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Extrusion of unilamellar lipid nanotubes by kinesin-powered microtubule filaments

Zachary I. Imam, George D. Bachand

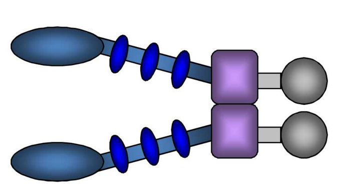
Center for Integrated Nanotechnologies, (505) 845-7968, zimam@sandia.gov

U.S. DEPARTMENT OF ENERGY
Office of Science
cint.lanl.gov

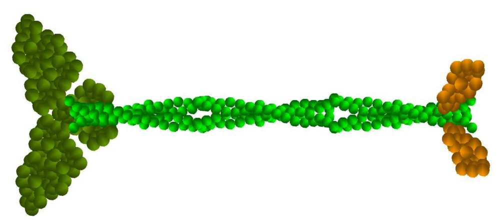
Introduction

Cytoskeletal filaments and motor proteins (kinesin and myosin) are involved in lipid vesicle transportation and membrane reorganization.

Myosin II (muscle myosin)
linear motor

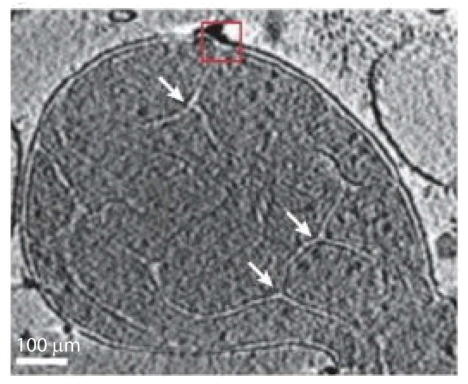


Kinesin (conventional)
linear motor



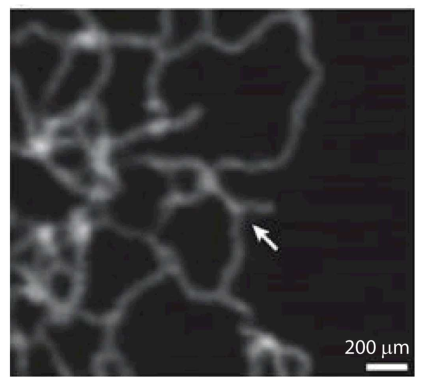
Lipid nanotubes in Nature

Mitochondria



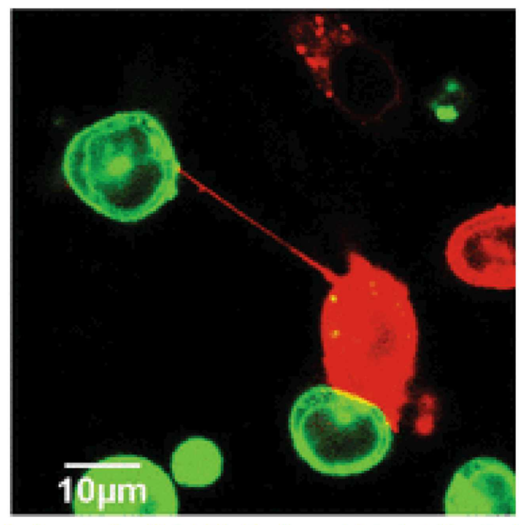
Voeltz et al., (2007) *Nat. Rev. Mol. Cell Biol.*

Endoplasmic Reticulum



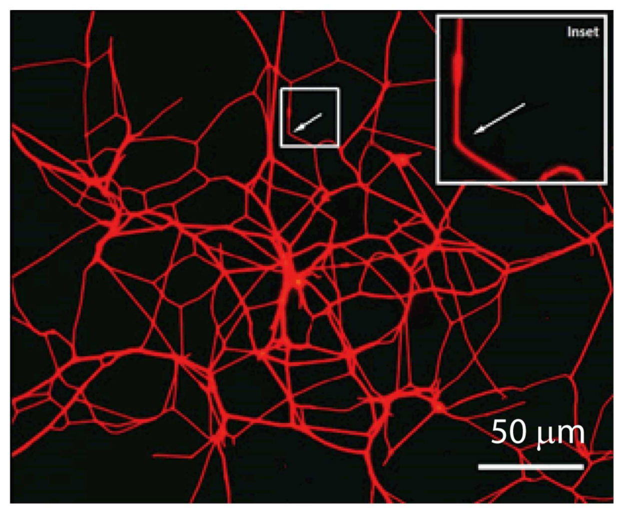
Voeltz et al., (2007) *Nat. Rev. Mol. Cell Biol.*

