

Computer Science E-7

Exposing Digital Photography

Lecture 5: Optics
October 5, 2009

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Exposure

Metering



1/13s, ISO 200, f/3.3, 0ev at 6.3mm (38mm equiv)

Photo by Larry Woods, 2009

Exposure

Metering



Image from <http://www.dpreview.com/reviews/CanonEOS5D/page6.asp>

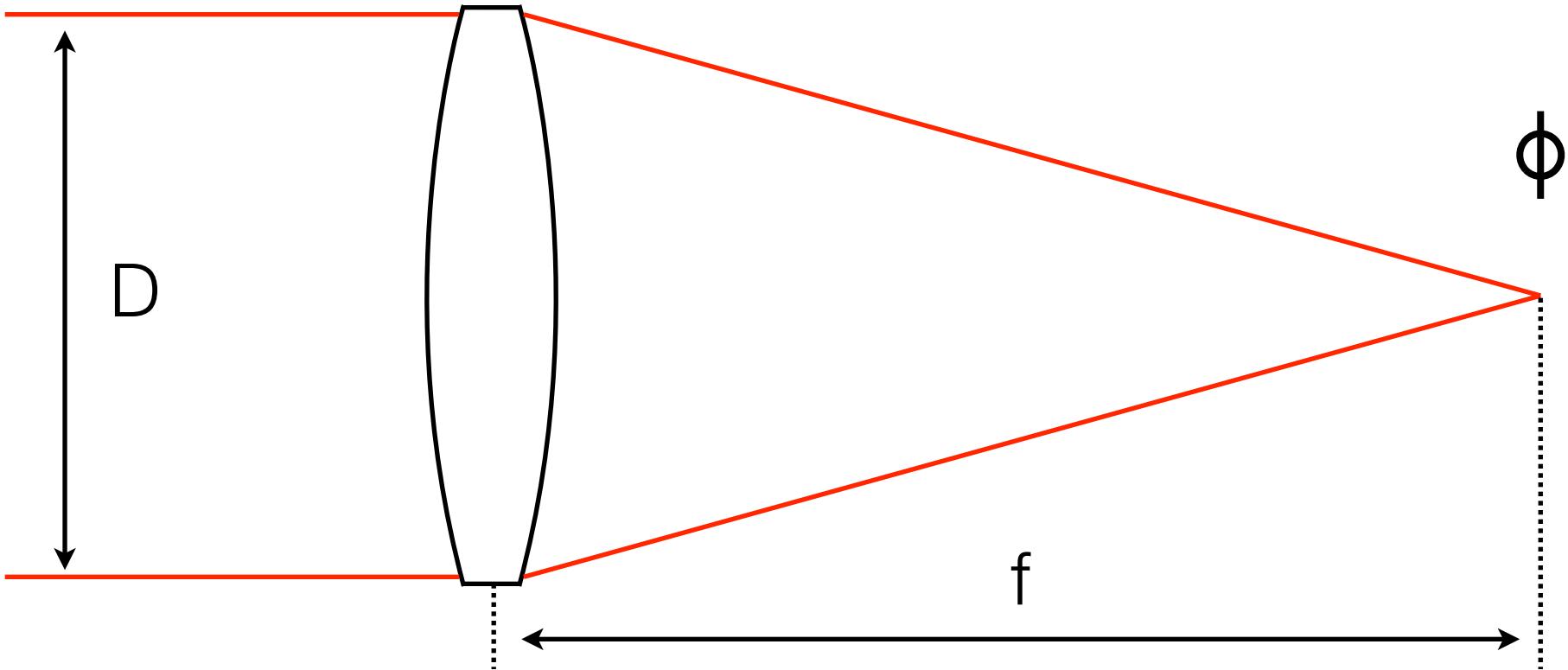
Metering

Camera Modes



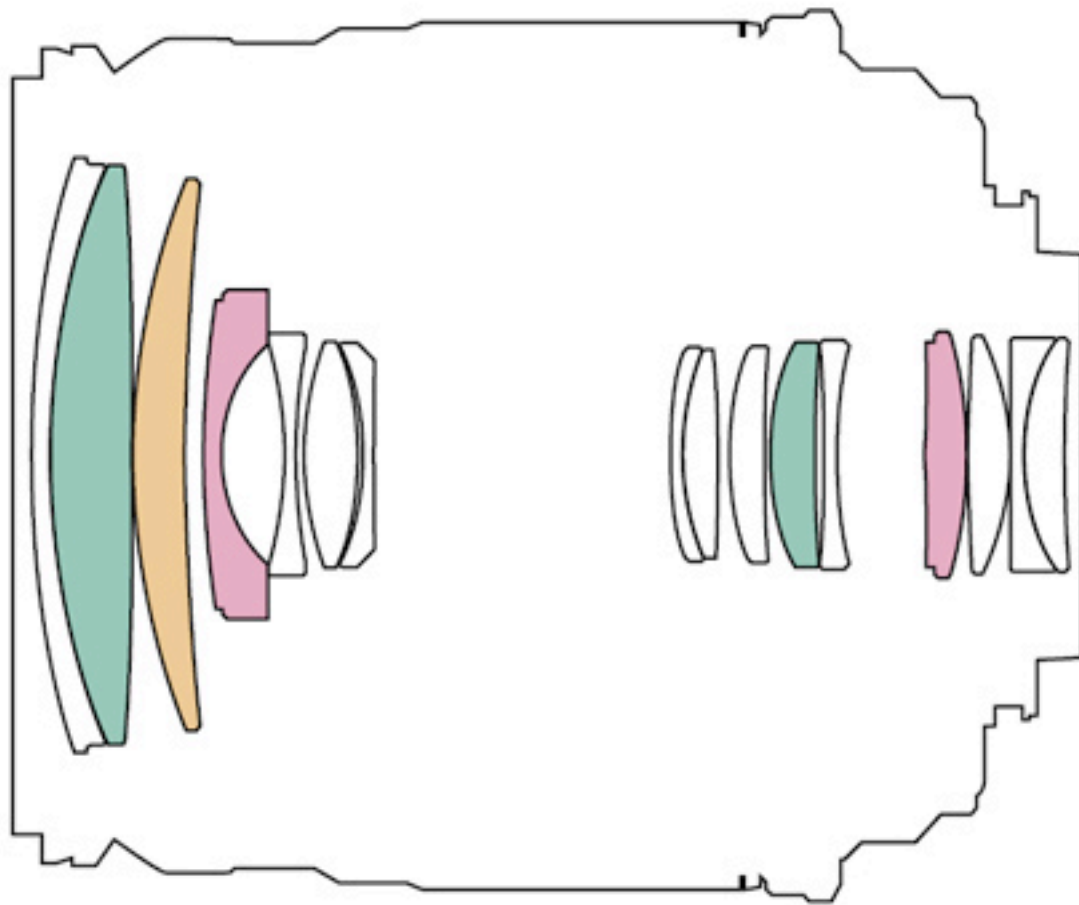
Optics

Lenses



Lenses

$$\text{F-number} = f/D$$



Lenses

Many glass elements



Left: 1/320s, ISO 800, f/2.5, 0ev at 80mm Right: 1/40s, ISO 1600, f/3.5, 0ev at 16mm

