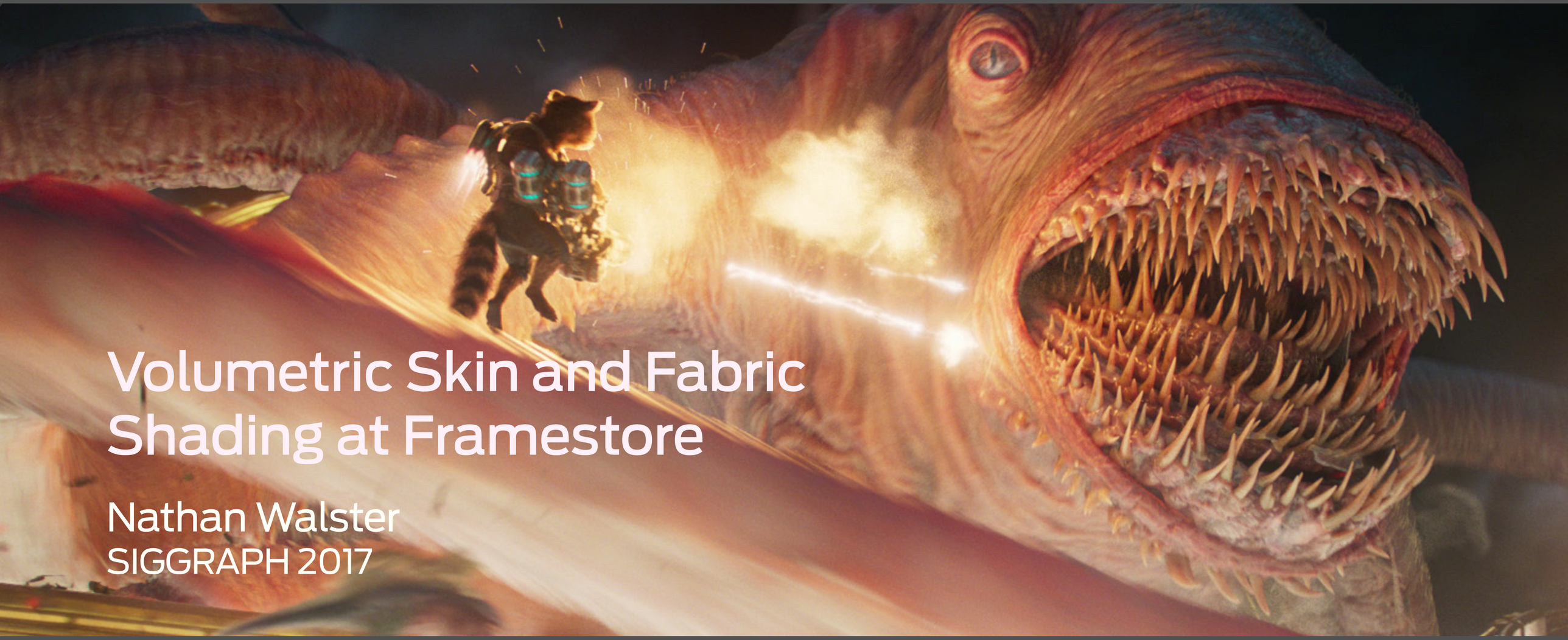
FRAMESTORE



Volumetric Skin and Fabric Shading at Framestore

Nathan Walster

SIGGRAPH 2017

/framestore

Existing Skin Shading

- BSSRDF (Normalised diffusion model)
- Single scattering

- Complex layering/blending
- Artist led, ad-hoc approach

Motivation

- Guardians of the Galaxy Vol. 2
- Alien: Covenant

- More general and elegant approach
- Internal structure
- Layers of translucent materials

Abilisk

- Large translucent creature
- Outer skin varying from thick and dense to thin membrane
- Internal structure important for story
- Ridges and wrinkles

Chest Burster

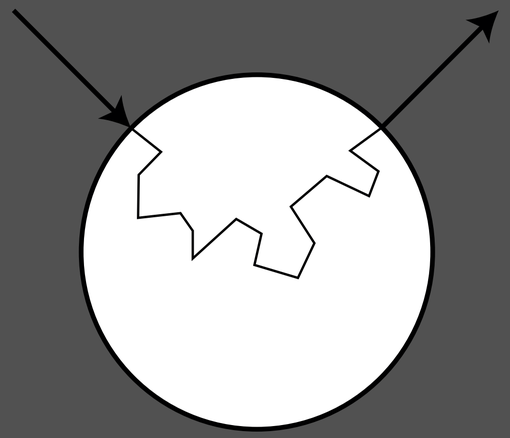
- Multiple layers of translucent material
- Subtle scattering effects to portray scale
- Internal structure of skeleton, veins, arteries and sinew
- Outer layer of mucus and blood
- Need to solve light transport together for realistic appearance

Outline

- Some Theory of Monte-Carlo Subsurface Scattering
- Practice
- Artist Workflow and Parameters
- Results and Problems
- Extending to Fabric Shading