Lipid nanotubes
in murine B-cells



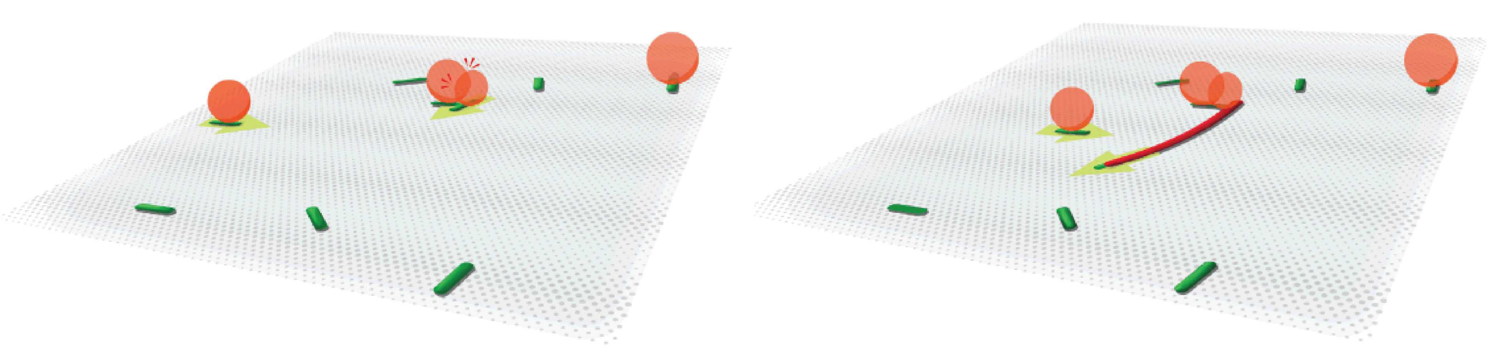
Molnár et al., (2016) *Cell and Mol. Life Sciences*

