Data summary for the paper “Polarization response and scaling law of chirality for 1 a nanofibre optical interface”

→ This document contains a summary of the four data sets used in our paper.

→ Along with the data actually displayed in the paper, we show our measurements of intensity scattered into the fiber modes as we scan the fiber through the excitation beam spot along the fiber axis. In most cases, we correlated these measurements with the SEM measured particle positions allowing us to have excellent confidence in associating optical measurements with specific particles found in SEM measurements. Because this method is fairly self explanatory and other groups have already published similar results, we didn't include it in our manuscript of supplementary material, but we include it here to show our working.

→ The sole exception regarding this correlation method is for Fiber 040. Because the fiber broke before we could find the second particle in the SEM, this correlation process could not be completed for fiber 040. However, after a number of successful experiments, where very good agreement was seen between experimental and theoretical results, we felt confident that we could identify which optical measurement corresponded to the SEM measured particle in fiber 040 by comparison between theory and experiment. The situation is explained in more detail in the data slides for fiber 040.

→ Because we were focusing on chirality in this paper, we didn't show our half wave plate data explicitly (it is, of course, included in the 3D scans presented in the paper). Instead we showed a reconstructed 1D scan along the great circle through HRVL which demonstrates chirality. However, we show the HWP data here for completeness. We have not been able to determine the cause of the small phase shifts between the theory and the experimental waveplate scans, but they are almost certainly due to non-perfect sphericality of the particles, or other systematic effects which break symmetry.

Fiber 040

Notes:

→ Due to fiber breakage during SEM measurements, we could not produce an unambiguous Identification between SEM and optical data from the SEM measurements alone.

→ For this reason, we compare the theory for the parameters measured in the SEM with the experimental measurements and chose the closest match.

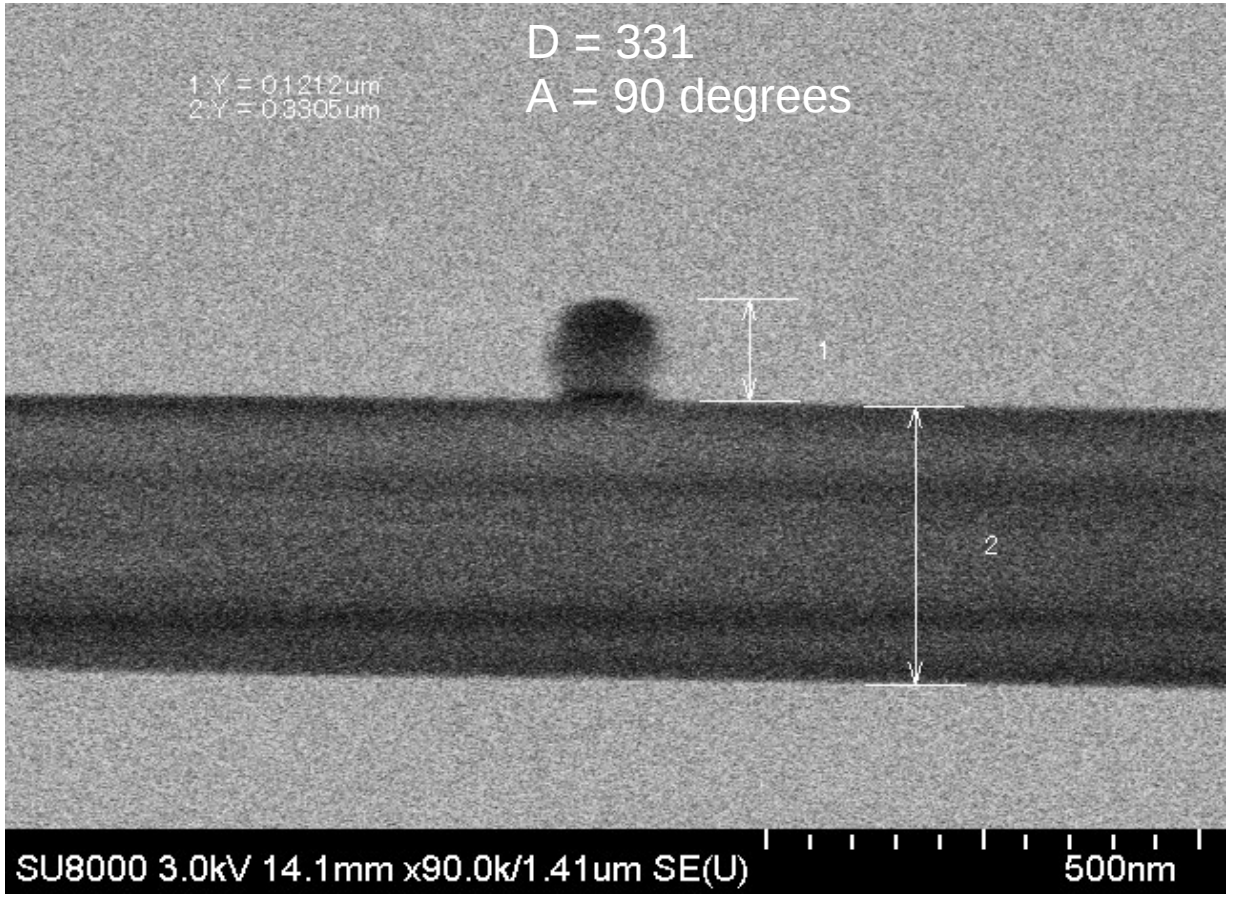
→ Note on signal to noise: For the H-polarization, measurements show that the background scattering into the fiber away from the nanosphere region is a mere 0.05%! The background is bascially negligible for all these experiments.

→ **Important: Fiber040 was measured in the SEM before we labelled the left and right sides of the fiber. Therefore there was ambiguity about which side of the fiber was left and right relative to the measurement direction in the SEM.**
We resolved this ambiguity later by comparing with data for fibers where left and right was labelled and so no such ambiguity existed. From these comparisons it was found that the fiber was rotated 180 degrees in the SEM relative to the optical measurements. We correct for this by swapping the left and right channel measurements when we analyse the optical measurements for this fiber

Fiber 040

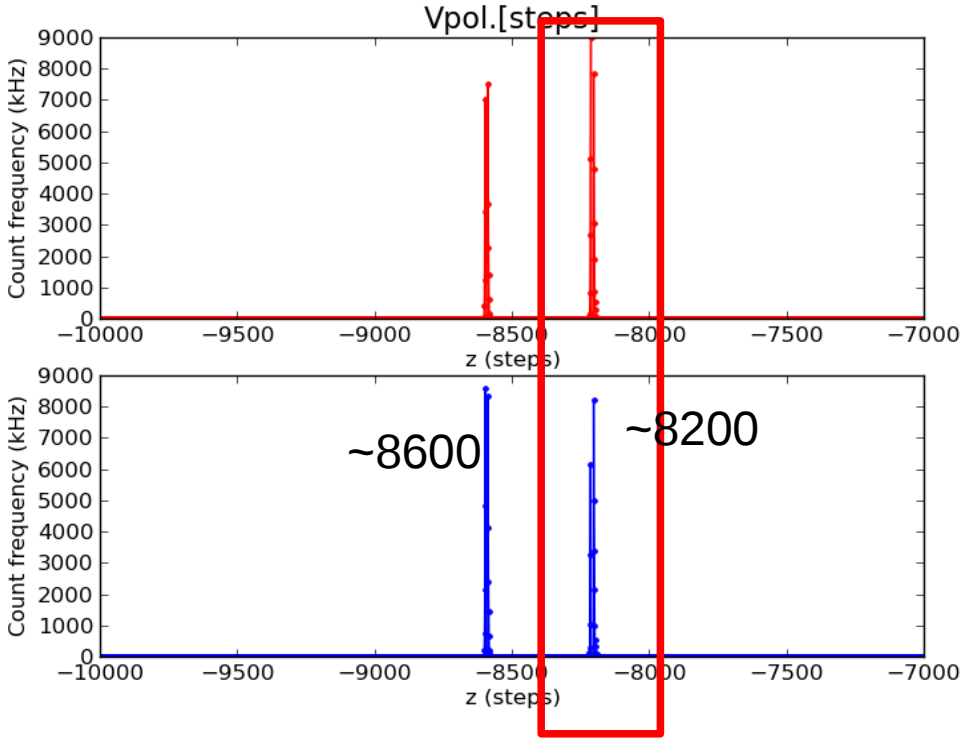
SEM:

This is the fiber upper-side

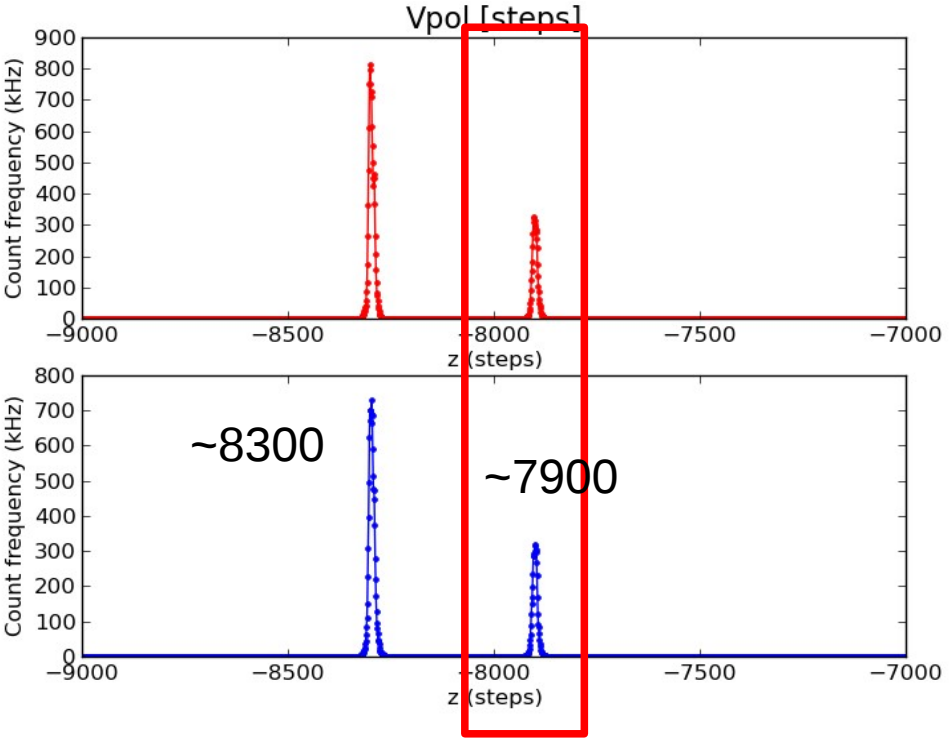


Fiber 040

Backside scan



Frontside scan



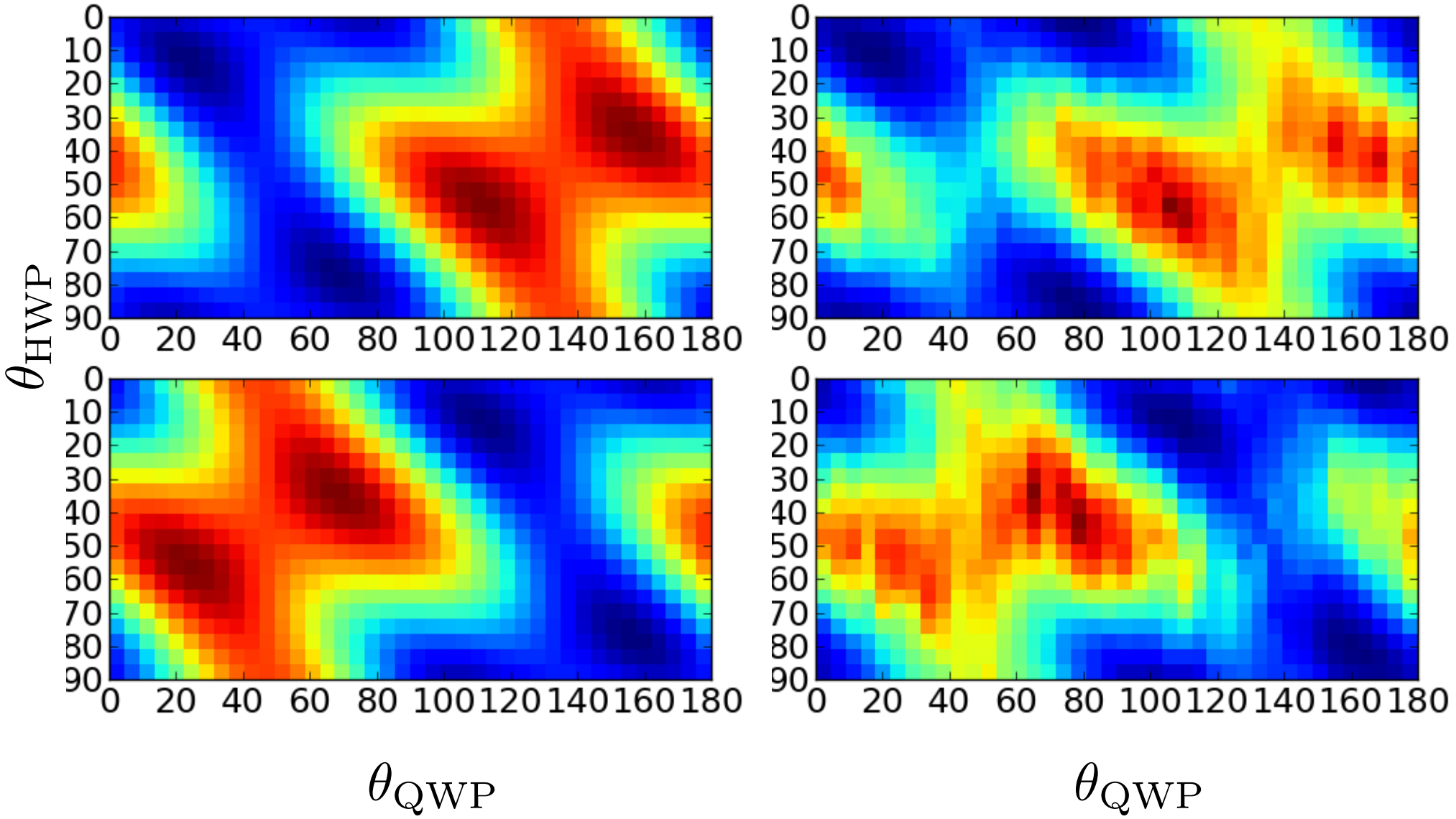
The particle shown in the previous page's SEM image is associated with this peak, as justified in the next pages

