NOW:

TIME

http://getwallpapers.com/wallpaper/full/f/8/c/573277.jpg

https://en.wikipedia.org/

ANTIKYTHERA MECHANISM

~100BCE

BACK

CLOCK of the LONG NOW

01997, ONGOING

http://longnow.org/clock/


A Story That Lasts 10,000 Years (featuring Neil Gaiman)
Long Now
1:18 / 1:29
Scroll for details

WHY TIME AT ITP?

PHILOSOPHY

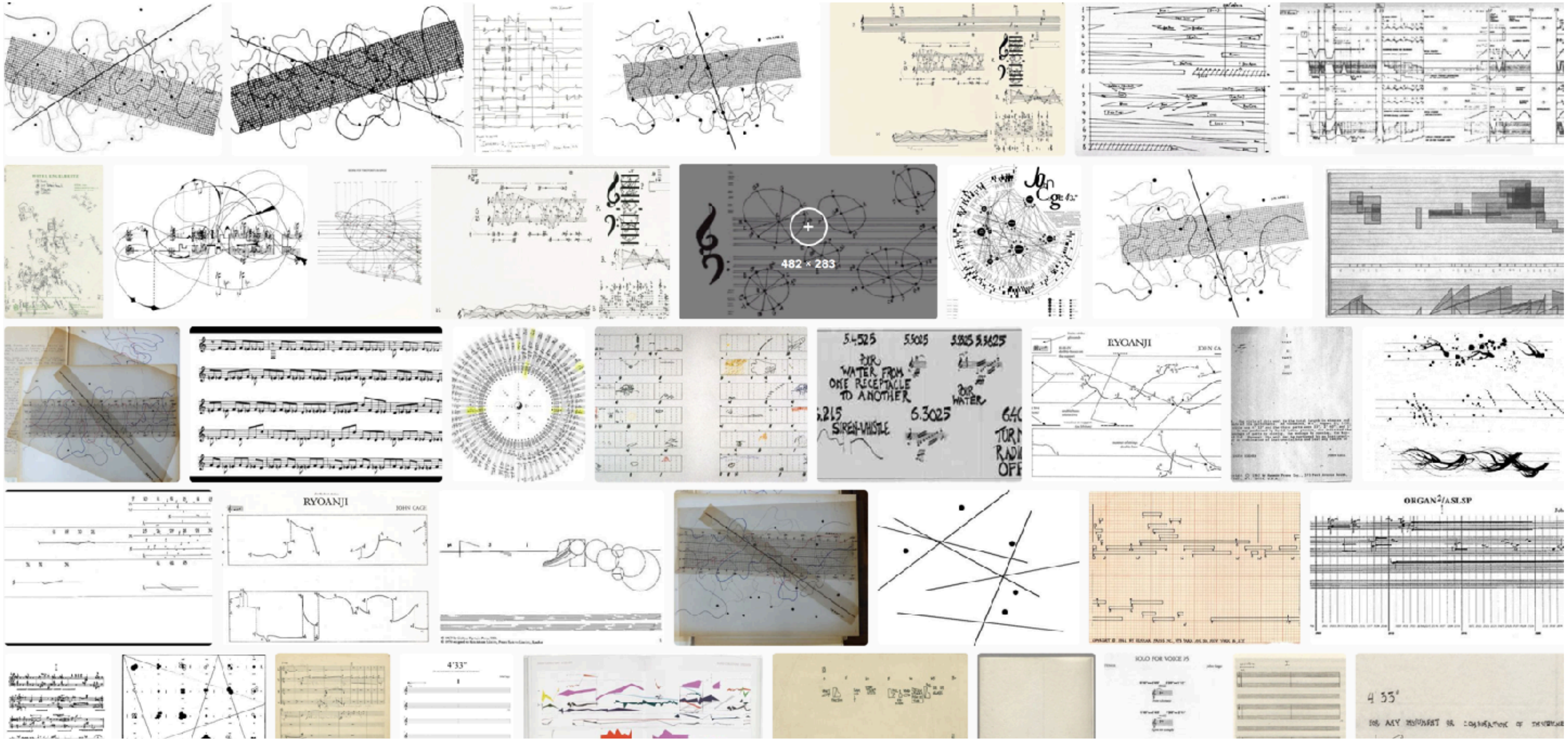
Language, history, politics, life…

+

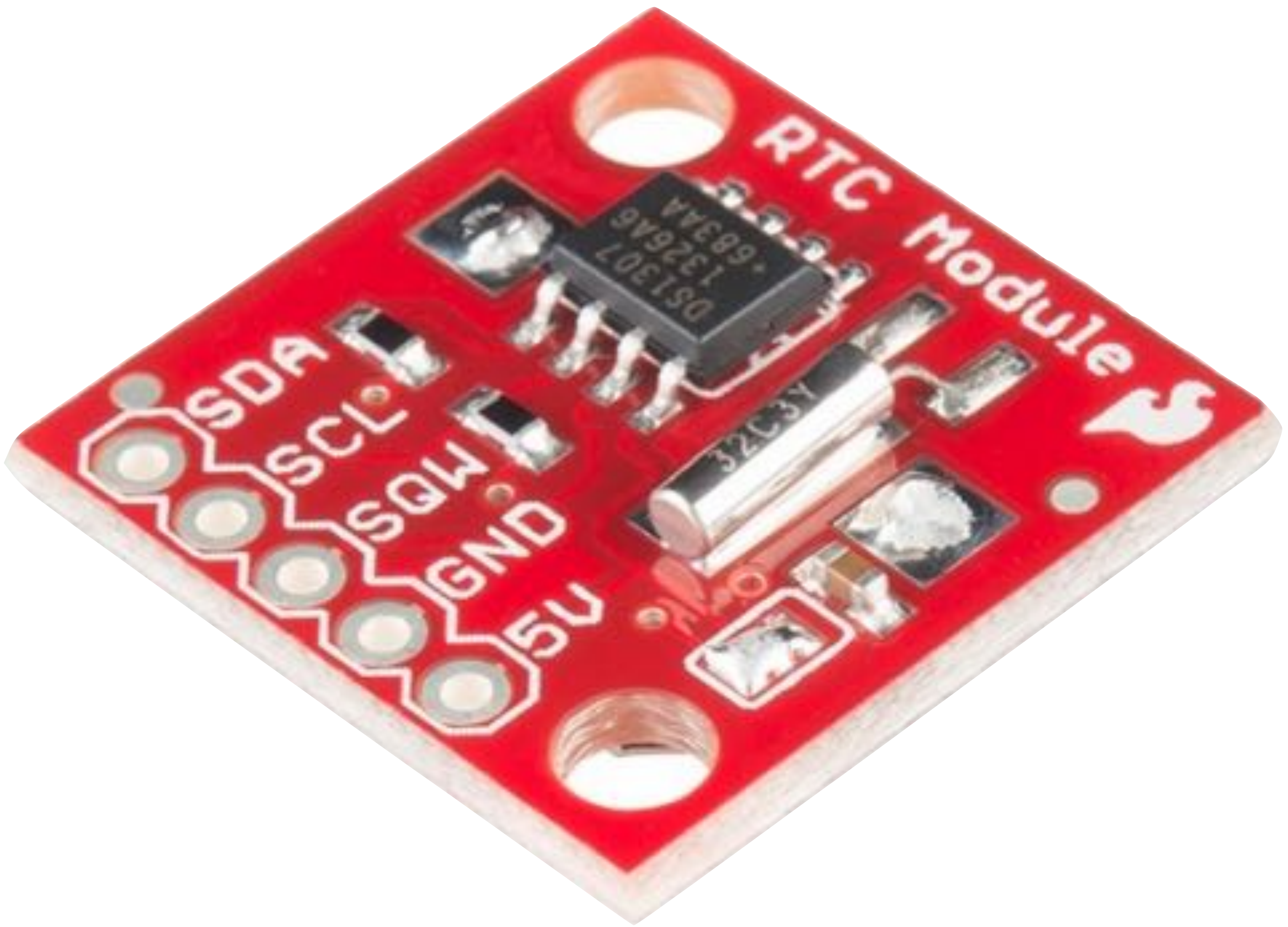
SCIENCE

Modeling nature, engineering, code, design…

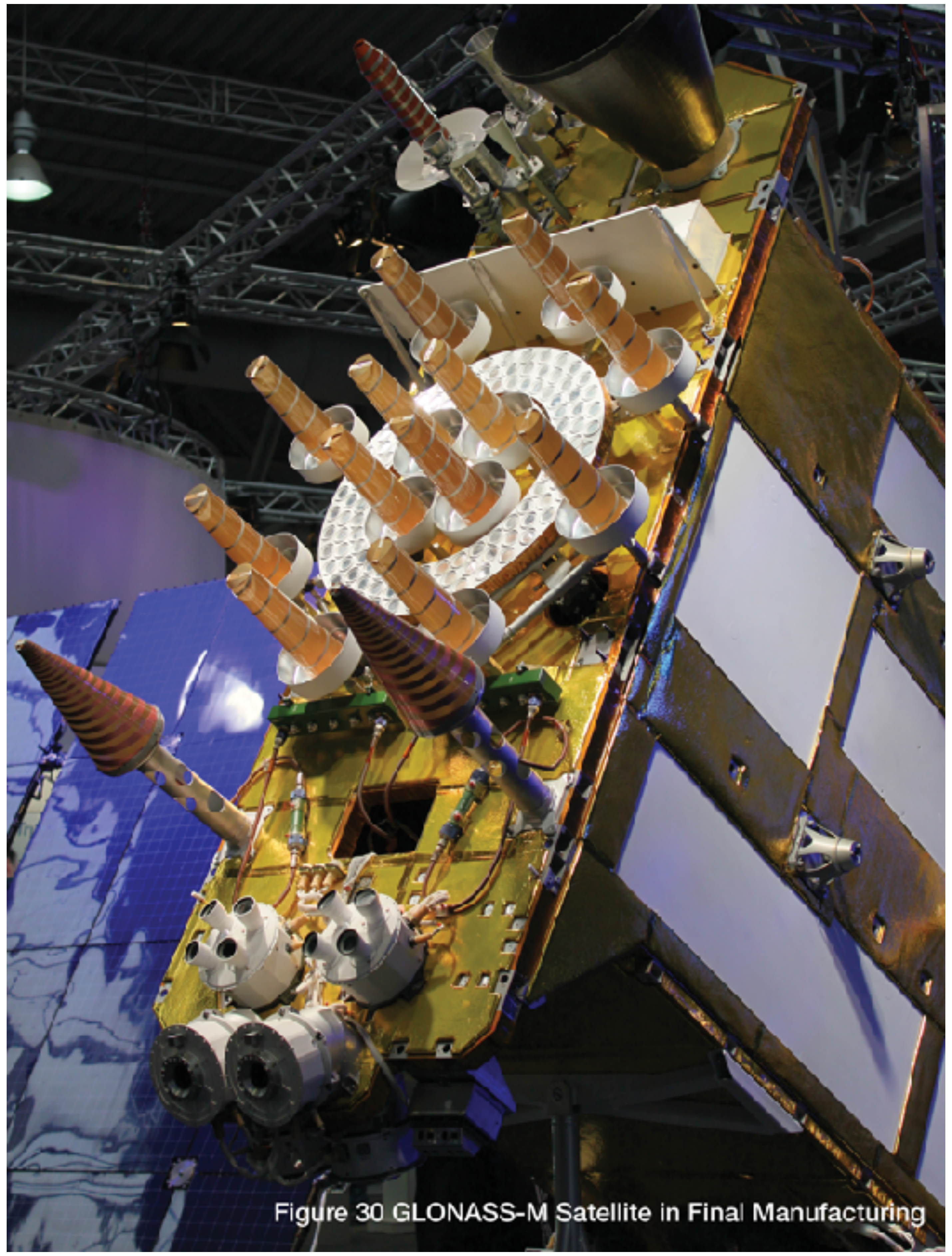
http://getwallpapers.com/wallpaper/full/f/8/c/573277.jpg



482 × 283
FOR WATER FROM ONE RECEPTACLE TO ANOTHER
SIREN-WHISTLE
RYOANJI
JOHN CAGE
RYOANJI
ORGAN²/ASLSP
4'33"



Sparkfun RTC Breakout boards



Russian GLONASS satellite with atomic clock

gnomon (n.)

"vertical shaft that tells time by the shadow it casts" … from Latin *gnomon*, from Greek *gnōmōn* "indicator (of a sundial), carpenter's rule" … "one that discerns or examines, interpreter, expert," from *gignōskein* "to come to know," **from Proto-Indo-European root *gno- "to know."**

https://www.etymonline.com/word/gnomon

ARJUNA

“As rivers flow into the ocean, all the warriors of this world are passing into your fiery jaws; all creatures rush to their destruction like moths to a flame. You lap the worlds into your burning mouths and swallow them... Tell me who you are, O Lord of terrible form. I bow before you; have mercy! I want to know who you are, you who existed before all creation. Your nature and workings confound me.”

KRISHNA

"I AM TIME, DESTROYER OF ALL."

BHAGAVAD GITA

TAOSI GNOMON

Xiangfen 襄汾, Shanxi Province

2300 - 1900 BCE

Oldest gnomon, oldest observatory

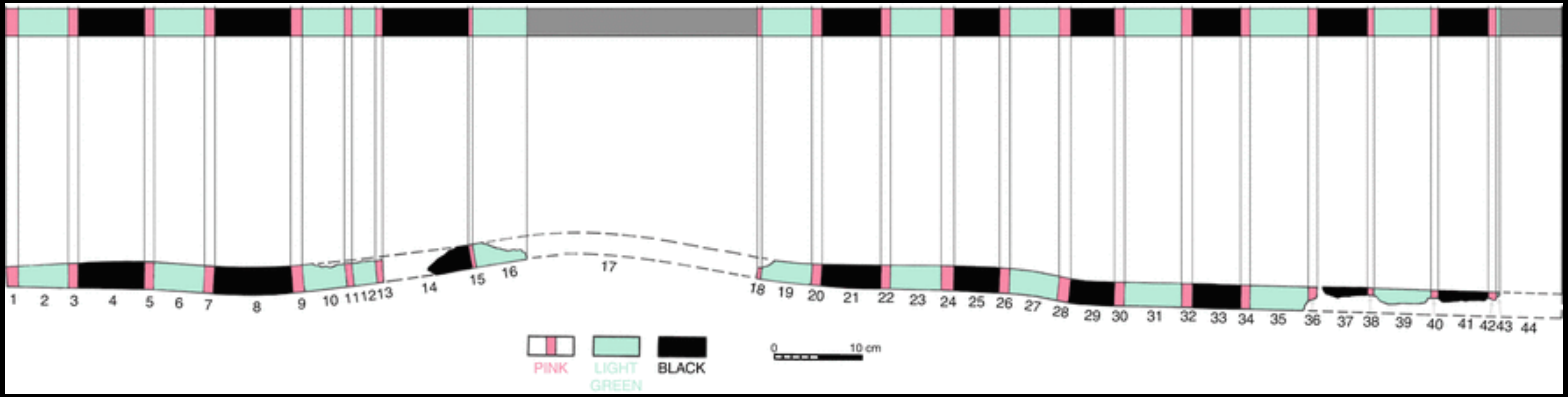
[Handbook of Archaeoastronomy and Ethnoastronomy]

TAOSI GNOMON

Xiangfen 襄汾, Shanxi Province

2300 - 1900 BCE

Oldest gnomon, oldest observatory



[Handbook of Archaeoastronomy and Ethnoastronomy]

TAOSI GNOMON

Xiangfen 襄汾, Shanxi Province

2300 - 1900 BCE

Oldest gnomon, oldest observatory

[Handbook of Archaeoastronomy and Ethnoastronomy]

EGYPTIAN SUNDIAL

13th century BCE

“temporary hours”

livescience.com

BYZANTINE SUNDIAL
6TH CENTURY CE

http://hist.science.online.fr/


JANTAR MANTAR, JAIPUR
goibibo.com

JANTAR MANTAR, JAIPUR

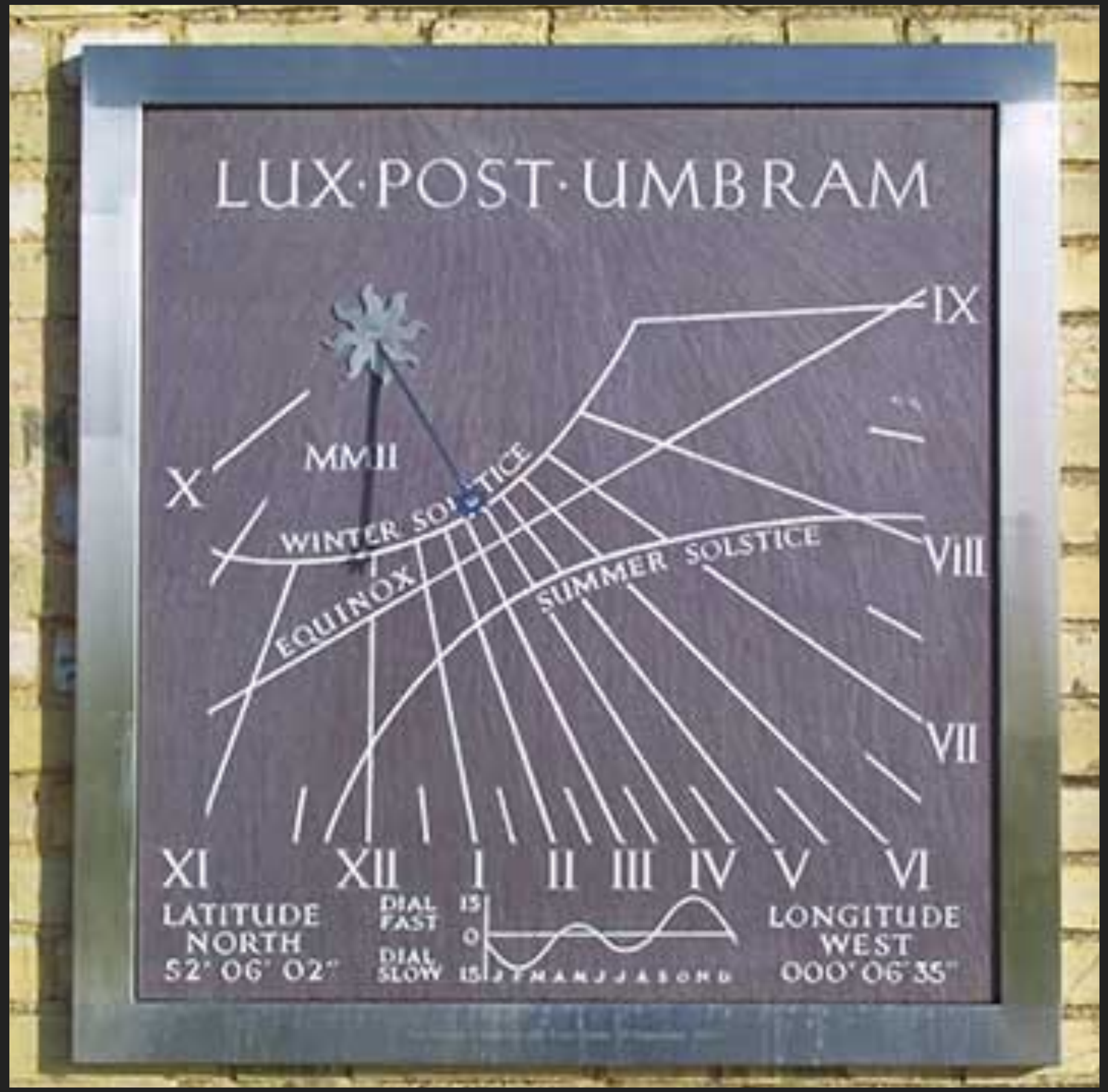
wikipedia

https://www.helios-sonnenuhren.de/en/helios-subsolaris
https://www.helios-sonnenuhren.de/en/helios-solar-ring

