
STOPPING TIME:


STOPPING TIME:
from flashes...
to lasers


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from flashes...
to lasers

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from flashes…
to lasers


STOPPING TIME:
from flashes...
to lasers

speed up clock:

see things that
go slowly

speed up clock:

see things that
go slowly

slow down clock:

see things that
go fast

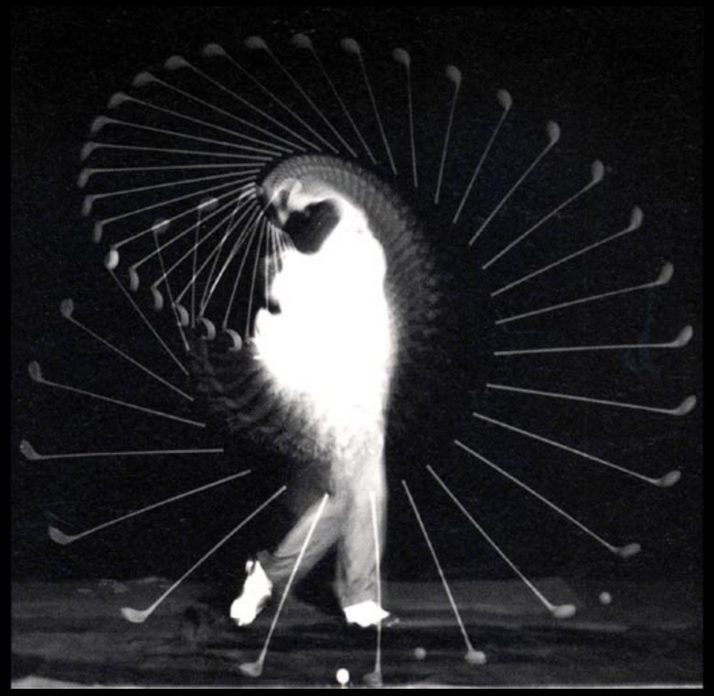
how can we
slow down clock?

speed up clock:

see things that
go slowly

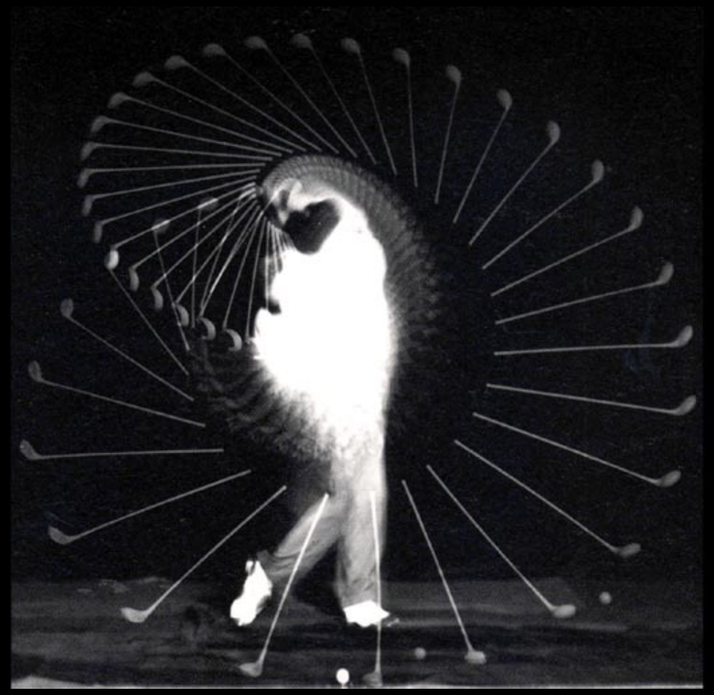
slow down clock:

see things that
go fast



Harold Edgerton

1903 – 1990



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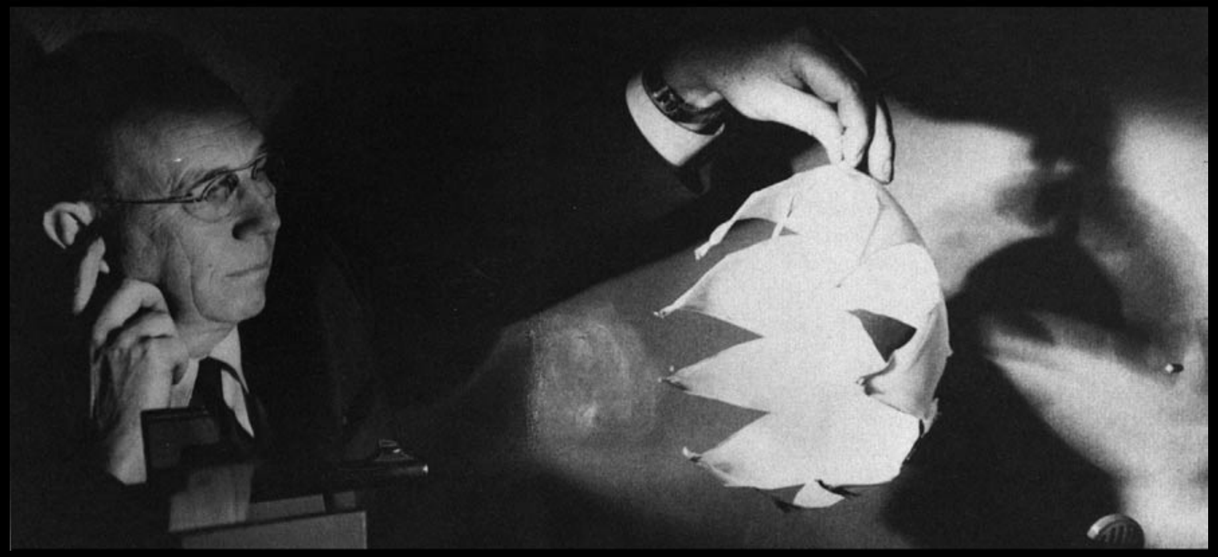
1903 – 1990

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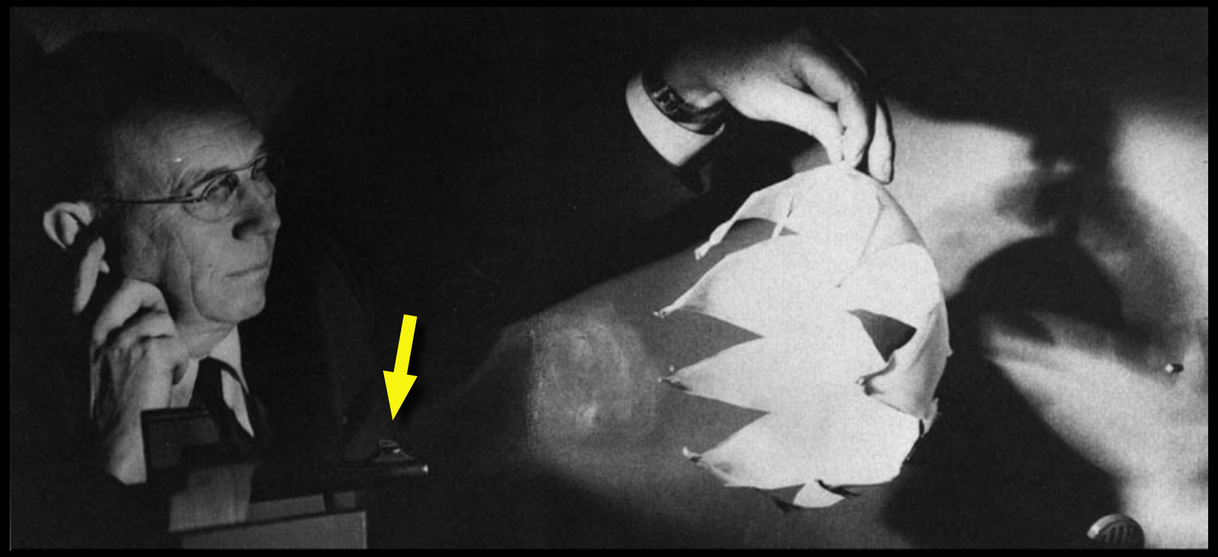


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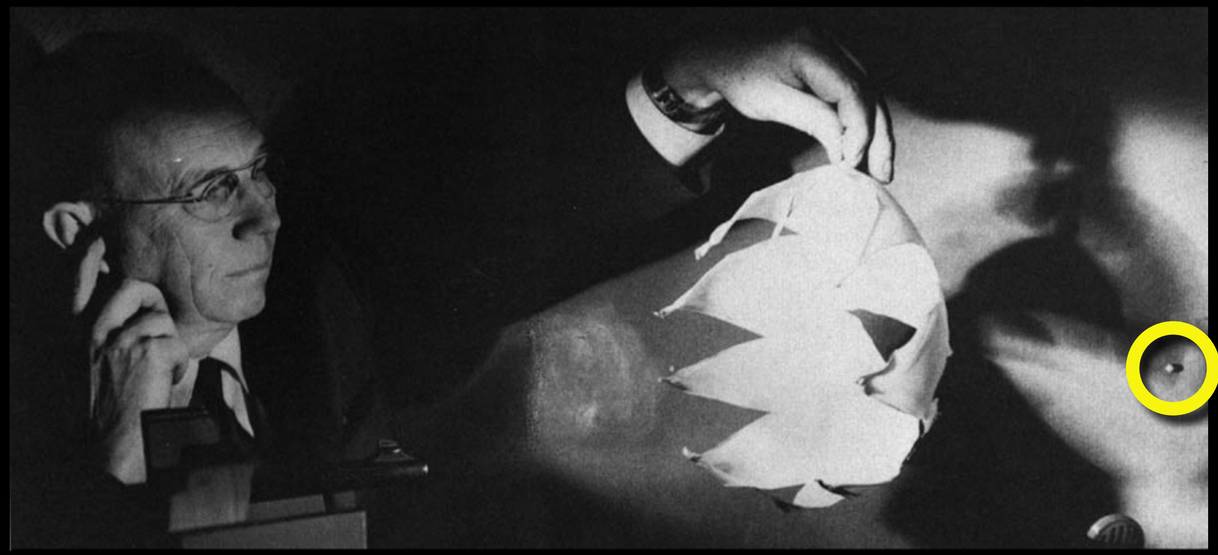


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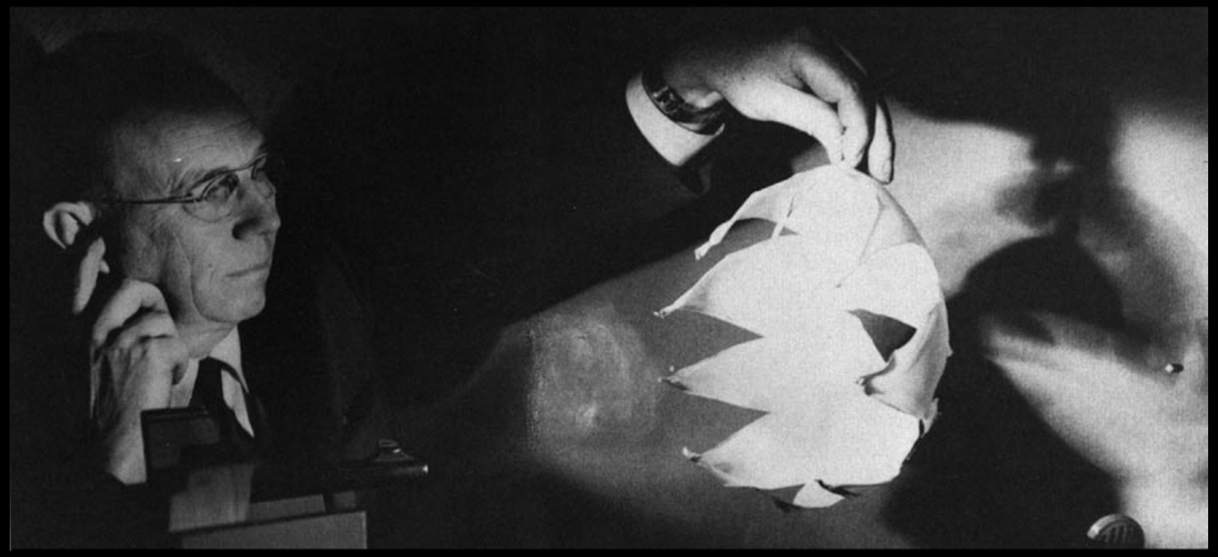


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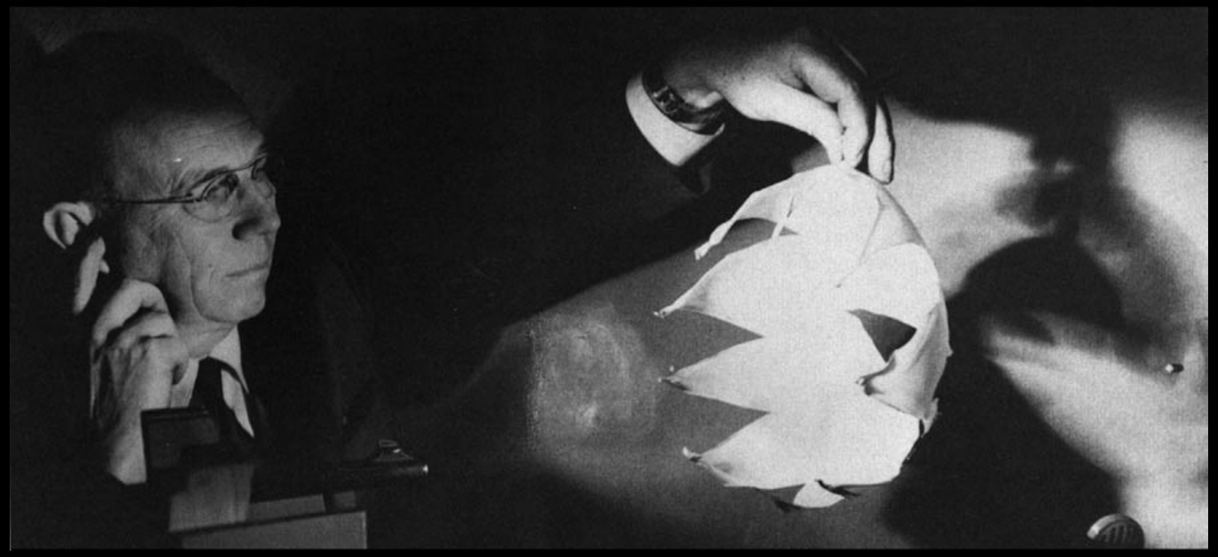

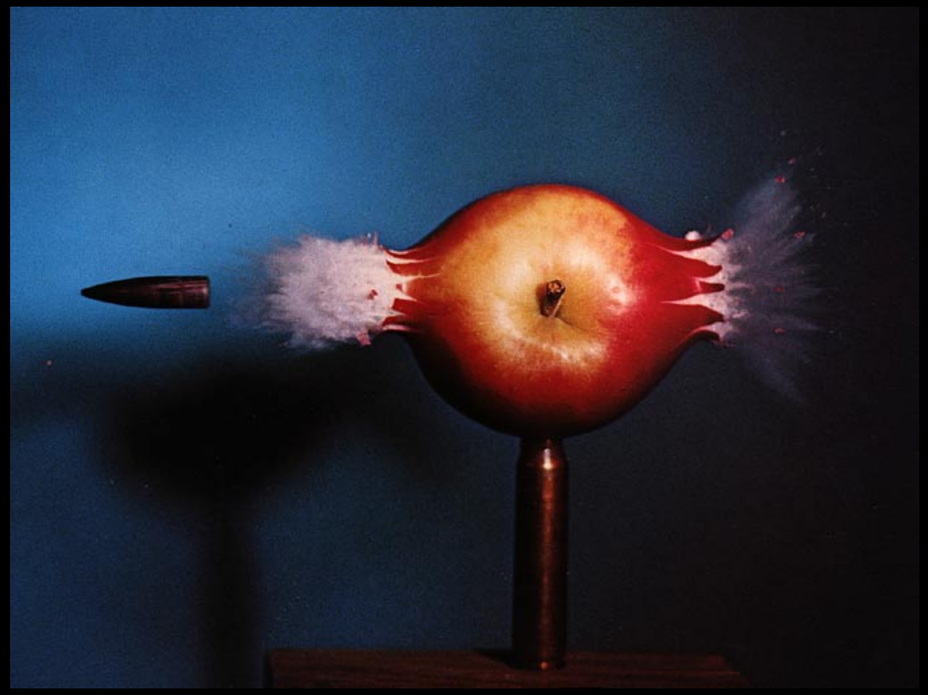

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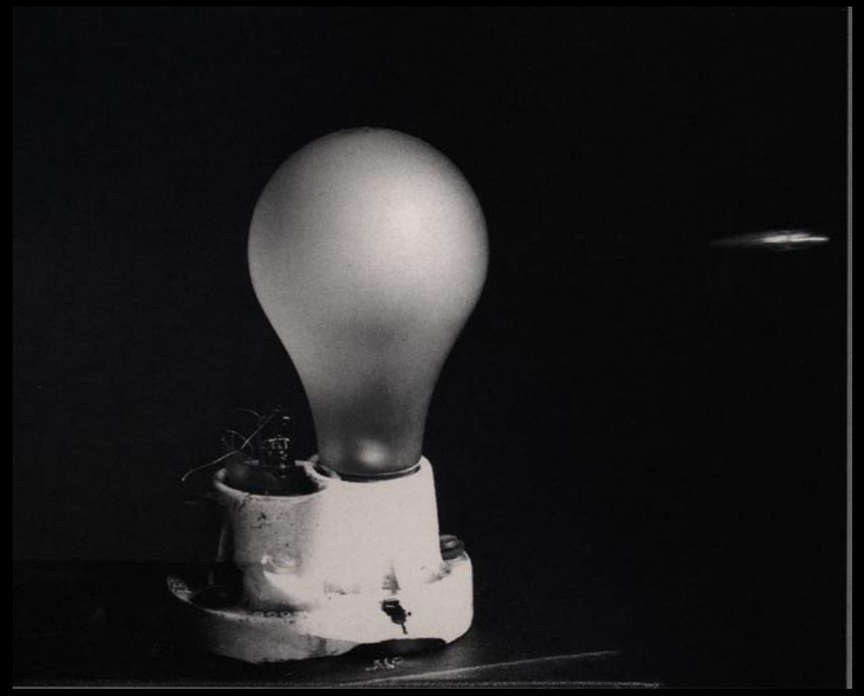