Lipid nanotubes in vitro

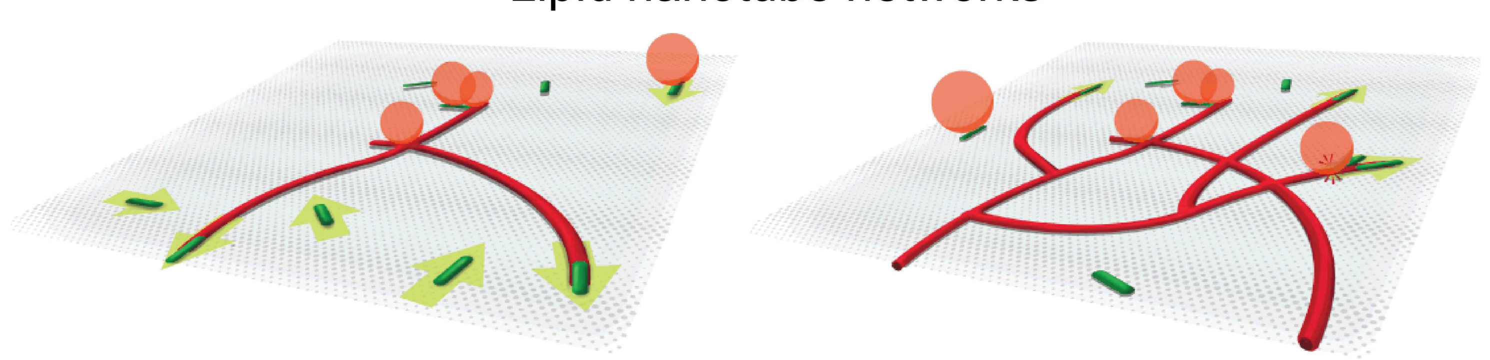


Bouxsein et al., (2013) *Langmuir*

Methods

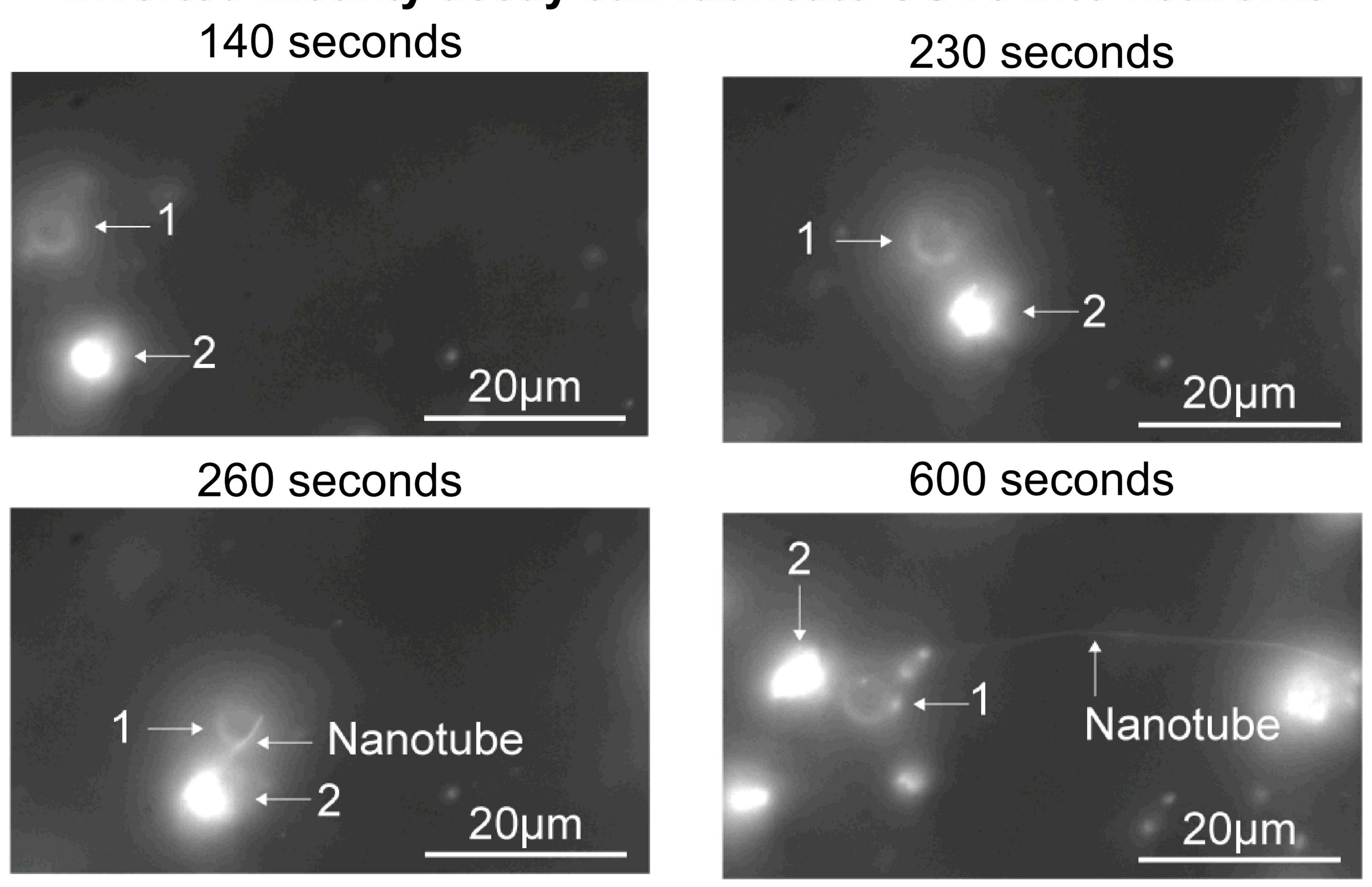


