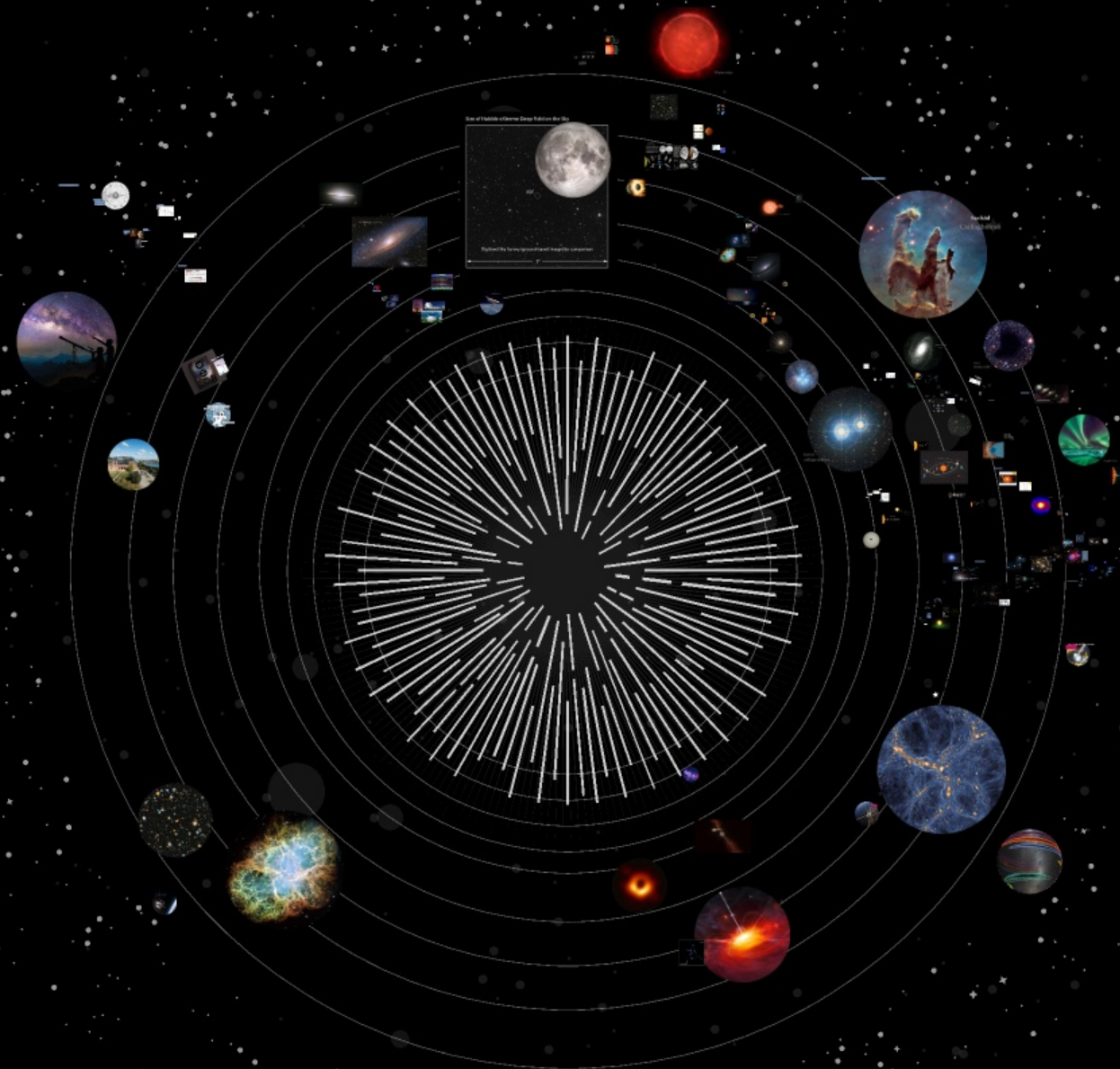


Open Books

GetYourScience
ELTETTK



Kis-Tóth Ágnes

Randevú a Kozmoszal



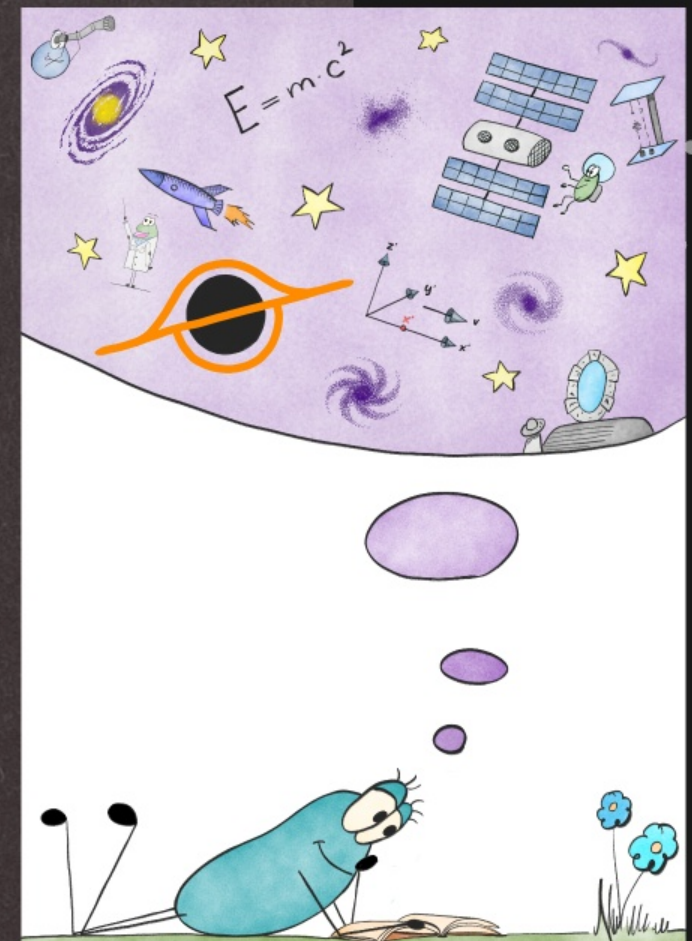
**KIS-TÓTH
ÁGNES**

**RANDEVÚ
A
KOZMOSSZAL**

*Szinte minden,
amit tudni szeretnél
volna az univerzum
felfedezéséről*

Op!n

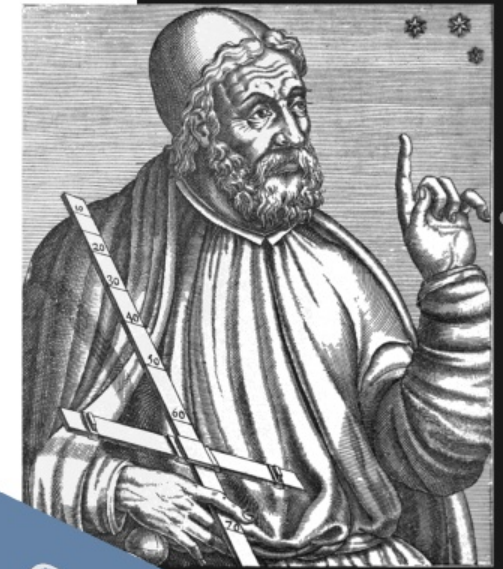
Op!n Books



@csillikdavidjanos



Nap, a Hold, a bolygók, a csillagok és mi.
Hát ez meg mi?

