Image-Based Lighting II

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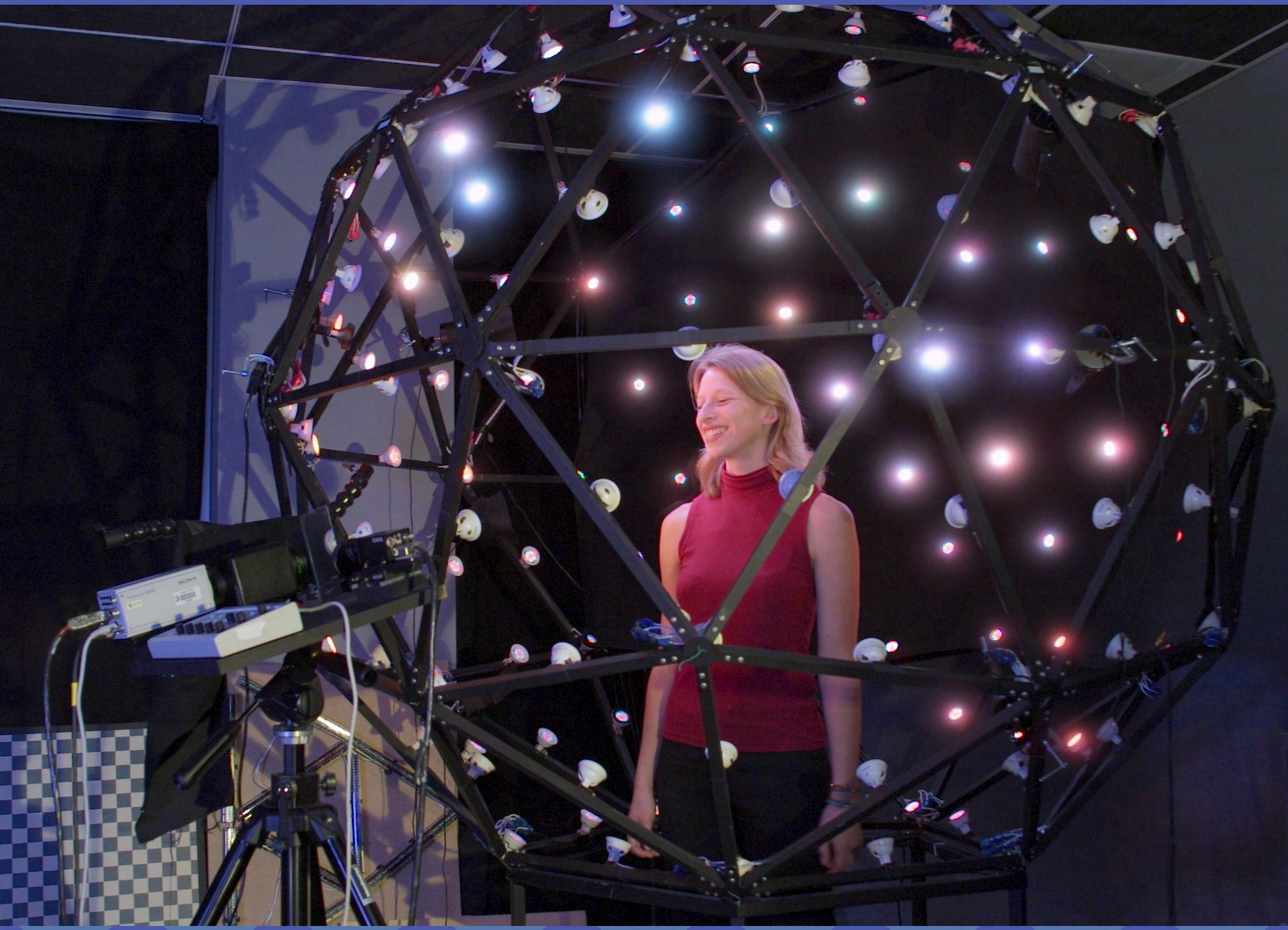
…with a lot of slides donated by Paul Debevec

