

The Art of Successful Focus Stacking

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Forum: <http://photomacrography.net>

SEM Is Wonderful !



1 micron resolution,
3.75 mm depth of field



But This Is Optical !



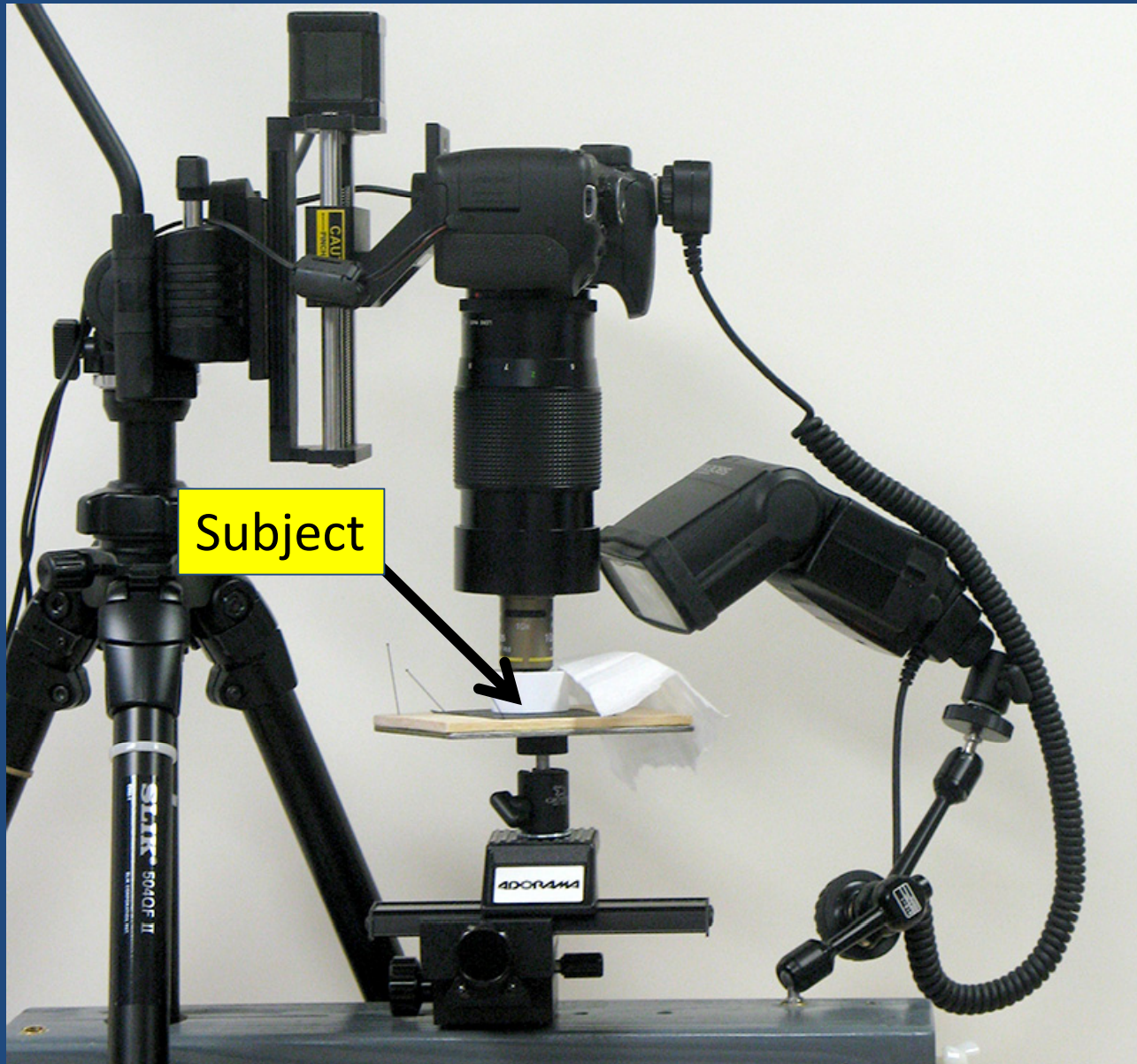
1 micron resolution,
3.75 mm depth of field



