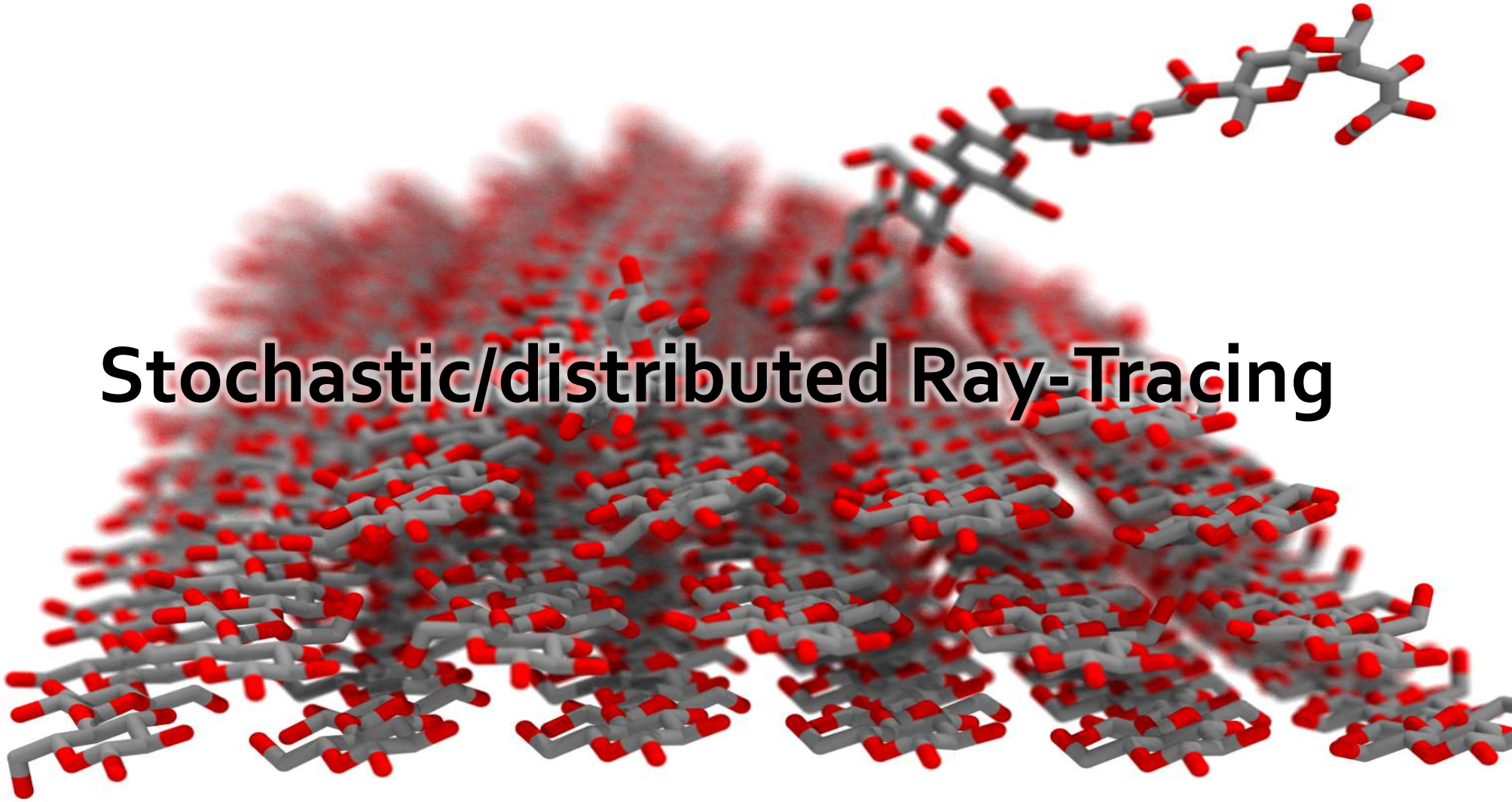
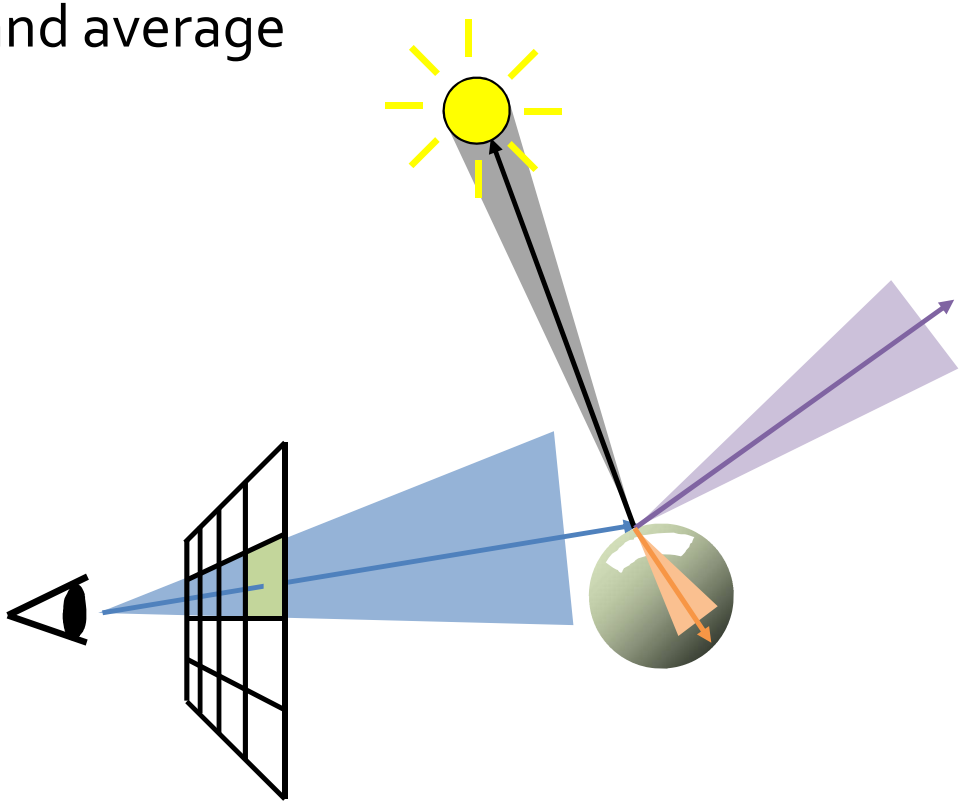
Stochastic/distributed Ray-Tracing