HORIZONTAL

sundialsoc.org.uk

VERTICAL



https://www.davidharber.co.uk/

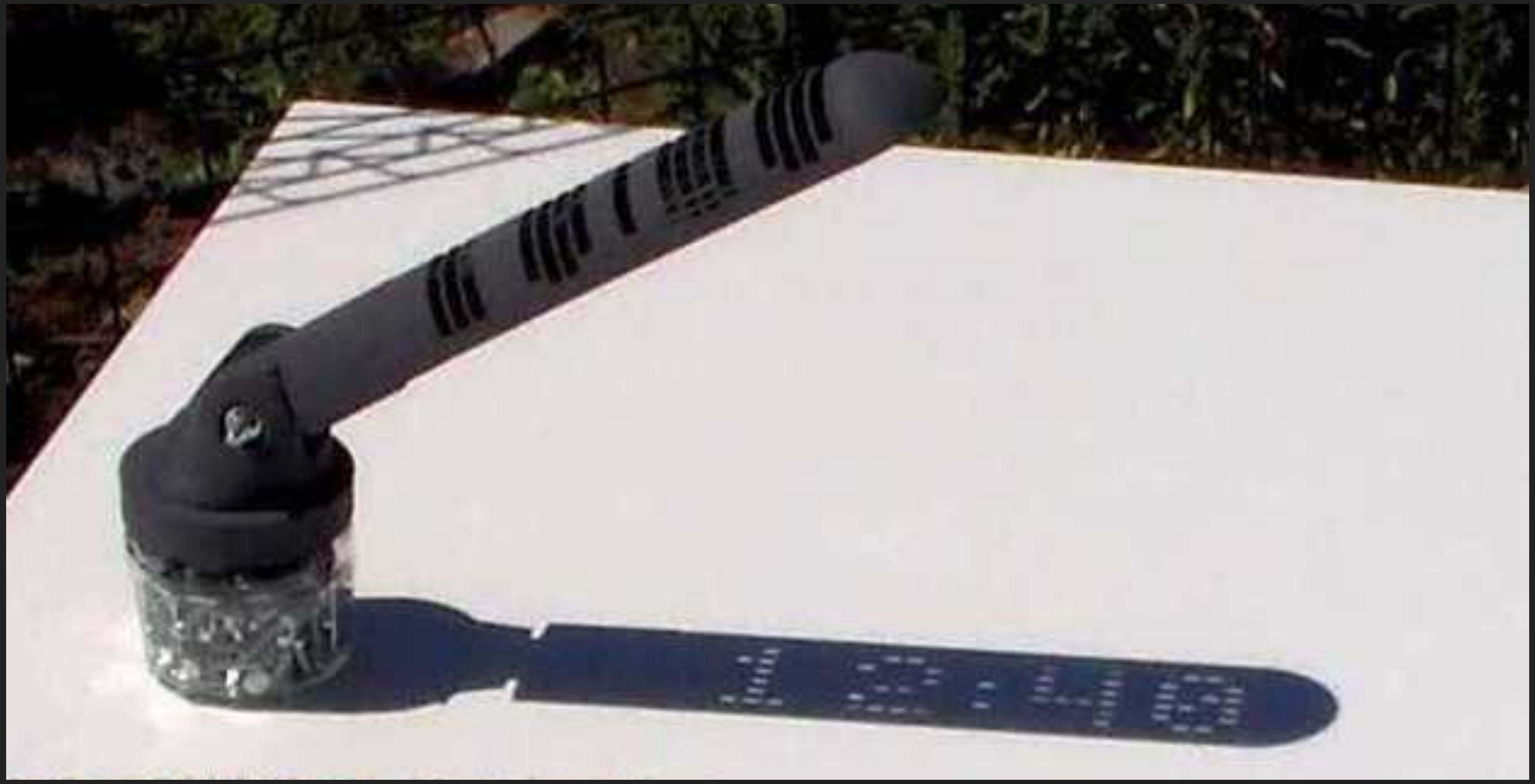
EQUITORIAL

ebay.com

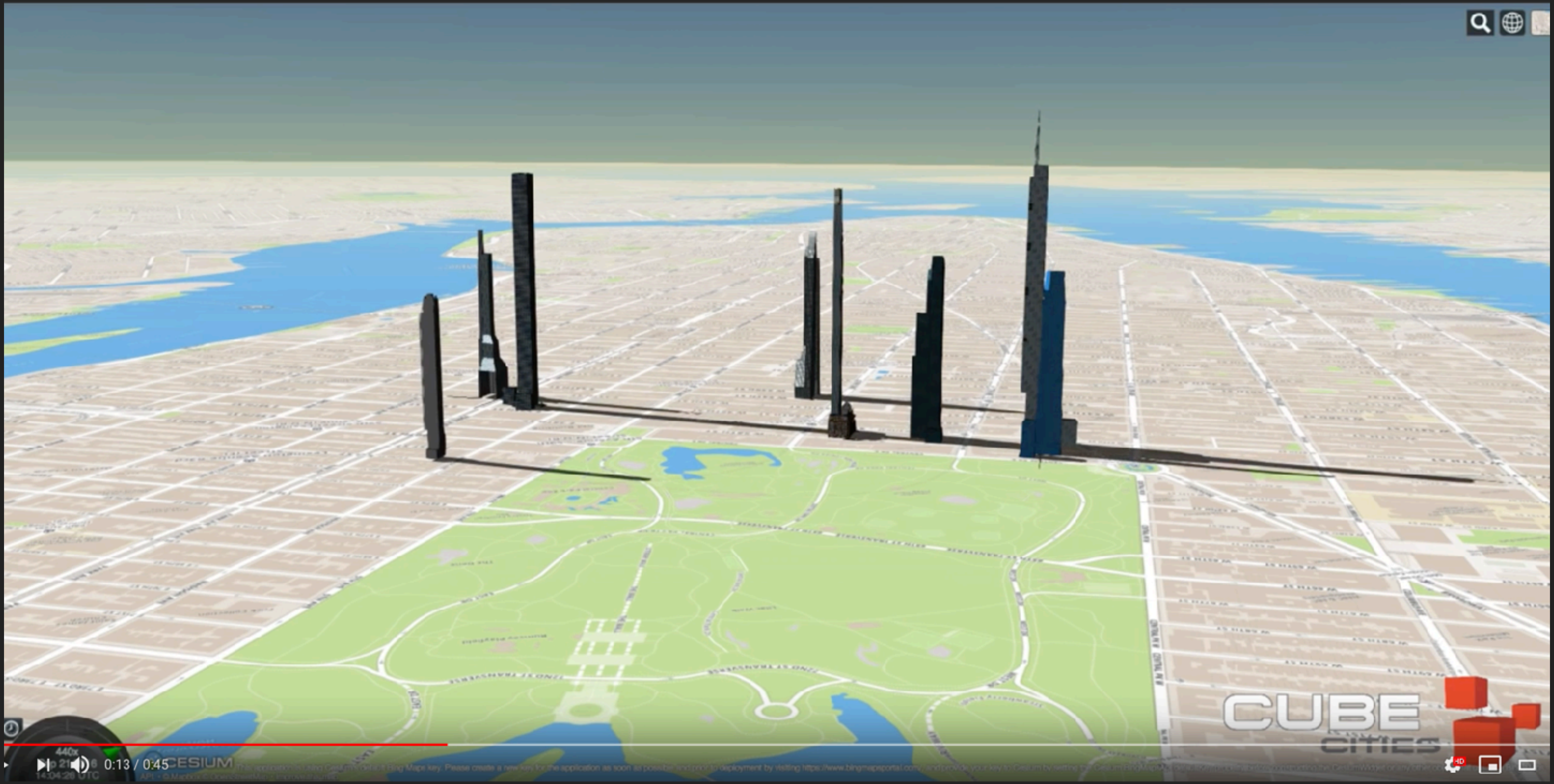
CONCAVE

Jang Yeong-sil Science Garden

JIYEON SONG, ONE DAY POEM PAVILION

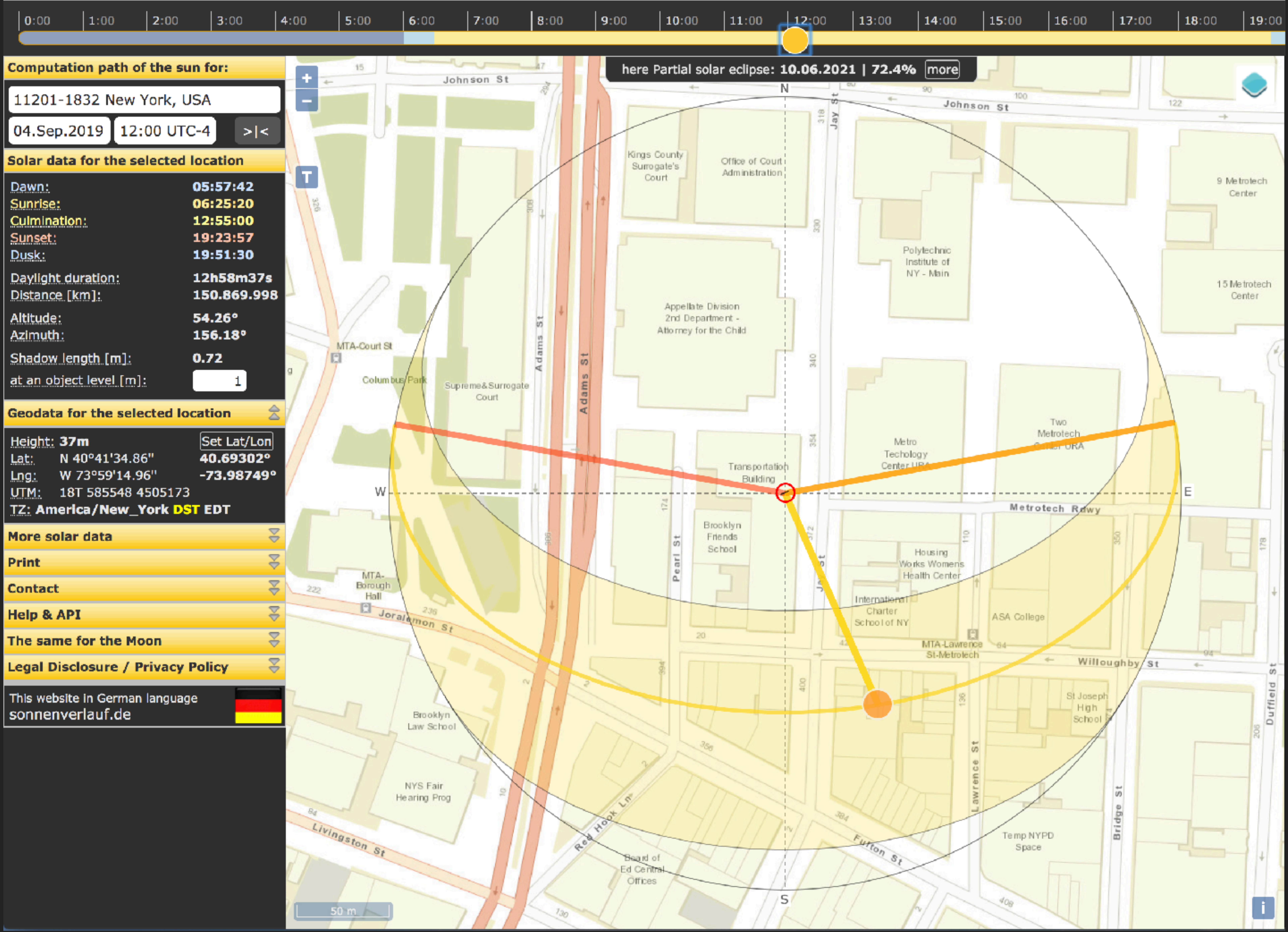


https://www.thingiverse.com/thing:1068443

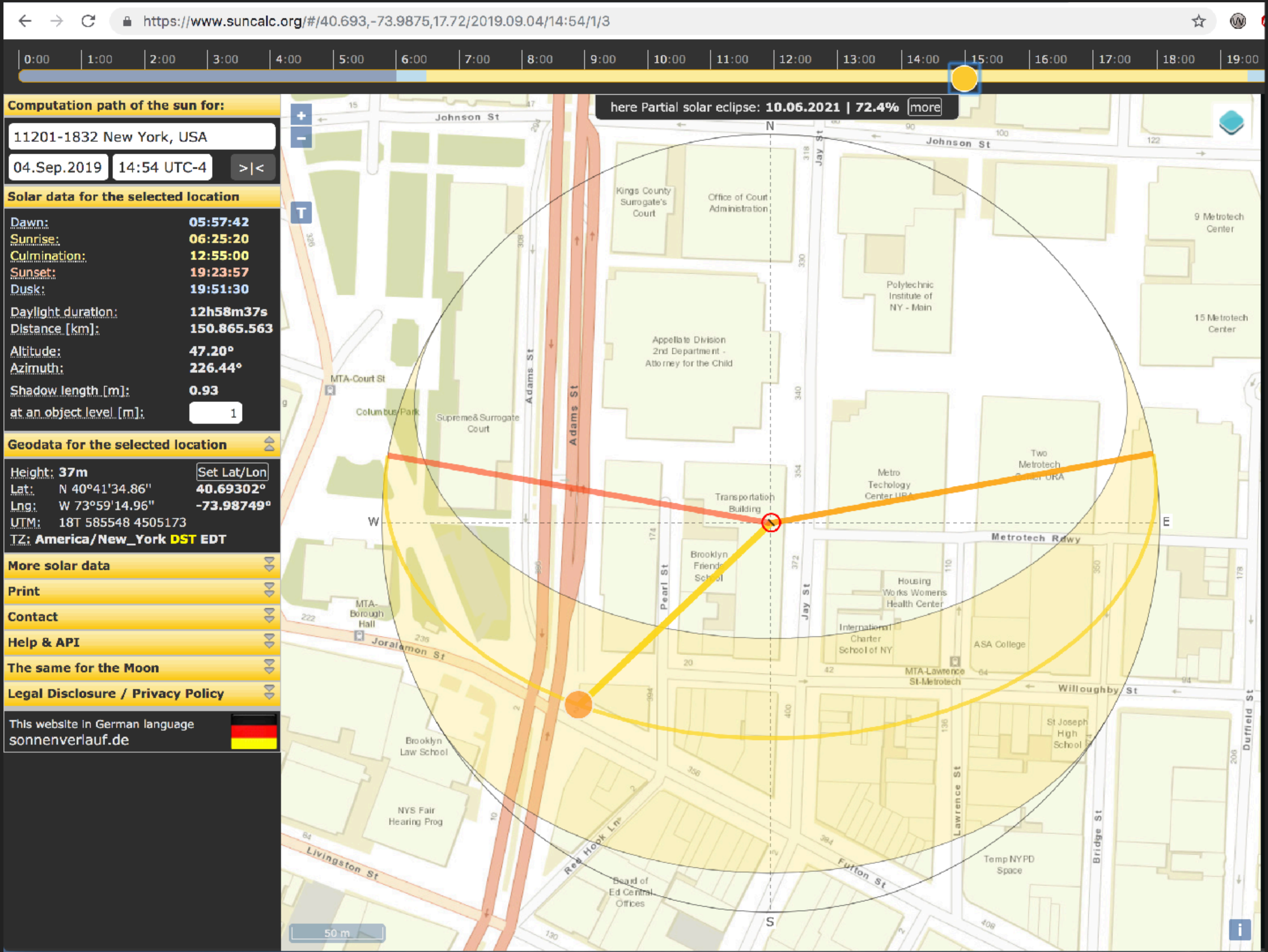


https://www.youtube.com/watch?v=_E3IqHq2tNU


PIZZA
PHARMACY

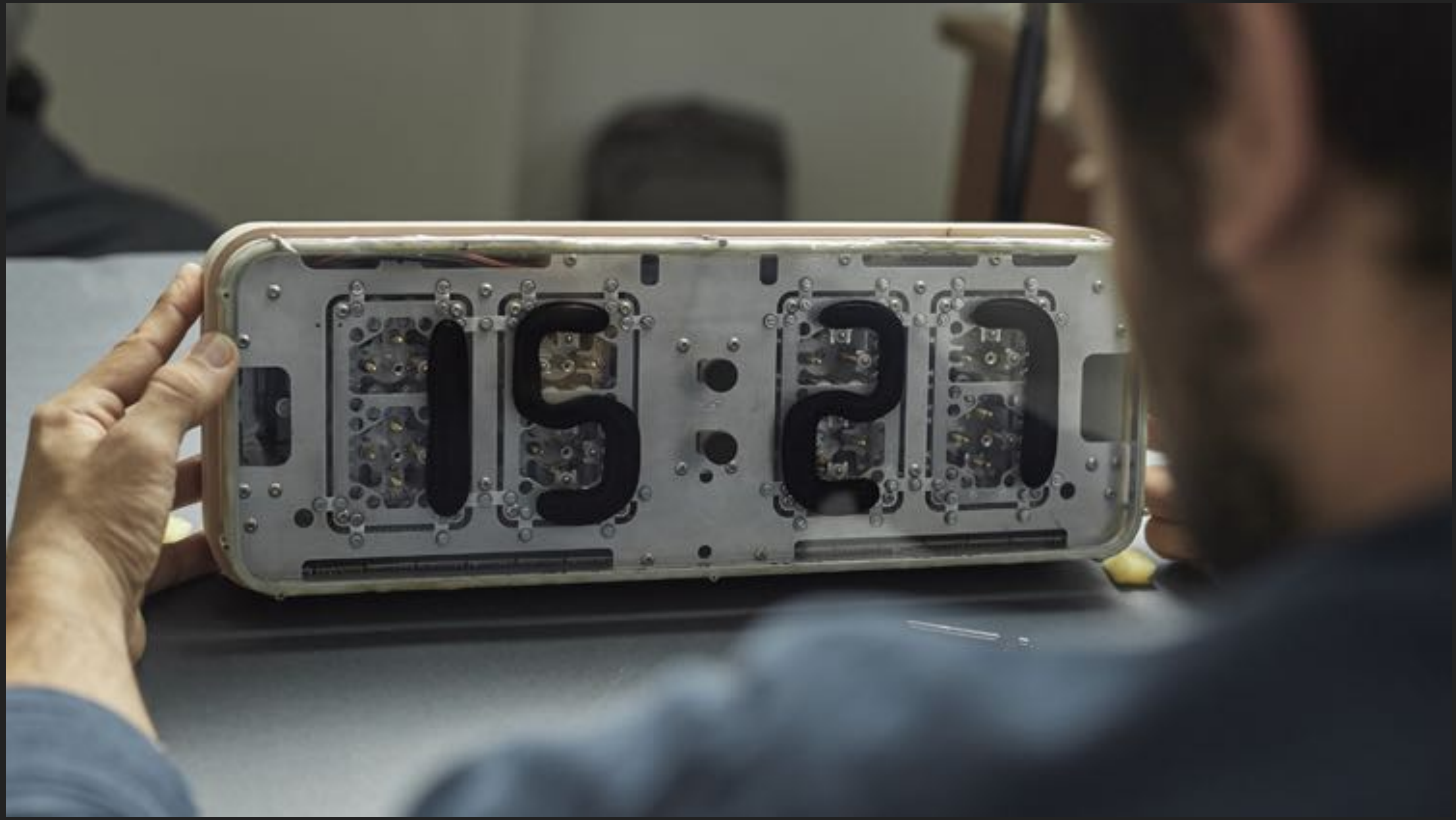


https://www.suncalc.org/#/40.693,-73.9875,17.72/2019.09.04/14:54/1/3


https://www.suncalc.org/#/40.693,-73.9875,17.72/2019.09.04/14:54/1/3
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00
Computation path of the sun for:
11201-1832 New York, USA
04.Sep.2019
14:54 UTC-4
>|<
Solar data for the selected location
Dawn: 05:57:42
Sunrise: 06:25:20
Culmination: 12:55:00
Sunset: 19:23:57
Dusk: 19:51:30
Daylight duration: 12h58m37s
Distance [km]: 150.865.563
Altitude: 47.20°
Azimuth: 226.44°
Shadow length [m]: 0.93
at an object level [m]: 1
Geodata for the selected location
Height: 37m
Set Lat/Lon
Lat: N 40°41'34.86" 40.69302°
Lng: W 73°59'14.96" -73.98749°
UTM: 18T 585548 4505173
TZ: America/New_York DST EDT
More solar data
Print
Contact
Help & API
The same for the Moon
Legal Disclosure / Privacy Policy
This website in German language
sonnenverlauf.de
here Partial solar eclipse: 10.06.2021 | 72.4% more
N
S
W
E
Johnson St
Kings County Surrogate's Court
Office of Court Administration
9 Metrotech Center
Polytechnic Institute of NY - Main
15 Metrotech Center
Appellate Division 2nd Department - Attorney for the Child
MTA-Court St
Columbus Park
Supreme& Surrogate Court
Adams St
Jay St
Two Metrotech
Metro Techology Center
Transportation Building
Metrotech Rdwy
Brooklyn Friends School
Pearl St
Housing Works Womens Health Center
International Charter School of NY
ASA College
MTA-Borough Hall
Joralemon St
MTA-Lawrence St-Metrotech
Willoughby St
St Joseph High School
Brooklyn Law School
NYS Fair Hearing Prog
Lawrence St
Bridge St
Duffield St
Temp NYPD Space
Red Hook Ln
Fulton St
Livingston St
Board of Ed Central Offices
50 m

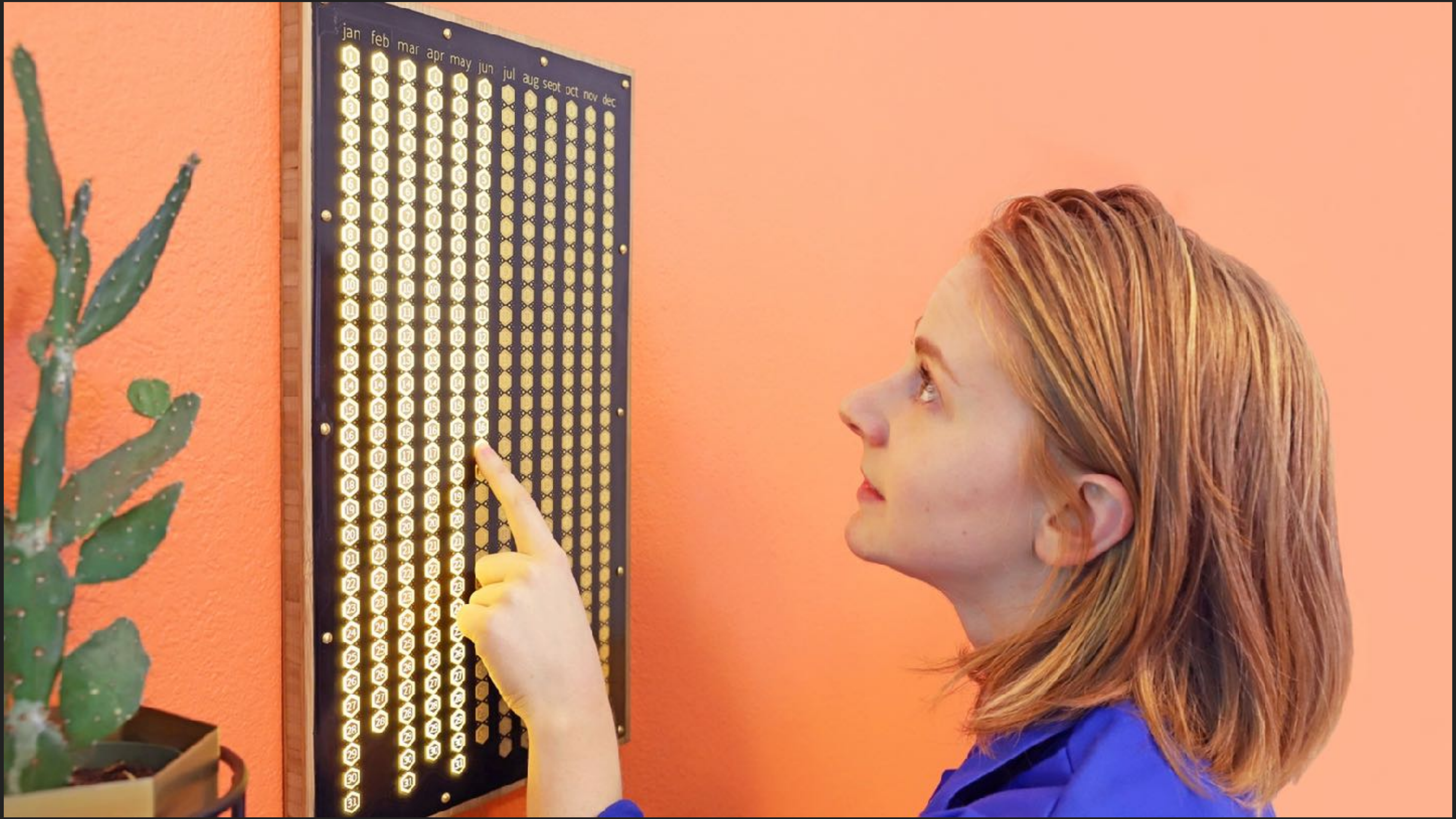
Clocks are cool

Straousborg Astronomical Clock [Atlas Obscura]



[Ferrofluid Clock]

[Scott Thrift 1-year and 1-day clock]

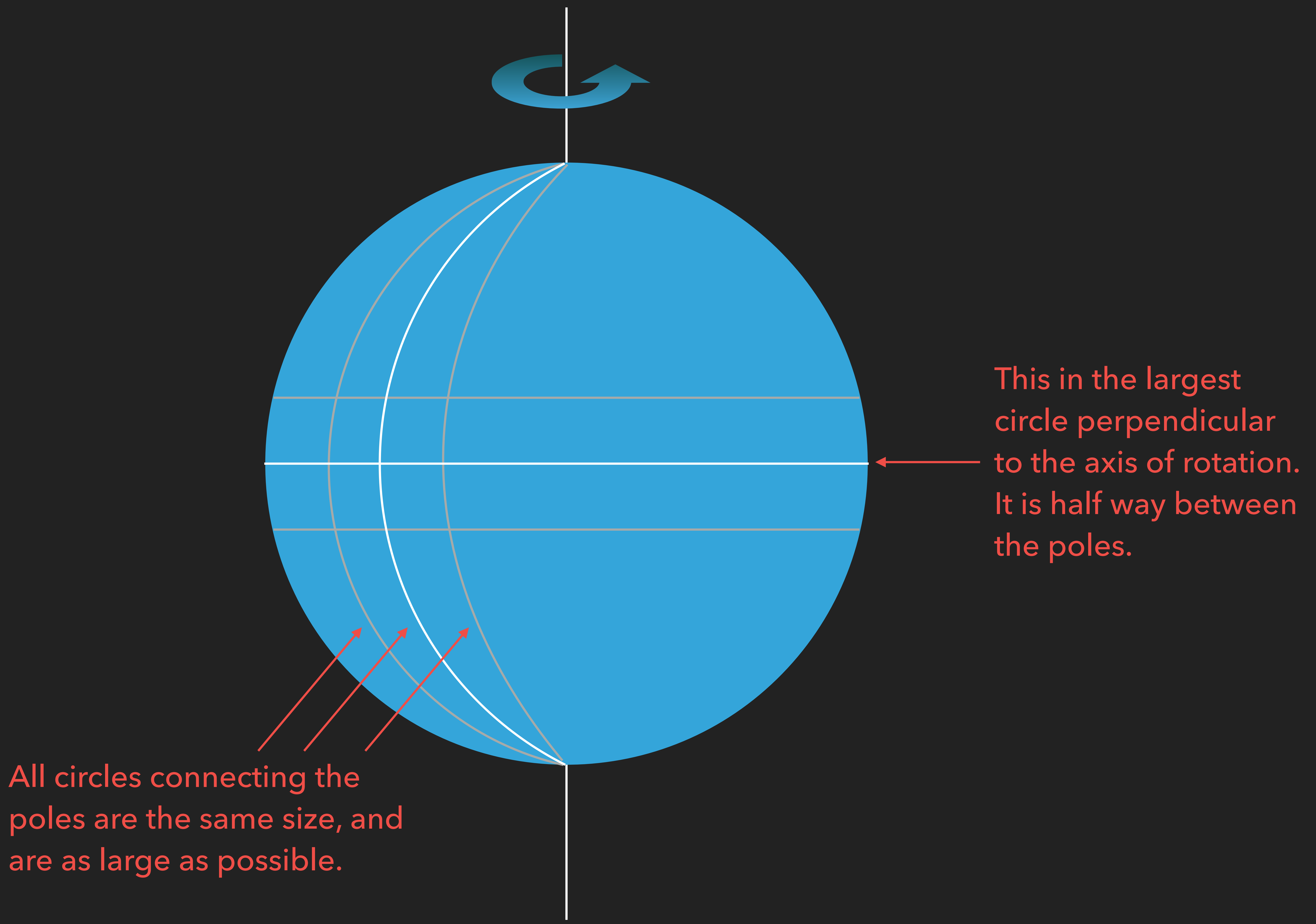


[Simone Giertz Every Day Calendar]

