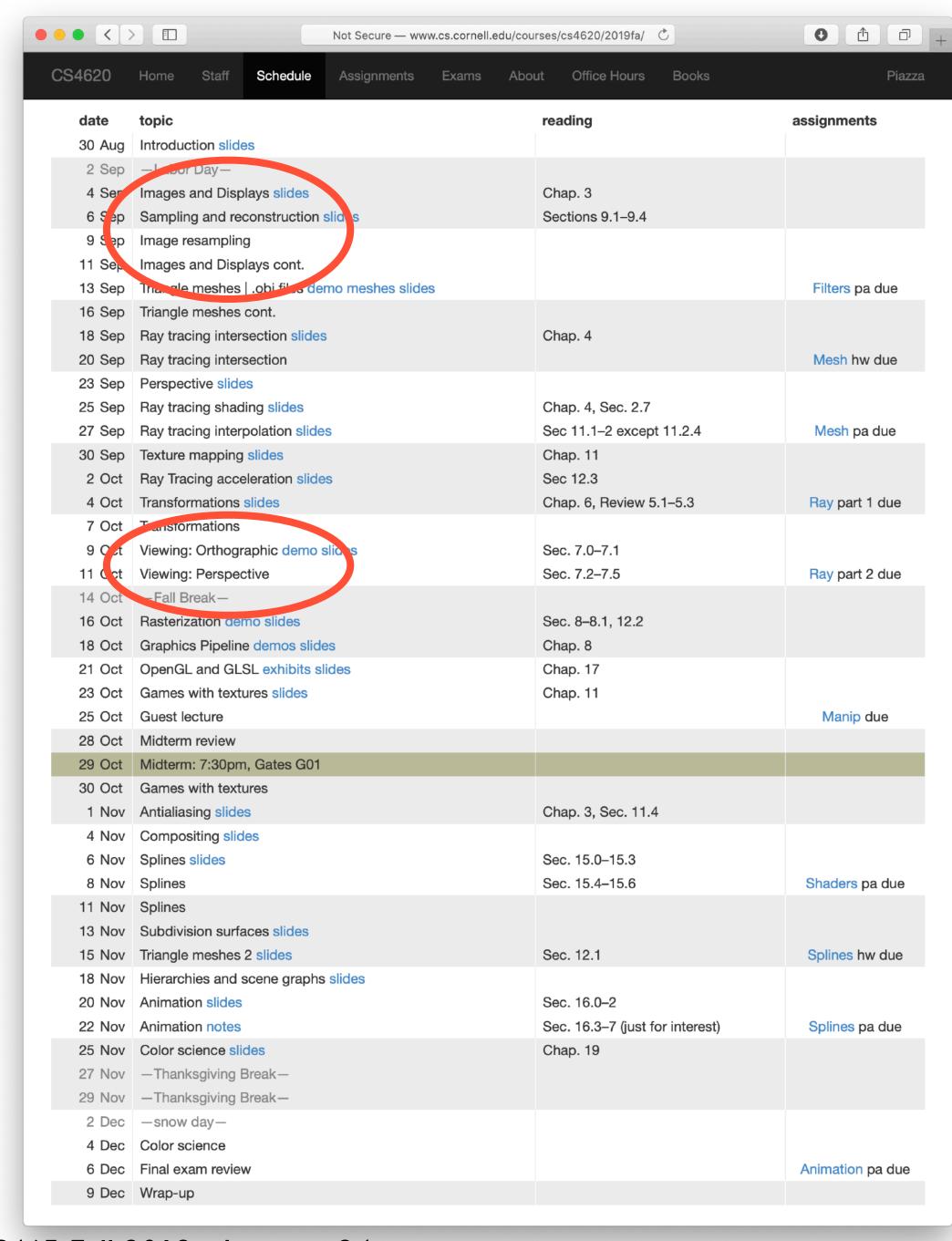
Wrap-up

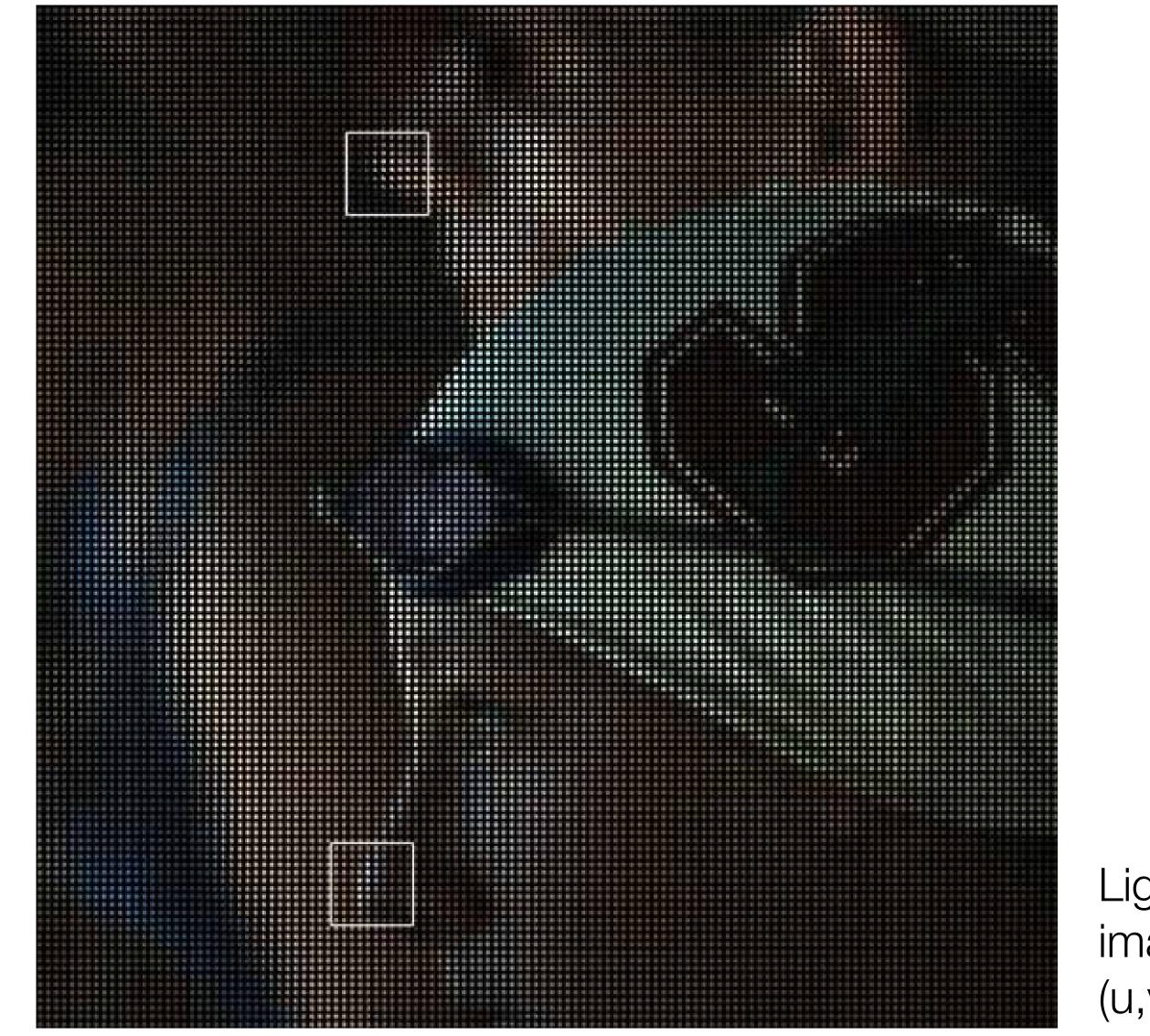
CS4620 Lecture 24





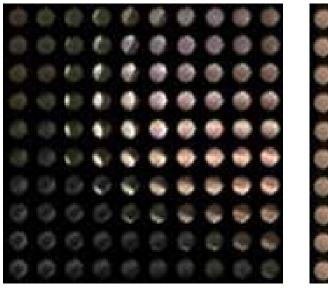
Computational Photography

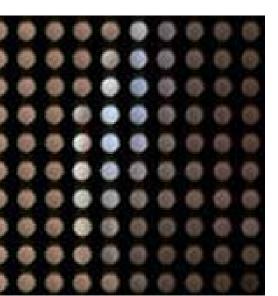
Panoramas
Light field cameras
Non-line-of-sight imaging



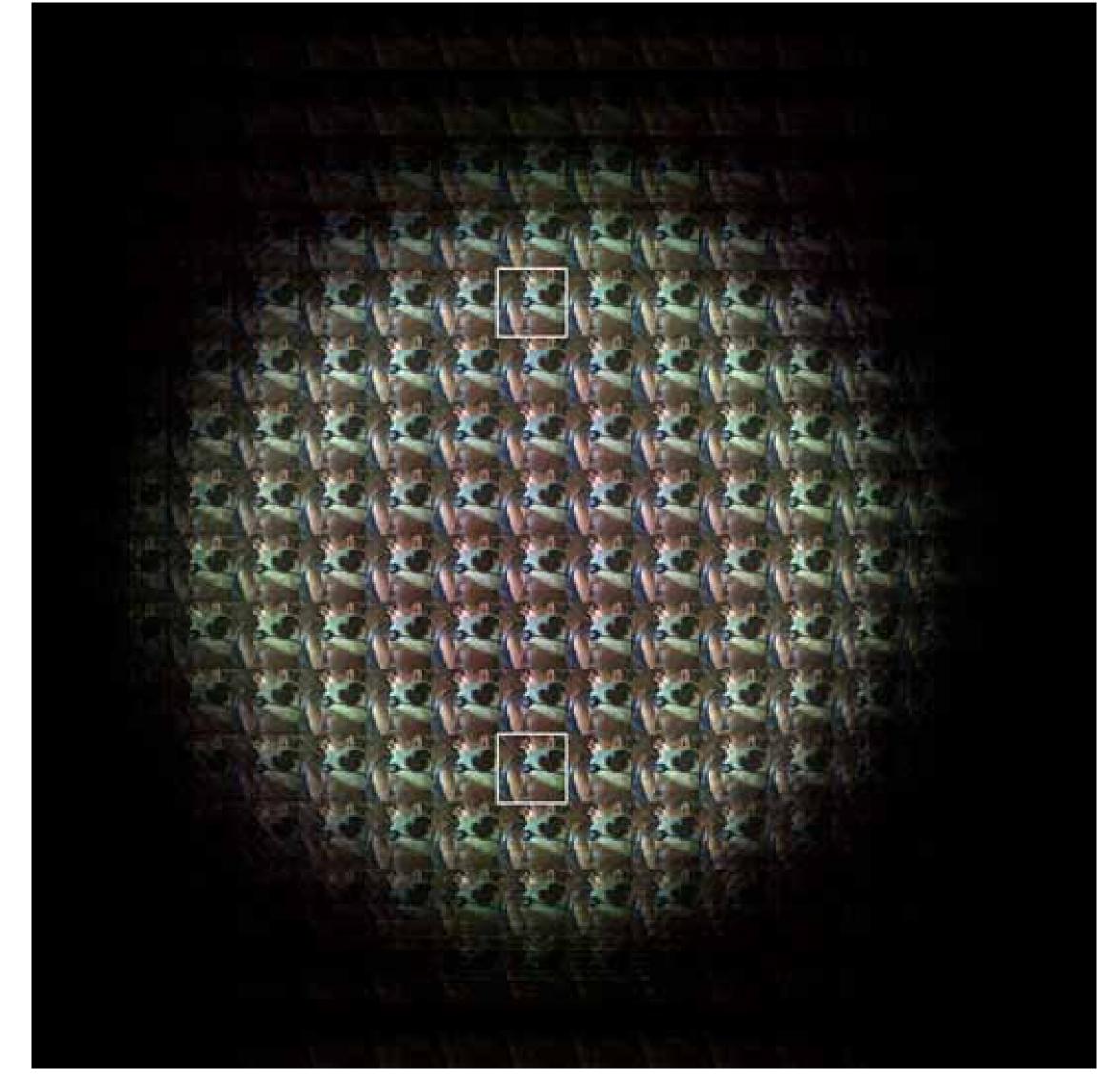
Light field camera native image: (s,t) is outer loop; (u,v) is inner loop

[Ren Ng thesis]





Characteristic behavior: objects at the focus plane become constant-colored circles; more distant points look like inverted views of a small area of the image.



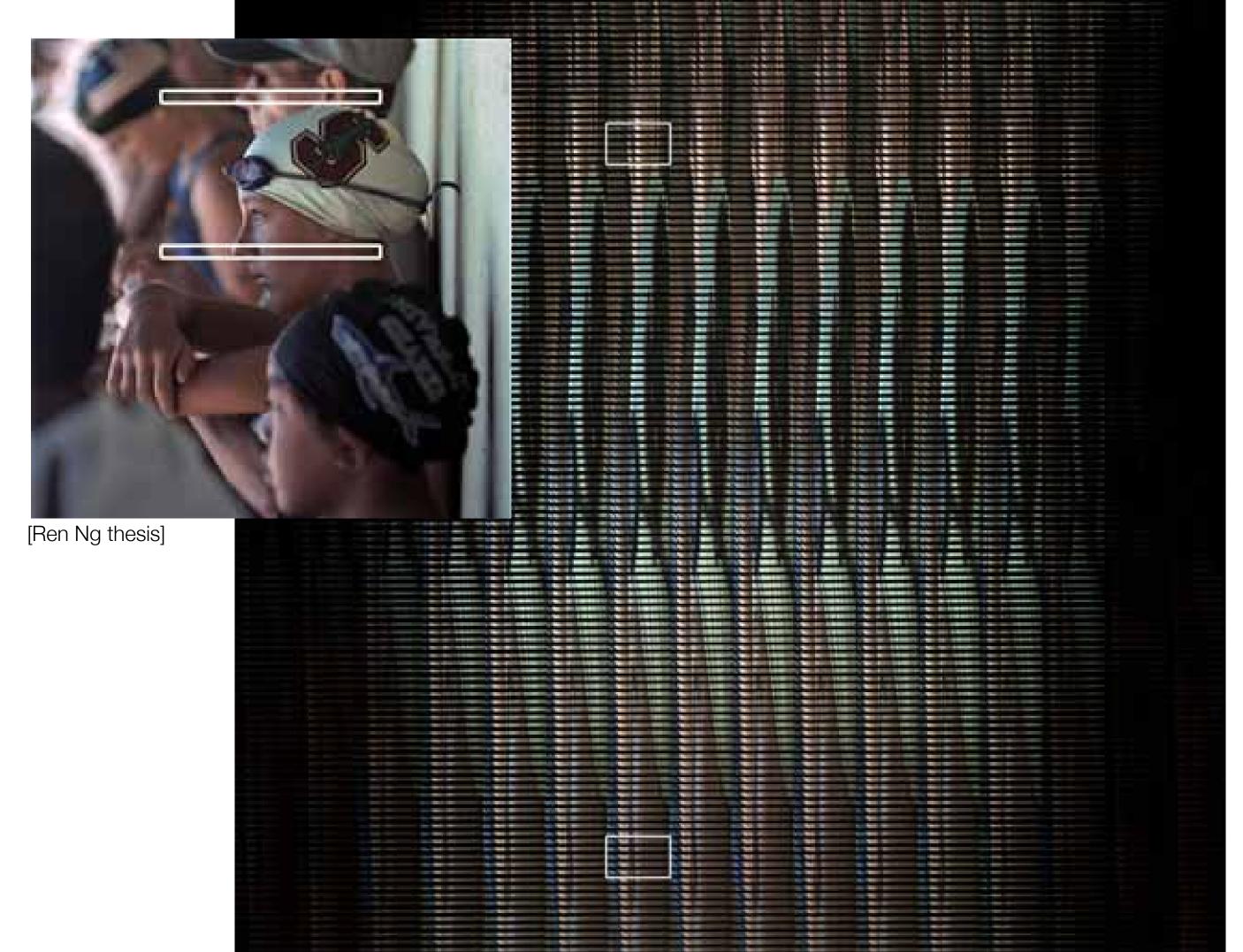
Transposed image: (u,v) is the outer loop, (s,t) is the inner loop.

[Ren Ng thesis]

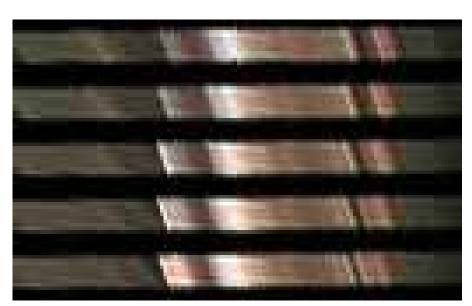


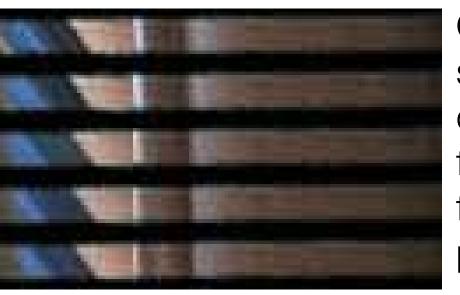


Characteristic behavior: the constant-uv images correspond to cameras located at different positions in the lens's entrance pupil. Note vertical parallax between these two images.



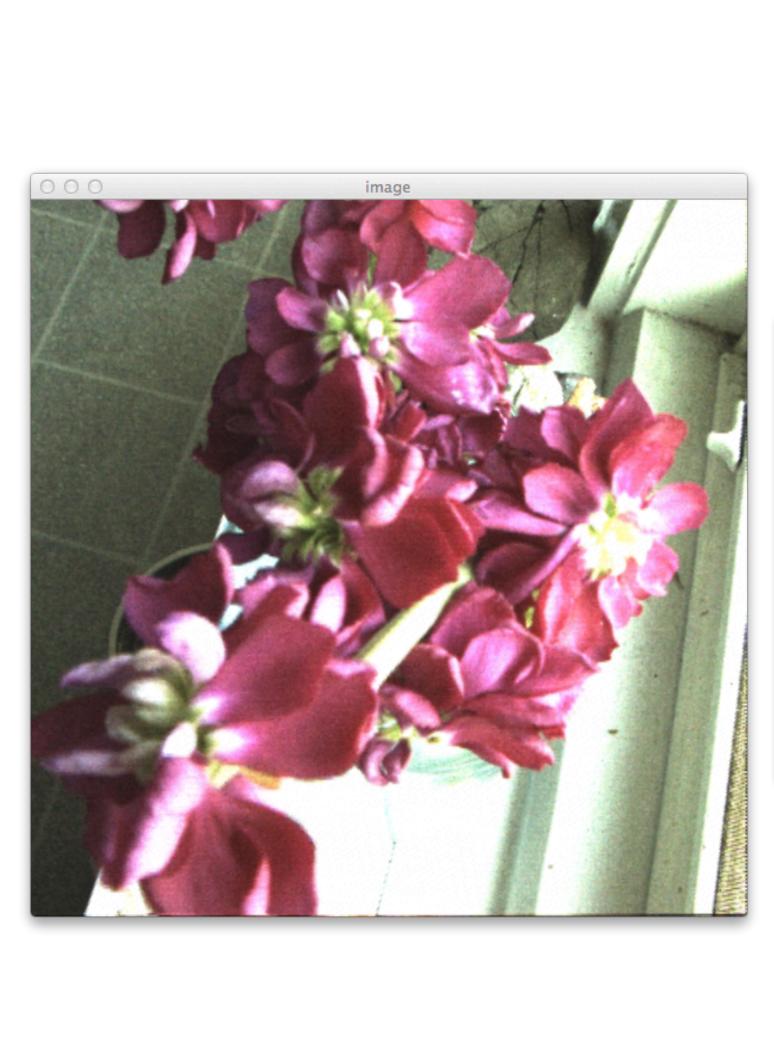
Epipolar plane format: (v,t) is the outer loop and (s,u) is the inner loop.



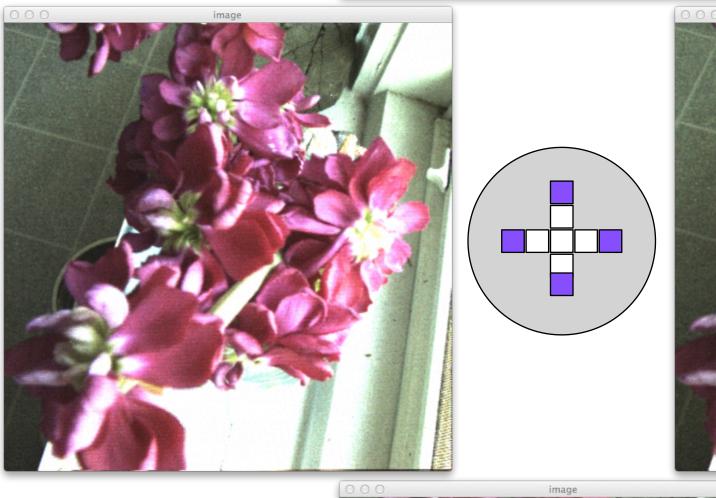


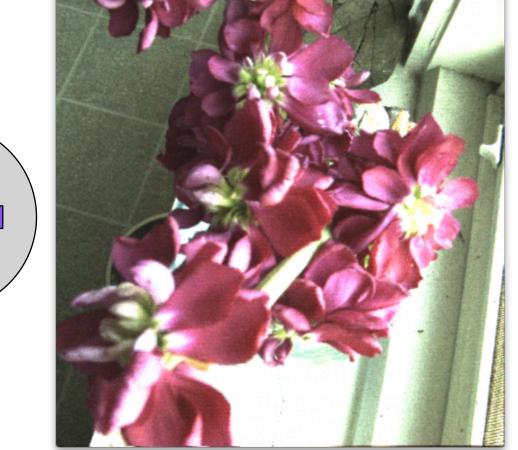
Characteristic behavior: points in scene become lines with slope depending on distance. Objects at focus plane produce vertical features; more distant objects produce negative slopes.

