



1

**A Lighting Reproduction Approach
to Live-Action Compositing**



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**Paul Debevec Andreas Wenger Chris Tchou
Andrew Gardner Jamie Waese Tim Hawkins**
USC Institute for Creative Technologies

The slide features a central image of a woman with dark hair, wearing a black and white striped shirt, looking upwards. The background of the image is a warm, orange and yellow glow. In the top right corner of the image, there is a small, circular inset showing a glowing, metallic sphere. The slide is framed by a dark blue background with a large, light blue star shape. The SIGGRAPH 2002 San Antonio logo is repeated on both the left and right sides of the slide.

2

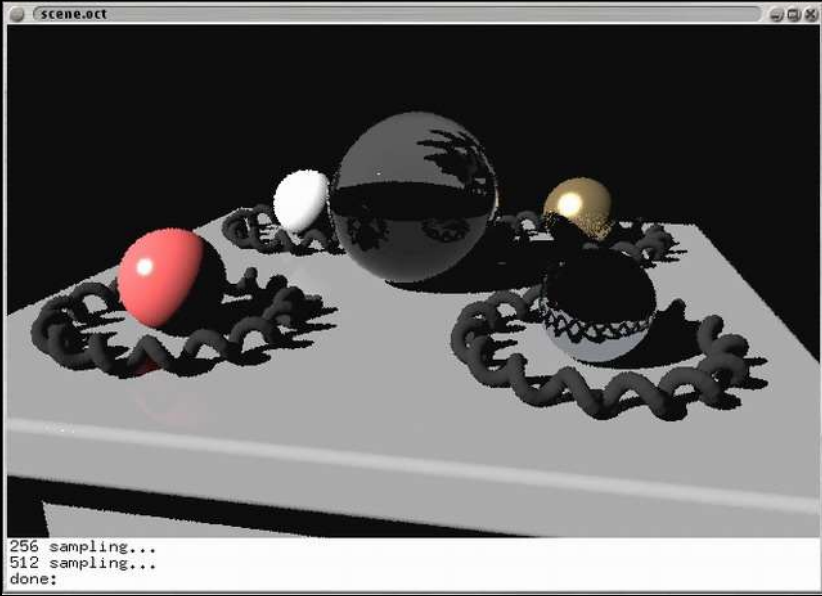
Traditional Live-Action Compositing




Images: BKSTS film process chart



3



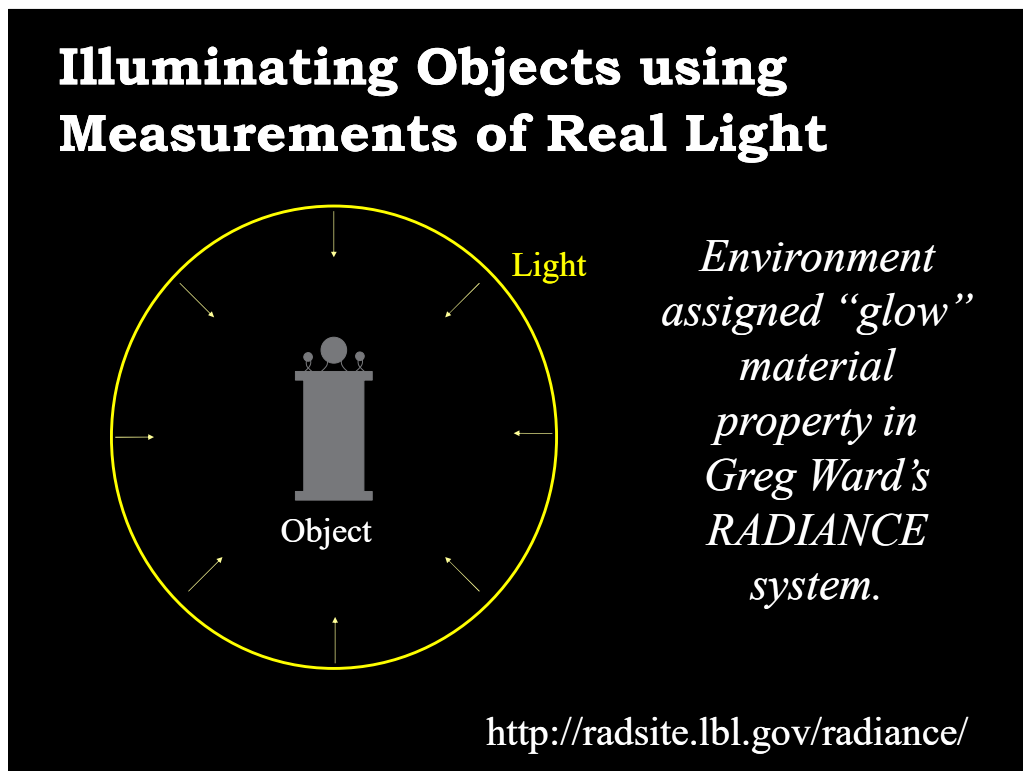
256 sampling...
512 sampling...
done:



