Physical Rendering: Strategic Overview

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Light paths

- Light starts at the luminaire, ends at the eye
  - Rendering involves accounting for these paths
    - pixel value= Sum over paths (light contributed by path)
  - When we ray trace, we are tracking a path that light followed
    - we could go forward or backward along the path
      - either way involves easy geometry we know how to do
  - Label the path with L (bounces) E
- Bounce labels are D (diffuse), S (specular/transmissive)

- Big distinction:
  - S we know the next dir, D we don't

Light paths

- Example paths
  - e.g. LDE
    - luminaire to diffuse surface to eye
      - already done these; trace eye ray then
        - shadow ray+dot product (point light source)
        - area source integral (area luminaire)
  - LDSE
    - luminaire to diffuse to specular to eye
    - already done these; trace eye ray, one specular/transmissive ray then
        - shadow ray+dot product (point light source)
        - area source integral (area luminaire)

Light paths

- Example paths:
  - LDS*E
    - already done this, multiple specular/transmissive bounces
  - LSDE
    - sketched this; fire light out of luminaire, stick it in a map, pick up later
  - LDD+E
    - i.e. more than one diffuse bounce
      - have not yet talked about this, next topic
      - these paths can contribute a lot of light, but are hard to evaluate

Main points

- When a light path arrives at/leaves from S
  - we know where it's going/came from
- When a light path arrives at/leaves from D
  - we don't know where it's going/came from

- Rendering ALWAYS answers "how bright is this"

Brightness = Diffuse term + term from far end of specular+ term from far end of transmitted