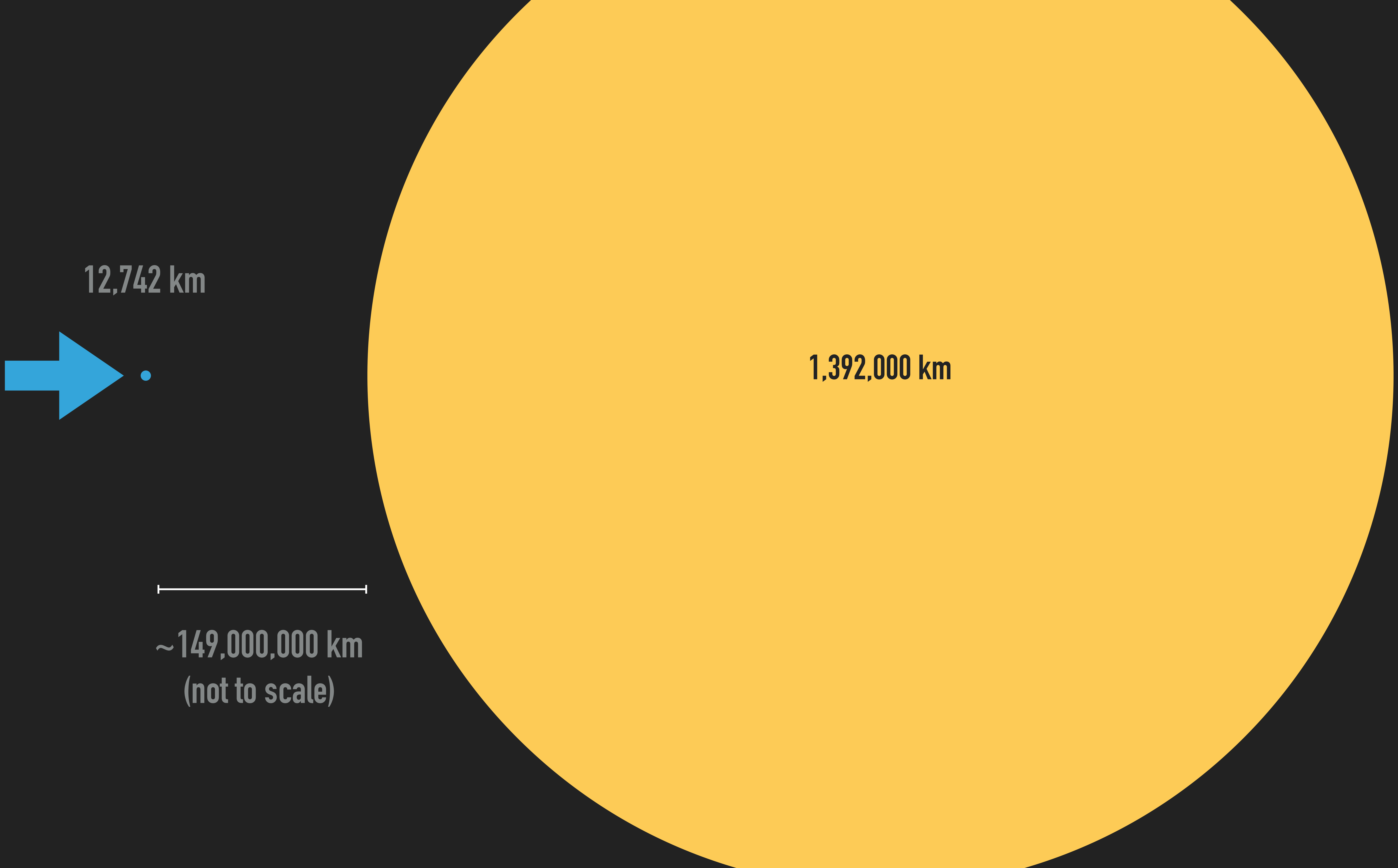
SPACE

A SPHERE IN SPACE

A SPHERE IN SPACE, SPINNING

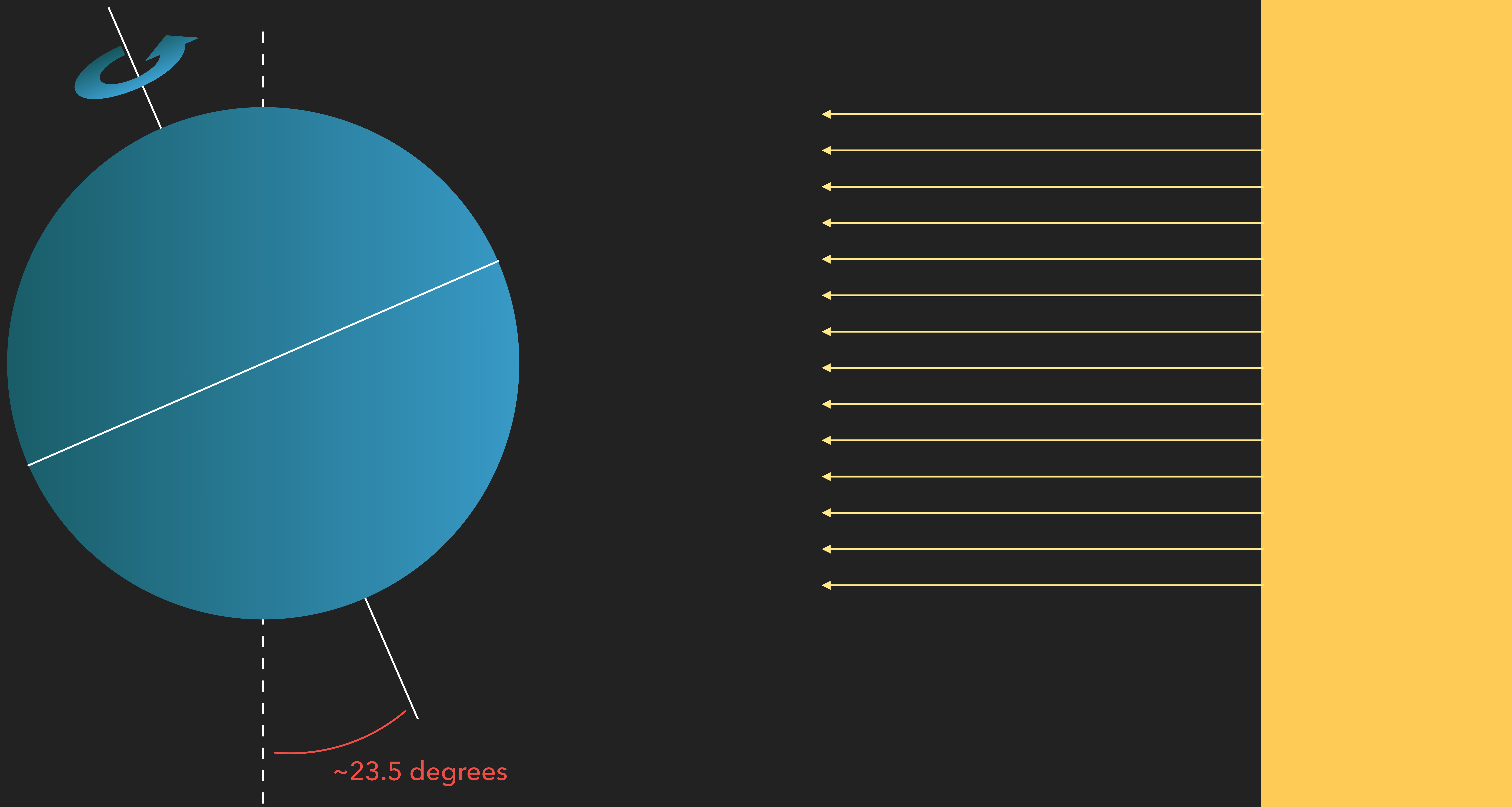


RELATIVE SIZE, SUN 109X EARTH'S DIAMETER



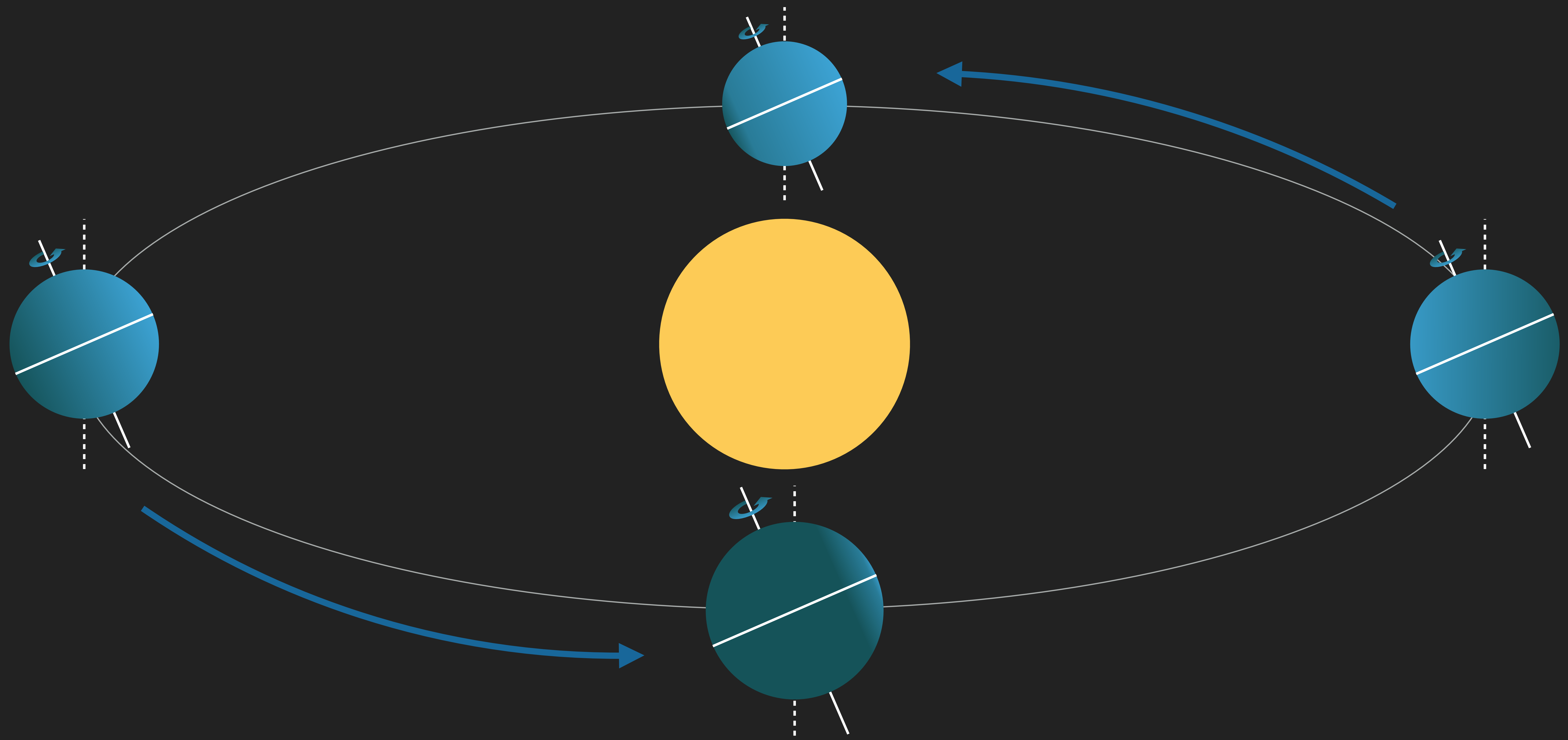
RELATIVE DISTANCE, EARTH NOT VISIBLE

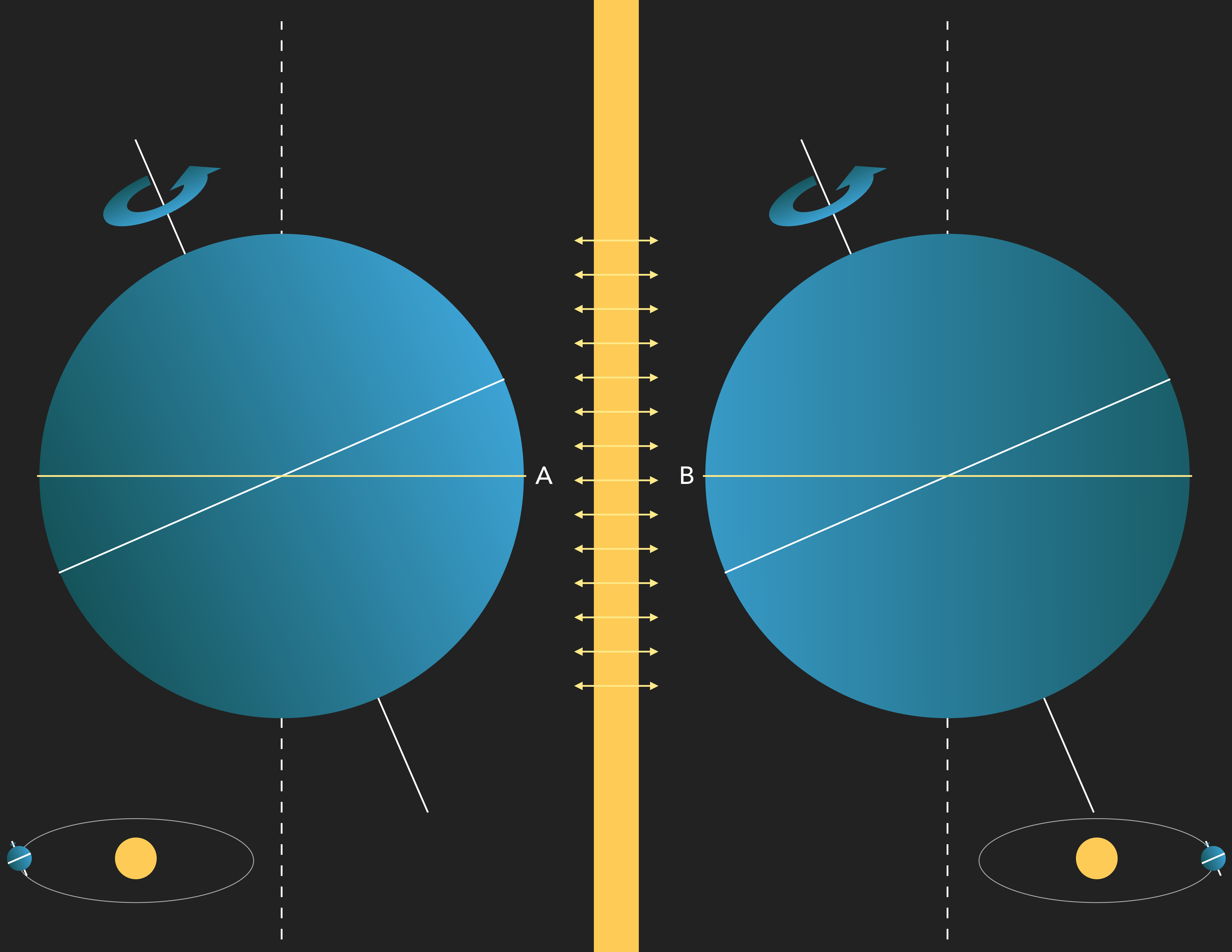
A SPHERE IN SPACE, SPINNING, TILTED

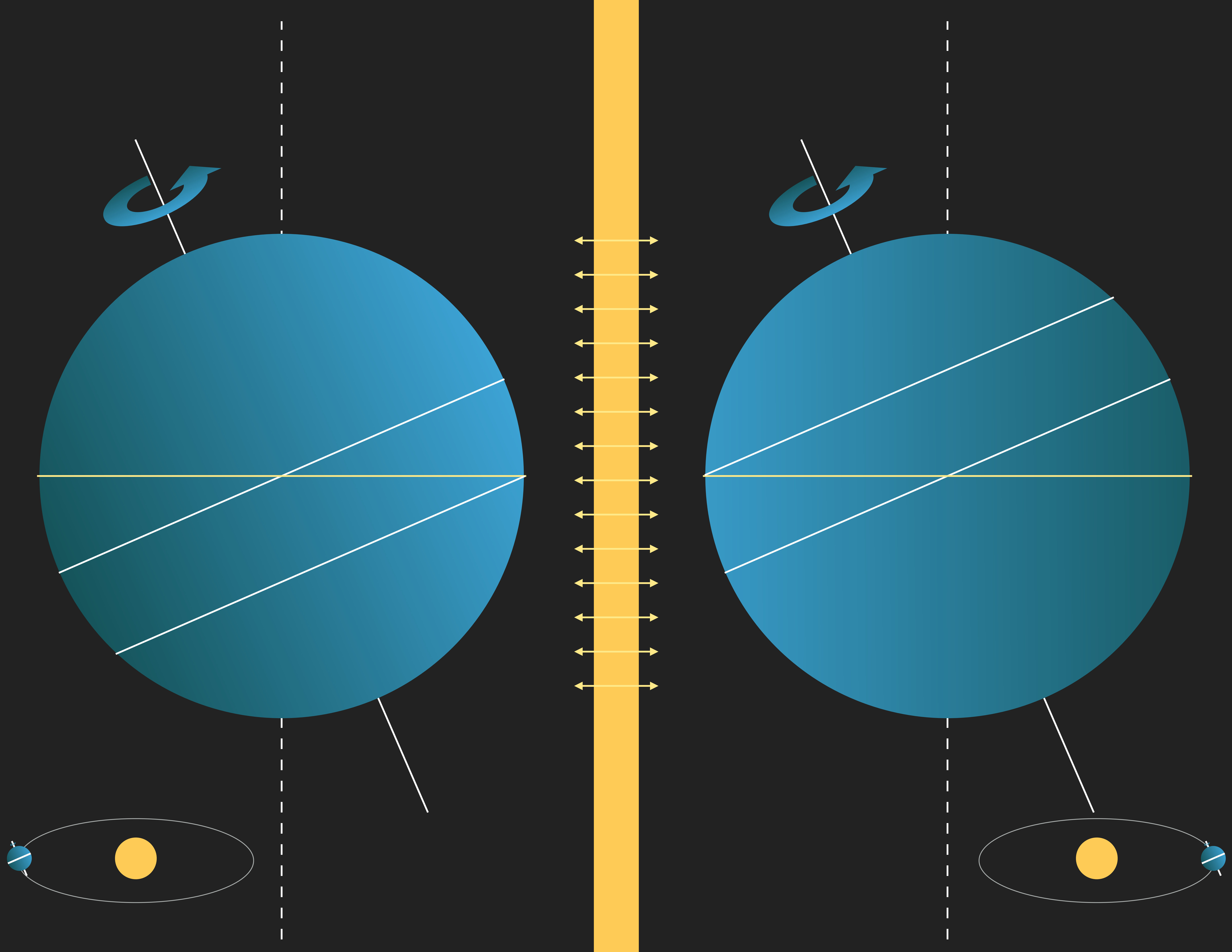


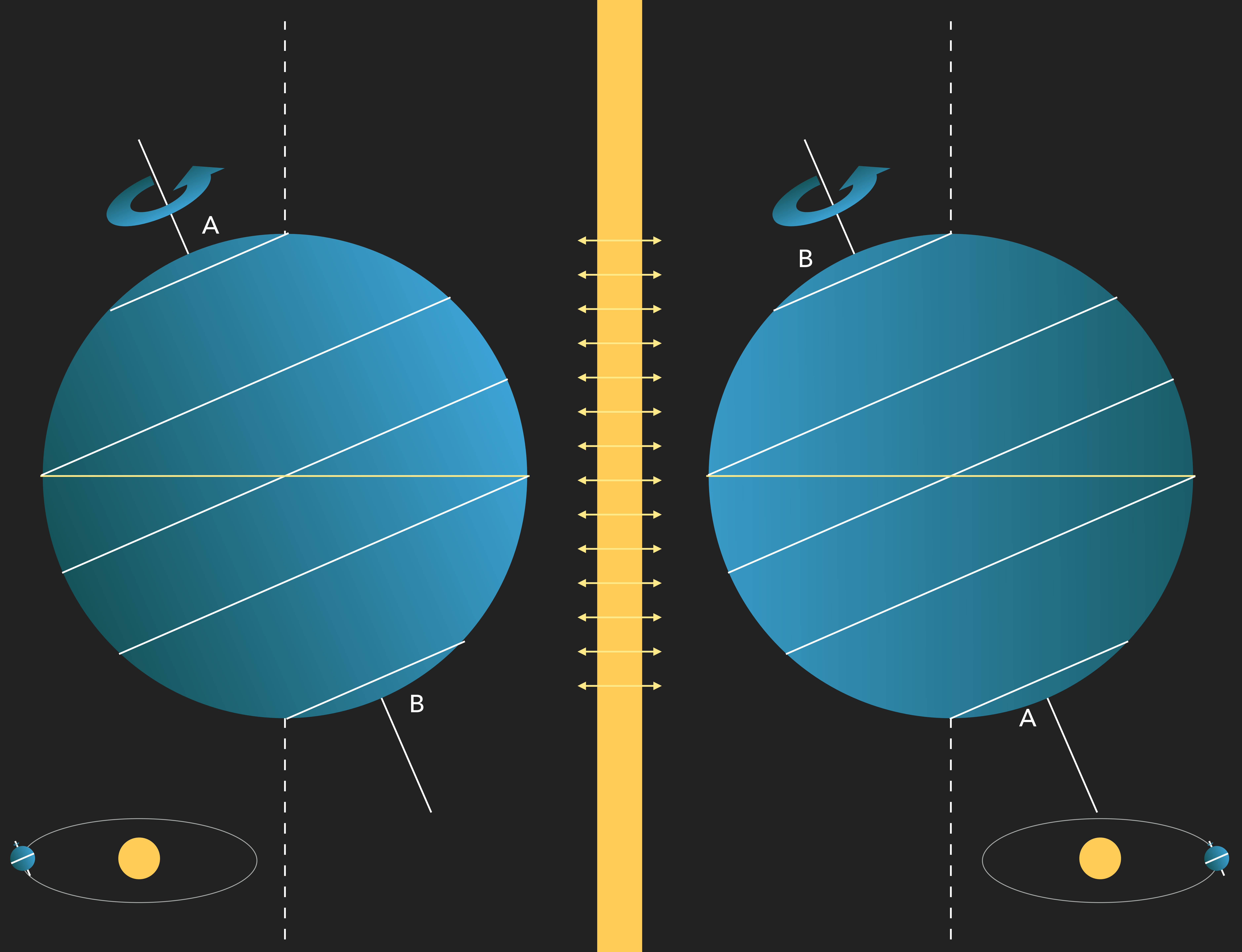
A SPHERE SPINNING, TILTED, AND ORBITING

WITH CONSTANT TILT

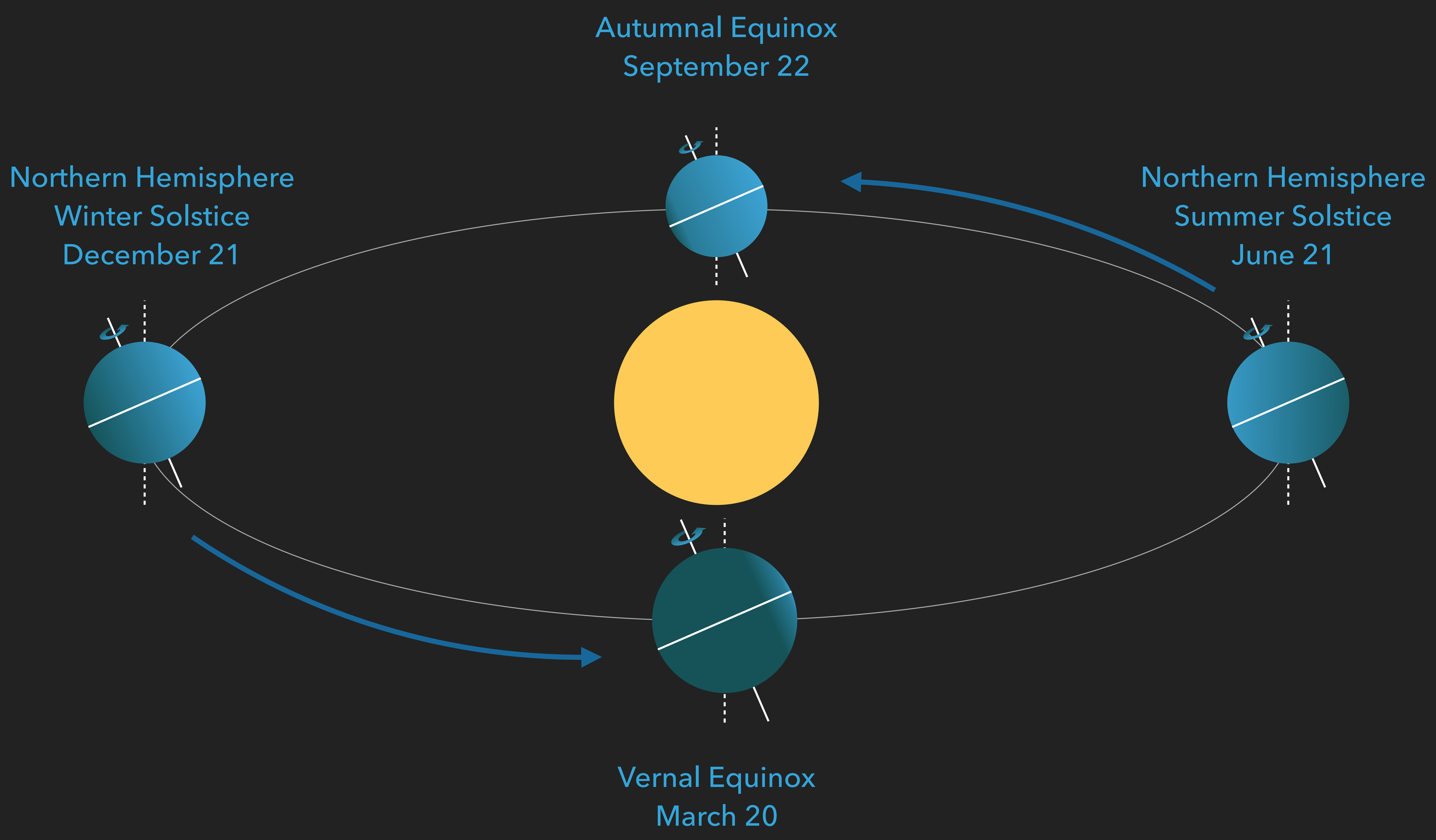



A
B




A
B
B
A

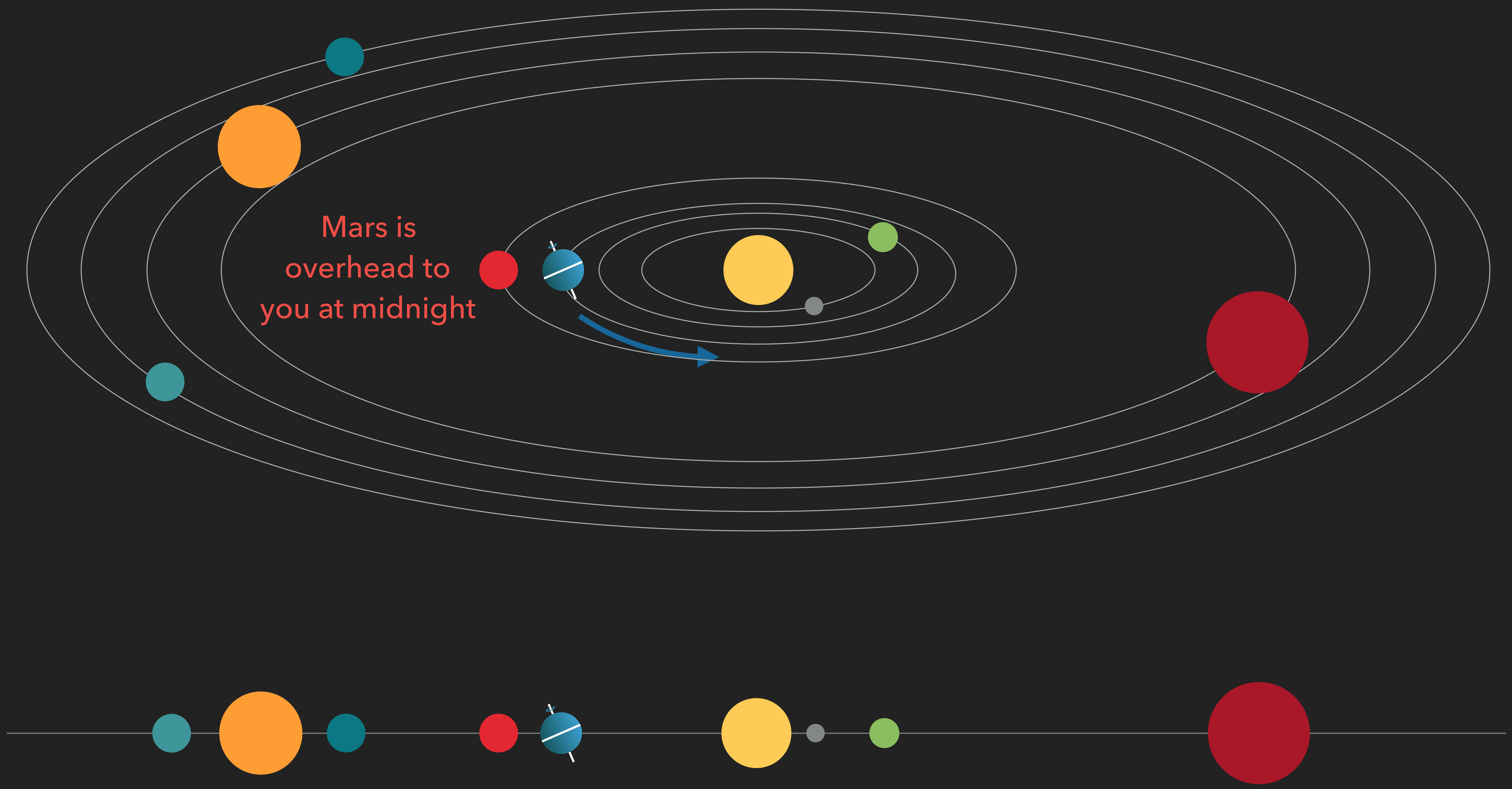

Axial tilt, obliquity, ε epsilon
No sun
Sun low
Arctic Circle
ε
ε
Tropic of Cancer
Sun
high
Equator
Tropic of Capricorn
All sun
Antarctic Circle
ε = ~23.44°


Autumnal Equinox
September 22
Northern Hemisphere
Winter Solstice
December 21
Northern Hemisphere
Summer Solstice
June 21
Vernal Equinox
March 20

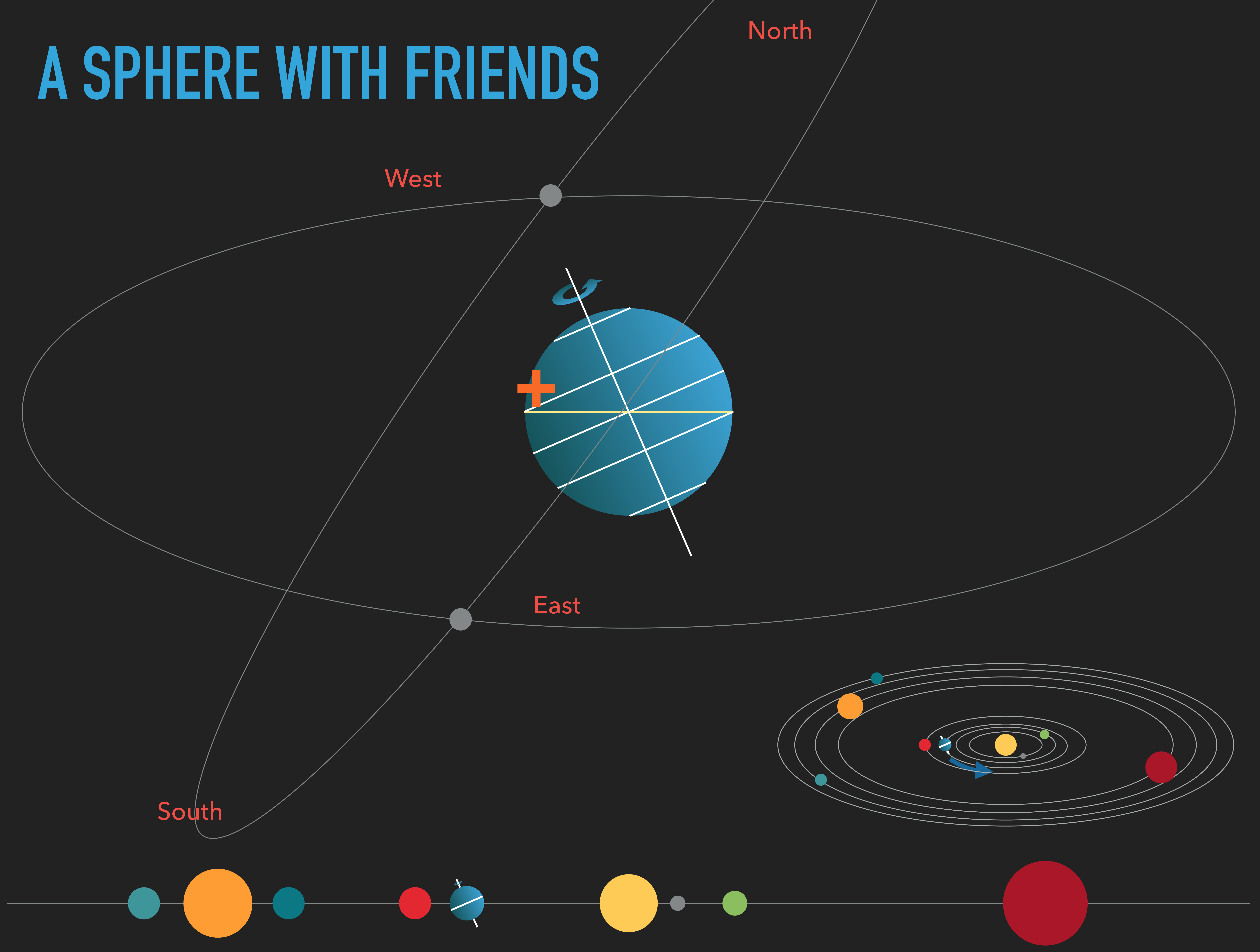
(PHEW)

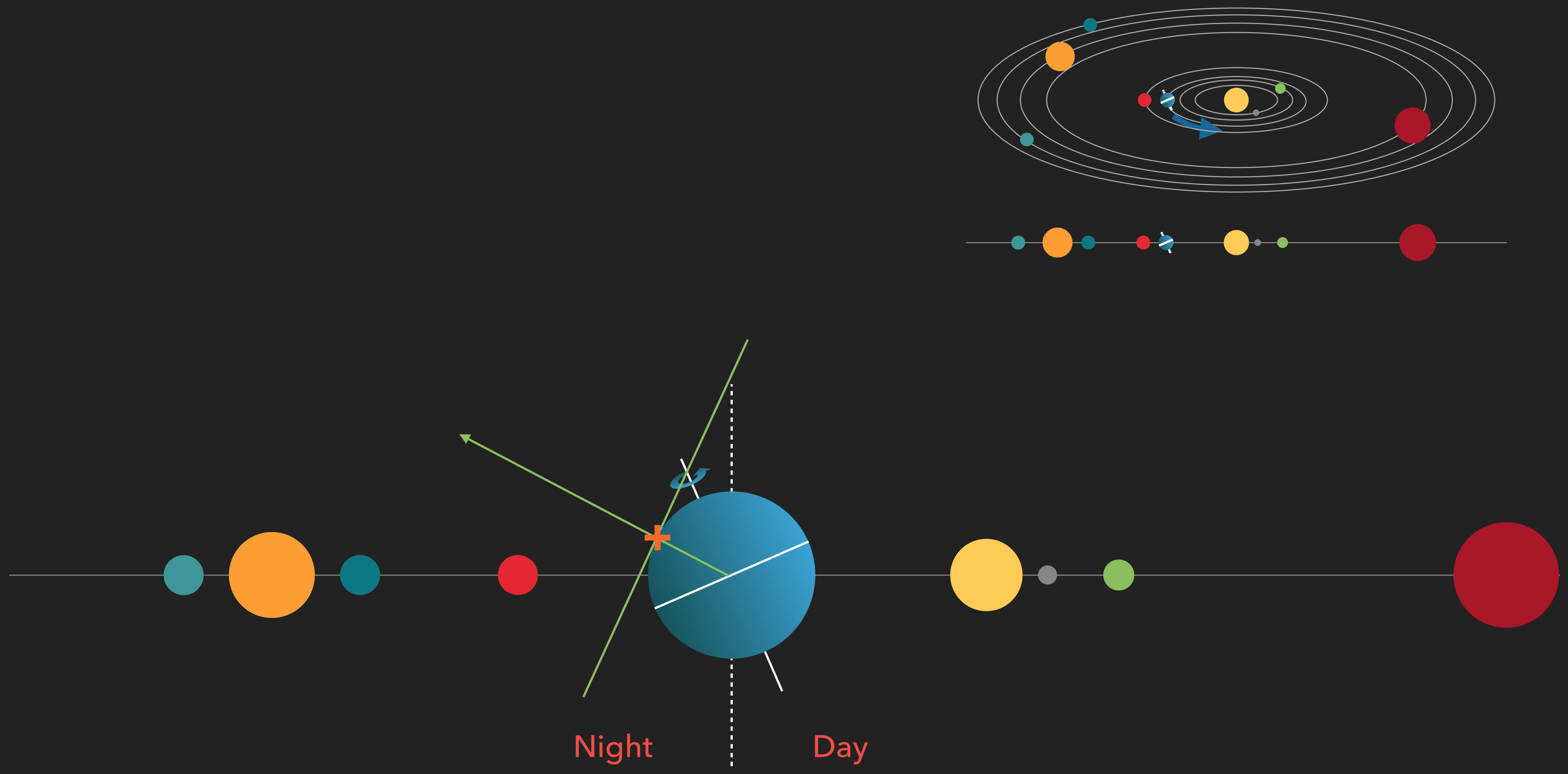

Axial tilt, obliquity, ε epsilon
North
Your "up"
Midnight
You
ε
ε
Your horizon
(south)
ε = ~23.5°