Microtubule motility drives aggregation of GUVs to form Lipid nanotube networks

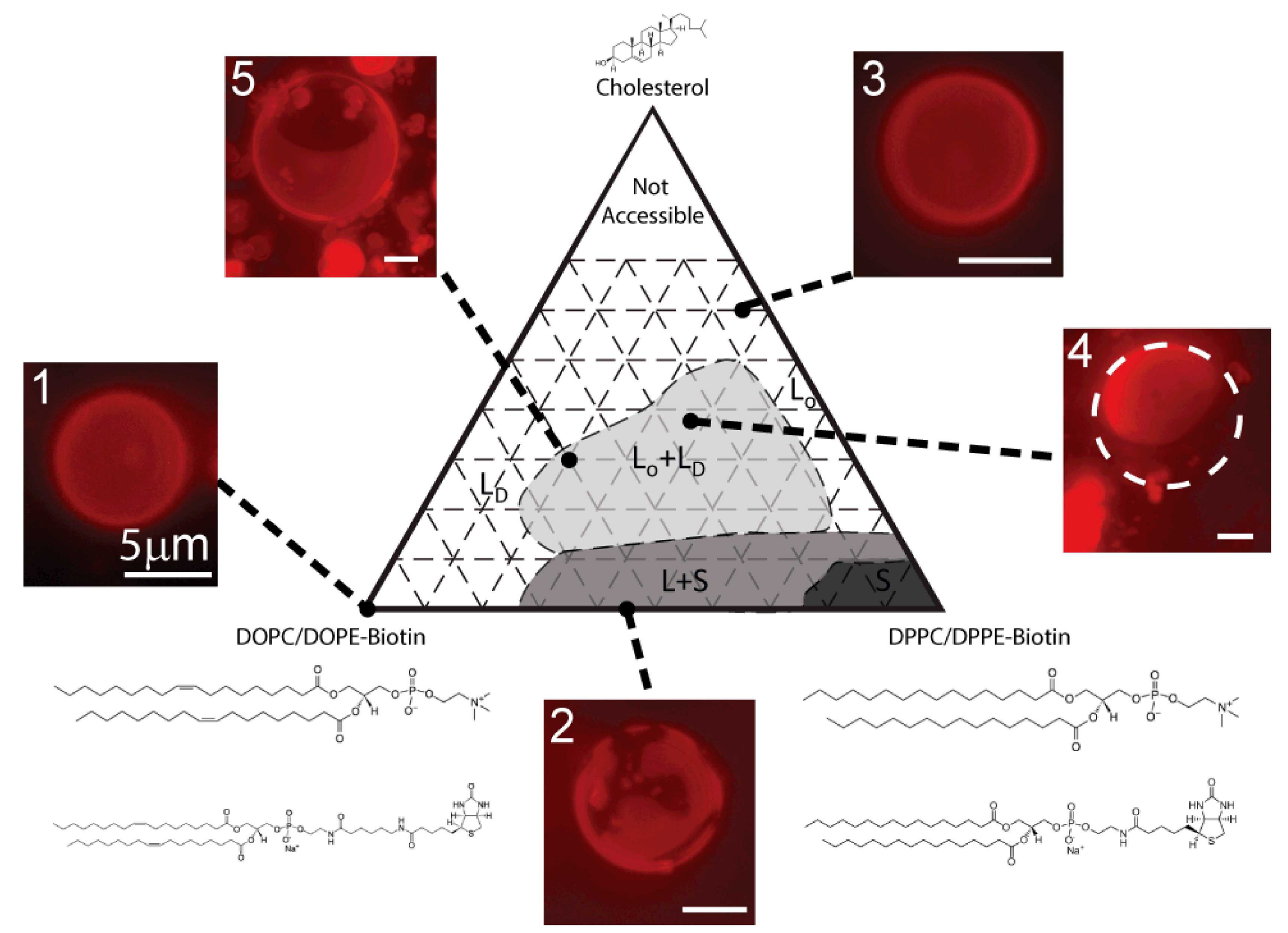


Results