4



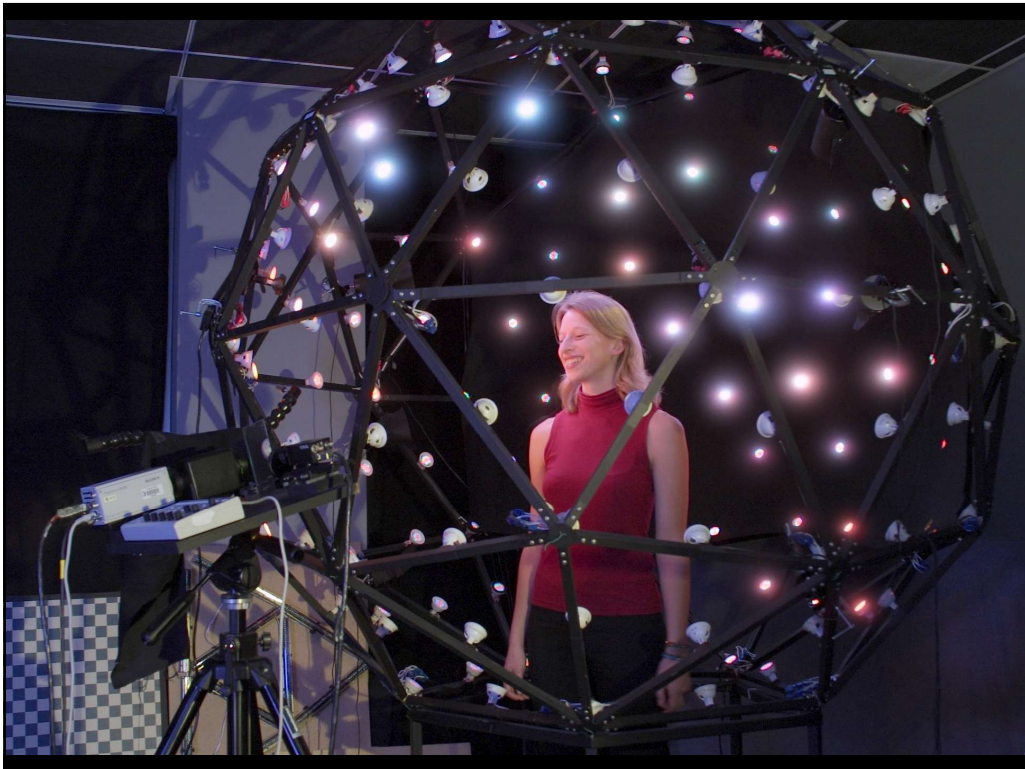
5



6

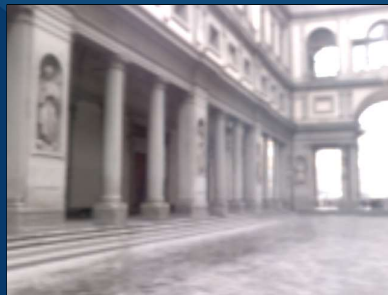


7



8

A Lighting Reproduction Approach



9

Related Work

- **Blue Screen Matting**
Smith and Blinn 96
Chuang et al. 02 (Video Matting)
- **Recombining basis lighting**
Debevec et al. 00 (Light Stage 1) Hawkins
et al. 01 (Light Stage 2) Malzbender et al.
01 (PTMs)
Koudelka et al. 01
- **Environment Matting**
Zongker et al. 99
Chuang et al. 00 (Real time!)

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10

www.desertdomes.com

2 frequency alternate dome










Dome Radius:

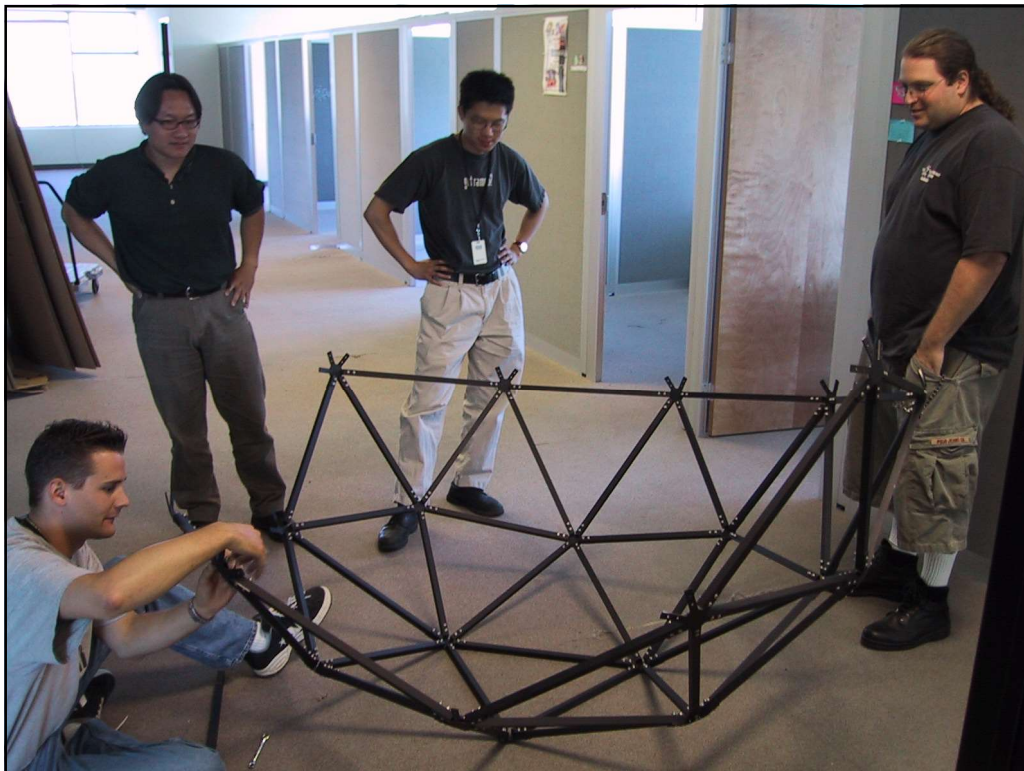
Don't include units here. For example, if you want to build a dome that's 10' 6" high, enter 10.5

Check out the new [FAQ page!](#)

Strut	Length	Dome	Sphere
A	<input type="text" value="0.618"/>	35	60
B	<input type="text" value="0.546"/>	30	60
4-way connectors		10	0
5-way connectors		6	12
6-way connectors		10	20



11



12

Color Kinetics iColor MR Light



www.colorkinetics.com

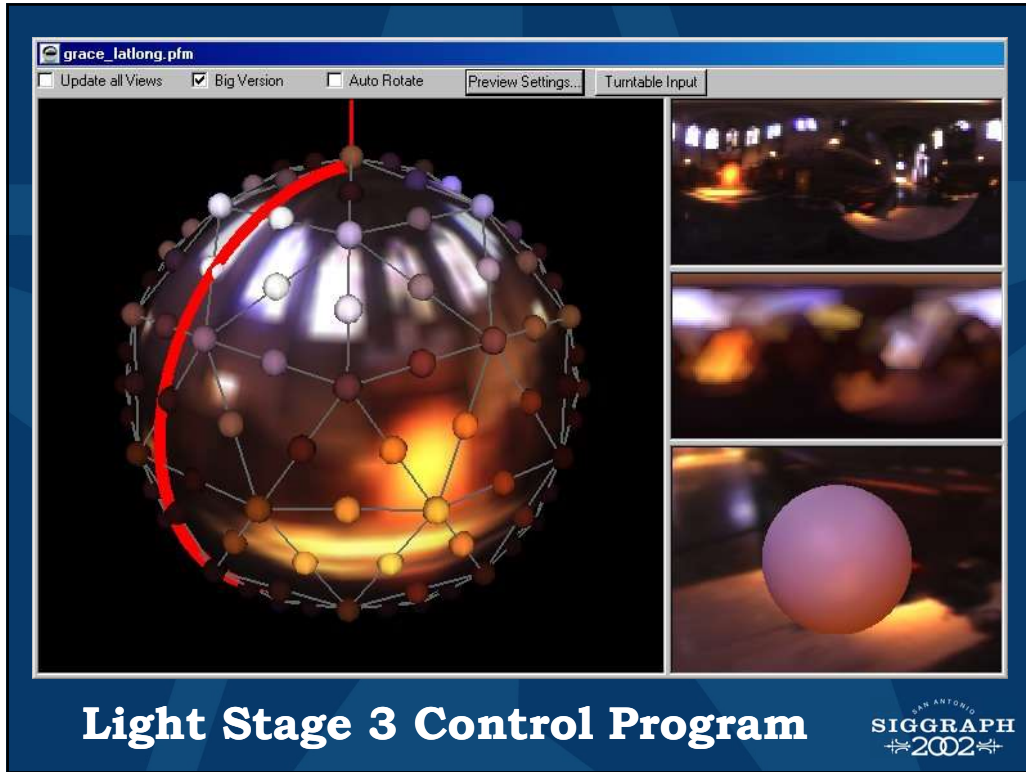
- 18 LEDs: 8 Red, 5 Green, 5 Blue
- USB Addressable, 8-bit RGB values