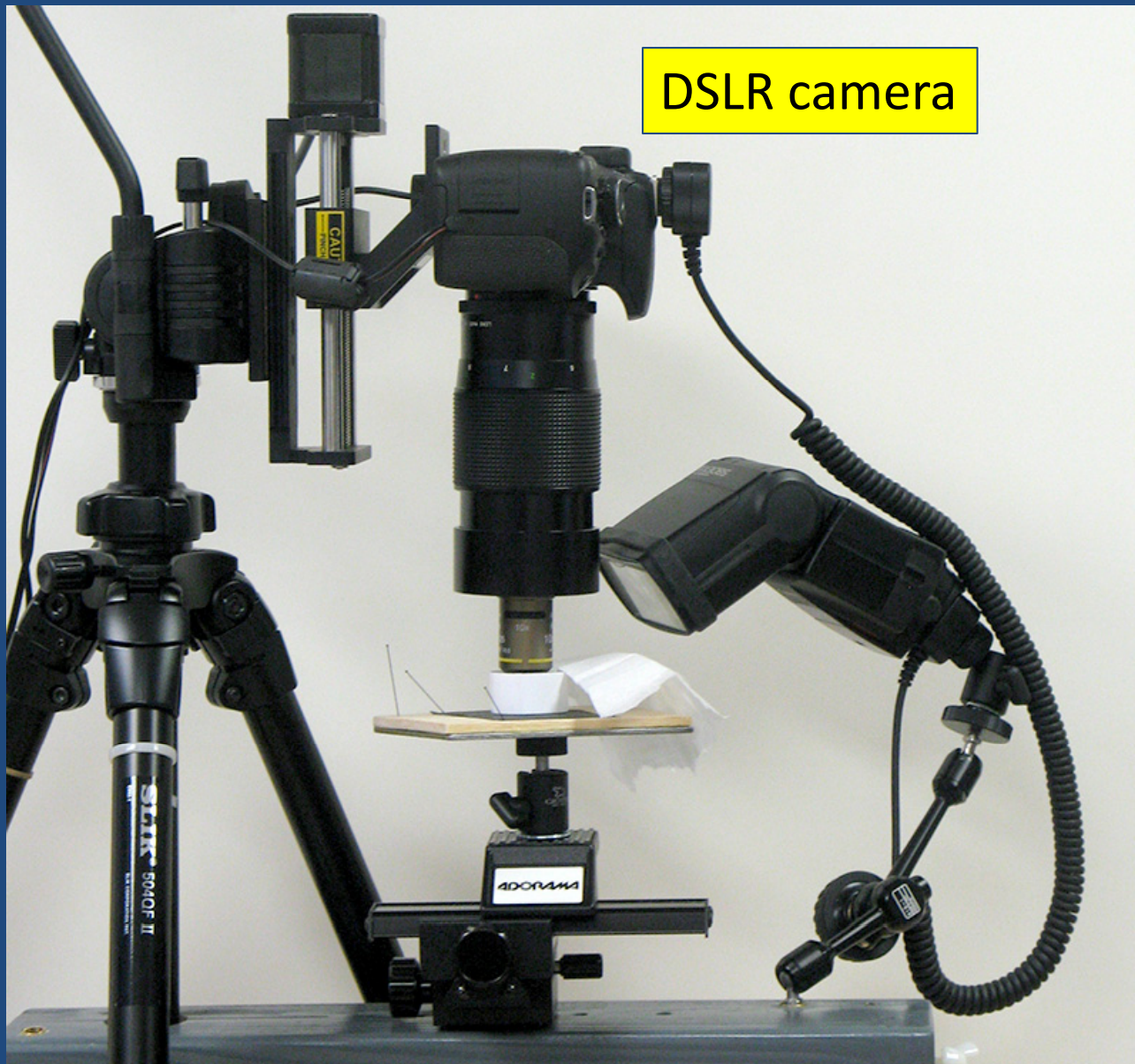
Here's the Setup



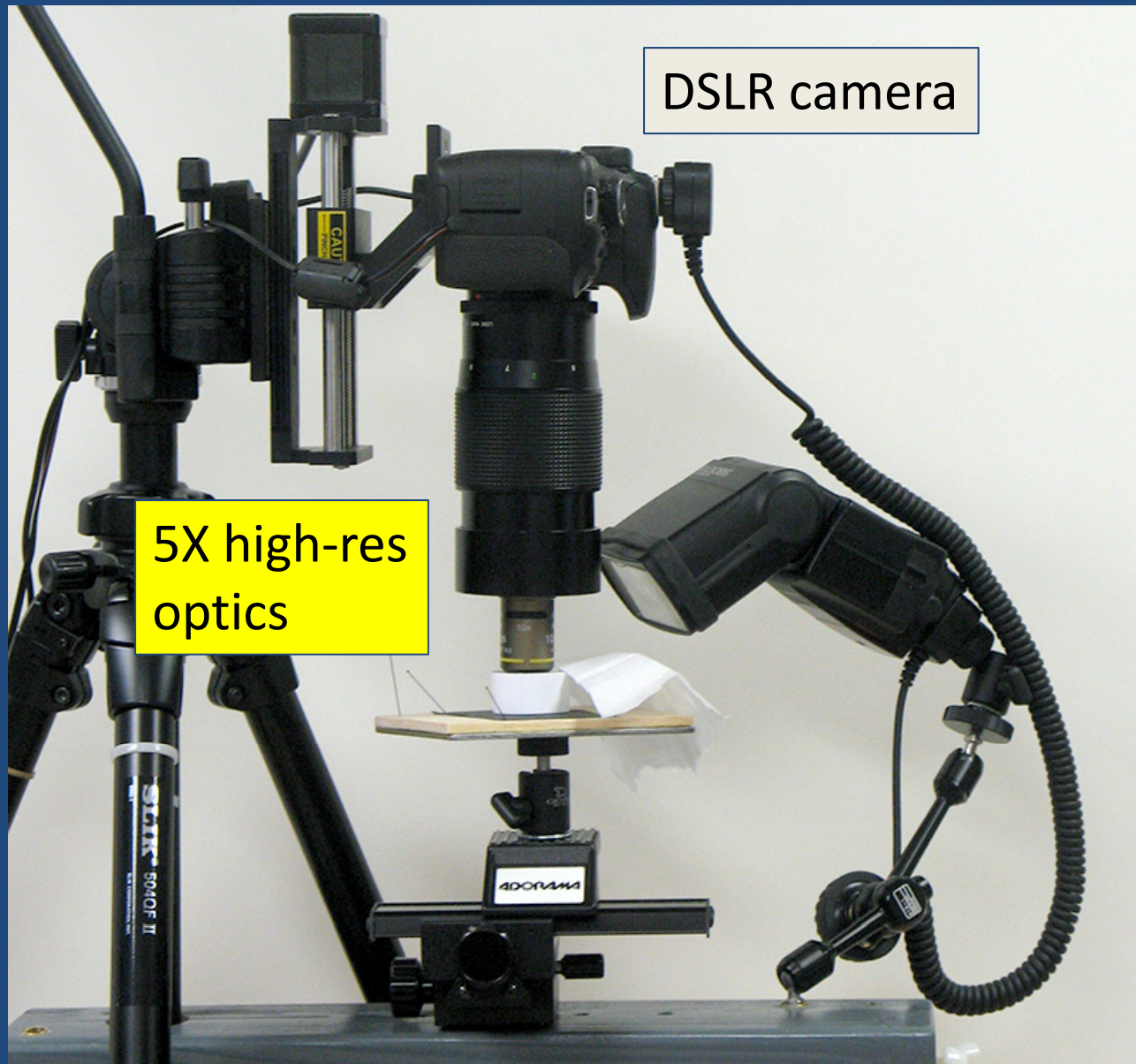
Here's the Setup



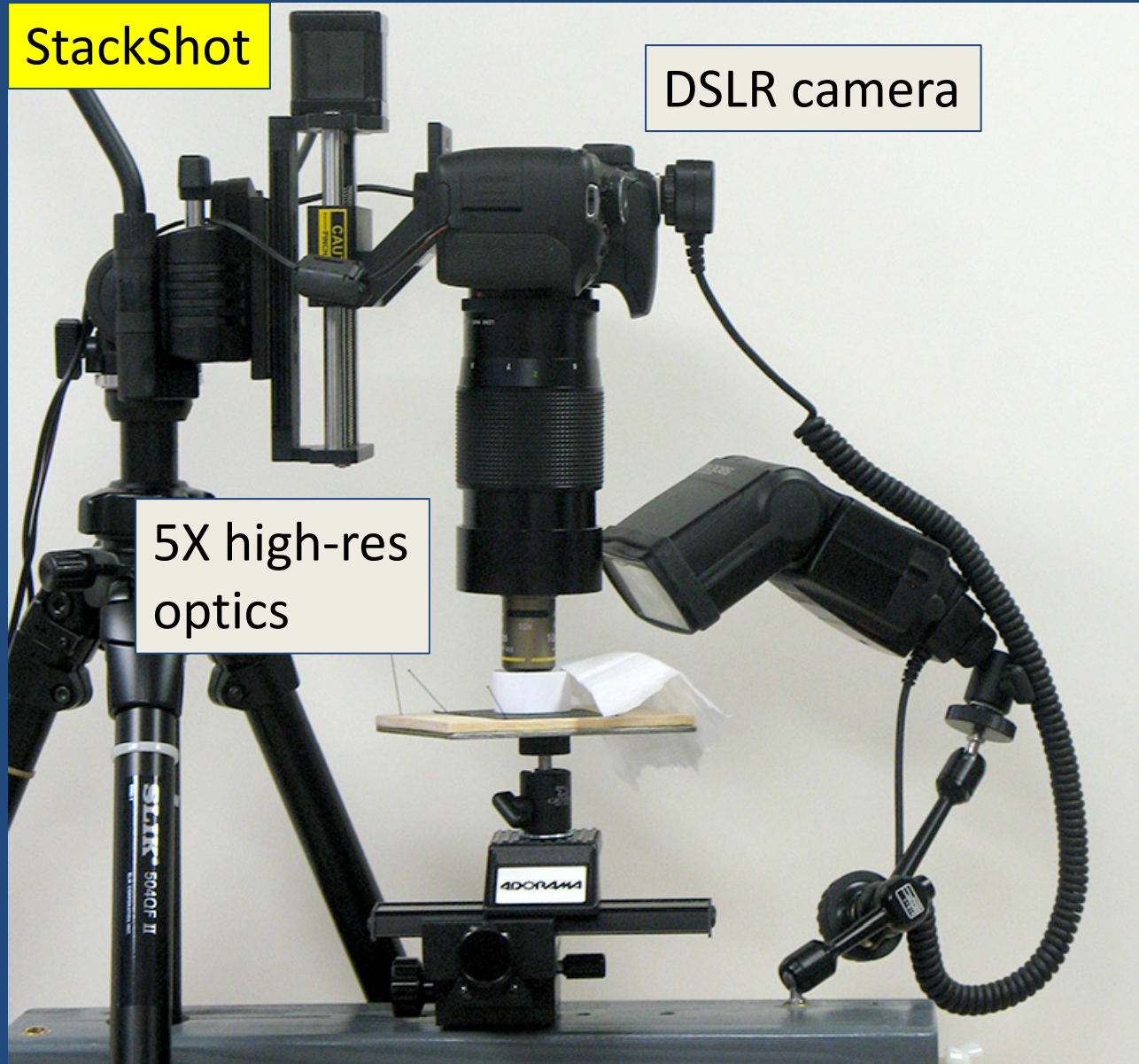
Here's the Setup



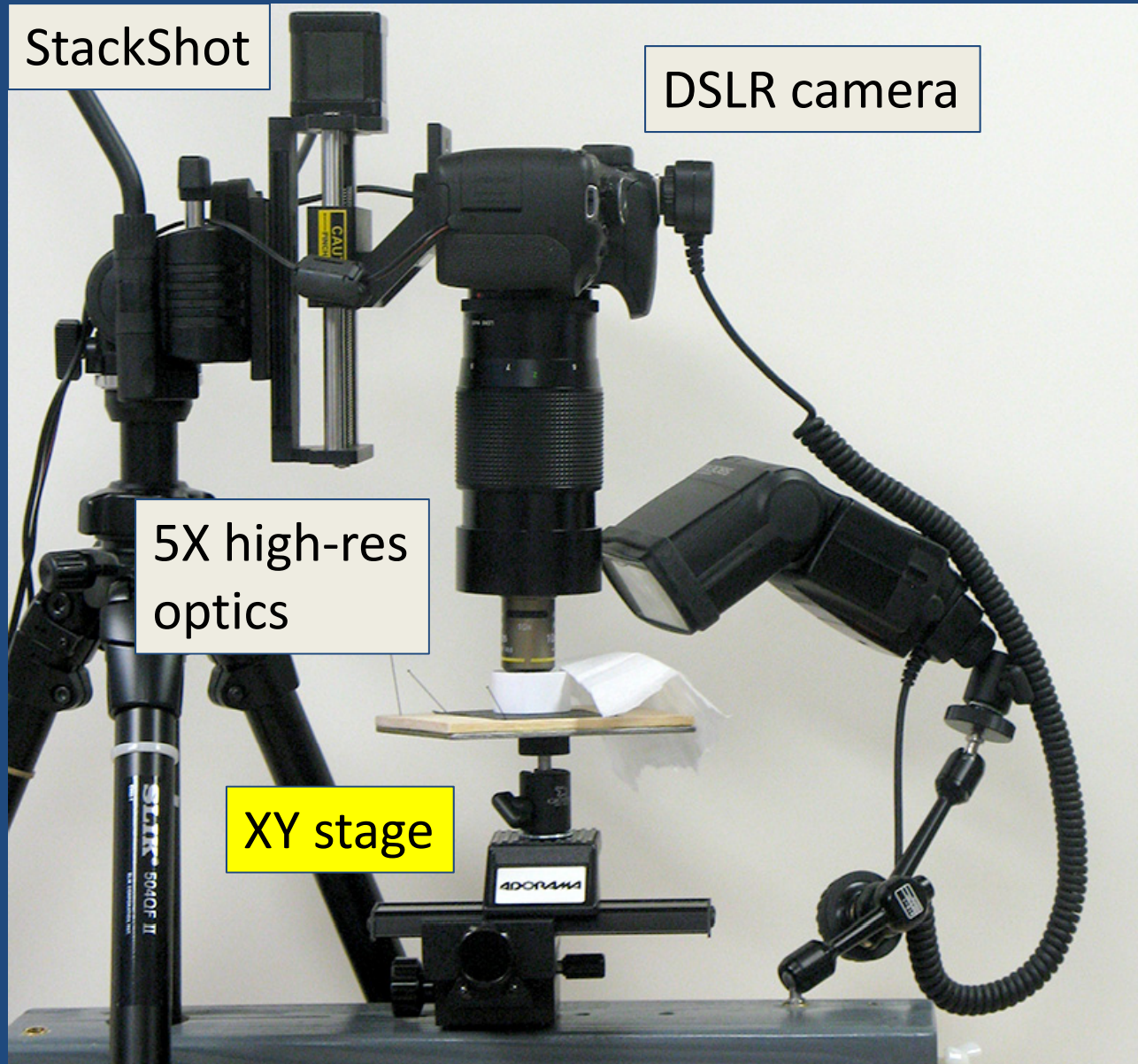
Here's the Setup



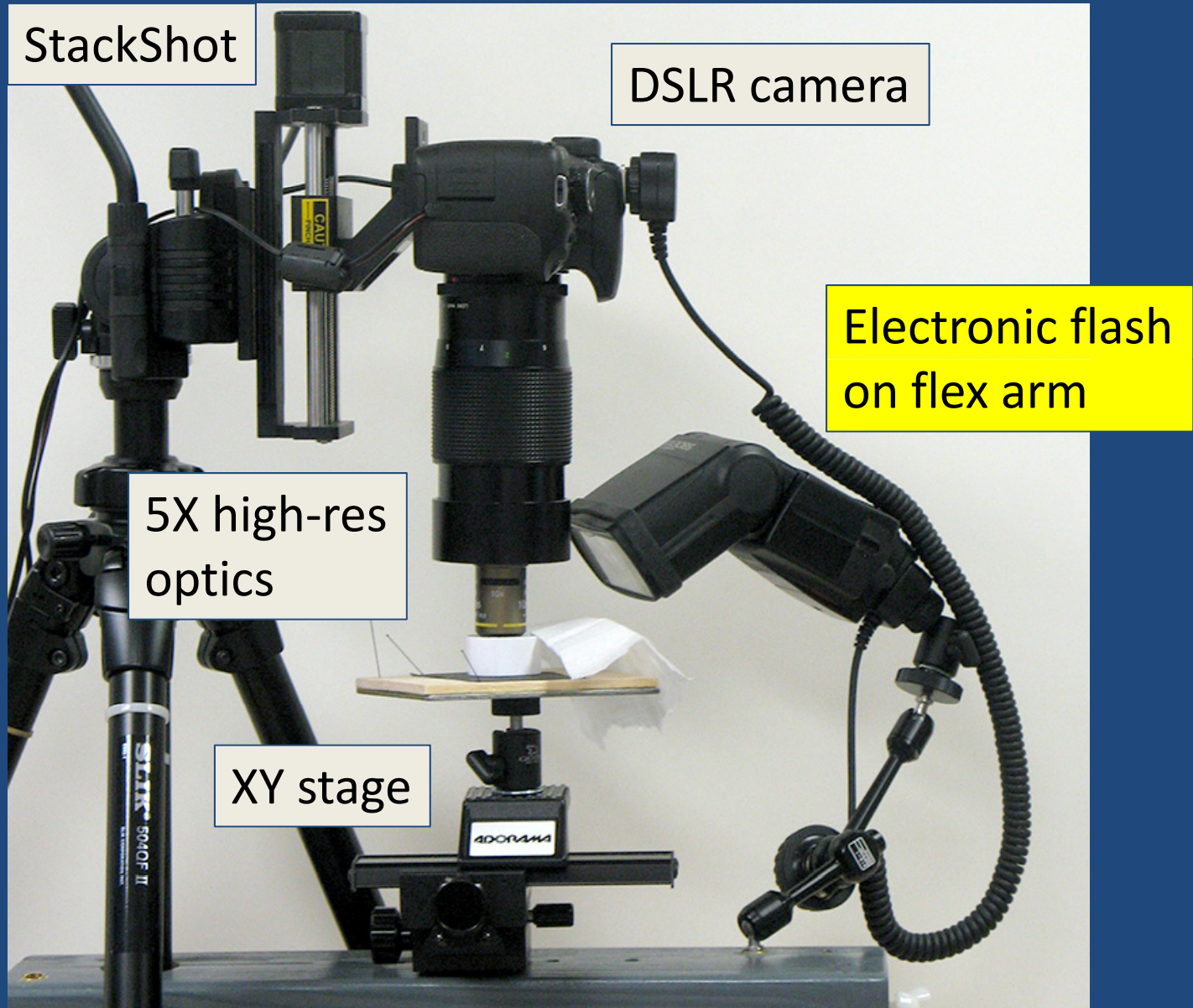
Here's the Setup



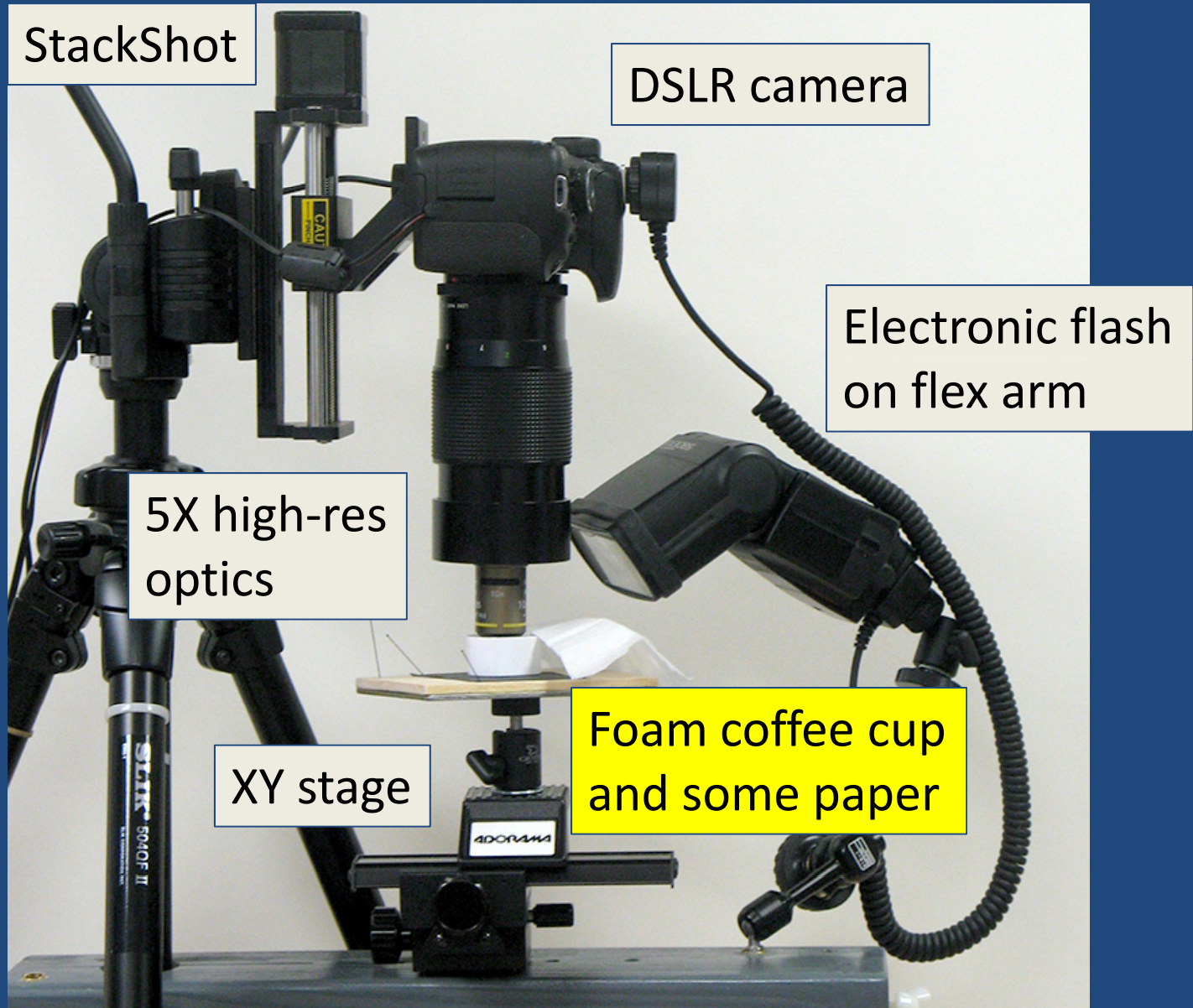
Here's the Setup



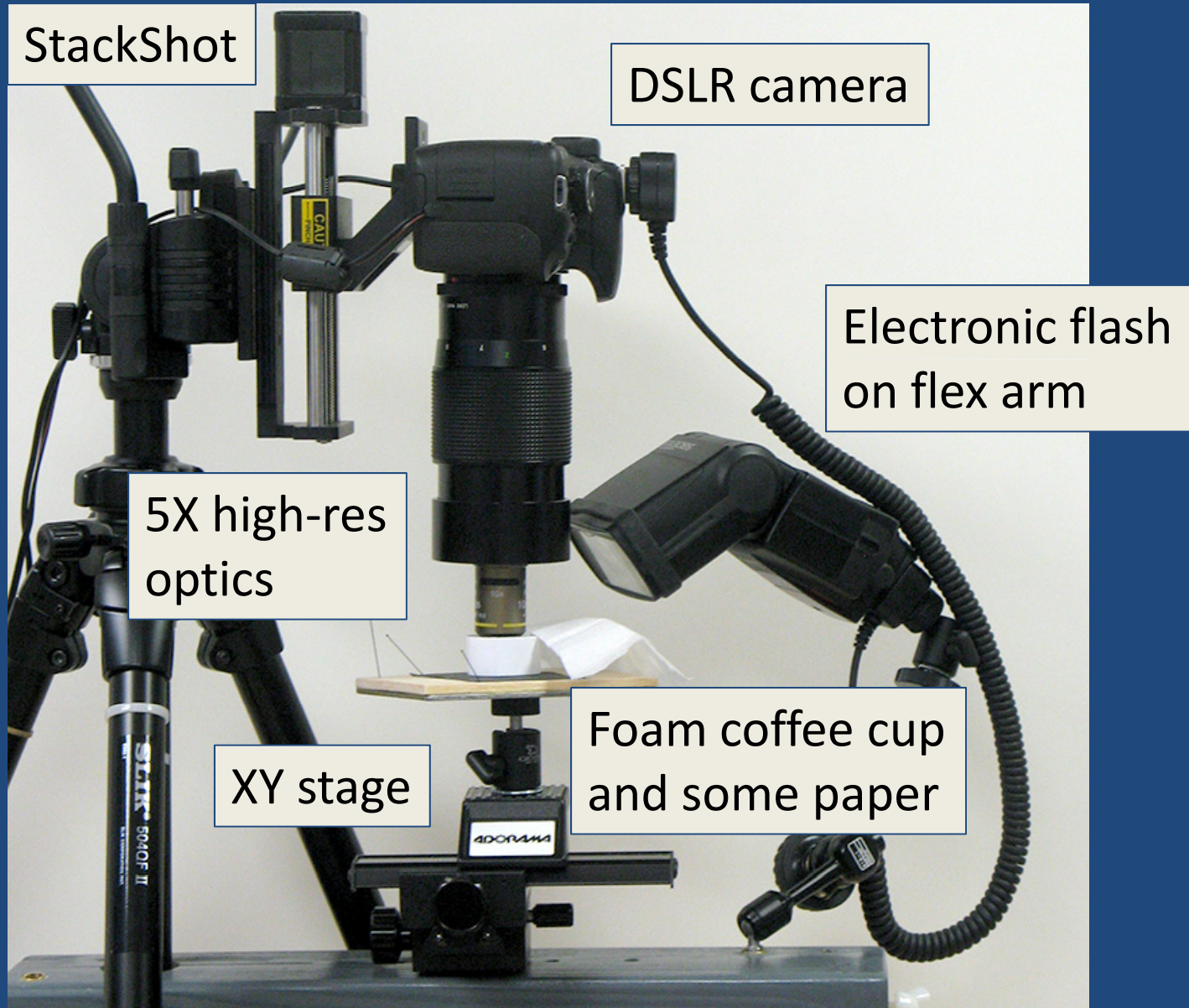
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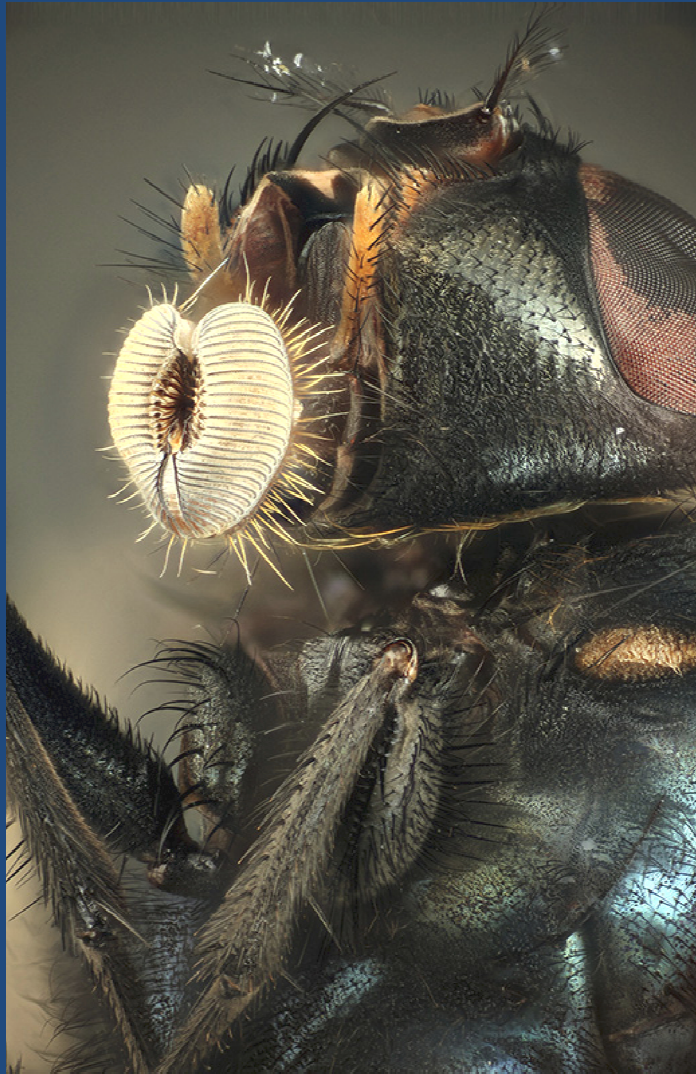
Here's the Setup



Here's the Setup