Fiber 040

Waveplate scans:

Theory

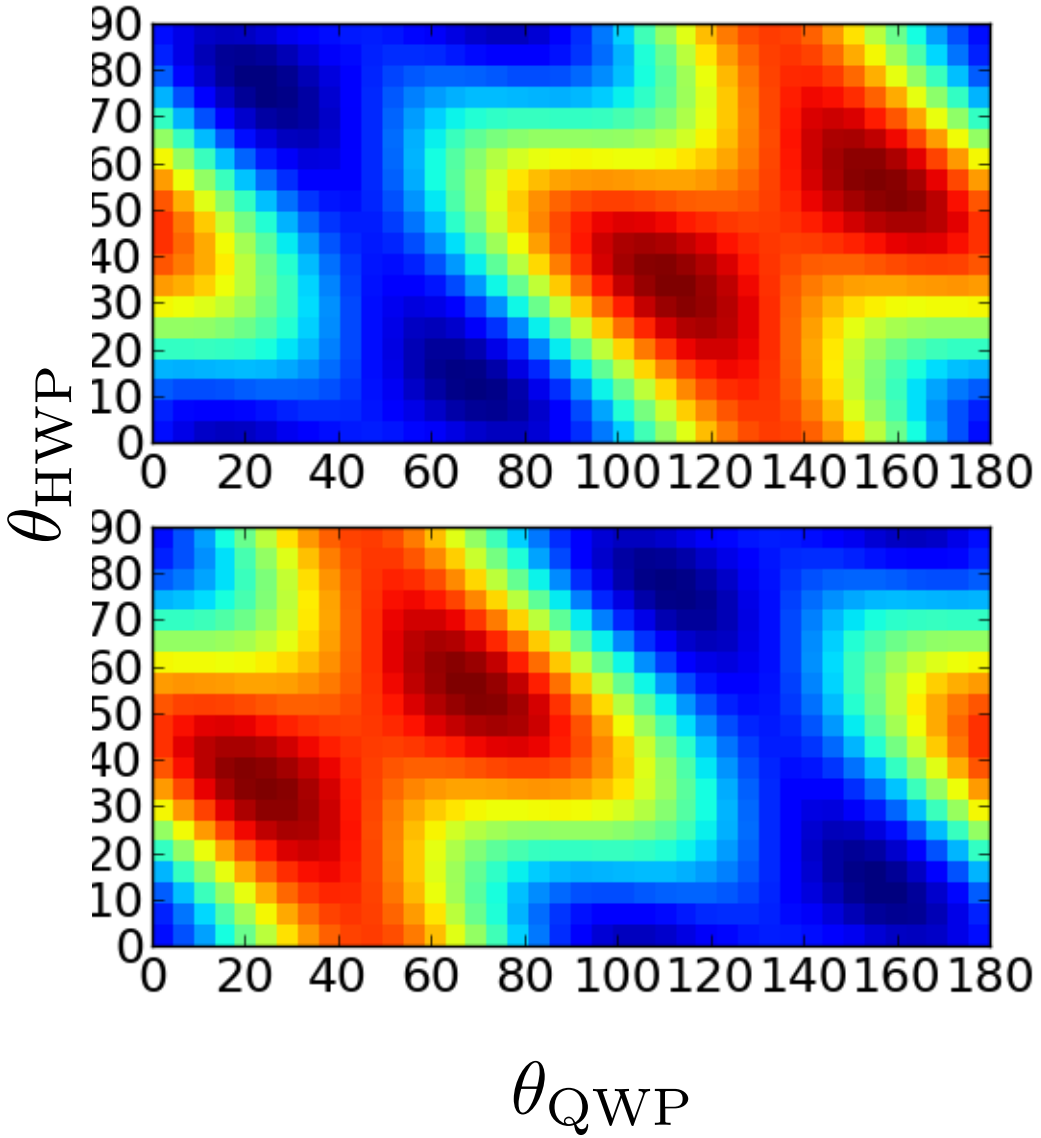
Experiment – 2017/02/03 – Front side – Z= -8294



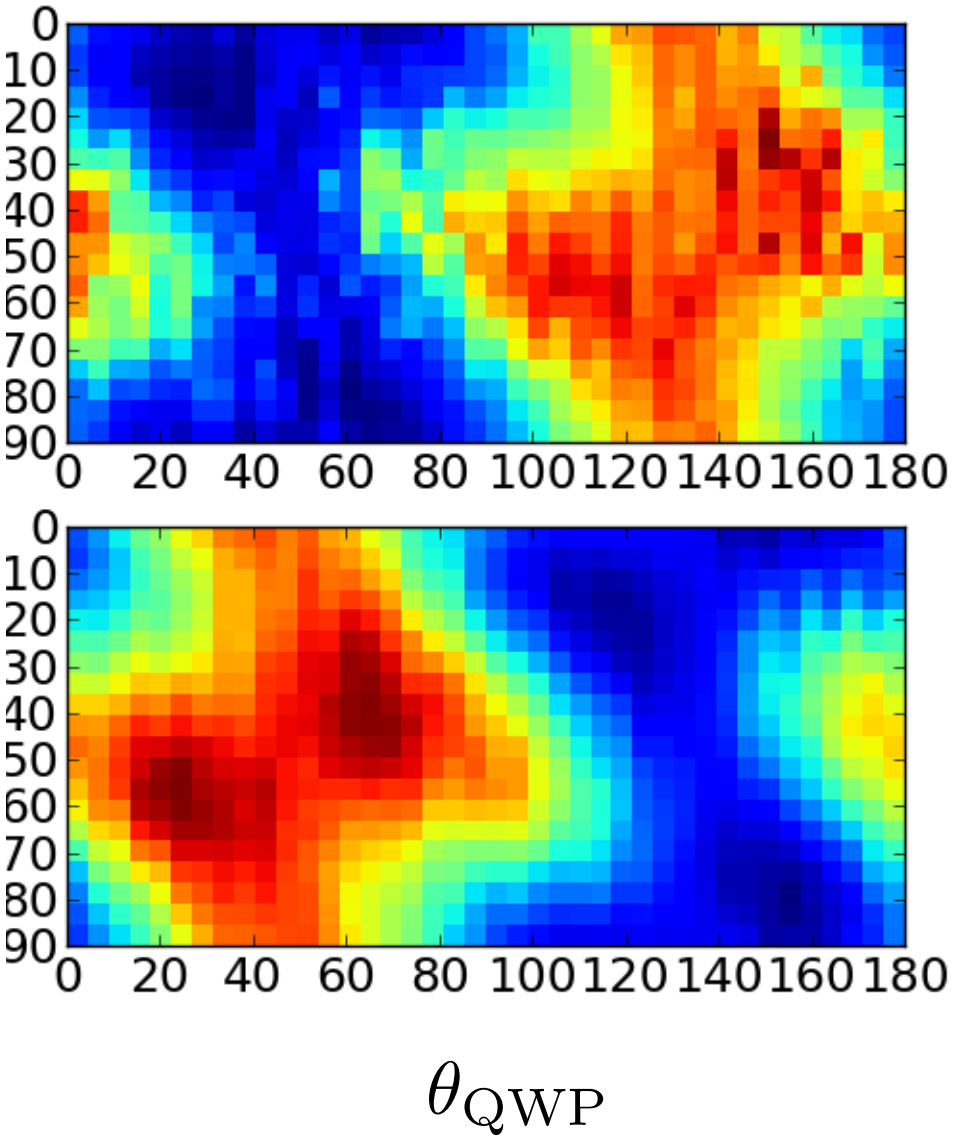
Fiber 040

Waveplate scans:

Theory



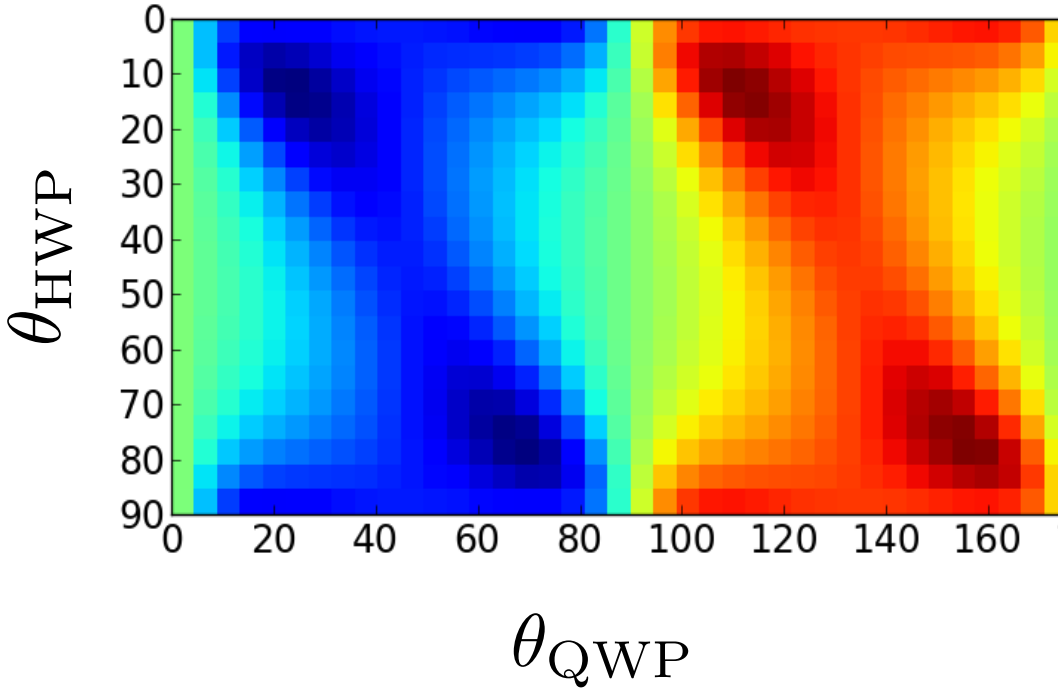
Experiment – 2017/02/03 – Front side – Z= -7899



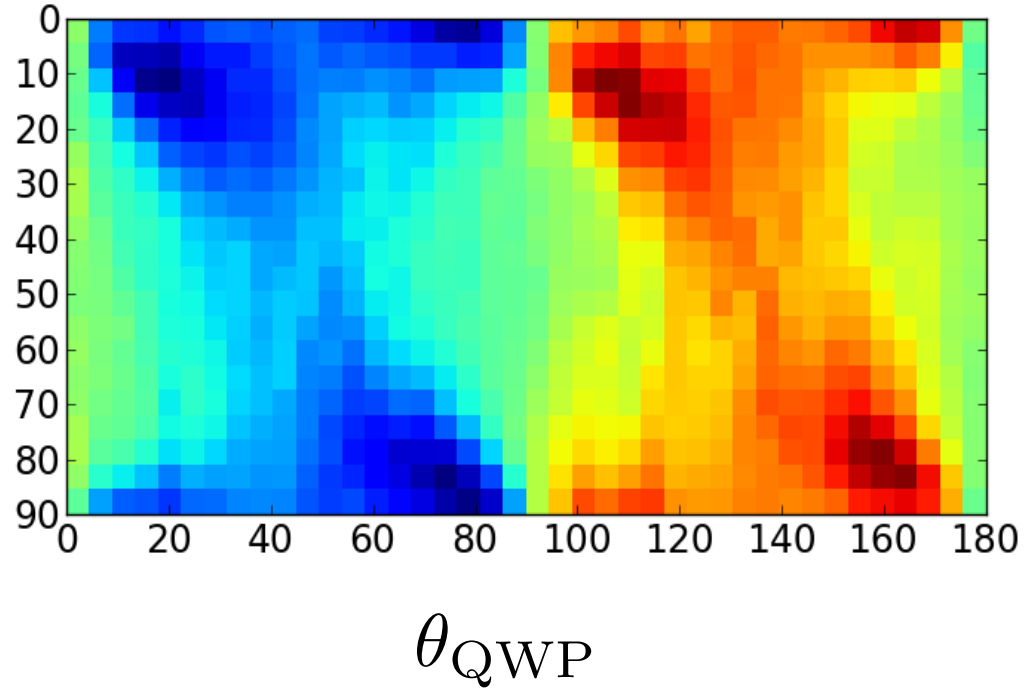
Fiber 040

Directionality:

Theory



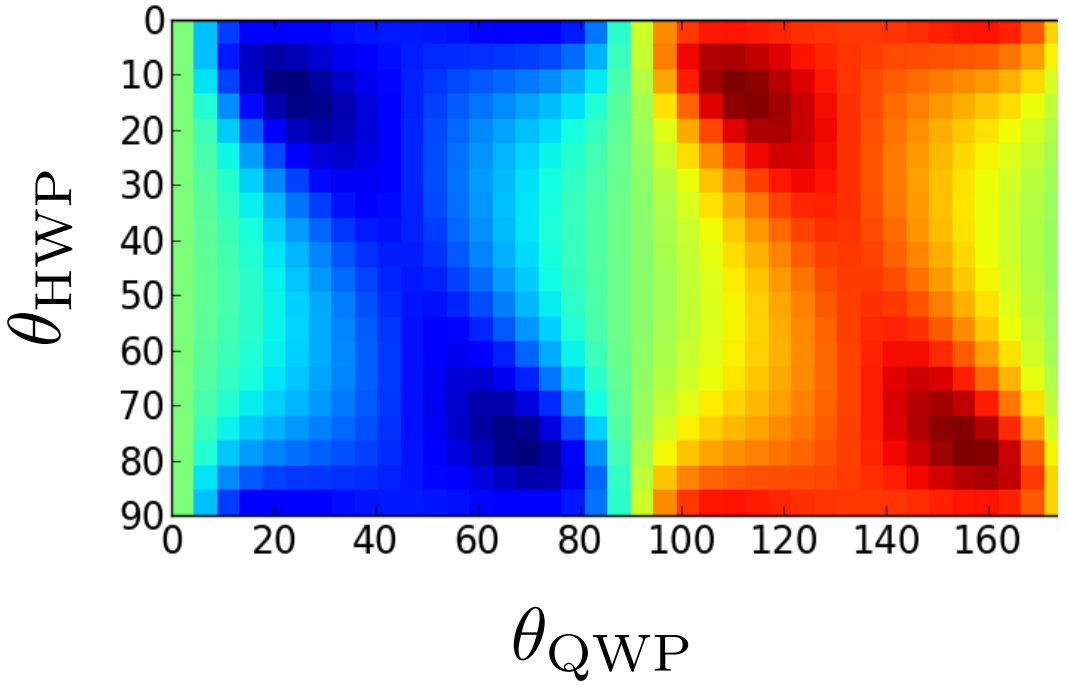
Experiment – 2017/02/03 – Front side – Z= -8294



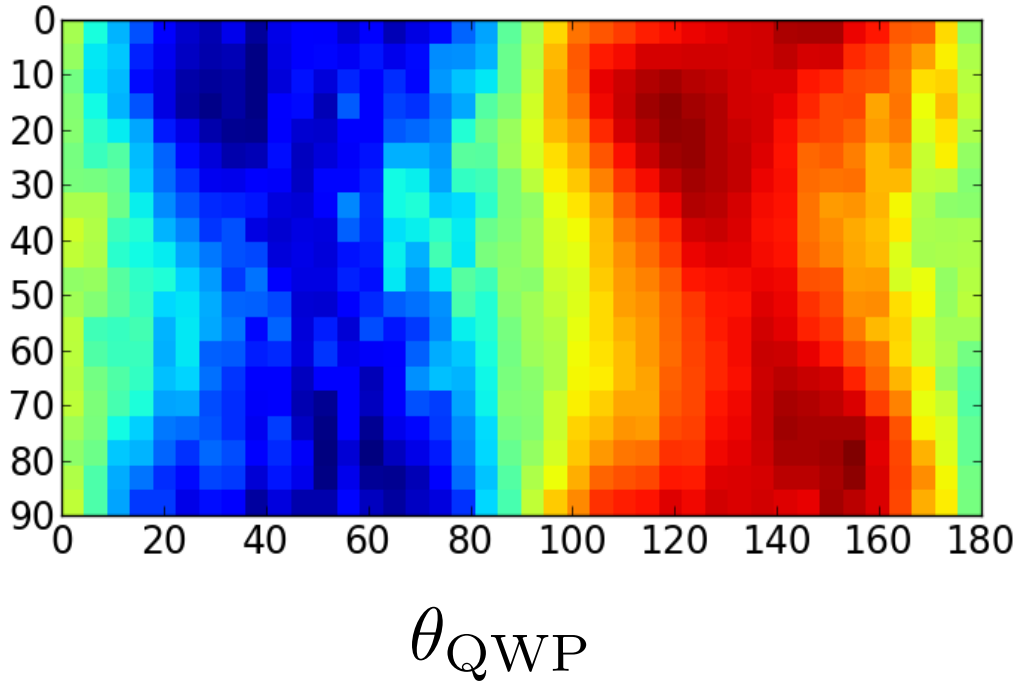
Fiber 040

Directionality

Theory



Experiment – 2017/02/03 – Front side – Z= -7899



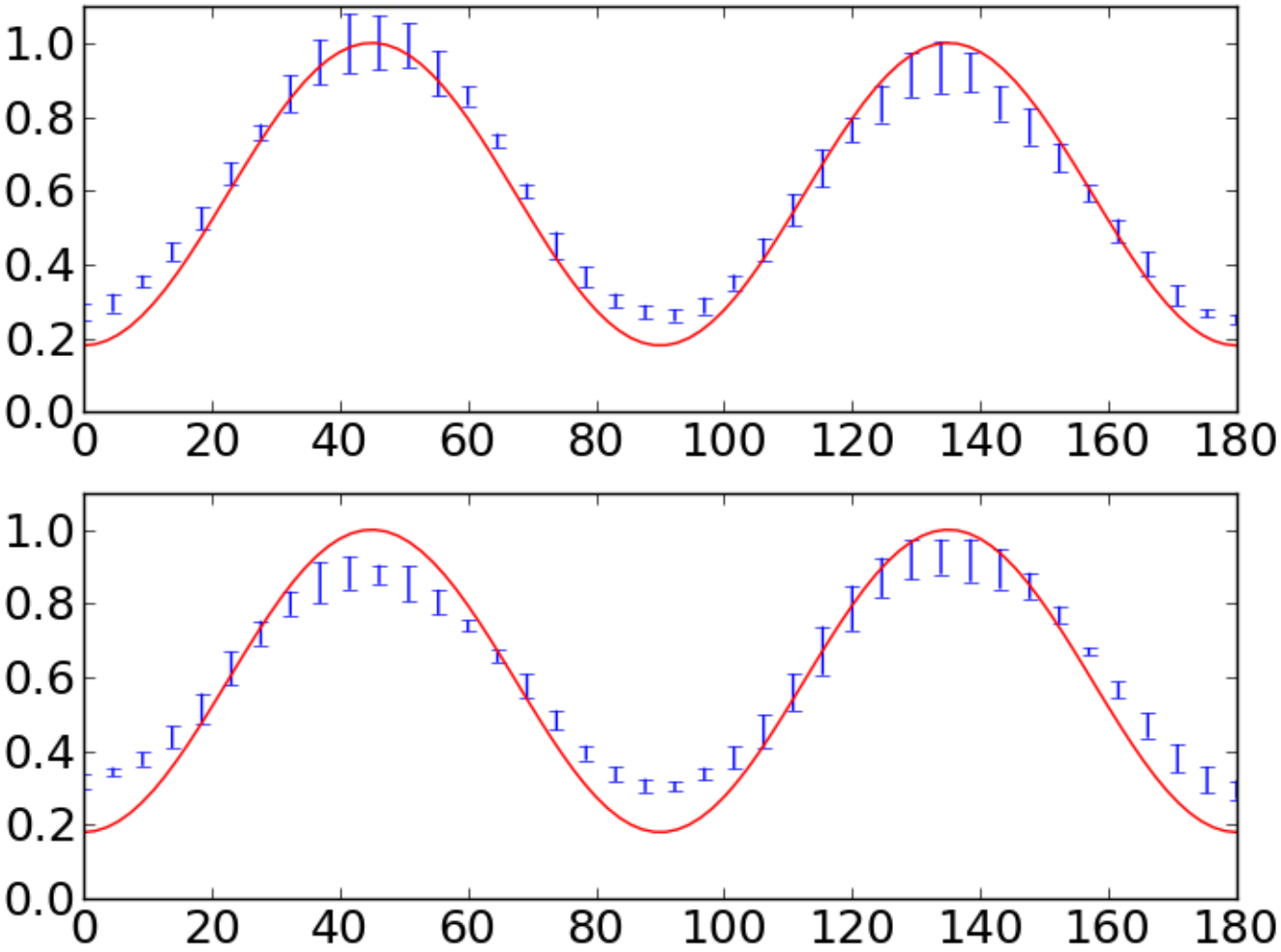
Based on the directionality and waveplate data, we conclude that the particle measured in the SEM corresponds to the front side Z=-7899 data

Fiber 040

Experiment – 2017/02/03 – Front side – Z= -8294

Half wave plate measurements

Red line = theory for the particle position and fiber radius as measured by the SEM



$$|E_z/E_y|_{\text{exp}} = 0.53 \pm 0.02$$

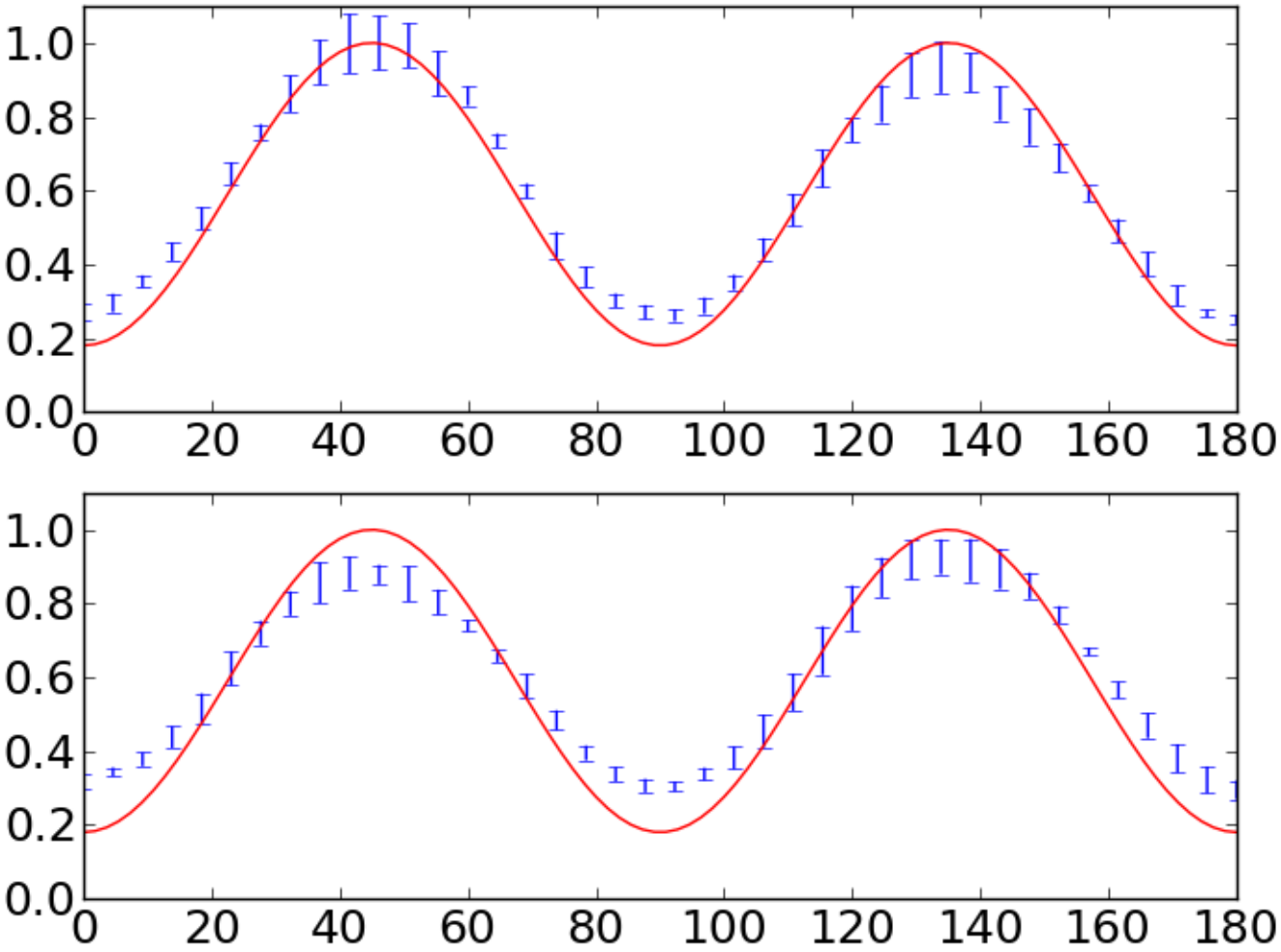
$$|E_z/E_y|_{\text{theory}} = 0.42$$

Fiber 040

Experiment – 2017/02/03 – Front side – Z= -7899

Half wave plate measurements

Red line = theory for the particle position and fiber radius as measured by the SEM



$$|E_z/E_y|_{\text{exp}} = 0.43 \pm 0.03$$

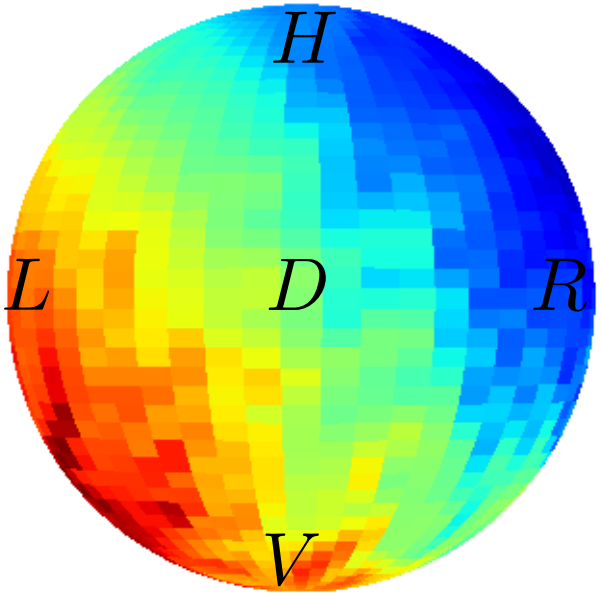
$$|E_z/E_y|_{\text{theory}} = 0.42$$

Fiber 040

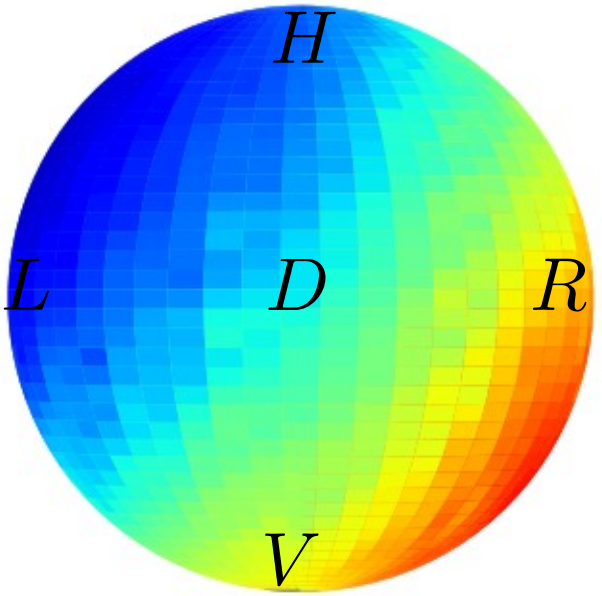
Experiment – 2017/02/03 – Front side – Z= -7899

