

#WWDC18

Designing Fluid Interfaces

Session 803

Chan Karunamuni

Nathan de Vries

Marcos Alonso

Apple Human Interface Design Team



What makes an interface feel fluid?

What makes an interface feel fluid?

fast?

smooth?

What makes an interface feel fluid?

natural?

magical?

You know it when you feel it

A tool that feels like an
extension of your mind





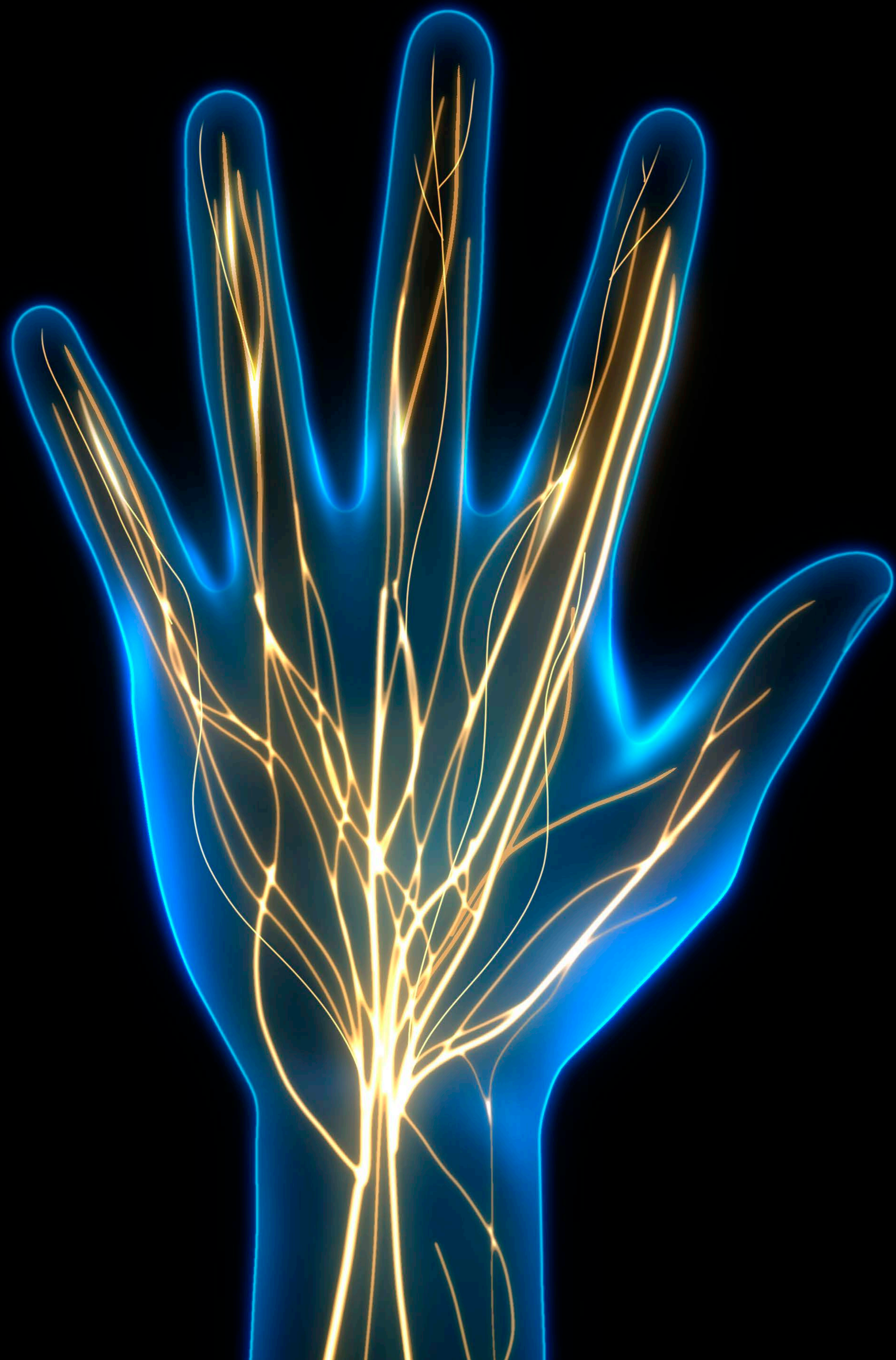
Paleolithic Handaxe
150000 BC

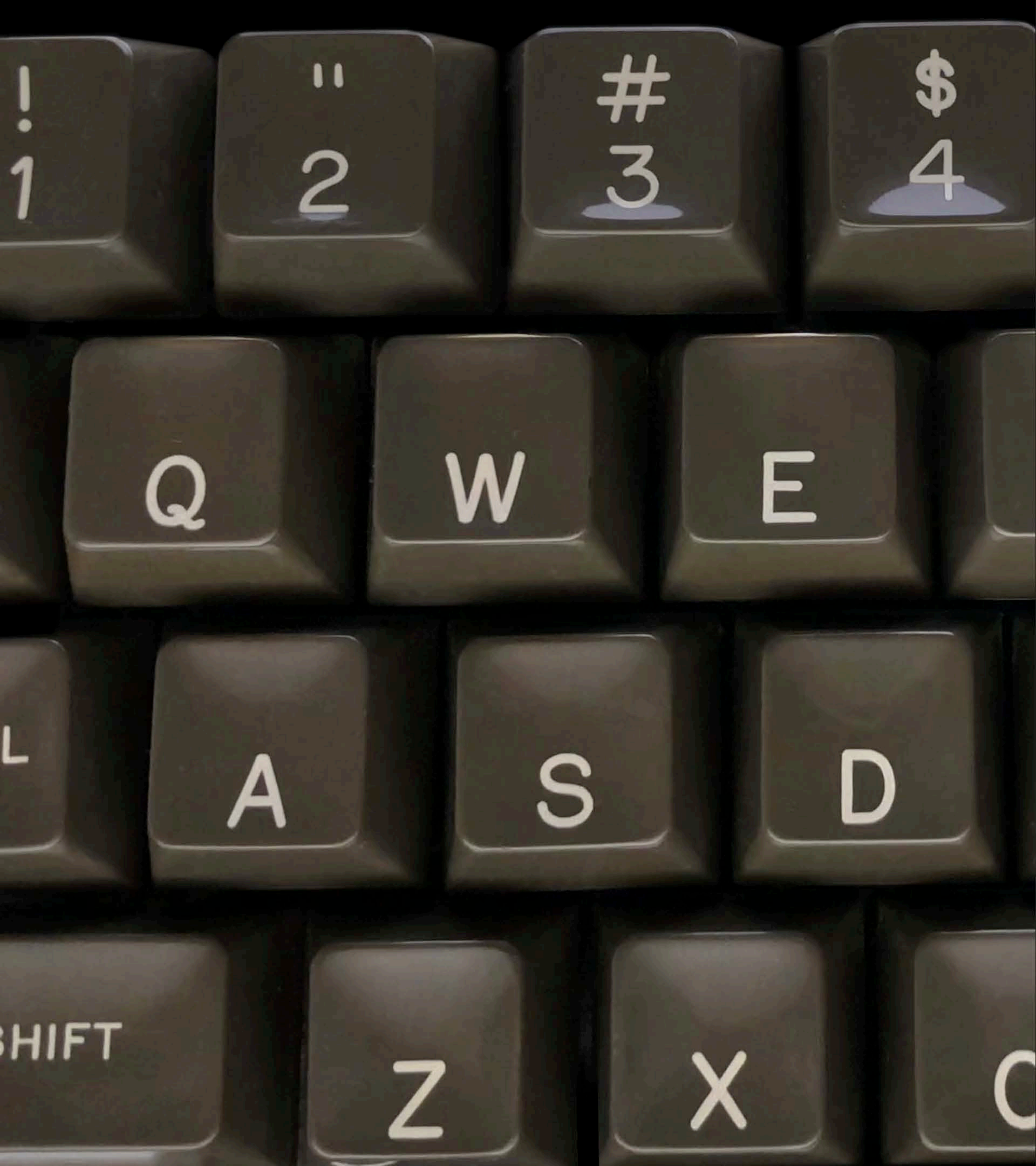


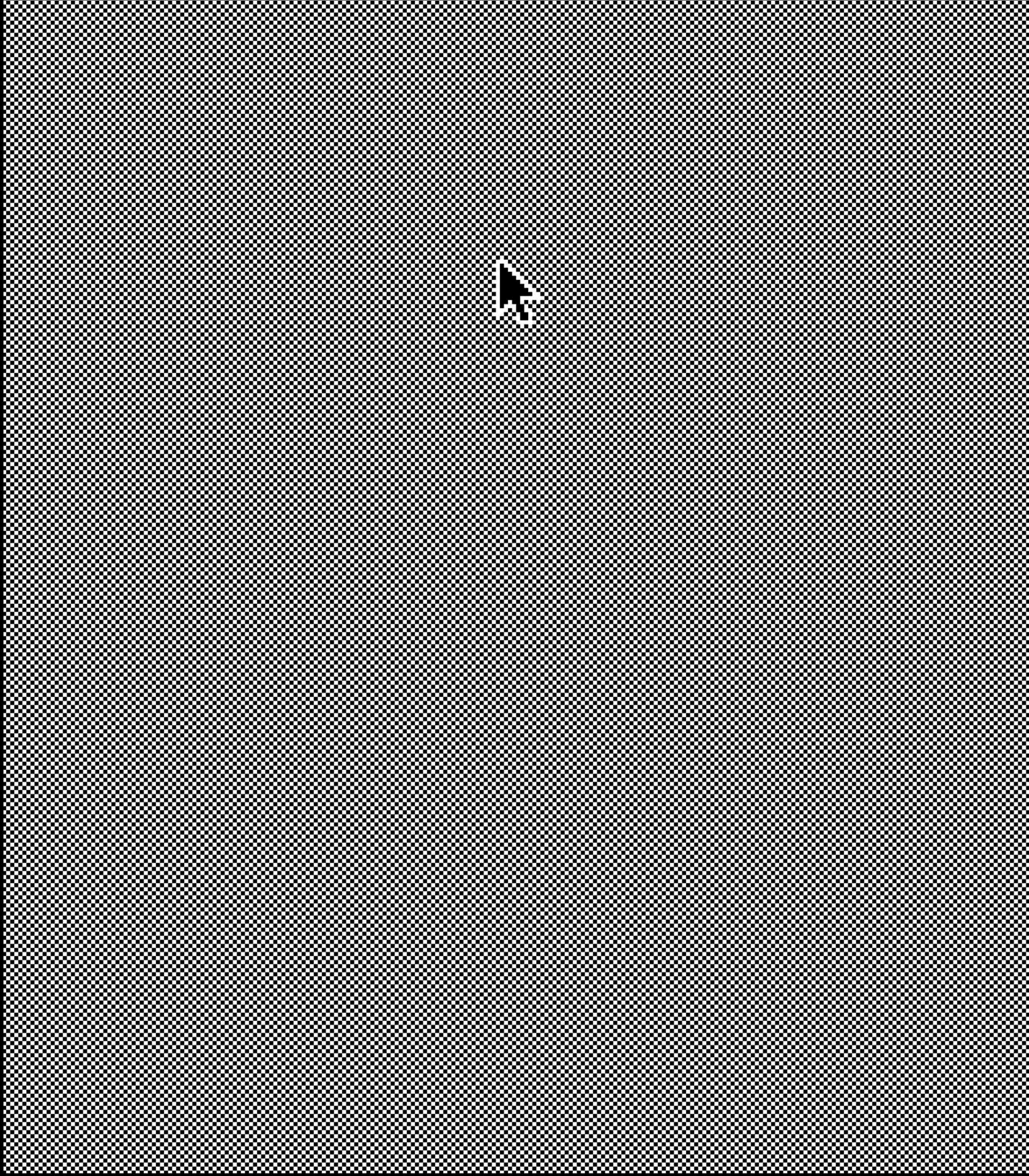
Apple iPhone
2017 AD













An extension of the natural world

An extension of yourself

Interfaces that extend our minds

Interfaces that extend our minds
Designing with dynamic motion

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

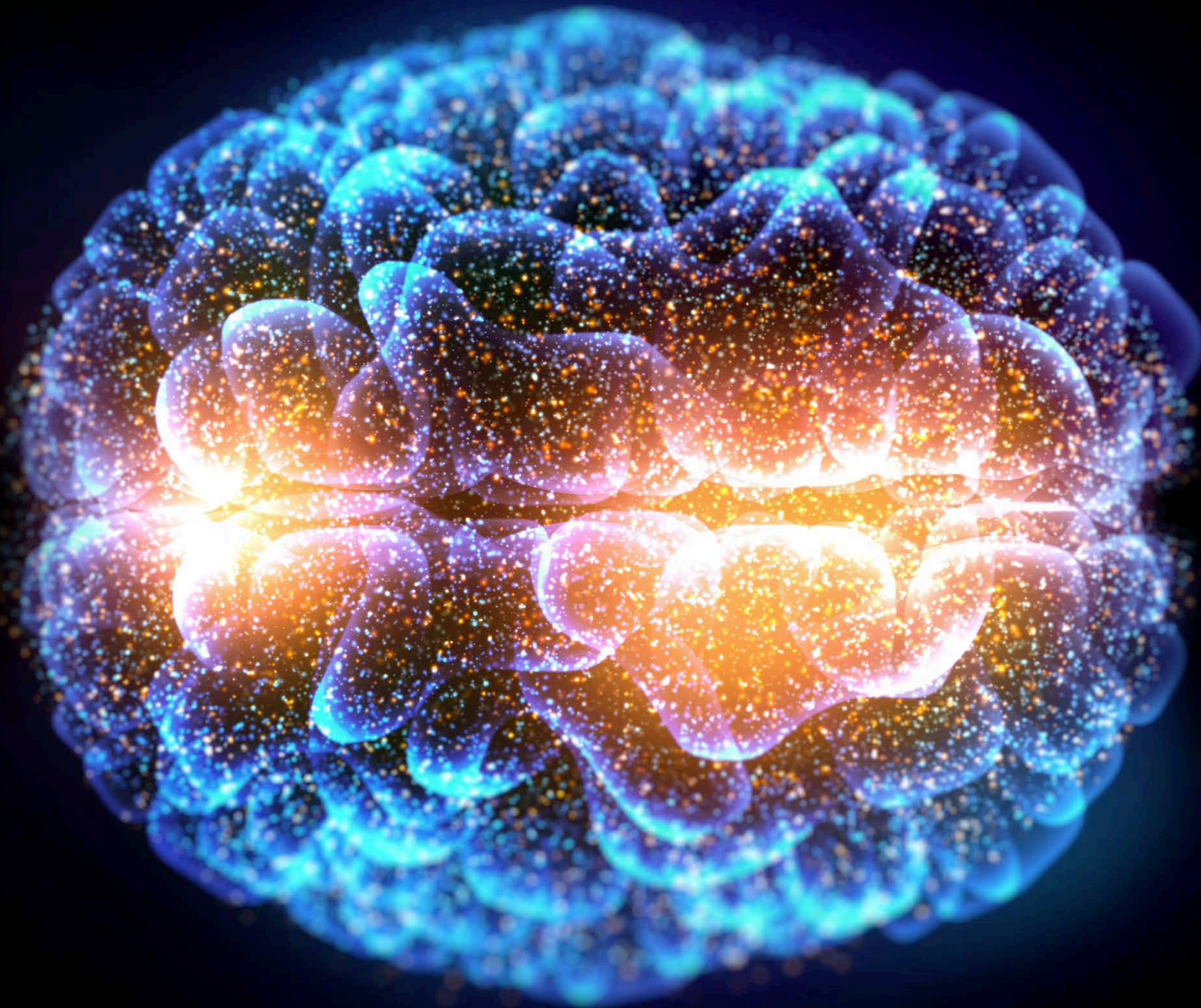
Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Aligning interfaces to the way we think
and the way we move



Our interfaces need to be fluid
because *we* are fluid

Respond to input instantly





10ms lag



50ms



100ms



200ms

Look for delays everywhere

Allow for constant redirection
and interruption



What if it wasn't redirectable?

Linear interfaces

Gesture happens *after* thought

Thought

Decision

Gesture

Release



Thought

Decision

Gesture

Release



Gesture happens in *parallel* with thought

Thought

Decision

Gesture

Release



Gestures in Parallel With Thought

Faster than thinking before doing

One gesture solves multiple problems

Helps with discovery

Allows you to layer gestures at the speed of thought

9:41



< May



S M T W T F S
20 21 22 23 24 25 26

Monday May 21, 2018

9 AM

10 AM

Weekly Team Meeting
3rd floor conference room

11 AM

Noon

1 PM

Budget Review
3rd floor conference room

2 PM

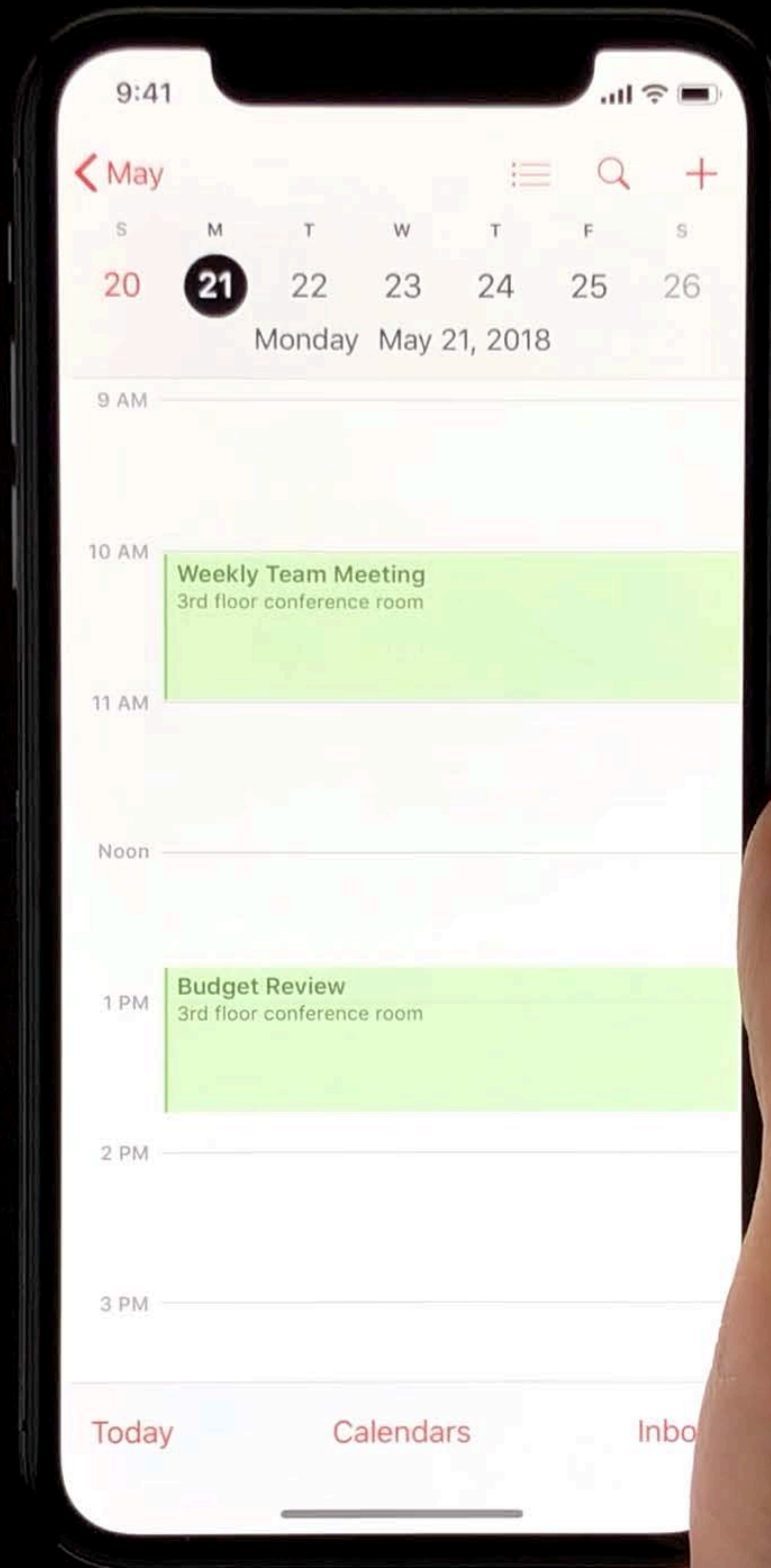
3 PM

Today

Calendars

Inbo

Swipe homescreen
pages *while* going home





9:41



Mail



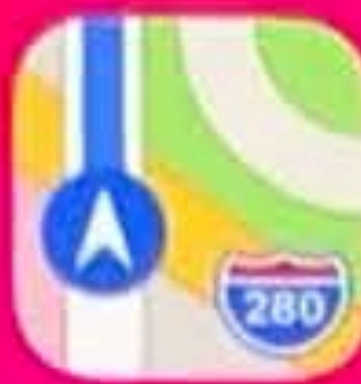
Calendar



Photos



Camera



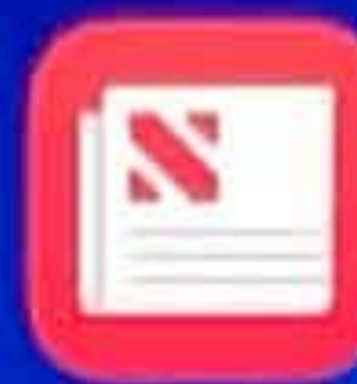
Maps



Clock



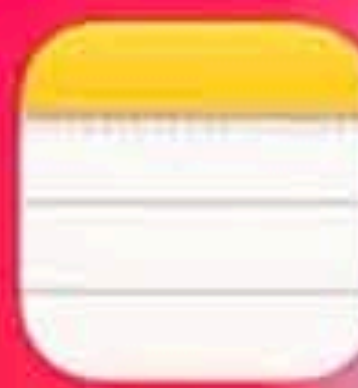
Weather



News



Home



Notes



Stocks



Reminders



TV



App Store



iTunes Store



Books



Health



Wallet



Settings



Go to multitasking while
app is launching





Close app while
launching app

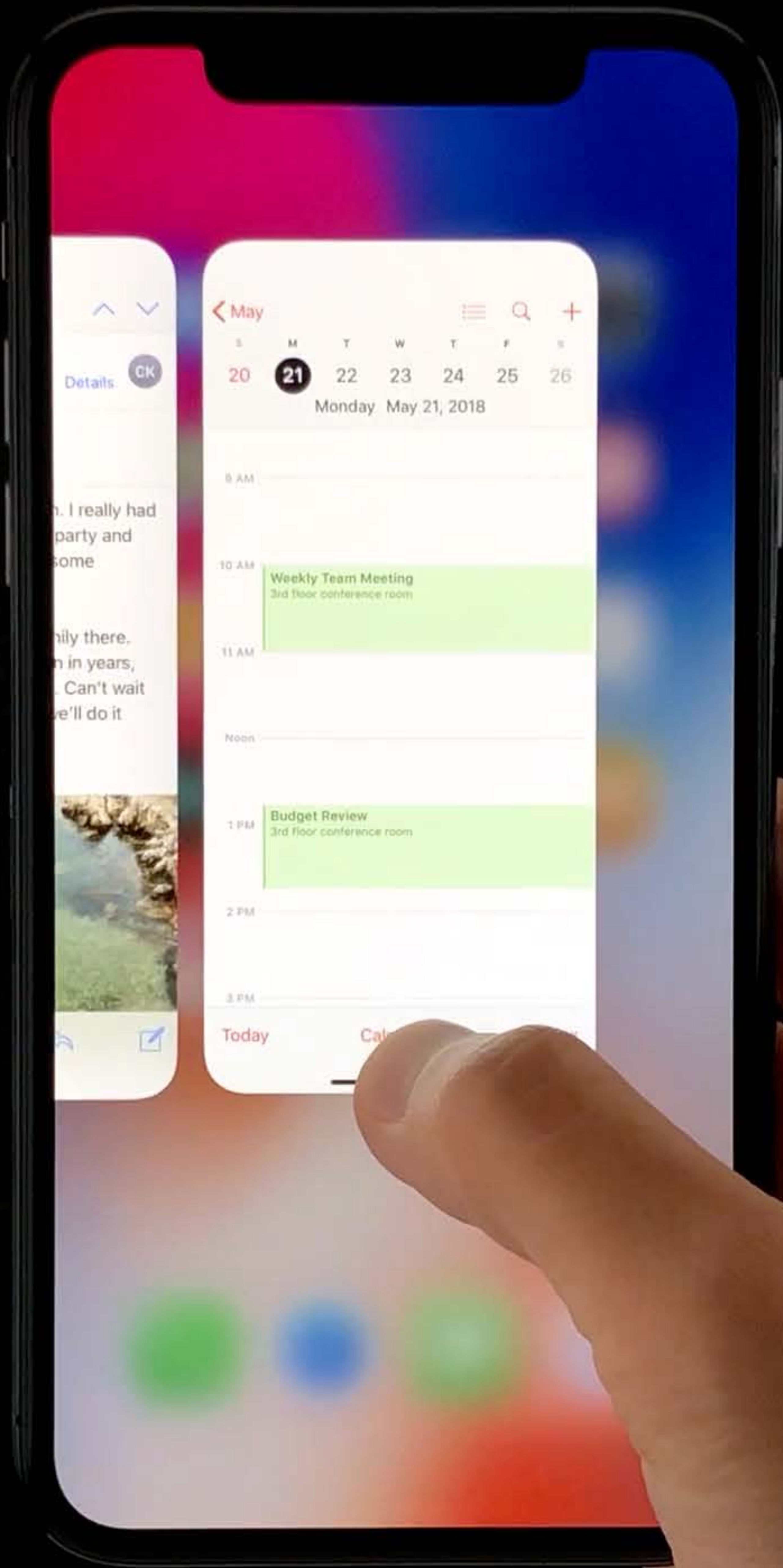




Interact with app
as it launches



Respond to redirection
as fast as possible



< May

S M T W T F S
20 21 22 23 24 25 26

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3rd floor conference room

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3 PM

Today

Cal

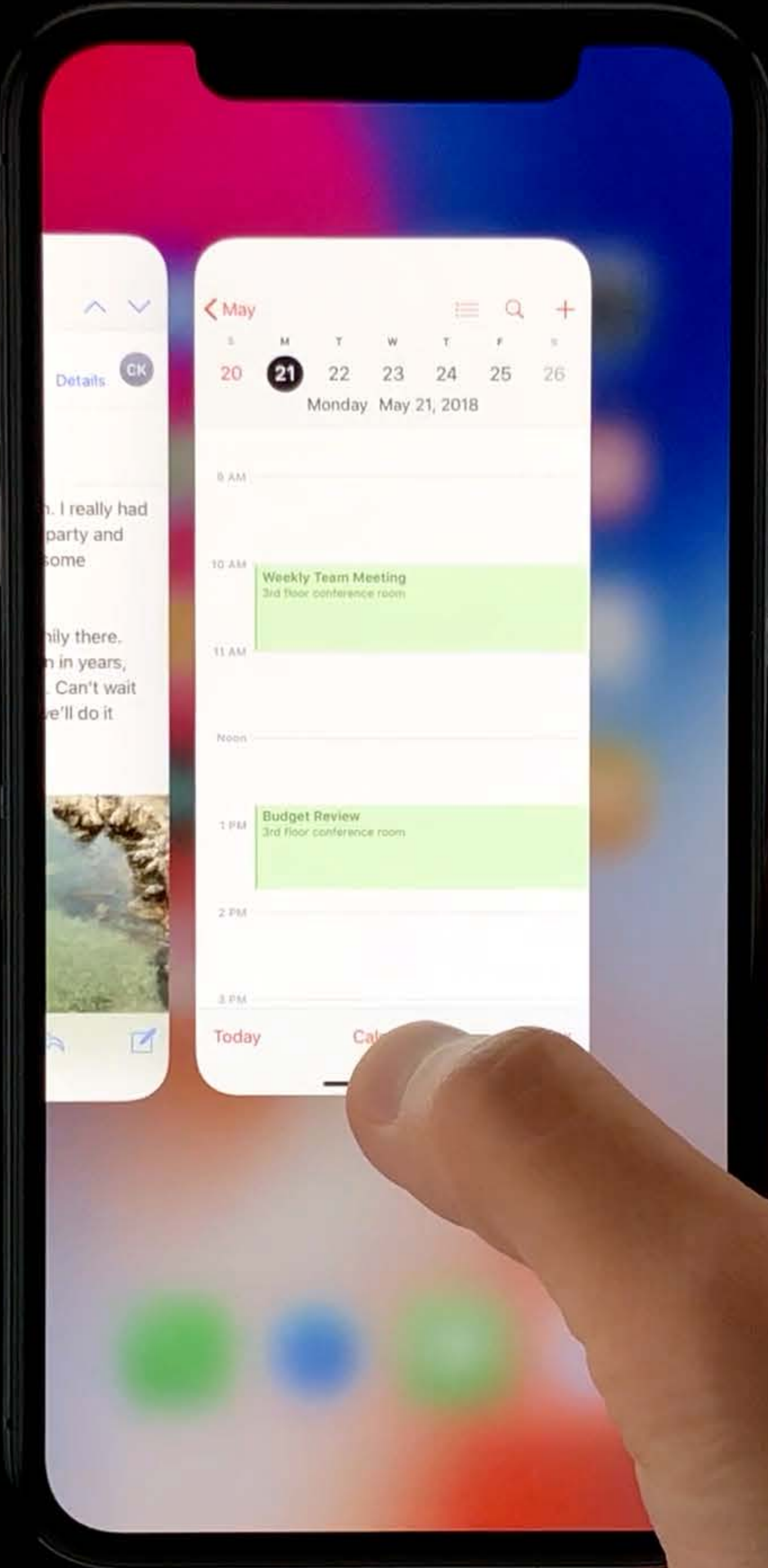
Details CK

n. I really had
party and
some

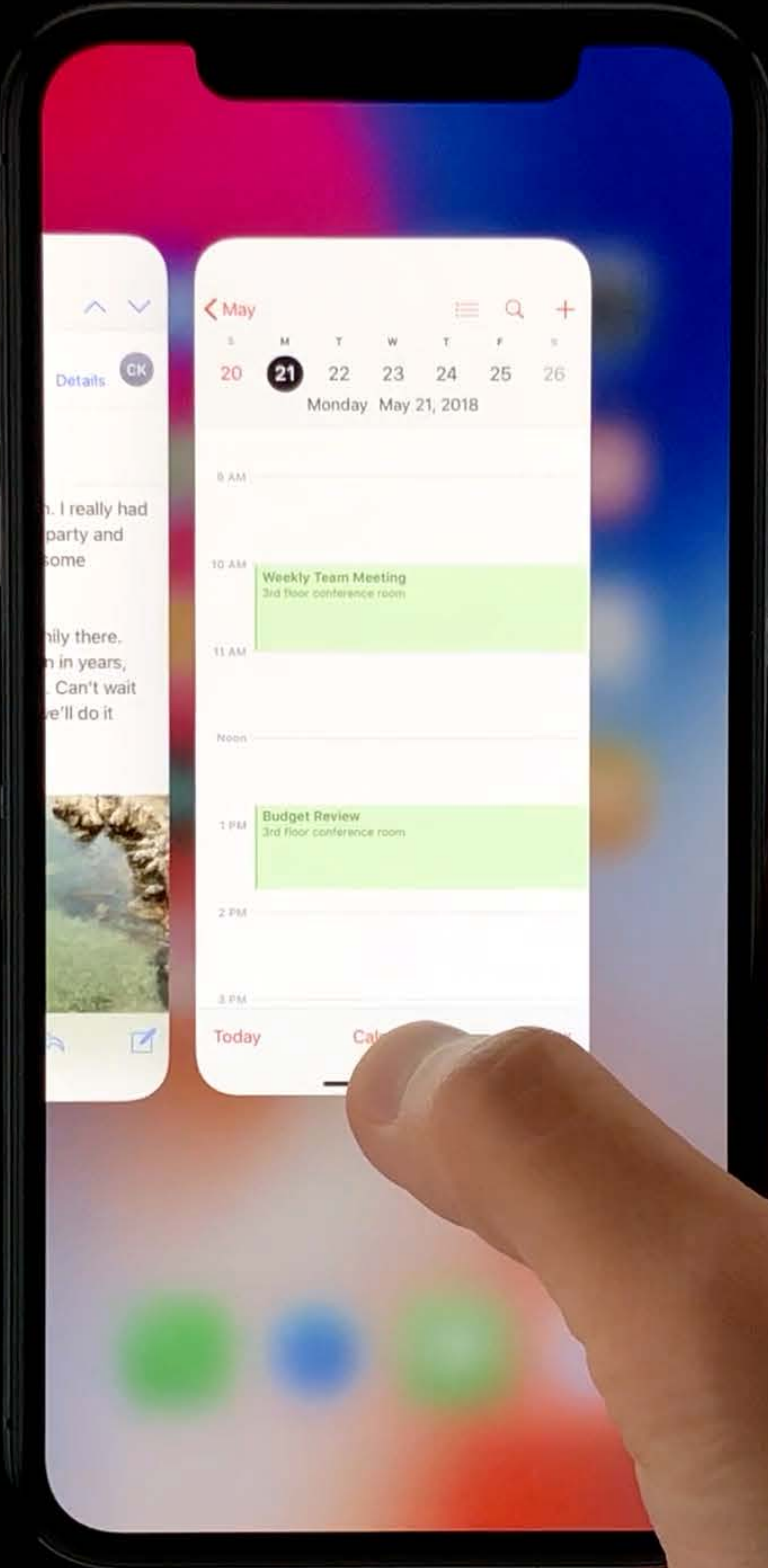
hily there.
n in years,
. Can't wait
e'll do it.



How can we detect this
pause in motion?



How can we detect this
pause in motion?



Timer too slow

< Inbox



Izzy Weberbauer

To: John Bishop

Details



Birthday canoe trip

Today at 9:35 AM

Hey! Yesterday was so much fun. I really had an amazing time at my birthday party and the canoe trip was such an awesome surprise.

It was so great having all the family there. There were cousins I hadn't seen in years, like before they could even walk. Can't wait to go canoeing again. Promise we'll do it sooner than later? 😊



VERTICAL FINGER ACCELERATION

10000

-10000



< Inbox



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To: John Bishop

Details



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VERTICAL FINGER ACCELERATION

10000

-10000



Maintain spatial consistency
throughout movement

Out of view

In view



Out of view

In view



Consistent location



[Mailboxes](#)

Inbox

[Edit](#)

 **Izzy Weberbauer** 9:35 AM >


Birthday canoe trip

Hey! Yesterday was so much fun. I really had an amazing time at my birthday party and the can...

 **Brian Rekasis** 9:21 AM >

The new digs

Do you think I should go with the designer we saw yesterday? Seems...

 **Gray McCarty** 8:43 AM >

Friday's show

You've got to check out his latest album first. I can't stop playing it!

 **Kevin Angel** 8:16 AM >

Summer getaway

Road trip? I'm totally down for that. Anything to get me out of going to...

John Baily 7:36 AM >

Puppy training

Thanks for the advice yesterday. Everything worked out fine.

Lia Longo Yesterday >

Greek life

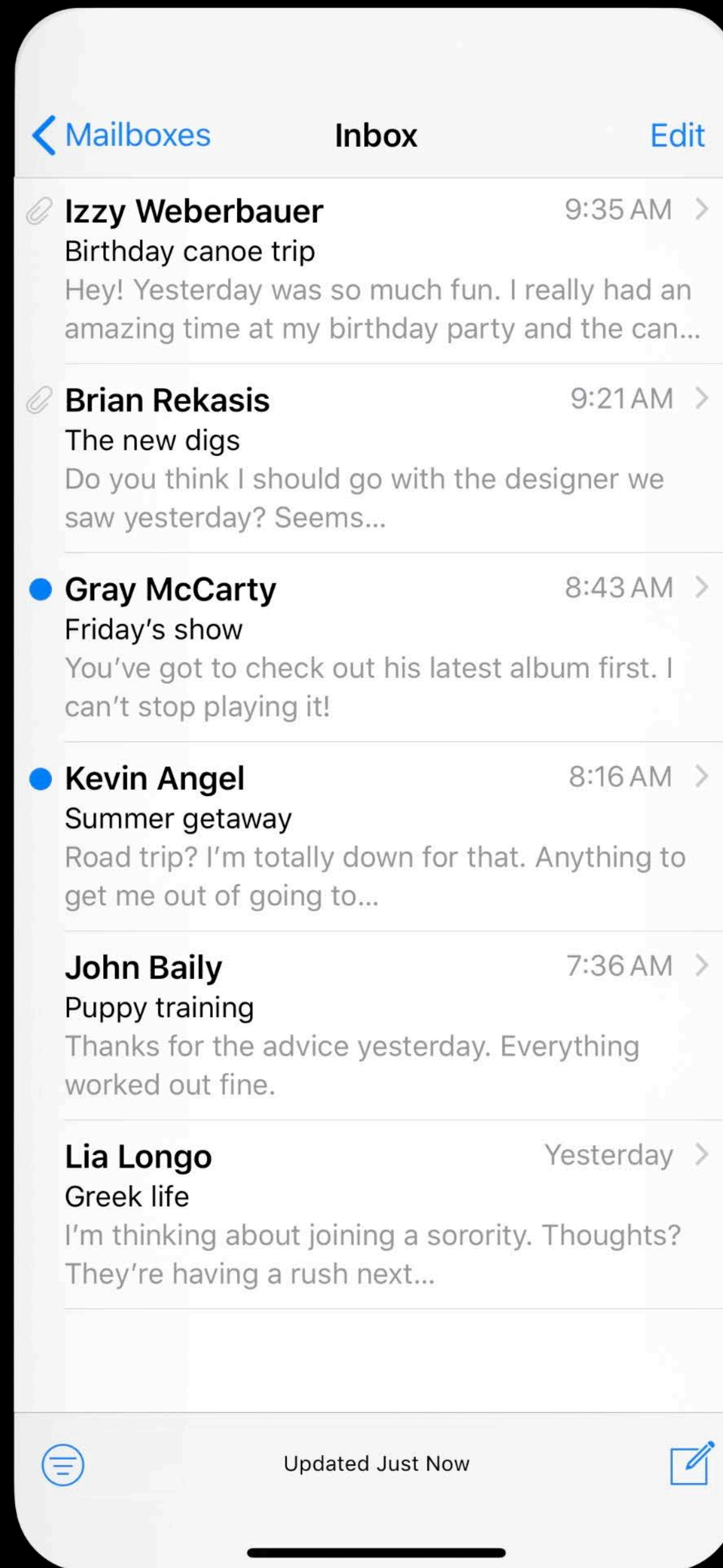
I'm thinking about joining a sorority. Thoughts? They're having a rush next...