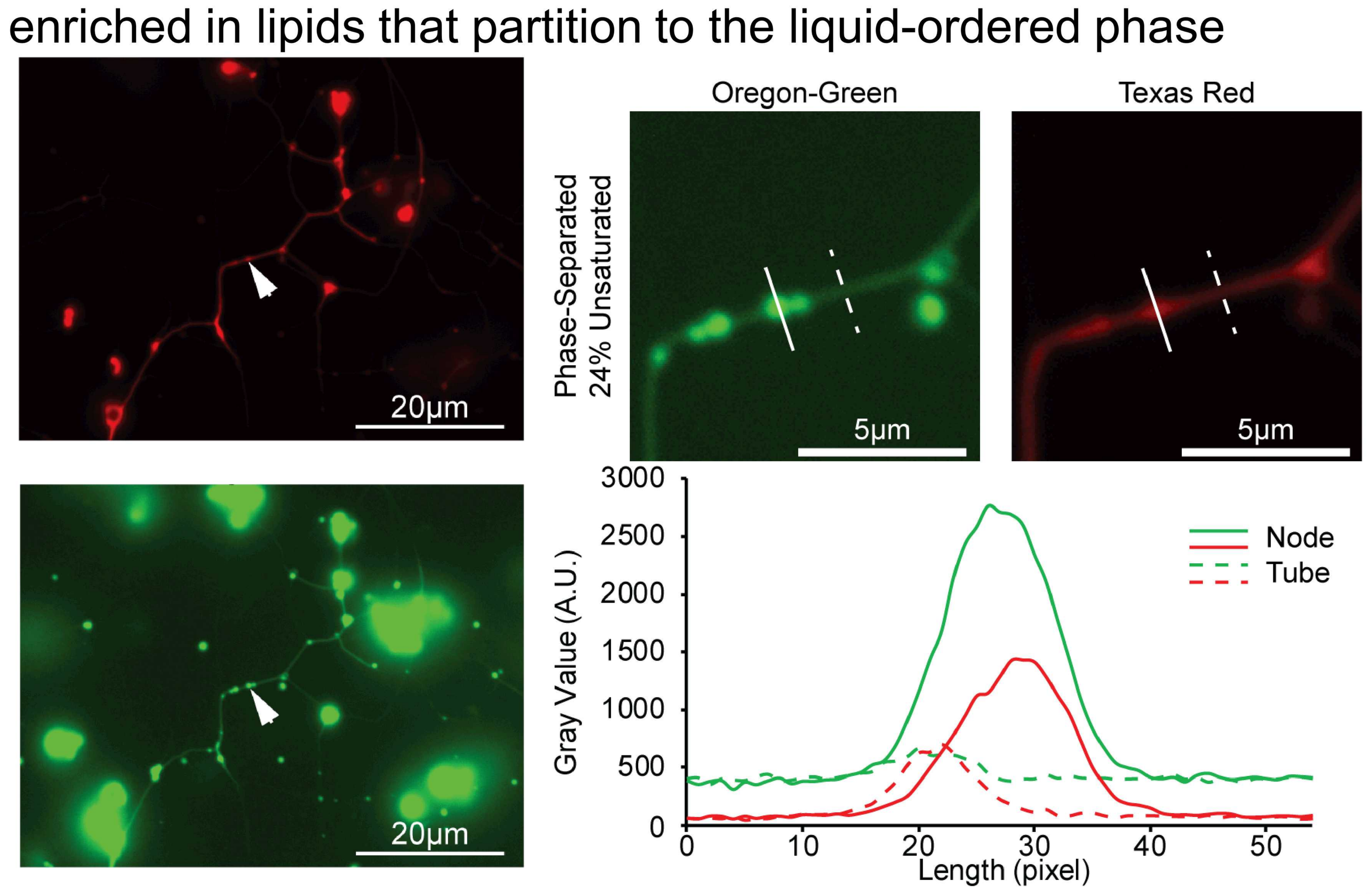
Inverted motility assay can fabricate GUVs into networks



Will lipid membrane phase behavior affect nanotubes?

