nm 8.01 mT (saturated)

緑をとるには、上流ミラーの角度を深くする必要がある

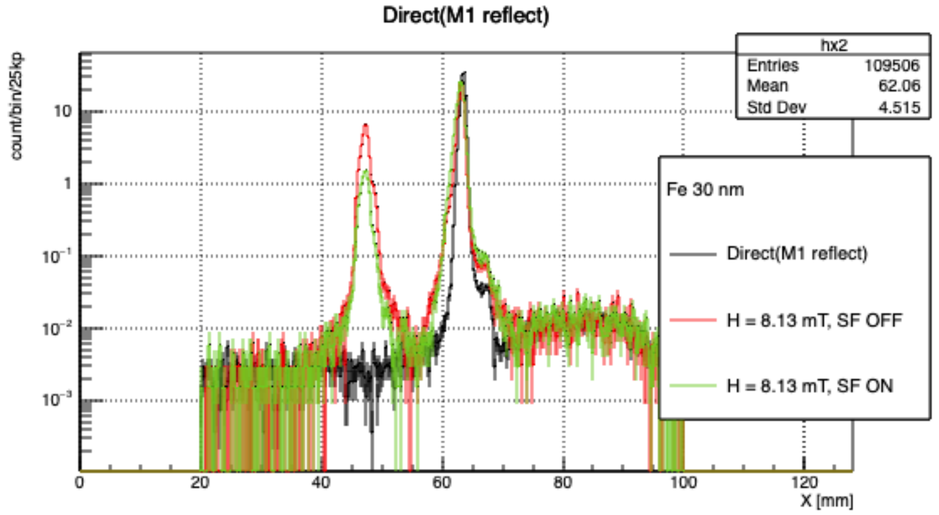


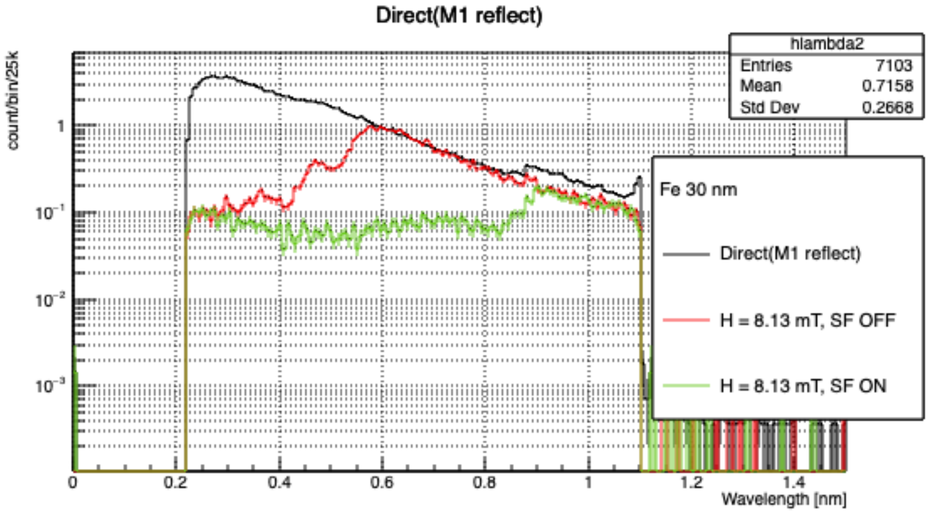