15-463: Computational Photography
Alexei Efros, CMU, Fall 2008

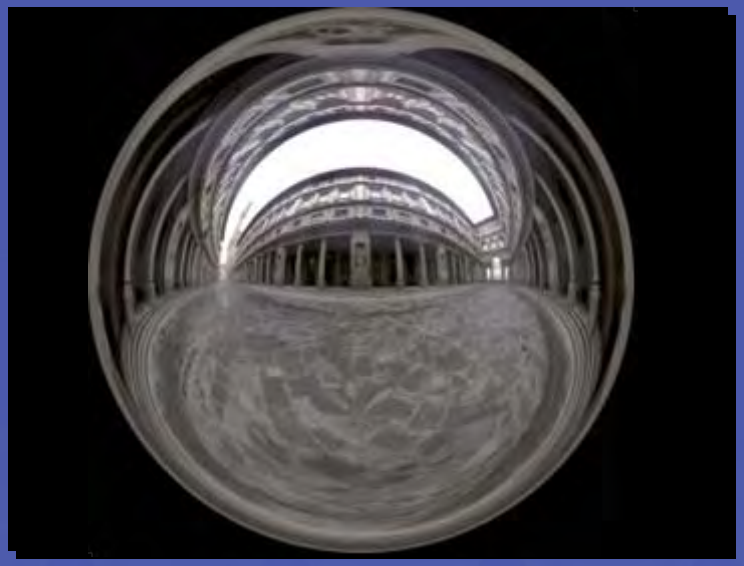
Real objects under new lighting

Rendering Light Probes as Light Sources

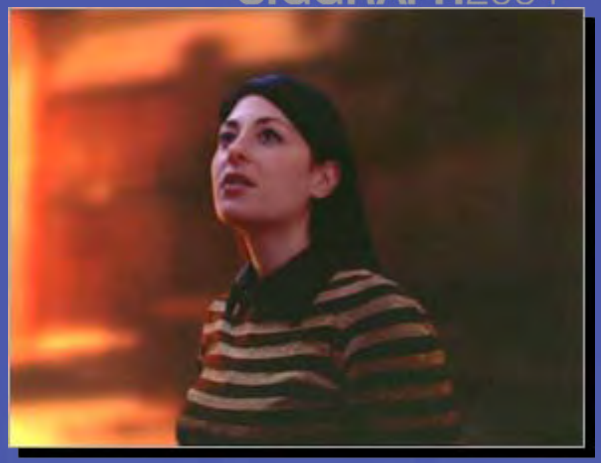
1999

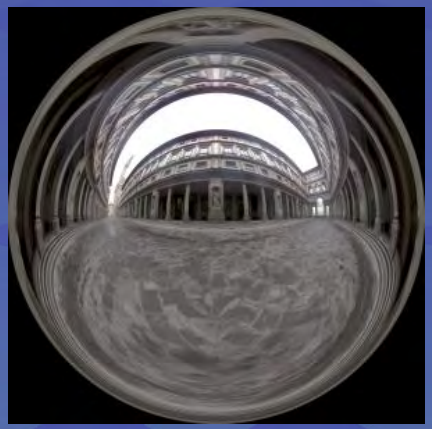


A Lighting Reproduction Approach



Composited Results



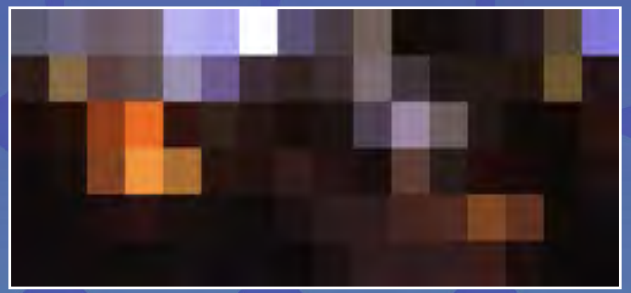


Light Stage 1.0

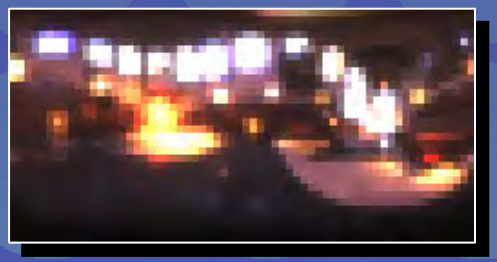
Debevec, Hawkins, Tchou, Duiker, Sarokin, and Sagar. *Acquiring the Reflectance Field of a Human Face*. SIGGRAPH 2000.