How Is This Possible???

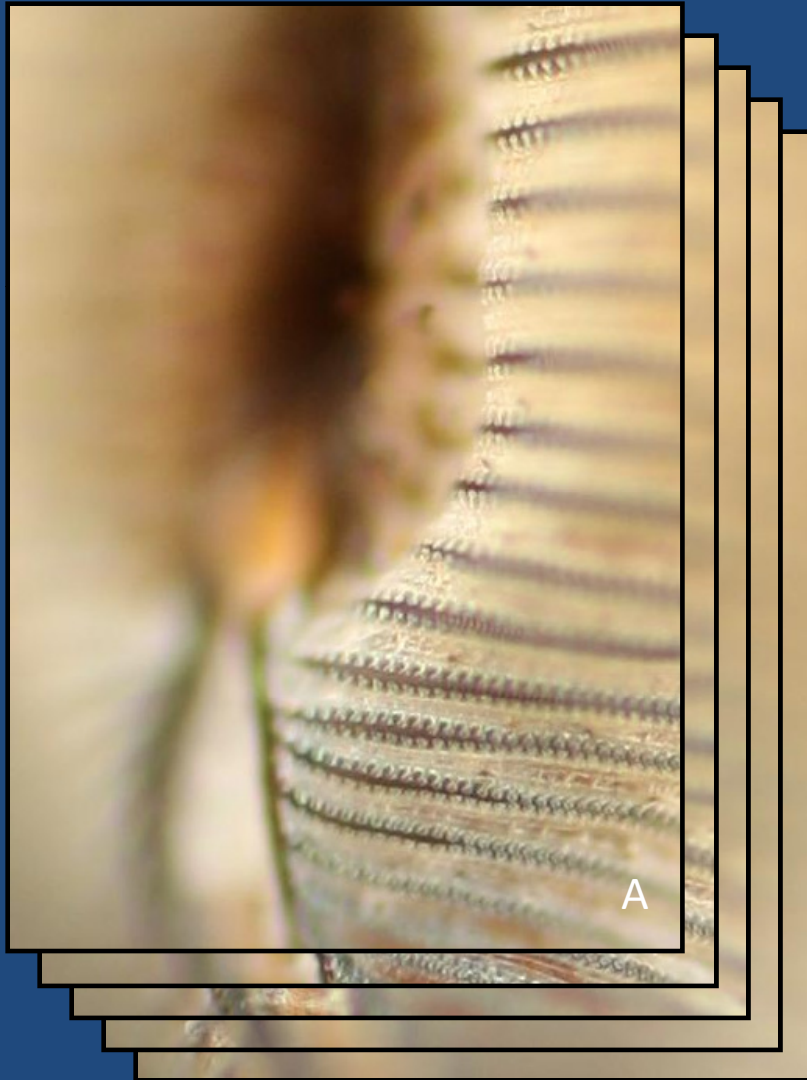


1 micron resolution,
3.75 mm depth of field



Focus Stacking: “Just pick out the sharp parts and piece them together”

High Resolution Slices



Computer
Software



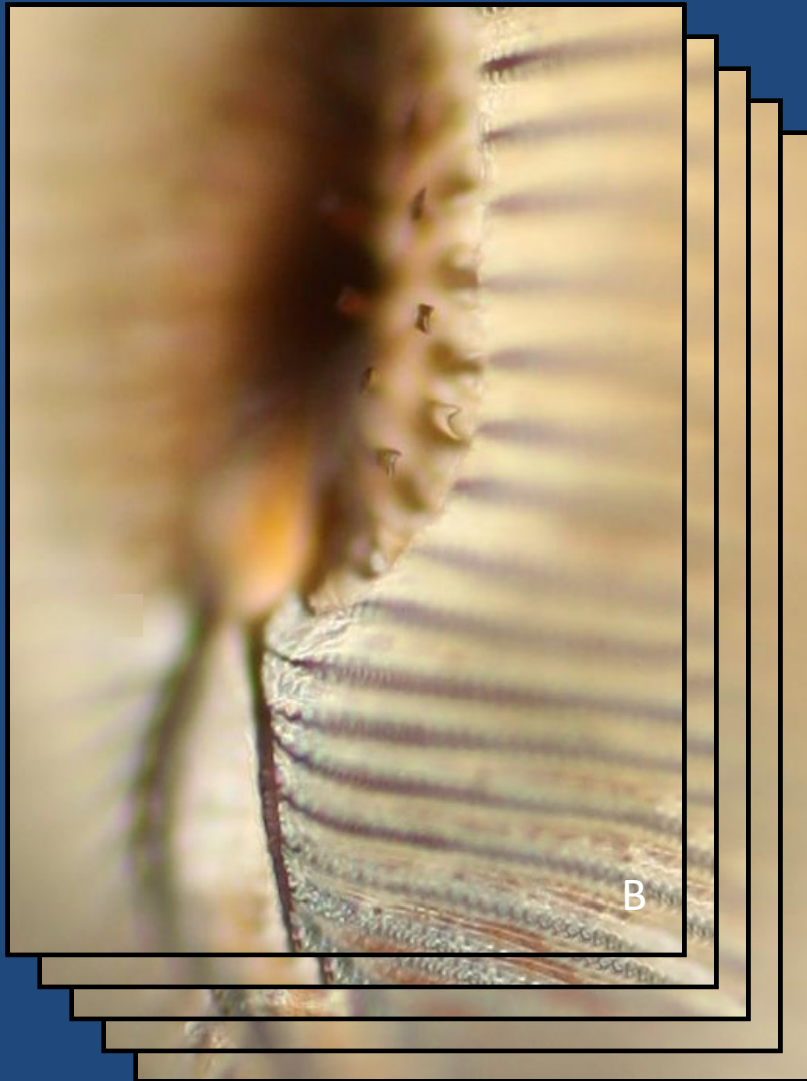
*Zerene
Stacker*

Final Image



Focus Stacking: “Just pick out the sharp parts and piece them together”

High Resolution Slices



Computer
Software



*Zerene
Stacker*

Final Image



Focus Stacking: “Just pick out the sharp parts and piece them together”