A SPHERE WITH FRIENDS

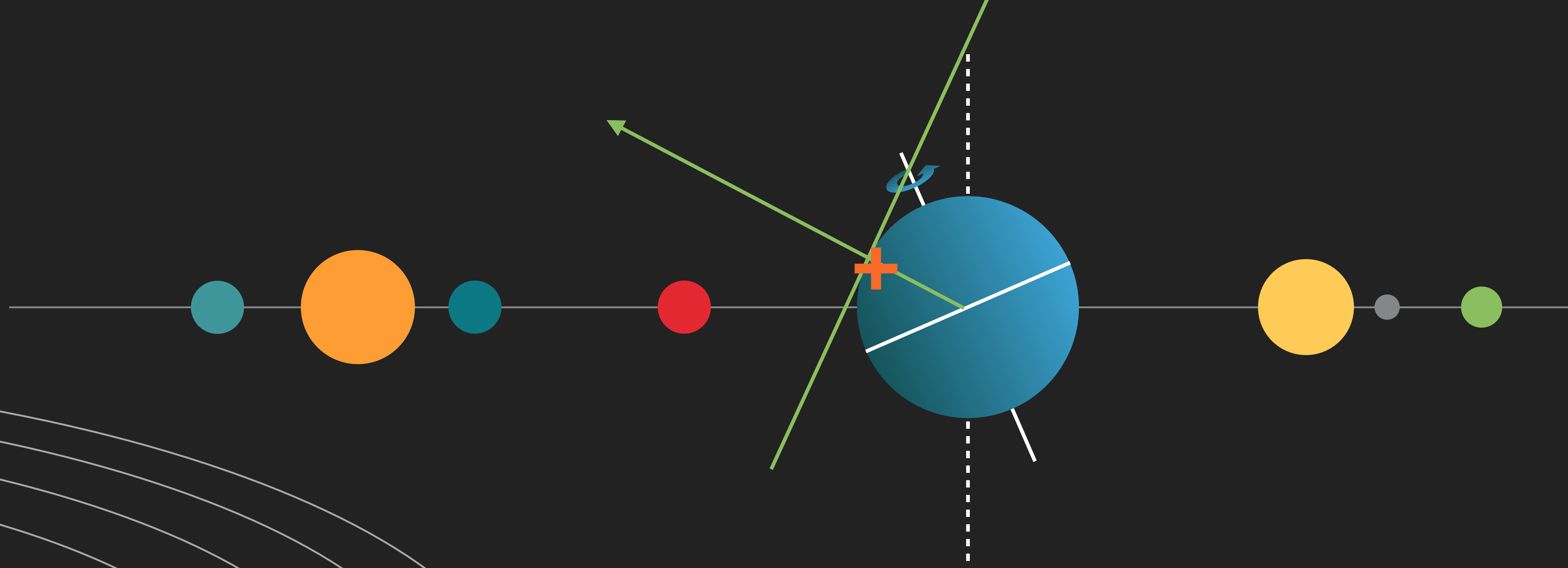


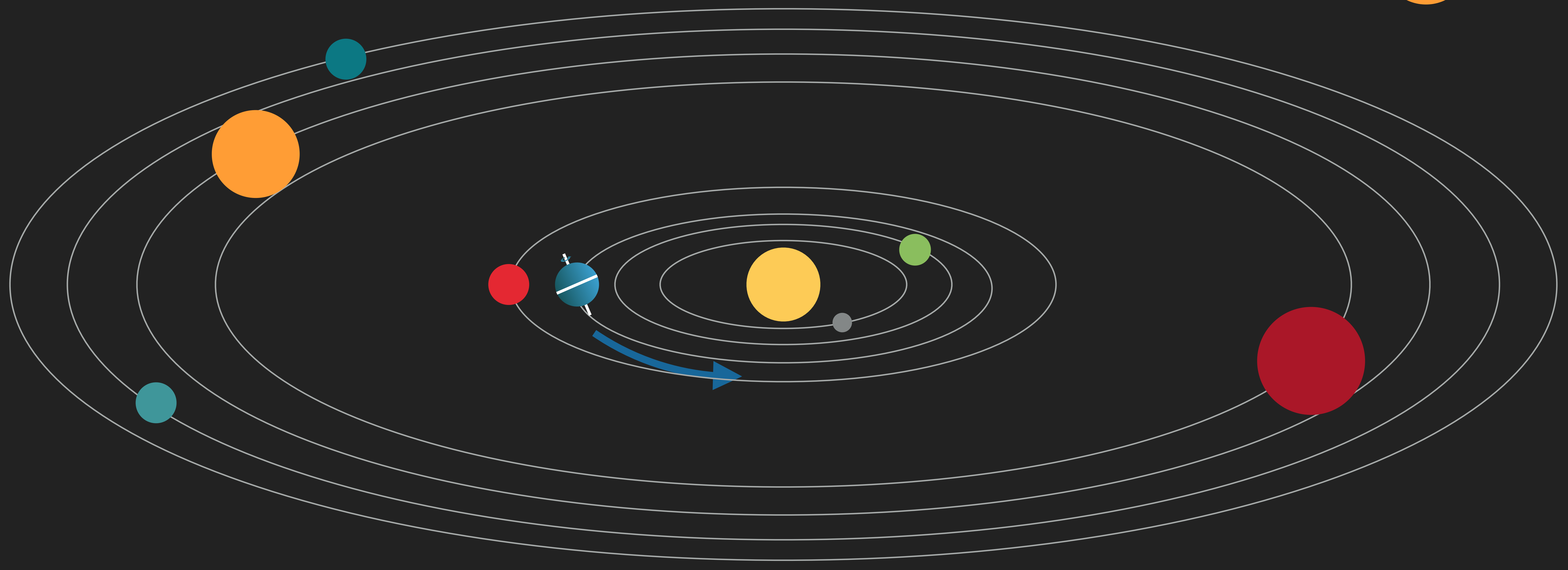
A SPHERE WITH FRIENDS




Night
Day

ECLIPTIC

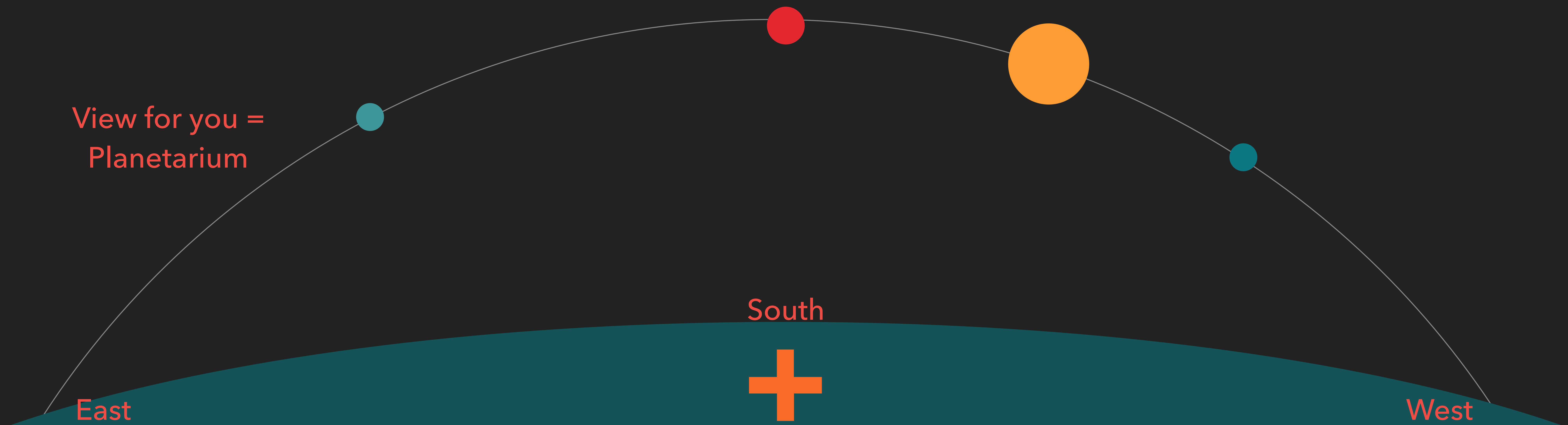




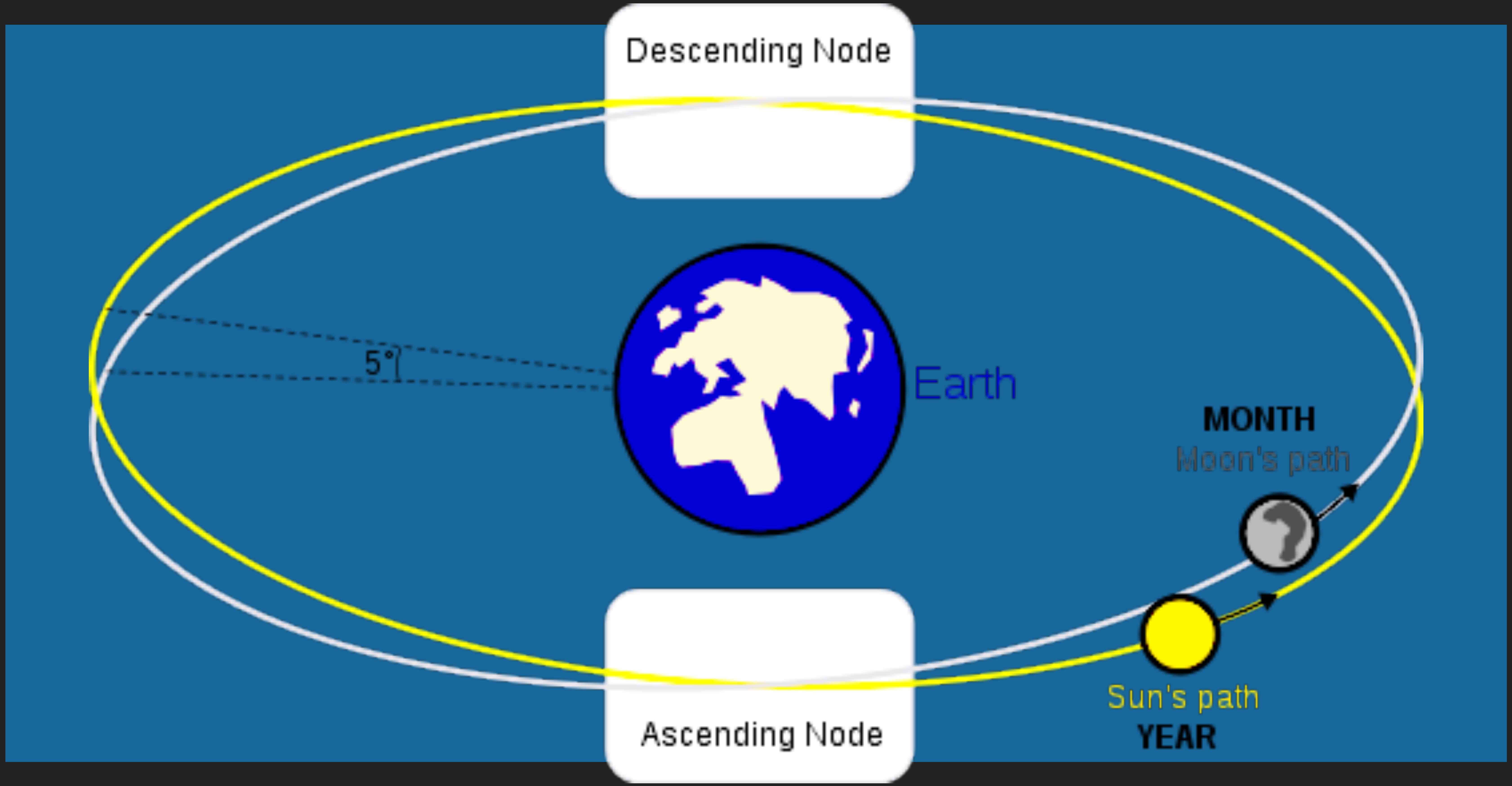
View from “outside” = Orrery

Mars is overhead

View for you = Planetarium



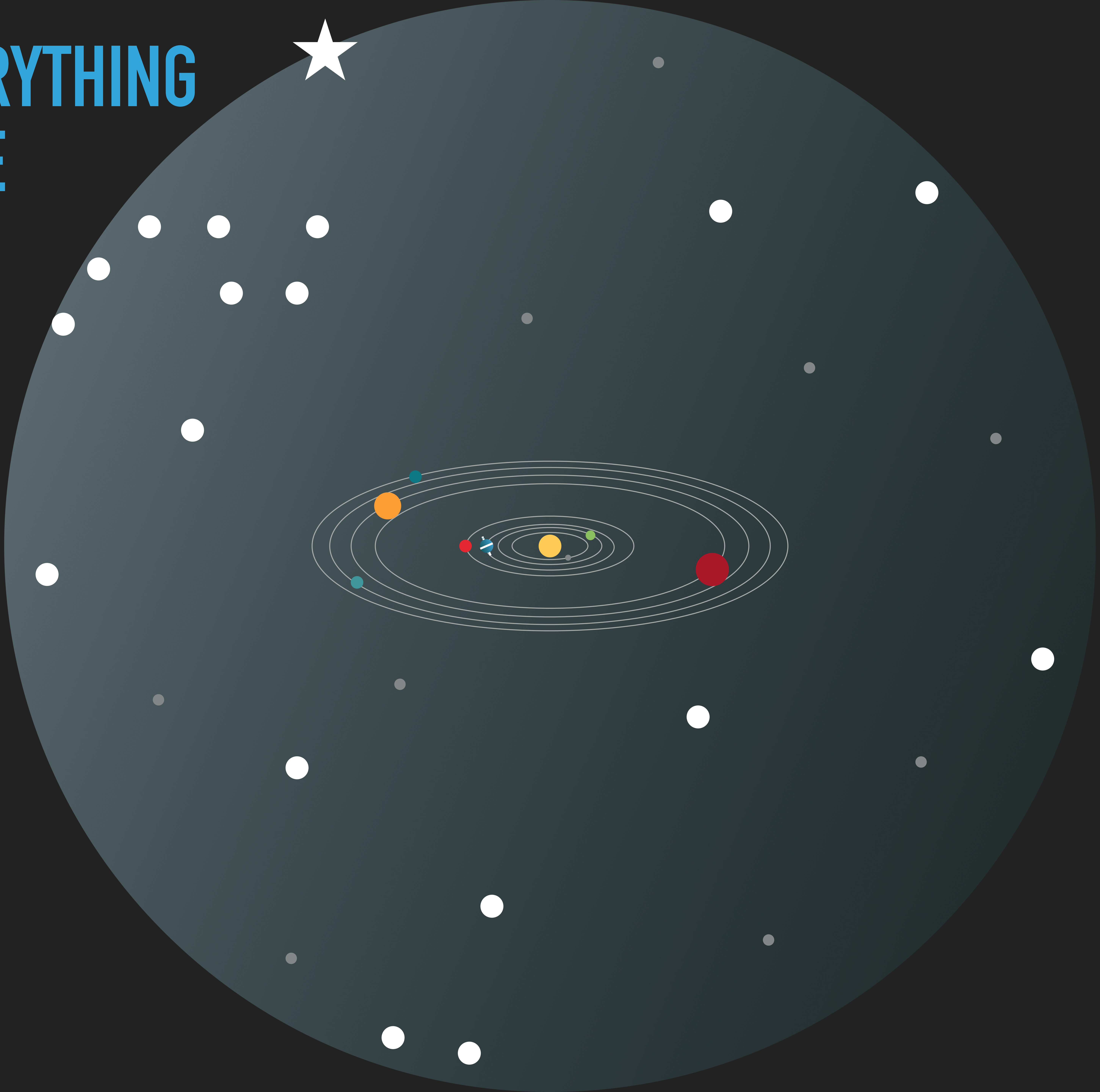
WHY “ECLIPTIC”



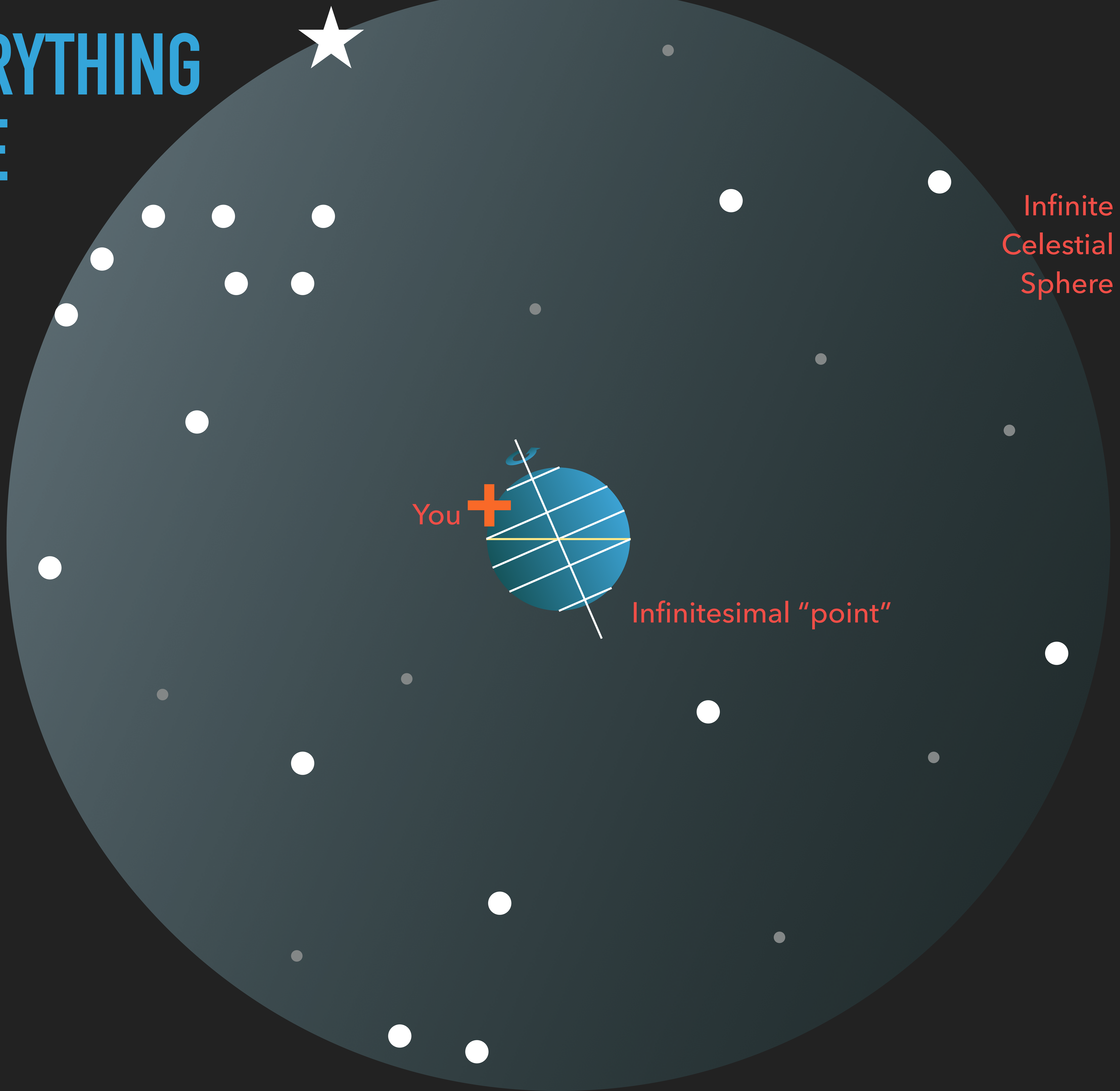
https://earthsky.org/

(PHEW X 2)