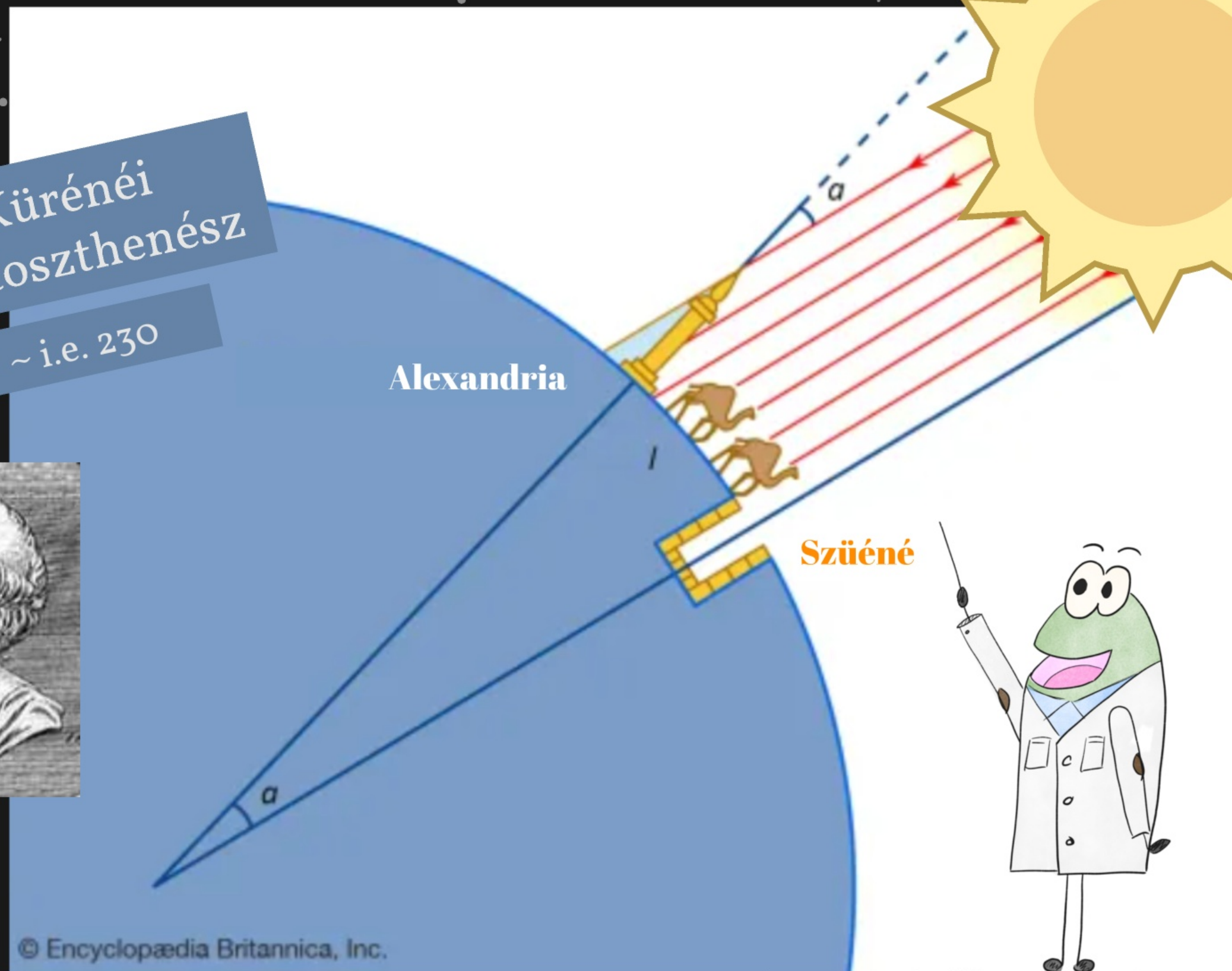


Szamoszi
Arisztarkhosz
i.e. 3. század



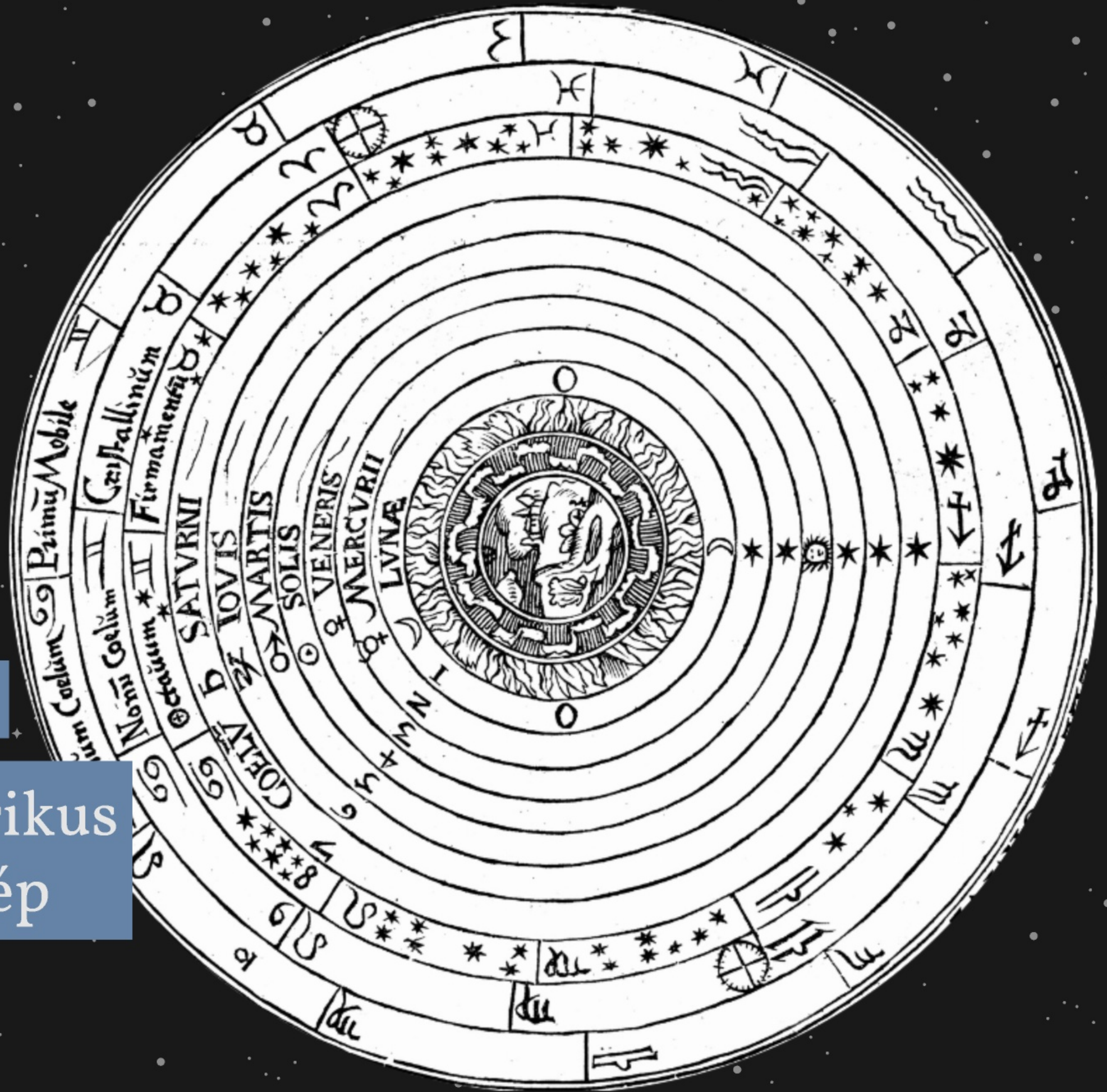
Kürénéi
Eratoszthenész

~ i.e. 230

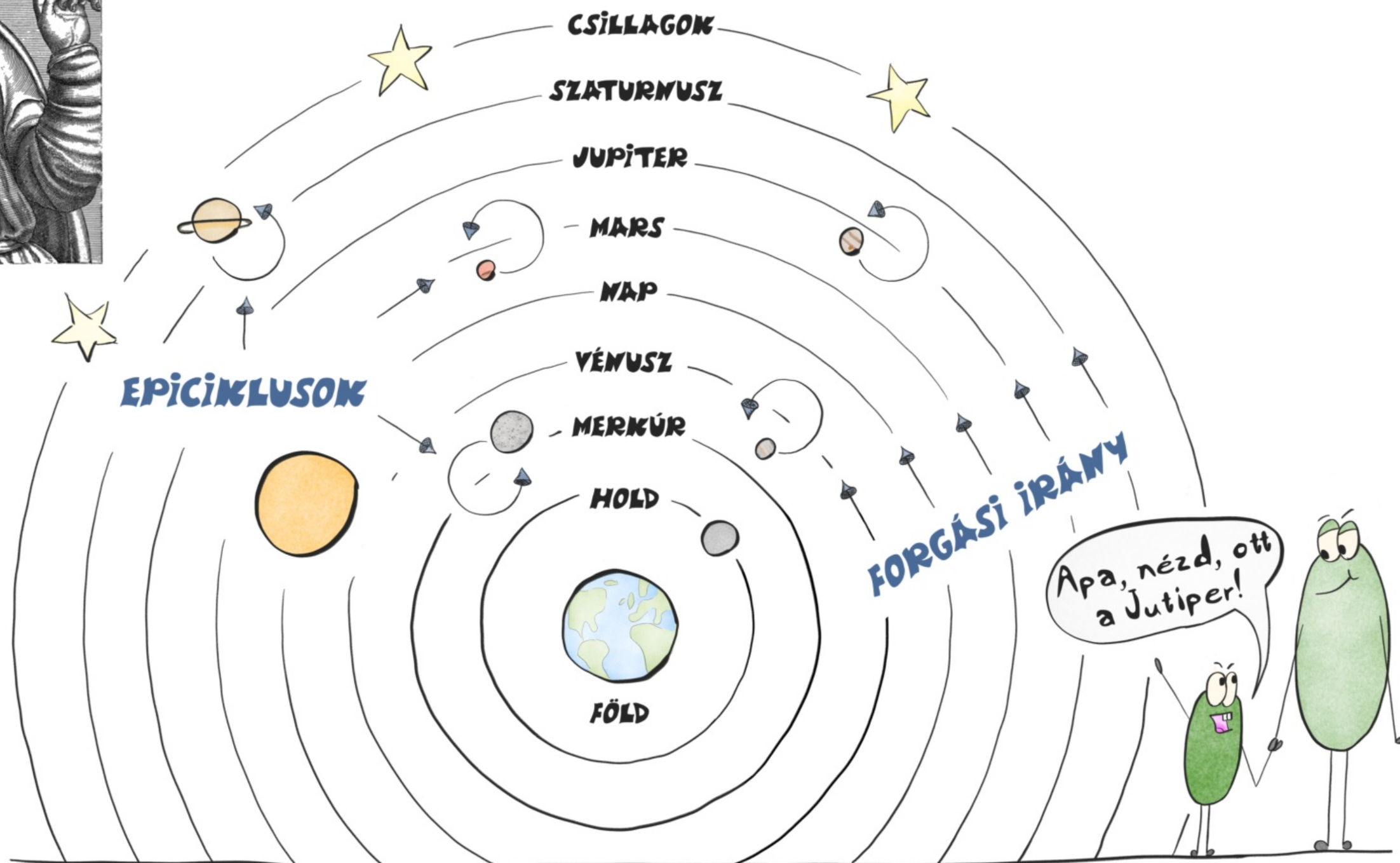
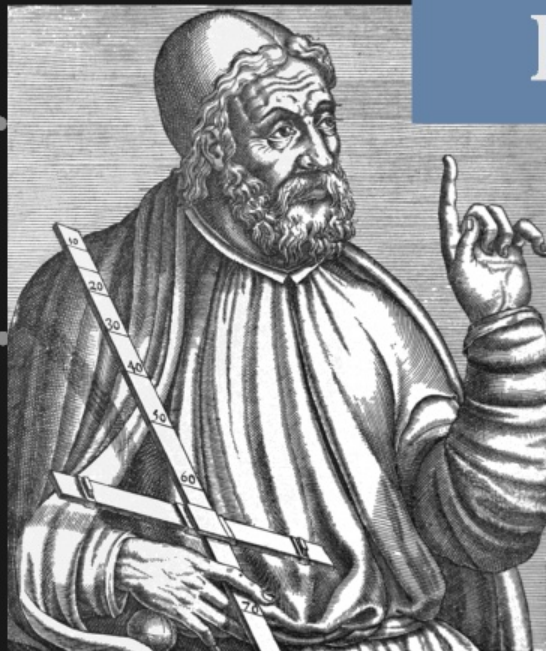


