

# Surface Charge Matters for Particle-Cell Interactions



witzmann@ipfdd.de

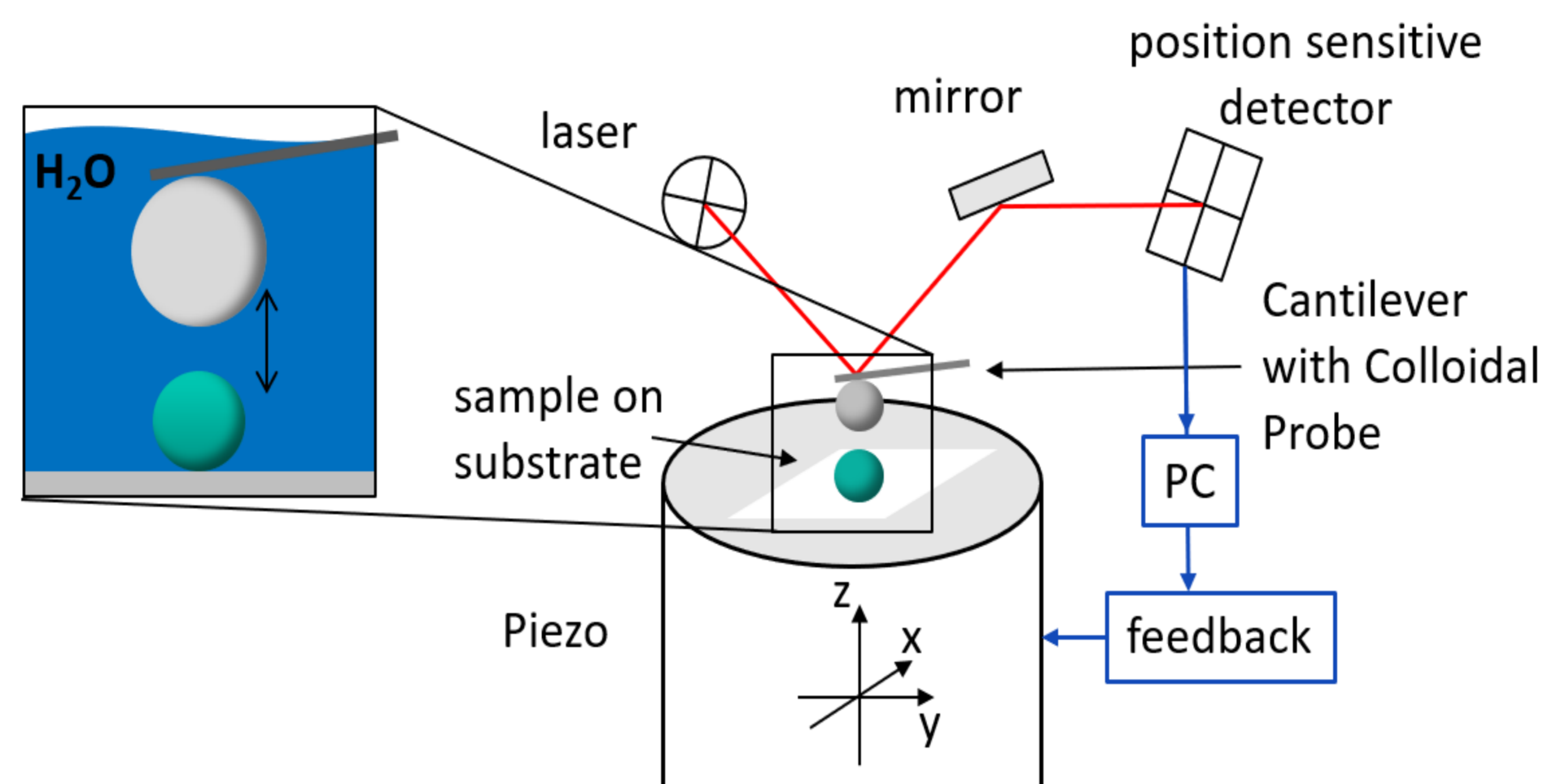
Anja Ramsperger<sup>1</sup>, Julia Rudolph<sup>1</sup>, Matthias Völkl<sup>1</sup>, Thomas Witzmann<sup>2</sup>, Marcel Meinhart<sup>1</sup>, Valérie Jérôme<sup>1</sup>, Winfried Kretschmer<sup>1</sup>, Ruth Freitag<sup>1</sup>, Jürgen Senker<sup>1</sup>, Andreas Fery<sup>2</sup>, Holger Kress<sup>1</sup>, Thomas Scheibel<sup>1</sup>, Christian Laforsch<sup>1</sup>