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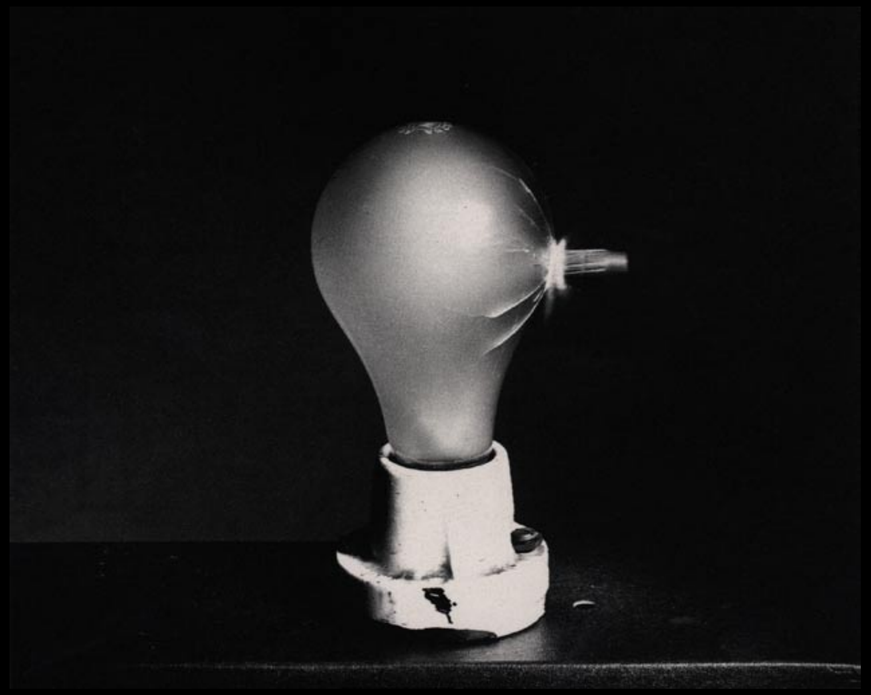


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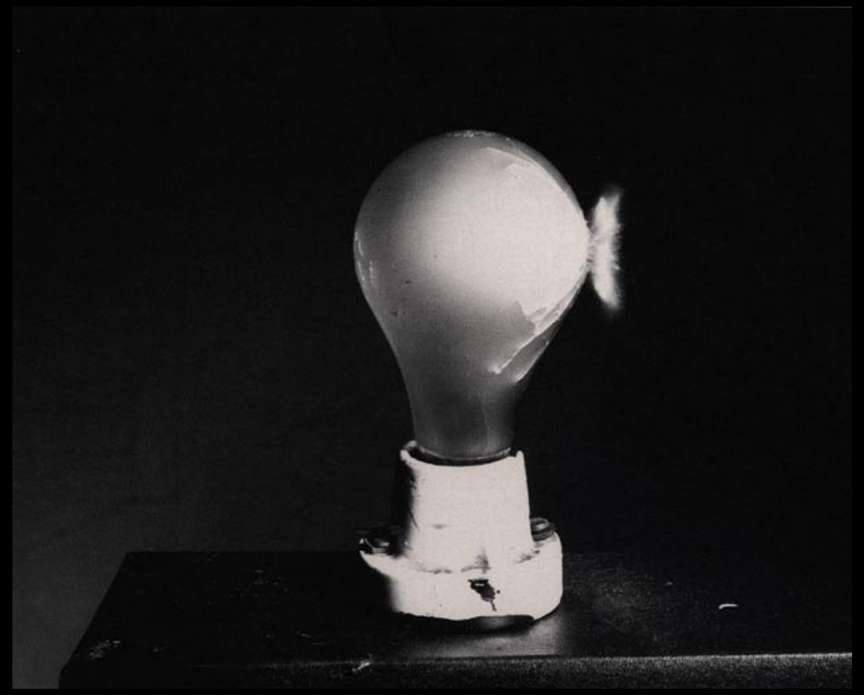


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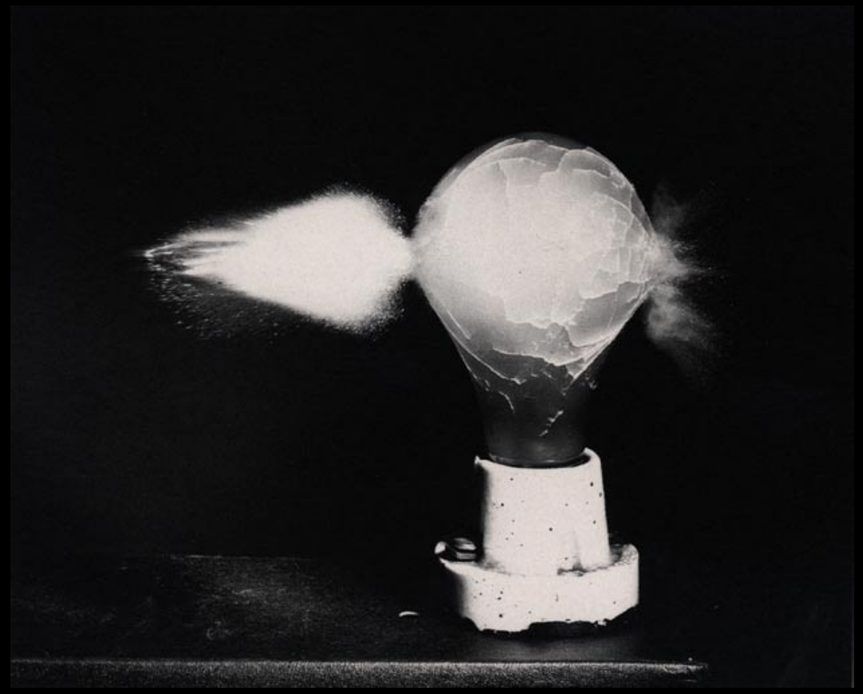


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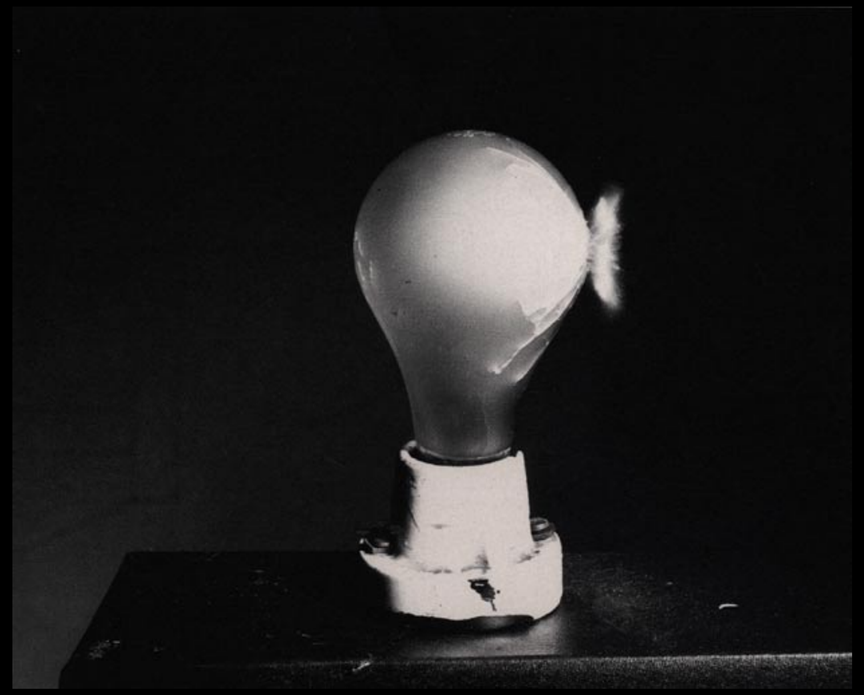
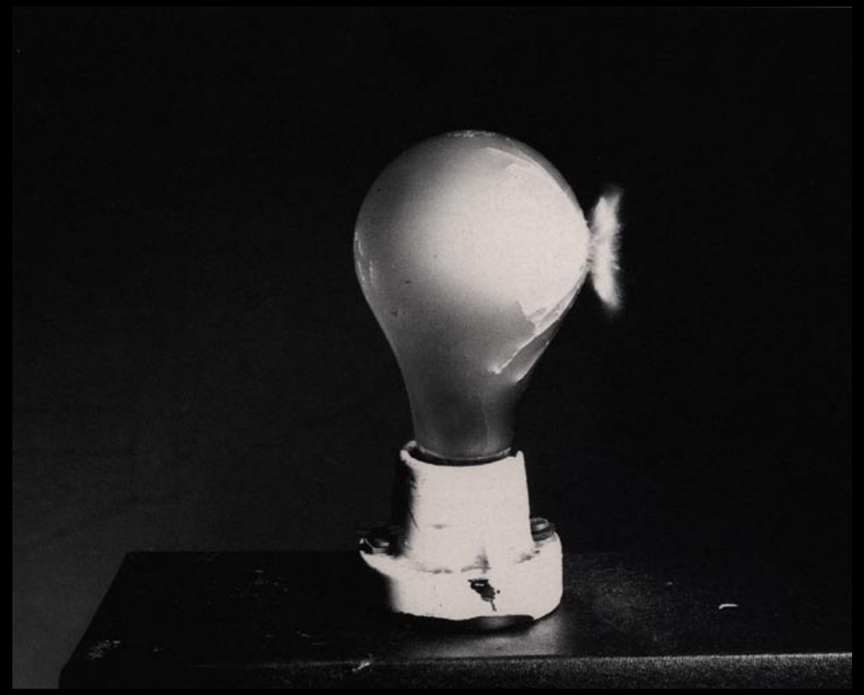


how do you capture

a bullet in a bulb?



how do you capture

a bullet in a bulb?

flash exposure:

about 1 microsecond

flash exposure:

about 1 microsecond

that’s one millionth

of a second!

flash exposure:

about 1 microsecond

that’s one millionth

of a second!

1 microsecond is
to a second

flash exposure:

about 1 microsecond

that's one millionth

of a second!

what a second is

to 2 weeks!


1s
(one second)


STOPPING TIME:
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in 1 s light travels

300,000,000 m

in 1 s light travels

300,000,000 m

that's from here to

the moon and back!

1/1,000 S

1 ms

(one millisecond)

STOPPING TIME:

from flashes...
to lasers

in 1 ms light travels

300,000 m

in 1 ms light travels

300,000 m

that's from here to

San Francisco


1/1,000,000 S
1 µs
(one microsecond)


STOPPING TIME:
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in 1 μs light travels

300 m

in 1 µs light travels

300 m

that's the length

of an aircraft carrier


1/1,000,000,000 s
1 ns
(one nanosecond)


STOPPING TIME:
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in 1 ns light travels

0.3 m

in 1 ns light travels

0.3 m

that’s one foot

1/1,000,000,000,000 S

1 ps

(one picosecond)

1/1,000,000,000,000 S

1 ps

(one picosecond)

in 1 ps light travels

0.3 mm

1/1,000,000,000,000 S

(one picosecond)

in 1 ps light travels

0.3 mm

that's a few times

the width of a hair

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

in 1 fs light travels

0.3 μm

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

in 1 fs light travels

0.3 μm

that's few thousandths

of the width of a hair

note that the shorter

the time interval...

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

...the smaller the scale

things happen on

so a ‘flash’ of a few

femtoseconds shows...

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

very fast events

on a small scale

a flash of just

a few femtoseconds

is a lot of light

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

a flash of just

a few femtoseconds

1/1,000,000,000,000,000 S

1 fs

(one femtosecond)

