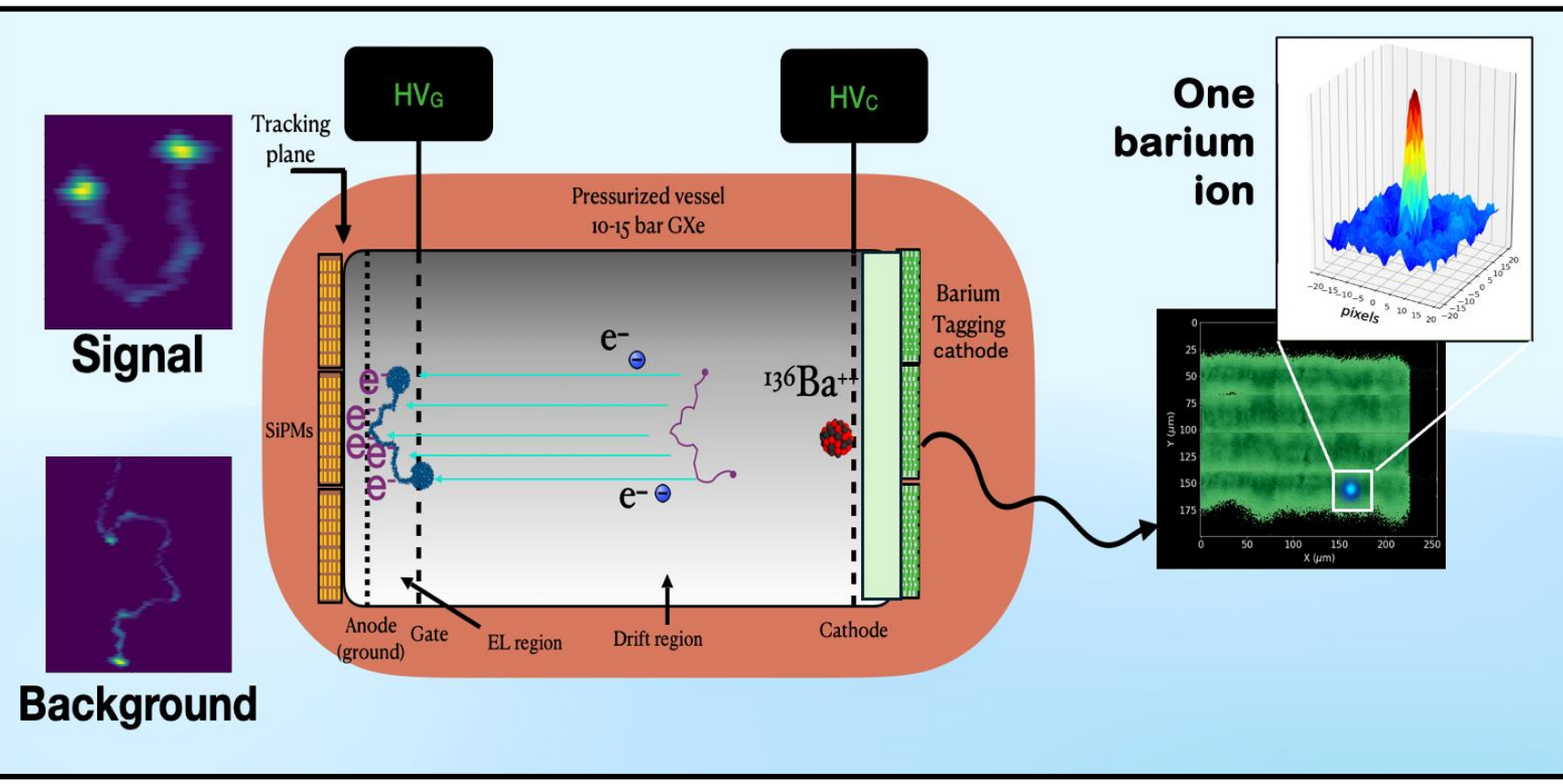


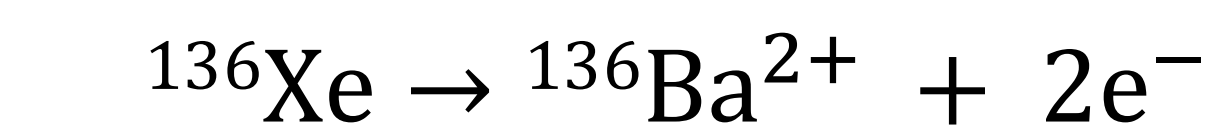
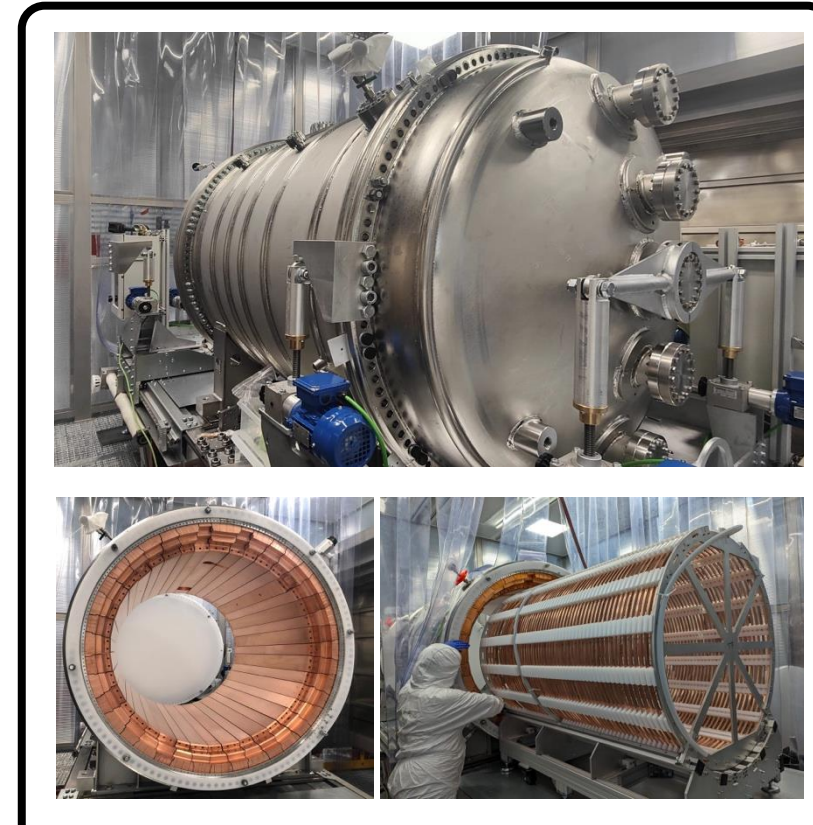
Neutrinoless Double Beta Decay