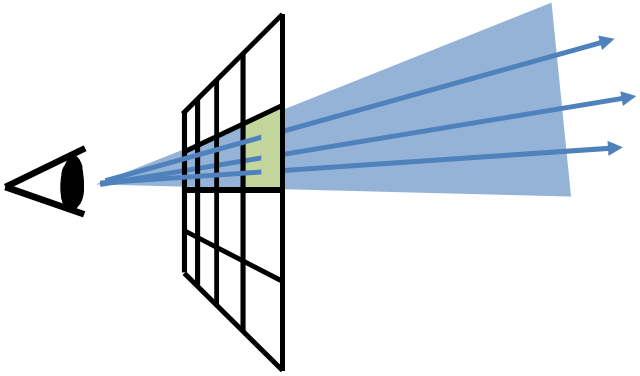
Stochastic/distribution Ray-Tracing

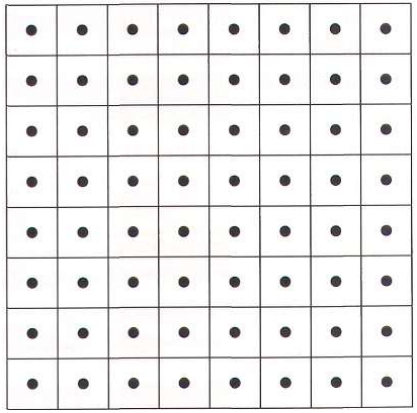
- Apply distribution-based sampling to parts of the ray-tracing algorithm
  - Send multiple perturbed rays and average
- Rendering of "soft" phenomena
  - Anti-aliasing
  - Soft shadows
  - Glossy reflections
  - Depth of field
  - Motion blur



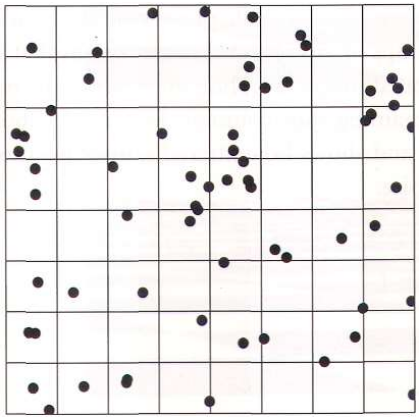
Anti-Aliasing

- Shoot many rays per pixel
- Average retrieved colors
- Methods

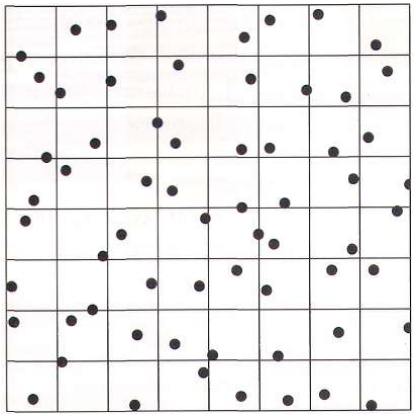




Regular sampling

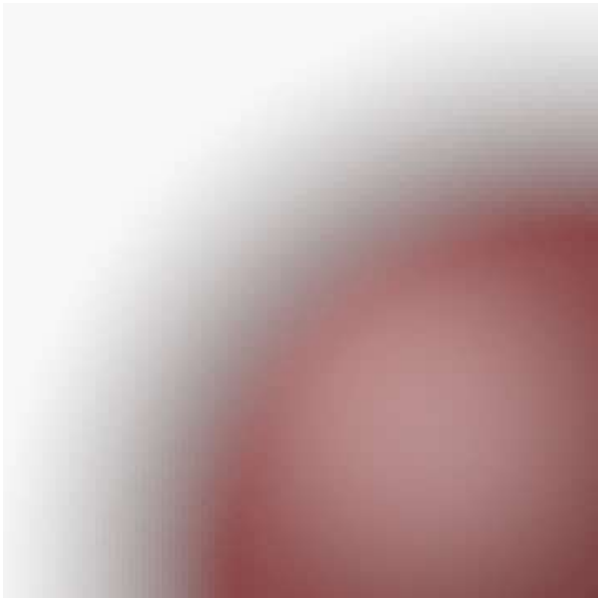


Random Sampling



Stratified Sampling

Anti-Aliasing – Examples



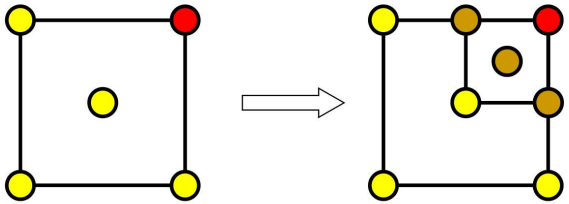
Reference

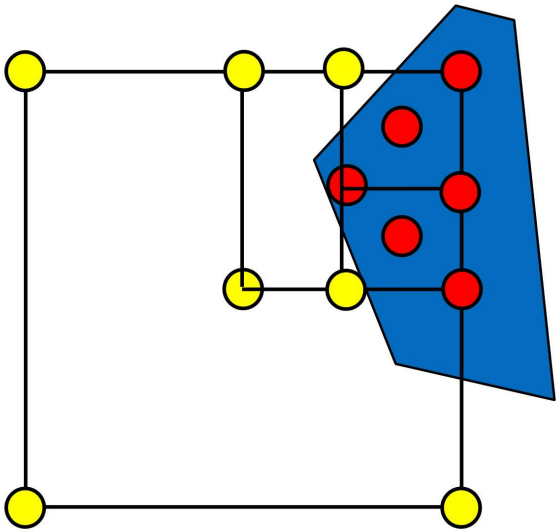
Random Sampling

Stratified Sampling

Anti-Aliasing – Adaptive Supersampling

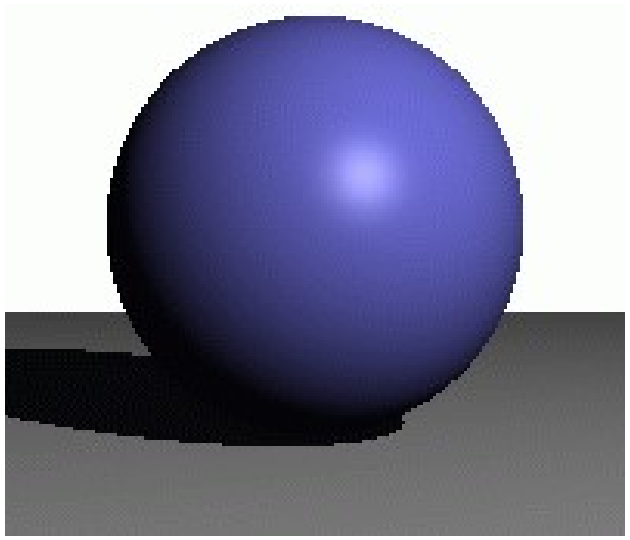
- Shoot more rays only in case of large differences in color