is a lot of light

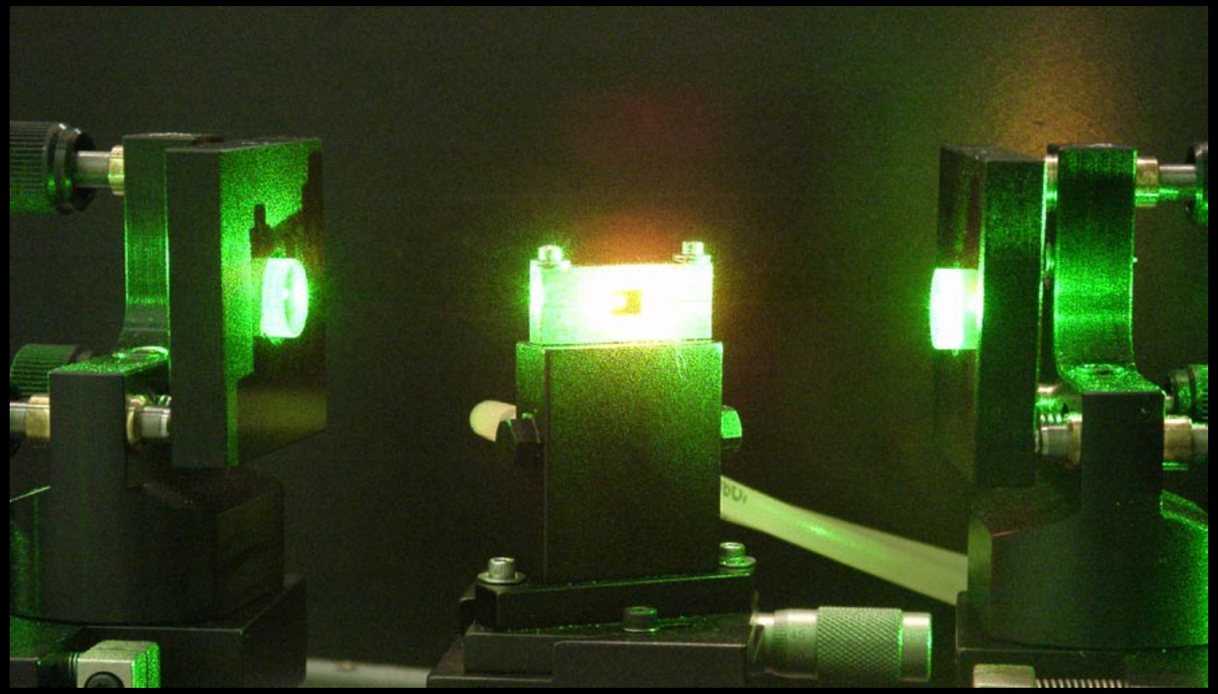
in very little time

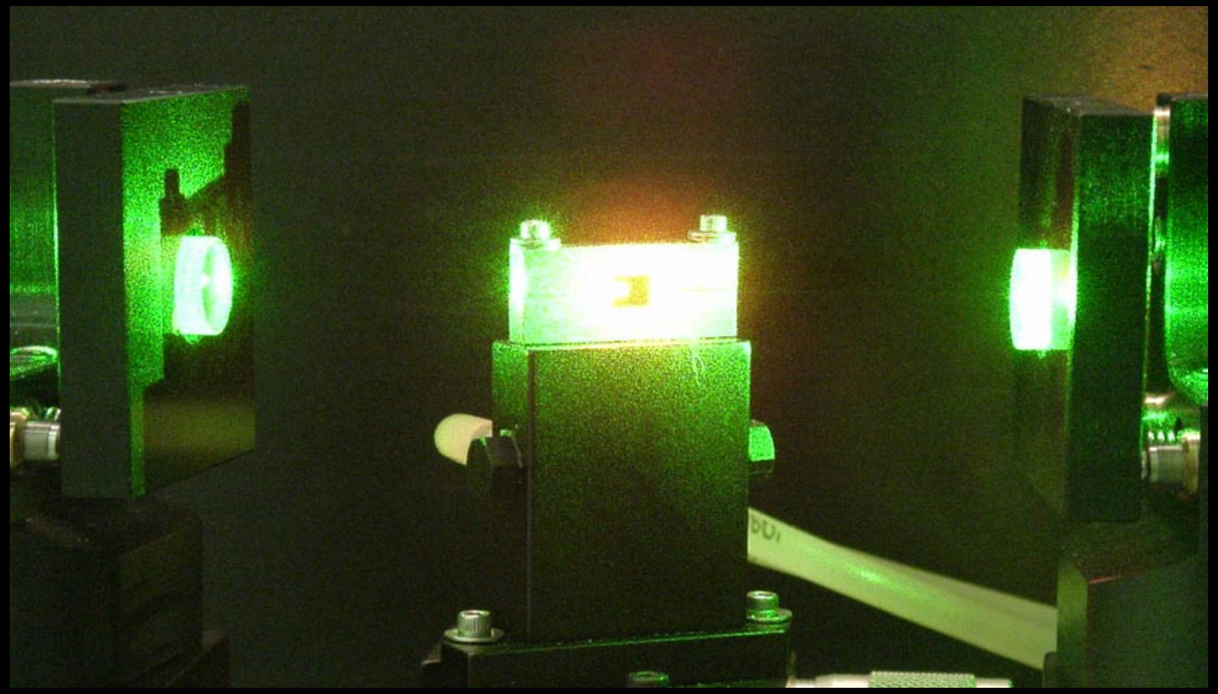
a flash of just

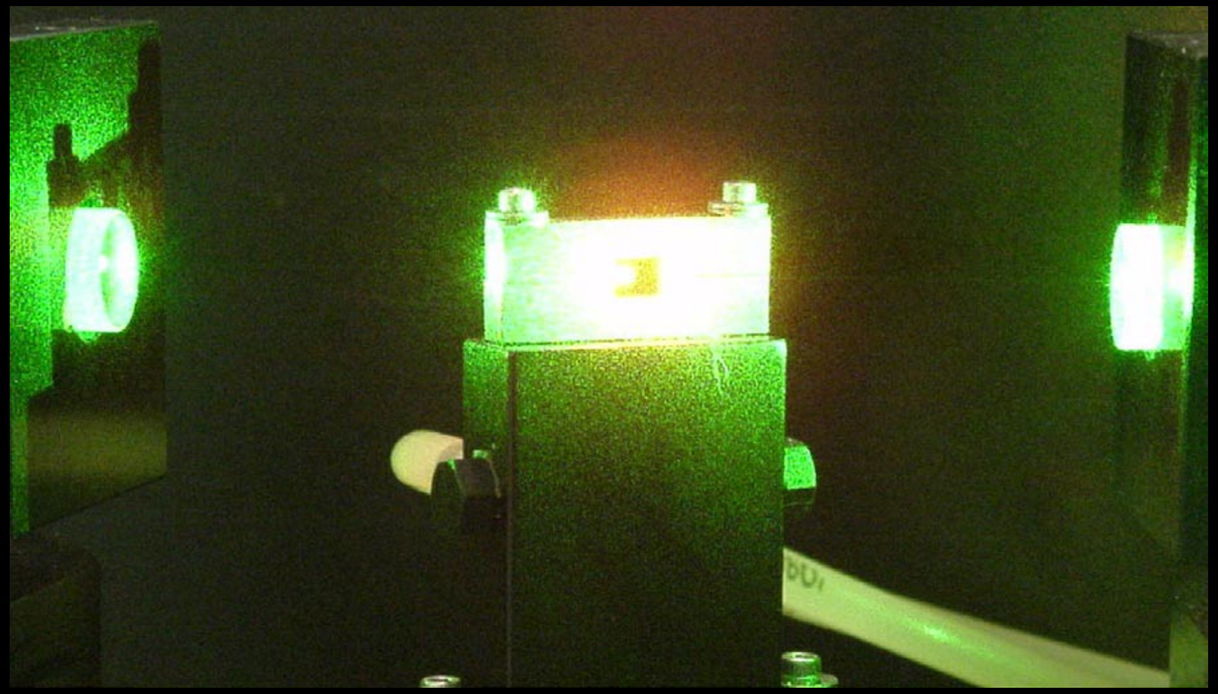
a few femtoseconds

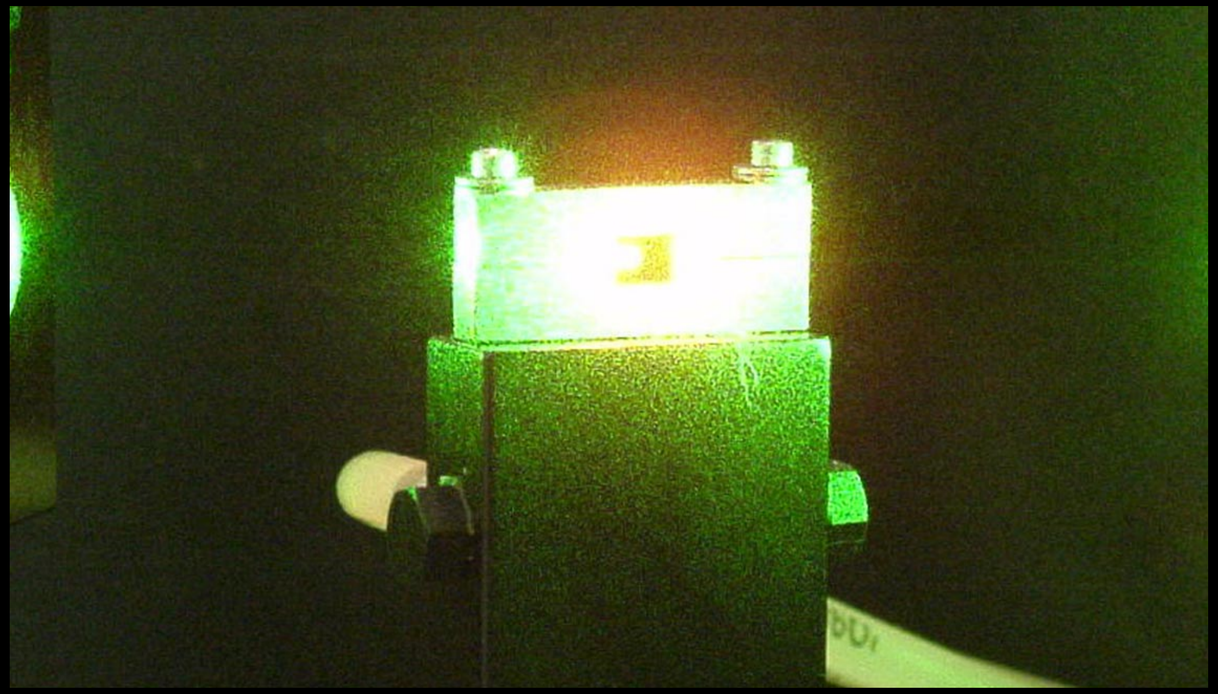
is a lot of light

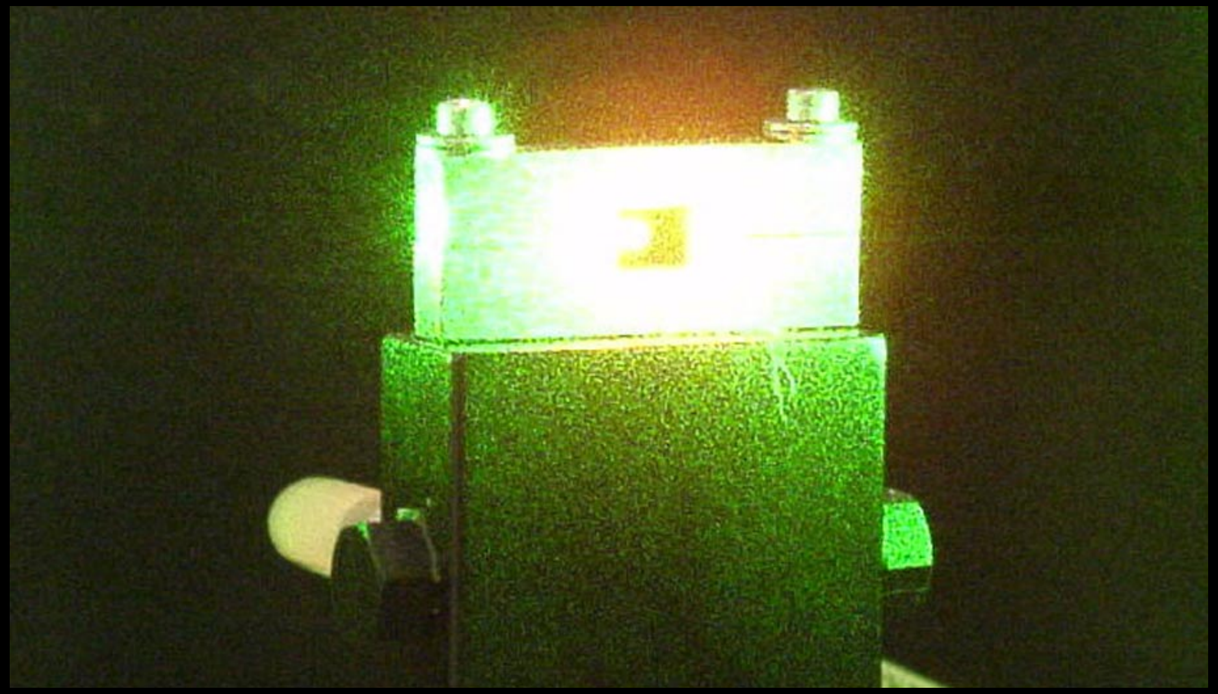
in very little time

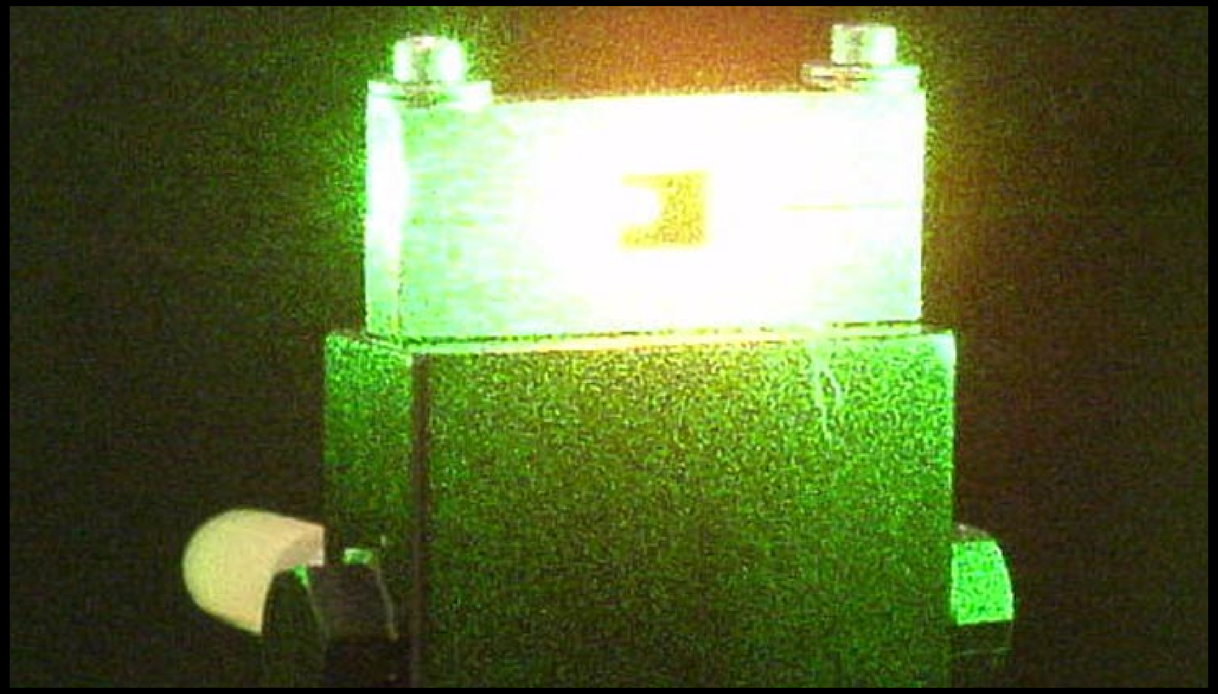


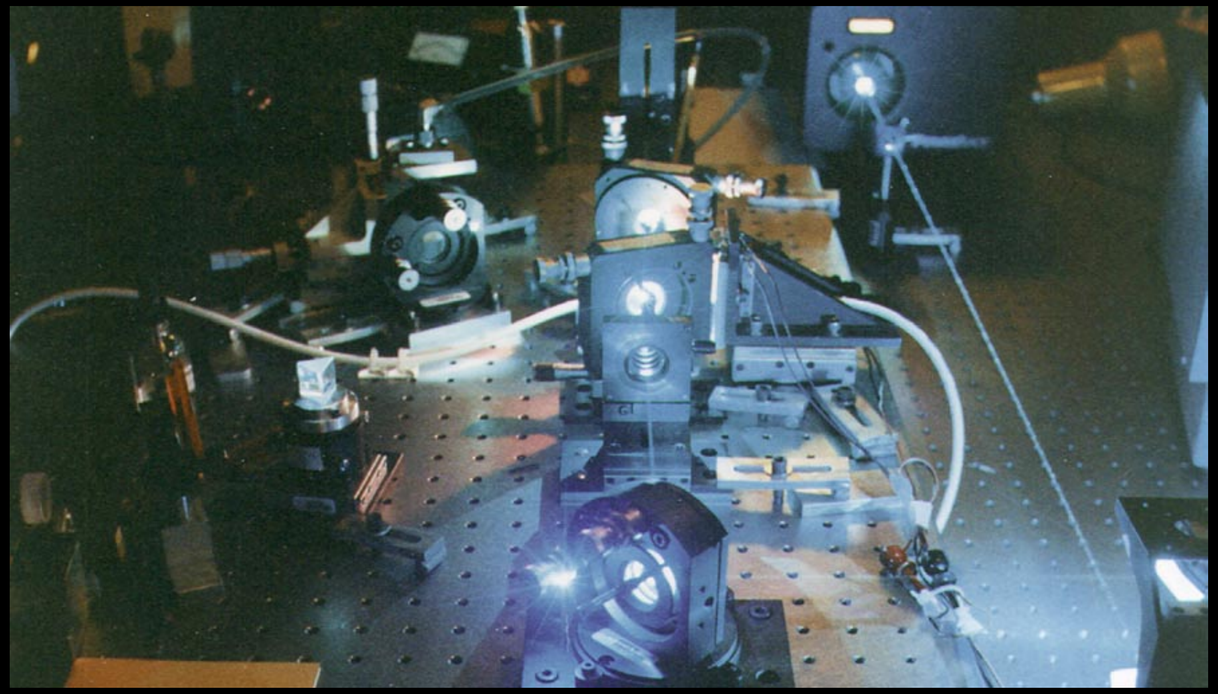


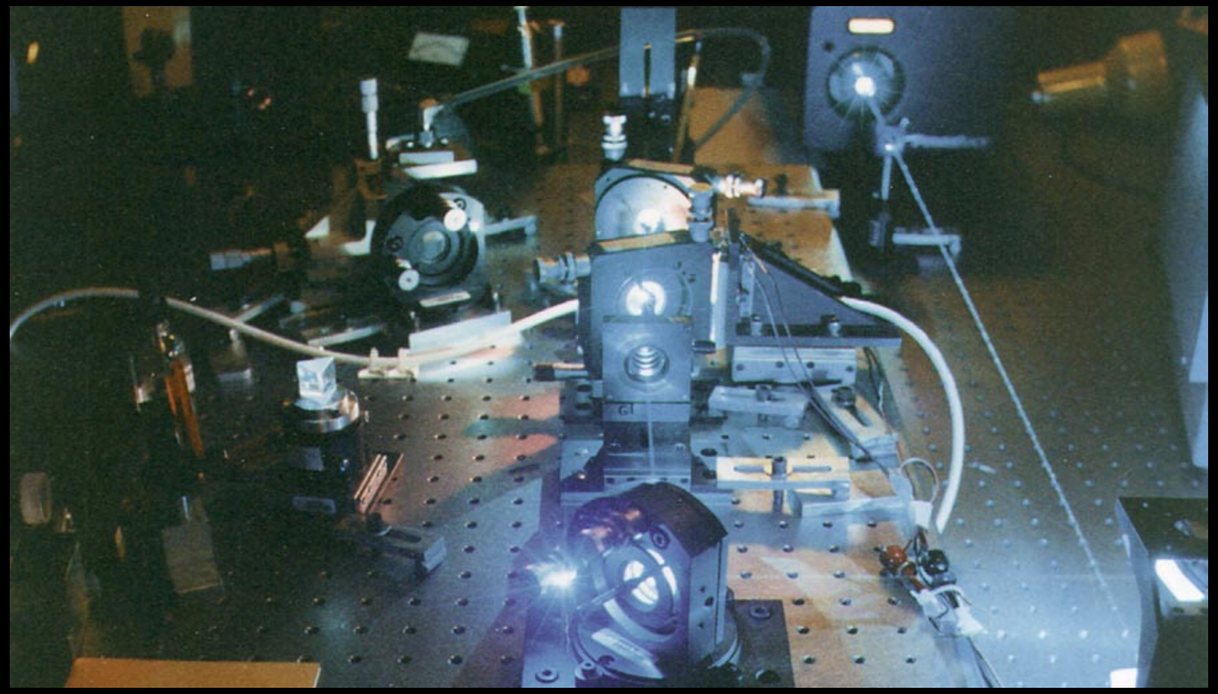