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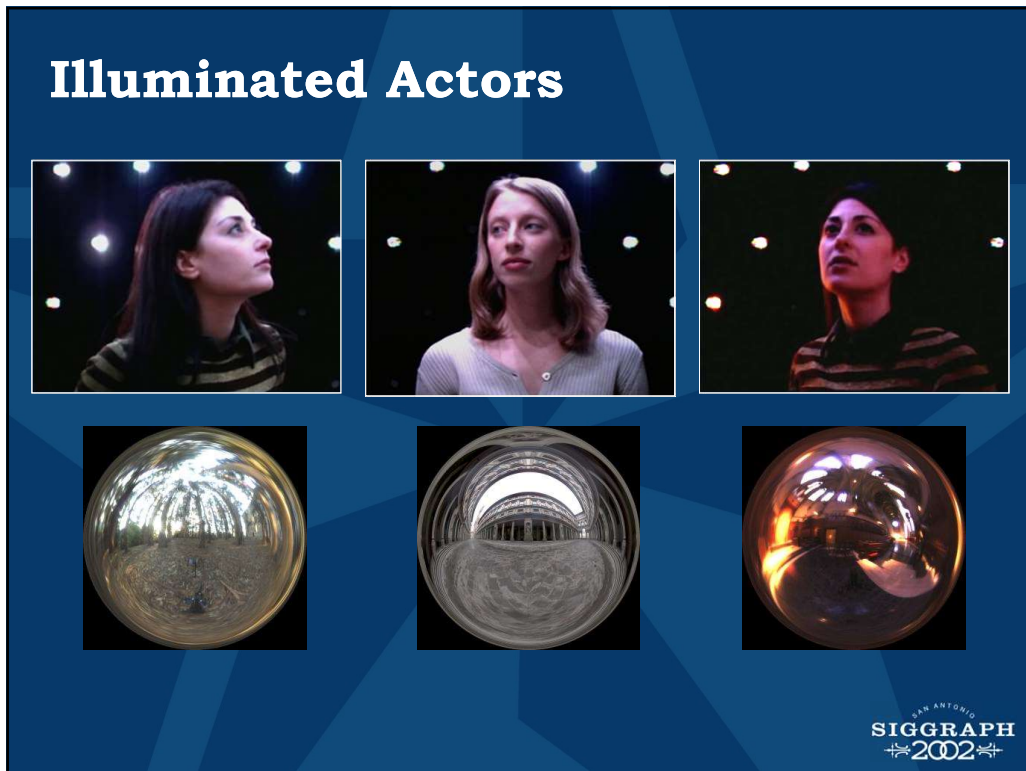
13



14



15



16

Obtaining a Matte



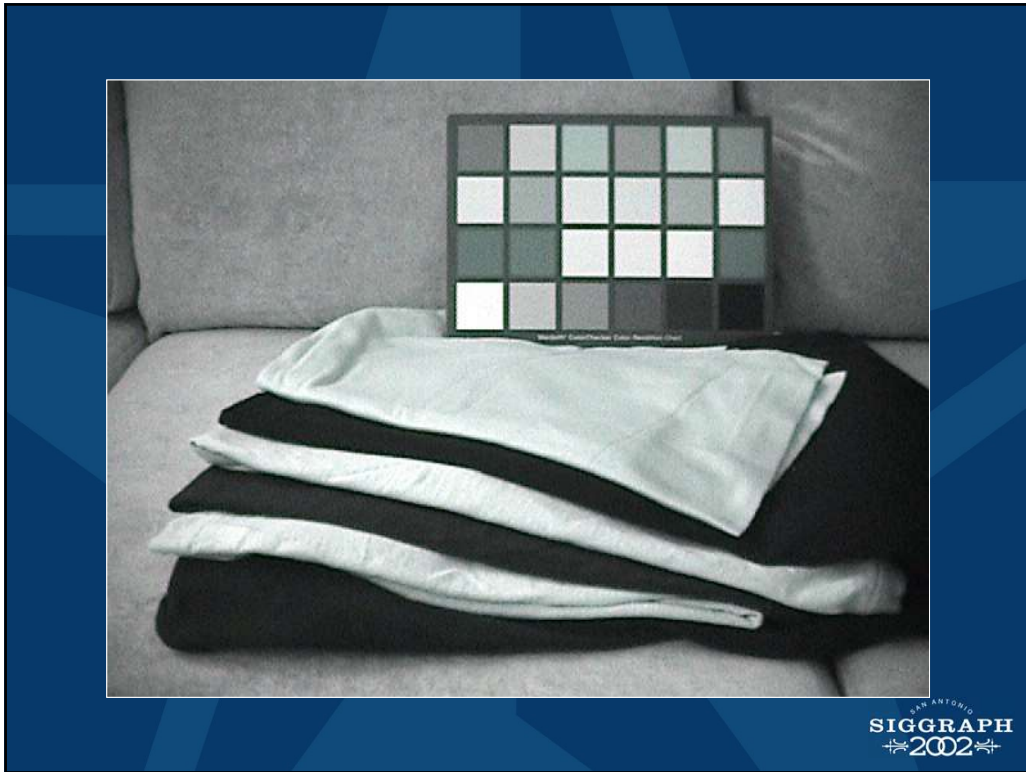
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17



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18



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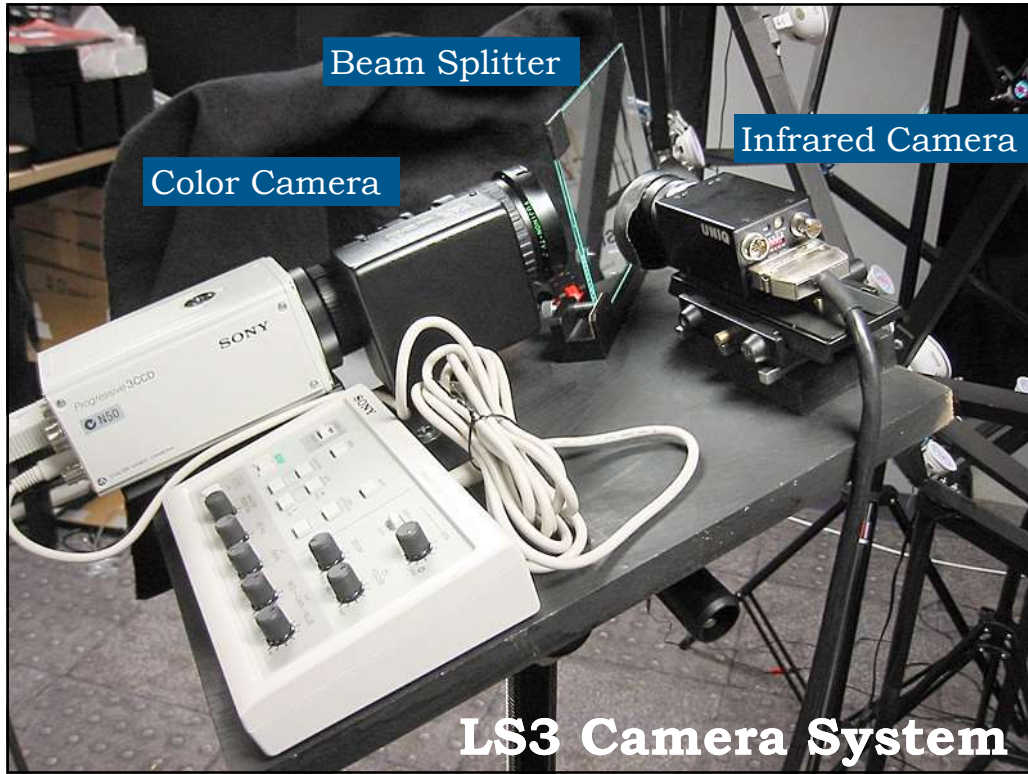
19

Infrared LED IR-Screen Lights



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20



21

Matte Division

The diagram shows the process of matte division. The top row consists of three images: a silhouette of a person against a background of light spots, a division symbol (\div), a grayscale image of the light spots, and an equals sign (=). The bottom row consists of three images: a silhouette of a person against a white background, a right-pointing arrow (\rightarrow), and a silhouette of a person against a white background. The background is a blue geometric pattern.

