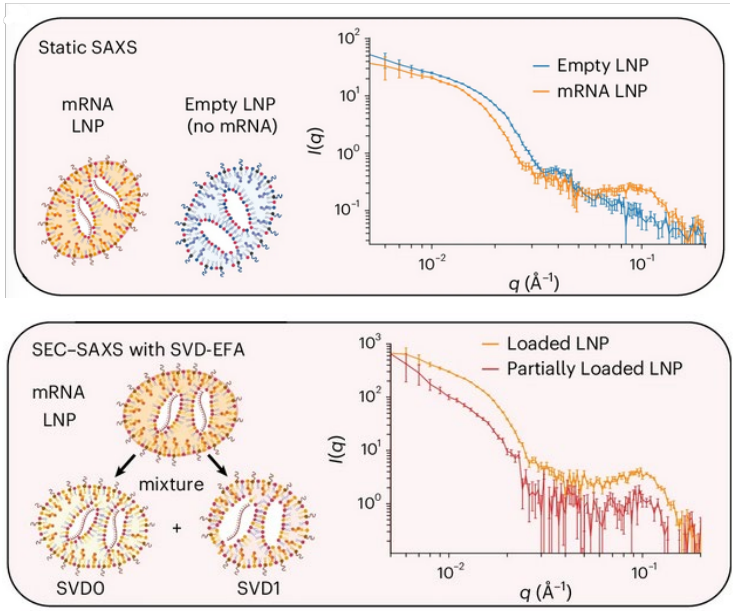
Lipid Nanoparticles : Shaping Therapeutic Delivery



Comparison between static small-angle X-ray scattering (SAXS) and size-exclusion chromatography SAXS (SEC-SAXS) with singular value decomposition and evolving factor analysis.

Scientific Achievement

Researchers discover that clinically used lipid nanoparticles (LNPs) have diverse, previously unrecognized shapes and internal structures.

Significance and Impact

This structural diversity explains differences in delivery performance, enabling more precise design of LNPs for specific therapies.

Research Details

- Scientists examined four well-known LNPs, including particles used in vaccines and gene therapies.
- SEC-SAXS experiments at the Life Science X-ray Scattering (LiX) beamline were used to quantify the particles' geometric characteristics.
- Once thought to be spherical, LNPs have more varied, "jellybean-like" shapes.

Marshall S. Padilla, Sarah J. Shepherd, Andrew R. Hanna, Martin Kurnik, Xujun Zhang, Michelle Chen, James Byrnes, Ryann A. Joseph, Hannah M. Yamagata, Adele S. Ricciardi, Kaitlin Mrksich, David Issadore, Kushol Gupta, and Michael J. Mitchell. Elucidating lipid nanoparticle properties and structure through biophysical analyses. Nat Biotechnol (2025). https://doi.org/10.1038/s41587-025-02855-x

Work was performed in part at NSLS-II