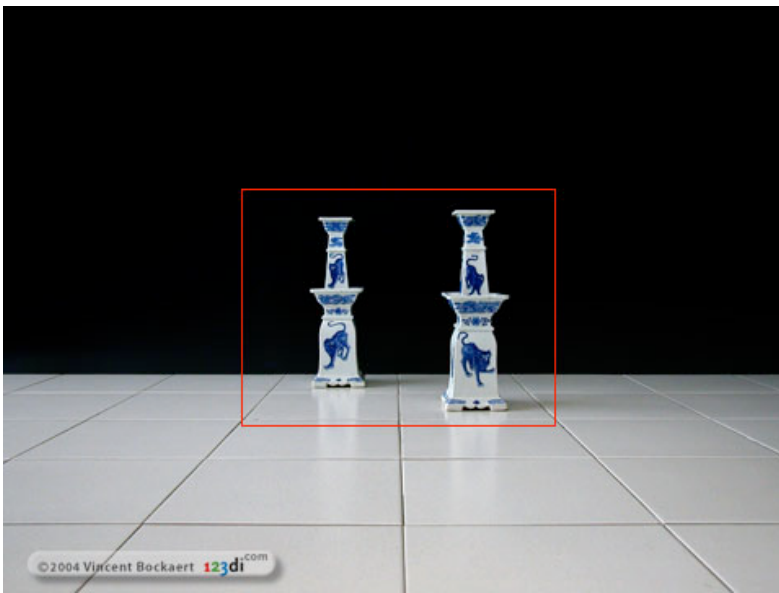


Photos by Dan Armendariz, 2005

Lenses

Focal Length and Perspective

1.



2.



3.



4.



1. 33mm. 2. Crop of #1. 3. 80mm from same distance. 4. 33mm & closer

Images from http://www.dpreview.com/learn/?/Glossary/Optical/Perspective_01.htm

Perspective

Focal Length



Left: 1/60s, ISO 1600, f/3.5, 0ev at 16mm



Right: 1/50s, ISO 400, f/4, 0ev at 16mm

Perspective

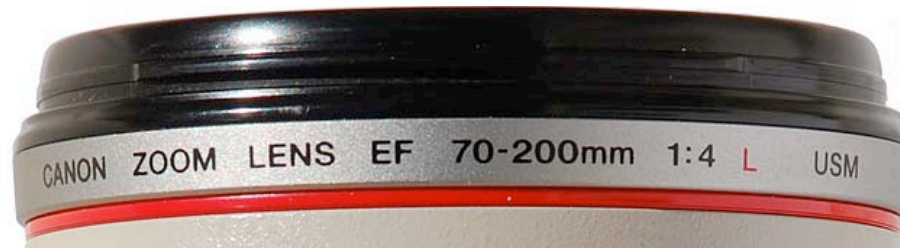
Wide-Angle Distortion



Image from <http://www.the-digital-picture.com/Reviews/Canon-TS-E-24mm-f-3.5-L-Tilt-Shift-Lens-Review.aspx>

Perspective

Correcting with Tilt-Shift



Images from <http://dpreview.com> and <http://www.kenrockwell.com/>

Lenses

Data



Left to Right: 24-70mm f/2.8, 70-200 f/4, 70-200 f/2.8 IS, 70-200 f/2.8 IS, 500 f/4 IS