2. század

Geocentrikus
világkép

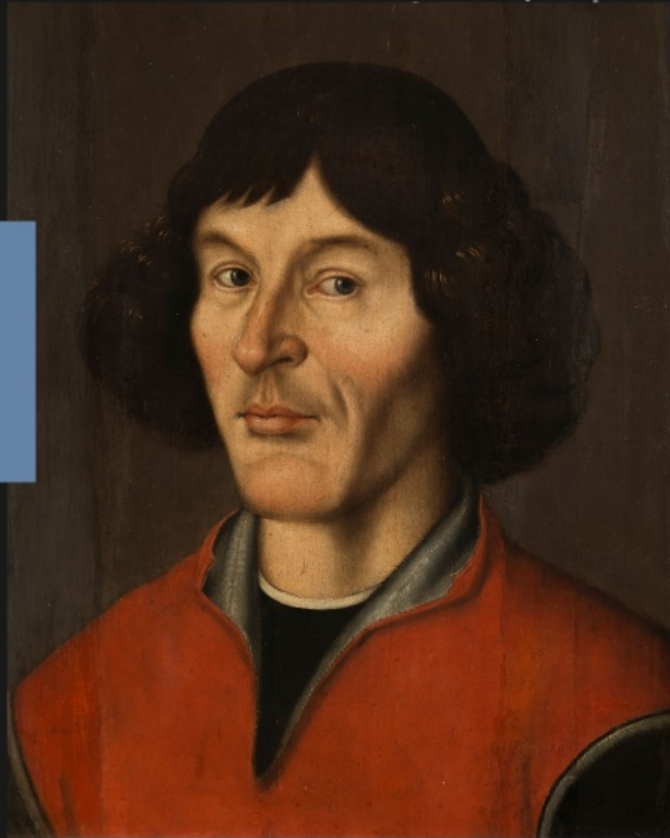


Klaudiosz Ptolemaiosz



Nikolausz
Kopernikus

1510



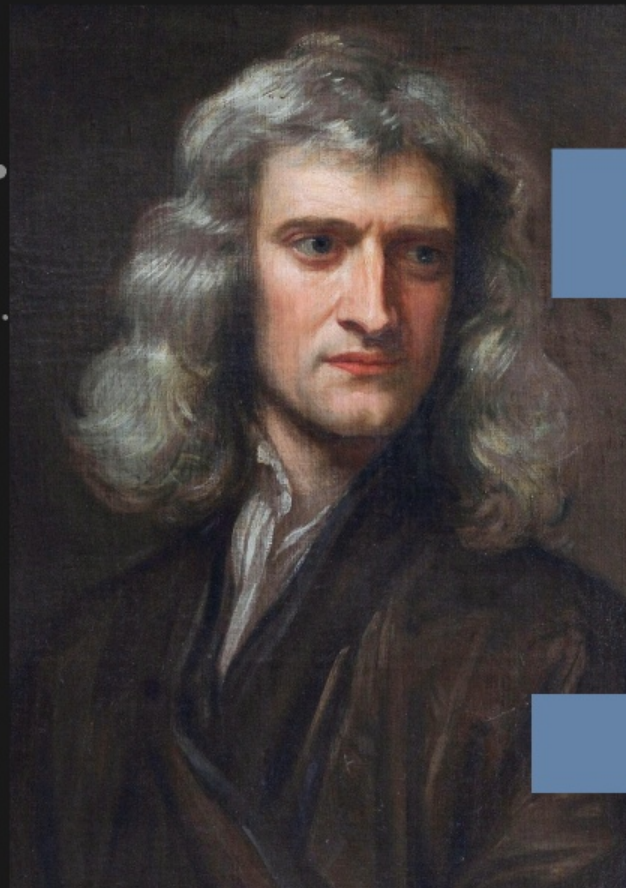
Johannes
Kepler

1609



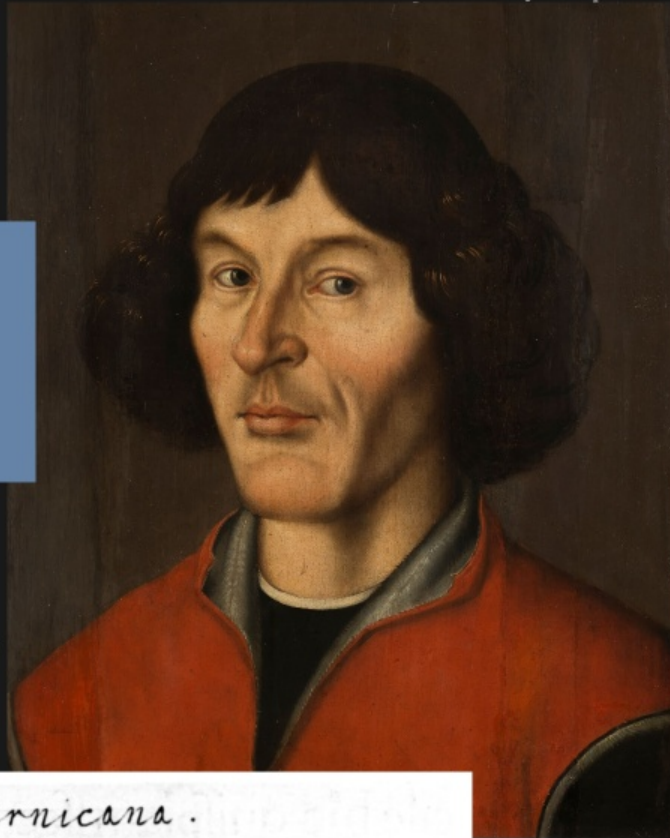
Isaac Newton