Updated Just Now



Not spatially
consistent

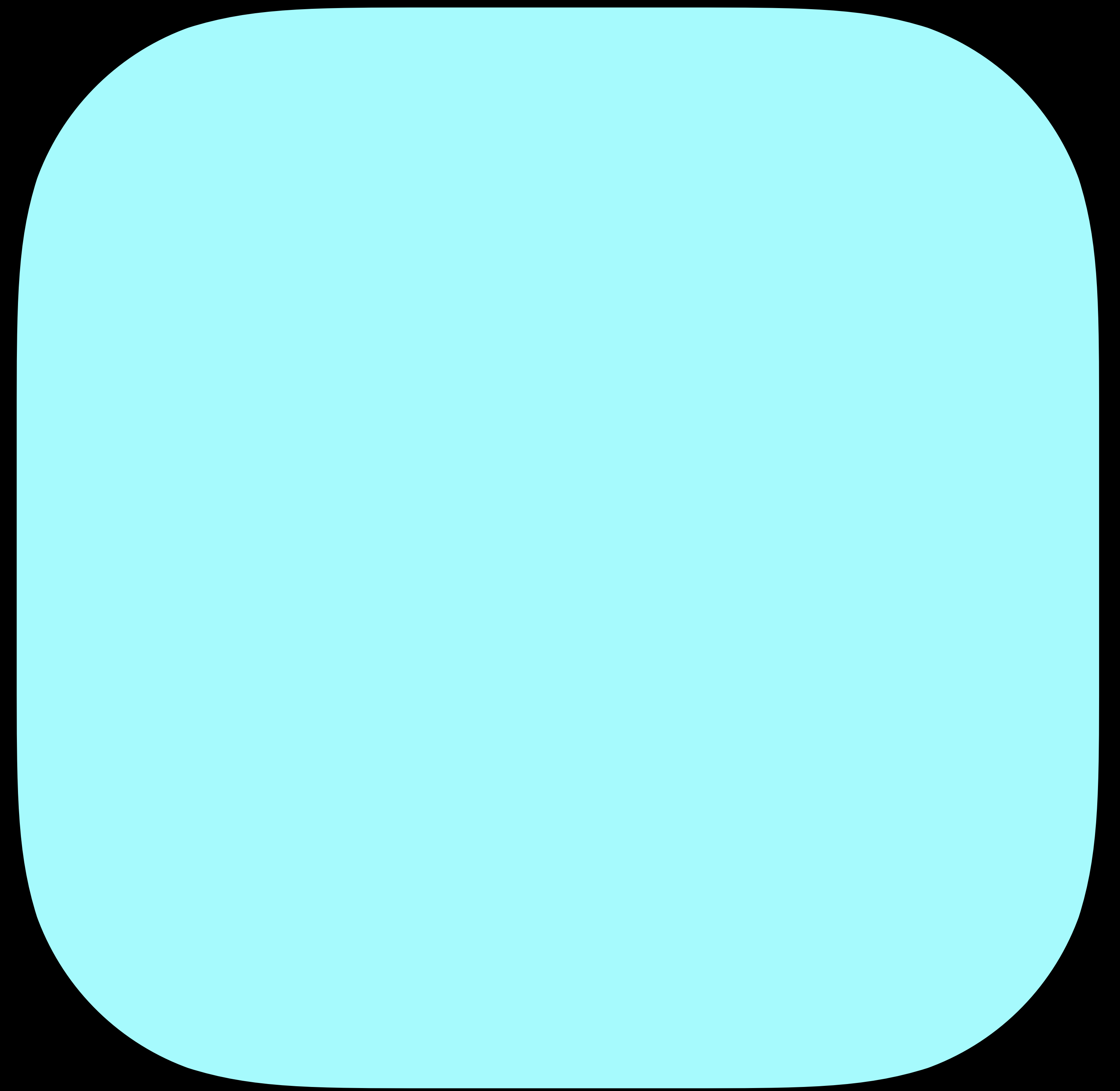


Hint in the direction of the gesture

Initial



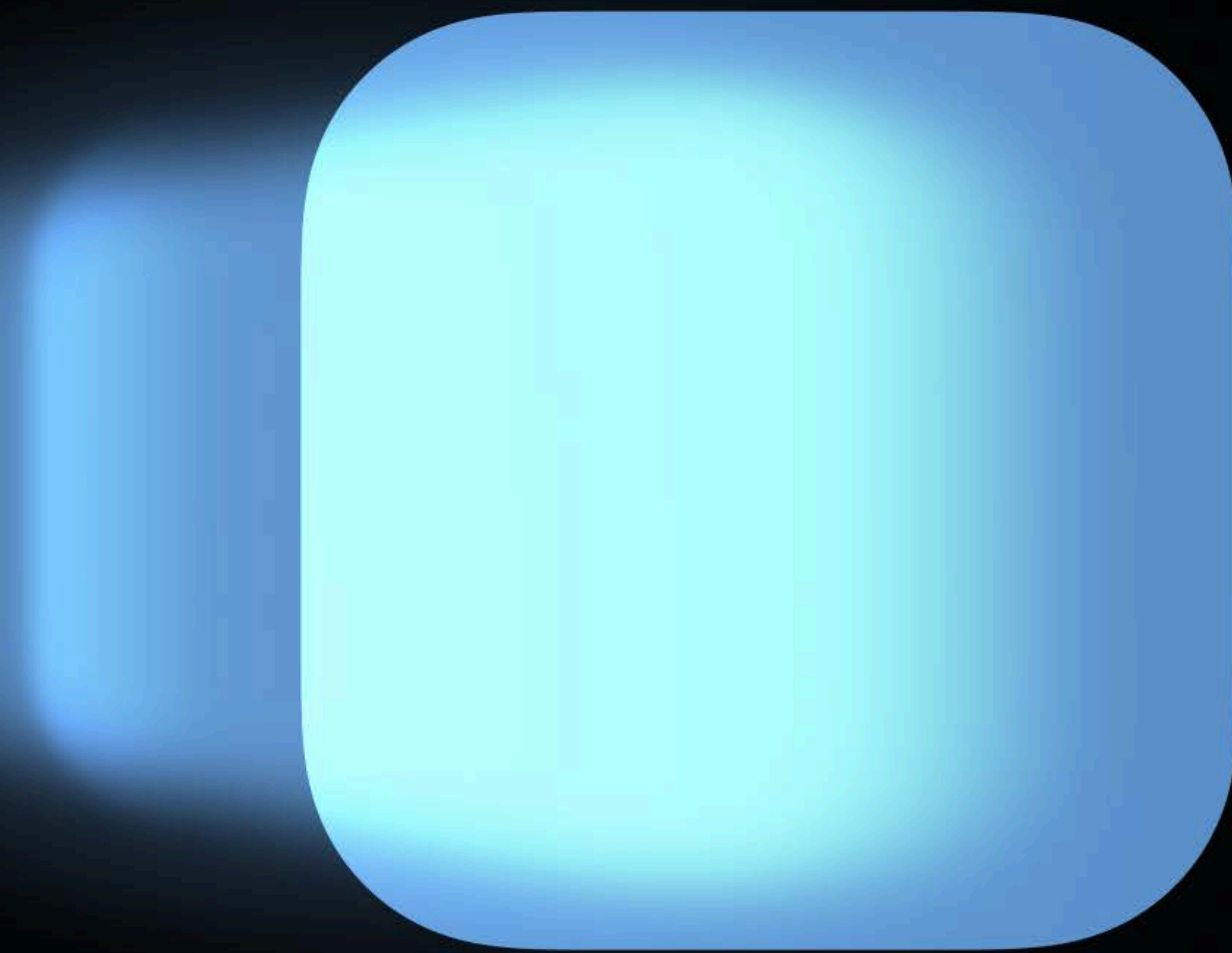
Final



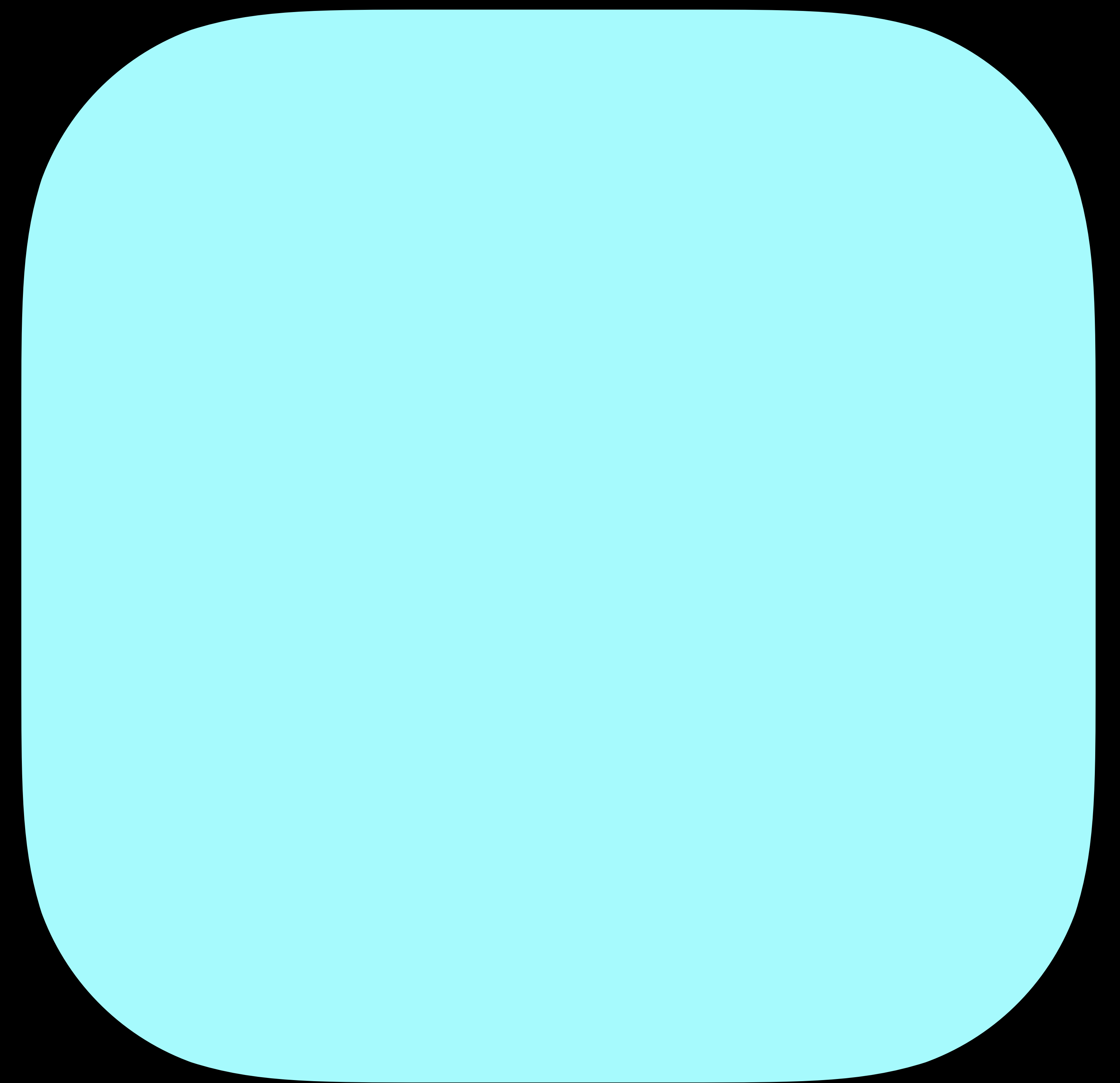
Initial



Hinting



Final



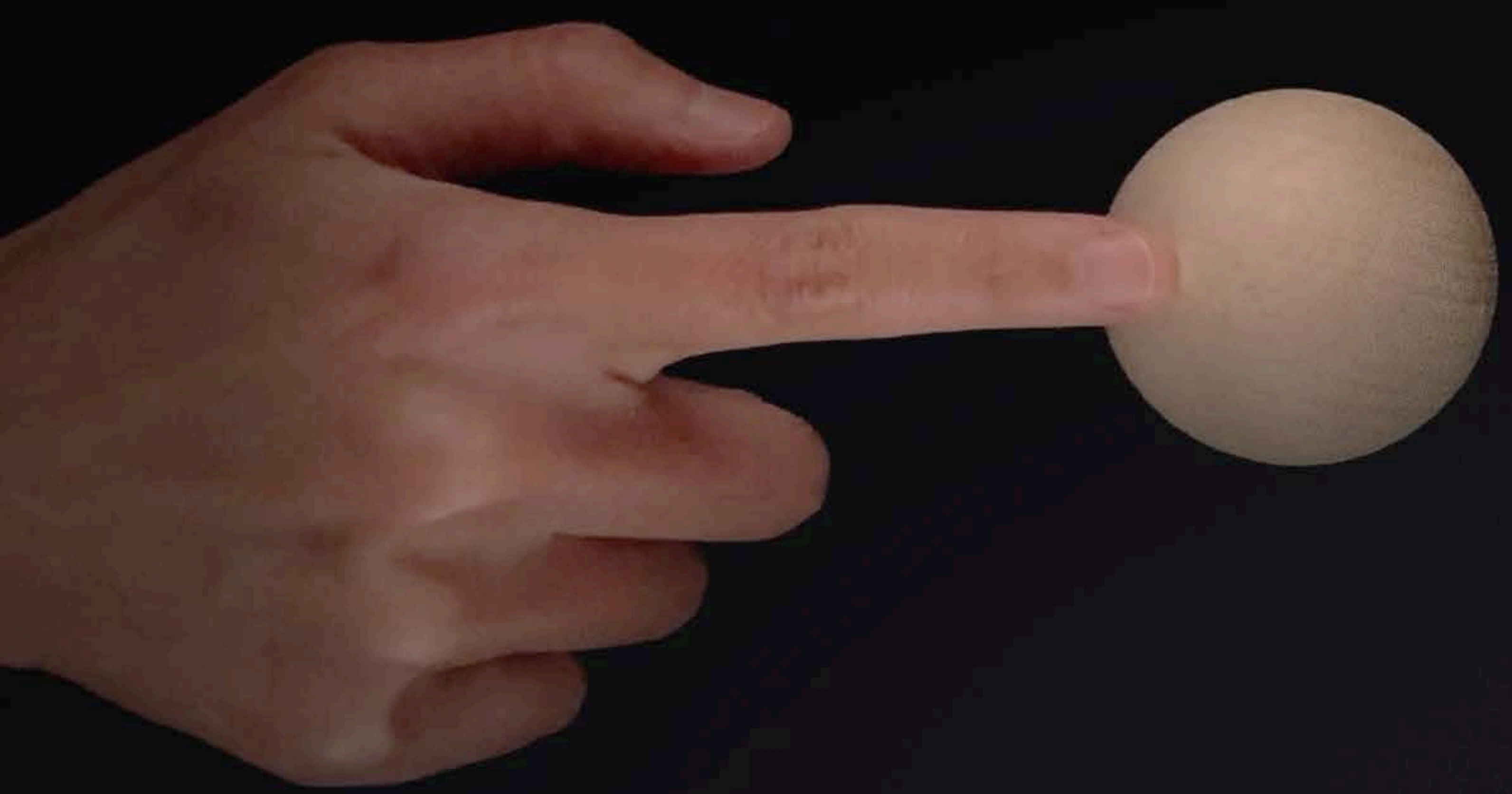


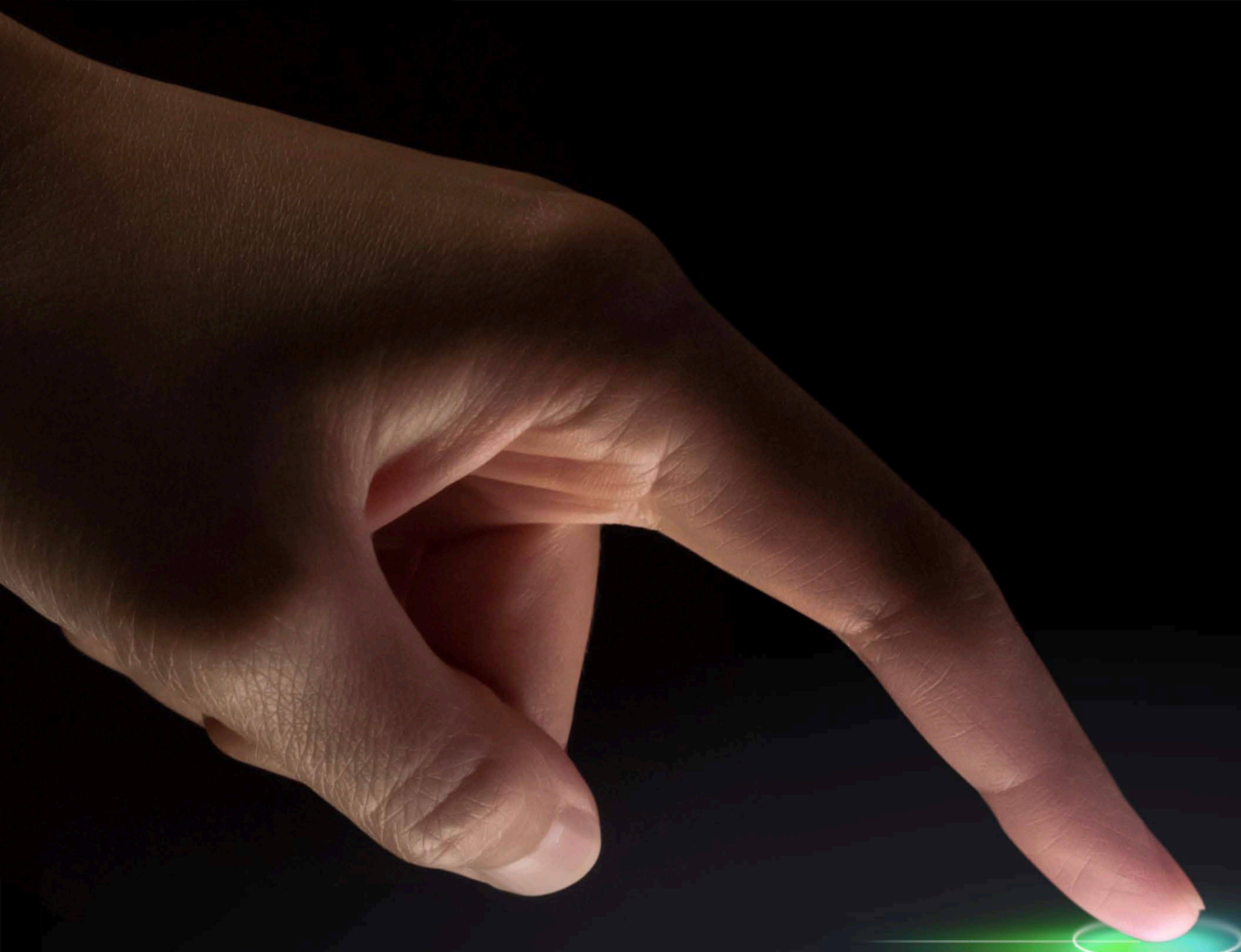
Surface
Bonobo



Keep touch interactions lightweight

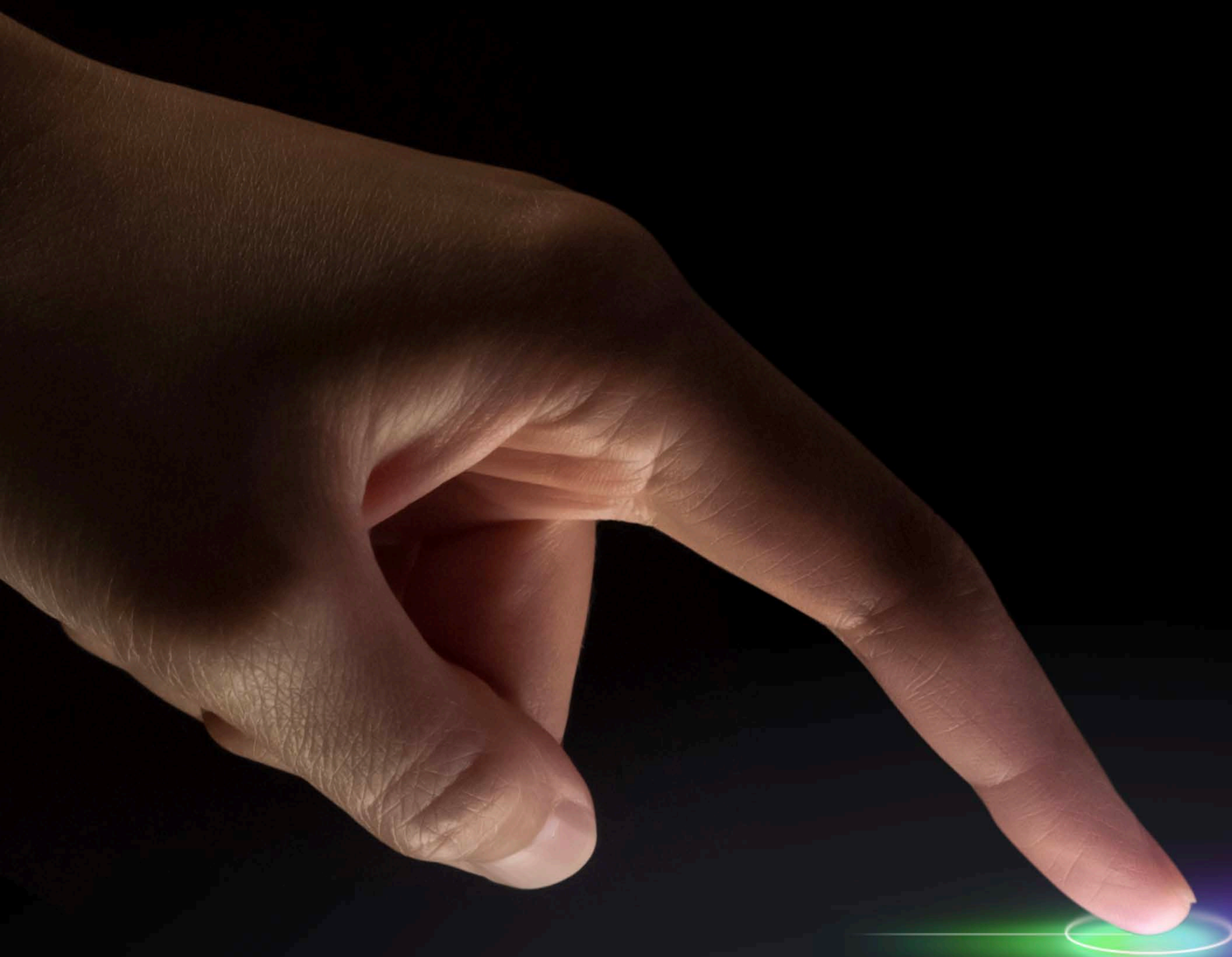
Keep touch interactions lightweight
but amplify their motion



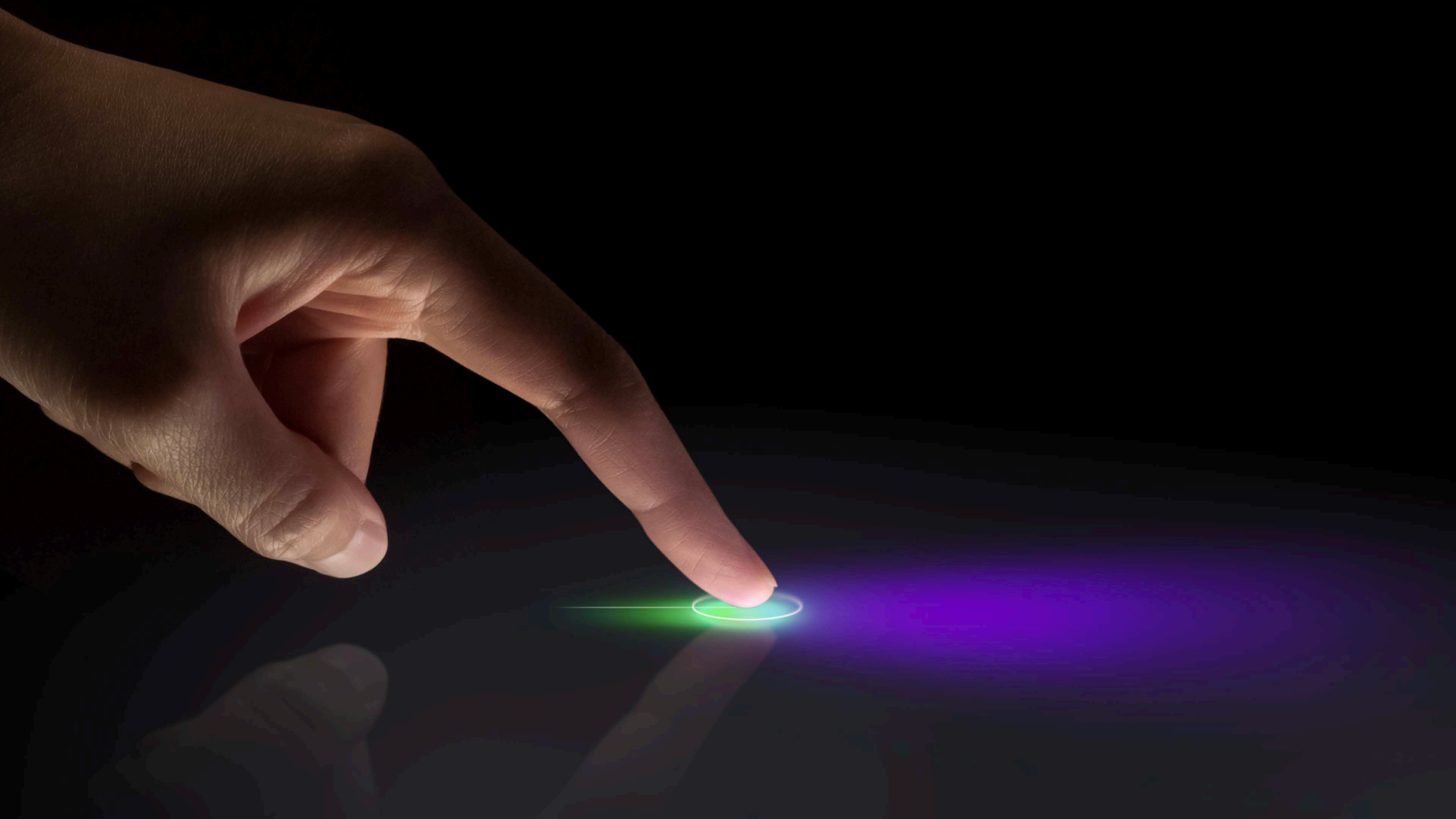


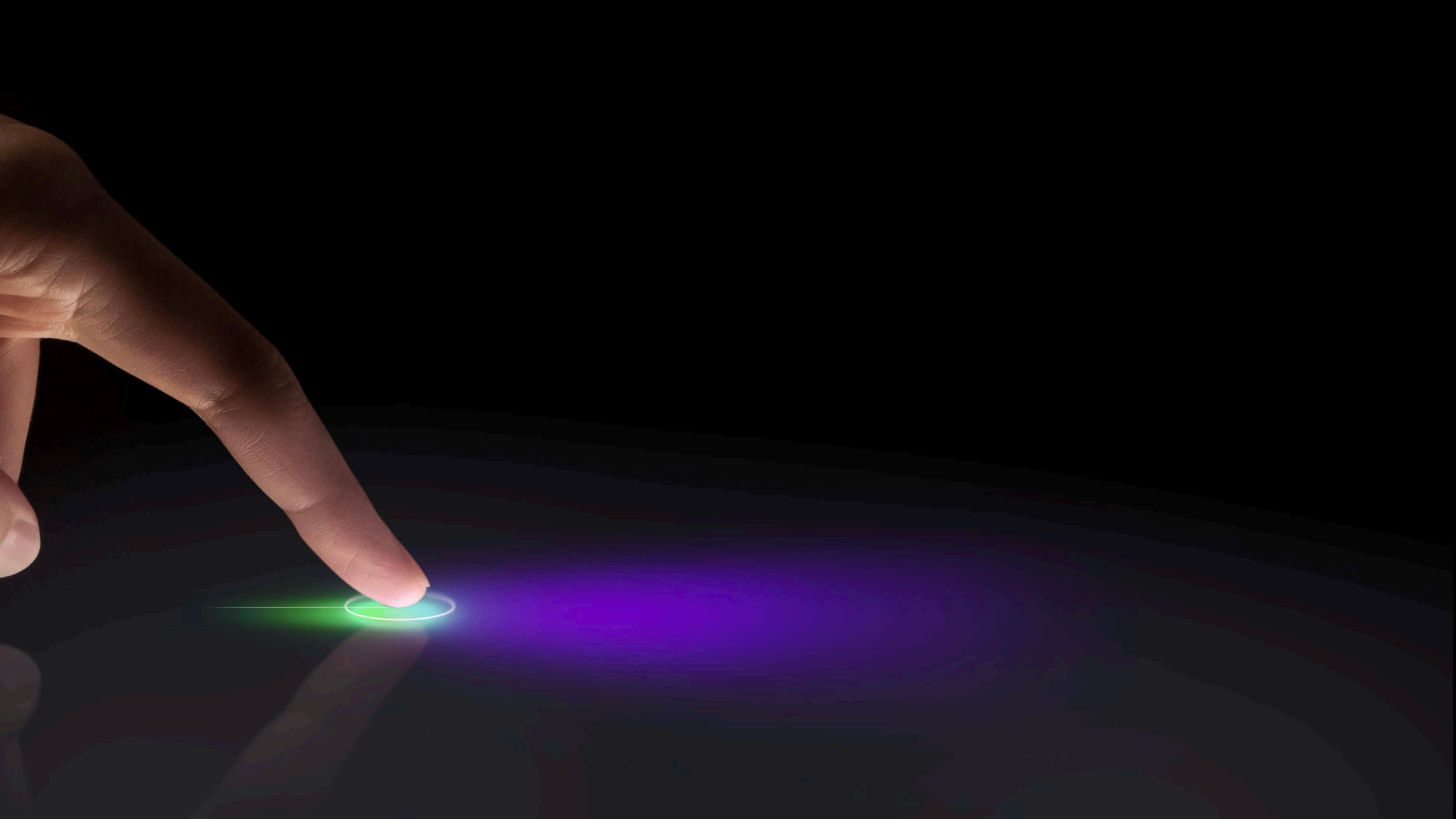
Short interaction

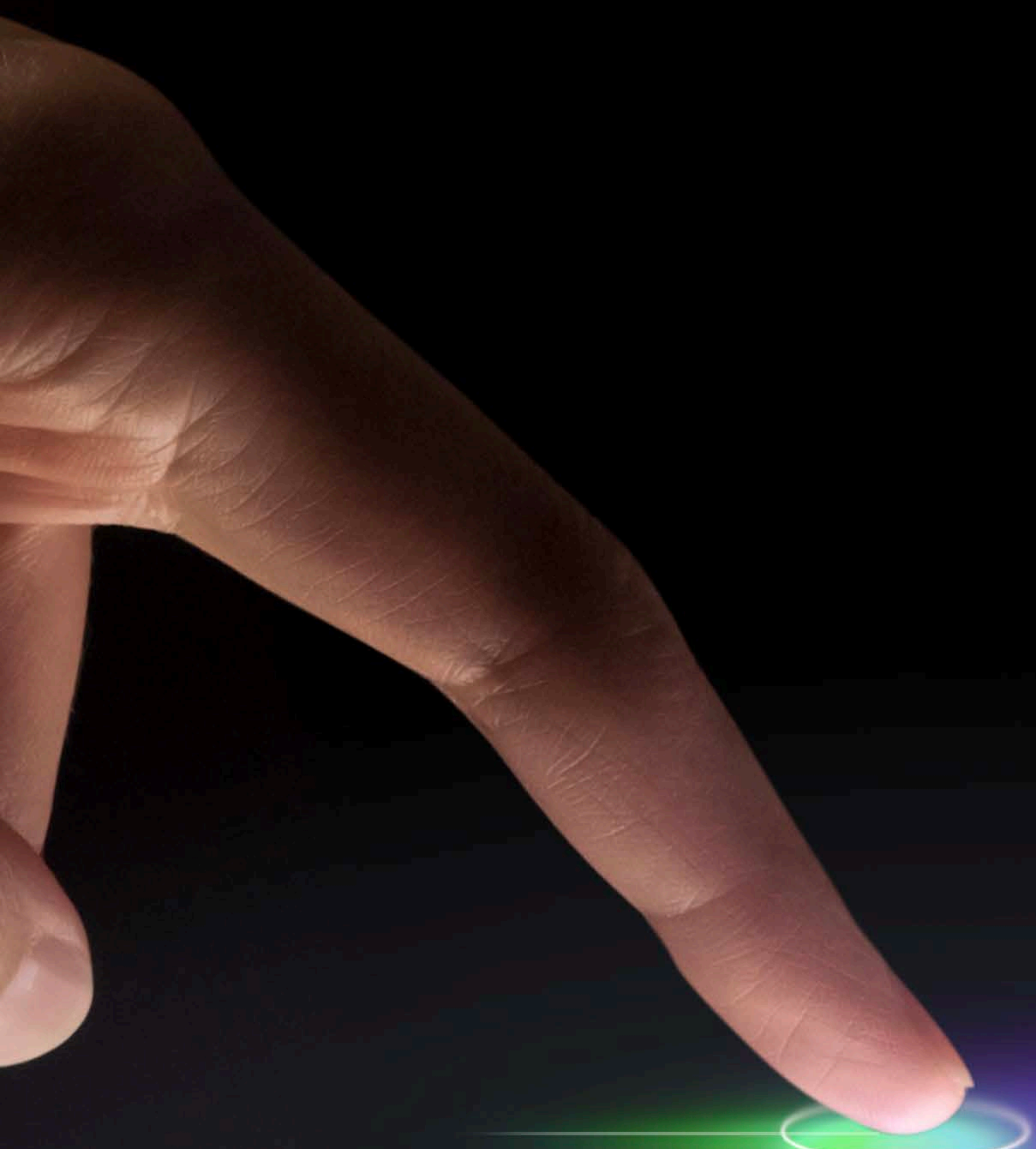




infer trajectory with
position
velocity
speed
force







Amplified result of movement
that still feels like an
extension of you



9:41

Inbox

Chan Karunamuni

To: chandemo@icloud.com

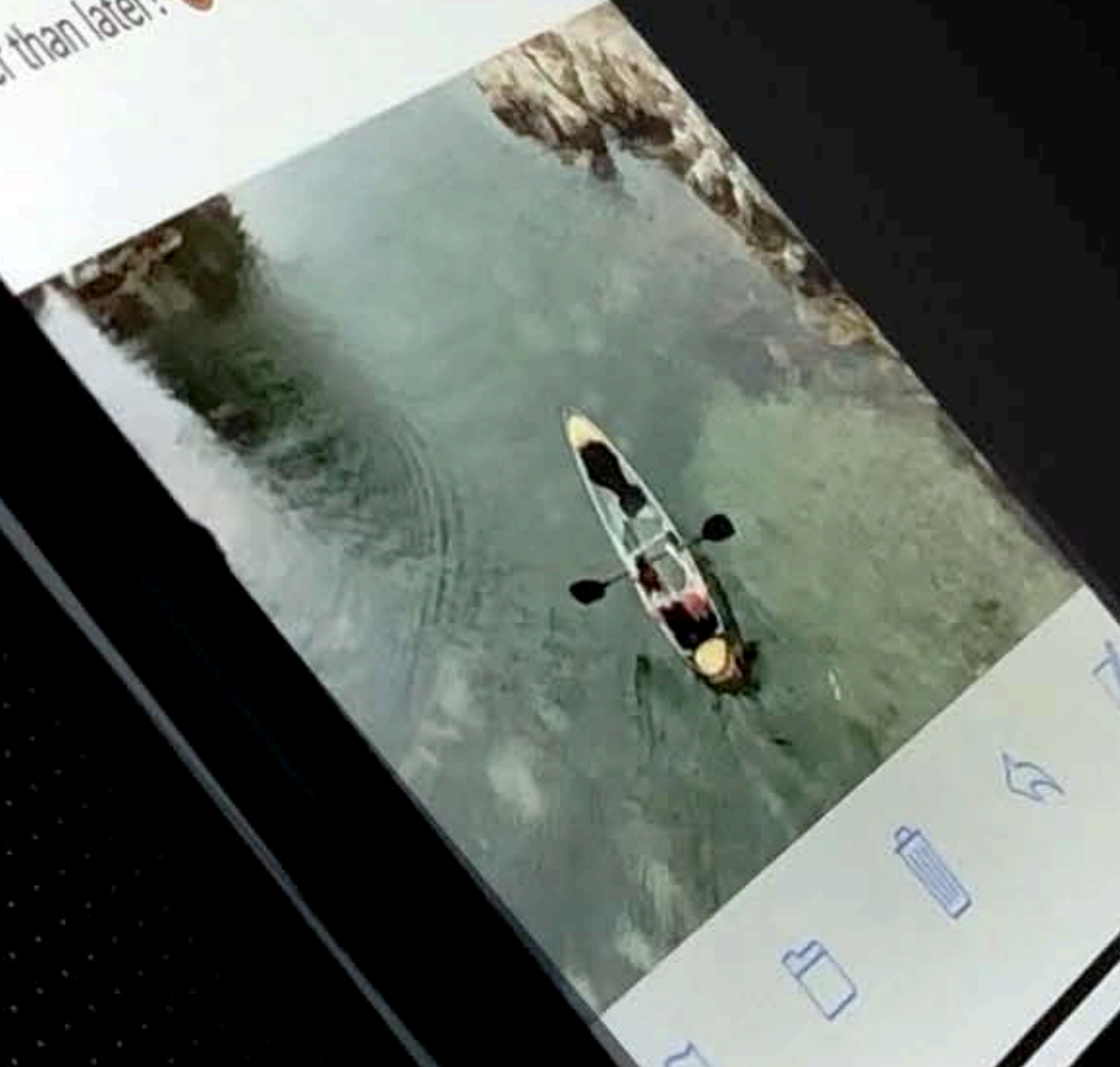


Birthday canoe trip

Yesterday at 1:15 AM

Hey! Yesterday was so much fun. I really had an amazing time at my birthday party and the canoe trip was such an awesome surprise.

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9:41

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Chan Karunamuni

To: chandemo@icloud.com

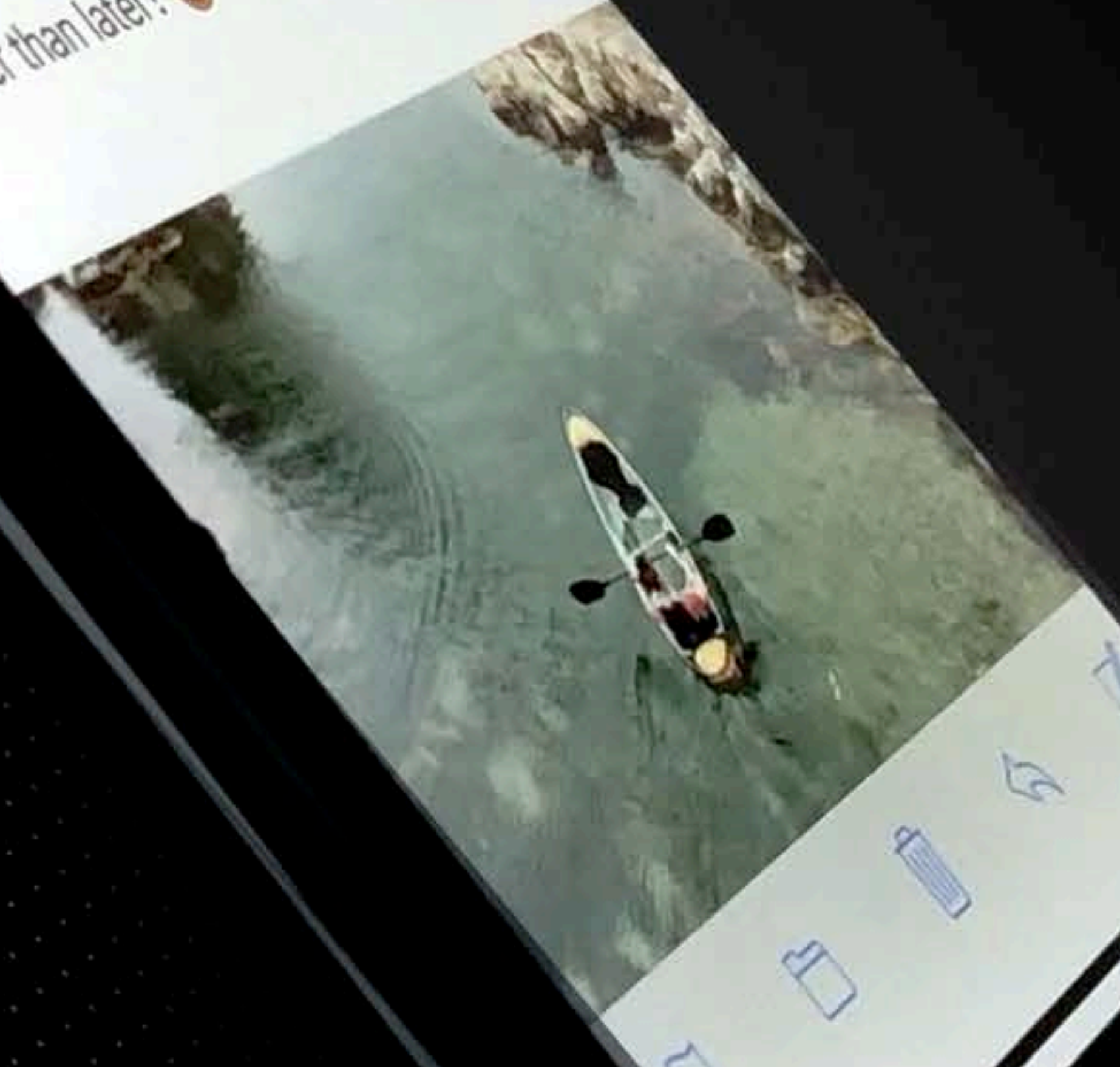


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9:41

Inbox

Chan Karunamuni

To: chanbema@icloud.com

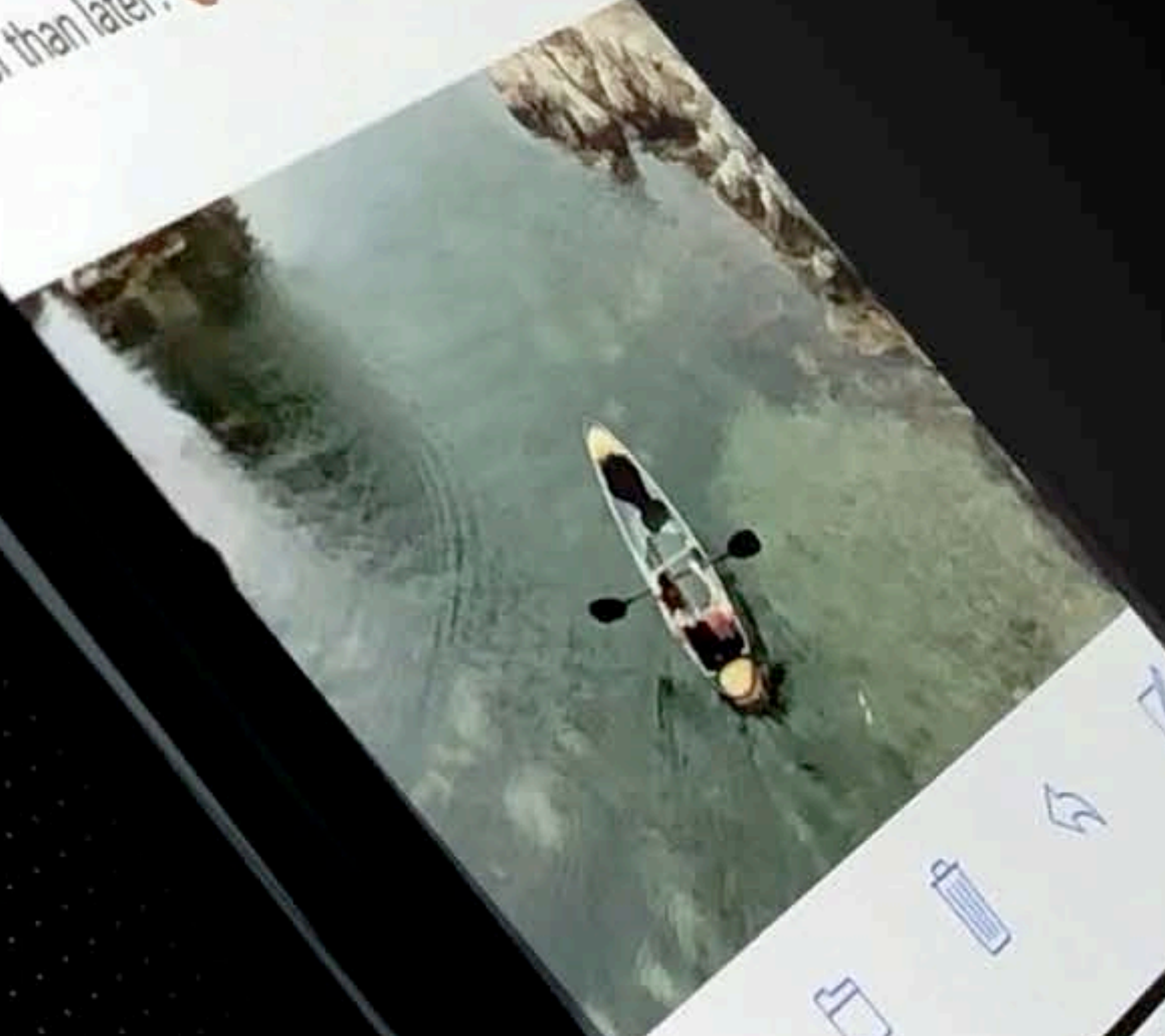
Details

Birthday canoe trip

April 19, 2018 at 6:38 PM

Hey! Yesterday was so much fun. I really had an amazing time at my birthday party and the canoe trip was such an awesome surprise.

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Reply, Delete, Forward, Share icons

