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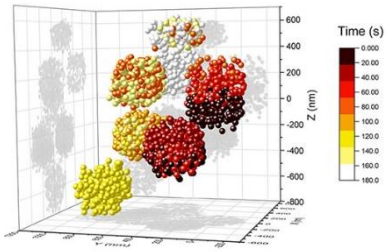
Selection of Publications featuring DHO Light Engineering™

Connecting Hindered Transport in Porous Media across Length Scales: From Single-Pore to Macroscopic.

Wu, H., Wang, D., & Schwartz, D. K. (2020).

Journal of Physical Chemistry Letters, 11, 8825–8831.

https://doi.org/10.1021/acs.jpclett.0c02738



Hindered mass transport is widely observed in various porous media; however, there is no universal model capable of predicting transport in porous media due to the heterogeneity of porous structures and the complexity of the underlying microscopic mechanisms. Here, we used a highly ordered porous medium as a model system to directly explore the effects of geometric parameters (i.e., pore size, pore throat size, and tracer particle size) and microscopic interaction parameters (e.g., controlled by ionic strength) on nanoparticle transport in porous environments using single-particle tracking. We found a linear scaling relation between the macroscopic diffusion coefficient and microscopic diffusion behavior involving a combination of parameters associated with pore-scale features and phenomena, including both geometric effects and particle-wall interactions. The proportionality coefficient relating micro and macro behaviors was complex and related to the connectivity of the matrix and the pore-size variation, which could lead to tortuous diffusion pathways, hindering macroscopic transport.

Three-dimensional localization microscopy in live flowing cells.

Weiss, L.E., Ezra, Y.S., Goldberg, S., Ferdman, B., Adir, O., Schroeder A., Alalouf, O. & Shechtman, Y.

Nat. Nanotechnology 15, 500-506 (2020).

https://doi.org/10.1038/s41565-020-0662-0

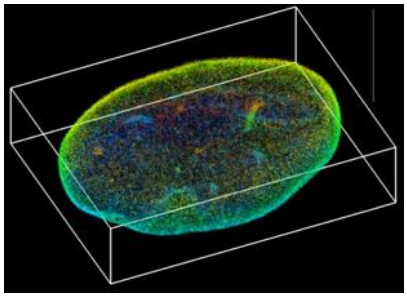
Capturing the dynamics of live cell populations with nanoscale resolution poses a significant challenge, primarily owing to the speed-resolution trade-off of existing microscopy techniques. Flow cytometry would offer sufficient throughput, but lacks subsample detail. Here we show that imaging flow cytometry, in which the point detectors of flow cytometry are replaced with a camera to record 2D images, is compatible with 3D localization microscopy through point-spread-function engineering, which encodes the depth of the emitter into the emission pattern captured by the camera. The extraction of 3D positions from sub-cellular objects of interest is achieved by calibrating the depth-dependent response of the imaging system using fluorescent beads mixed with the sample buffer. This approach enables 4D imaging of up to tens of thousands of objects per minute and can be applied to characterize chromatin dynamics and the uptake and spatial distribution of nanoparticles in live cancer cells.

3D single-molecule super-resolution microscopy with a tilted light sheet.

Gustavsson, A.-K., Petrov, P. N., Lee, M. Y., Shechtman, Y. & Moerner, W. E.

Nat. Commun. 9, 123 (2018).

https://doi.org/10.1038/s41467-017-02563-4



Tilted light sheet microscopy with 3D point spread functions (TILT3D) combines a novel, tilted light sheet illumination strategy with long axial range point spread functions (PSFs) for low-background, 3D super-localization of single molecules as well as 3D super-resolution imaging in thick cells. We validate TILT3D for 3D super-resolution imaging in mammalian cells by imaging mitochondria and the full nuclear lamina using the double-helix PSF for single-molecule detection and the recently developed tetrapod PSFs for fiducial bead tracking and live axial drift correction.

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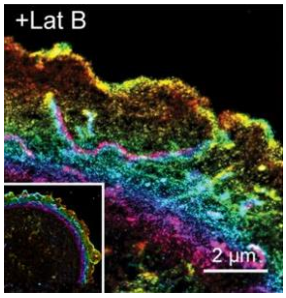
HER2 Cancer Protrusion Growth Signaling Regulated by Unhindered, Localized Filopodial Dynamics.

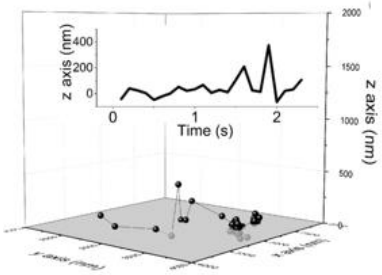


Vu, T. et al. Biorxiv.org (2019).

https://doi.org/10.1101/654988

Protrusions are plasma membrane extensions that are found in almost every cell in the human body. Cancer cell filopodial and lamellipodial protrusions play key roles in the integral processes of cell motility and signaling underlying tumor invasion and metastasis. 3D super-resolution imaging shows LatB+ retracted protrusions appearing curved and flattened and was performed 100X 1.49 NA objective and the Double-Helix (DH) SPINDLE® (Jain et al., 2016; Wang et al., 2017a) module with and phase mask (Grover et al., 2012; Pavani et al., 2009) optimized for far-red dyes.

Three-Dimensional Tracking of Interfacial Hopping Diffusion.



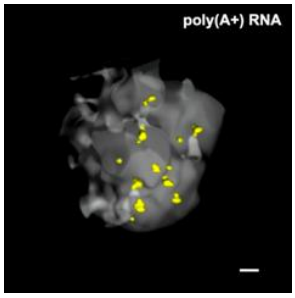
Wang, D., Wu, H. & Schwartz, D. K.

Phys. Rev. Lett. 119, 1–6 (2017).

https://doi.org/10.1103/physrevlett.119.268001

Theoretical predictions have suggested that molecular motion at interfaces—which influences processes including heterogeneous catalysis, (bio)chemical sensing, lubrication and adhesion, and nanomaterial self-assembly—may be dominated by hypothetical "hops" through the adjacent liquid phase, where a diffusing molecule readsorbs after a given hop according to a probabilistic "sticking coefficient." Here, we use three-dimensional (3D) single-molecule tracking to explicitly visualize this process for human serum albumin at solid-liquid interfaces that exert varying electrostatic interactions on the biomacromolecule. These findings explicitly demonstrate that interfacial diffusion is dominated by biased 3D Brownian motion involving bulk-surface coupling and that it can be controlled by influencing short- and long-range adsorbate-surface interactions.

ATPase-Modulated Stress Granules Contain a Diverse Proteome and Substructure.



Jain, S. et al.

Cell 164, 487–498 (2016).

https://doi.org/10.1016/j.cell.2015.12.038

Stress granules are mRNA-protein granules that form when translation initiation is limited, and they are related to pathological granules in various neurodegenerative diseases. Super-resolution microscopy reveals stable substructures, referred to as cores, within stress granules that can be purified. Our observations suggest that stress granules contain a stable core structure surrounded by a dynamic shell with assembly, disassembly, and transitions between the core and shell modulated by numerous protein and RNA remodeling complexes.

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For more information about our SPINDLE Family, phase mask library, and 3DTRAX Software products please contact us: *imaging@doublehelixoptics.com*