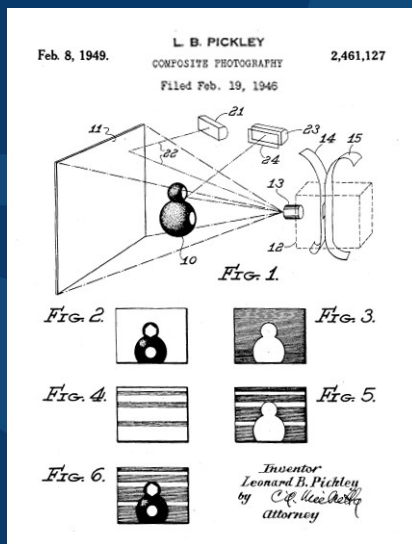
22

Composited Results

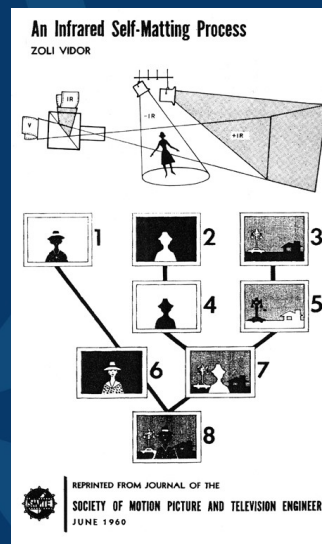


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23



“Composite Photography”
L. B. Pickley USPTO 1949



“An Infrared Self-Matting Process”
Z. Vidor JSMPTE 1960

Research thanks: Johnathan Banta, Ken Wiatrak

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24

Front-Projection Blue Screen

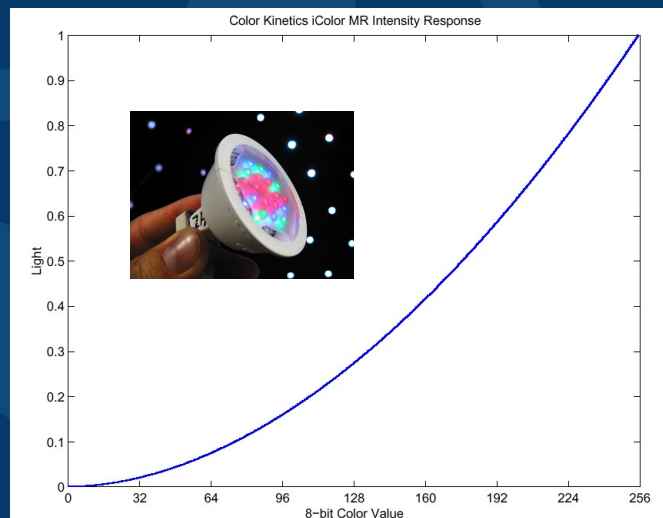


Used at Keio University for "The Magick Lesson"
Directed by Mark Dippe and Masa Inakage

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25

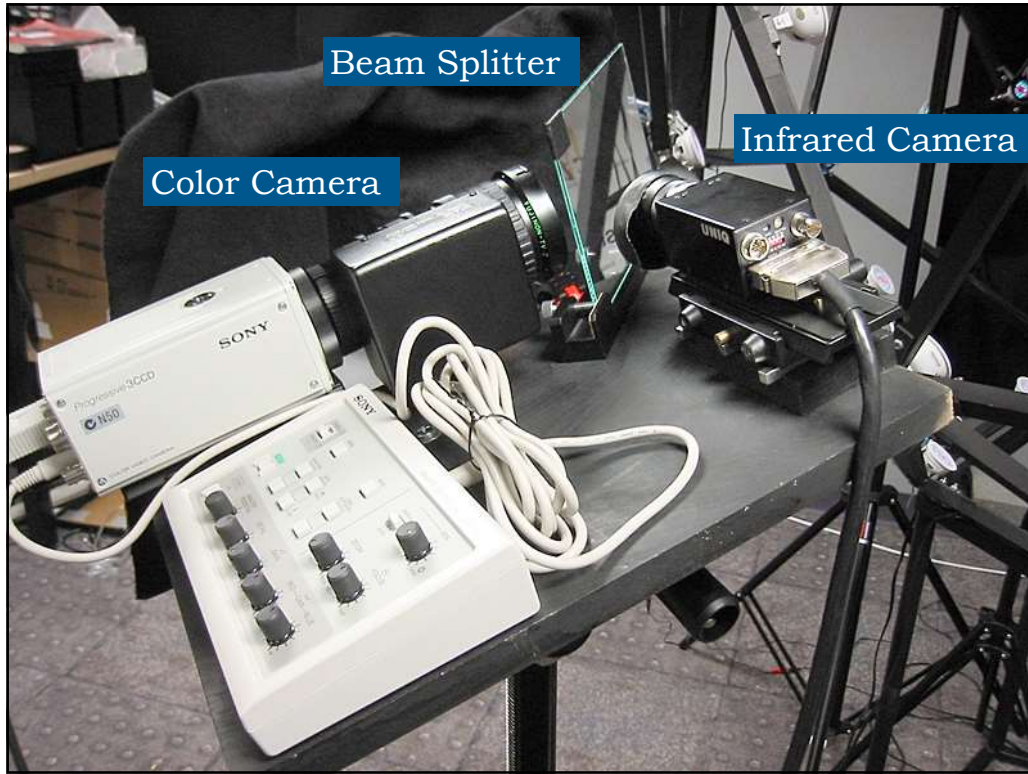
iColor MR Response Curve



Calibrated using Photo Research PR650
Spectroradiometer <http://www.photoresearch.com/>