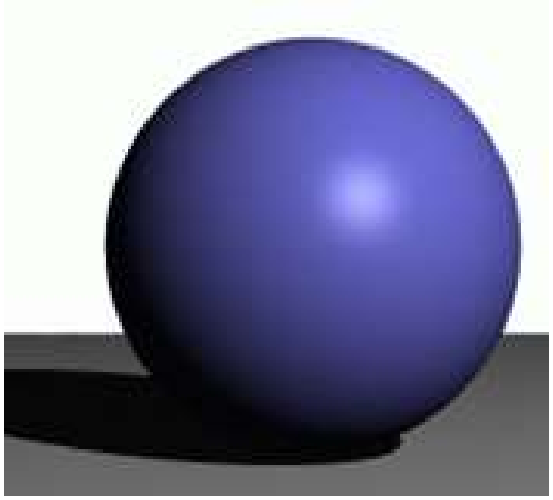


Anti-Aliasing – Examples

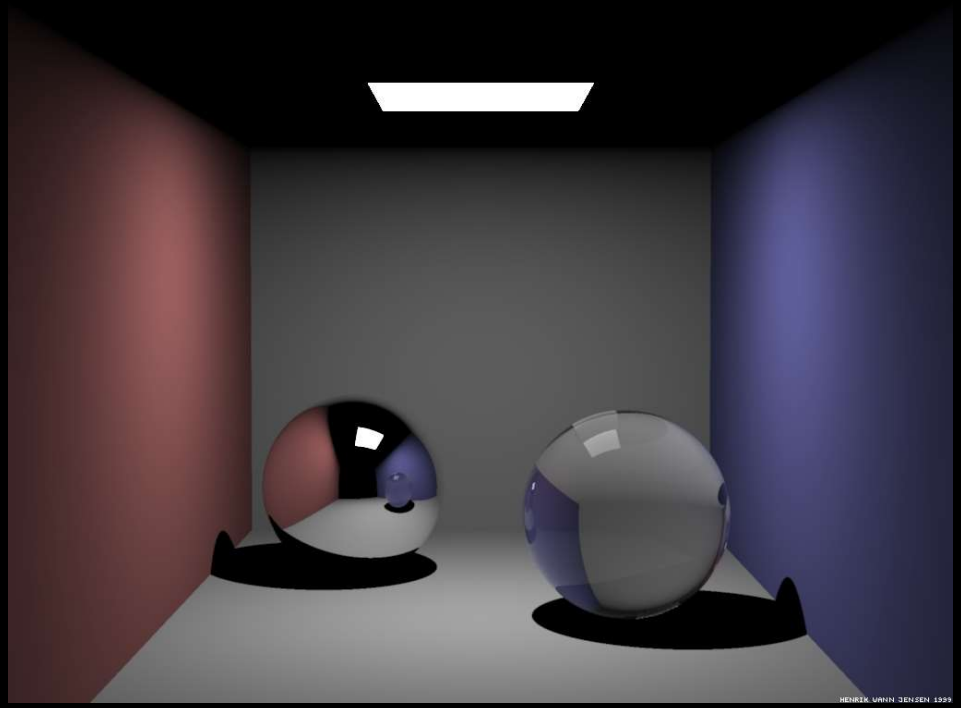
Aliasing

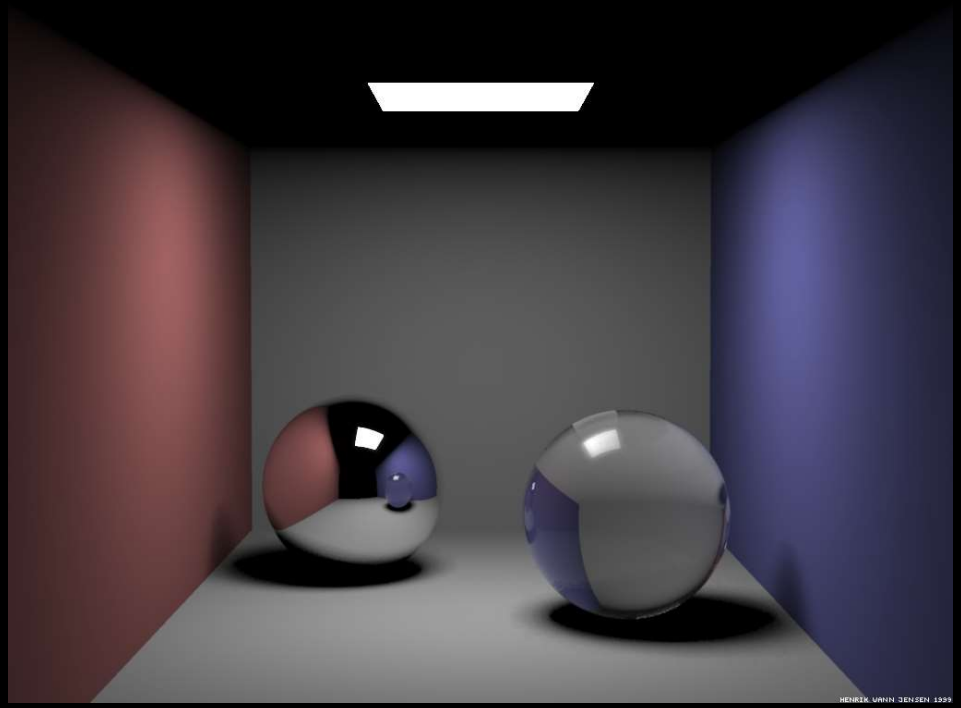


Anti-Aliasing



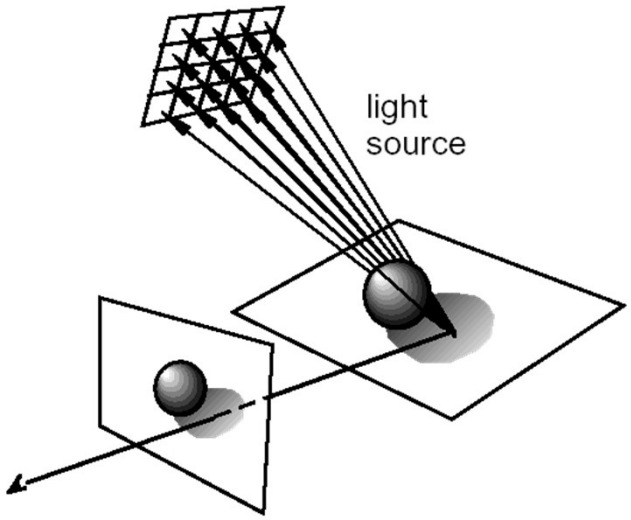
Soft Shadows

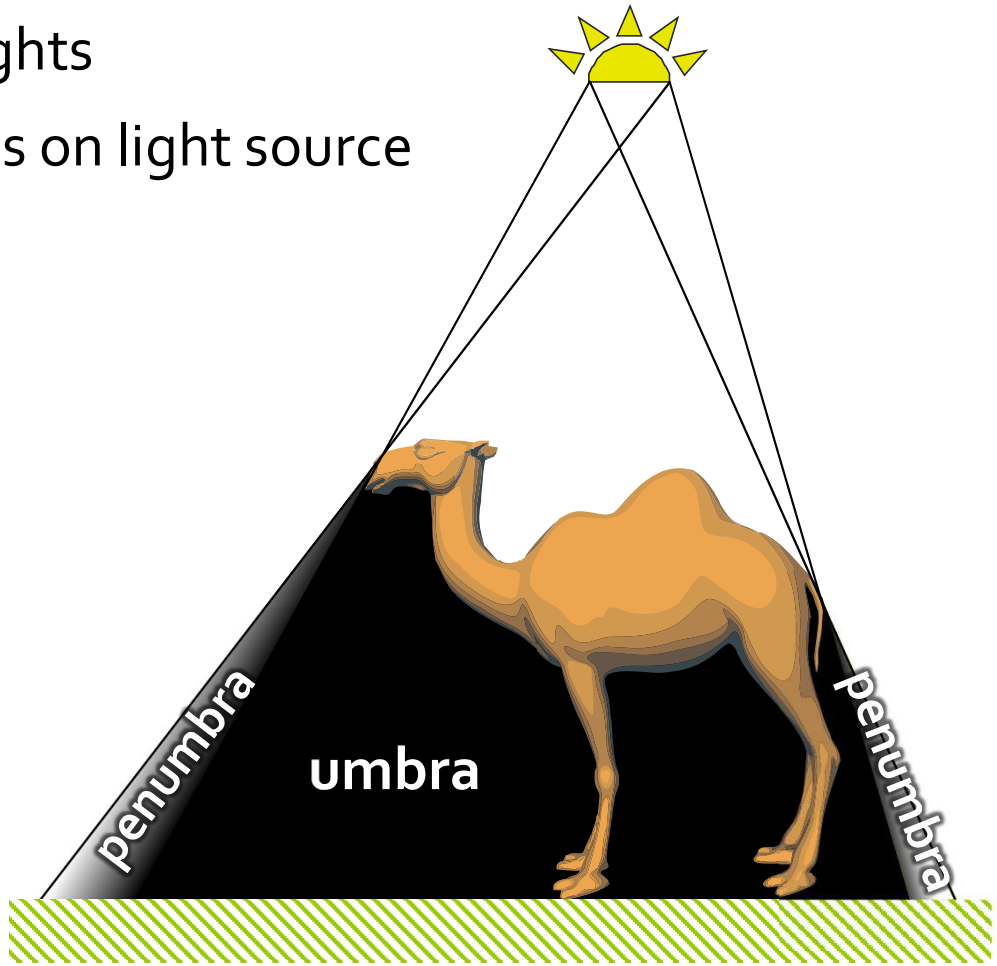




