Exercise 5: Optical Tweezers

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| Group | Student 1 |
|  | Student 2 |
| Date | Assistant |

Staple the graphs, which you base your analysis on, to the answer form.

The level of detail of a complete answer is such that the answer fits in the box if typed in average handwriting.

Instead of typing in the boxes below, you may write on separate sheets.

The numbering of the questions below refers to the corresponding labels in the instructions. Notice that not all the latter questions will be considered in this *lomake* assignment.

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| 1)Briefly describe the principle of operation of the optical tweezers and concept of light polarization. Explain both the ray and wave optical pictures. |
| 2)How can you determine the spring constant of the tweezers? Wy does a birefringent particle begin to rotate under the influence of elliptically polarized light? How are angular velocity and the shape parameter D defined? |
| 5) Determine the dependence of the spring constant of the tweezers on the laser power in both the x- and y-direction using the image series you collected. Plot graphs and remember the error limits. Reflect what the possible reasons for differences in the spring constants could be. For this task, you need to determine the location of the particle in the optical tweezers. |
| 6) Discuss the magnitude of the force exerted by optical tweezers and the magnitude of force that can measured with optical tweezers |
| 7) Describe the effect of the polarization state of light (linear, left- and right-handed circular polarization, elliptical) on the orientation and motion of birefringent particles. Explain your findings |
| 8) Analyze the dependence of the orientation of the calcite particle on the direction of linear polarization. What is the relationship between the orientation of the particle and the position of the half-wave plate? Use images and graphs to support the analysis. Remember the error limits. |
| 9) Determine the angular velocity of the particle rotation dependent on the orientation of the quarter-wave plate by analyzing the time series you measured. Compare the dependence of the angular velocity you get on the position of the wave plate with the theory presented in the instruction. Determine the value of parameter D from the graph using equation (23). Remember the error limits |