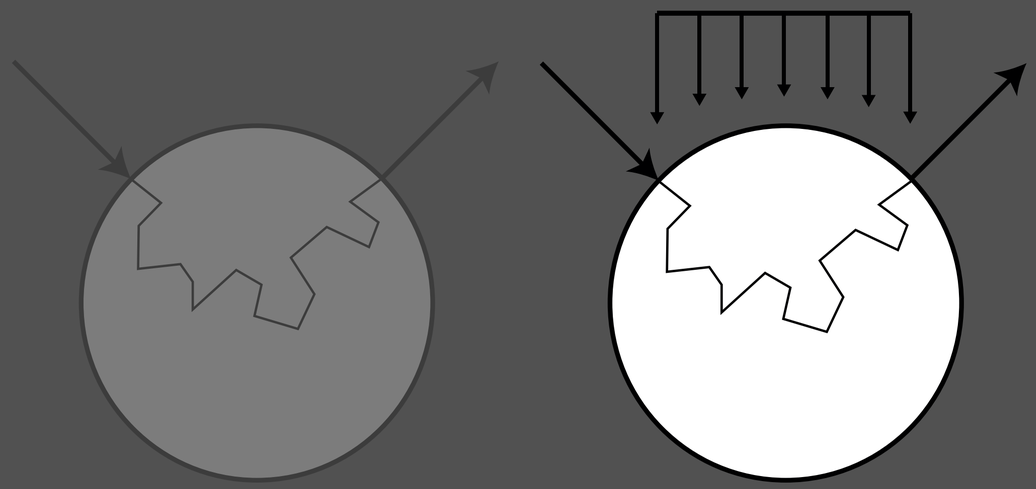
Path-Traced Subsurface Scattering

- Subsurface transport



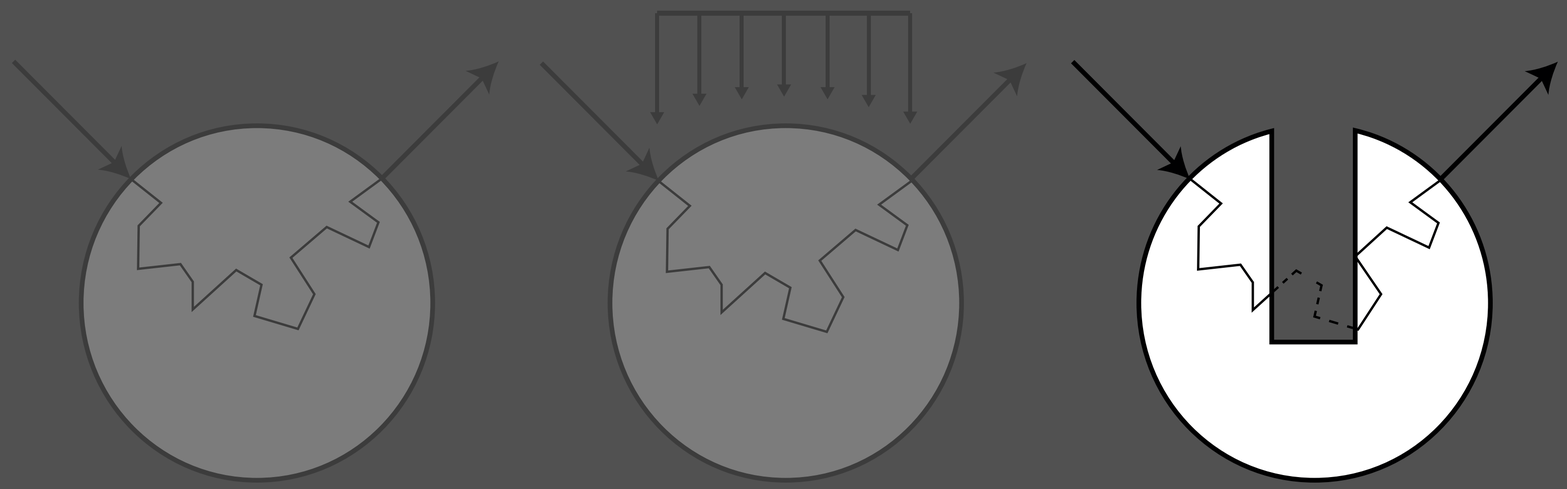
Path-Traced Subsurface Scattering

- BSSRDF importance sampling (King et al.)



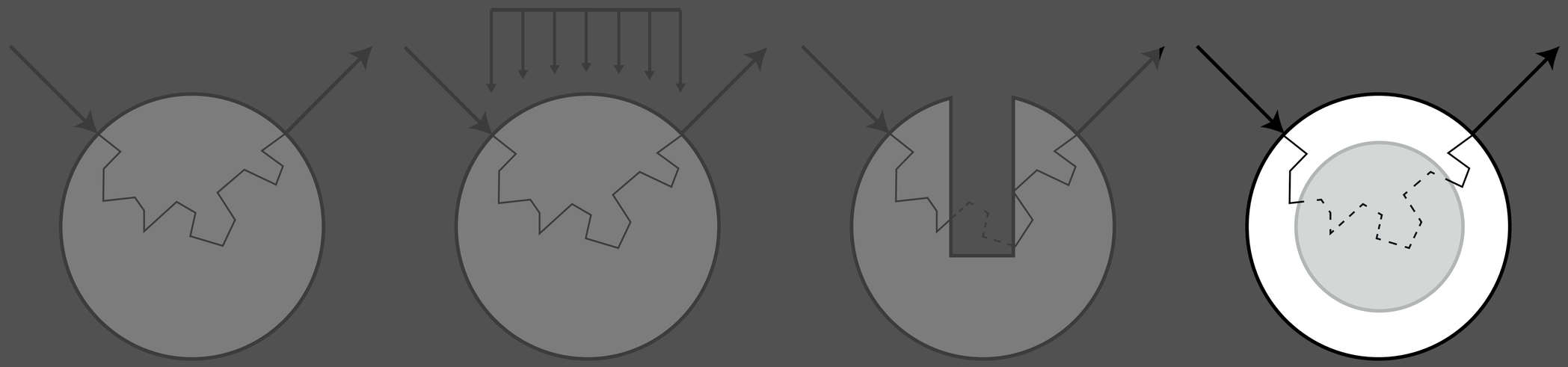
Path-Traced Subsurface Scattering

- Non-trivial geometry



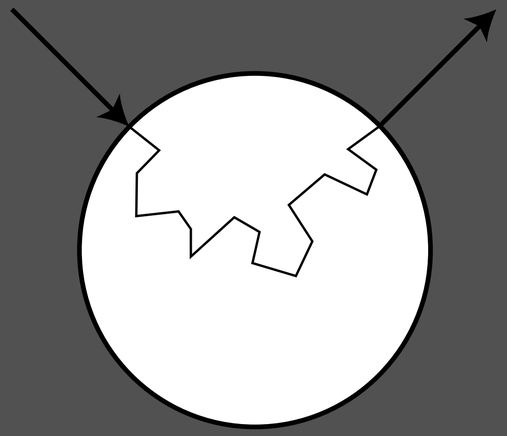
Path-Traced Subsurface Scattering

- Internal objects



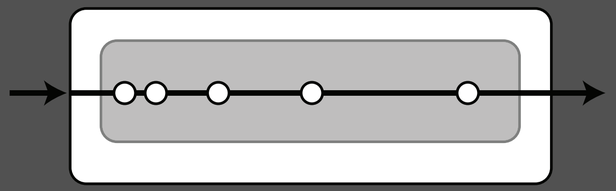
Some Theory

- Monte-Carlo subsurface
- Simple, robust and unbiased



A Bit More Theory

- Importance sample extinction



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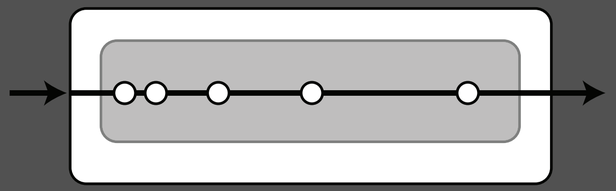
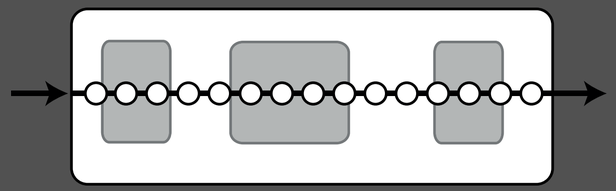


- Ray-Marching



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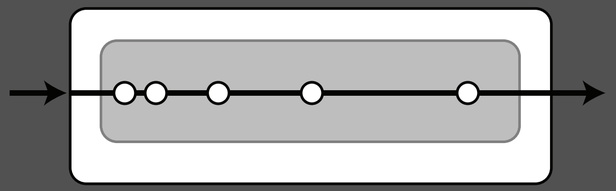
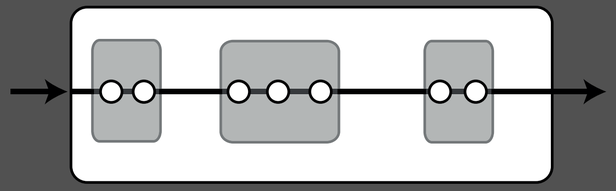


- Delta Tracking (or Woodcock)