Images from <http://www.the-digital-picture.com>

Lenses

Short to Long

Optics

Background Blur



Photo by Dan Armendariz, 2004
1/1250s, ISO 200, f/2.8

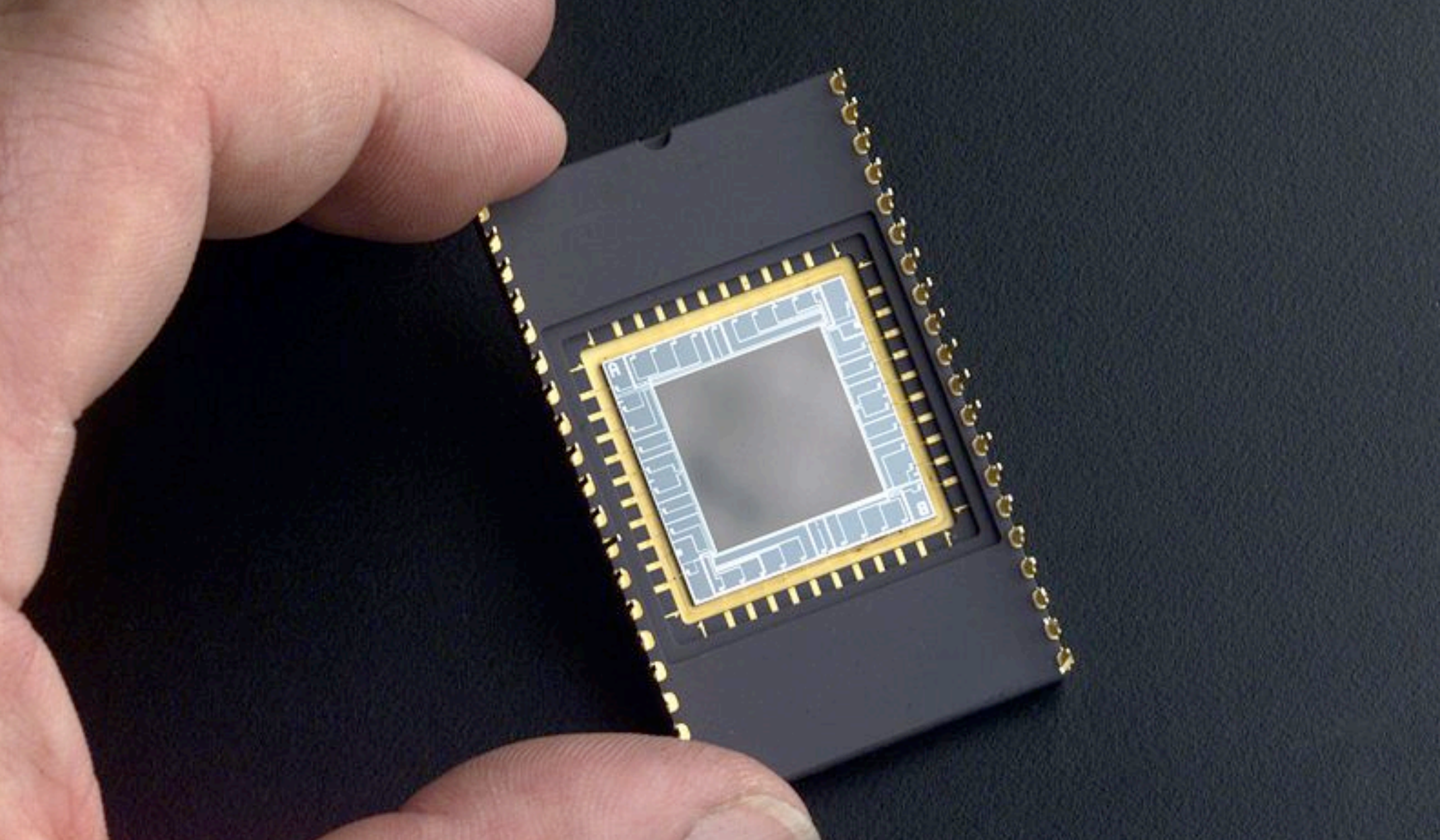
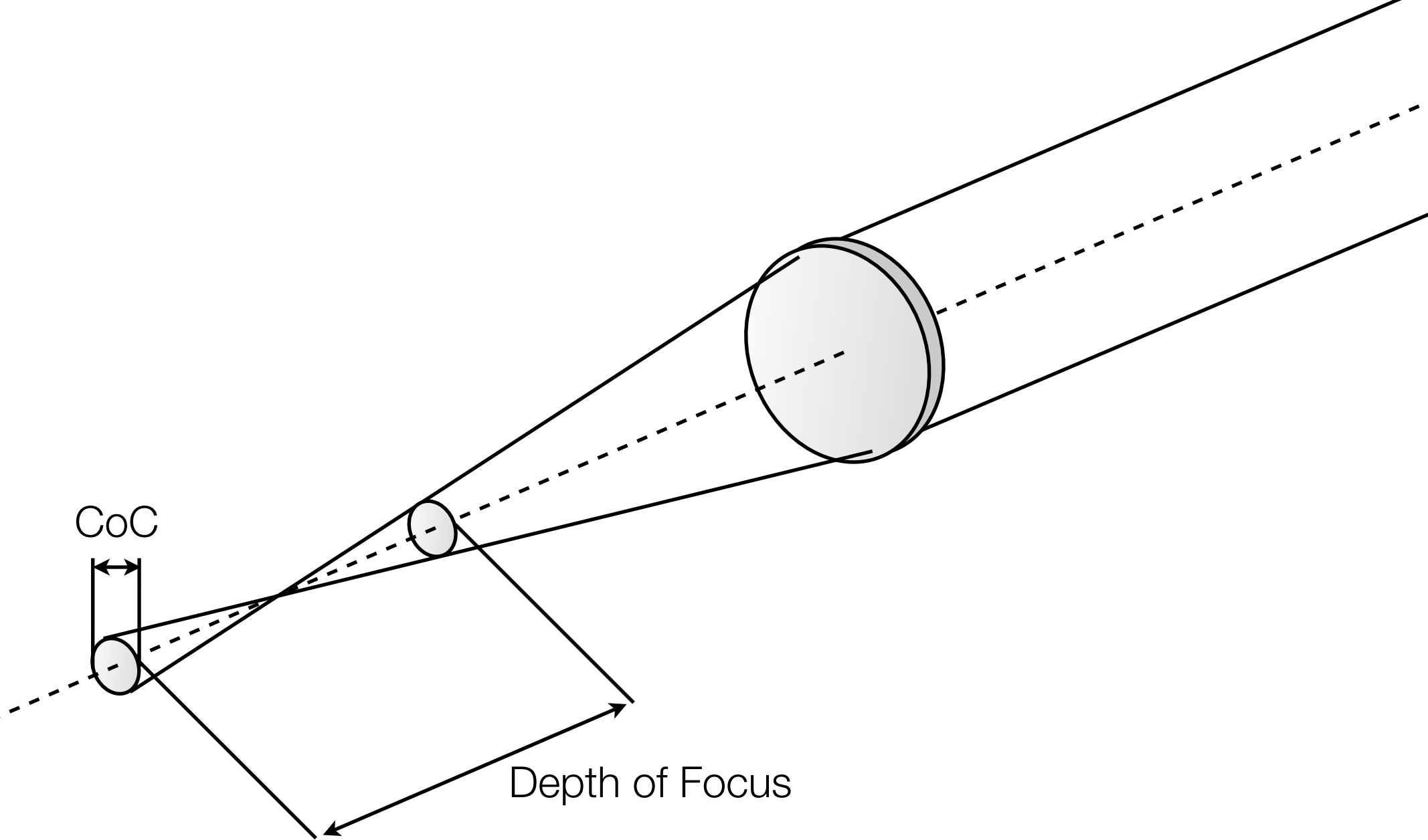