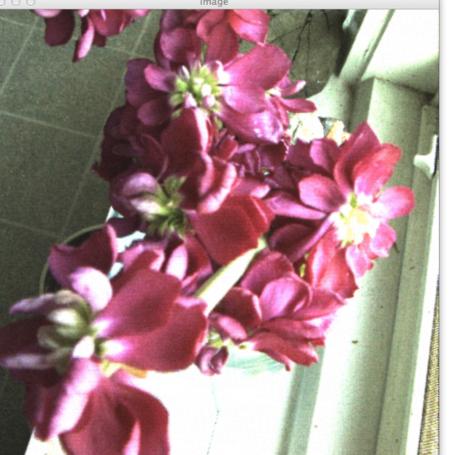


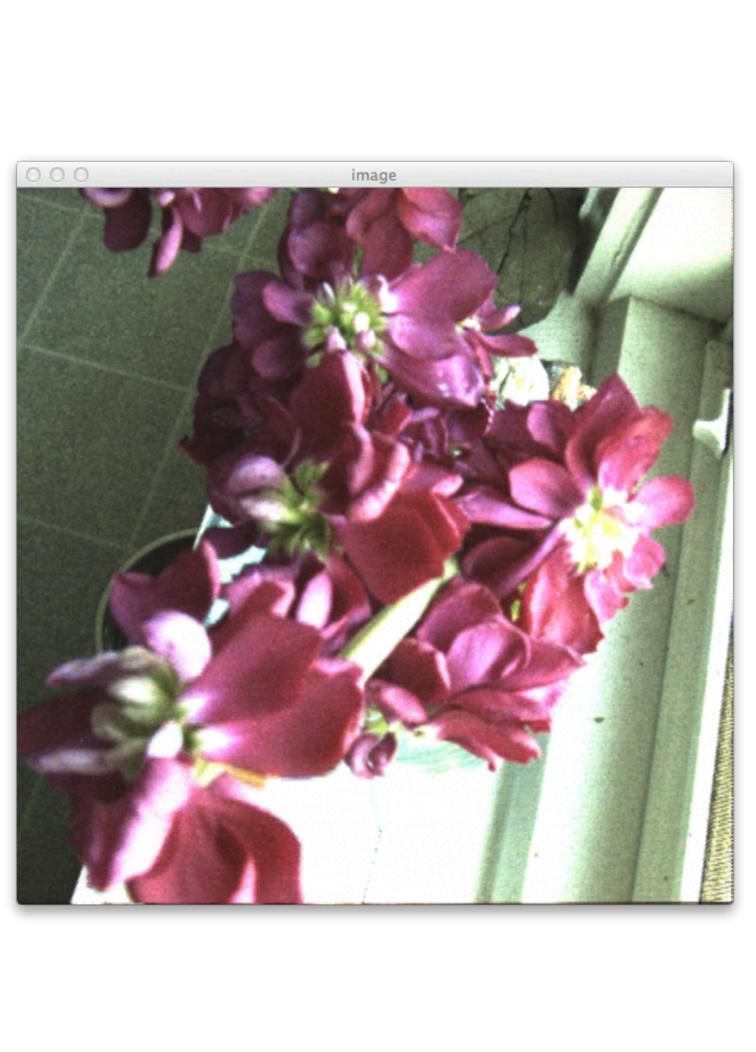


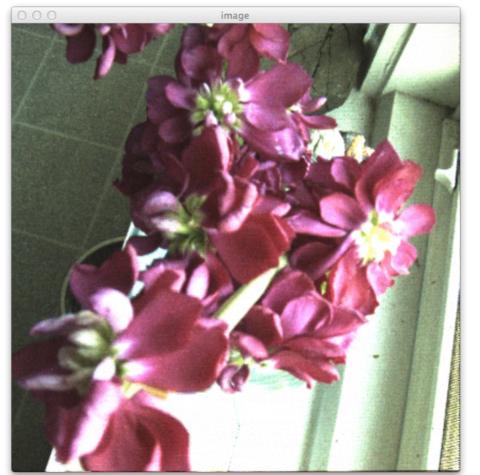


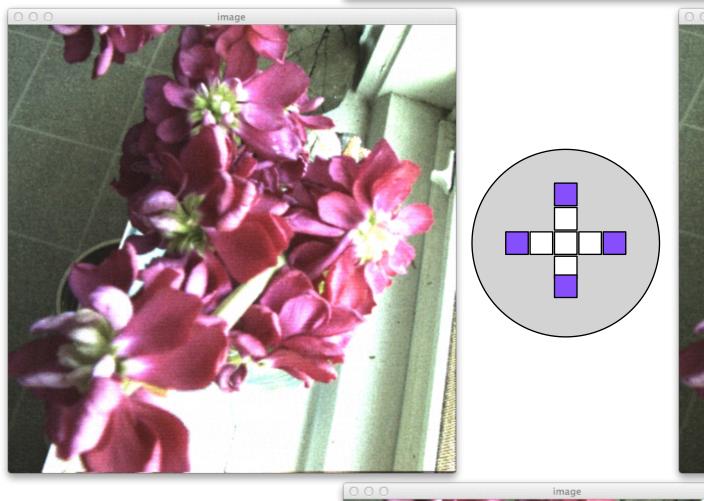




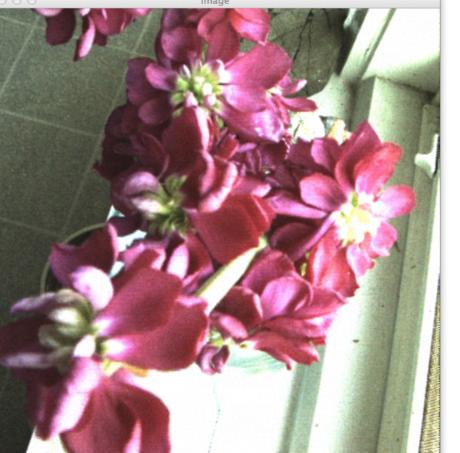


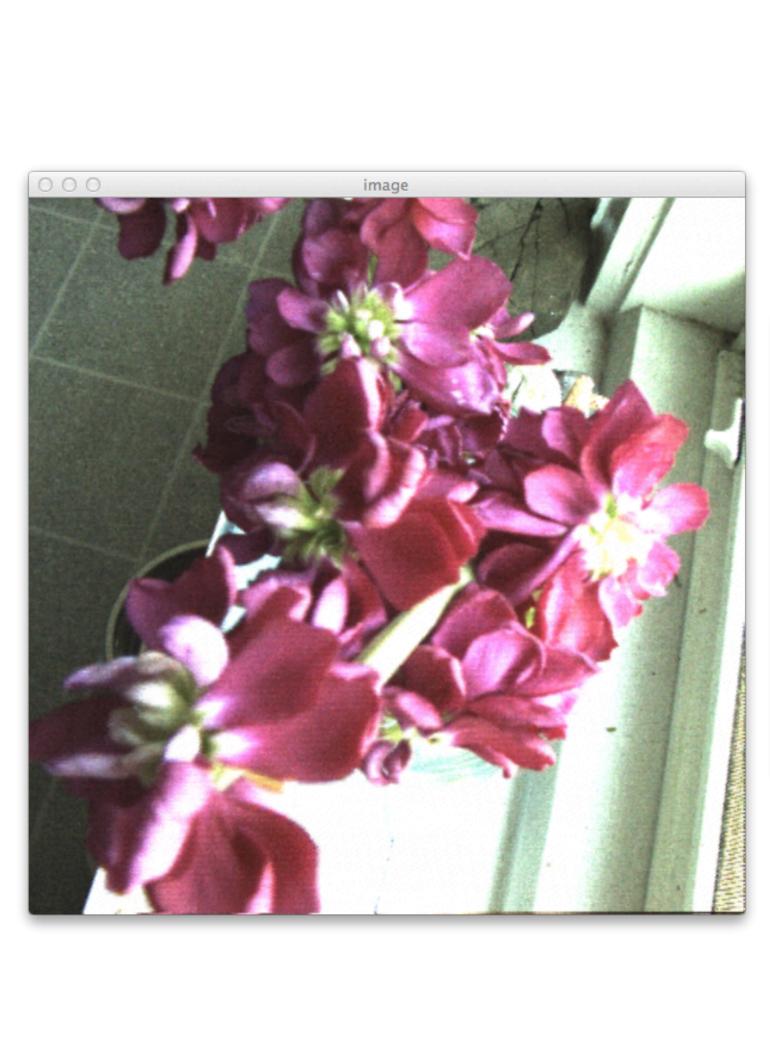






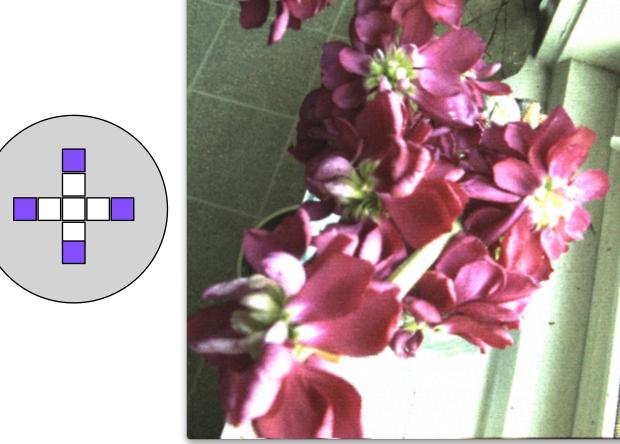


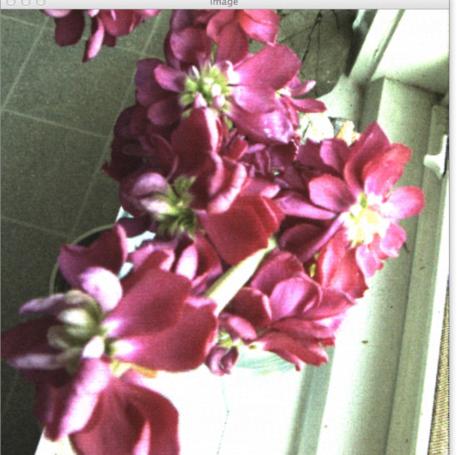


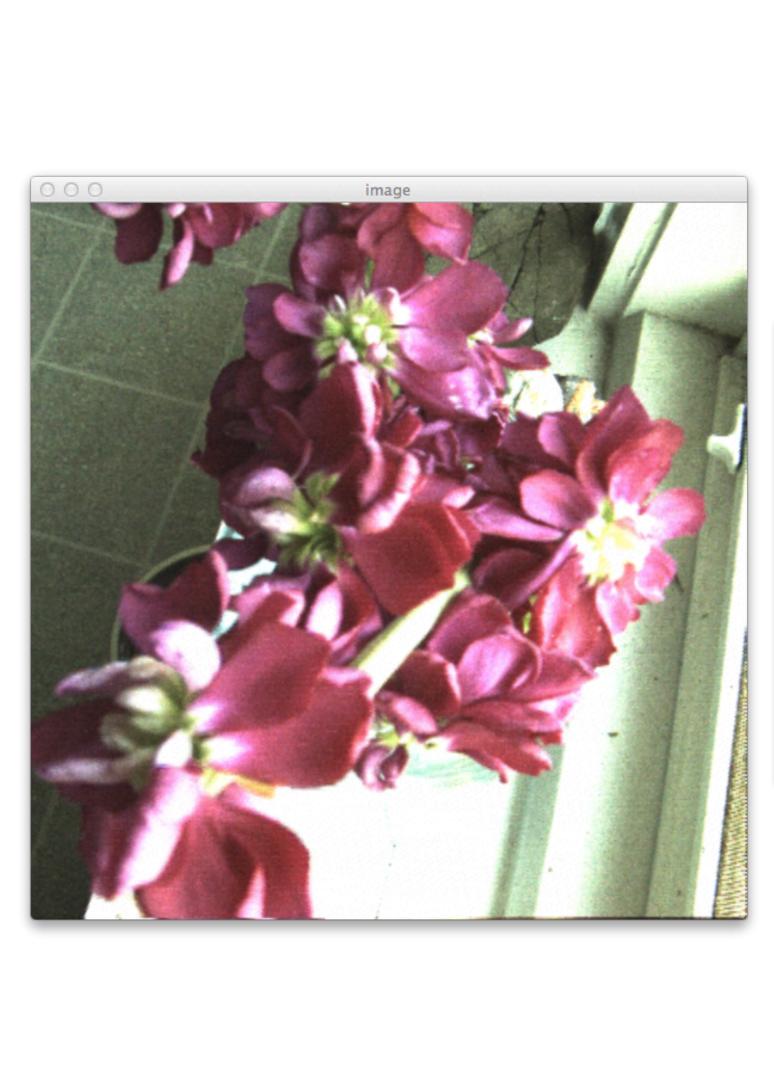




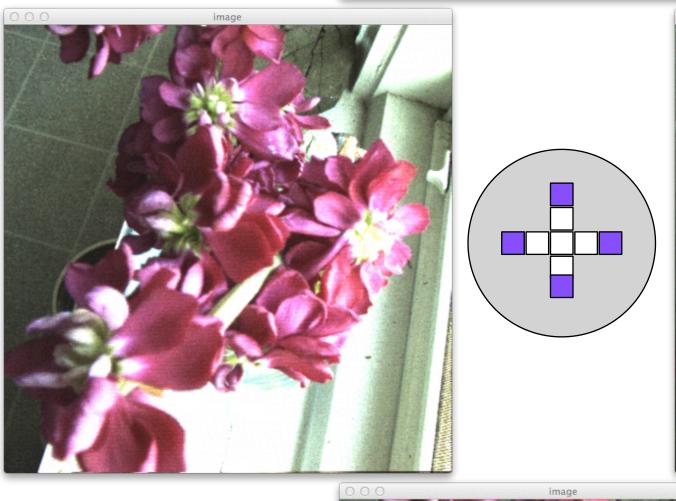


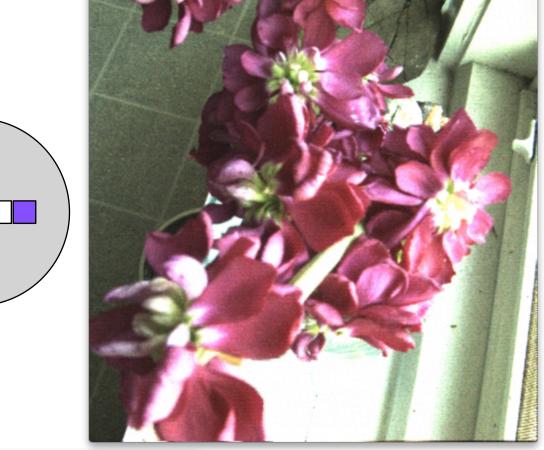


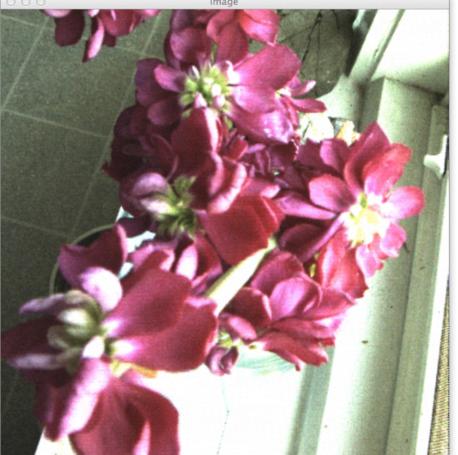


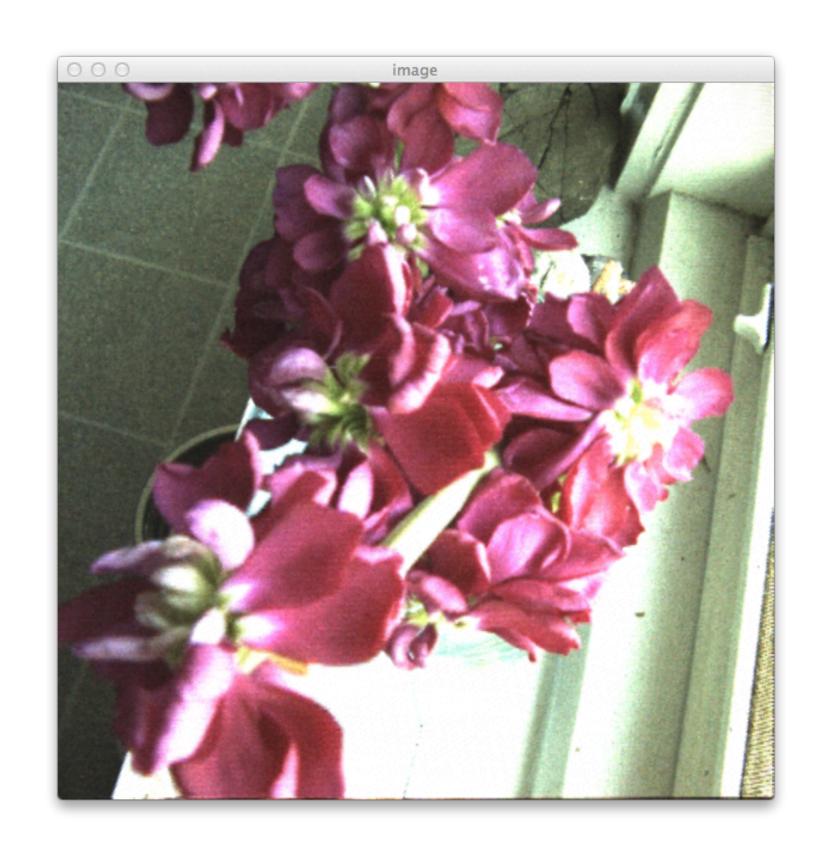


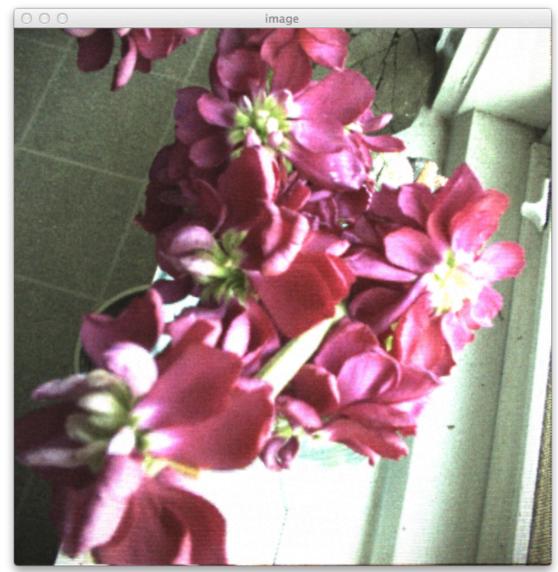










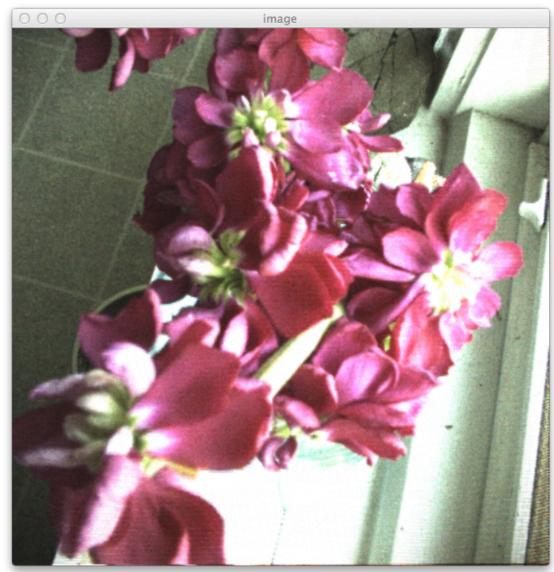


closer viewpoint ($\alpha = 0.9$)

farther viewpoint ($\alpha = 1.1$)







closer viewpoint ($\alpha = 0.9$)

farther viewpoint ($\alpha = 1.1$)



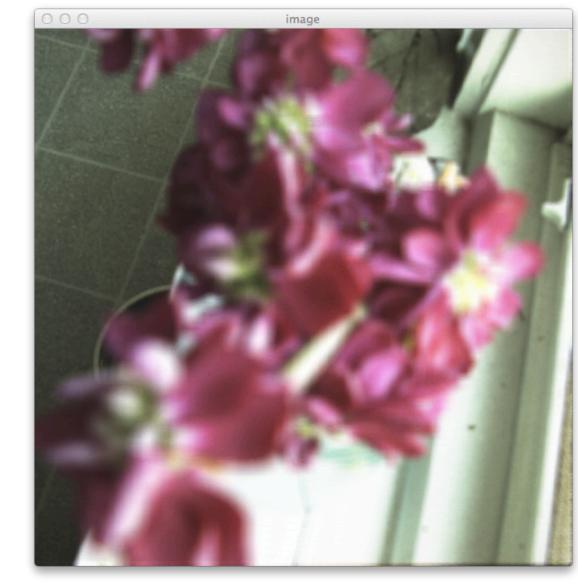
8



closer focus ($\alpha = 0.9$)



closer focus



farther focus ($\alpha = 1.1$)





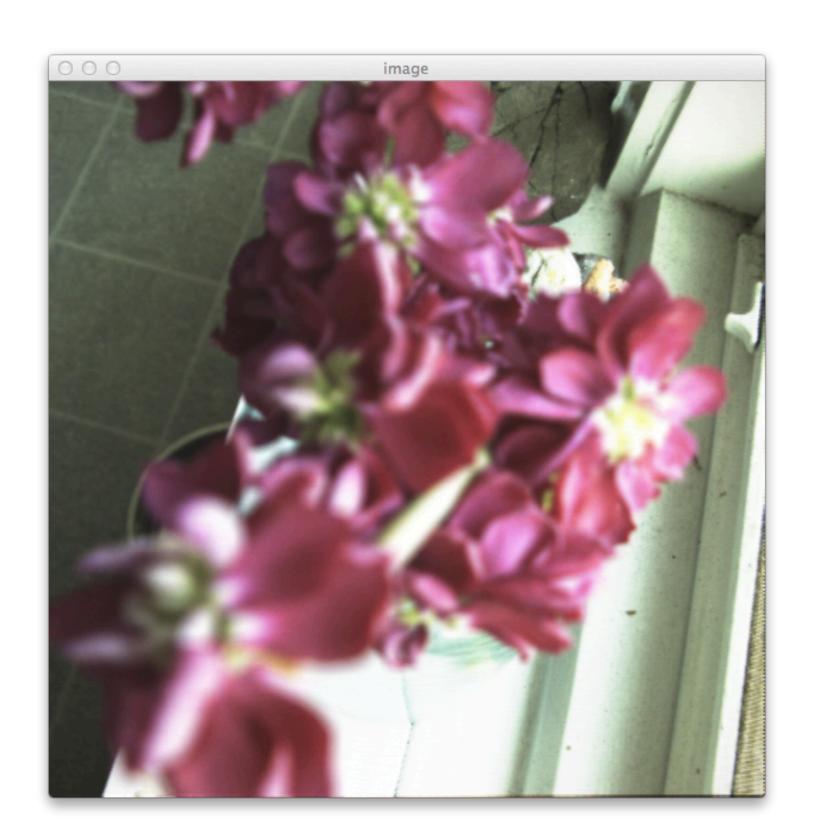
closer focus ($\alpha = 0.9$)



closer focus



farther focus ($\alpha = 1.1$)





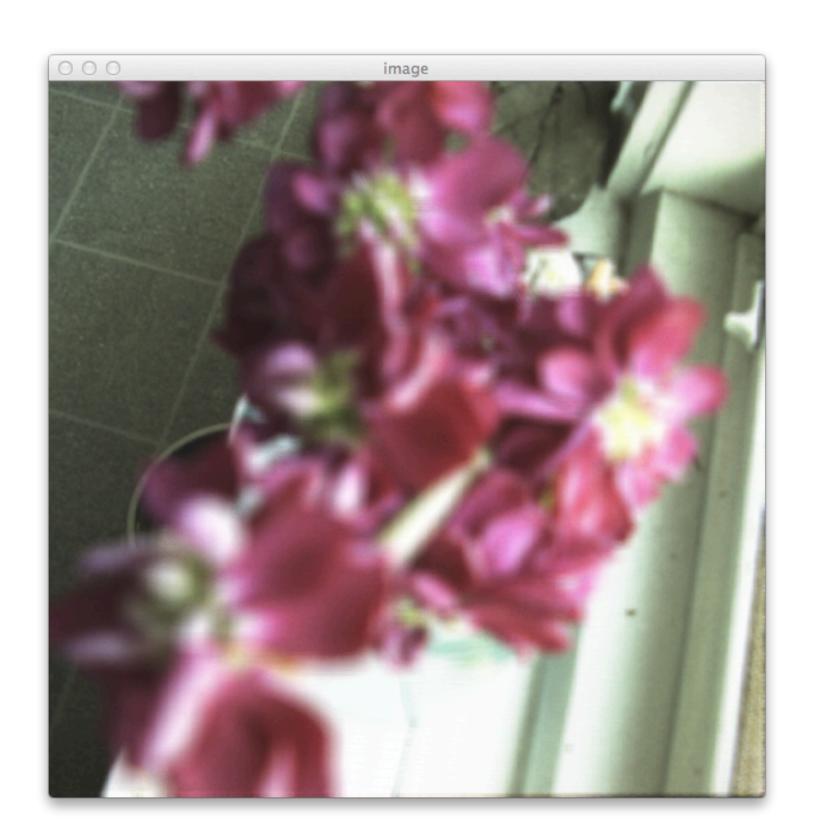
closer focus ($\alpha = 0.9$)

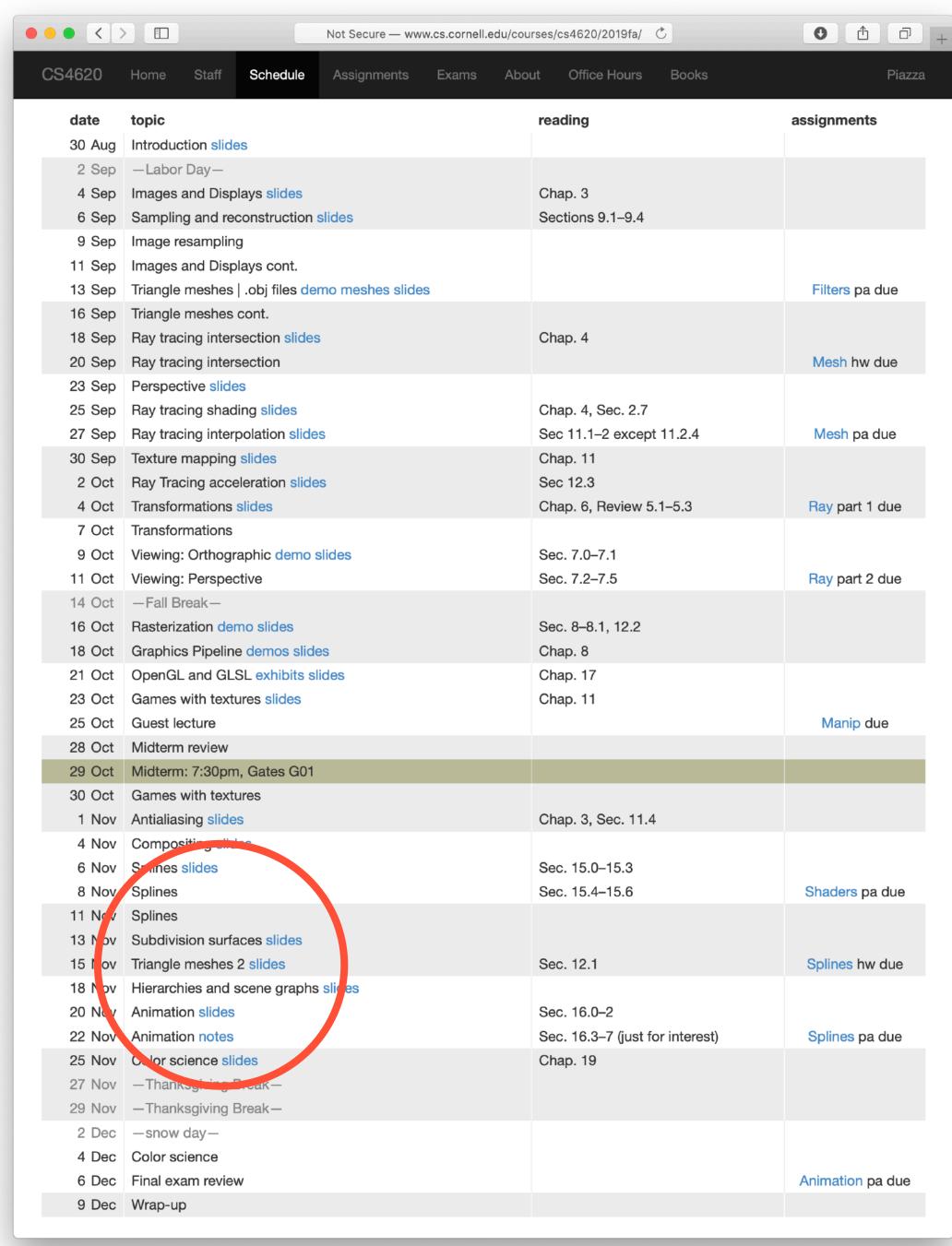


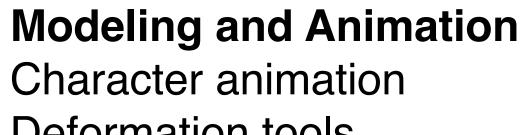
closer focus



farther focus ($\alpha = 1.1$)







Deformation tools
Physics-based animation

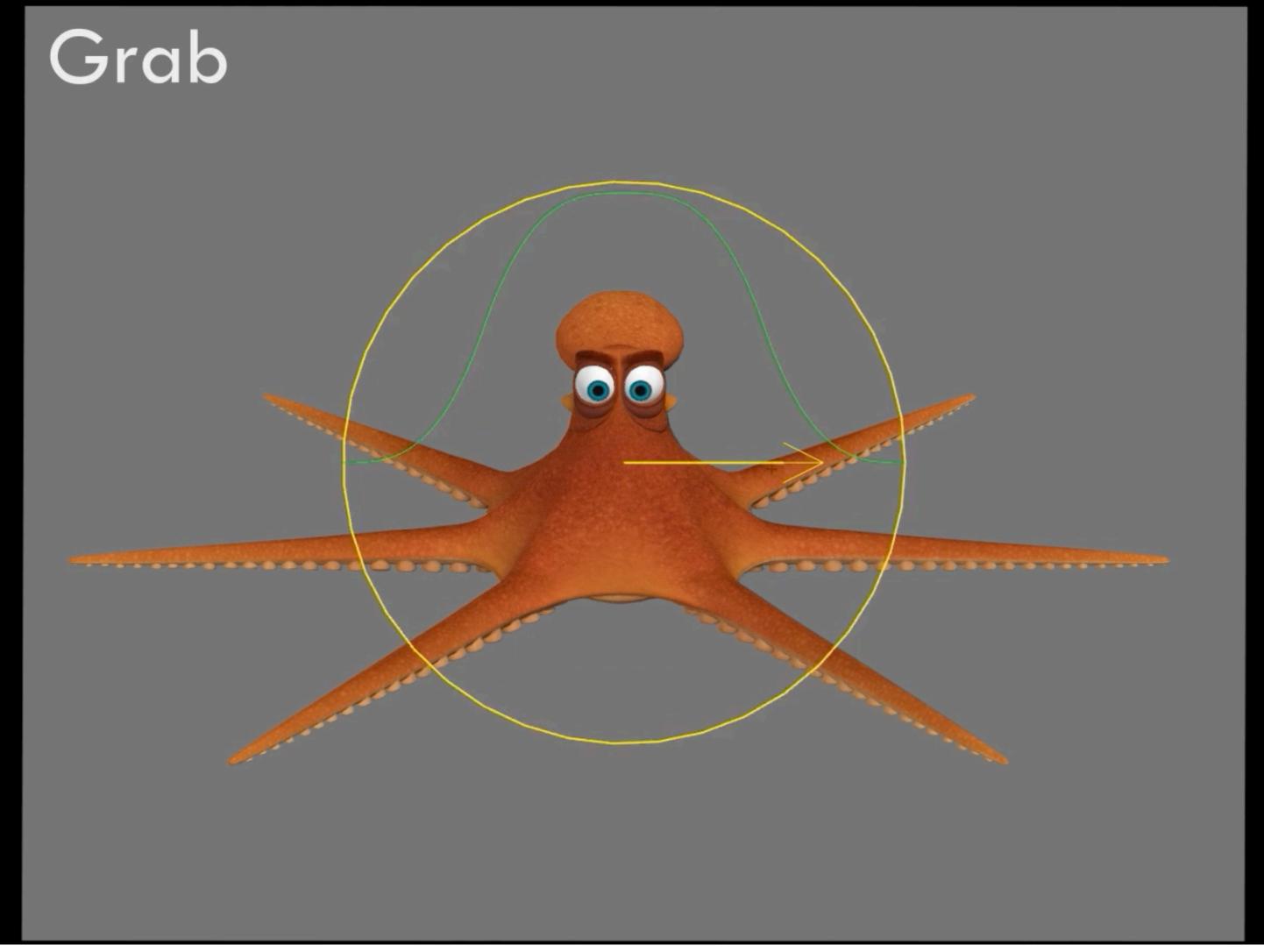
Target Height = 1.3m

Lee, Lee, Park, & Lee. "Scalable Muscle-actuated Human Simulation and Control" SIGGRAPH 2019

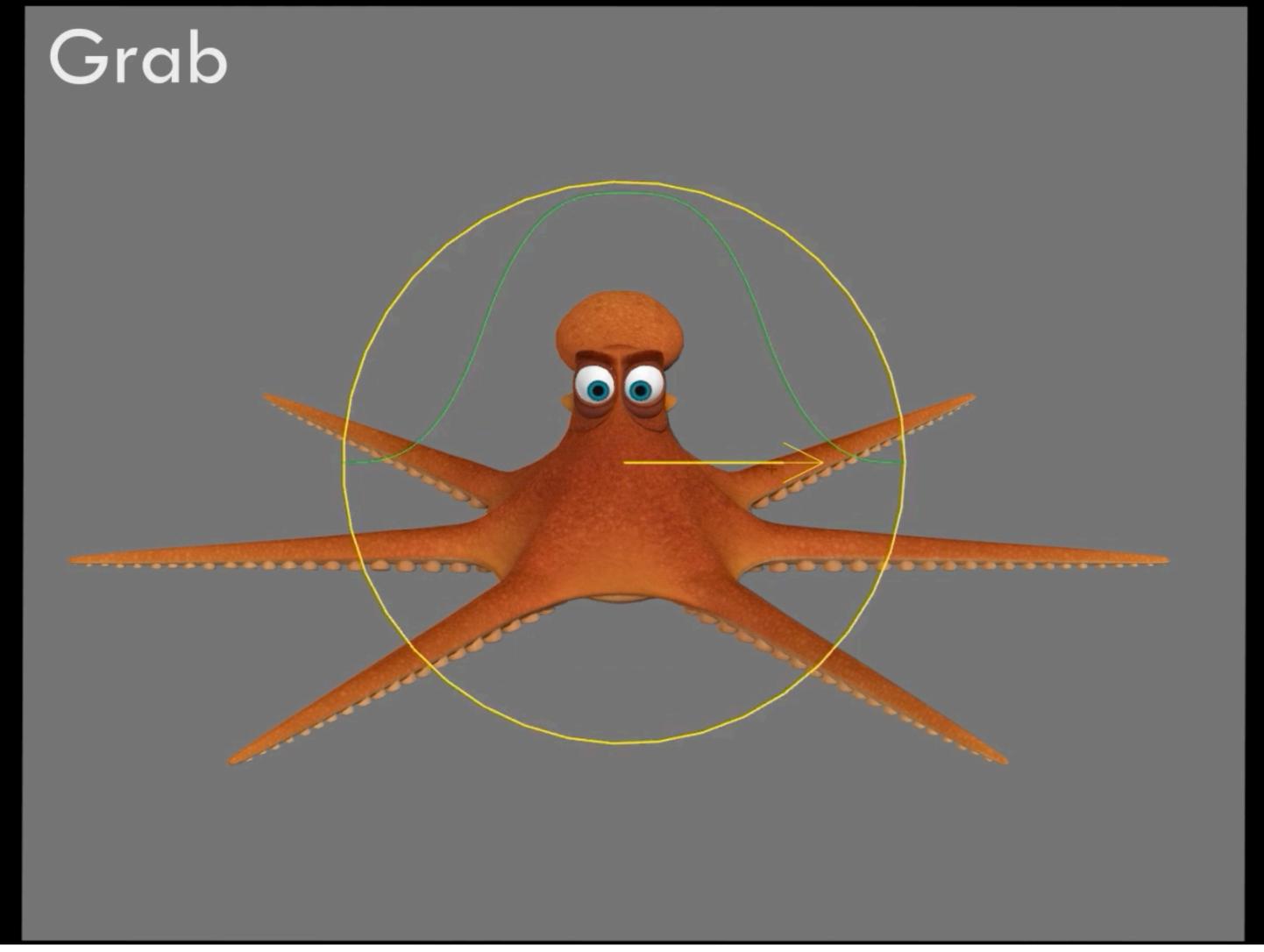
Target Height = 1.3m

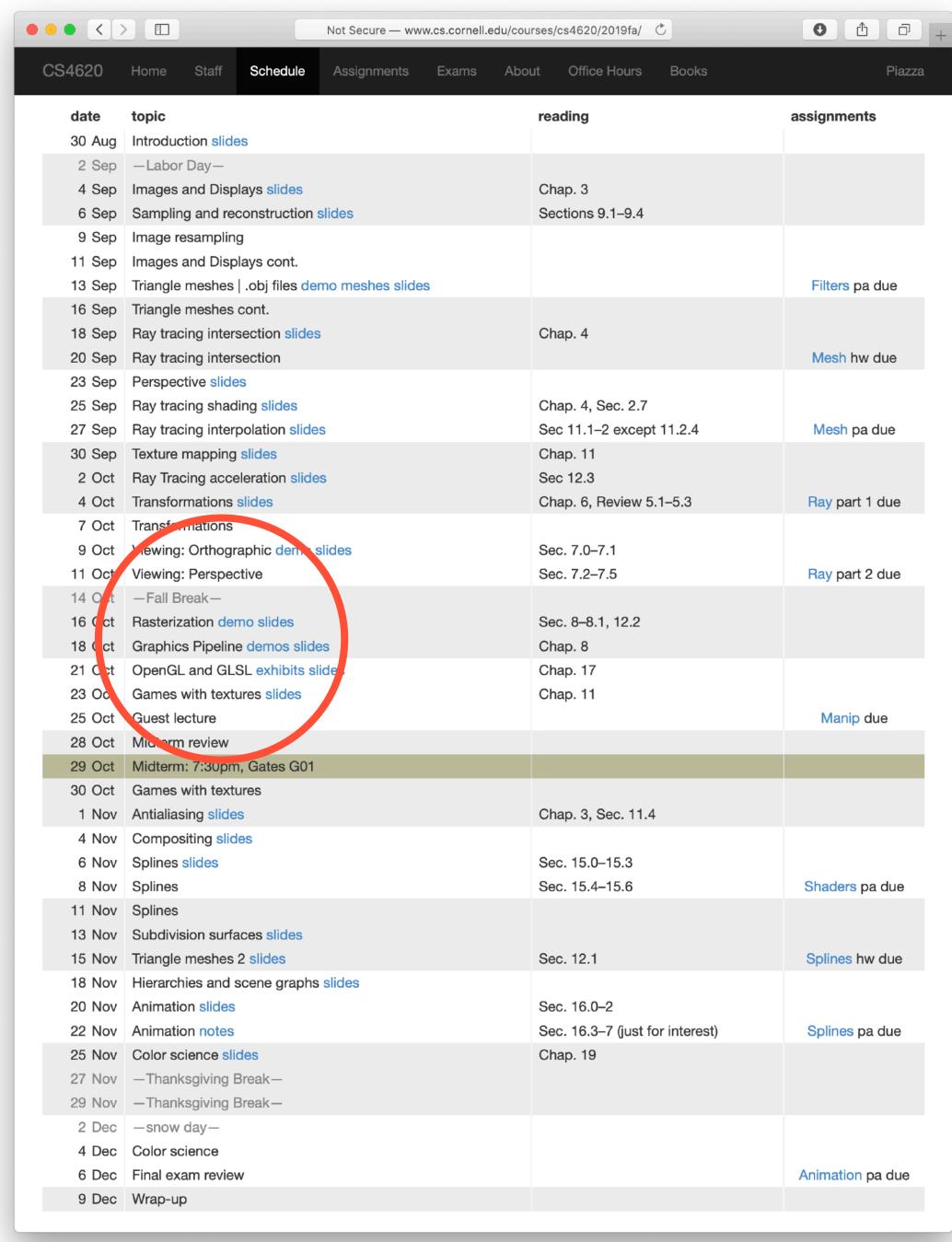
Lee, Lee, Park, & Lee. "Scalable Muscle-actuated Human Simulation and Control" SIGGRAPH 2019

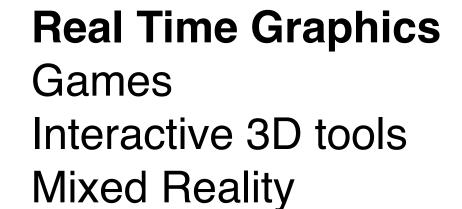
Preview: 3D Kelvinlet brush deformations