9:41

Inbox

Chan Karunamuni

To: chanbema@icloud.com

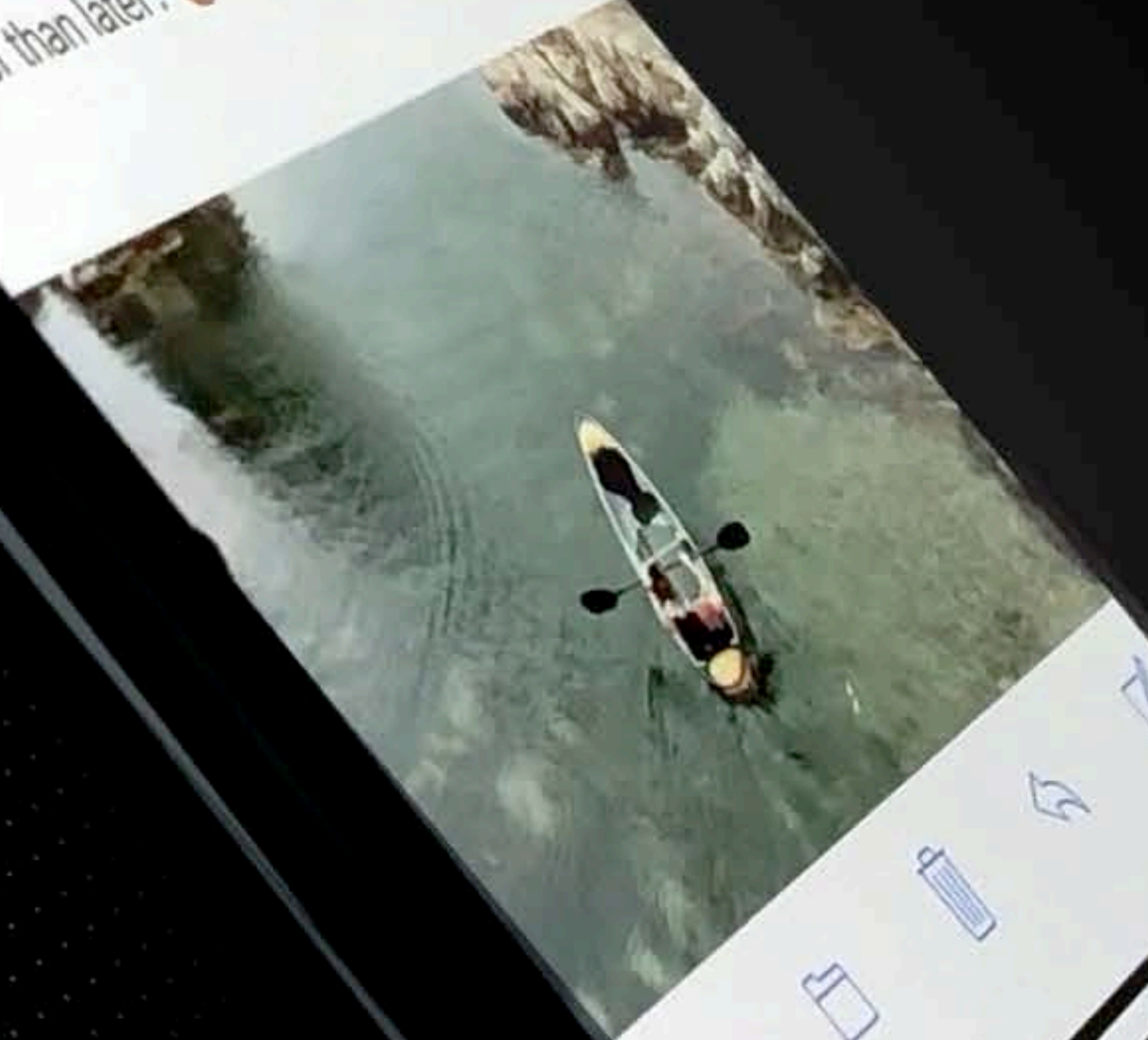
Details

Birthday canoe trip

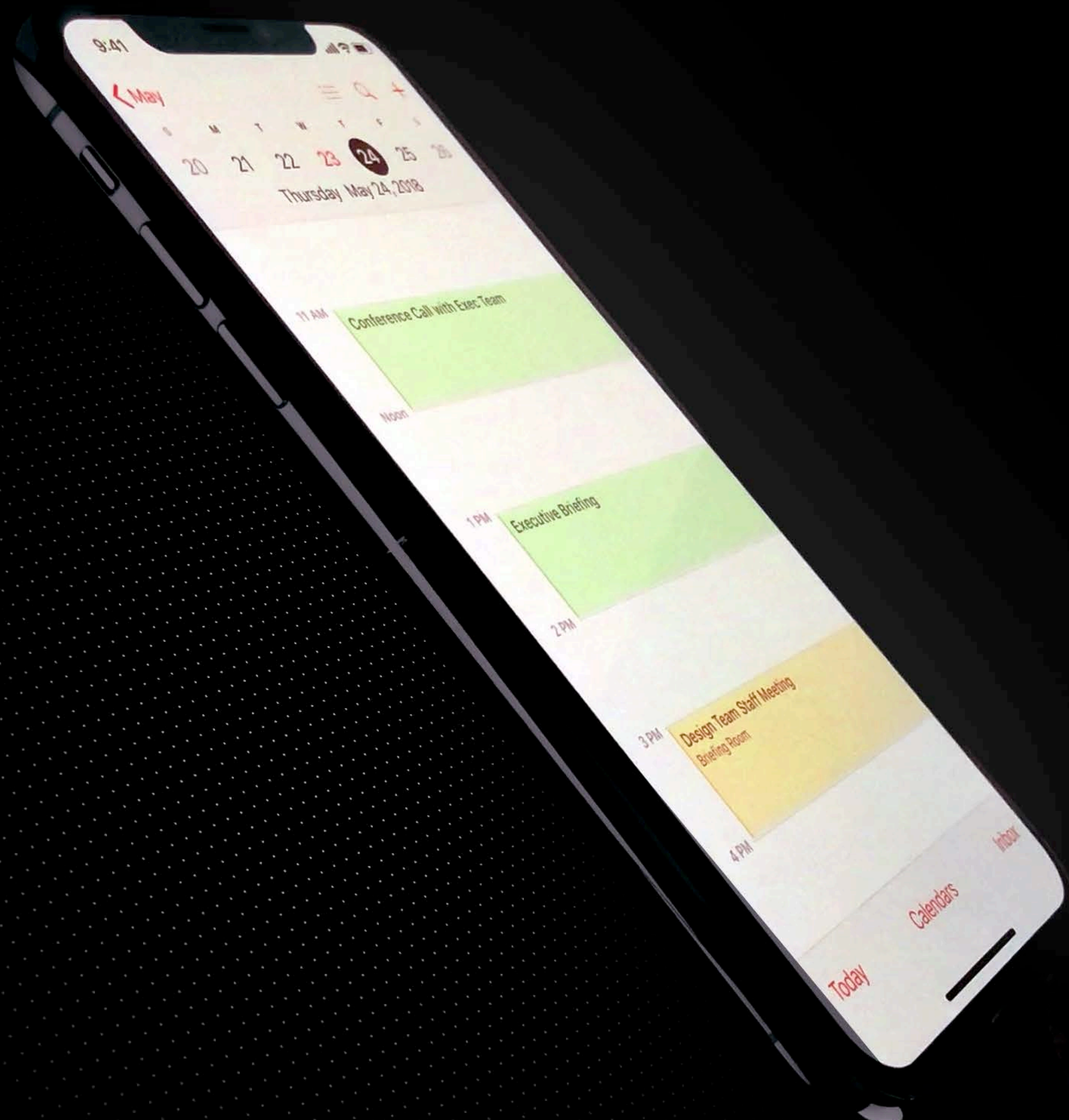
April 19, 2018 at 6:38 PM

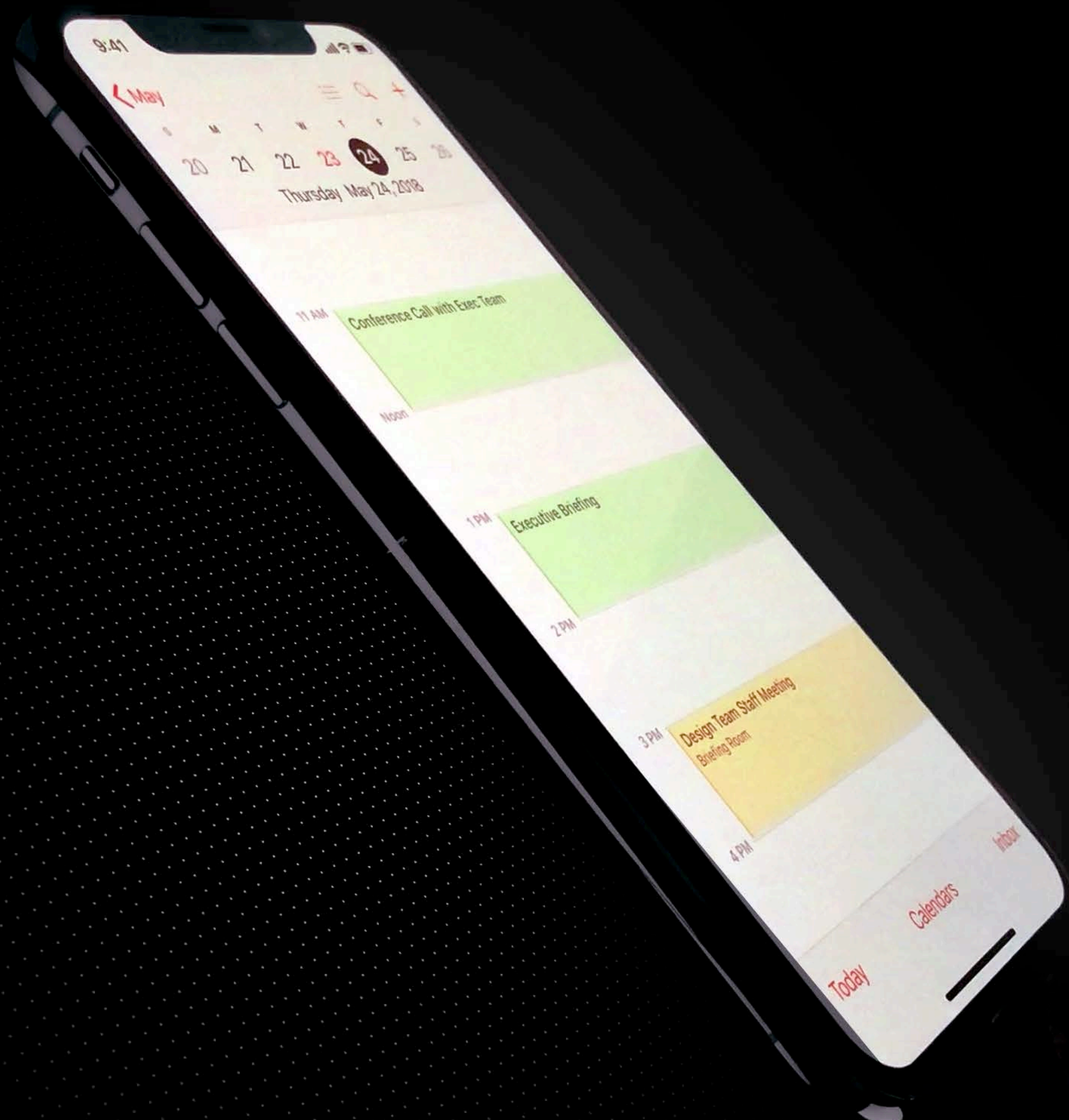
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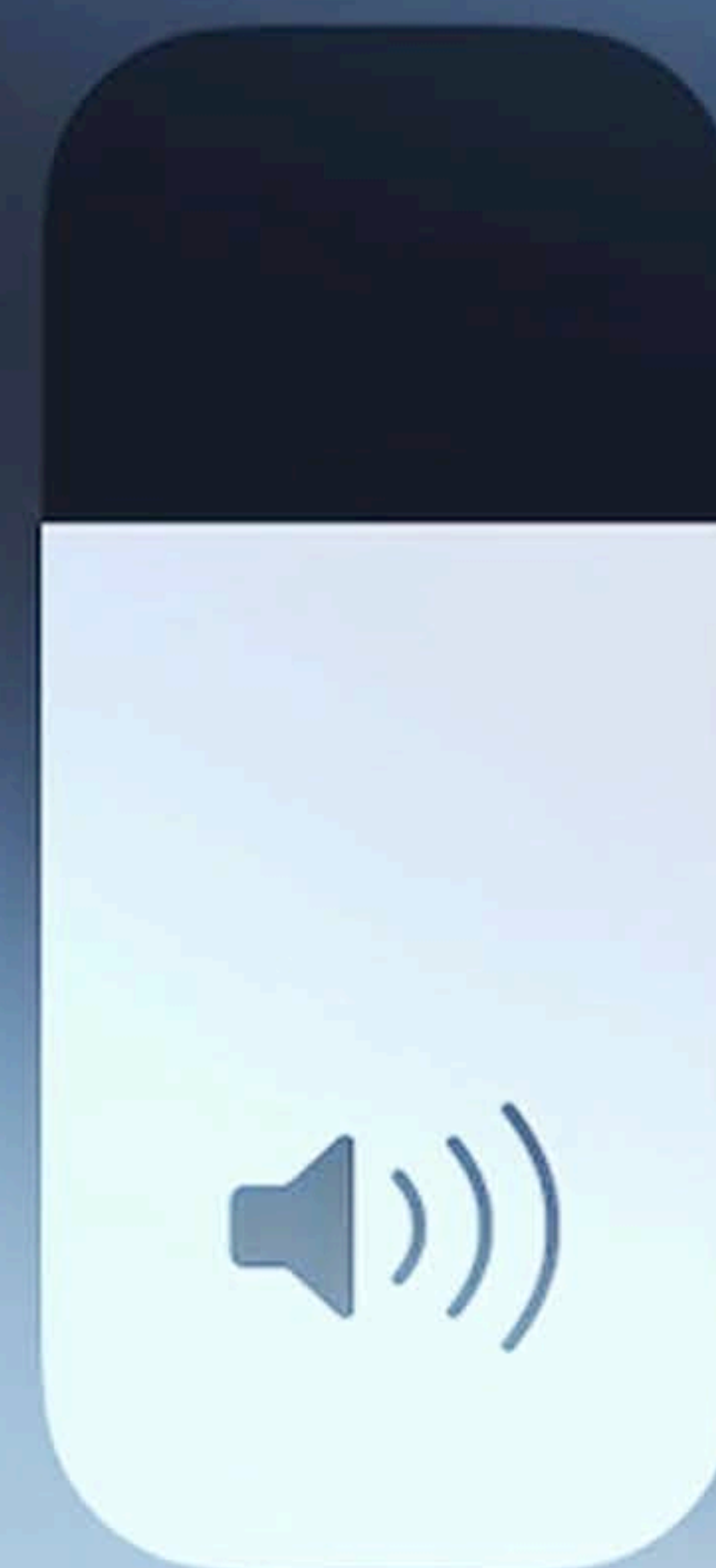
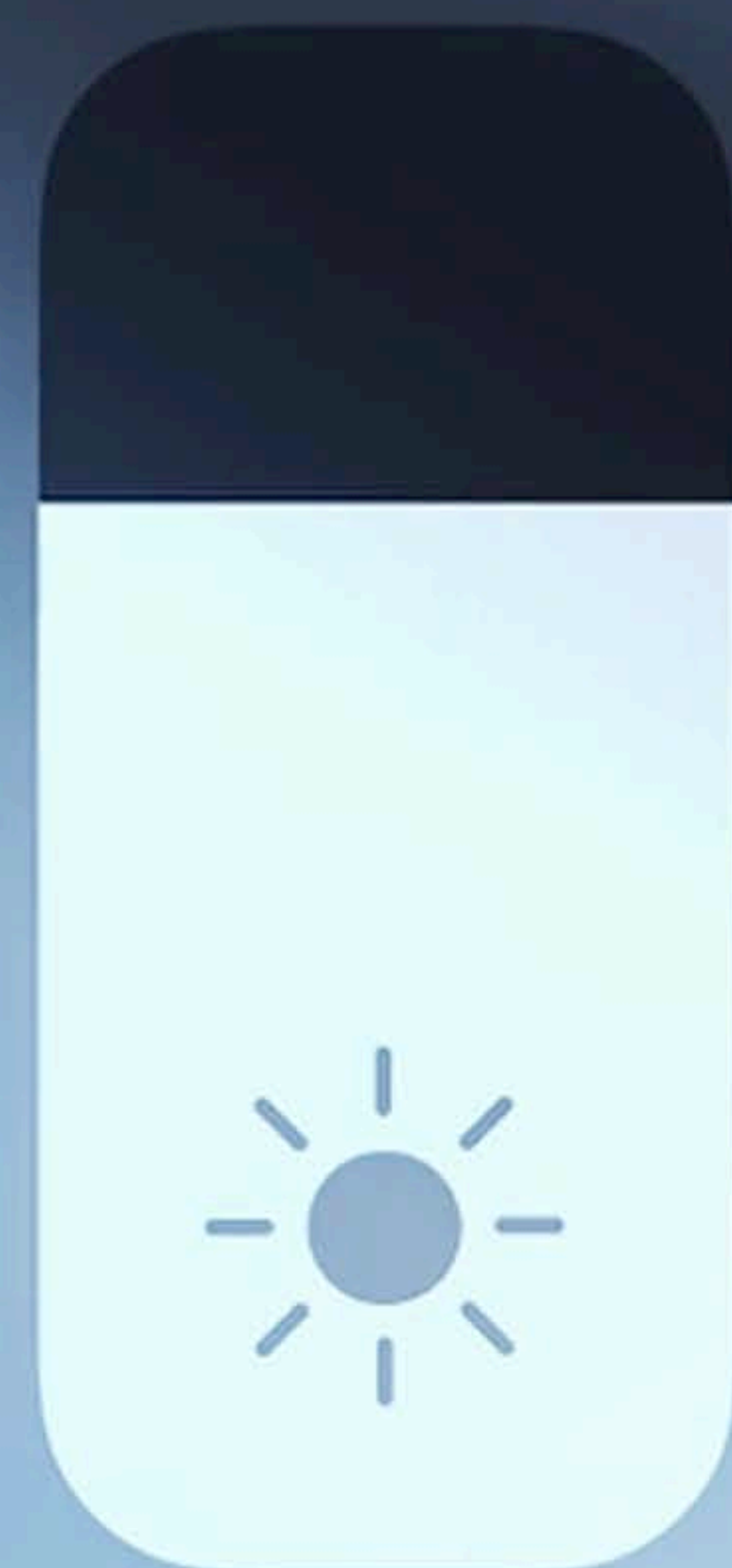
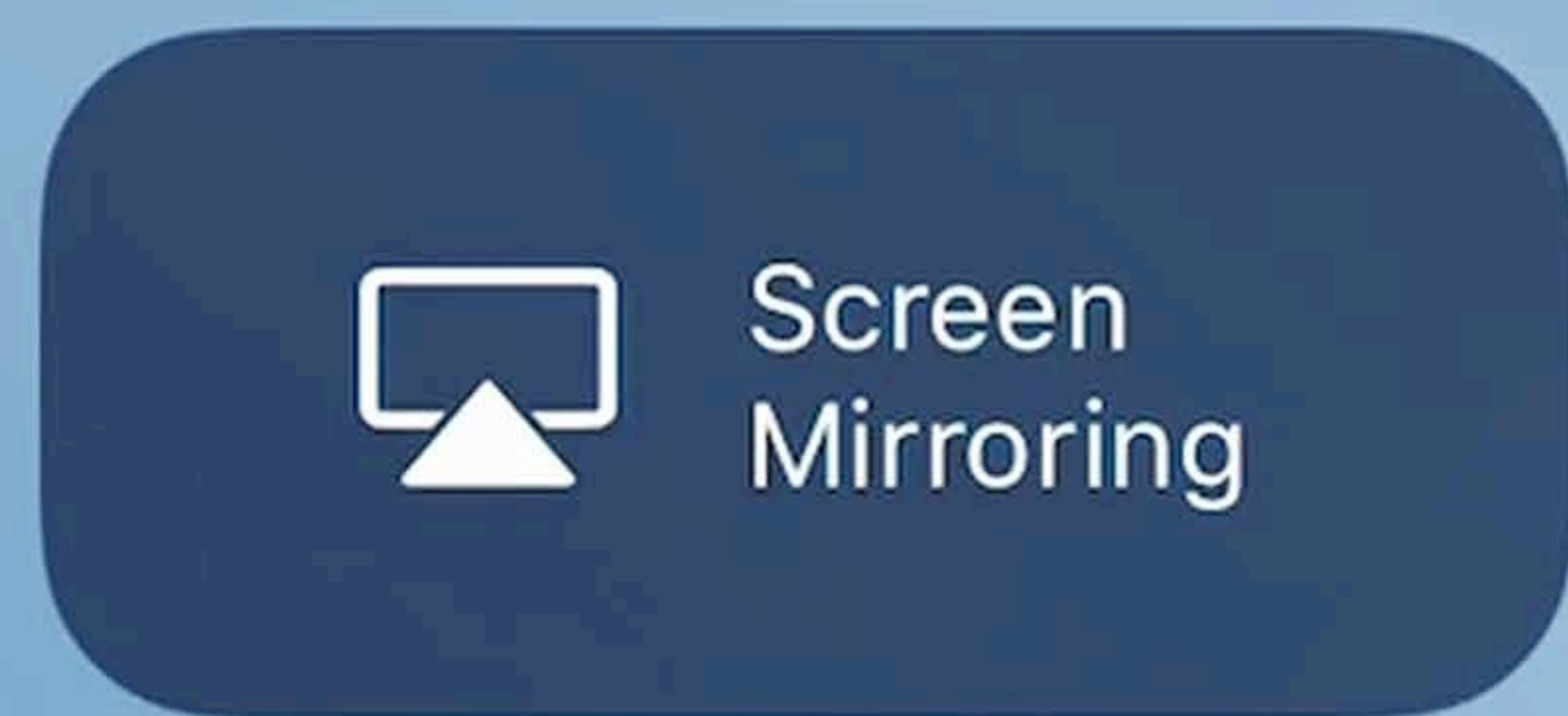
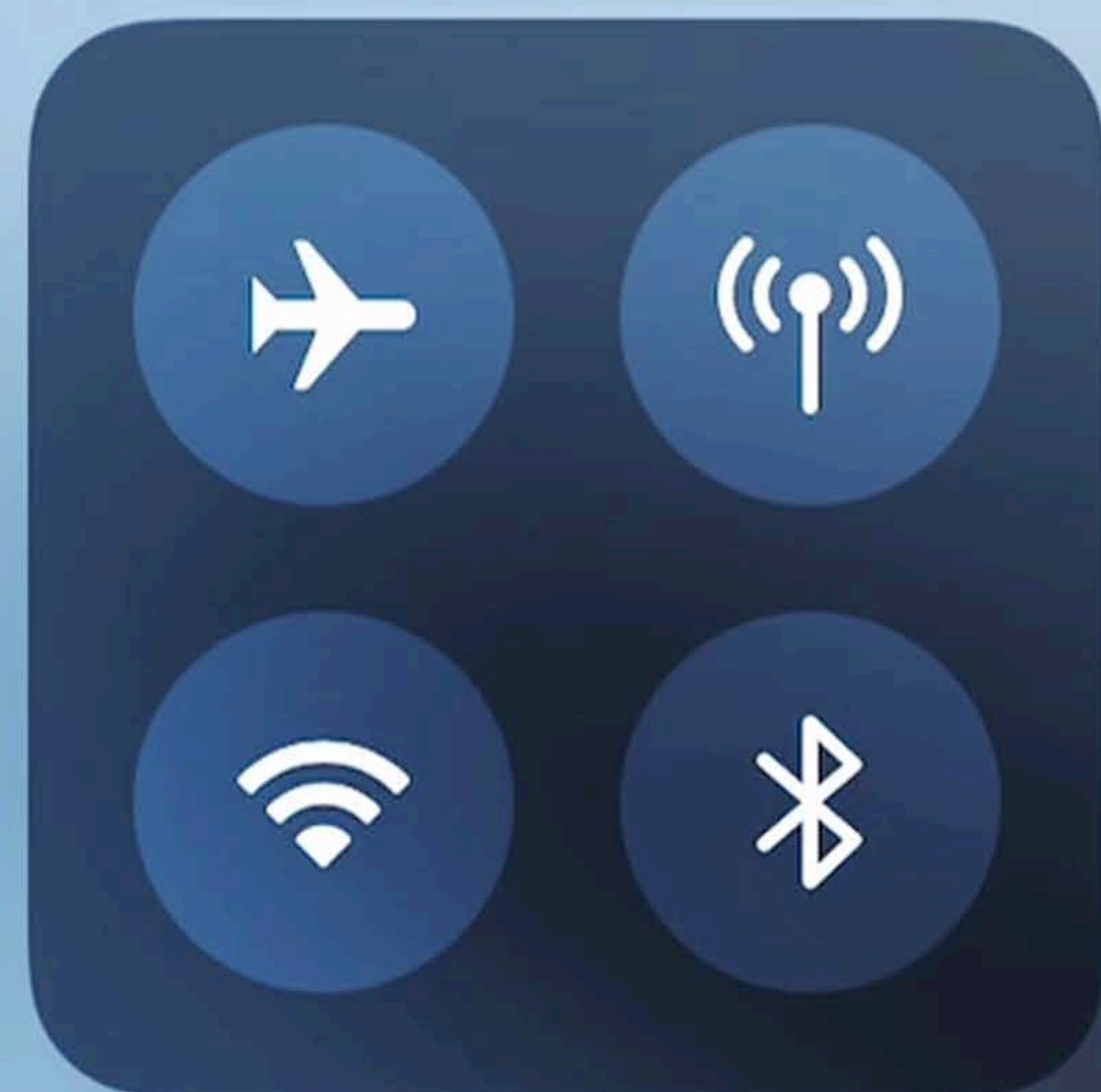
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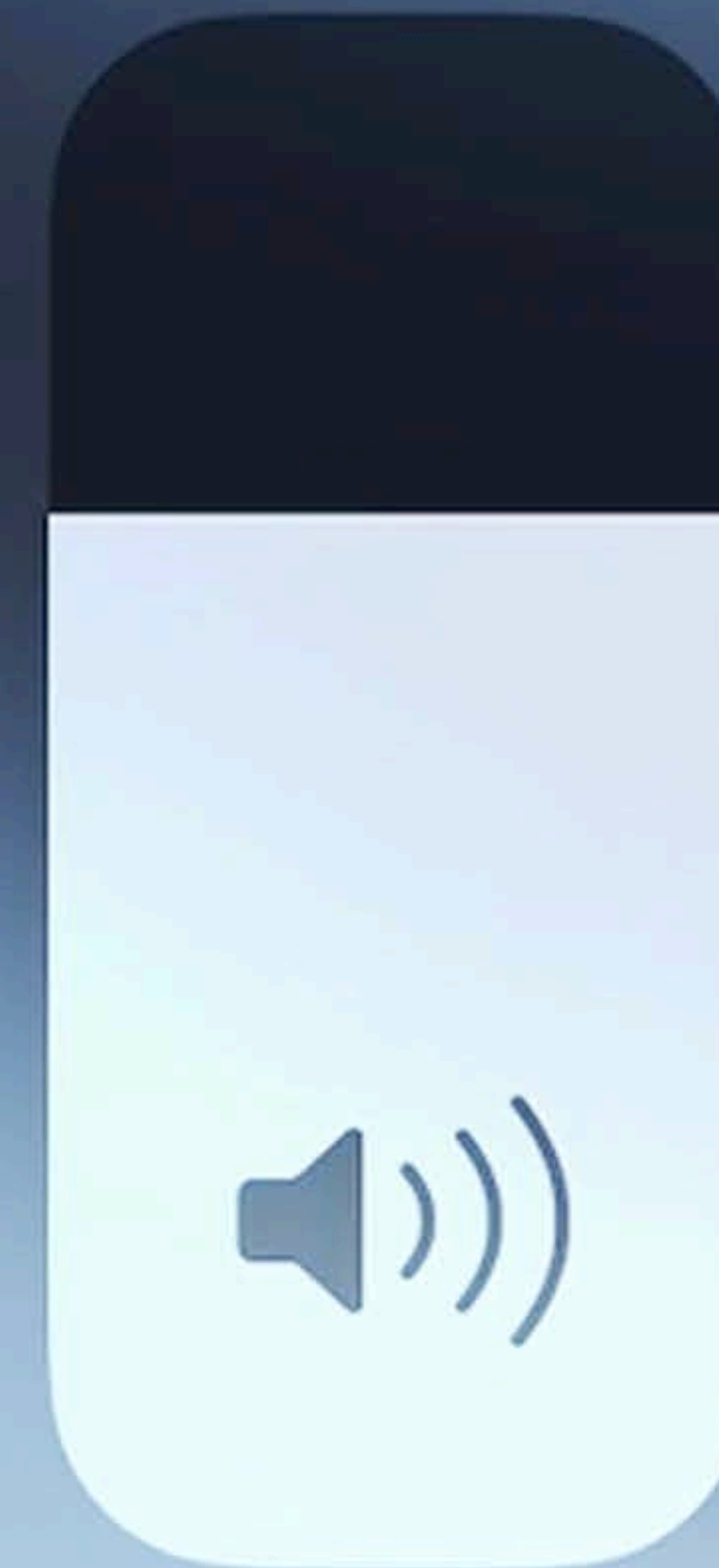
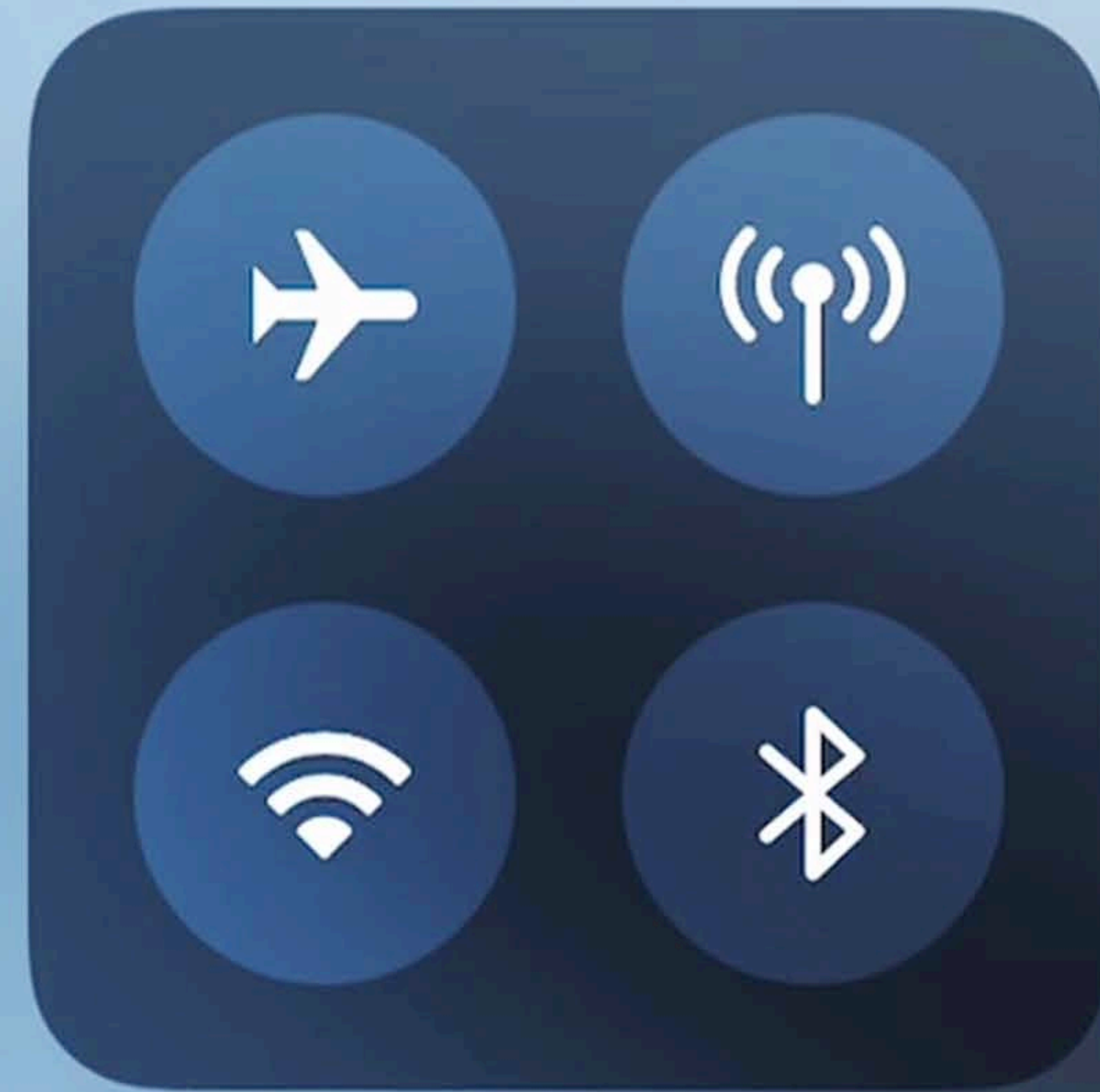