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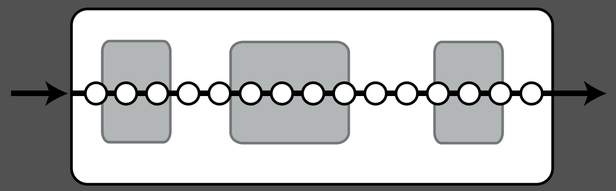

A Bit More Theory

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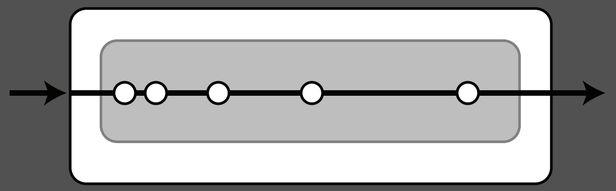

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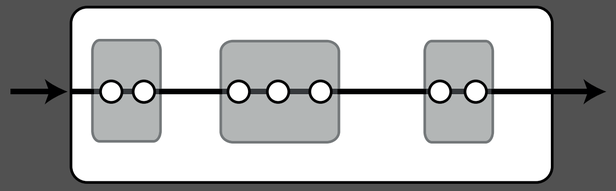

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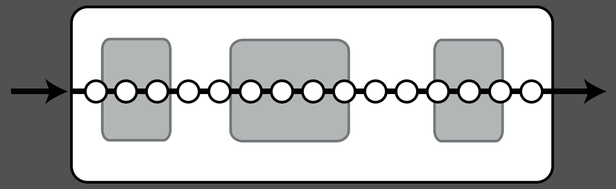
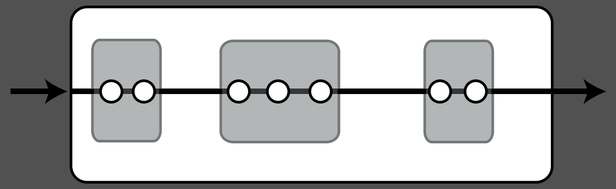
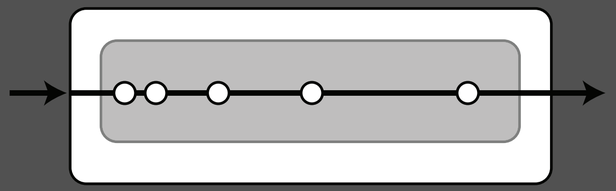


- Ratio/Residual Tracking



A Bit More Theory

- Importance sample extinction



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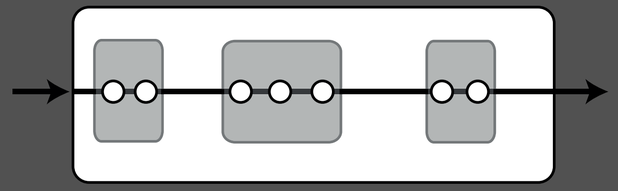
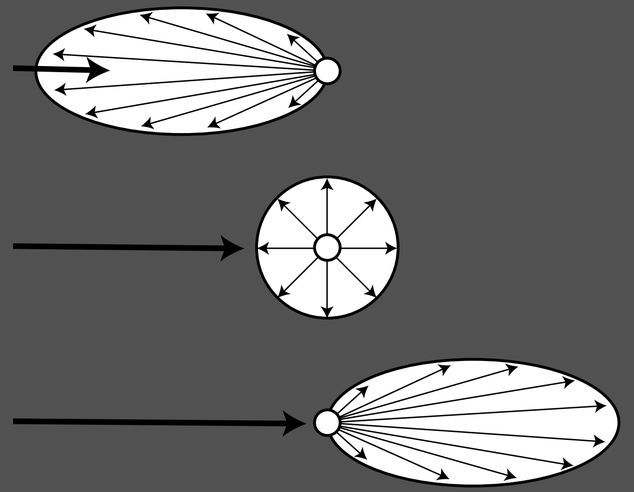


- Phase Functions (Henyey-Greenstein)



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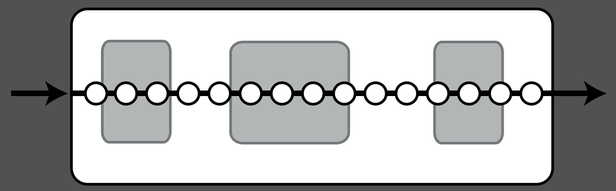

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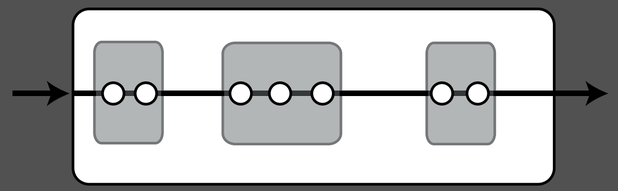
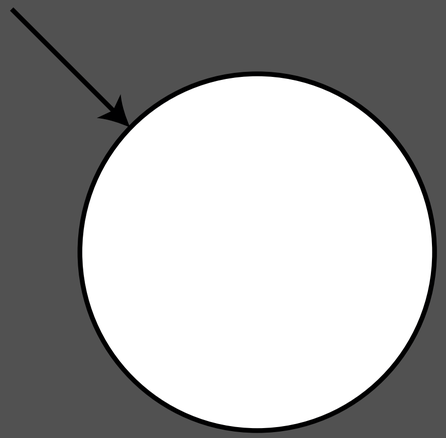