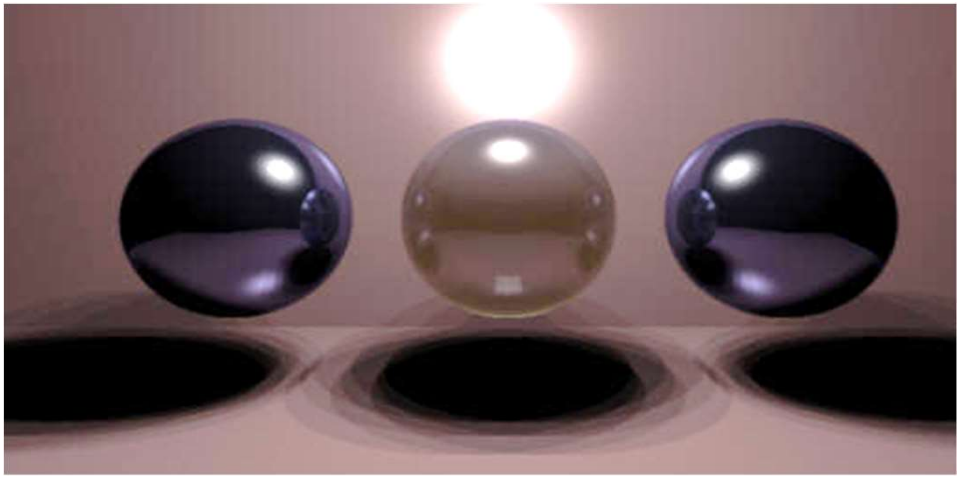
Soft Shadows

- Soft shadows are created by area lights
- Trace shadow rays to multiple points on light source

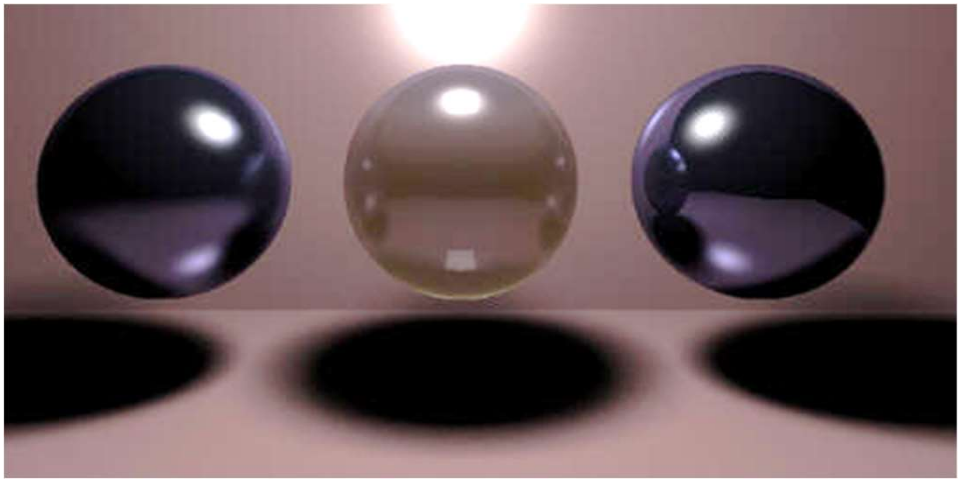




Soft Shadows



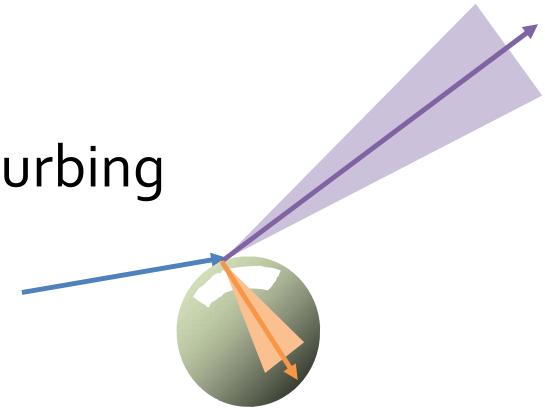
9 shadow rays (3*3 grid)