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26



29

Color/IR Image Registration

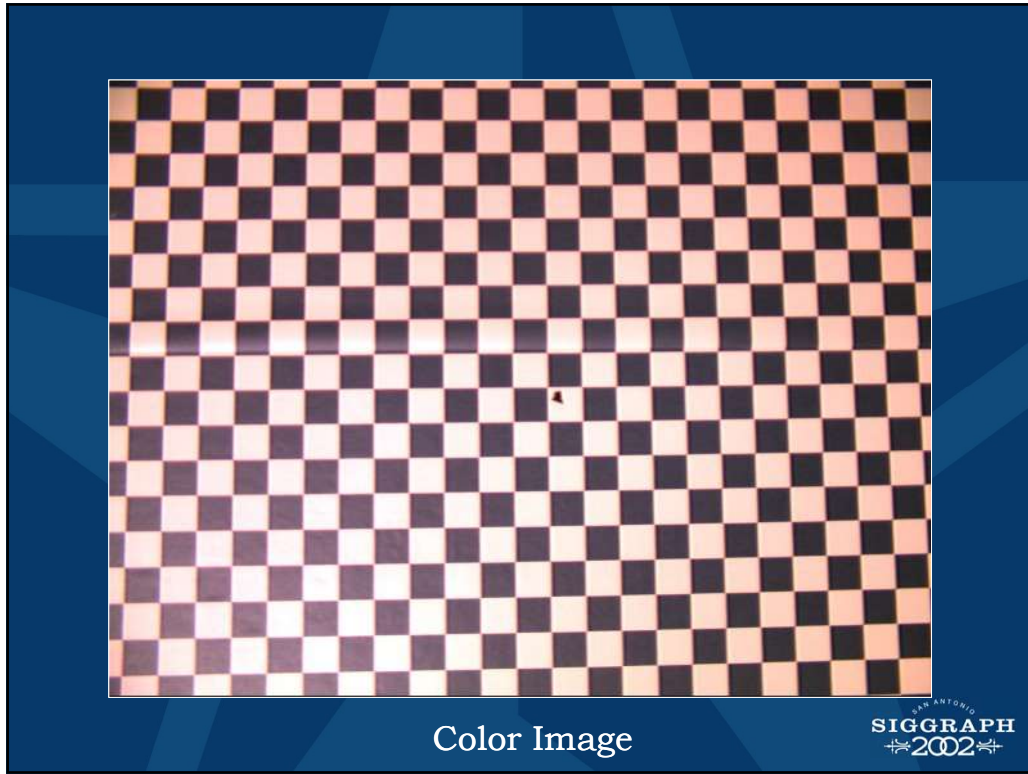
The image shows two square checkerboard patterns side-by-side. The left one is a standard color checkerboard with alternating white and black squares. The right one is a grayscale checkerboard with alternating light and dark gray squares. Both are used for image registration.

Color Image

IR Image

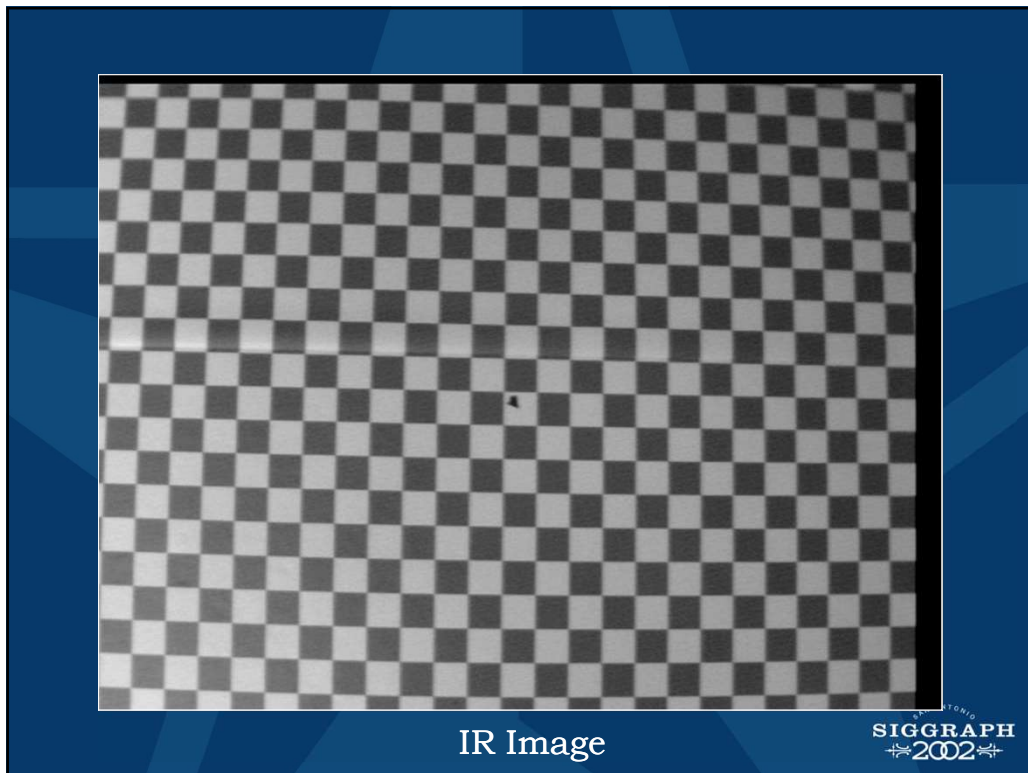
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30