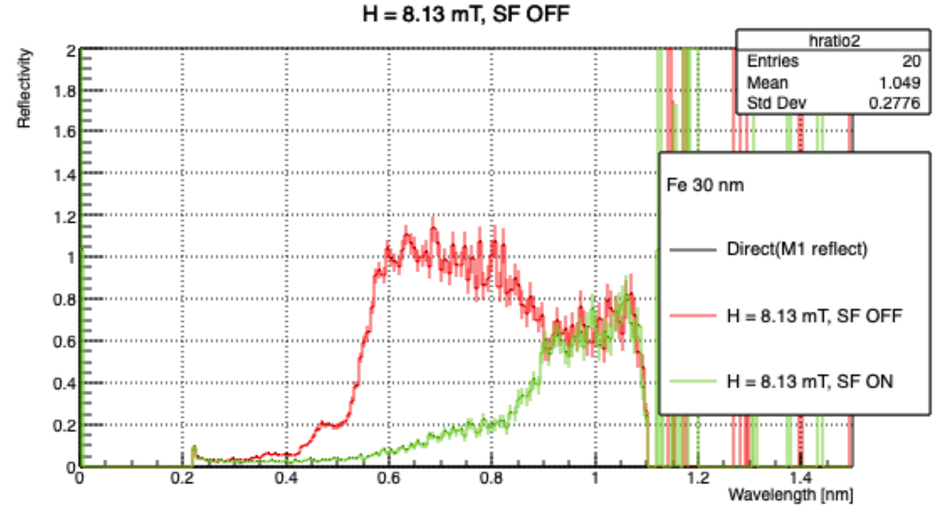


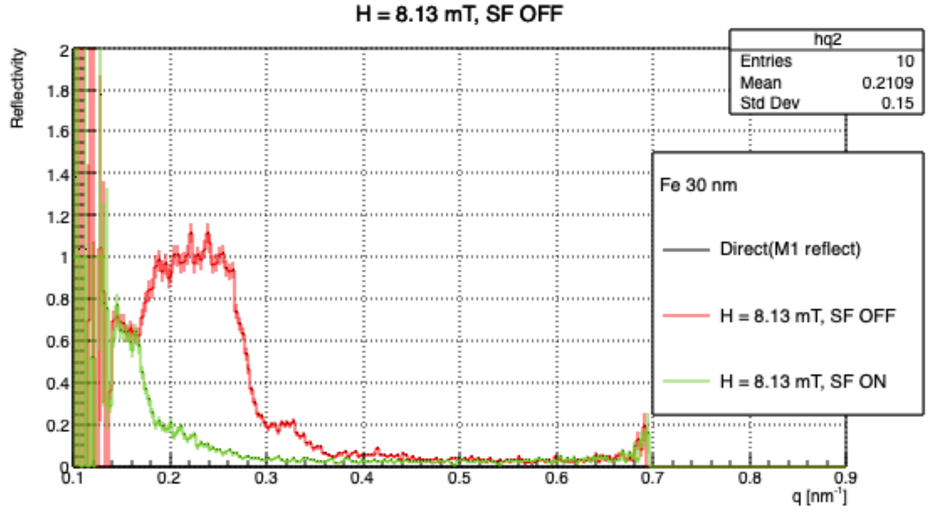


sample 50 nm 8.13 mT (saturated)