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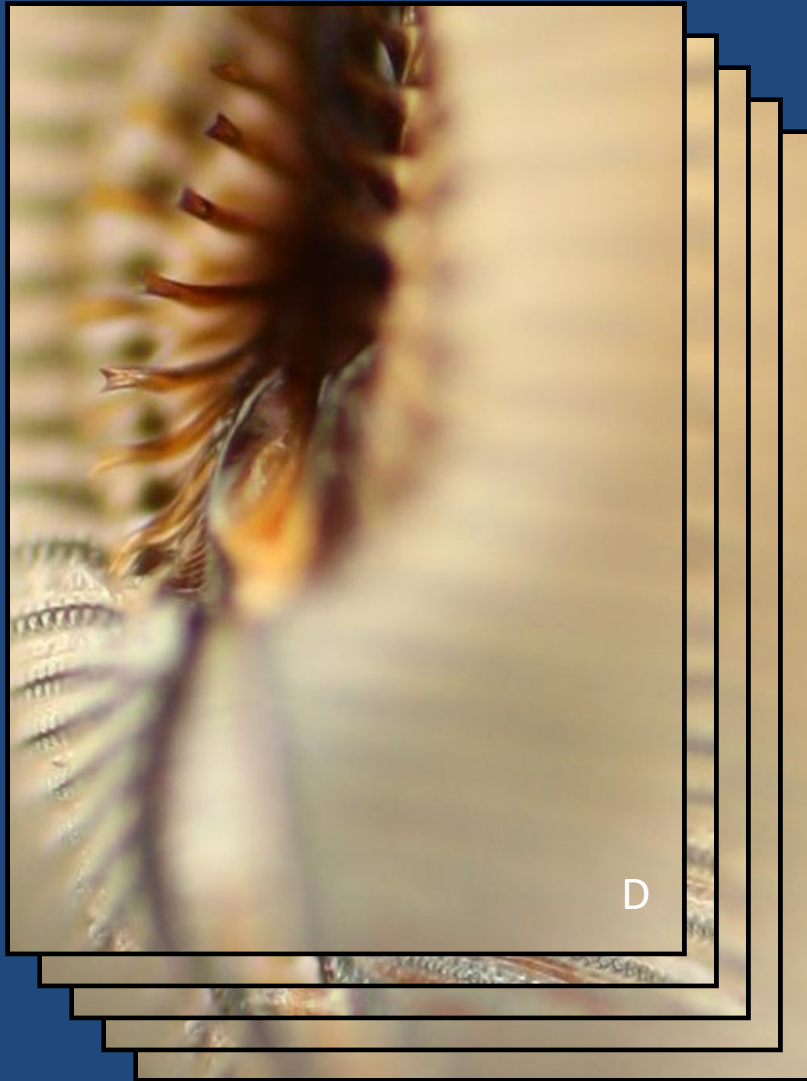
*Zerene
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Final Image



Focus Stacking: “Just pick out the sharp parts and piece them together”

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Final Image



Focus Stacking: “Just pick out the sharp parts and piece them together”

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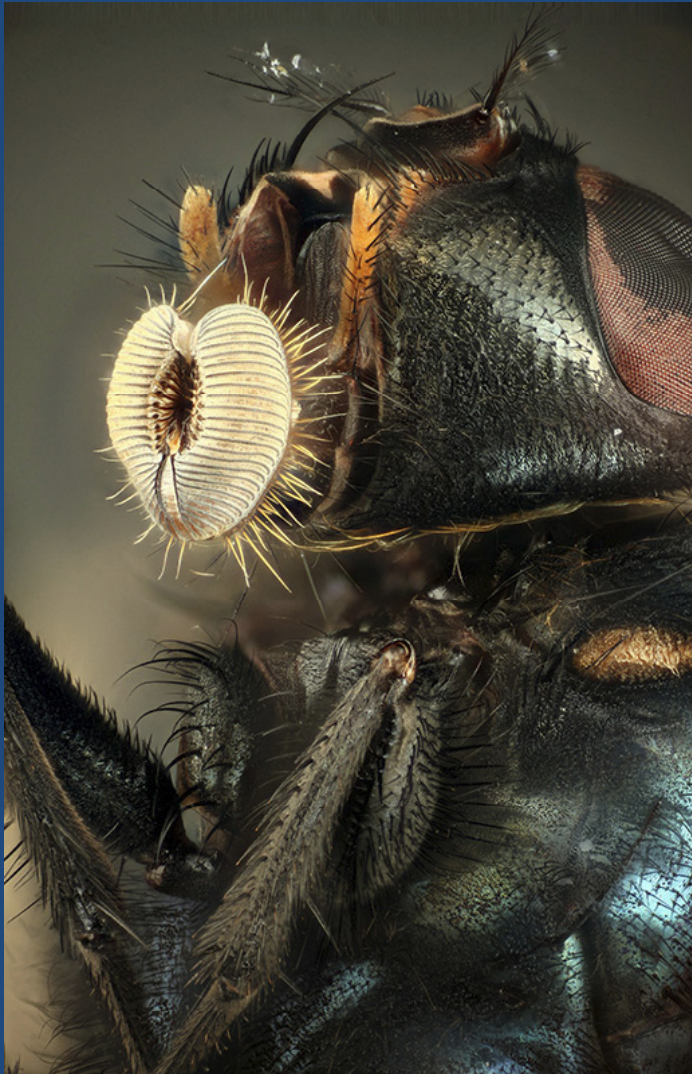


*Zerene
Stacker*

Final Image



This Case: 375 frames



0.01 mm focus step,
3.75 mm depth of field



Why Use Focus Stacking?



Here's The Picture We Want



0.2 mm

But The Camera Sees This



0.2 mm

Why Not Just Stop Down??

Why Not Just Stop Down??

Because diffraction makes images **blurred**

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Because diffraction makes images **blurred**

It's because of the wave properties of light.

Why Not Just Stop Down??

Because diffraction makes images **blurred**

It's because of the wave properties of light.

If you really want to know more, see me later...

As we stop down...

f/2

(effect.
f/26)



What
we
want

As we stop down...

f/2.8

(effect.
f/36)



What
we
want

As we stop down...

$f/4$

(effect.
 $f/52$)



What
we
want

As we stop down...

f/5.6

(effect.
f/73)



What
we
want

As we stop down...

f/8

(effect.
f/104)



What
we
want

As we stop down...

f/11

(effect.
f/143)



What
we
want

As we stop down...

f/16

(effect.
f/208)



What
we
want

Stopping down doesn't work...

f/16

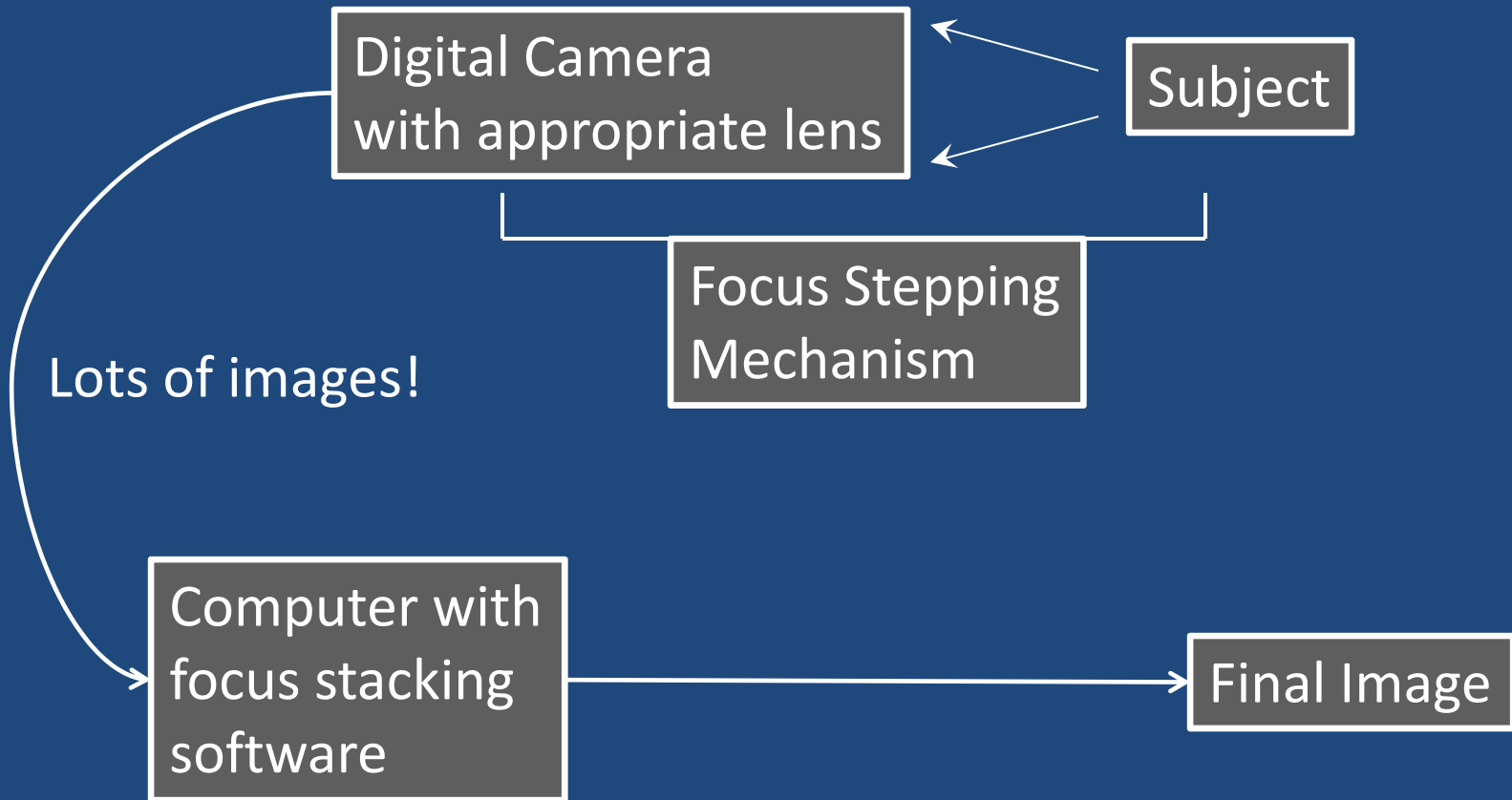
(effect.
f/208)



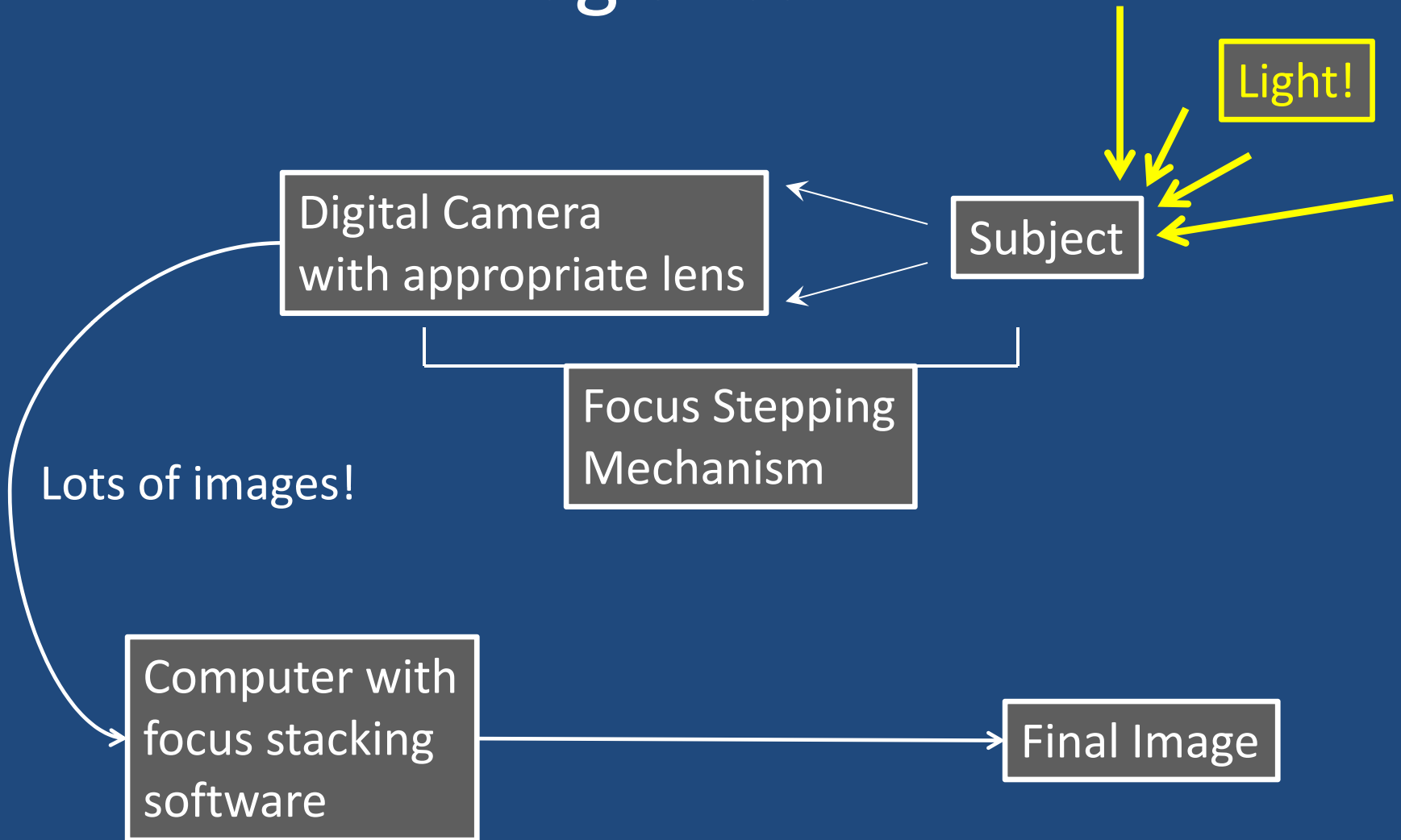
What
we
want

...because stopping down
makes the image blurred!

