The Origami Cosmic Web

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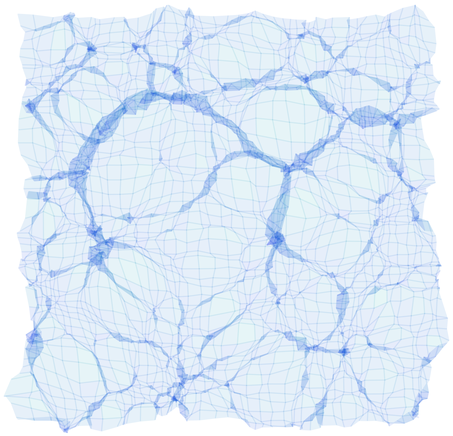


FIGURE 1. A dark-matter sheet in a 2D universe, that distorts and folds through an approximation to gravity, called the Zel'dovich approximation. The darkness of the color at each position gives the number of streams there. Initially, all vertices were nearly on a regular lattice. Since then, gravity has distorted the mesh, causing regions with a bit more matter than average to accumulate more matter around them. The patch shown is $> 10^8$ light-years on a side; nodes correspond to galaxies or clusters of galaxies.

See links at https://2014.spaceappschallenge.org/project/fold-your-own-universe/ to fold a "universe" from an arbitrary photo.

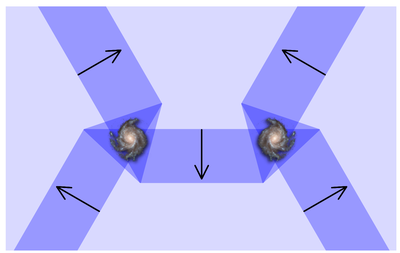


FIGURE 2. Triangular collapse of a pair of galaxies, on smaller scales than at right.

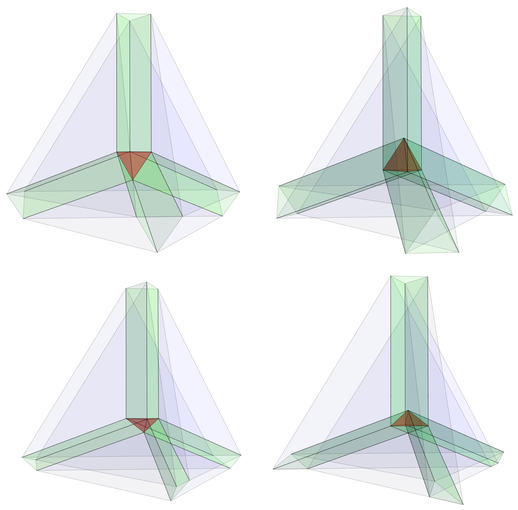
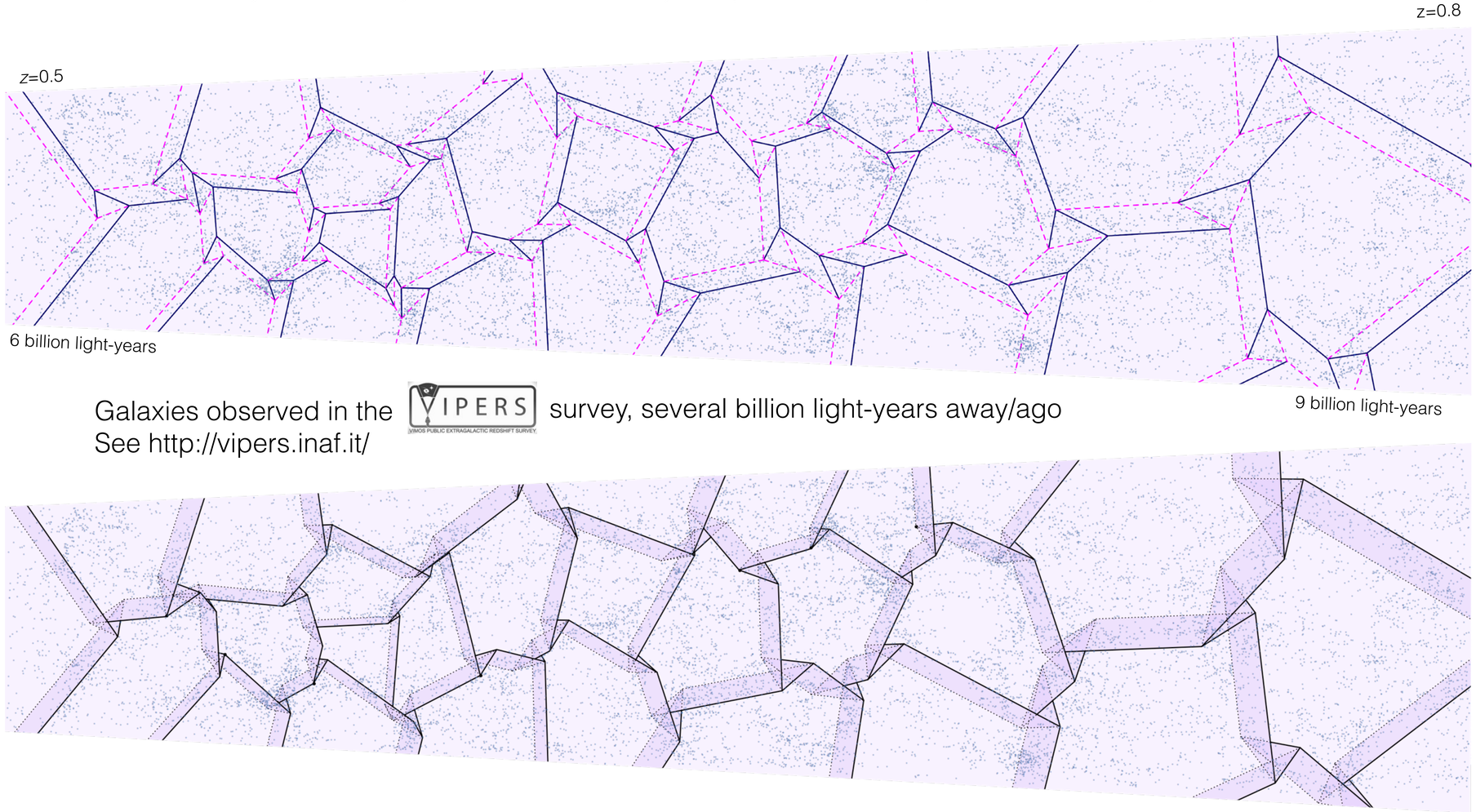