Image from http://en.wikipedia.org/wiki/Charge-coupled_device

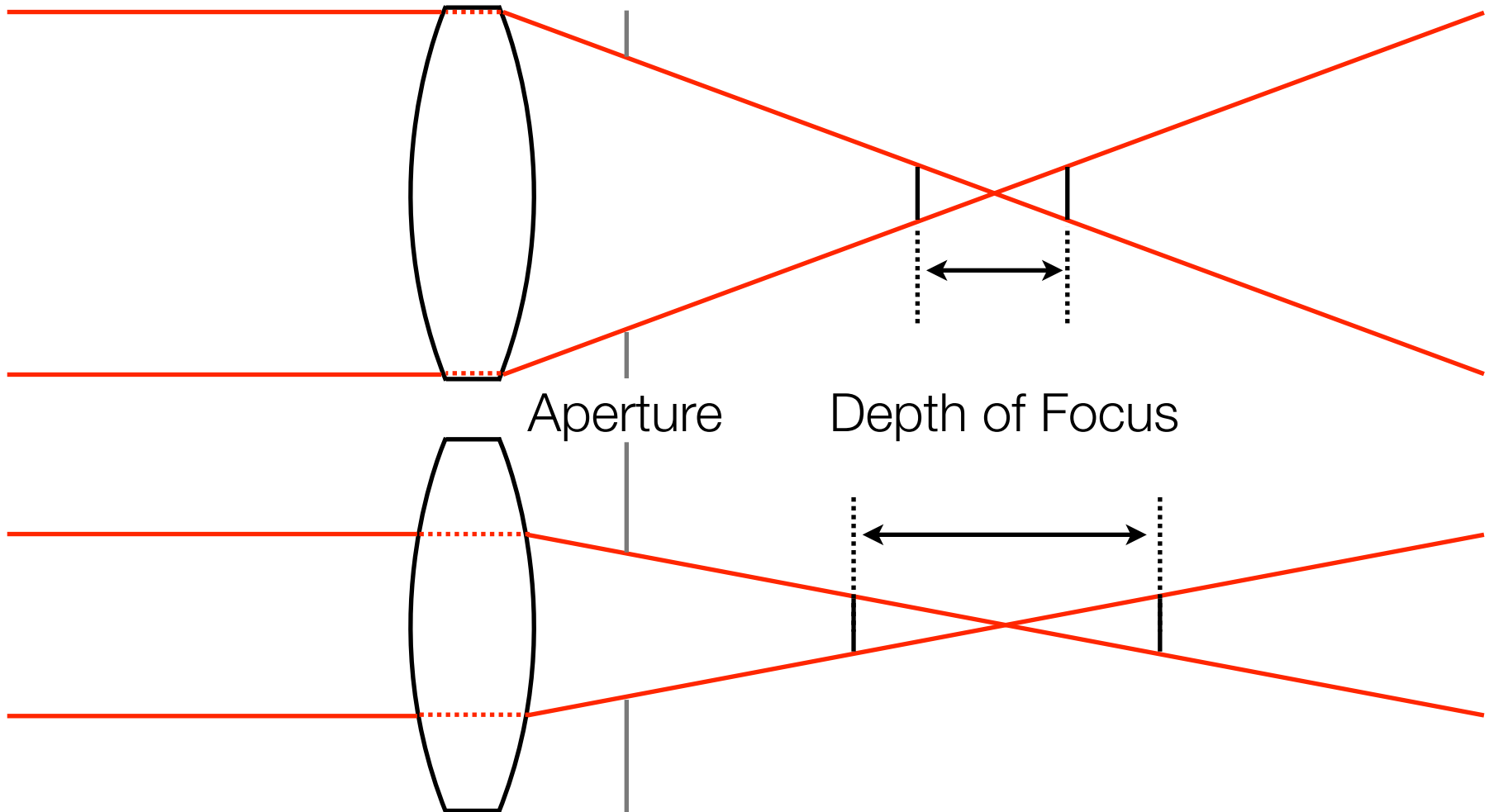
Background Blur

Sensor



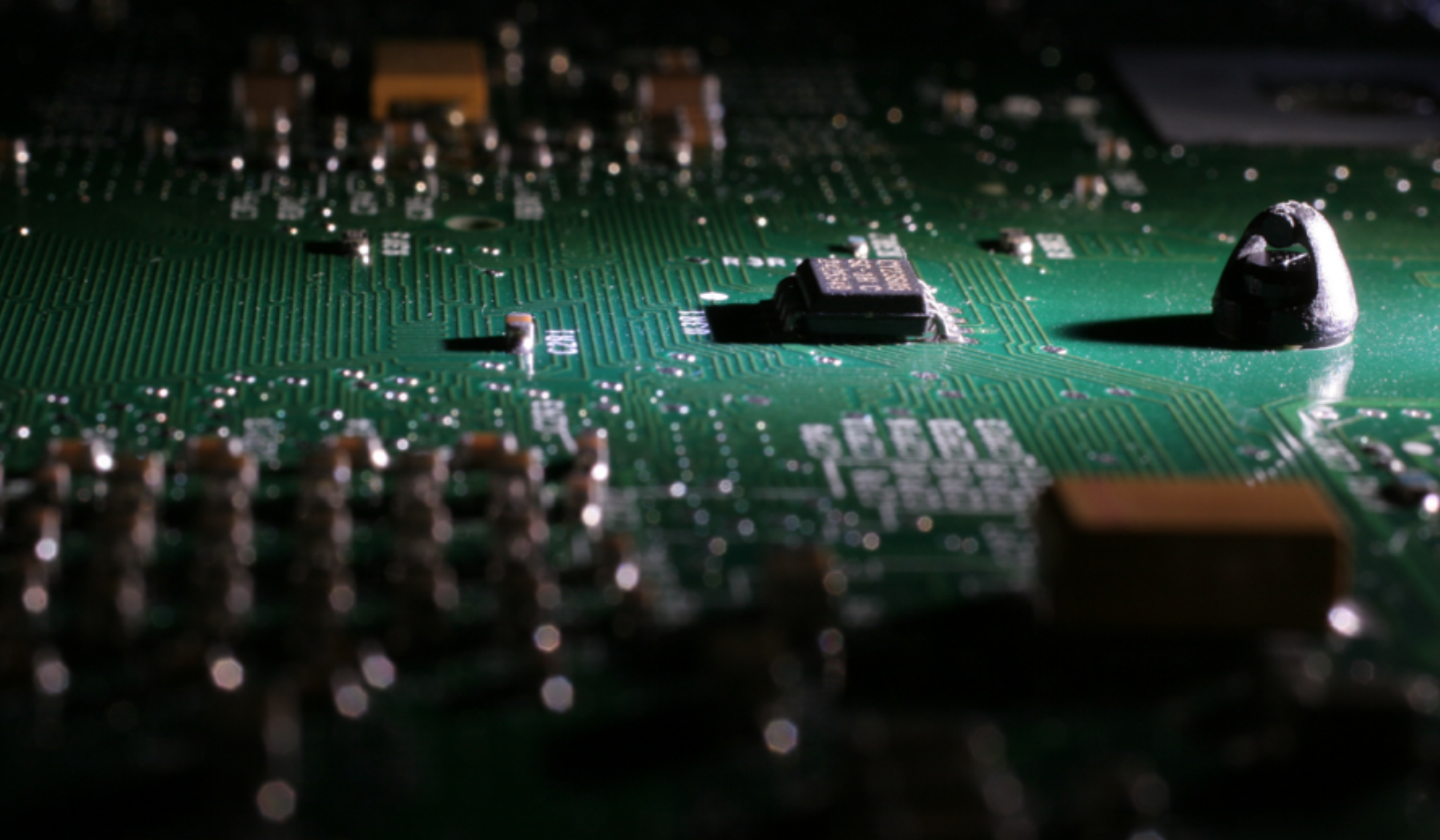
Background Blur

Circle of Confusion



Background Blur

Affect from Aperture

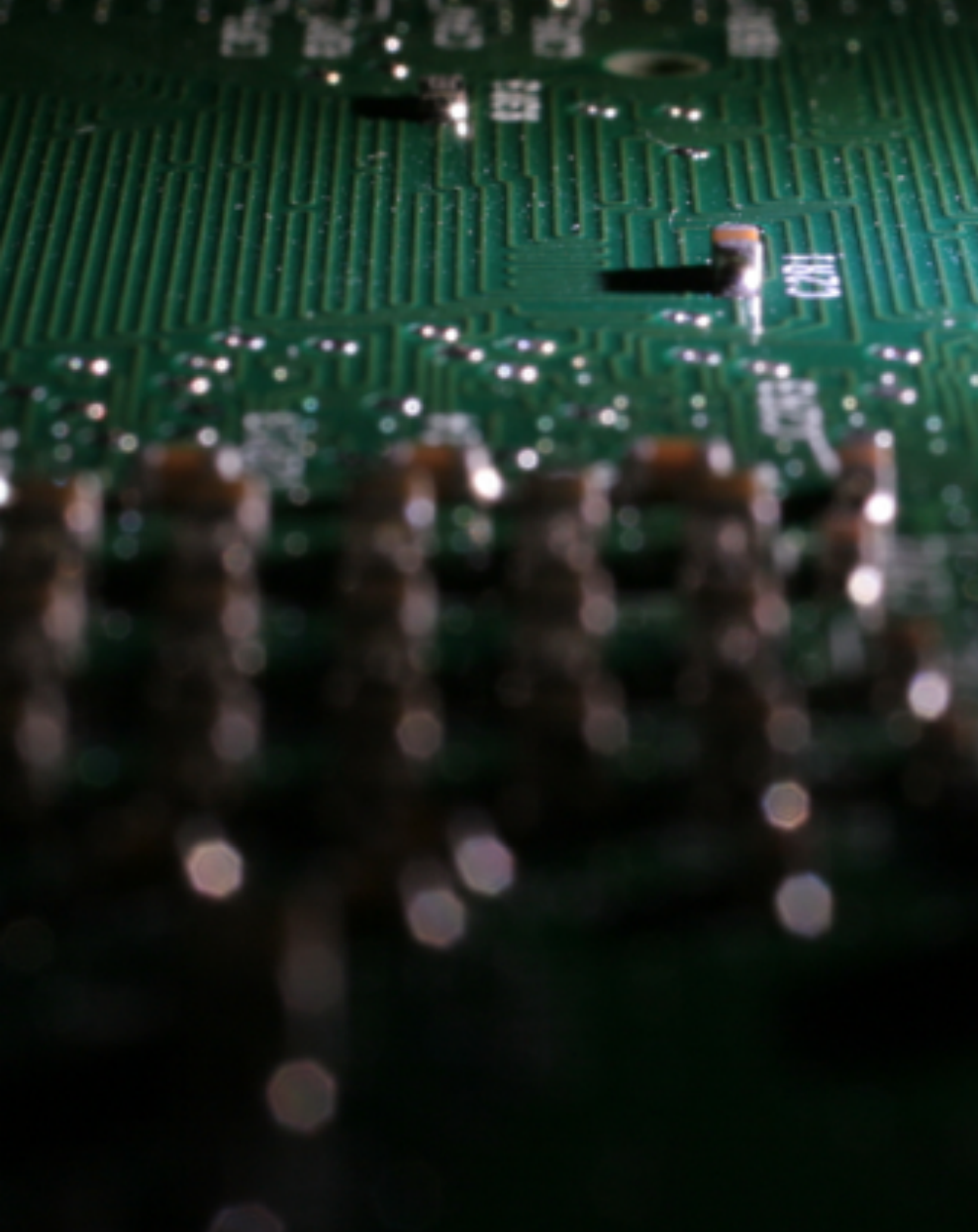


6s, ISO 100, f/16, -2ev @ 50mm

Photo by Dan Armendariz, 2005