NEXT Concept: HPXe EL TPC

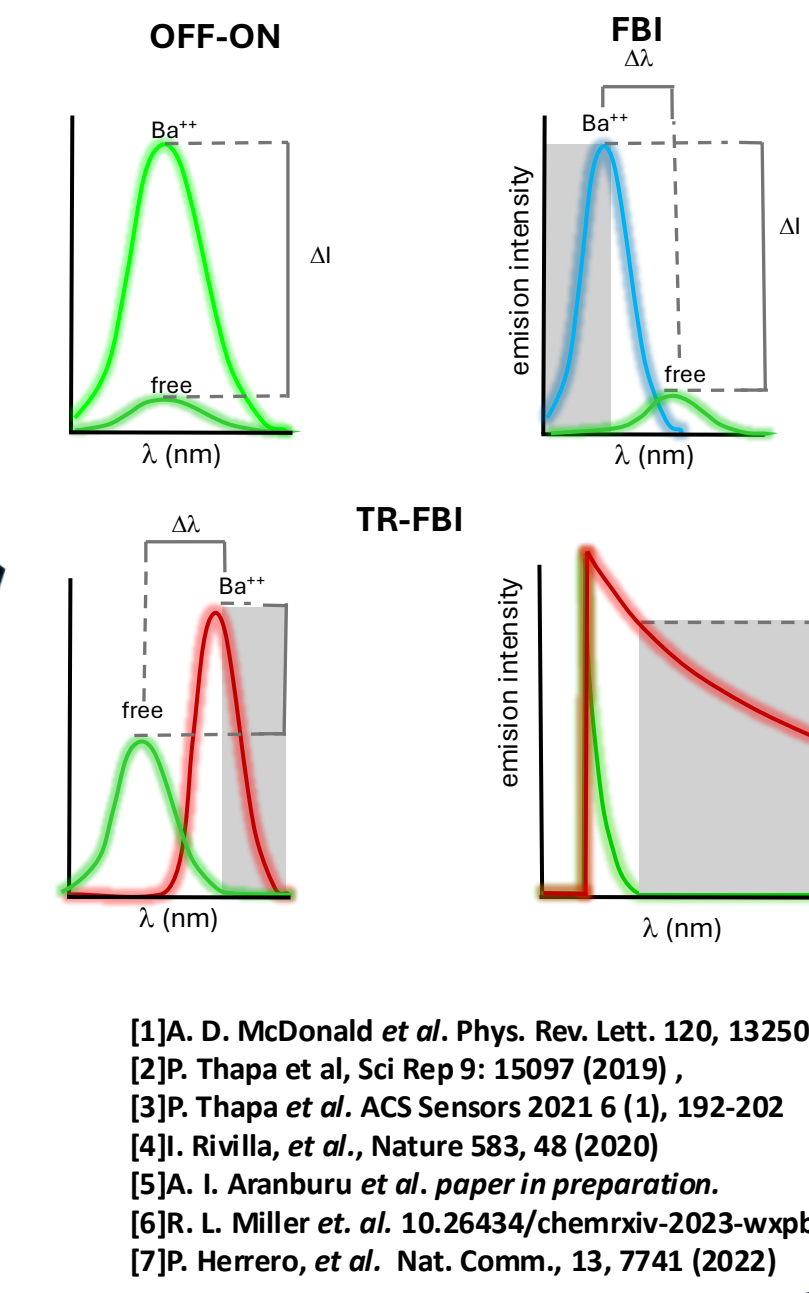
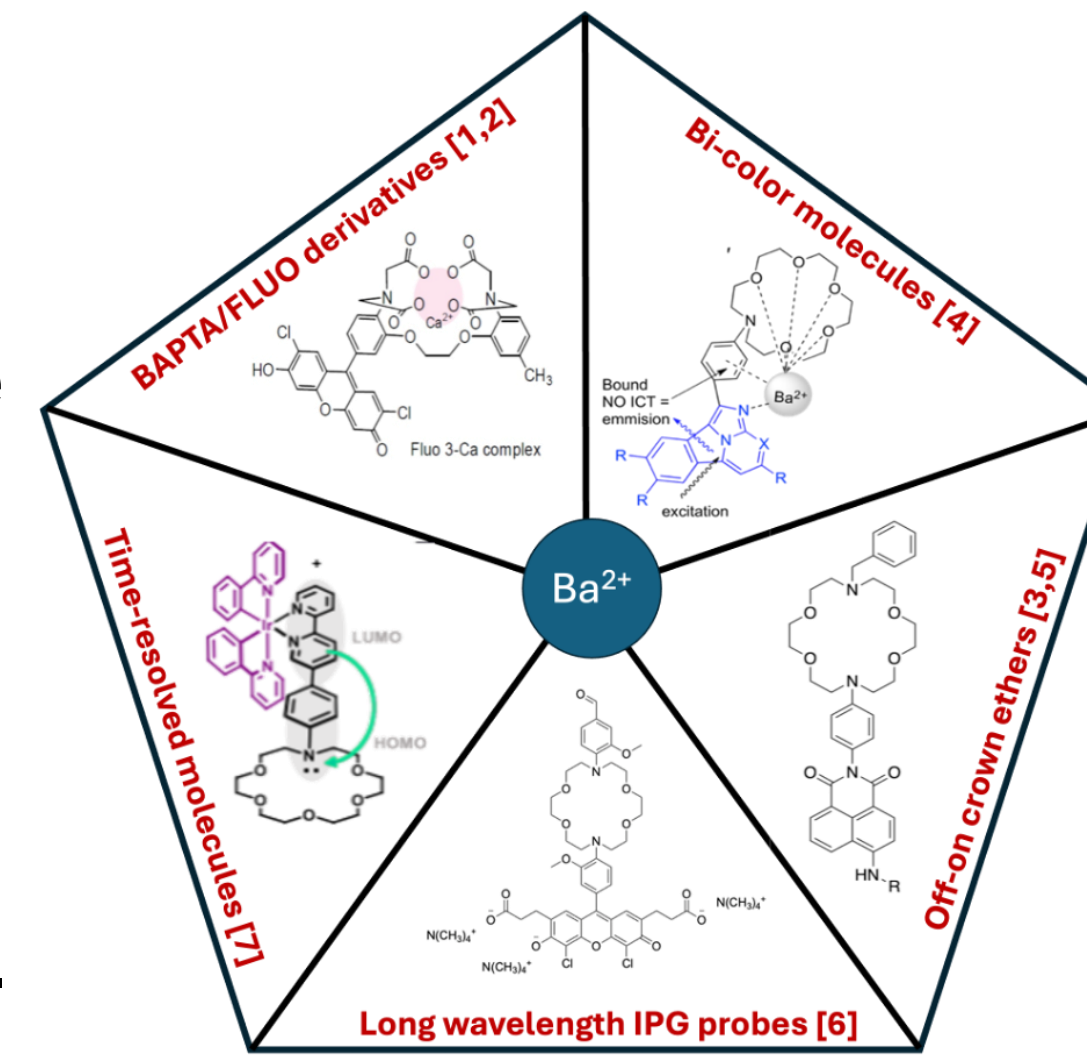
NEXT 100 in operation
See poster by Pau Novella

Observation of 0νββ would imply the majorana nature of neutrino.