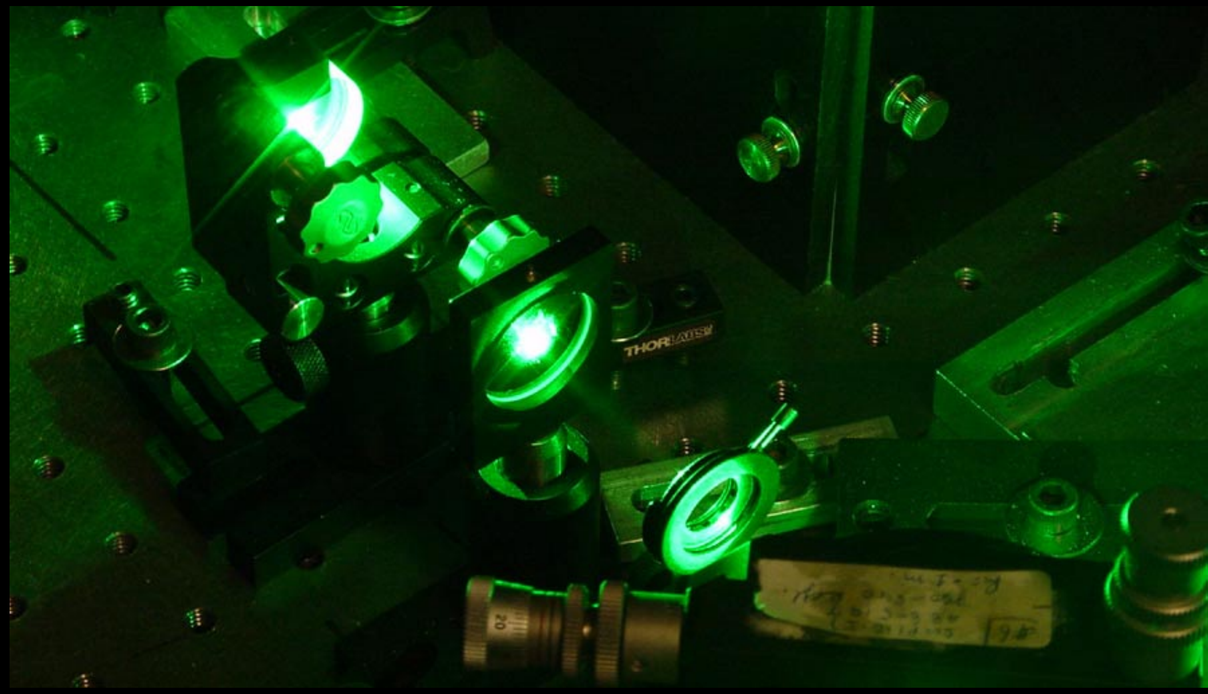


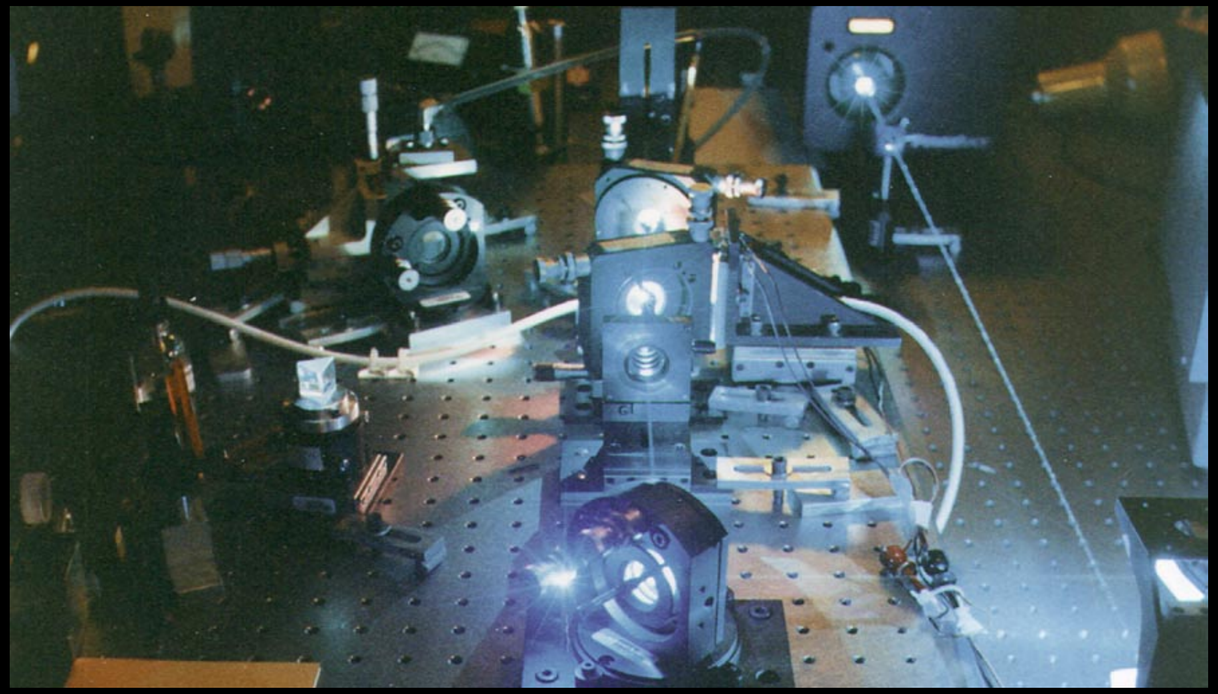


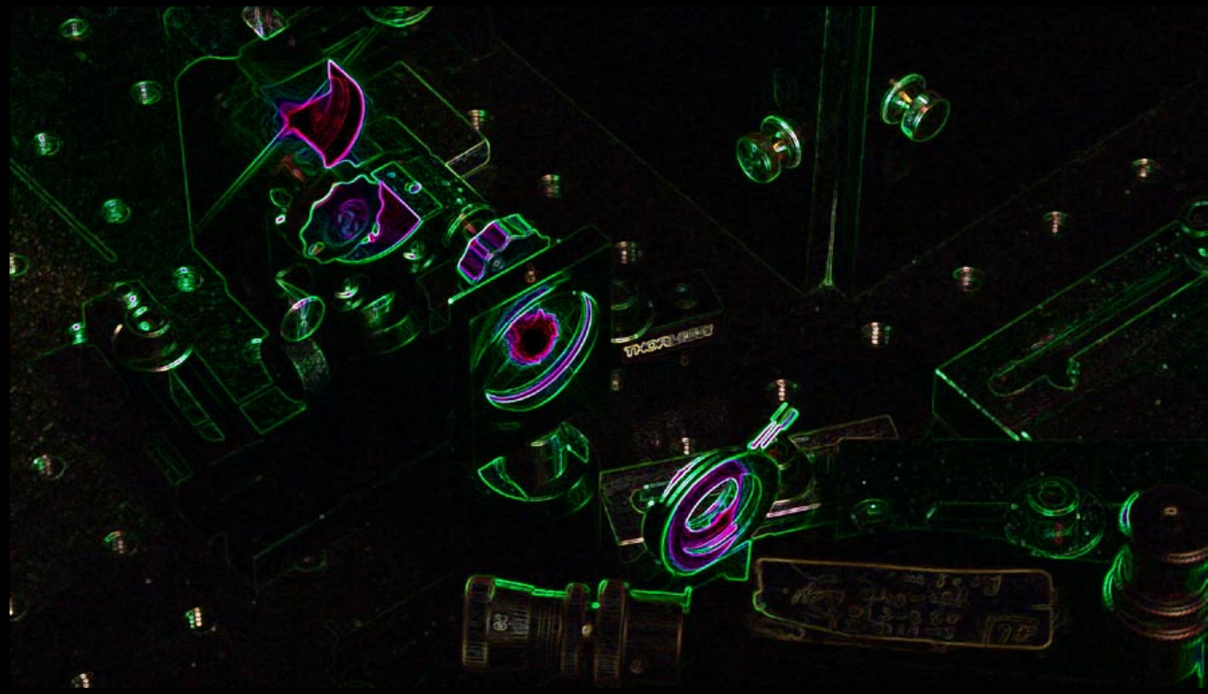


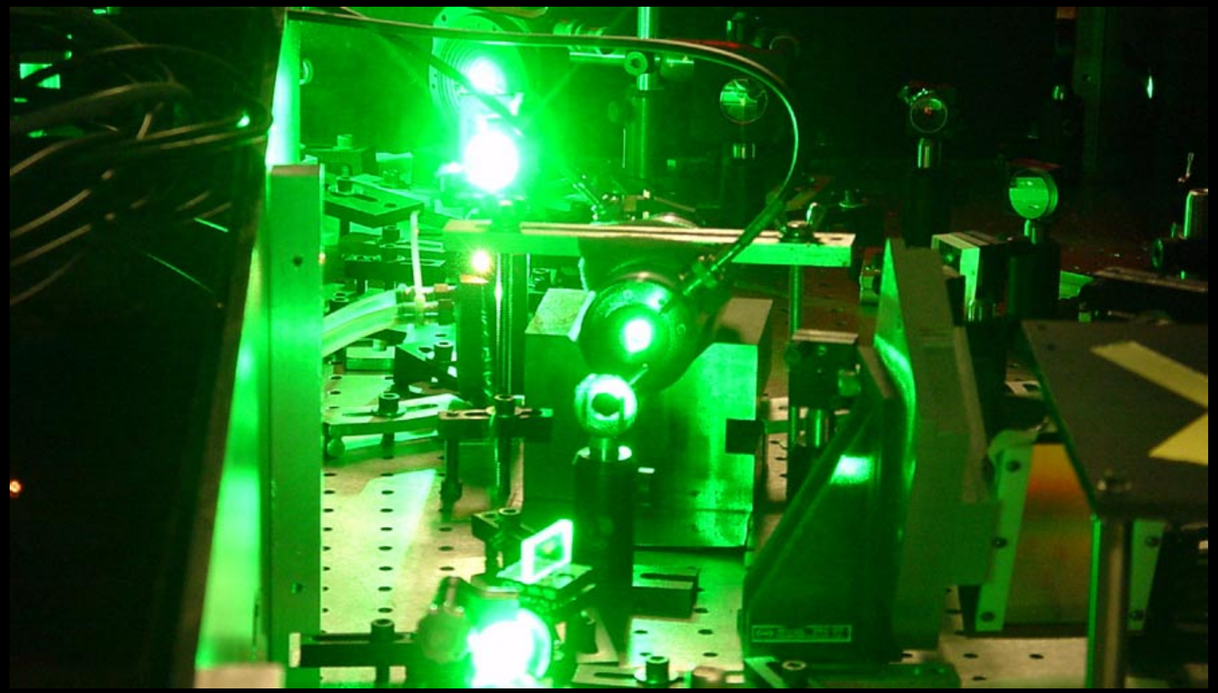


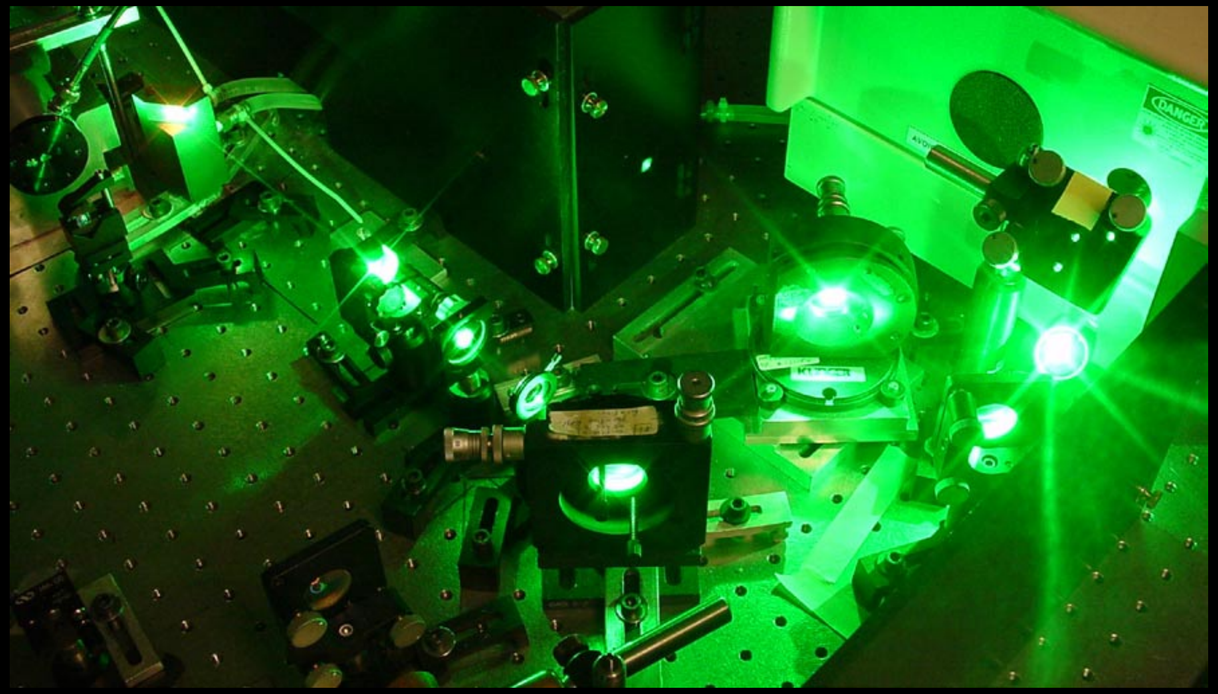


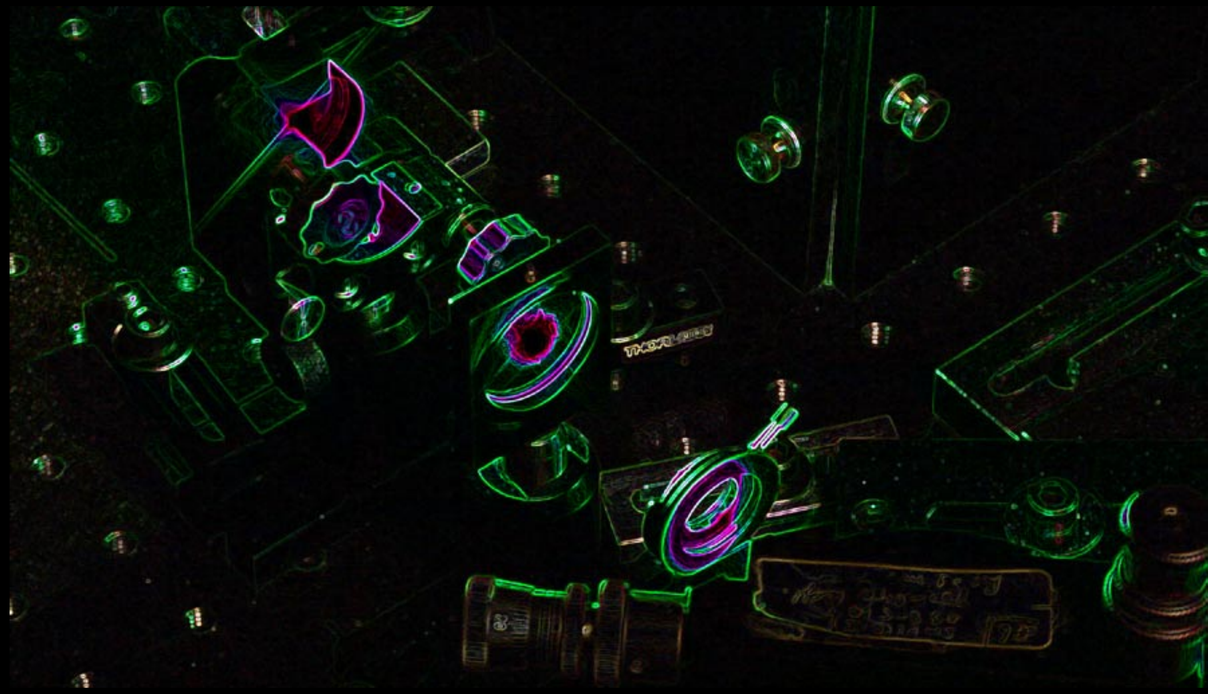

THORLABS

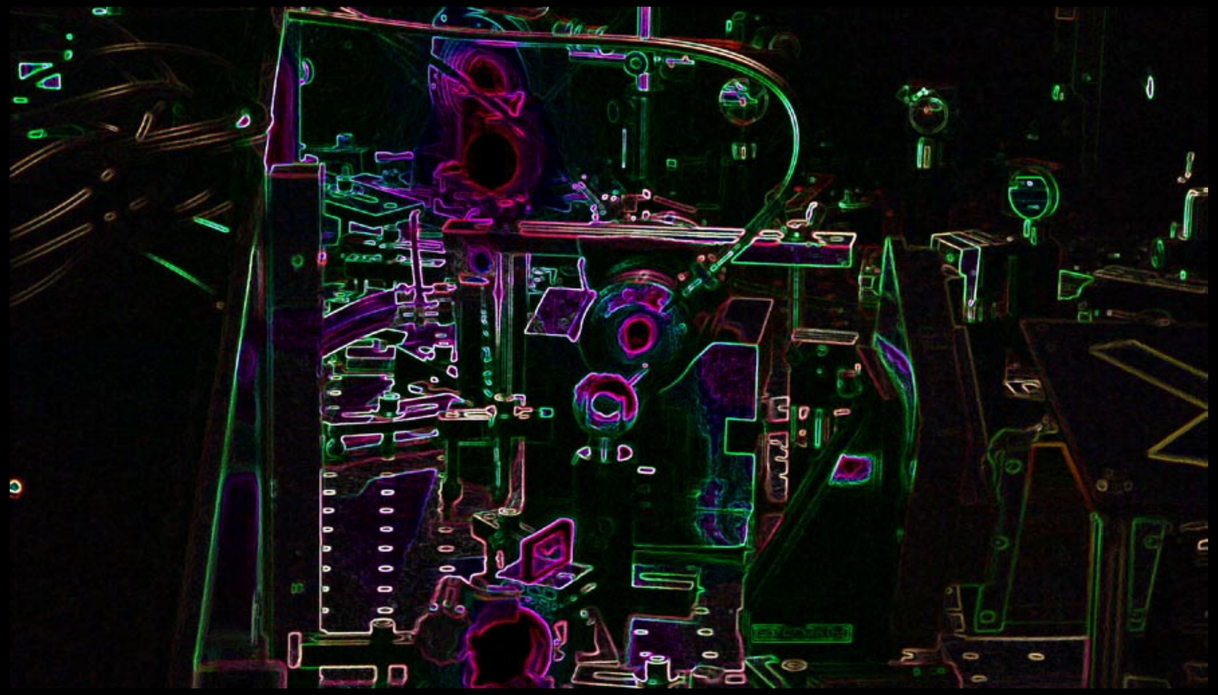


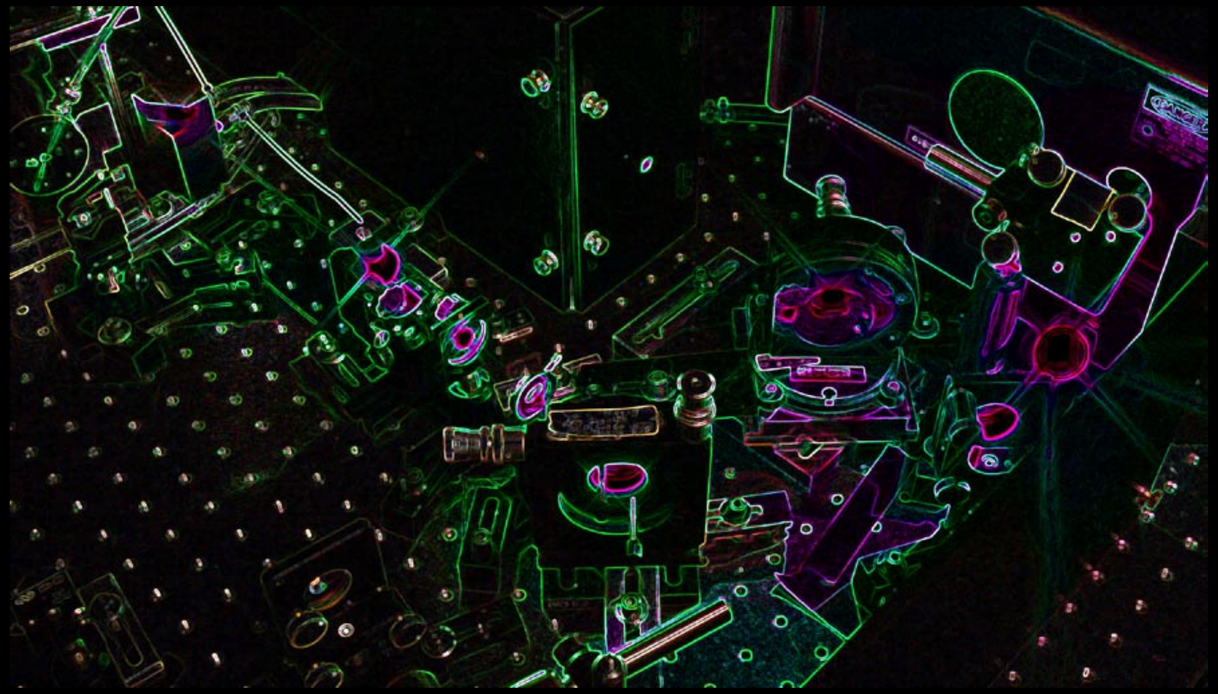


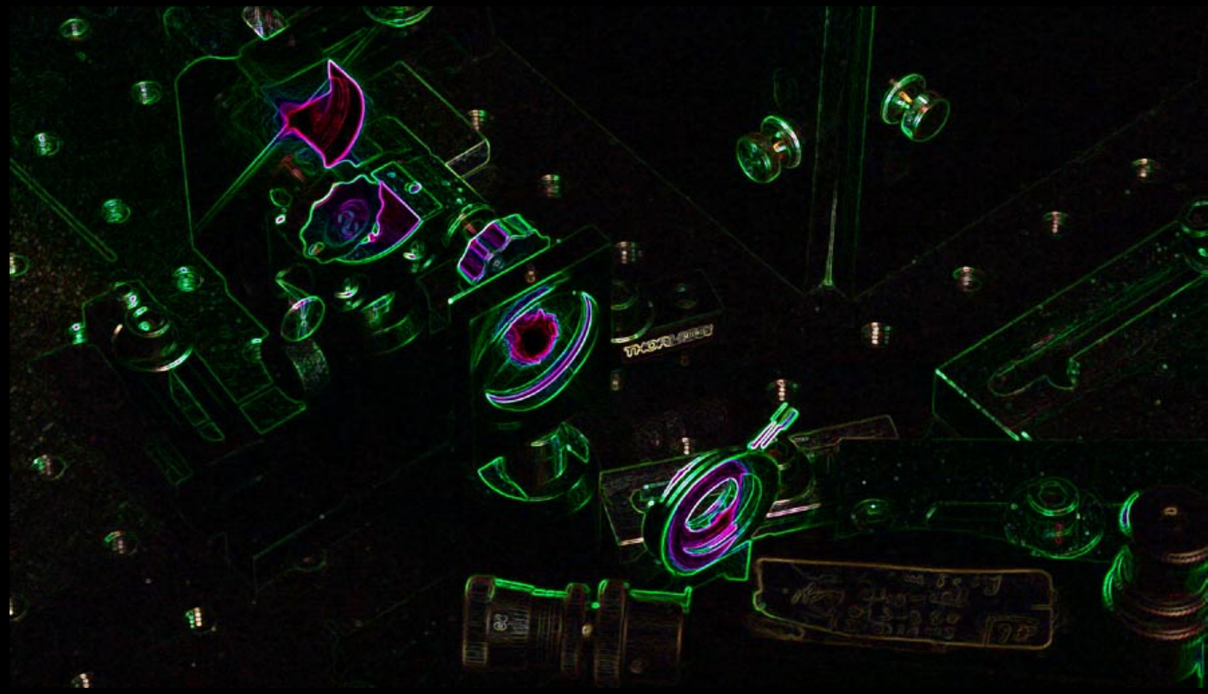


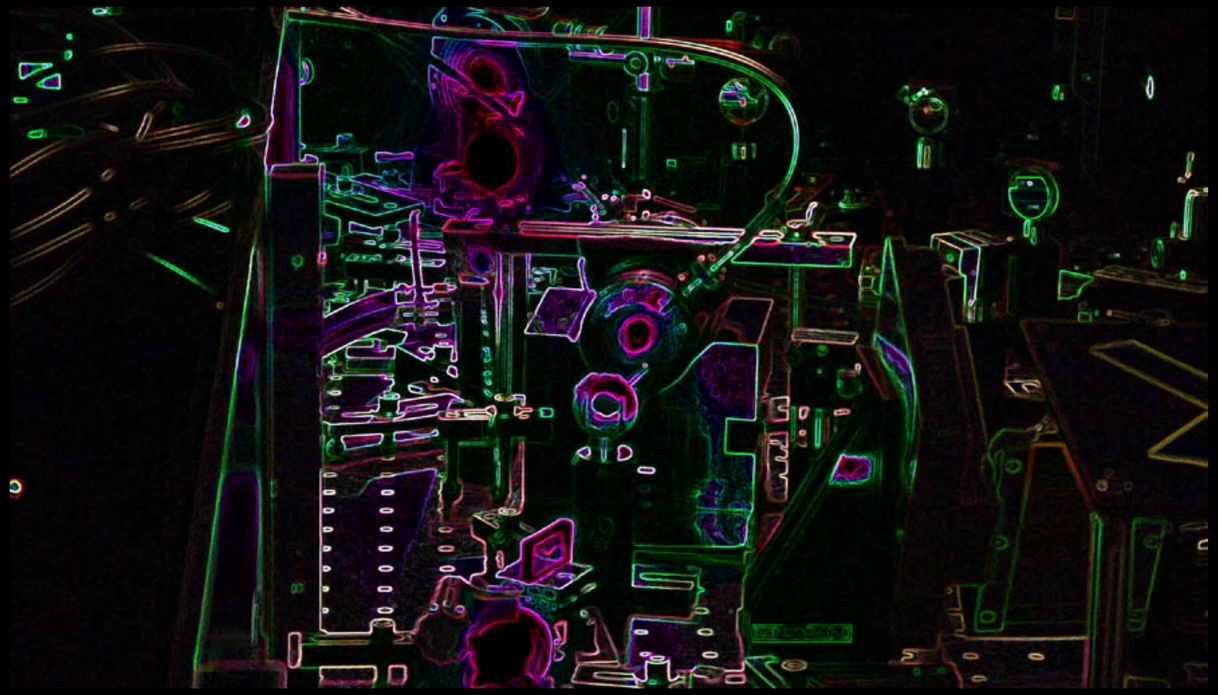