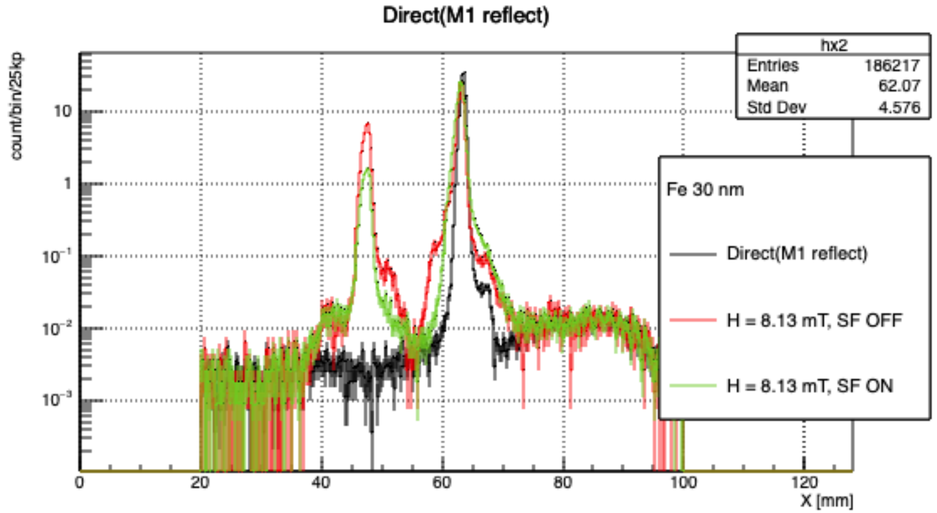


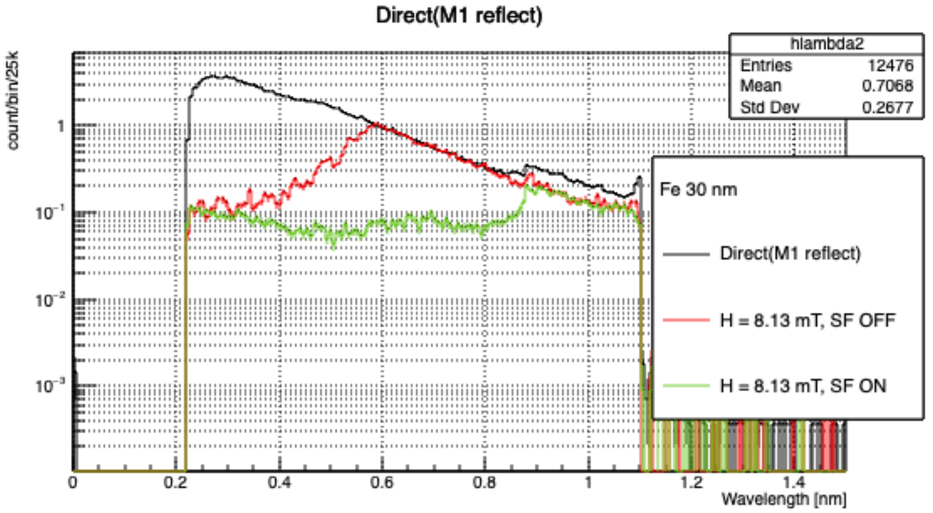