<sup>1</sup> Universität Bayreuth; <sup>2</sup> Leibniz-Institut für Polymerforschung Dresden, Germany

## Motivation

Microplastic particles and their effect on and interaction with living cells have been studied a lot in the recent years. Though results are often contradictory even when particles with same polymer type, size and shape are used <sup>[1]</sup>. Therefore we investigated the surface charge of non-functionalised, spherical polystyrene (PS) particles with the same size (3 µm) from two different manufacturers (P-MPP & M-MPP). P-MPP shows **higher** particle-cell interactions & internalisation.

## Colloidal Probe-Atomic Force Microscopy



- Single particle analysis
- Surface interaction forces
- Resolution pN & nm

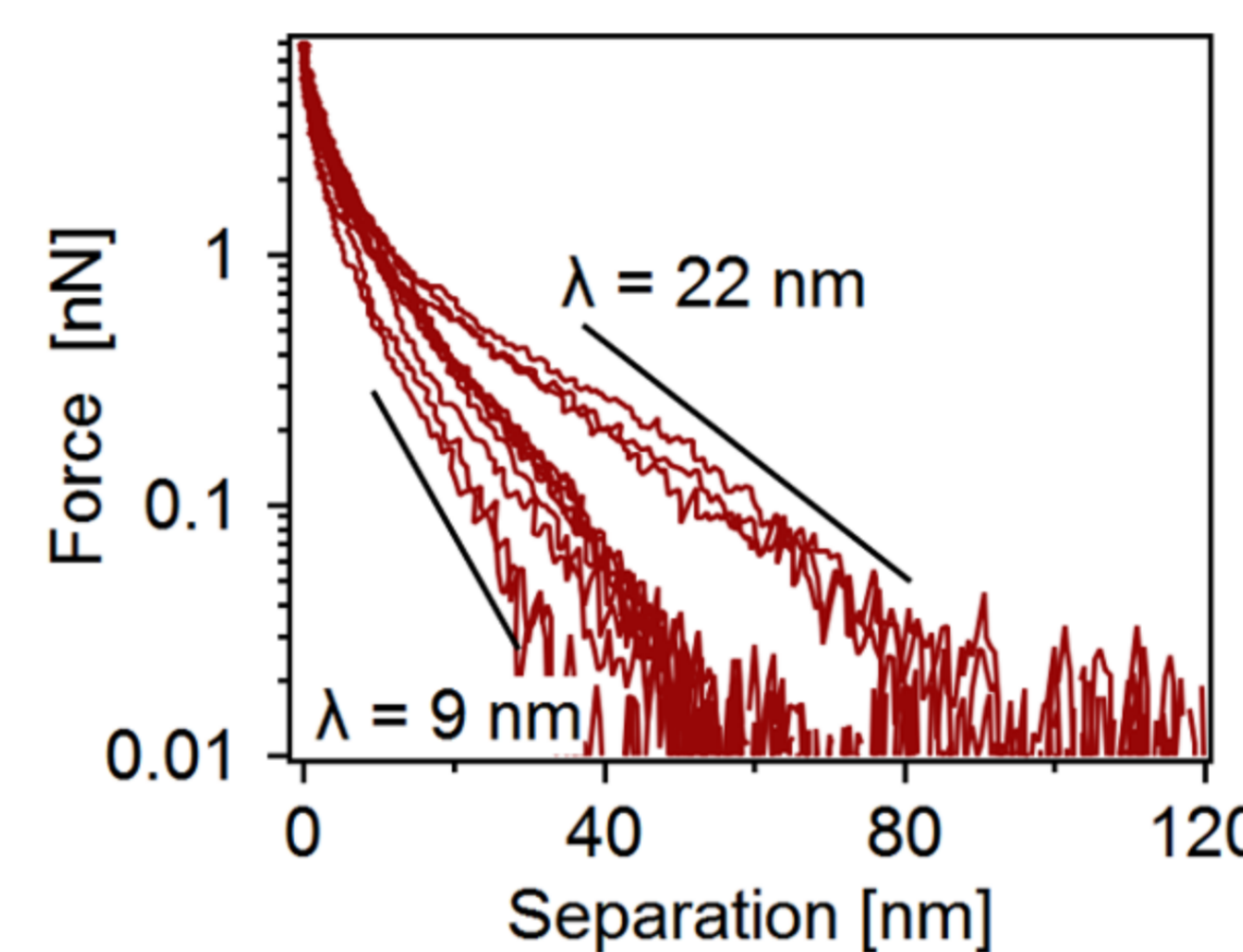
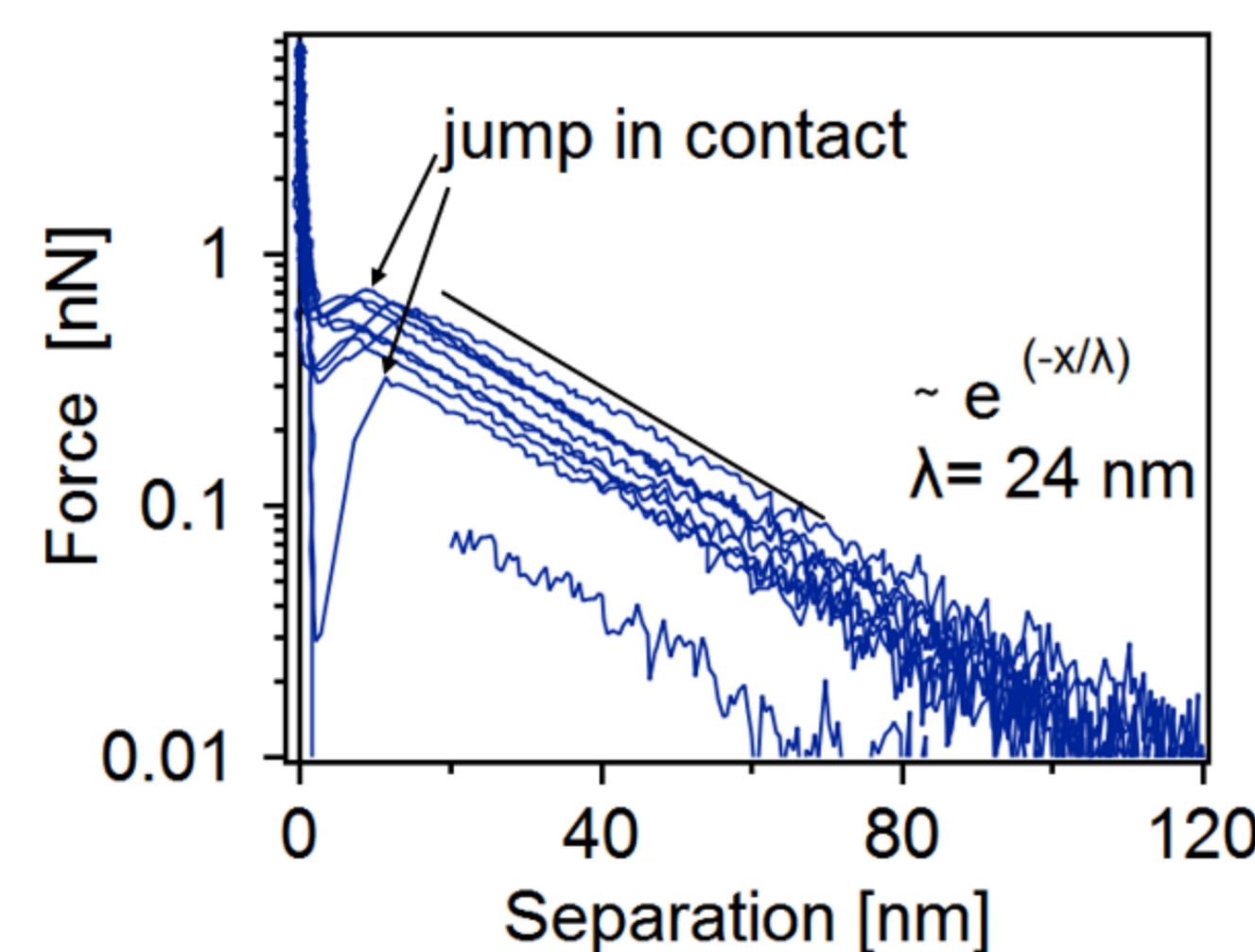
### P-MPP