Background Blur

Depth of Field



Left: 6s, ISO 100, f/16, -2ev @ 50mm Right: 0.6s, ISO 3200, f/10 @ 2000mm



Photo by Dan Armendariz, 2005

Background Blur

Bokeh



10s, ISO 100, f/8, +0ev @

Photo by Dan Armendariz, 2004

Background Blur

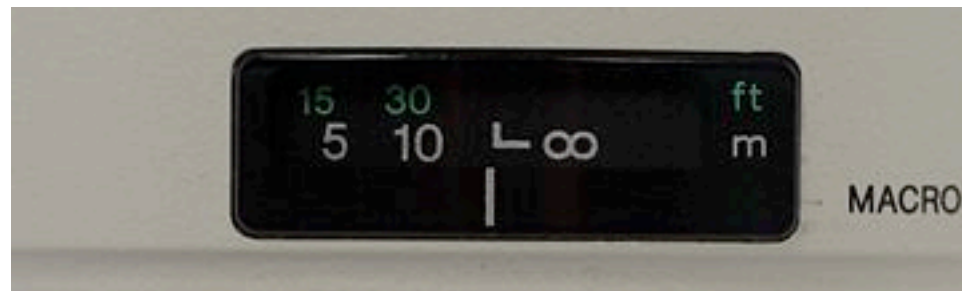
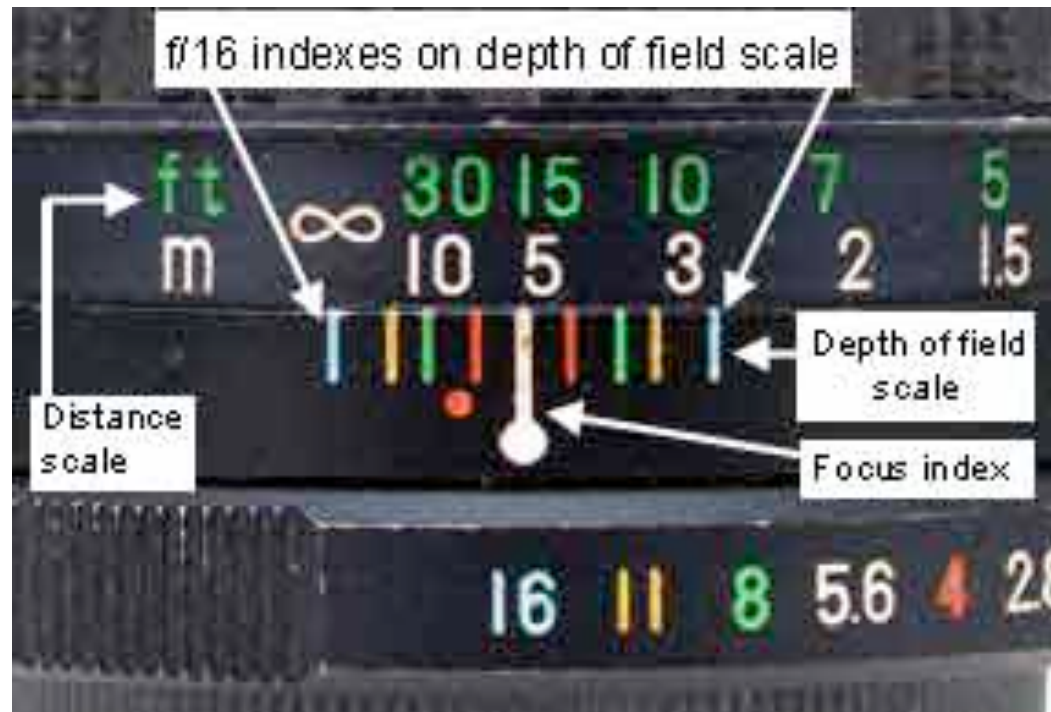
Hyperfocal Distance