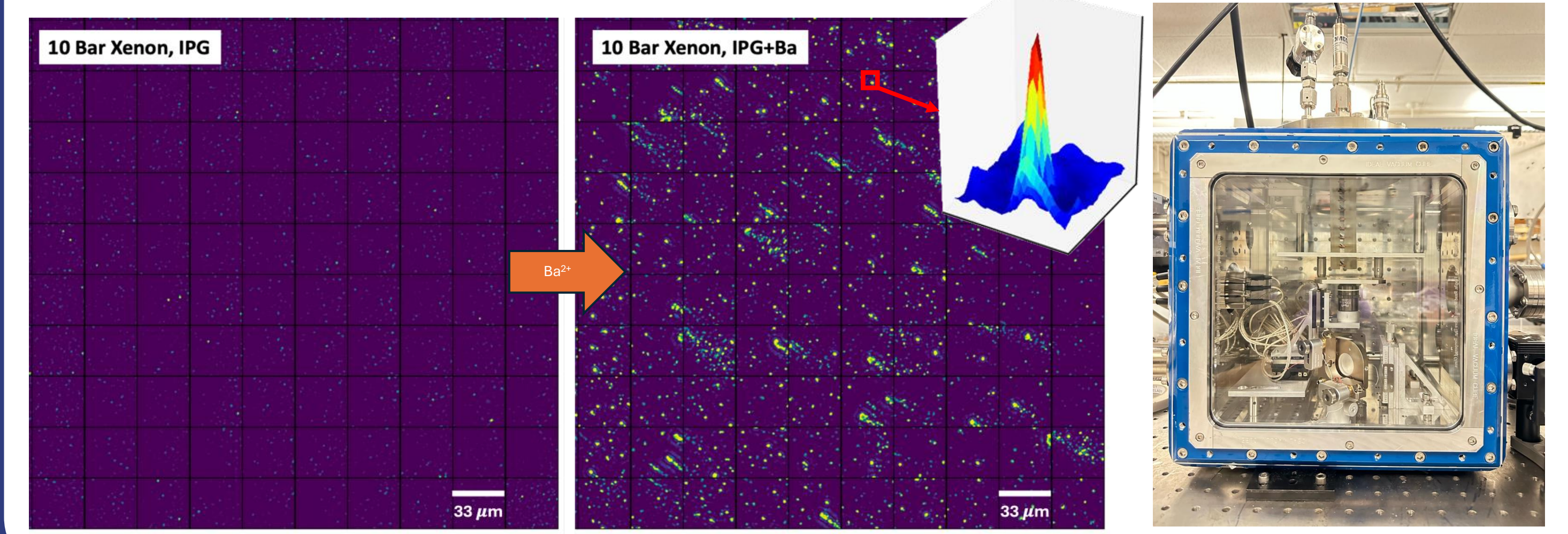
Barium Tagging for 0νββ

- Ba²⁺ is only produced in ββ decays of ¹³⁶Xe.
- Single Molecule Fluorescent Imaging (SMFI): Single molecule changes its fluorescence upon ion capture.
- The NEXT collaboration has developed novel organic fluorophores to detect Ba ions in Xe gas.