femtosecond pulses

open door to

extremely fast

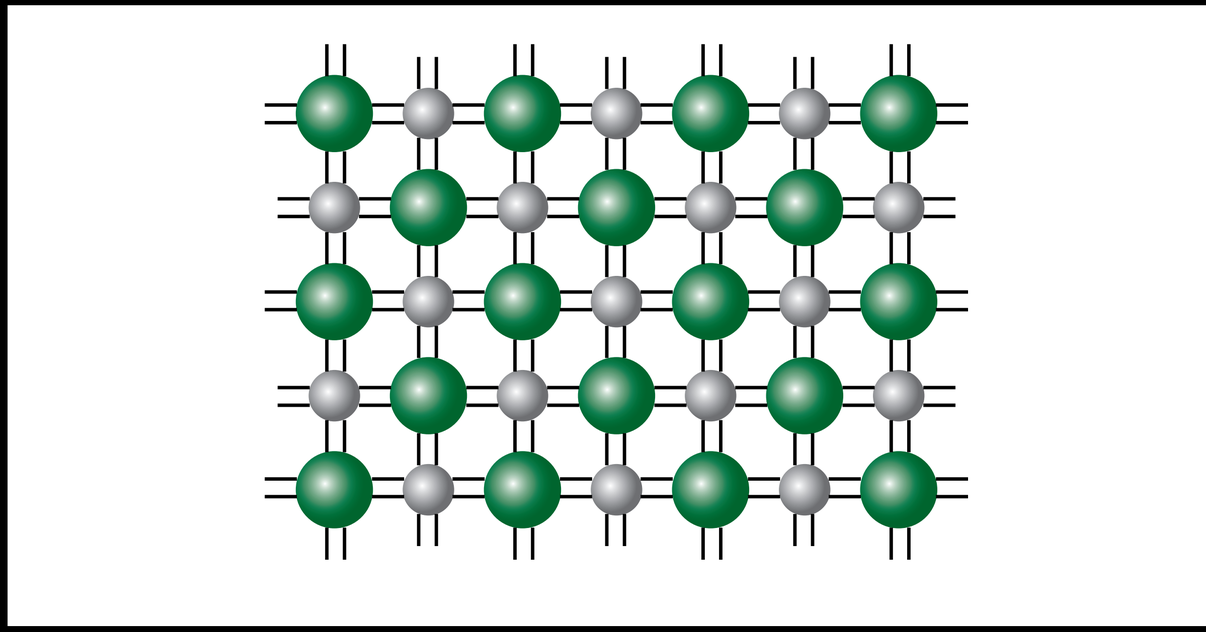
STOPPING TIME:

from flashes...
to lasers

extremely fast

STOPPING TIME:

from flashes...
to lasers



extremely fast

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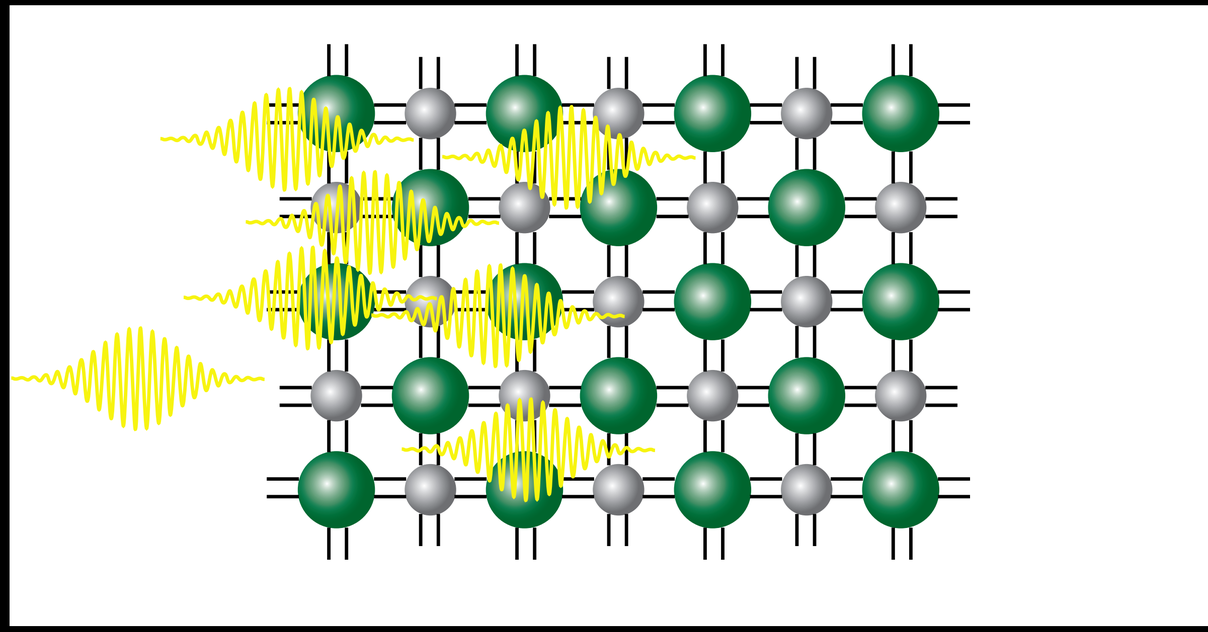

extremely fast

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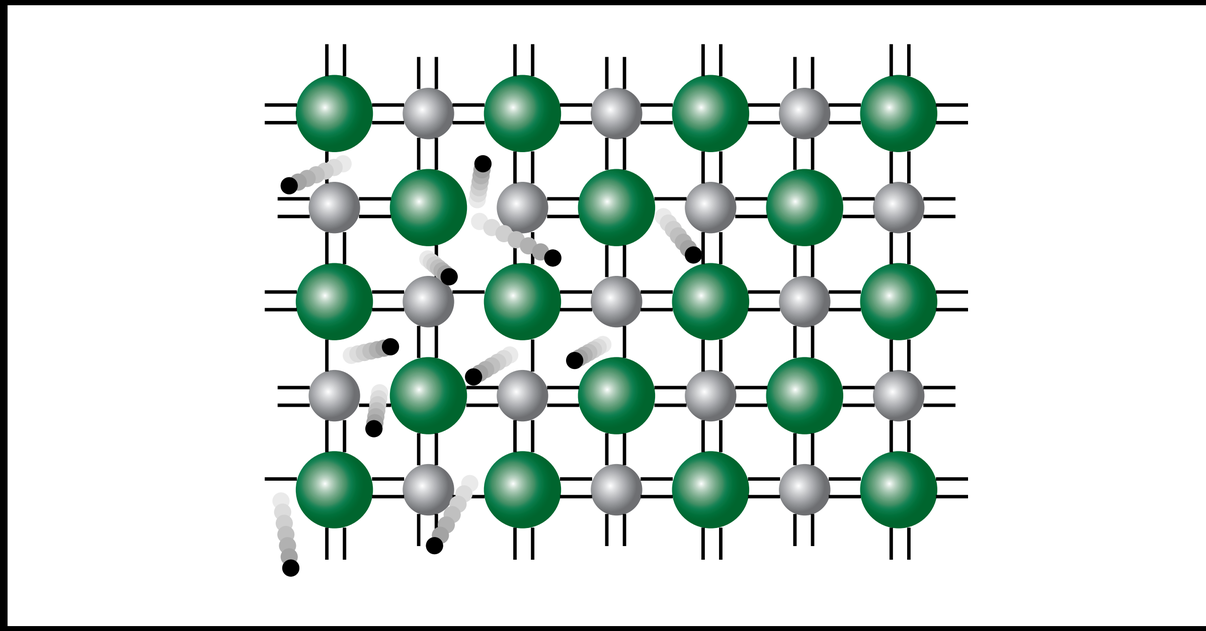