FIGURE 6. Tetrahedral-collapse models. Filament creases (green) are indicated by triangular tubes, intersecting at the central node. Wall creases (blue), extend from filament edges through the thin lines drawn between filaments. Node creases are in red. **Left:** Pre-folding/collapse (Lagrangian). **Right:** Post-folding/collapse (Eulerian). **Top**: An irrotational model ($\alpha_1 = \pi/2$). Each filament vector $\mathbf{f}_i \perp$ a face of the central tetrahedron. Walls, filaments, and the node invert along their central planes, axes, and point, but remain connected as before. Void regions simply move inward. All 15 initial regions overlap at the center. **Bottom**: A rotational model ($\alpha_1 = \pi/6$). The top filament rotates counter-clockwise by $\pi/3$, while the smaller, bottom filaments rotate clockwise by $2\pi/3$. See `http://skysrv.pha.jhu.edu/~neyrinck/TetCollapse` for an interactive model.



Galaxies observed in the VIPERS survey, several billion light-years away/ago
See http://vipers.inaf.it/

VIMOS PUBLIC EXTRAGALACTIC REDSHIFT SURVEY

What the galaxies might have done since then (schematically)

Designed with help from Robert J. Lang's *Tessellatica* Mathematica package

References:

Falck, B., Neyrinck, M., & Szalay, A., 2012, *ORIGAMI: Delineating Halos Using Phase-space Folds*, ApJ, 754, 126, arXiv:1201.2353

Guzzo, L. et al., 2014, *The VIMOS Public Extragalactic Redshift Survey (VIPERS). An unprecedented view of galaxies and large-scale structure at 0.5 < z < 1.2*, A&A, 566, 108

Neyrinck, M., *Cosmological Origami: Properties of Cosmic-Web Components when a Non-Stretchy Dark-Matter Sheet Folds*, to appear in Origami^6, arXiv:1408.2219

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