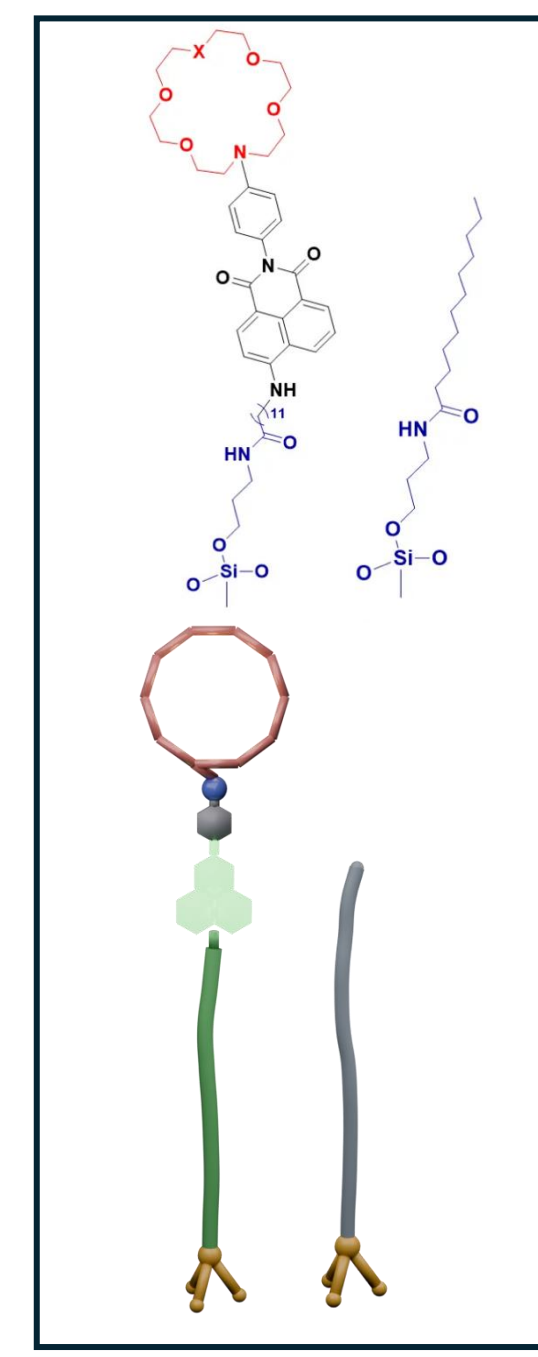
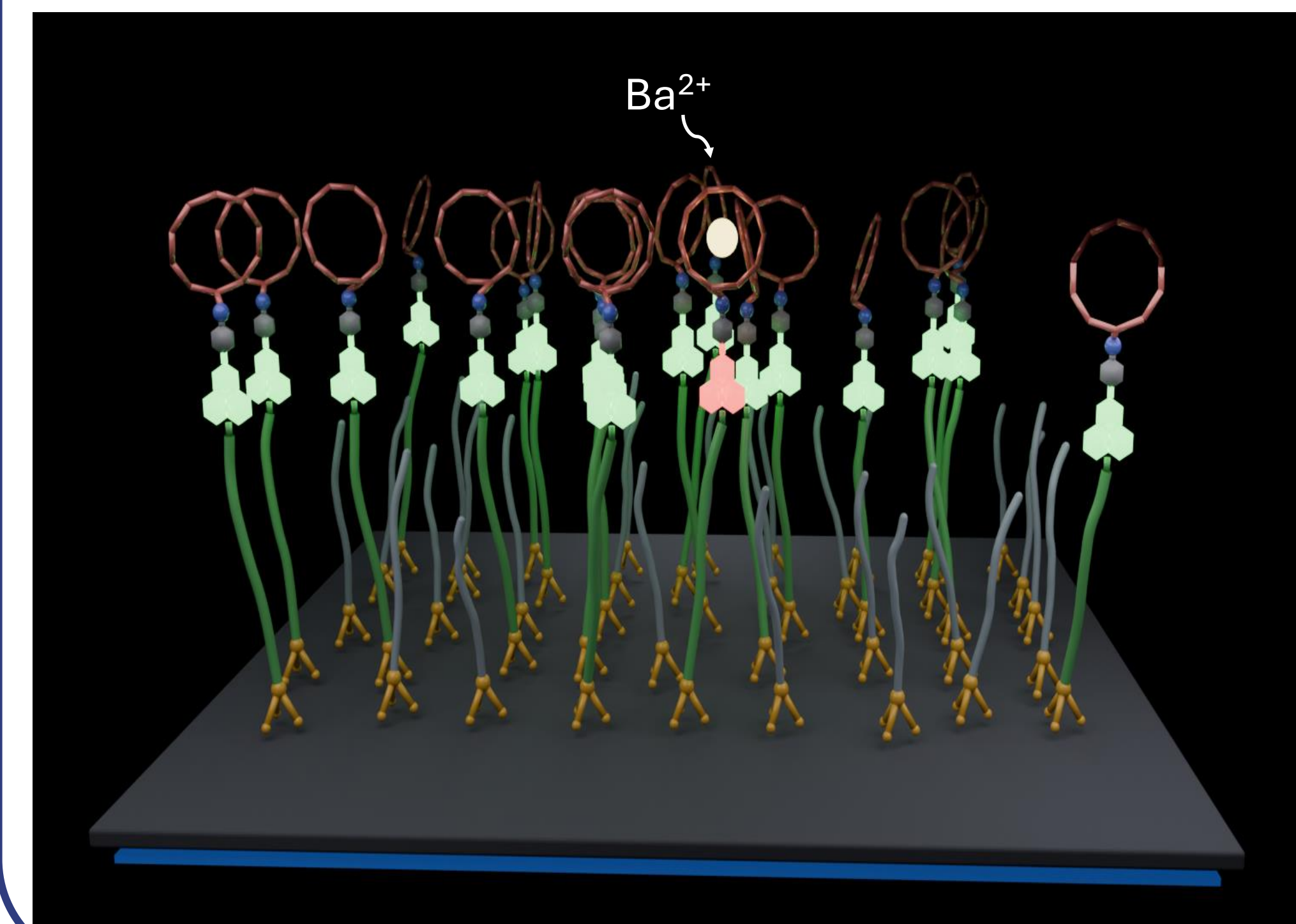
Single Ion Resolution

A novel fluorescence microscope was developed with wide-field scanning and operational in high-pressure (10 bar) xenon gas [8].