Reply, Delete, Forward, Share icons









Softly indicate boundaries

9:41



< Inbox



Chan Karunamuni

To: chandemo@icloud.com

Details

CK

Birthday canoe trip

April 19, 2018 at 6:38 PM

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Soft transitions

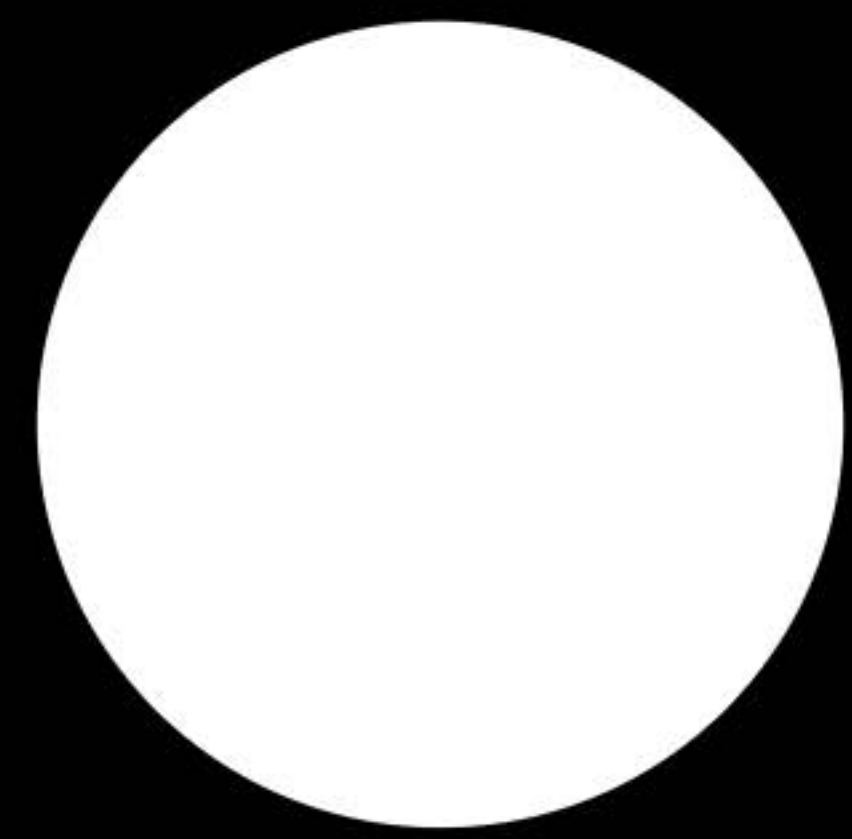
Next Post

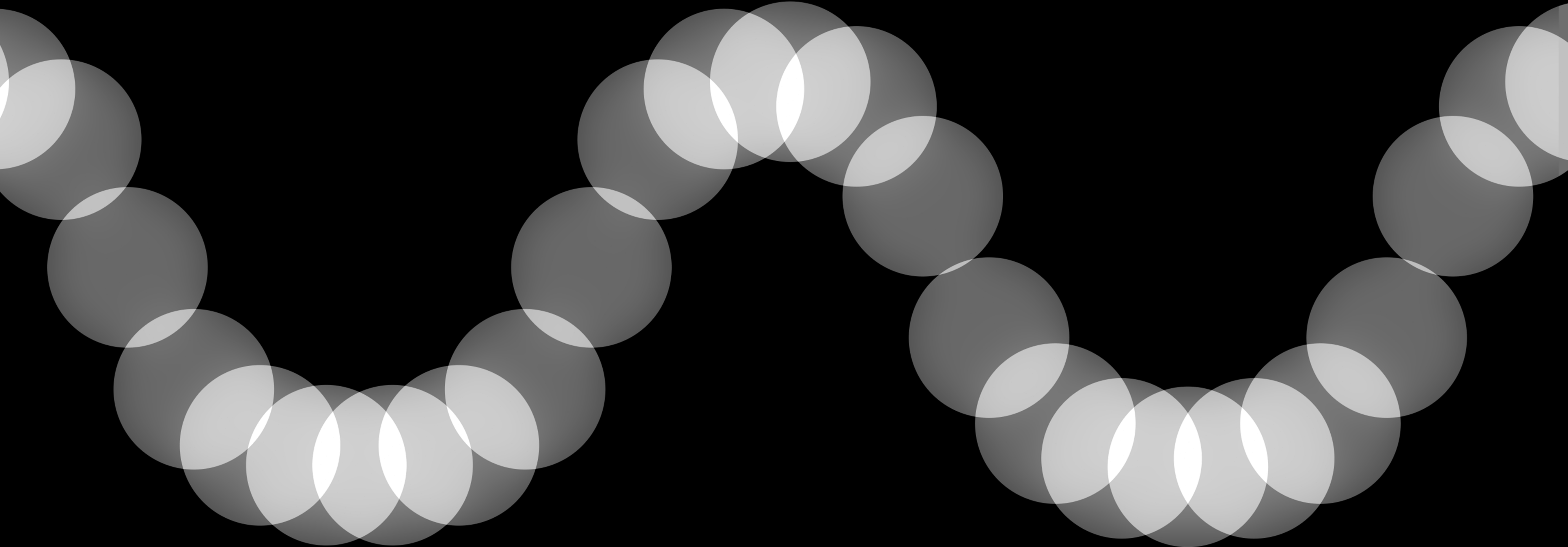
Apartamento
Alan by EO
arquitectura

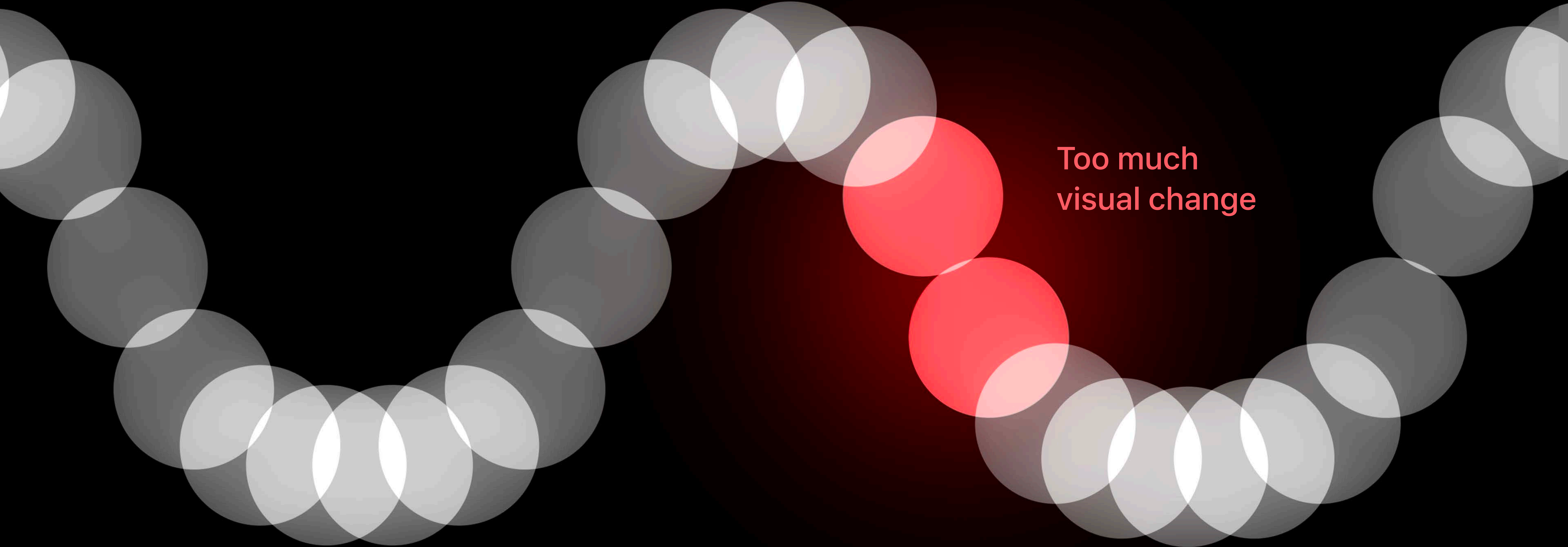


Soft transition from dock to app

Design smooth frames
of motion

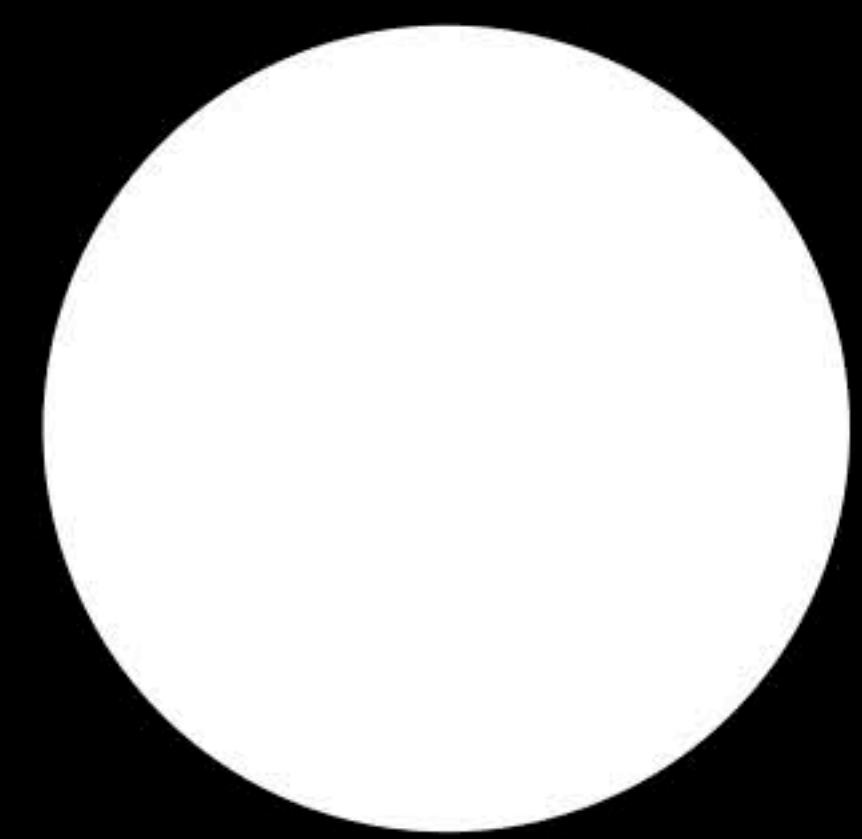




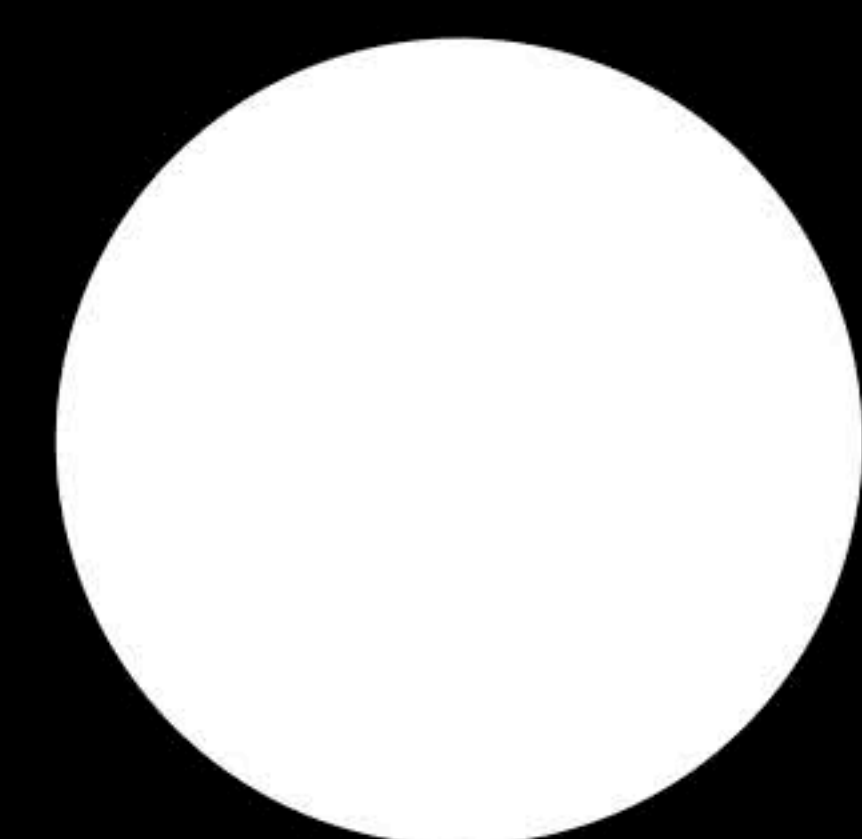


Too much
visual change

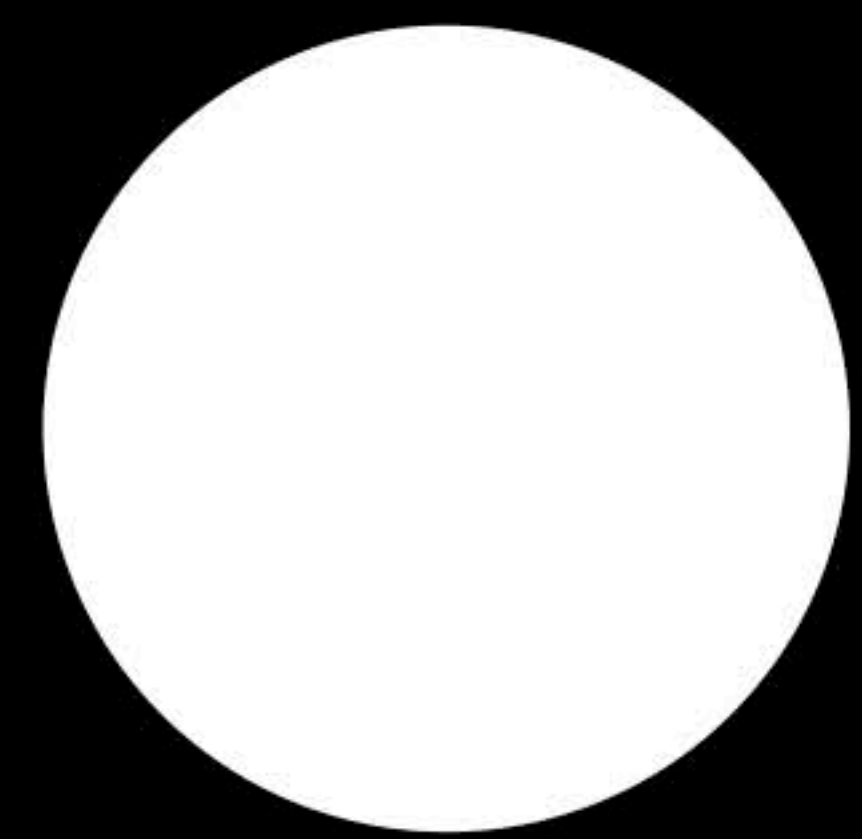




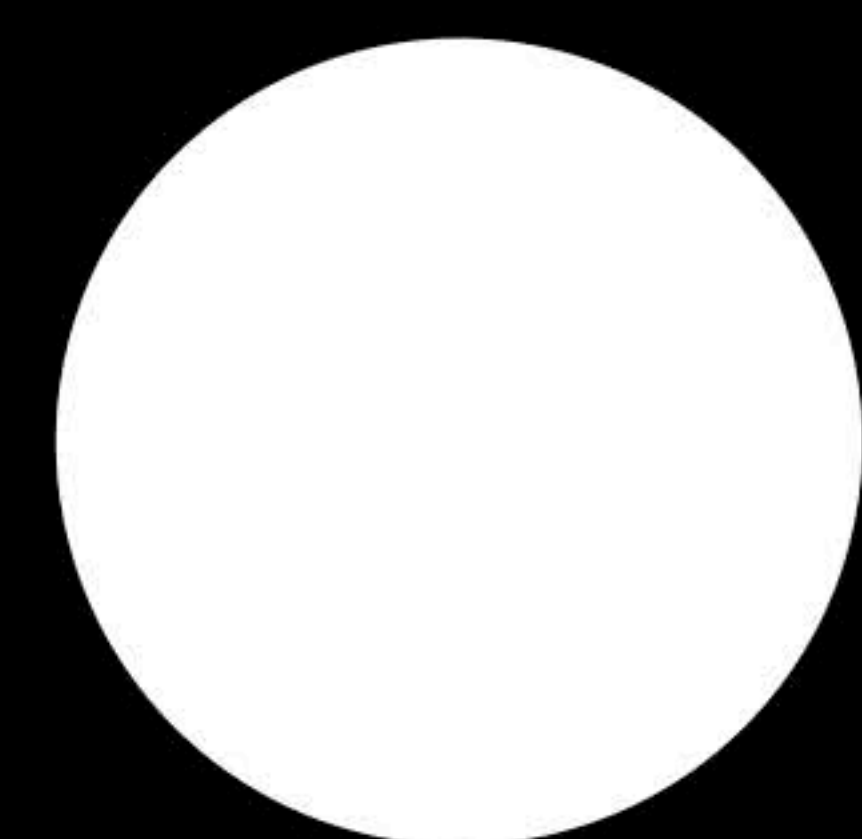
30fps
looks smooth



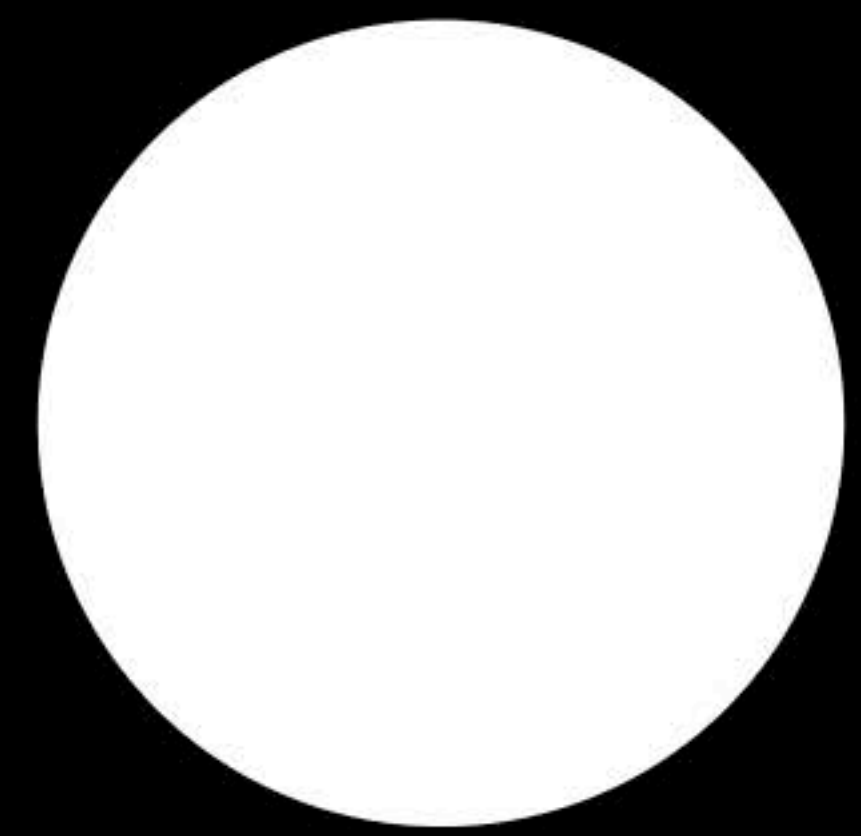
30fps
visually strobos



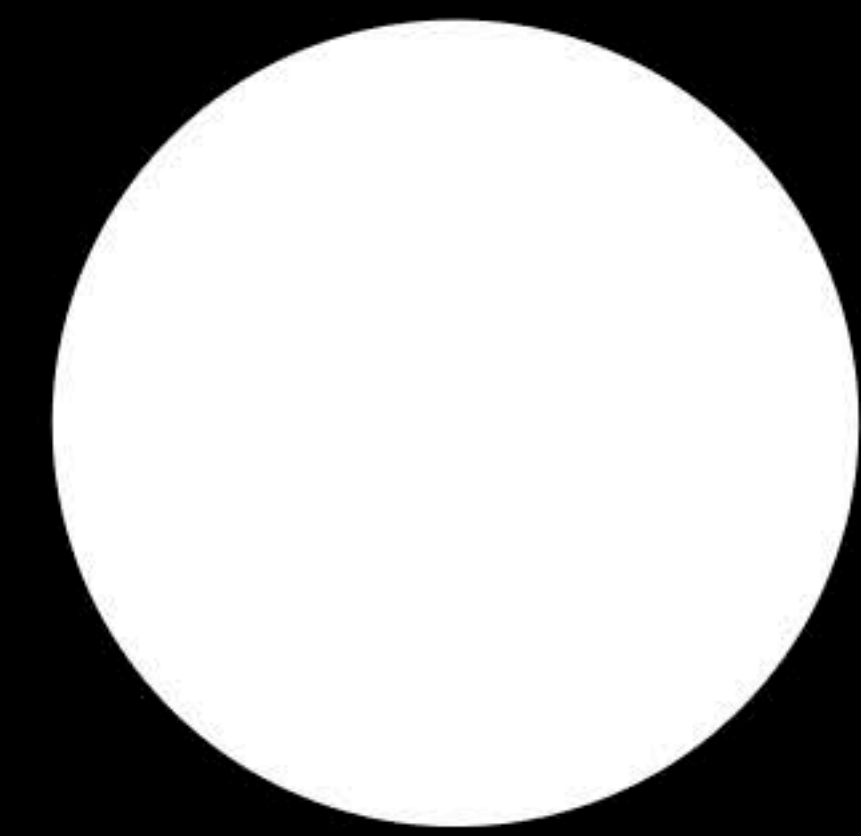
30fps
looks smooth



30fps
visually strobescs

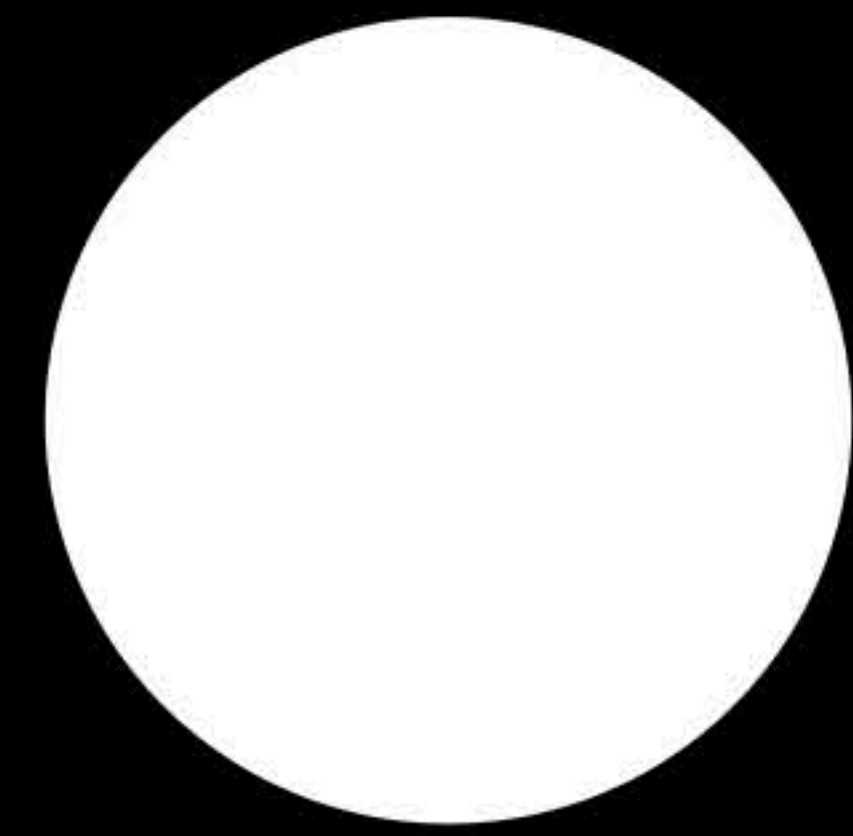


30fps

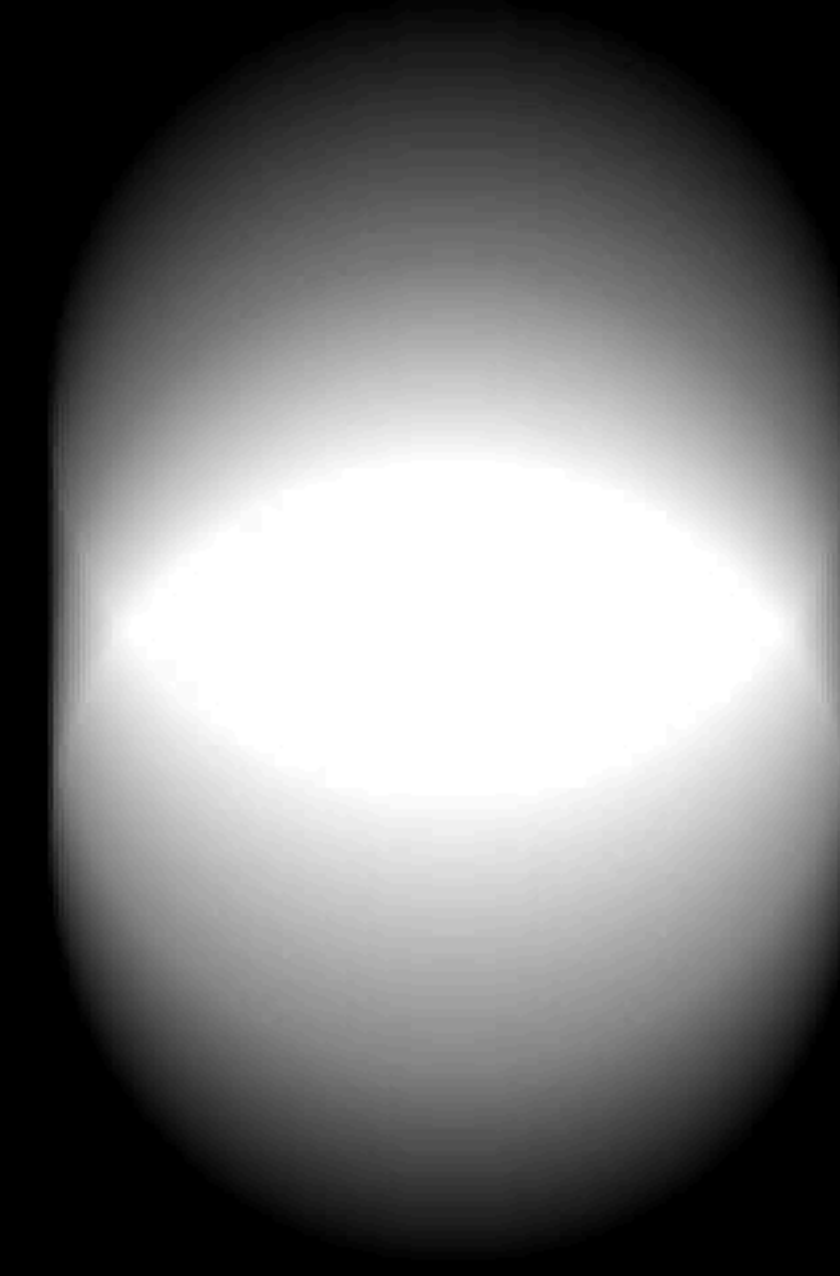


60fps

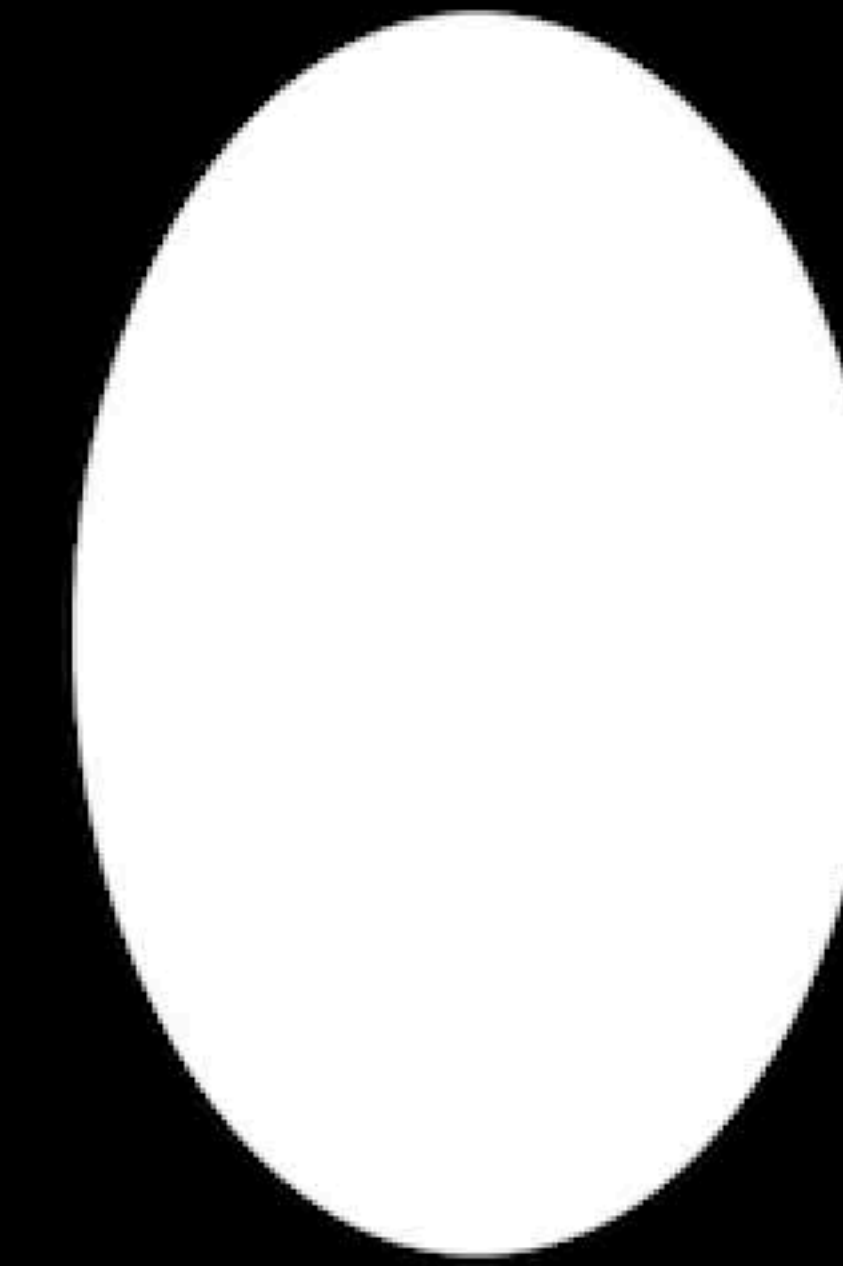
less strobing at
same speed



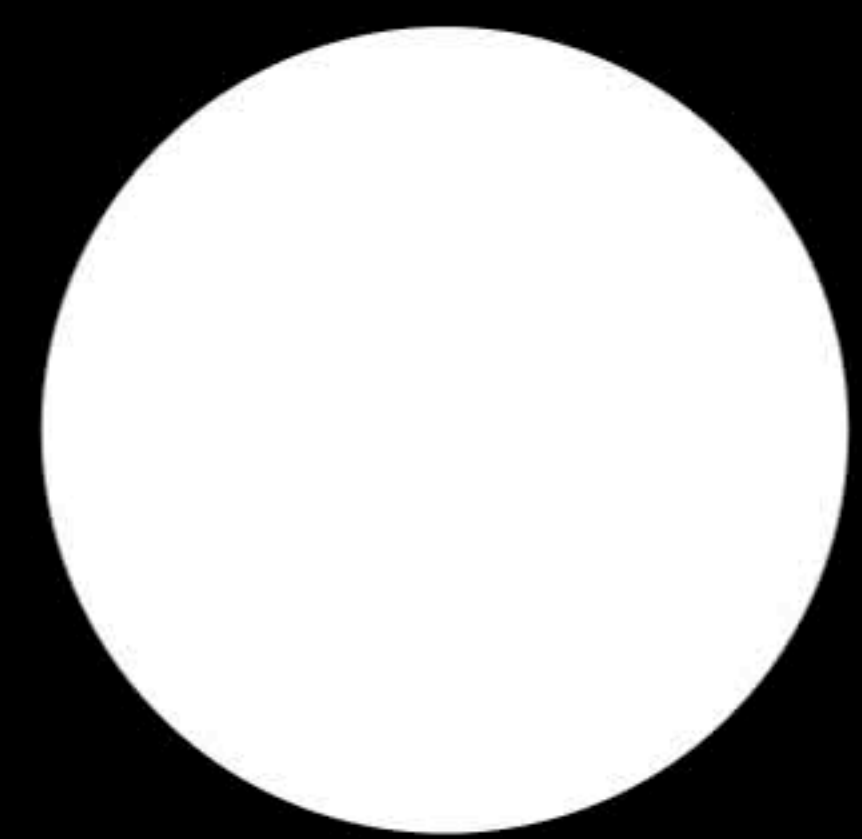
Normal



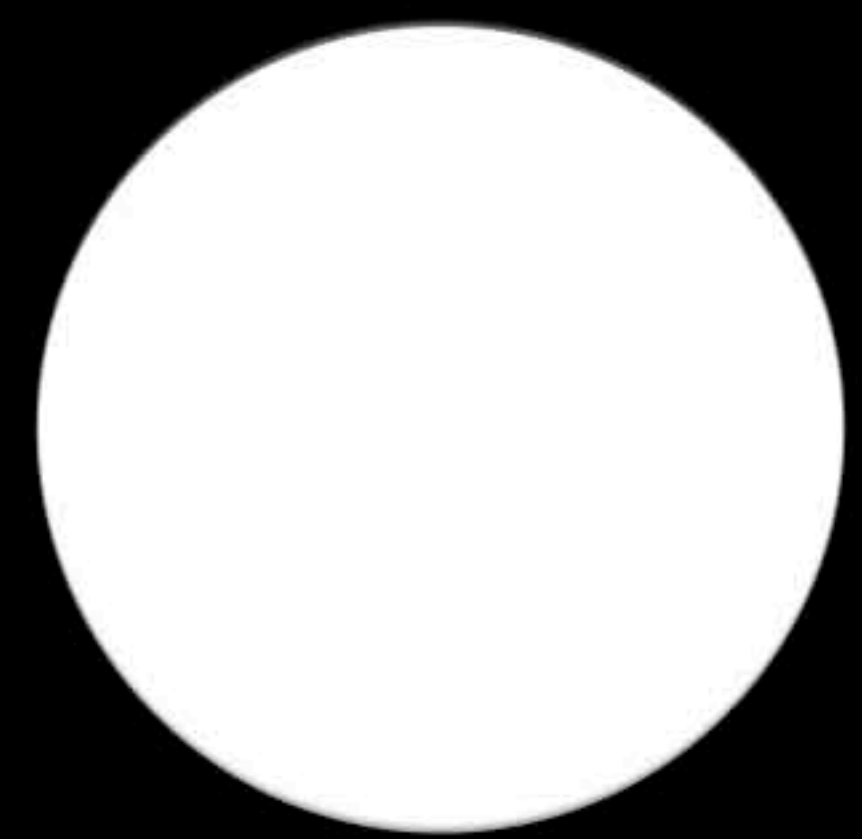
Motion
Blur



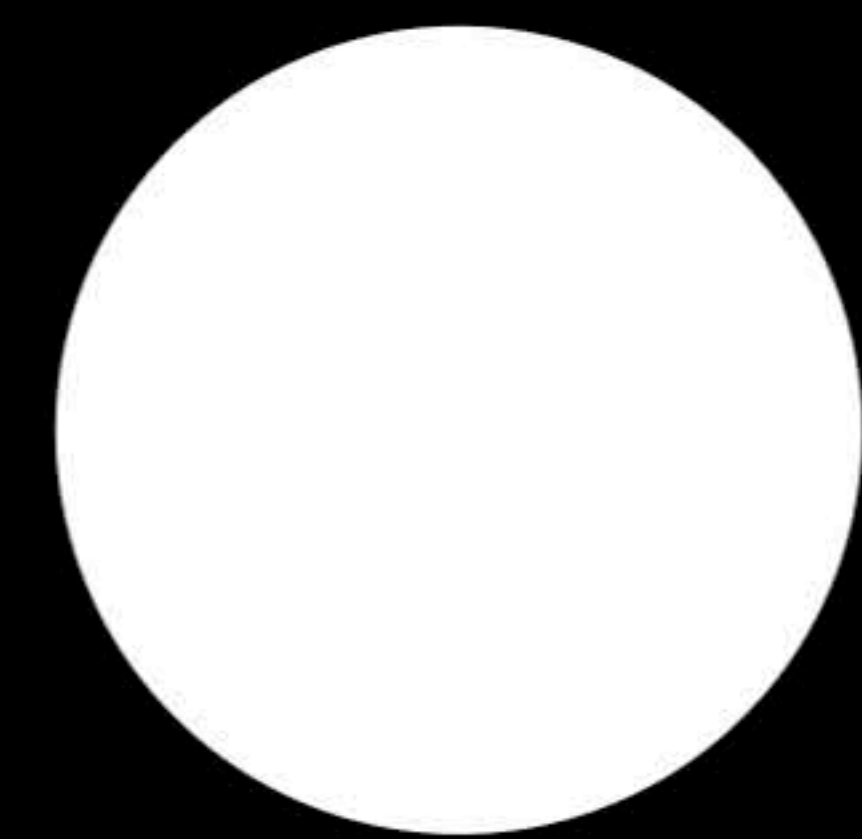
Motion
Stretch



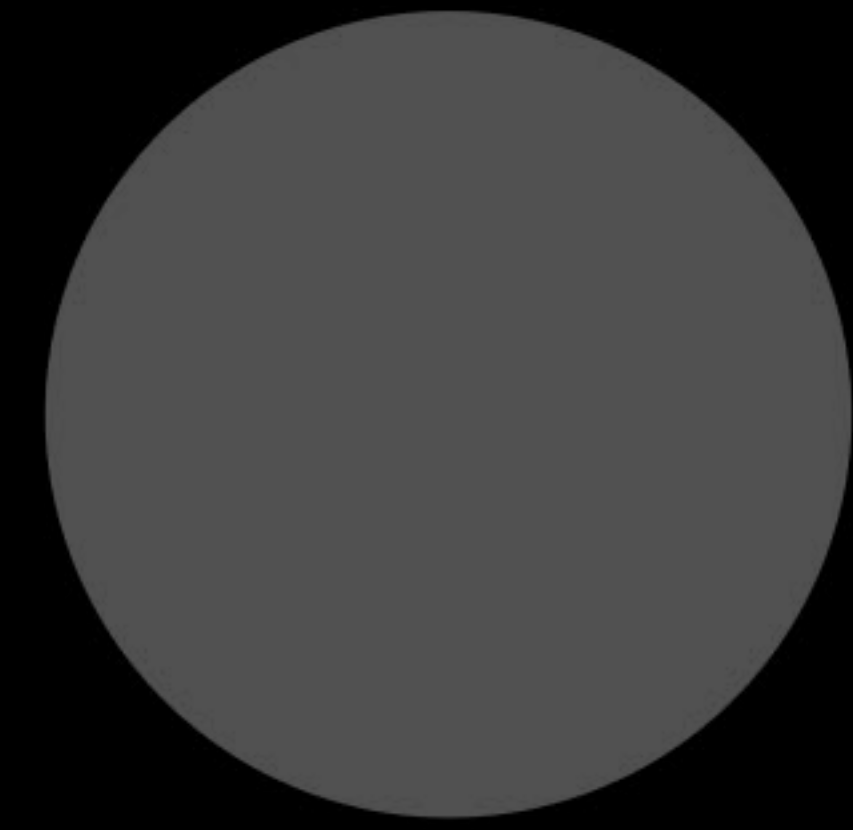
Normal



Motion
Blur



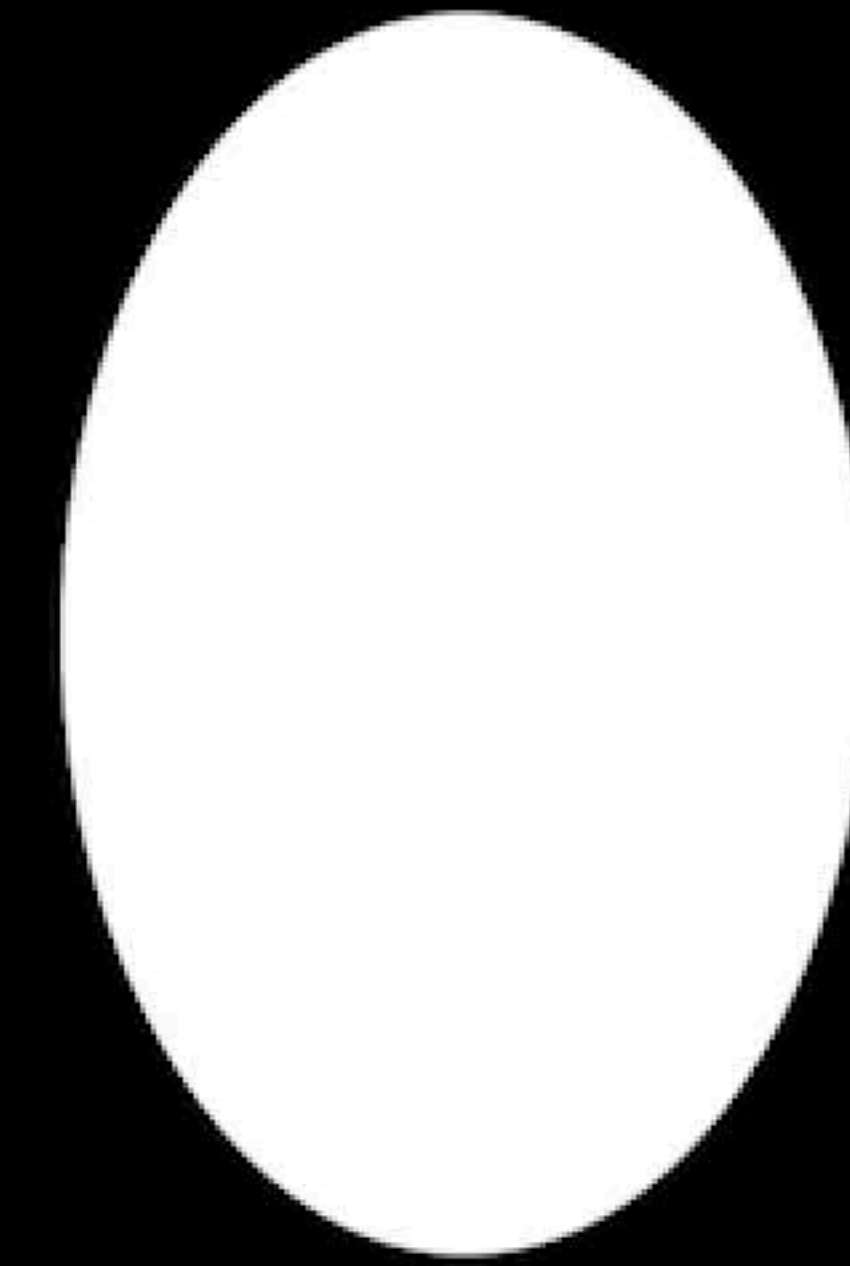
Motion
Stretch



Normal



Motion
Blur



Motion
Stretch



Mail



Calendar



Photos



Camera



Maps



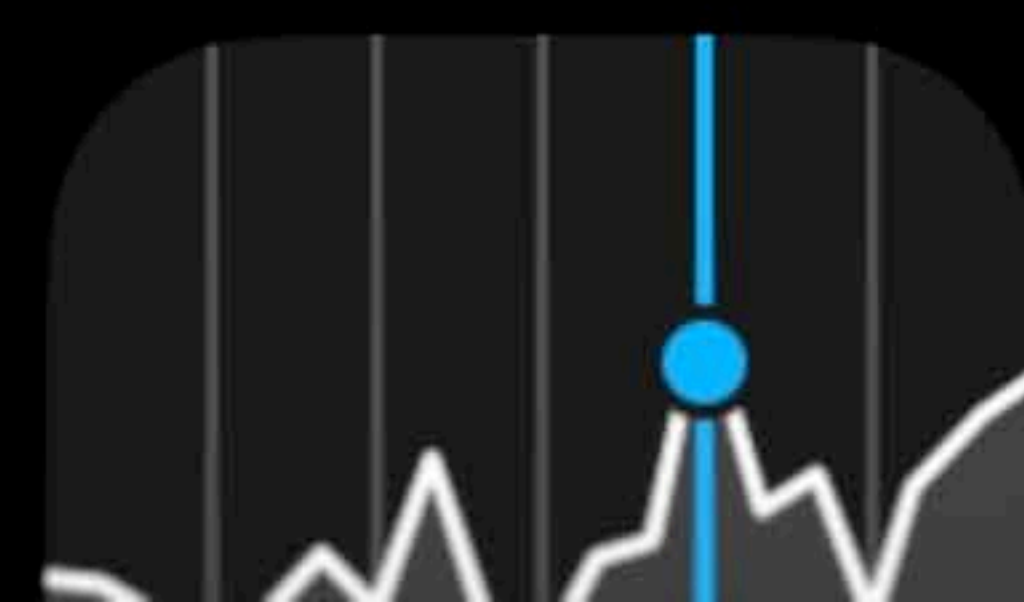
Clock



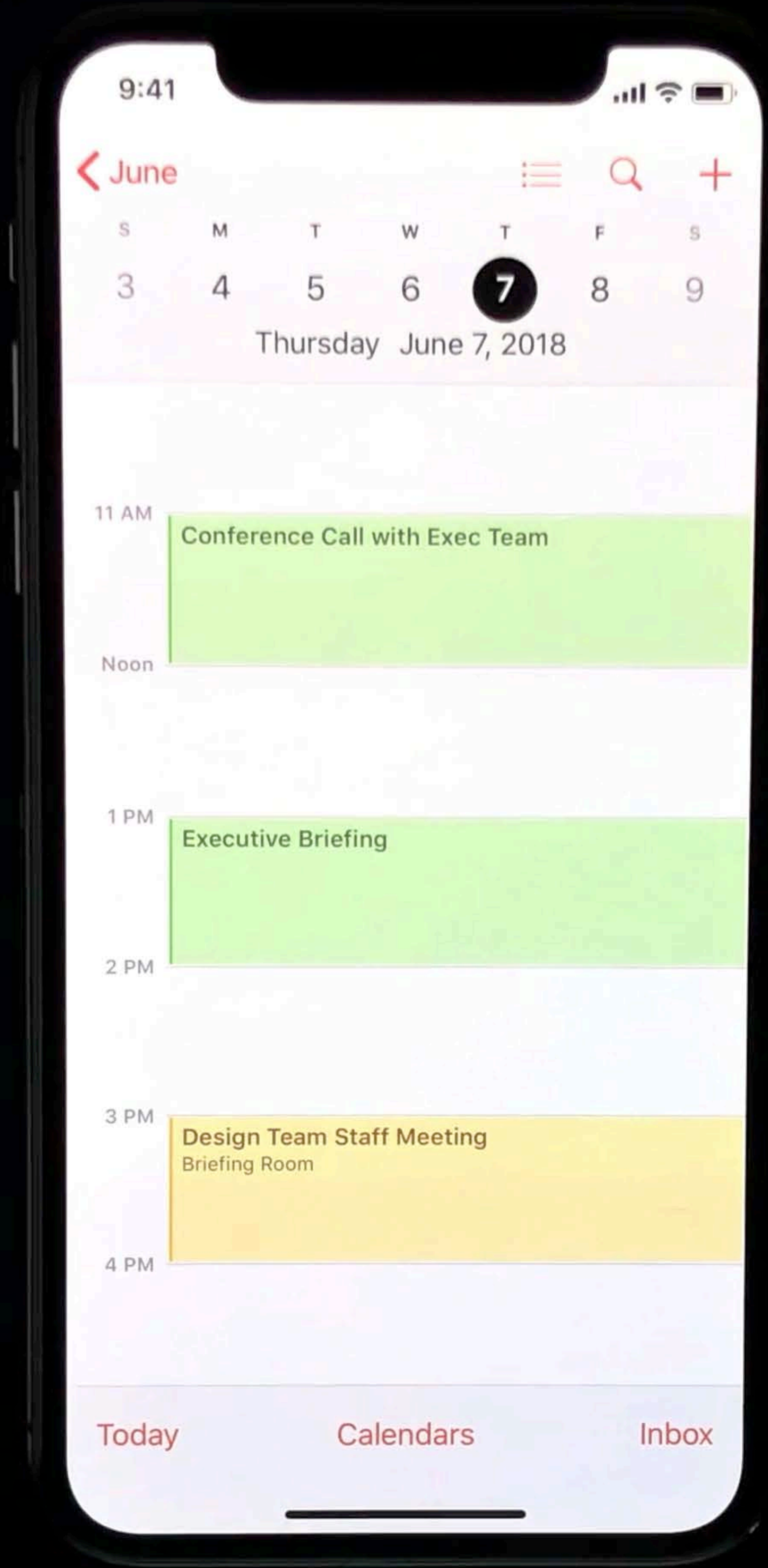
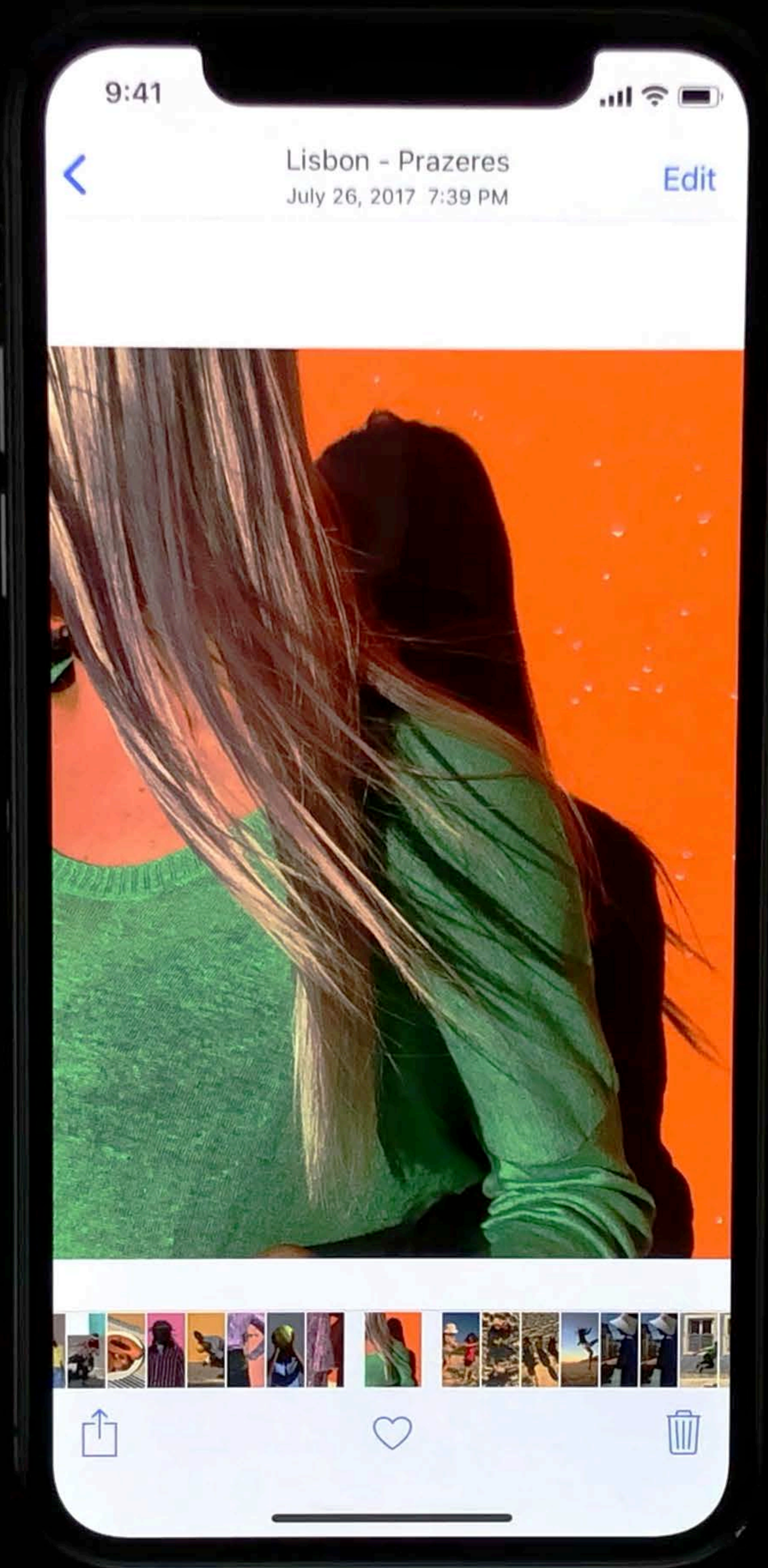
Weather



News



Work with *behavior*
rather than animation



Fluid Interfaces Think Like Us

Fluid Interfaces Think Like Us

Instant response and constant redirection

Fluid Interfaces Think Like Us

Instant response and constant redirection

Maintain spatial consistency

Fluid Interfaces Think Like Us

Instant response and constant redirection

Maintain spatial consistency

Hint in the direction of the gesture

Fluid Interfaces Think Like Us

Instant response and constant redirection

Maintain spatial consistency

Hint in the direction of the gesture

Lightweight interactions, amplified output

Fluid Interfaces Think Like Us

Instant response and constant redirection

Maintain spatial consistency

Hint in the direction of the gesture

Lightweight interactions, amplified output

Soft boundaries and transitions

Fluid Interfaces Think Like Us

Instant response and constant redirection

Maintain spatial consistency

Hint in the direction of the gesture

Lightweight interactions, amplified output

Soft boundaries and transitions

Design smooth, dynamic behavior

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Timed animations

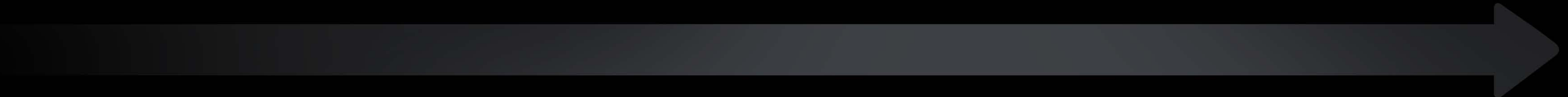
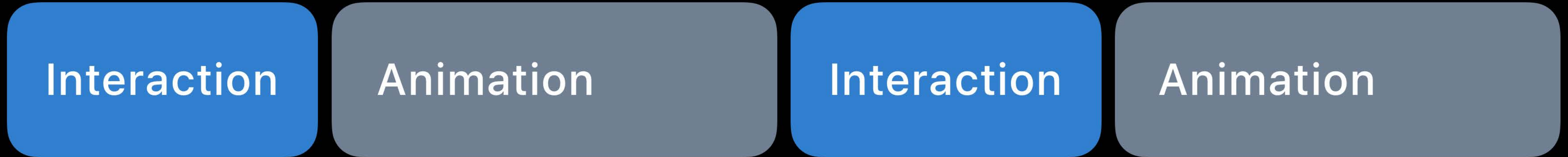
Interactions result in *discrete animations*

Interaction

Animation

Interaction

Animation



Dynamic motion

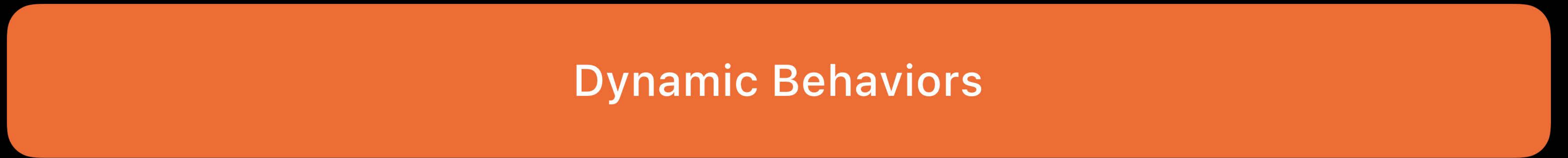
Interactions influence continuous *dynamic behaviors*

Interaction

Interaction

Interaction

Dynamic Behaviors



Designing with Dynamic Motion

Designing with Dynamic Motion

Seamless motion

Designing with Dynamic Motion

Seamless motion

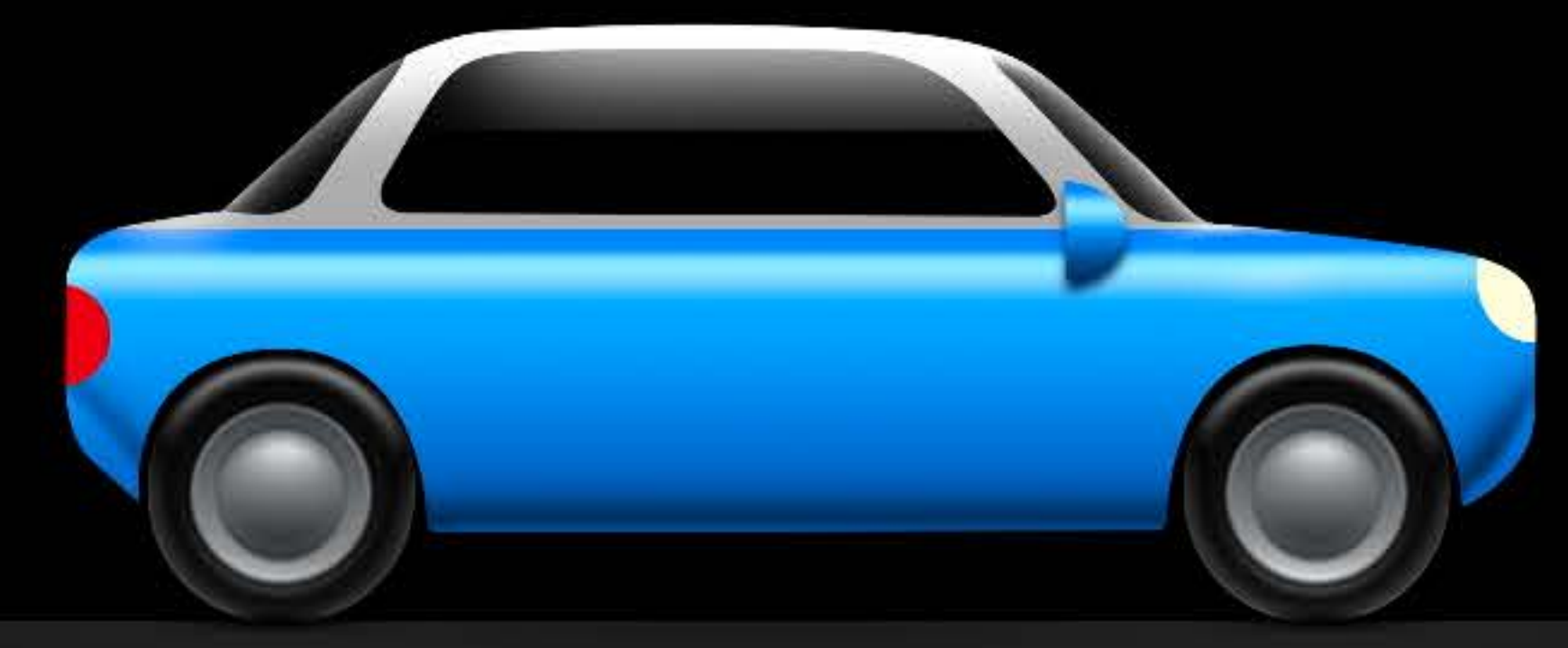
Crafting a character

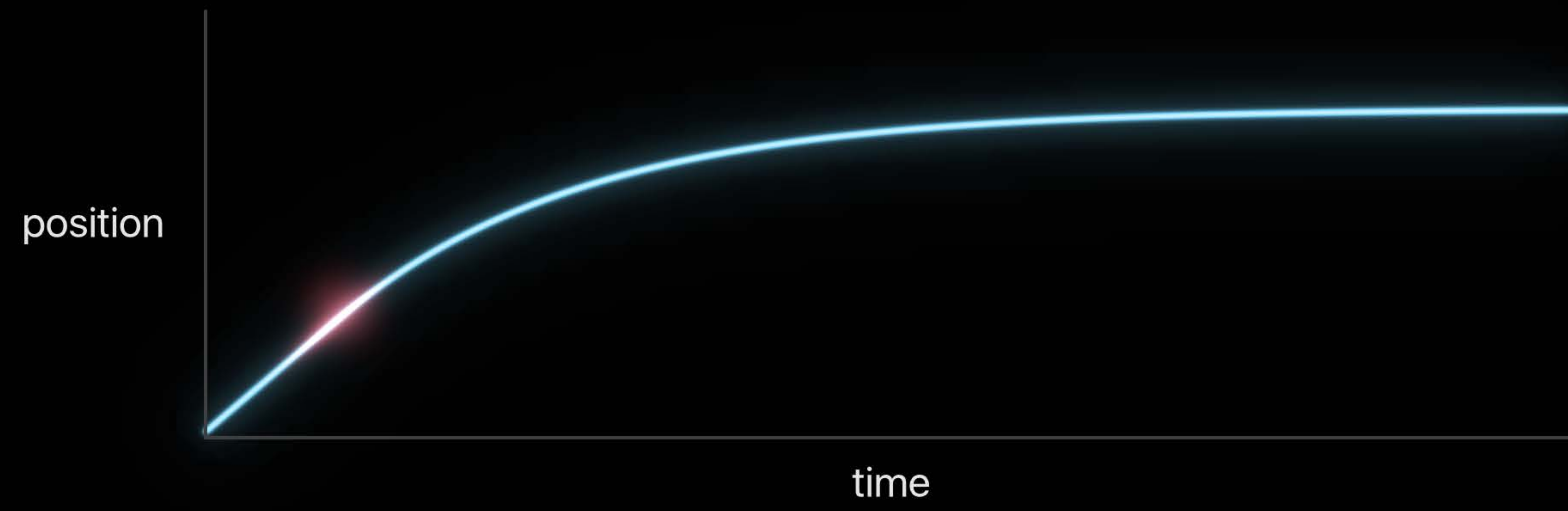
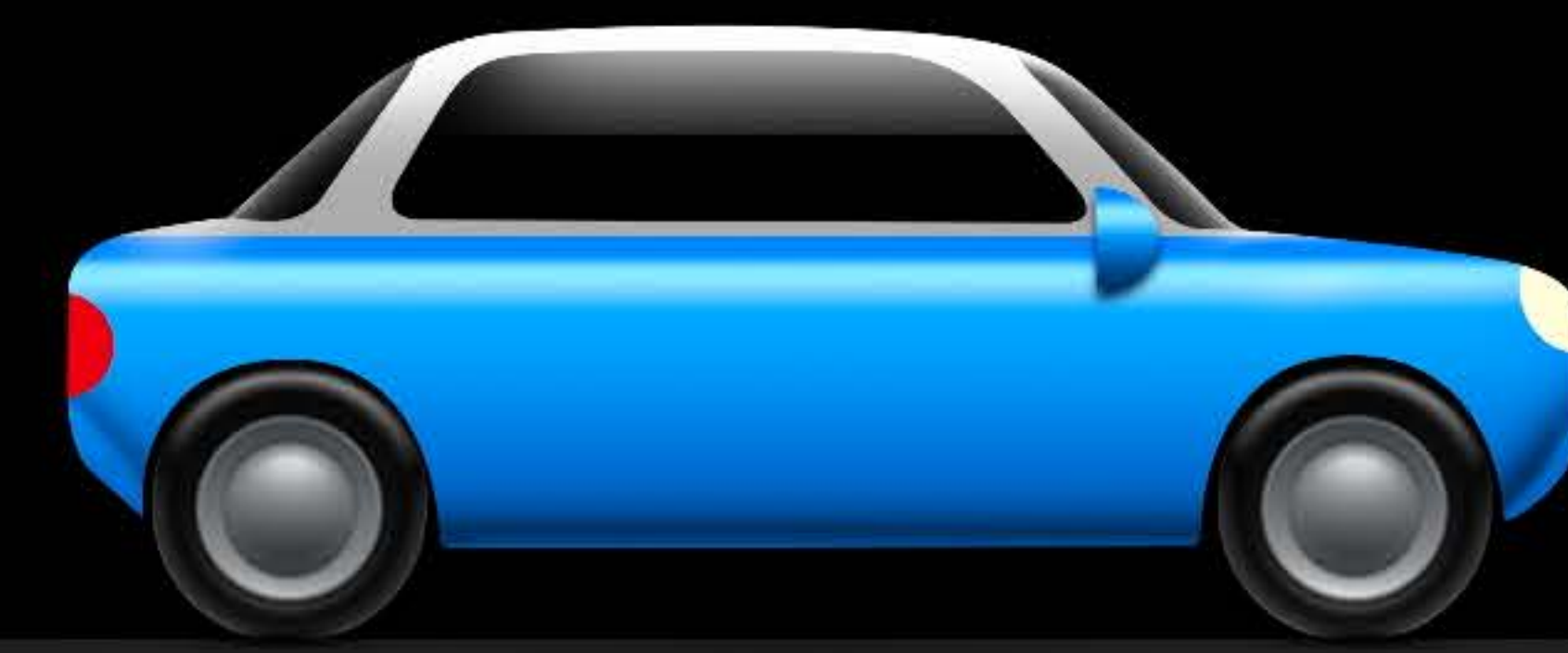
Designing with Dynamic Motion