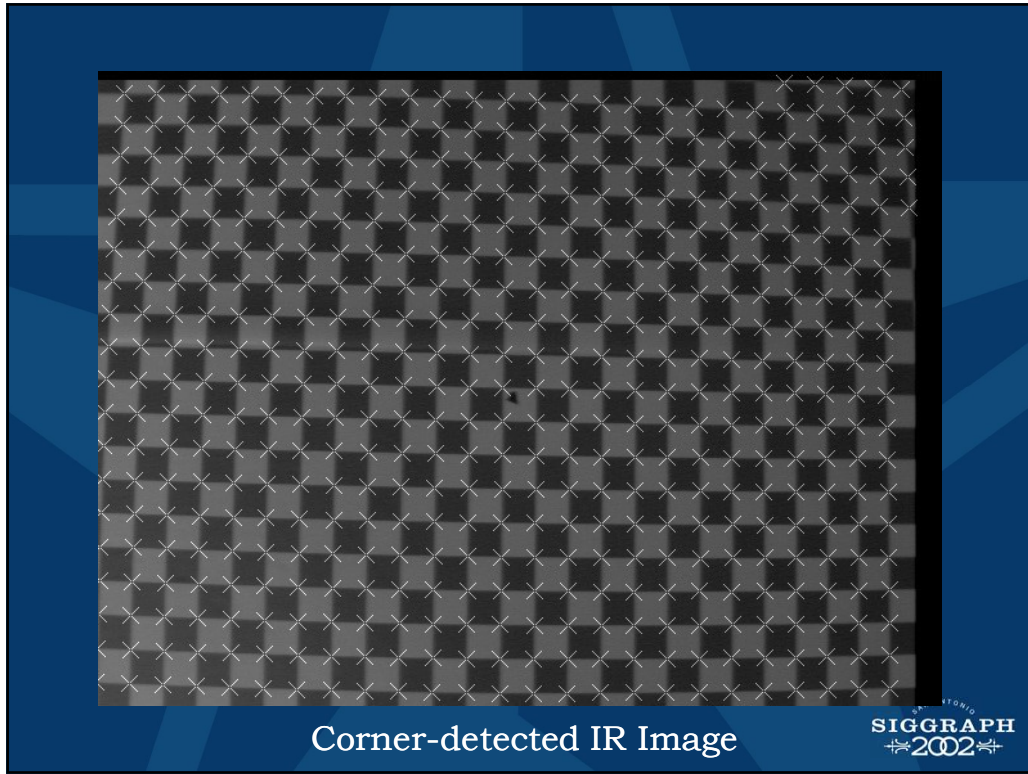
Color Image

31

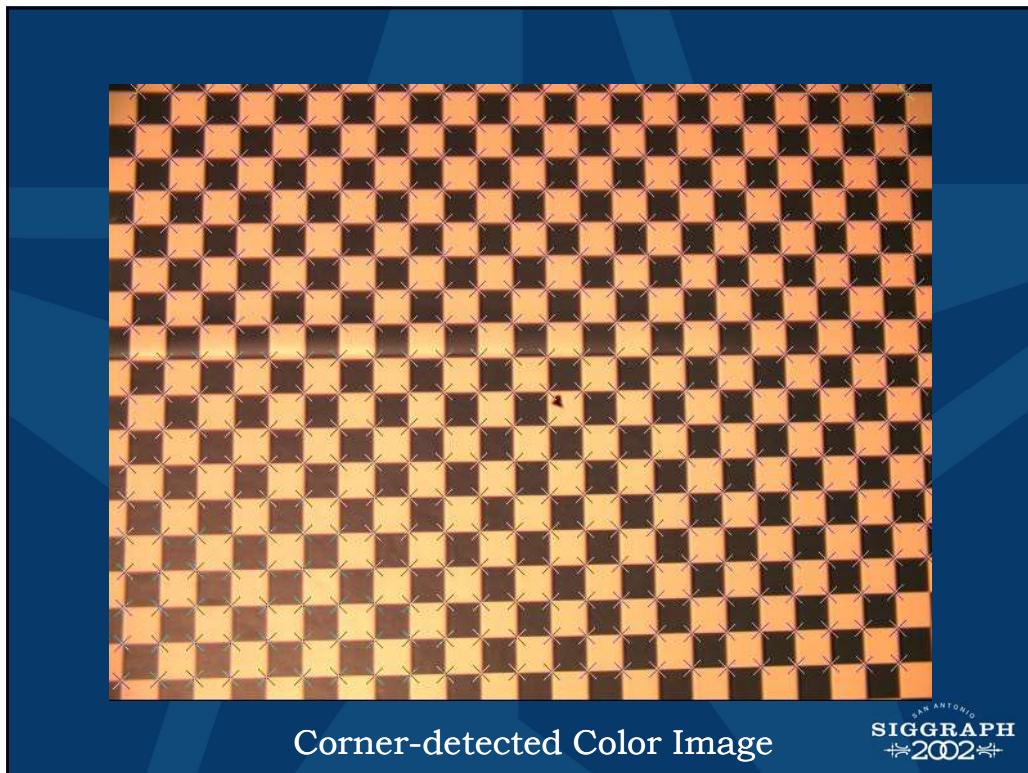


IR Image

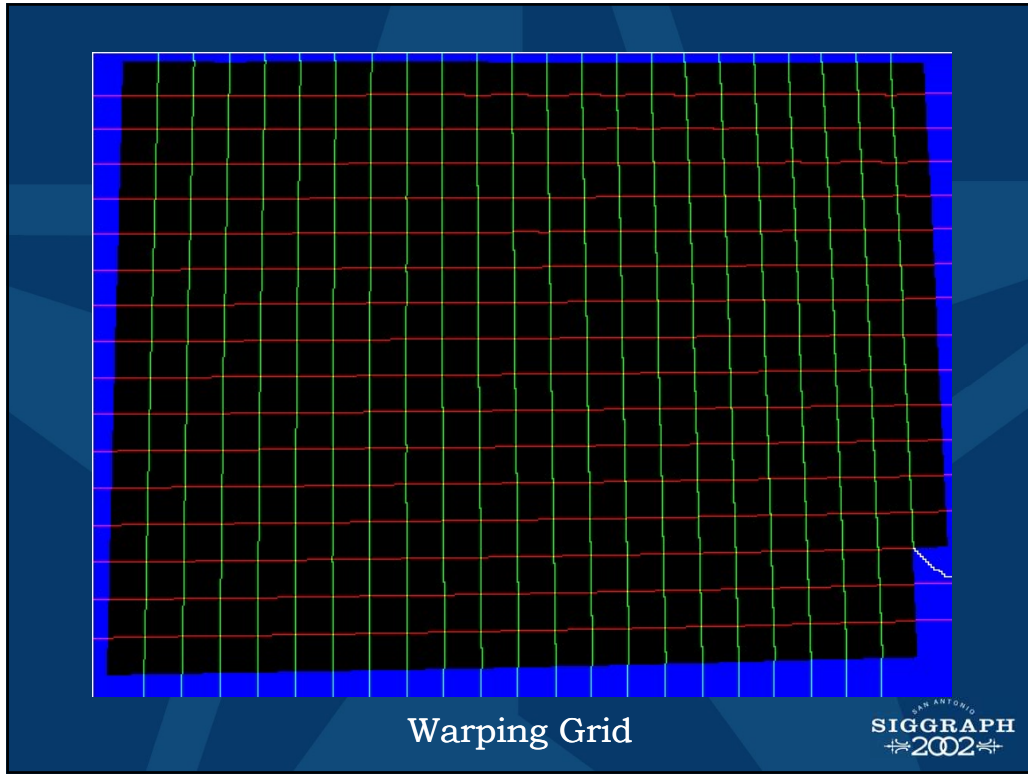
32



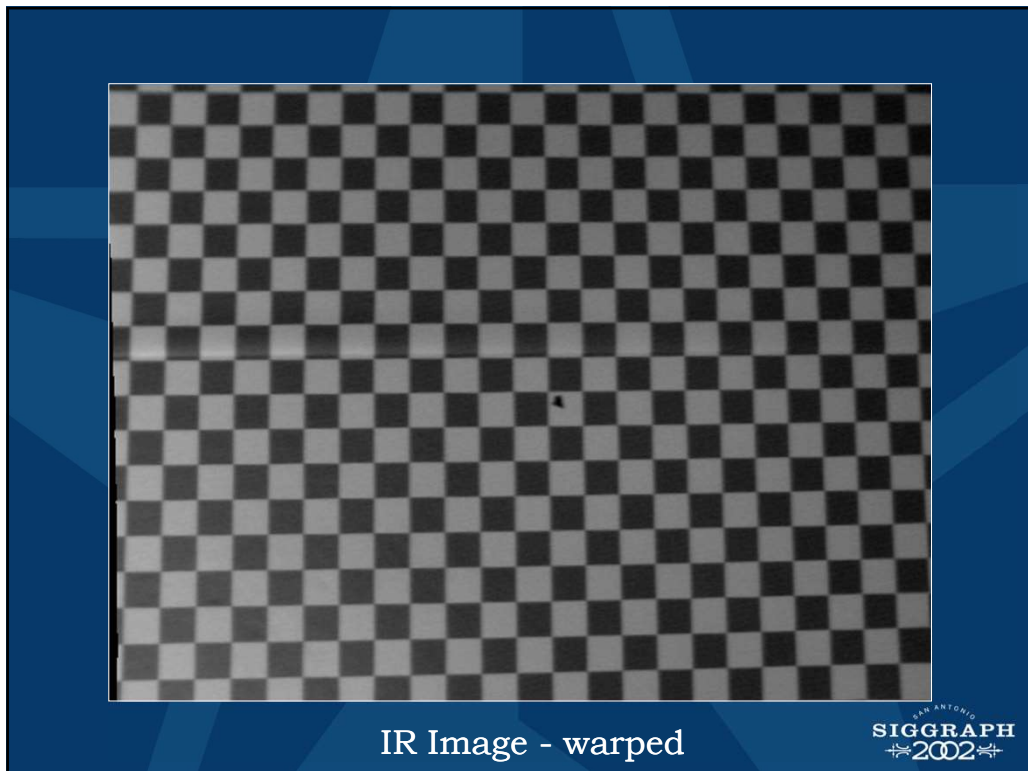
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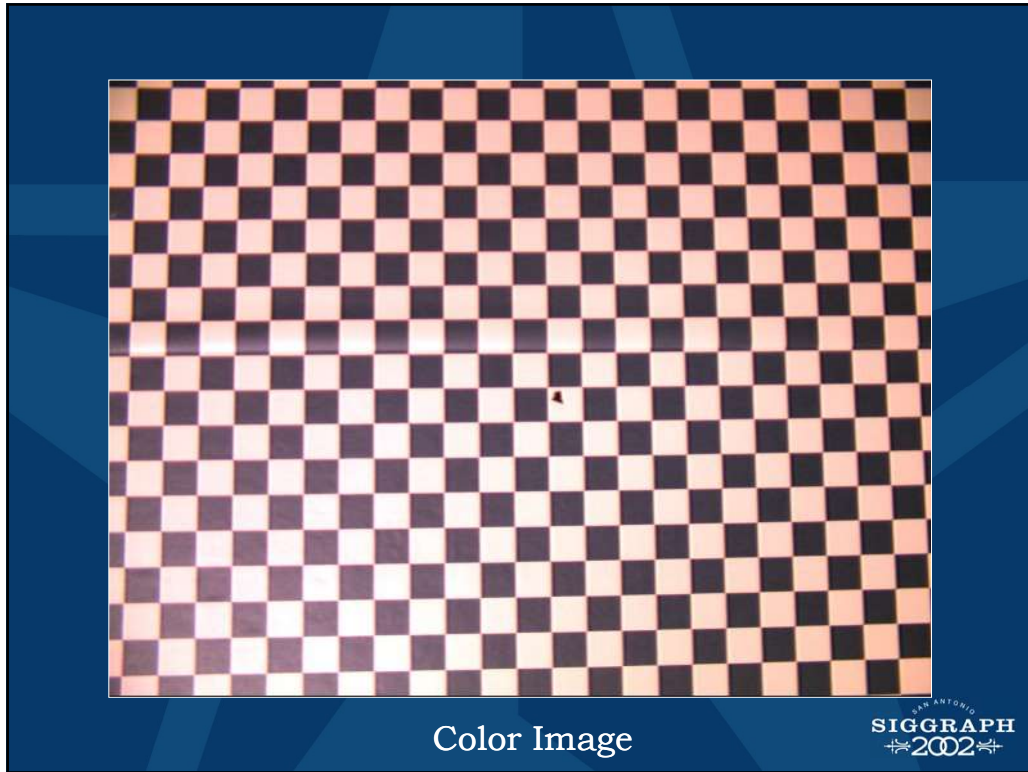
34



35



36



37



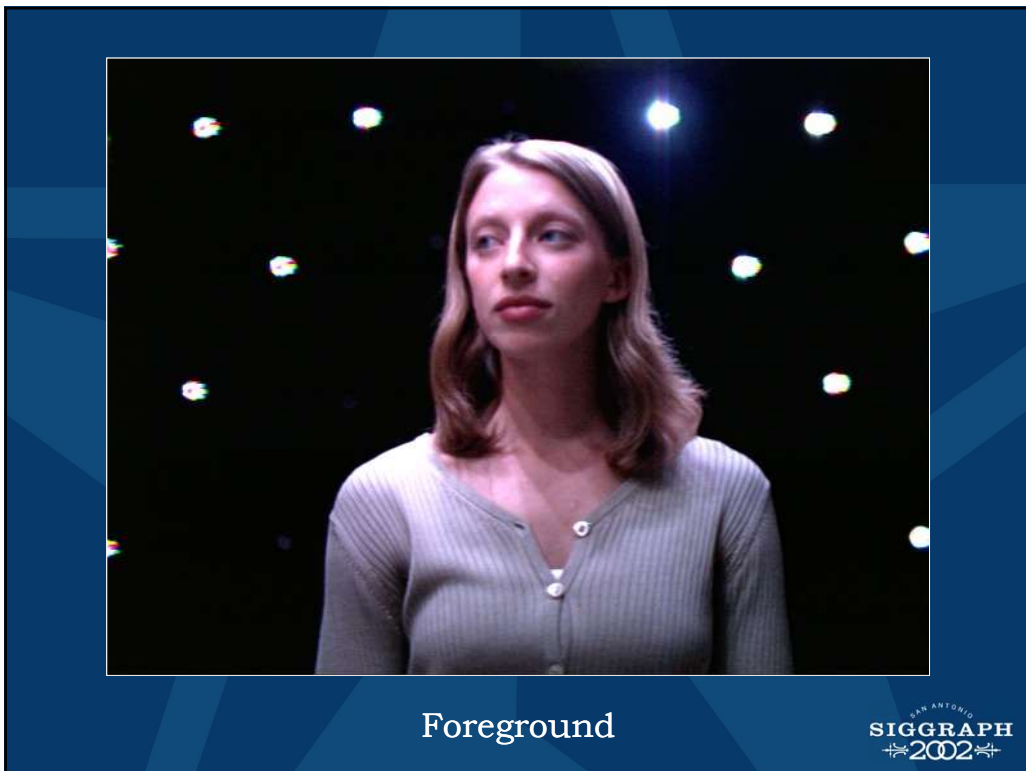
38



Warped Matte

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39



Foreground

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40



Plate with matte holdback



41

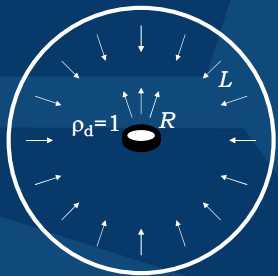
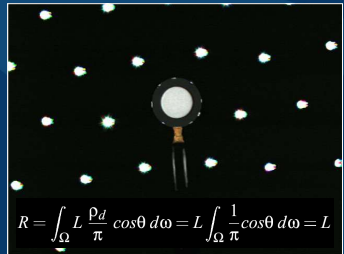


Final Composite



42

Color Calibration

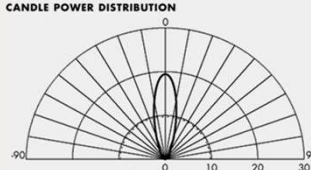



$$R = \int_{\Omega} L \frac{\rho_d}{\pi} \cos\theta \, d\omega = L \int_{\Omega} \frac{1}{\pi} \cos\theta \, d\omega = L$$