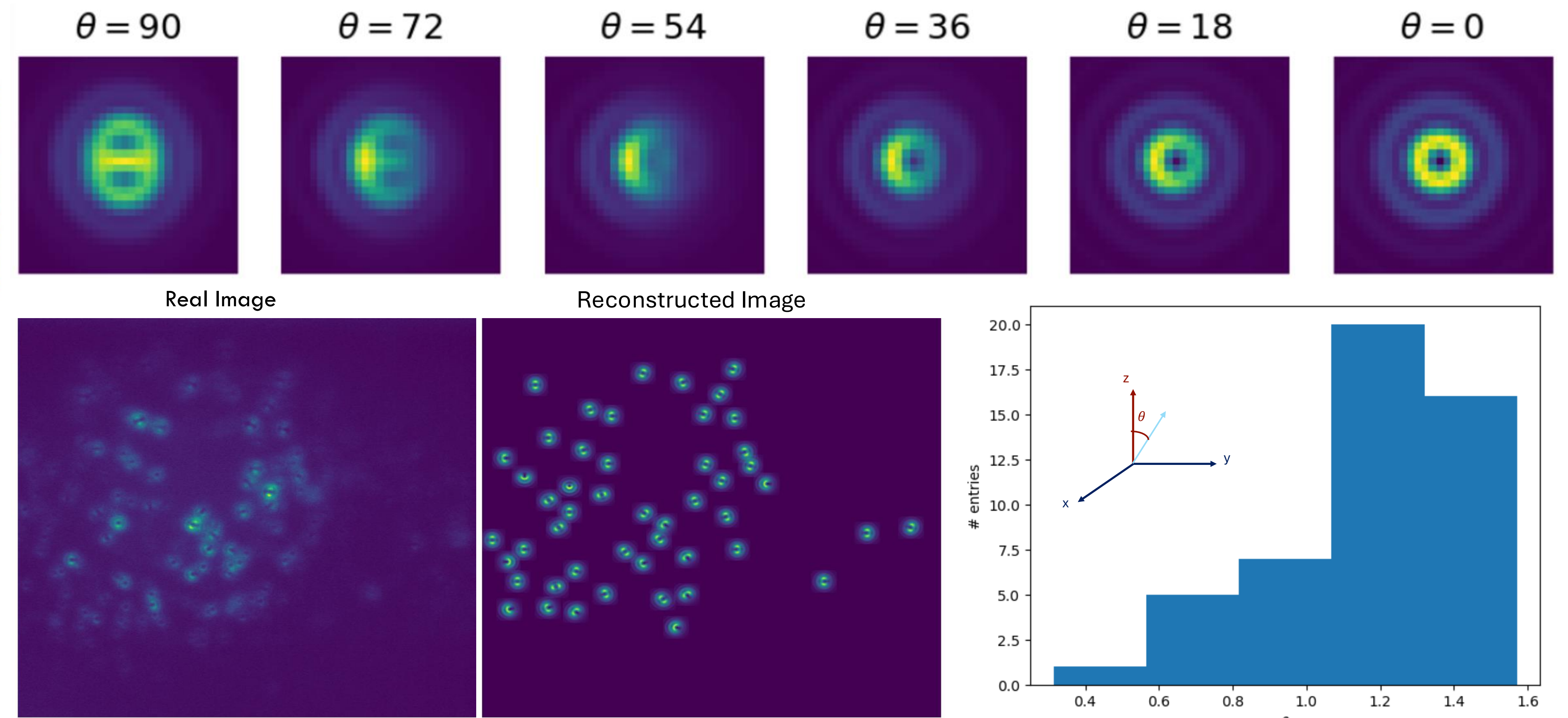
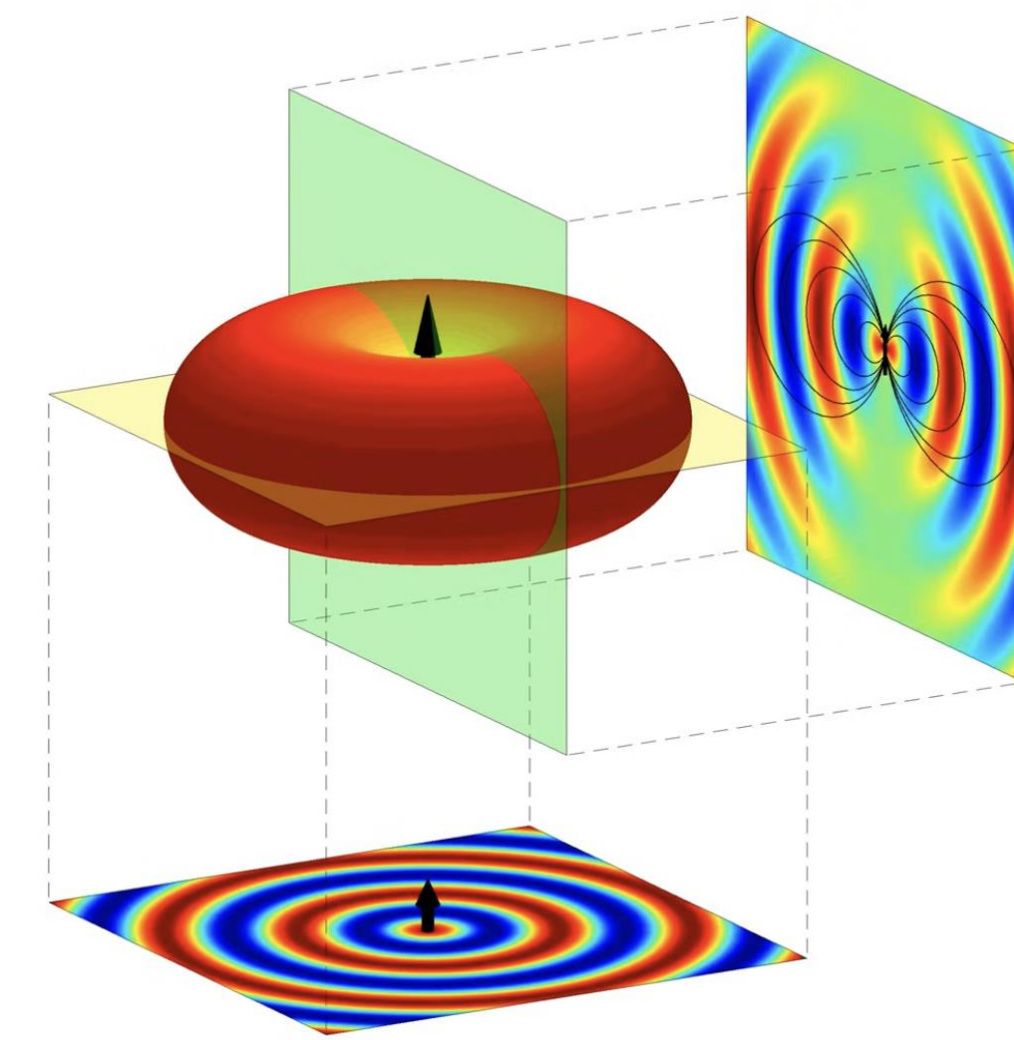


Self Assembled Monolayer : Surface Functionalization & Molecular Orientation Study

- Ba should find molecule anywhere it lands on the surface: need a dense coverage of molecules.
- The current research frontier is development and characterization of a dense, self-assembled monolayer.