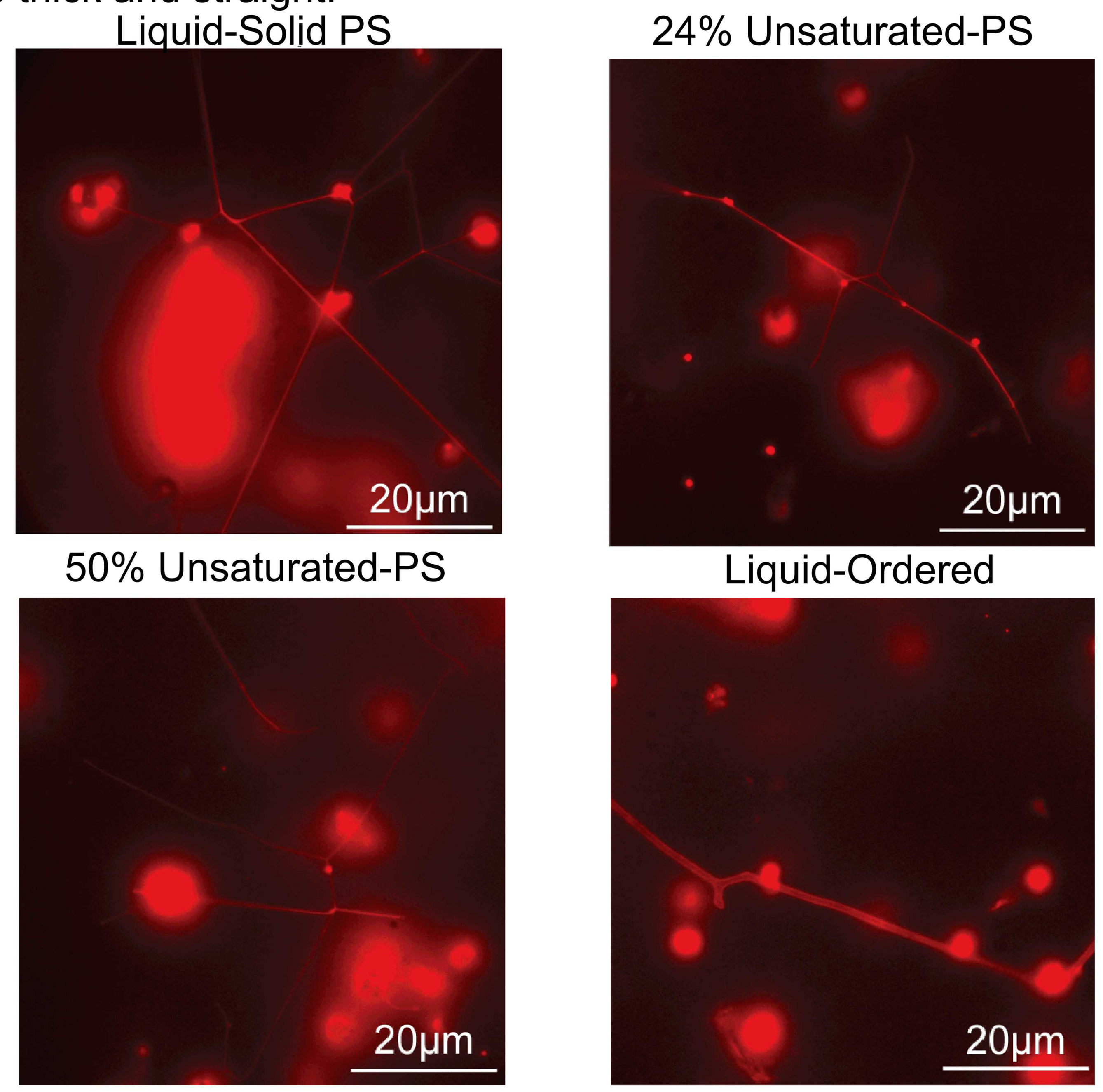


LNTs formed from phase-separated GUVs have nodes enriched in lipids that partition to the liquid-ordered phase