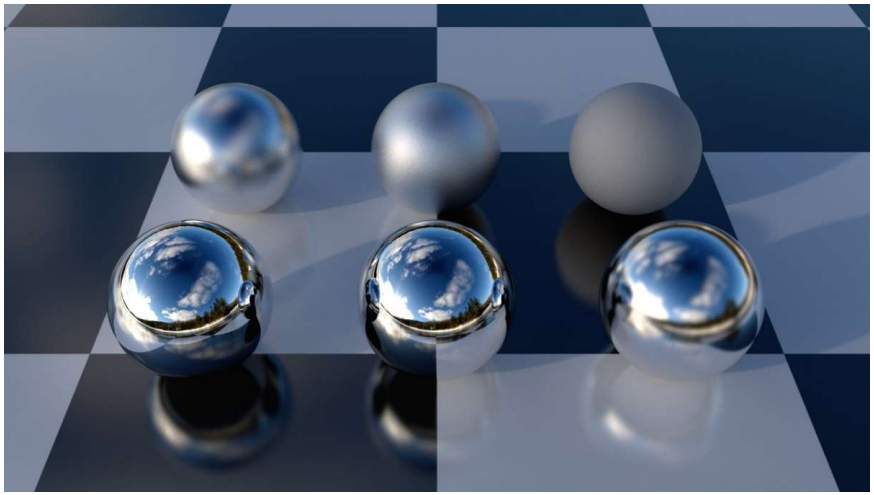


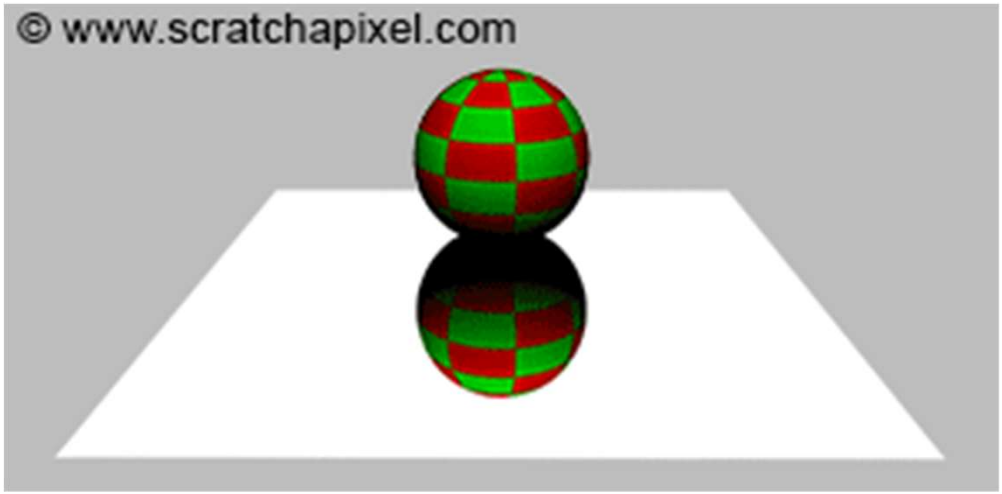
16.384 shadow rays (128*128 grid)

Gloss/Translucency

- Produce blurry reflections/refractions by randomly perturbing reflection/refraction rays from their "true" directions