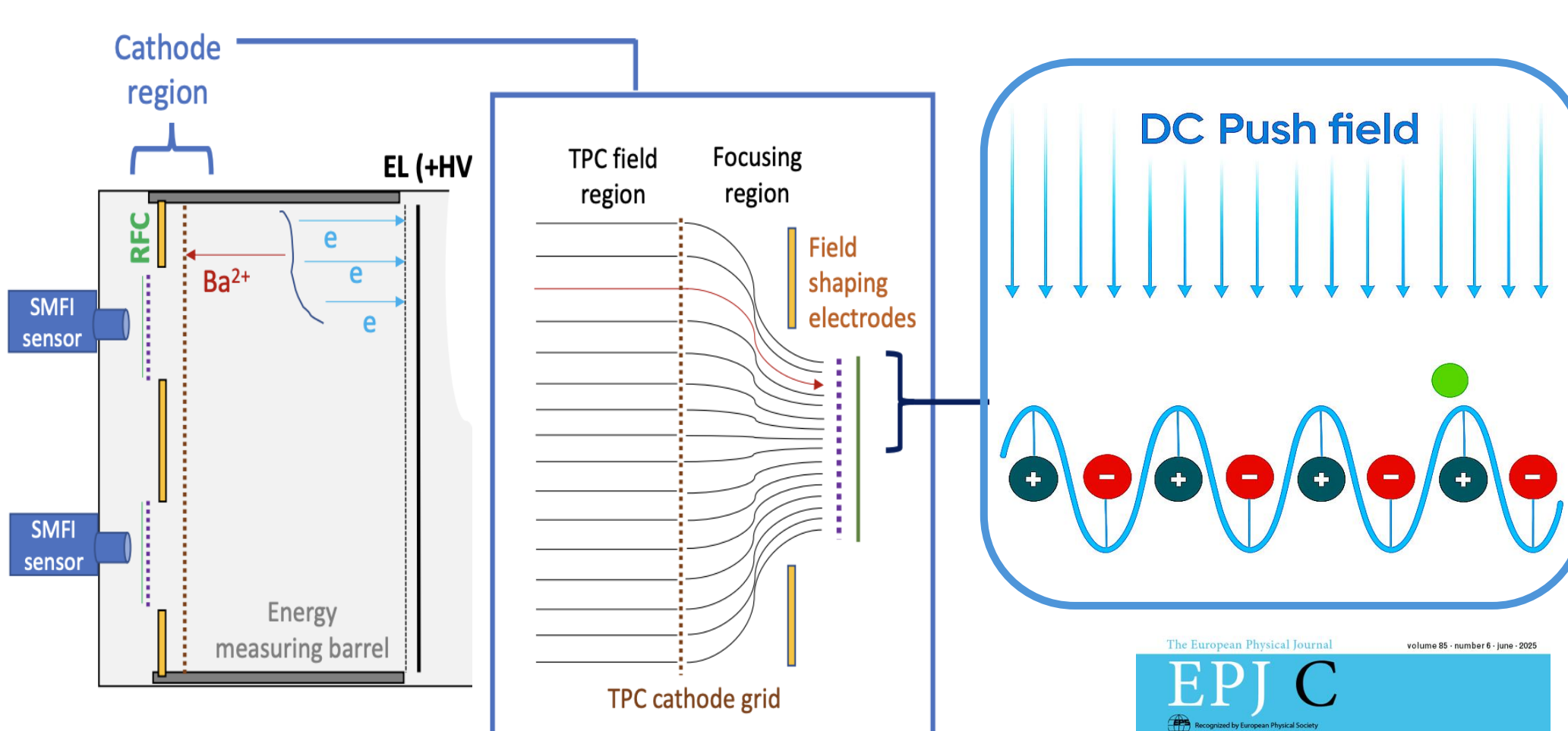
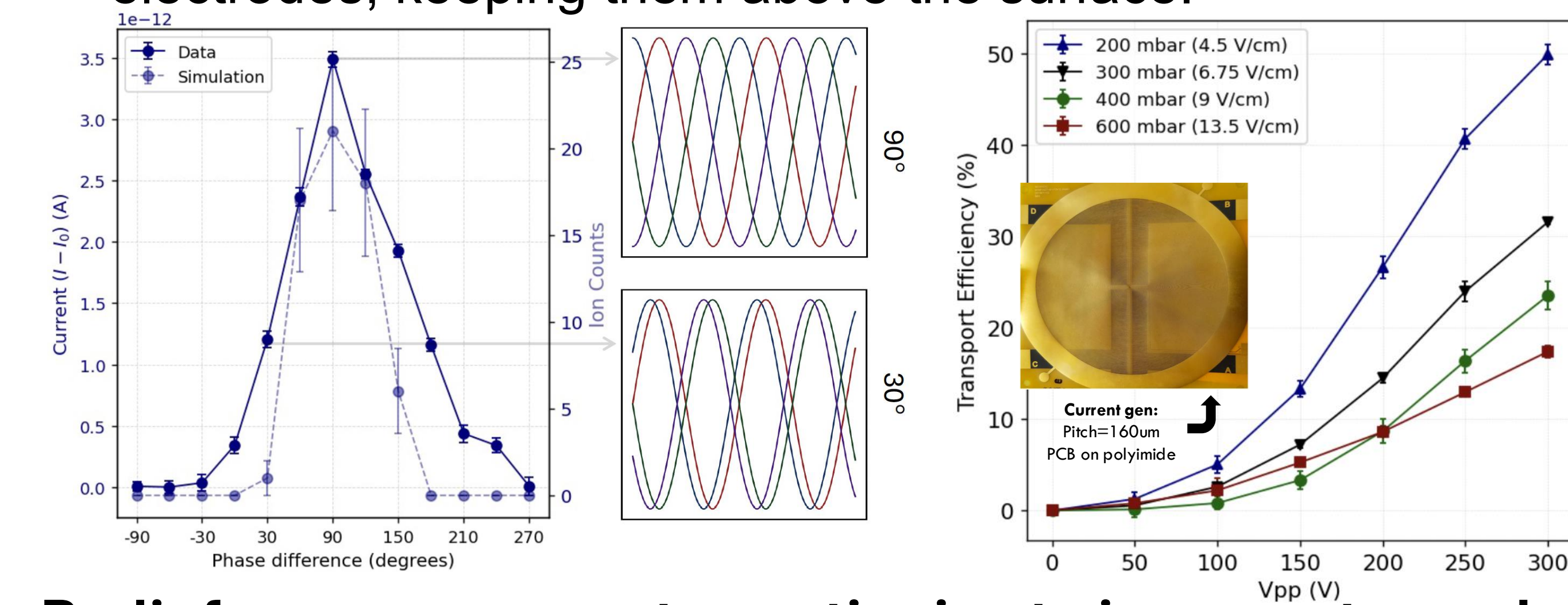
- Fluorescent molecules emit light in dipole radiation pattern.
- In-focus molecules appear as simple dots in the image.
- Defocused (~500 nm) images show unique ring patterns that encode the 3D orientation of each molecule's dipole [9].



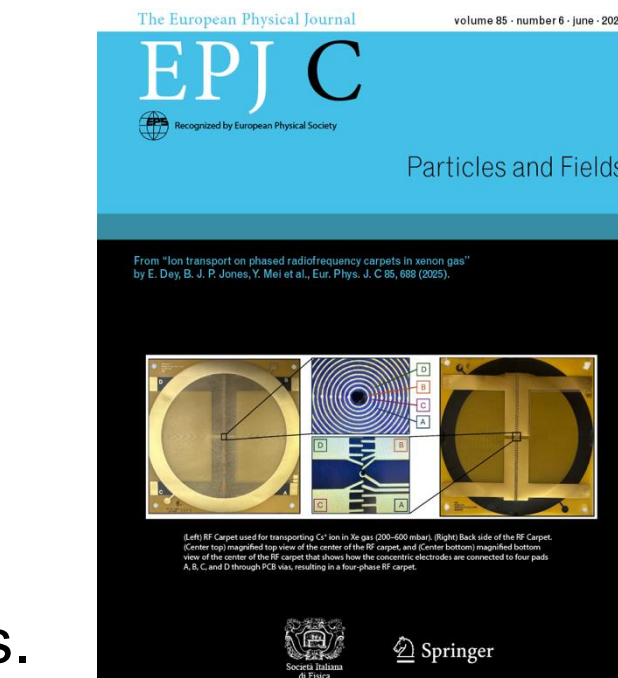
Orientation imaging is being pursued by NEXT as a key tool for understanding the structure and organization of monolayers. [9] J. Opt. Soc. Am. A 43, 50-58 (2026)

Ion Transport & Confinement

- RF carpets use alternating radiofrequency electrodes with a DC push field to transport ions across a surface.
- Applying N-phased RF voltages generates a traveling wave [10].
- Ions experience a time-averaged repulsive force from the electrodes, keeping them above the surface.