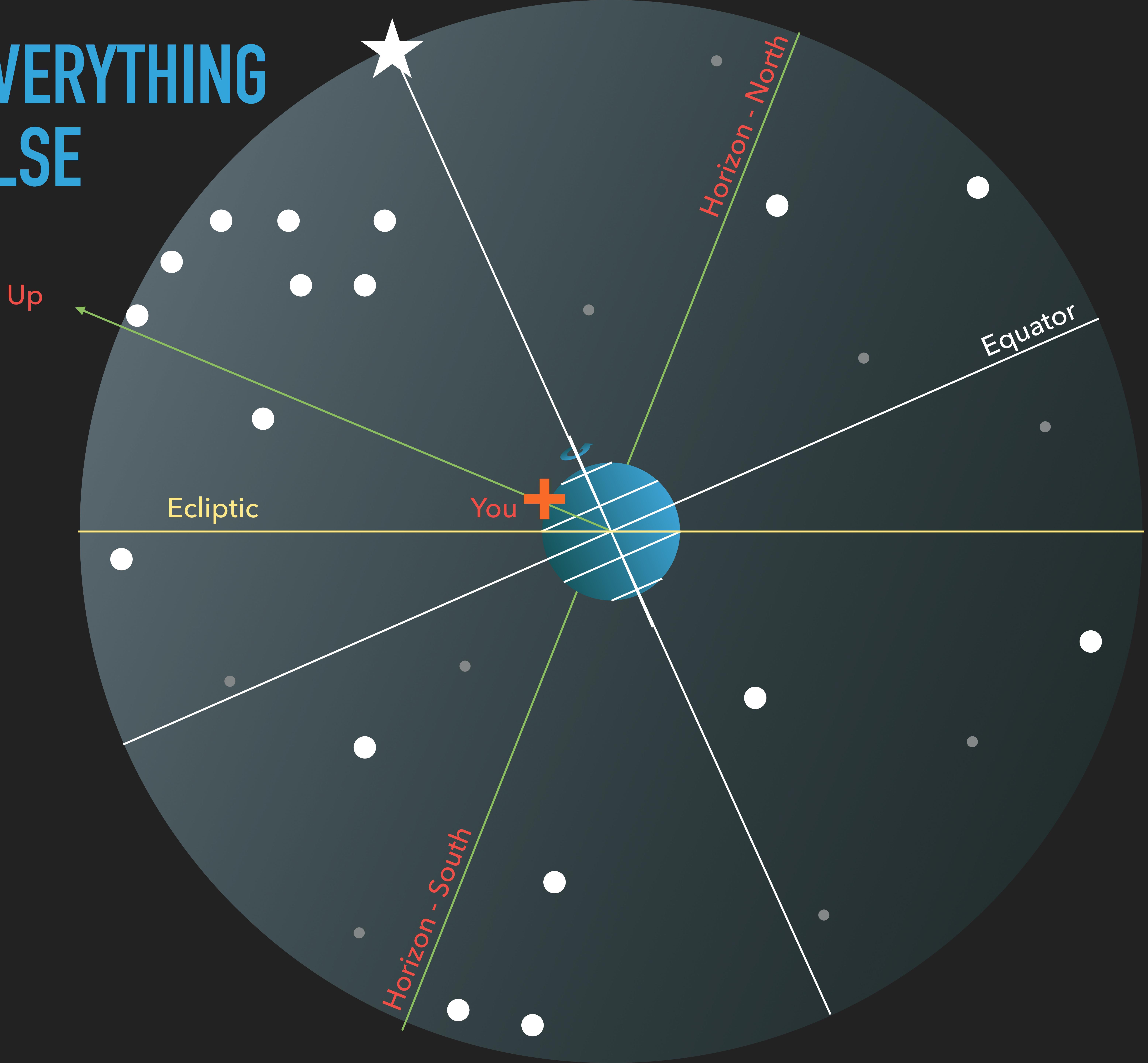
EVERYTHING ELSE



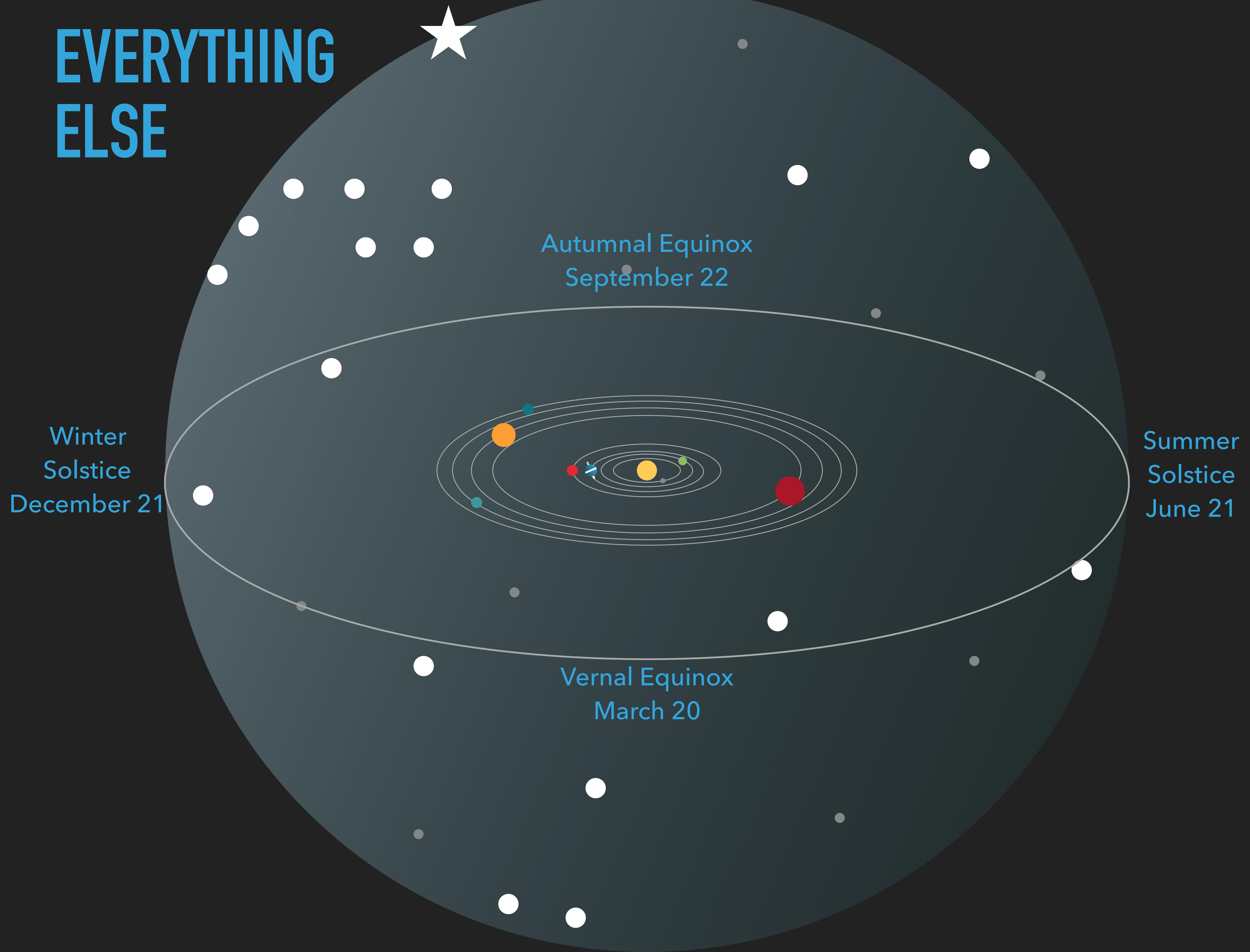
EVERYTHING ELSE



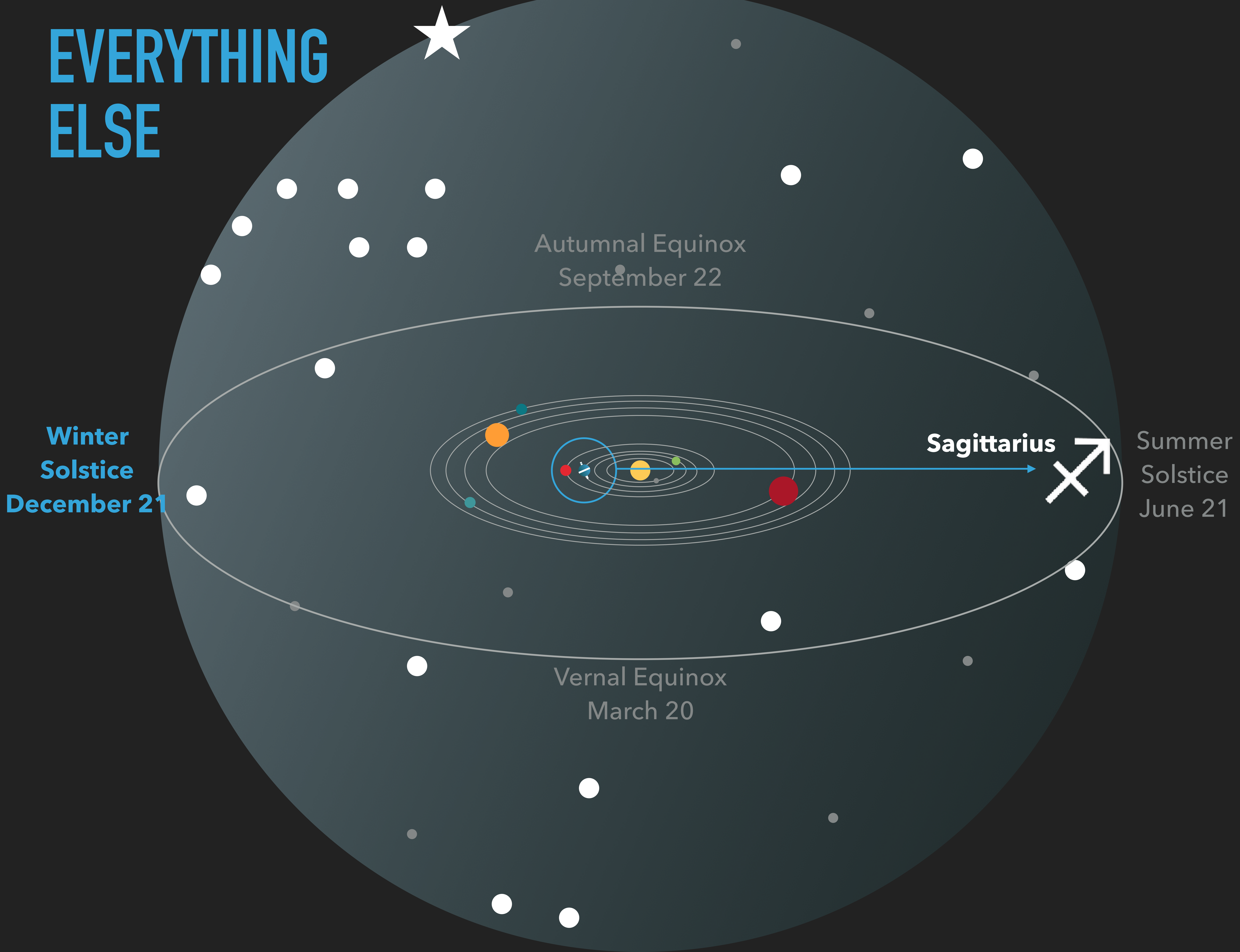
EVERYTHING ELSE



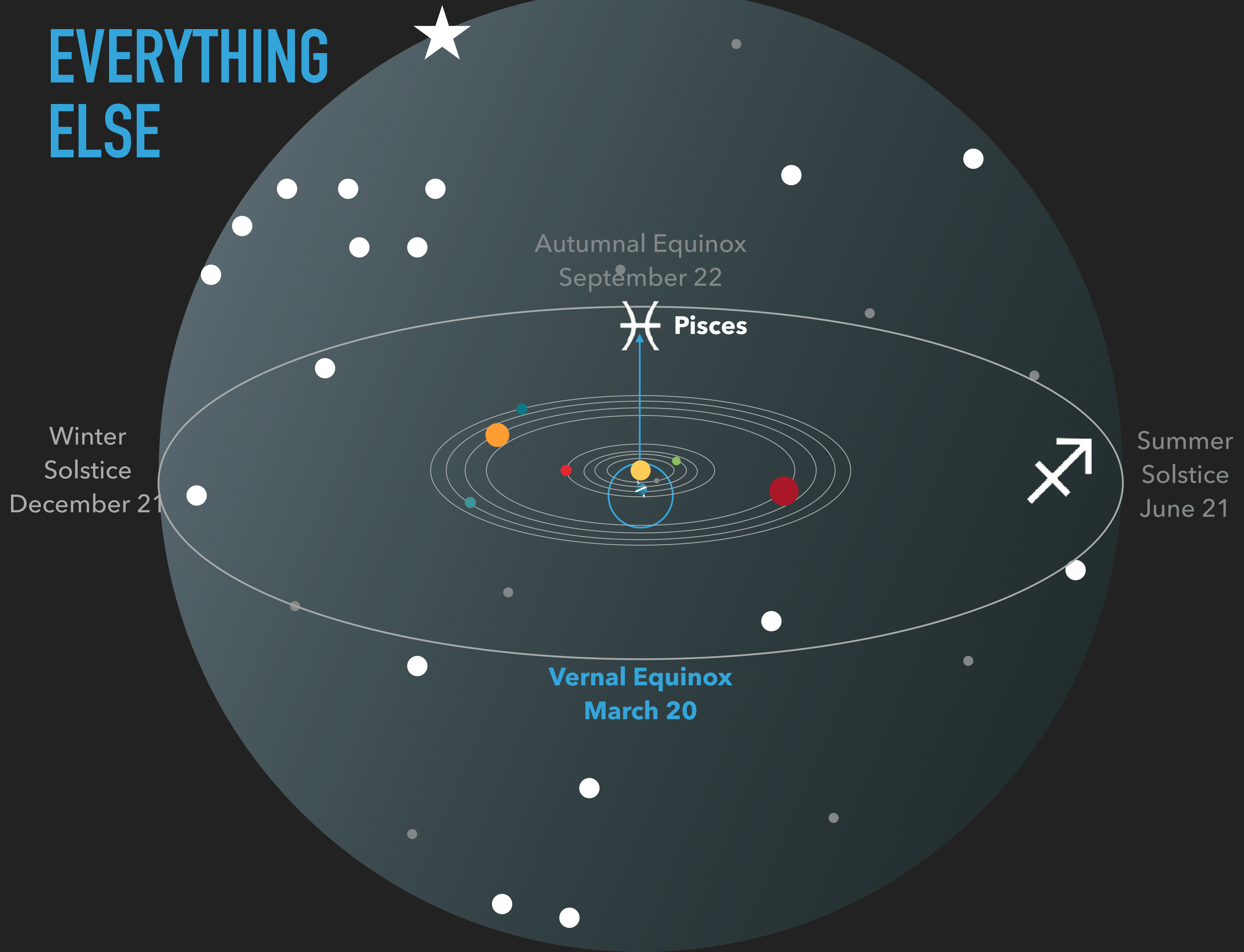
EVERYTHING ELSE



EVERYTHING ELSE

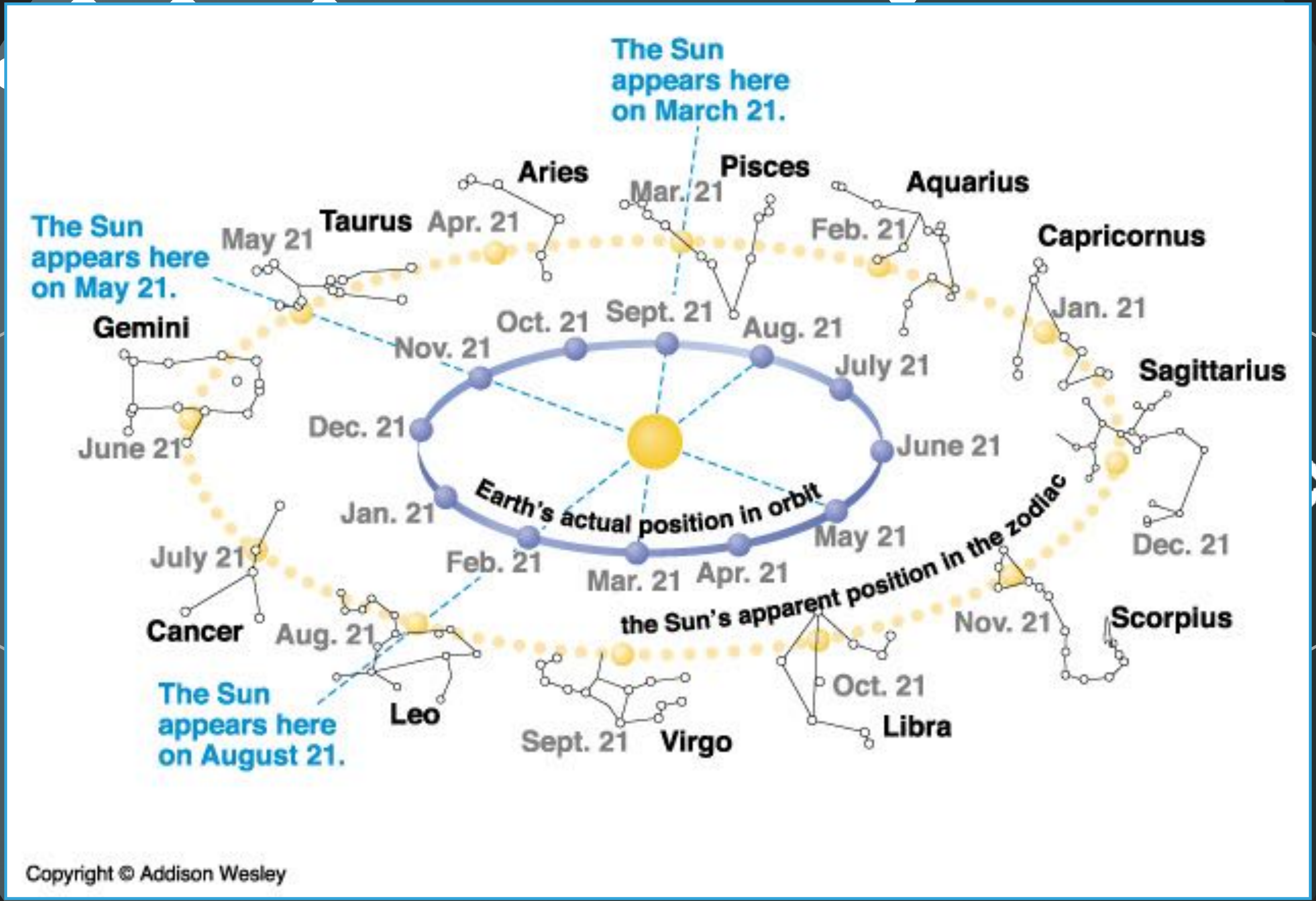


EVERYTHING ELSE



EVERYTHING ELSE

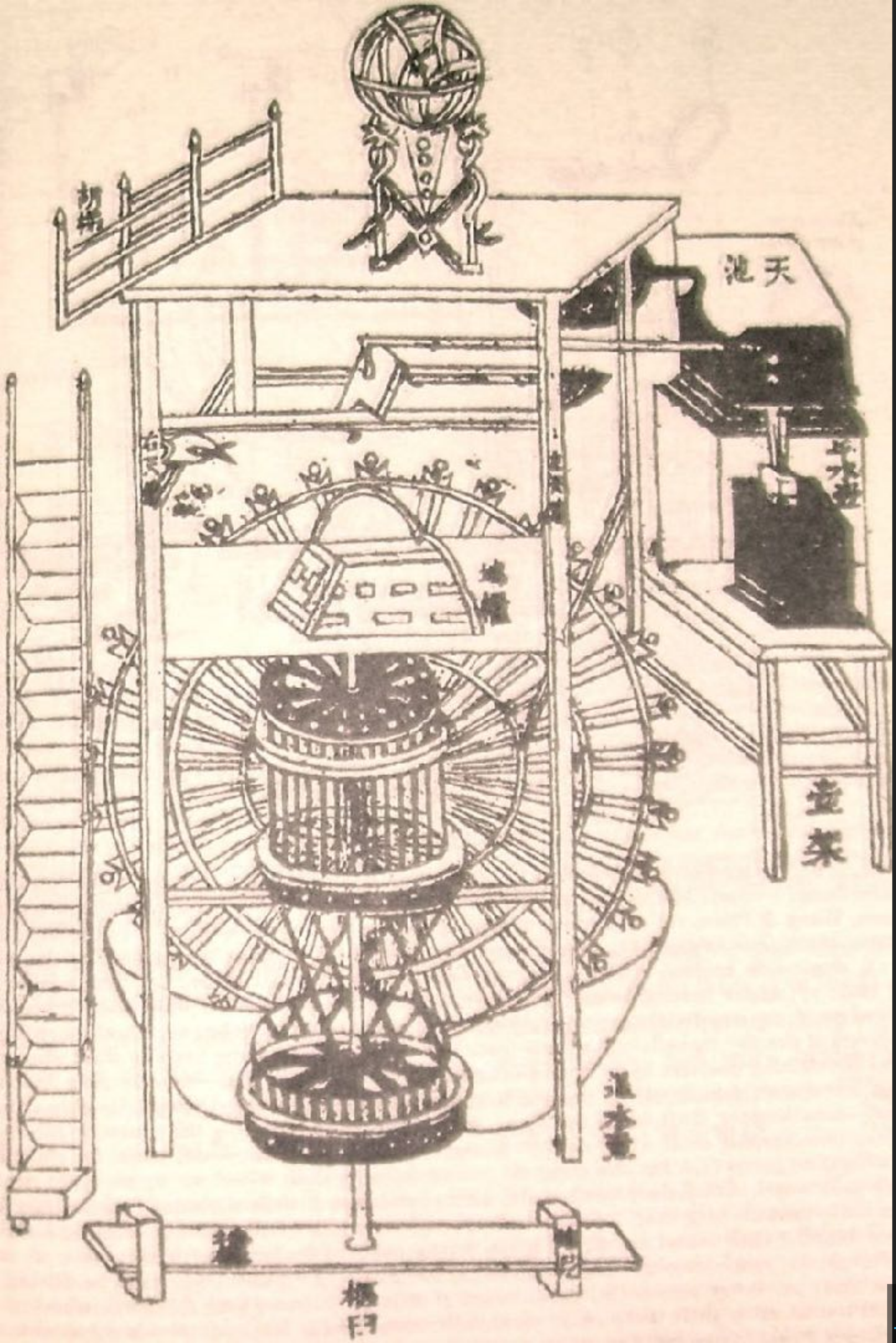
Winter Solstice December 21



Summer Solstice June 21

http://cse.ssl.berkeley.edu

(PHEW X 3)



https://www.revolution.watch/past-masters-the-astronomical-water-clock-of-su-song

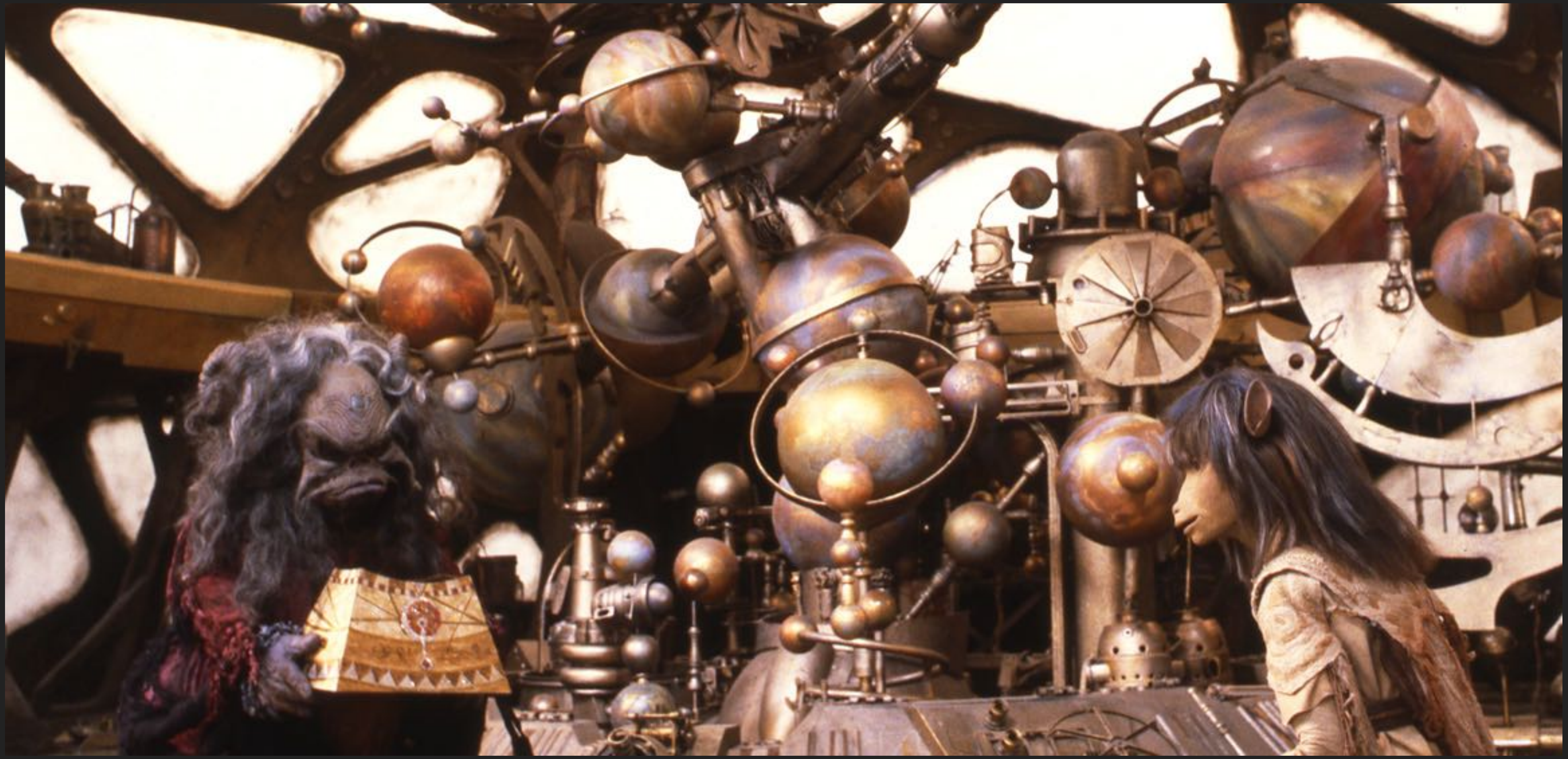
SU SONG ASTRONOMICAL WATER CLOCK

01094 CE, FIRST ESCAPEMENT

“Thus if the water is made to pour with perfect evenness, then the comparison of the rotary movements (of the heavens and the machine) will show no discrepancy or contradiction; for the unresting follows the unceasing.”

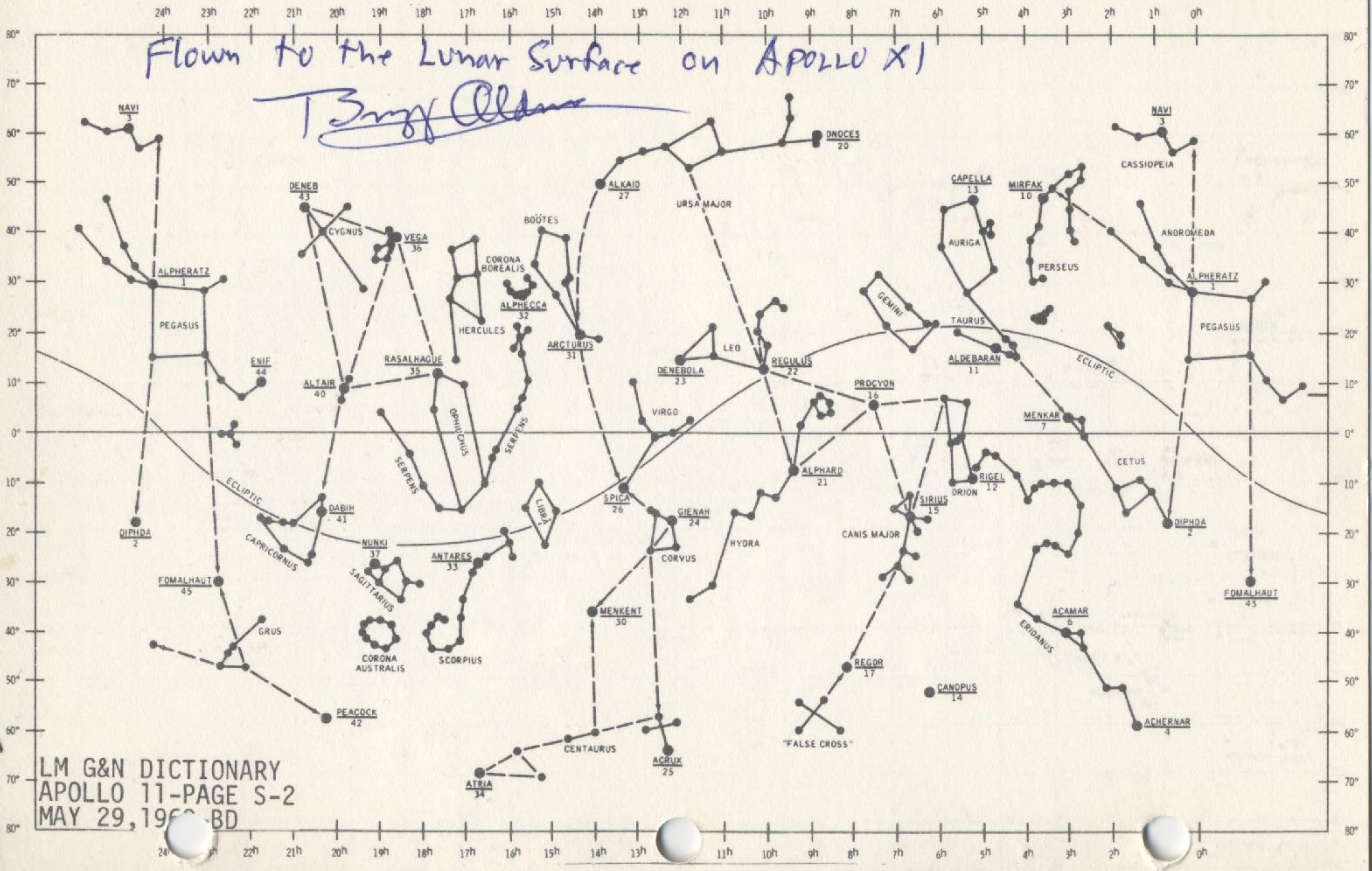
ARMILLARY SPHERE MADE BY GIROLAMO DELLA VOLPAIA, FLORENCE, ITALY, 01554

[London Science Museum]

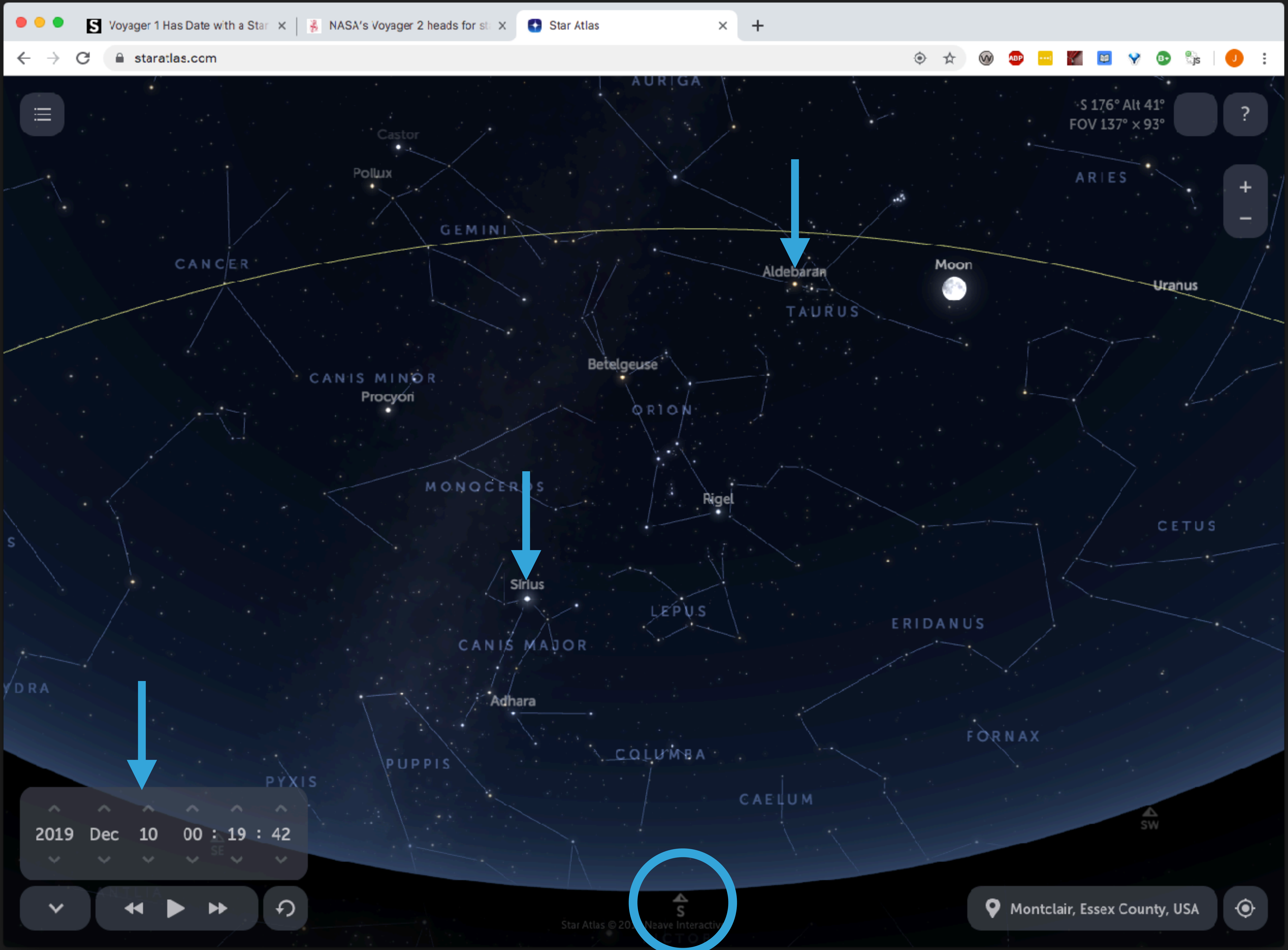


AUGHRA´S ORRERY

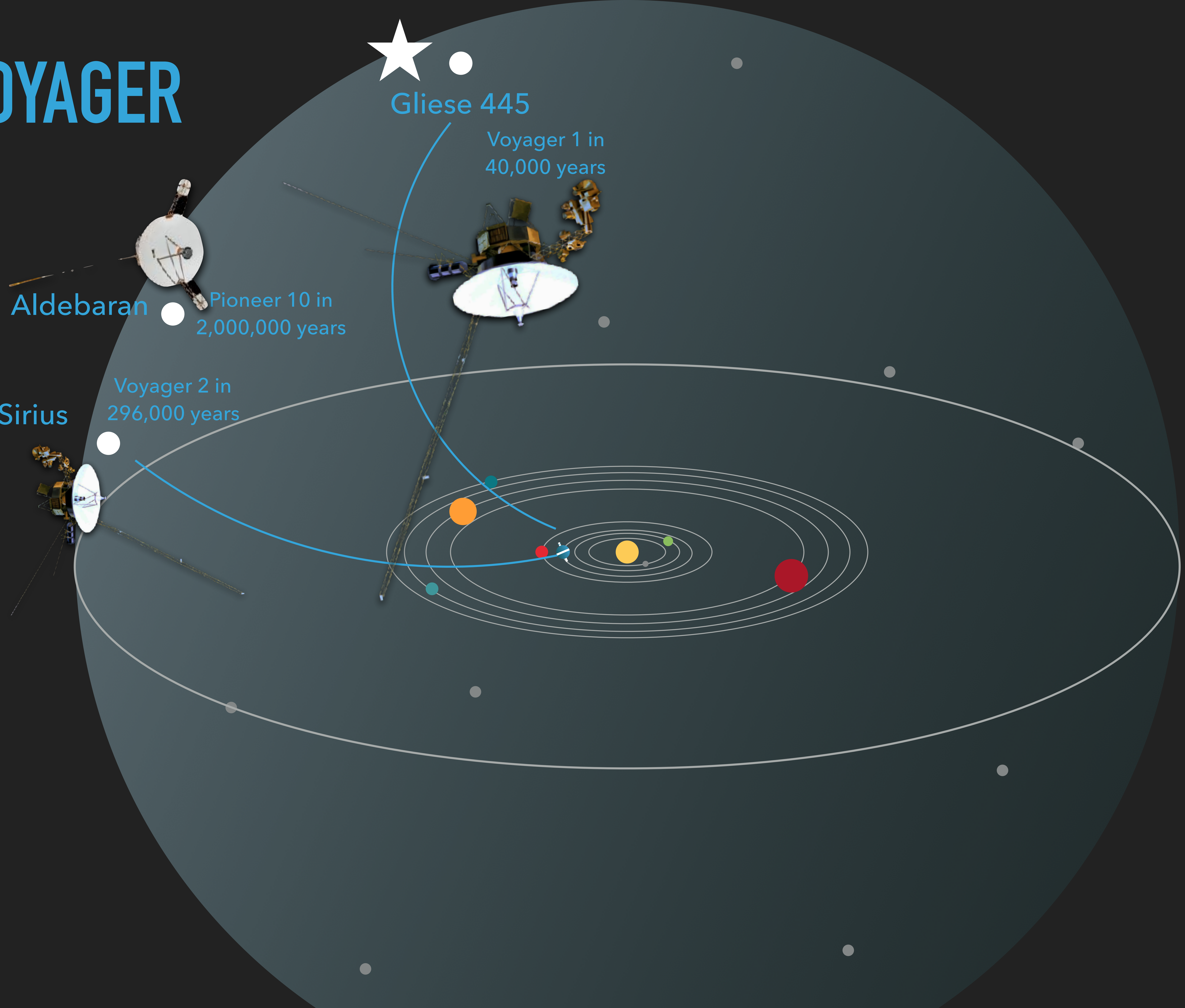
Dark Crystal



LM G&N DICTIONARY
APOLLO 11-PAGE S-2
MAY 29,196[illegible] BD


Voyager 1 Has Date with a Star
NASA's Voyager 2 heads for st
Star Atlas
staratlas.com
S 176° Alt 41°
FOV 137° x 93°
AURIGA
Castor
Pollux
GEMINI
CANCER
ARIES
Aldebaran
Moon
Uranus
TAURUS
Betelgeuse
CANIS MINOR
Procyon
ORION
MONOCEROS
Rigel
CETUS
Sirius
LEPUS
ERIDANUS
CANIS MAJOR
Adhara
FORNAX
COLUMBA
PUPPIS
PYXIS
CAELUM
SW
2019 Dec 10 00 : 19 : 42
S
Montclair, Essex County, USA

VOYAGER



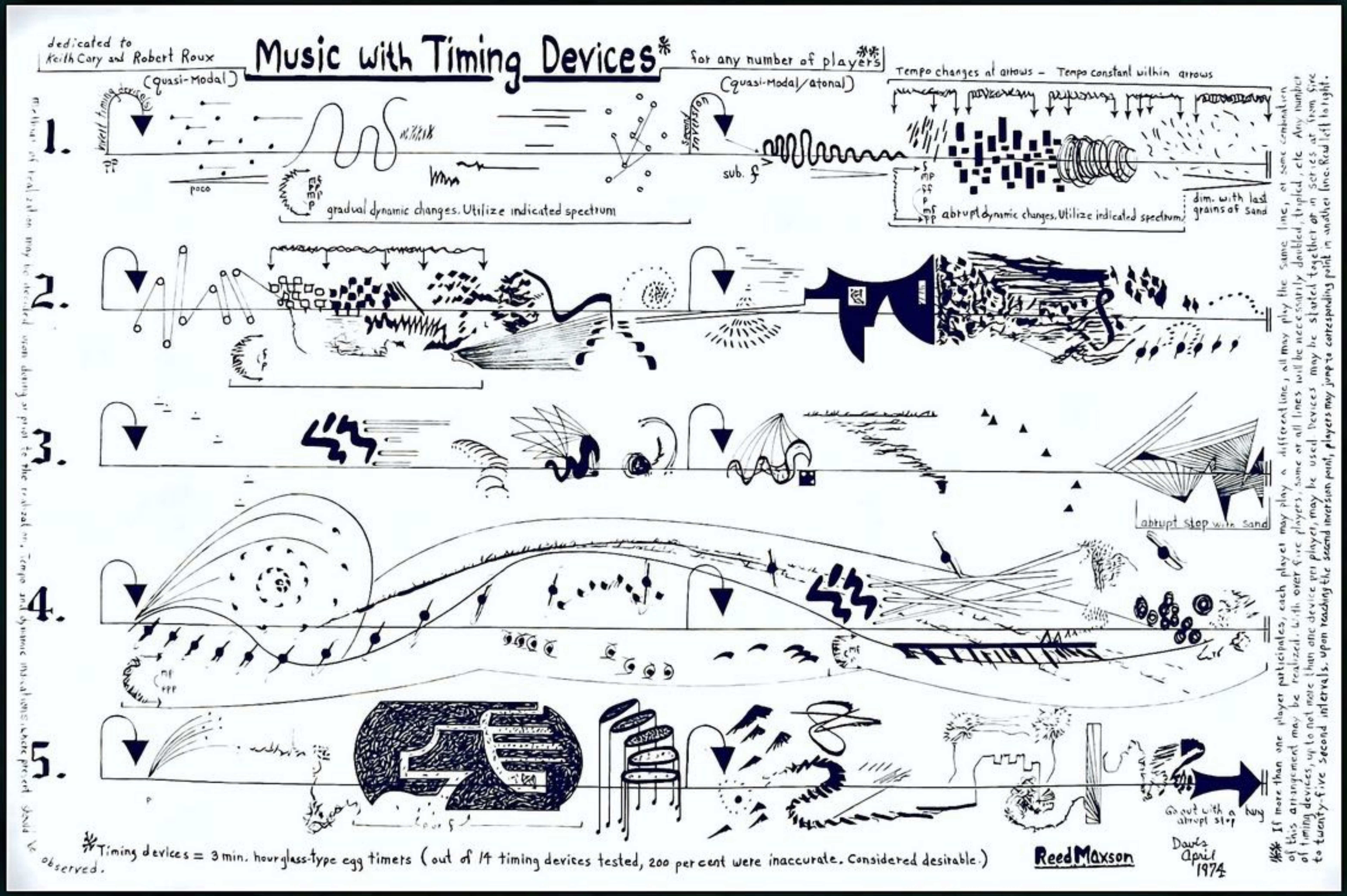
https://space.stackexchange.com/questions/1621/where-are-pioneer-10-11-and-the-voyagers-ultimately-headed