Rendering strategy

Evaluate the far end of rays to give brightness answer

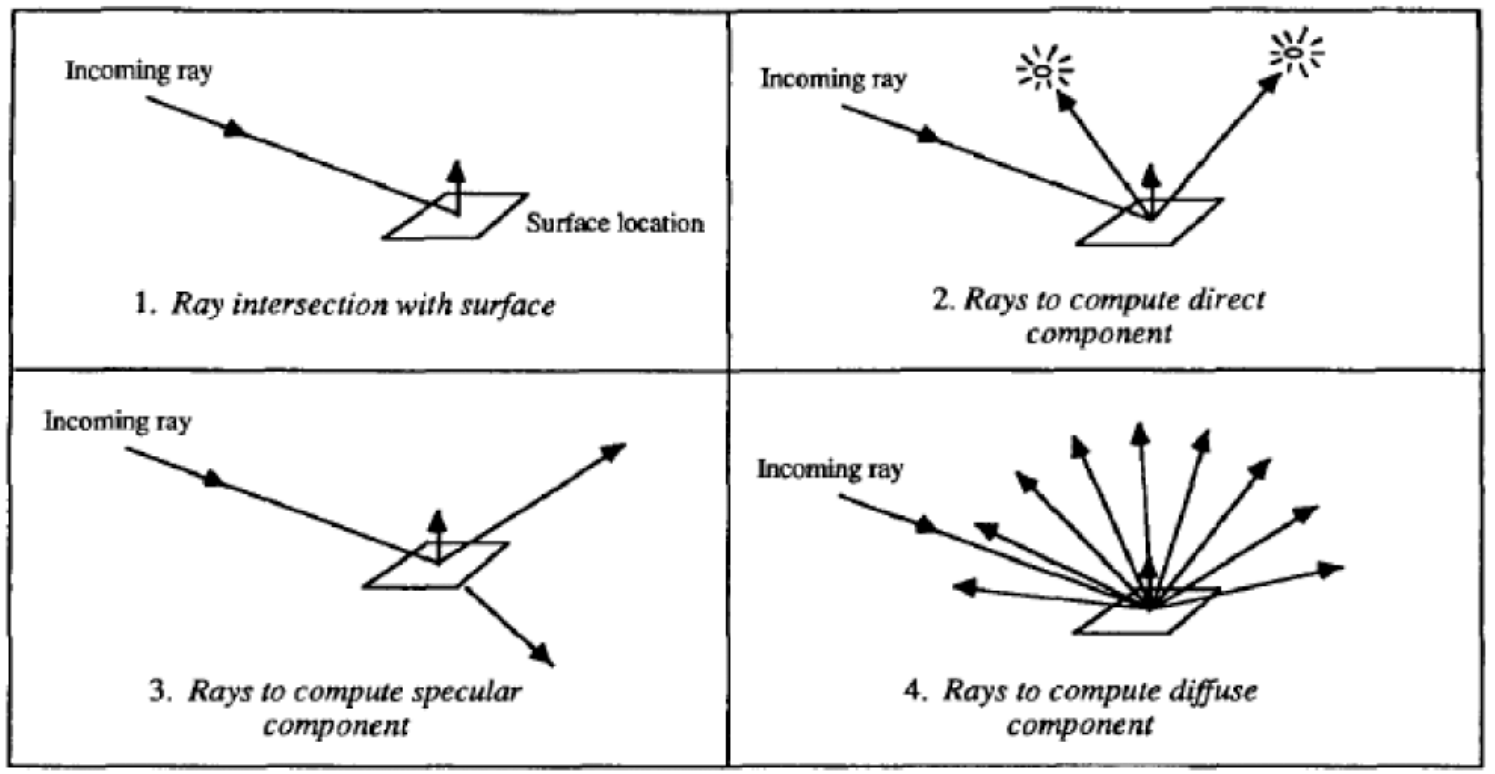