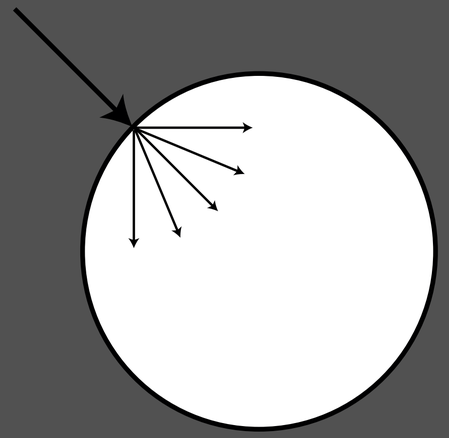
Practice

- Subsurface transport



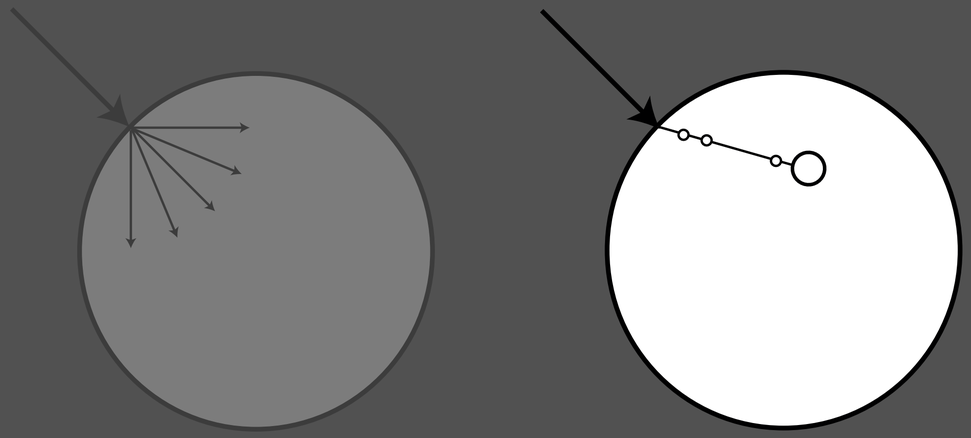
Practice

- Sample microfacet to choose between specular or transmission



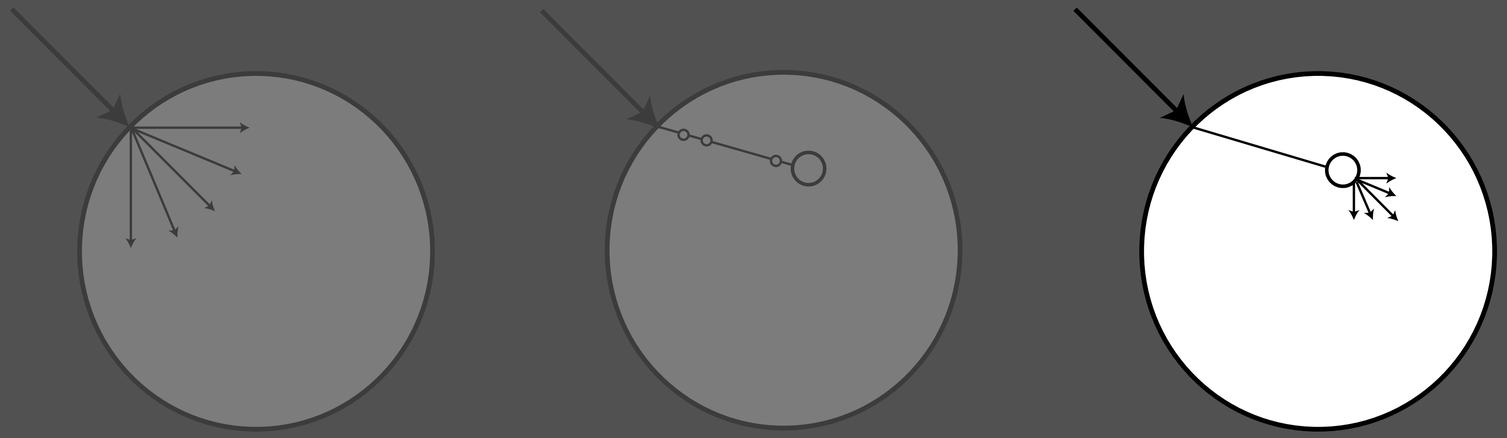
Practice

- Sample distance with delta tracking



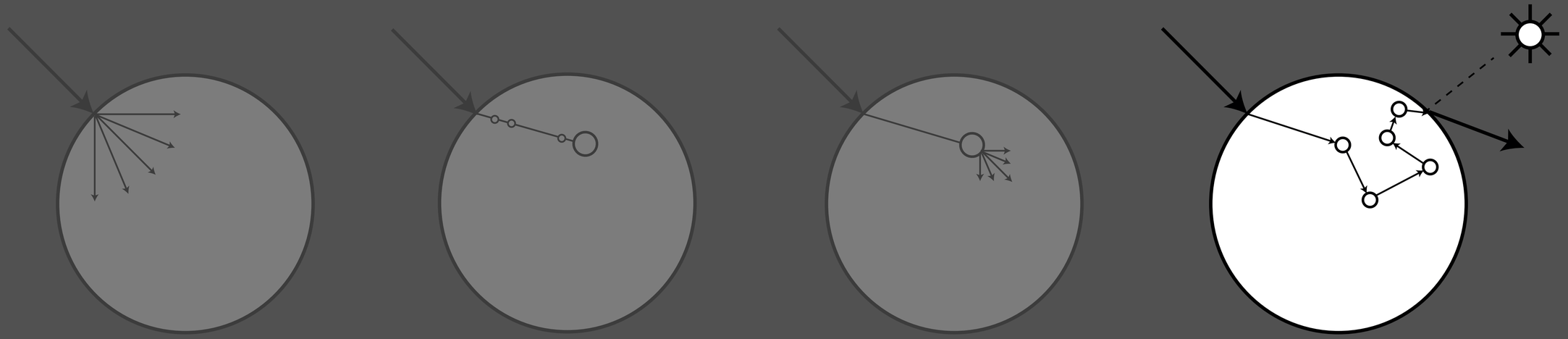
Practice

- Sample direction with phase function



Practice

- Continue path until an intersection is found
- Do next event estimation

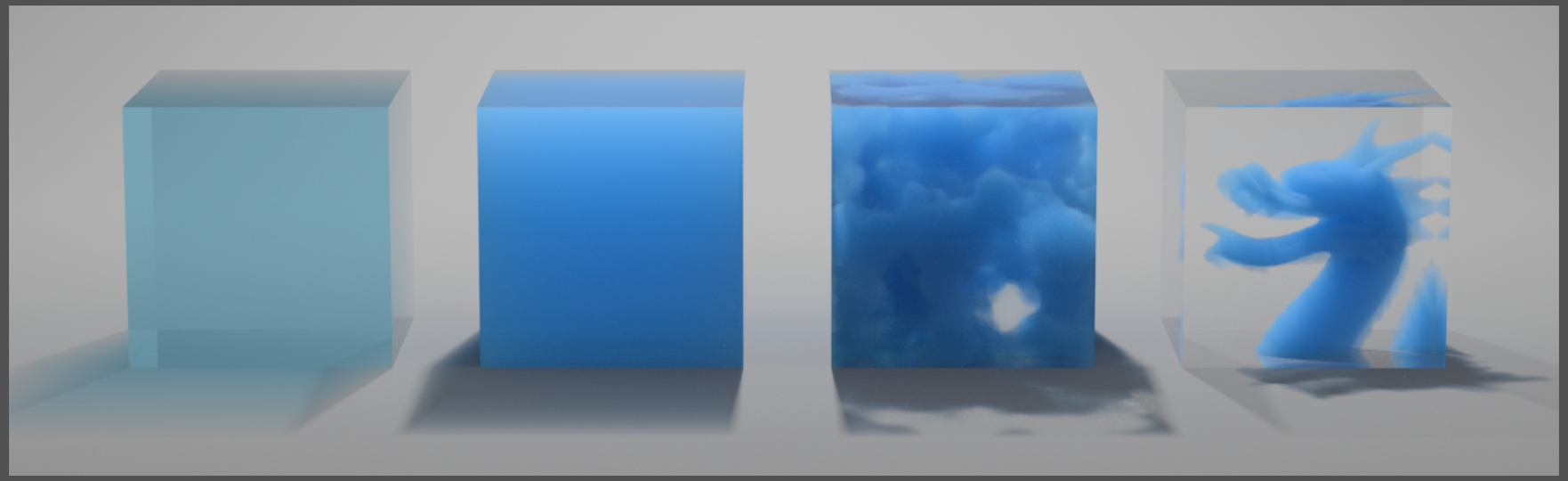


Artist Workflow

- Different shader types
- Albedo / attenuation
- Density
- Phase function
- Heterogeneous properties
- Next event estimation