Seamless motion

Crafting a character

Understanding intent





Characteristics of the physical world
make great behaviors



9:41



< May



S M T W T F S
20 21 22 23 24 25 26

Sunday, May 20, 2018

Favorites

Mindful Minutes **3 min**
Today at 8:02 AM

Sleep Analysis **7 h 37 m**
Today at 7:50 AM

Activity

Activity Today at 4:32 PM



Move **1,035/800CAL**
Exercise **42/30MIN** Stand **9/12HRS**

Resting Energy **2,161 kcal**
Today at 5:04 PM

Stand Hours **9 hr**
Today at 5:00 PM



Today



Health Data



Sources

Me

Seamless Scrolling

Seamless Scrolling

Familiar, natural motion

Seamless Scrolling

Familiar, natural motion

Maintains throw momentum

Seamless Scrolling

Familiar, natural motion

Maintains throw momentum

Friction gracefully reduces speed

Seamless Scrolling

Familiar, natural motion

Maintains throw momentum

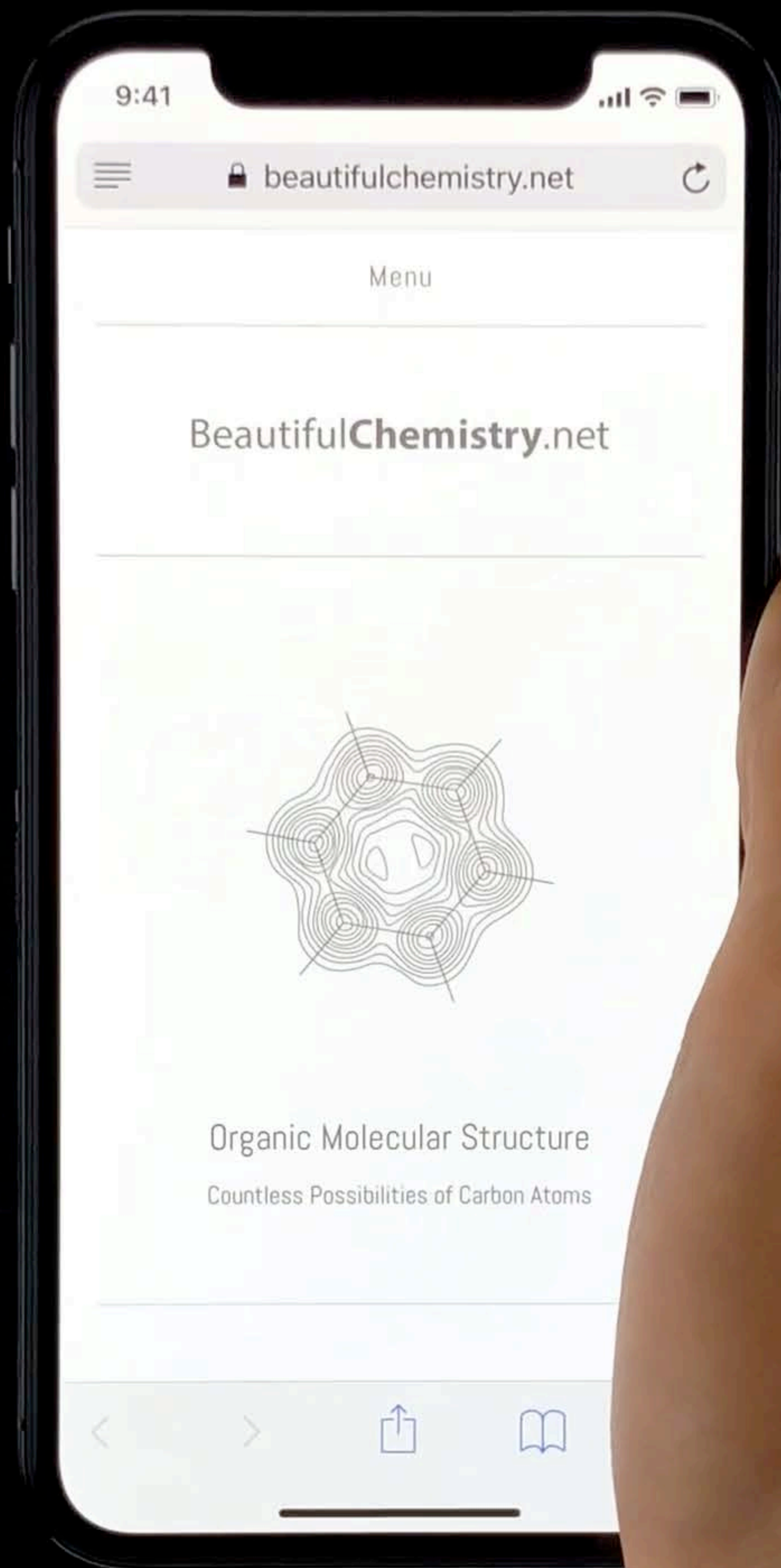
Friction gracefully reduces speed

Imperceptibly comes to rest

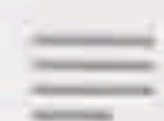








9:41

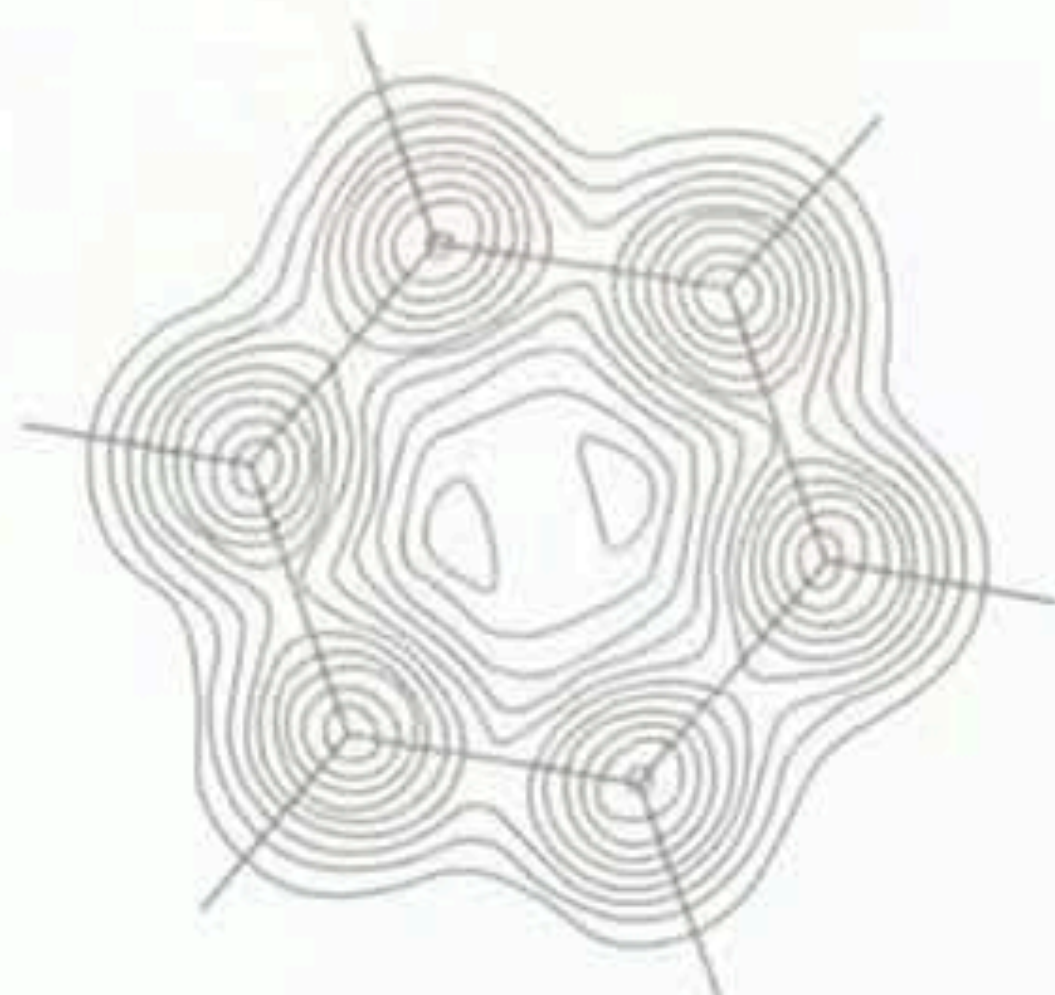


beautifulchemistry.net



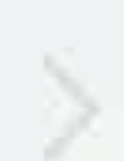
Menu

Beautiful**Chemistry**.net

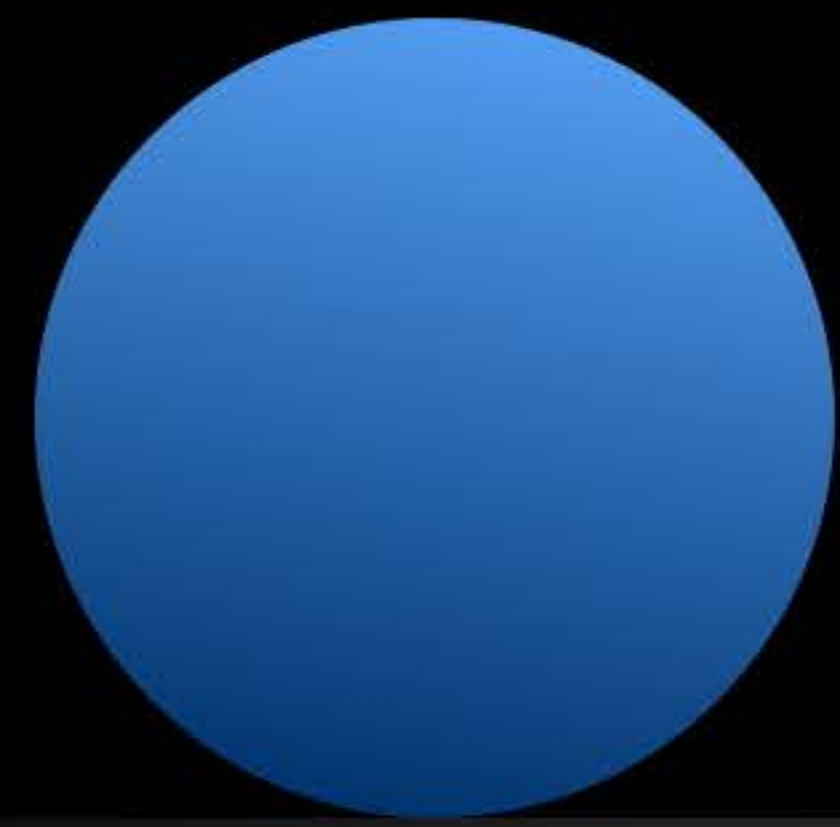


Organic Molecular Structure

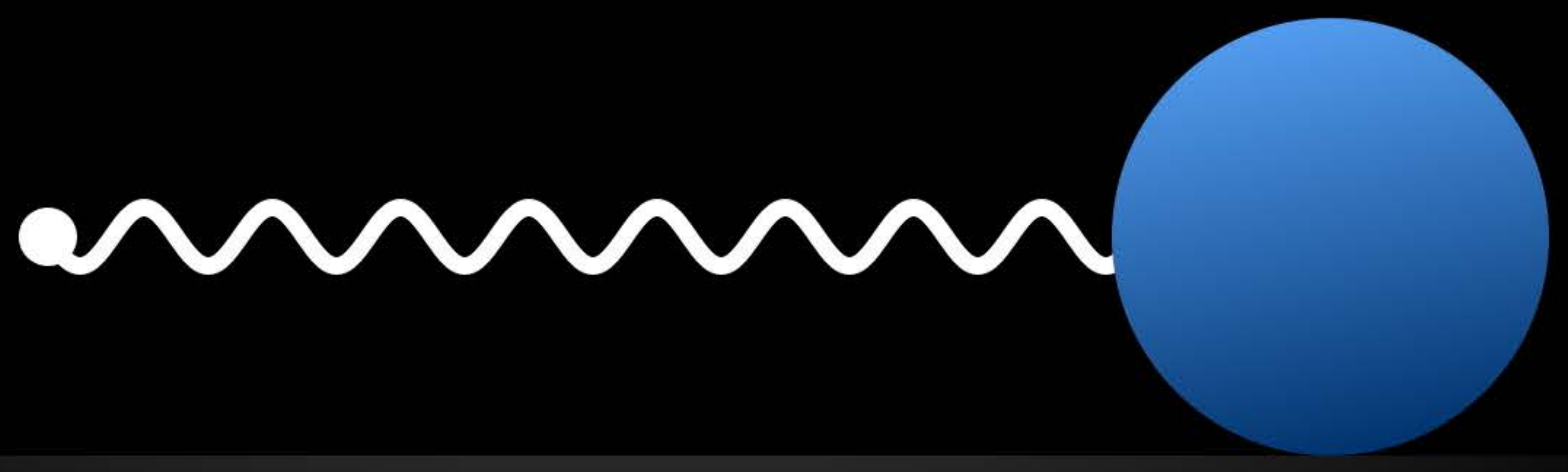
Countless Possibilities of Carbon Atoms



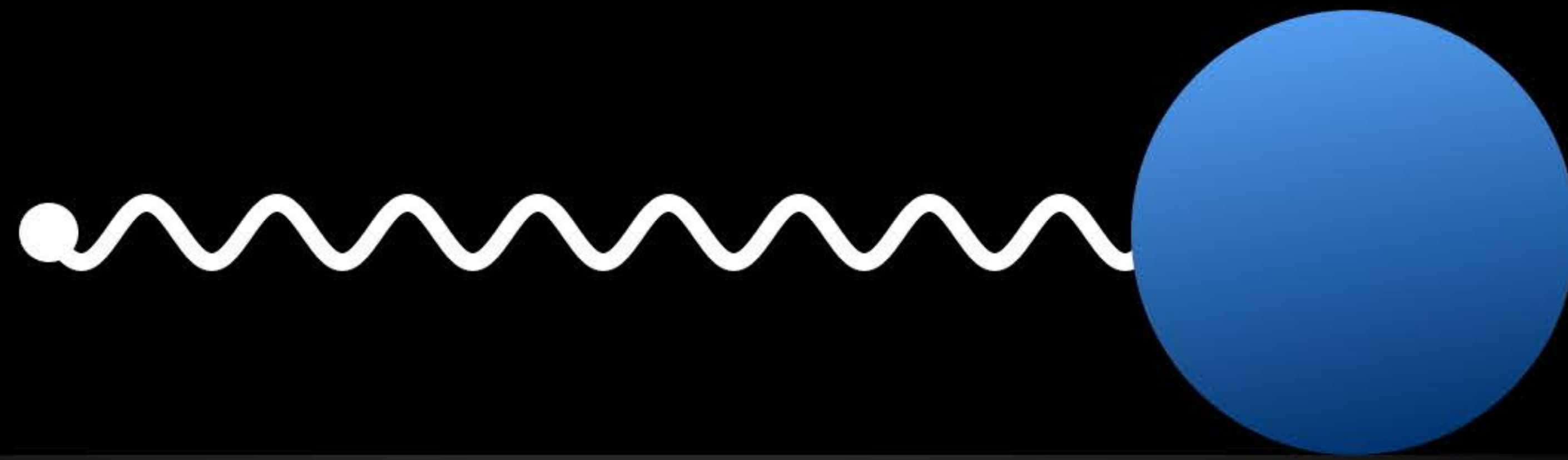
REST POSITION



REST POSITION

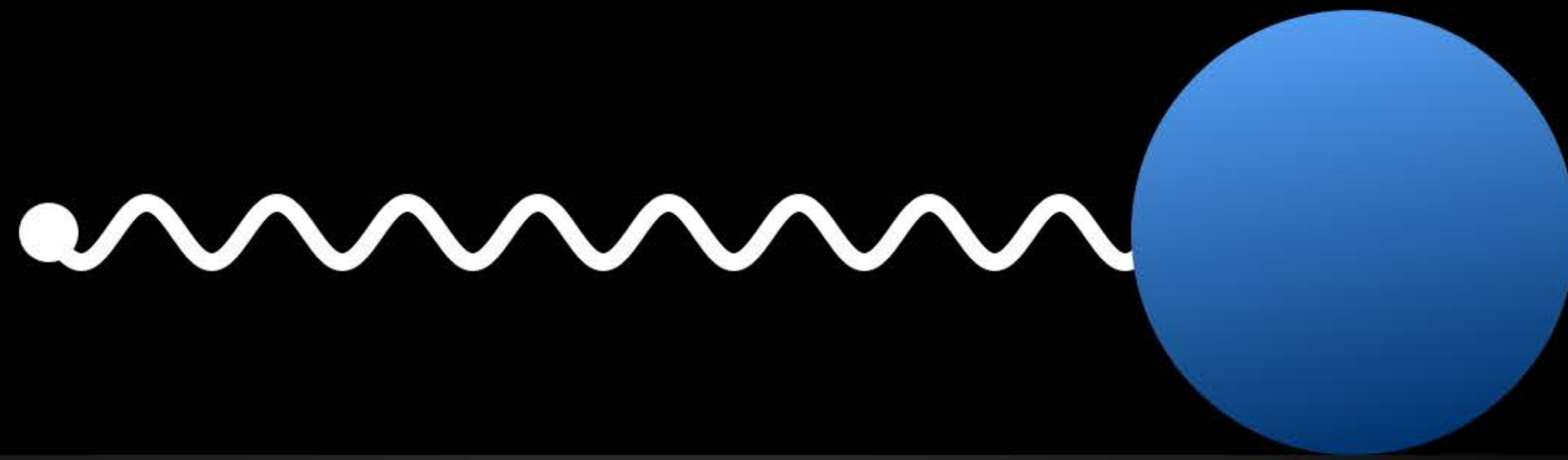


TARGET



CURRENT

TARGET

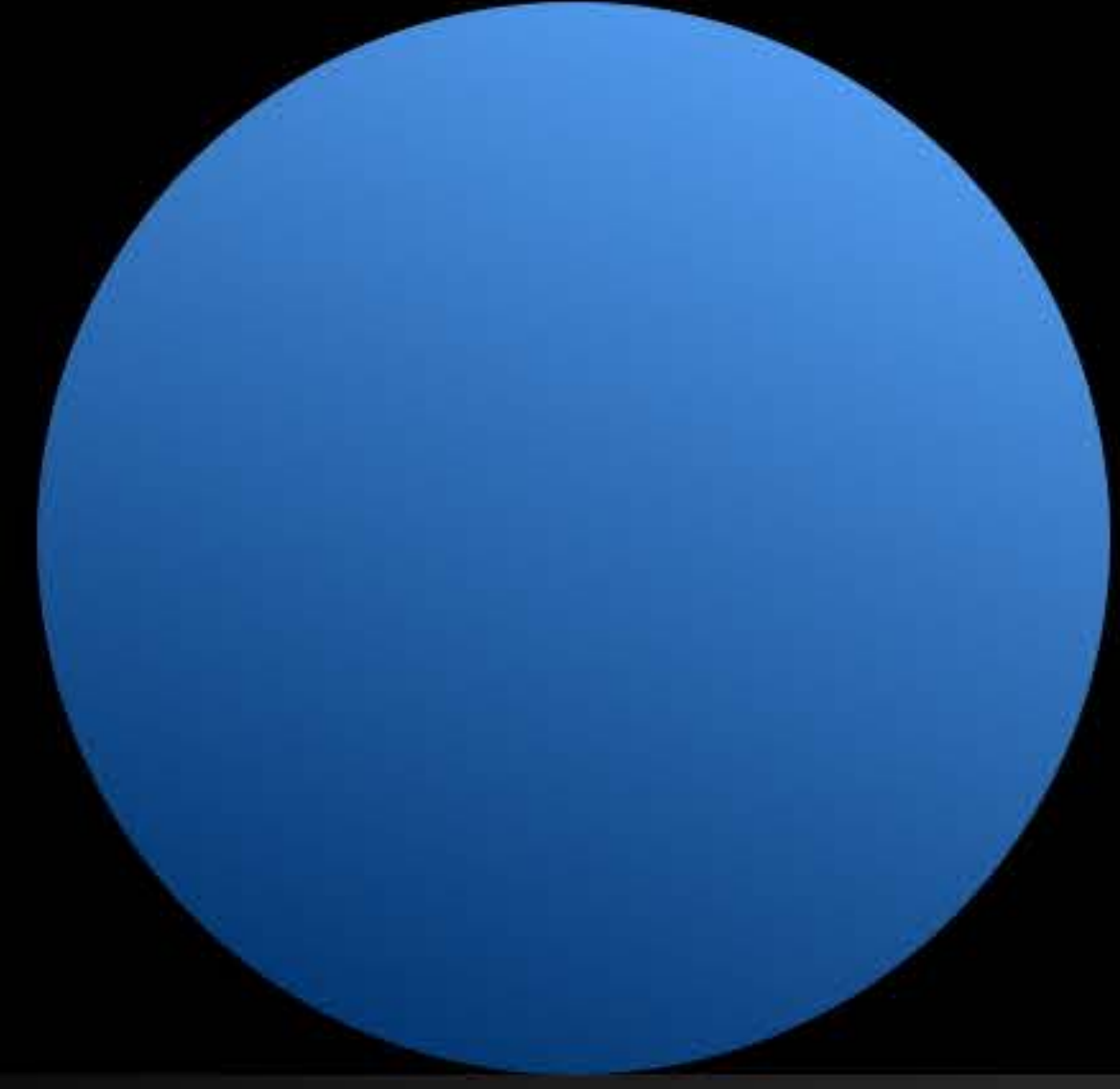


CURRENT

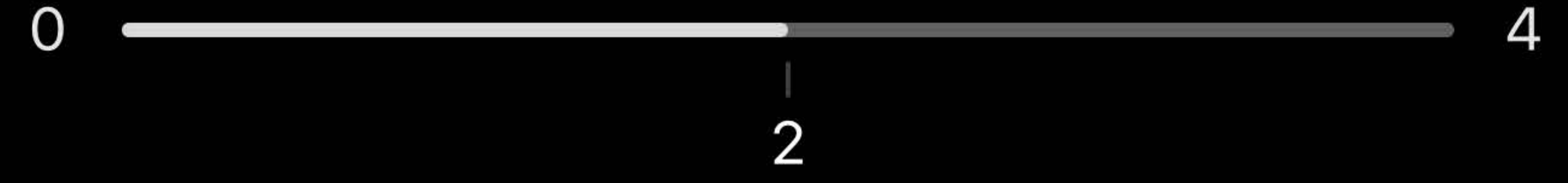
TARGET



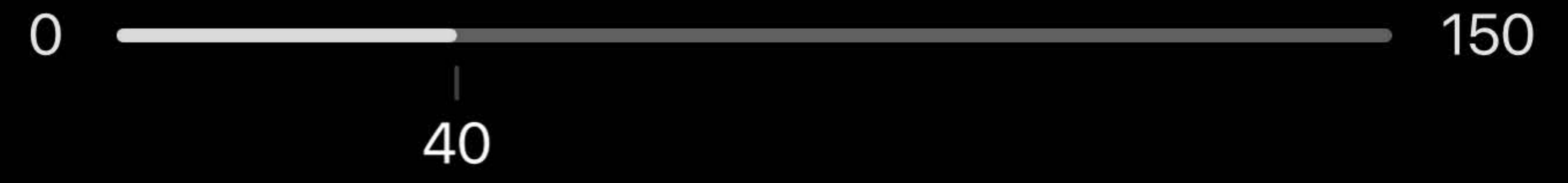
CURRENT



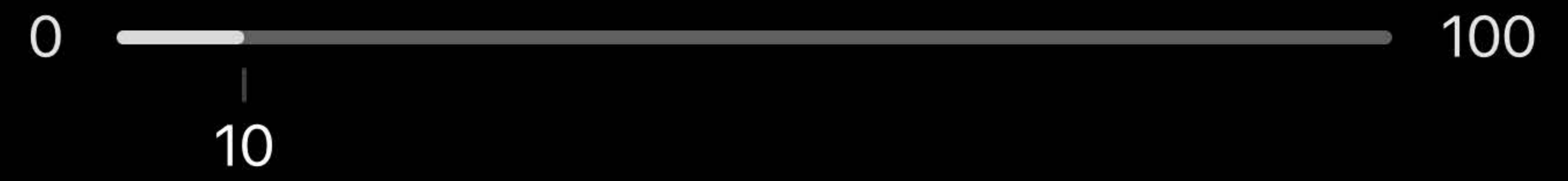
MASS

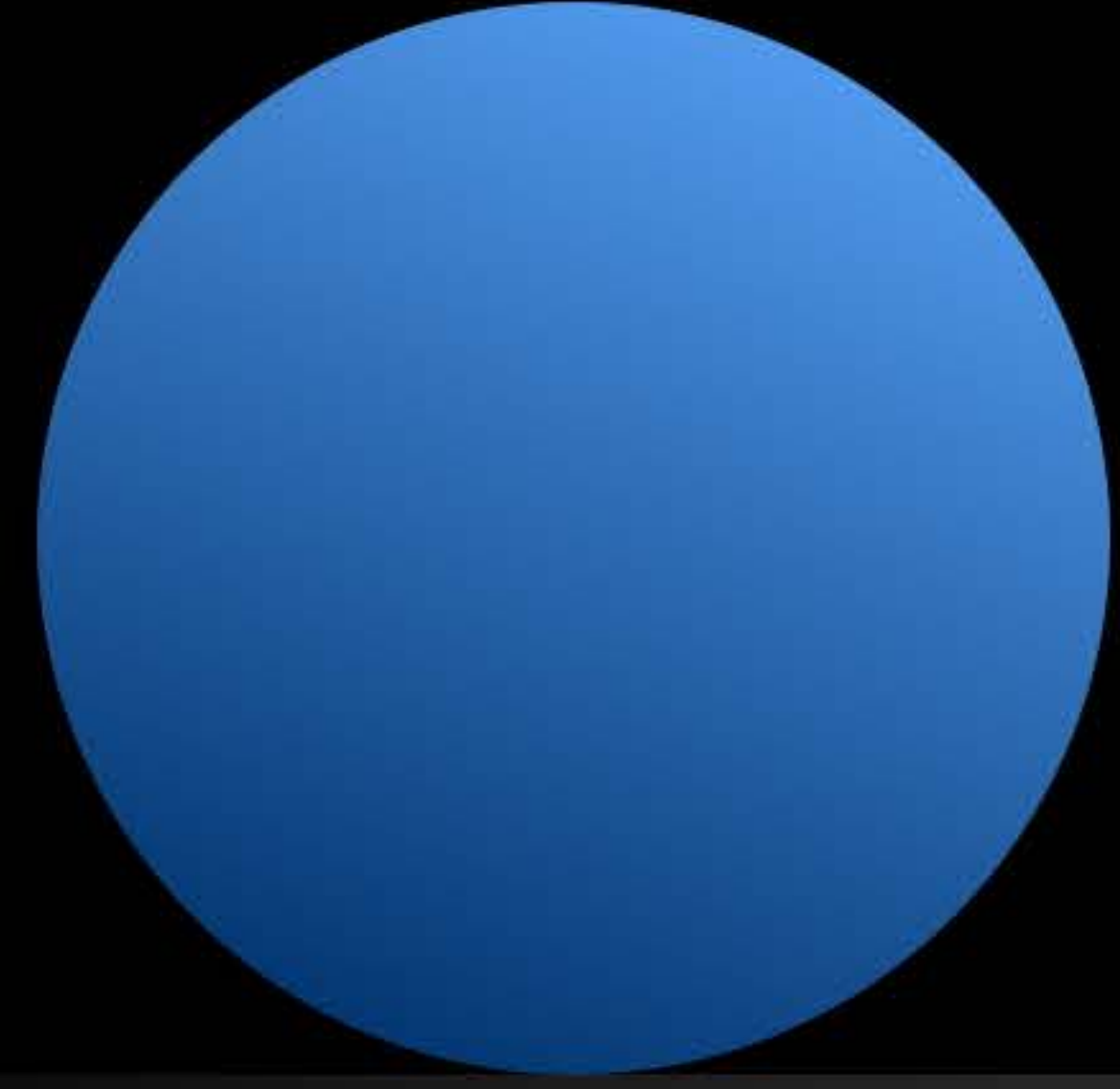


STIFFNESS

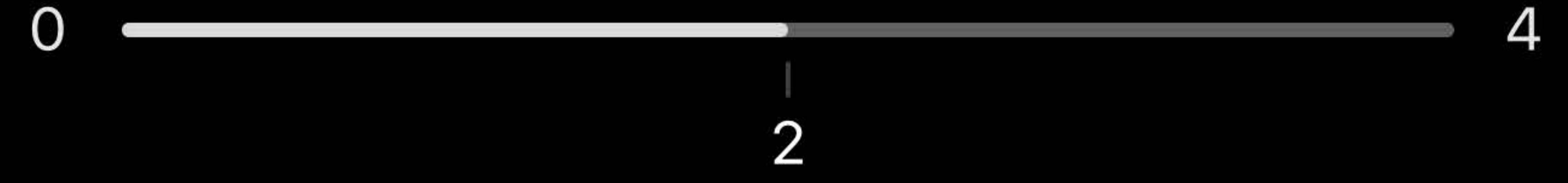


DAMPING

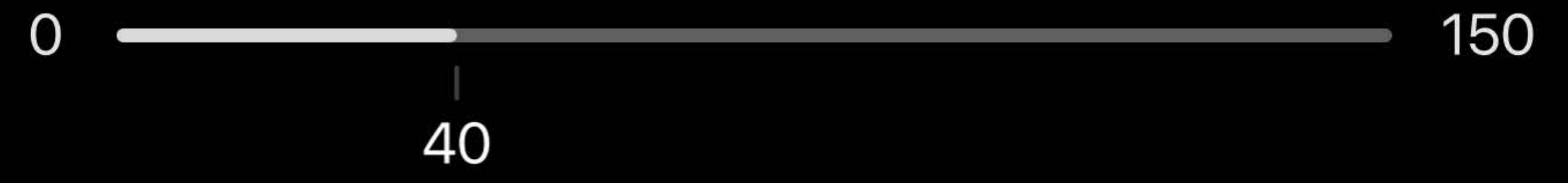




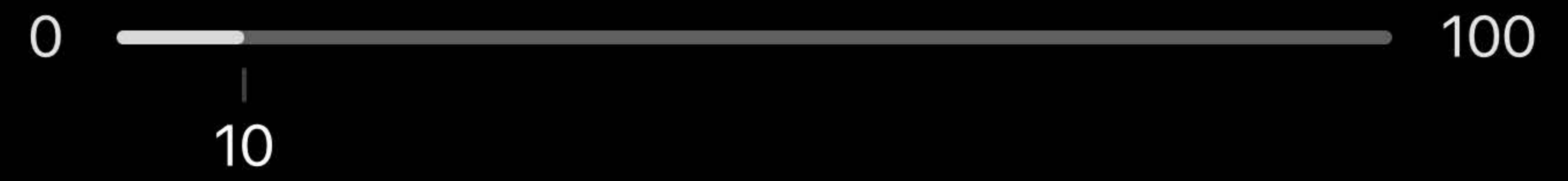
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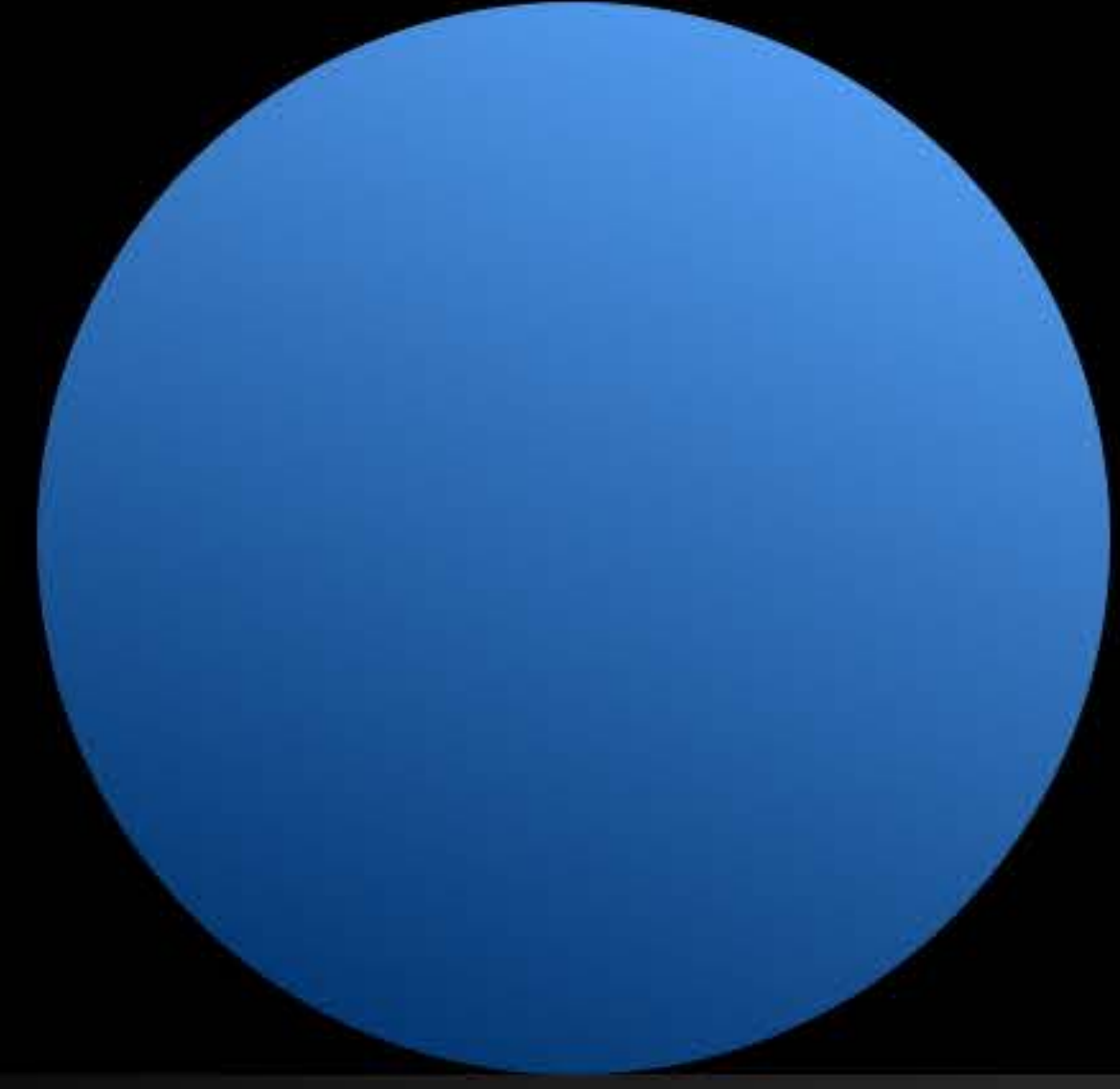


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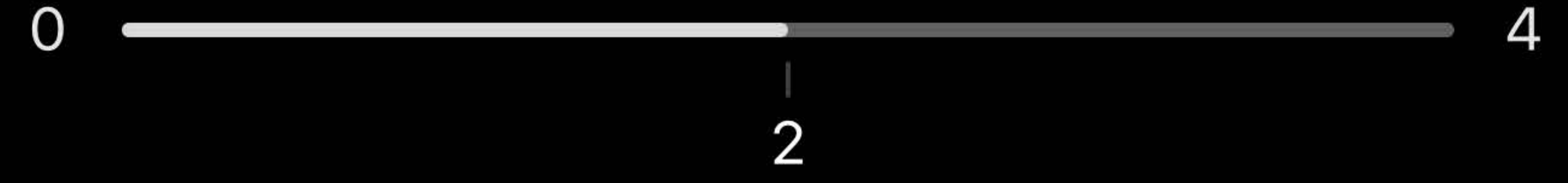


DAMPING





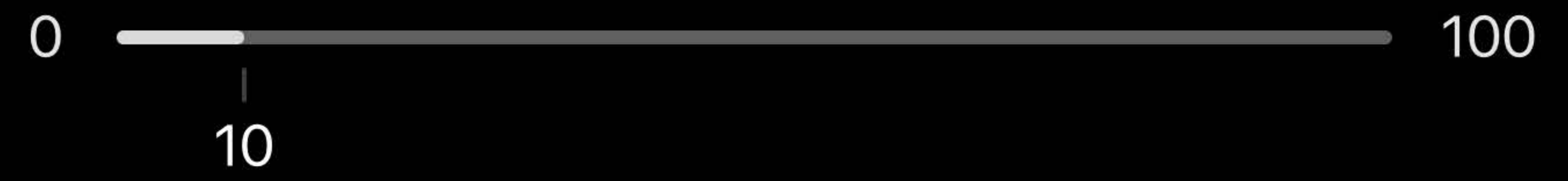
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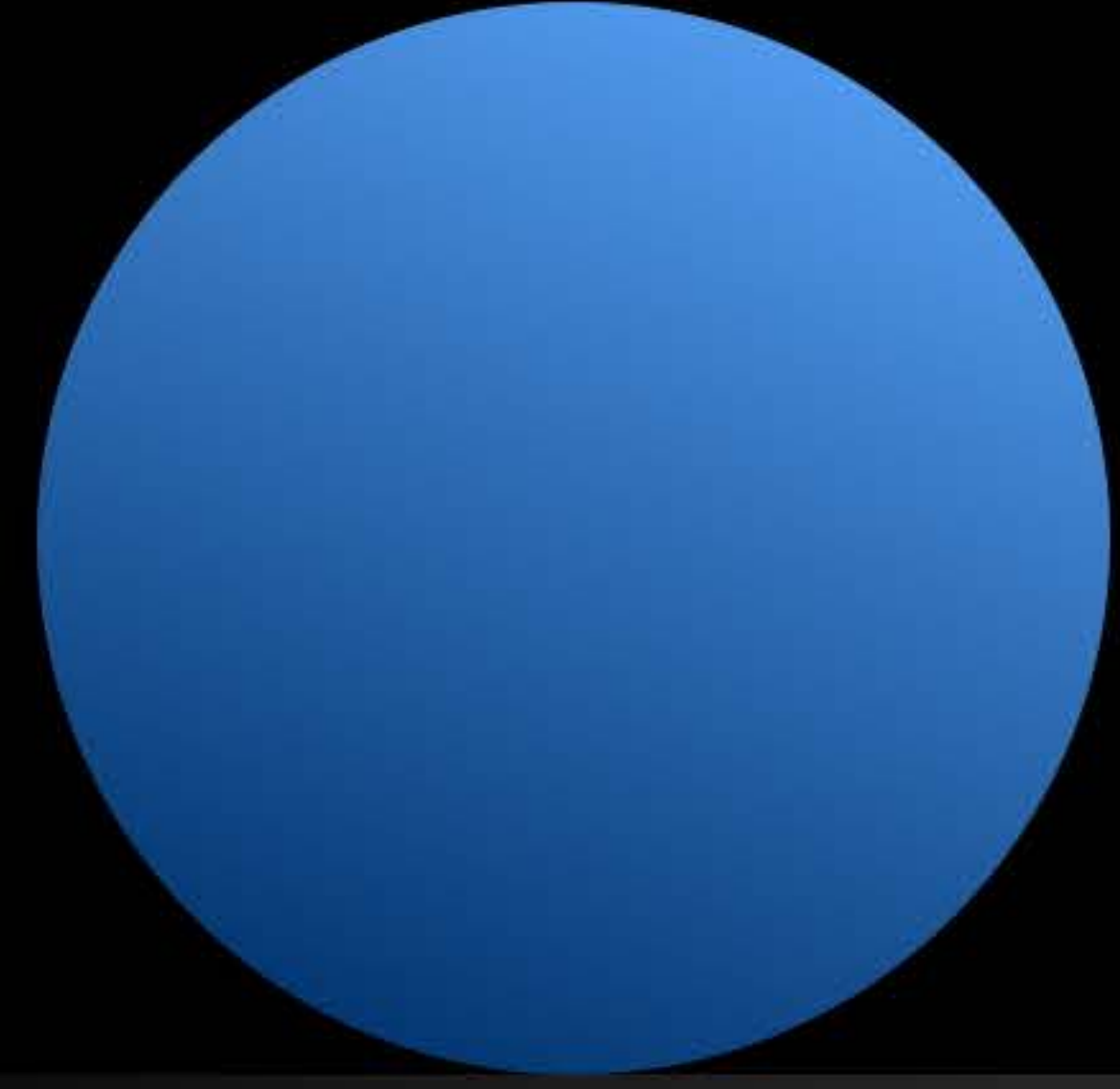


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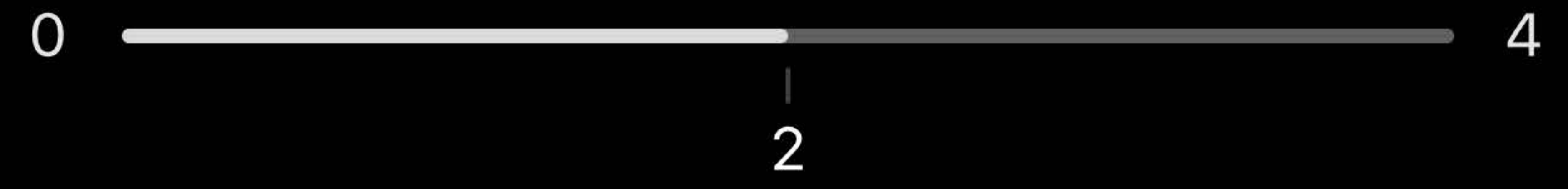


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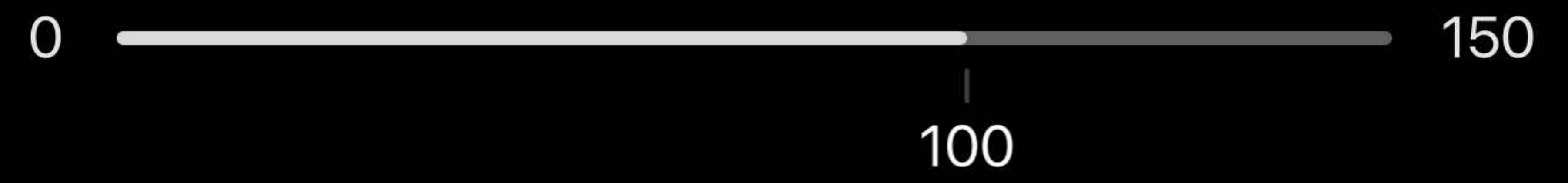




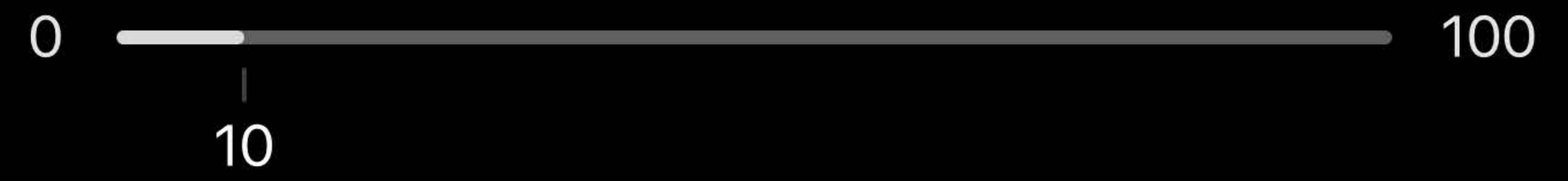
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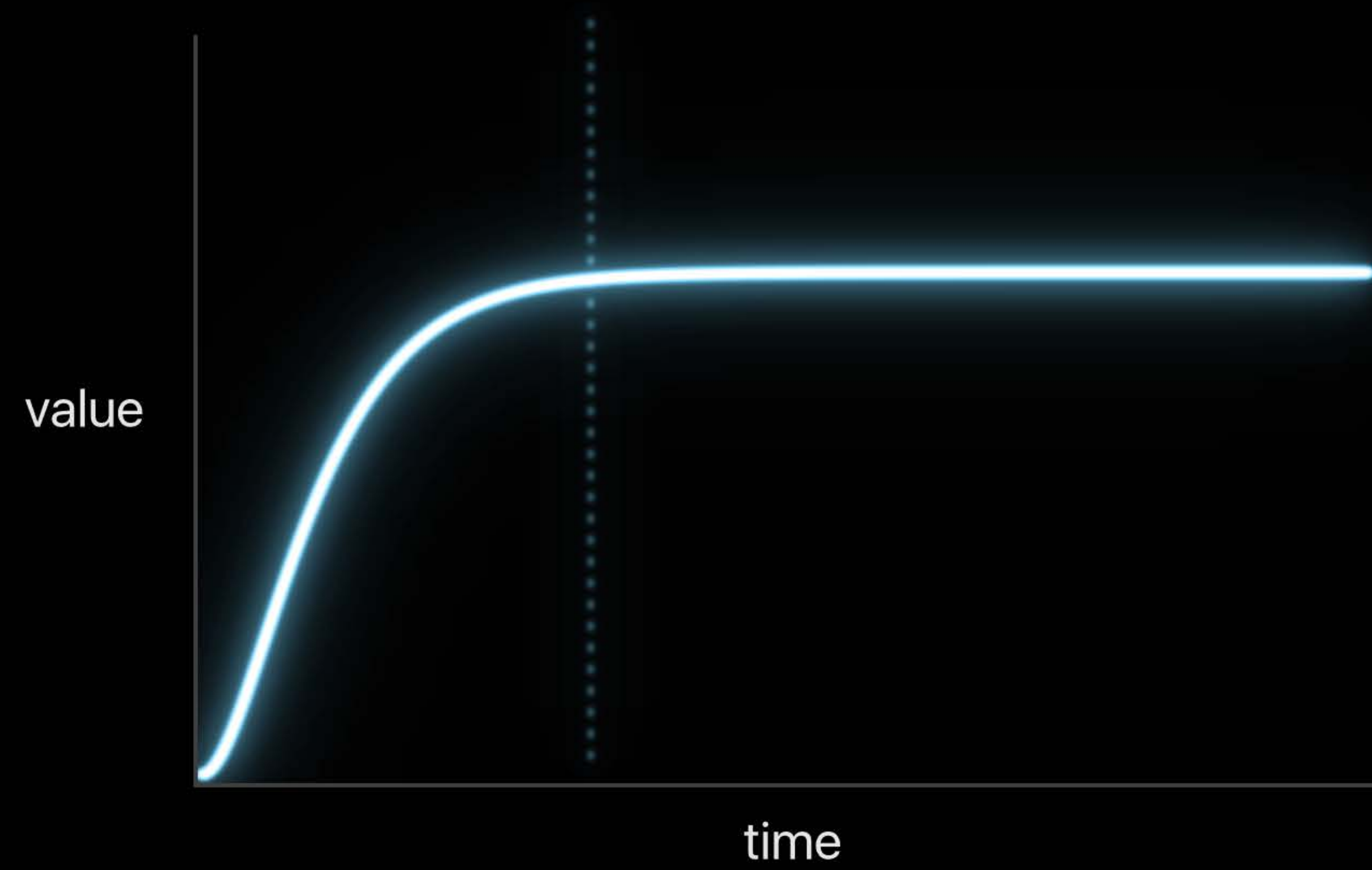


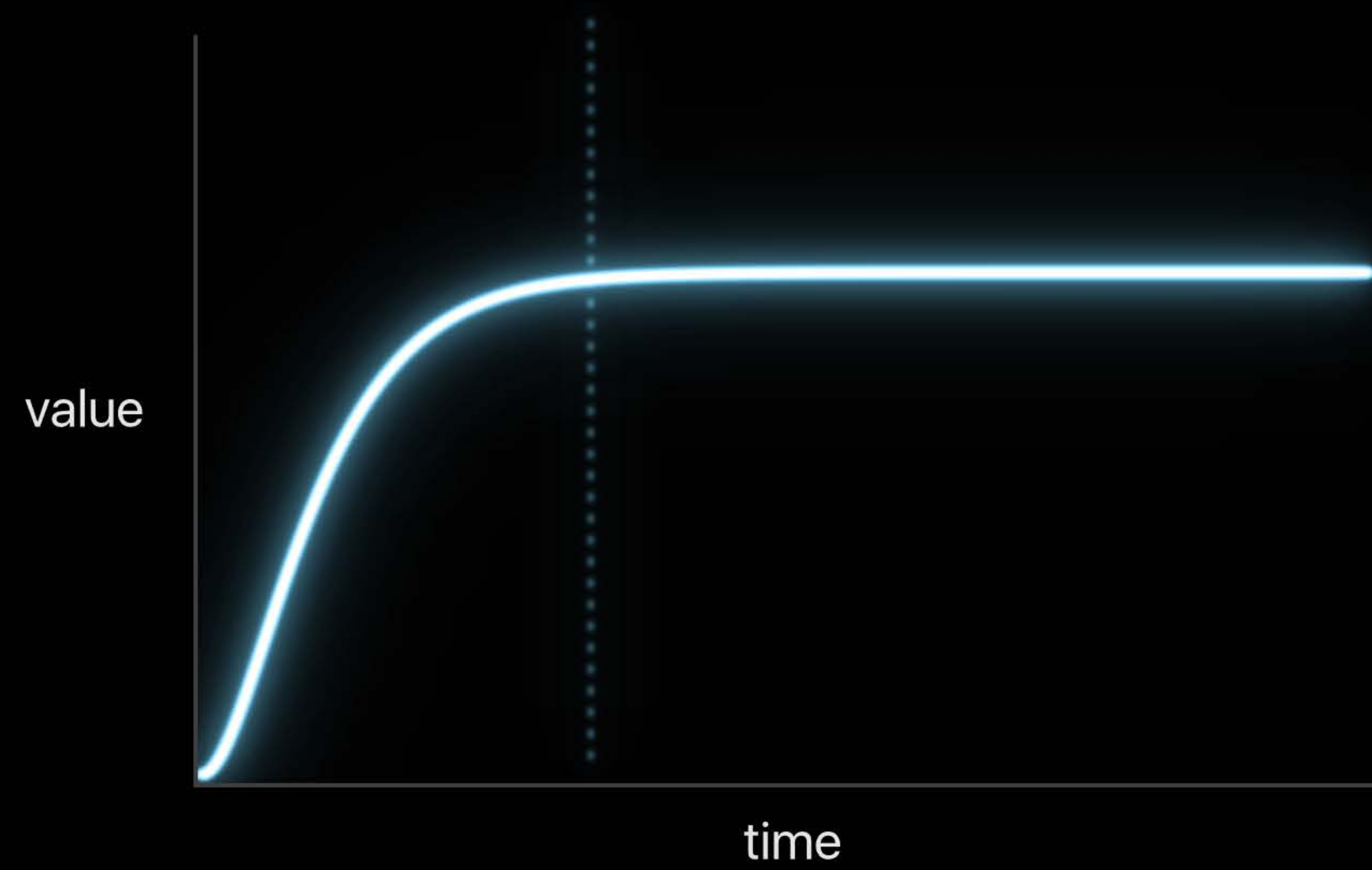
STIFFNESS

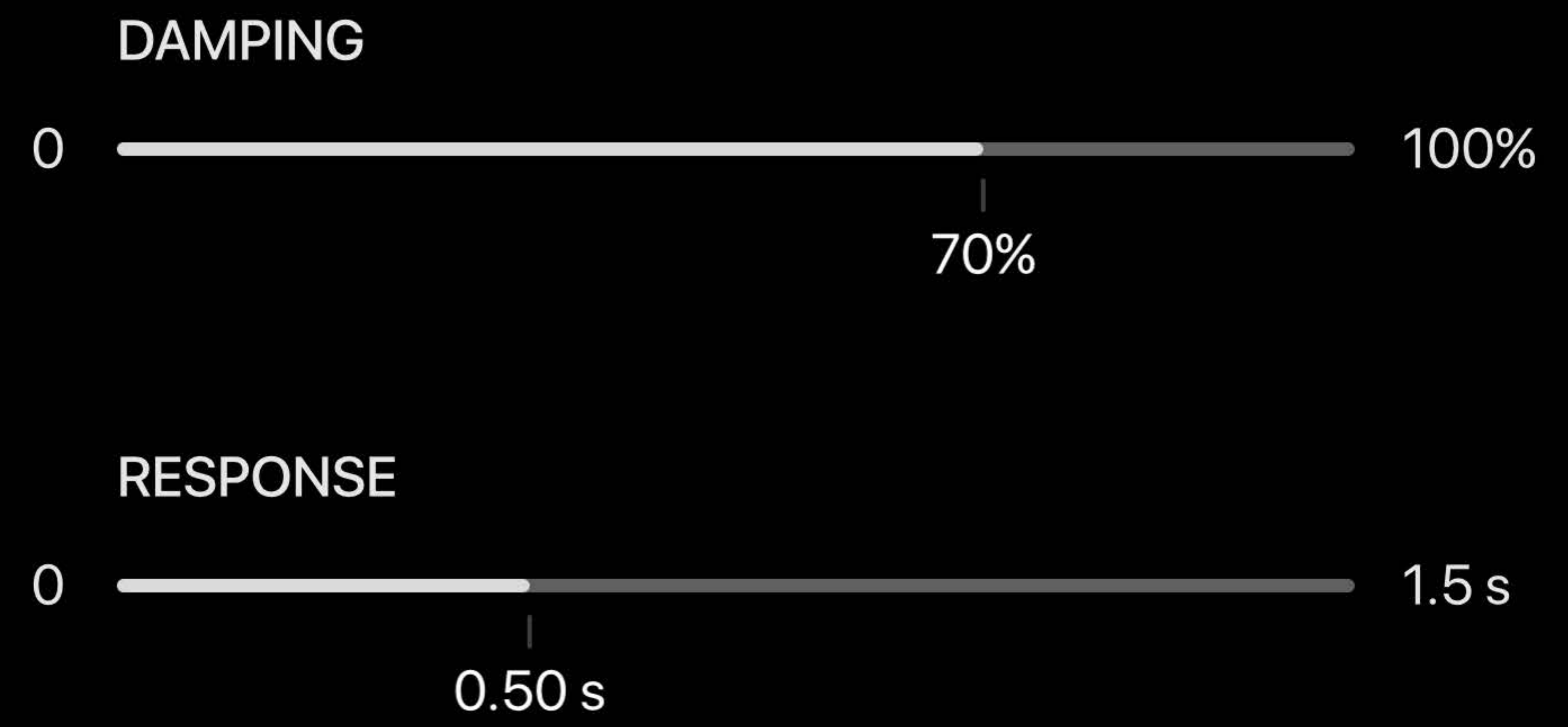
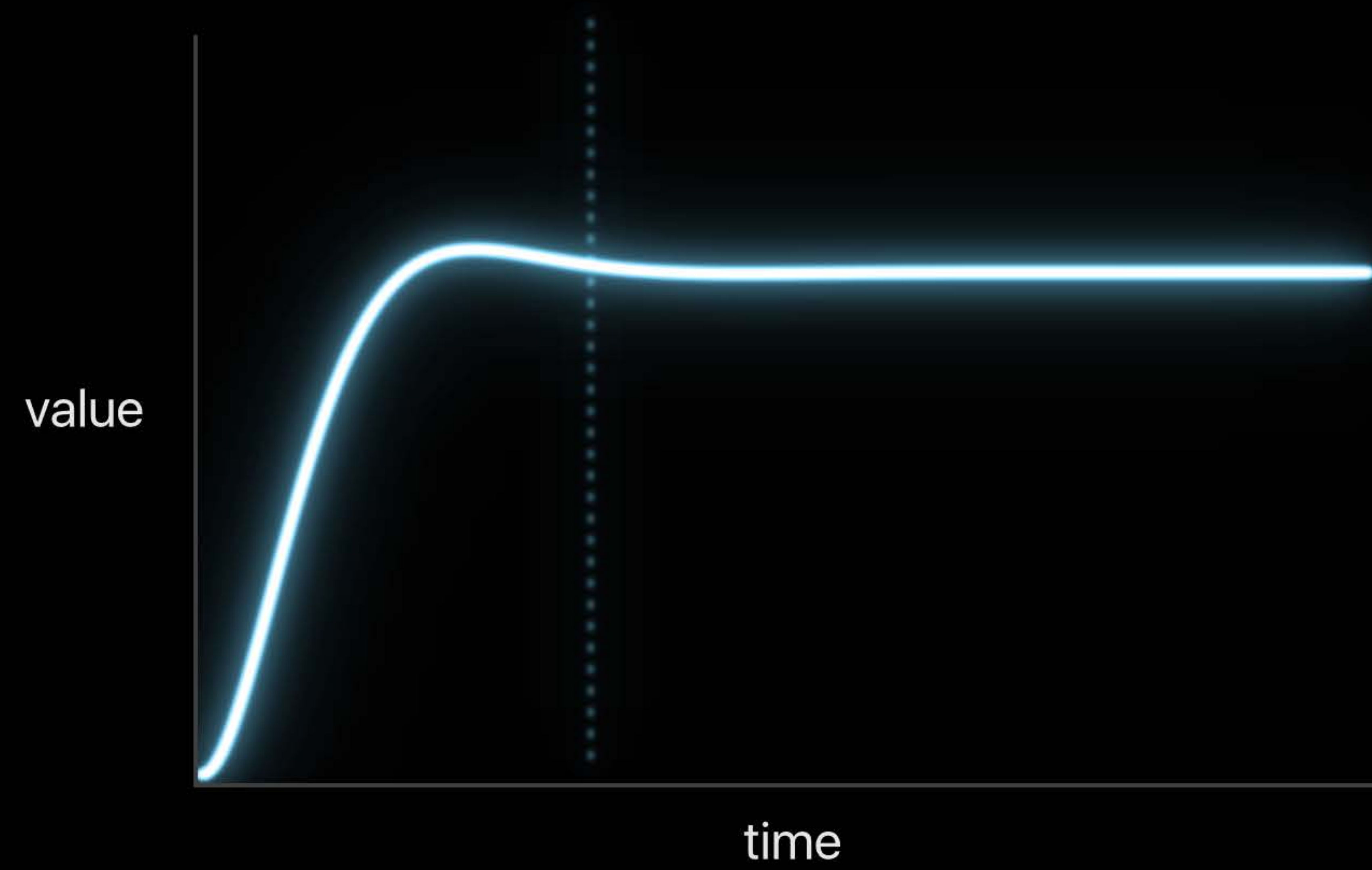