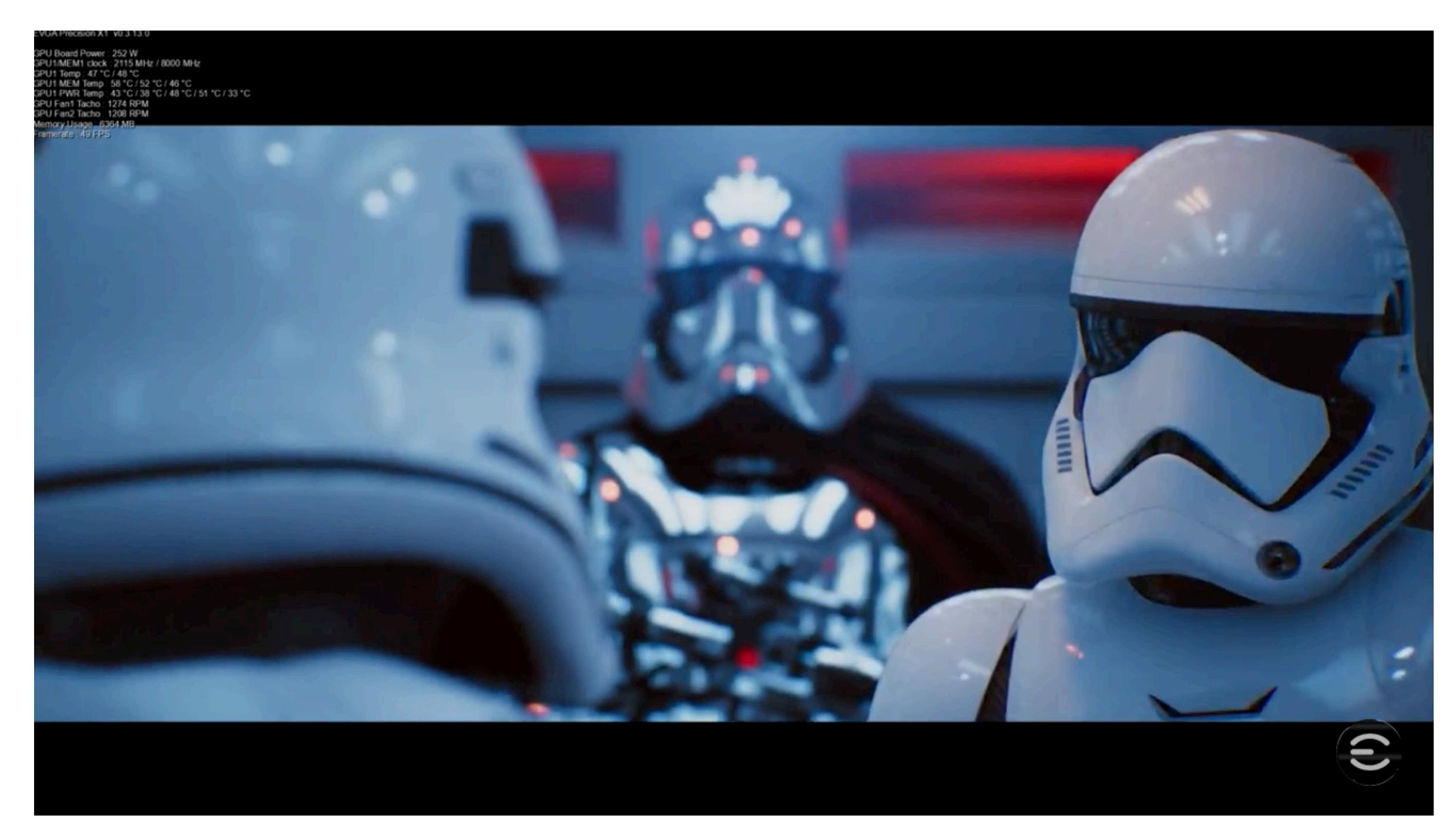


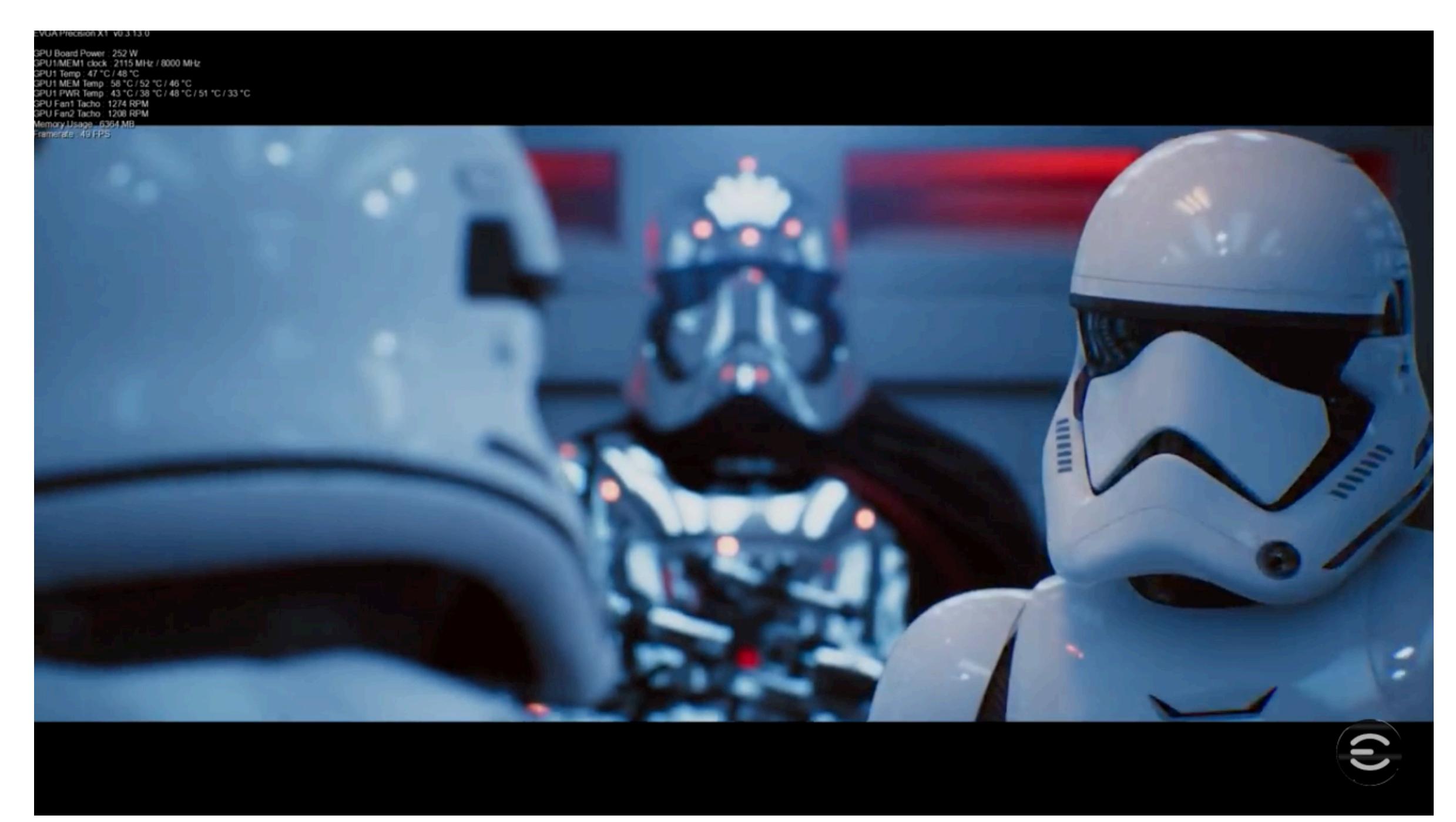
Preview: 3D Kelvinlet brush deformations

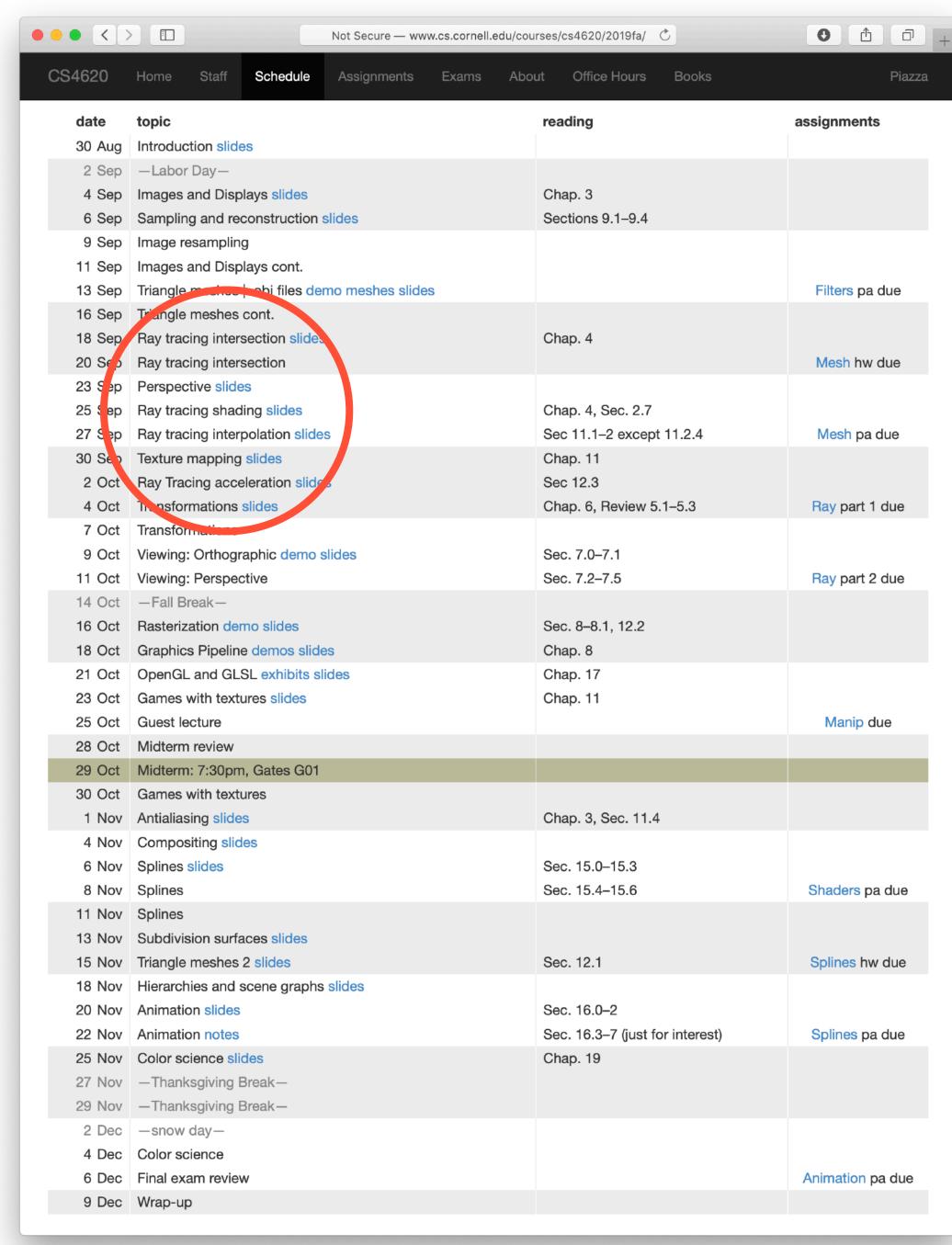




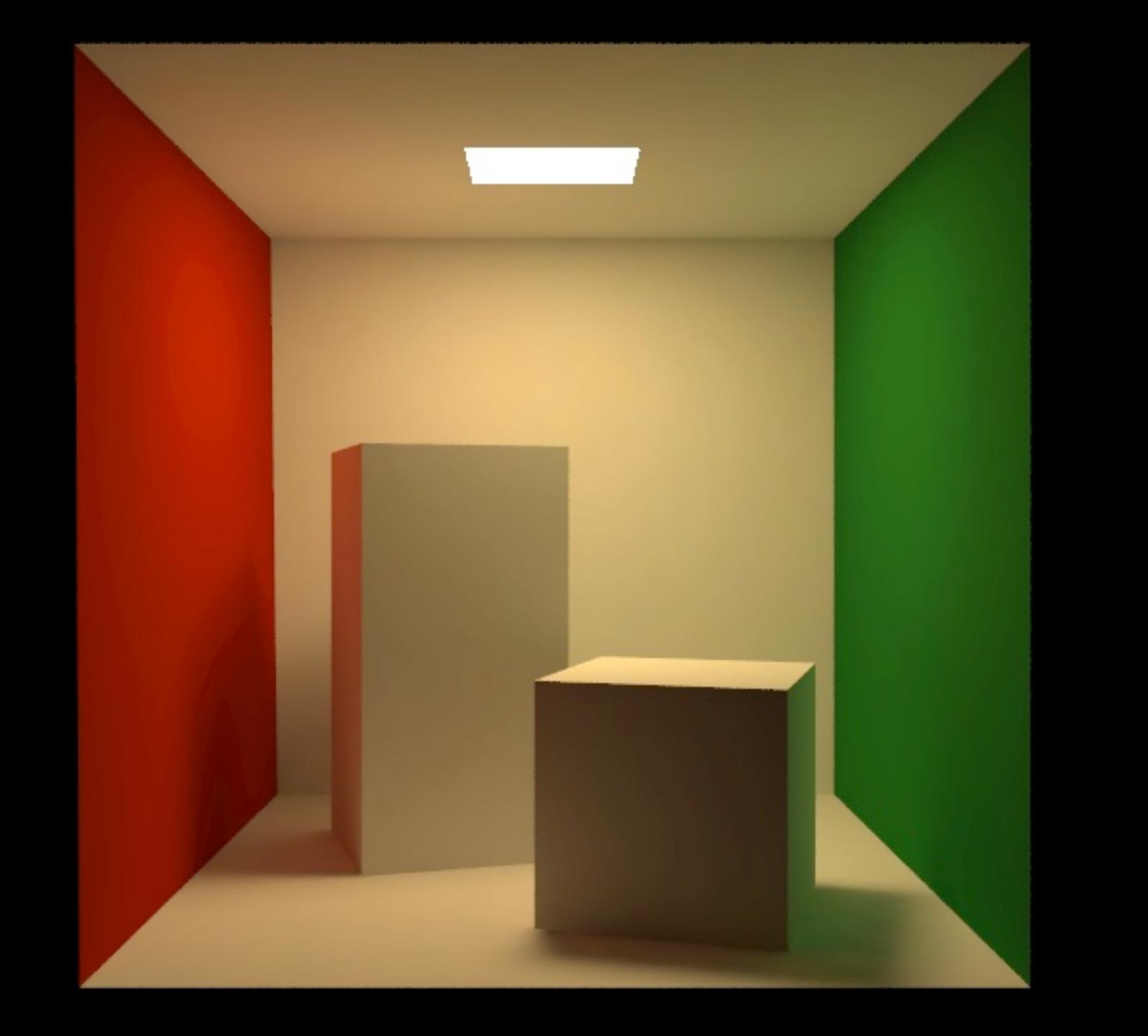


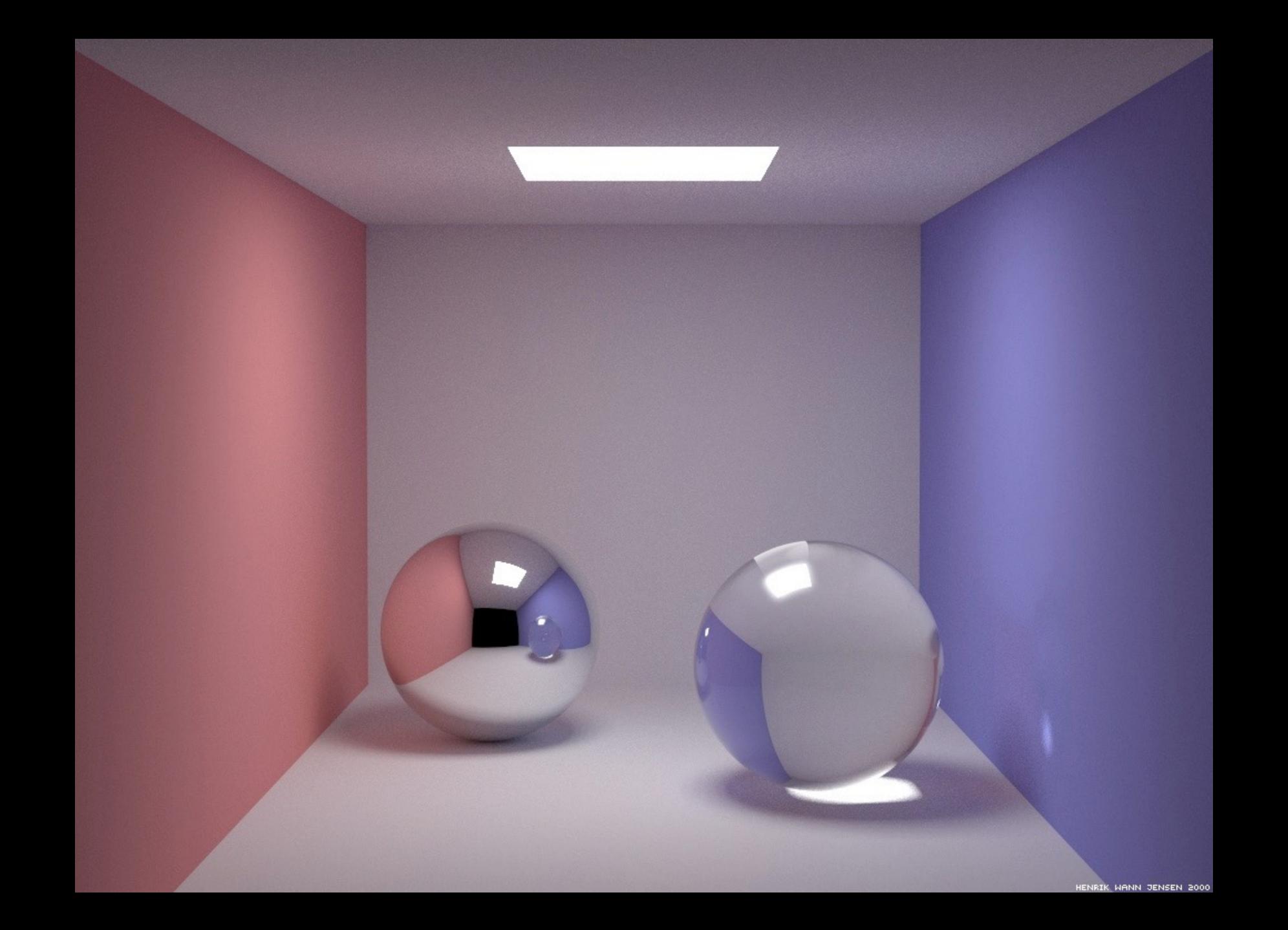






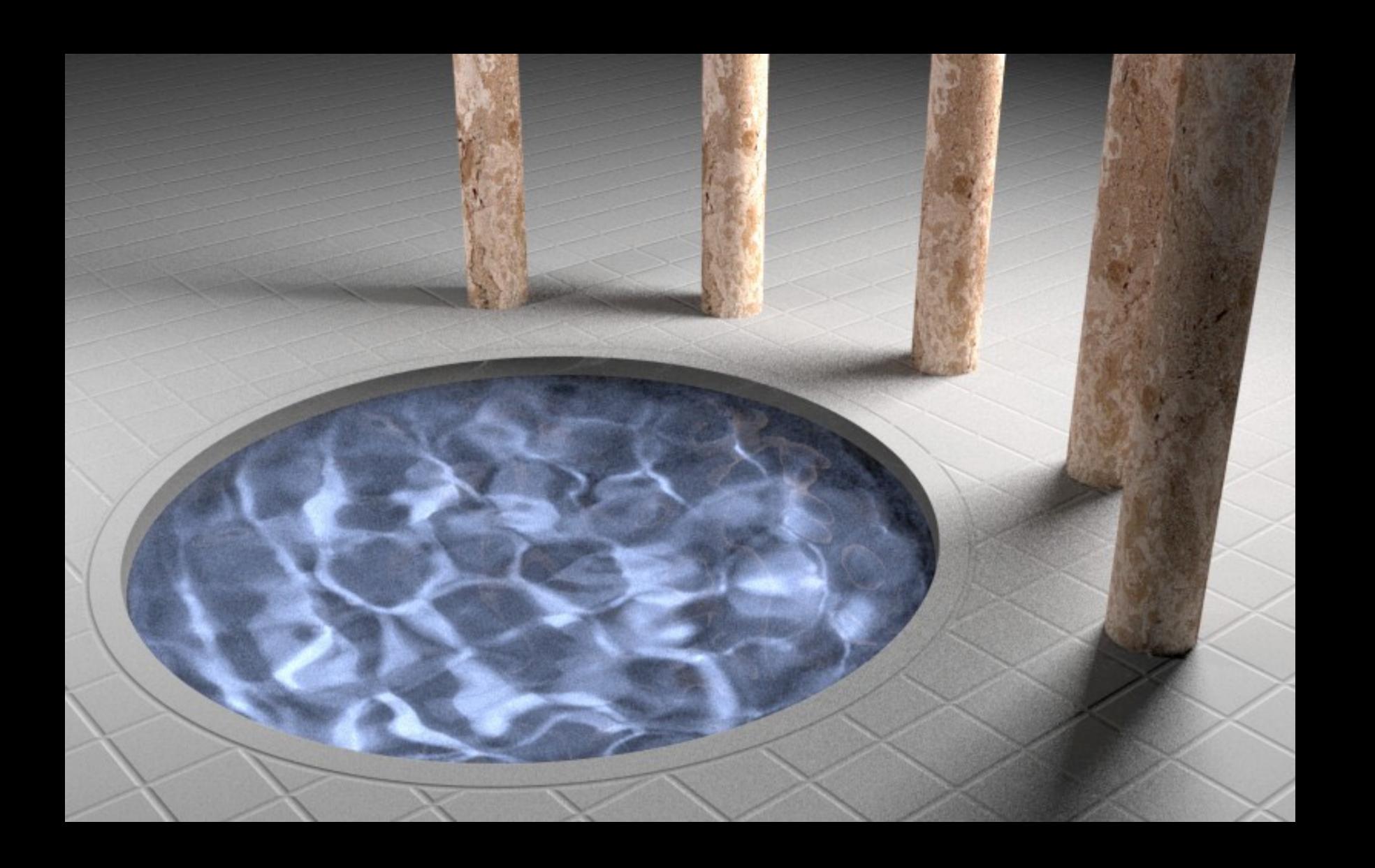
Realistic Image Synthesis
Global illumination
Light transport
Material appearance







ırik Wann Jensen





White isotropic scattering diel. half space $(\eta = 1.5)$ White isotropic scattering dielectric ($\eta = 1.5$) $\alpha = 0.04$ Conductor (Aluminum) Measured BRDF (Blue metallic paint 2, [Matusik et al.]) White isotropic scattering dielectric ($\eta = 1.5$)

Measured BRDF (Blue metallic paint 2, [Matusik et al.])

Blue isotropic scattering dielectric ($\eta = 1.5$) Conductor (copper) Clear dielectric ($\eta = 1.5$) Textured diffuse layer Thin blue absorbing dielectric ($\eta = 1.5$) Purple anisotropic scattering diel. (η = 1.5, g=0.8) $\alpha = 0.02$ Conductor (chrome) Slightly absorbing blue-green dielectric $(\eta = 1.5)$

[Jakob et al. SIGGRAPH 2014]











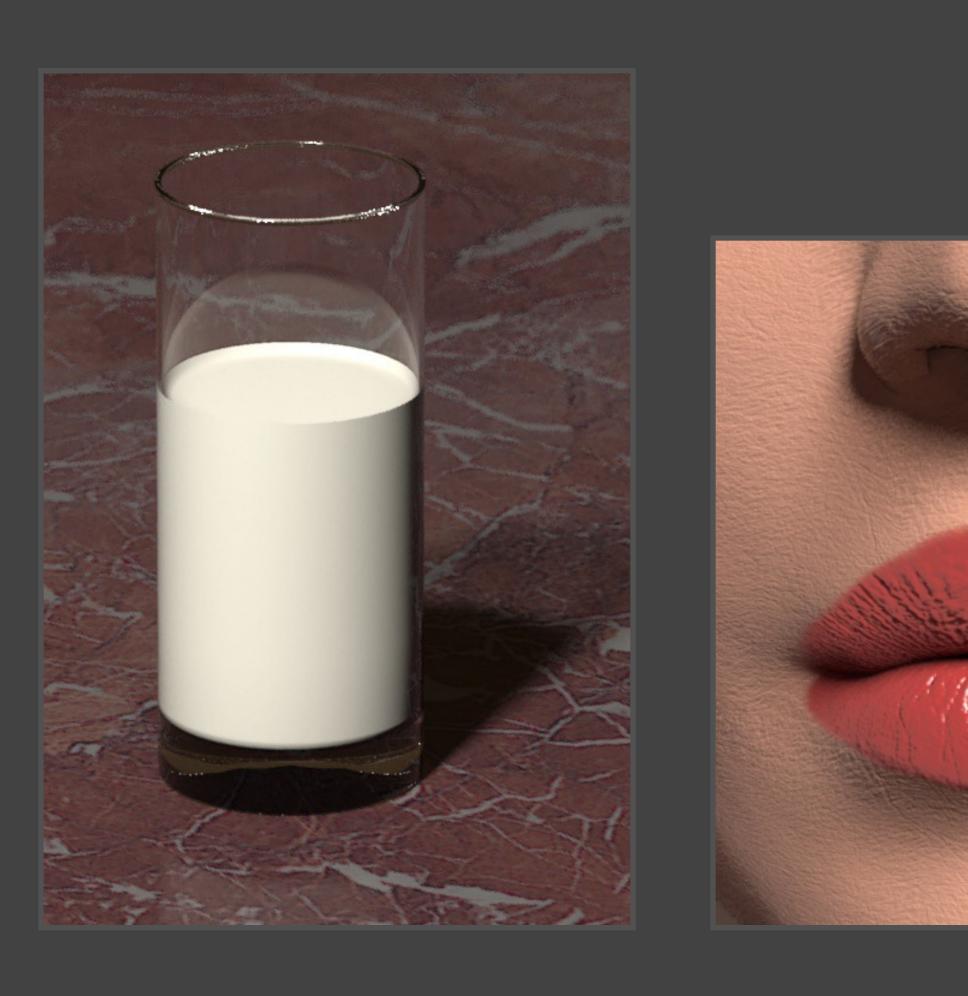
volume optics

light reflection from translucent materials

volume optics light reflection from translucent materials

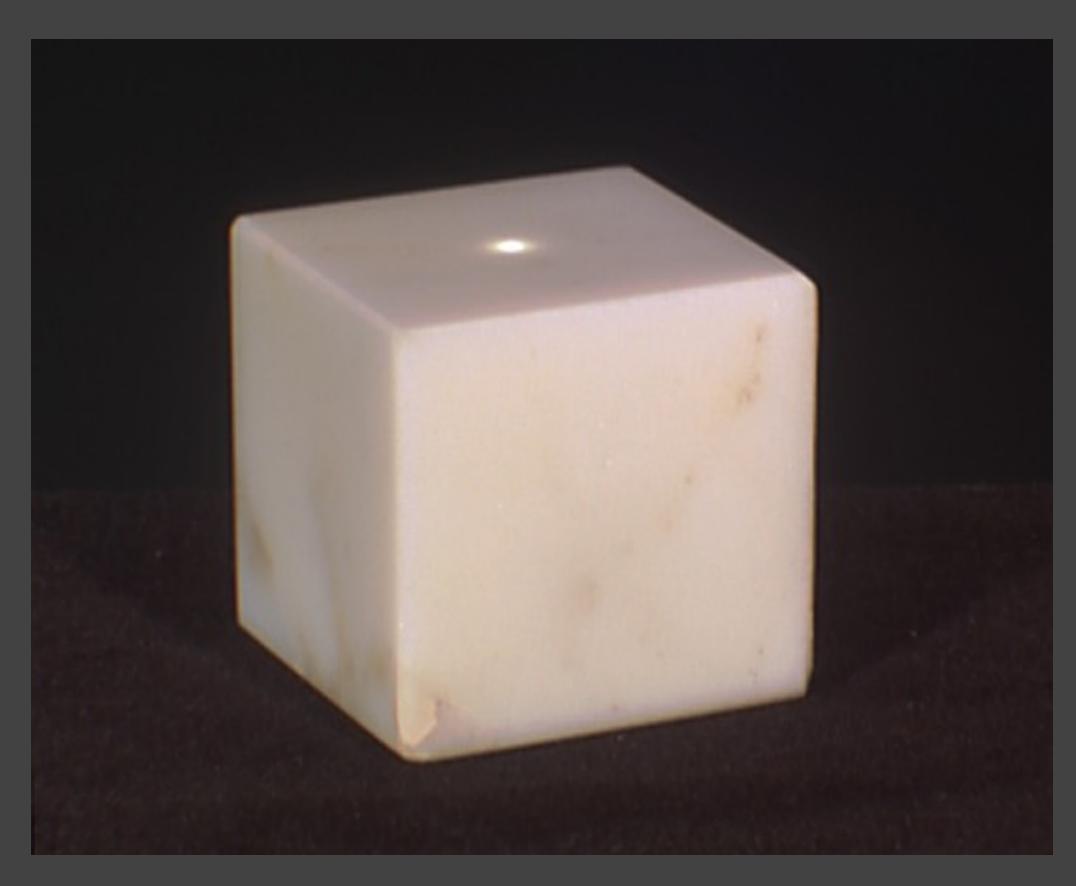
Henrik Wann Jensen, Stephen R. Marschner, Marc Levoy, and Pat Hanrahan. "A Practical Model for Subsurface Light Transport." SIGGRAPH 2001.

Why do these look wrong?