Poincare sphere visualizations

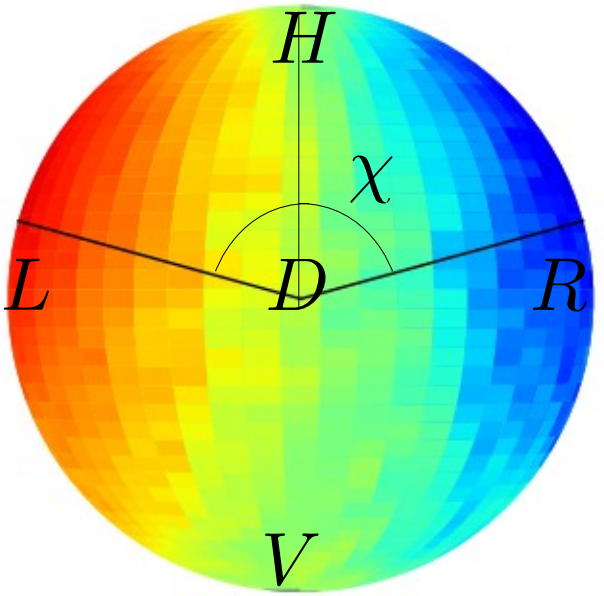
Channel 1



Channel 2



Directionality



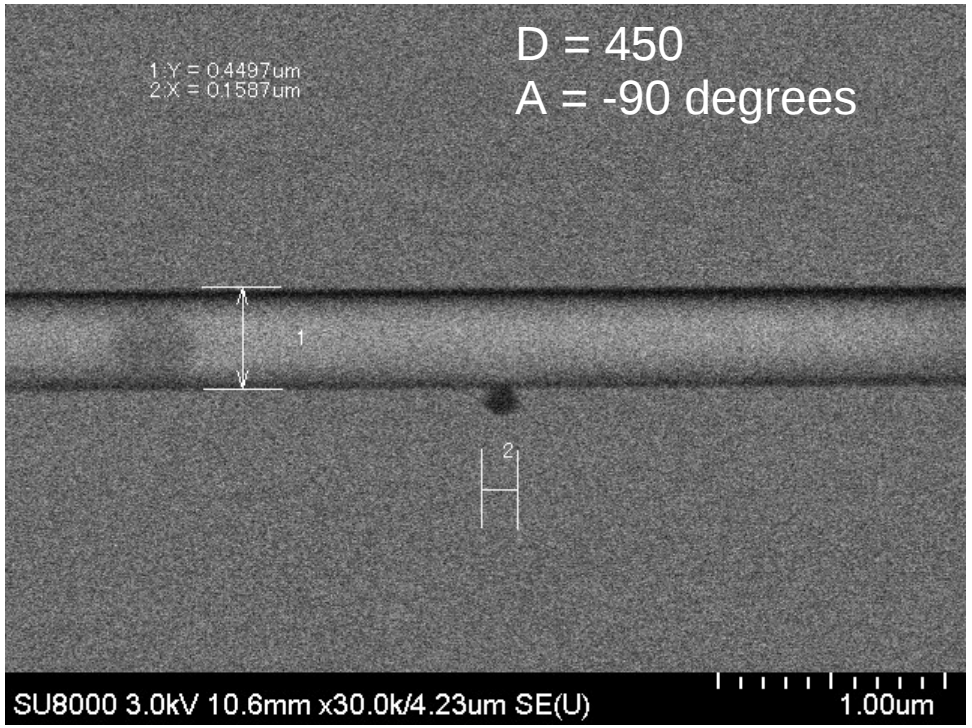
Fiber 042

Notes:

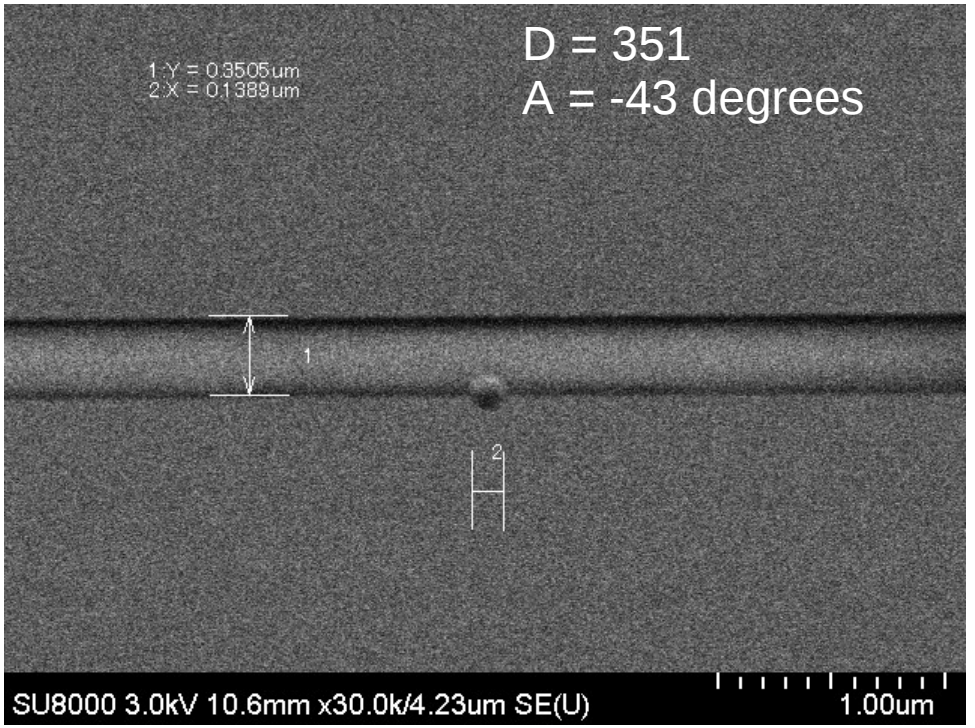
→ 2 particles were identified with optical measurements rigorously for this fiber