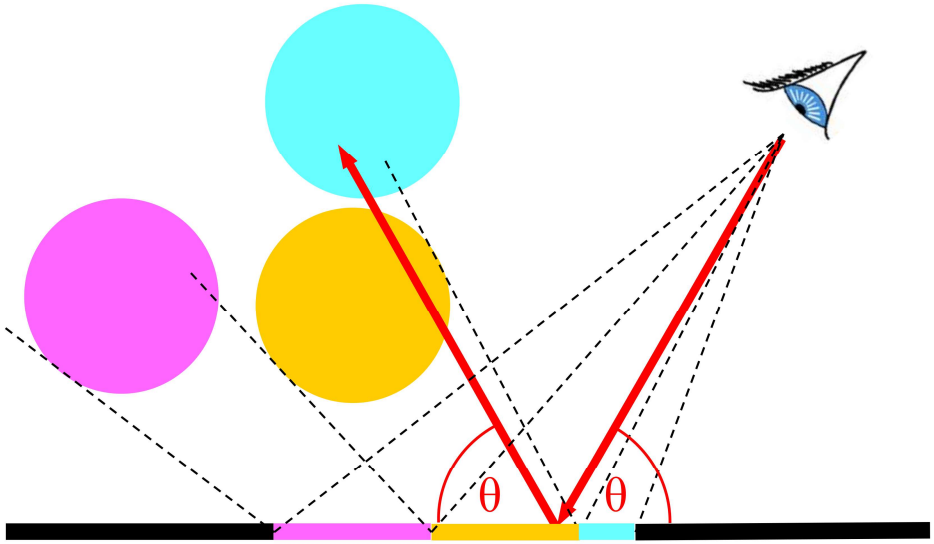




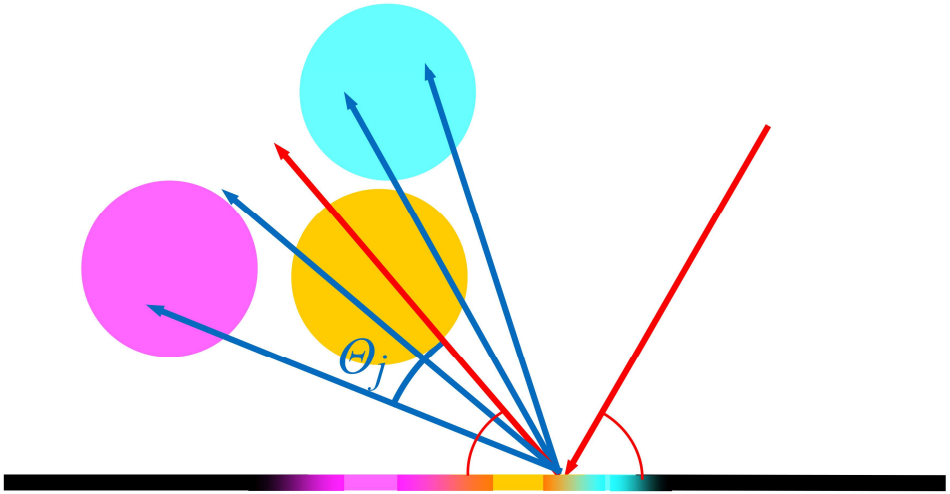


Gloss/Translucency

- So far, exactly 1 reflected ray



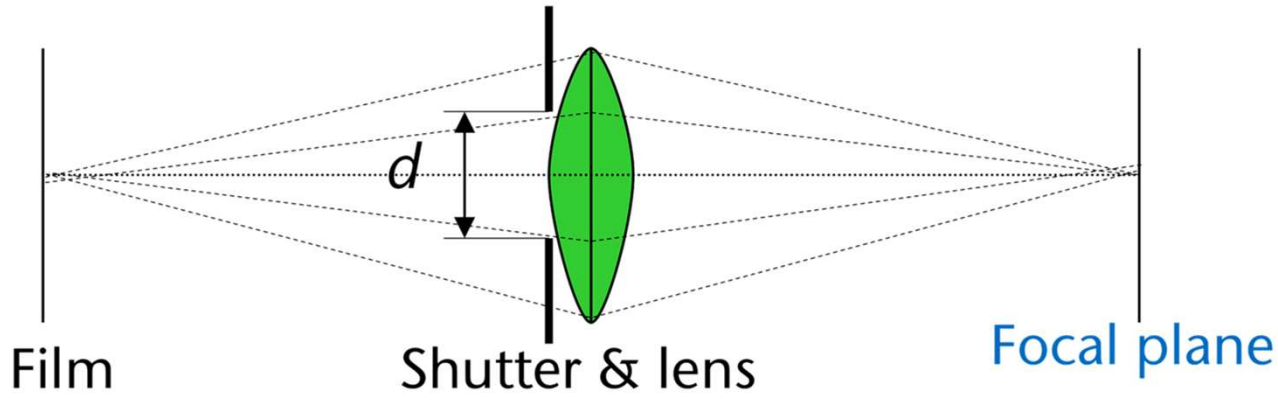
- Shoot many "reflected" rays
- Accumulate, weighted by power-cosine law (Phong) $\cos^{p}\Theta_j$



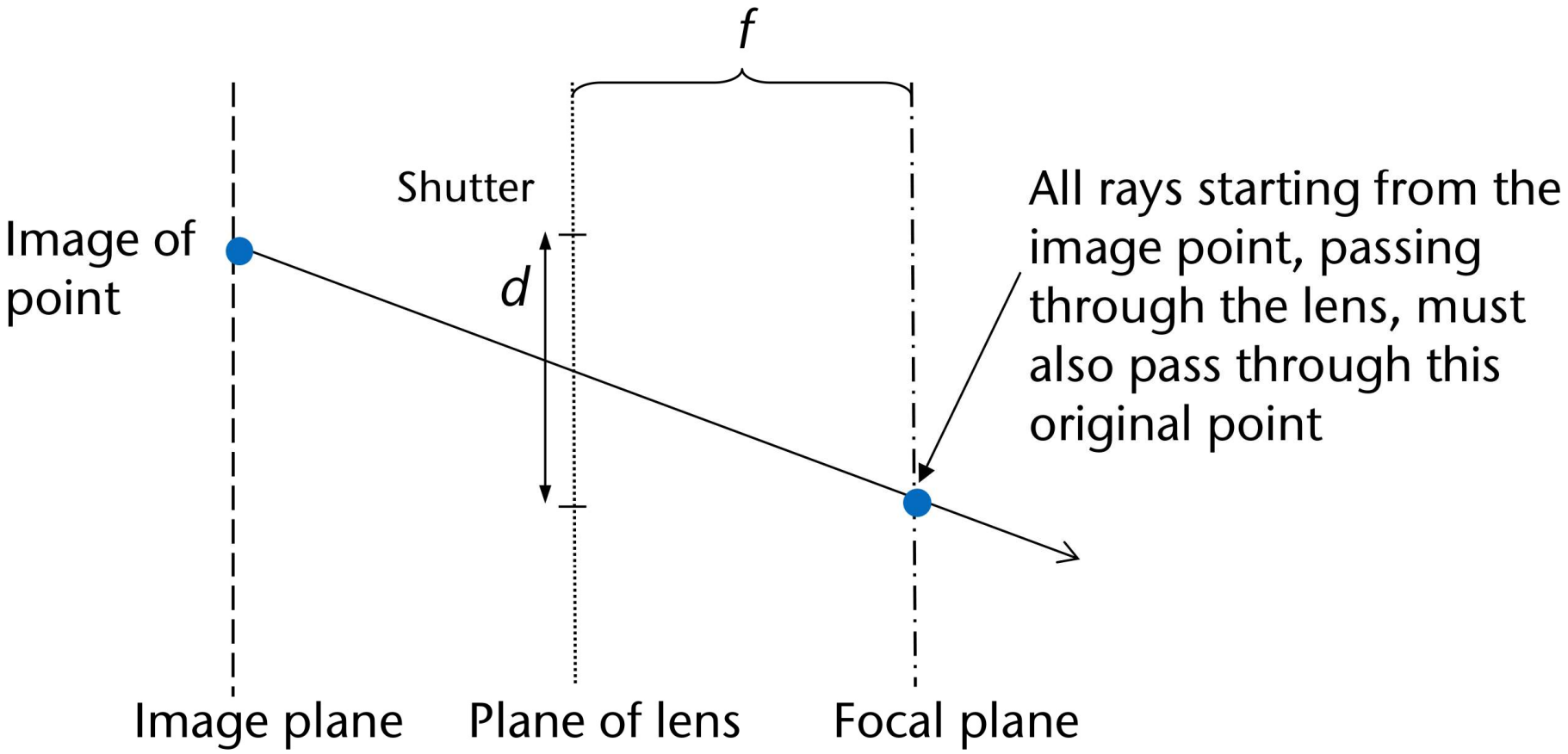

Gloss/Translucency
Glossy
Glossy
Diffuse
Mirror like
Glossy
Glossy
Glossy

Depth of Field

- So far: ideal pin-hole camera model
- For depth-of-field, we need to model real cameras