$$H = \frac{f^2}{Nc}$$

f = focal length, N = F-number,
 c = minimum circle of confusion diameter

Background Blur

Hyperfocal Distance



Images from <http://www.dofmaster.com/hyperfocal.html> and http://en.wikipedia.org/wiki/Canon_EF_lens_mount

Background Blur

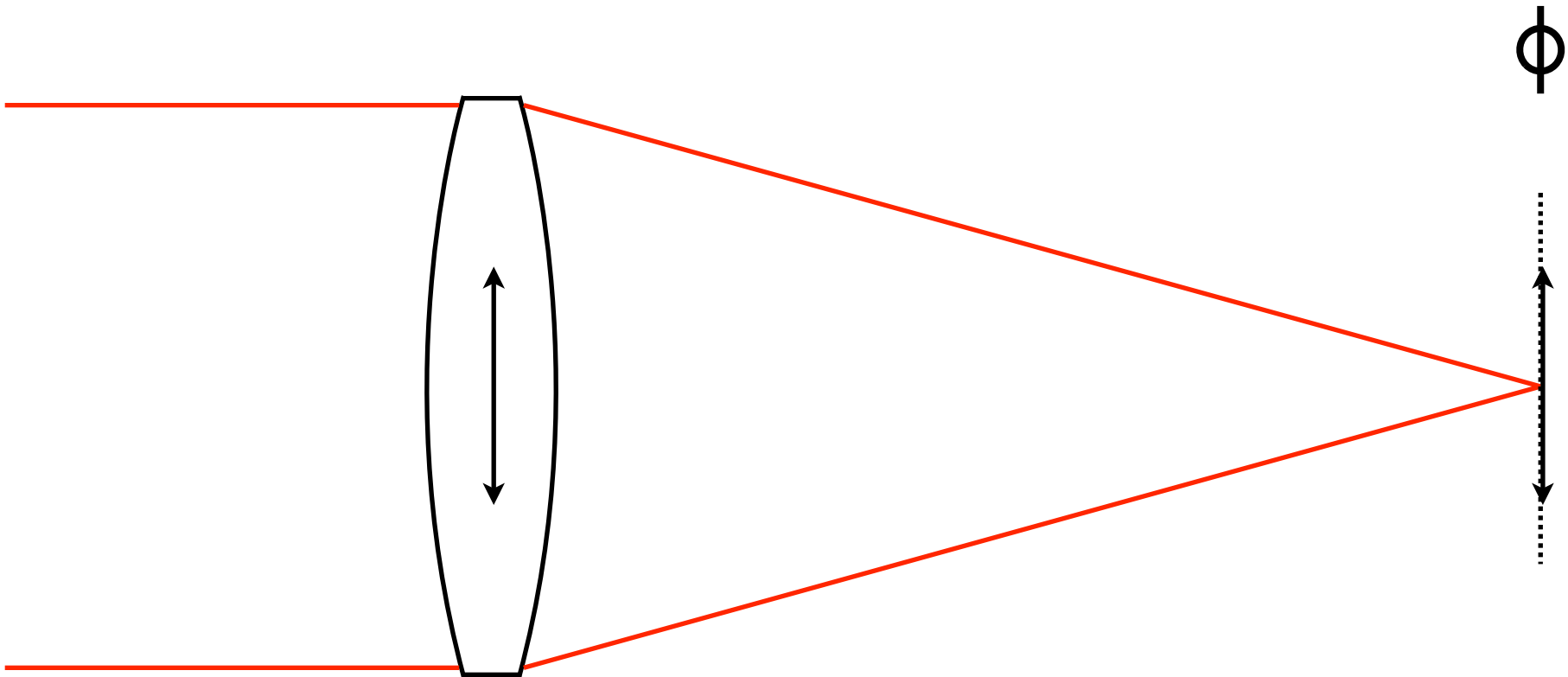
Hyperfocal Distance



Images from http://en.wikipedia.org/wiki/Image_stabilization

Optics

Image Stabilization



Optics

Image Stabilization



Images from <http://www.bentimagelab.com/sg/pages/Smallgantics.htm>

Optics

Tilt-Shift Lenses

(the red line shows exactly where the camera is aimed)

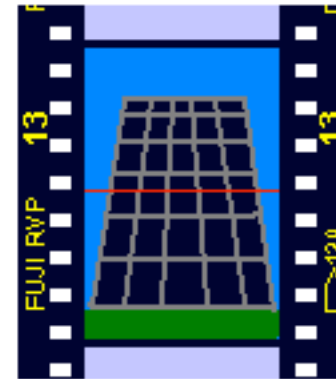
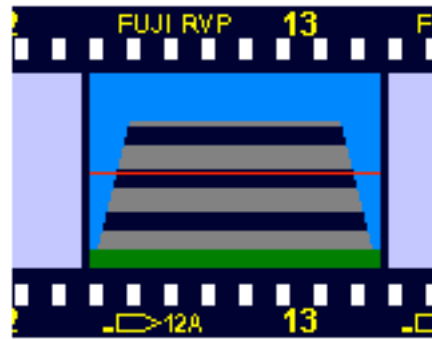


Image 1: Bad Perspective with Normal Lens

(the red line shows exactly where the camera is aimed)