extremely fast

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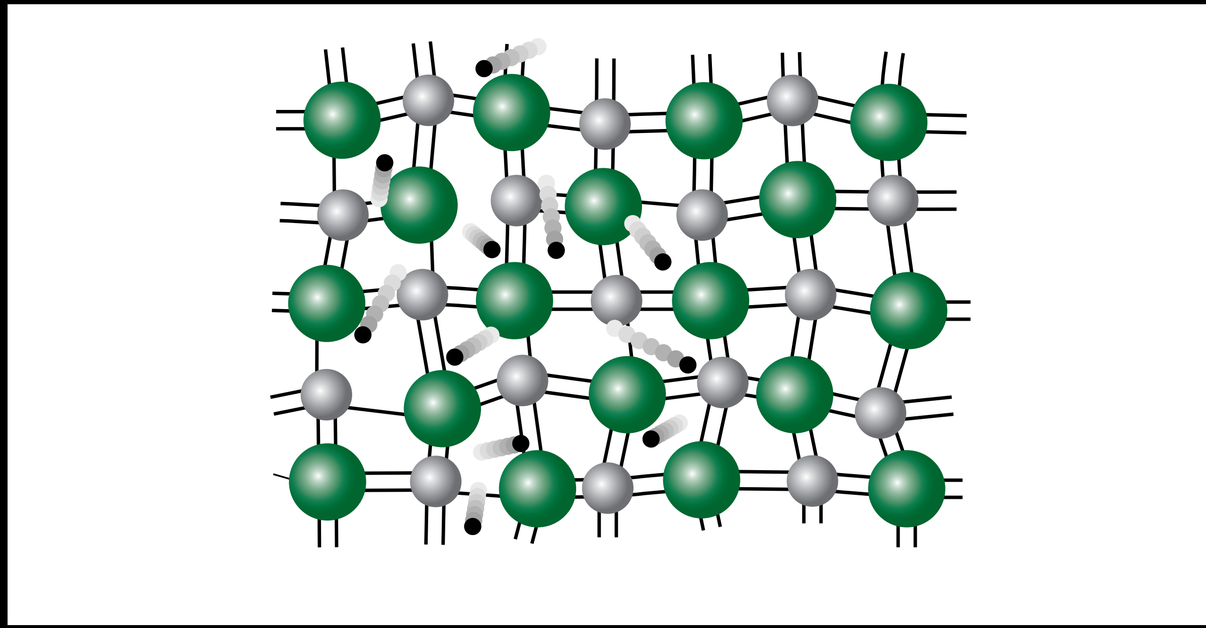

extremely fast

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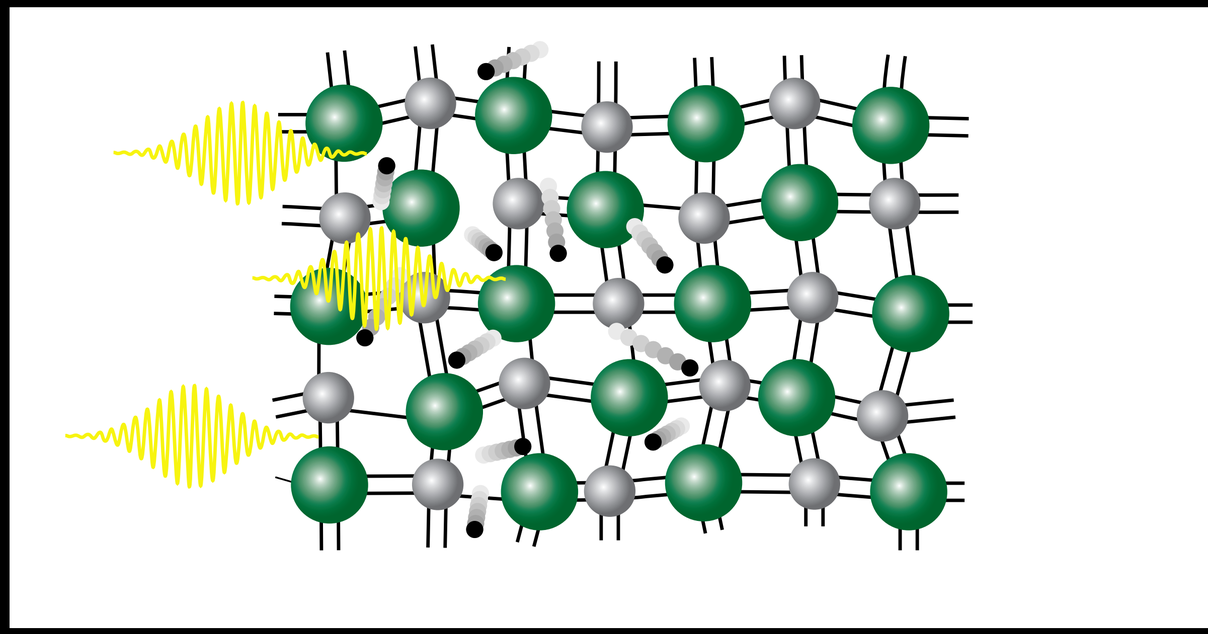

extremely fast

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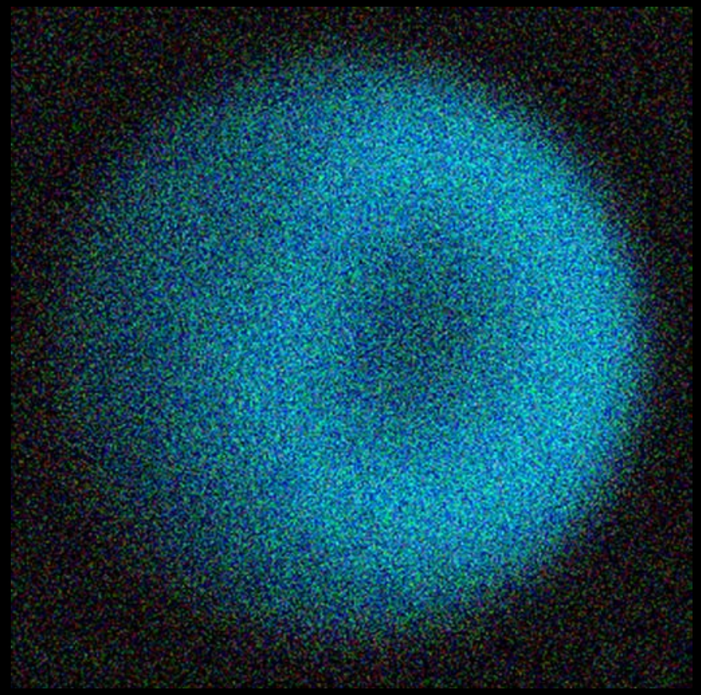
extremely hot

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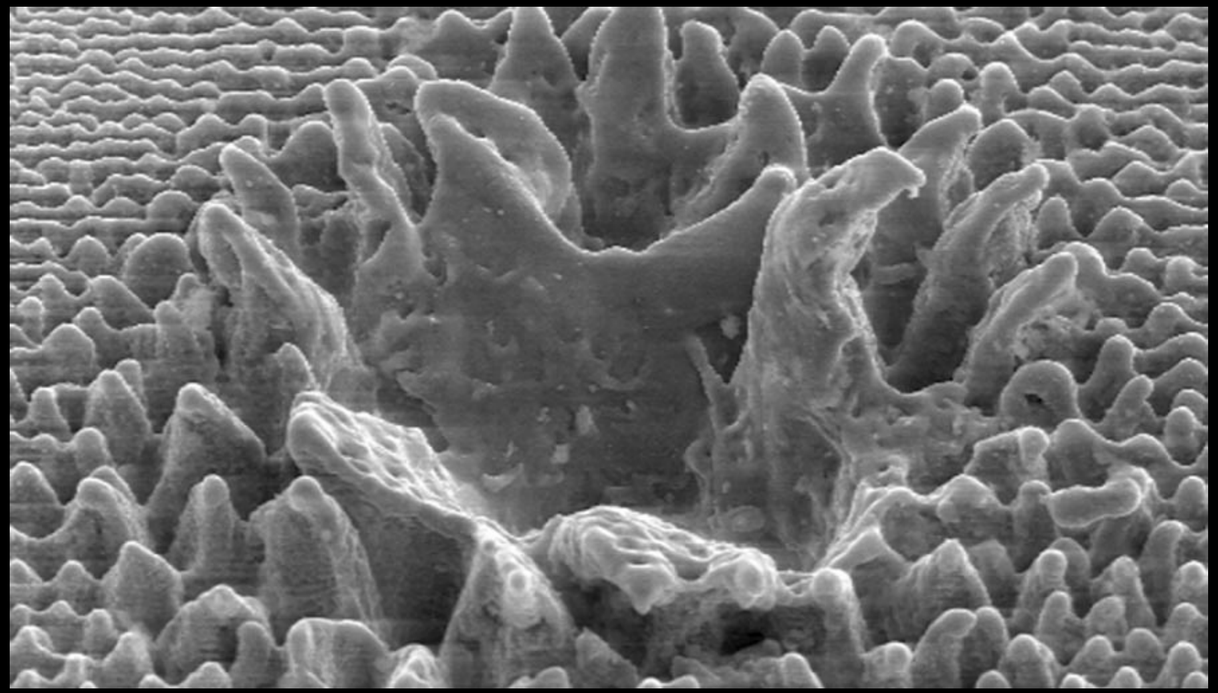
usually matter