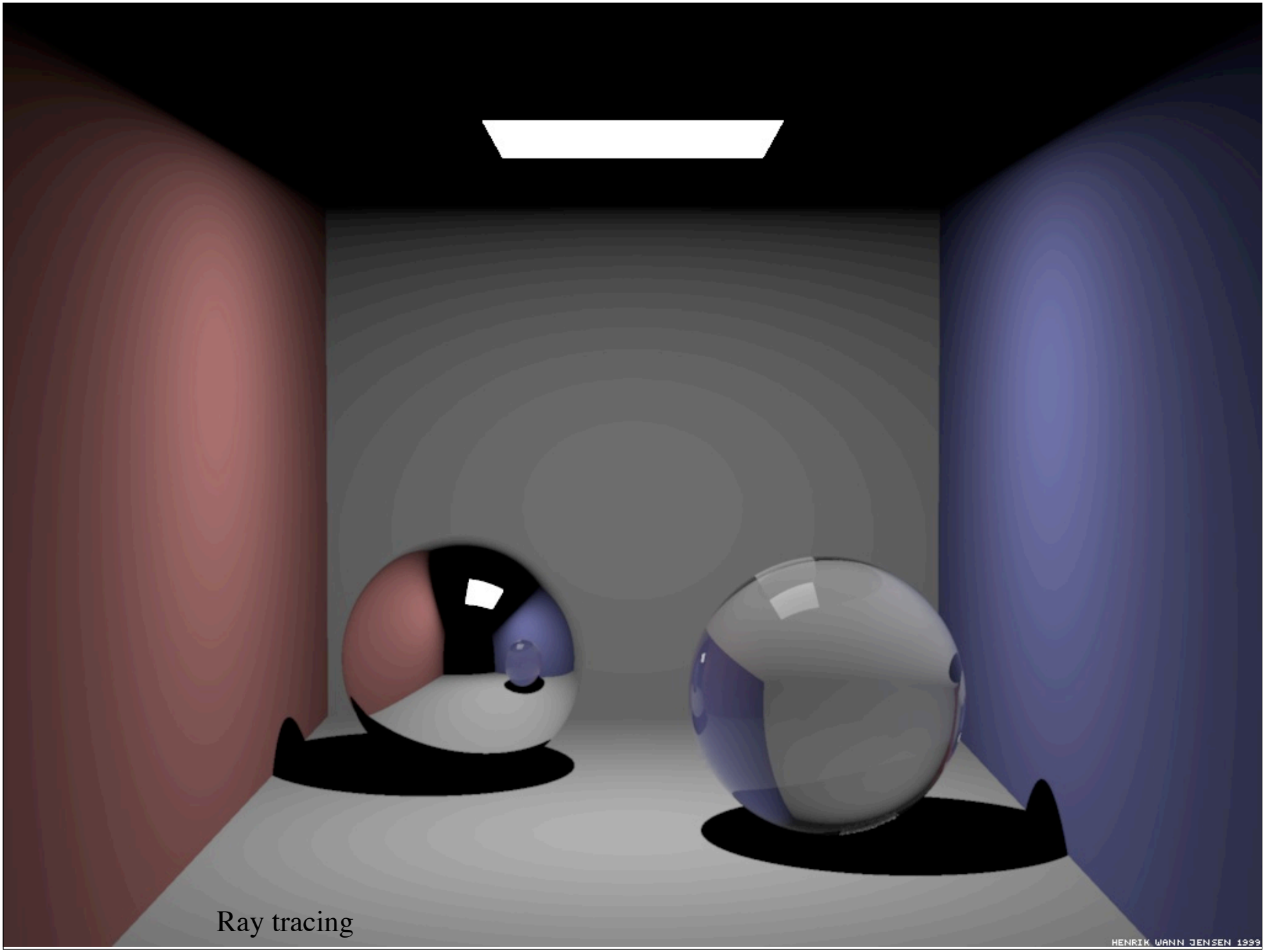
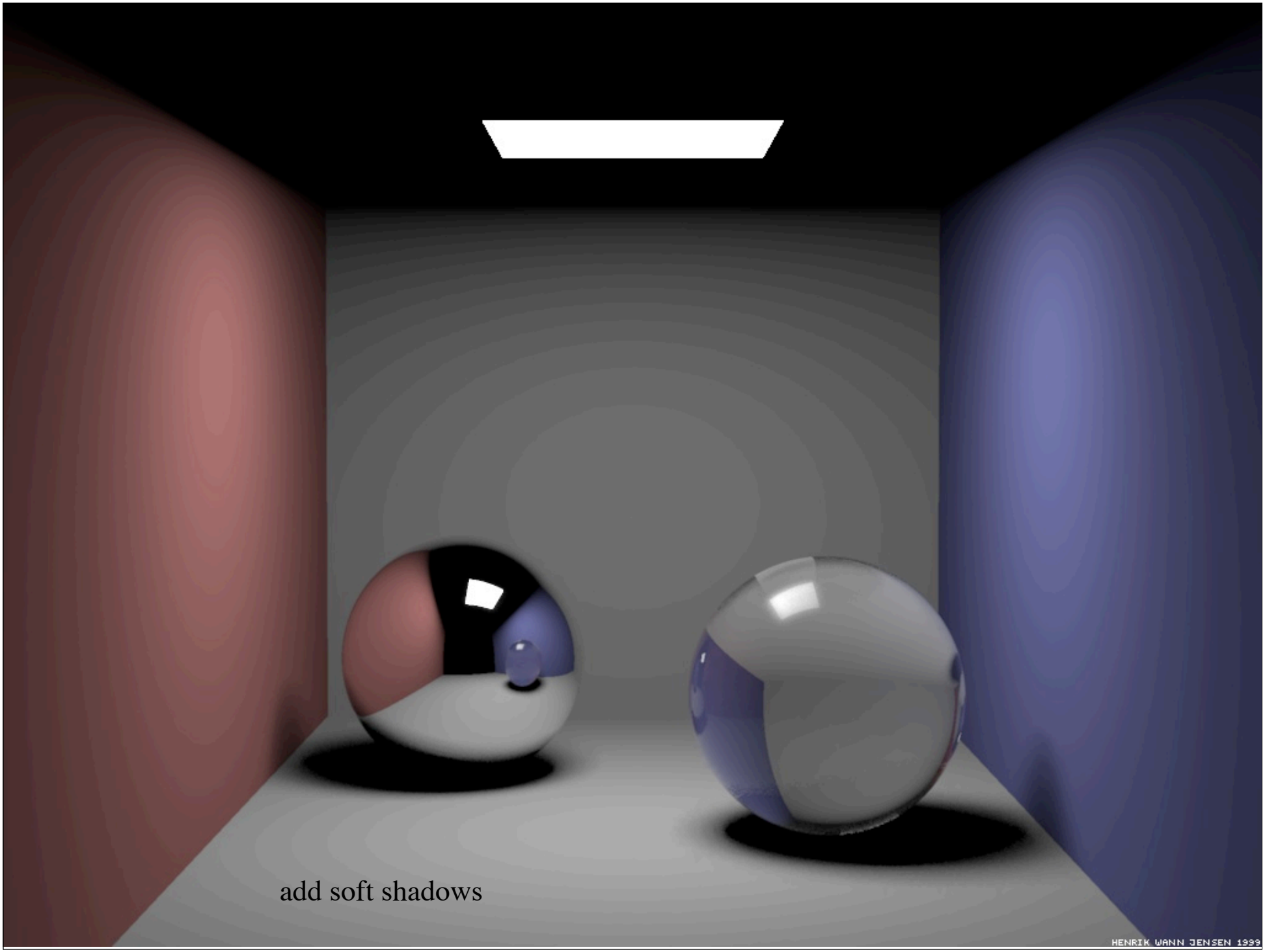