SEM: Backside

Particle a

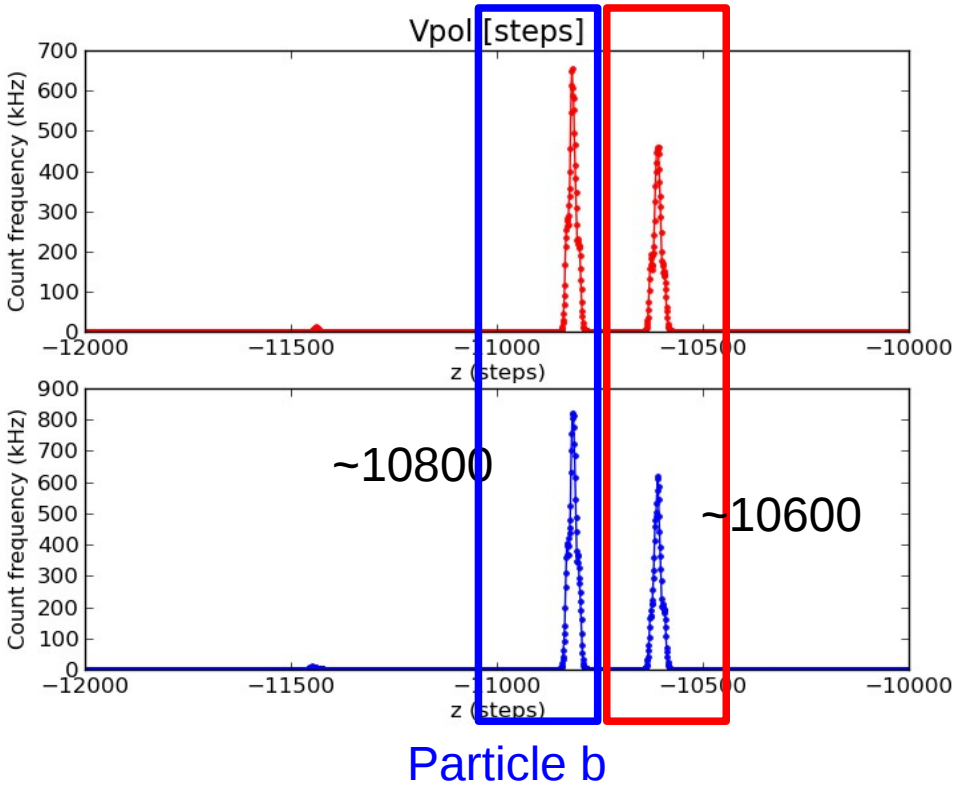


Particle b

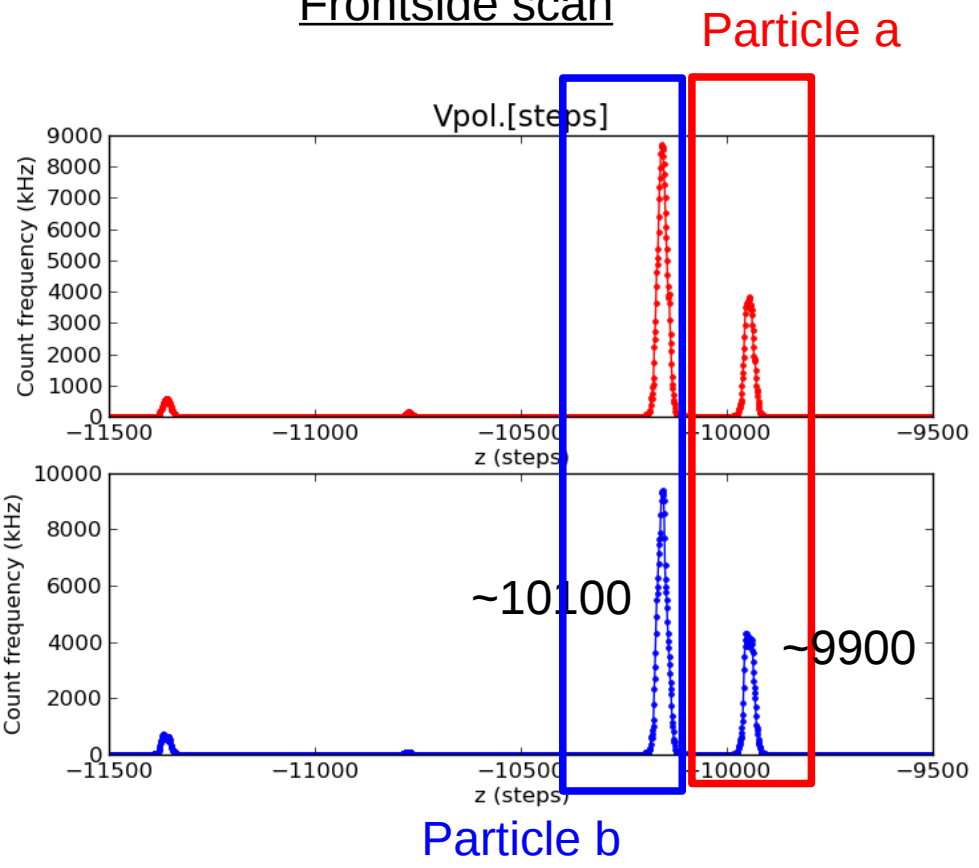


Fiber 042

Backside scan



Frontside scan



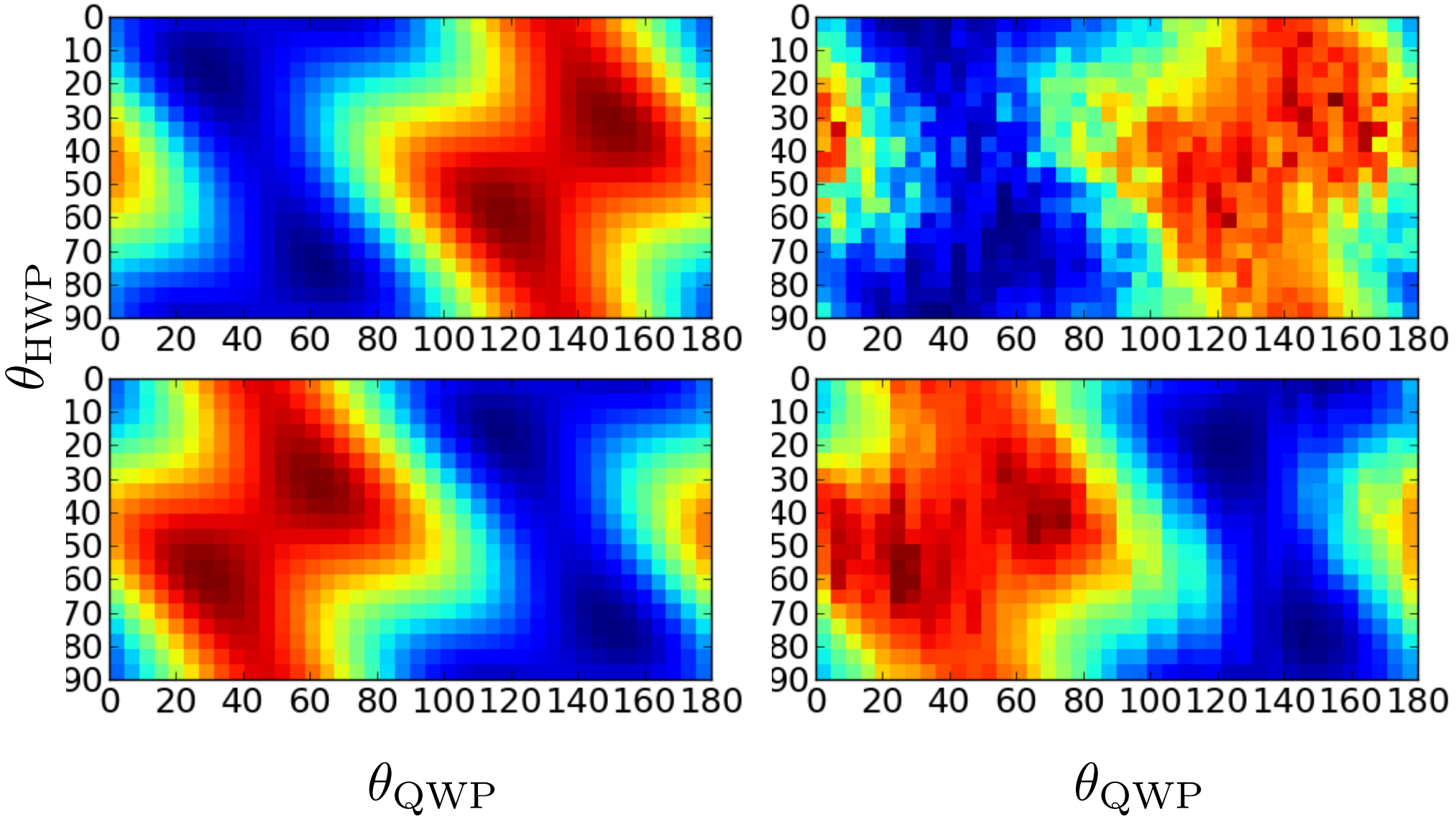
Fiber 042

Waveplate scans:

Particle a

Theory

Experiment – 2017/02/09 – Backside – Z= -10611

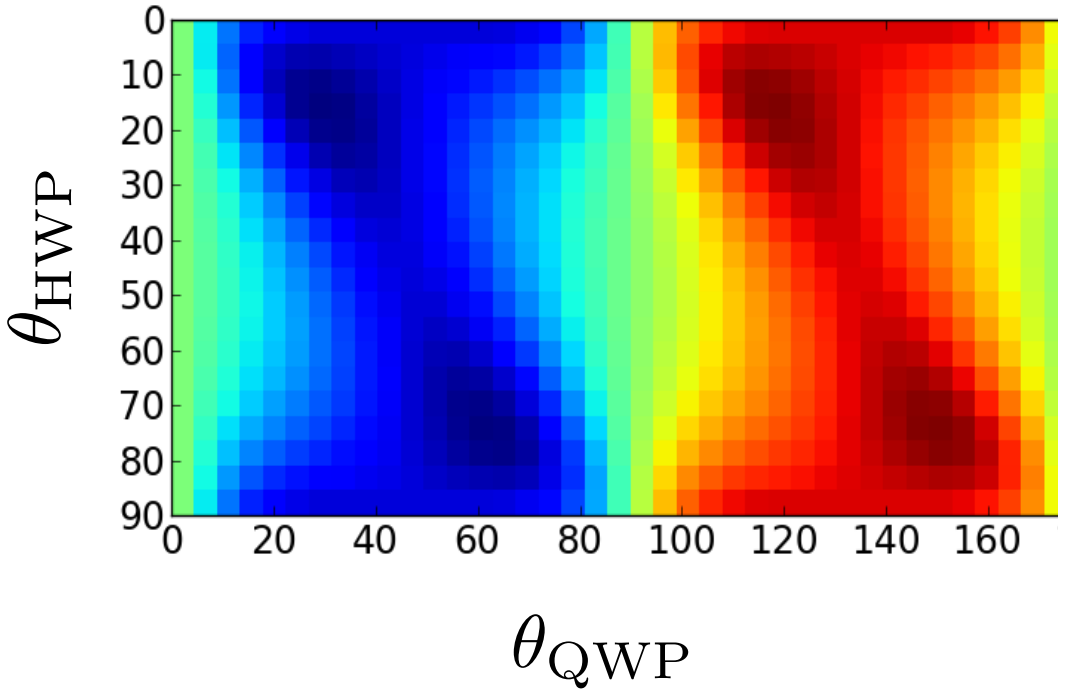


Fiber 042

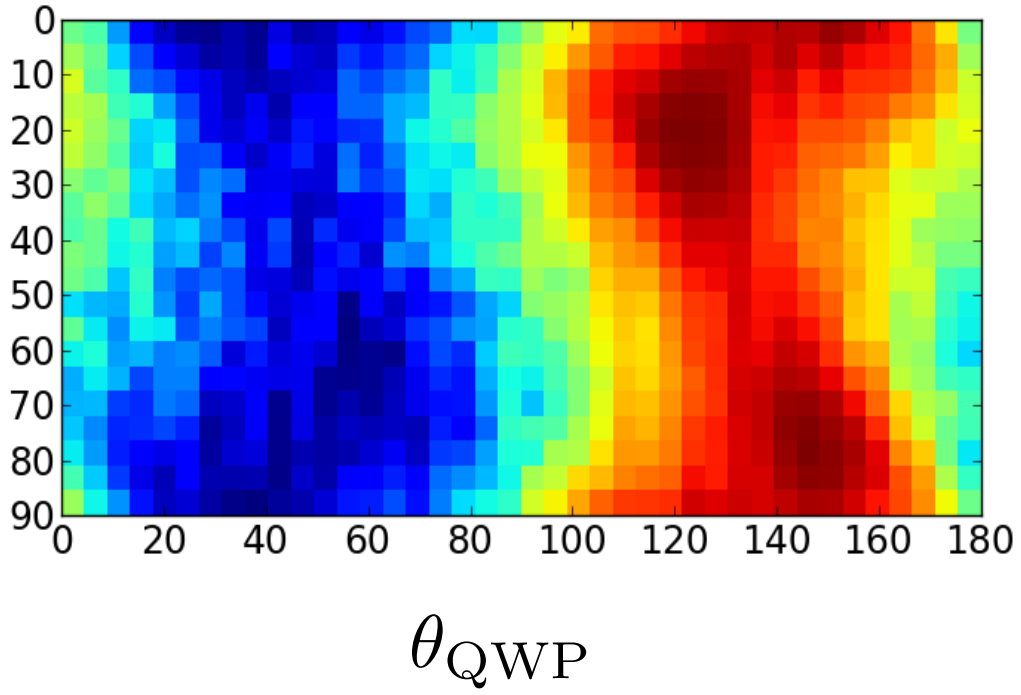
Directionality:

Particle a

Theory



Experiment – 2017/02/09 – Backside – Z= -10611



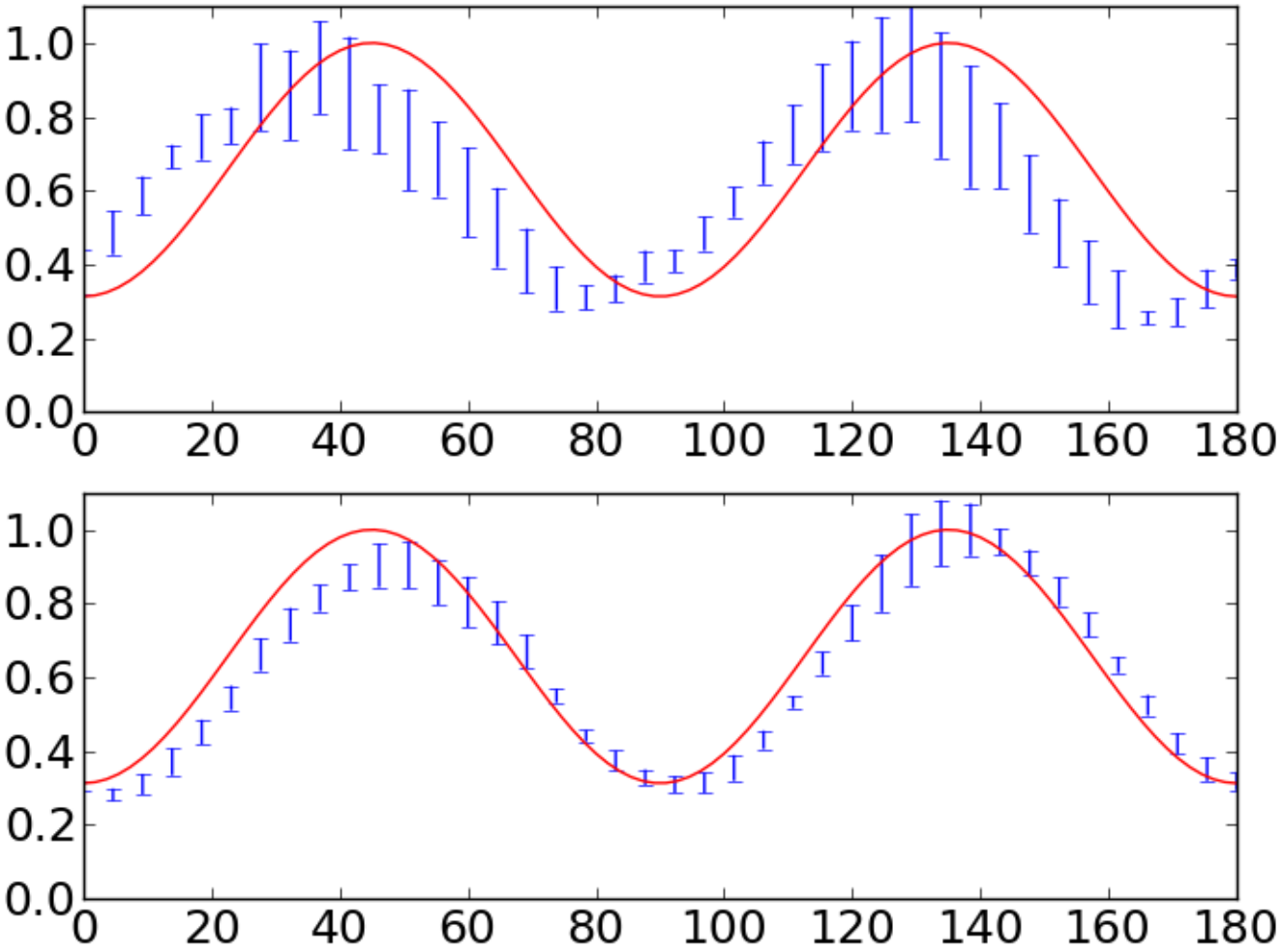
Fiber 042

Half wave plate measurements

Experiment – 2017/02/09 – Backside – Z= -10611

Particle a

Red line = theory for the particle position and fiber radius as measured by the SEM