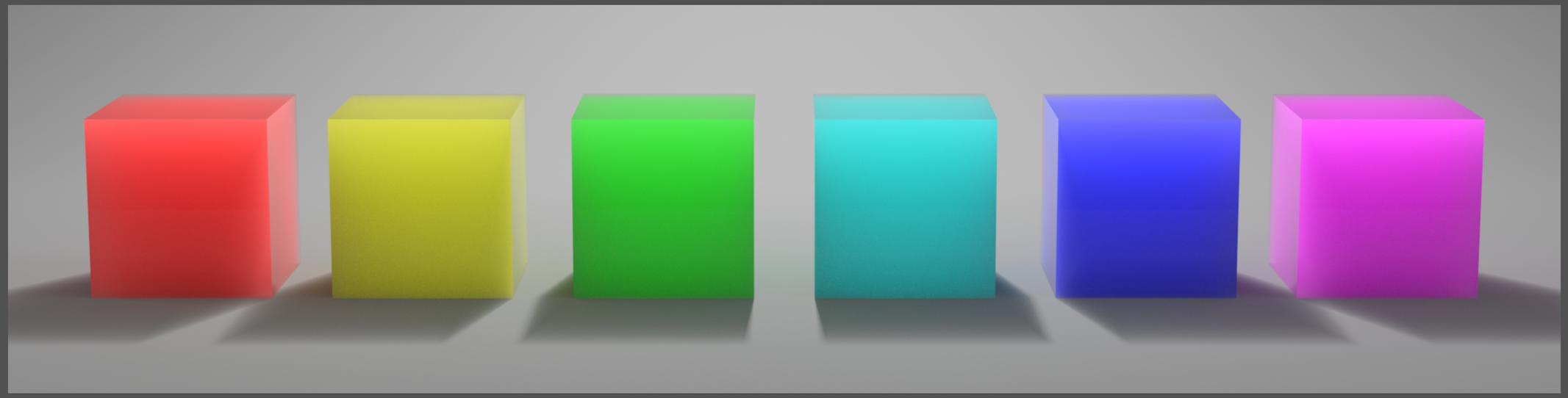
Shader Types

- Absorption
- Homogeneous scattering
- Heterogeneous scattering
- Voxel



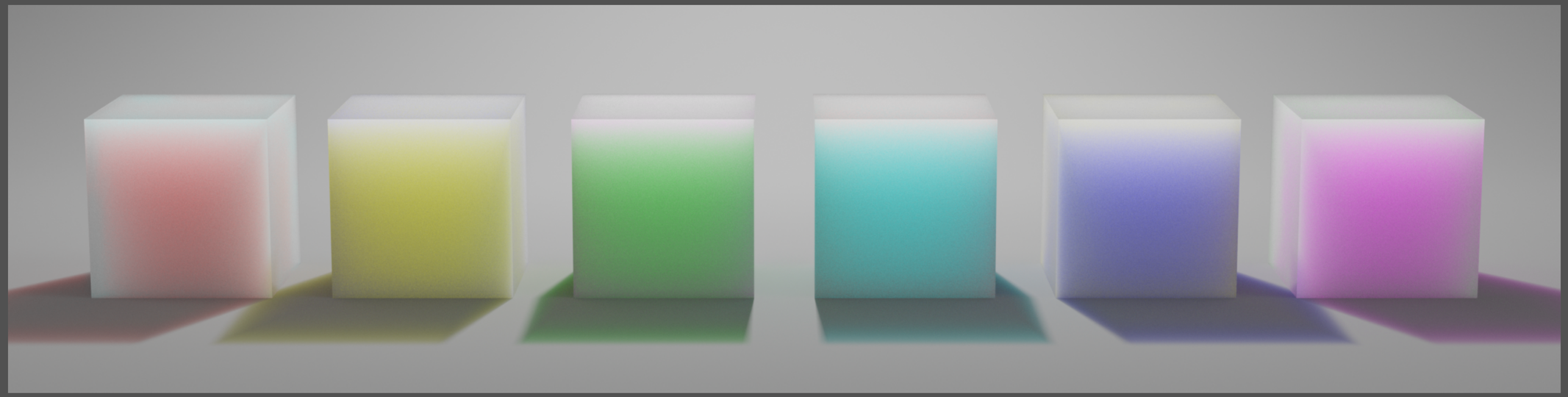
Albedo

- Defines the colour of the medium
- Convert from multiple scattering to single scattering (Chiang et al)