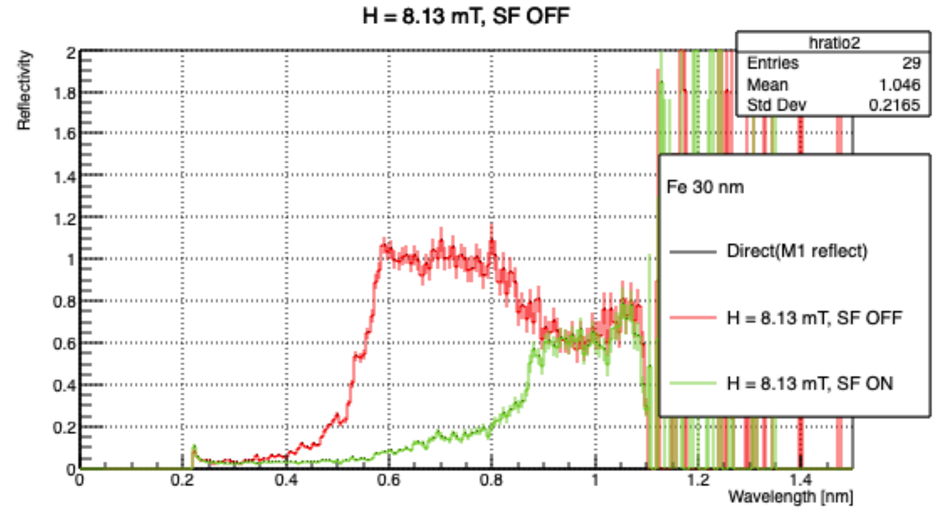


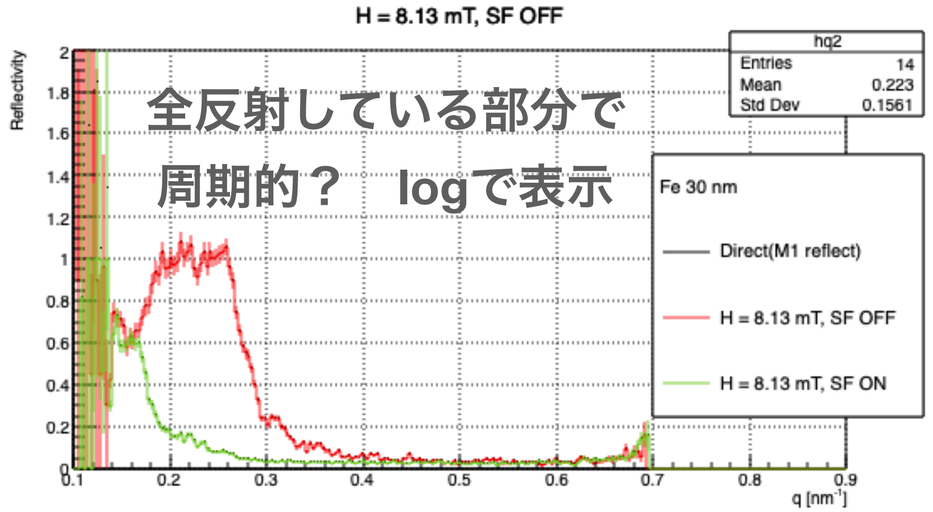


sample 90 nm 8.13 mT (saturated)