Logistics...

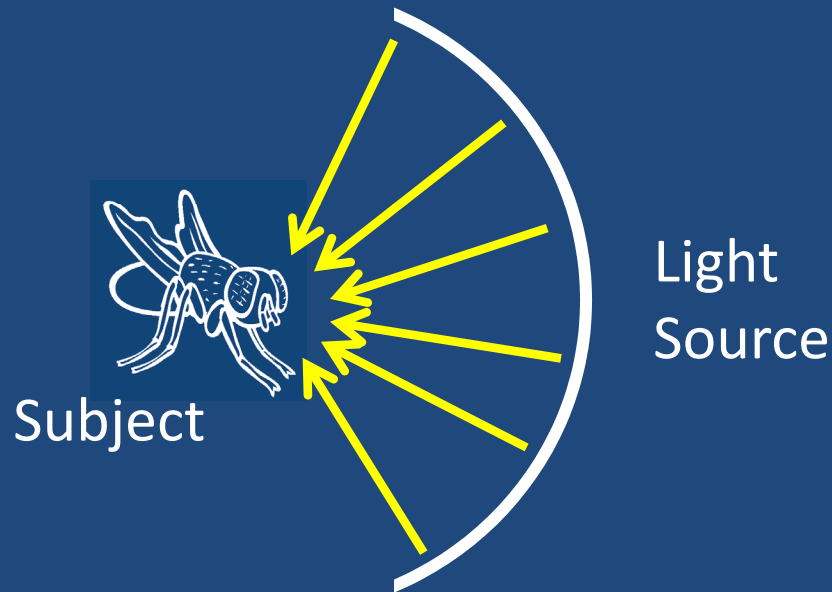


Logistics...

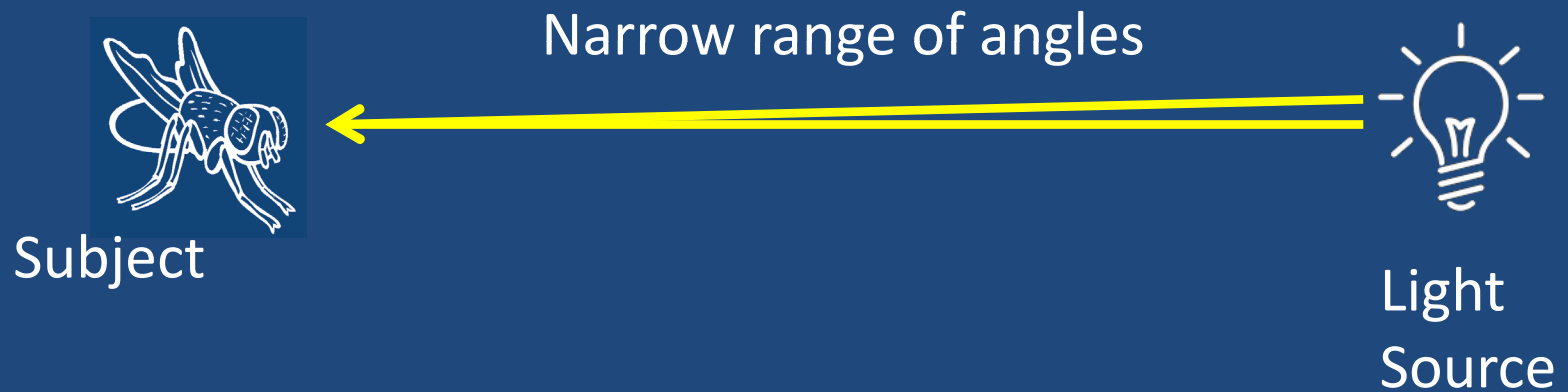


Good Lighting Is “Diffused”

(Hits subject from wide range of angles)

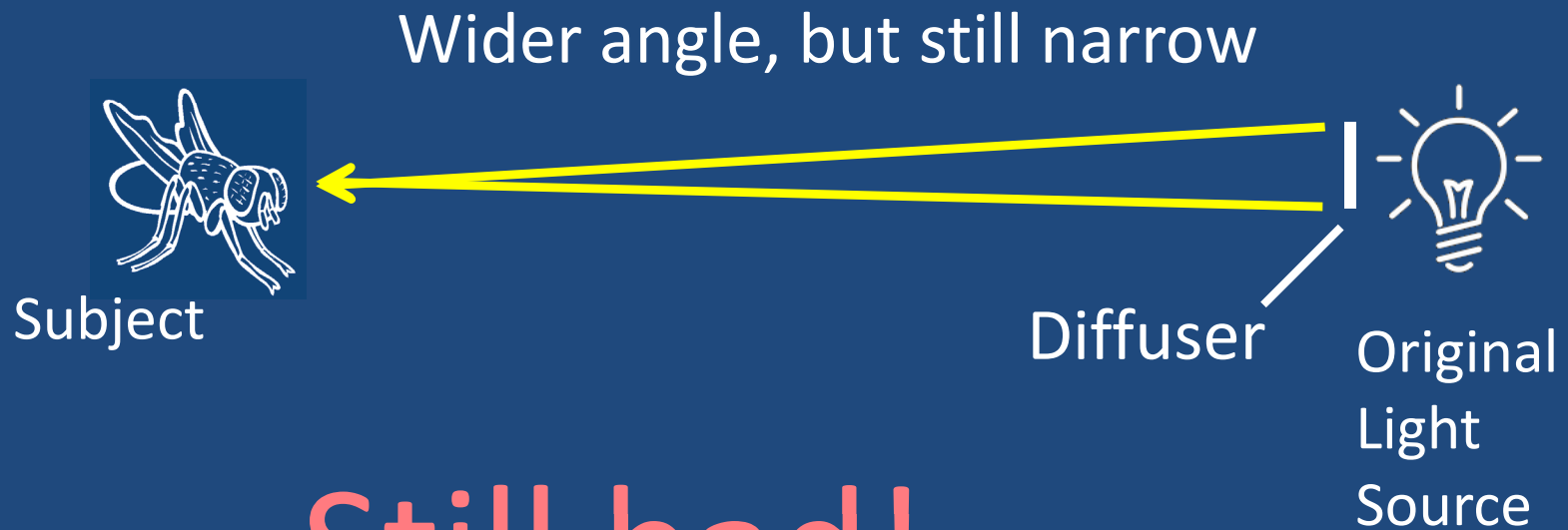


Naked Lights Are Bad



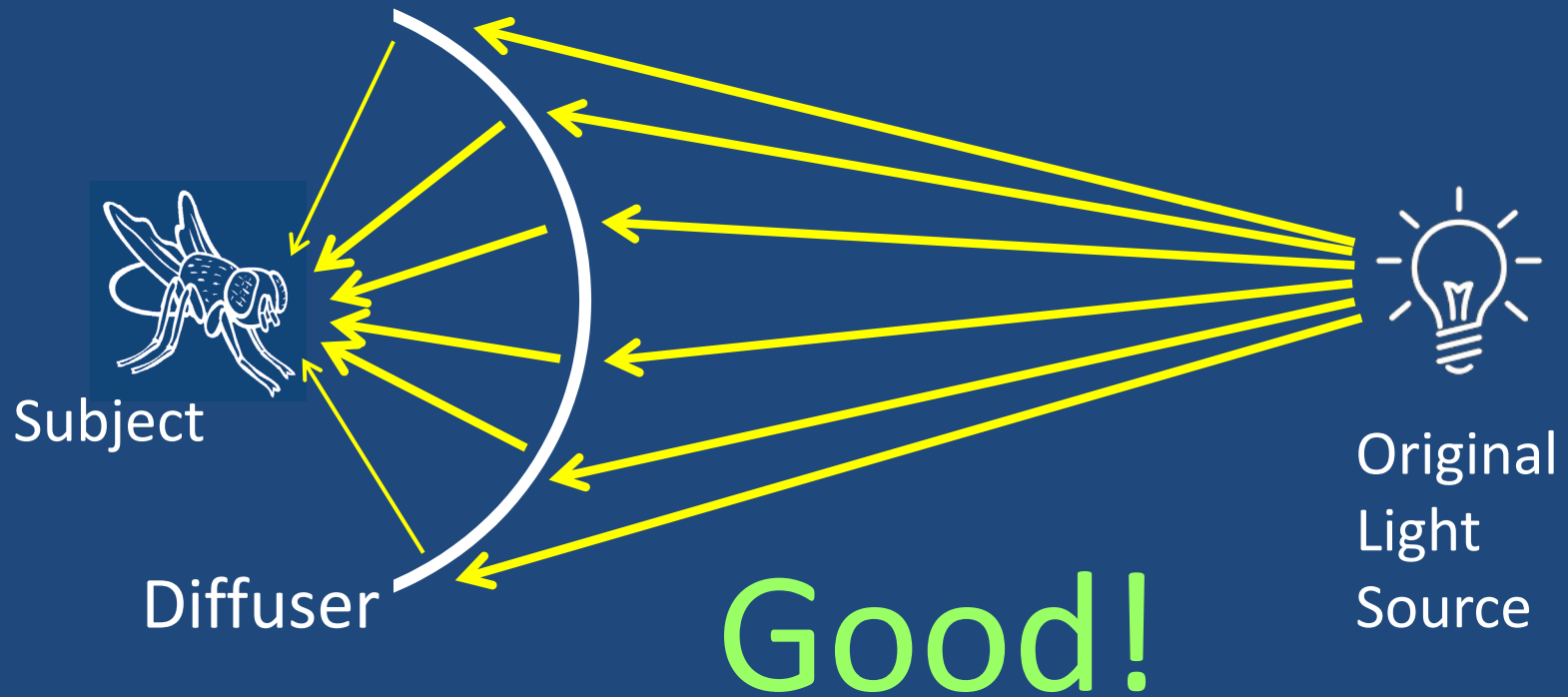
Awful!

Adding Diffuser At Source Helps, But Not Much

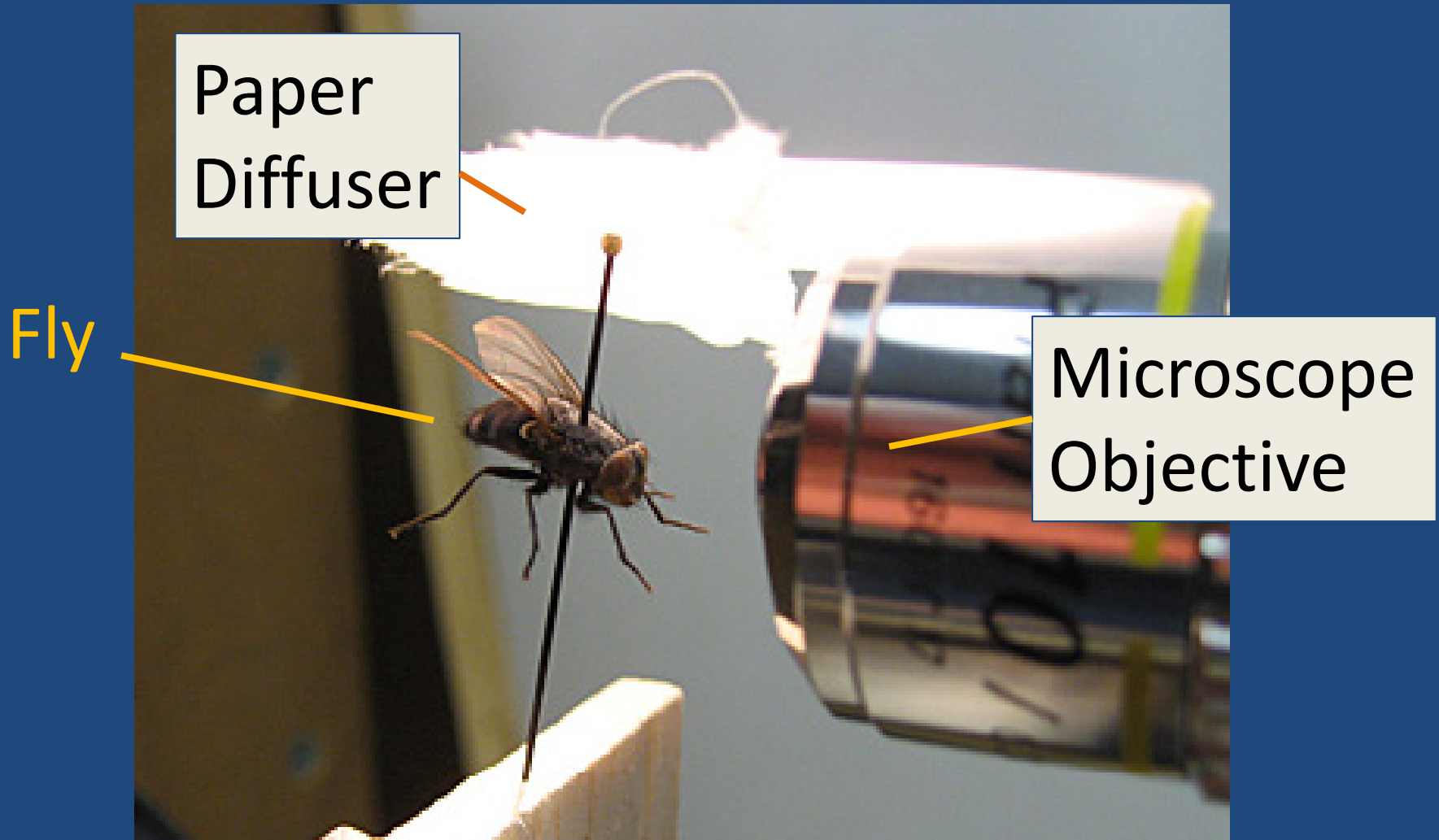


Still bad!