The Light Stage:
60-second
exposure

Light Stage – 4D Reflectance Field



Modulated Images



Light Stage 1 Results

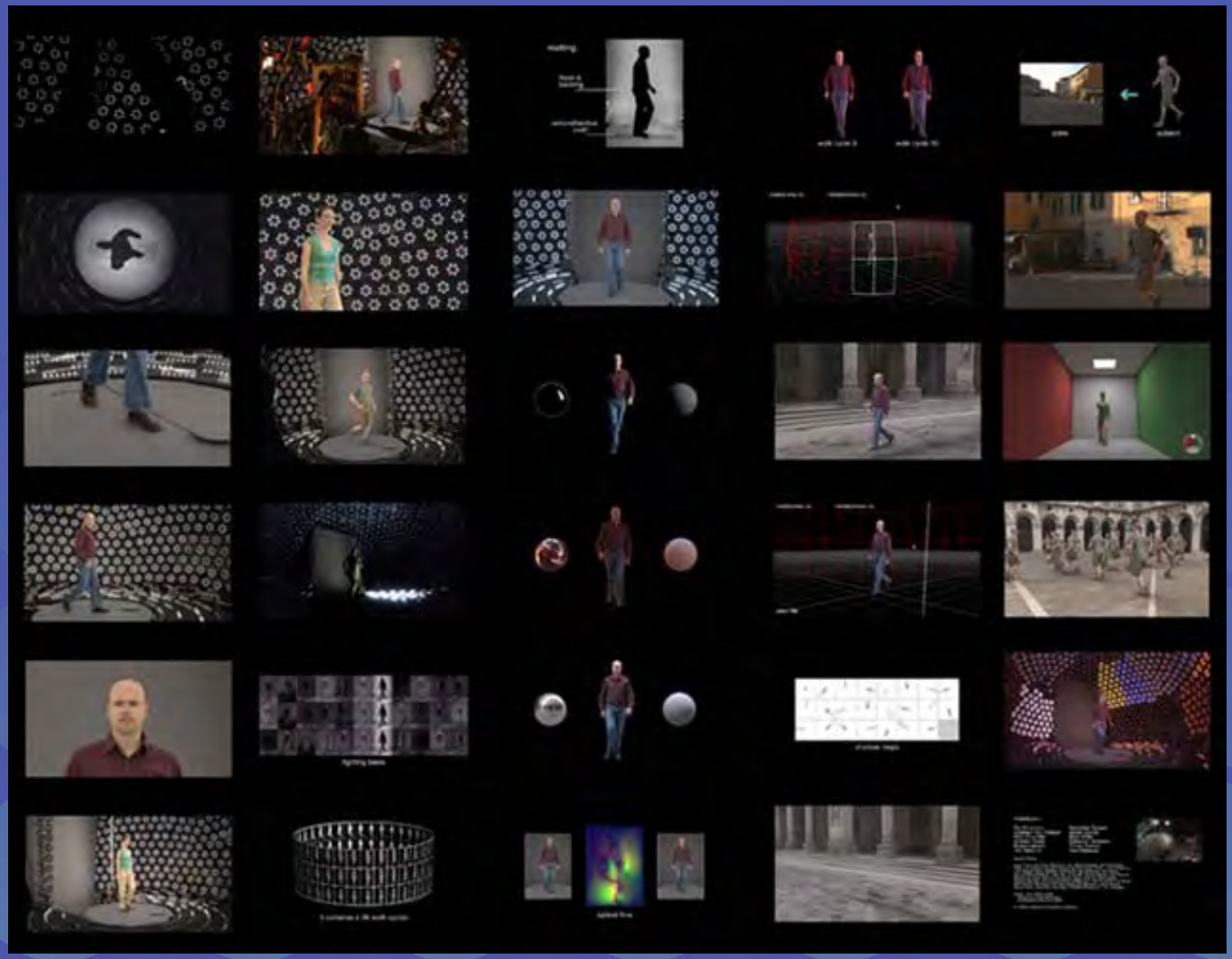
Environments from the **Light Probe Image Gallery**