1687



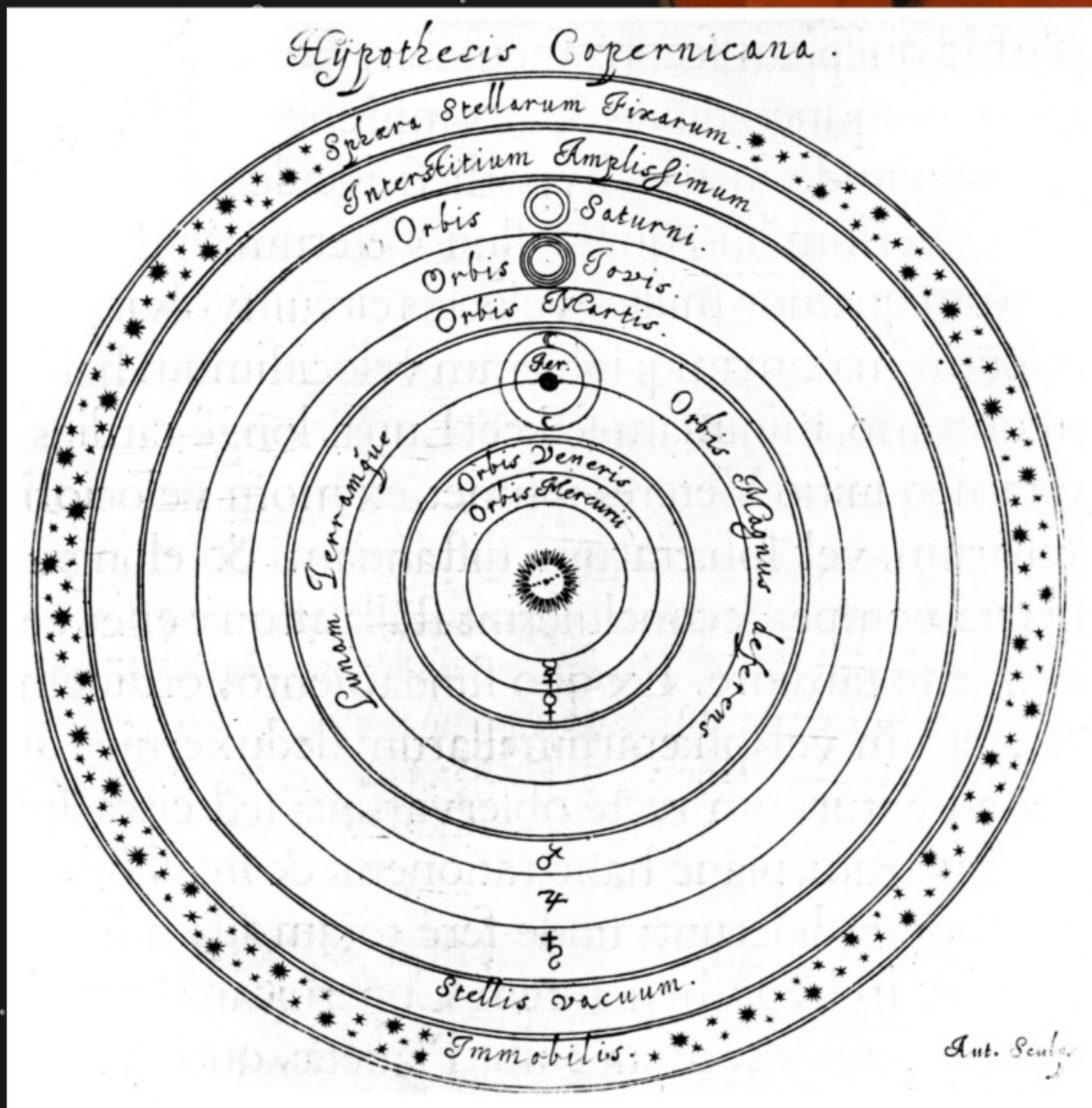
Nikolausz Kopernikus

1510



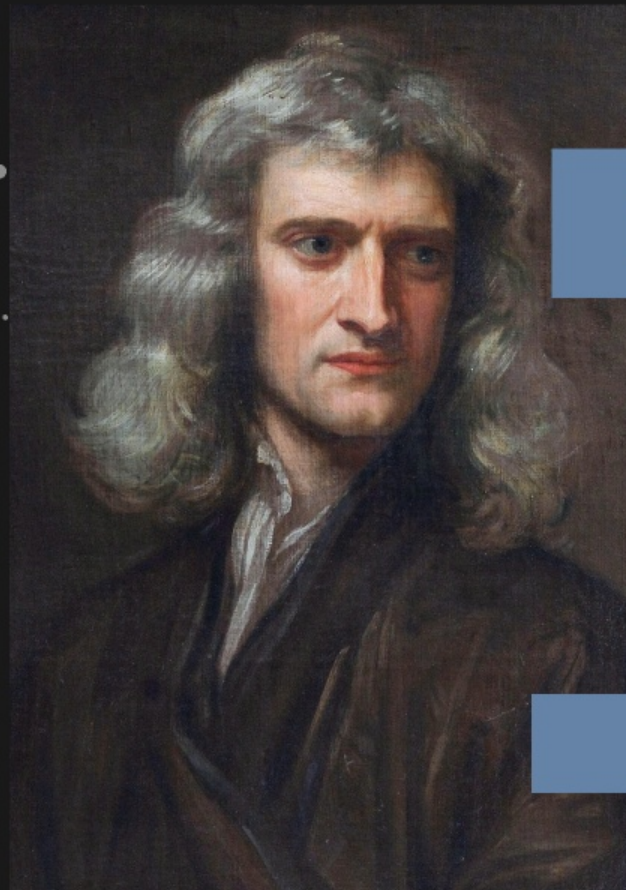
Johannes Kepler

1609



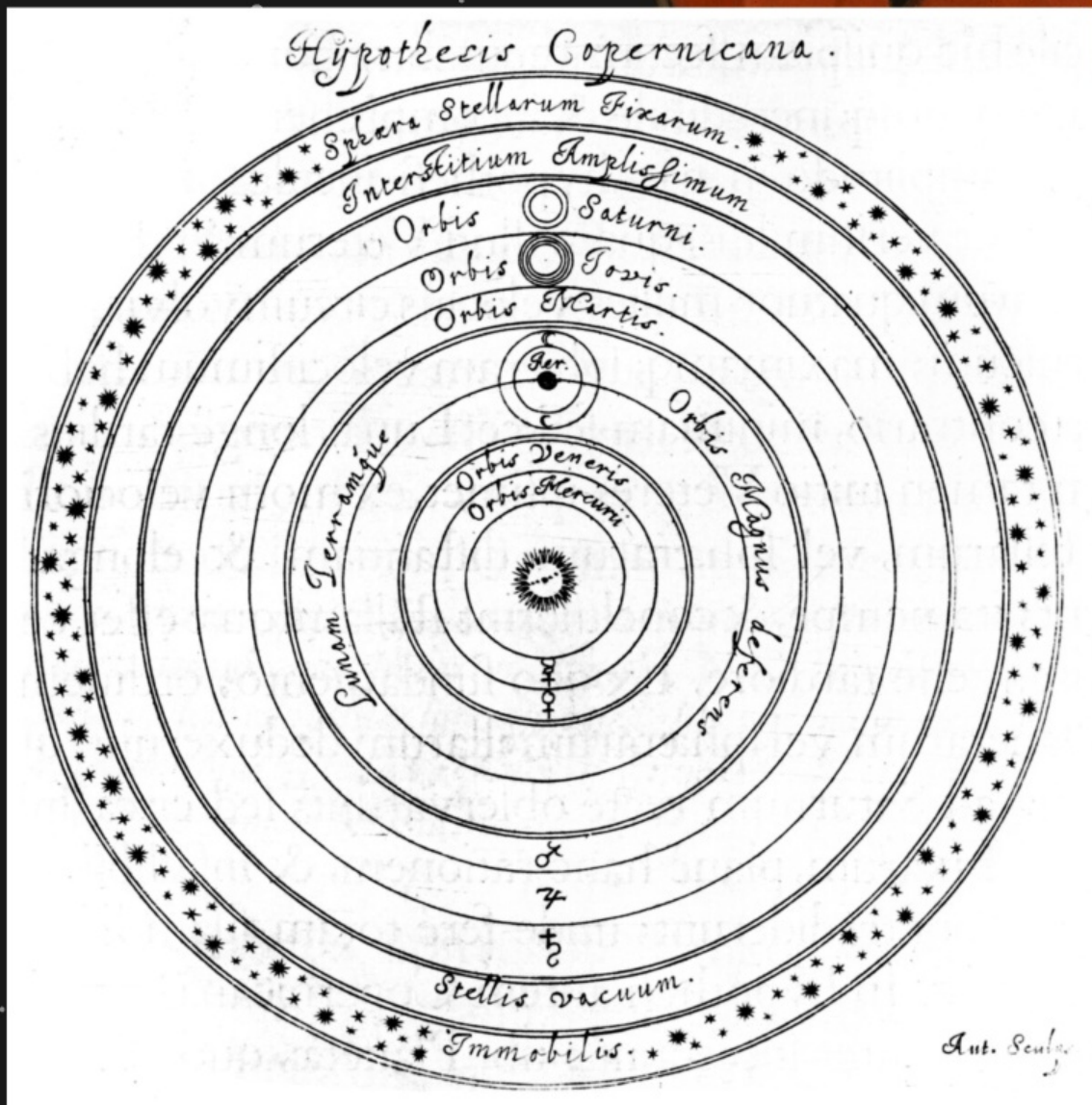
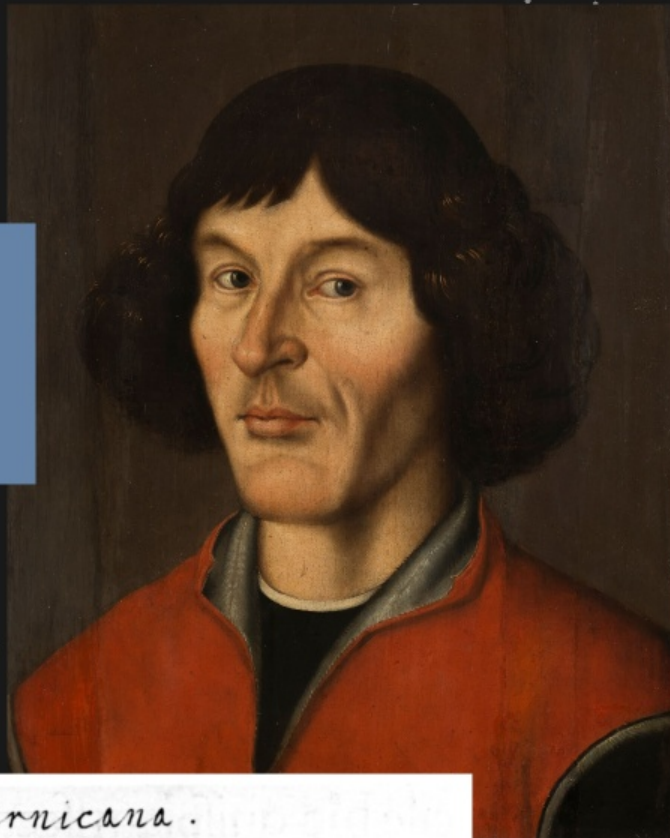
Isaac Newton