$$|E_z/E_y|_{\text{exp}} = 0.52 \pm 0.03$$

$$|E_z/E_y|_{\text{theory}} = 0.56$$

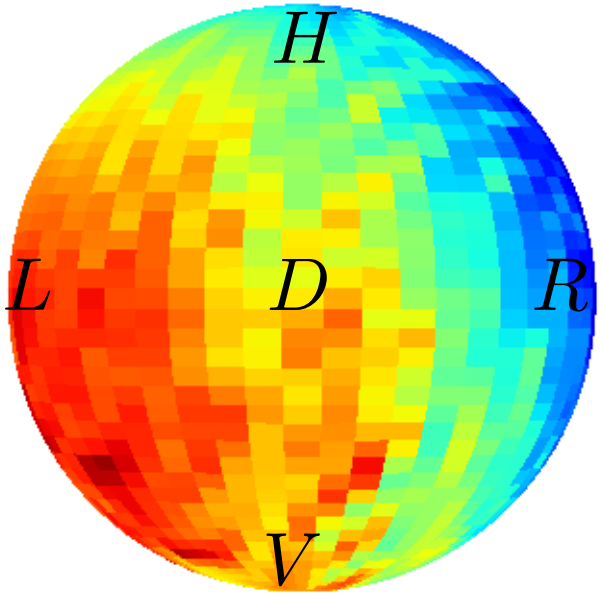
Fiber 042

Experiment – 2017/02/09 – Backside – Z= -10611

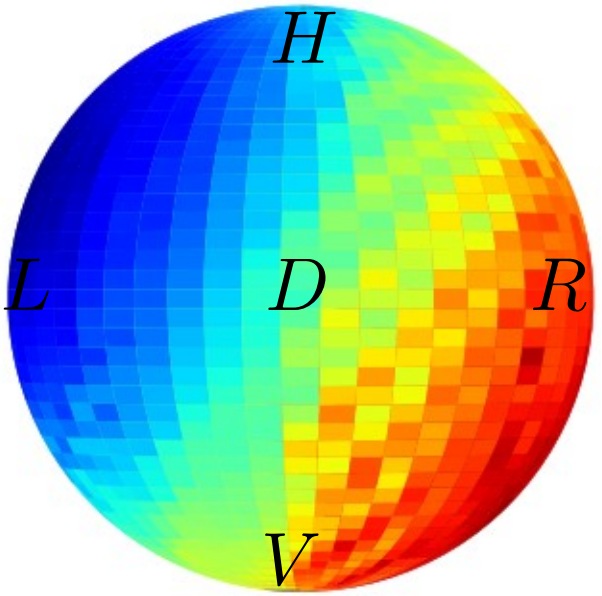
Particle a

Poincare sphere visualizations

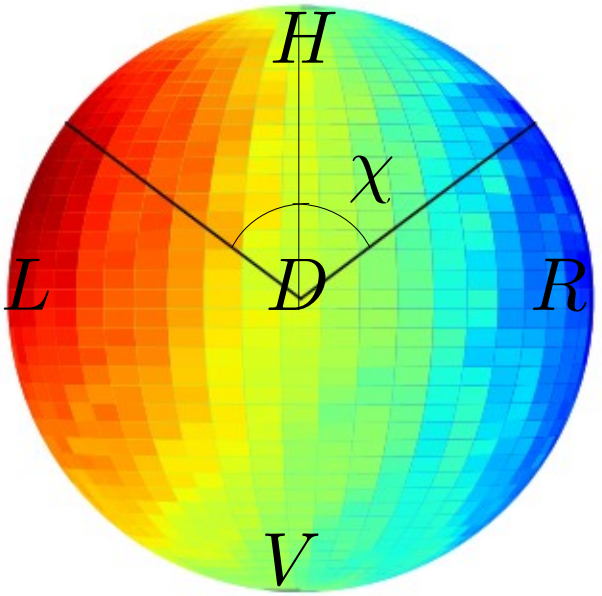
Channel 1



Channel 2



Directionality



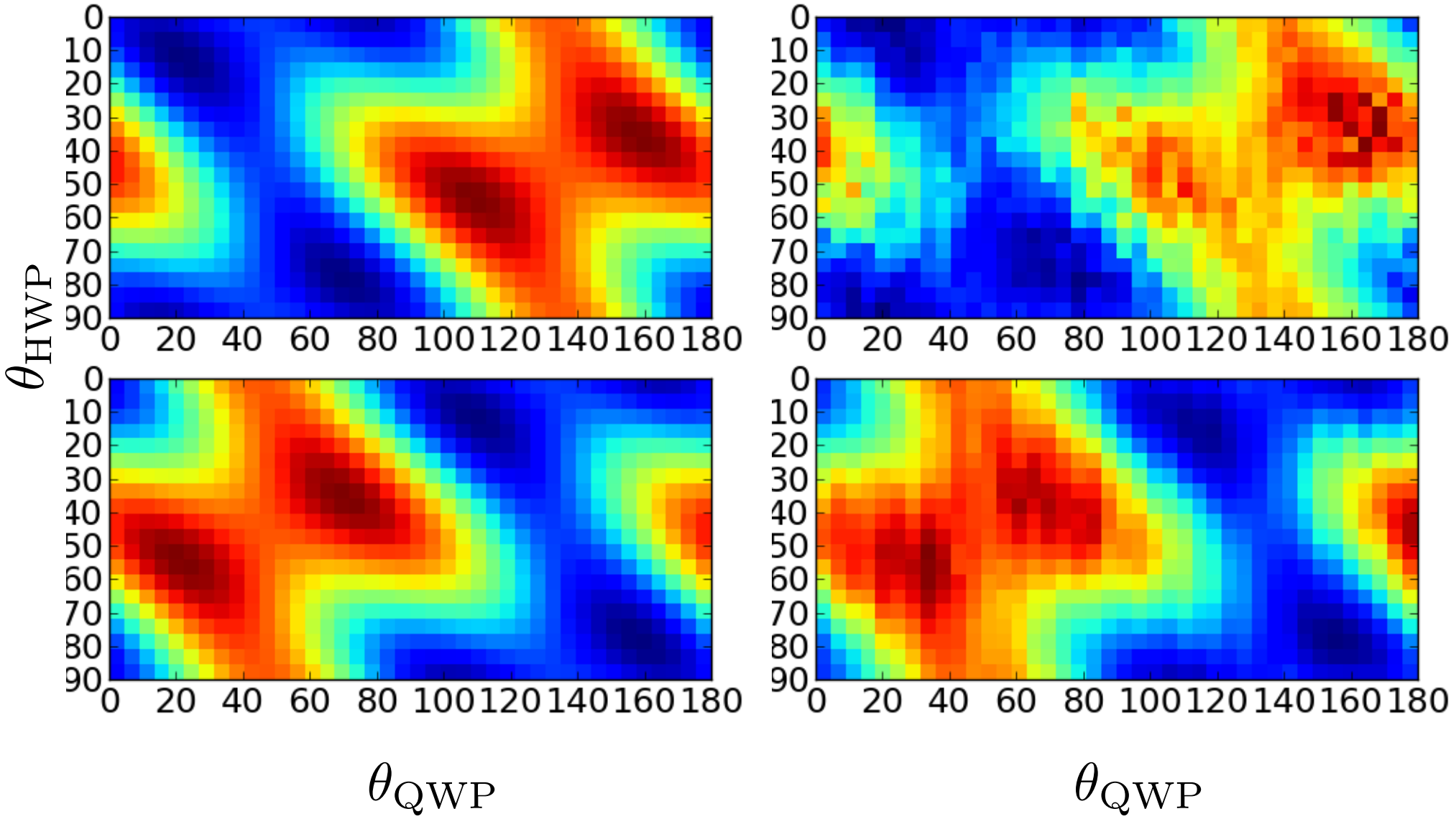
Fiber 042

Waveplate scans:

Particle b

Theory

Experiment – 2017/02/09 – Backside – Z= -10814

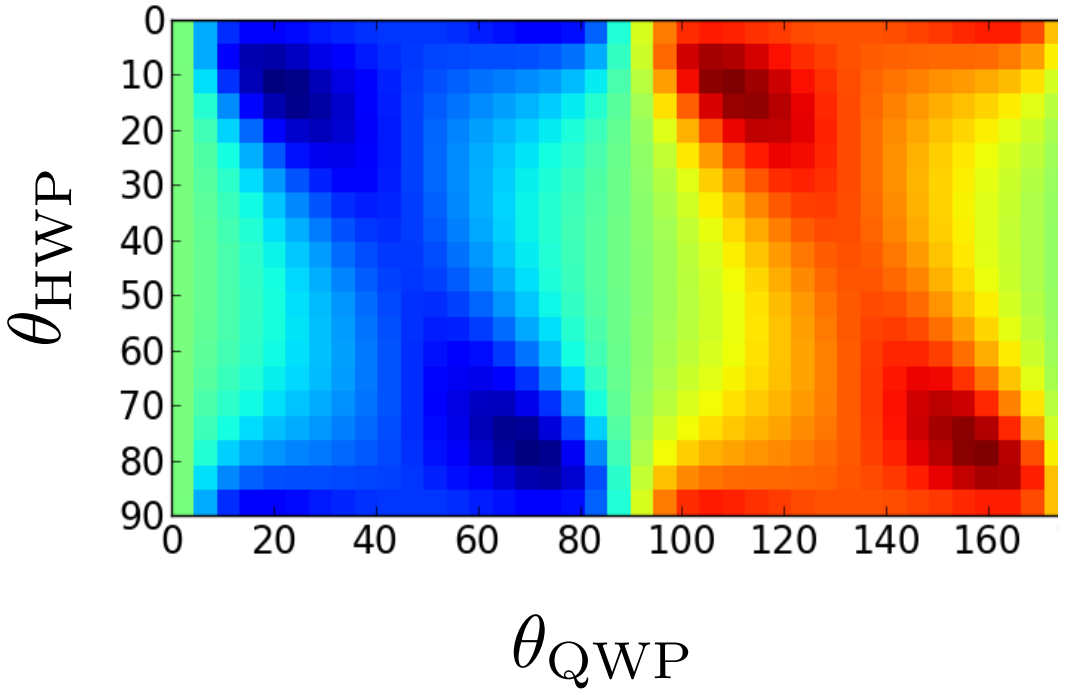


Fiber 042

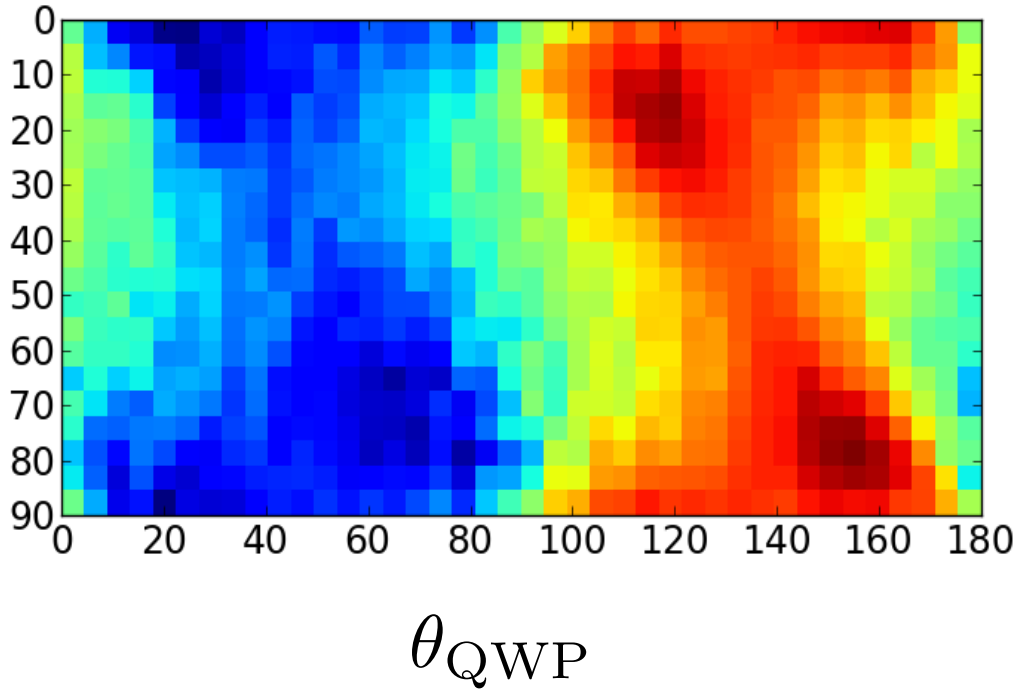
Directionality:

Particle b

Theory



Experiment – 2017/02/09 – Backside – Z= -10814



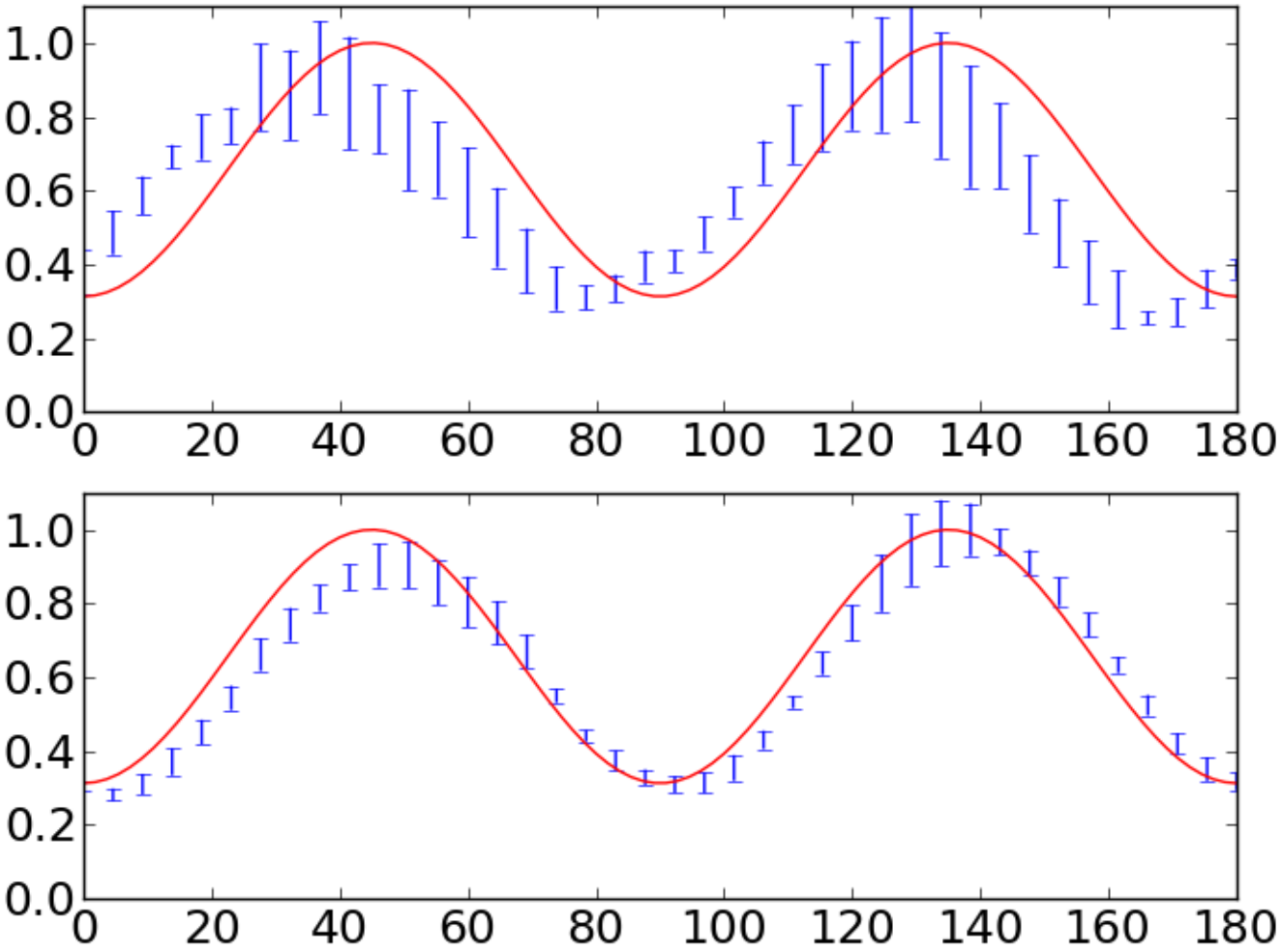
Fiber 042

Half wave plate measurements

Experiment – 2017/02/09 – Backside – Z= -10814

Particle b

Red line = theory for the particle position and fiber radius as measured by the SEM