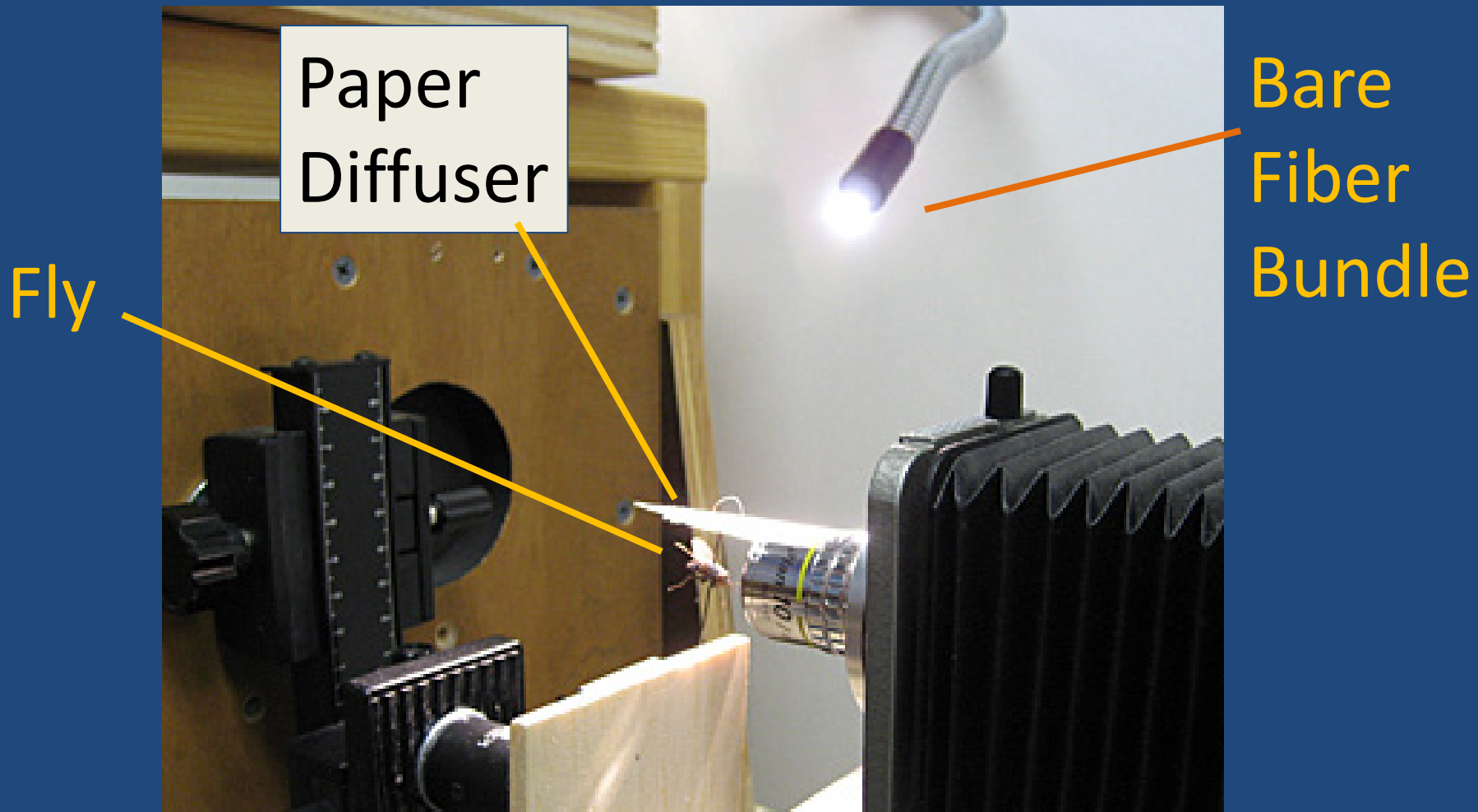
Put Diffuser Close To Subject



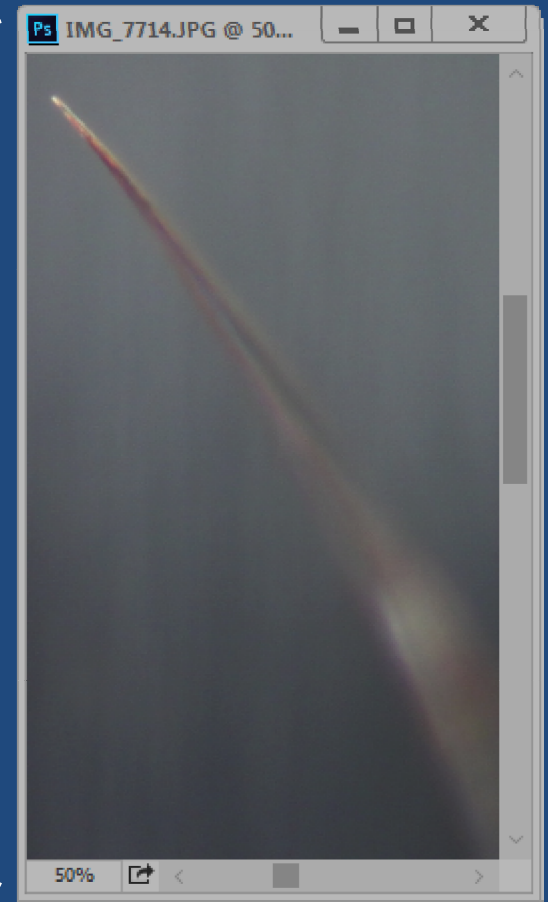
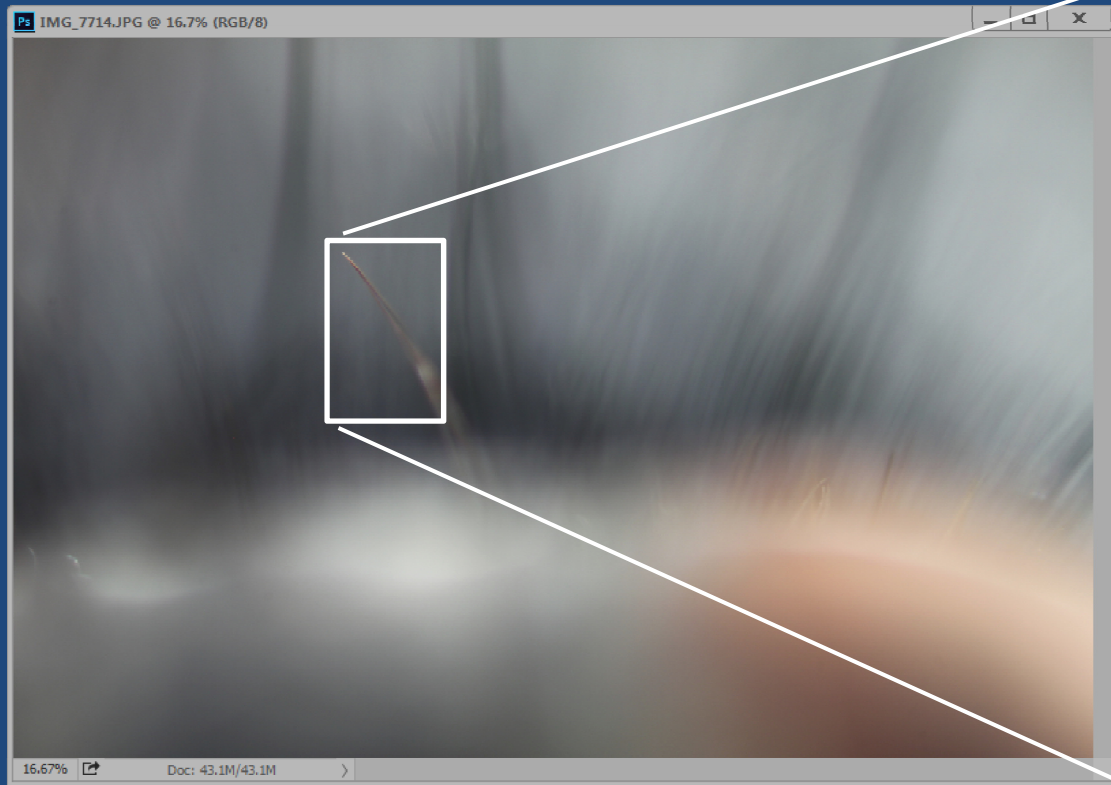
An Extreme Example – The Setup



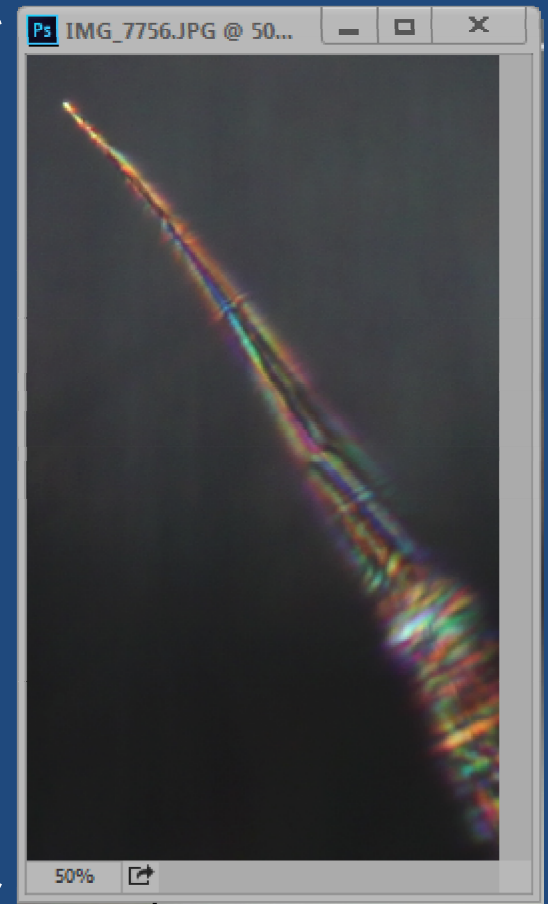
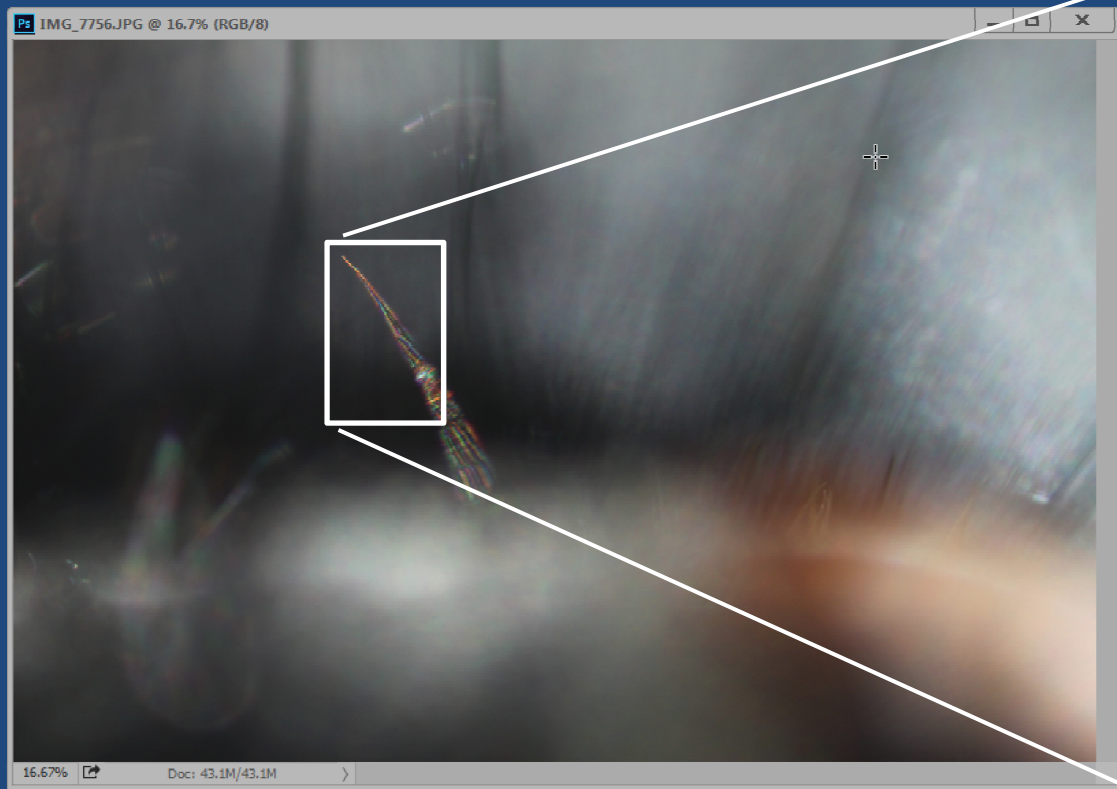
An Extreme Example – The Setup



What The Camera Sees (with the diffuser)



What The Camera Sees (without the diffuser)



This is a lot like laser speckle.