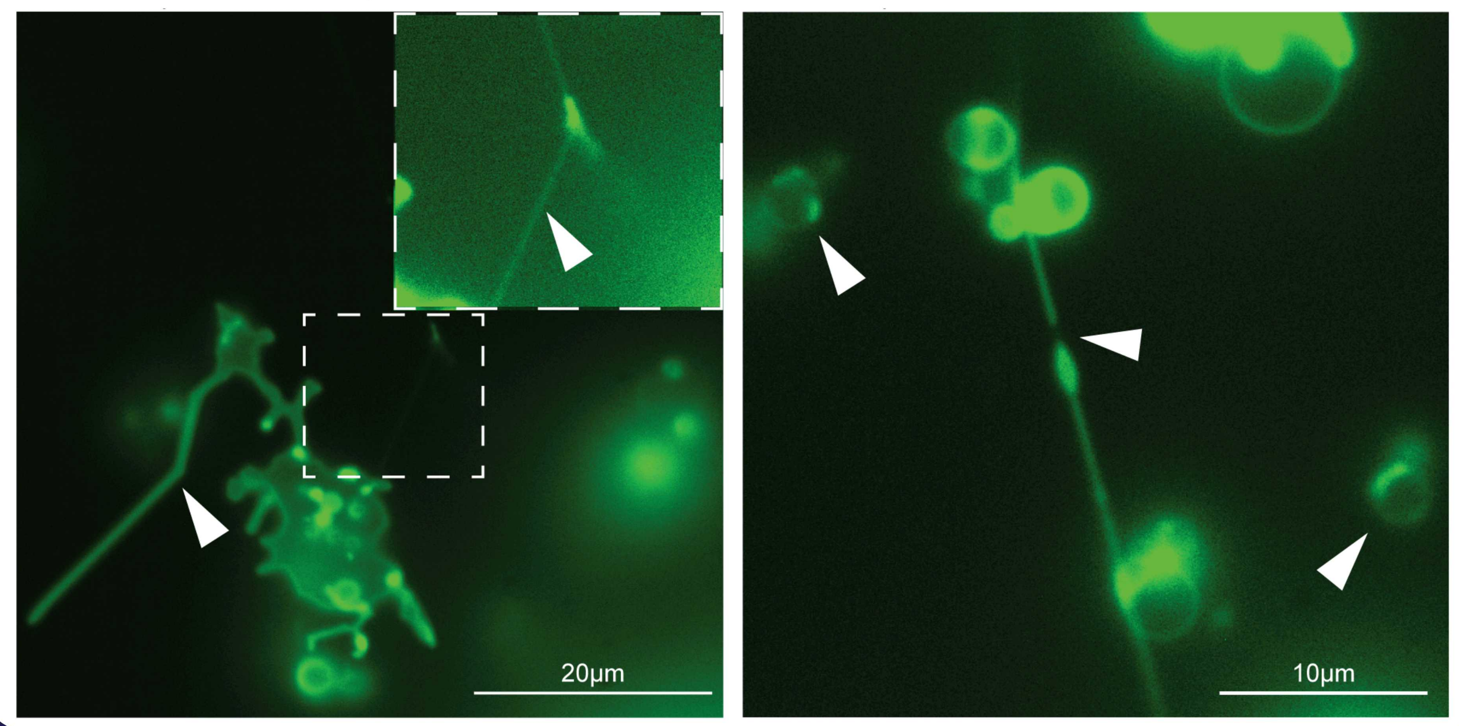


Results

The phase-behavior of the lipid membrane changes the phenotype of nanotubes. Liquid and liquid disordered phase Tubes are thin and branched, while liquid-ordered phase tubes Are thick and straight.



LNTs from both phases can be extruded from phase-separated GUVs. Phase-separation can occur within LNTs



Conclusion

- Large lipid nanotube networks observed in liquid phase membranes.
- Liquid-disordered phase nanotubes were observed to be thin.
- Liquid-ordered phase nanotubes were observed to be thick approximately 3 times thicker than liquid-disordered tubes.

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