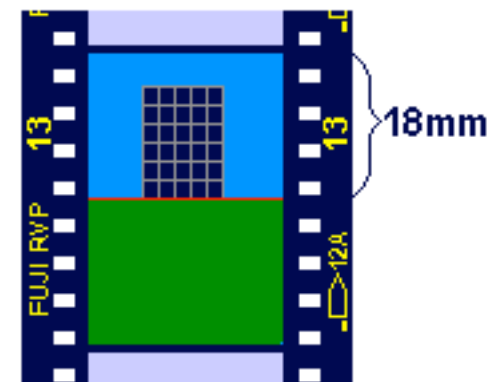
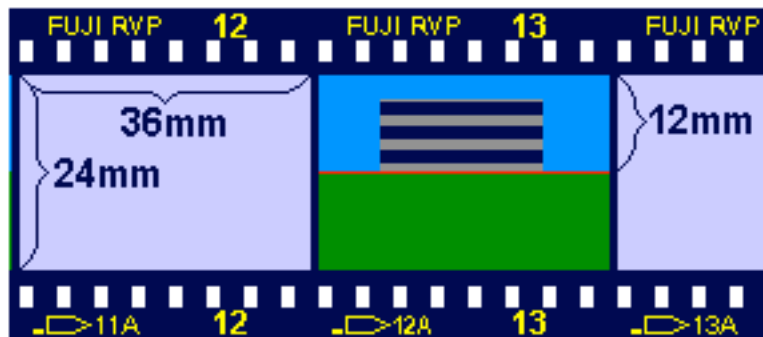


Image 2: Correct Perspective with Normal Lens

Images from <http://photo.net/equipment/canon/tilt-shift>

Tilt-Shift Lenses

Shift

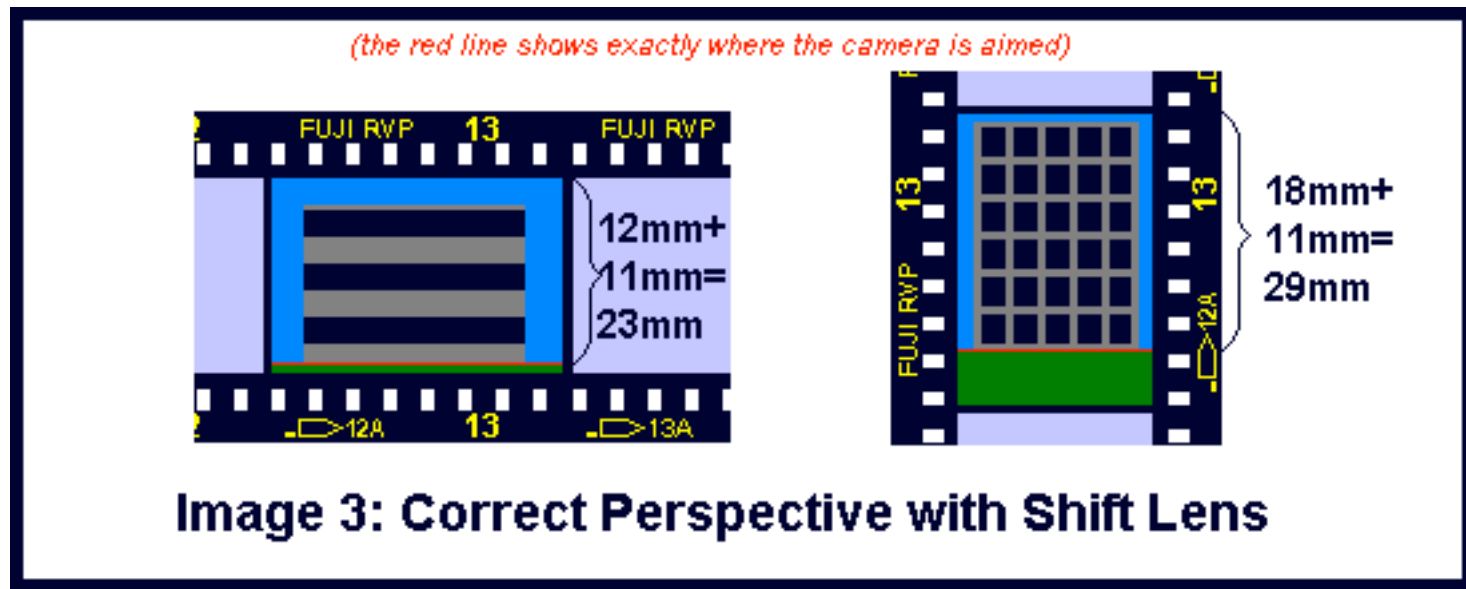
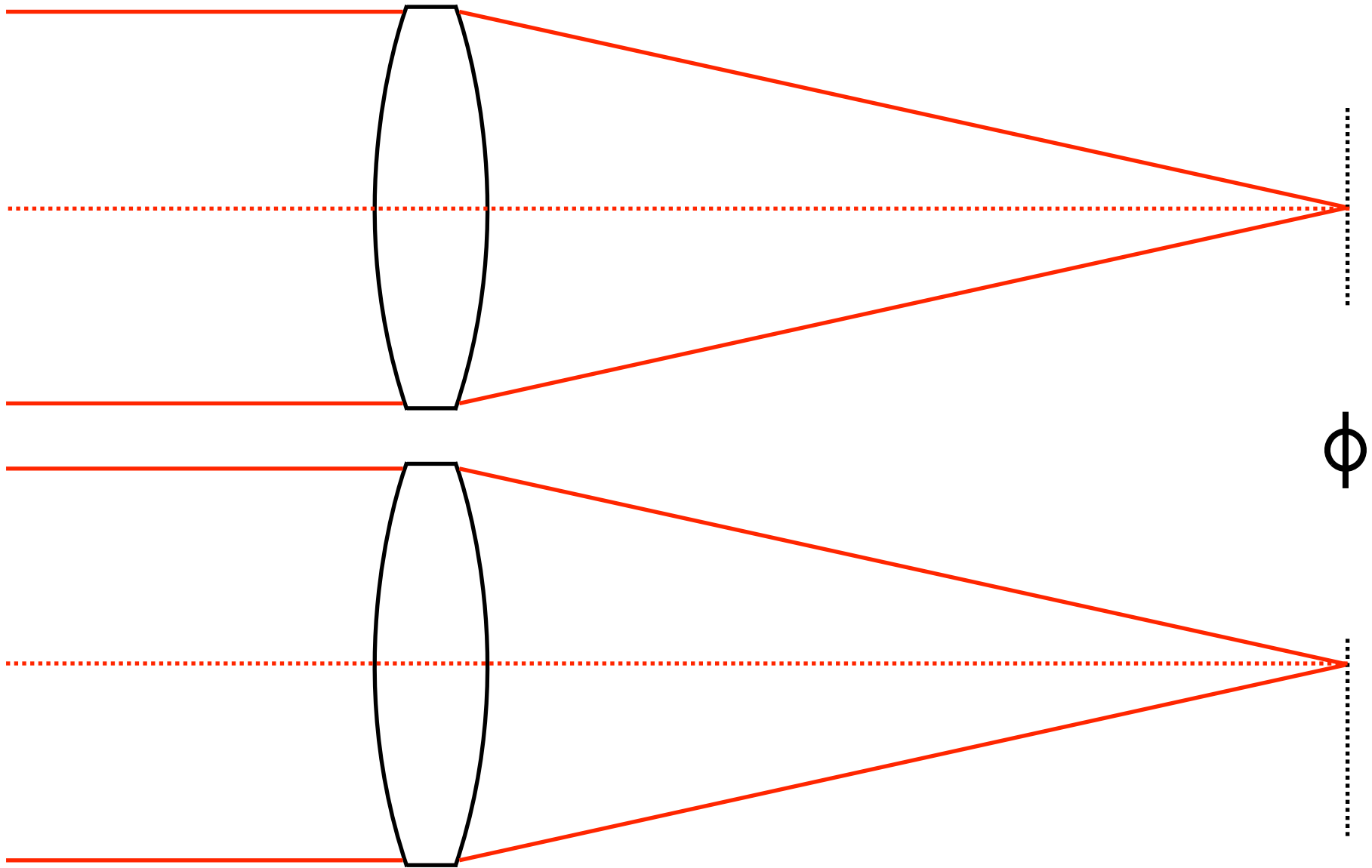