Marble sample



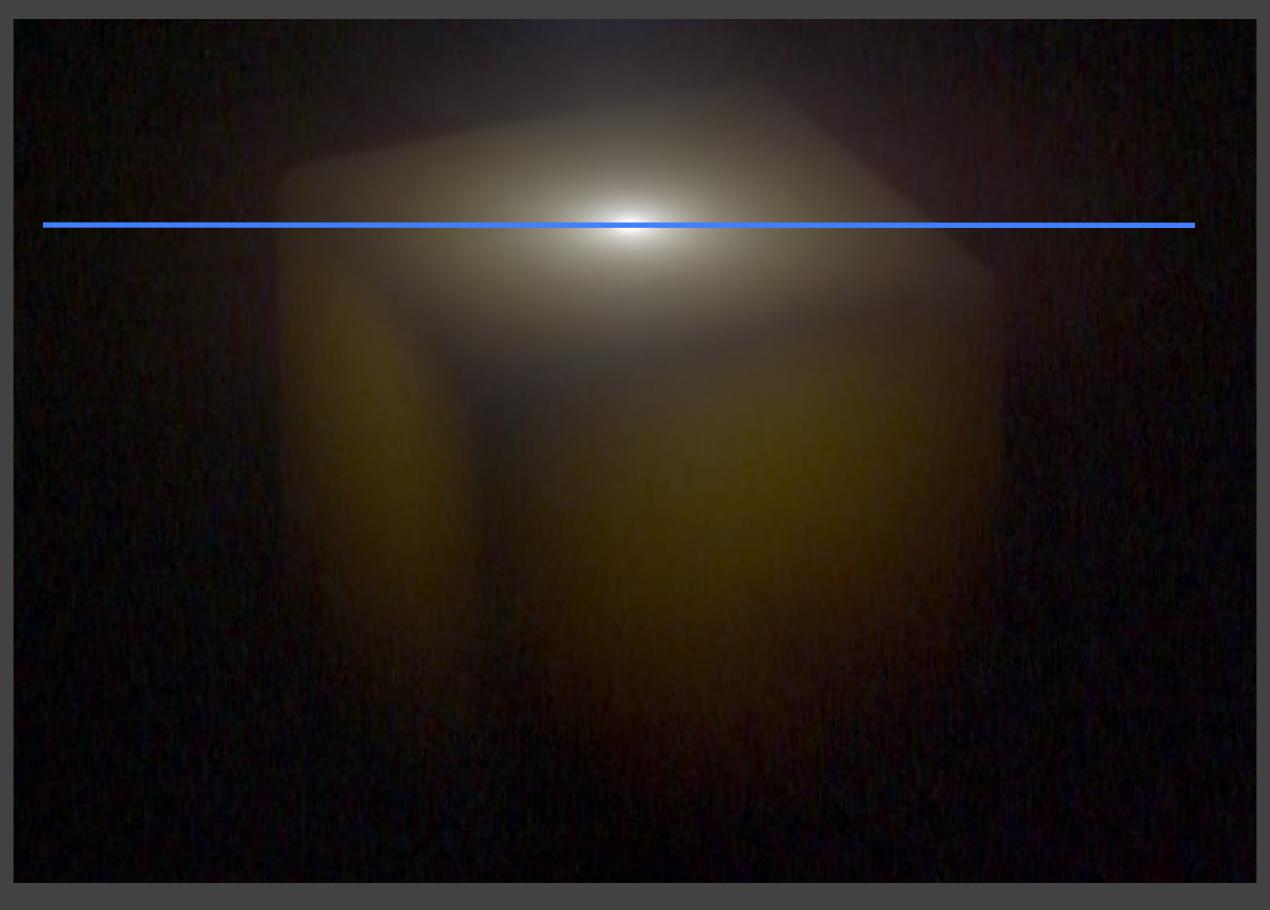
40mm cube of statuary marble

HDR photograph

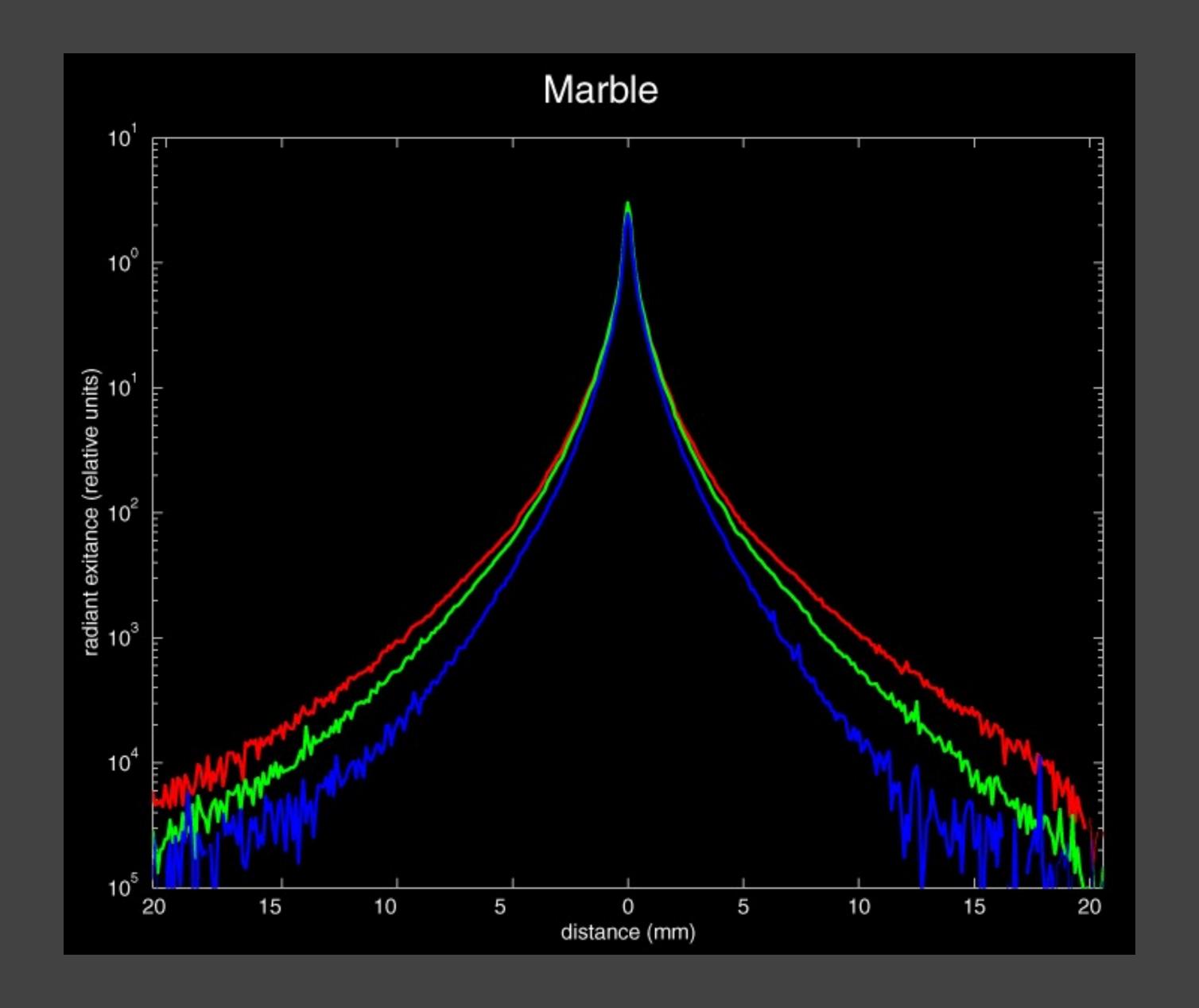


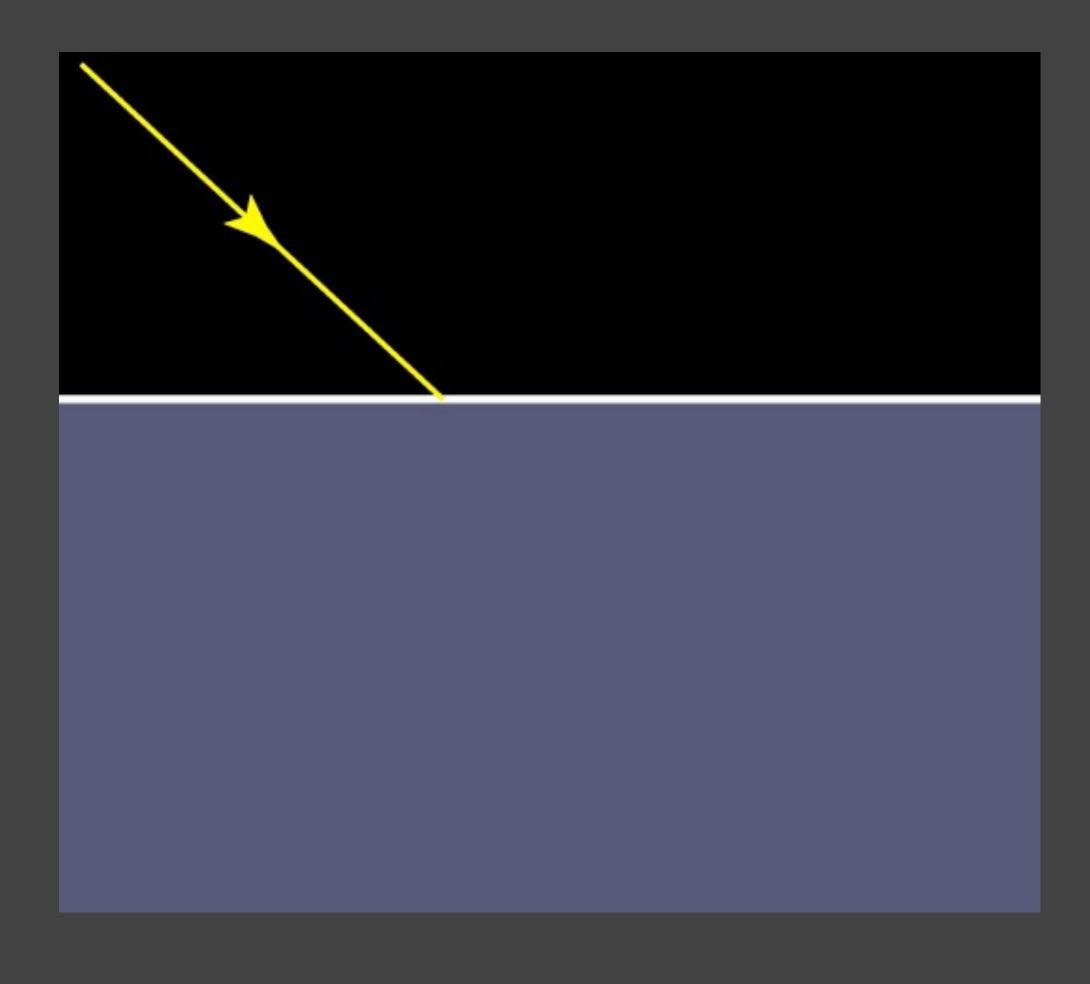
(log scaled image)

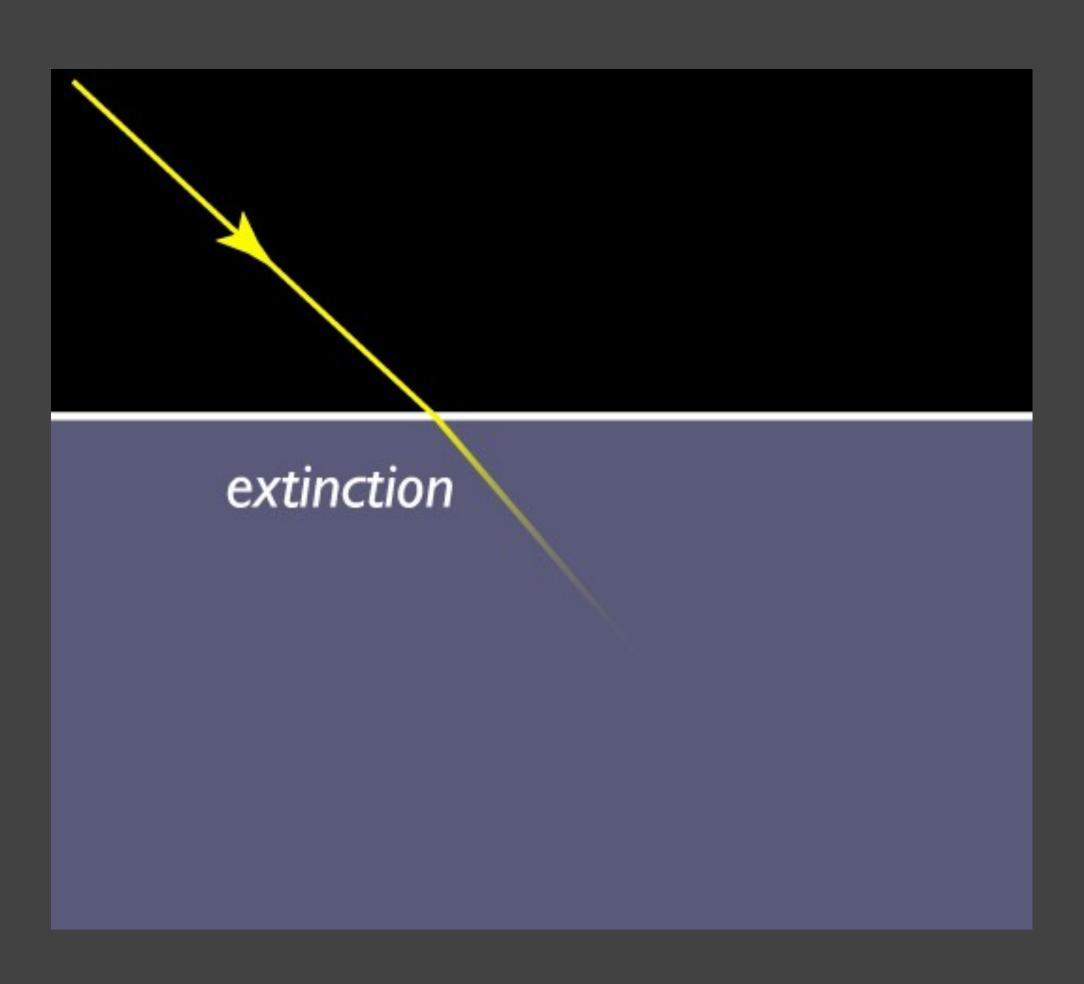
HDR photograph

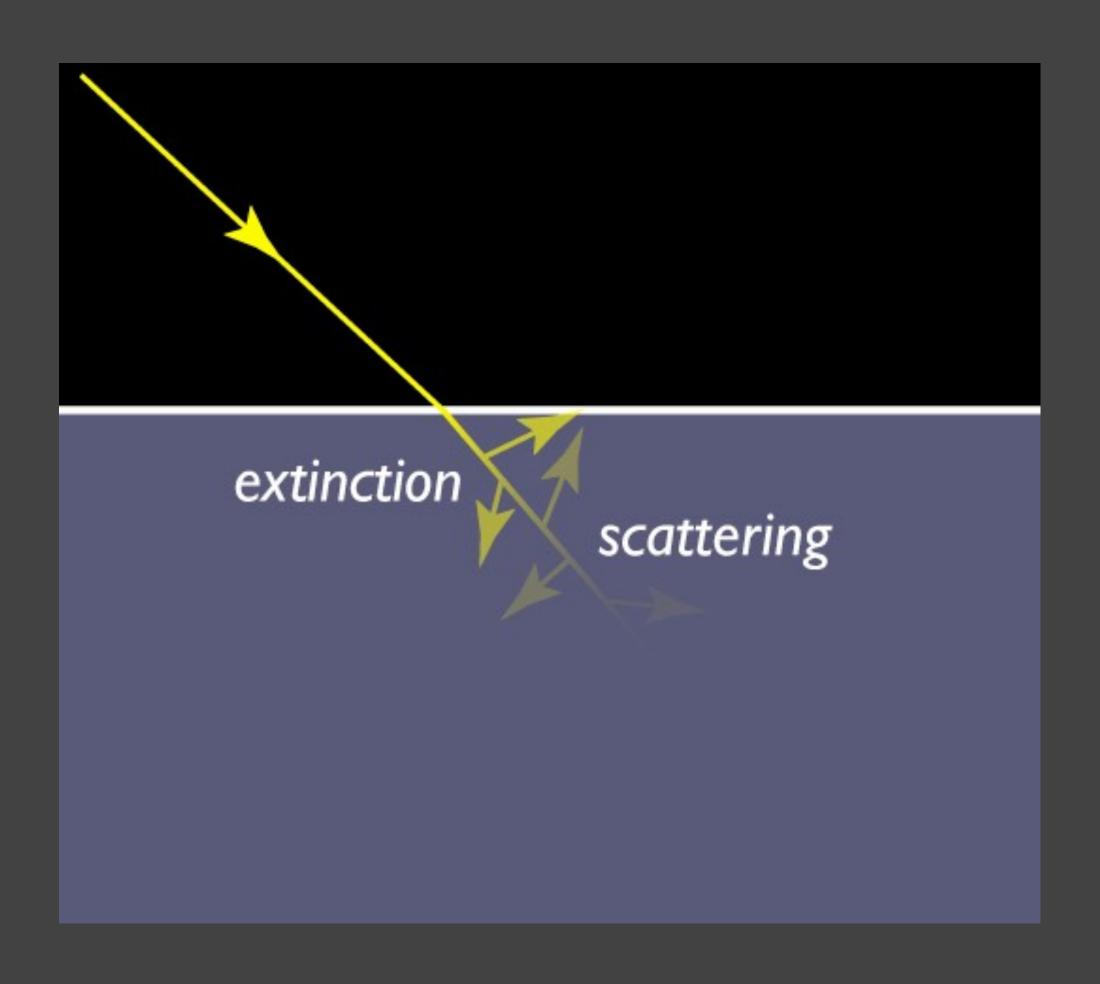


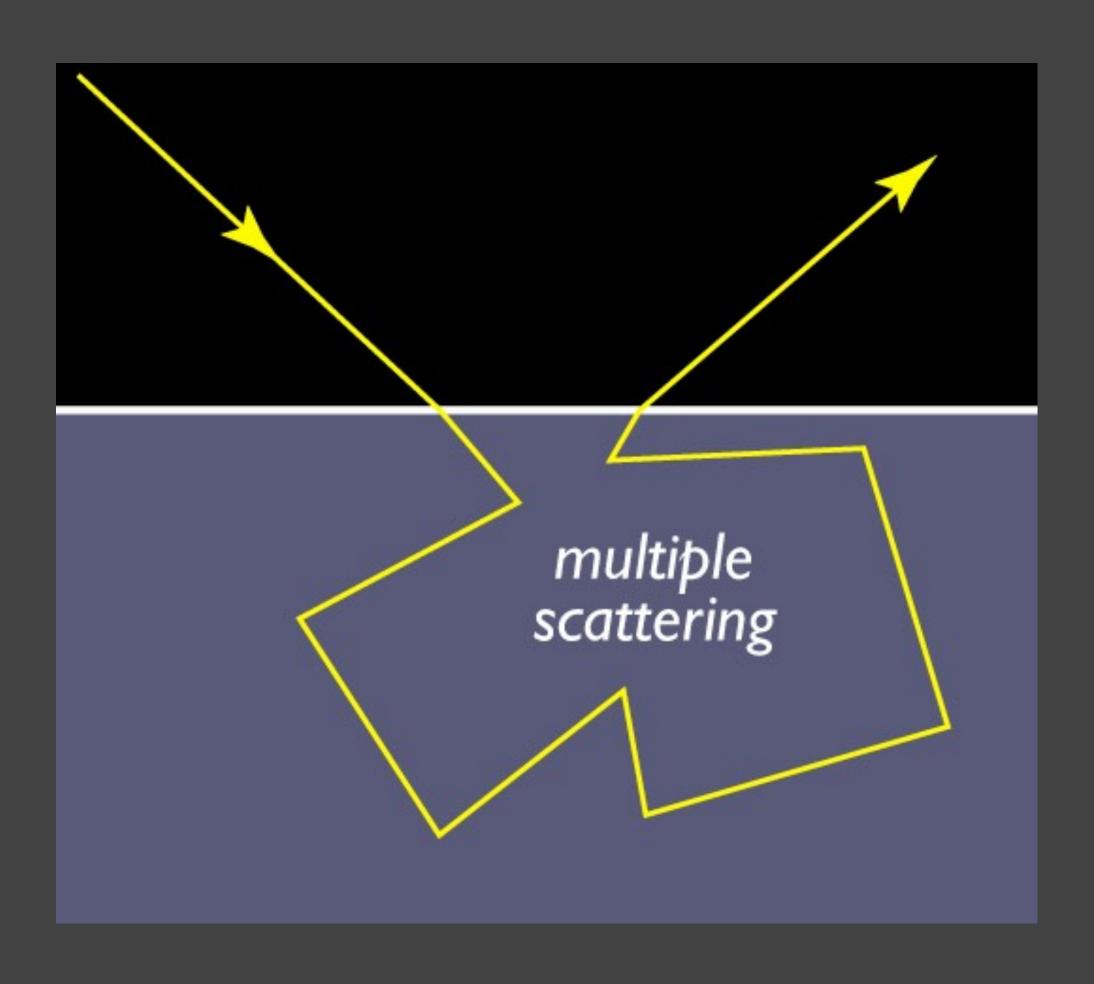
(log scaled image)







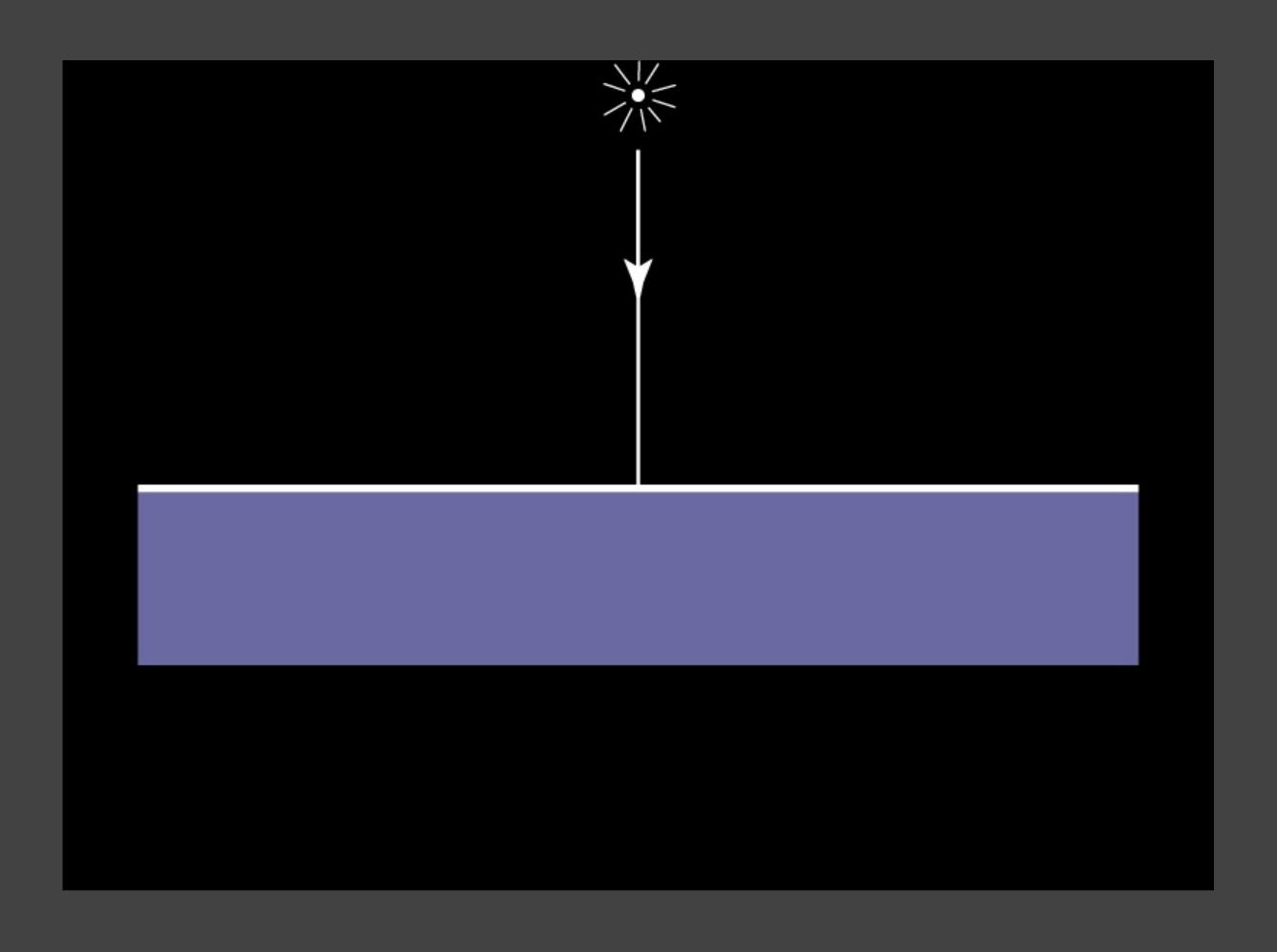




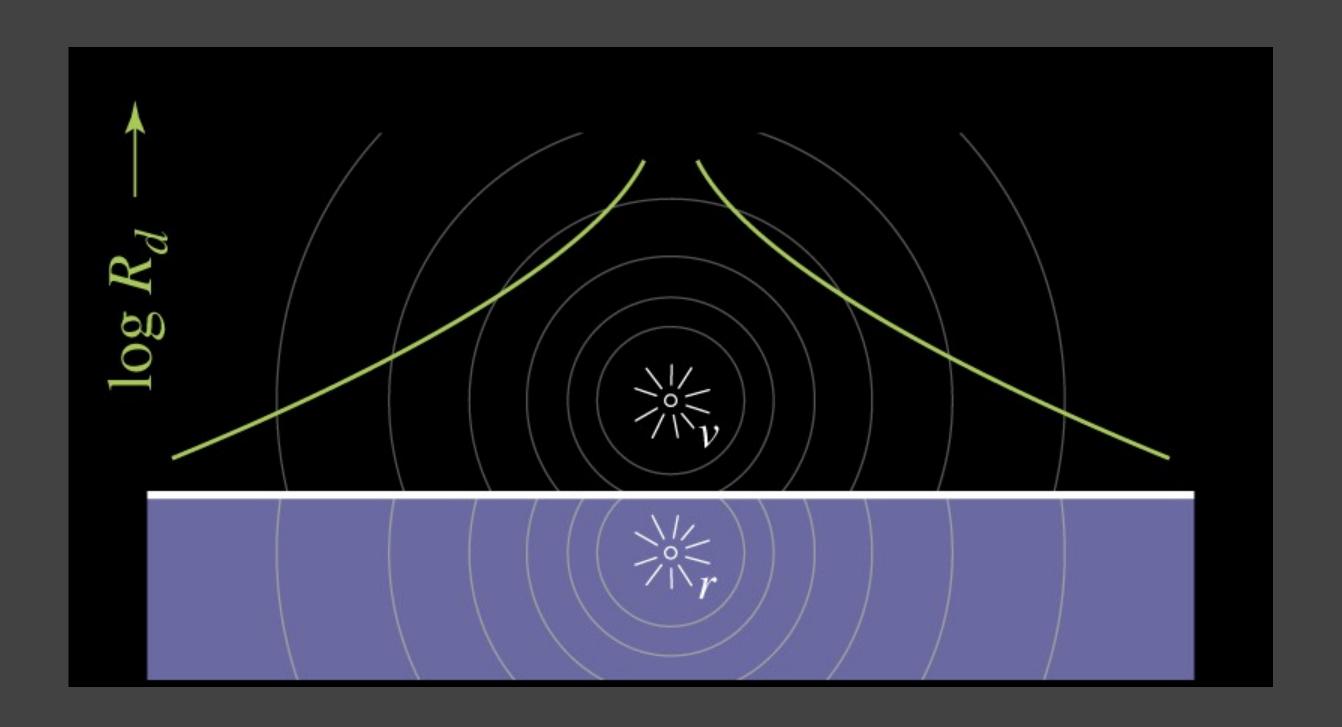
Light diffusion

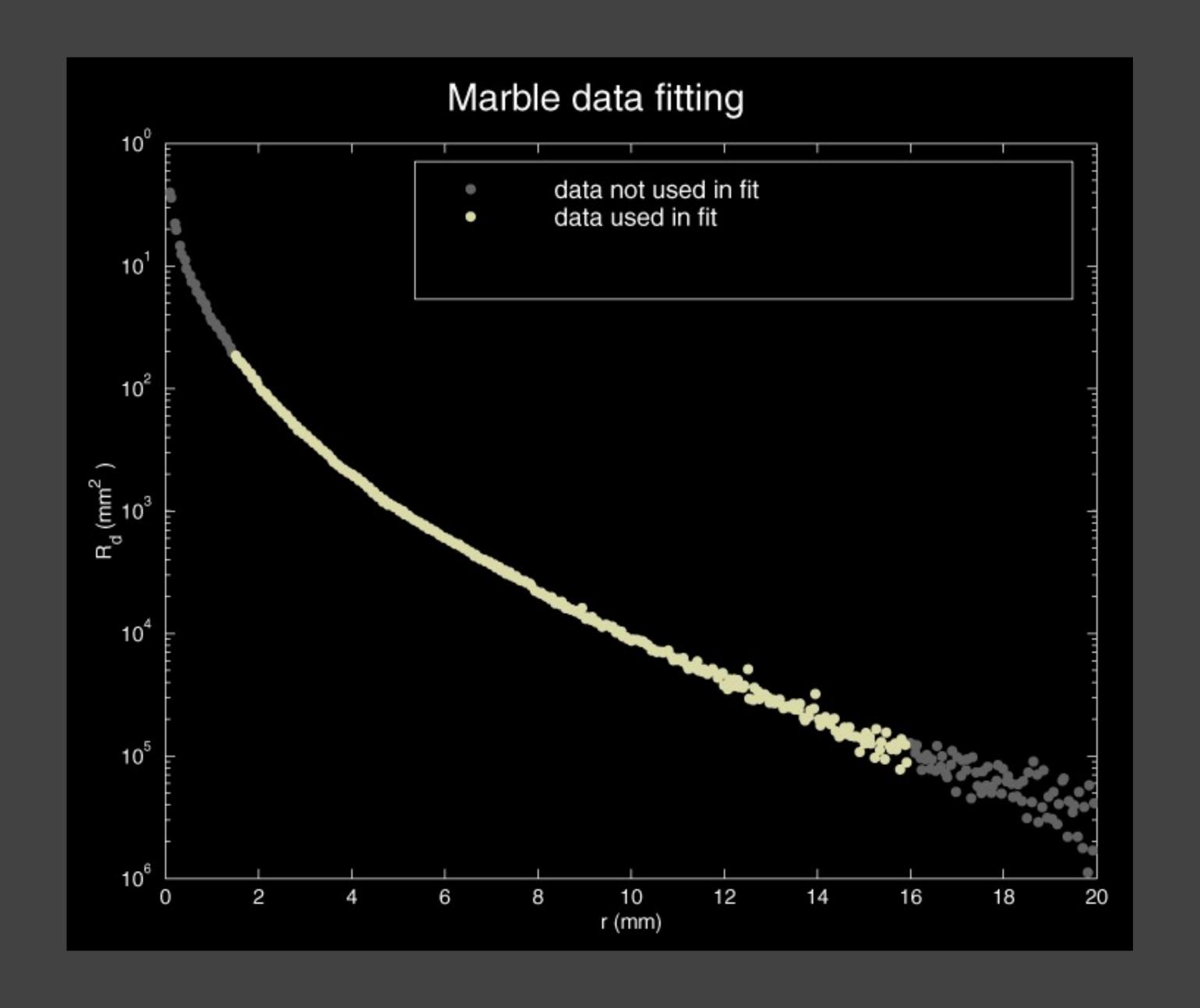


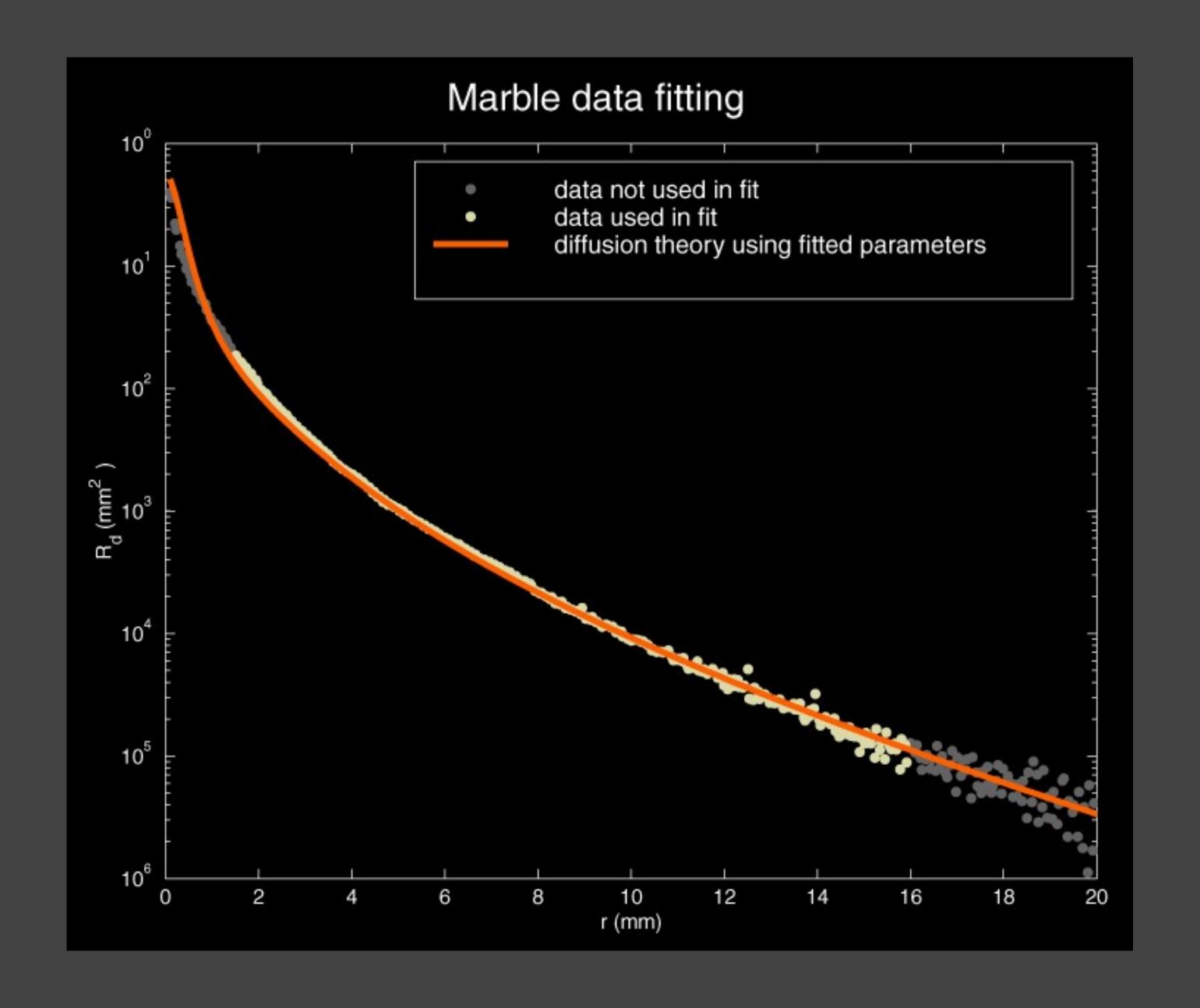
Diffusion approximation



Diffusion approximation







Results: milk



Diffuse "milk"