1687



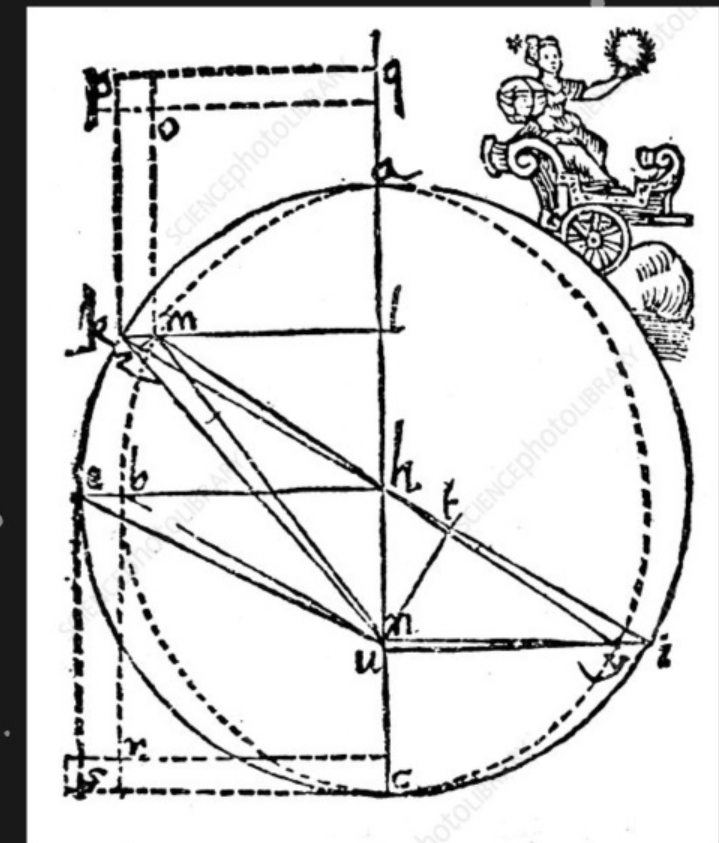
Nikolausz Kopernikus

1510



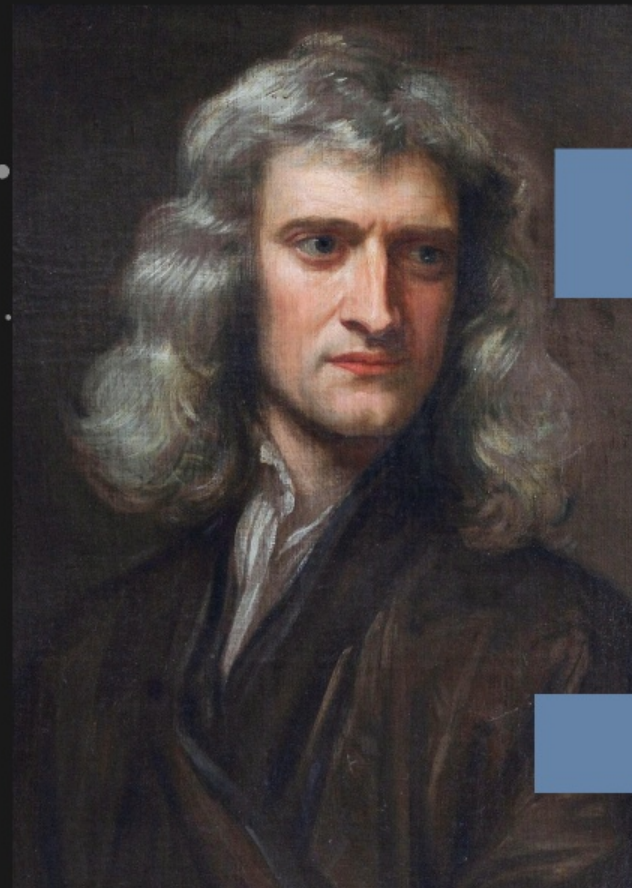
Johannes Kepler

1609



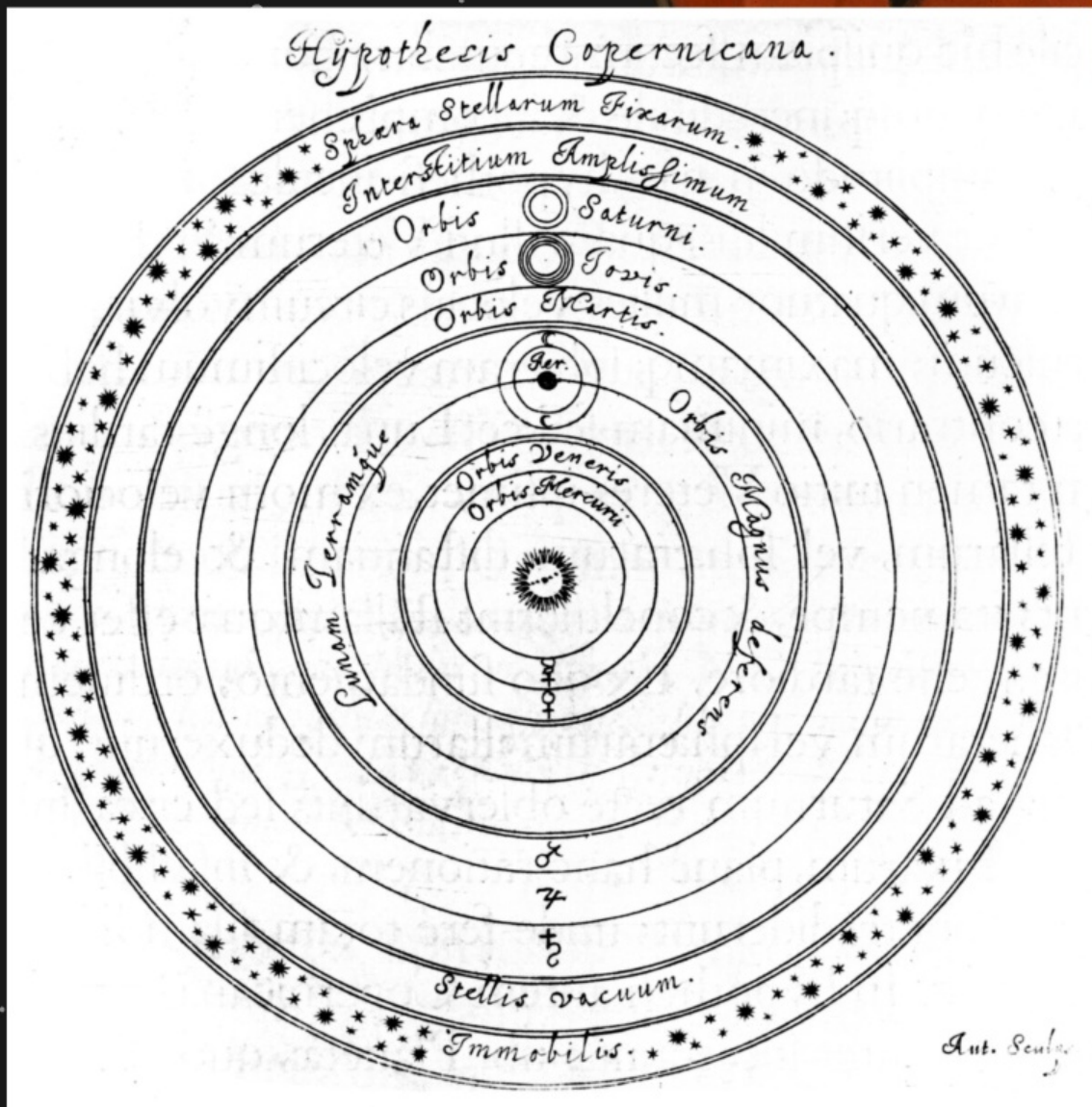
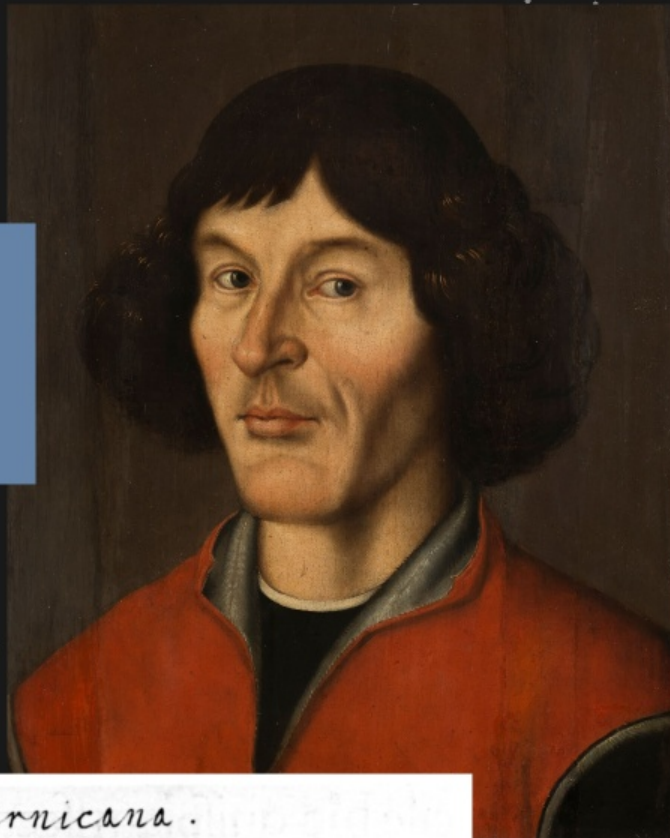
Isaac Newton

1687



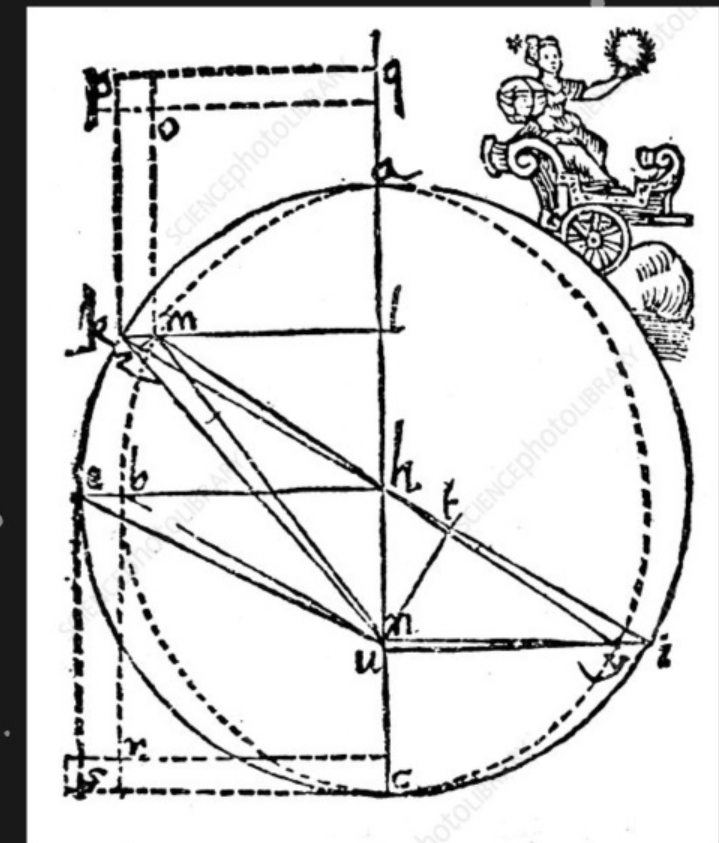
Nikolausz Kopernikus

1510



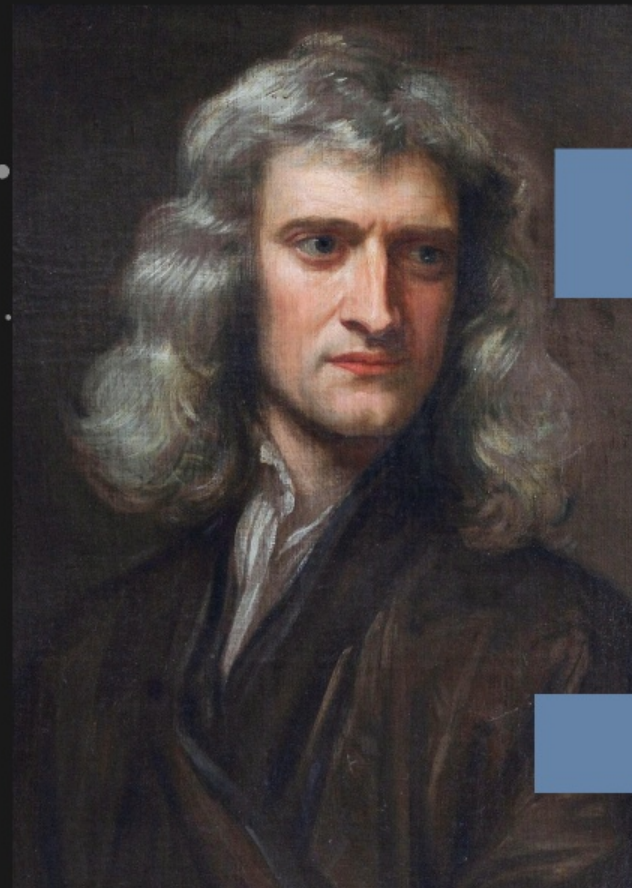
Johannes Kepler

1609



Isaac Newton

1687



$$F = G \frac{m_1 \cdot m_2}{R^2}$$

Hééé, ki öntötte ki a tejet az égboltra?