$L' = MR$


Falloff Compensation


CANDLE POWER DISTRIBUTION



Horizontal and Vertical (solid line) [Candelas]

Measured on: White
 Beam center: 20 cd
 Thin dashed line: Indicates 50% of peak
 Multipliers: 0.28 Red, 0.61 Green, 0.17 Blue





43

3D Virtual Set



Rendered with Global Illumination and Image-Based HDR Lighting in "Arnold" by Marcos Fajardo



44

Virtual Set Composite with Dynamic Lighting



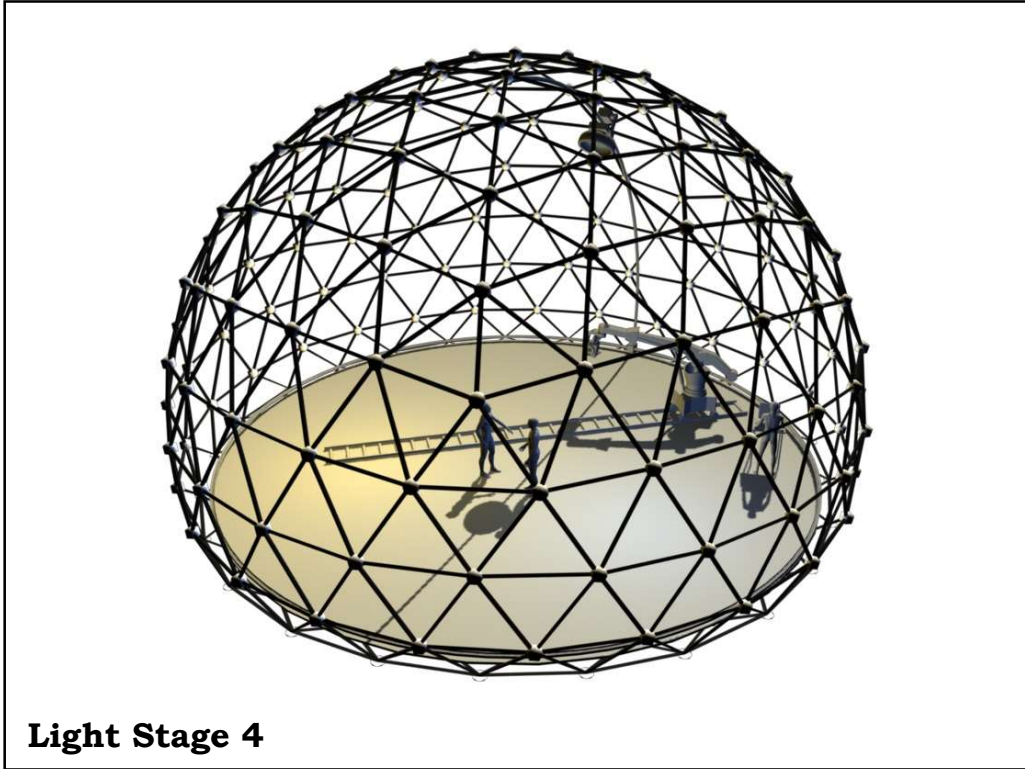
45

Future Work

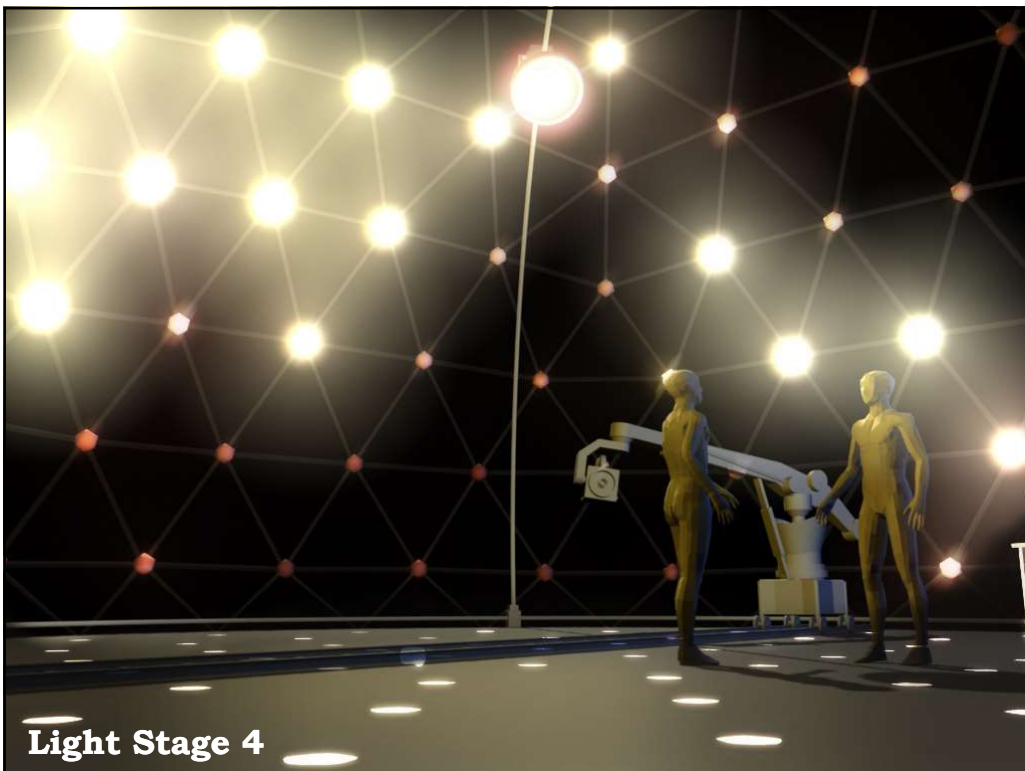
- **Reproduce near-field incident illumination**
 - Video Projectors
- **Add artistic controls**
 - Rim Lights
 - Bounce cards
- **More and Brighter Lights**
- **Larger Stage**

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46



47



48

Credits

Video Producer: Diane Piepol

Editing and Animation: Brian Emerson

Textures and Illustrations: Marc Brownlow

3D Virtual Set: Brian Emerson, Yikuong Chen, Rippling Tsou, Shivani Khanna, Diane Suzuki

Arnold Global Illumination Renderer: Marcos Fajardo

Infrared Matte Backing: Maya Martinez

Actors: Elana Livneh and Emily DeGroot

Consultants: Alex Singer, Randal Kleiser, Woody Omens, ASC, Gordie Haakstad, Kelly Richard, Andy Lesniak, Ken Wiatrak, and Ayten Durukan

Special Thanks: Dick Lindheim, Bill Swartout, Mike Andrews, Mike Macedonia, James Blake, Jacki Morie, Van Phan, Anshul Panday, Bobbie Halliday, Kevin Dowling, Andy van Dam, and Linda Miller, STRICOM, and Color Kinetics, Inc.

Sponsored by the United States Army, the University of Southern California, and TOPPAN Printing Co., Ltd.



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