Results: milk



Diffuse "milk"

Skim milk

Results: milk

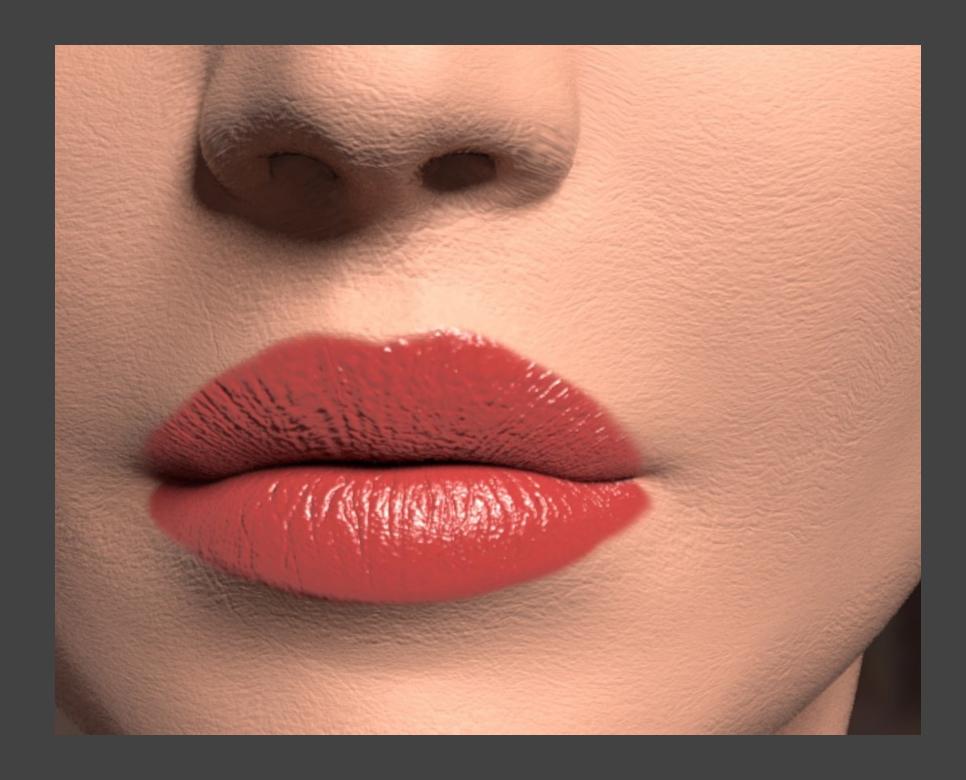


Diffuse "milk"

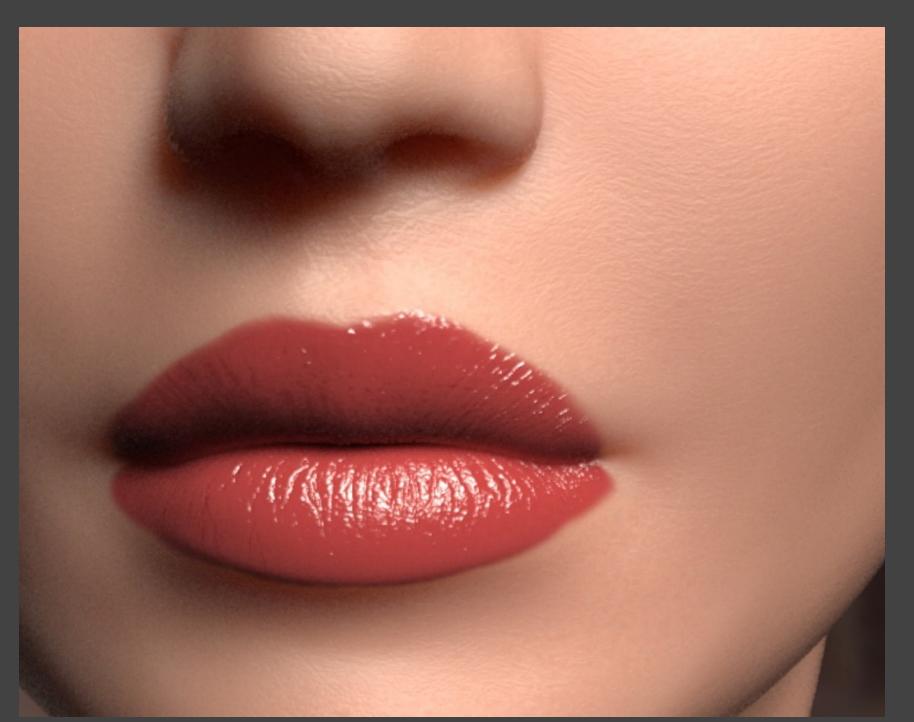
Skim milk

Whole milk

Results: skin

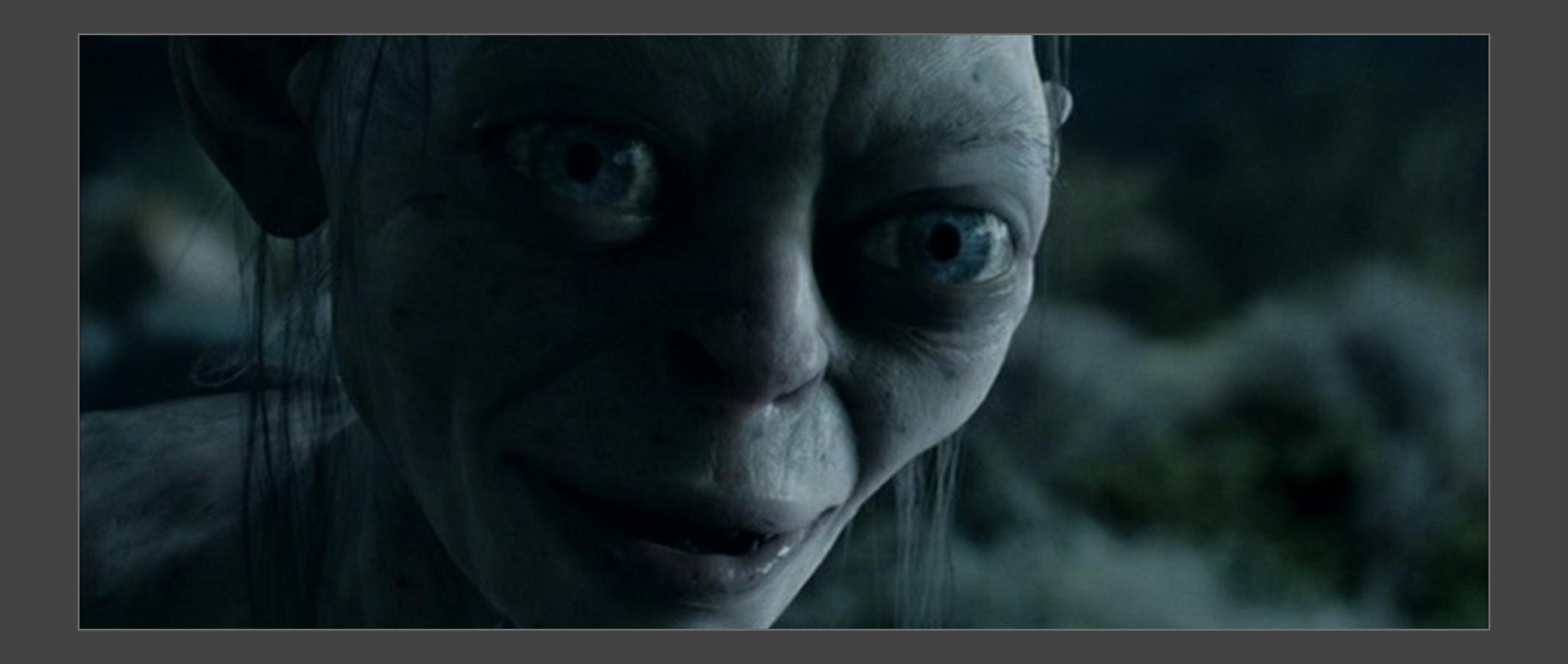


opaque skin



translucent skin

The Two Towers (2002)

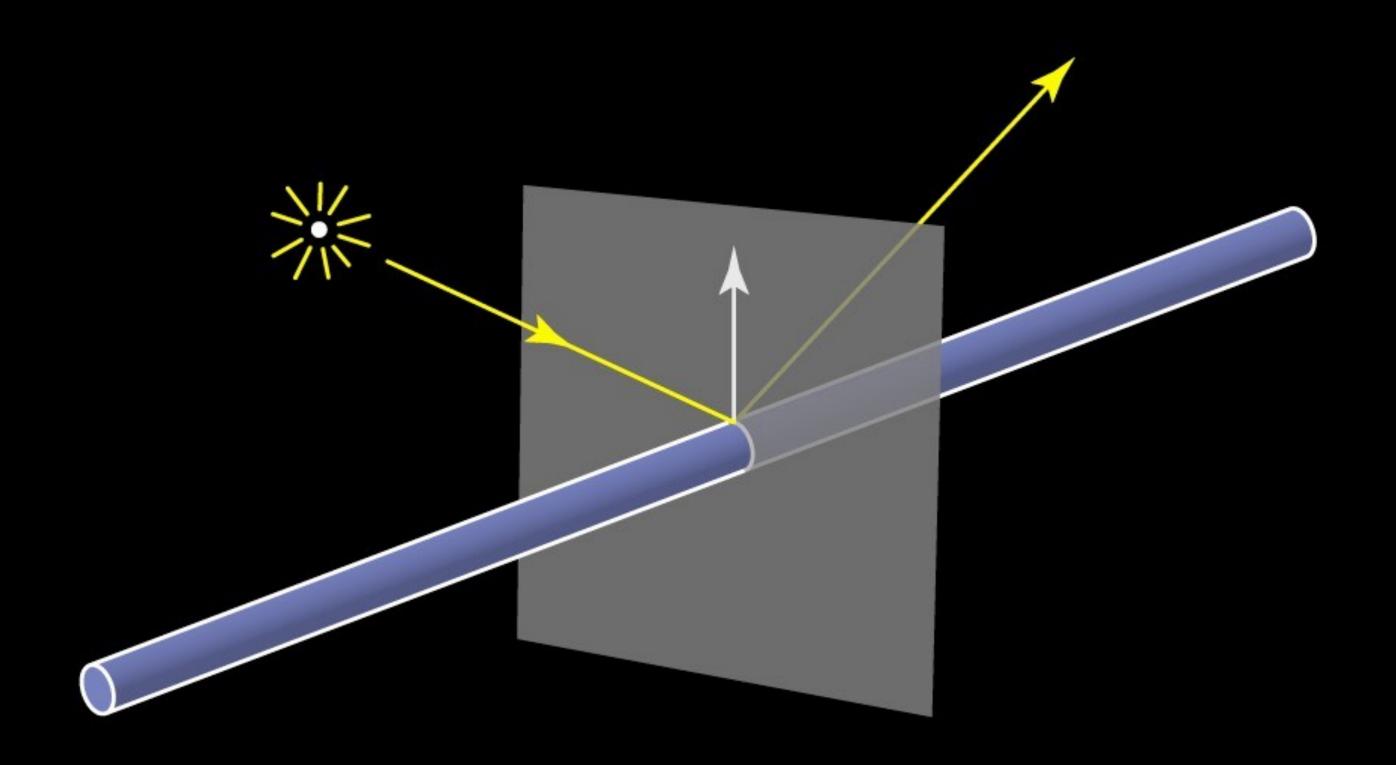


hair optics scattering from human hair fibers

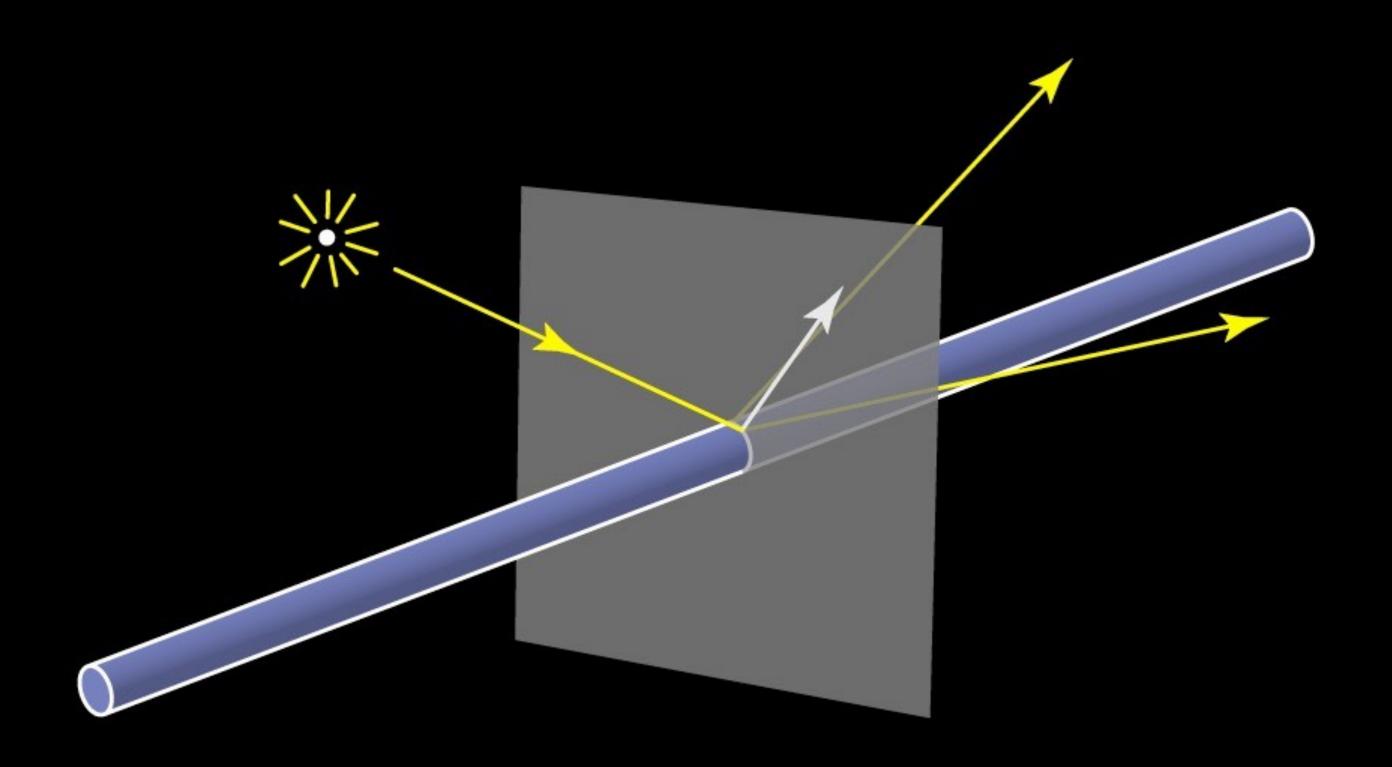
hair optics scattering from human hair fibers

Stephen R. Marschner, Henrik Wann Jensen, Mike Cammarano, Steve Worley, and Pat Hanrahan. "Light Scattering from Human Hair Fibers." SIGGRAPH 2003.