Image from <http://photo.net/equipment/canon/tilt-shift>

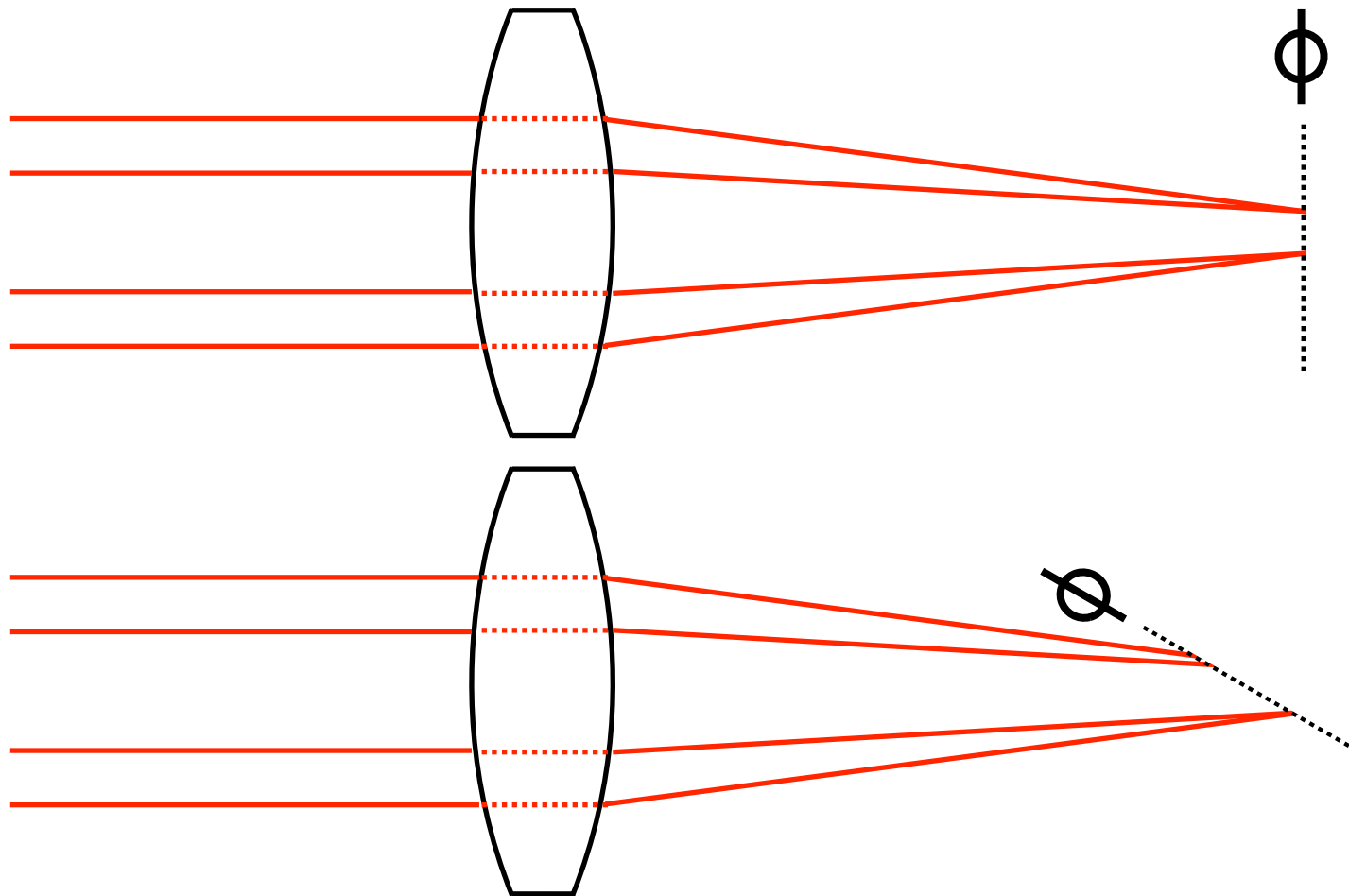
Tilt-Shift Lenses

Shift



Tilt-Shift Lenses

Shift



Tilt-Shift Lenses

Tilt



Images from <http://www.bentimagelab.com/sg/pages/Smallgantics.htm>

Tilt-Shift Lenses

Tilt



Filter size symbol: Ø

Image from <http://dpreview.com>

Optics

Filters



2s, ISO 100, f/13

Photo by Dan Armendariz, 2007

Filters

Neutral Density



1/500s, ISO 400, f/8

Photo by Dan Armendariz, 2004

Filters

(No) Polarizer



1/125s, ISO 400, f/8

Photo by Dan Armendariz, 2004

Filters

Polarizer



Left: 1/400s, ISO 400, f/8, -2/3ev Right: 1/200s, ISO 400, f/8, -2/3ev



Photos by Dan Armendariz, 2004

Filters

Polarizer affects reflections

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