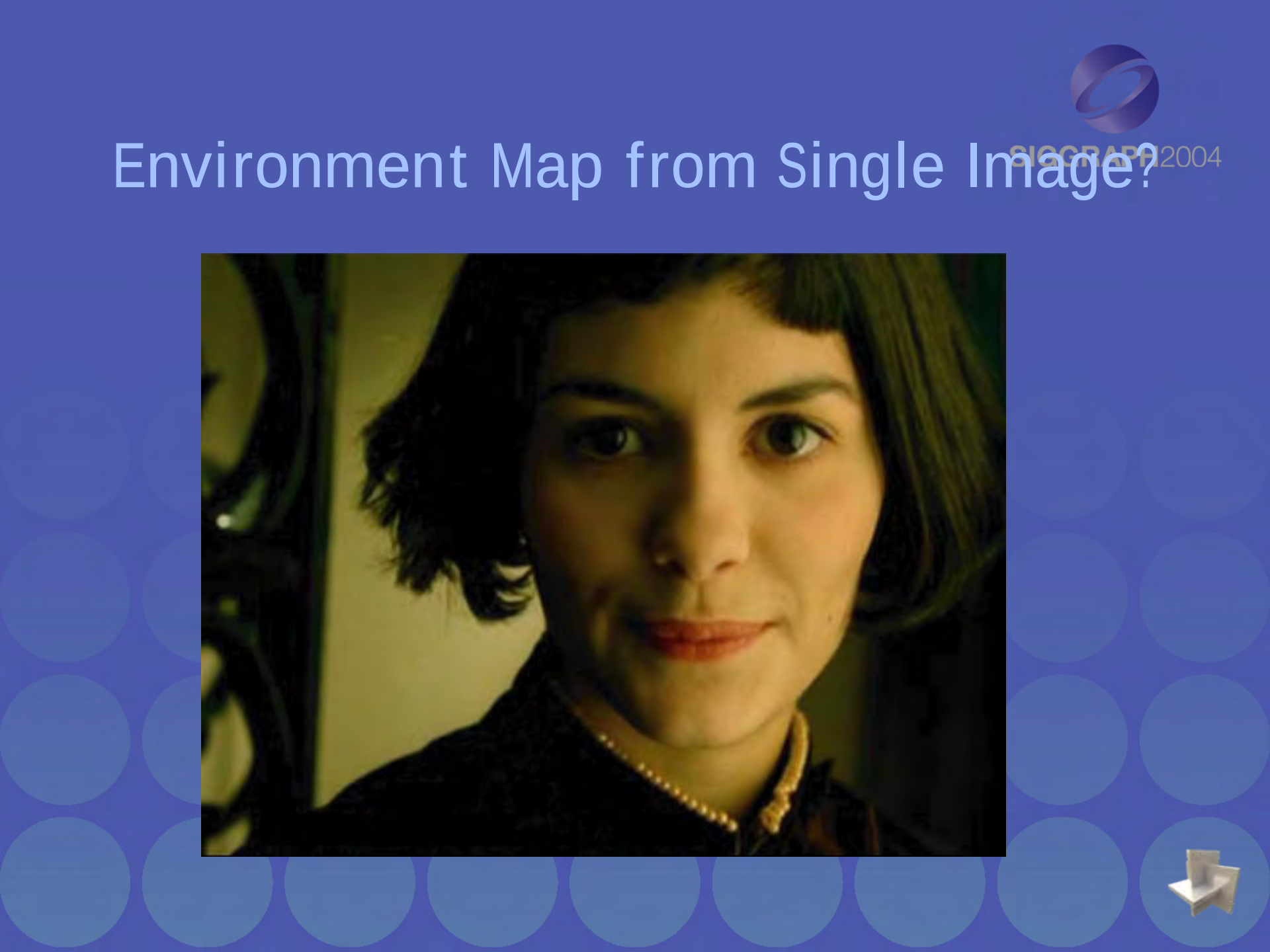
www.debevec.org

Light Stage 3

Structured Light

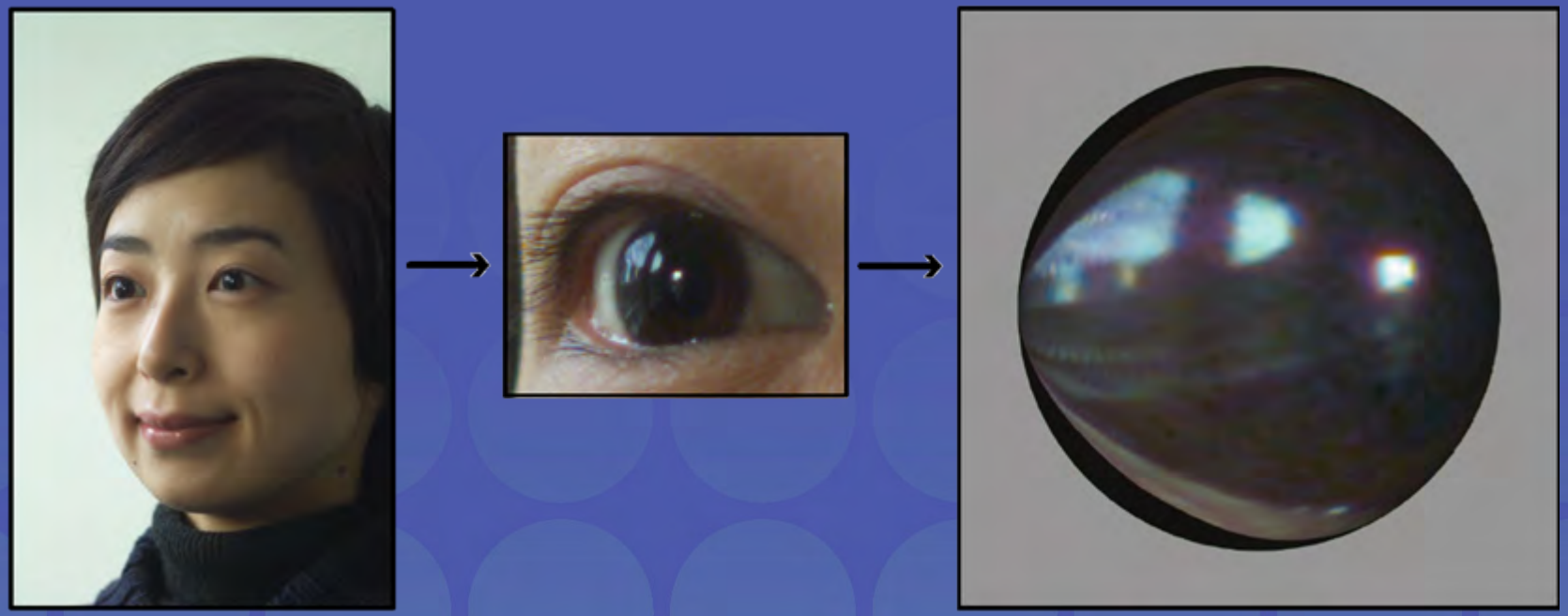
Light Stage 6



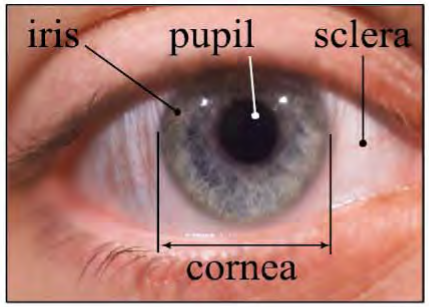


Environment Map from Single Image?

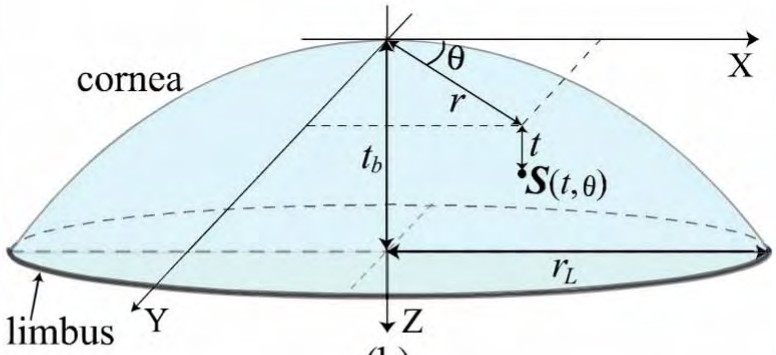
Eye as Light Probe! (Nayar et al)



Cornea is an ellipsoid



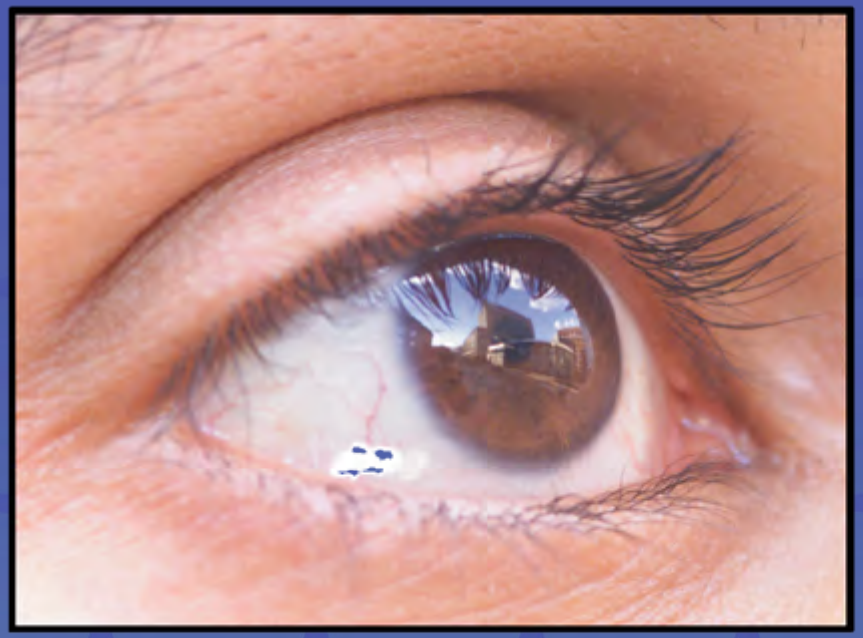
(a)



(b)

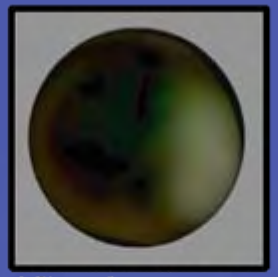
Figure 2: (a) An external view of the human eye. (b) A normal adult cornea can be modeled as an ellipsoid whose outer limit corresponds to the limbus. The eccentricity and radius of curvature at the apex can be assumed to be known.

Ellipsoid fitting



(a1) original image

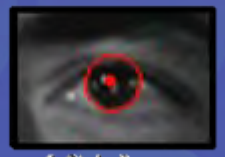
(a2) left eye



(a3) environment map

(a4) face replaced image

(a) replacing faces in *Amelie*



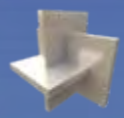
(b2) left eye

(b3) environment map

Putting it all together!