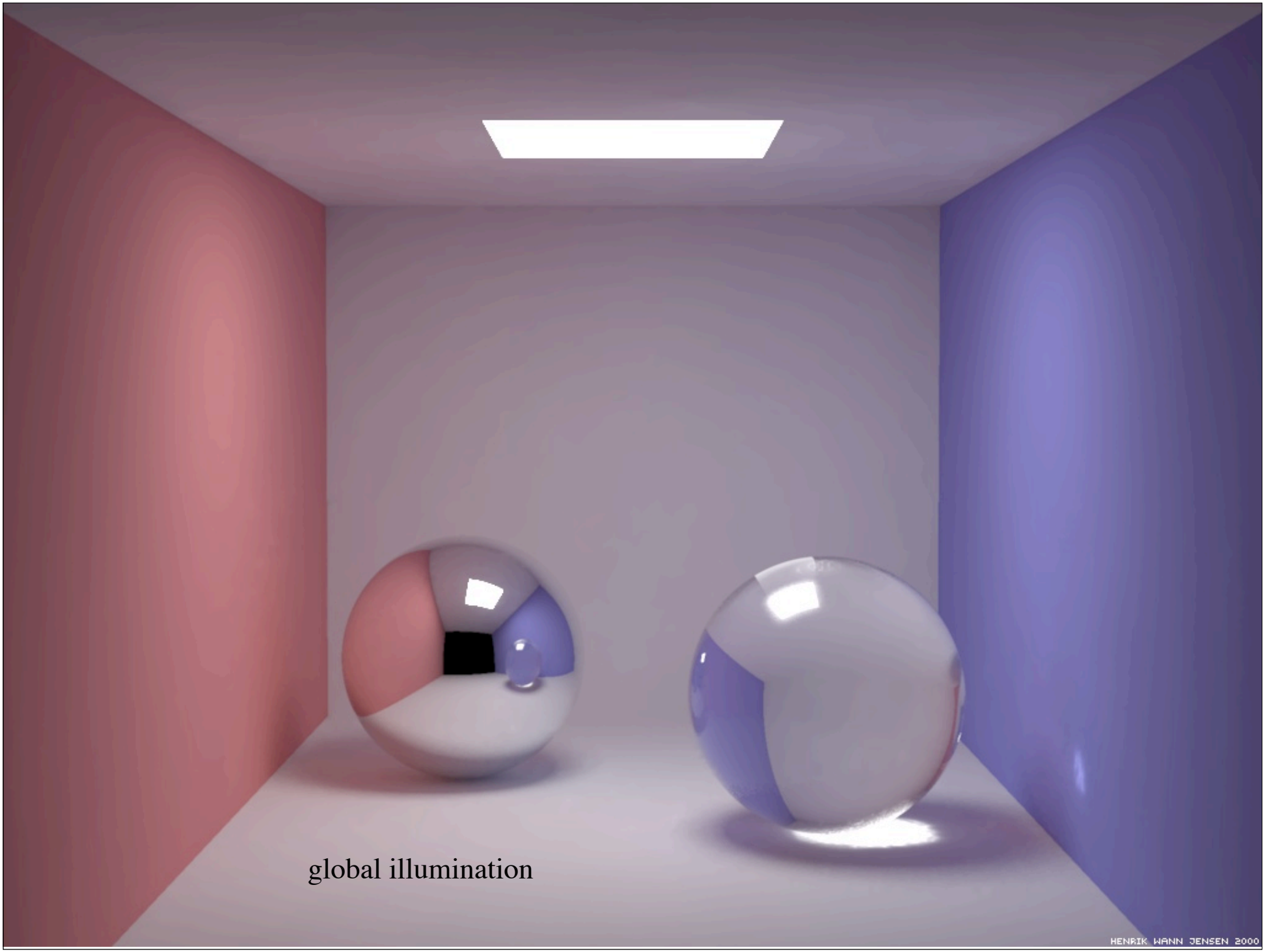
Figure 1: The four steps of ray tracing.

Figure from Ward et al, "A Ray-tracing solution for diffuse interreflection", 1988



Ray tracing


add soft shadows
HENRIK WANN JENSEN 1999



global illumination

Strategy

- Specular and transmitted terms are basically simple
  - from eye, follow the S, find what's at the far end
  - from luminaire, follow the S, leave a blob of light
- Diffuse term is not

  - Physical model of the diffuse term
  - Rendering strategy:
    - build rough approximation of LDD+E path contributions
    - exploit that to compute shading values at pixels
  - Three interlinked topics
    - physical model (straightforward)
    - what to do with approximation (fairly straightforward)
    - how to build (numerous options, can be quite confusing)