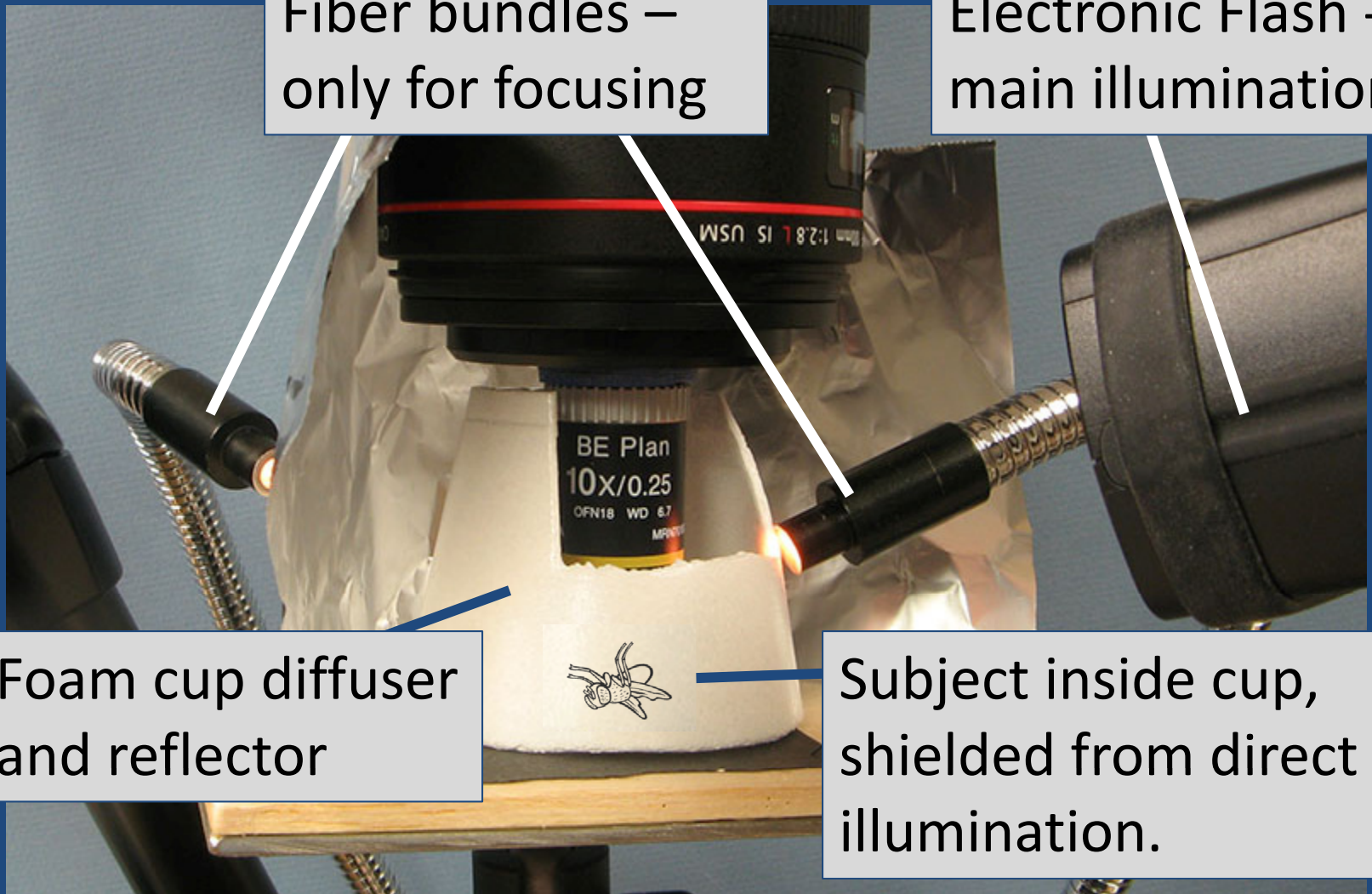
Here's How The Blowfly Was Shot

Fiber bundles –
only for focusing

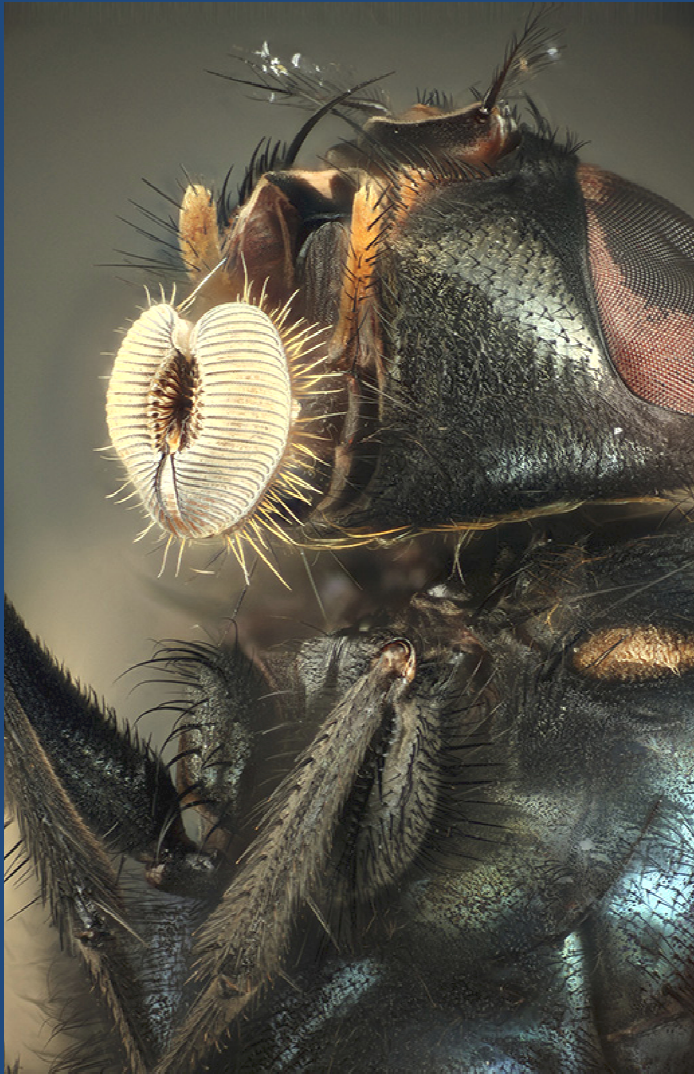
Electronic Flash --
main illumination

Foam cup diffuser
and reflector

Subject inside cup,
shielded from direct
illumination.



And Here's That Result Again



1 micron resolution,
3.75 mm depth of field



Recap So Far...

- What focus stacking is
- Why we have to do it
- Why diffuse illumination is important

What Else?

- What focus stacking is
- Why we have to do it
- Why diffuse illumination is important
- Stop down as far as sharpness allows
- Try multiple stacking methods
- Expect to use retouching for best results

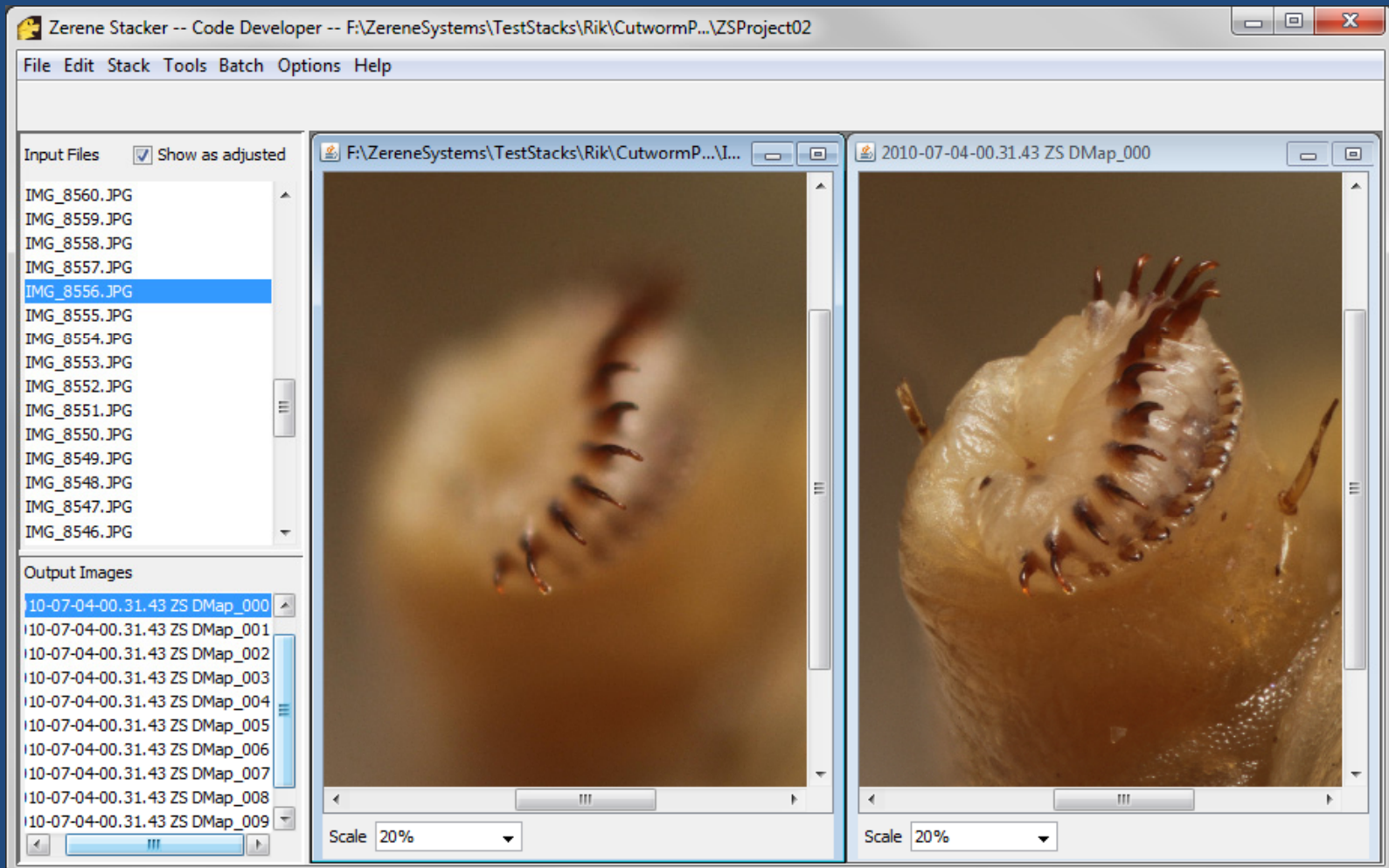
What Else?

- What focus stacking is
- Why we have to do it
- Why diffuse illumination is important
- Stop down as far as sharpness allows
- Try multiple stacking methods
- Expect to use retouching for best results
- Consider stereo or animated rocking

Synthetic Stereo & Rocking

Zerene Stacker

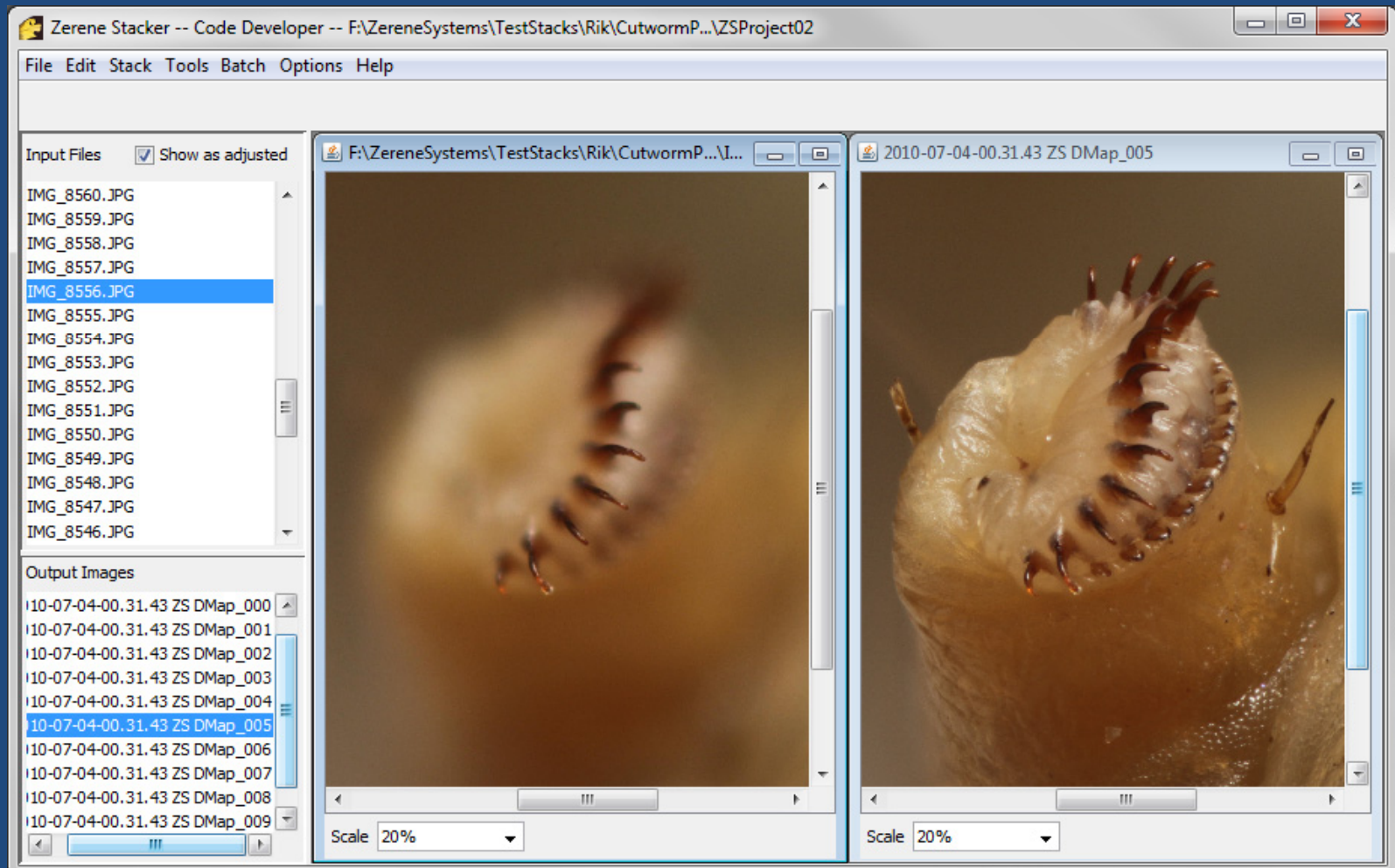
optimized for high magnification and tough subjects,
includes synthetic stereo & rocking from single stack