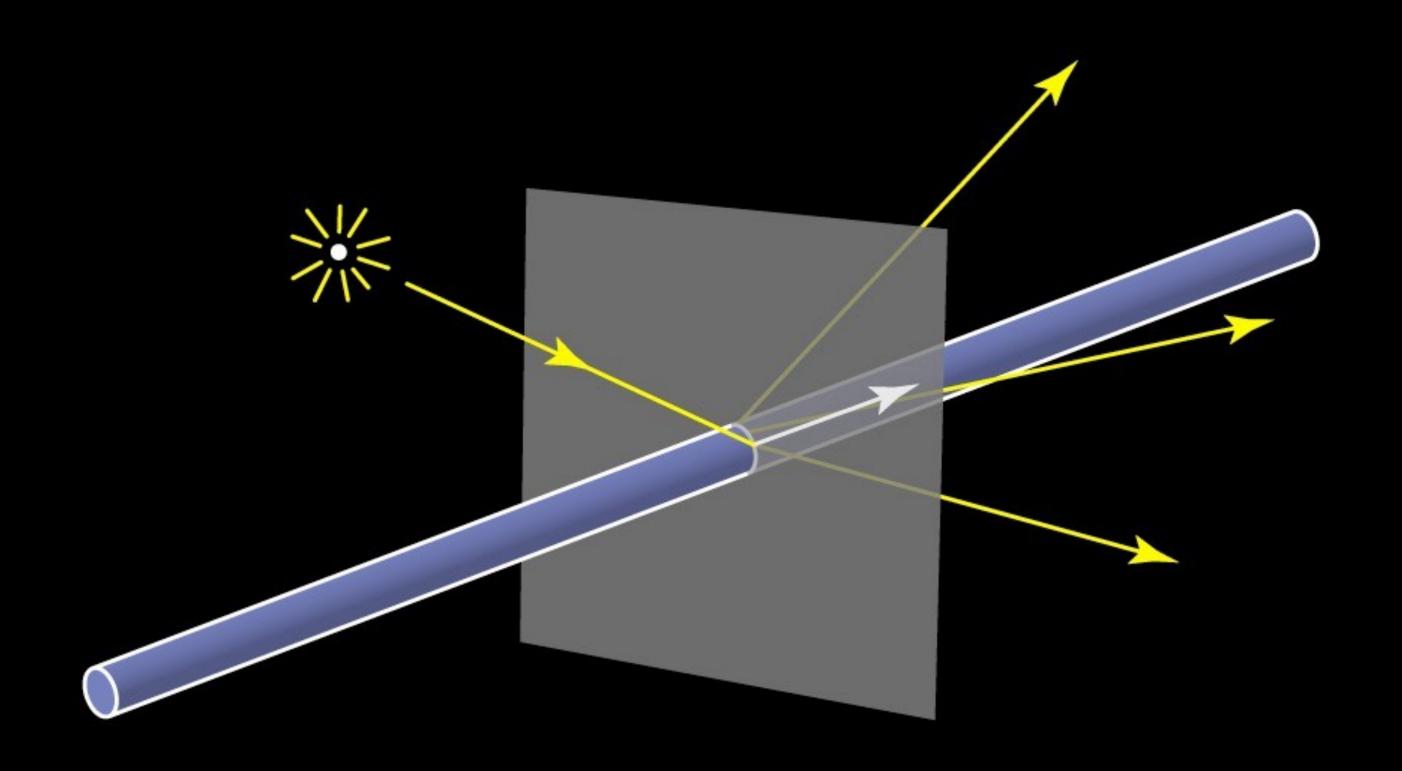




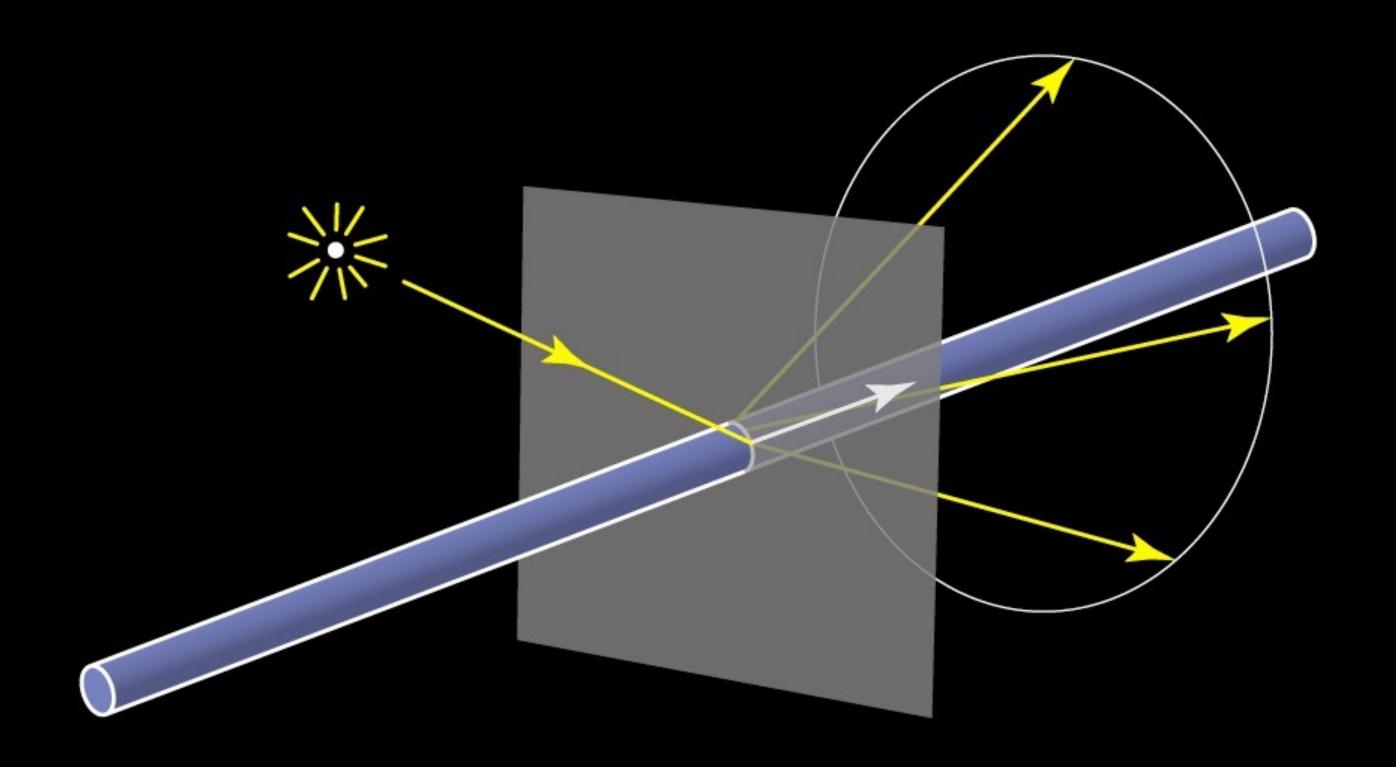
predicts a single, white highlight



predicts a single, white highlight



predicts a single, white highlight

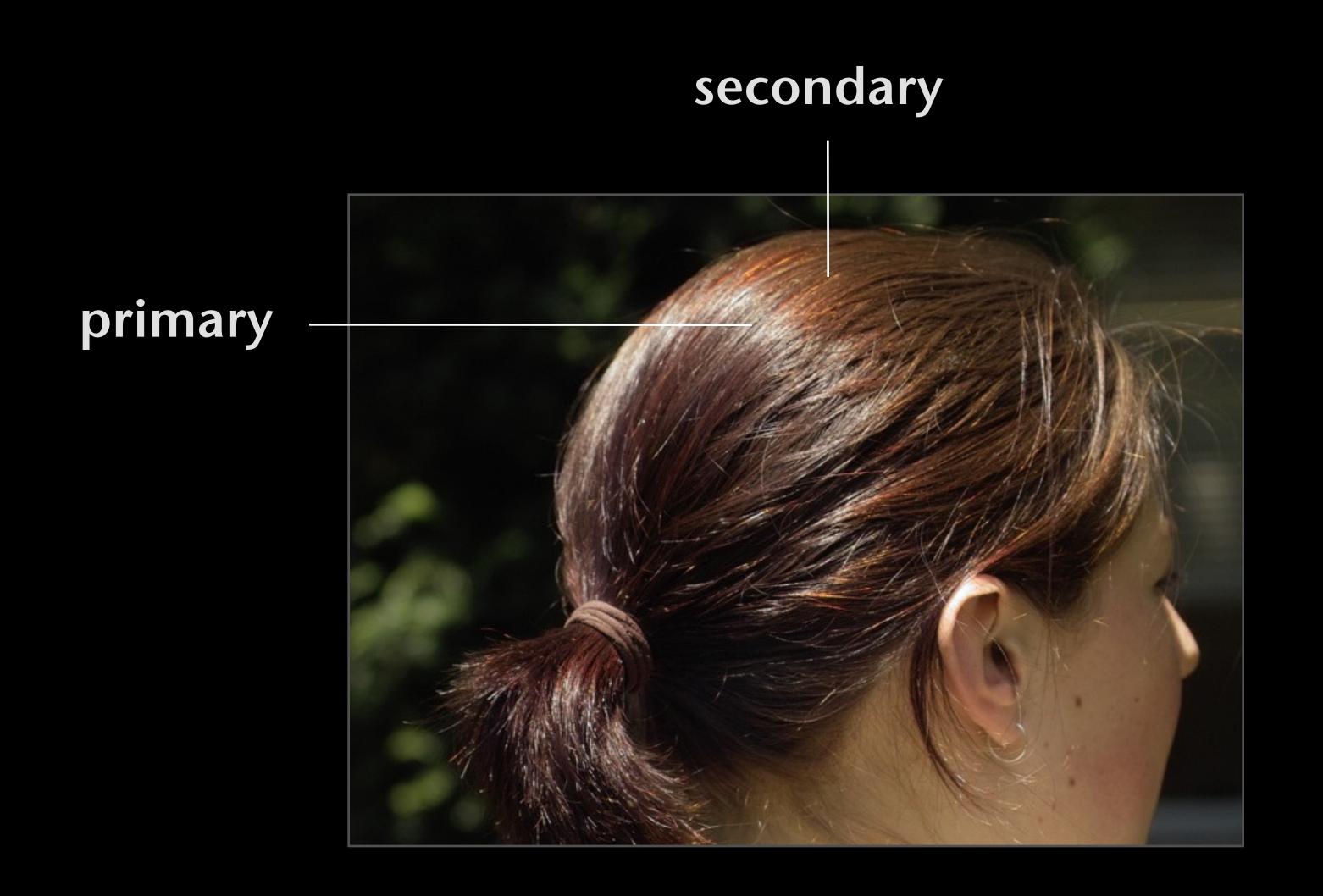


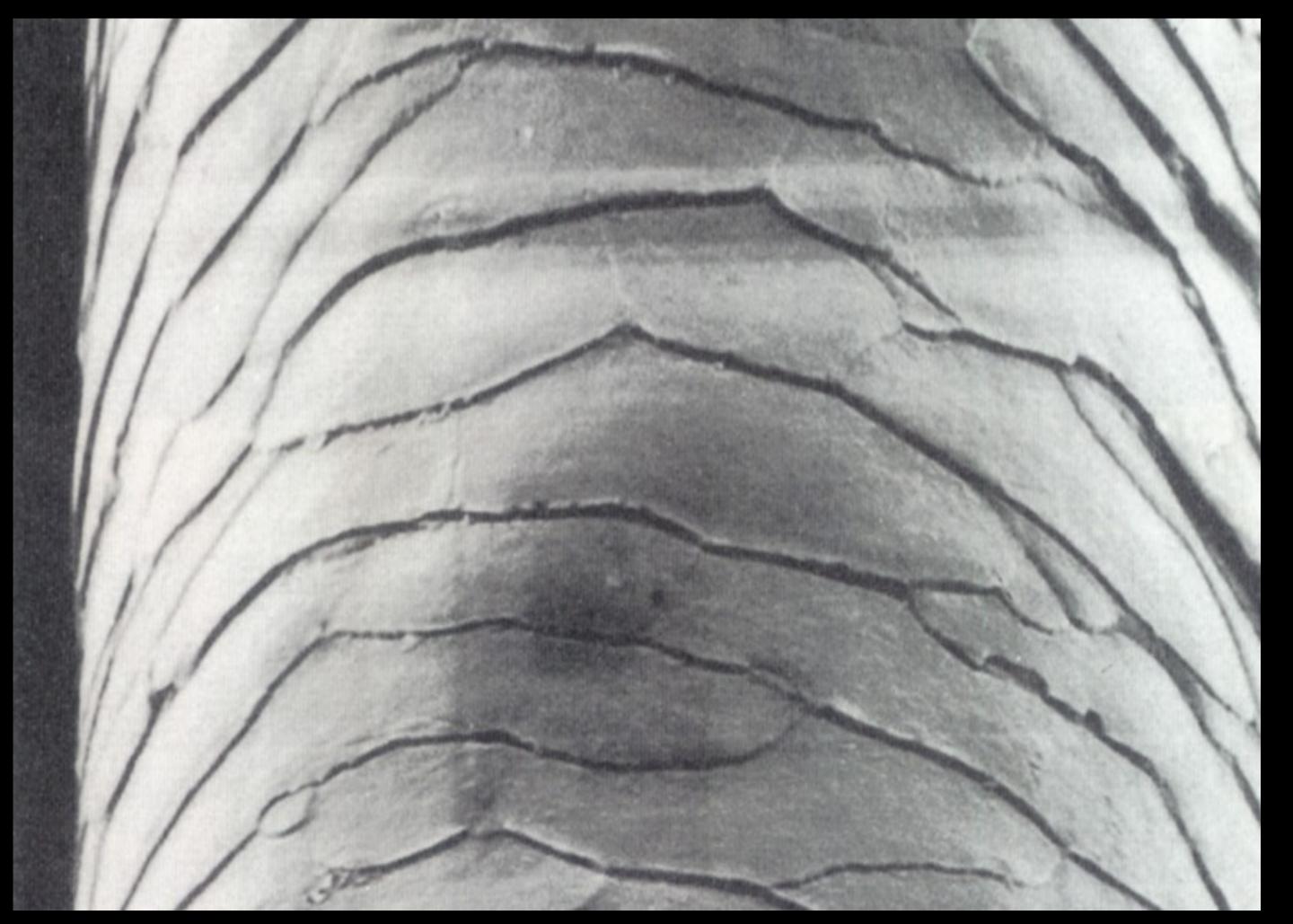
predicts a single, white highlight



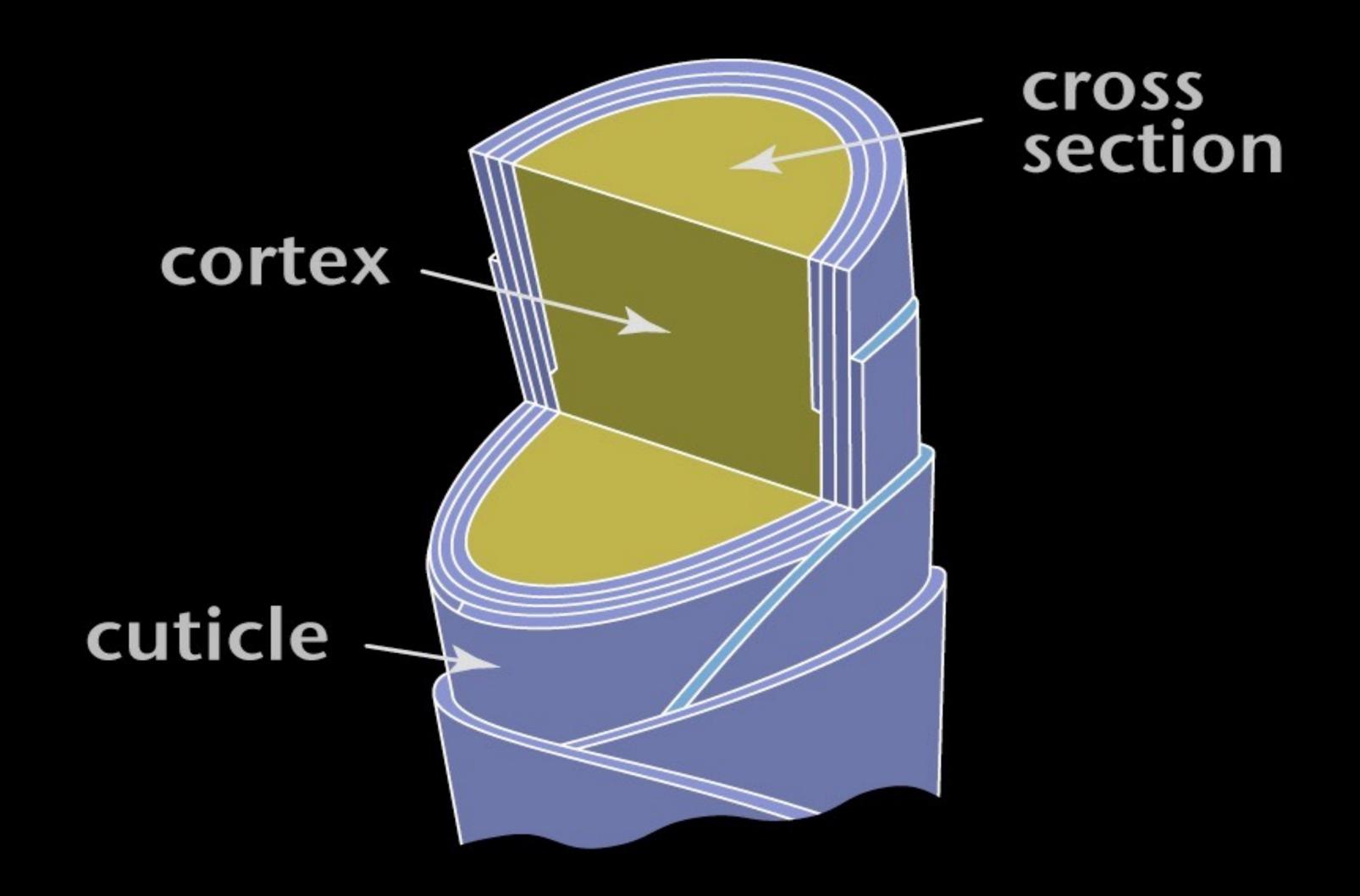


secondary

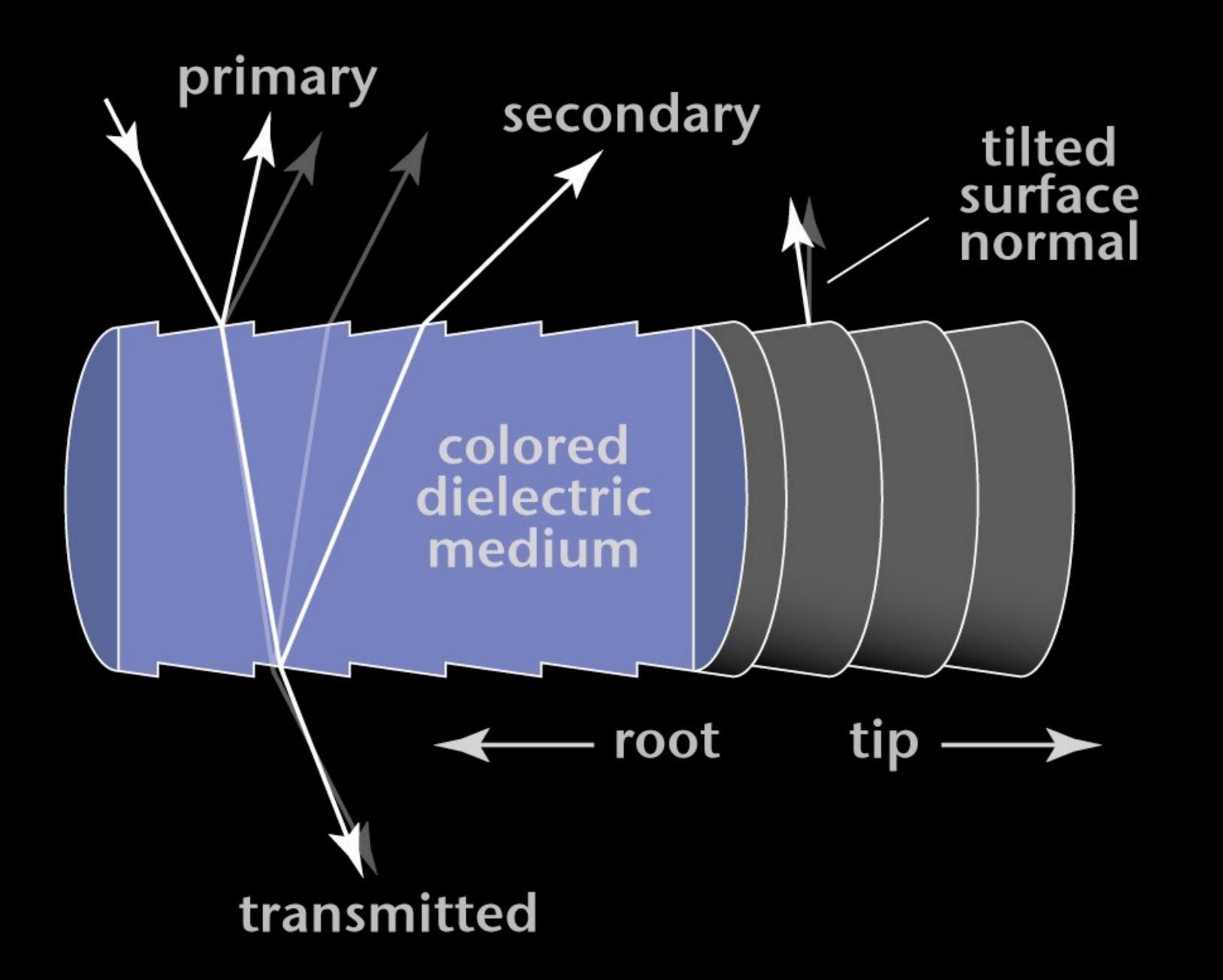




[Robbins 1994]



(after [Robbins 1994])

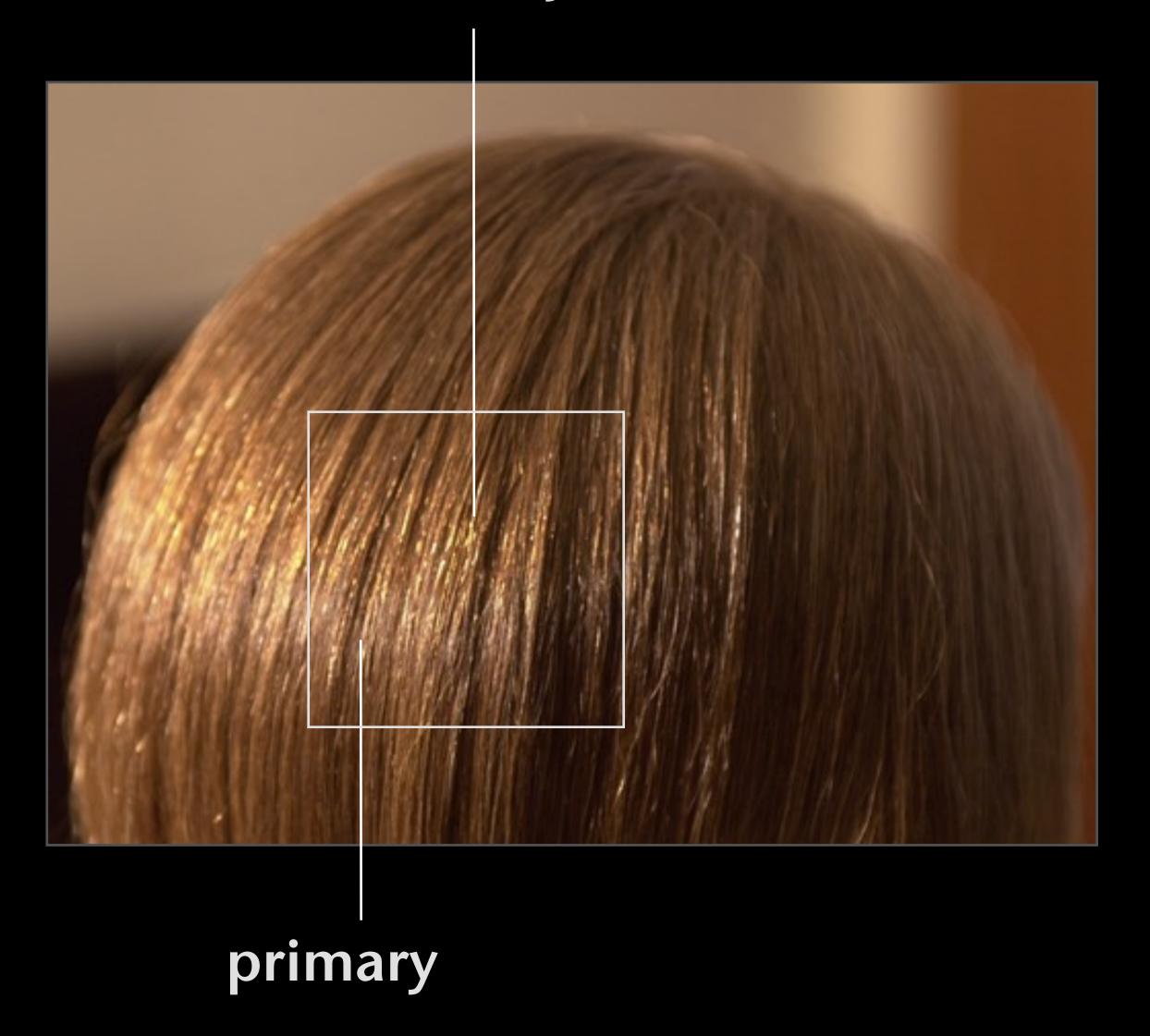


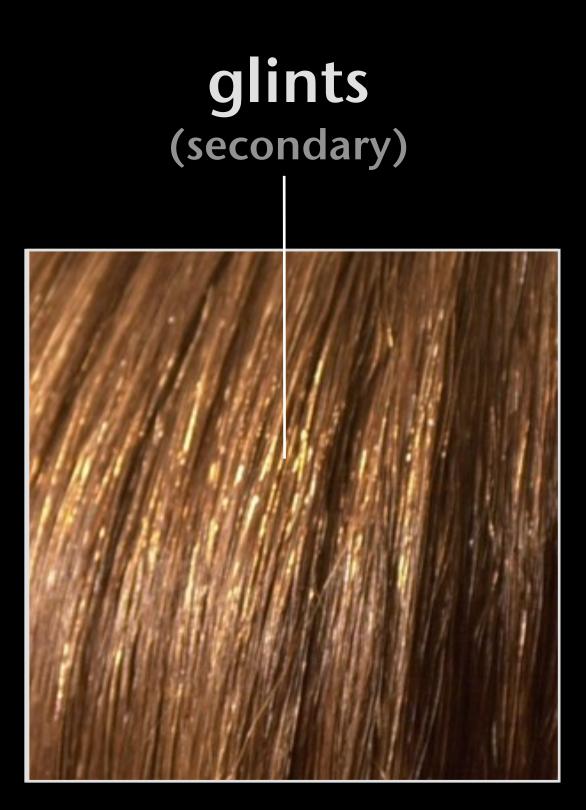
secondary



primary

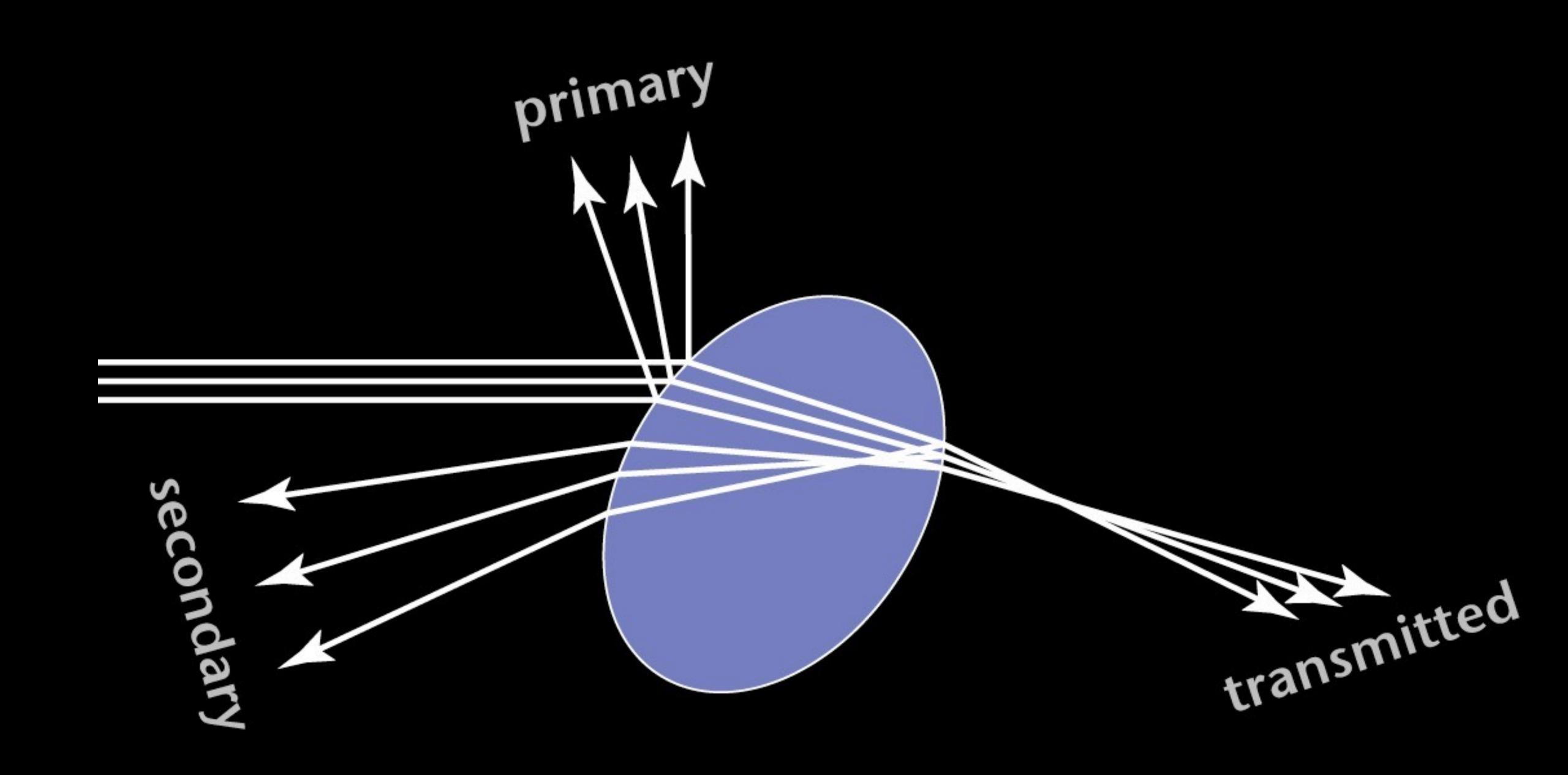
secondary







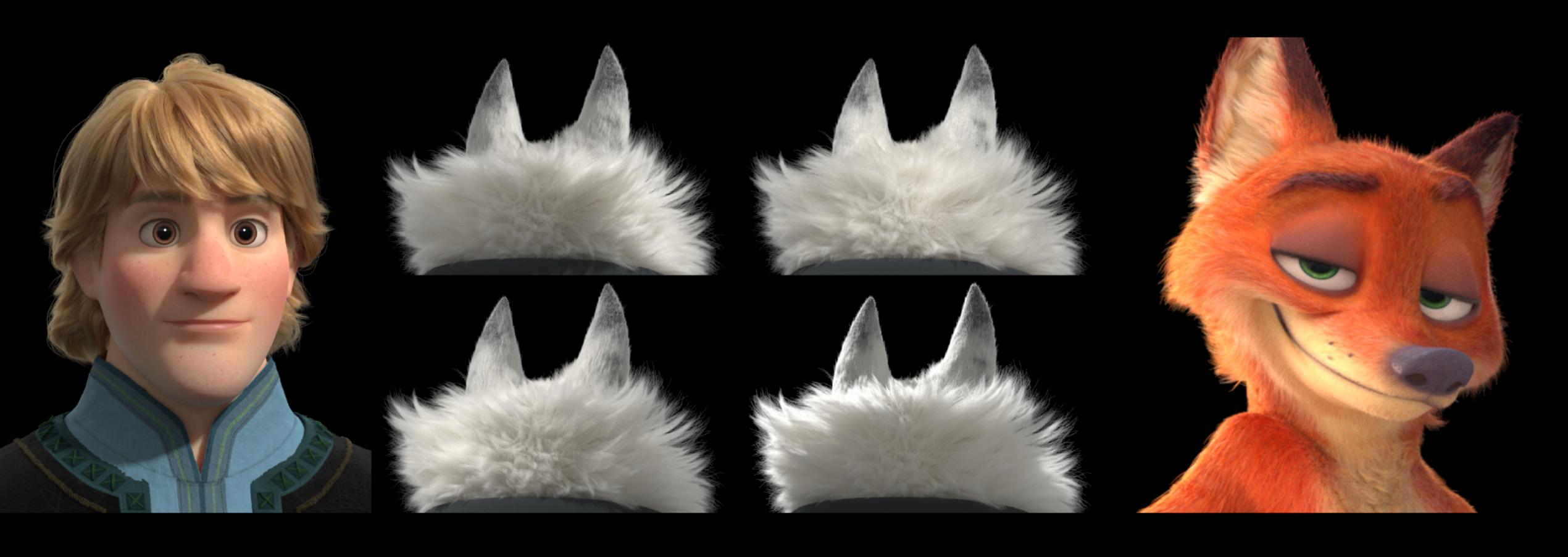






King Kong (2005) | visual effects: Weta Digital





A Practical and Controllable Hair and Fur Model for Production Path Tracing Matt Jen-Yuan Chiang, Benedikt Bitterli, Chuck Tappan, Brent Burley Eurographics Symposium on Rendering, 2016

cloth mechanics yarn-based cloth modeling

cloth mechanics yarn-based cloth modeling

Jonathan Kaldor, Doug James, and Steve Marschner. "Simulating Knitted Cloth at the Yarn Level." SIGGRAPH 2008

Jonathan Kaldor, Doug James, and Steve Marschner. "Efficient Yarn-based Cloth with Adaptive Contact Linearization." SIGGRAPH 2010

Cem Yuksel, Jonathan Kaldor, Doug James, and Steve Marschner. "Stitch Meshes for Modeling Knitted Clothing with Yarn-level Detail." SIGGRAPH 2012

Why Yarns Are Important

- Cloth is not a continuum
 - Discrete yarn behavior drives overall cloth behavior
- Particularly evident in knit fabrics



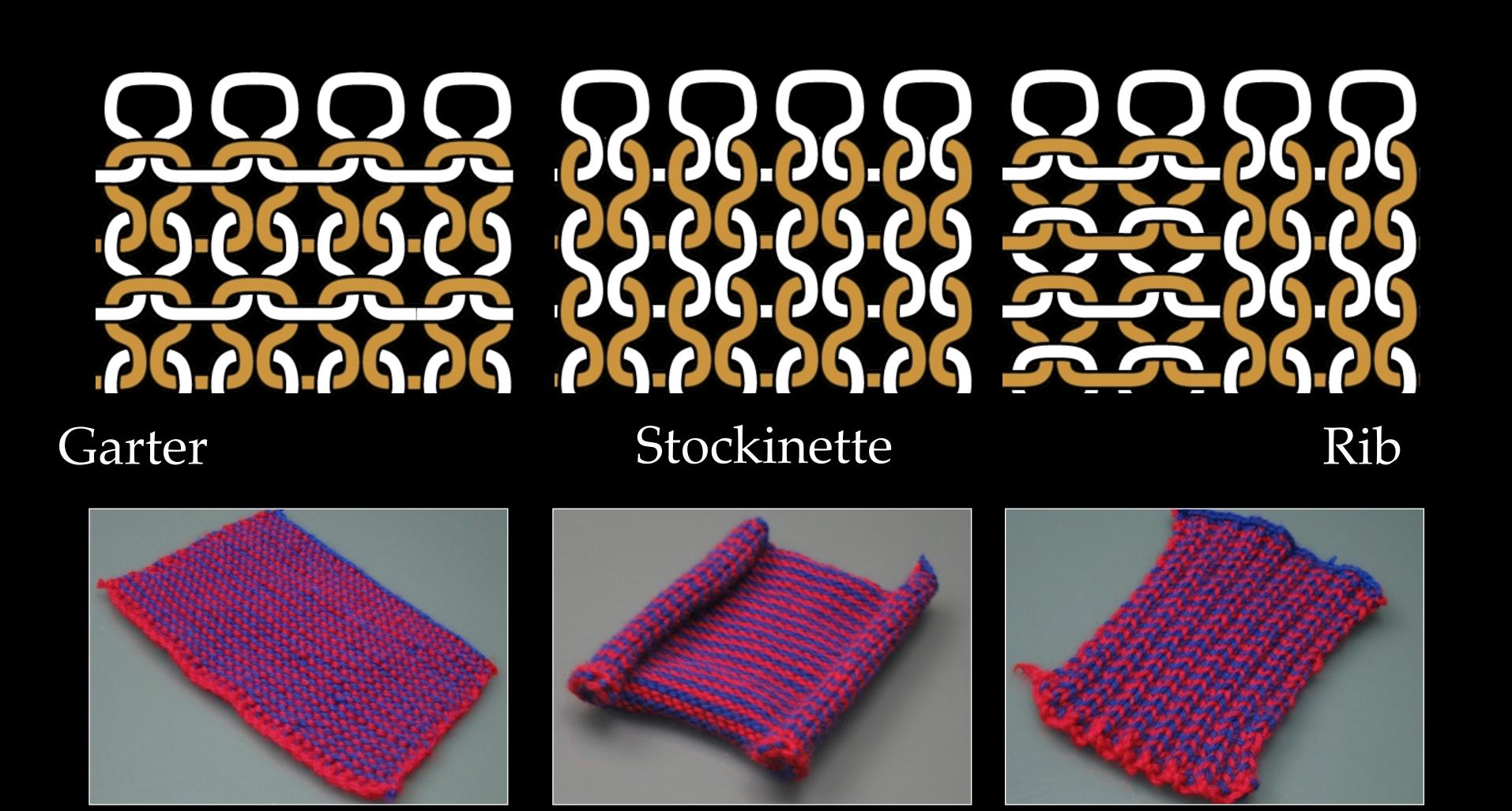
http://toveb.typepad.com/

Why Yarns Are Important

- Cloth is not a continuum
 - Discrete yarn behavior drives overall cloth behavior
- Particularly evident in knit fabrics



Structure-Dependent Behavior



Yarn Properties

- Thin, flexible rods, with many degrees of freedom
- Strongly resist stretching
- Weakly resist bending
- Can compress laterally
- Friction between yarns



Yarn Properties

 Thin, flexible rods, with many degrees of freedom



- Weakly resist bending
- Can compress laterally
- Friction between yarns

■ Constrained Lagrangian dynamics $\mathbf{M\ddot{q}} = \mathbf{f} - \nabla \mathbf{E} - \nabla \mathbf{D}$ $\mathbf{C(q)} = \mathbf{0}$

- Inextensibility constraints
- Bending, twisting energies
- Collision energy
- Velocity filter for damping

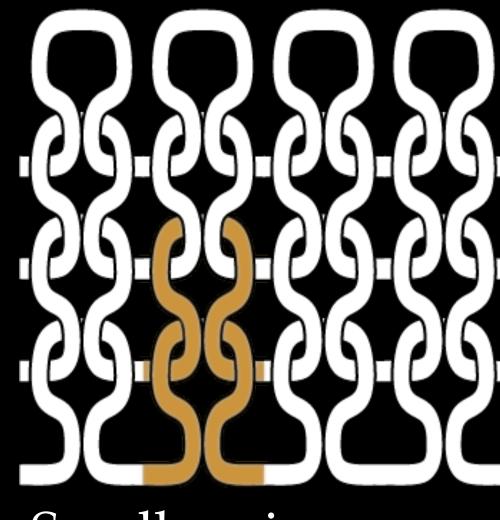
Modeling Dissipation

- Damp yarn-yarn contacts
- Damp non-rigid motion
 - [Müller et al. 2006][Rivers and James 2007]
- Small regions: stabilizing collisions
- Large regions: damp cloth-level motion



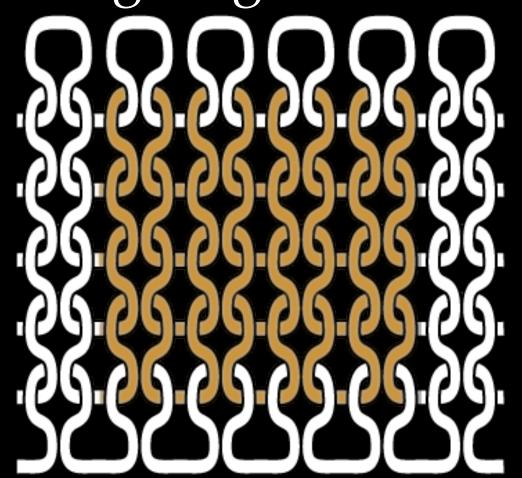
Modeling Dissipation

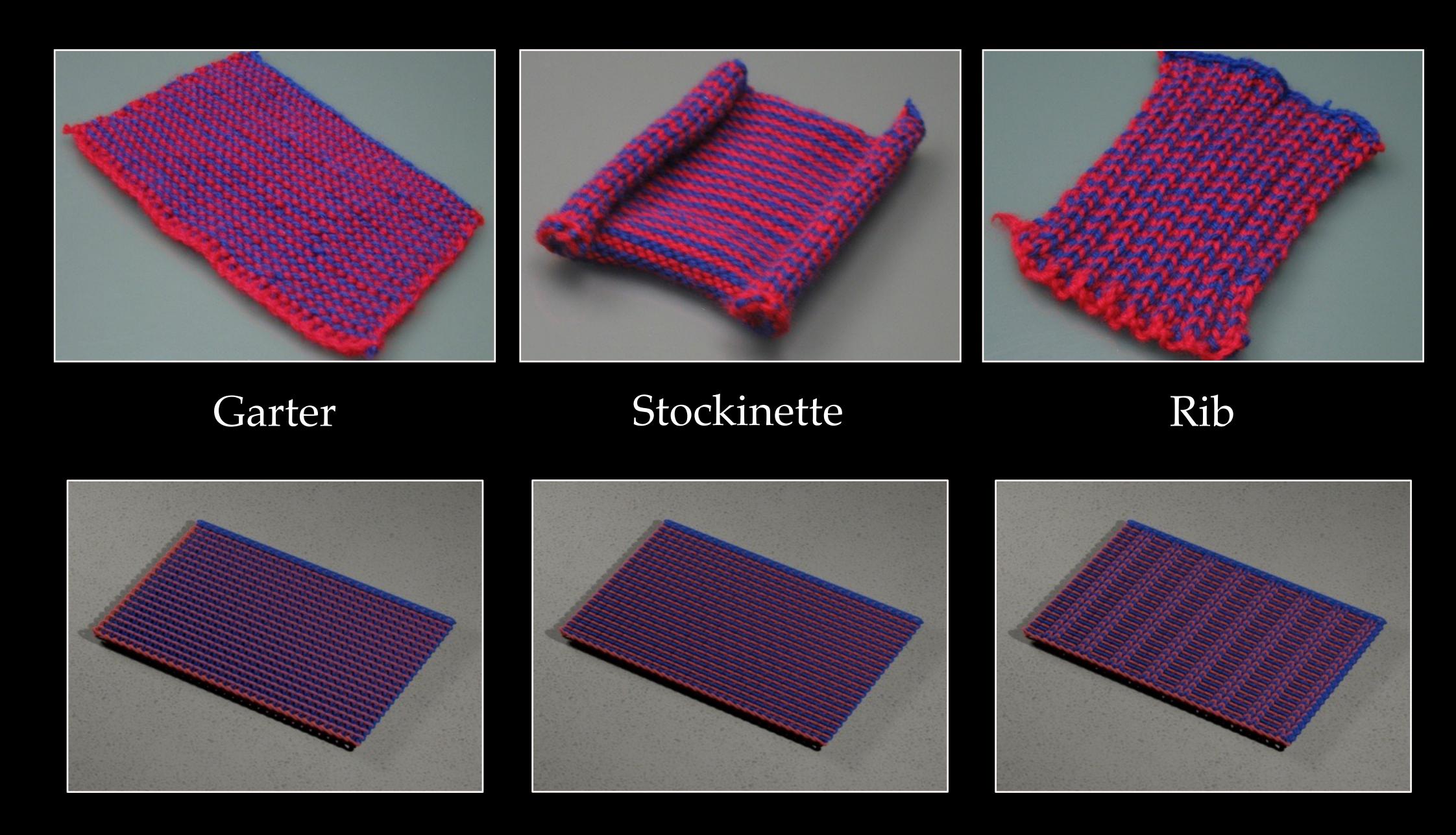
- Damp yarn-yarn contacts
- Damp non-rigid motion
 - [Müller et al. 2006][Rivers and James 2007]
- Small regions: stabilizing collisions
- Large regions: damp cloth-level motion