Reach for the sky

- How can we capture the whole sky as an environment map?
- What happens with the sun?



Direct HDR Capture of the Sun and Sky

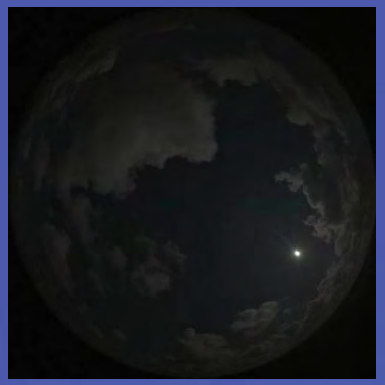
- Use Sigma 8mm fisheye lens and Canon EOS 1Ds to cover entire sky
- Use 3.0 ND filter on lens back to cover full range of light
  - Only 0.1% of light gets through!

Stumpfel, Jones, Wenger, Tchou, Hawkins, and Debevec. "Direct HDR Capture of the Sun and Sky". To appear in Afrigraph 2004.

Extreme HDR Image Series

1 sec
f/4

1/4 sec
f/4



1/30 sec
f/4

1/30 sec
f/16

1/250 sec
f/16

1/1000 sec
f/16

1/8000 sec
f/16

Extreme HDR Image Series

- sun closeup

1 sec
f/4

1/4 sec
f/4

1/30 sec
f/4

1/30 sec
f/16

1/250 sec
f/16

1/1000 sec
f/16

1/8000 sec f/16
only image that does not saturate!

Spectral Calibration – ND filters are NOT Necessarily Neutral!

