

Data set for Unbroken \mathcal{PT} -symmetry in the absence of gain or loss

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1. General Information

Dataset title:	Unbroken \mathcal{PT} -symmetry in the absence of gain or loss
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Language:	English
Rights:	CC BY-ND 4.0
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2. Description

This document serves as a guideline for the data repository of the publication [1]. The guideline concerns the acquisition and processing of measurement data as well as information about the deposited files.

3. Data Acquisition

The provided experimental data is obtained by measuring the intensity of the fluorescence light from the top according to Fig. 3a in [1] with a CCD camera (Basler A102f, Exposure time = 81.9 ms, Gain = 0 dB). The CCD camera captures a segment of approximately $680 \times 909 \mu\text{m}$. In order to generate a single image of the entire propagation range, 11 images/cm are taken in a scanning process and stitched together by software (LabVIEW®) afterwards. In doing so, each sub-image of the

CCD device is scaled down from its initial resolution of 1040×1392 px, to 1040×25 px. The results of these fluorescence images are stored in the ‘Fluorescence measurements’ folder.

For image preparation, as in Fig. 4a in [1], the fluorescence images are rotated to straighten the image and only the interesting row and column regions are selected. After subtracting the background, which is determined in the edge regions far from the waveguides, the exponential decay along the propagation direction is compensated.

The waveguide profiles, as displayed in Fig. 4b and Fig. S6a in [1], are extracted from this prepared fluorescence image by taking the vertical sum of a rectangle around the center of each waveguide. The profiles are normalized such that the local minima of the sum are on average equal to 1. These profiles are then used to determine the parameters of interest. For the directional coupler, fitting the theory to the difference of the two profiles leads directly to the physical constants coupling and detuning. For the three-waveguide coupler, however, the fits to the second profile and to the difference between the first and third profiles first result in some fit parameters. They are related to the physical parameters according to Eqs. (S11)-(S14) in [1]. The results of all evaluated parameters are stored in the ‘Parameters’ folder.

4. File Format

The measurement data is provided in an ASCII format file (.dat), using a horizontal tabulation as delimiter to separate array elements. For example, individual data files can be read out with MATLAB® via the command `dlmread('filename')` or `load('filename')`. The determined parameters are provided in Excel sheets (.xlsx). The colormaps are provided in MATLAB® function (.m) and MATLAB® data (.mat) format.

5. Archive Structure

Fluorescence measurements

Filename	Description
2021_Aug_23\Directional_coupler_1\ koppelv100mmpermin_d07mum_1.dat, ... 2021_Aug_23\Directional_coupler_1\ koppelv100mmpermin_d18mum_1.dat	Contains measured fluorescence images for directional couplers written at a velocity of 100 mm/min with waveguide separations from 7 μm to 18 μm when exciting the first waveguide. The measurement was taken on 23 rd August 2021. The results of these measurements are displayed in Fig. S6 in [1].

<p>2021_Aug_23\Directional_coupler_2\ koppelv100mmpermin_d07mum_2.dat, ... 2021_Aug_23\Directional_coupler_2\ koppelv100mmpermin_d18mum_2.dat</p>	<p>Contains measured fluorescence images for directional couplers written at a velocity of 100 mm/min with waveguide separations from 7 μm to 18 μm when exciting the second waveguide. The measurement was taken on 23rd August 2021.</p>
<p>2021_Aug_24\Directional_coupler_1\ Koppel_L_100.9mm_v150mmpermin_d07mum_1.dat, ... 2021_Aug_24\Directional_coupler_1\ Koppel_L_100.9mm_v150mmpermin_d18mum_1.dat</p>	<p>Contains measured fluorescence images for directional couplers written at a velocity of 150 mm/min with waveguide separations from 7 μm to 18 μm when exciting the first waveguide. The measurement was taken on 24th August 2021.</p>
<p>2021_Aug_24\Directional_coupler_2\ Koppel_L_100.9mm_v150mmpermin_d07mum_2.dat, ... 2021_Aug_24\Directional_coupler_2\ Koppel_L_100.9mm_v150mmpermin_d18mum_2.dat</p>	<p>Contains measured fluorescence images for directional couplers written at a velocity of 150 mm/min with waveguide separations from 7 μm to 18 μm when exciting the second waveguide. The measurement was taken on 24th August 2021.</p>
<p>2021_Aug_23\Waveguide_Triple_1\ Triple_L_100mm_v100mmpermin_d07mum_1.dat, ... 2021_Aug_23\Waveguide_Triple_1\ Triple_L_100mm_v100mmpermin_d18mum_1.dat</p>	<p>Contains measured fluorescence images for three-waveguide structures written at a velocity of 100 mm/min with waveguide separations from 7 μm to 18 μm when exciting the first waveguide. The measurement was taken on 23rd August 2021. The results of these measurements are displayed in Fig. 4 in [1].</p>
<p>2021_Aug_23\Waveguide_Triple_3\ Triple_L_100mm_v100mmpermin_d07mum_3.dat, ... 2021_Aug_23\Waveguide_Triple_3\ Triple_L_100mm_v100mmpermin_d18mum_3.dat</p>	<p>Contains measured fluorescence images for three-waveguide structures written at a velocity of 100 mm/min with waveguide separations from 7 μm to 18 μm when exciting the third waveguide. The measurement was taken on 23rd August 2021. See Fig. S7 in [1] for the results.</p>

2021_Aug_24\Waveguide_Triple_1\ Triple_L_100.9mm_v150mmpermin_d07mum_1.dat, ... 2021_Aug_24\Waveguide_Triple_1\ Triple_L_100.9mm_v150mmpermin_d18mum_1.dat	Contains measured fluorescence images for three-waveguide structures written at a velocity of 150 mm/min with waveguide separations from 7 μm to 18 μm when exciting the first waveguide. The measurement was taken on 24 th August 2021. See Fig. S8 in [1] for the results.
2021_Aug_24\Waveguide_Triple_3\ Triple_L_100mm_v150mmpermin_d07mum_3.dat, ... 2021_Aug_24\Waveguide_Triple_3\ Triple_L_100mm_v150mmpermin_d18mum_3.dat	Contains measured fluorescence images for three-waveguide structures written at a velocity of 150 mm/min with waveguide separations from 7 μm to 18 μm when exciting the third waveguide. The measurement was taken on 24 th August 2021. See Fig. S9 in [1] for the results.

Parameters

Filename	Description
Parameters_directional_coupler.xlsx	Contains all evaluated parameters (coupling and detuning) of each directional coupler measurement.
Fit_parameters.xlsx	Contains all evaluated parameters of each three-waveguide measurement except from the physical parameters. It contains also the uncertainties from the fit parameters
Physical_parameters.xlsx	Contains all evaluated physical parameters and their uncertainties of each three-waveguide measurement.

Colormaps

Filename	Description
CustomColormap.mat	Colormap for the background of Fig. 3b and Fig. 4c,d in [1].
colorcet.m	Contains perceptually uniform colormaps [2].

6. References/Bibliography

- [1] Bentzien, J., Pinske, J., Maczewsky, L. J., Weimann, S., Heinrich, M., Scheel, S., and Szameit, A. Unbroken \mathcal{PT} -symmetry in the absence of gain or loss. *Nat. Commun.* **16**, 8225 (2025).
- [2] Kovési, P. Good Colour Maps: How to Design Them. [arXiv:1509.03700](https://arxiv.org/abs/1509.03700) (2015).