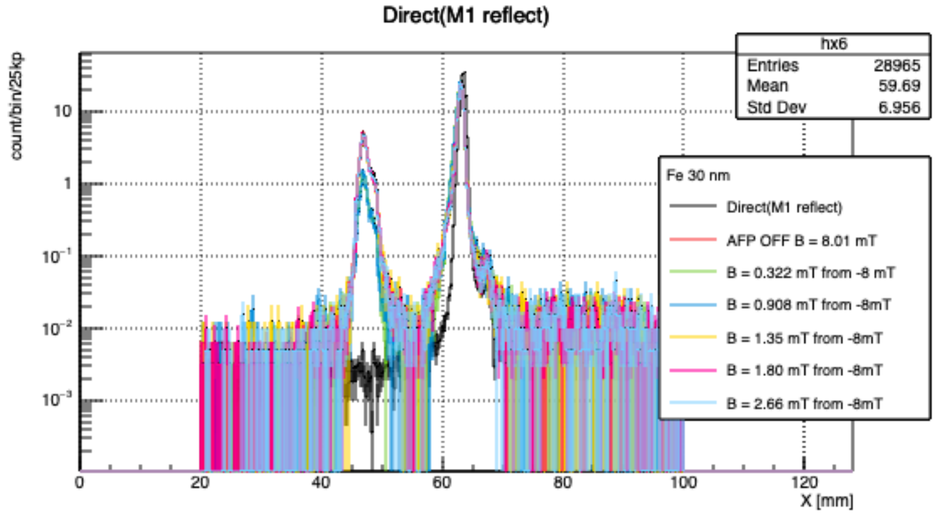


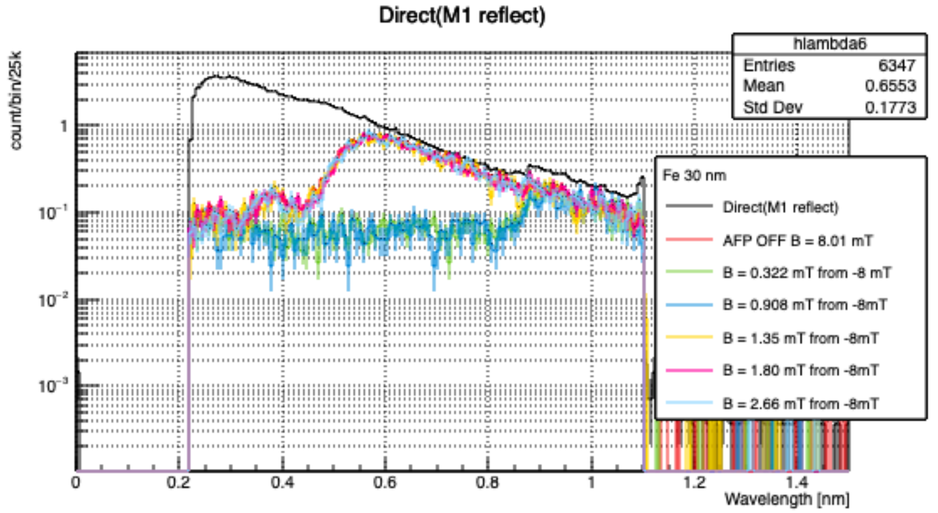


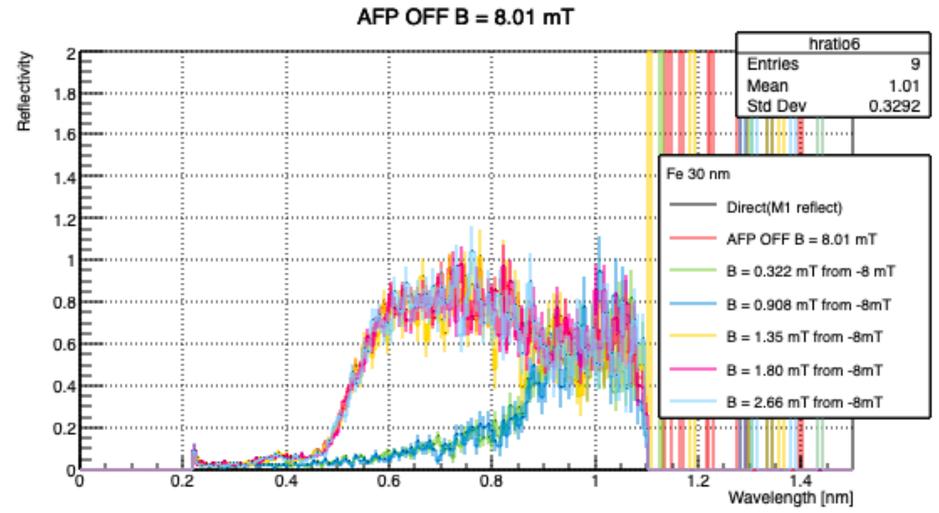


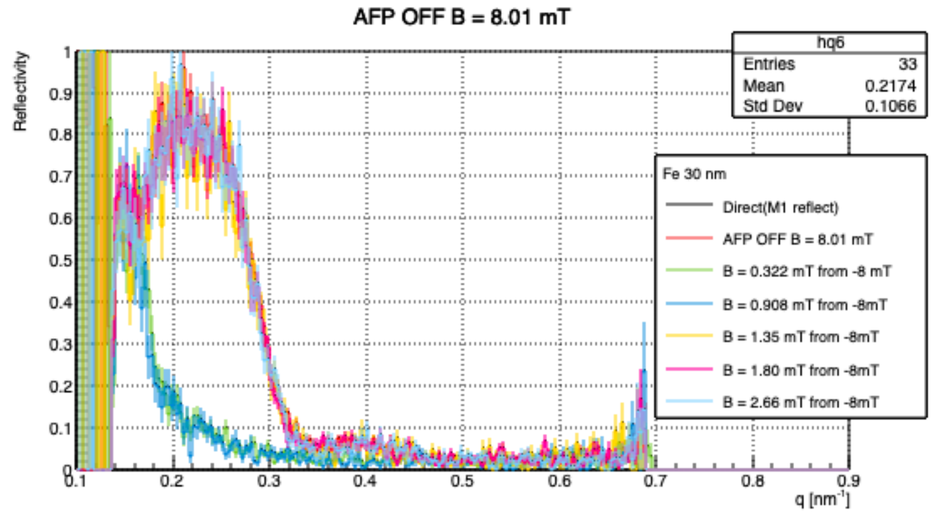


AFP OFF

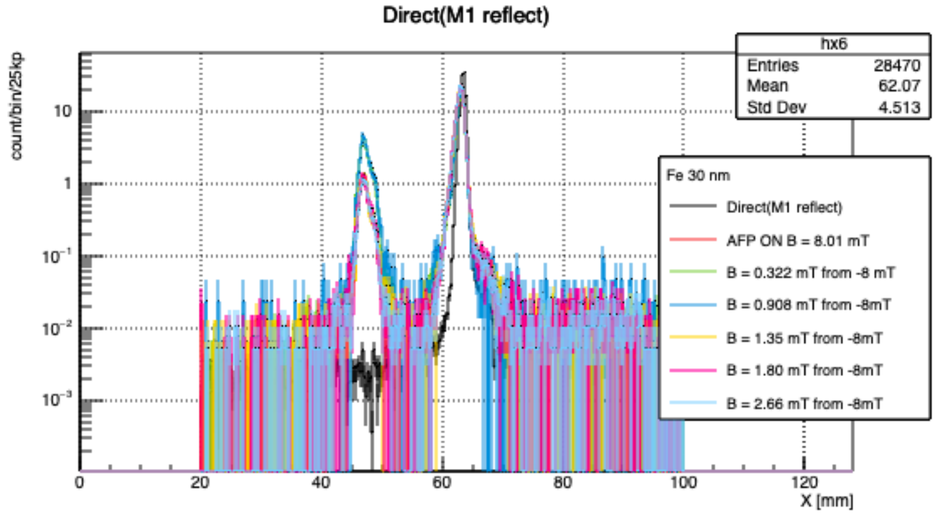

Direct(M1 reflect)
hx6
Entries 28965
Mean 59.69
Std Dev 6.956
count/bin/25kp
X [mm]
Fe 30 nm