EXISTING
IN
TIME


OFF

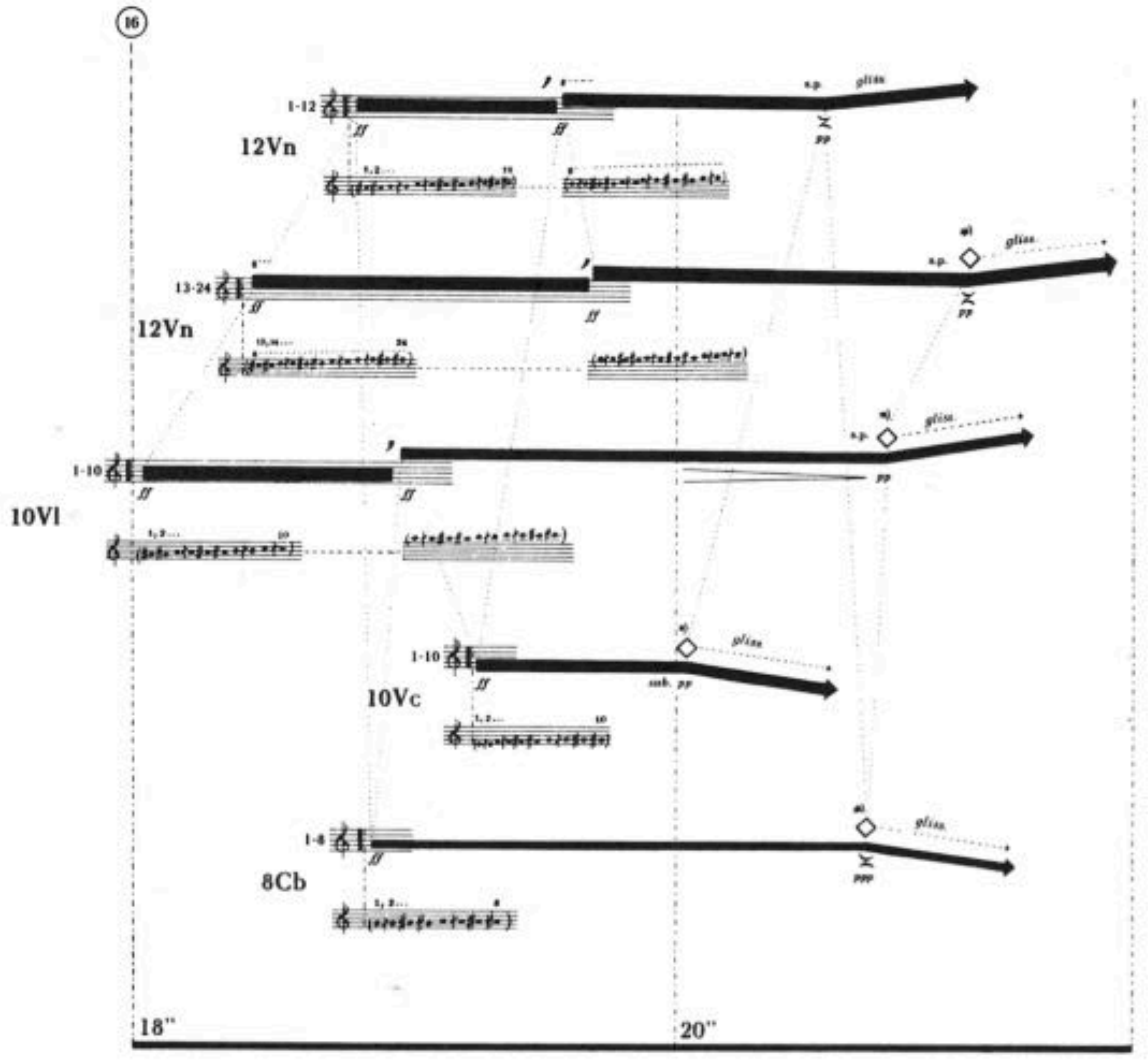
Soundcraft Vi6


SEASENSE
Marine / Sport
HORN
Recommended for boats up to 12 meters / 39.4 feet
Ideal for all sporting events
WARNING : Use only as directed. Do not spray near ignition sources, open flames, sparks or hot surfaces. Use only with adequate ventilation. Intentional misuse by deliberately concentrating and inhaling contents can be harmful or fatal.
KEEP OUT OF REACH OF CHILDREN.



https://www.reedmaxson.com/graphic-scores.html

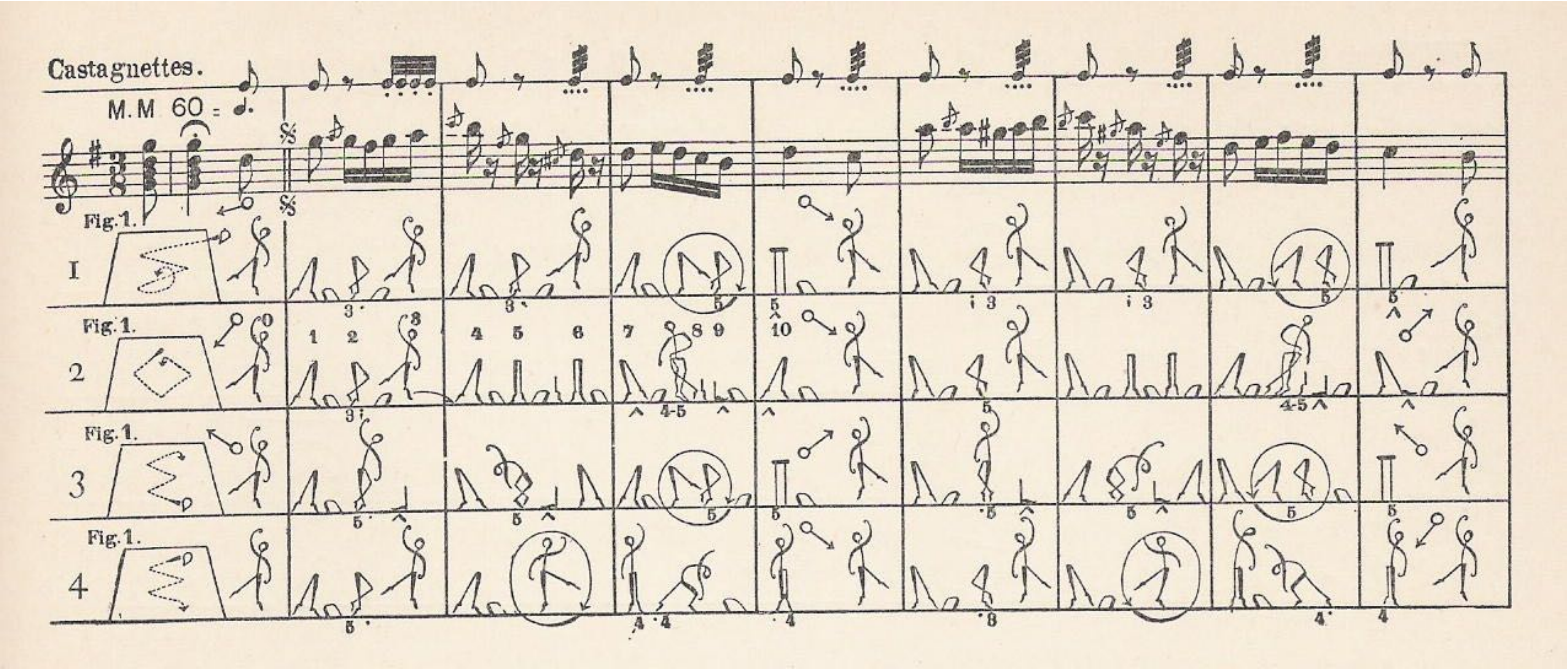
Krzysztof Penderecki: *Threnody for the Victims of Hiroshima* (1960)



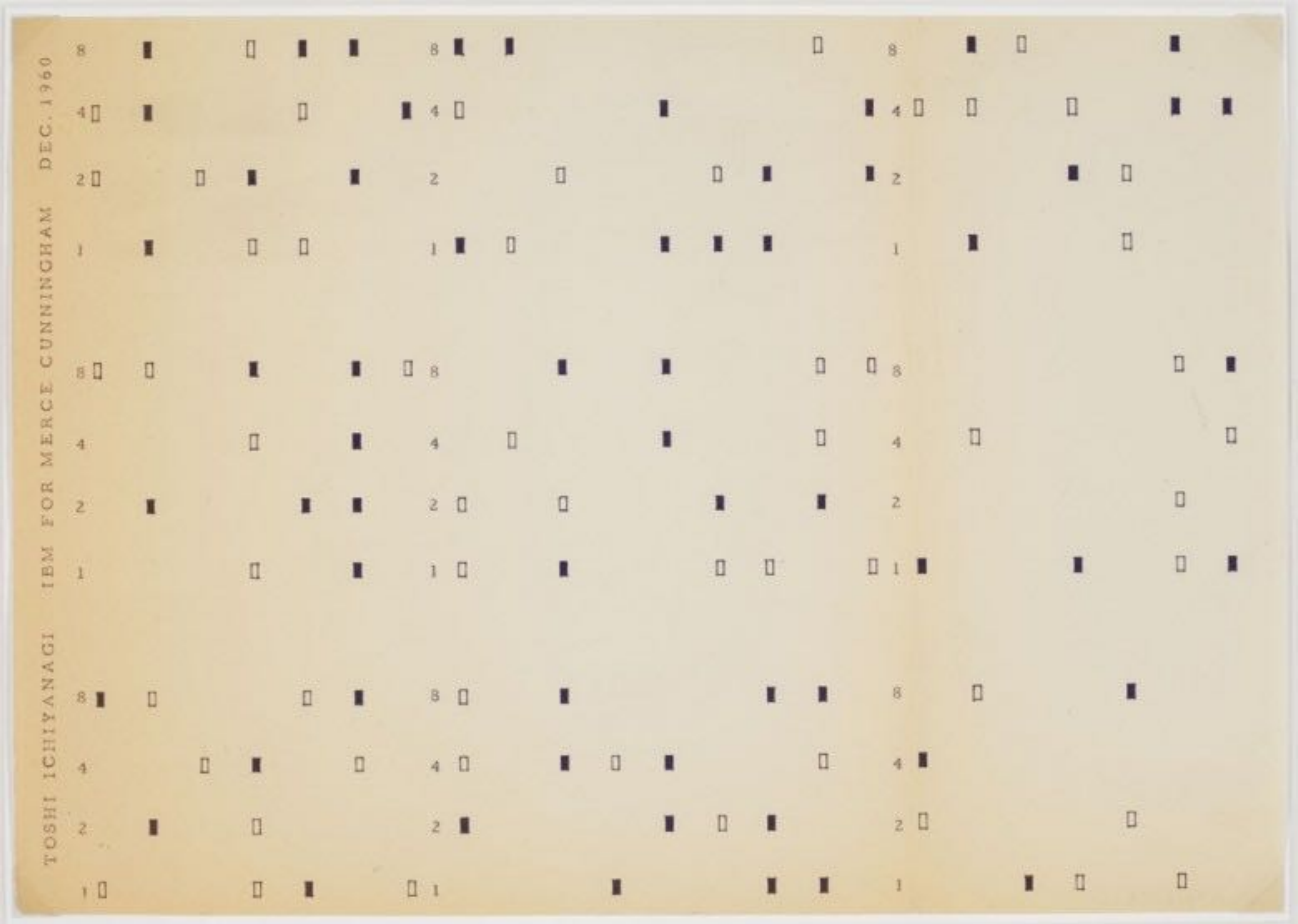
*) flageolet tones

Rite of Spring Score, Igor Stravinsky

Score of Ice Spirits, Meredith Monk



La Cachucha, by Friedrich Albert Zorn (wikipedia)



https://www.moma.org/explore/inside_out/2012/12/21/exhibiting-fluxus-keeping-score-in-tokyo-1955-1970-a-new-avant-garde/

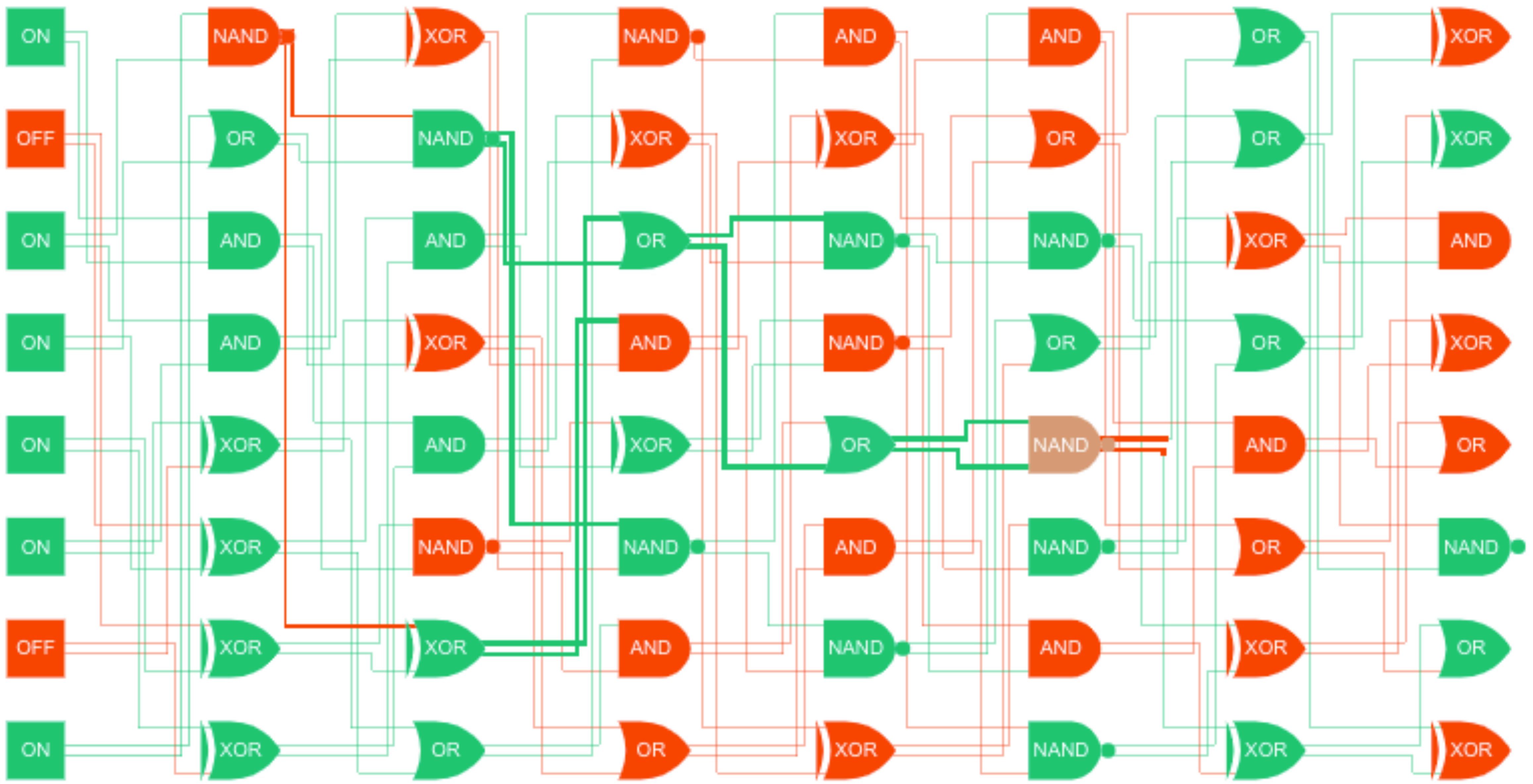

482 × 283
5.4525
5.5025
5.5525 5.5625
POUR WATER FROM ONE RECEPTACLE TO ANOTHER
POUR WATER
SIREN-WHISTLE
6.3025
RYOANJI
JOHN CAGE
RYOANJI
JOHN CAGE
ORGAN²/ASLSP
4'33"
SOLO FOR VOICE 95
4'33"
FOR ANY INSTRUMENT OR COMBINATION

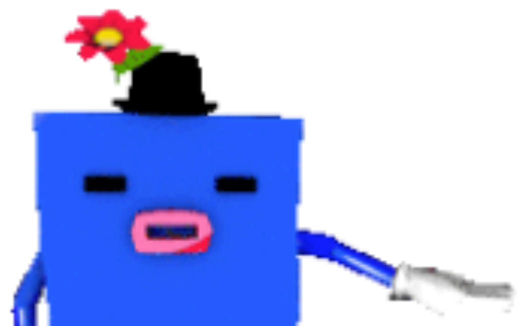

Fine Tune Keyframes
Video Effects
Motion
Opacity
Time Remapping
Brightness & Contrast
Black & White
Synth Lead

2

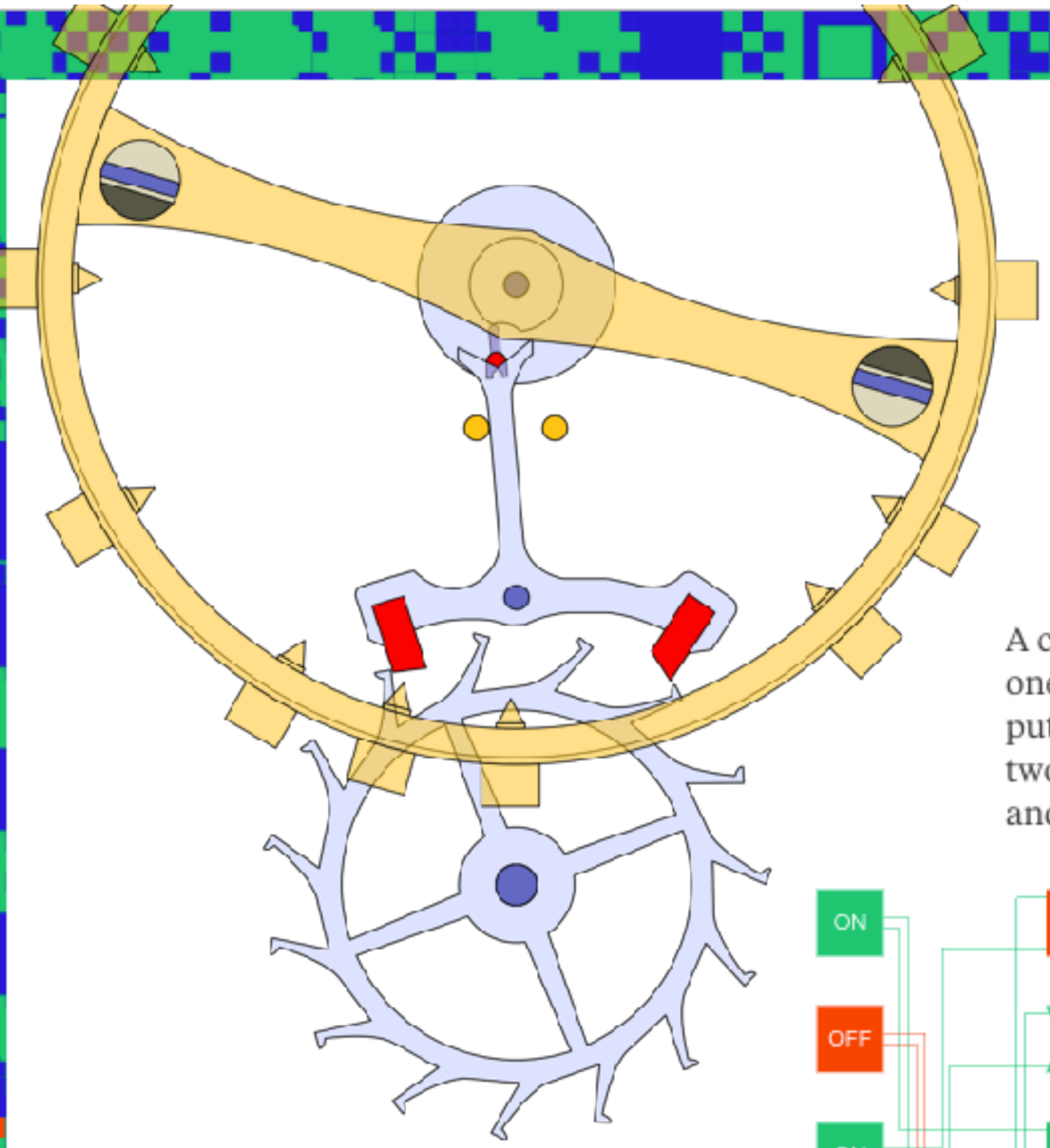
Let’s Begin

A computer is a clock with benefits. They all work the same, doing second-grade math, one step at a time: Tick, take a number and put it in box one. Tick, take another number, put it in box two. Tick, *operate* (an operation might be addition or subtraction) on those two numbers and put the resulting number in box one. Tick, check if the result is zero, and if it is, go to some other box and follow a new set of instructions.





This is simulated circuitry that’s computing as you watch. The switches on the left turn the current on and off at random, and the logic gates direct the flow of the current. Click the boxes to change the circuits. Enough of these can compute anything computable.

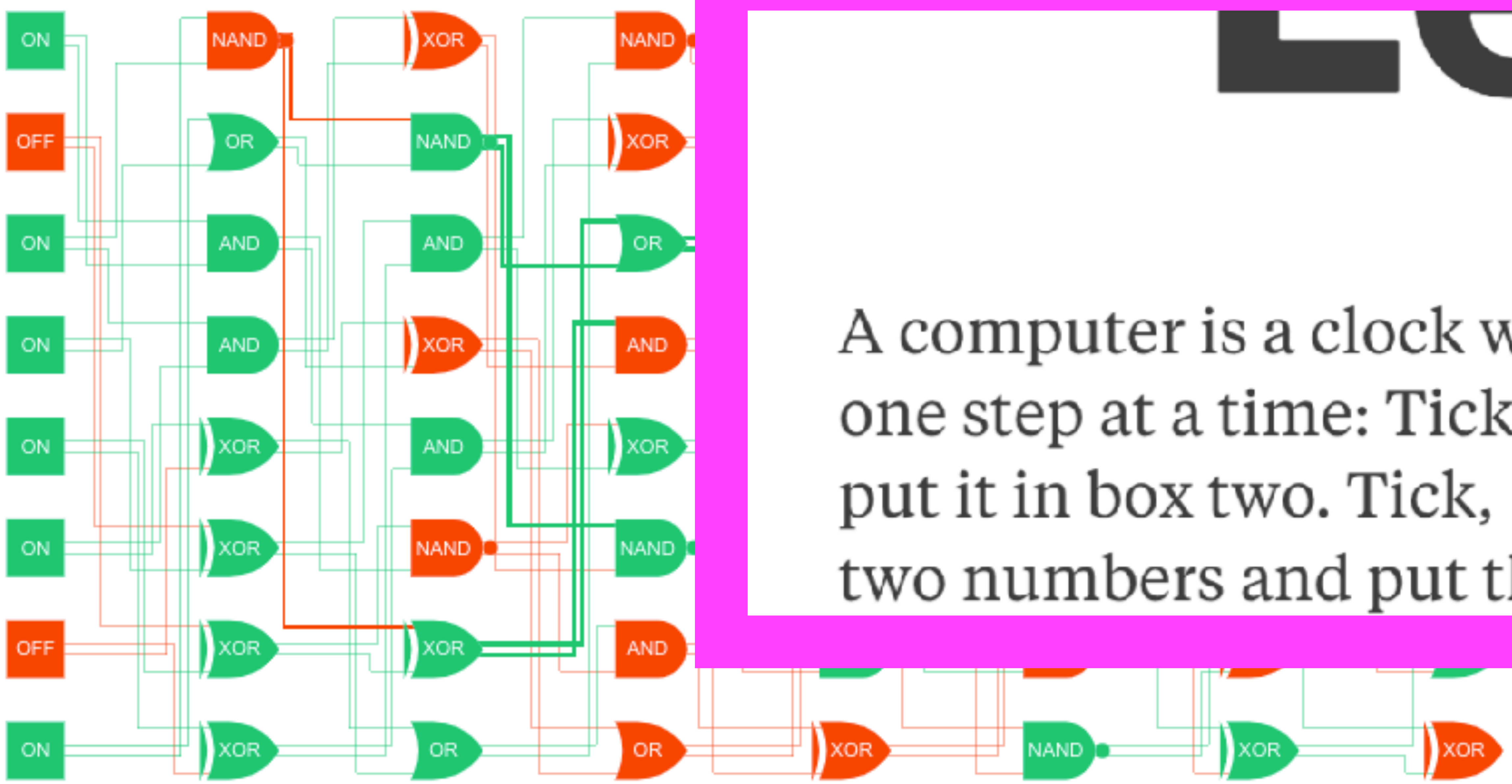


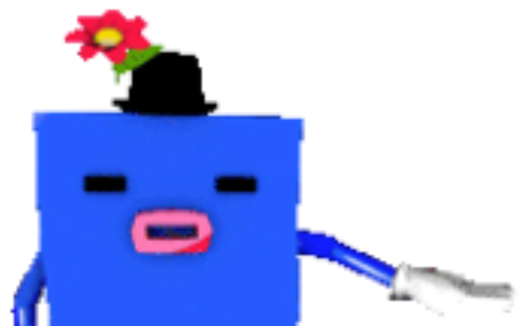
2

Let’s Begin

A computer is a clock with benefits. They all work the same, doing second-grade math, one step at a time: Tick, take a number and put it in box one. Tick, take another number, put it in box two. Tick, *operate* (an operation might be addition or subtraction) on those two numbers and put the resulting number in box one. Tick, check if the result is zero, and if it is, go to some other box and follow a new set of instructions.

A computer is a clock with benefits. They all work the
one step at a time: Tick, take a number and put it in b
put it in box two. Tick, *operate* (an operation might b
two numbers and put the resulting number in box on





This is simulated circuitry that’s computing as you watch. The switches on the left turn the current on and off at random, and the logic gates direct the flow of the current. Click the boxes to change the circuits. Enough of these can compute anything computable.


sketch_sep29a | Arduino 1.8.13
sketch_sep29a
void setup() {
// put your setup code here, to run once:
}
void loop() {
// put your main code here, to run repeatedly:
}
ARDUINO
sketch_200929a | Processing 3.5.3
Java
sketch_200929a
void setup() {
}
void draw() {
}
PROCESSING
Console
Errors
Updates
p5.js Web Editor
editor.p5js.org
p5*
File
Edit
Sketch
Help
English
Hello, jfeddersen!
Auto-refresh
Nettle cardboard
sketch.js
Preview
function setup() {
createCanvas(400, 400);
}
function draw() {
background(220);
}
P5JS
Console
Clear
"TICK"

EASING

Smoothly transition a variable from one value to another in a set time

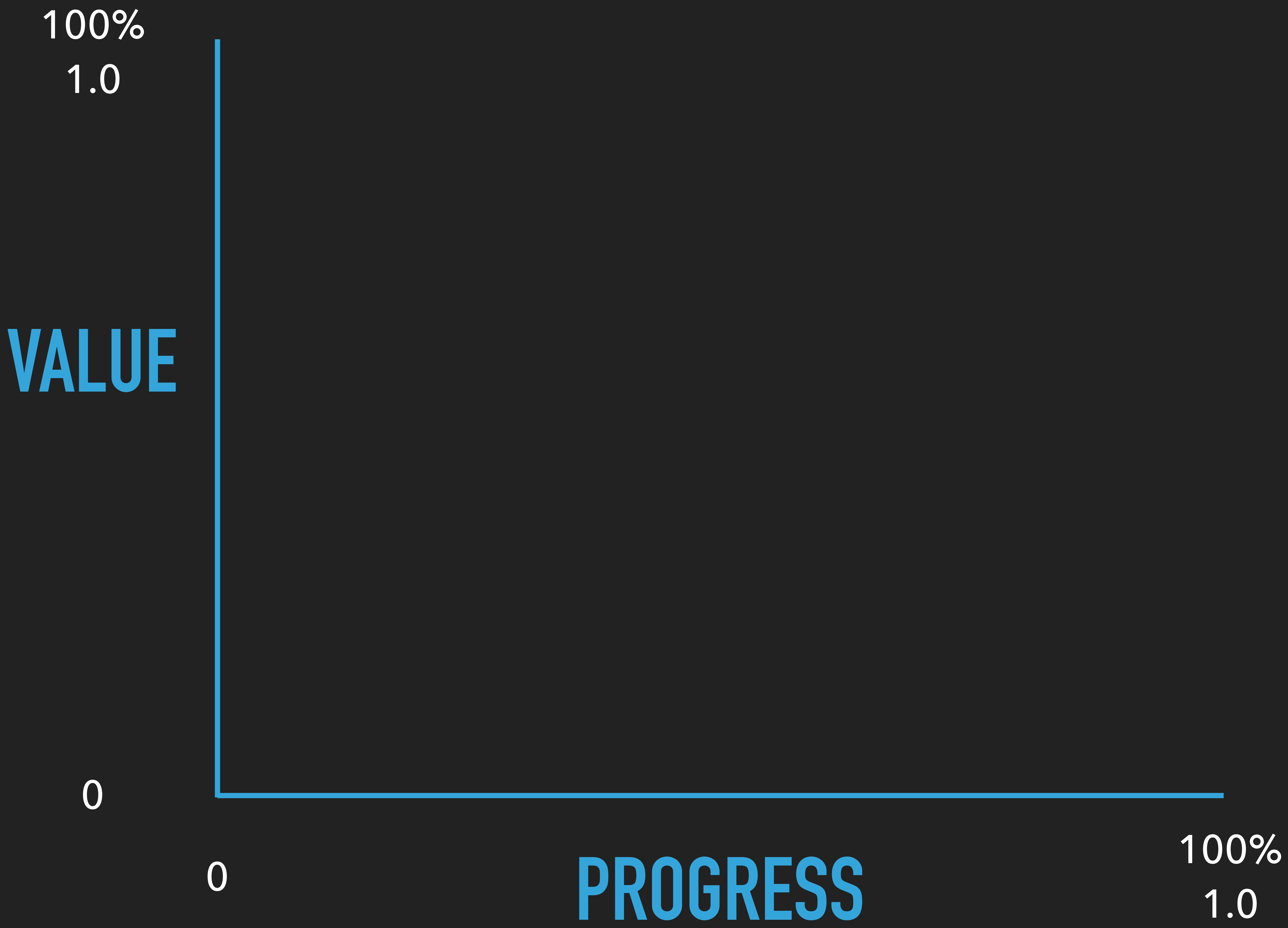
SIMULATION

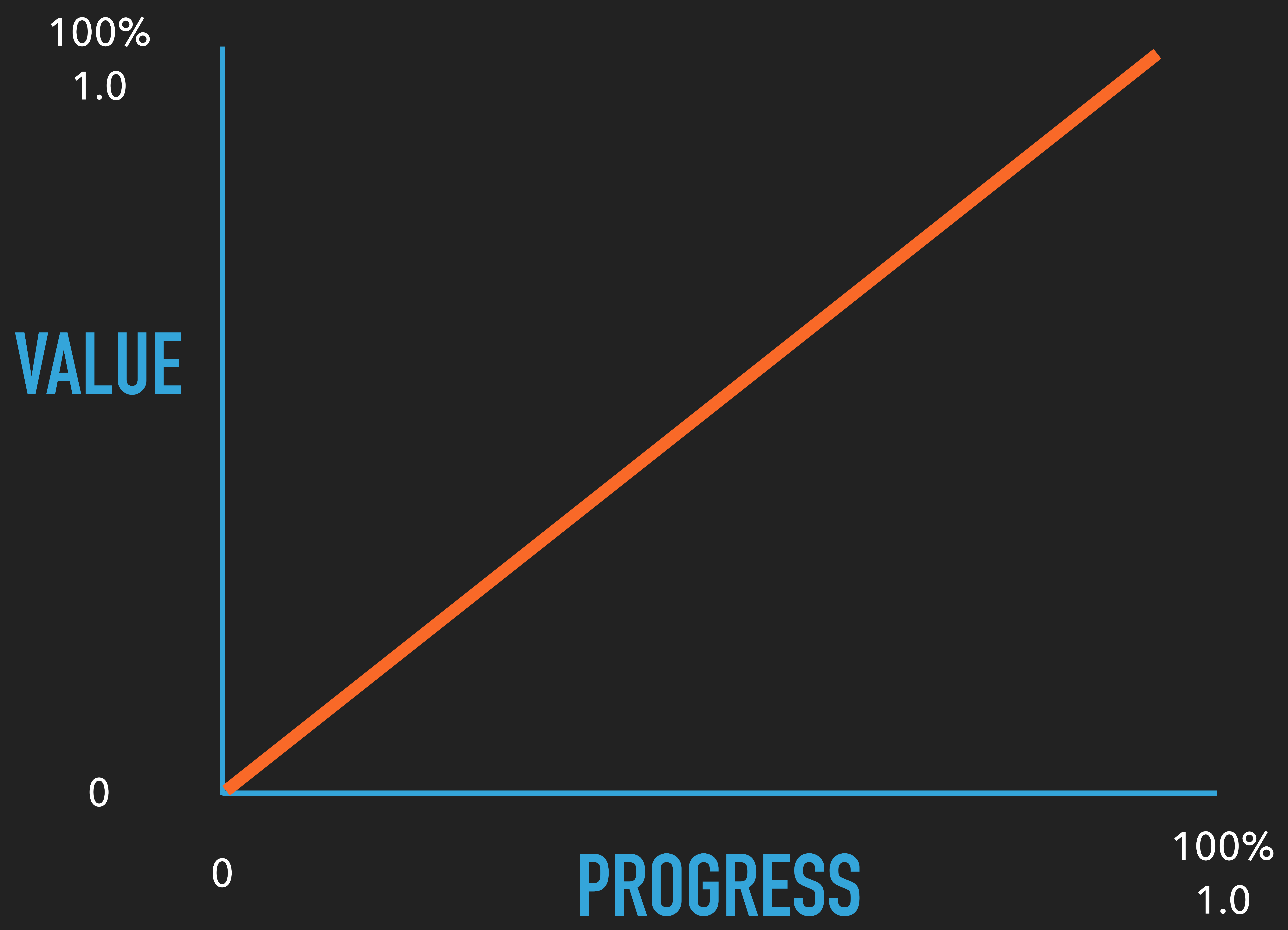
Use physics or other rules to determine next frame for one or more objects.