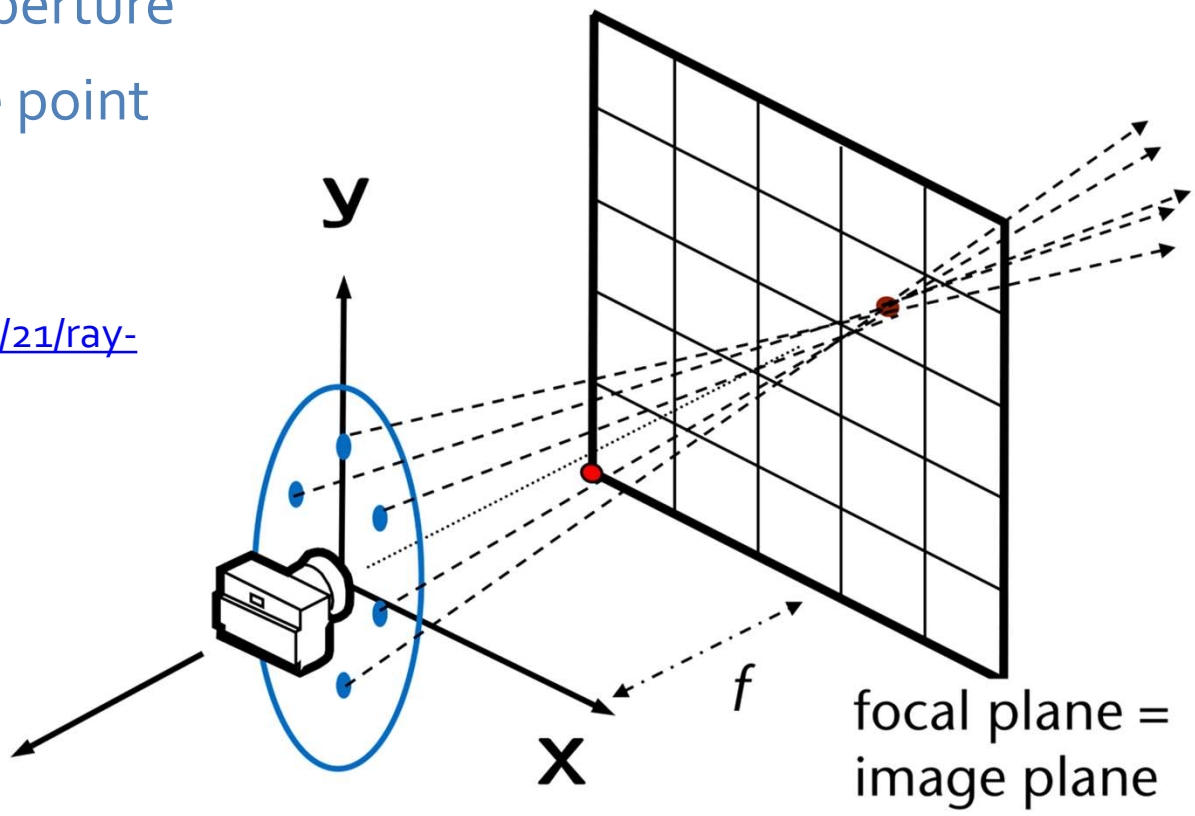


Depth of Field

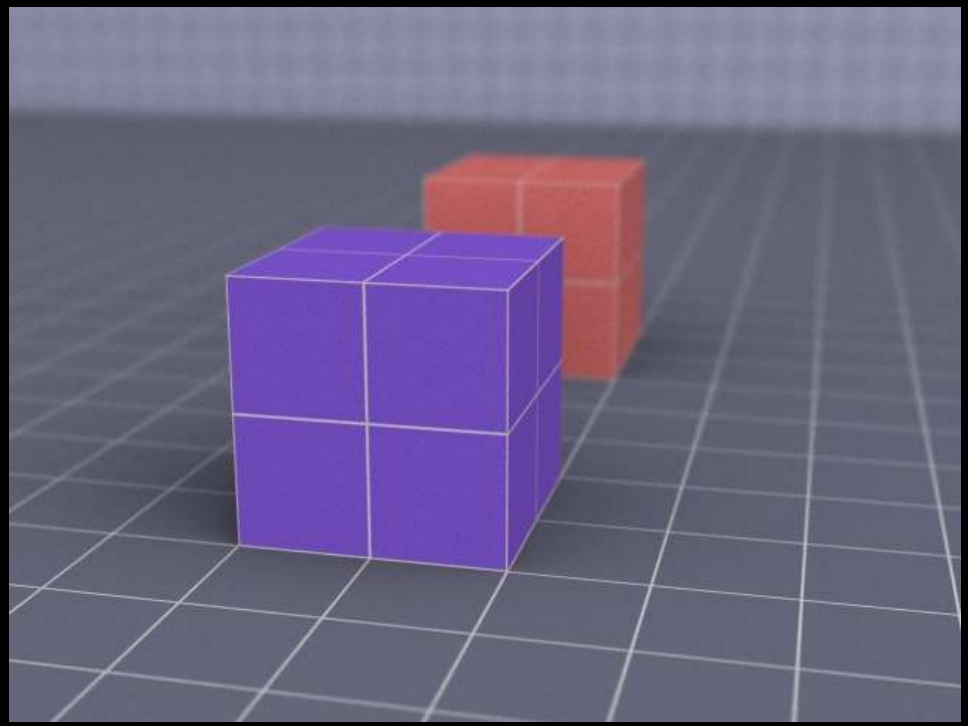


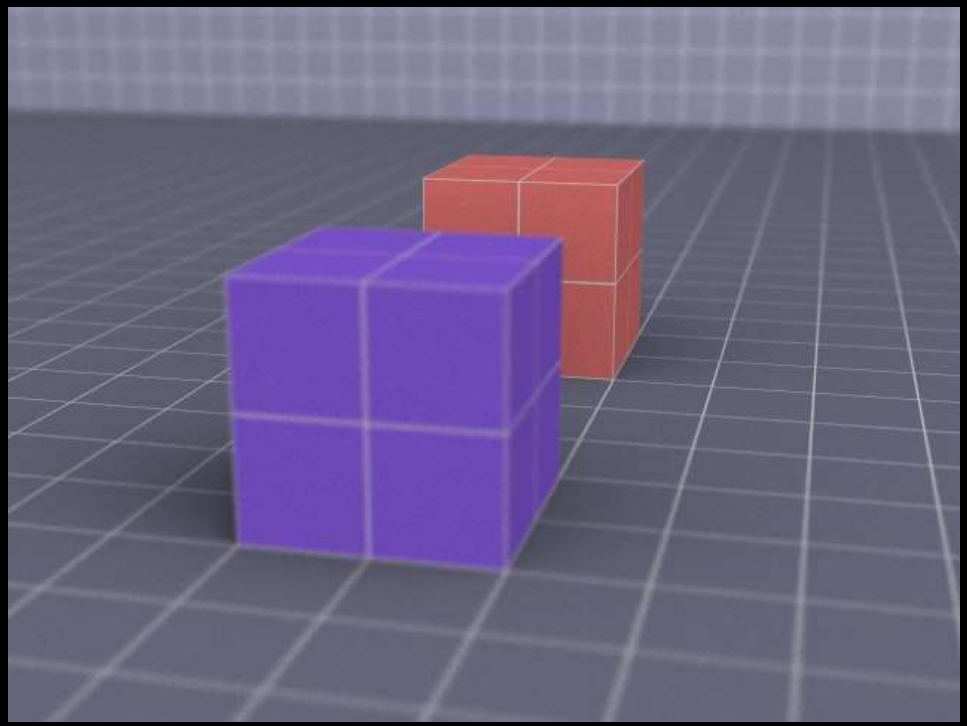
Depth of Field

- Sample the whole shutter aperture
- Shoot ray from each sample point through focal plane point
- Details of implementation
  steveharveynz.wordpress.com/2012/12/21/ray-tracer-part-5-depth-of-field