- Highest ever pressure 4-phased RF carpet operation, and first use in xenon [11]
- Demonstration with $m_{\text{atom}} = m_{\text{gas}}$.



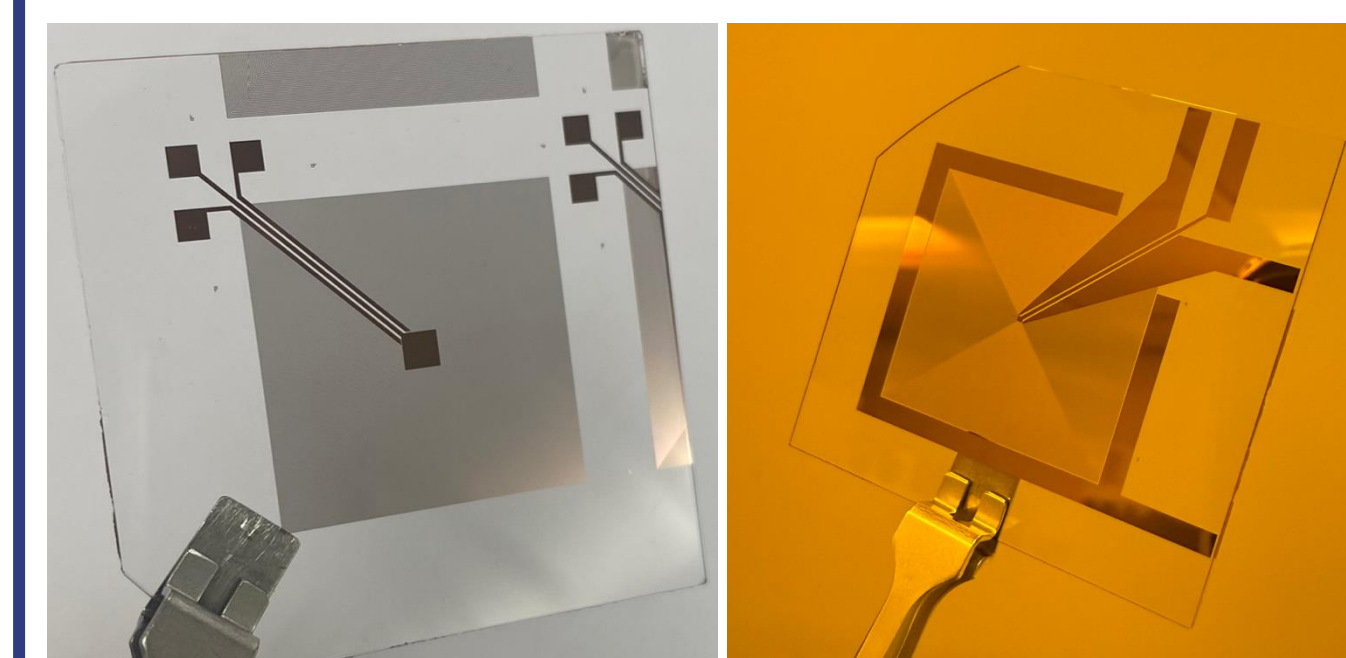
Radiofrequency carpets continuing to improve toward moving barium ions in high pressure xenon gas.