Direct(M1 reflect)
AFP OFF B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT

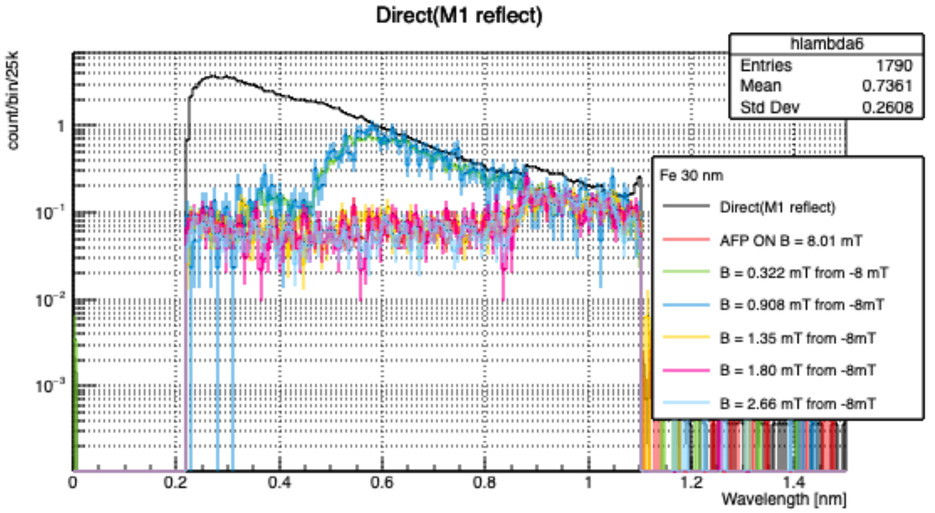

Direct(M1 reflect)
hlambda6
Entries 6347
Mean 0.6553
Std Dev 0.1773
count/bin/25k
Wavelength [nm]
Fe 30 nm
Direct(M1 reflect)
AFP OFF B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT

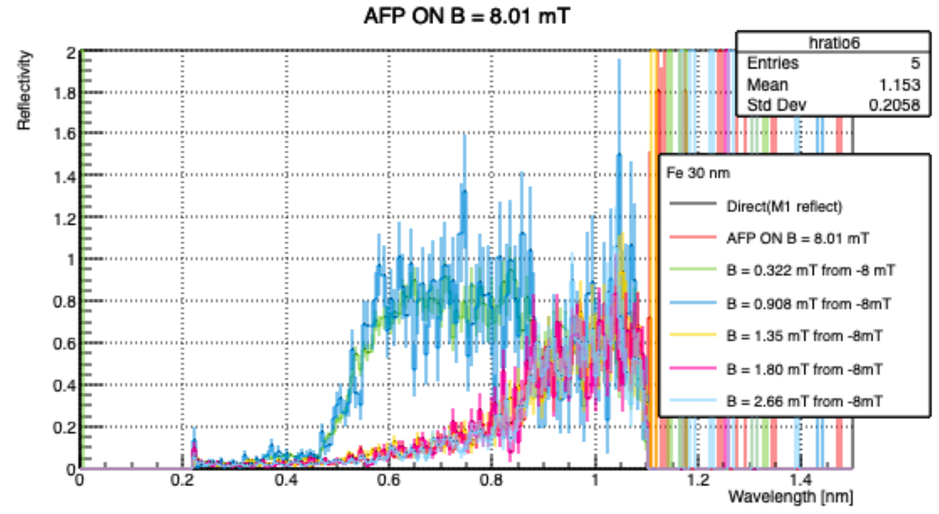

AFP OFF B = 8.01 mT
hratio6
Entries 9
Mean 1.01
Std Dev 0.3292
Reflectivity
Wavelength [nm]
Fe 30 nm
Direct(M1 reflect)
AFP OFF B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT

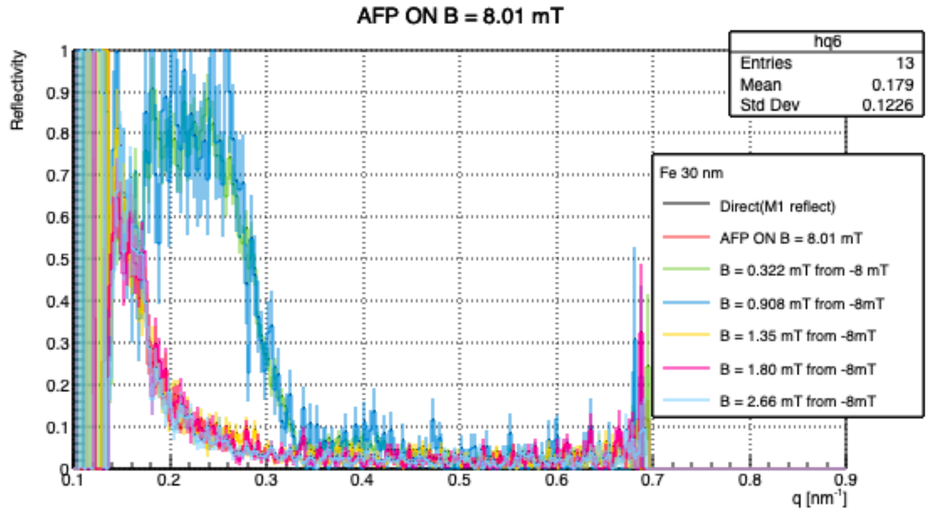

AFP OFF B = 8.01 mT
hq6
Entries 33
Mean 0.2174
Std Dev 0.1066
Reflectivity
q [nm^{-1}]
Fe 30 nm
Direct(M1 reflect)
AFP OFF B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT

AFP ON


Direct(M1 reflect)
hx6
Entries 28470
Mean 62.07
Std Dev 4.513
count/bin/25kp
X [mm]
Fe 30 nm
Direct(M1 reflect)
AFP ON B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT


Direct(M1 reflect)
hlambda6
Entries 1790
Mean 0.7361
Std Dev 0.2608
count/bin/25k
Wavelength [nm]
Fe 30 nm
Direct(M1 reflect)
AFP ON B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT


AFP ON B = 8.01 mT
hratio6
Entries 5
Mean 1.153
Std Dev 0.2058
Reflectivity
Wavelength [nm]
Fe 30 nm
Direct(M1 reflect)
AFP ON B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT


AFP ON B = 8.01 mT
hq6
Entries 13
Mean 0.179
Std Dev 0.1226
Reflectivity
q [nm^{-1}]
Fe 30 nm
Direct(M1 reflect)
AFP ON B = 8.01 mT
B = 0.322 mT from -8 mT
B = 0.908 mT from -8mT
B = 1.35 mT from -8mT
B = 1.80 mT from -8mT
B = 2.66 mT from -8mT

- Pol power の続き
- 上流ミラーのみをおいて測ったデータで何か言える？
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