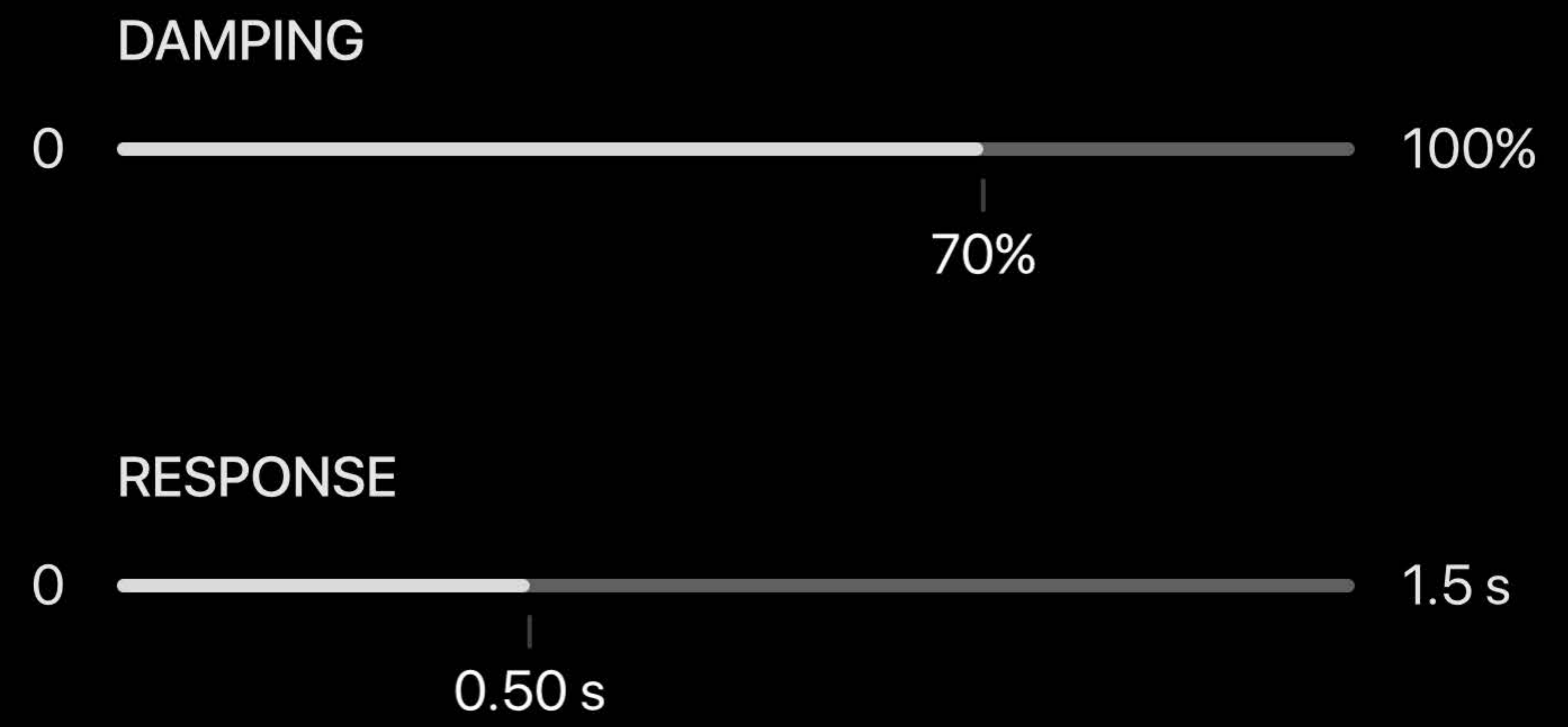
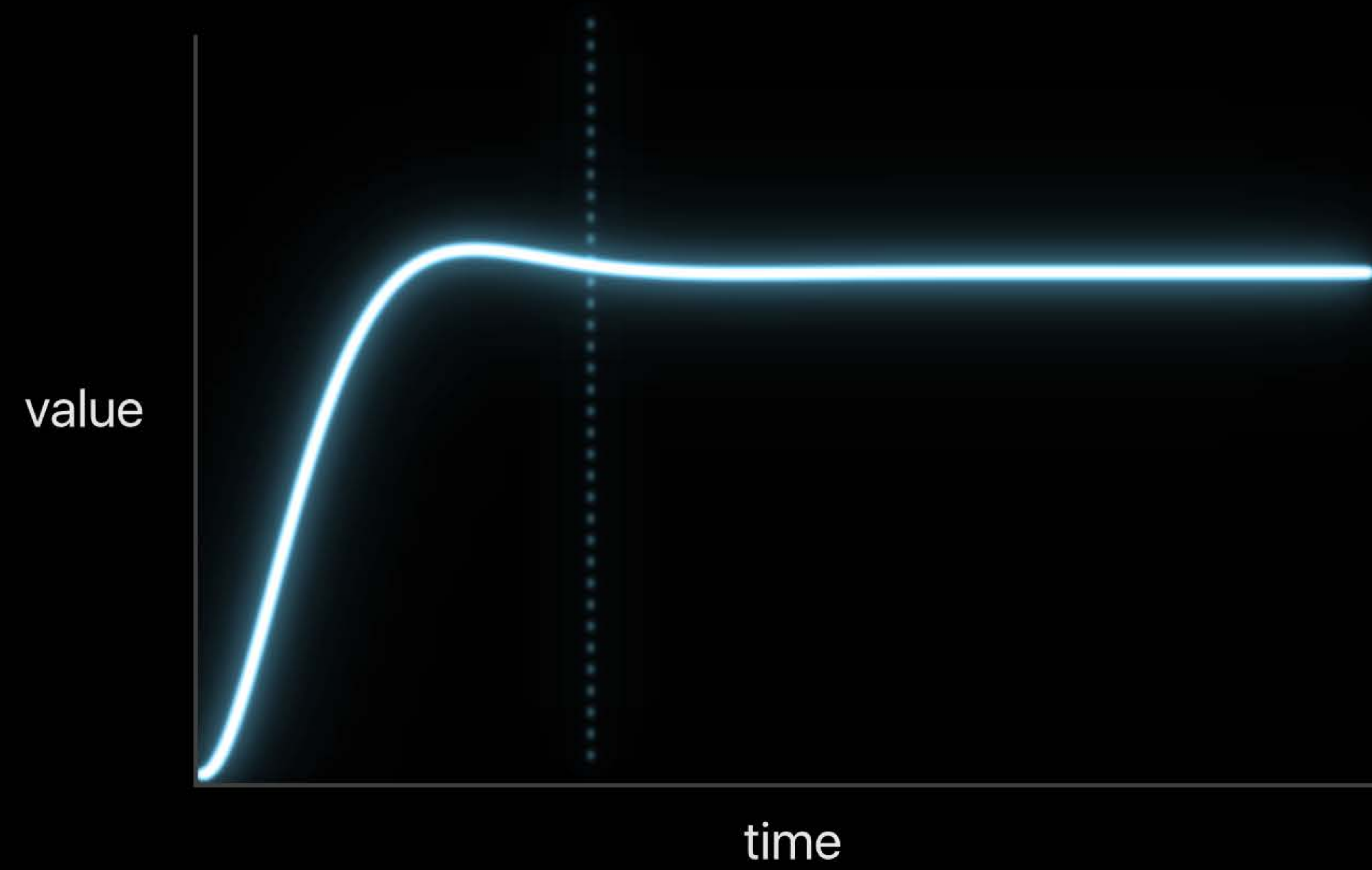
DAMPING















9:41



Ros de Vries

To: Nathan Cc: Cory & 10 more... Details



Let's celebrate my 35th!

Today at 10:30AM

Hi everyone,

We're well overdue for a camping trip to Big Sur, and I'd love to head there with you all for my birthday on the 24th of September!

I'm going to book a group campsite, so let me know if you're free 😊

Love,
Ros



9:41



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To: Nathan Cc: Cory & 10 more... Details



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Love,
Ros



9:41



WEDNESDAY, MAY 30

For You



MUSIC
Favorites Mix
Updated Yesterday

Friends Are Listening To

[See All](#)



Pure Party
Apple Music



The Shape That Lies...
Meaning Machine



Before Paris



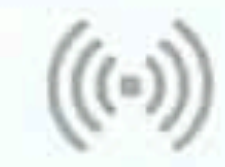
Library



For You



Browse



Radio



Search

9:41



WEDNESDAY, MAY 30

For You



MUSIC

Favorites Mix

Updated Yesterday

Friends Are Listening To

[See All](#)

MUSIC

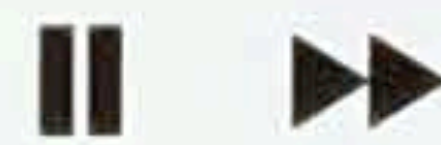
PURE PARTY

Pure Party
Apple Music

The Shape That Lies...
Meaning Machine



Before Paris



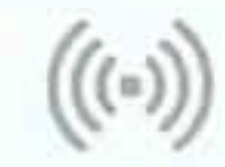
Library



For You



Browse



Radio



Search

9:41



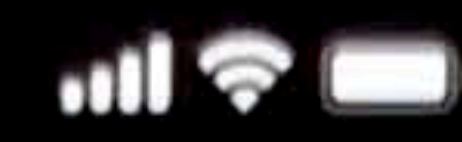
0:18

-2:11

Before Paris
Tom Misch — *Geography*



9:41



0:18

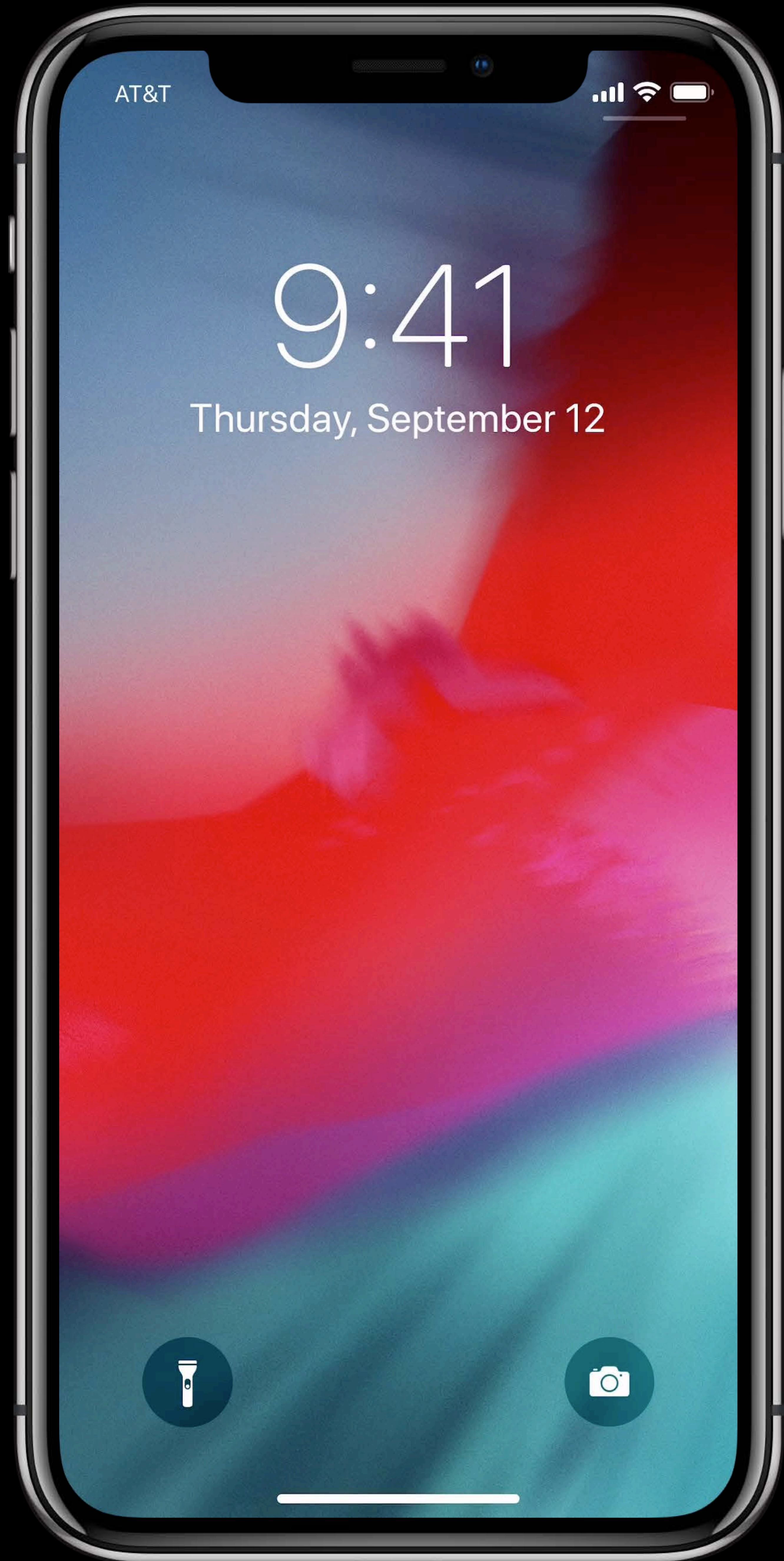
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Before Paris
Tom Misch — *Geography*



Bounciness can hint

Bounciness can hint



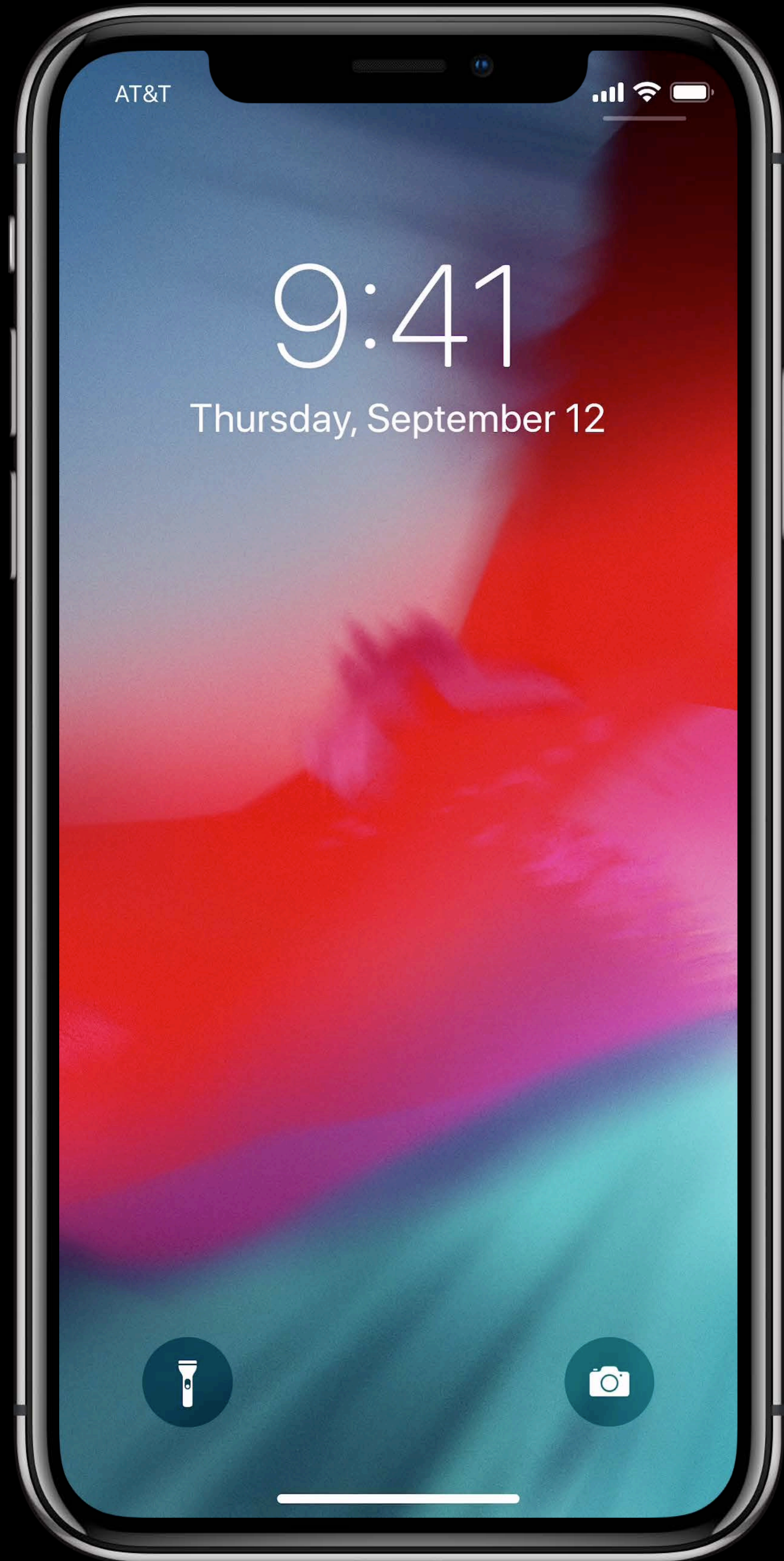
AT&T



9:41

Thursday, September 12





AT&T



9:41

Thursday, September 12











Think **beyond** motion

Tue Feb 06 8 56
Wed Feb 07 9 57
Thu Feb 08 10 58
Fri Feb 09 11 59

Sat Feb 10 12 00 AM

Sun Feb 11 1 01 PM
Mon Feb 12 2 02
Tue Feb 13 3 03
Wed Feb 14 4 04

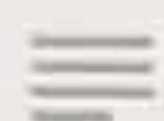
Tue Feb 06 8 56
Wed Feb 07 9 57
Thu Feb 08 10 58
Fri Feb 09 11 59

Sat Feb 10 12 00 AM

Sun Feb 11 1 01 PM
Mon Feb 12 2 02
Tue Feb 13 3 03
Wed Feb 14 4 04

Stay in character

9:41

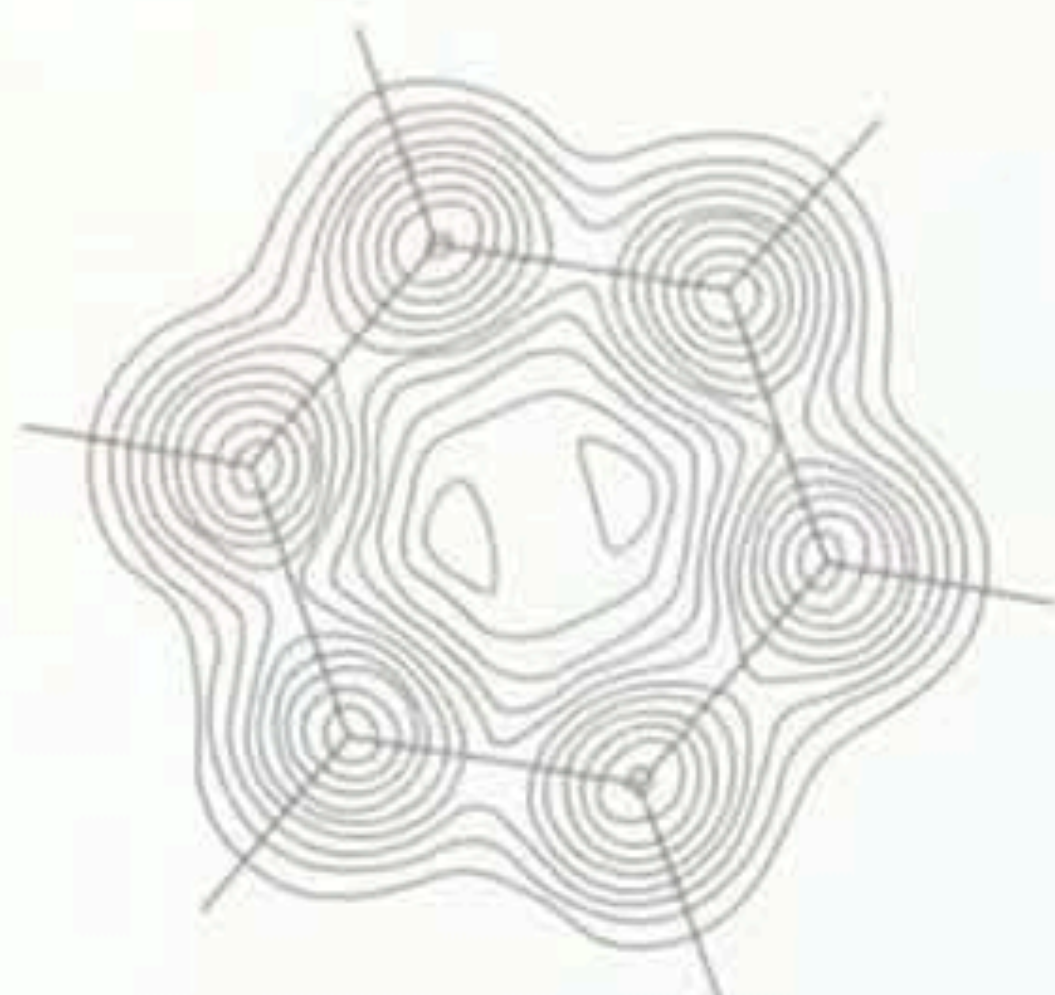


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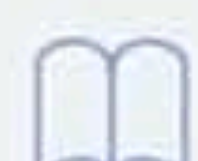
Menu