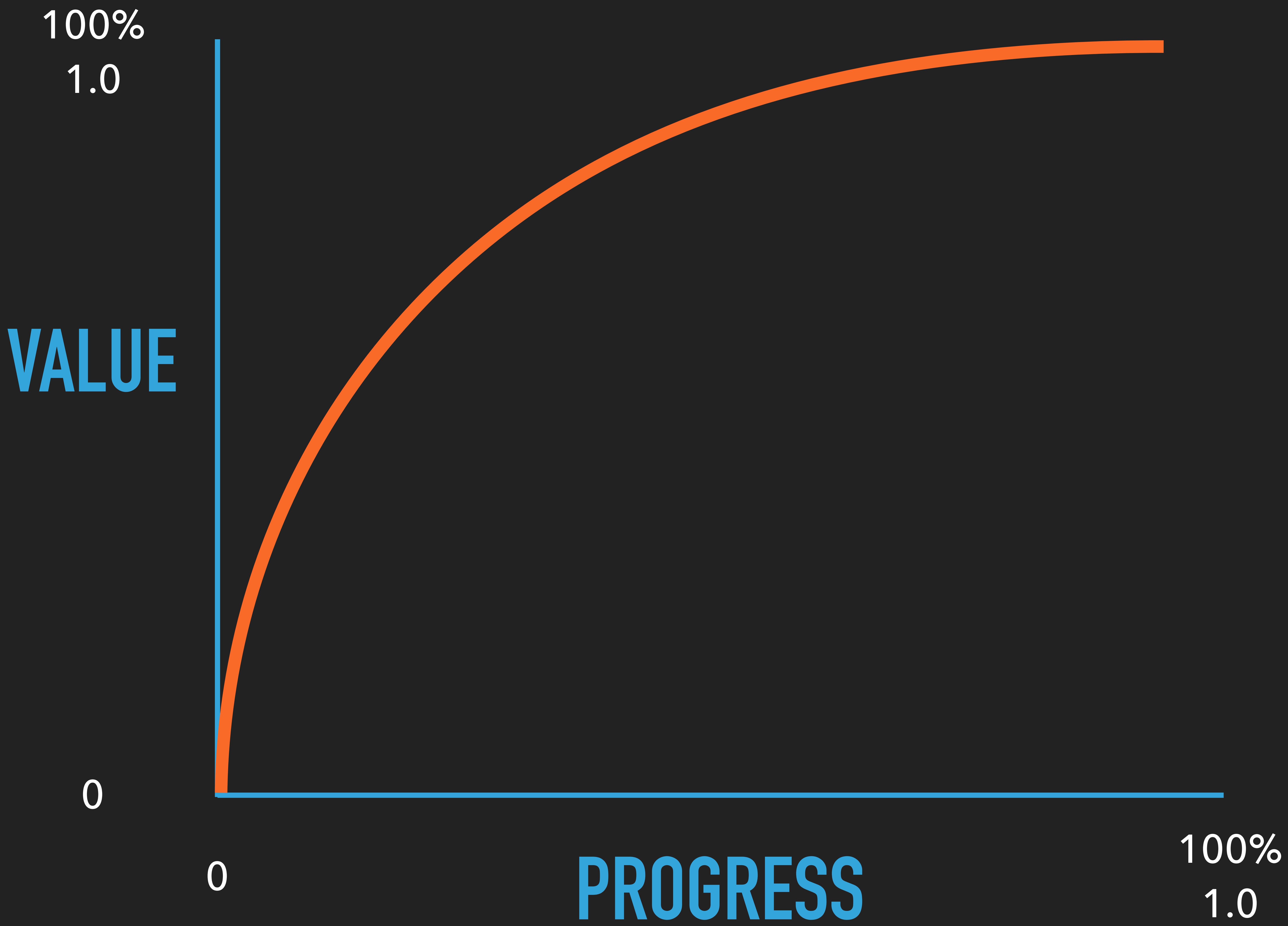
TIMELINES

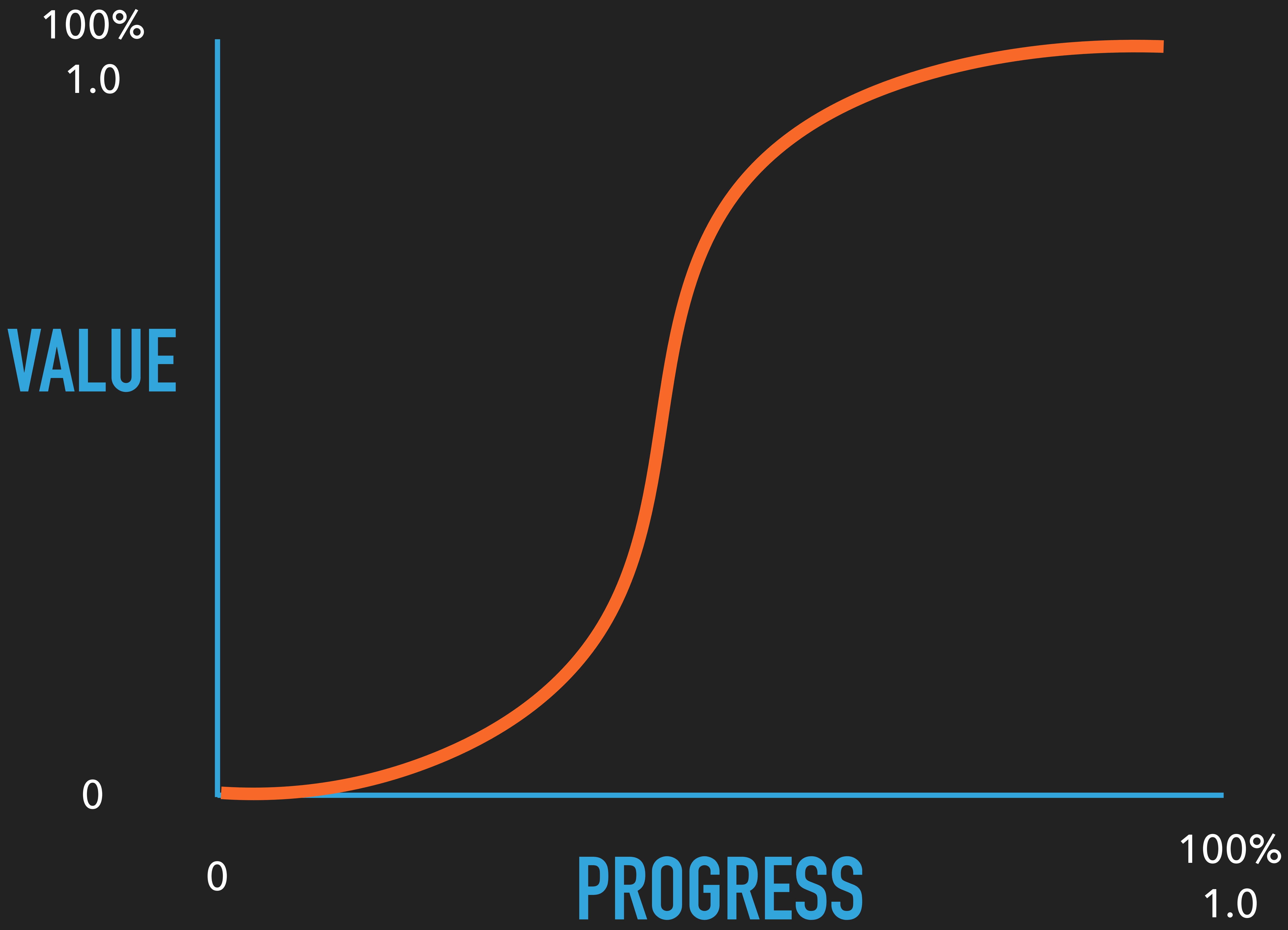
Schedule code for execution in the future

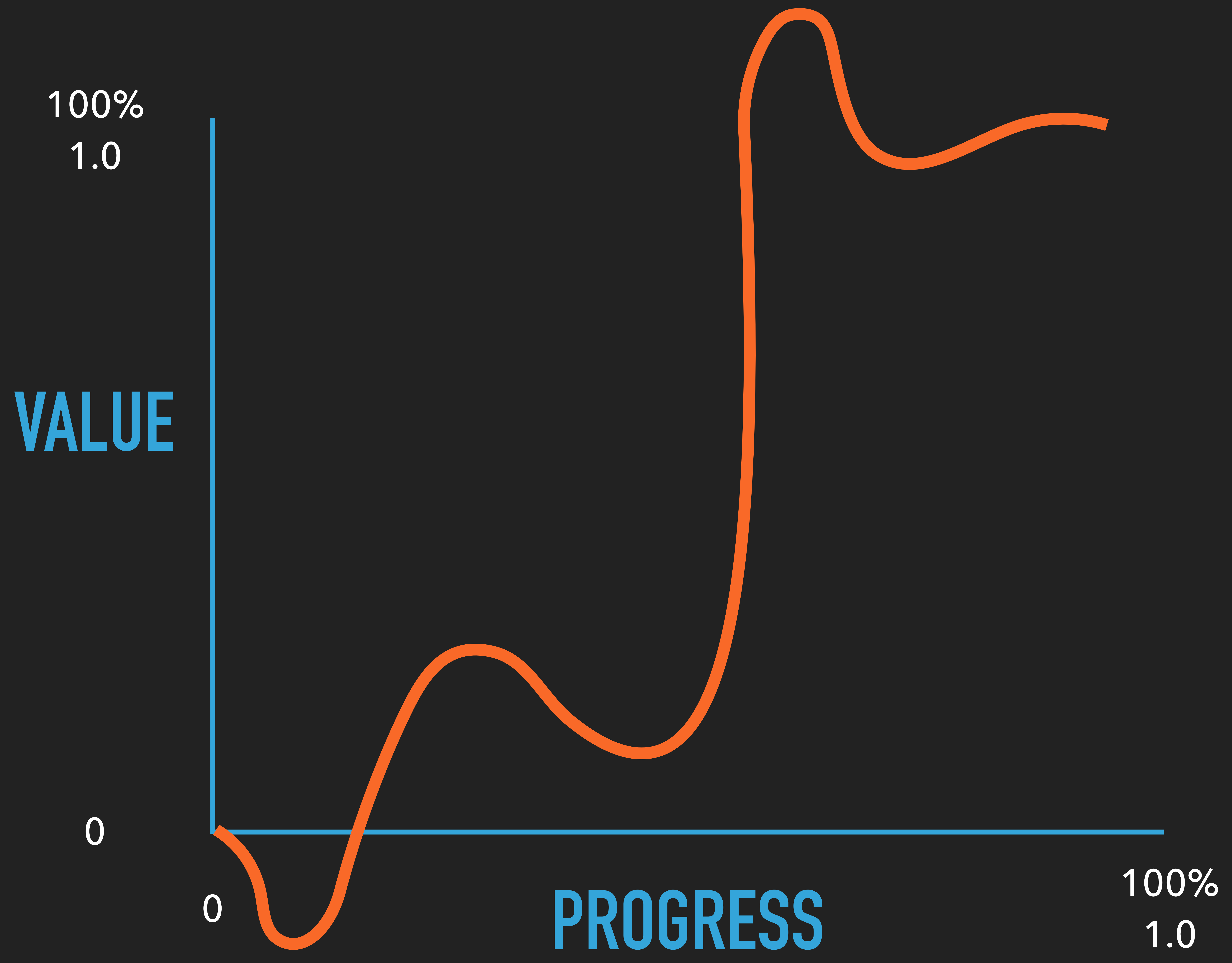
EASING Smoothly transition a variable from one value to another in a set time



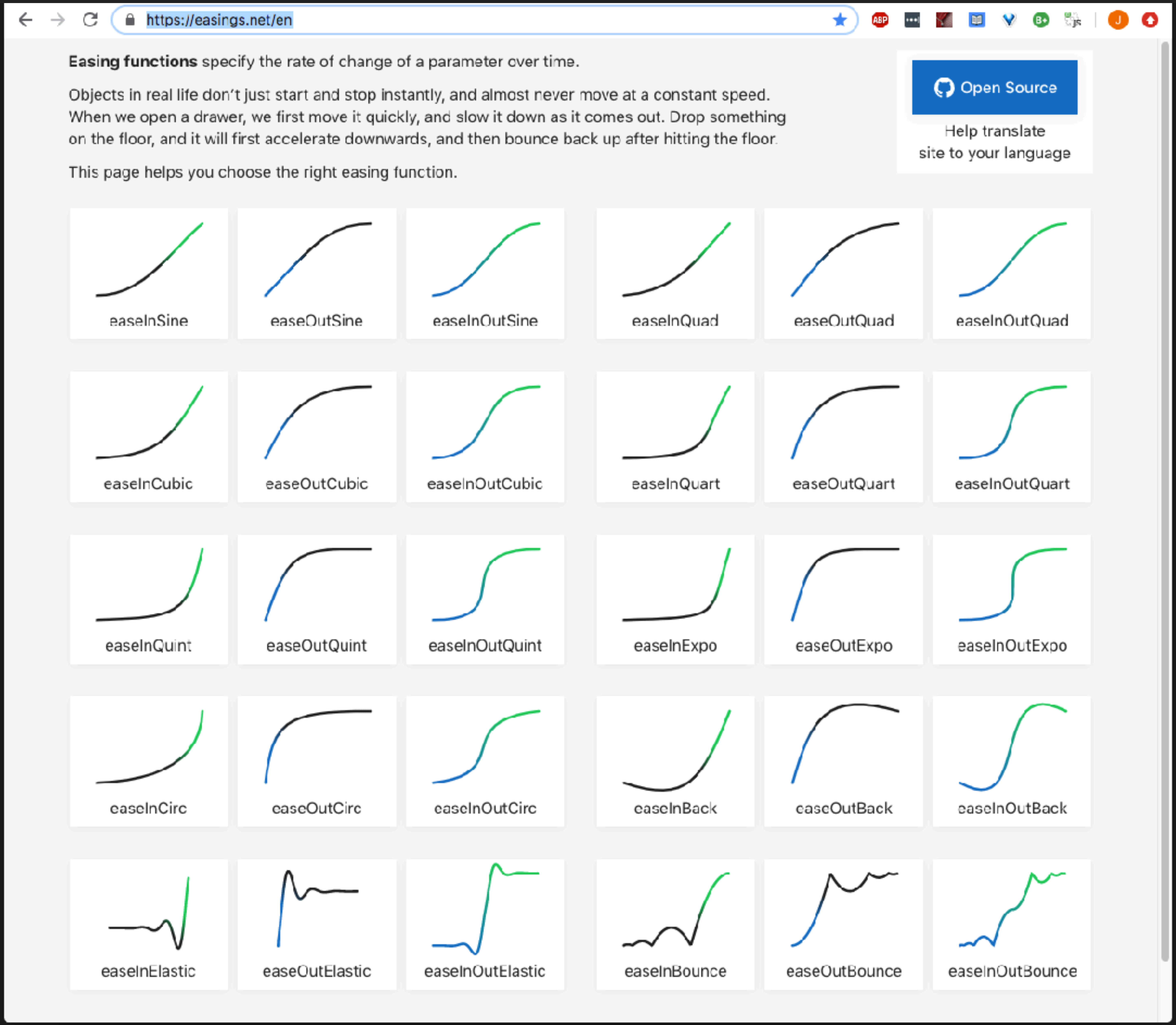

100%
1.0
VALUE
0
0
PROGRESS
100%
1.0


100%
1.0
VALUE
0
0
PROGRESS
100%
1.0


100%
1.0
VALUE
0
0
PROGRESS
100%
1.0


100%
1.0
VALUE
0
0
PROGRESS
100%
1.0

ROBERT PENNER



https://easings.net/en

ROBERT PENNER

Quadratic Easing

Flash's Timeline tweens use something called *quadratic easing*—which could actually be termed "normal" easing. The word *quadratic* refers to the fact that the equation for this motion is based on a squared variable, in this case, t^2:

$$p(t) = t^2$$

NOTE: I always wondered why the term *quadratic* (the prefix means "four") is used to describe equations with a degree of two (x^2). While writing this chapter, I finally looked it up in the dictionary (RTFD, you might say). I discovered that *quad* originally referred to the four sides of a square. Thus, a *squared* variable is *quadratic*.

I used the quadratic easing curve earlier in Figure 7-4. It's actually half a parabola. Here it is again, for reference purposes, in Figure 7-7.

Here's the quadratic ease-in ActionScript function:

```
Math.easeInQuad = function (t, b, c, d) {
    return c*(t/=d)*t + b;
};
```

Recall that `t` is time, `b` is beginning position, `c` is the total change in position, and `d` is the duration of the tween.

This equation is more complex than the linear tween, but it's the simplest of the equations that implement easing. Basically, I normalize `t` by dividing it by `d`. This forces `t` to fall between 0 and 1. I multiply `t` by itself to produce quadratic curvature in the values. Then I scale the value from a

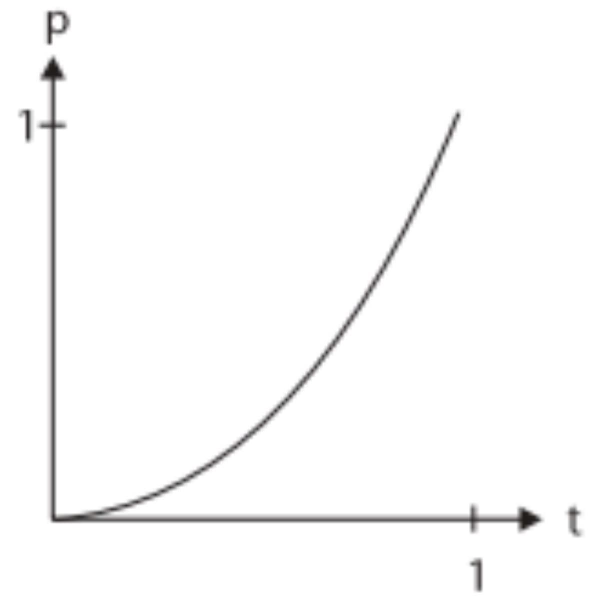
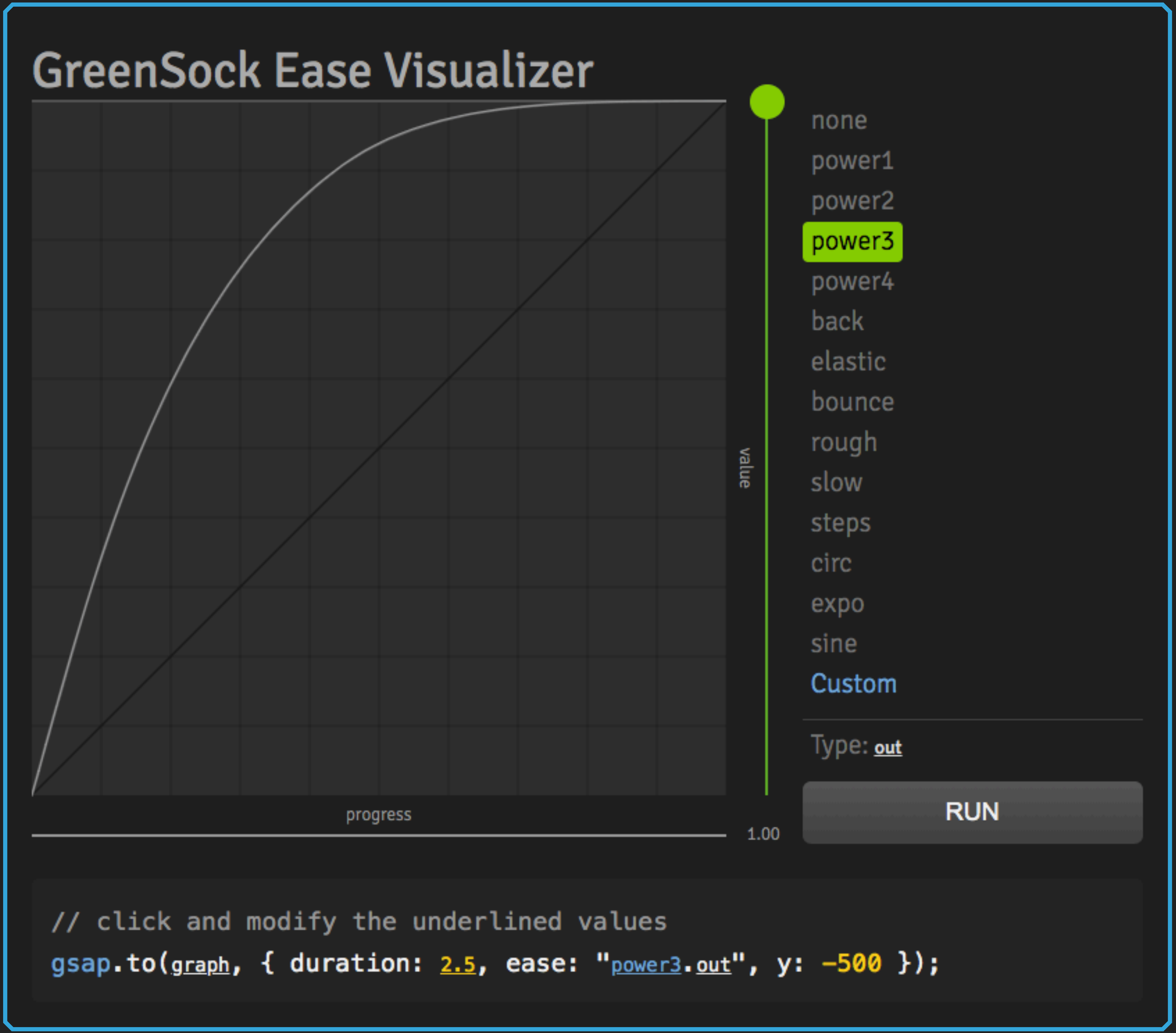


FIGURE 7-7

Graph of quadratic easing

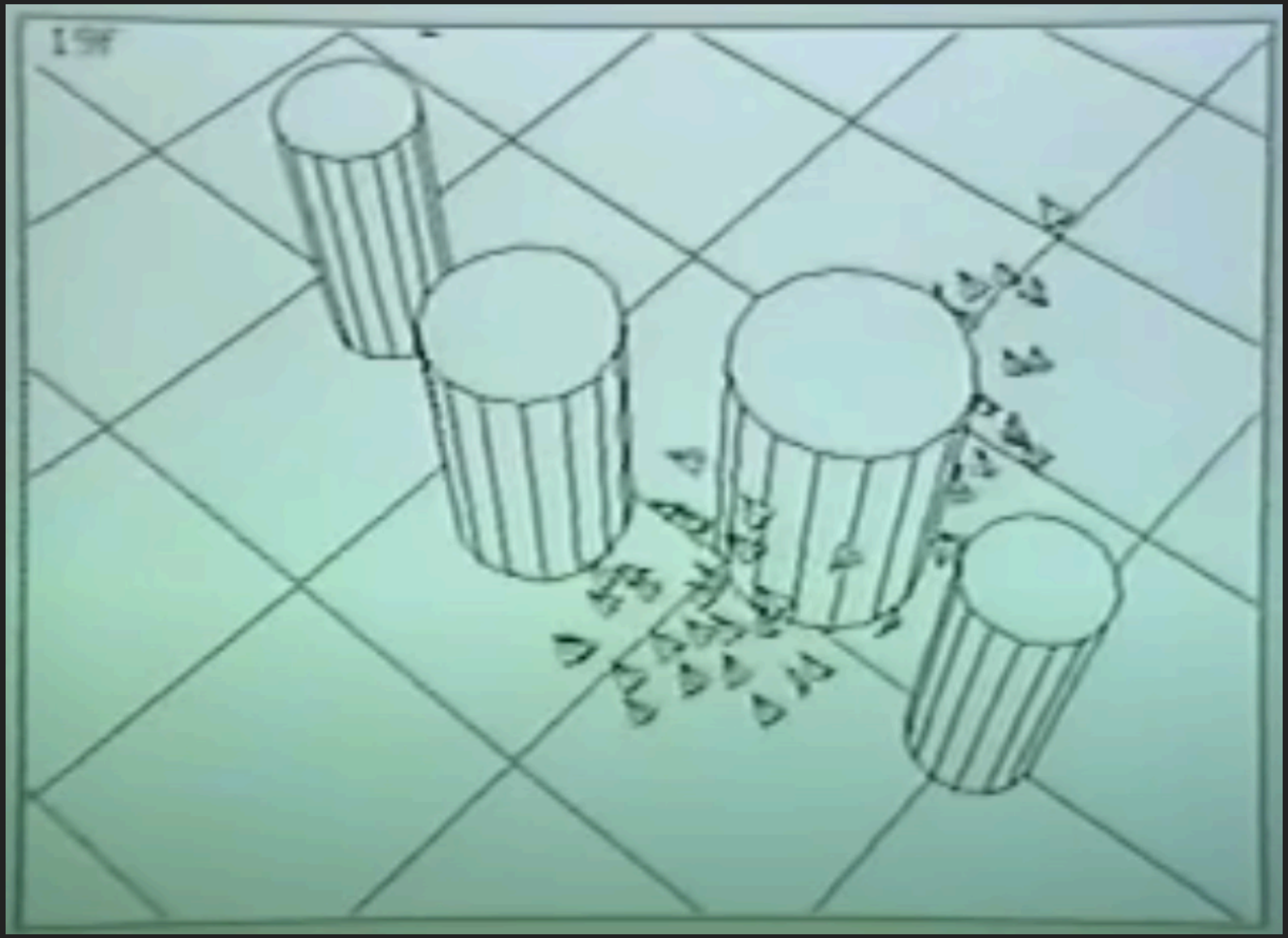
Robert Penner's Programming Macromedia Flash (2002)