Synthetic Stereo & Rocking

Zerene Stacker

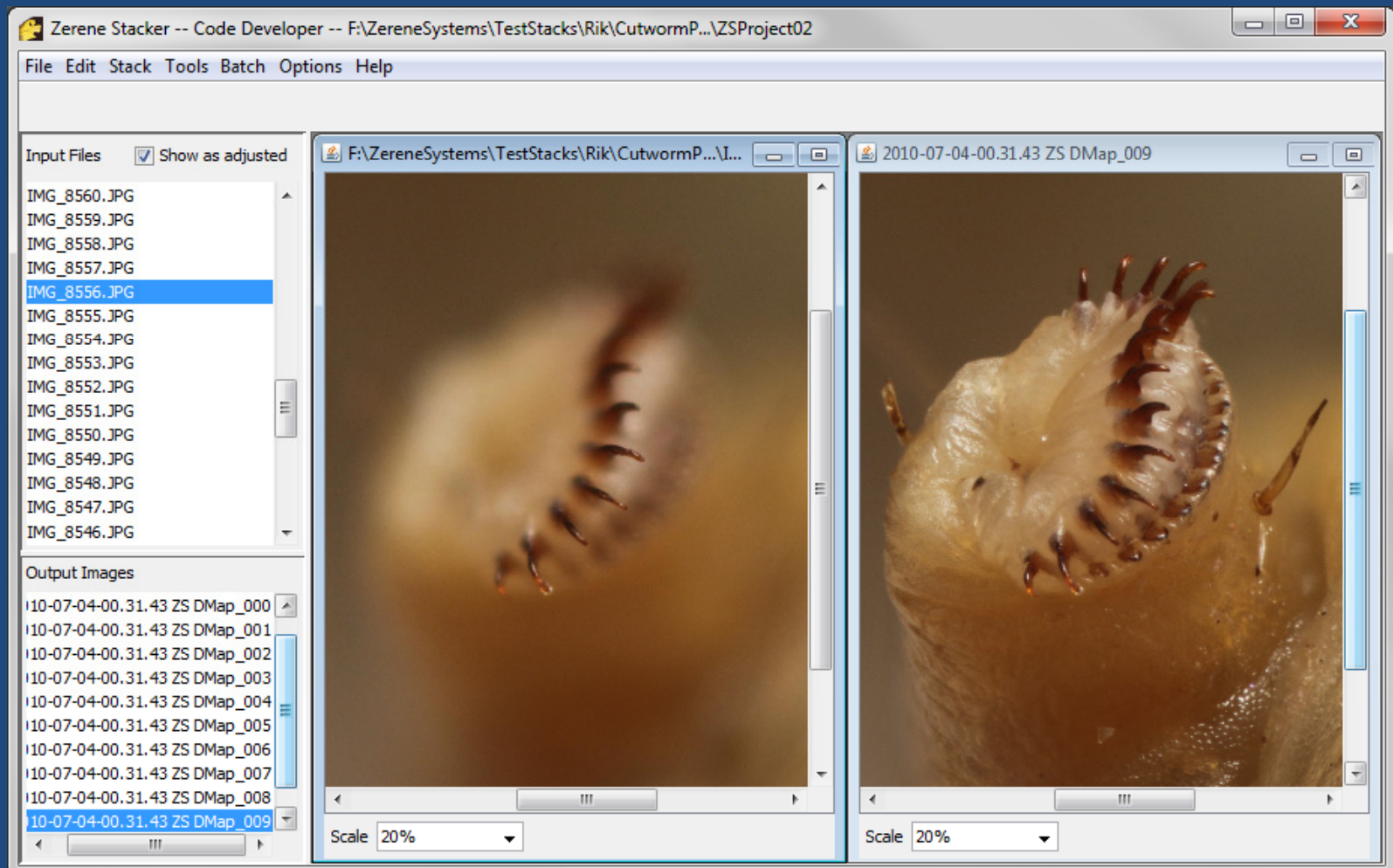
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Synthetic Stereo & Rocking

Zerene Stacker

optimized for high magnification and tough subjects,
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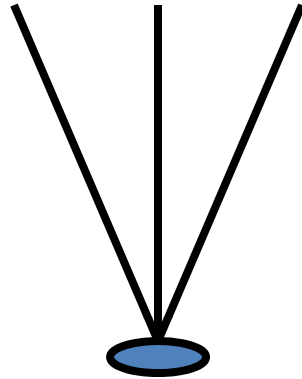


Also Consider...

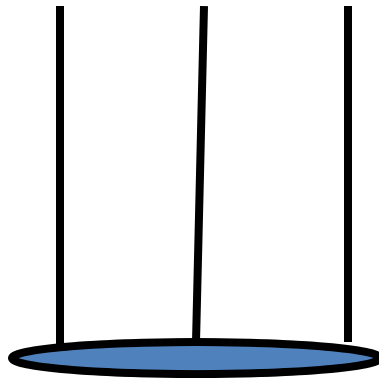
- Telecentric optics for stack-and-stitch
- Goniometers for subject positioning

Telecentric Optics Have No Parallax

Ordinary Optics

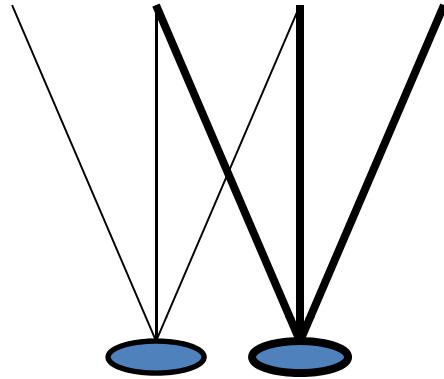


Telecentric Optics

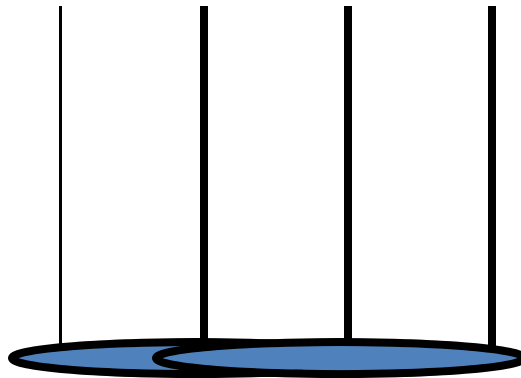


Telecentric Optics Have No Parallax

Ordinary Optics

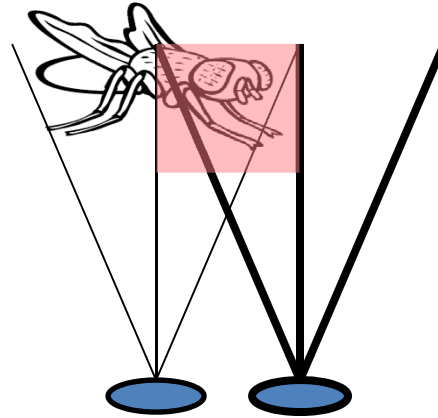


Telecentric Optics



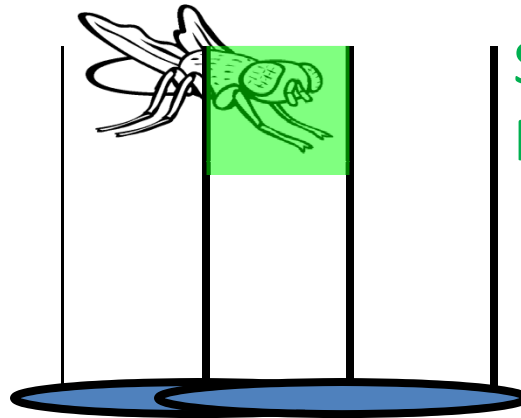
Telecentric Optics Have No Parallax

Ordinary Optics



Different Views –
Problem!

Telecentric Optics



Same View –
No Problem!

Telecentric Optics Have No Parallax

Ordinary Optics



Telecentric Optics



Telecentric Optics Have No Parallax

Ordinary Optics



Telecentric Optics



Telecentric Optics Have No Parallax

Ordinary Optics



Telecentric Optics



Telecentric Optics Have No Parallax

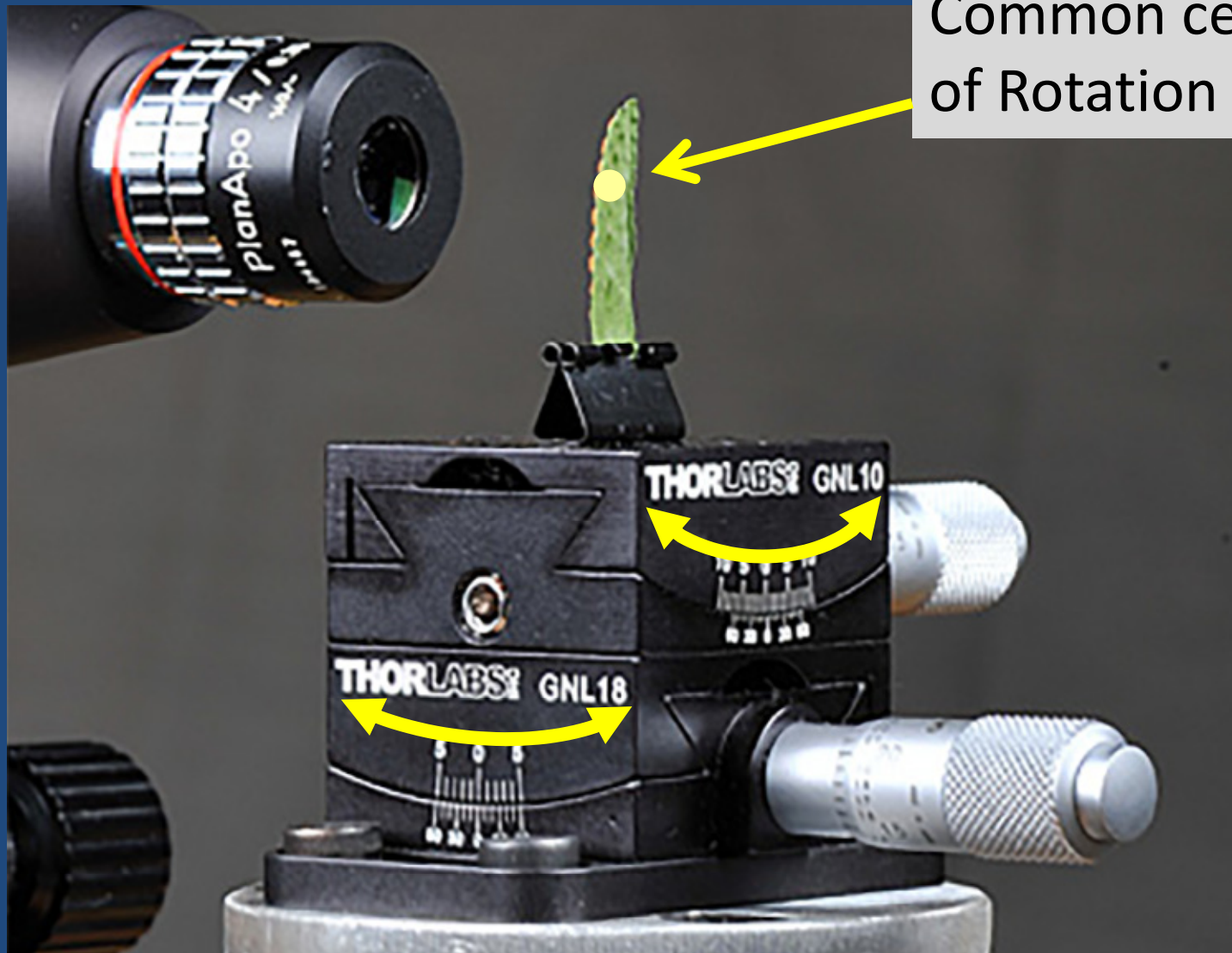
Ordinary Optics



Telecentric Optics



Goniometers Provide Tilt Control



One Last Image



Source: USGS Bee Inventory and Monitoring Lab

Contact Info

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Cell phone: 509-521-6860

(the end)