controls light

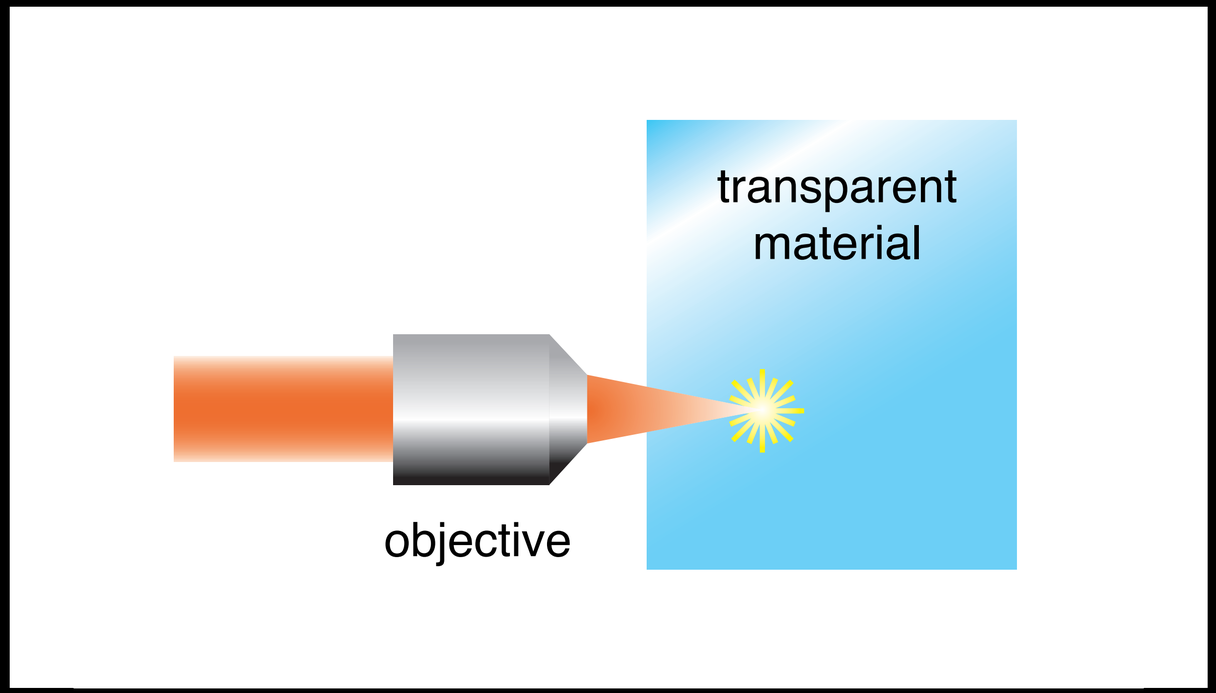
at very high intensity

light controls matter



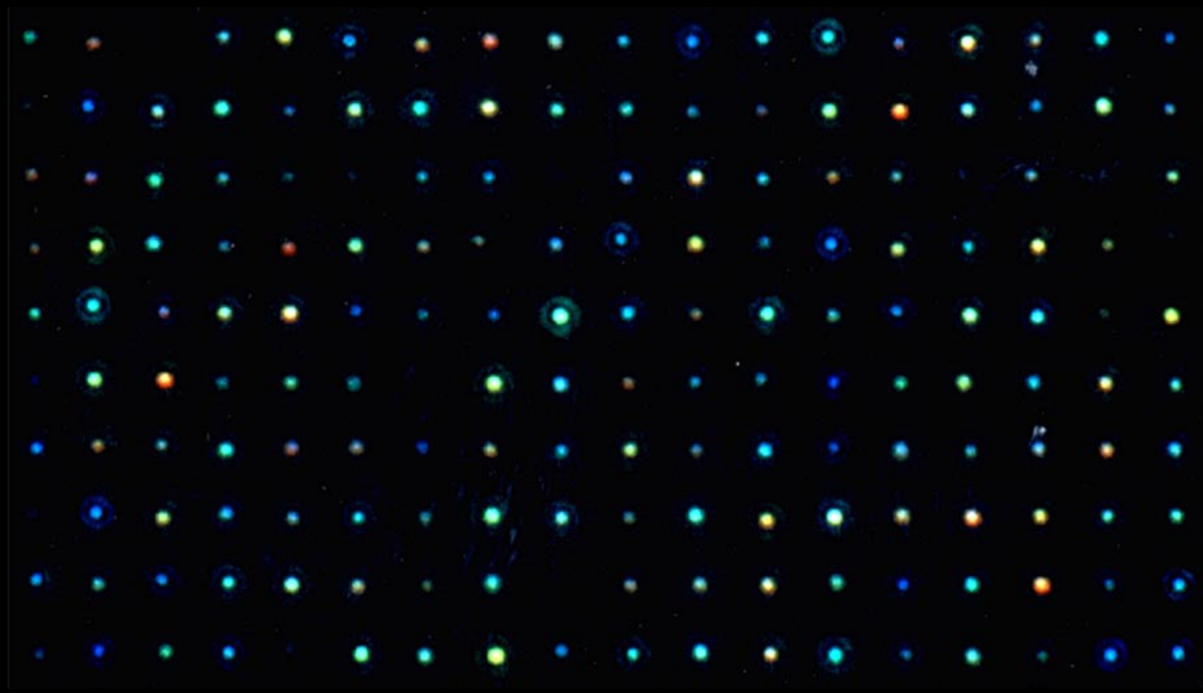
at very high intensity

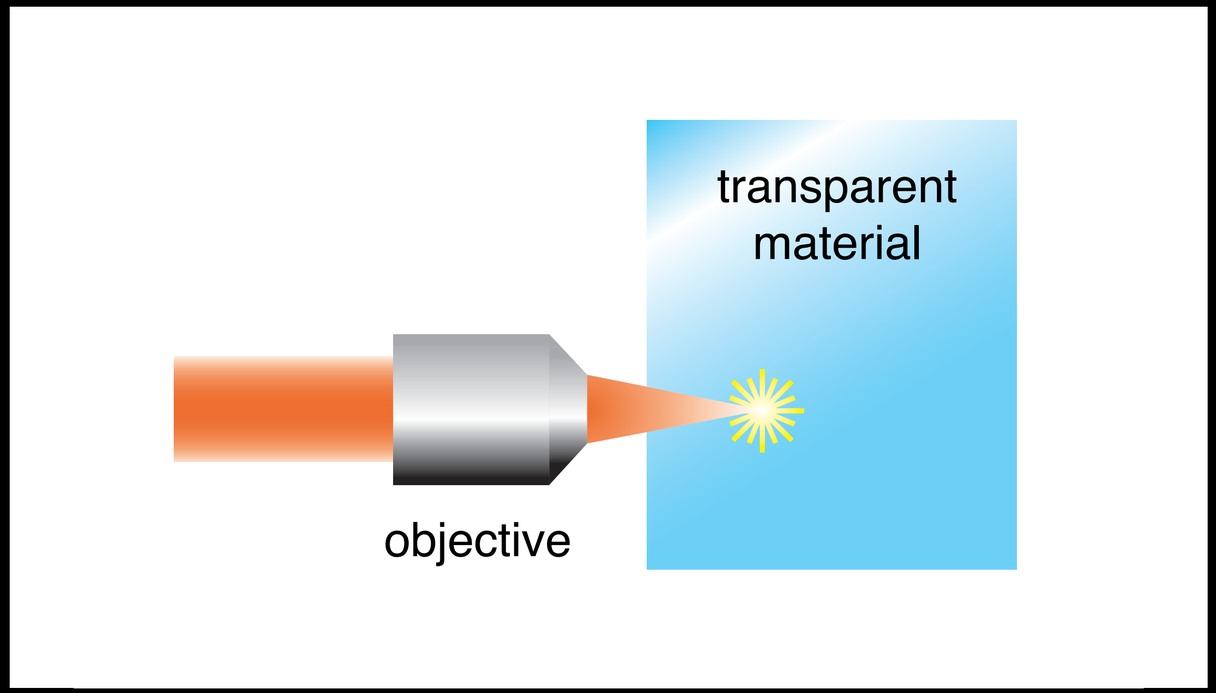
light controls matter



at very high intensity

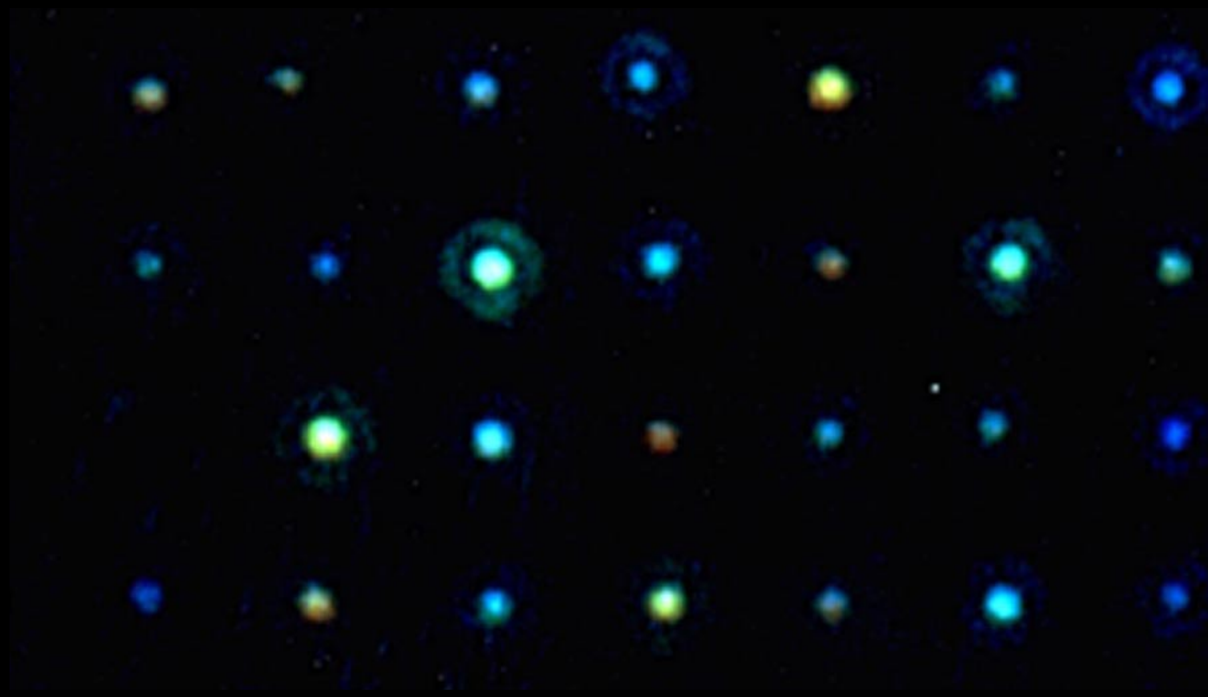
light controls matter

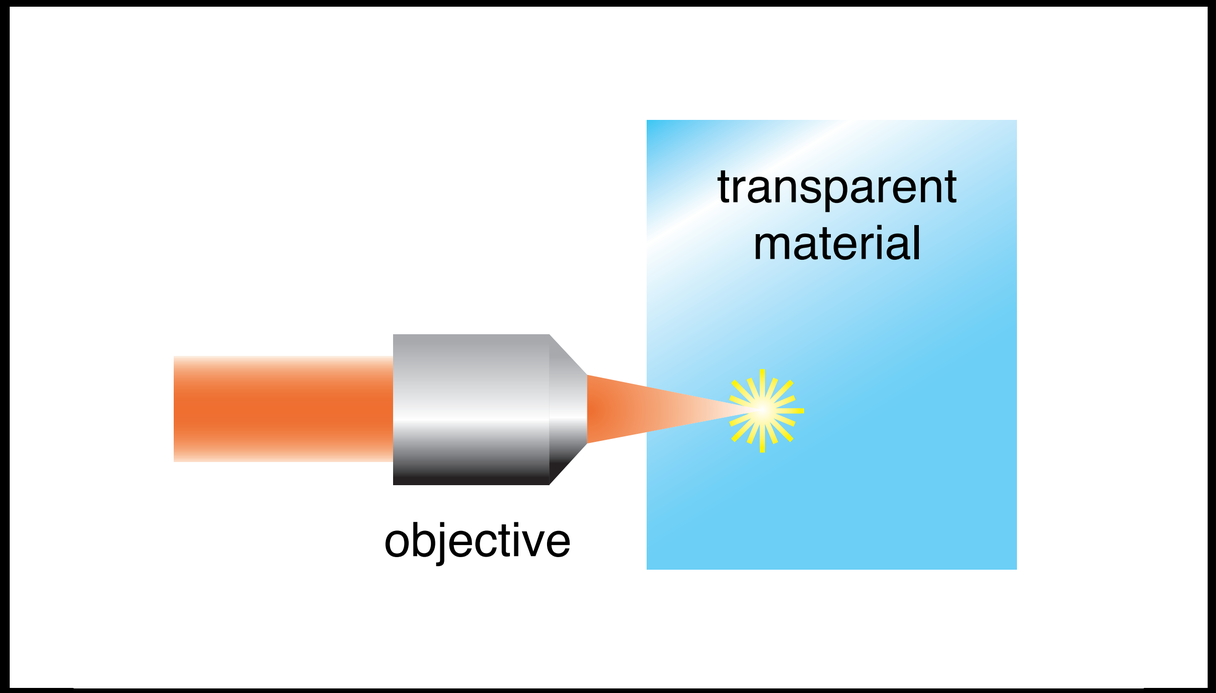




at very high intensity

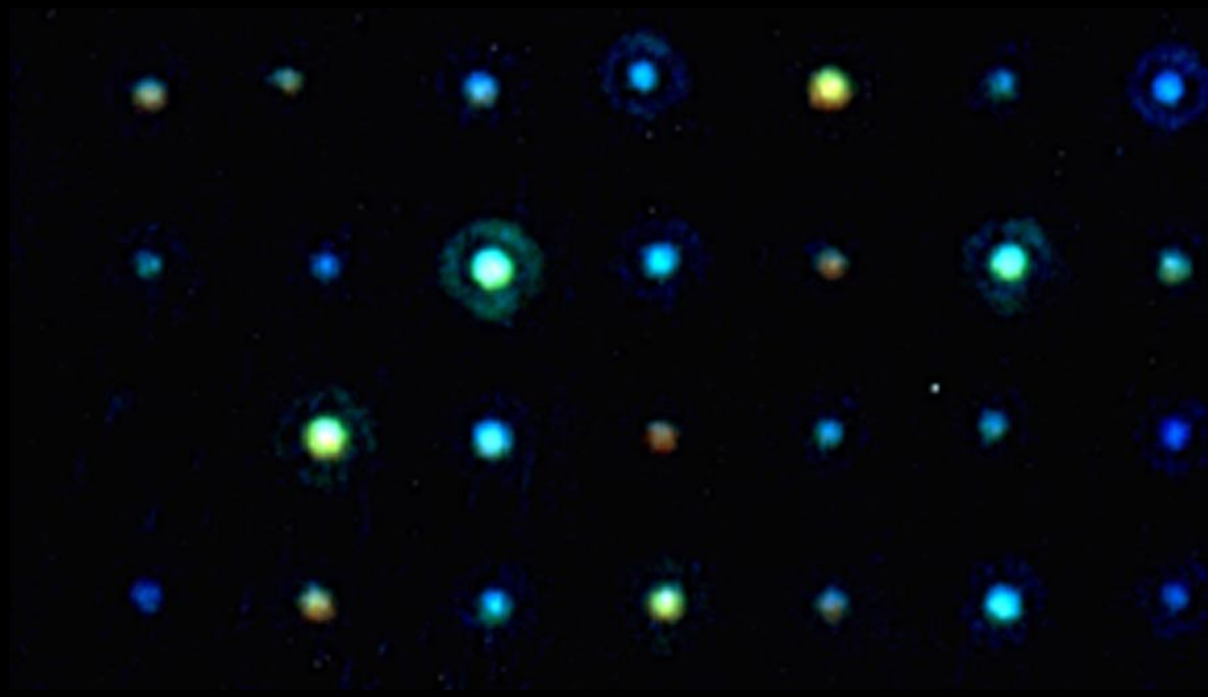
light controls matter

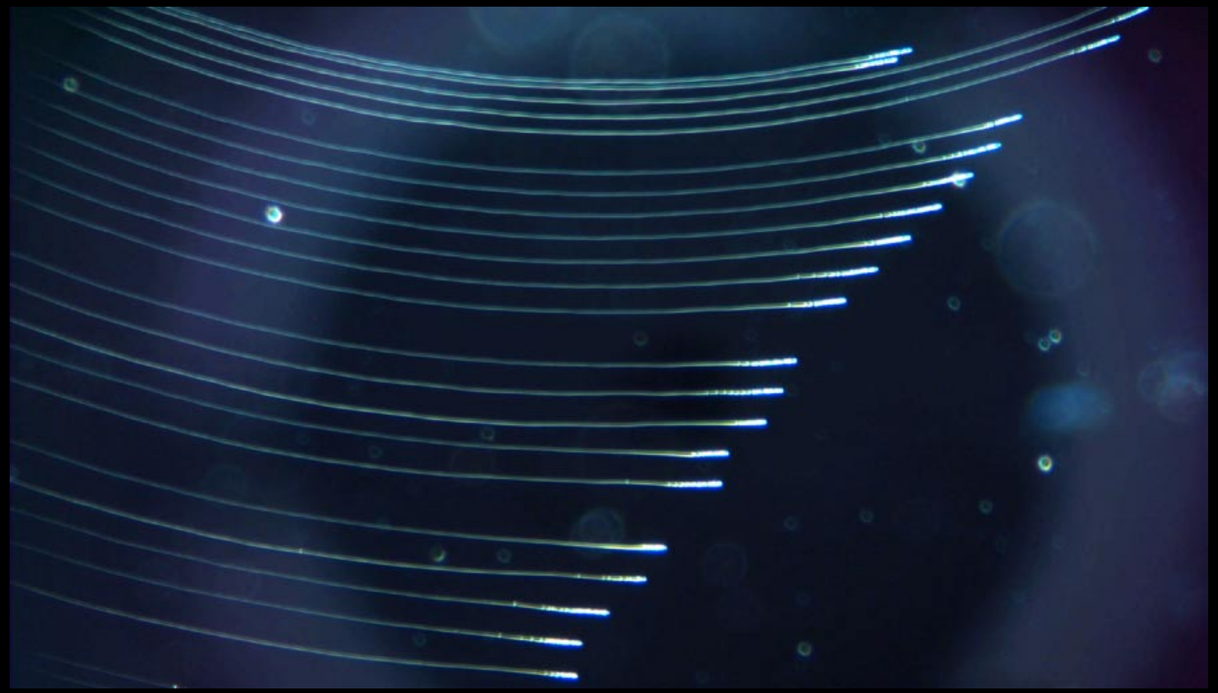




at very high intensity

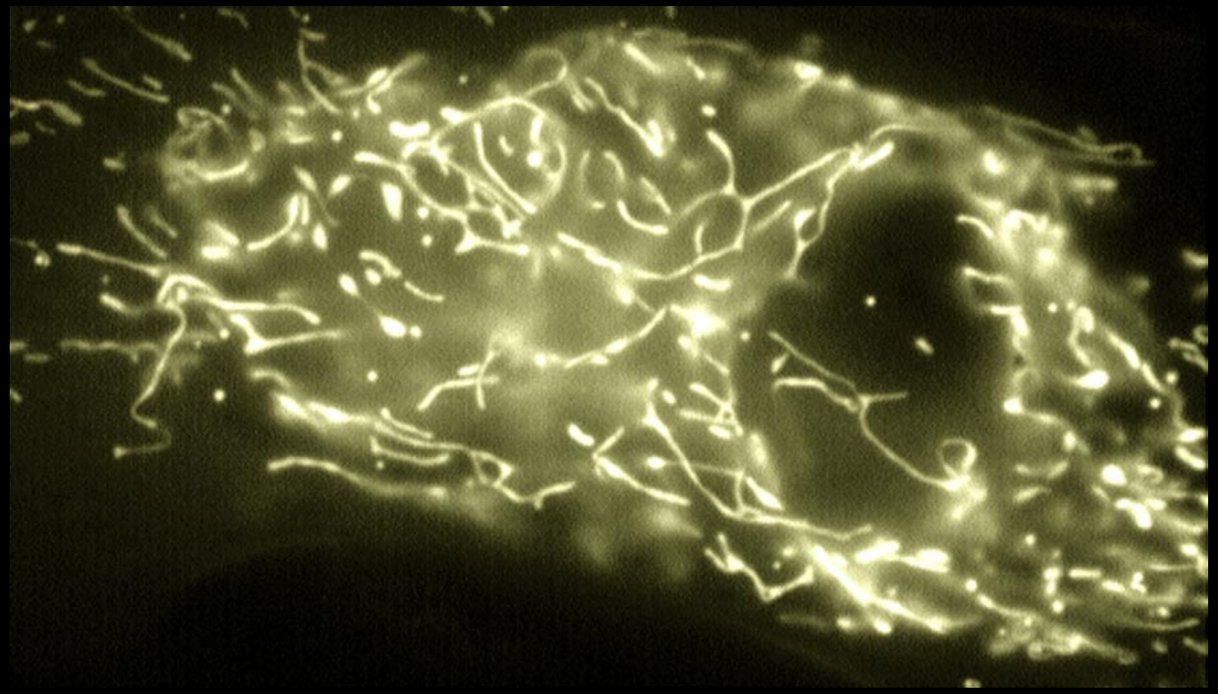
light controls matter





even at low energy

high intensity!

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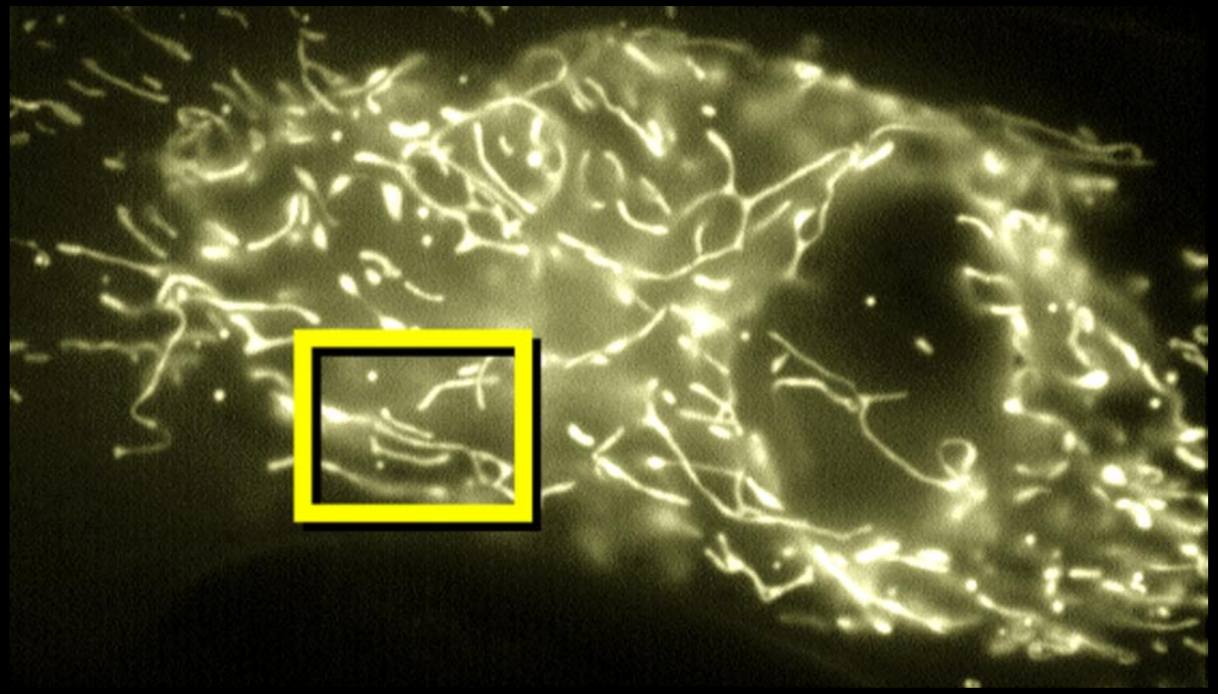


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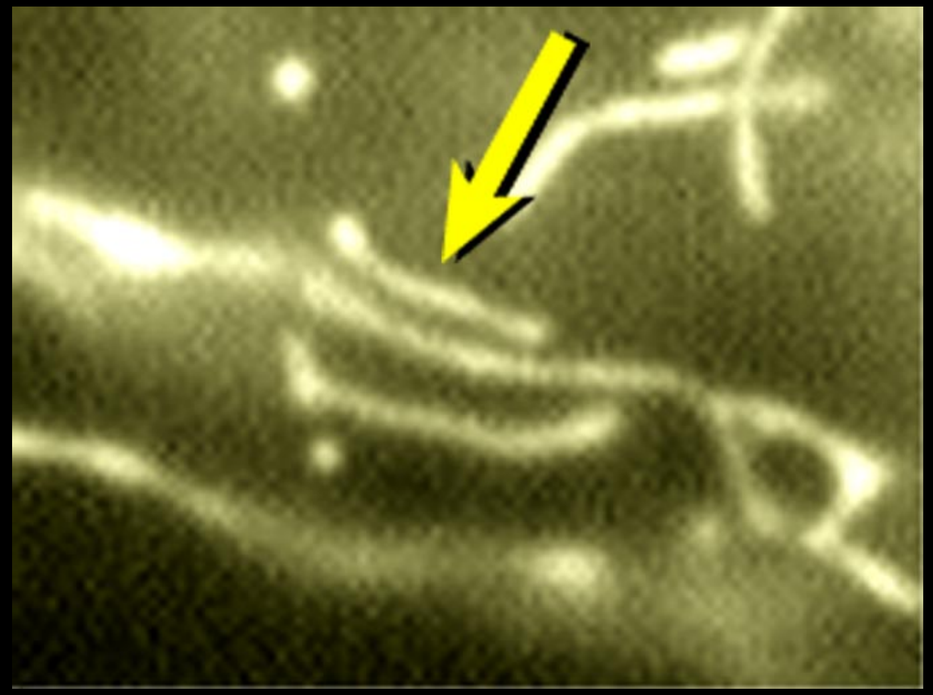