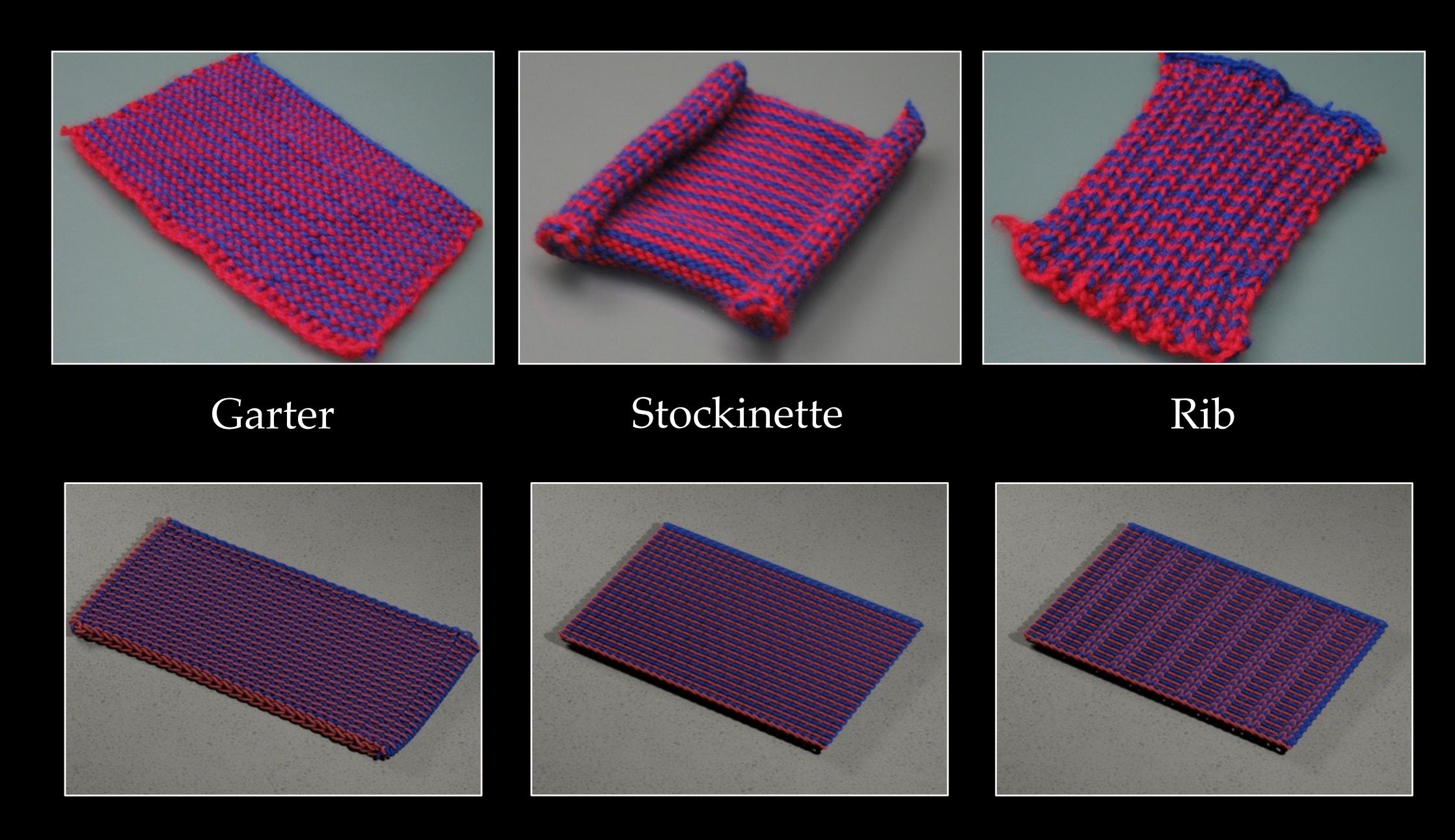


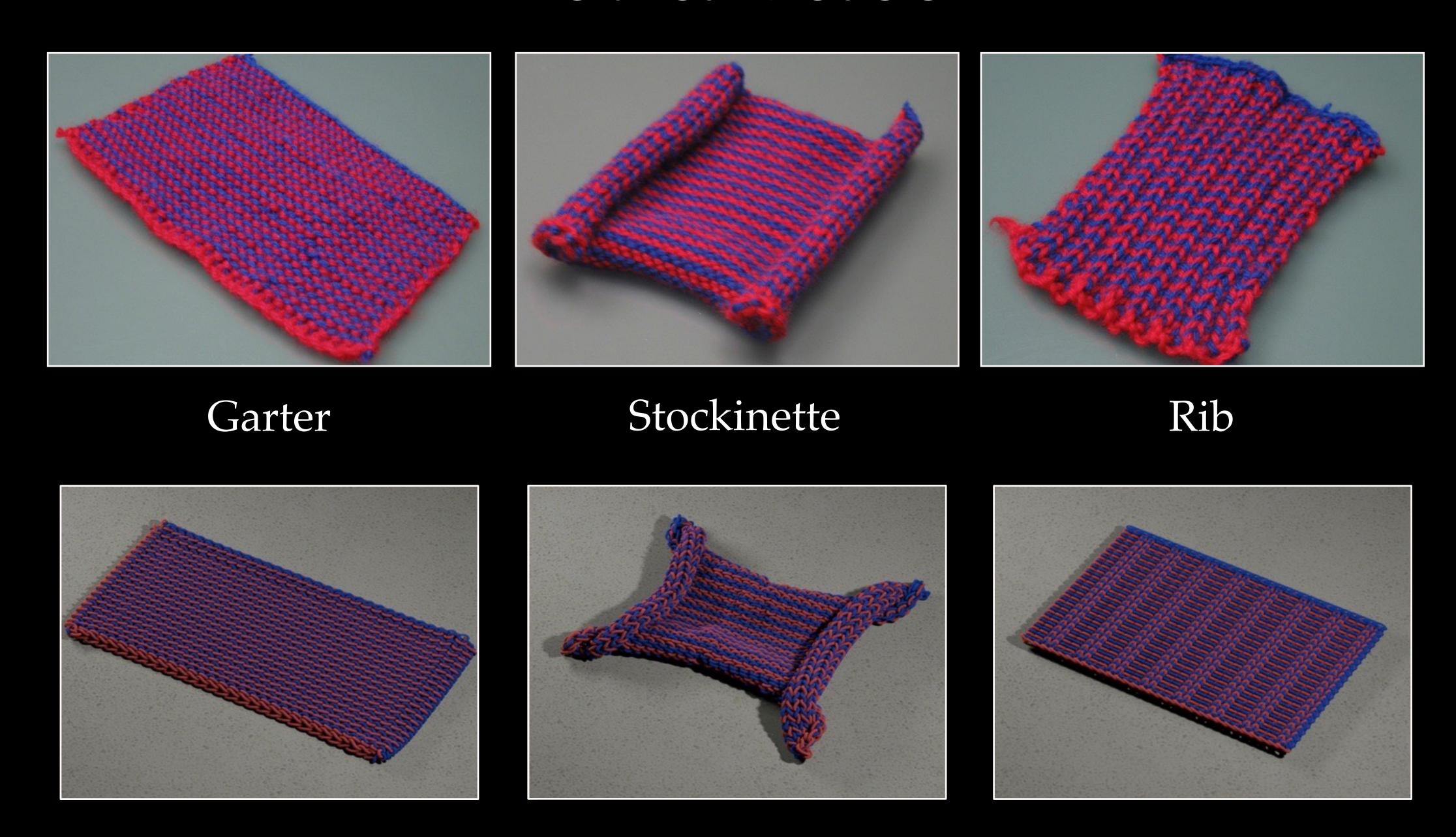
Small regions

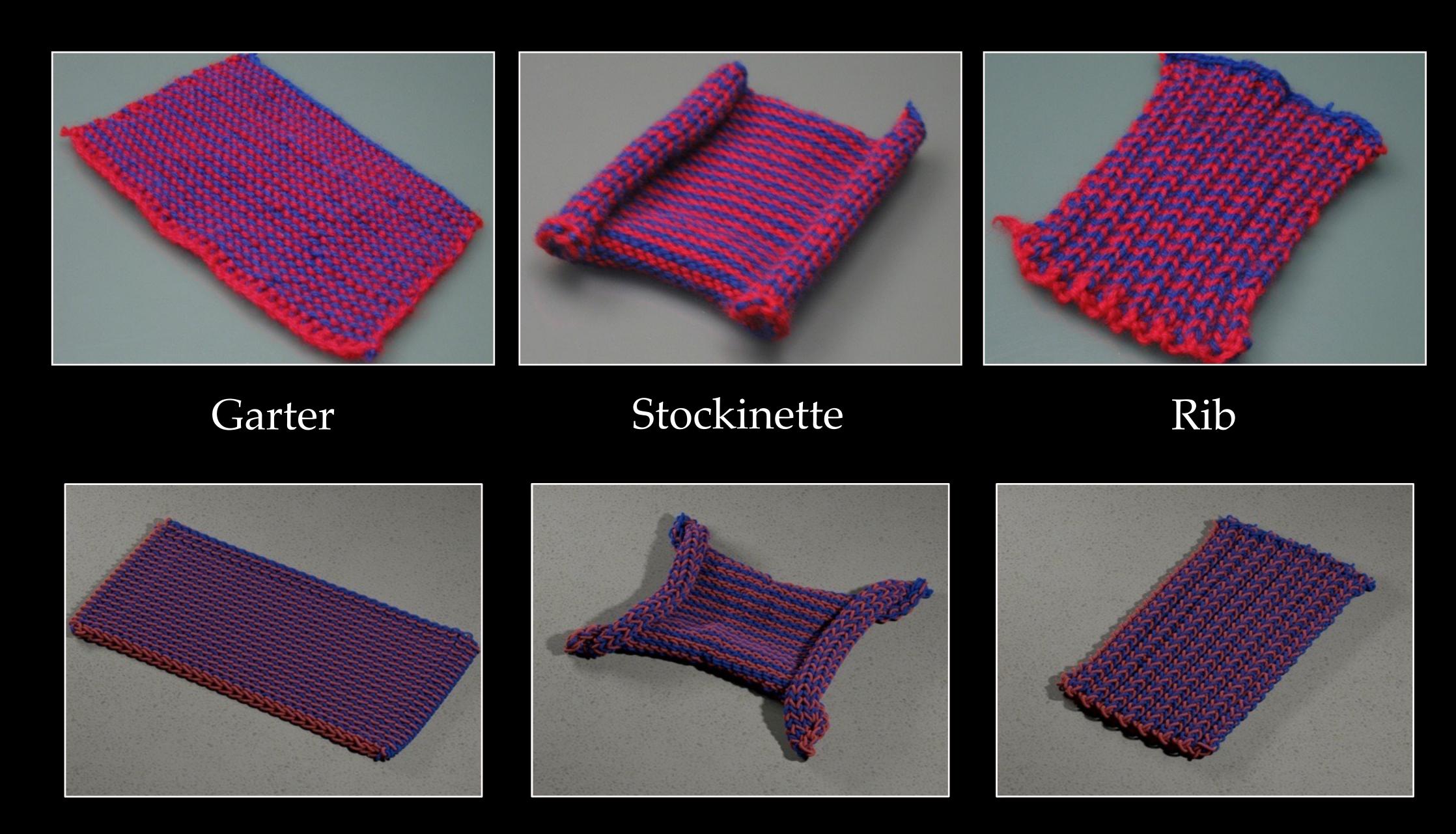
Large regions











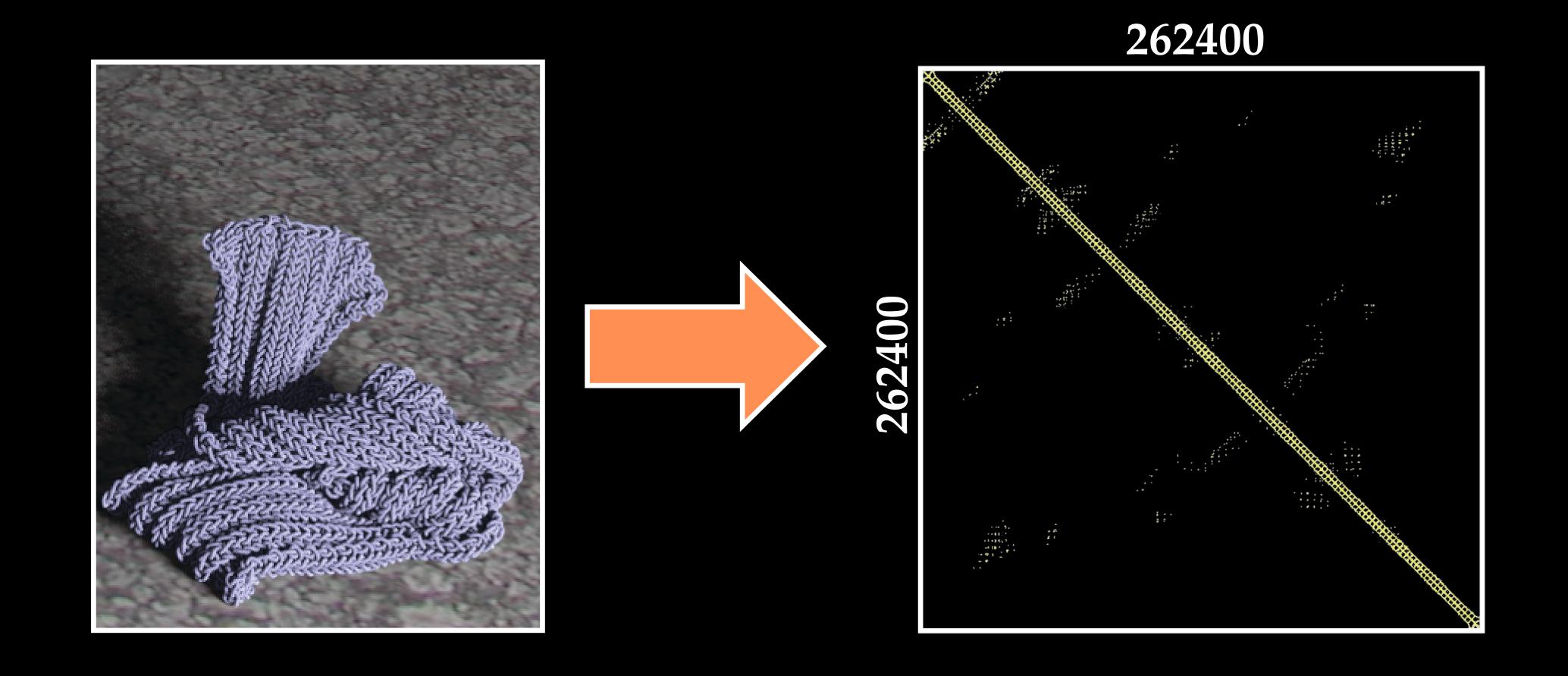


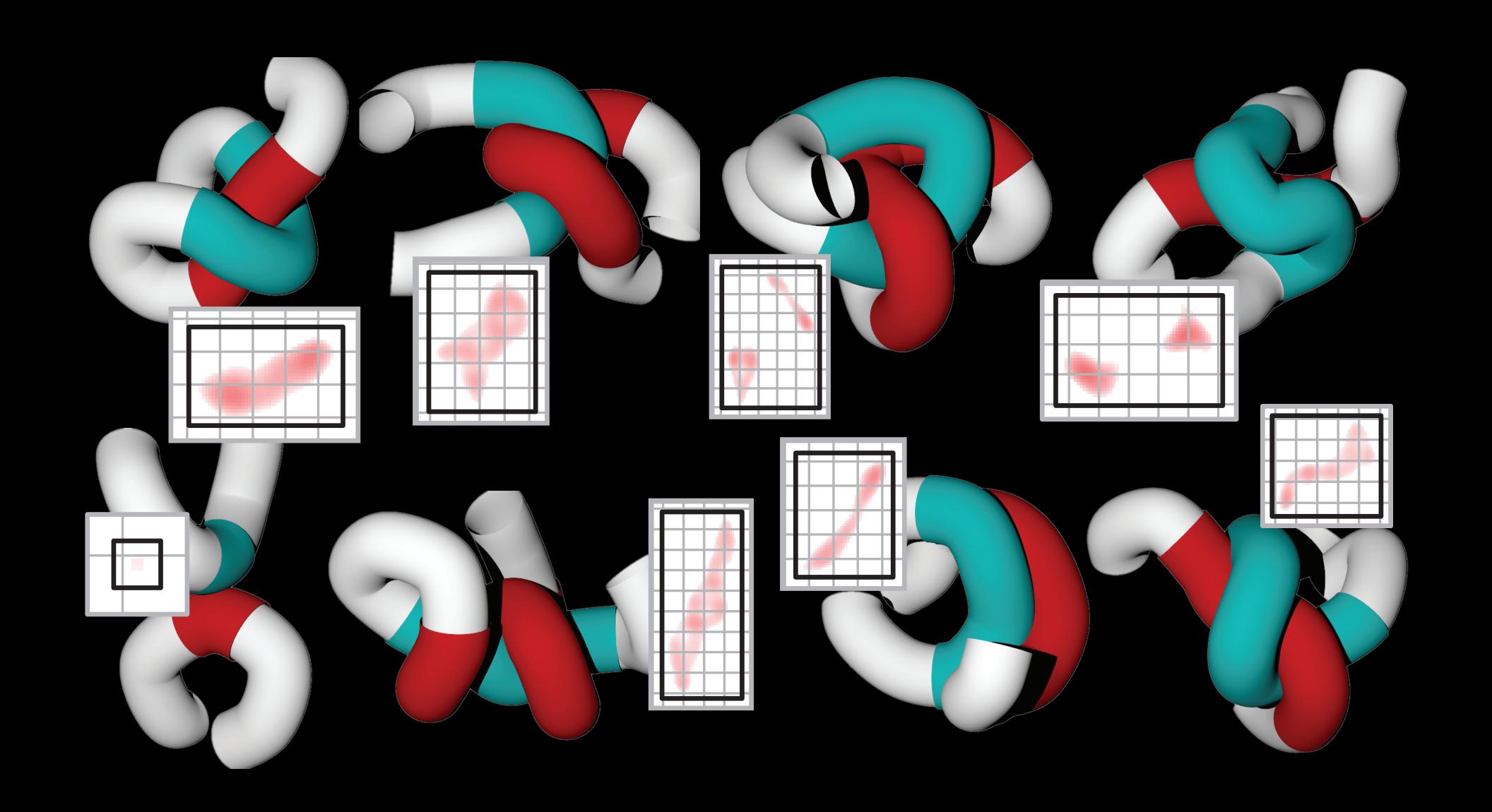


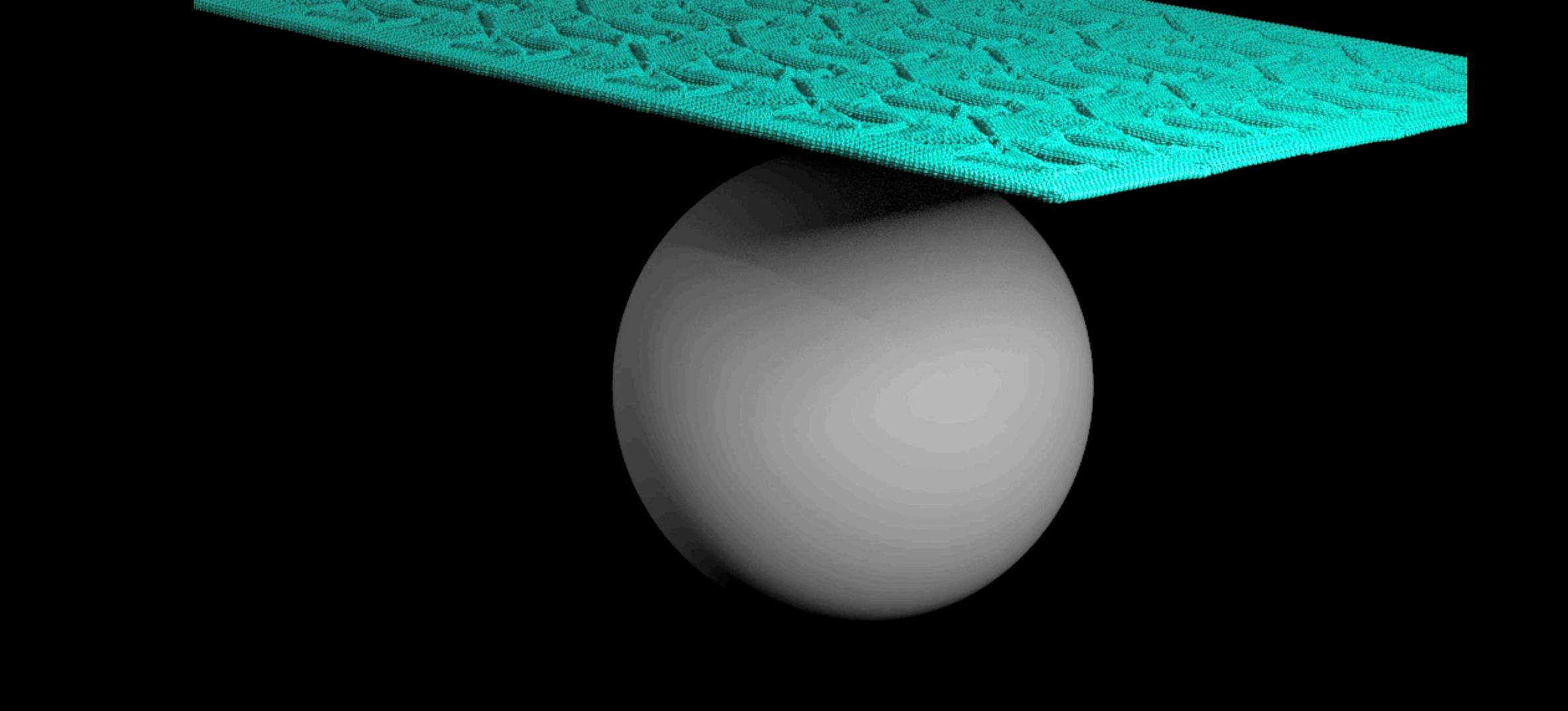




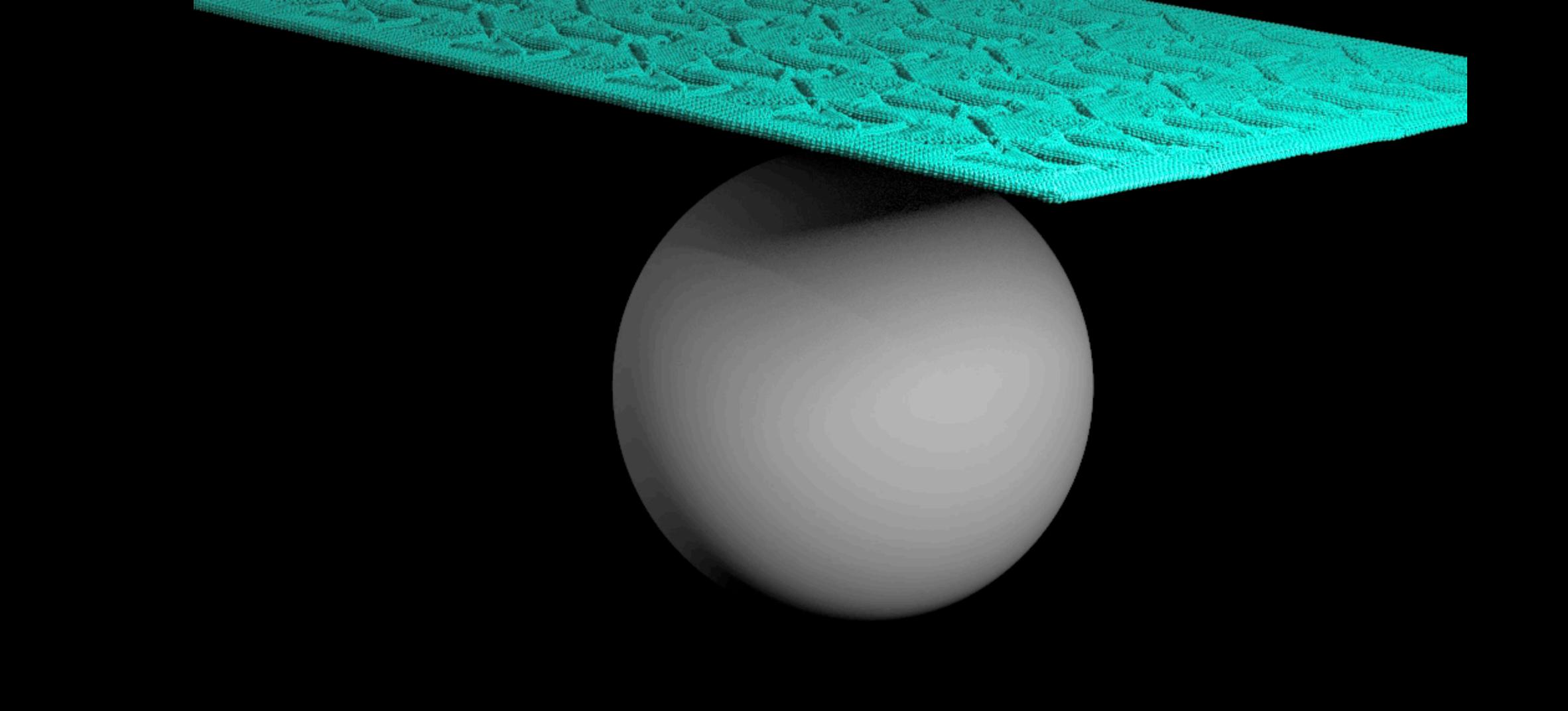
Contact Matrix







54,340 knit loops, ~365K contact sets 6.7X contact force speedup, 4.2X overall 10.5m per 1/30s frame



54,340 knit loops, ~365K contact sets 6.7X contact force speedup, 4.2X overall 10.5m per 1/30s frame