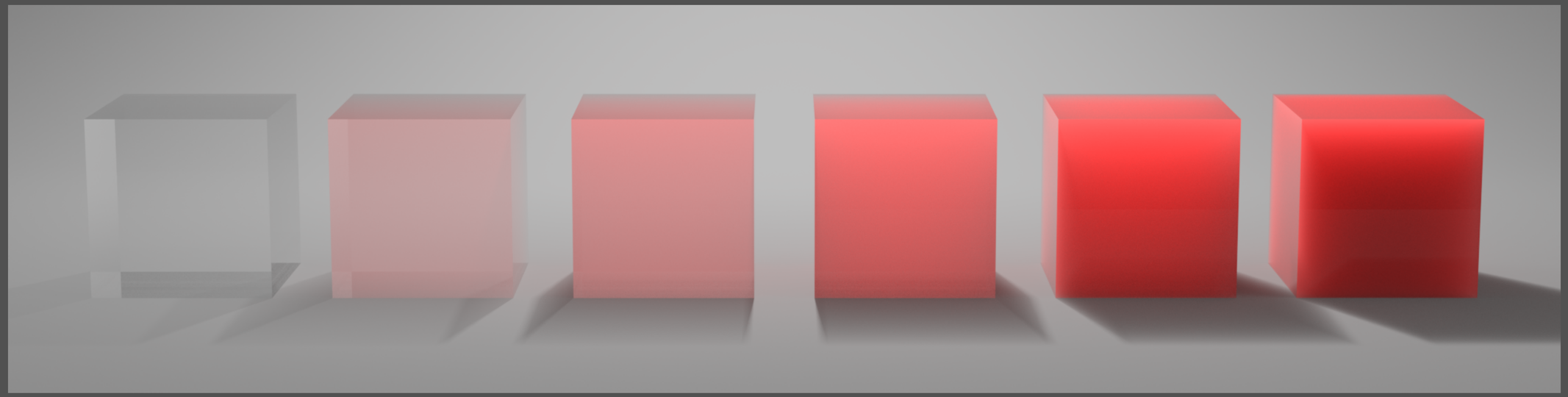
Attenuation

- Tinting effect over depth



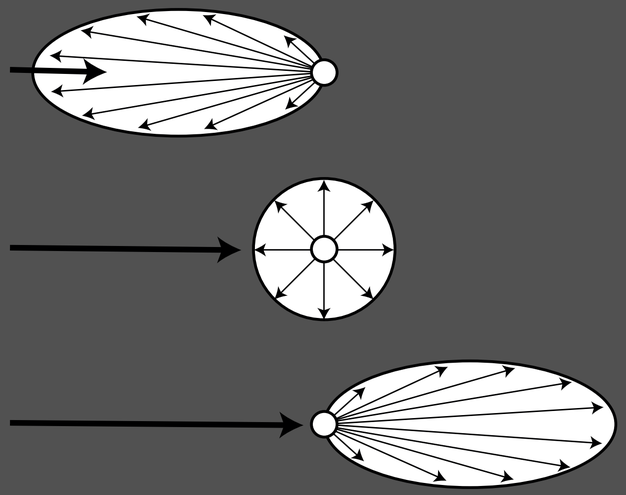
Density

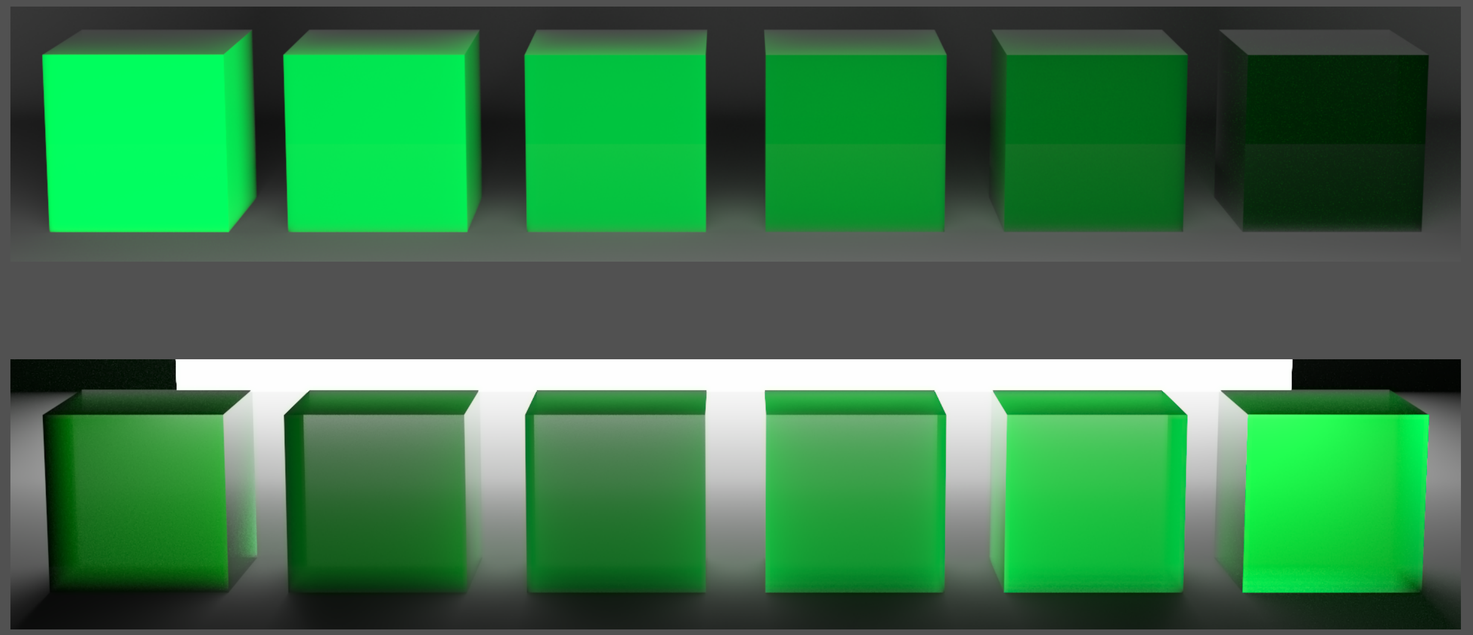
- Optical thickness of medium



Phase Function

- Direction of scattering
- Isotropic / anisotropic



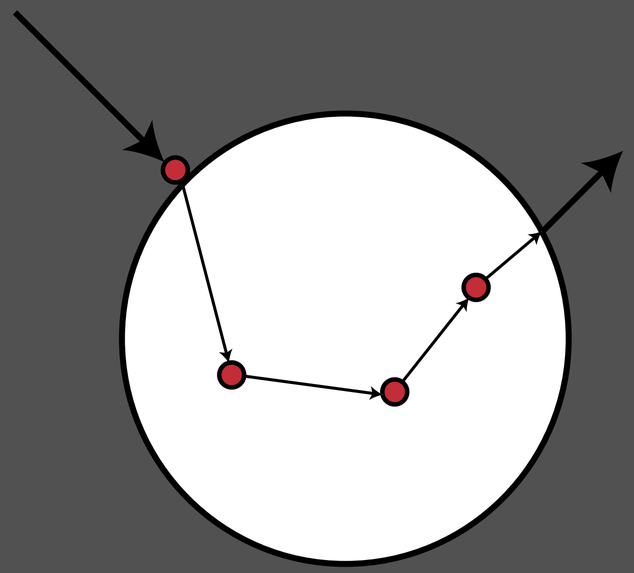


Heterogeneous Properties

- How to texture a volume?
- Balance -
  - Visual quality
  - Render cost
  - Ease of authoring