A csillagok,
amiket látunk
az éjszakai égbolton!

waitbutwhy.com

Galaxy – Milky – Tejes



Galaxy – Milky – Tejes

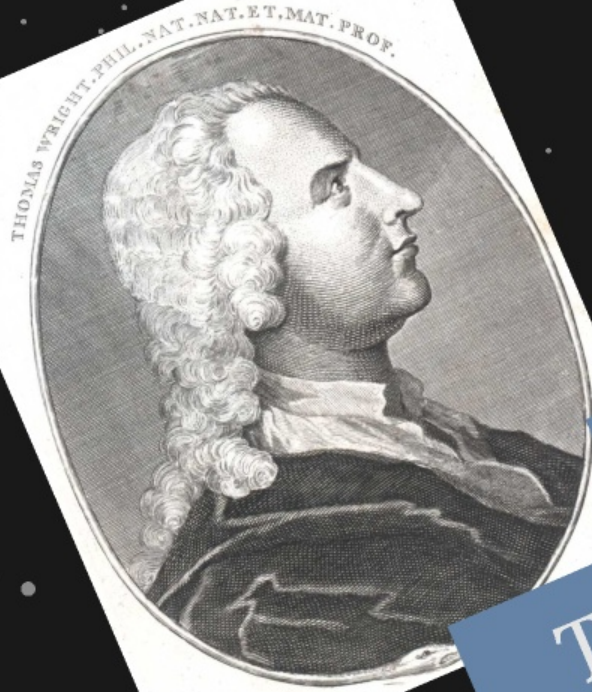


Galaxy – Milky – Tejes



Galileo
Galilei
1610





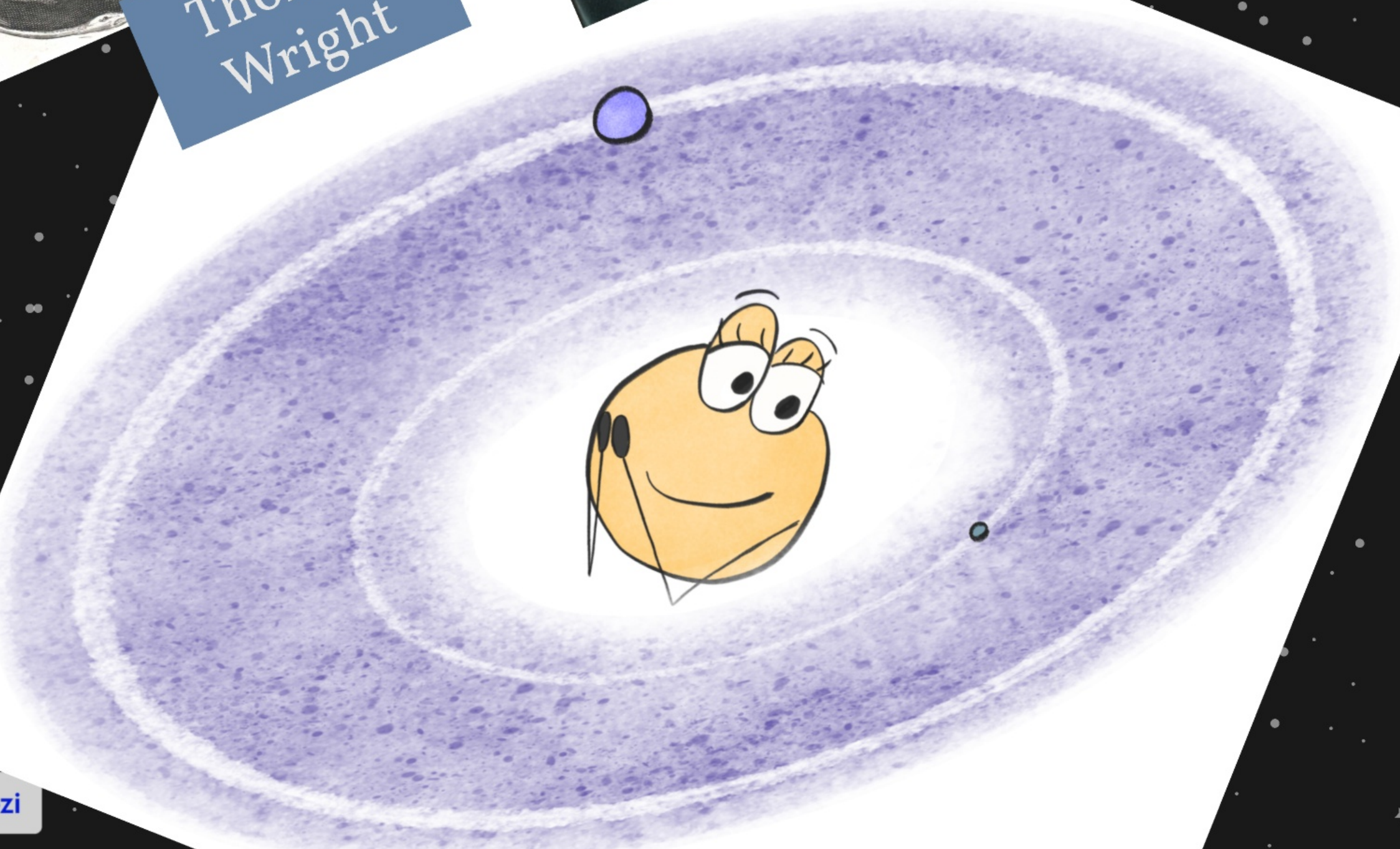
1750

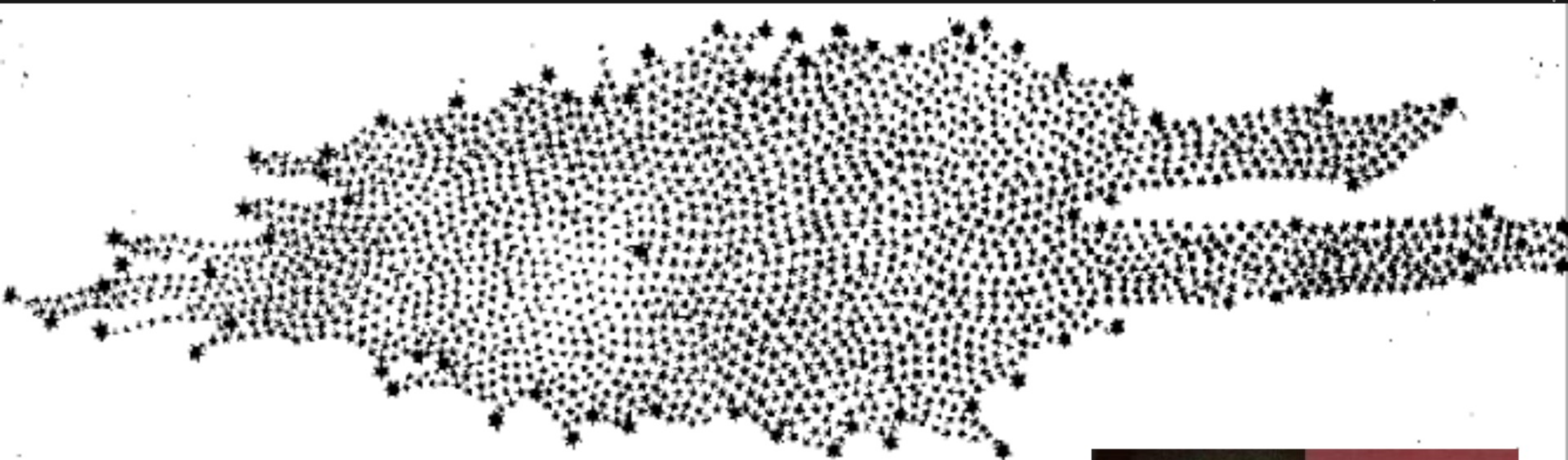
Thomas
Wright



Immanuel
Kant

1755



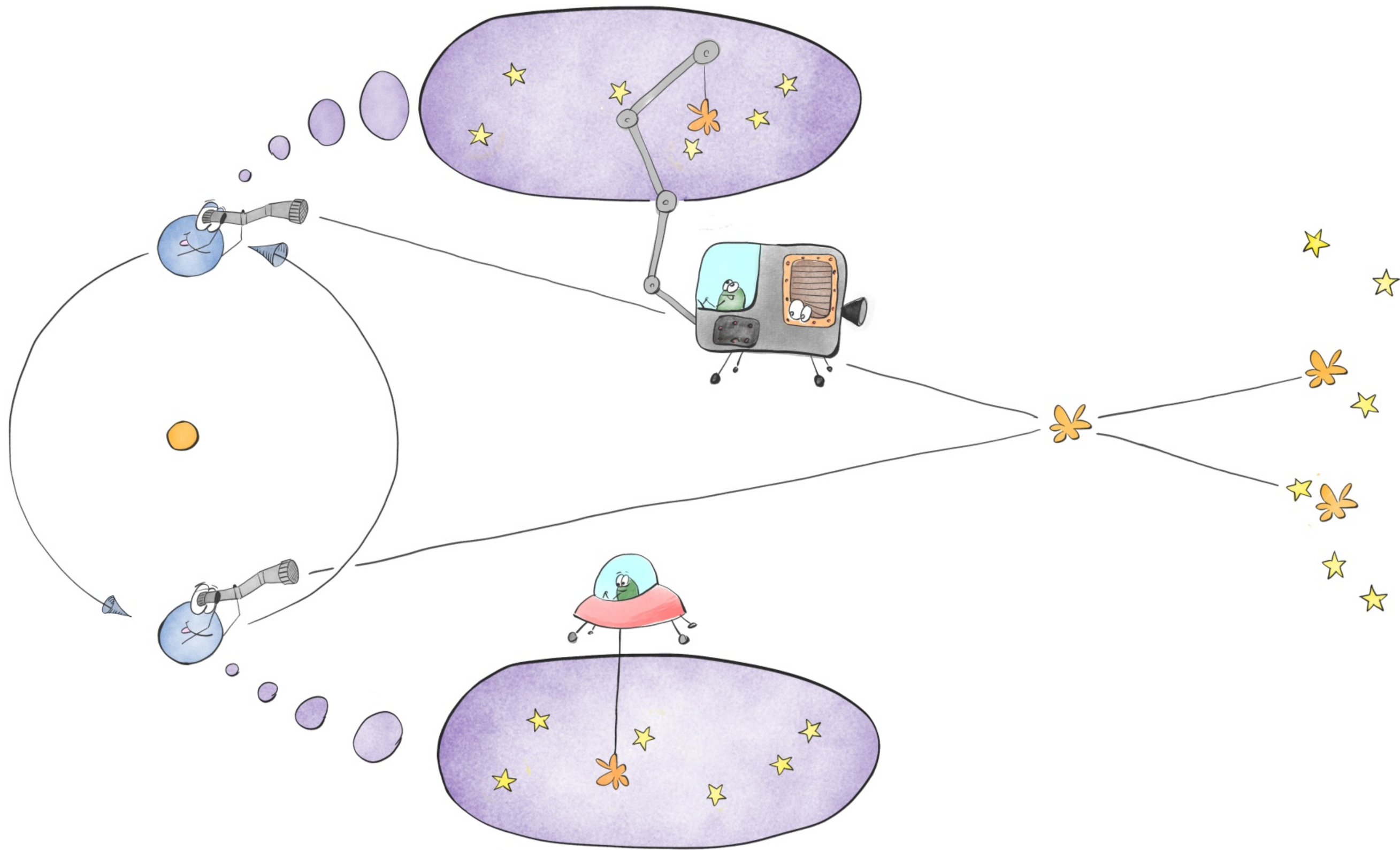


William & Caroline Herschel 1785



Távolságmérés » Parallaxis

1832 -38





Ködök

Messier Objektumok 1781



Messier Objektumok 1781