### M-MPP

## Surface Charge

- Particles show **parallel** force curves
- **Constant** repulsive electrostatic forces at higher separation
- **Attractive** forces at low separation

**Constant & stronger surface charge**

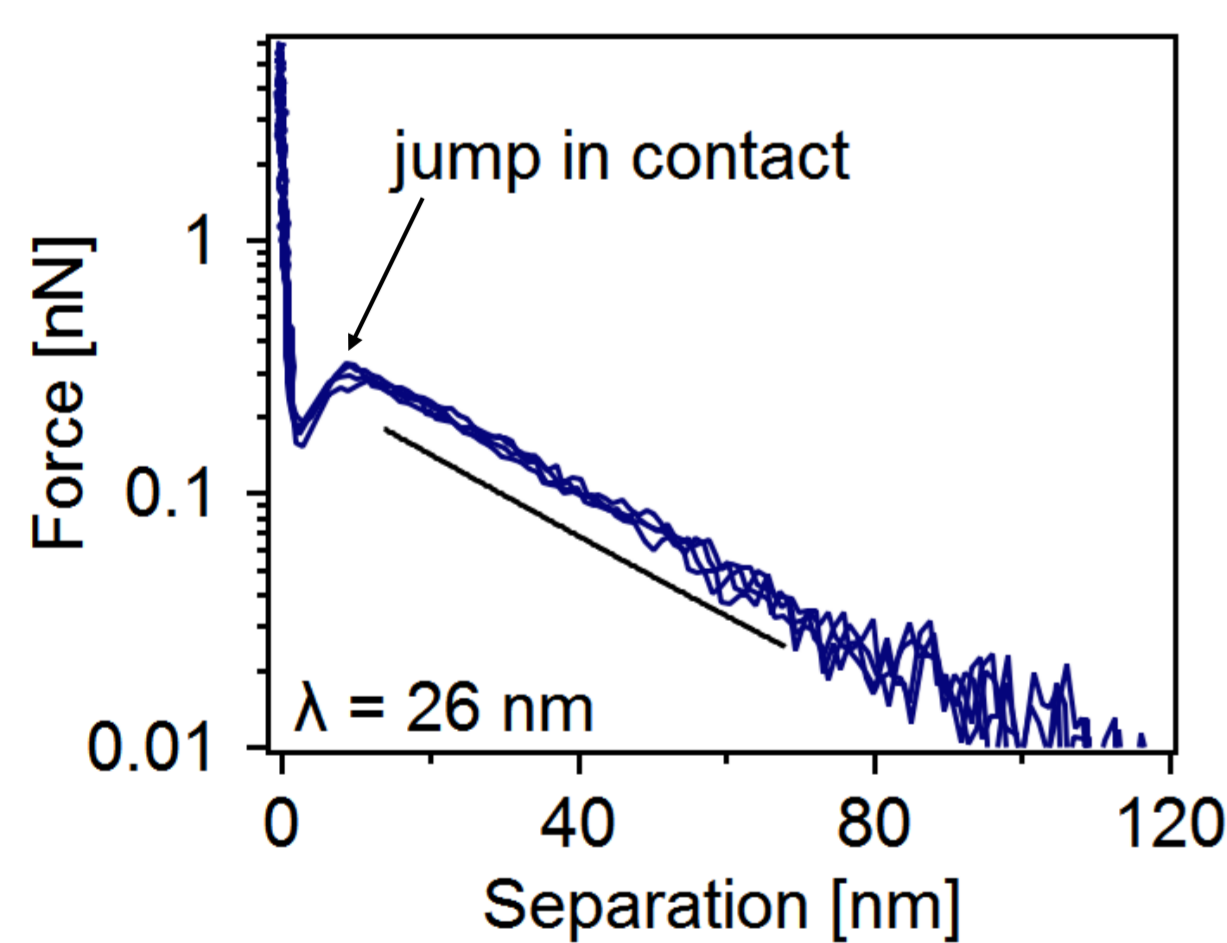


- Force curves **not** parallel
- **Varying** repulsive electrostatic forces
- **No** significant attractive forces at low separation