Beautiful**Chemistry**.net

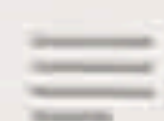


Organic Molecular Structure

Countless Possibilities of Carbon Atoms



9:41

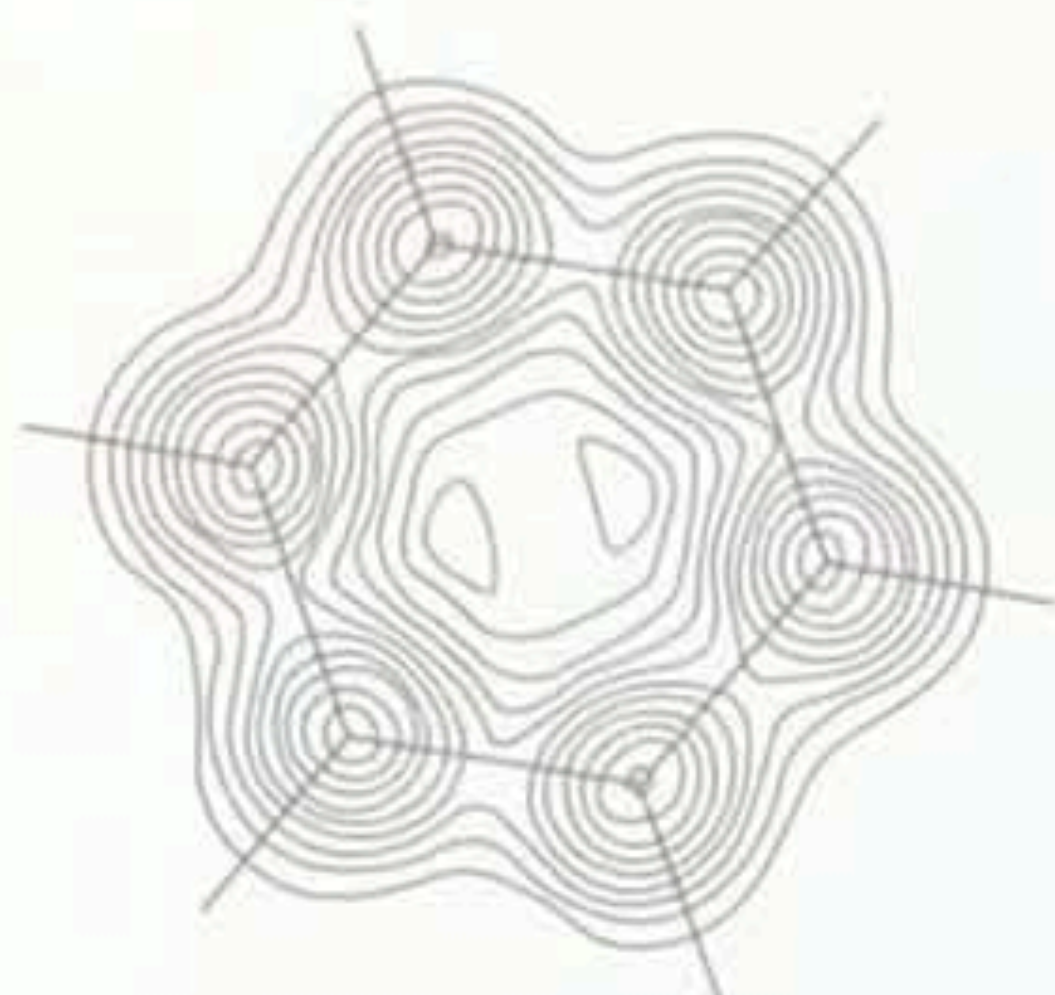


beautifulchemistry.net



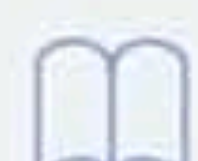
Menu

Beautiful**Chemistry**.net



Organic Molecular Structure

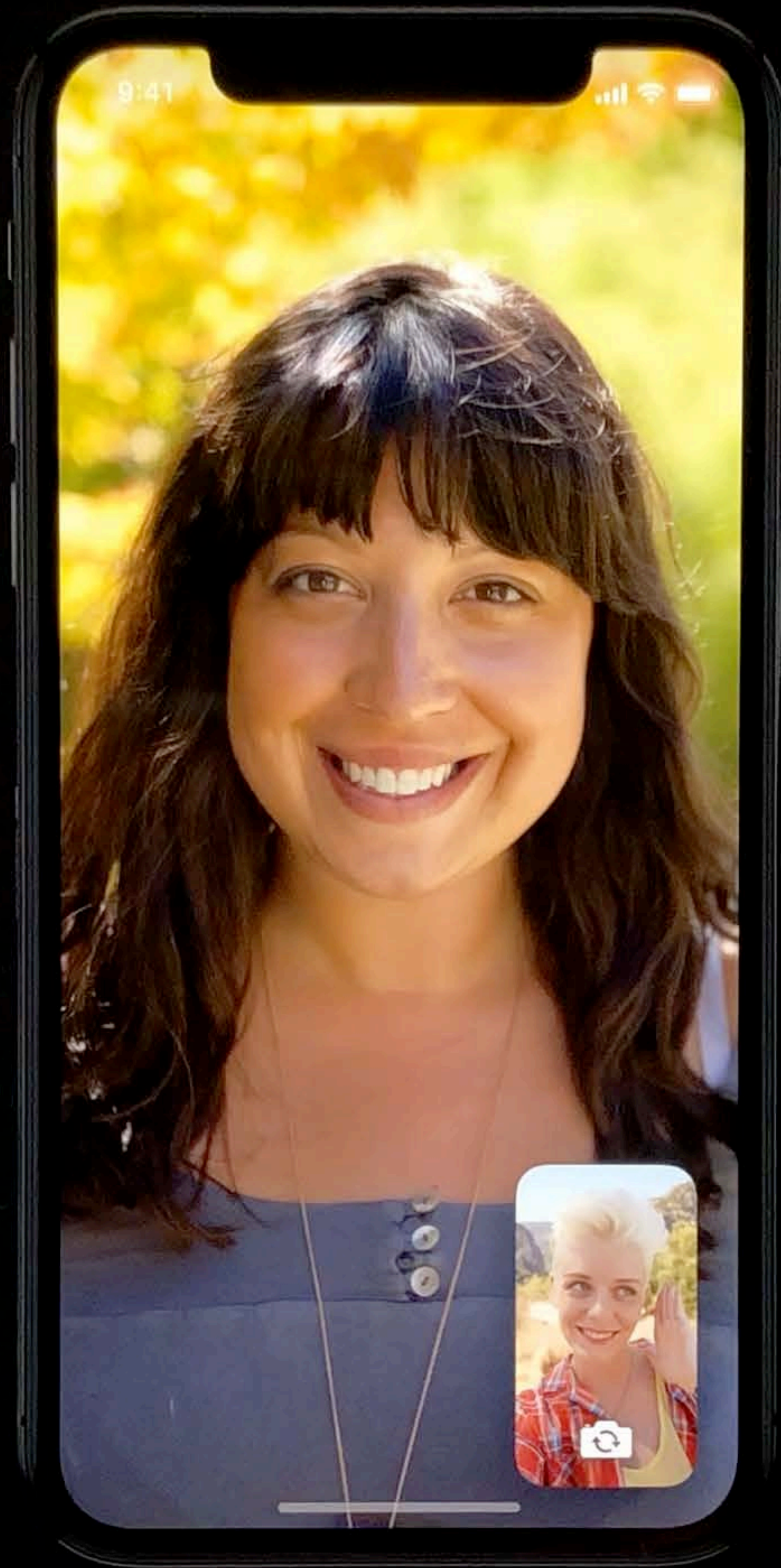
Countless Possibilities of Carbon Atoms

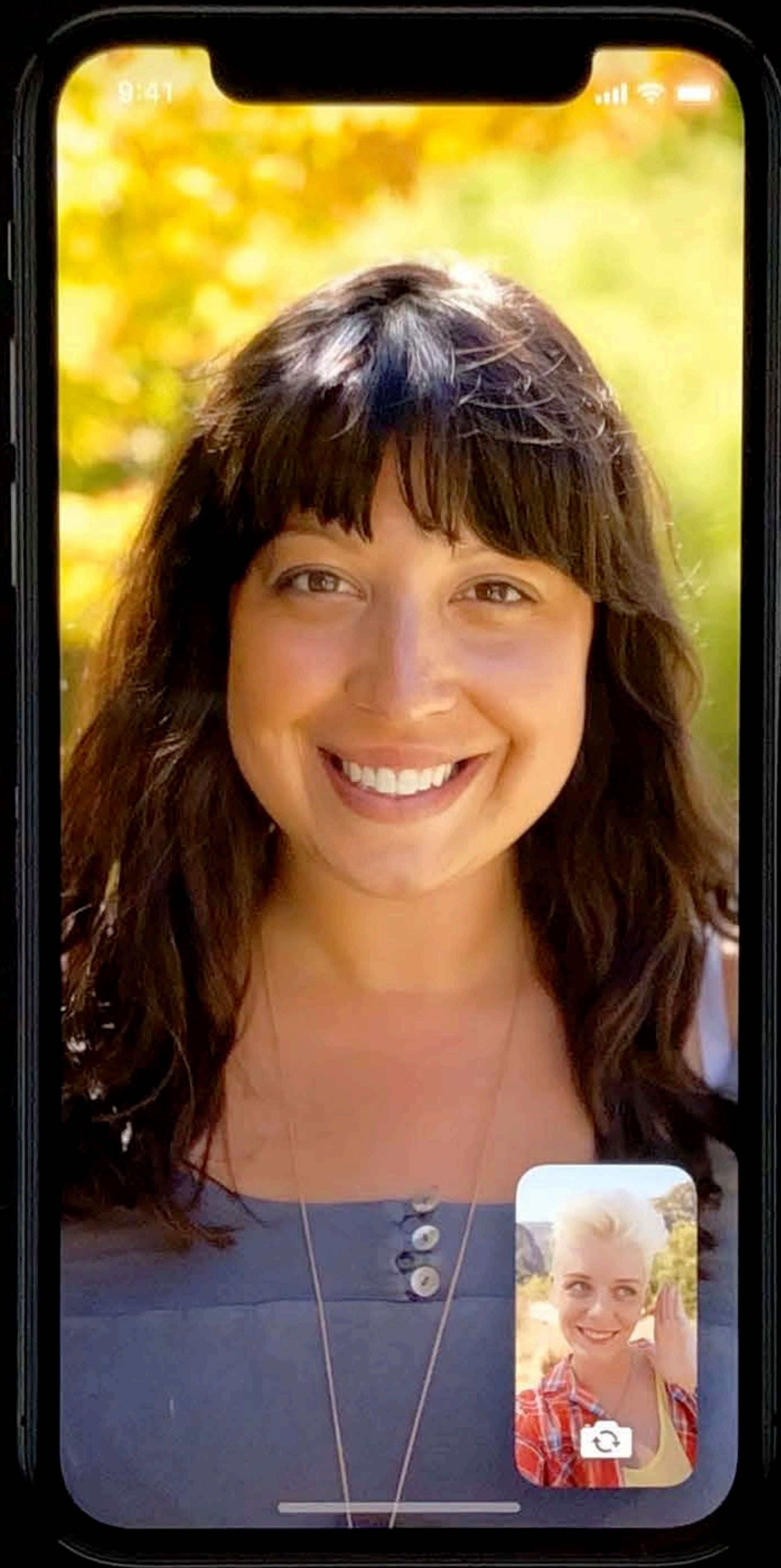






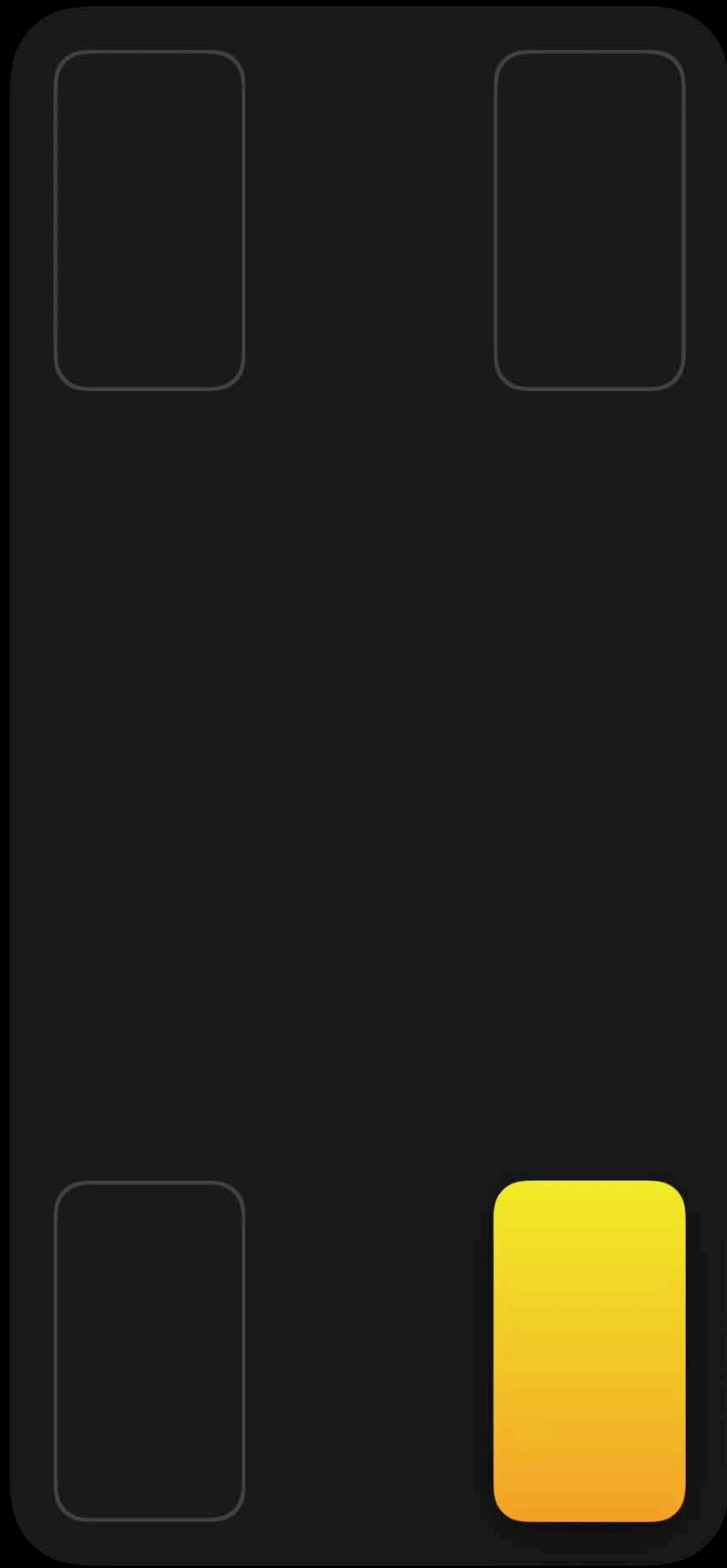
Intent is expressed through motion

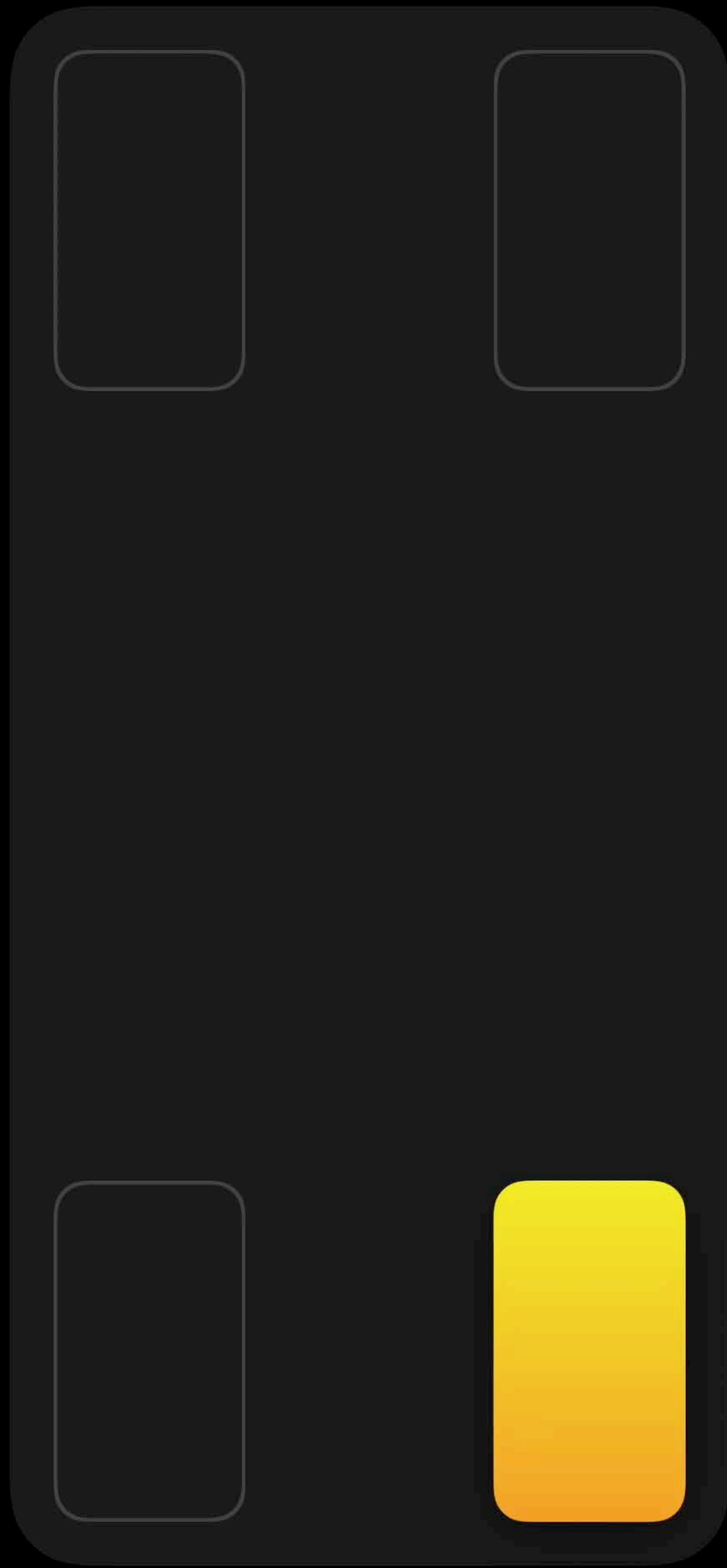




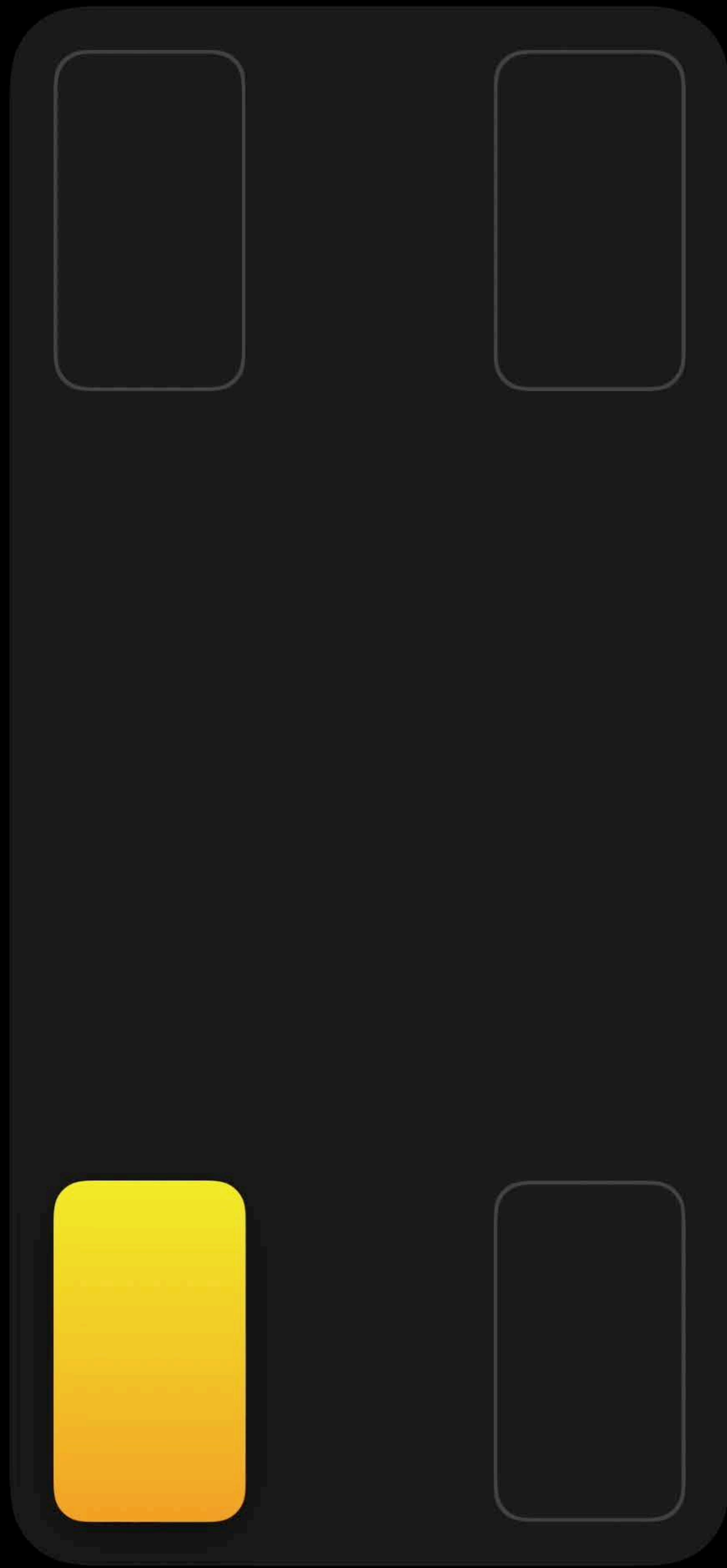


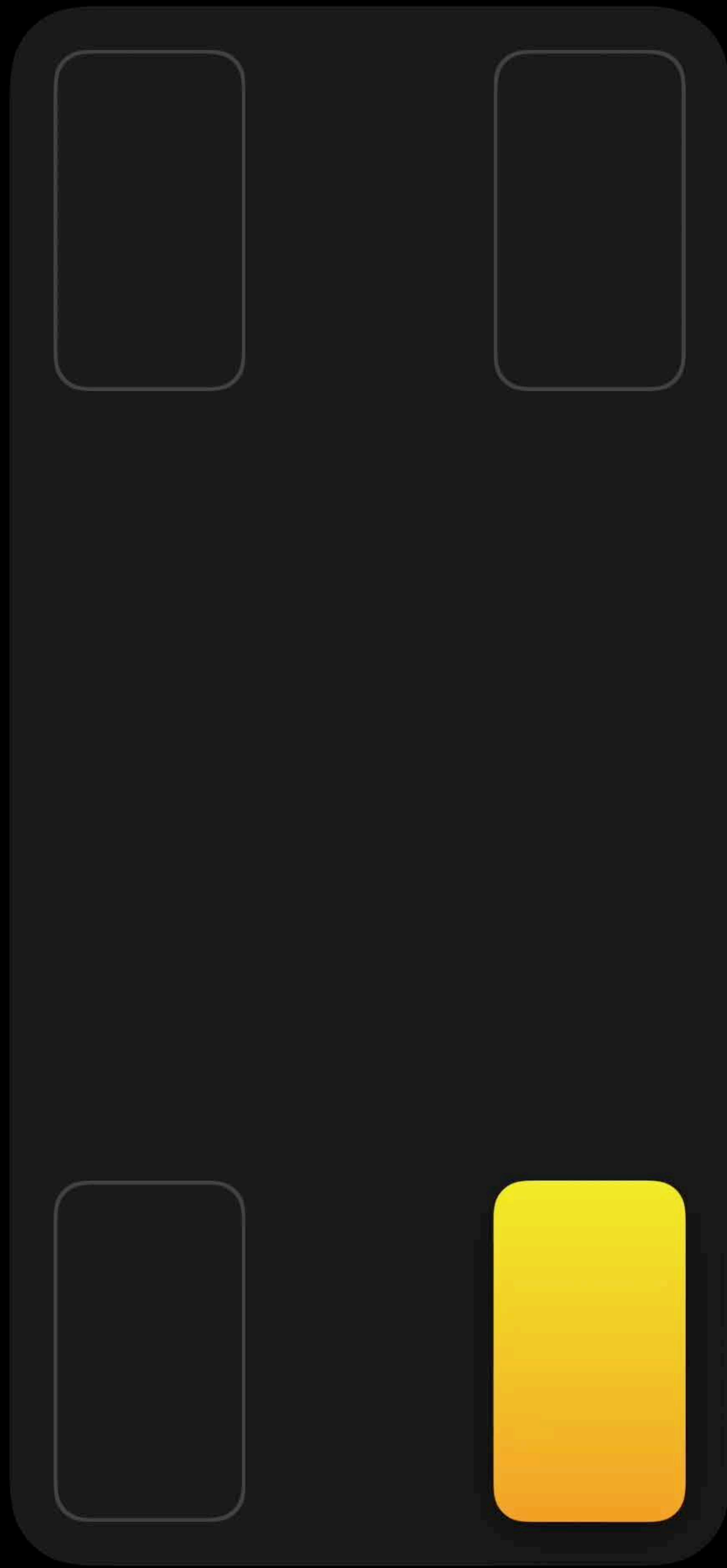


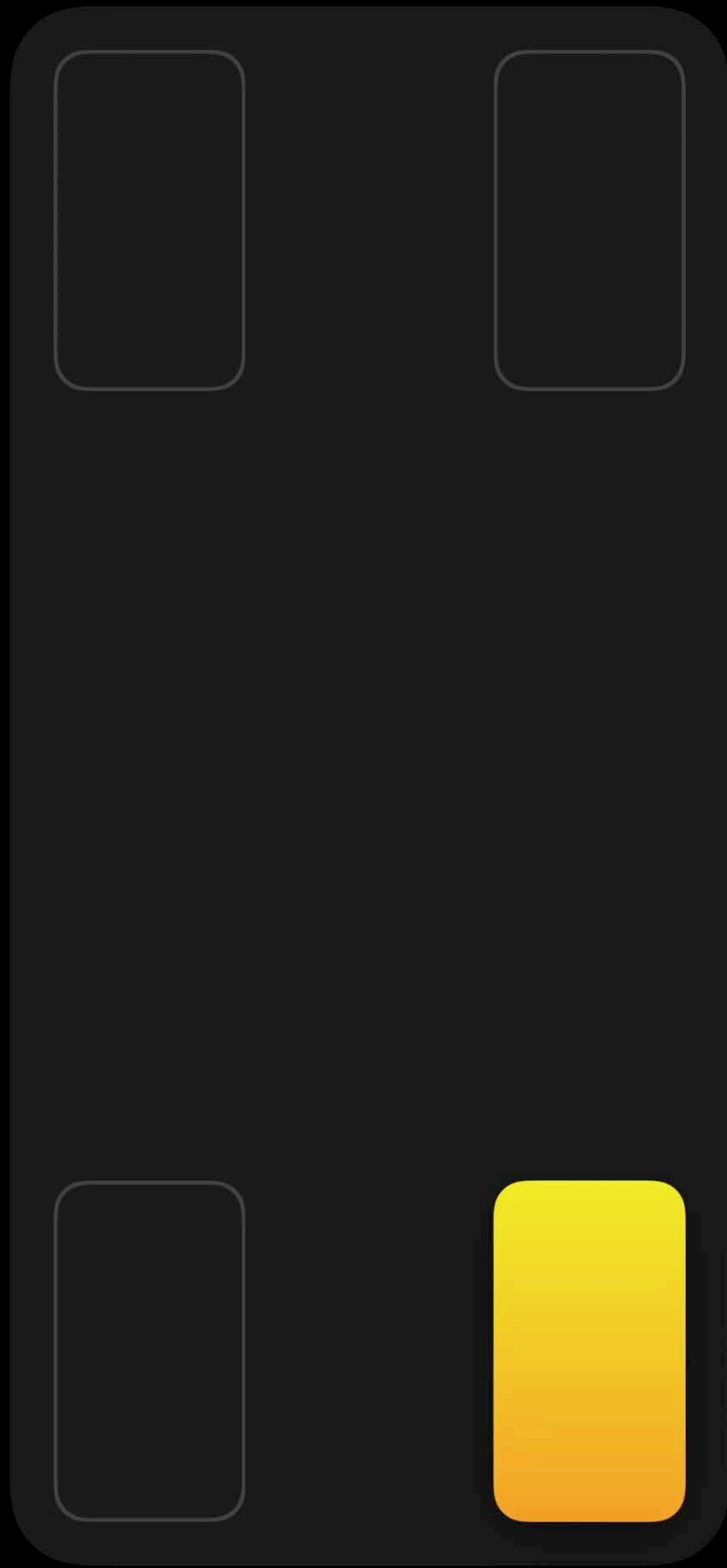


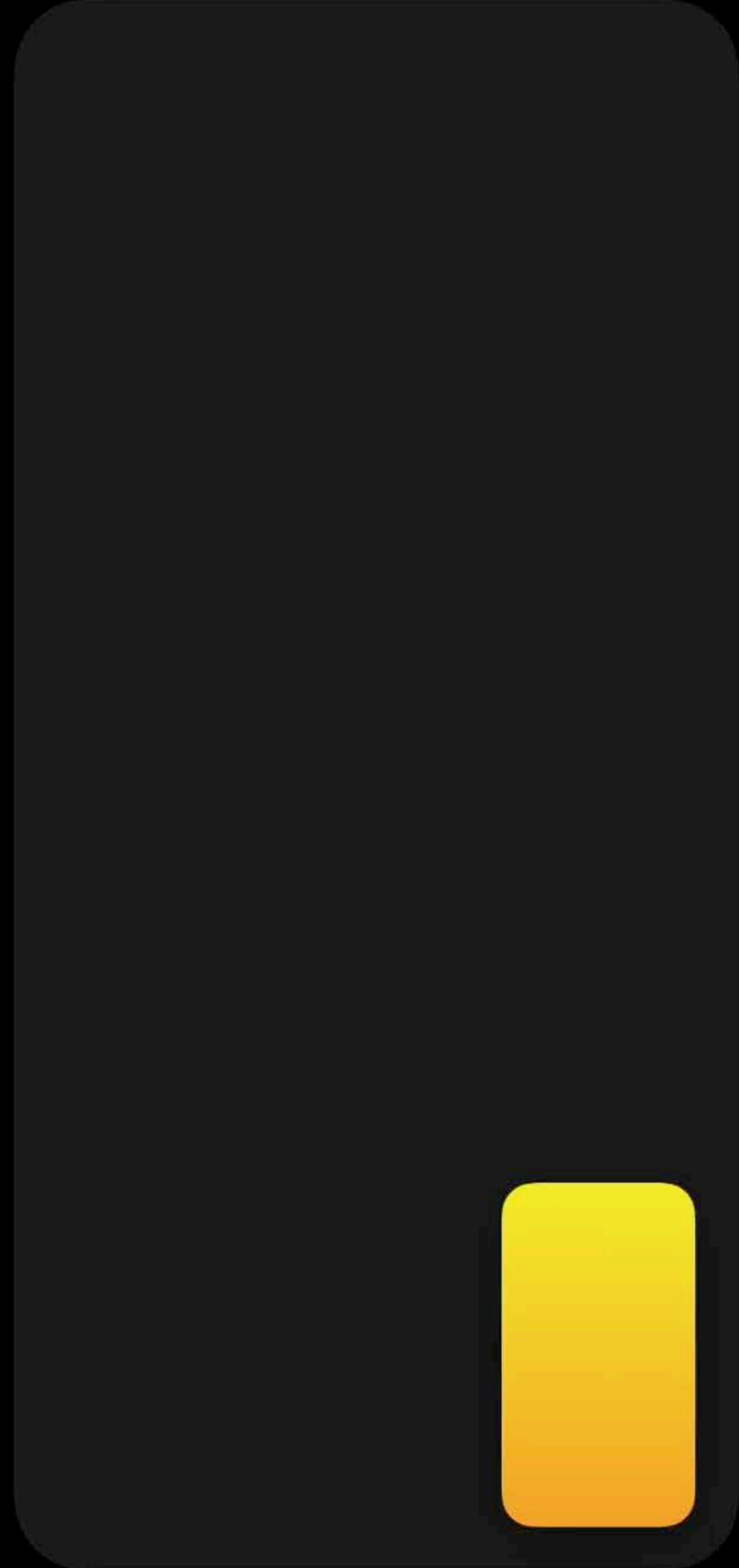


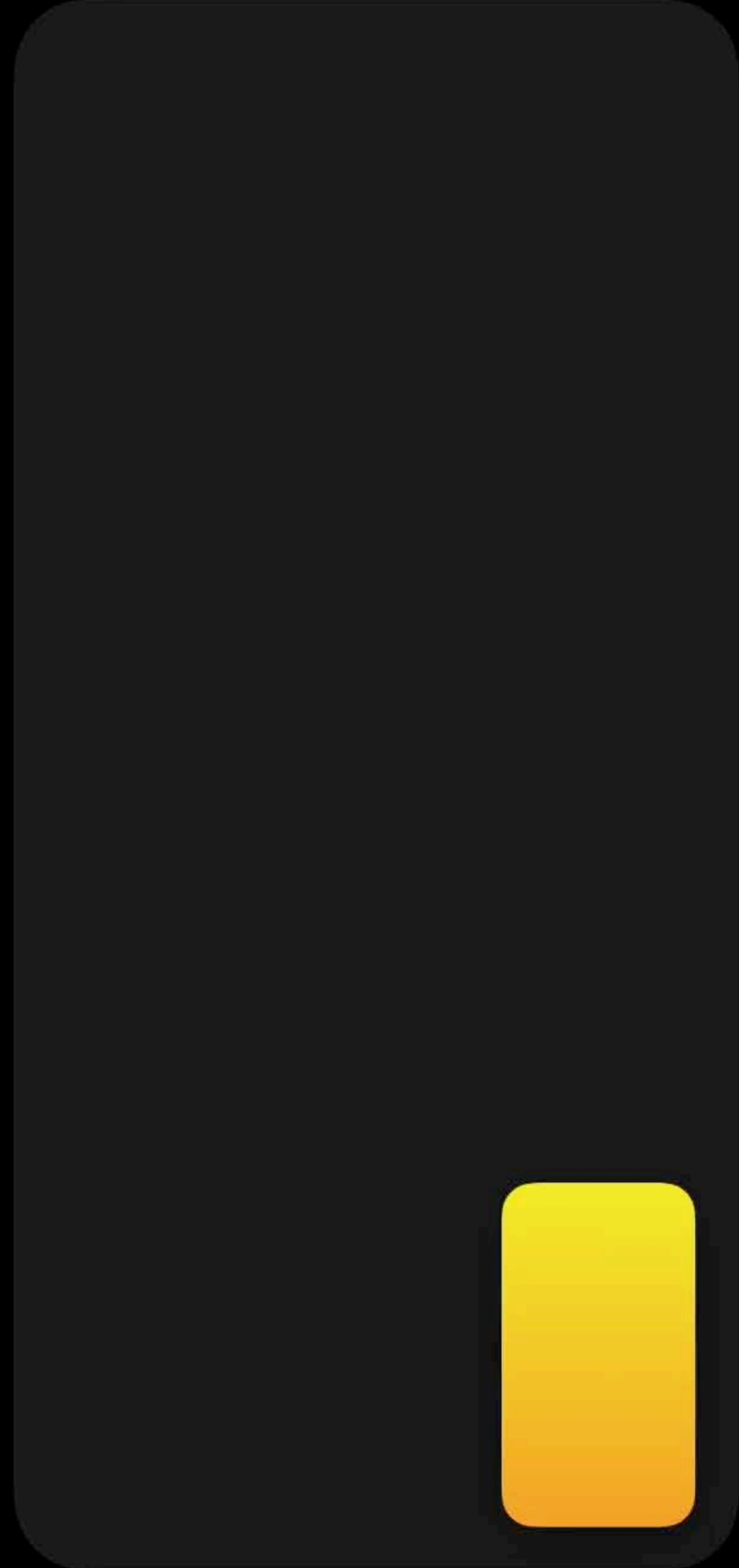


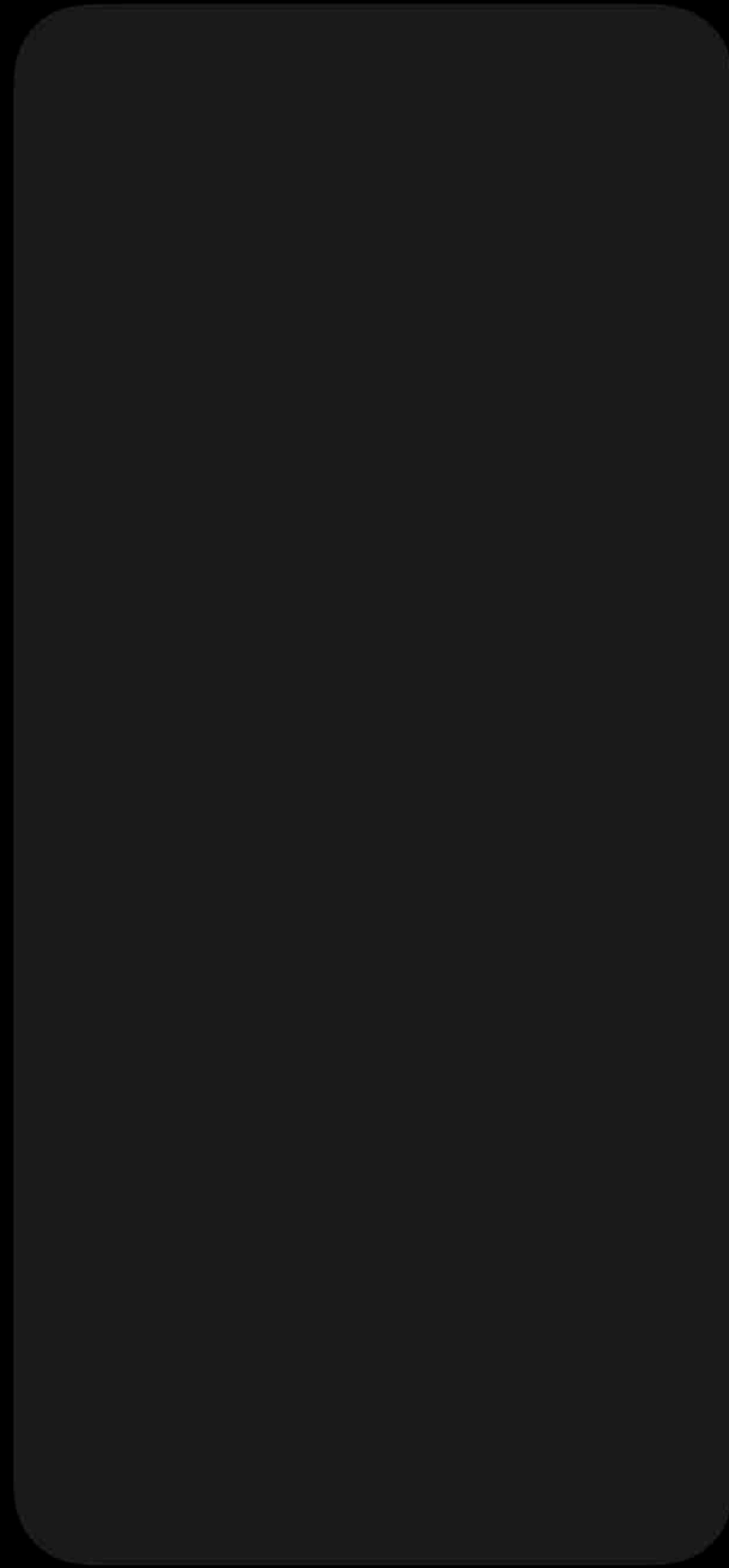
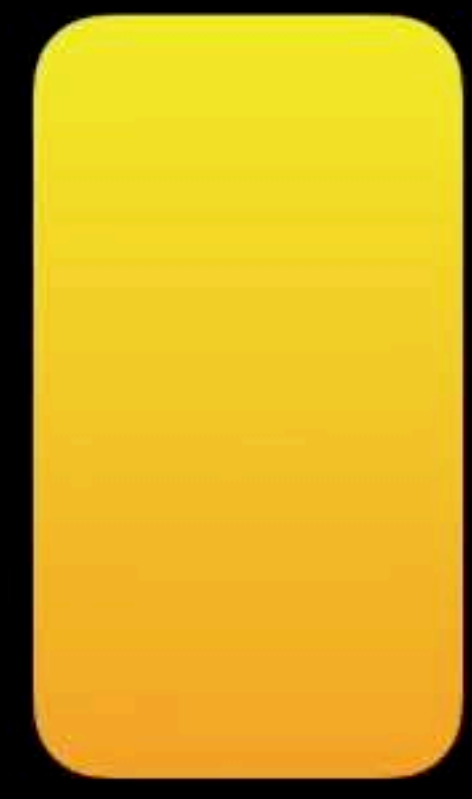


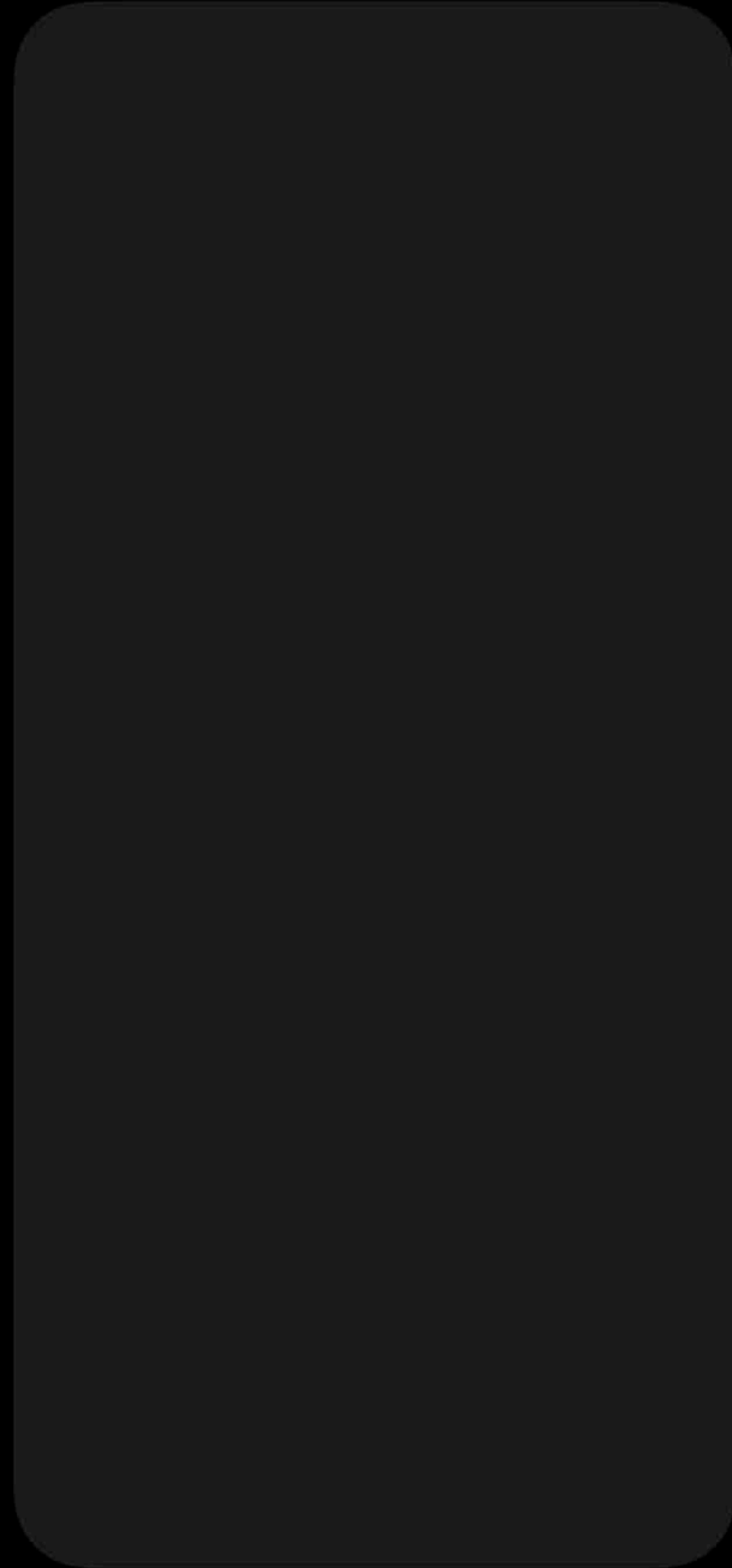
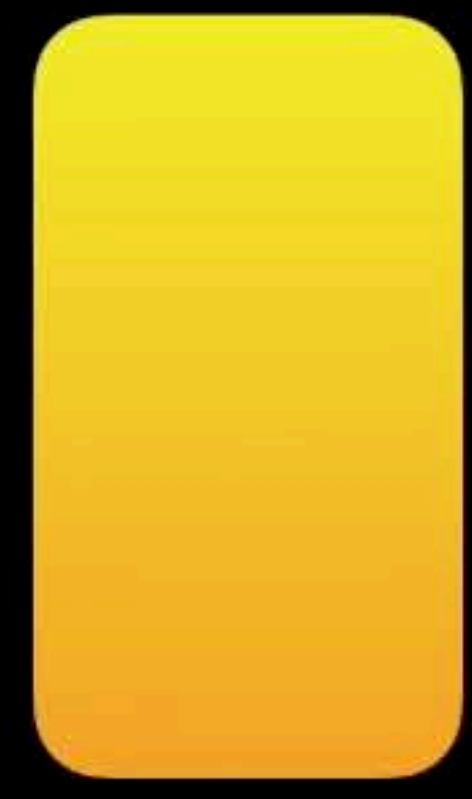












```
// Distance travelled after decelerating to zero velocity at a constant rate.  
func project(initialVelocity: Float, decelerationRate: Float) -> Float {  
    return (initialVelocity / 1000.0) * decelerationRate / (1.0 - decelerationRate)  
}
```



```
// After the PiP is thrown, determine the best corner and re-target it there.

let decelerationRate = UIScrollView.DecelerationRate.normal

let projectedPosition = (
    x: x.value + project(initialVelocity: x.velocity, decelerationRate: decelerationRate)
    y: y.value + project(initialVelocity: y.velocity, decelerationRate: decelerationRate),
)

let nearestCornerPosition = nearestCornerTo(projectedPosition)

x.target = nearestCornerPosition.x
y.target = nearestCornerPosition.y
```

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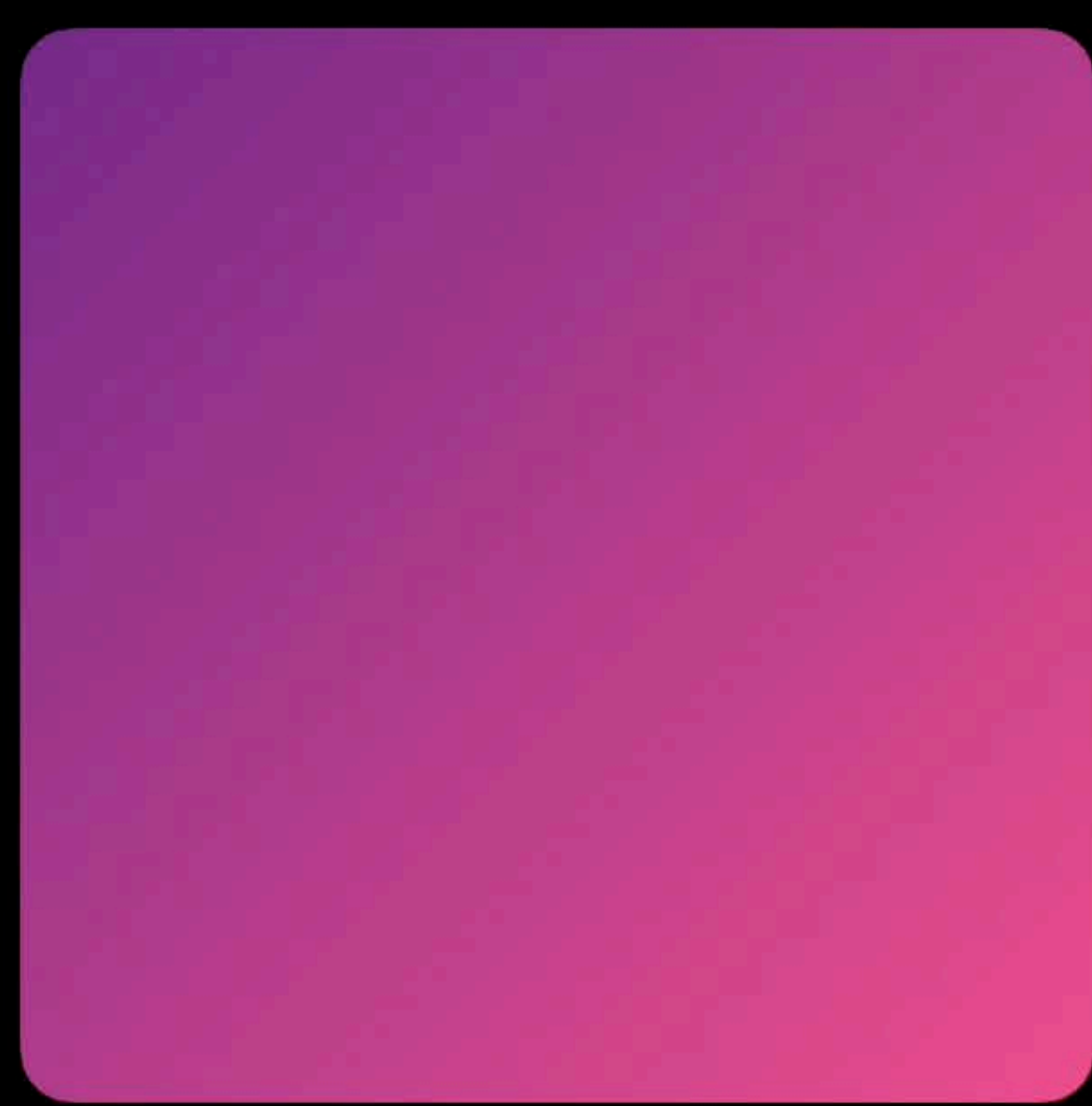
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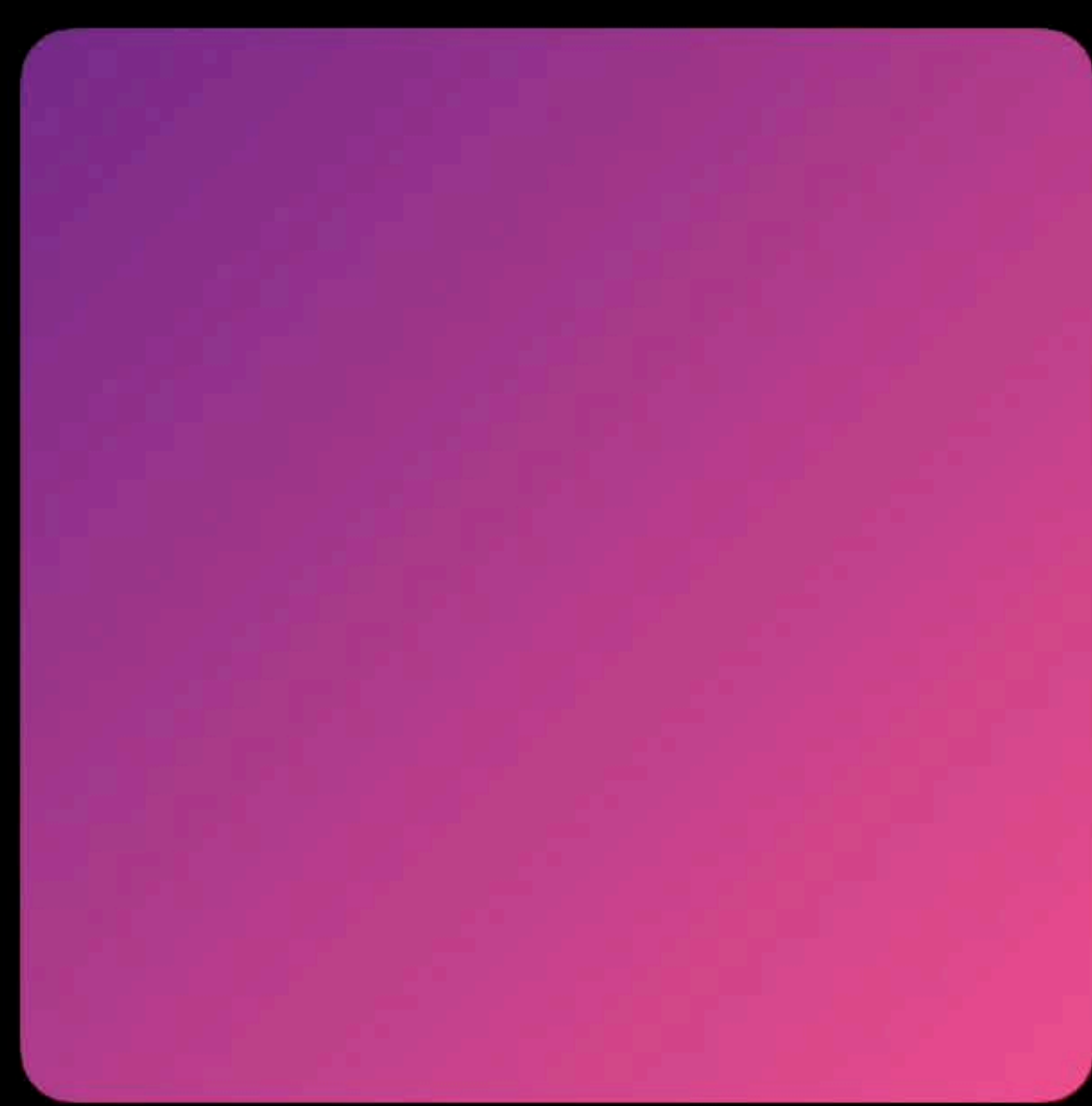
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```





Designing with Dynamic Motion

Designing with Dynamic Motion

Continuous behaviors, not timed animations

Designing with Dynamic Motion

Continuous behaviors, not timed animations

Draw inspiration from the physical world

Designing with Dynamic Motion

Continuous behaviors, not timed animations

Draw inspiration from the physical world

Springs don't need to be springy!

Designing with Dynamic Motion

Continuous behaviors, not timed animations

Draw inspiration from the physical world

Springs don't need to be springy!

Align motion with intent

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Responding to Interaction

Responding to Interaction

Design of taps and swipes

Responding to Interaction

Design of taps and swipes

Principles of fluid interactions

Responding to Interaction

Design of taps and swipes

Principles of fluid interactions

Dealing with multiple gestures

Designing a tap



8

9

X

8

9

X

8

9

X

8

9

X

8

9

X



8

9

X



9

8

X

7

6



9

8

X

7

6

Designing a *swipe*

drag

pan

flick

Designing a *swipe*

scroll

slide

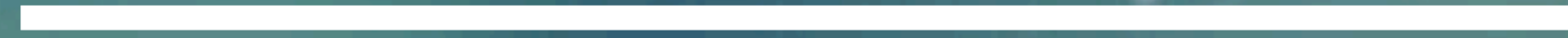
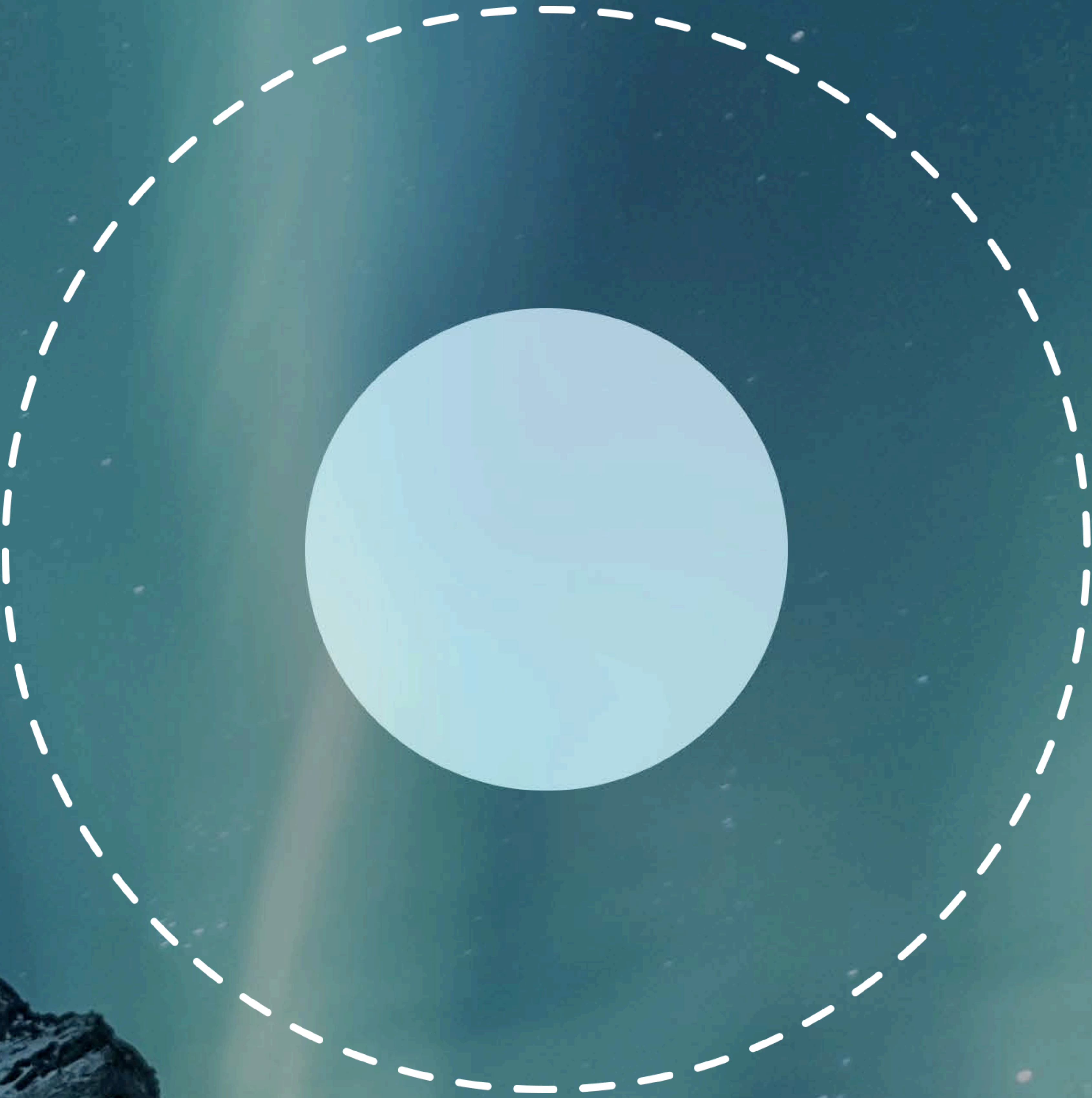
throw





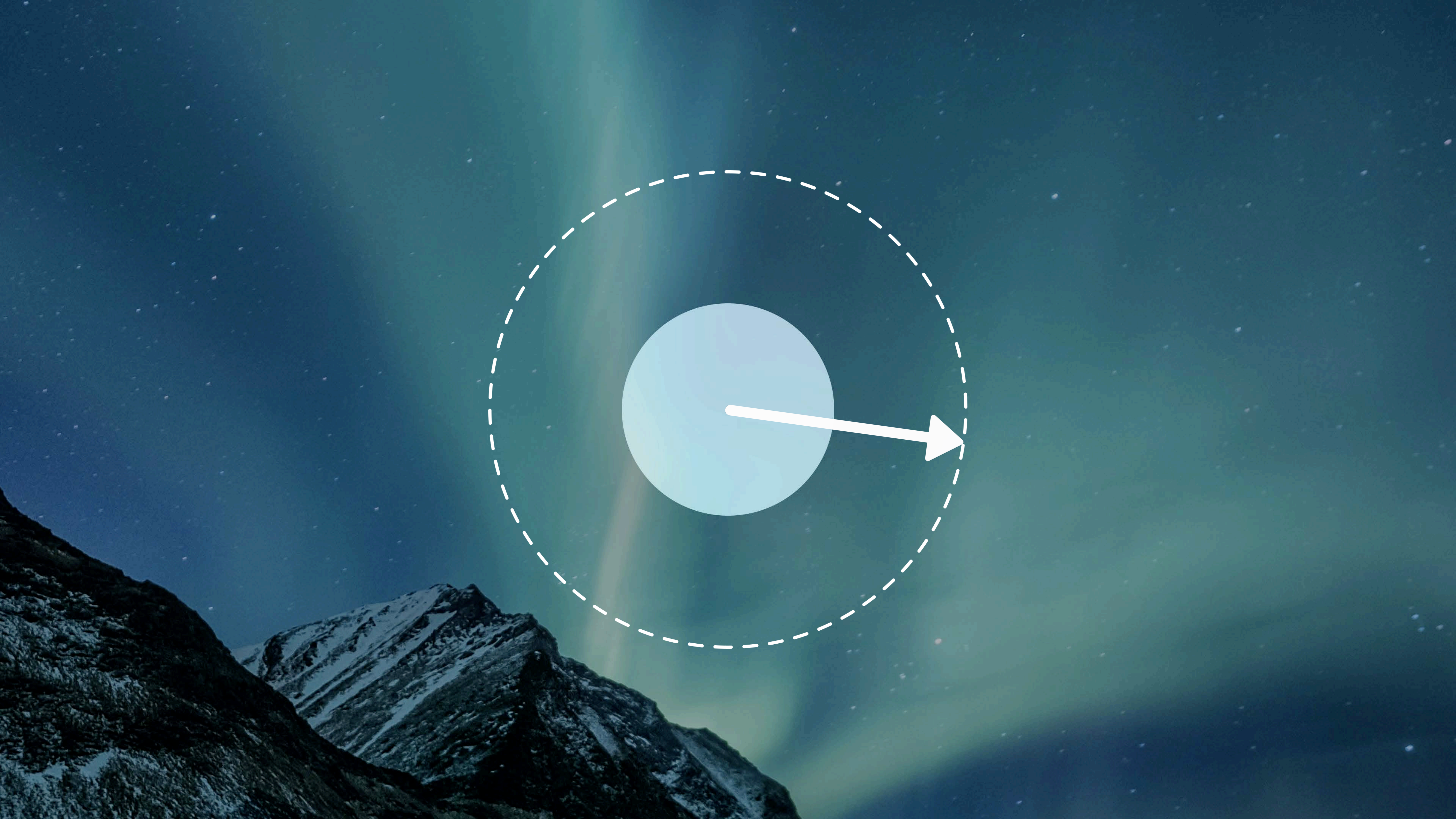






Hysteresis 10pt







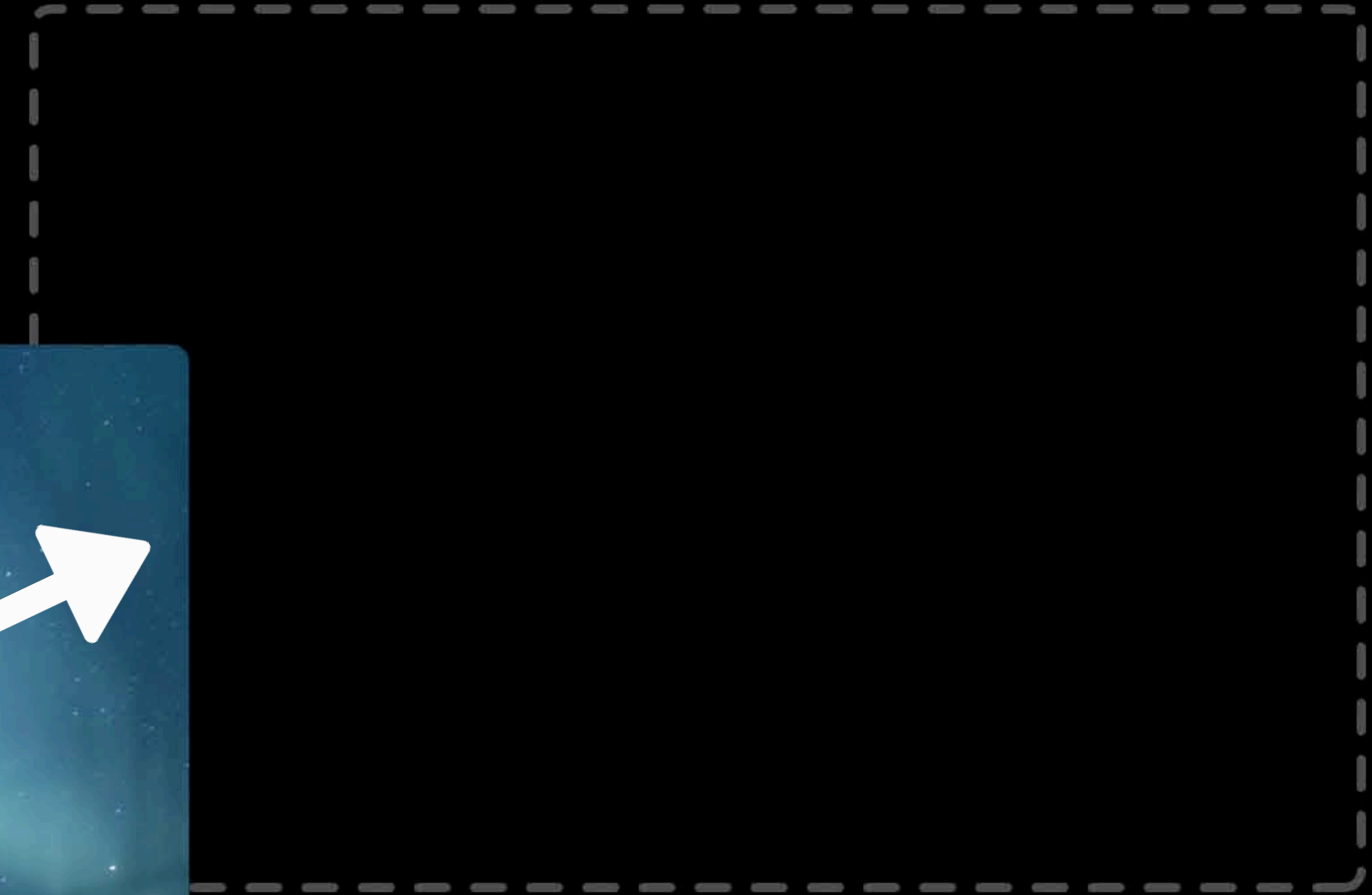












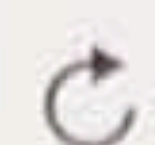


Touch and content move together

9:41

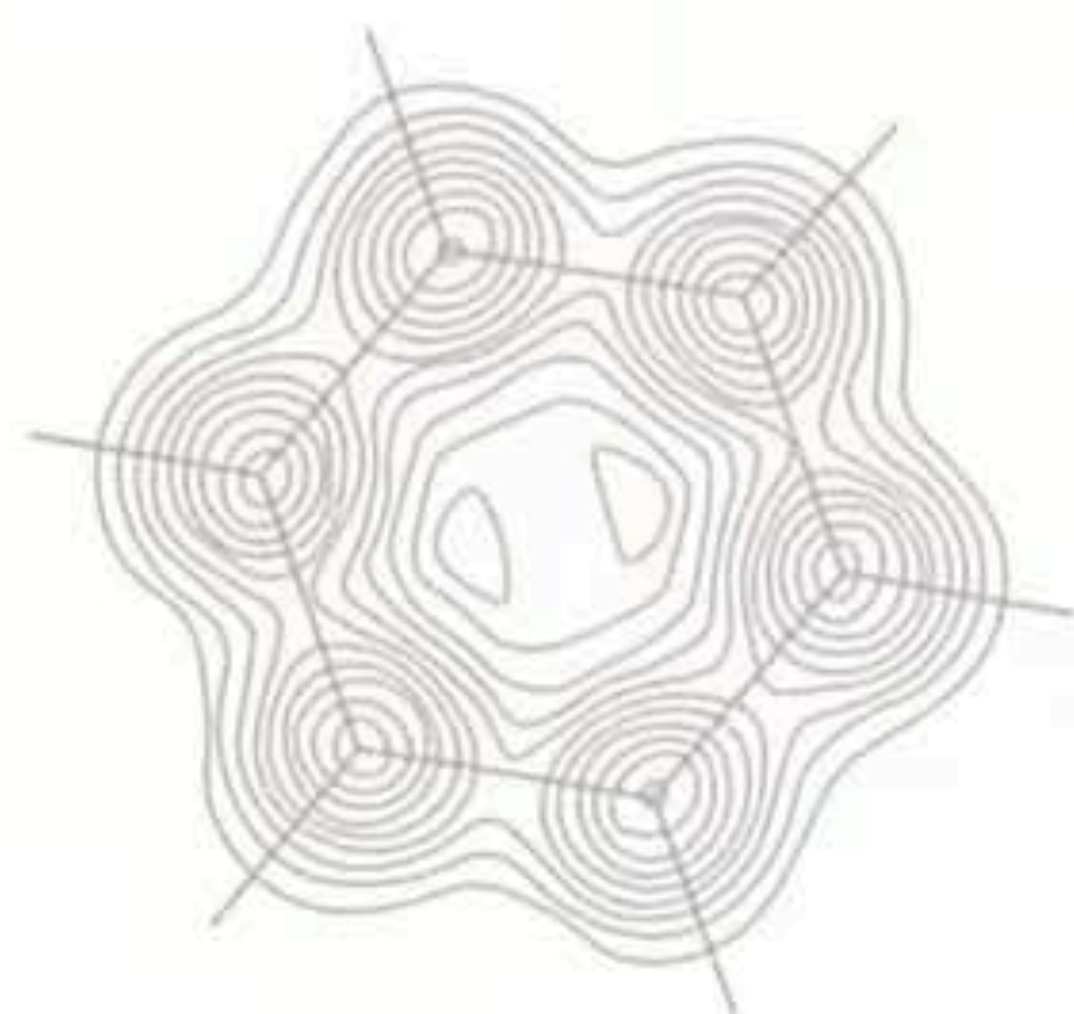


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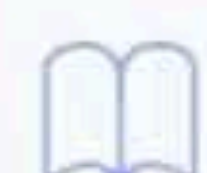
Menu

