# Possible Physics BSc and MSc Thesis Projects:

UNIVERSITÄT BONN

## Increasing signal/noise ratio in DNA-PAINT single-molecule microscopy via an event-based sensor

The Endesfelder lab performs research in the cross-section of optical and computational physics and microbiology: in our group, we employ advanced microscopy techniques such as single-molecule localization microscopy (SMLM) to look at *in vivo* processes in living cells. One method of SMLM is DNA-PAINT, in which fluorescent DNA strands selectively bind and unbind to patterned, stable structures. This binding/unbinding provides the capability to obtain super-resolved imaging down to ~10-20 nm accuracy. A downside of DNA-PAINT is that the bulk of the fluorescent DNA strands are diffusing in the solution, contributing to background fluorescence. While this can be remedied via TIRF (total internal reflection fluorescence), this cannot always be applied for all microscopes or samples.

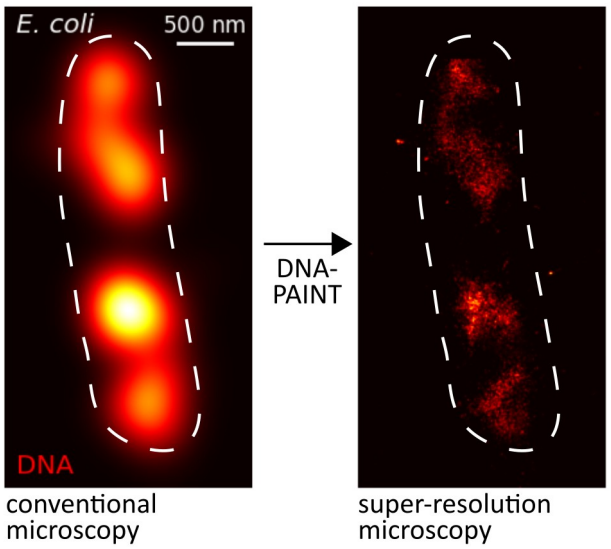


**Figure 1:** *E. Coli* cell imaged with DNA-PAINT.

In a recent publication by another university, a novel event-based sensor was used instead of a traditional camera in SMLM measurements. Instead of measuring incoming light on a 2d-detector, it measures *changes in light* with a much better temporal accuracy. An upside of this event-based sensor is that it is insensitive to high-background, but non-fluctuating signals. This is exactly the background expected in DNA-PAINT measurements. Therefore, we hypothesize that combining event-based sensors with DNA-PAINT will allow samples with major differences in biochemical composition, such as imager concentration. This could result in much better single-molecule DNA-PAINT-based microscopy measurements.

**In this project, you will work together with us to investigate paradigm-shifting changes to DNA-PAINT measurements possible via event-based sensors.** More specifically, the goals of this project would be:

- Evaluation of parameters of DNA-PAINT-based single-molecule microscopy experiments, specifically their effect when using an event-based sensor rather than traditional cameras.
- *Possible extension*: Algorithmic development in analysis of DNA-PAINT measurement data recorded specifically on event-based sensors.
- *Possible extension*: Optomechanical design and alignment of parts of our single-molecule microscope setup.

We are open to change this project to your specific interests, please do not hesitate to contact us!

## Contact:

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## References:

Event-based sensor

SMLM review, including DNA-PAINT