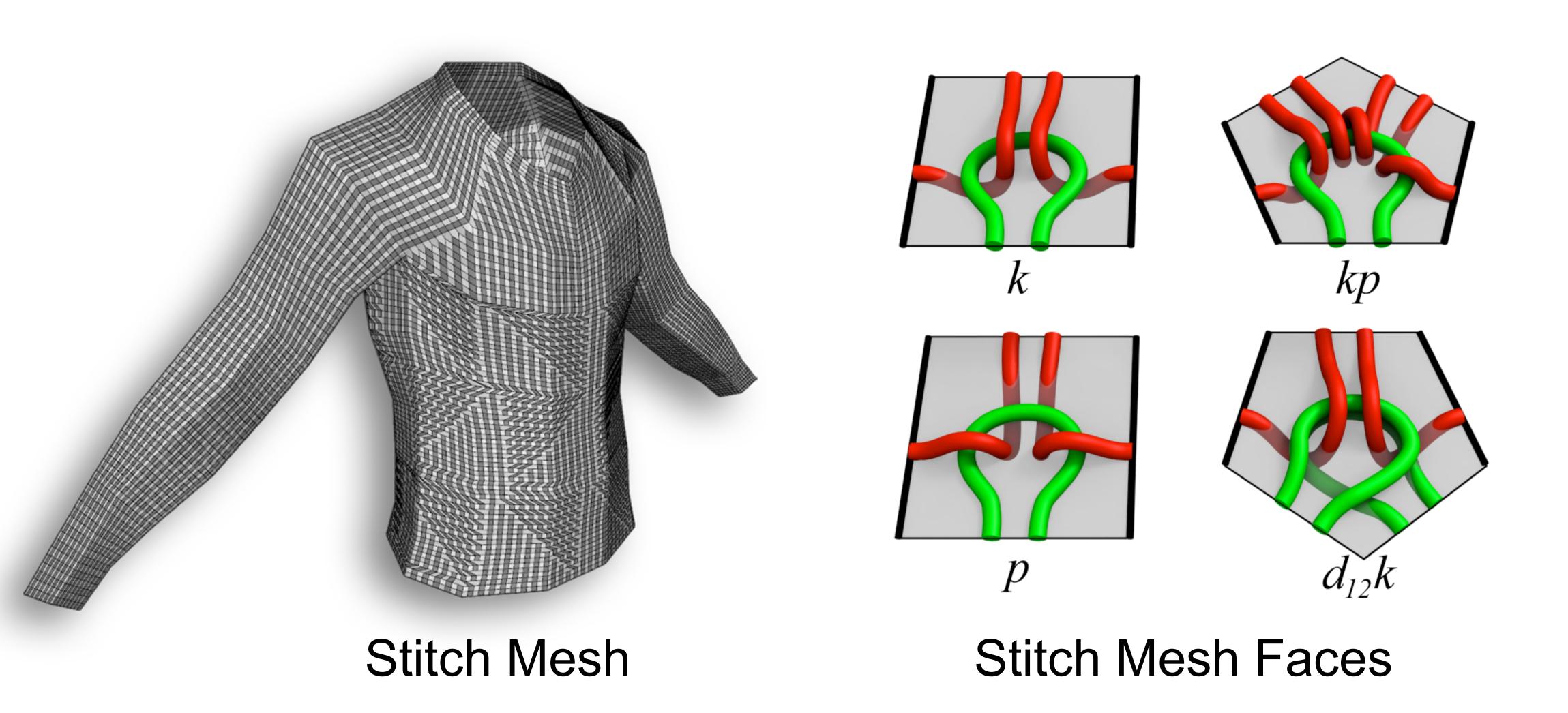
½ speed



½ speed

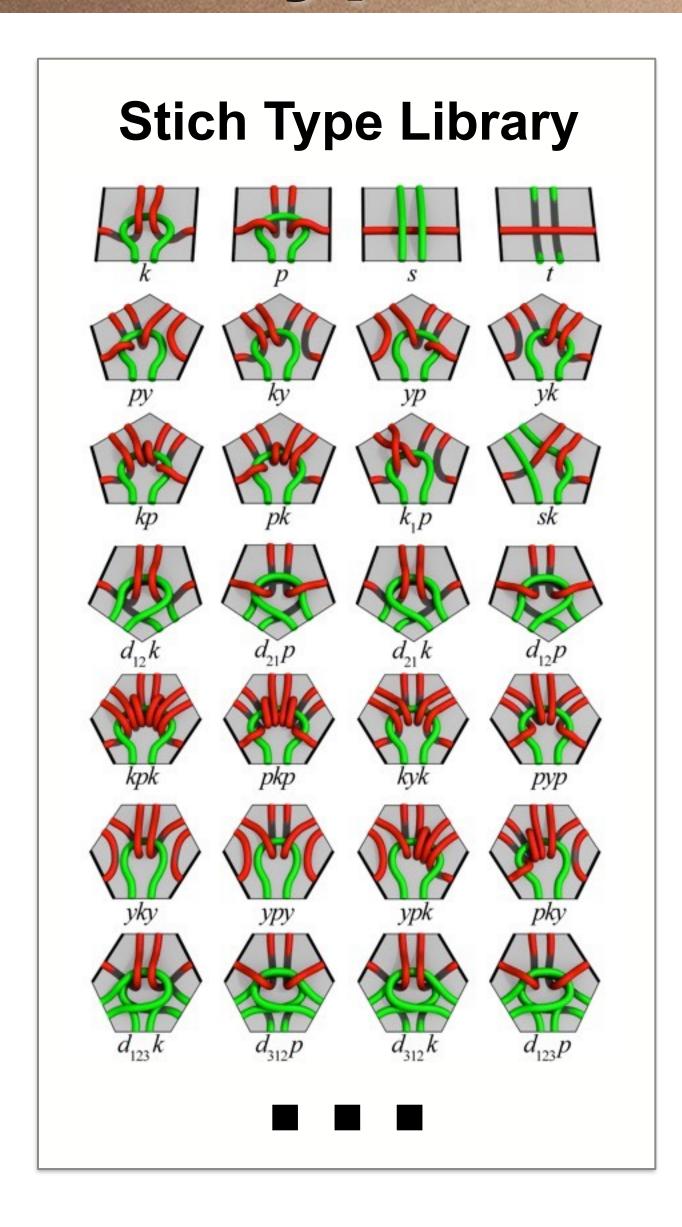
Stitch Meshes





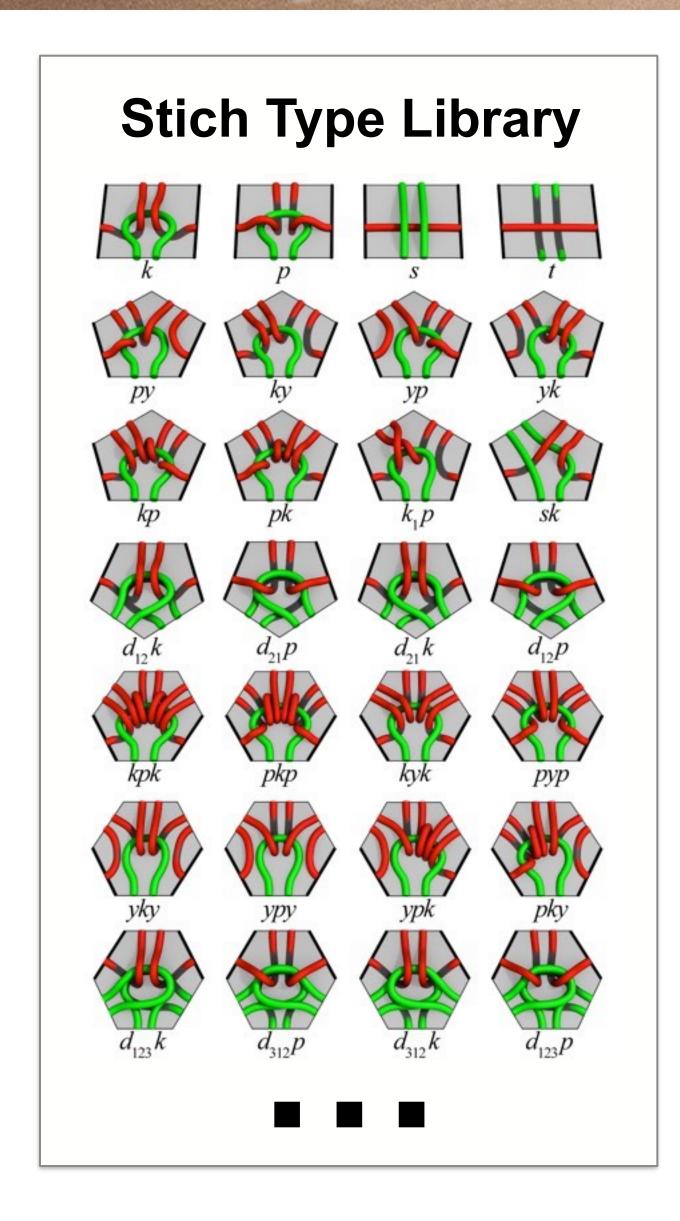
Stitch Type Library

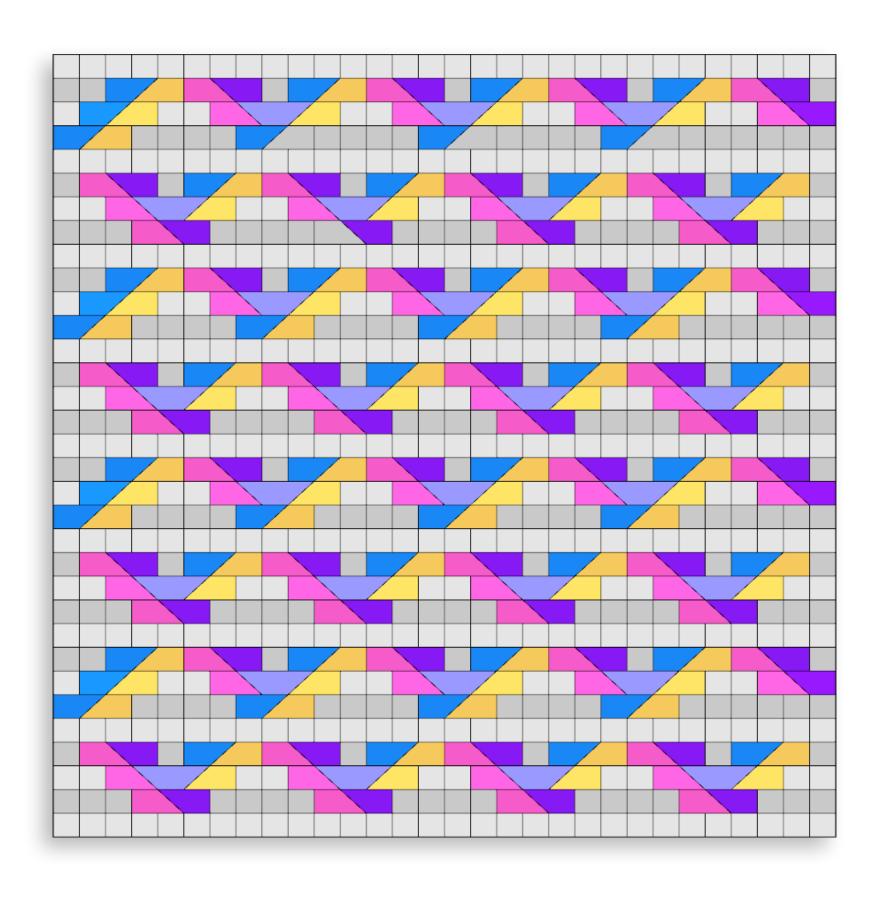




Stitch Type Library



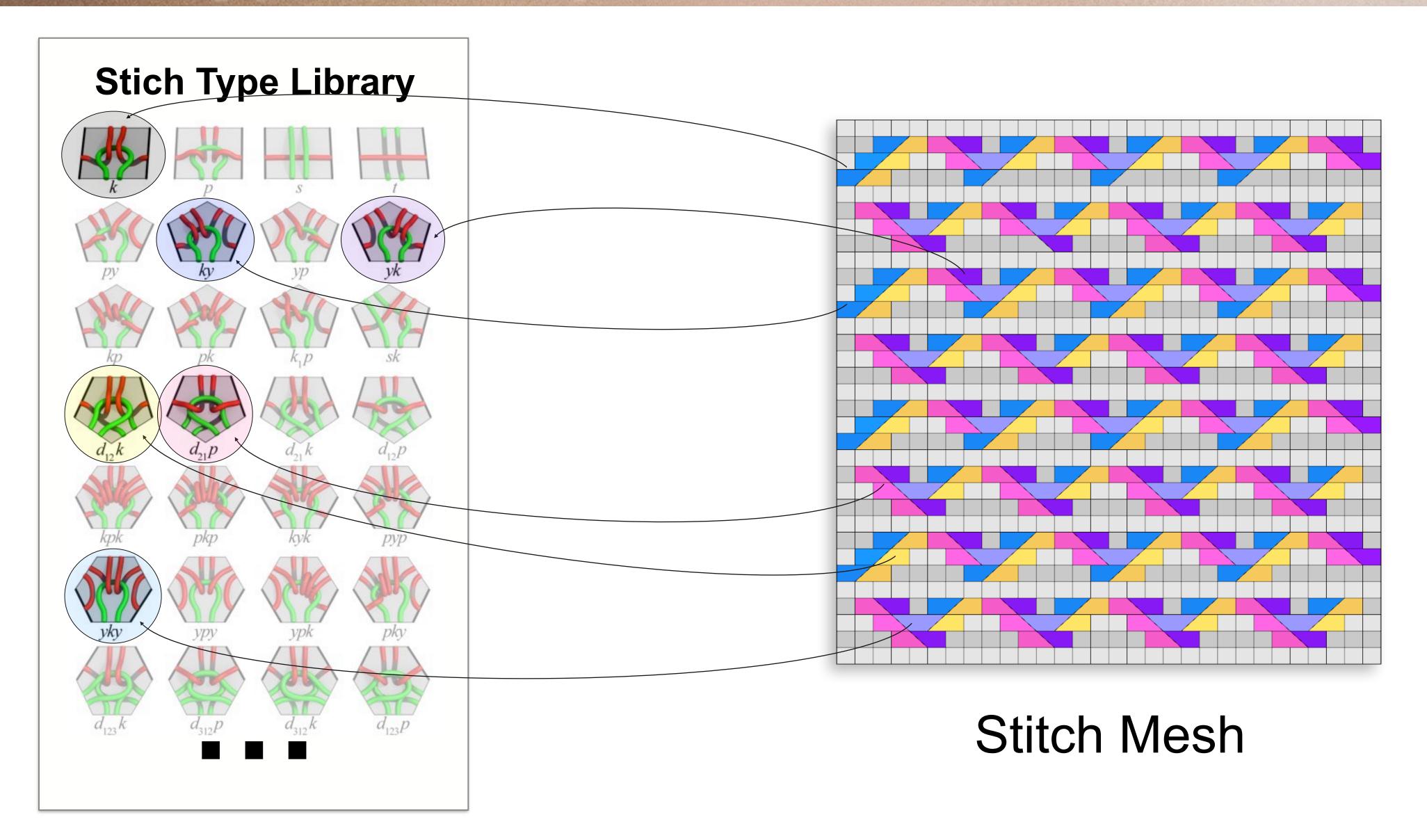




Stitch Mesh

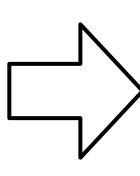
Stitch Type Library

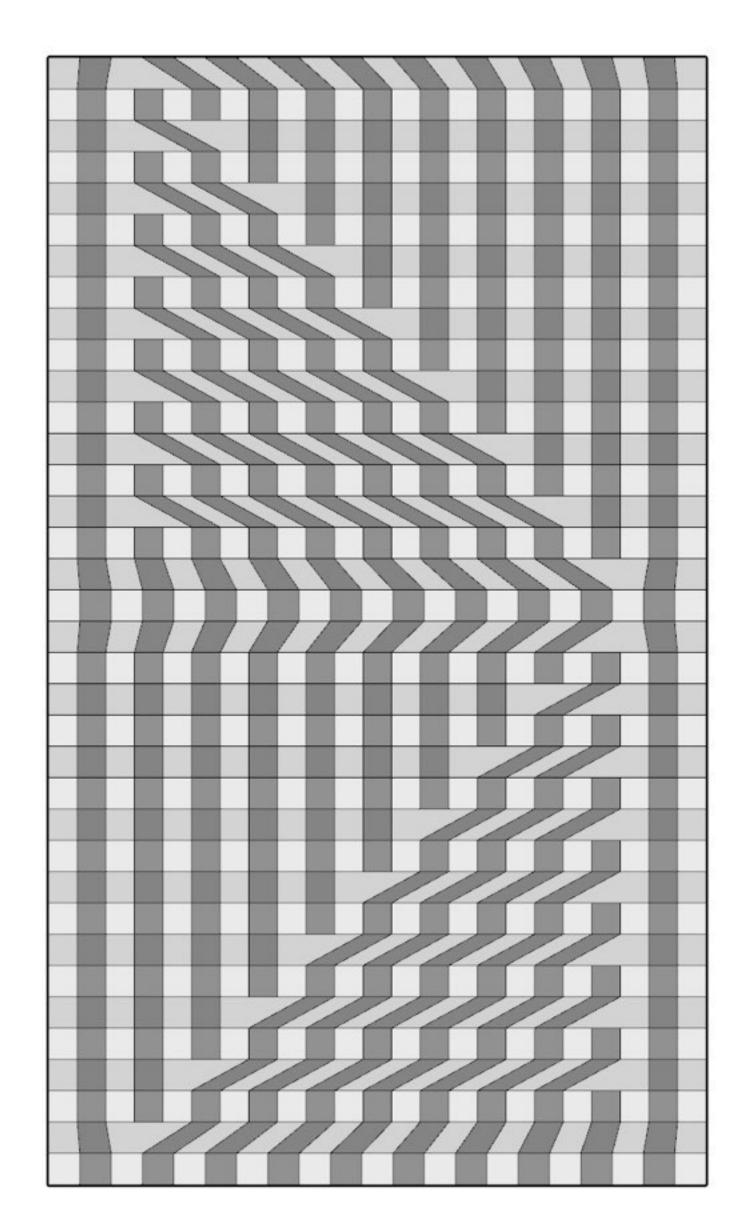




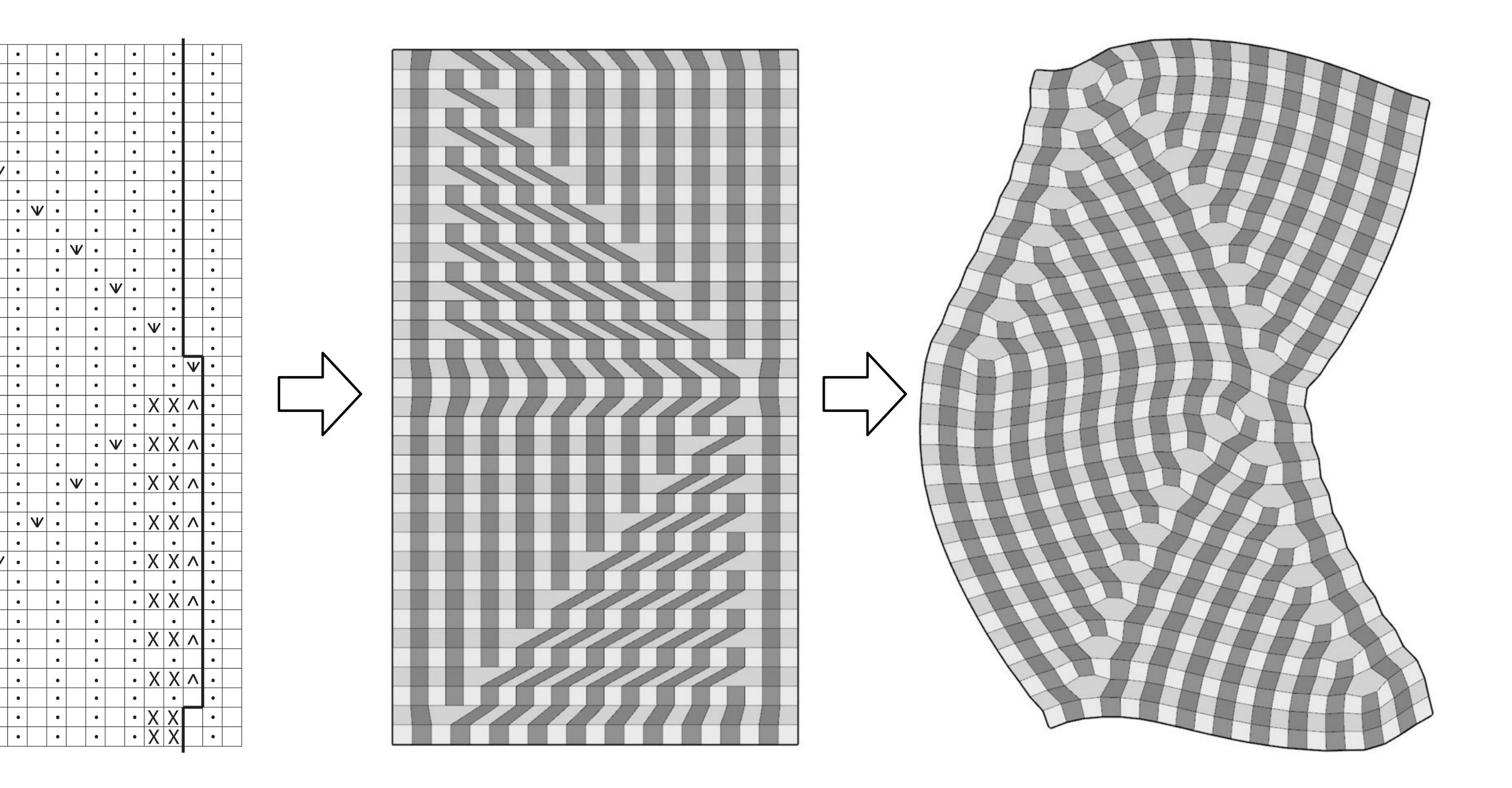
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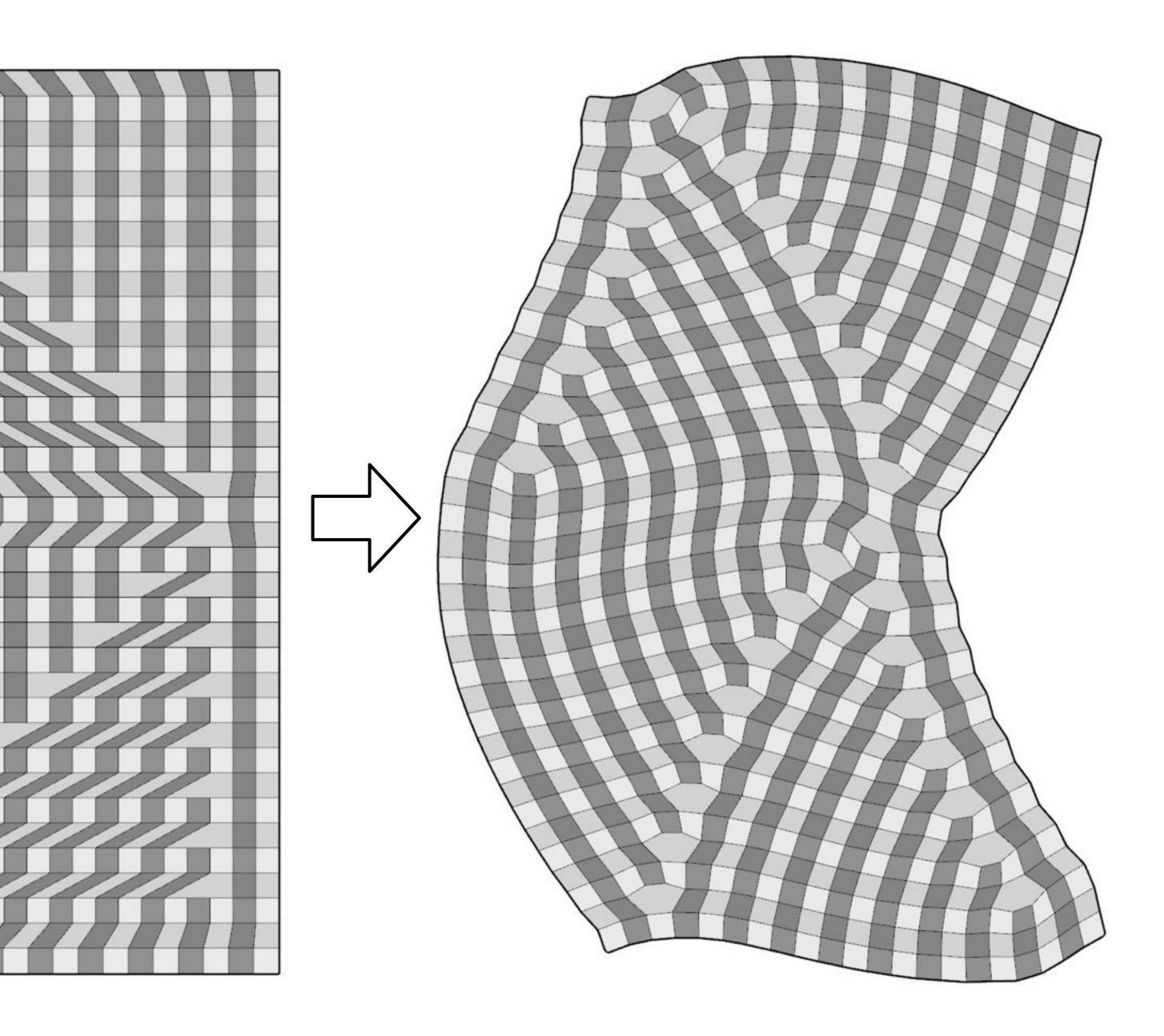
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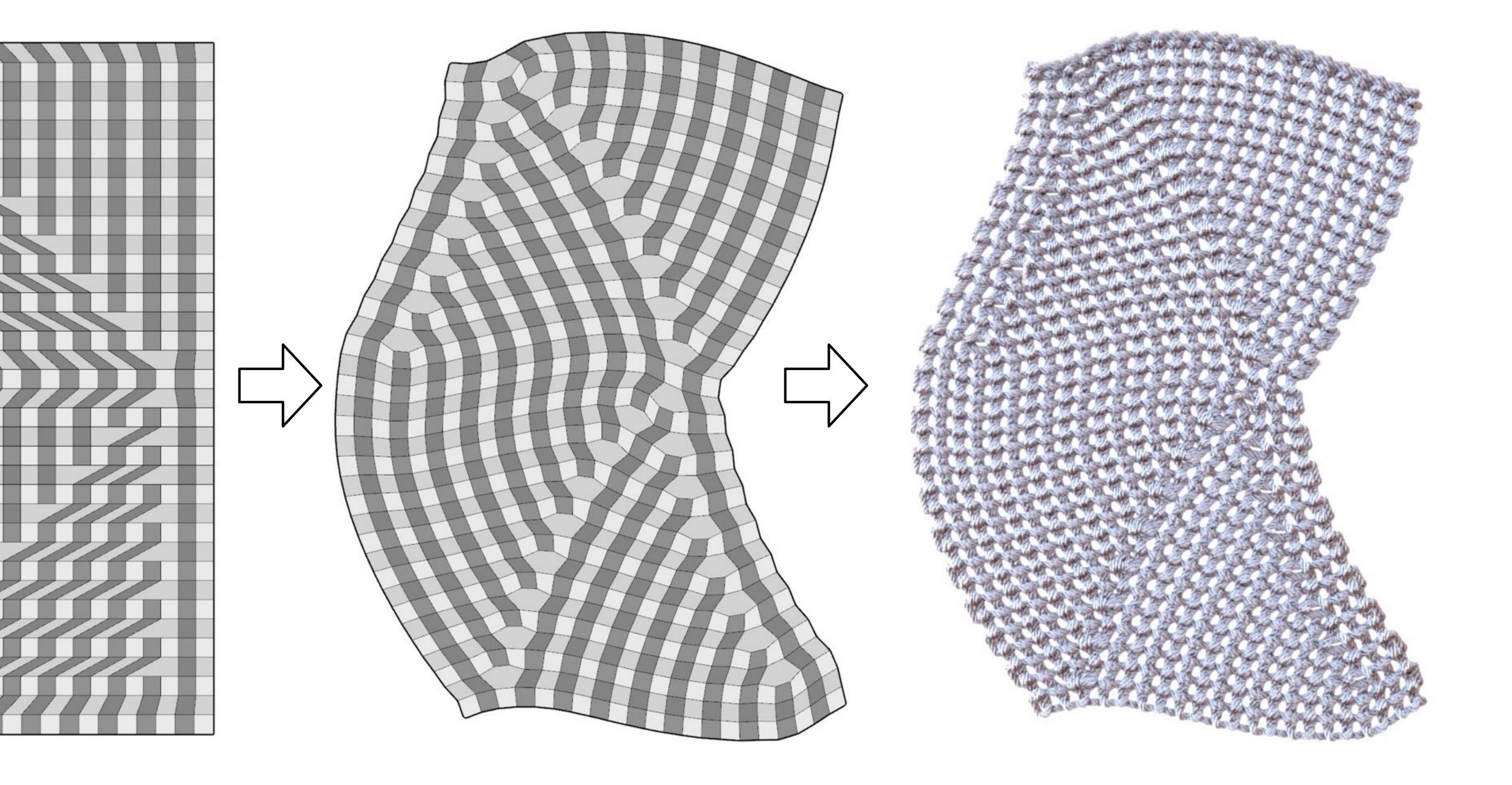


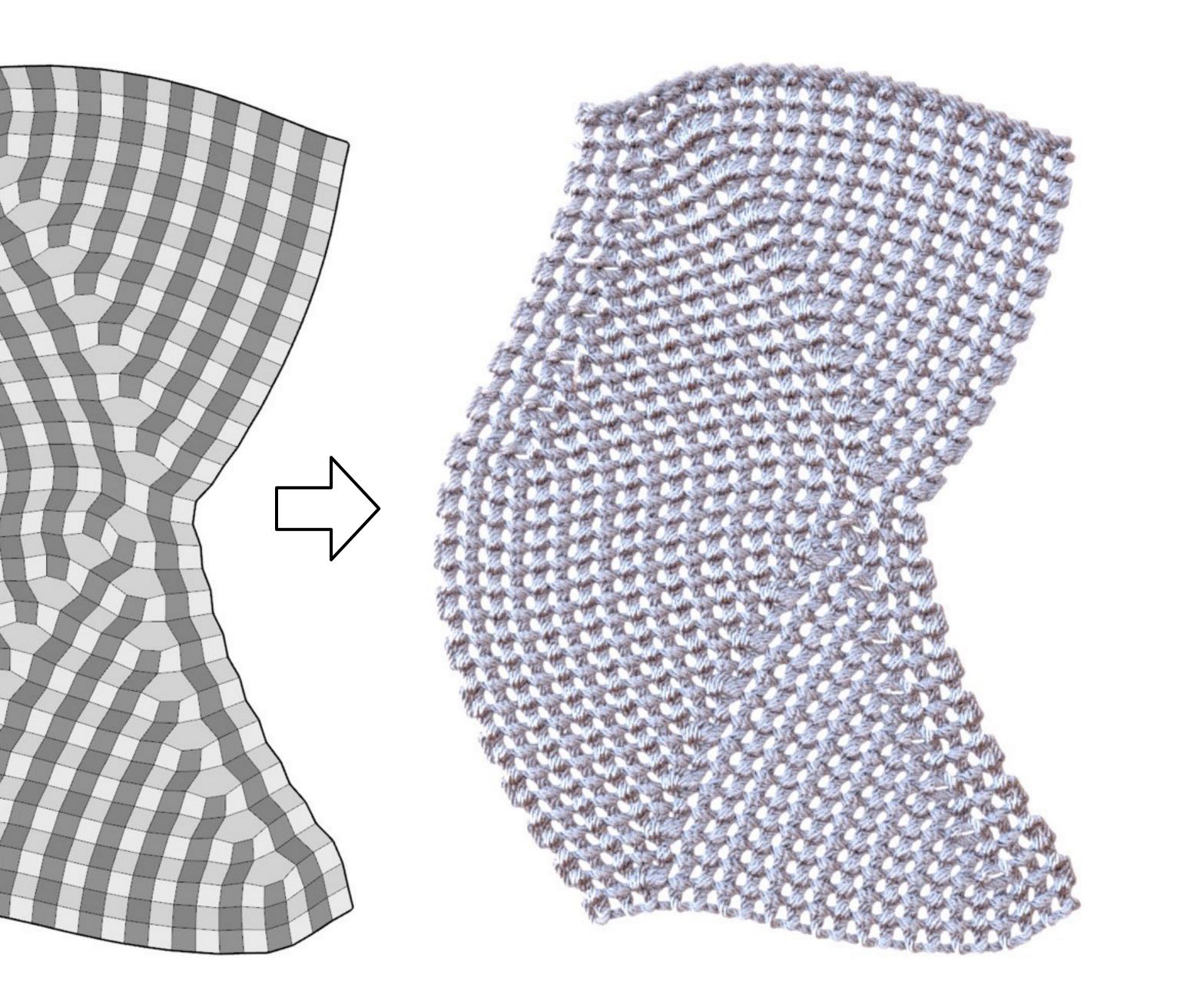


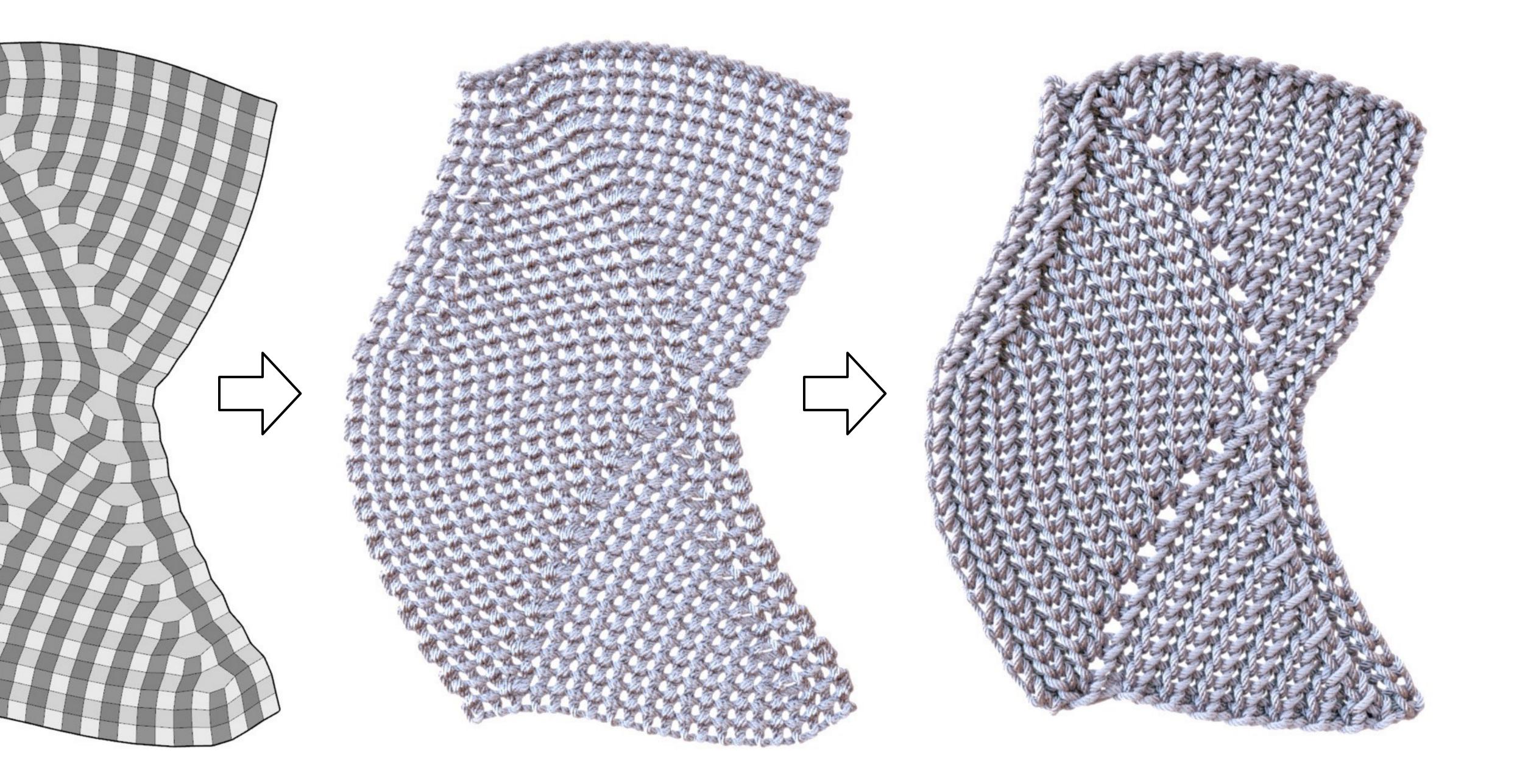
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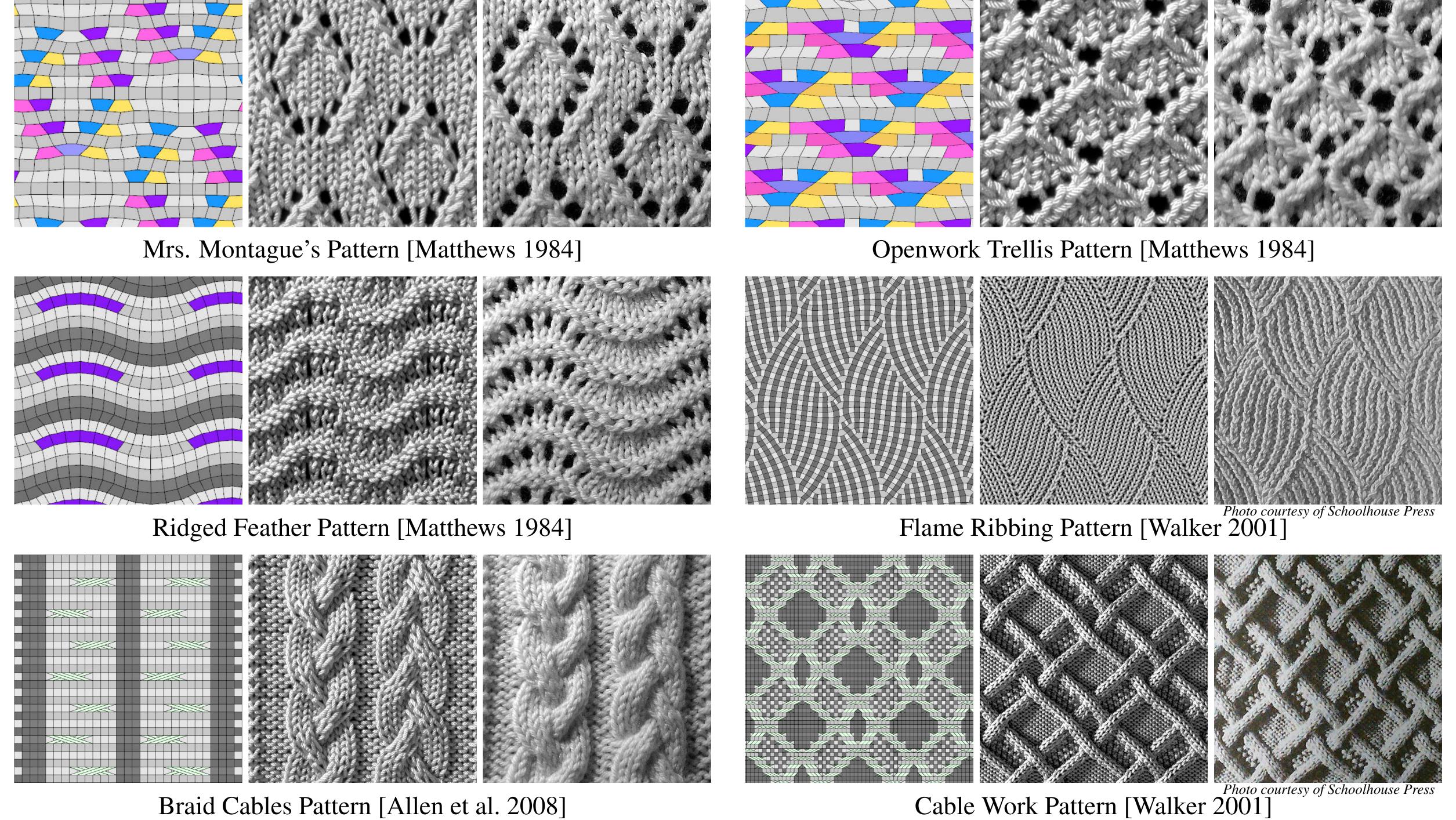






Mrs. Montague's Pattern

Mrs. Montague's Pattern









CS5625

SIGGRAPH 2019 Technical Papers Preview https://www.youtube.com/watch?v=EhDr3Rs5fTU