Távoli
"Island
universe"
vagy
születő
Naprendszer?

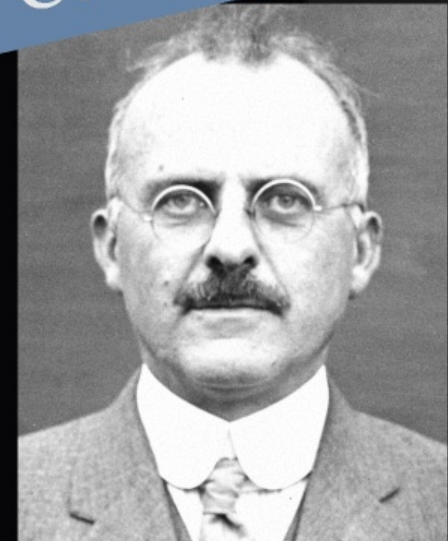


Shapley-Curtis

A nagy vita

1920

Heber
Curtis



Harlow
Shapley



Shapley's Milky Way:
300,000 ly

The Milky Way: 105,700 ly

Curtis's Milky Way:
30,000 ly



Henrietta
Swan Leavitt
1908



Henrietta
Swan Leavitt
1908





Henrietta
Swan Leavitt
1908

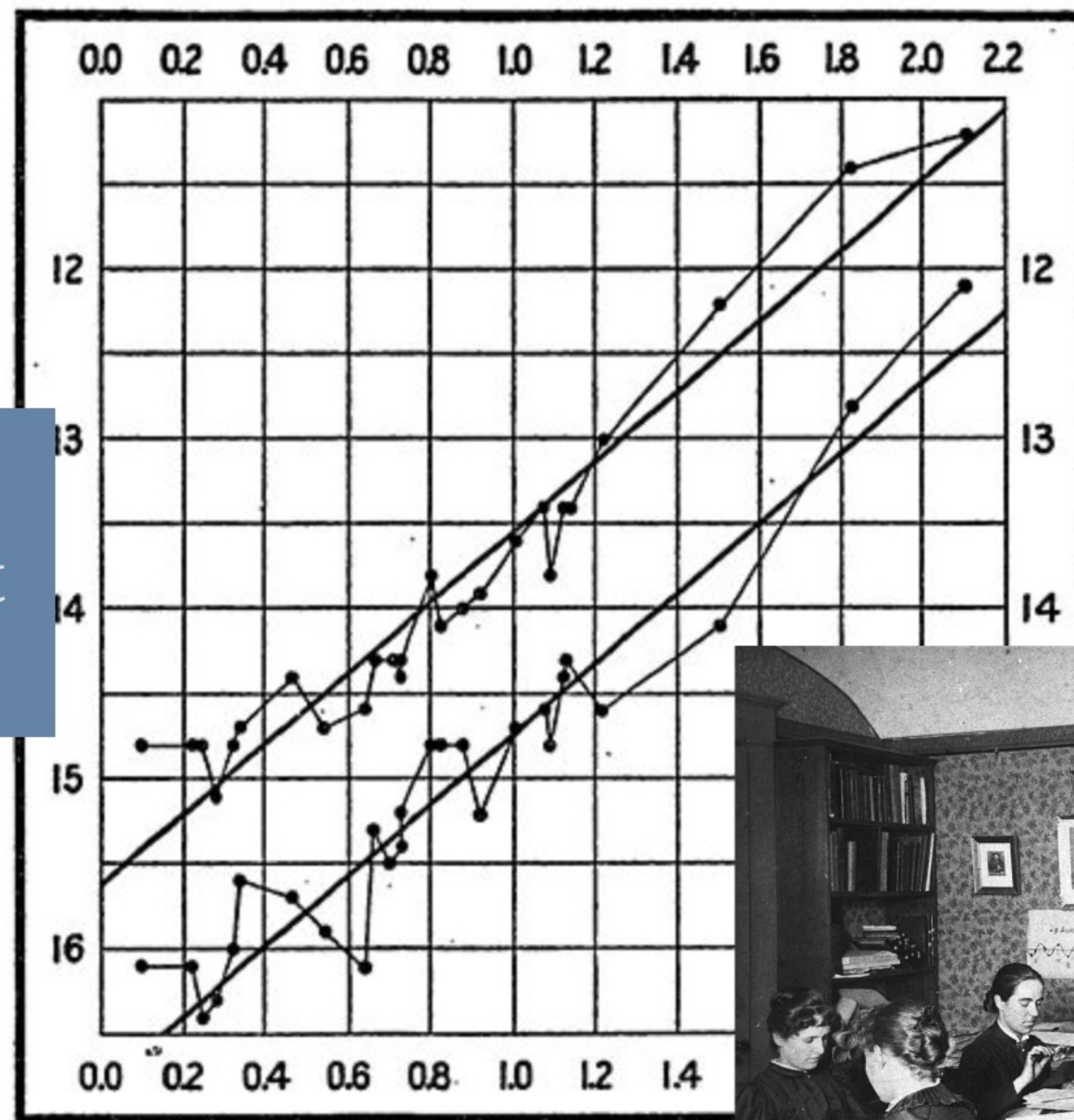
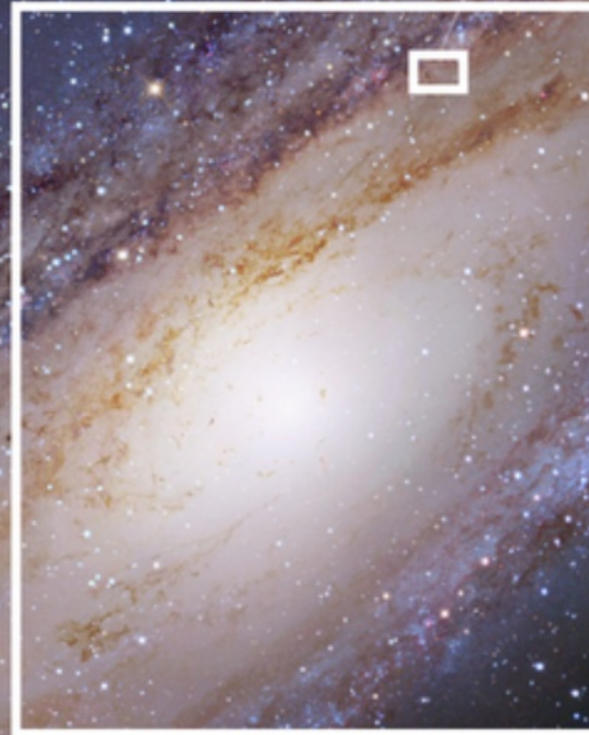


FIG. 2.



Edwin Hubble

October 6, 1923



Edwin Hubble
noted "VAR!"

N
VAR!