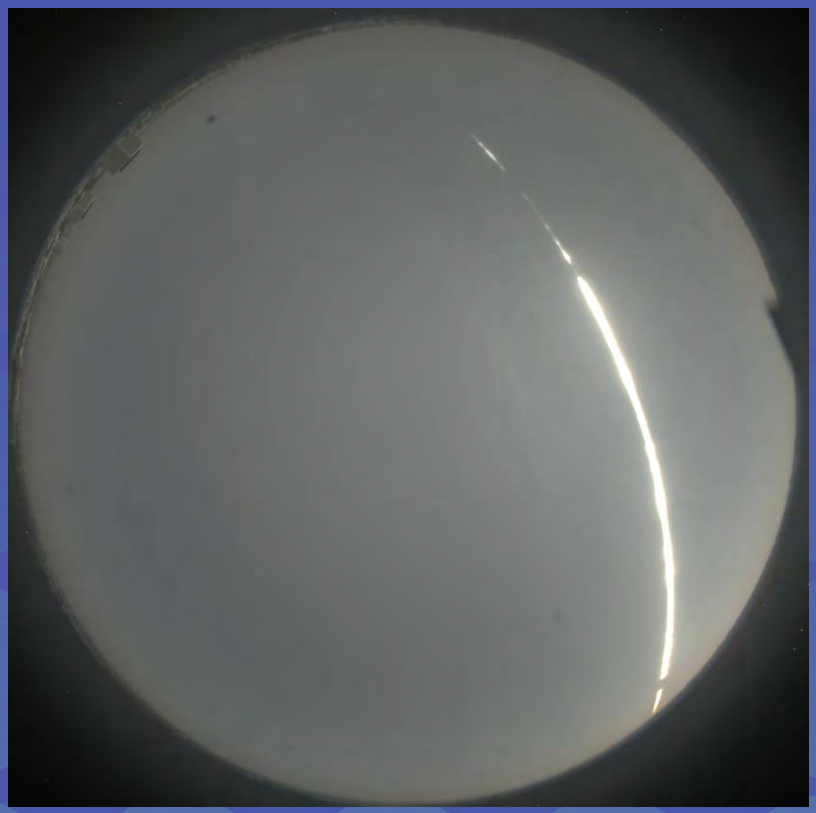
Before correction

After correction based on MacBeth ColorChecker chart appearance

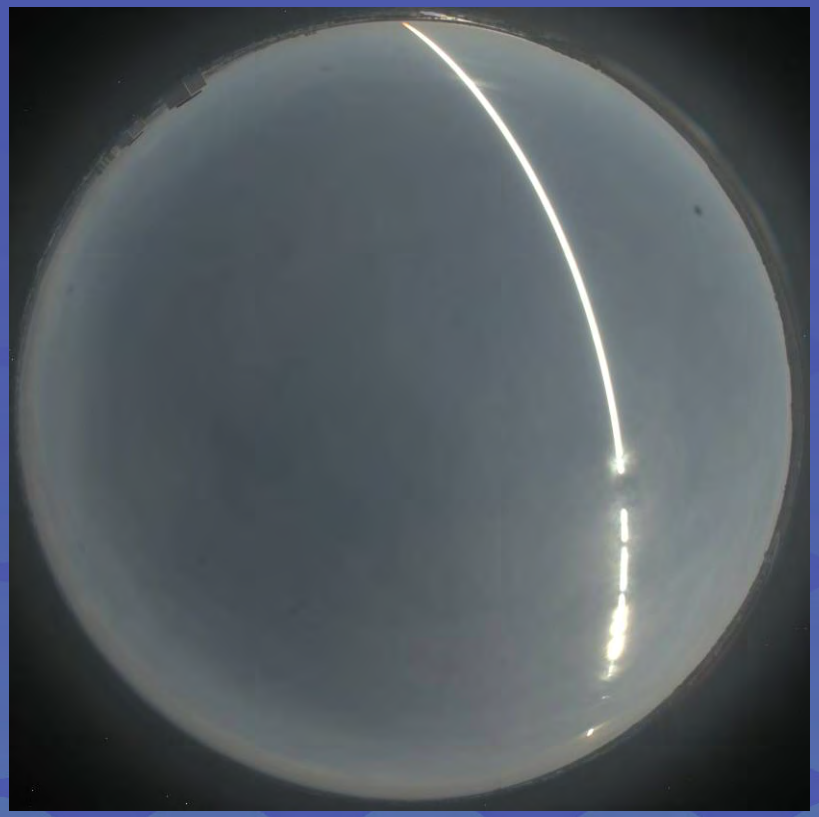
Two Complete days of HDR Lighting (see video)

SIGGRAPH2004

(day averages at 1 min. intervals)



Feb 22, 2004



Feb 23, 2004

Lit by sun and sky

9 samples per pixel, 17 min.

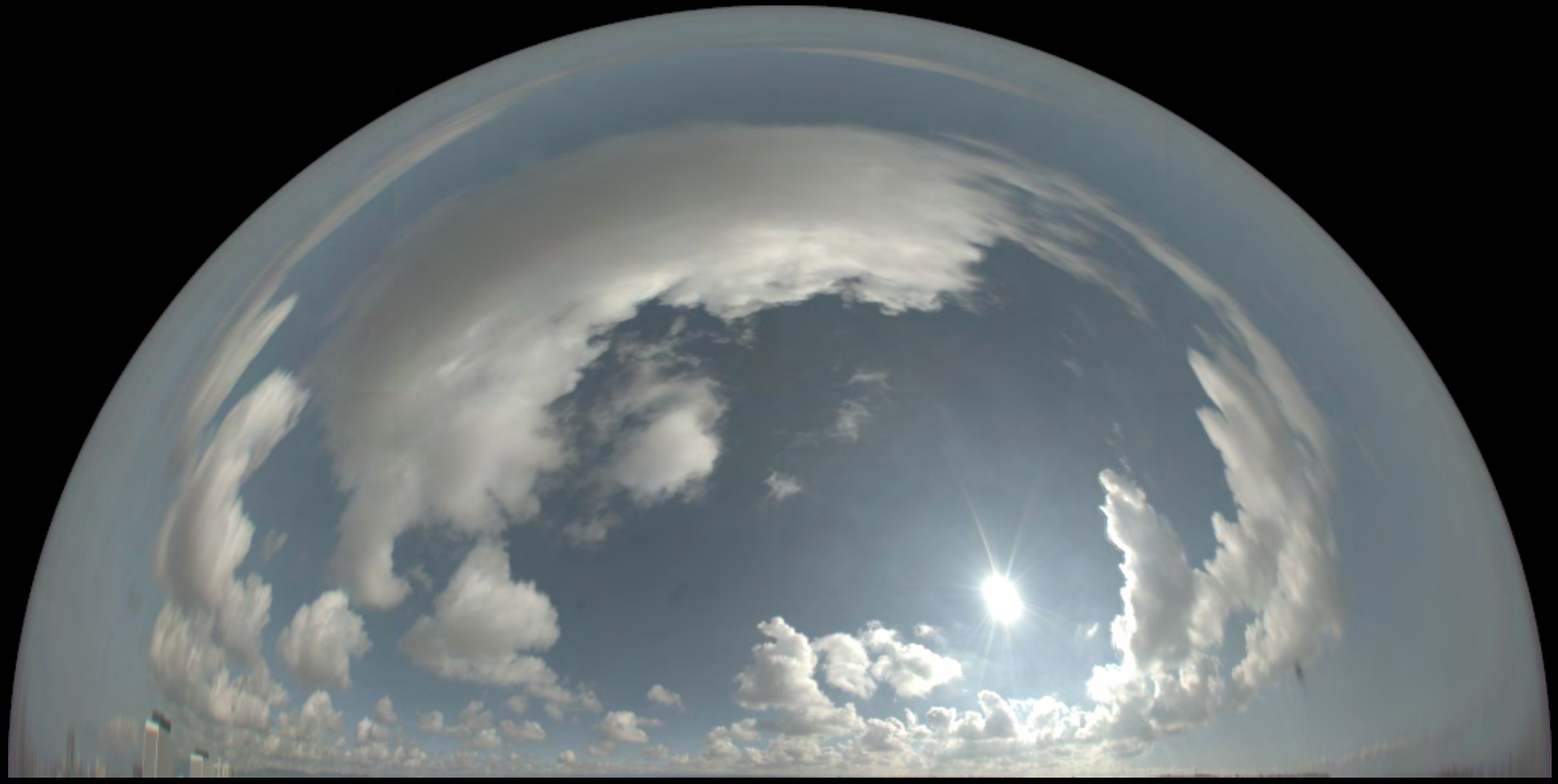
16 samples per pixel, 46 min.