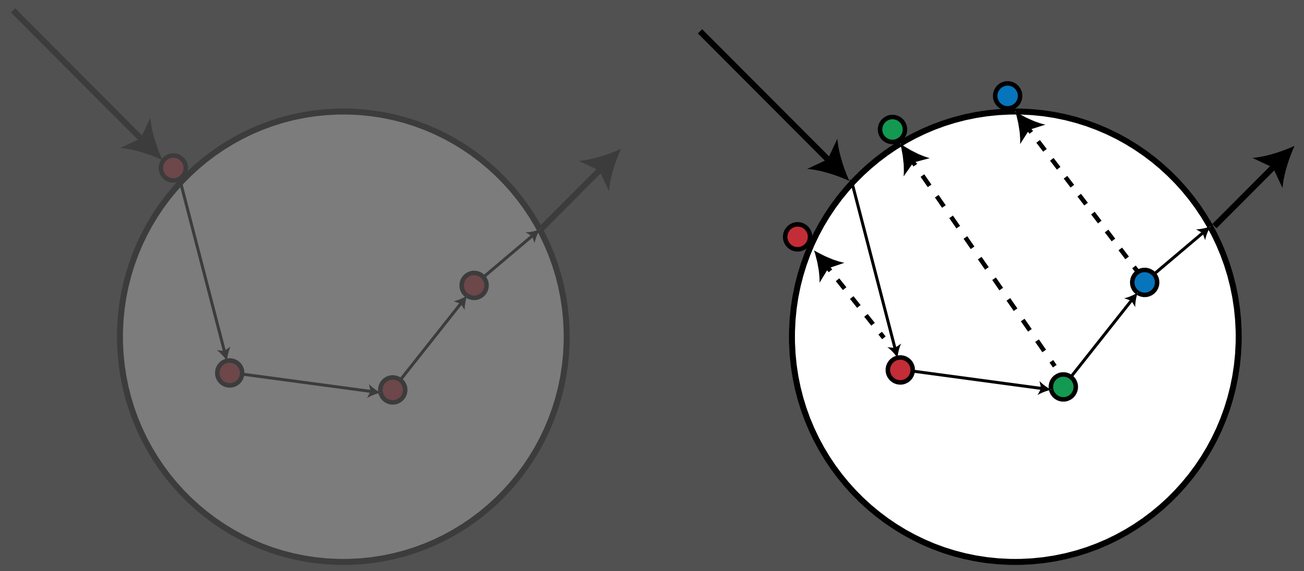
Heterogeneous Properties

- Project texture into medium



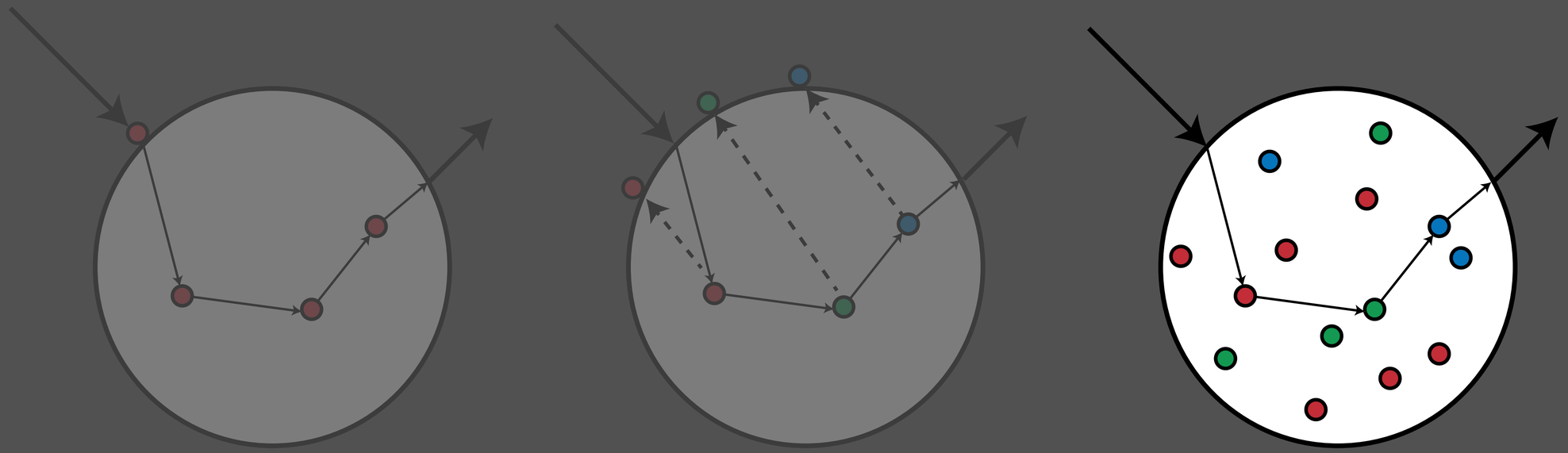
Heterogeneous Properties

- Parallax projection

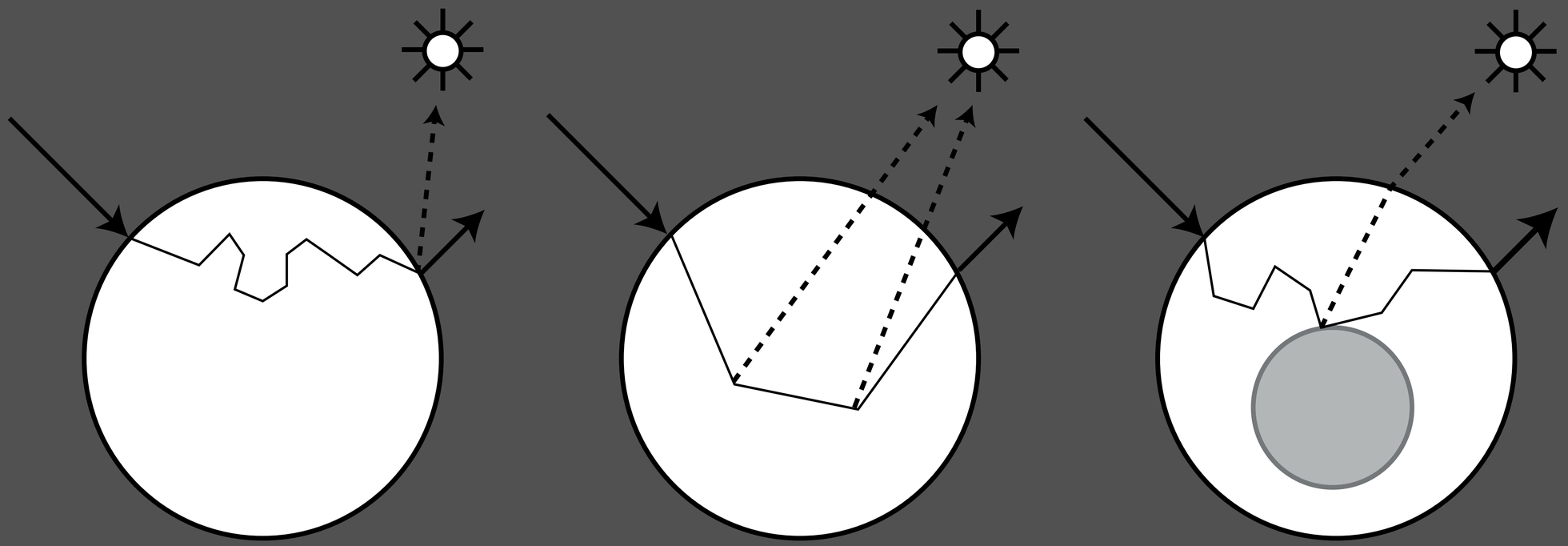


Heterogeneous Properties

- Procedural noise



Next Event Estimation

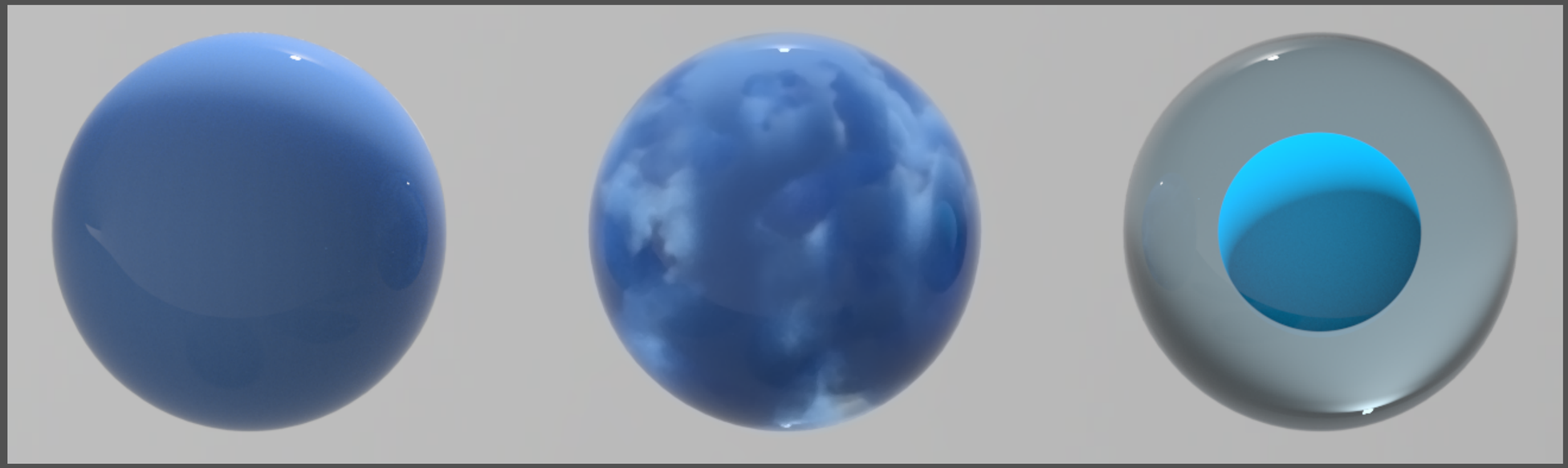


Exit

Interior

MNEE

Next Event Estimation



Exit Interior MNEE

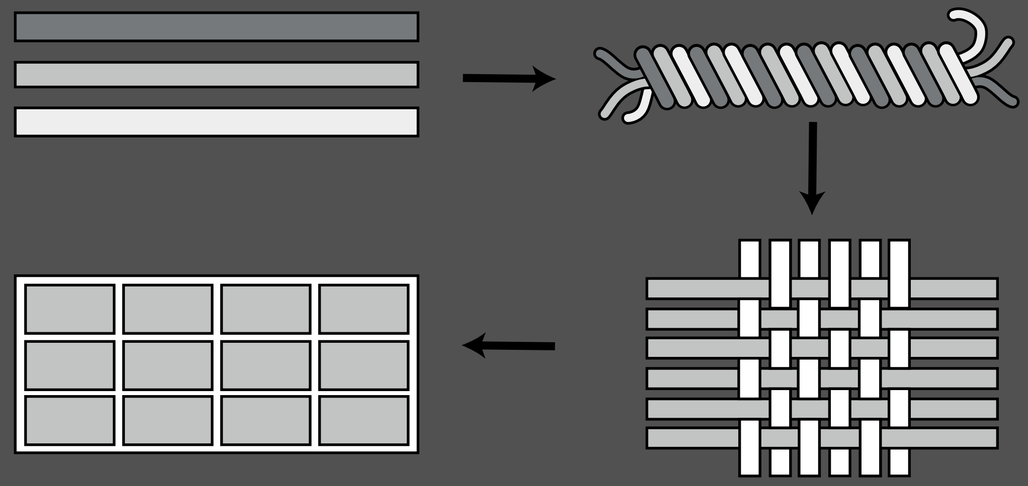
Production Results

Considerations/Problems

- What needed to change?
- Artistic considerations
- Modelling/texturing
- Render times

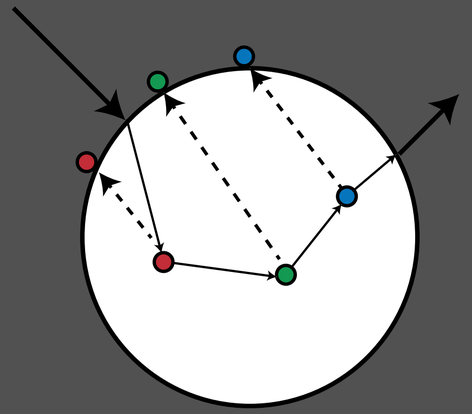
Procedural Fabric Modeliing

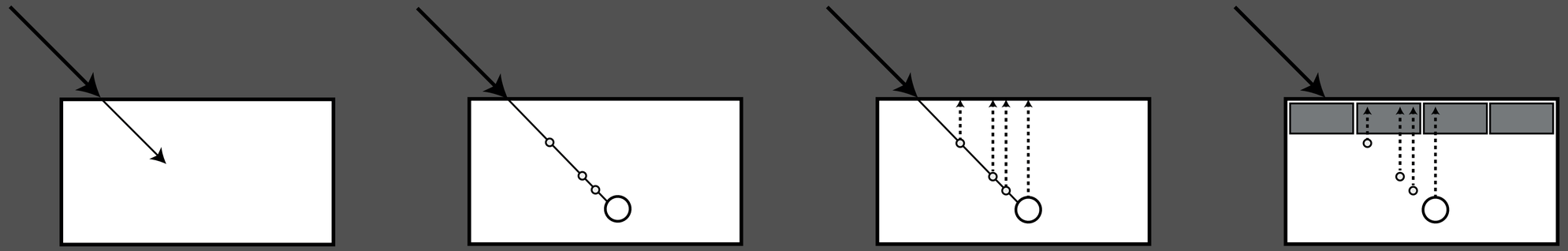
- Fabric is essentially volumetric