**Varying & weaker surface charge**

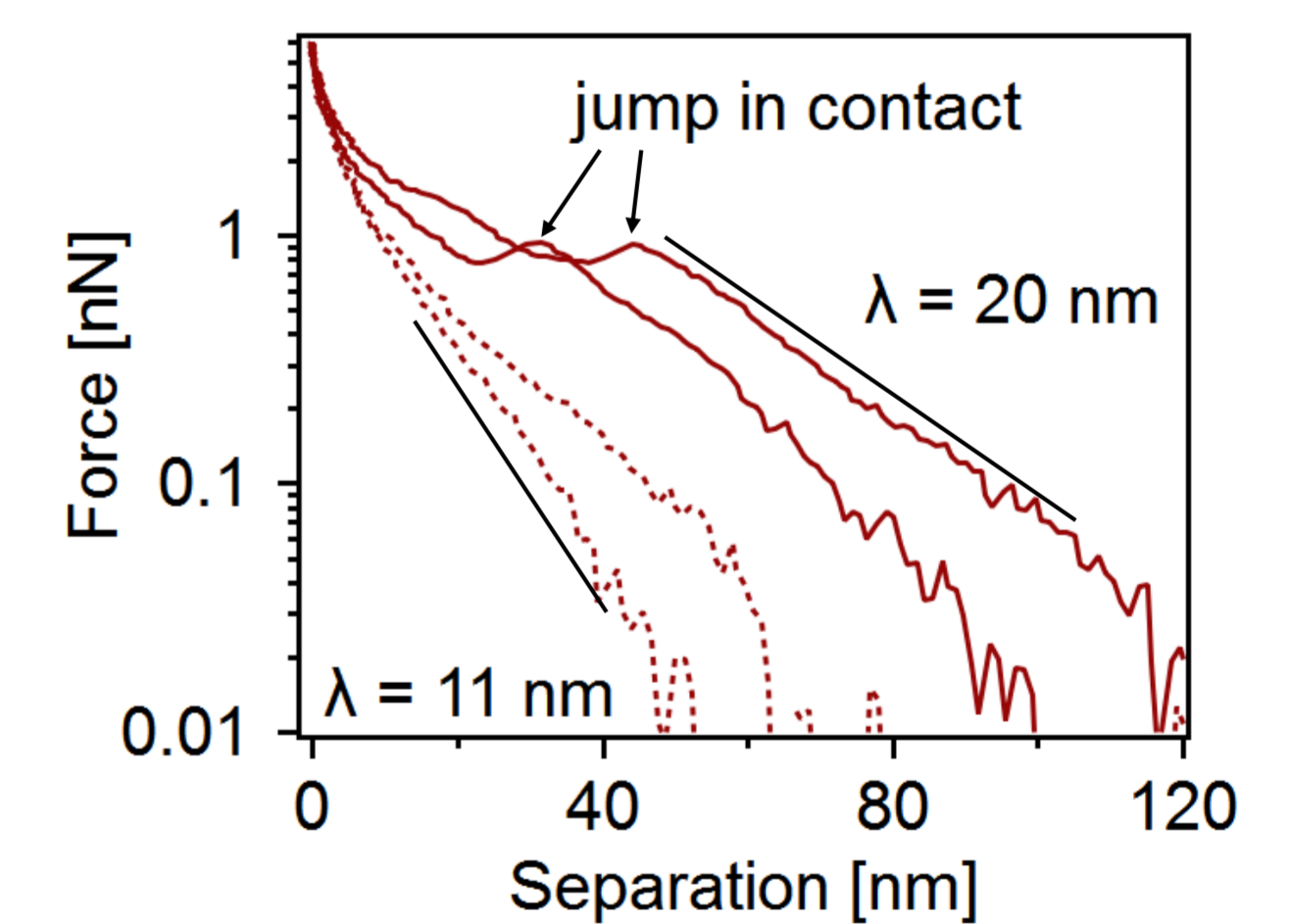
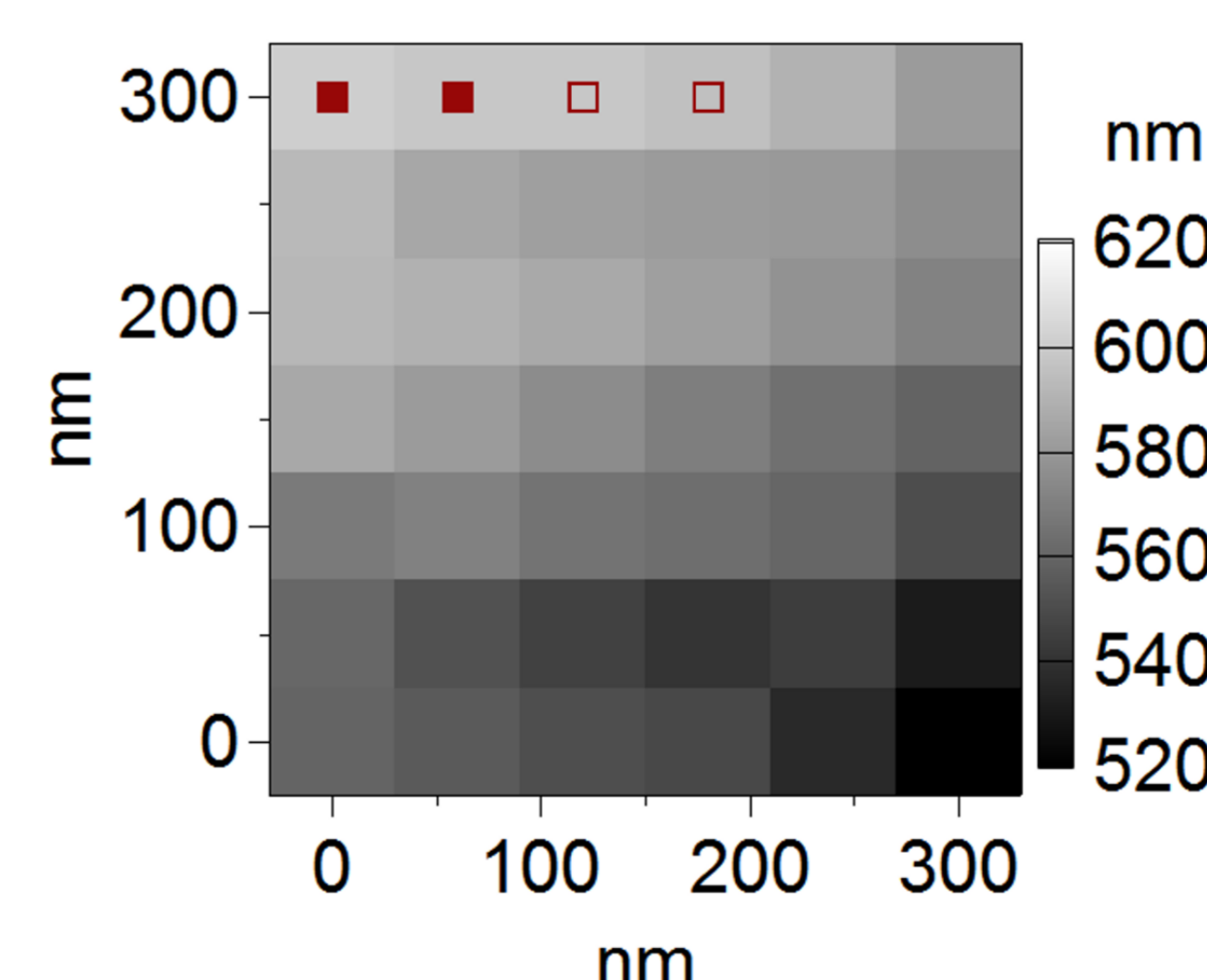
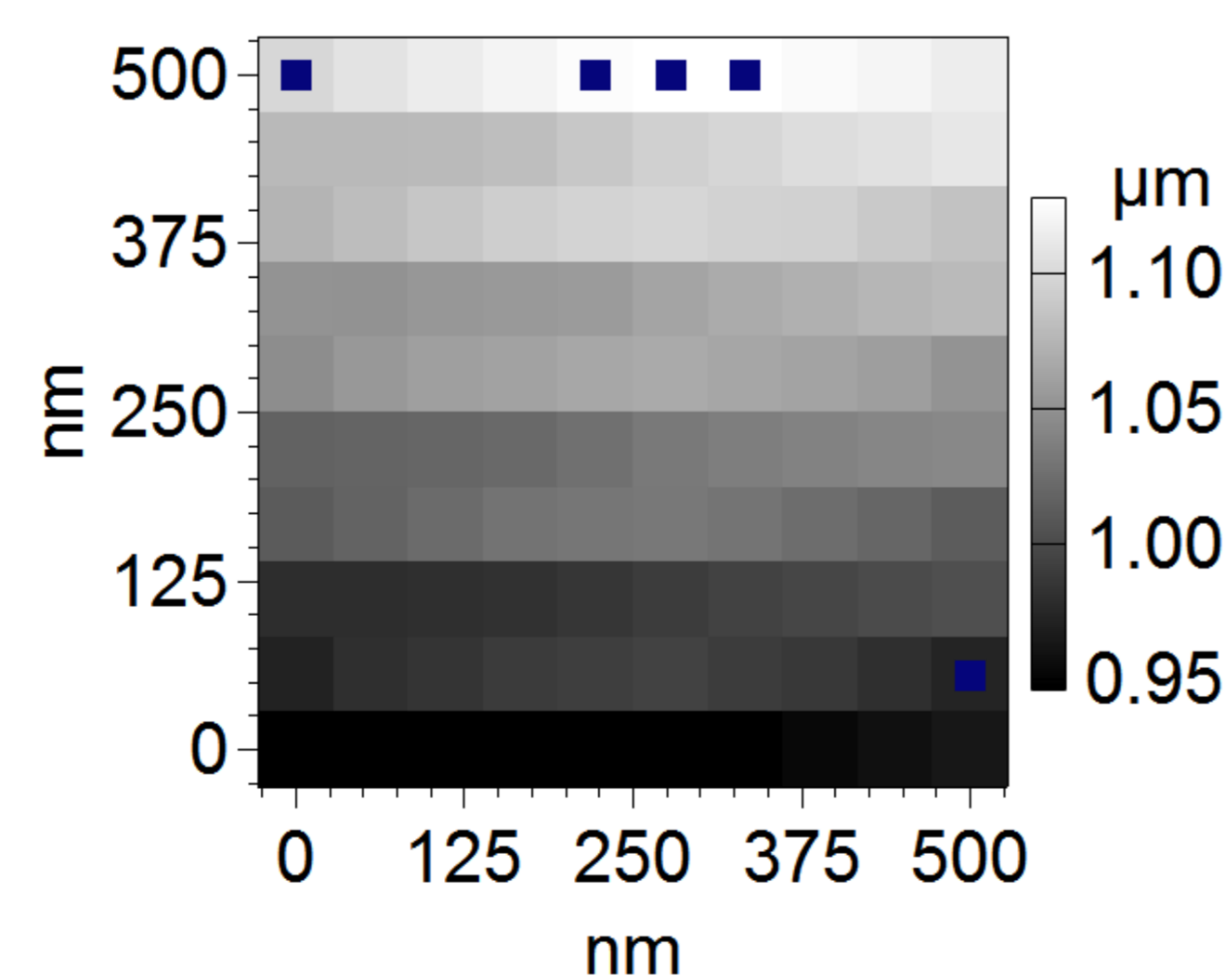
## Surface Charge Distribution

- Measurement on different locations of **one** P-MPP & M-MPP particle
- Force Maps show relative particle height in xy-direction in close proximity to apex
- Coloured pixels show measurement locations of force curves



Force curves **independent** of measurement location

**Homogenous surface charge distribution**



Force curves **dependent** of measurement location

**Varying & weaker surface charge origins from heterogenous charge distribution**

## Conclusion

- Microplastic particles can have same polymer type, size, shape but different **surface charge**
- Particle-cell-interactions **depend** on surface charge

### Acknowledgements



Günter Auernhammer

### References

(1) Yong, C. Q. Y., Valiyaveetil, S. & Tang, B. L. Toxicity of microplastics and Nanoplastics in mammalian systems. International Journal of Environmental Research and Public Health 17, 1509 (2020).