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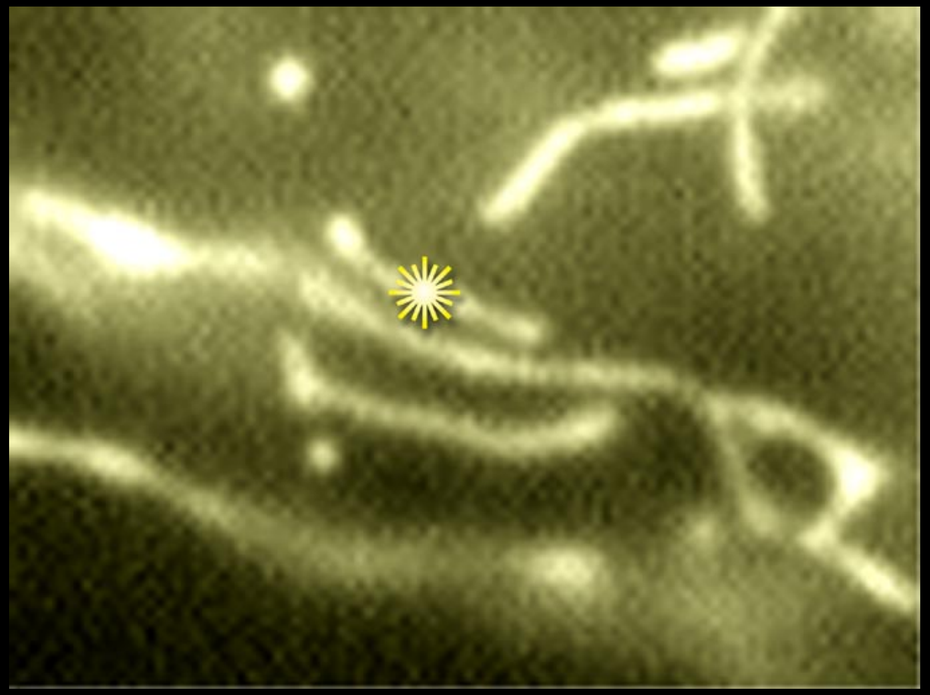


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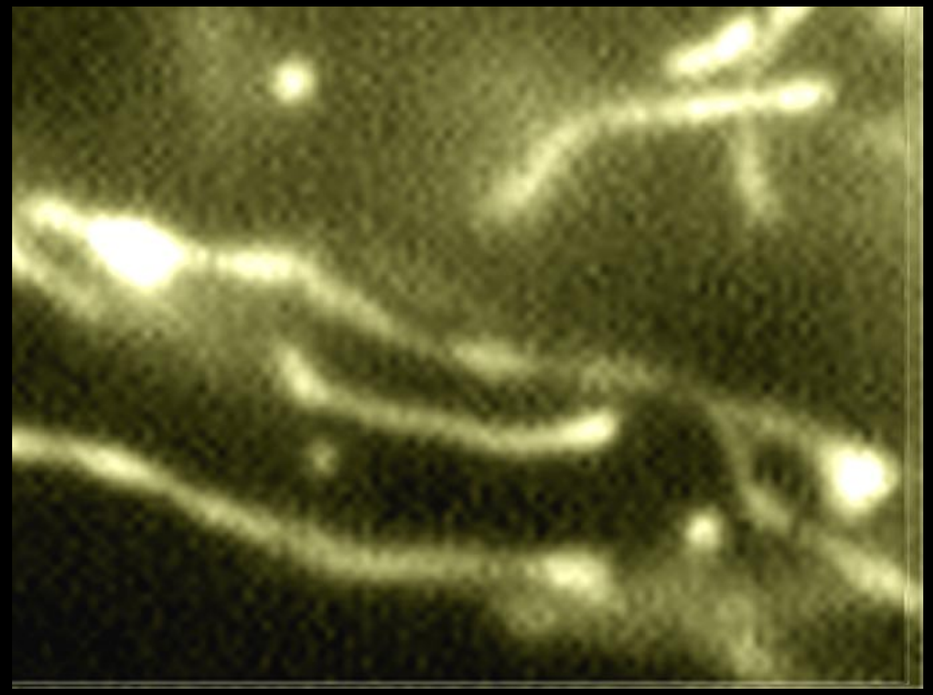


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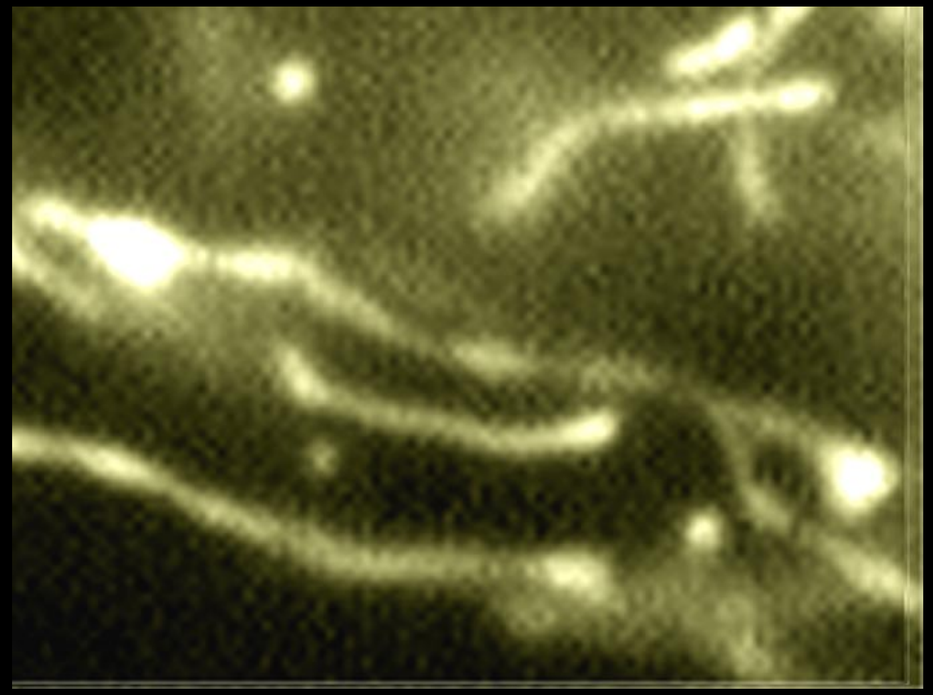
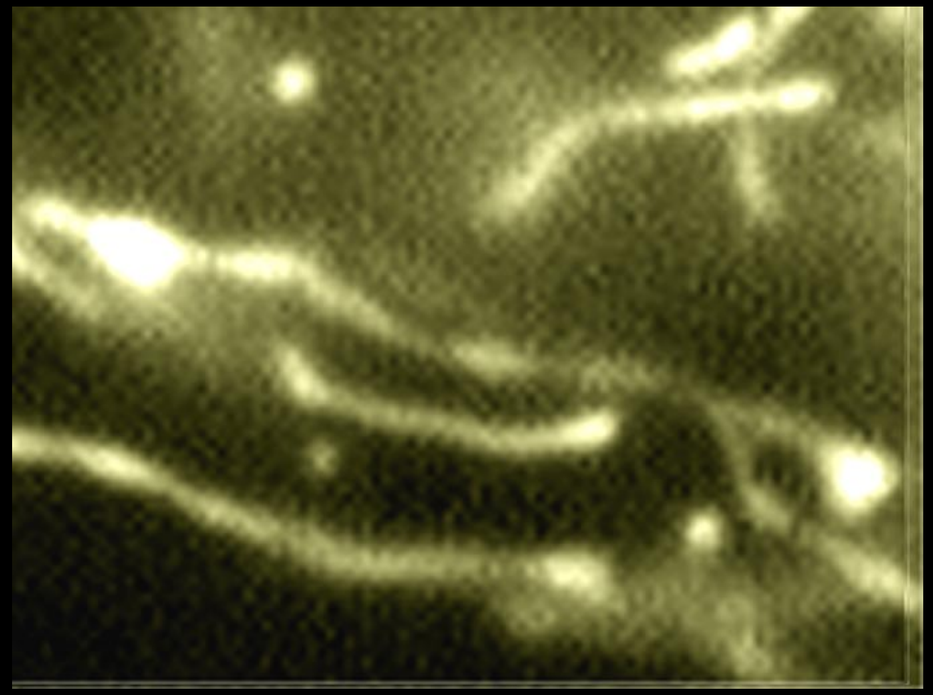
from flashes...
to lasers




STOPPING TIME:
from flashes...
to lasers

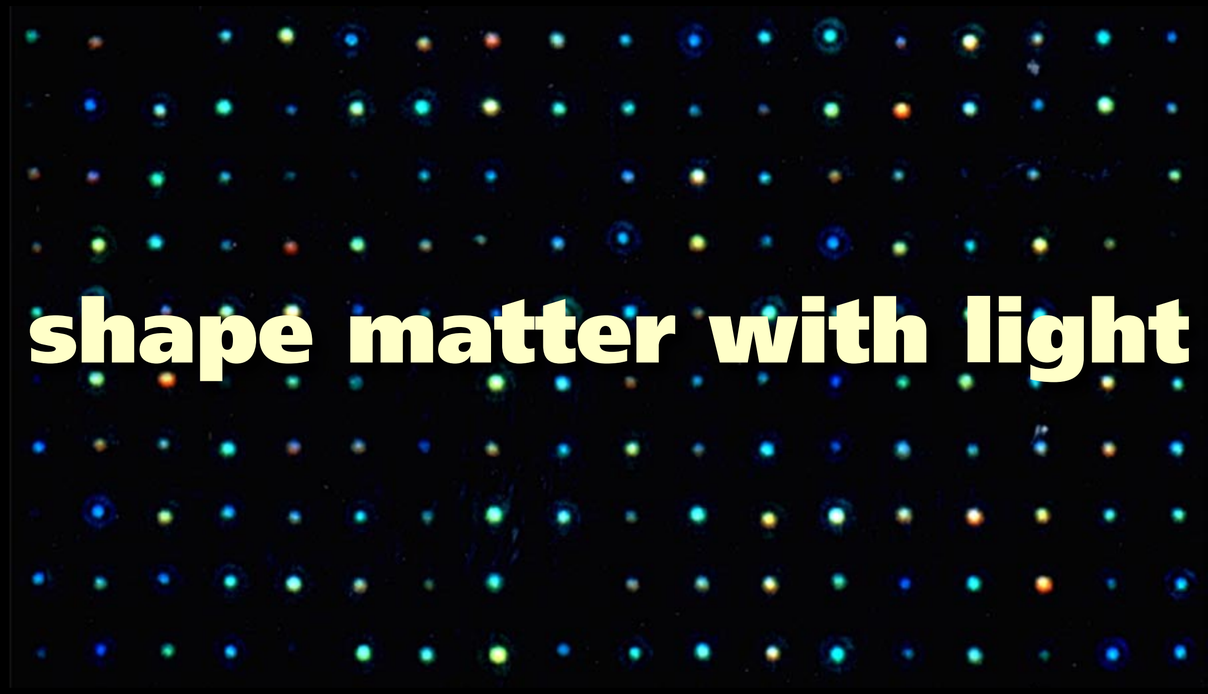


manipulating the

machinery of life!

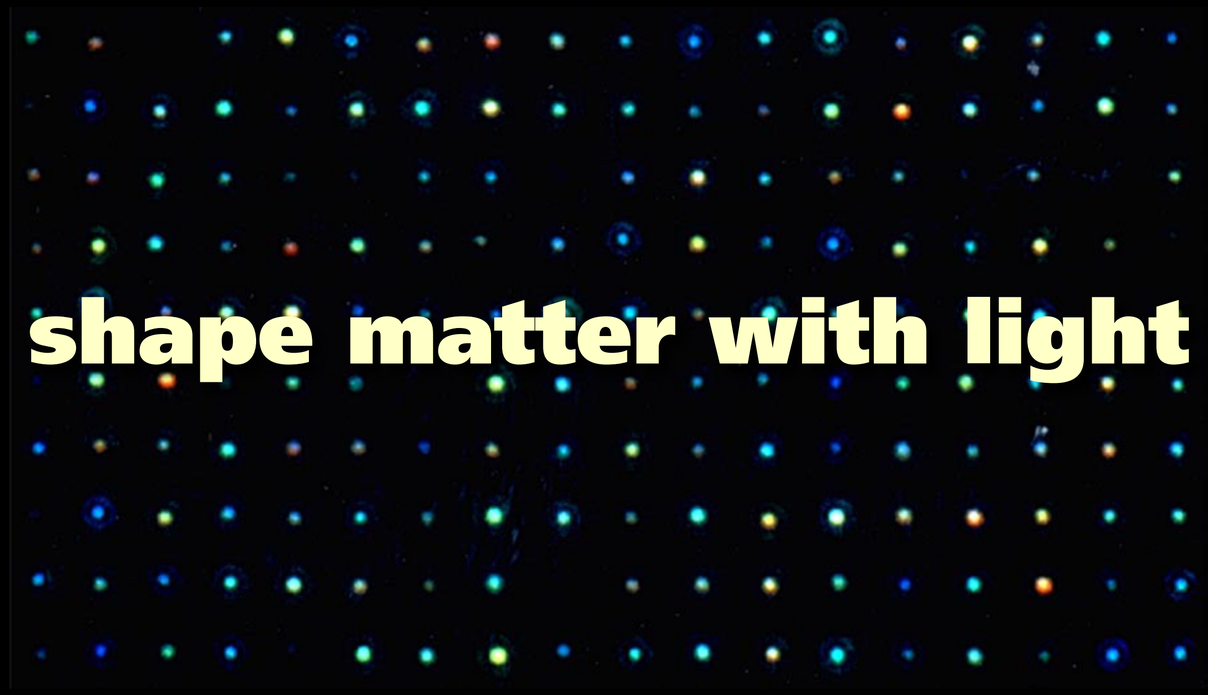
view very fast events

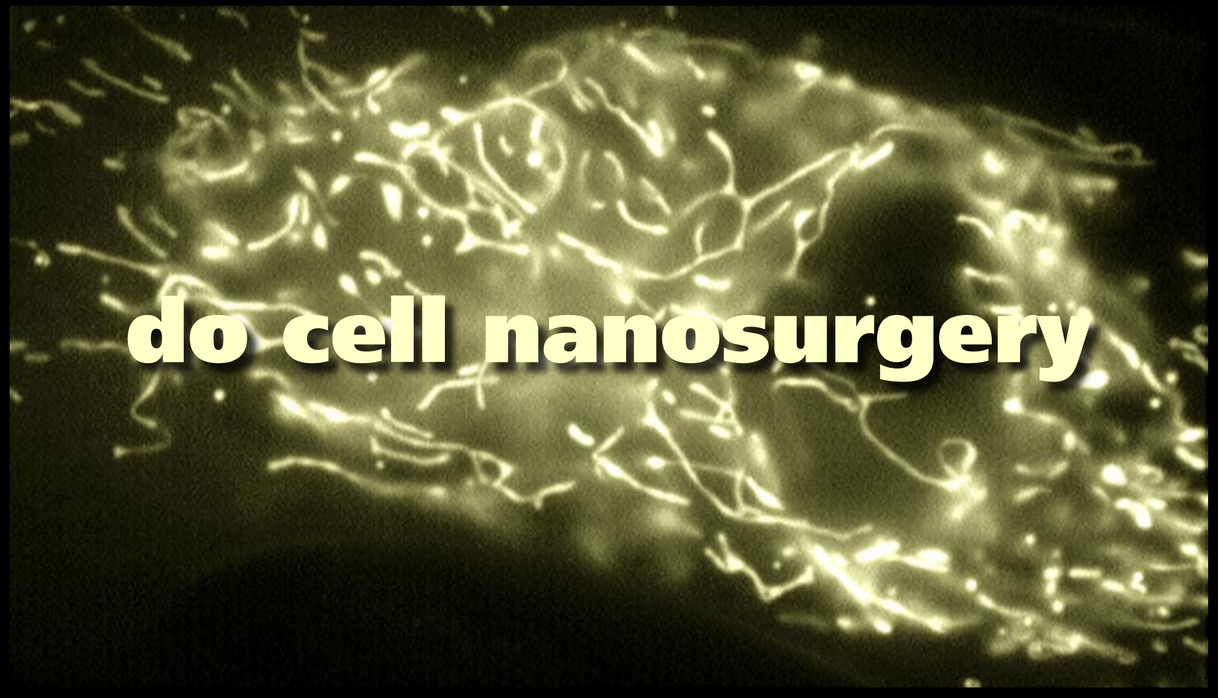
view very fast events



shape matter with light


view very fast events


shape matter with light


do cell nanosurgery


STOPPING TIME:
from flashes...
to lasers

On the Web:

http://mazur-www.harvard.edu