- Use as a heterogeneous input to existing system
- Lots of research on generating procedural yarns
- Generated at render time



Scattering Within Fabric

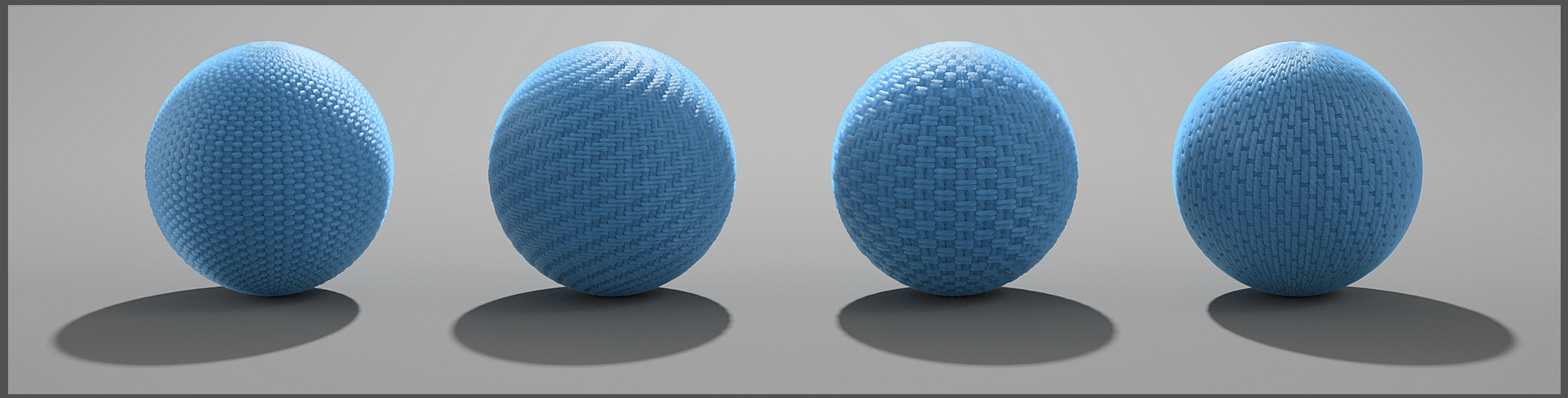
- Procedural fabric modelling
- Scattering model based on hair shading





Weave Examples

- Standard set of weave patterns
- Use textures / noise for variation



Where Next

- Bounding the extinction coefficient
  - Volume integration that does not require strict bounds
  - Useful for procedural textured media
- Microflakes
  - Shade volumes as surfaces
  - Procedural generated geometry

FRAMESTORE

Thank you

Josh Bainbridge
Manuel Gamito
Serguei Lapine

Stephen McAuley
Stephen Hill

http://blog.selfshadow.com/publications/s2017-shading-course/

/framestore