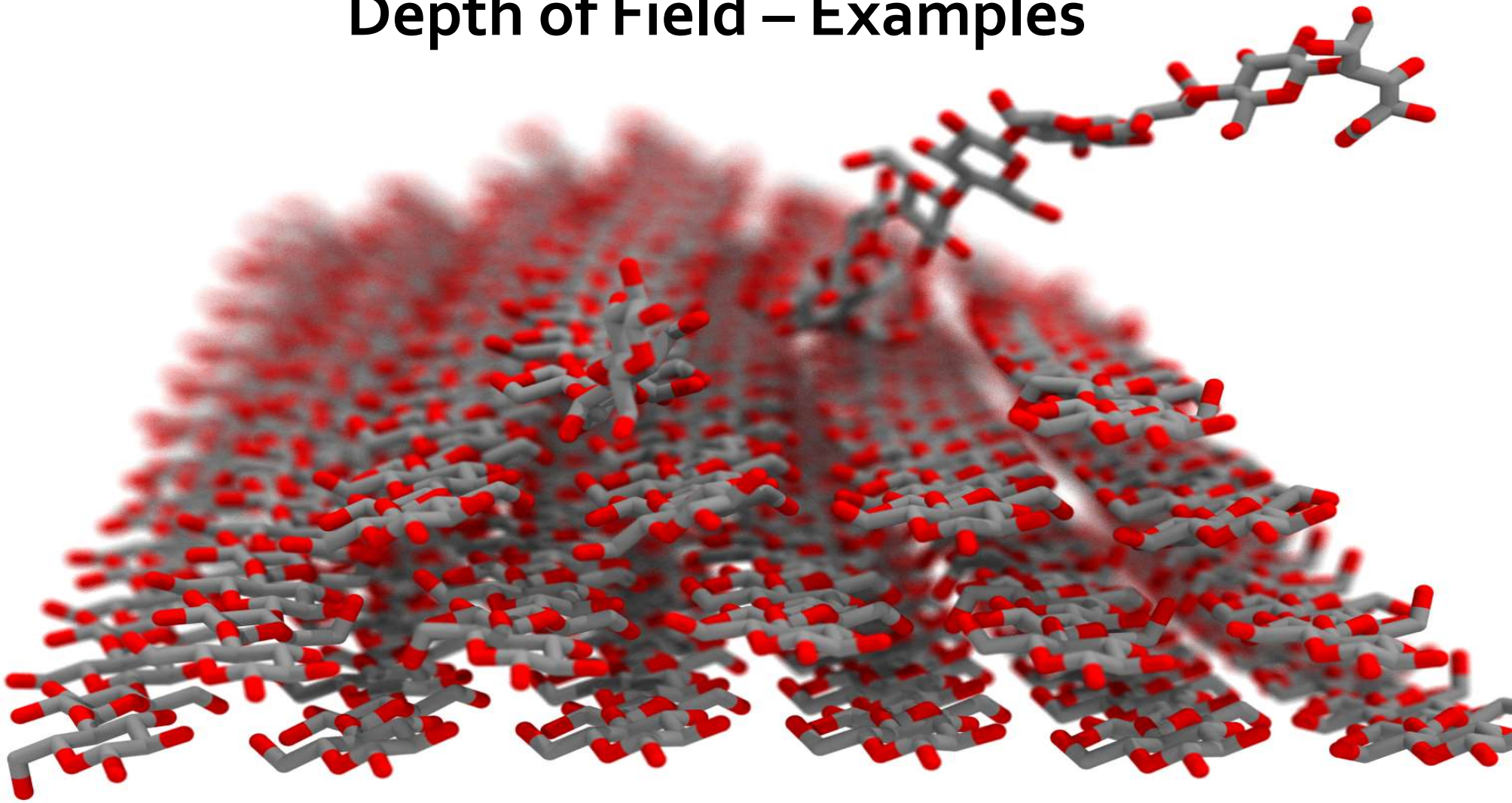


Depth of Field – Examples





Depth of Field – Examples

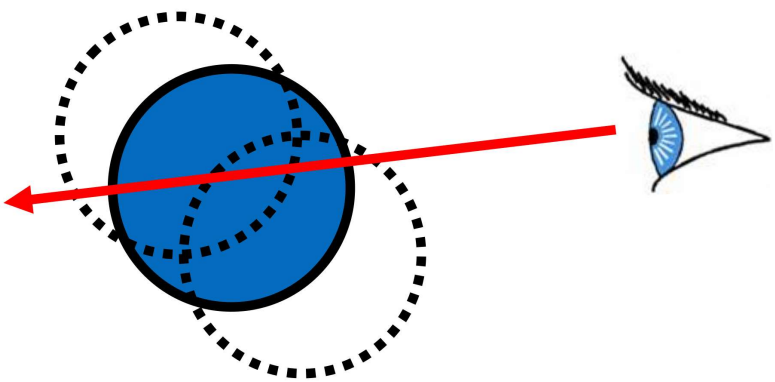


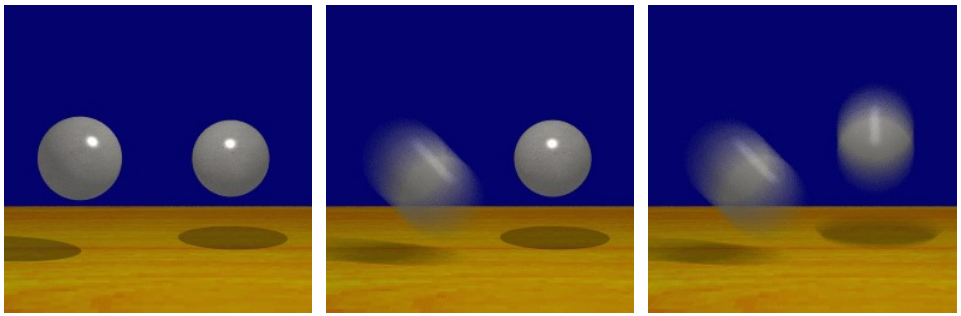
Depth of Field – Shutter Speed Artifects

- A slower shutter speed means the shutter is open for more time
- This can result in motion blur

Motion Blur

- Goal: compute "average" image for time interval , during which objects move
- Sample time interval and shoot one ray per point in time t
- Ray-object intersections, use positions P(t)
- Average color of all rays for one pixel





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