100 samples per pixel, 189 min.

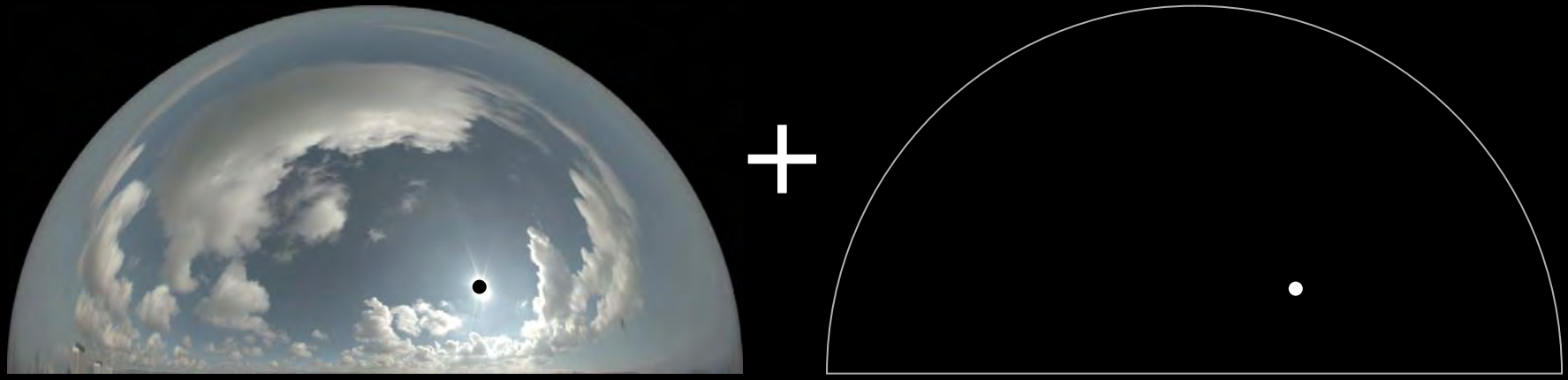
A sunlit sample point

A shadowed sample point

HDRI Sky Probe

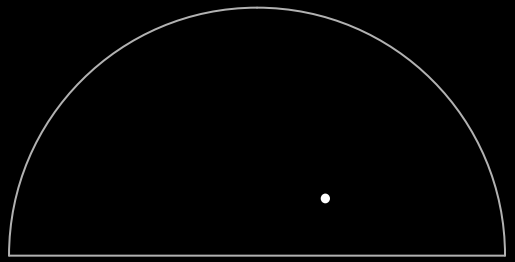
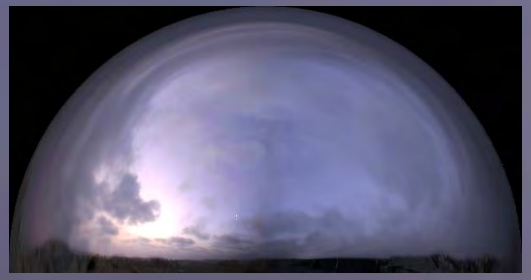
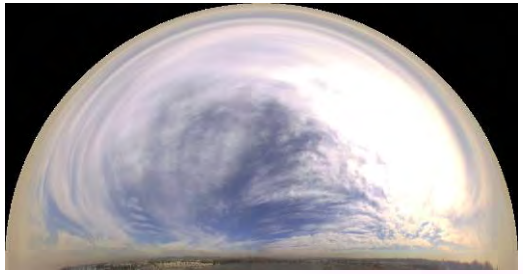


Clipped Sky + Sun Source



Lit by sky only, 17 min.

Lit by sun only, 21 min.



Lit by sun and sky, 25 min