$$|E_z/E_y|_{\text{exp}} = 0.52 \pm 0.03$$

$$|E_z/E_y|_{\text{theory}} = 0.56$$

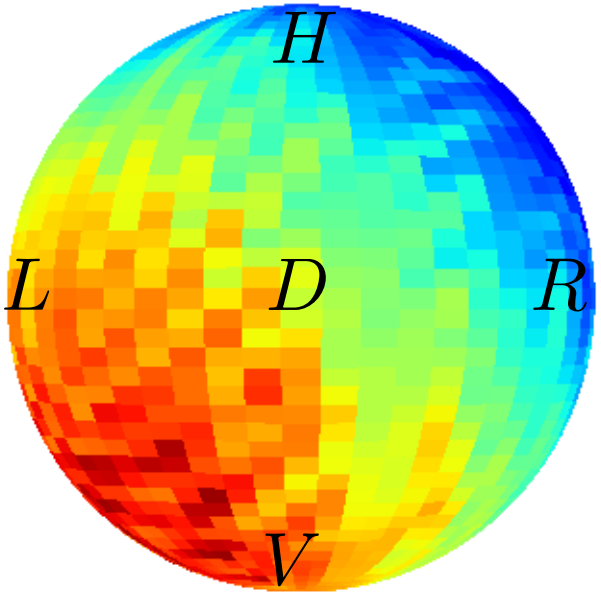
Fiber 042

Experiment – 2017/02/09 – Backside – Z= -10814

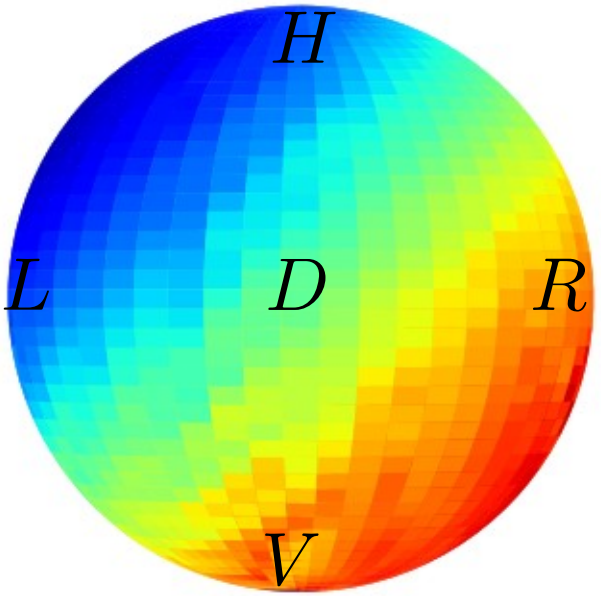
Particle b

Poincare sphere visualizations

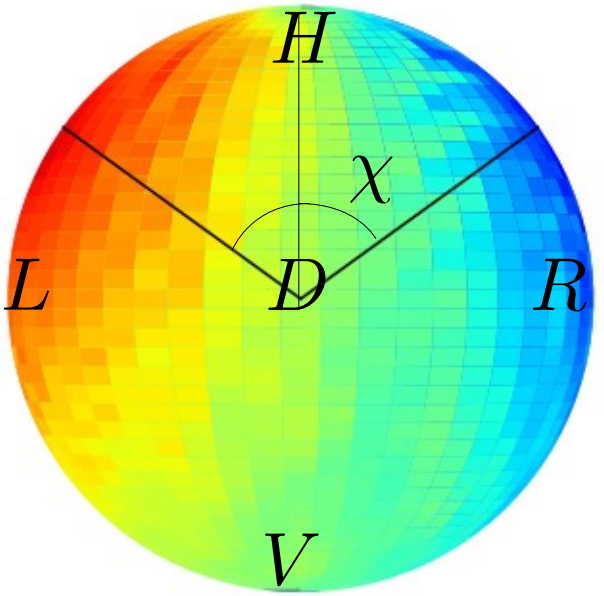
Channel 1



Channel 2



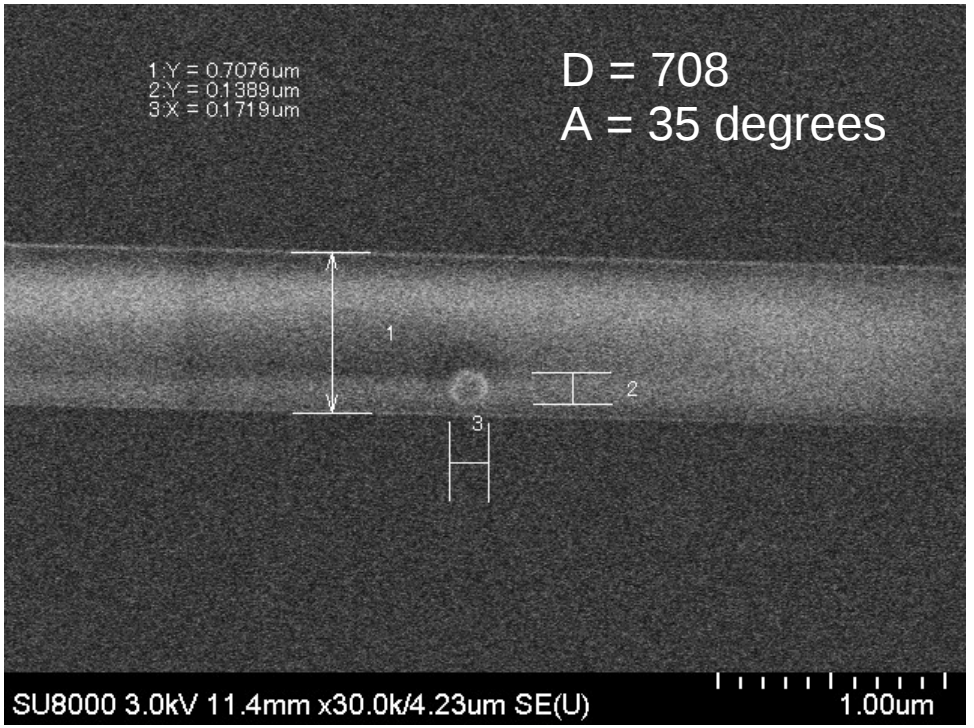
Directionality



Fiber 047

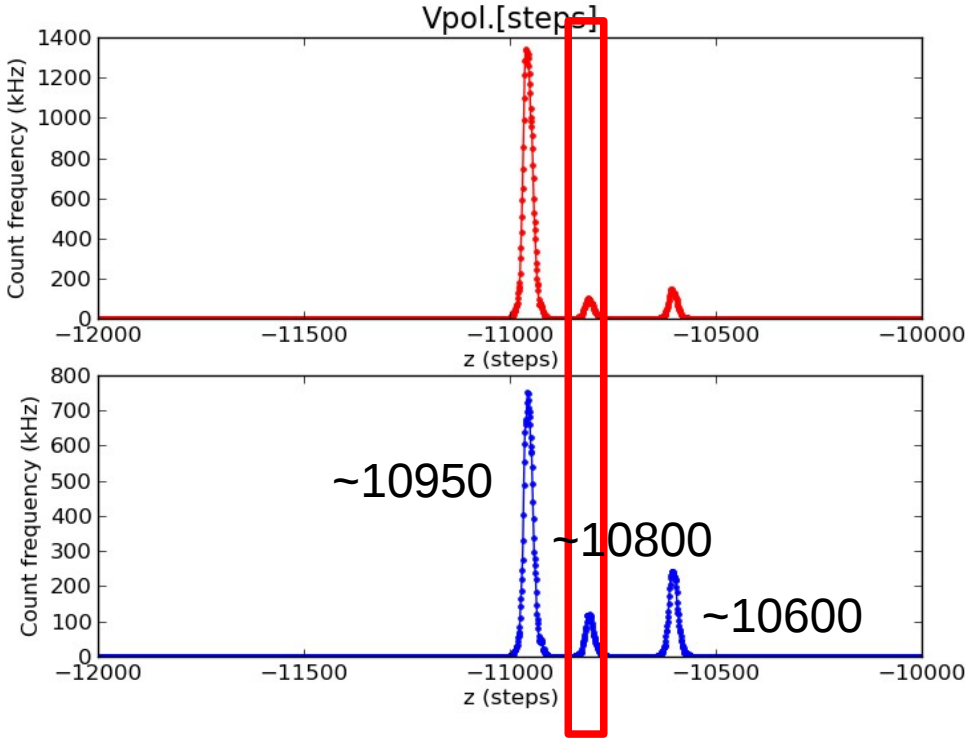
Notes:
→ 3 particles were identified with optical measurements rigorously for this fiber. Only the middle particle was a single GNP.