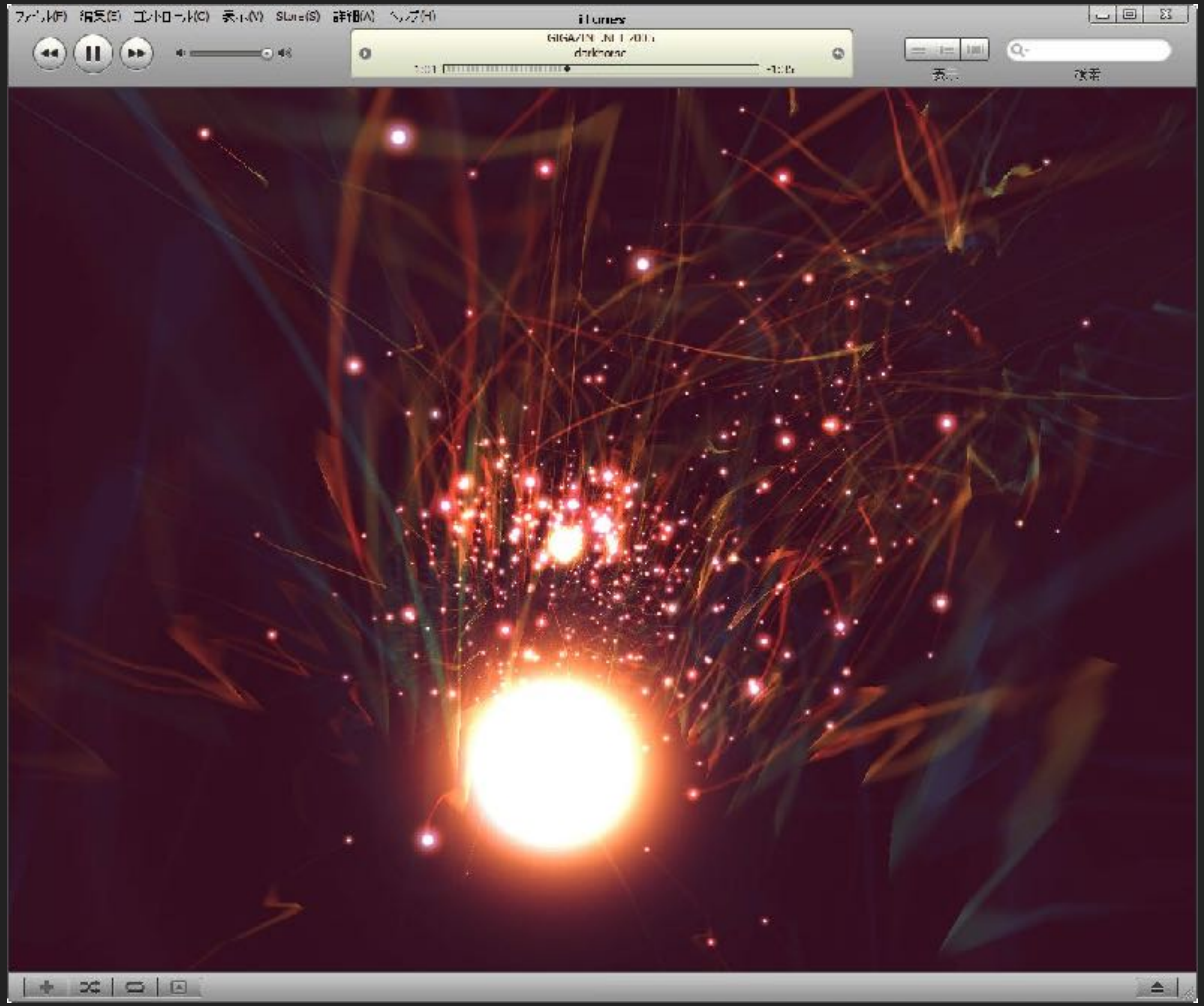
https://greensock.com/ease-visualizer

Fine Tune Keyframes
Video Effects
Motion
Opacity
Time Remapping
Brightness & Contrast
Brightness
Contrast
Black & White
Media Browser
Favorites
Local Drives
Network Drives
MVI_9405.MOV
MVI_9406.MOV
MVI_9411.MOV
MVI_9413.MOV
MVI_9419.MOV
Synth Lead
Snap: Smart
Drag: No Overlap

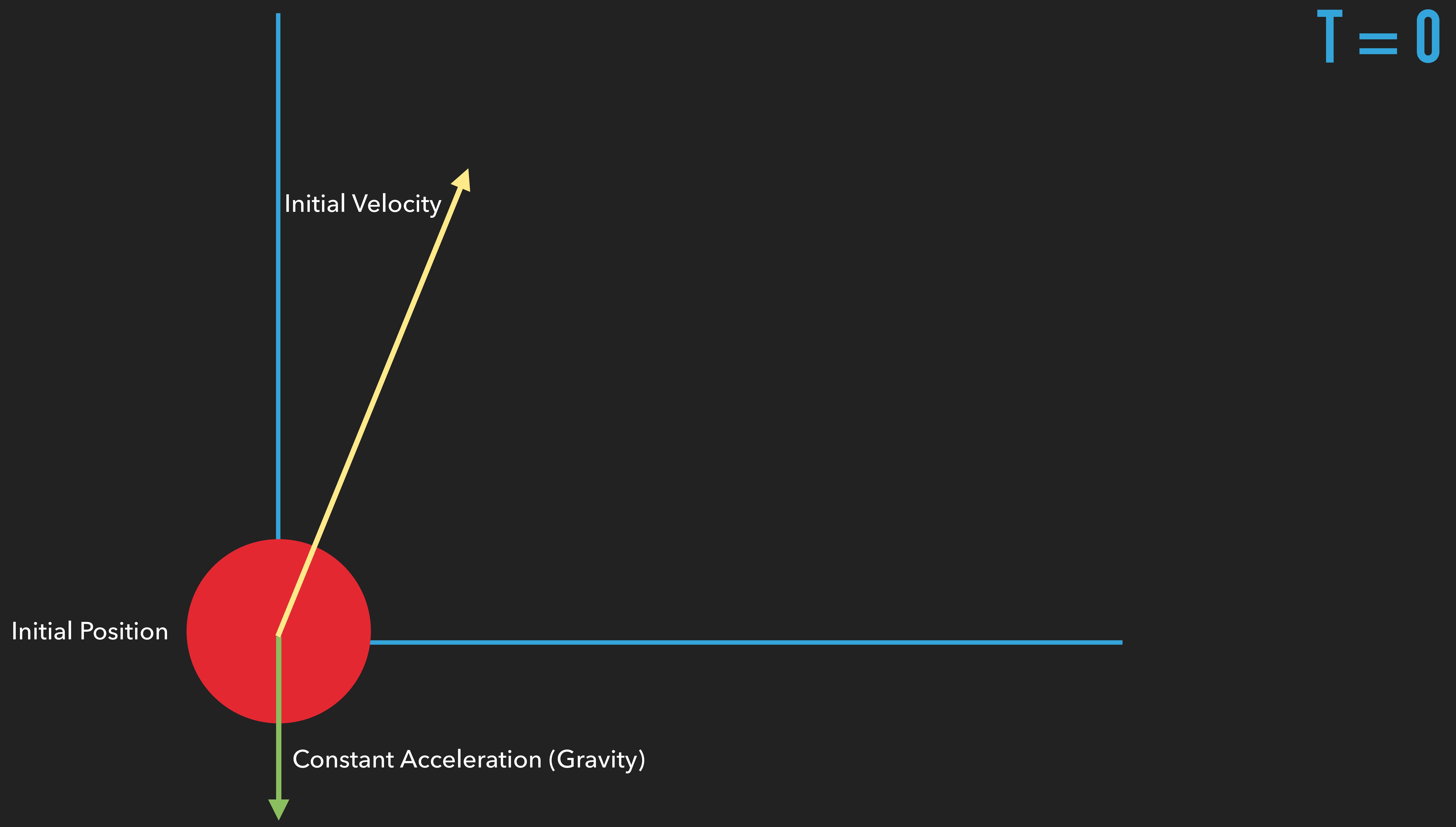
SIMULATION Use physics or other rules to determine next frame for one or more objects.



Craig Reynolds' Boids (1986)

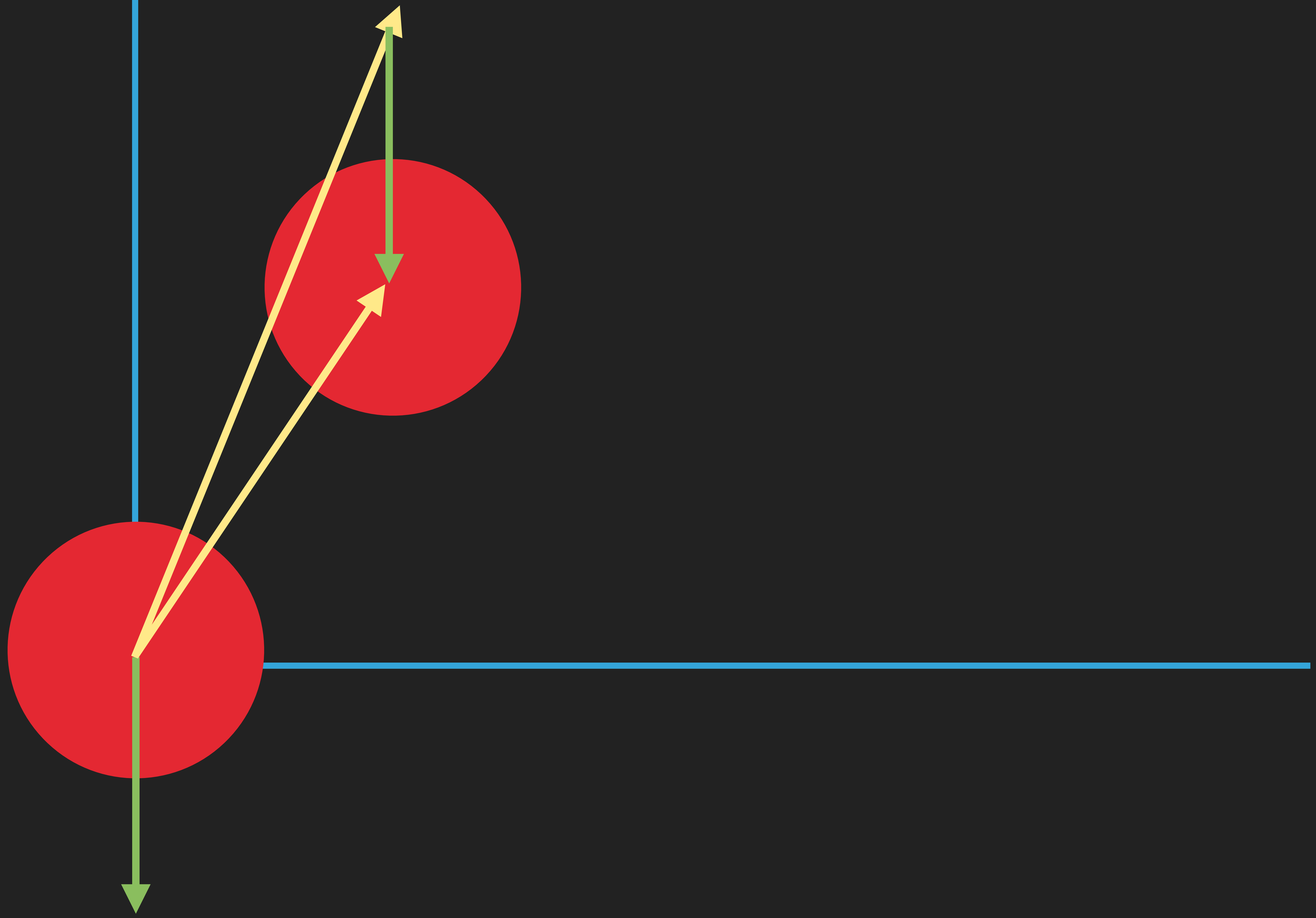


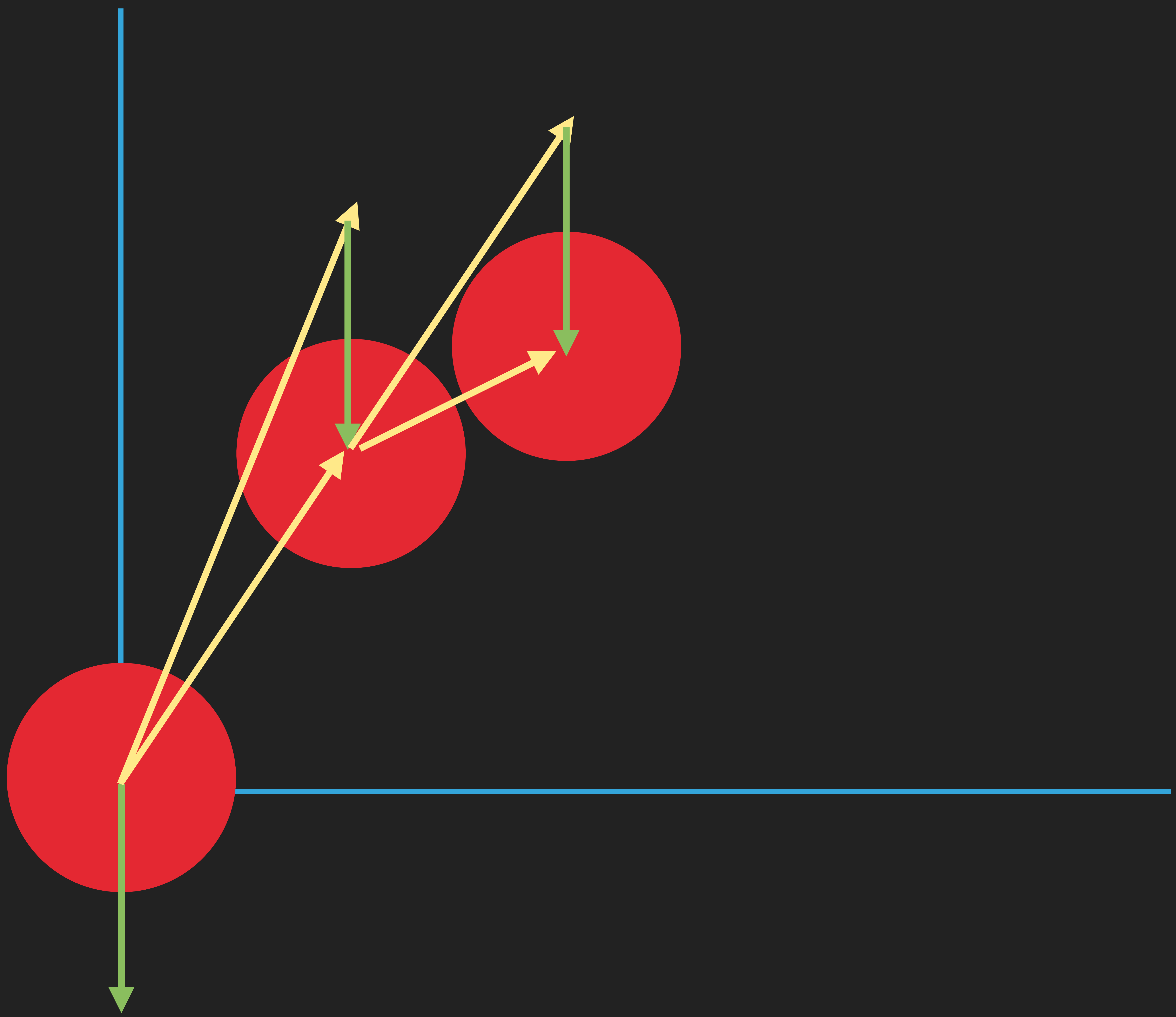
Robert Hodgin's (Flight 404) Magnetosphere, 2007


T = 0
Initial Velocity
Initial Position
Constant Acceleration (Gravity)

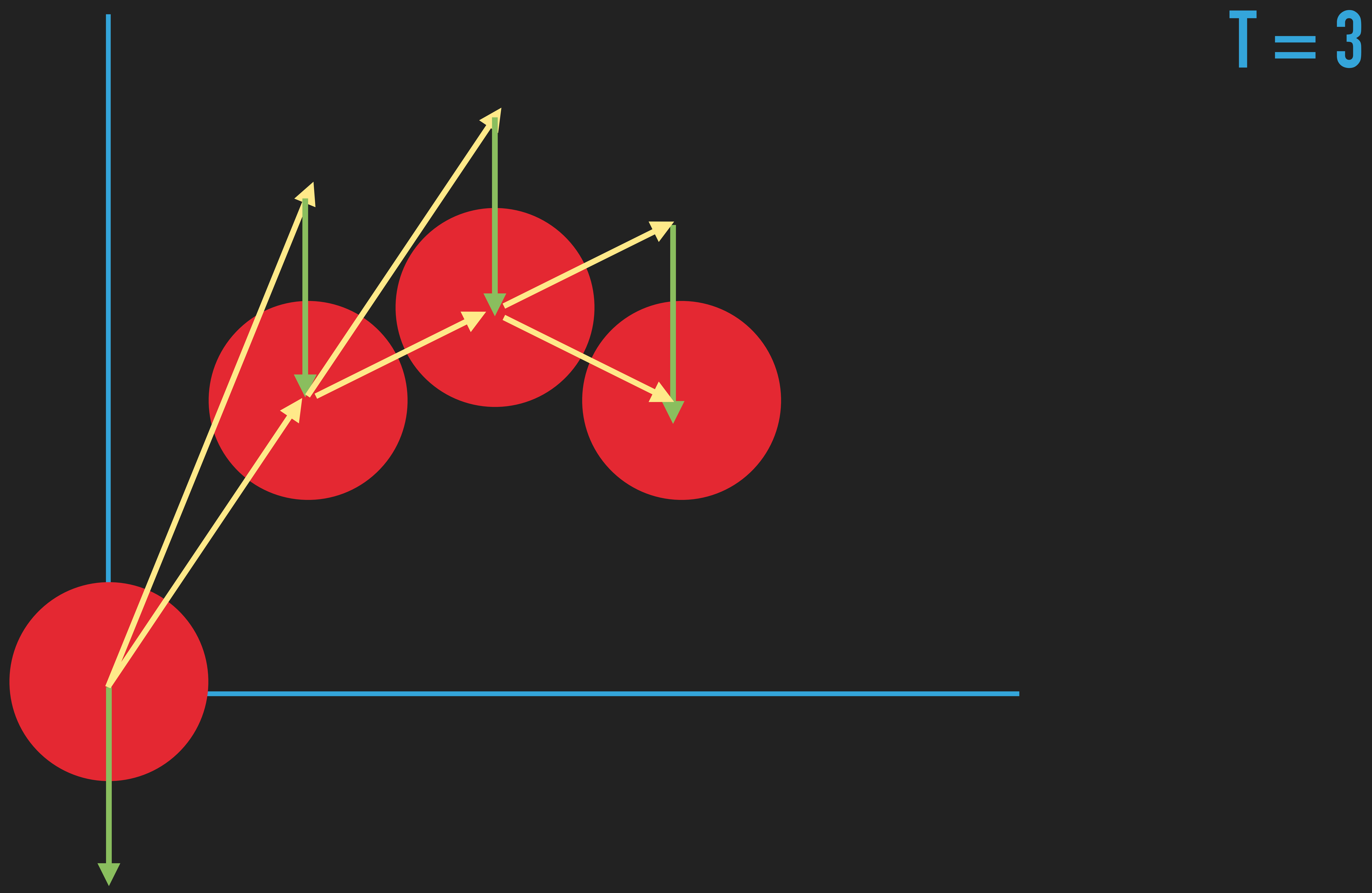
T = 1

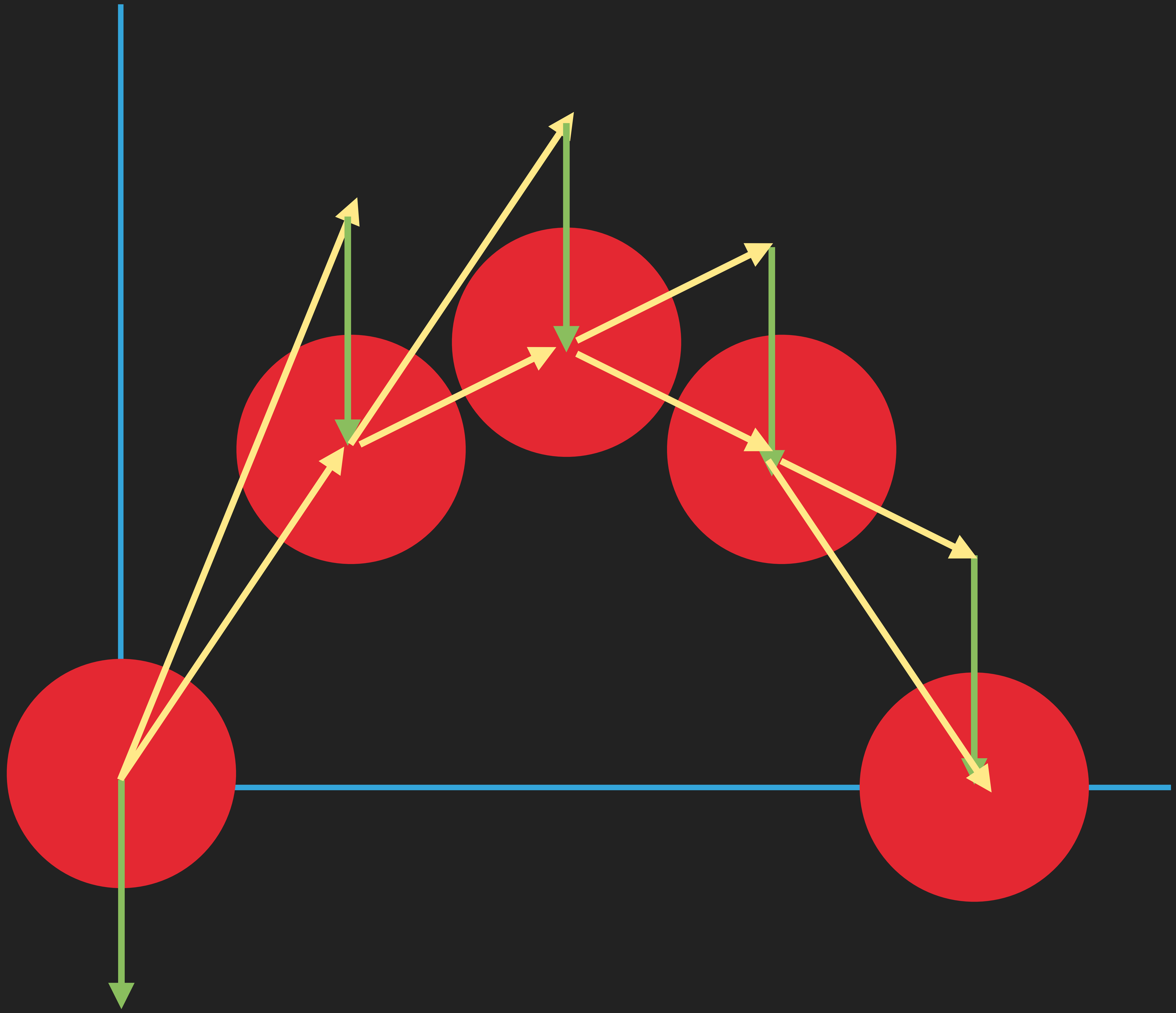
Acceleration is sum of forces acting on particle
Add acceleration to velocity
Add velocity to position





T = 2


T = 3



T = 4...

Can be expanded to three dimensions, multiple particles, and attractive and repulsive forces. But the steps between frames will remain basic vector addition.

http://roberthodgin.com/project/magnetosphere

```
//  Created by Robert Hodgin on 5/14/12.
//  Copyright (c) 2012 __MyCompanyName__. All rights reserved.
//

#include "cinder/app/AppBasic.h"
#include "cinder/Rand.h"
#include "cinder/Sphere.h"
#include "Particle.h"

using namespace ci;

Particle::Particle(){}

Particle::Particle( const Vec3f &pos, float charge )
        : mPos( pos ), mCharge( charge )
{
        mVel                    = Vec3f::zero();
        mAcc                    = Vec3f::zero();
        mForce                  = 0.0f;

        mRadius                 = 1.0f;
        mShellRadius    = 12.0f;
}

void Particle::update( const Camera &cam, float dt )
{
        Sphere s                = Sphere( mPos, mRadius * 10.0f );
        mScreenPos              = cam.worldToScreen( mPos, app::getWindowWidth(), app::getWindowHeight() );
        mScreenRadius   = cam.getScreenRadius( s, app::getWindowWidth(), app::get

        mColor                  = mCharge * 0.5f + 0.5f;

        mVel += mAcc * dt;
        mPos += mVel * dt;
        mAcc = Vec3f::zero();

        mShellRadius = mRadius + fabs( mForce ) * 50000.0f;

        mMatrix.setToIdentity();
        mMatrix.translate( mPos );
}

void Particle::draw()
{
        gl::color( Color( mColor, mColor, mColor ) );
        gl::drawSphere( mPos, mRadius );
```


```
mVel += mAcc * dt;
mPos += mVel * dt;
mAcc = Vec3f::zero();
```


Acceleration is sum of forces acting on particle
Add acceleration to velocity
Add velocity to position

https://github.com/flight404/Eyeo2012

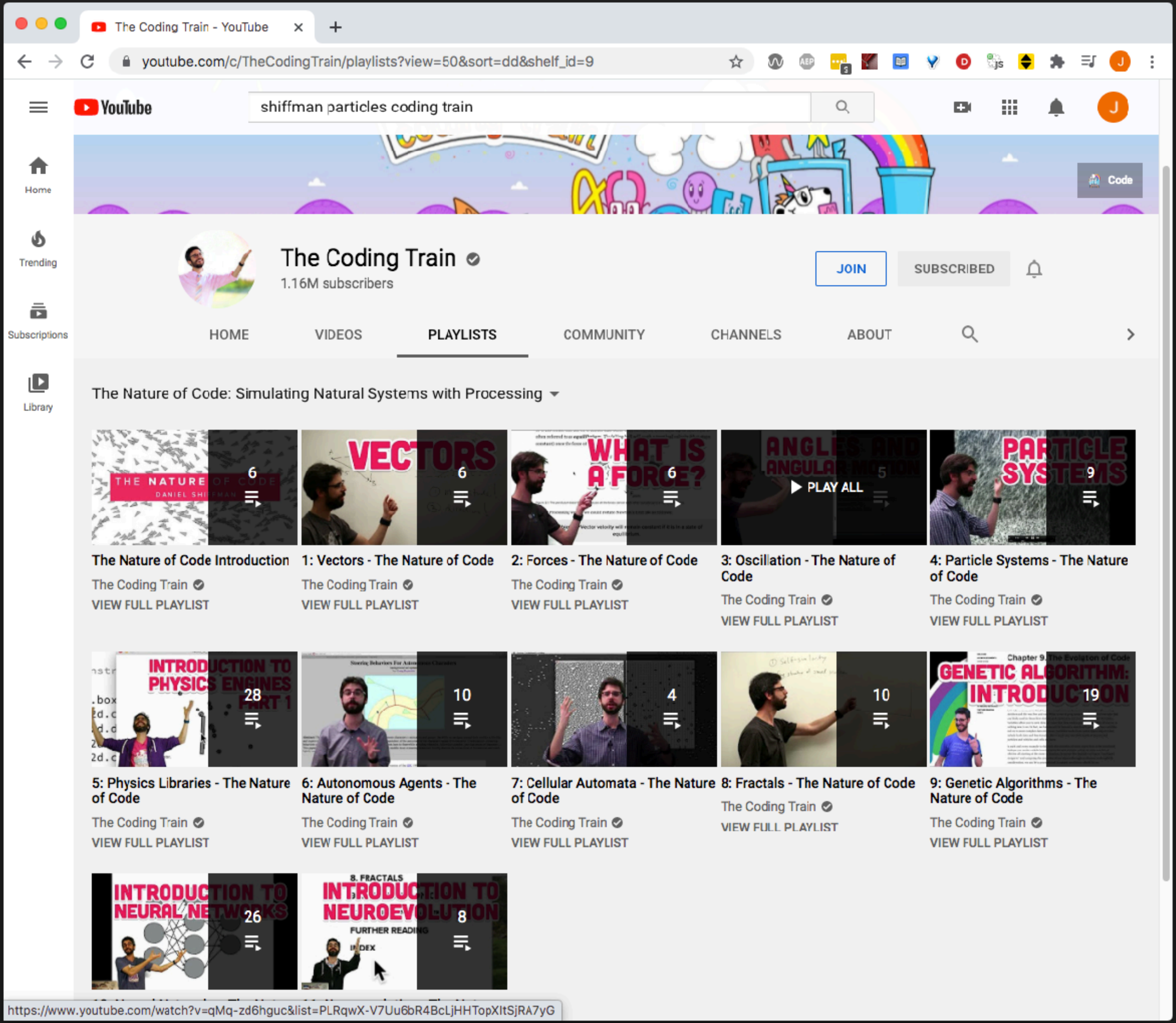
“The physics of the simple vehicle model is based on forward Euler integration. At each simulation step, behaviorally determined steering forces (as limited by *max_force*) are applied to the vehicle’s point mass. This produces an acceleration equal to the steering force divided by the vehicle’s mass. That acceleration is added to the old velocity to produce a new velocity, which is then truncated by *max_speed*. Finally, the velocity is added to the old position:

```
    steering_force = truncate (steering_direction,
max_force)
    acceleration = steering_force / mass
    velocity = truncate (velocity + acceleration,
max_speed)
    position = position + velocity
```

Acceleration is sum of forces acting on particle
Add acceleration to velocity
Add velocity to position

The simple vehicle model maintains its velocity-aligned local space by *incremental adjustment* from the previous time step.”

Steering Behaviors For Autonomous Characters
Craig W. Reynolds
https://www.red3d.com/cwr/steer/gdc99/



Pretty good source in-house