[10] Nucl. Instrum. Meth. A 1039 (2022)
[11] Eur. Phys. J. C 85 (2023) 6, 688

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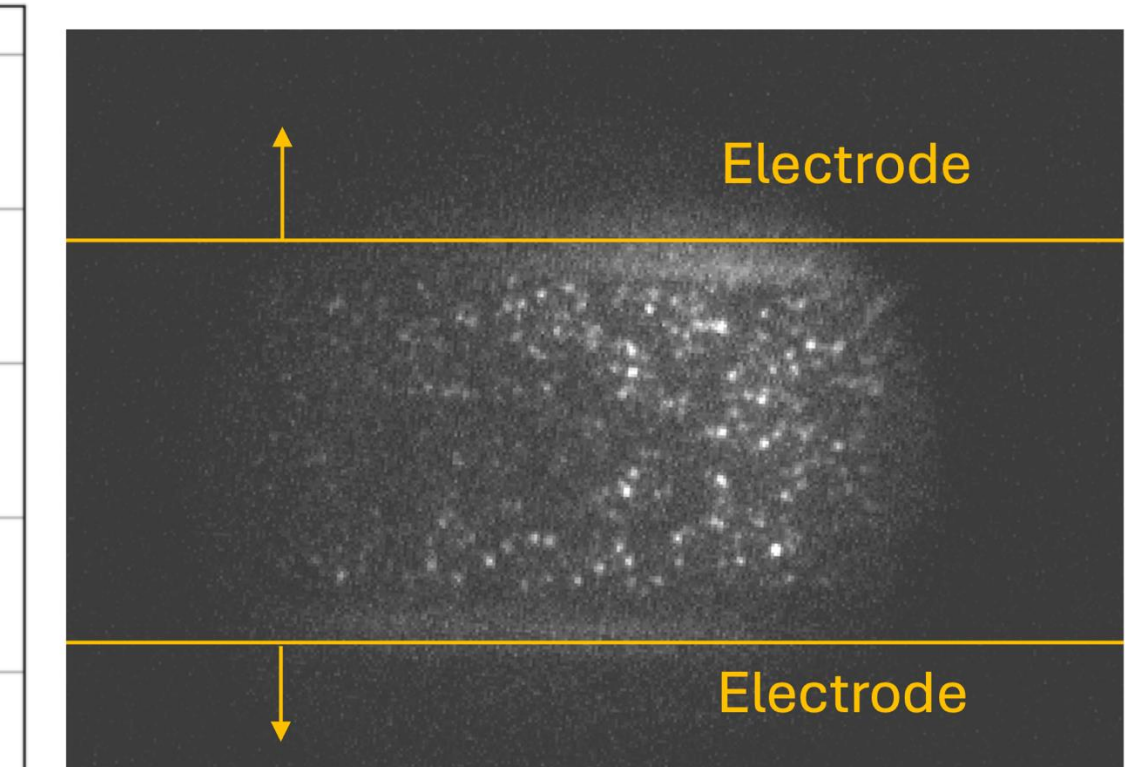
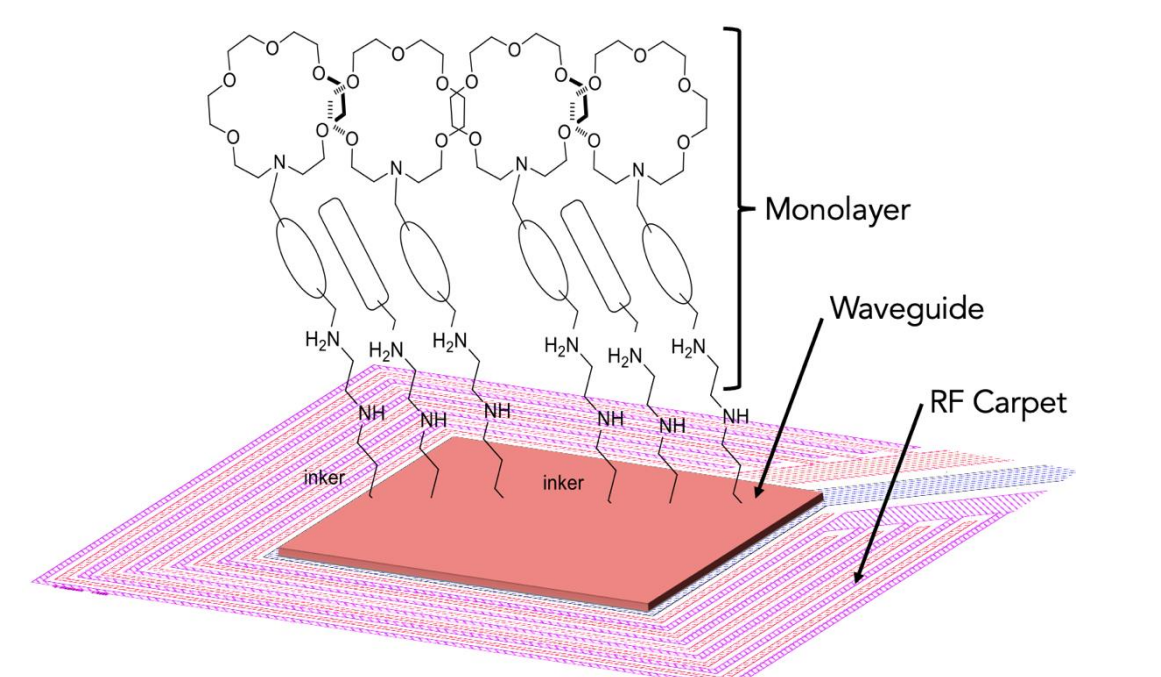
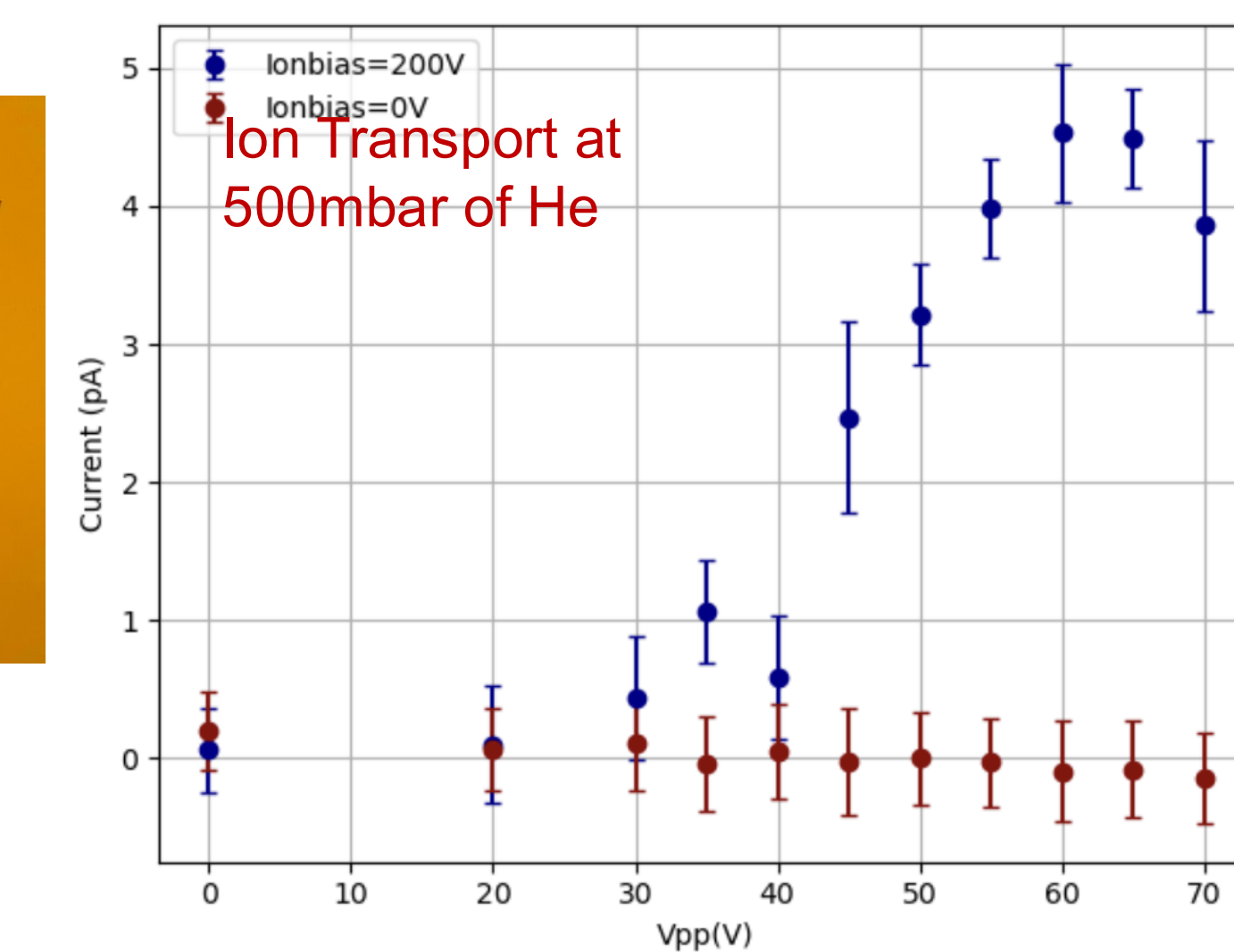
νBIT Chip

- For full-detector coverage, we are developing photonic chip-based sensor.
- νBIT incorporates integrated optical microscopy and microfabricated RF carpets.



Pitch=50um 2-phase

Pitch=50um 2-phase



SMFI Pad on integrated chip

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