SEM: Backside

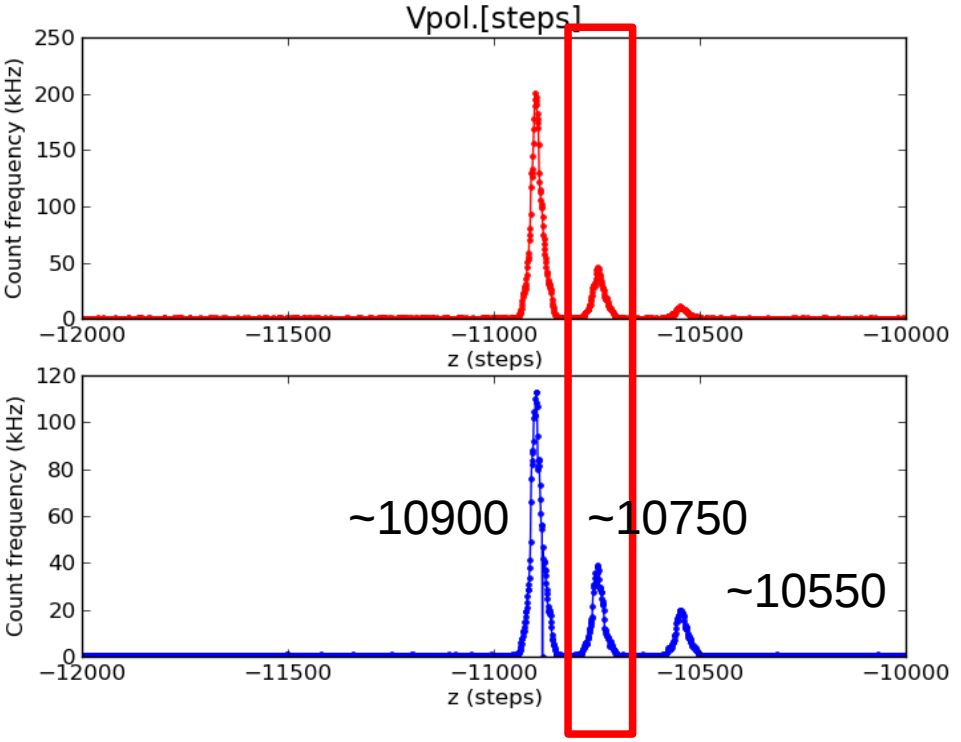


Fiber 047

Backside scan



Frontside scan



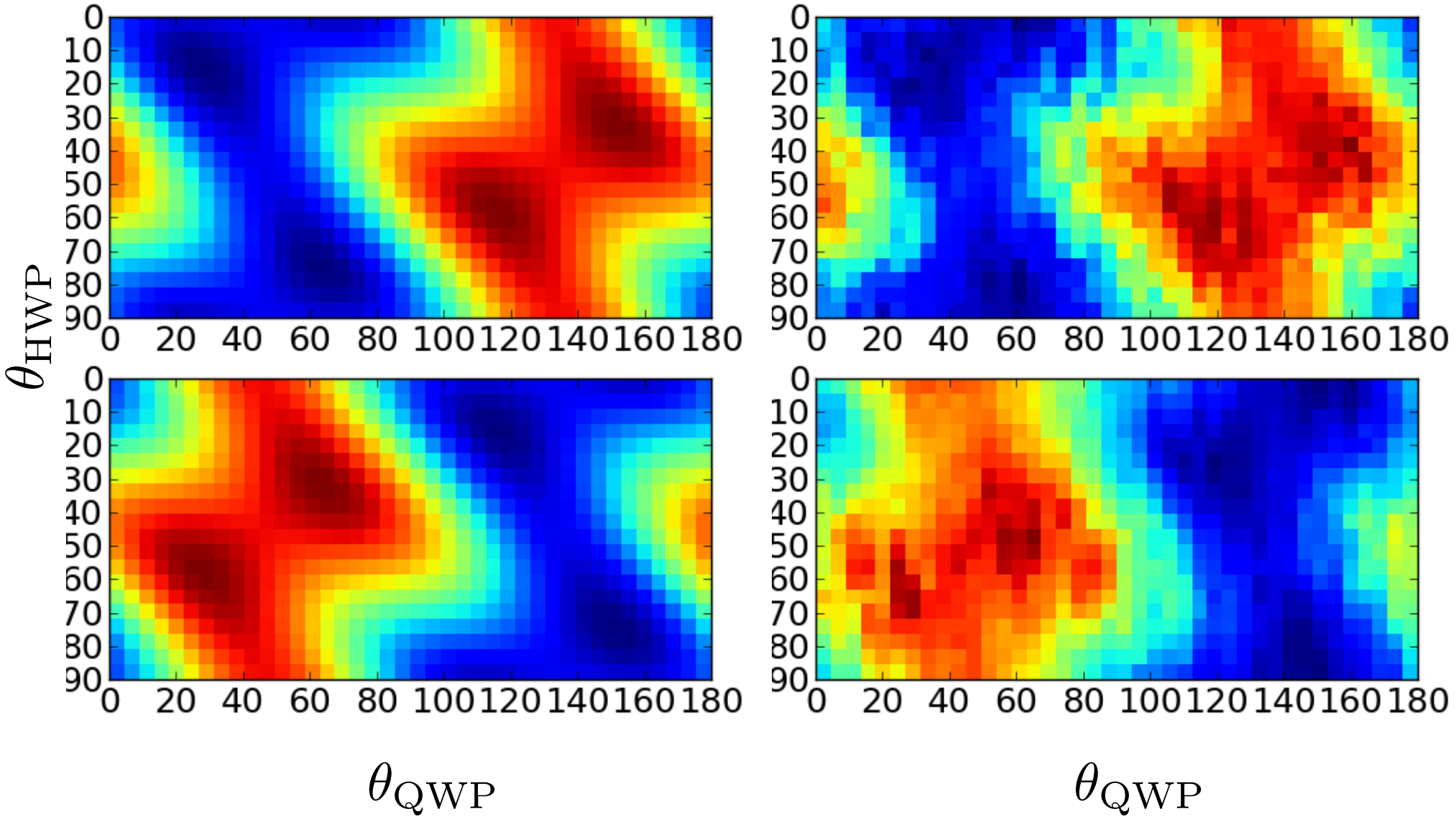
The middle particle is the only single particle found in the SEM measurements.

Fiber 047

Waveplate scans:

Theory

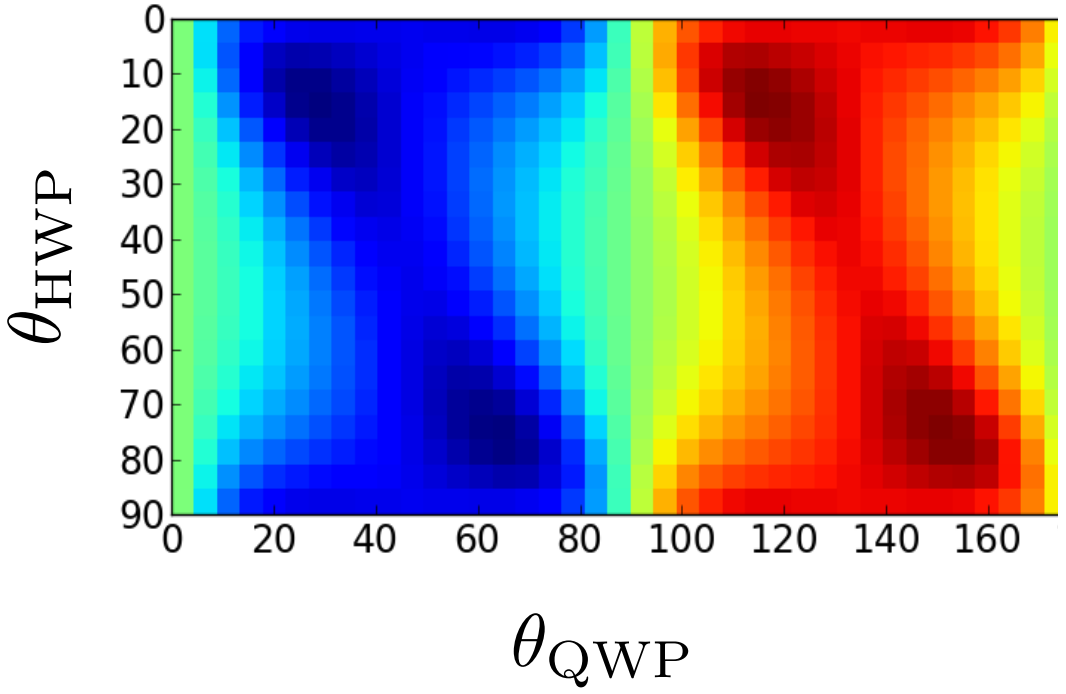
Experiment – 2017/03/06 – Backside – Z= -10810



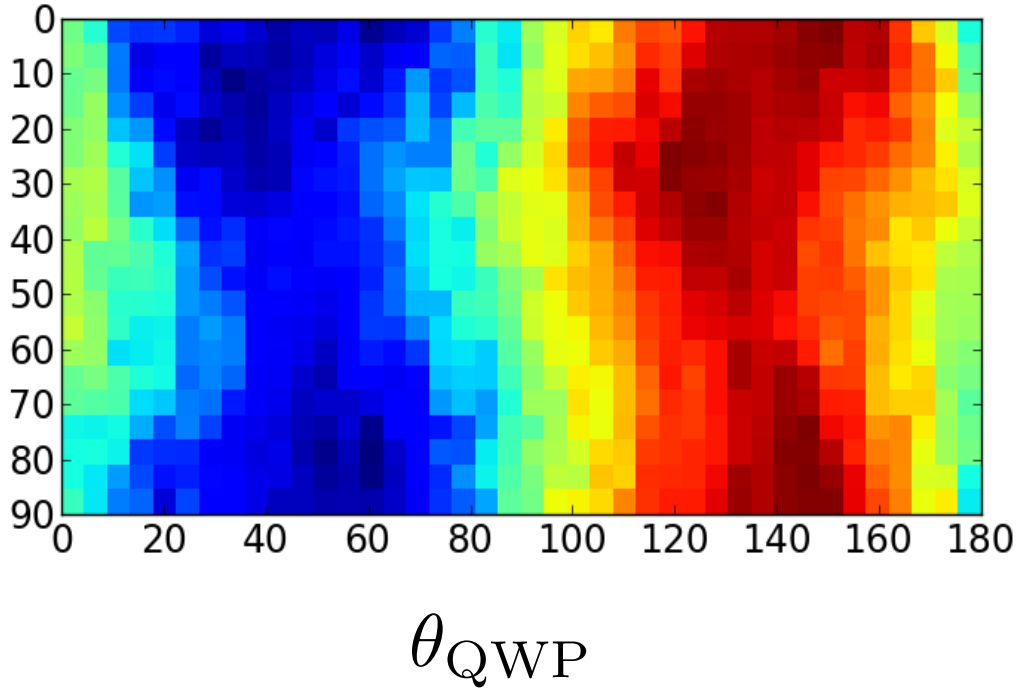
Fiber 047

Directionality:

Theory



Experiment – 2017/03/06 – Backside – Z= -10810

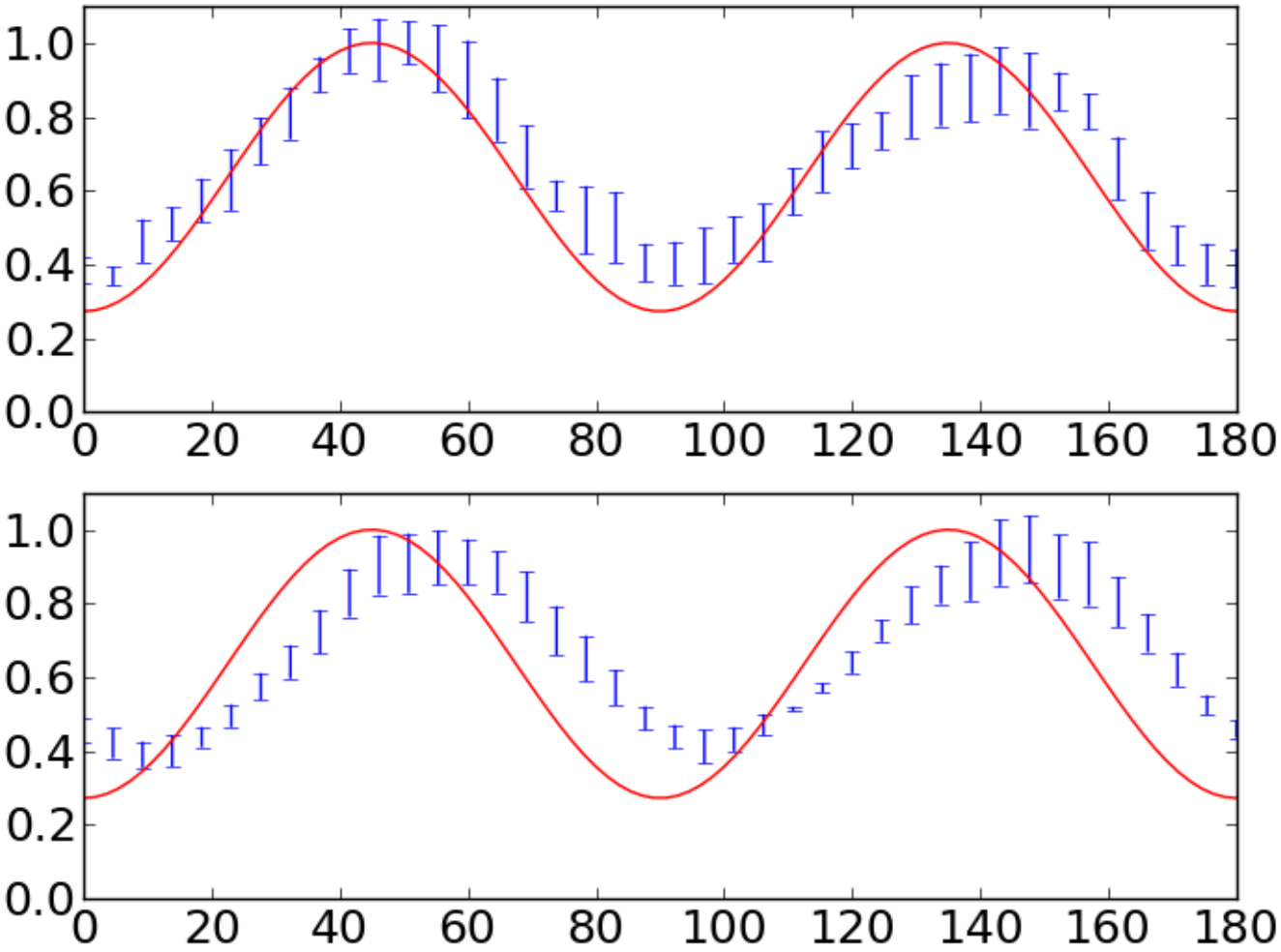


Fiber 047

Half wave plate measurements

Experiment – 2017/03/06 – Backside – Z= -10810

Red line = theory for the particle position and fiber radius as measured by the SEM



$$|E_z/E_y|_{\text{exp}} = 0.62 \pm 0.03$$

$$|E_z/E_y|_{\text{theory}} = 0.53$$

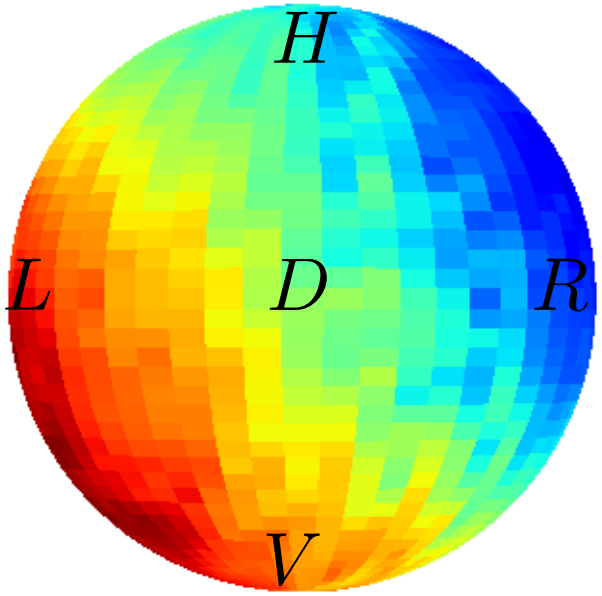
Fiber 047

Experiment – 2017/02/09 – Backside – Z= -10814

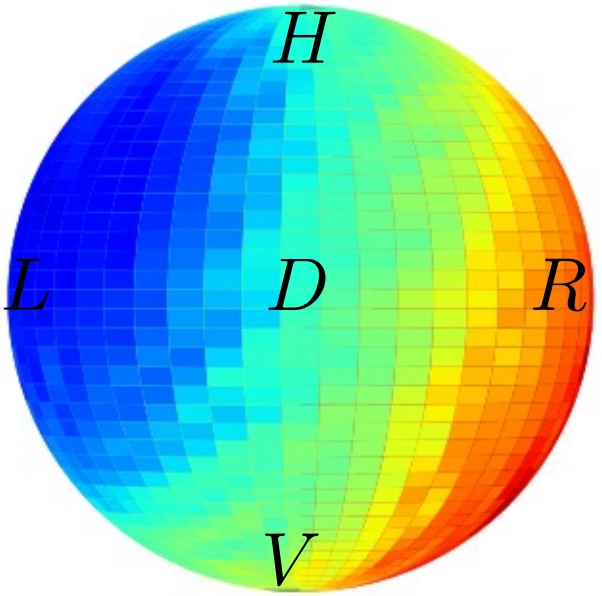
Particle b

Poincare sphere visualizations

Channel 1



Channel 2



Directionality