Beautiful**Chemistry**.net



Organic Molecular Structure

Countless Possibilities of Carbon Atoms



9:41

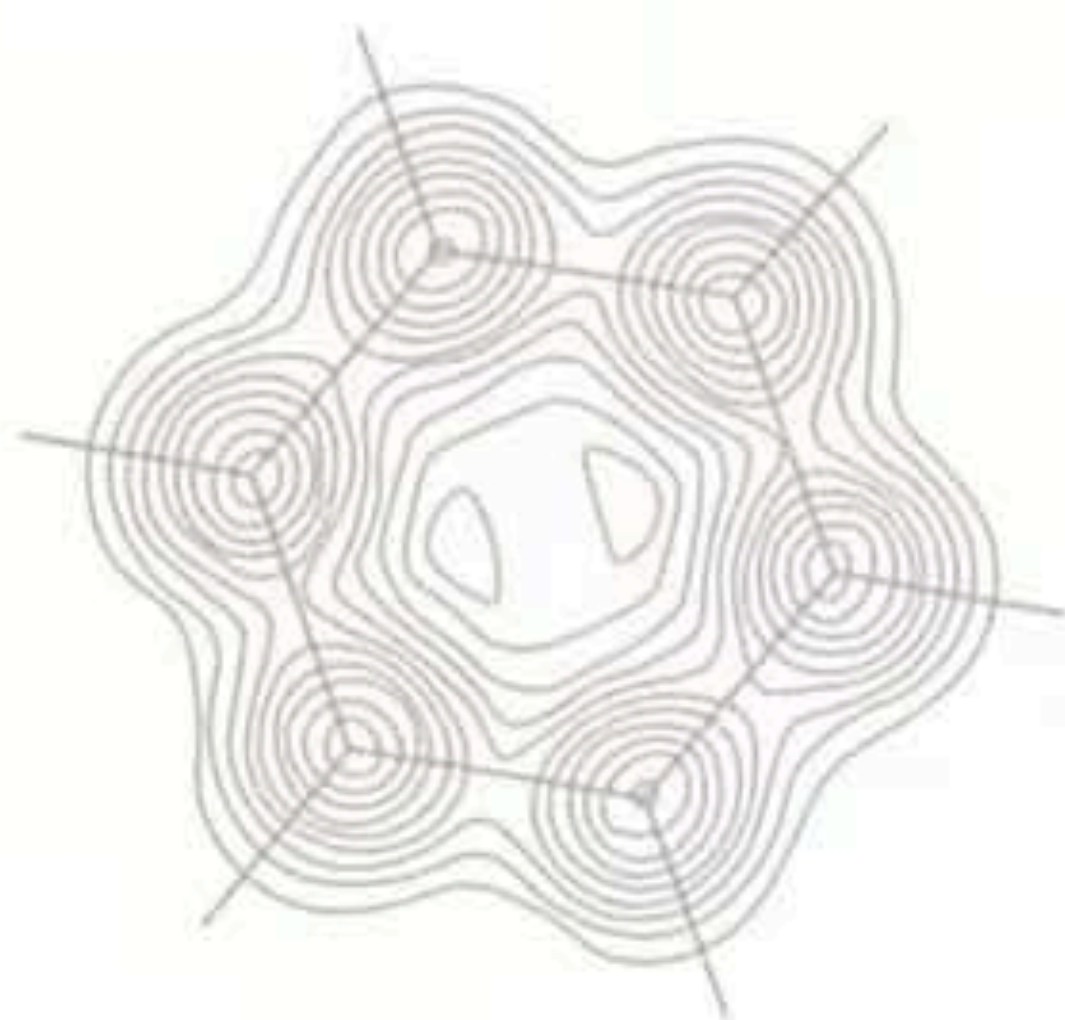


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Menu

Beautiful**Chemistry**.net

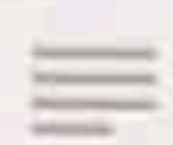


Organic Molecular Structure

Countless Possibilities of Carbon Atoms



9:41

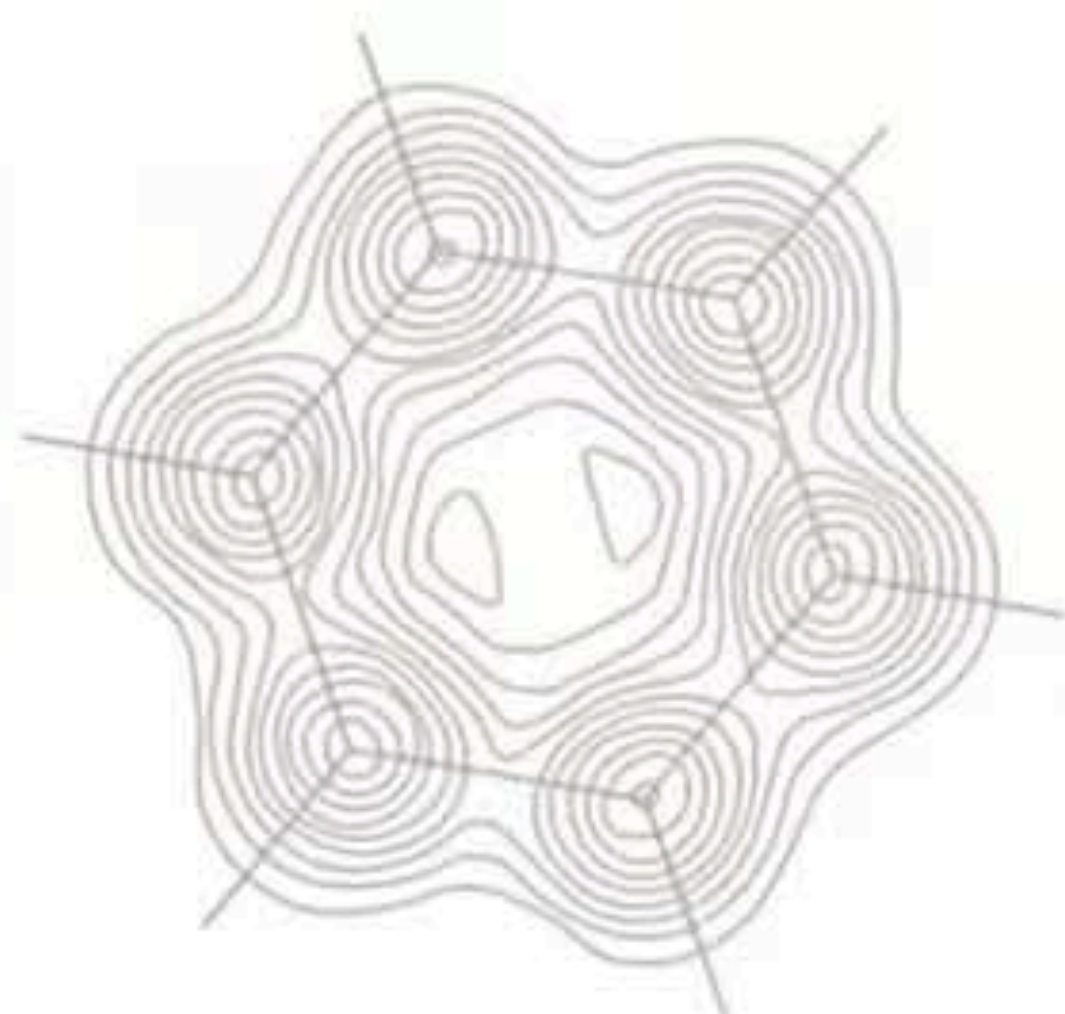


beautifulchemistry.net



Menu

Beautiful**Chemistry**.net

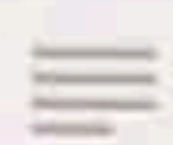


Organic Molecular Structure

Countless Possibilities of Carbon Atoms



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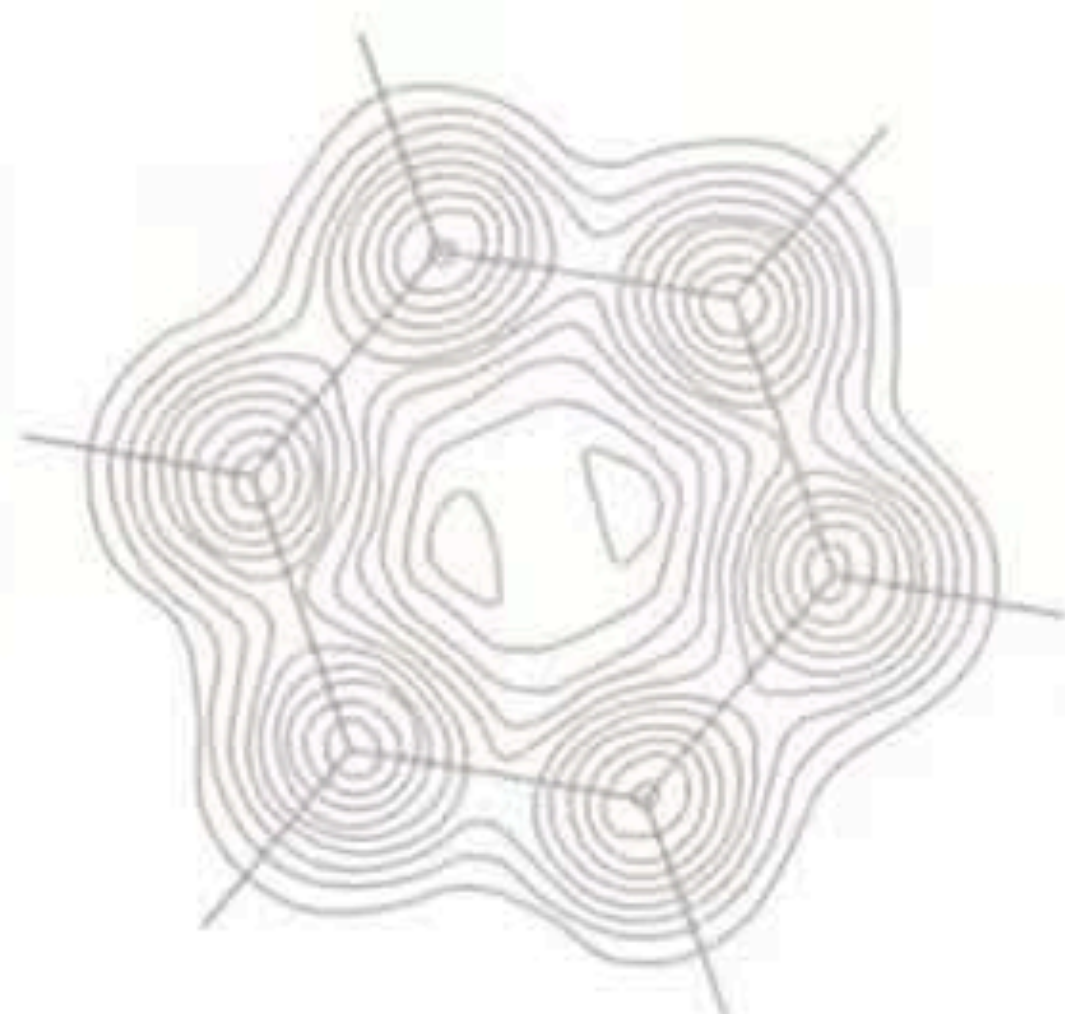


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Menu

Beautiful**Chemistry**.net



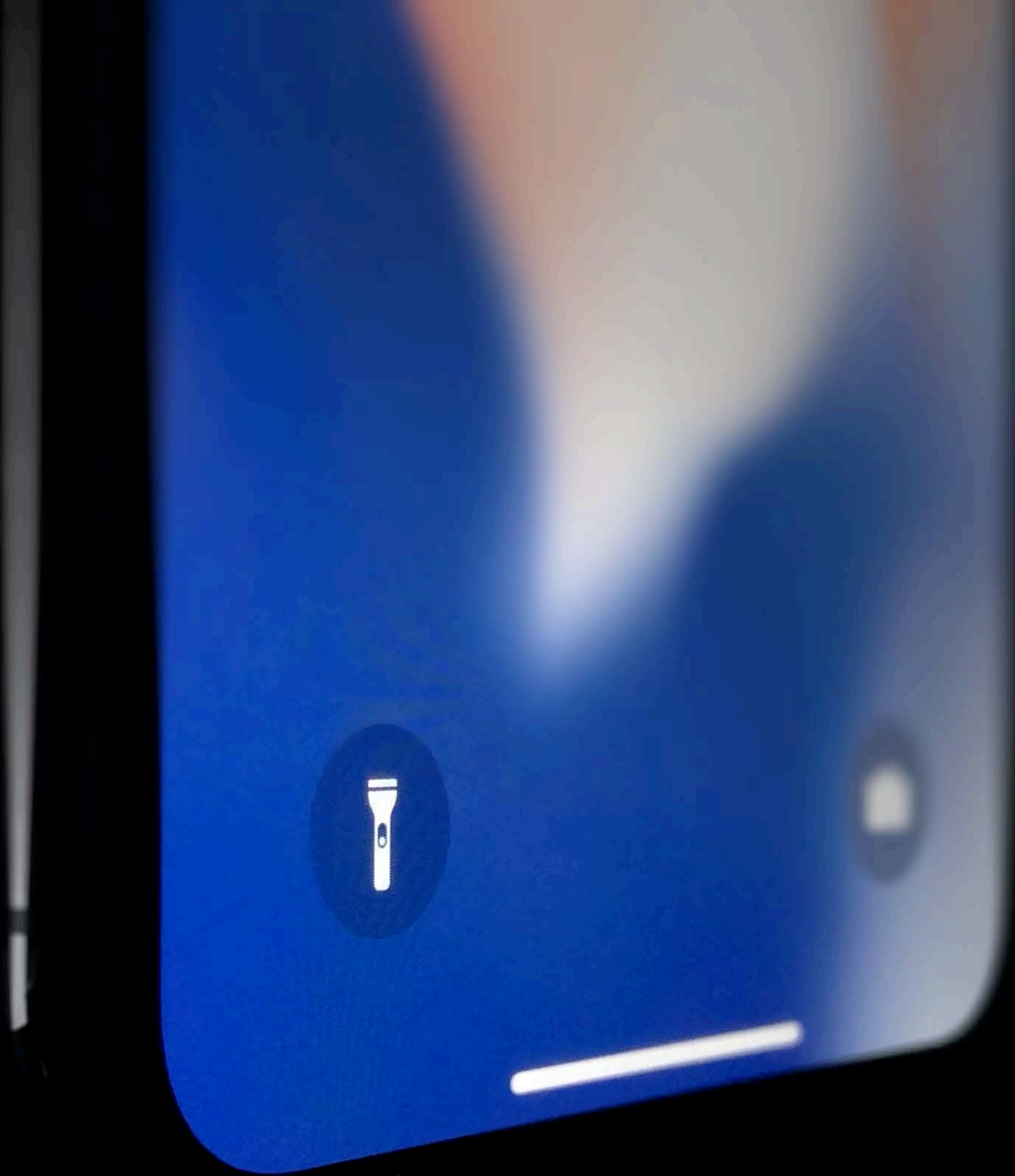
Organic Molecular Structure

Countless Possibilities of Carbon Atoms



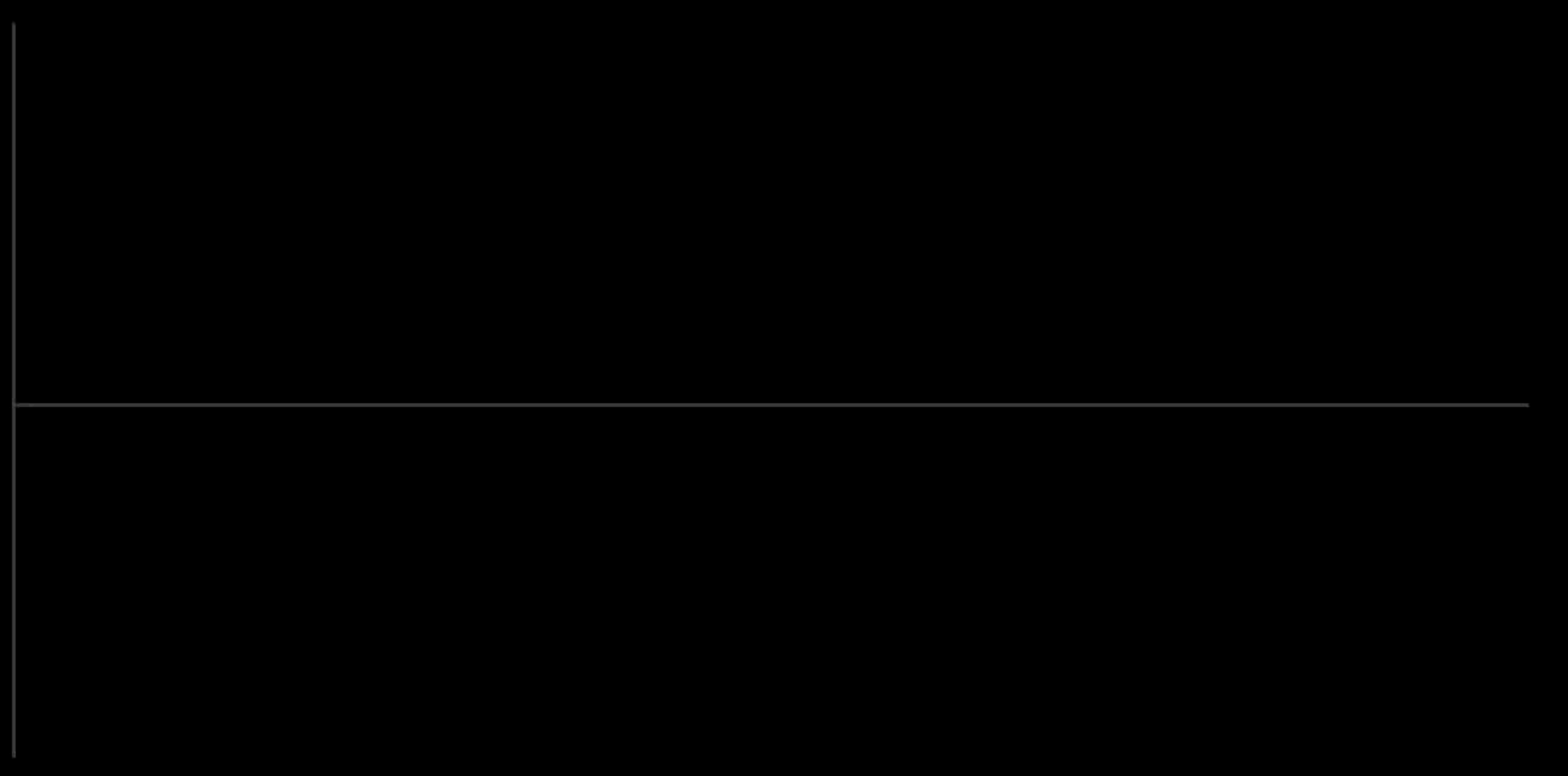


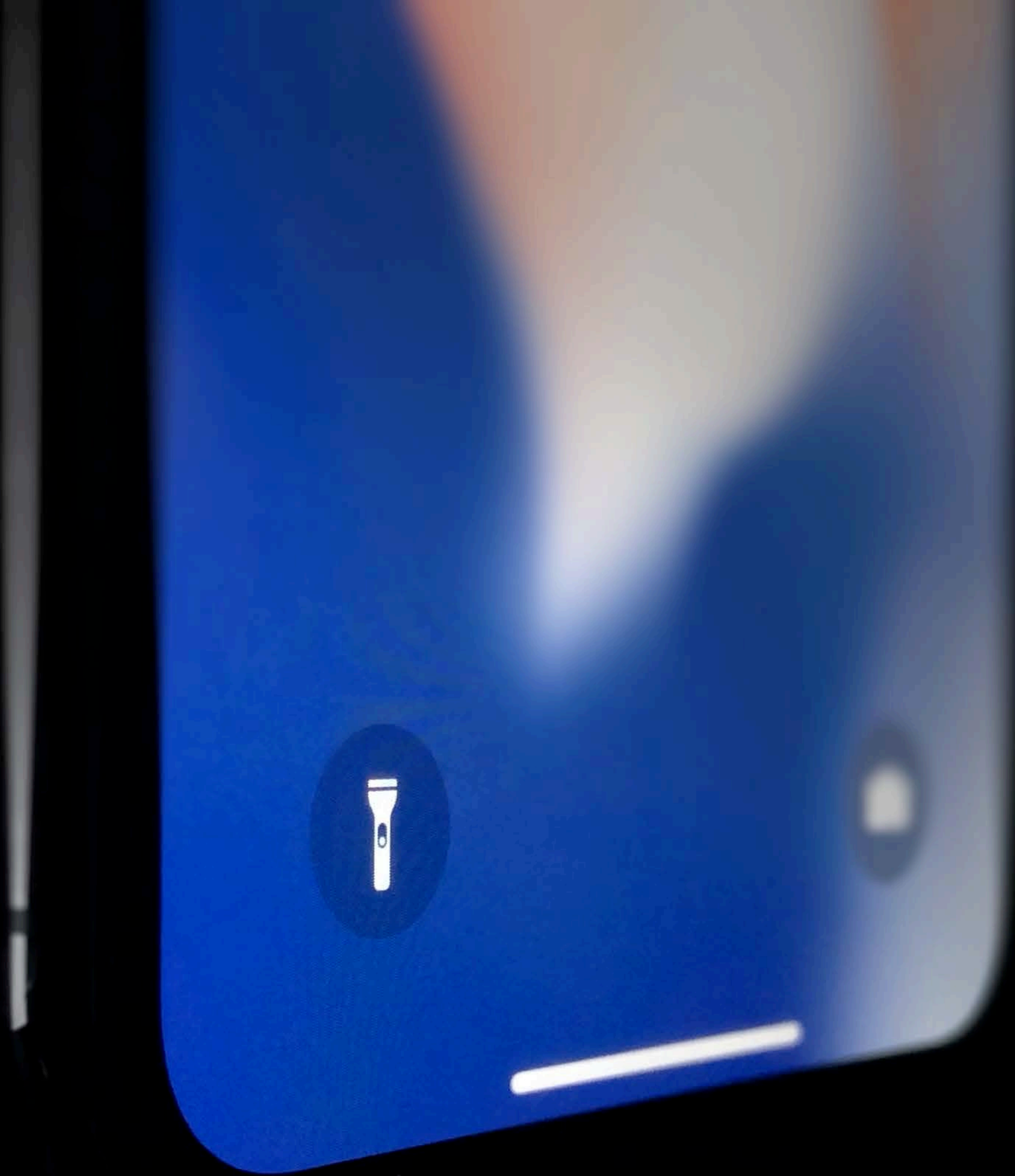
Provide continuous feedback



+500g

-500g

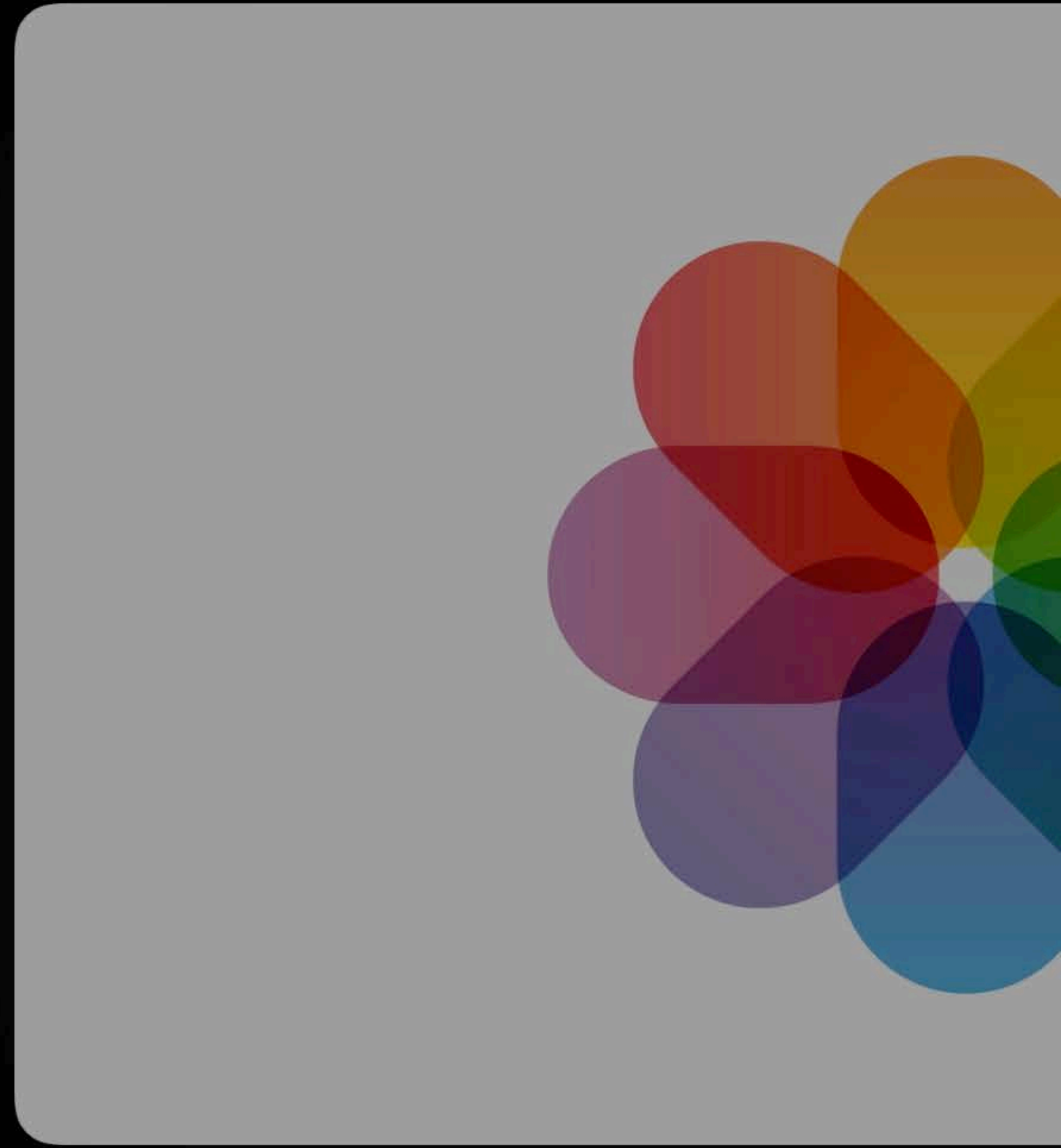


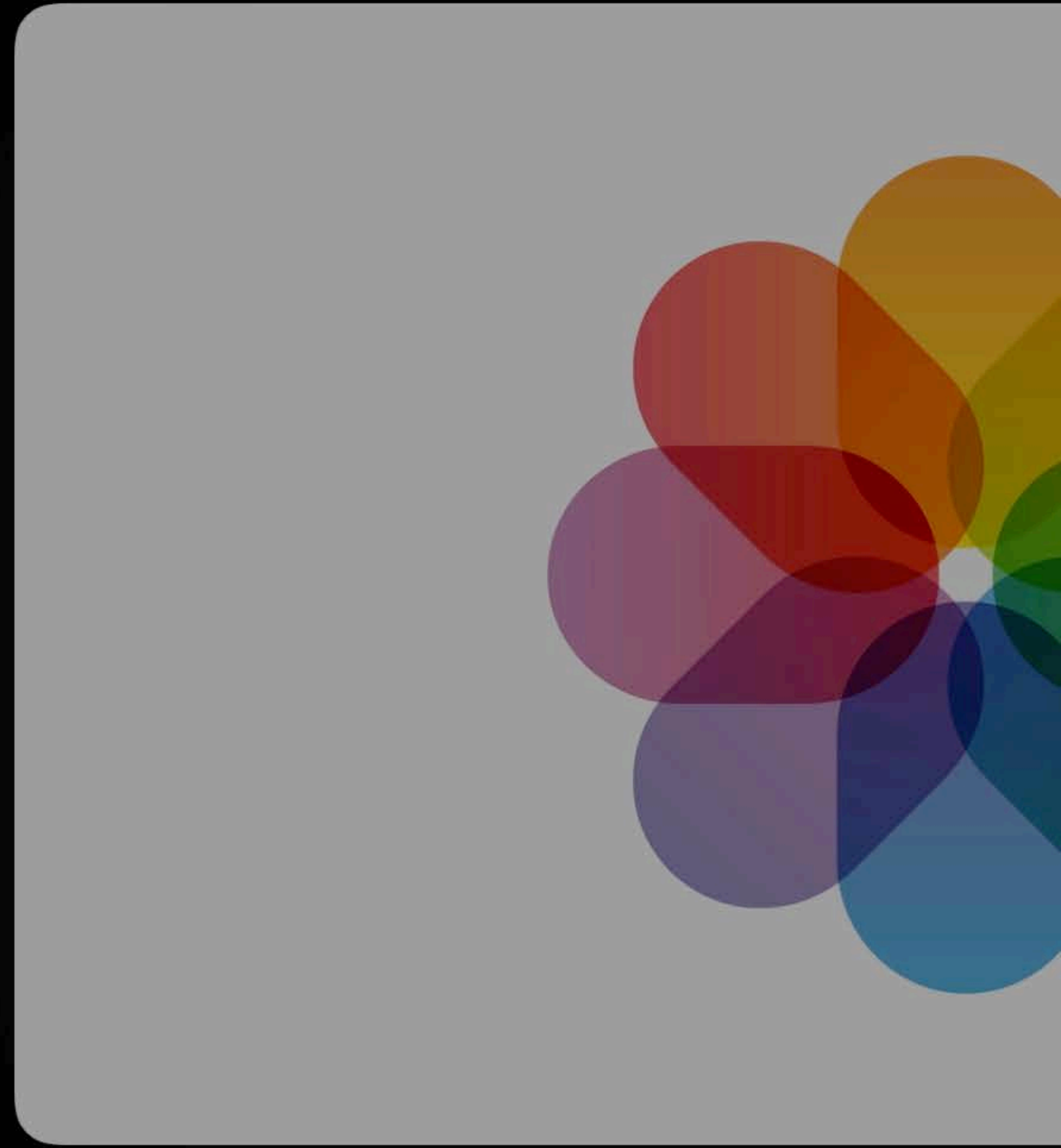


+500g

-500g







UISwipeGestureRecognizer

~~UISwipeGestureRecognizer~~

UITouches

UIPanGestureRecognizer

~~UISwipeGestureRecognizer~~

Combining gestures

9:41



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John Appleseed

My Card

A

Katie Abeles

Christina Ahmed

Jody Akana

Kelly Altick

Sarah Alvares

Brian Joseph Alvarez

Kevin Angel

Shota Aoyagi

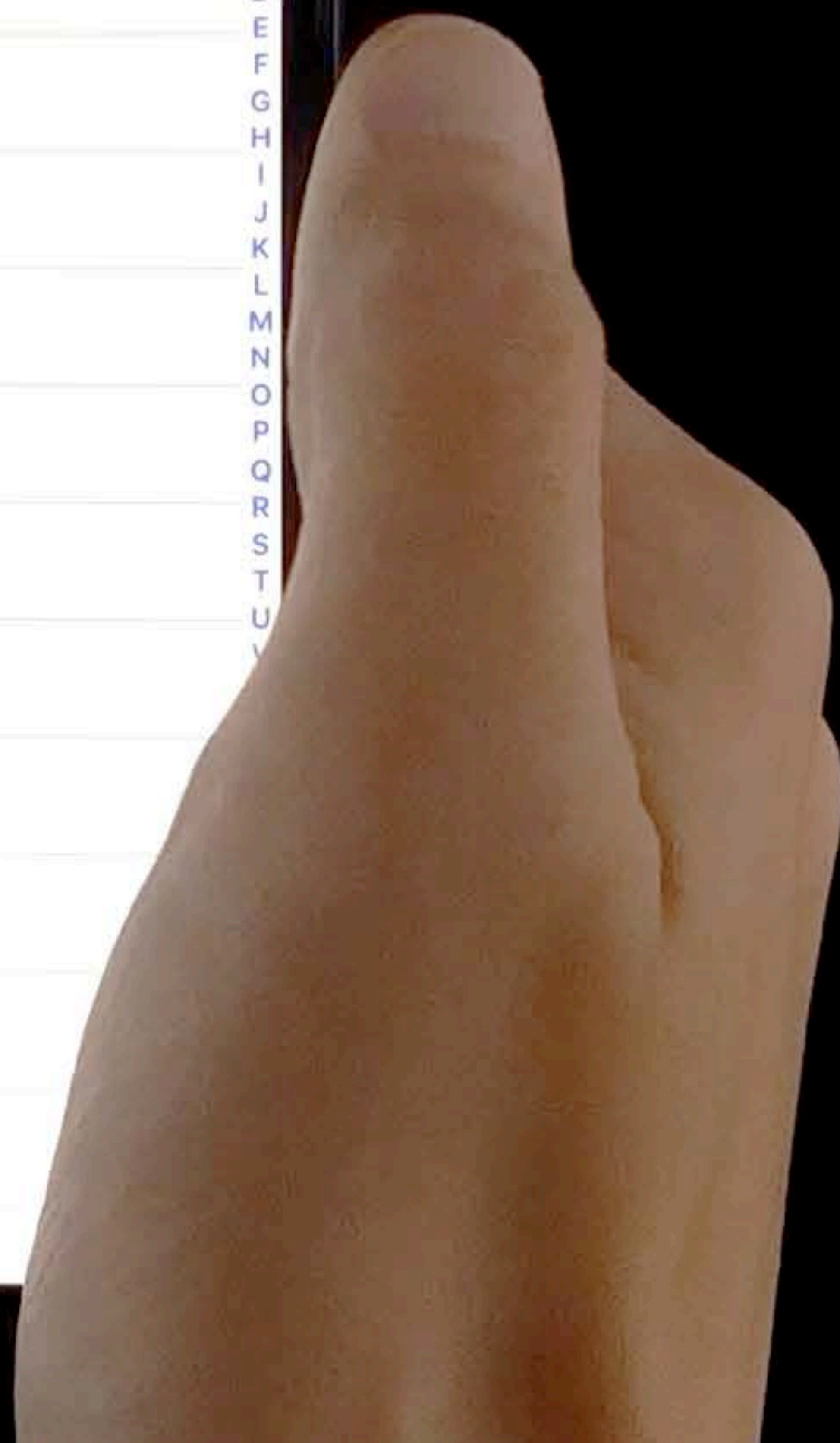
Greg Apodaca

John Appleseed

Erny Arifin

Yumi Asai

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9:41



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What is the gesture?

Visual feedback

Starts

Recognized

What is the gesture?

Visual feedback

Starts

Recognized



Scroll

3D Touch



Starts



Recognized



Scroll

3D Touch



Starts

Recognized



9:41



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Taps are delayed
because of double-tap



Responding to Interaction

Responding to Interaction

Design of taps and swipes

Responding to Interaction

Design of taps and swipes

Content and touch move one-to-one

Responding to Interaction

Design of taps and swipes

Content and touch move one-to-one

Provide continuous feedback

Responding to Interaction

Design of taps and swipes

Content and touch move one-to-one

Provide continuous feedback

Detect multiple gestures in parallel

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Interfaces that extend our minds

Designing with dynamic motion

Responding to interaction

Fluidity as a medium

Teaching

Visual Cues



One

Two

Three

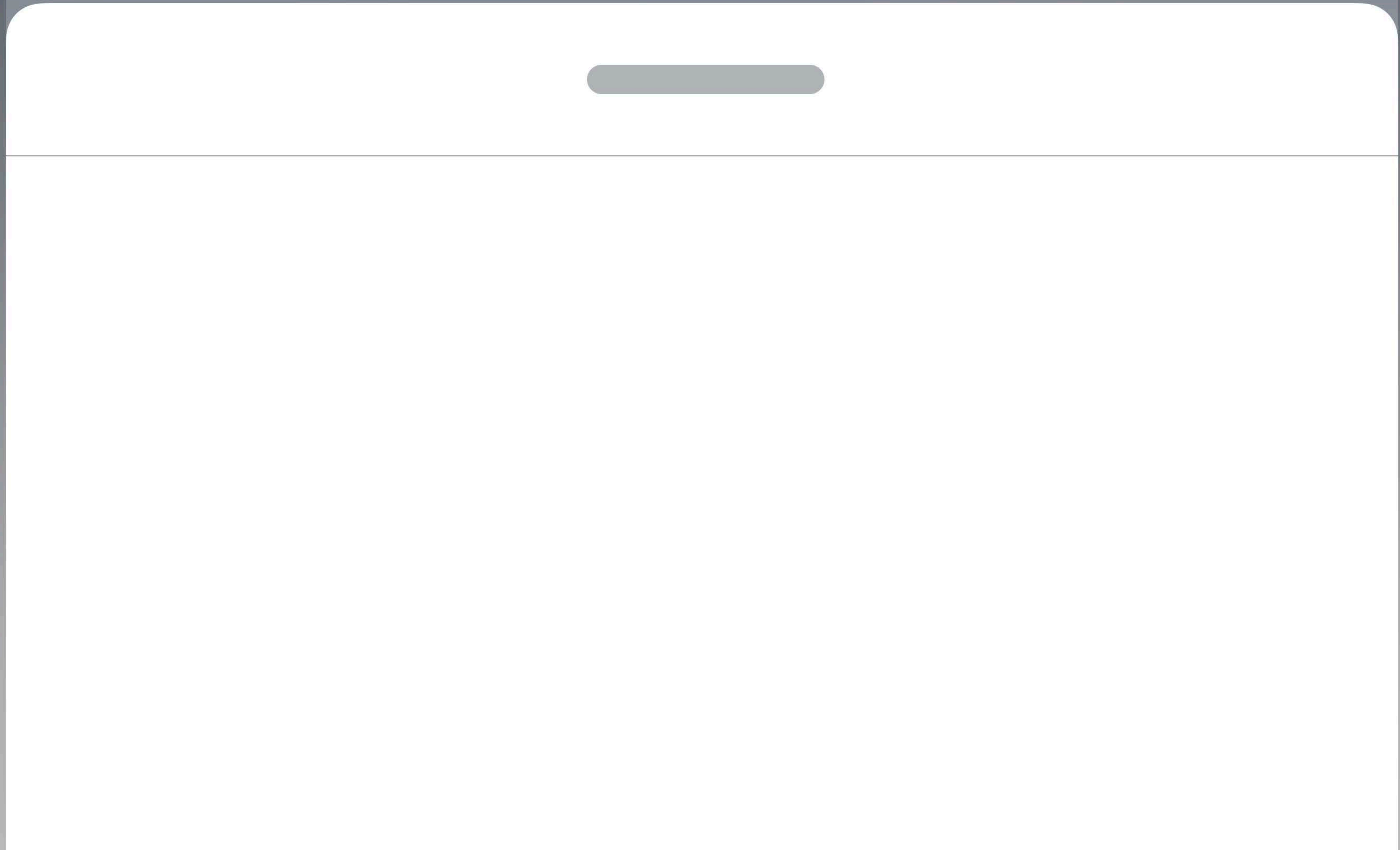
Four

Five

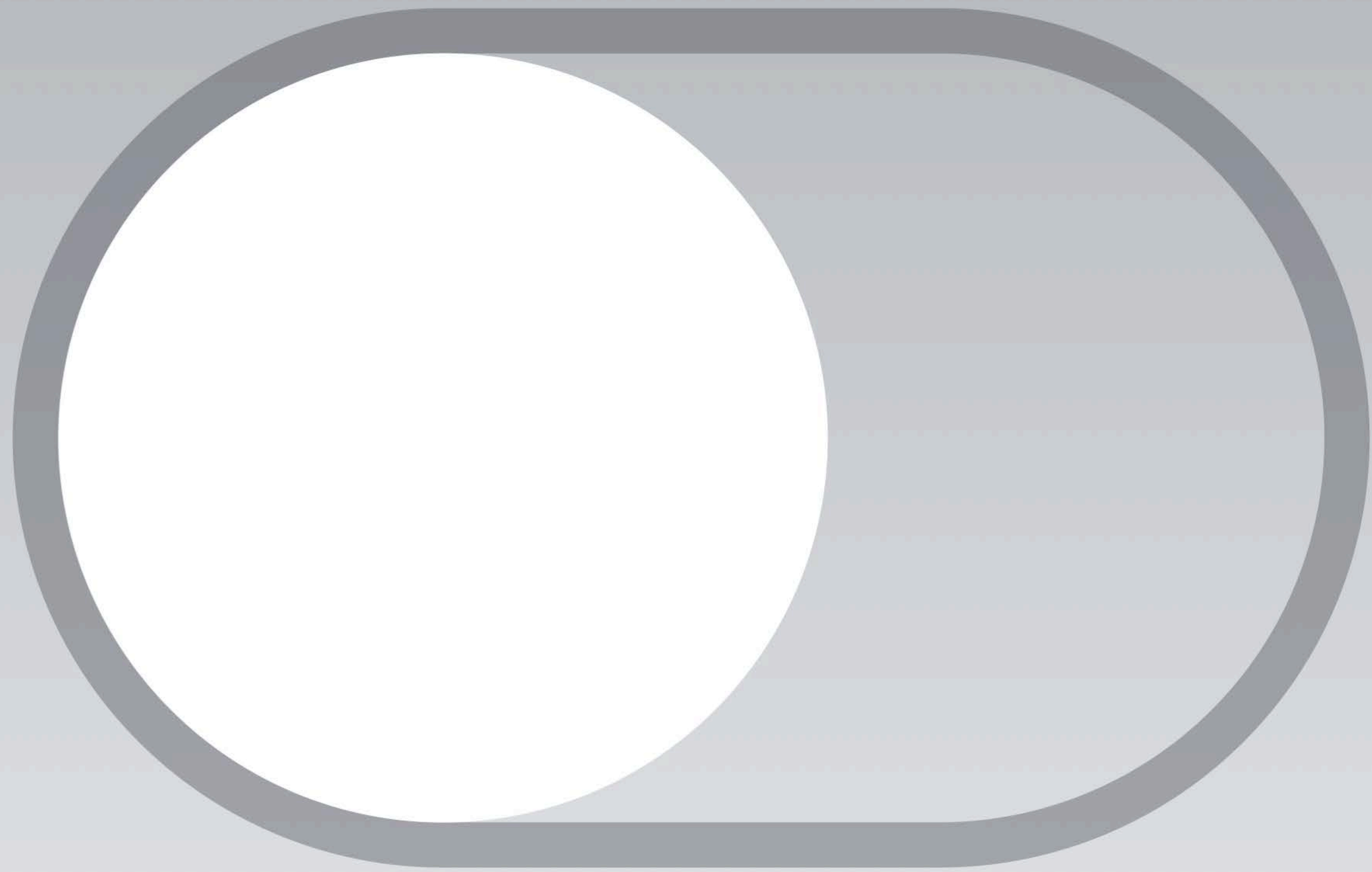
One

Two



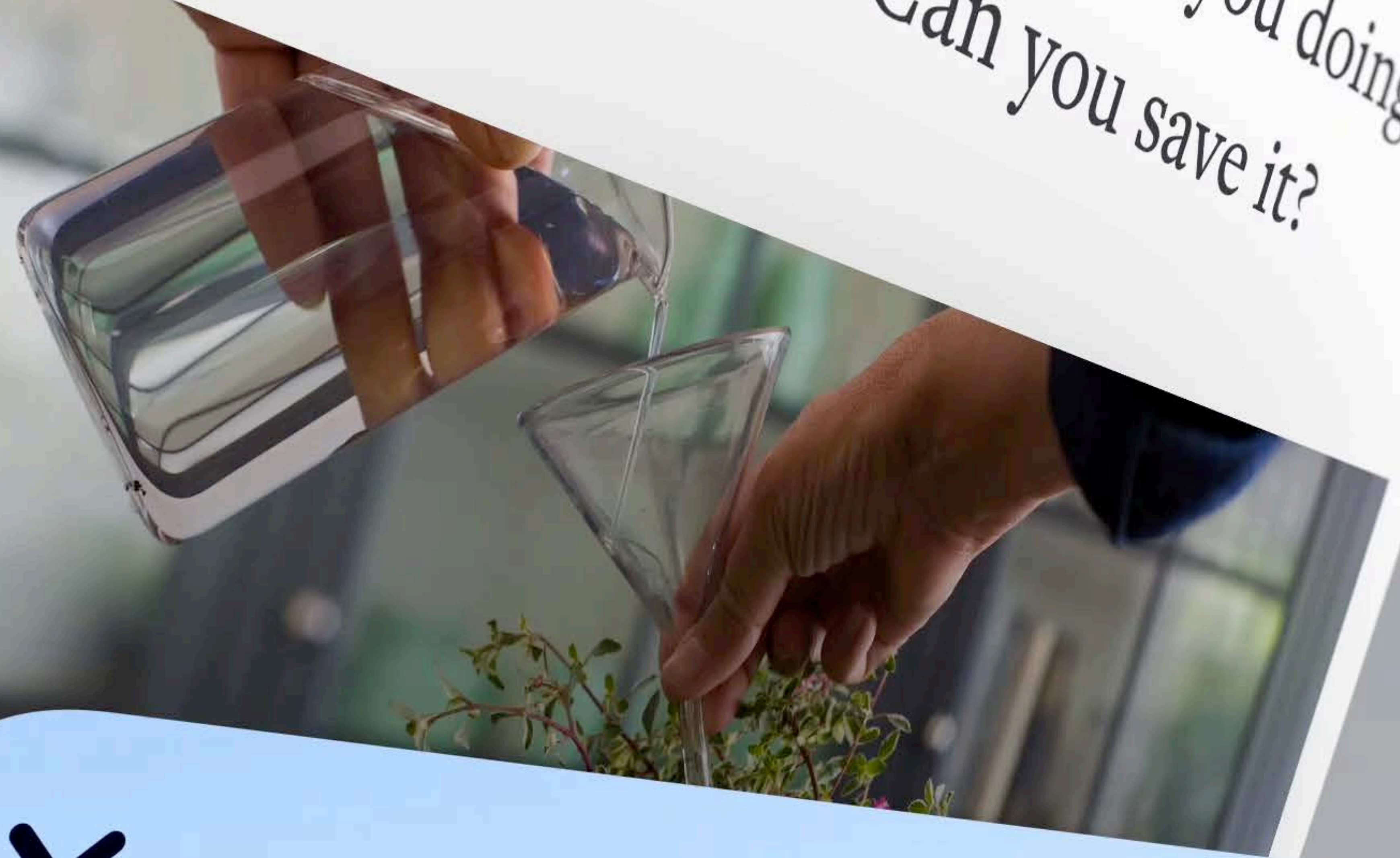


Elevate interactive elements to
a separate plane



Use behavior to teach gesture

... then it
... are you doing
... Can you save it?



T
S
R
M
B
Z

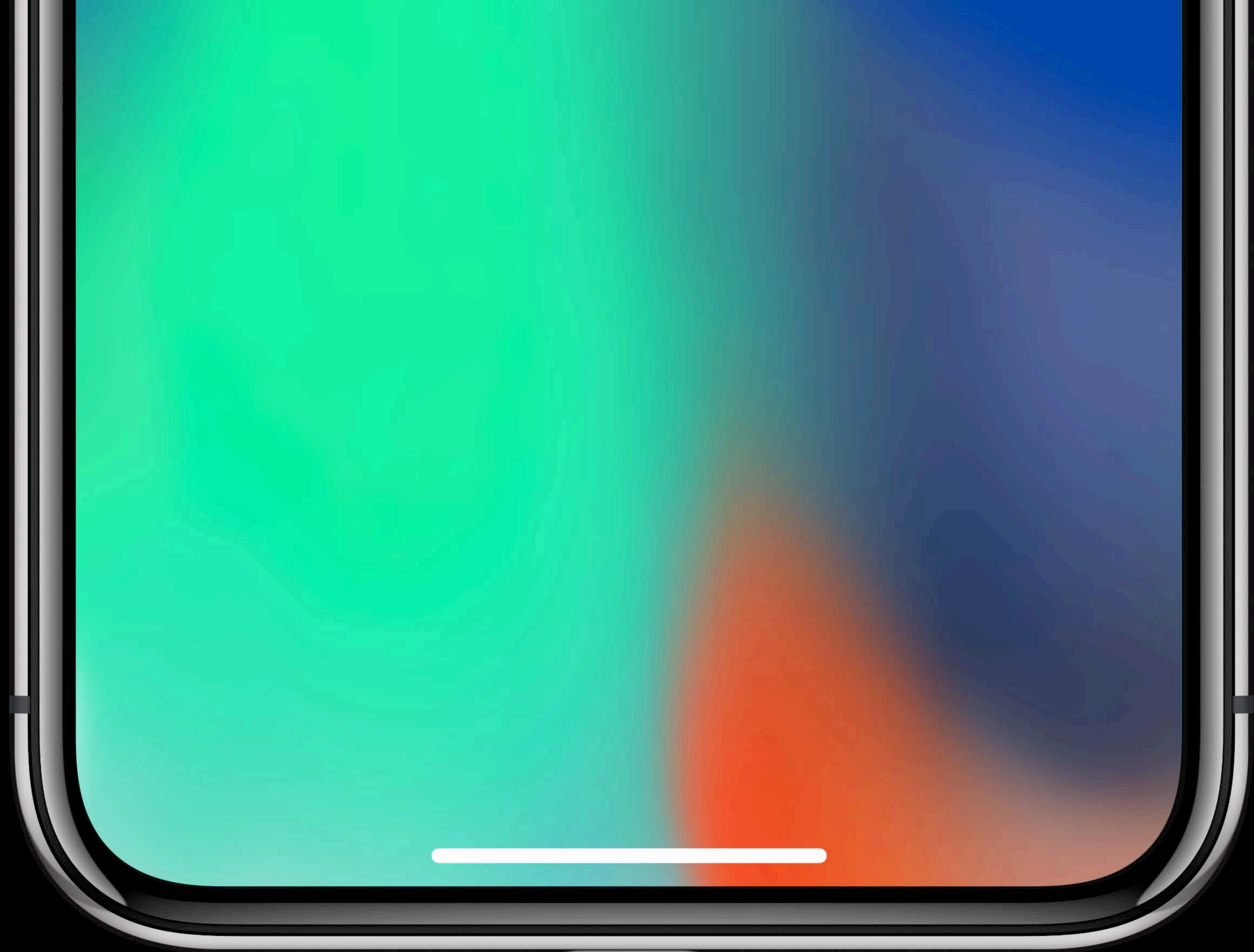


Maia Flore



For a

Explanations



Fun

Playfulness

Playfulness

A natural consequence of a fluid interface

Playfulness

A natural consequence of a fluid interface

Happens when the interface feels in sync with you

Playfulness

A natural consequence of a fluid interface

Happens when the interface feels in sync with you

You feel comfortable exploring new areas

Playfulness

A natural consequence of a fluid interface

Happens when the interface feels in sync with you

You feel comfortable exploring new areas

Allow people to **discover** your interface through play

Play into our natural fiddle factor

Fluidity as a Medium

Fluidity as a Medium

Fluidity as a Medium

Design the interactions to be *inseparable* from the visuals

Fluidity as a Medium

Design the interactions to be *inseparable* from the visuals

A interactive demo is worth a million static designs

Fluidity as a Medium

Design the interactions to be *inseparable* from the visuals

A interactive demo is worth a million static designs

Prototyping helps you *think* by exploring

Fluidity as a Medium

Design the interactions to be *inseparable* from the visuals

A interactive demo is worth a million static designs

Prototyping helps you *think* by exploring

Sets a goal for the implementation

Fluidity as a Medium

Design the interactions to be *inseparable* from the visuals

A interactive demo is worth a million static designs

Prototyping helps you *think* by exploring

Sets a goal for the implementation

Hard to copy and gives your app a unique character

 **WWDC18**