6-Oct
1923

Andromeda
Photo: R. Gendler

A galaxisok titkos élete és viharos találkozásai



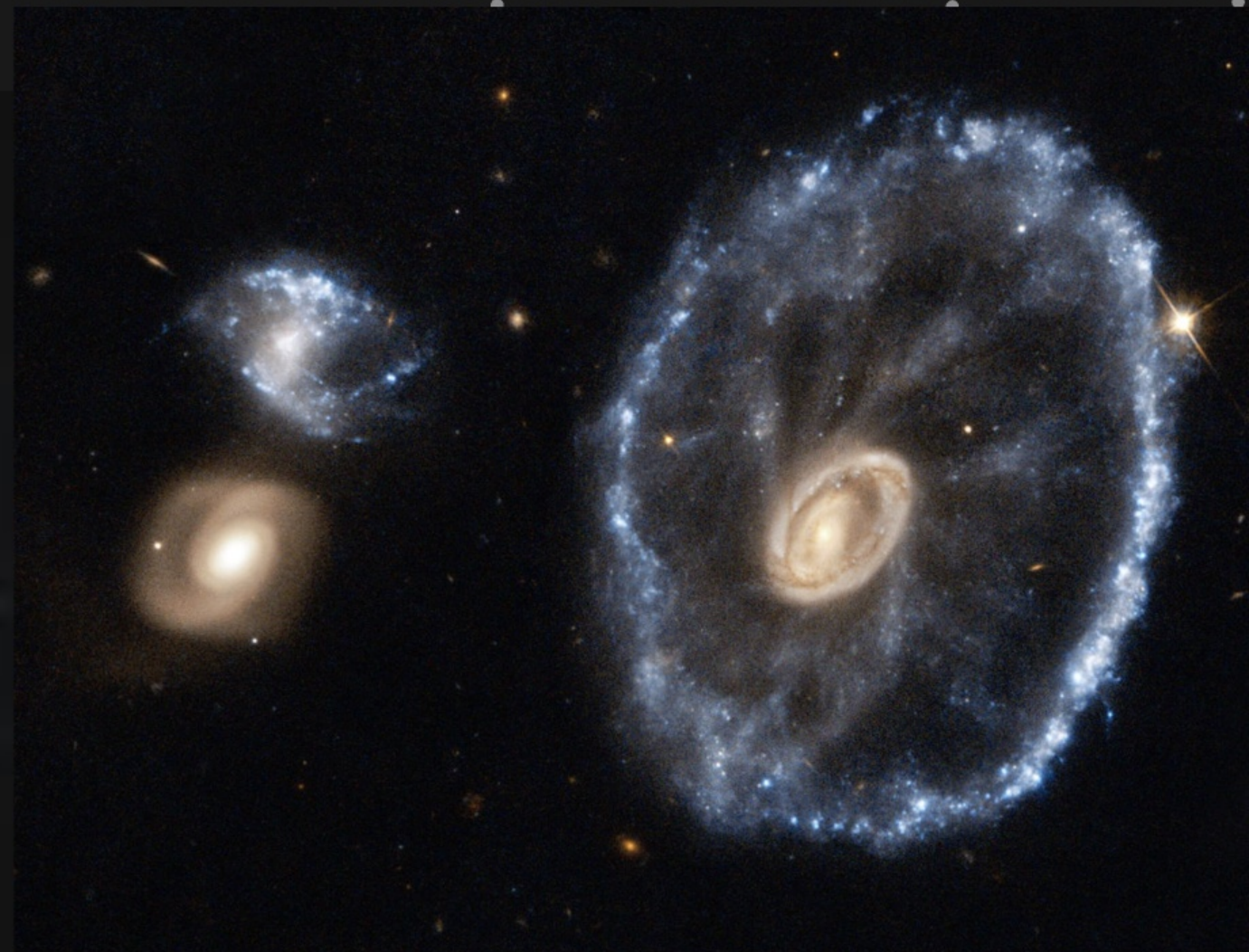
Spirál galaxisok



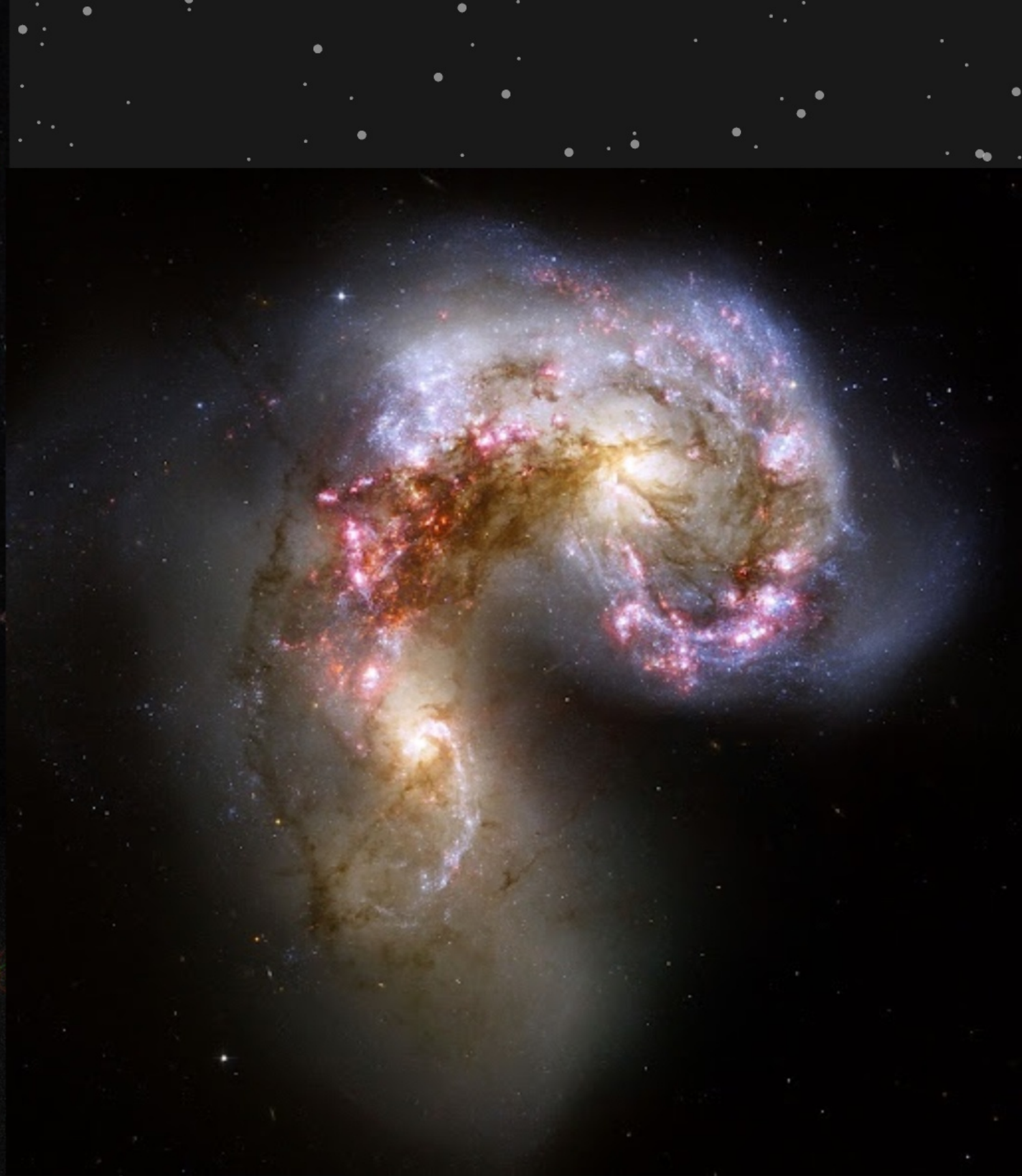


Elliptikus galaxisok





"Peculiáris" galaxisok

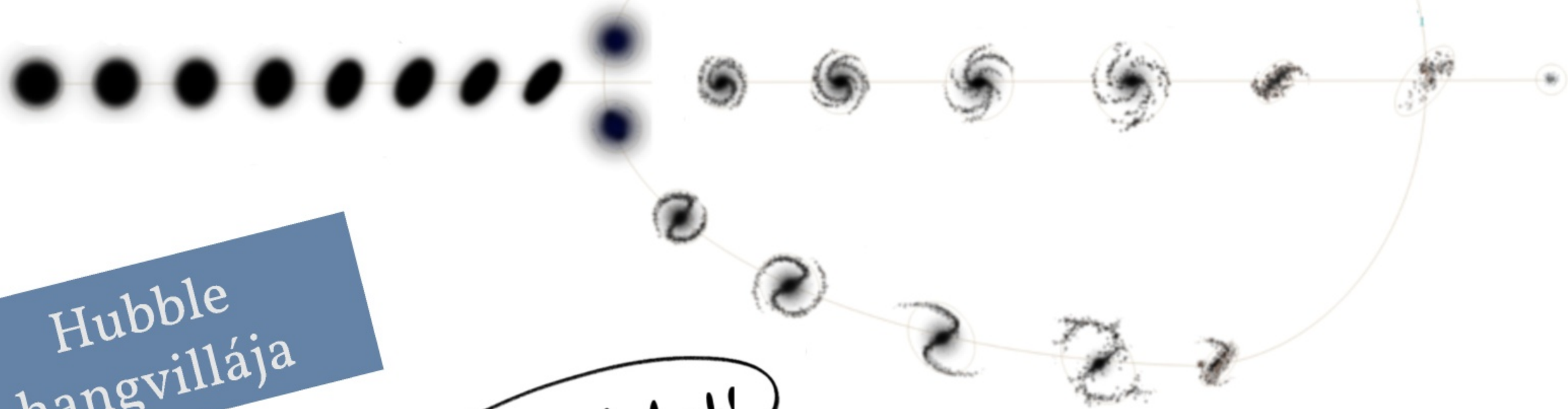


Irreguláris galaxisok

ELLIPTIKUS

SPIRÁL

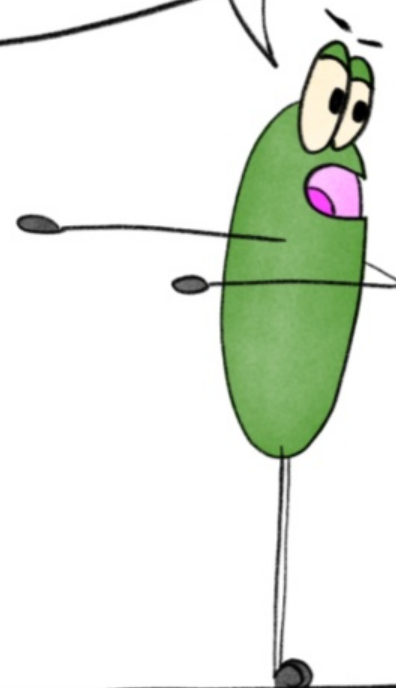
IRREGULÁRIS



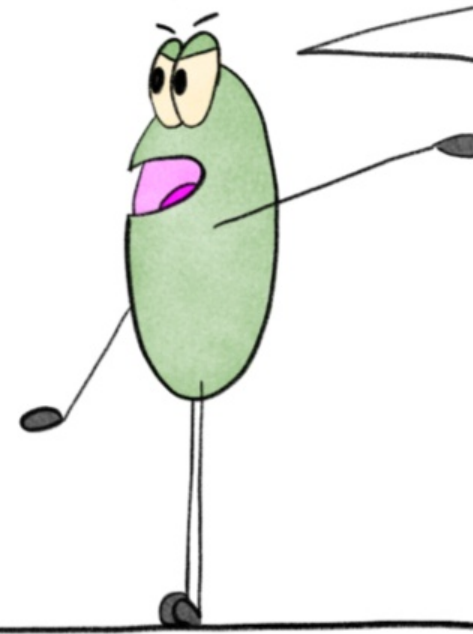
Hubble
hangvillája



Erre fejlődnek!



Nem is,
mert erre!

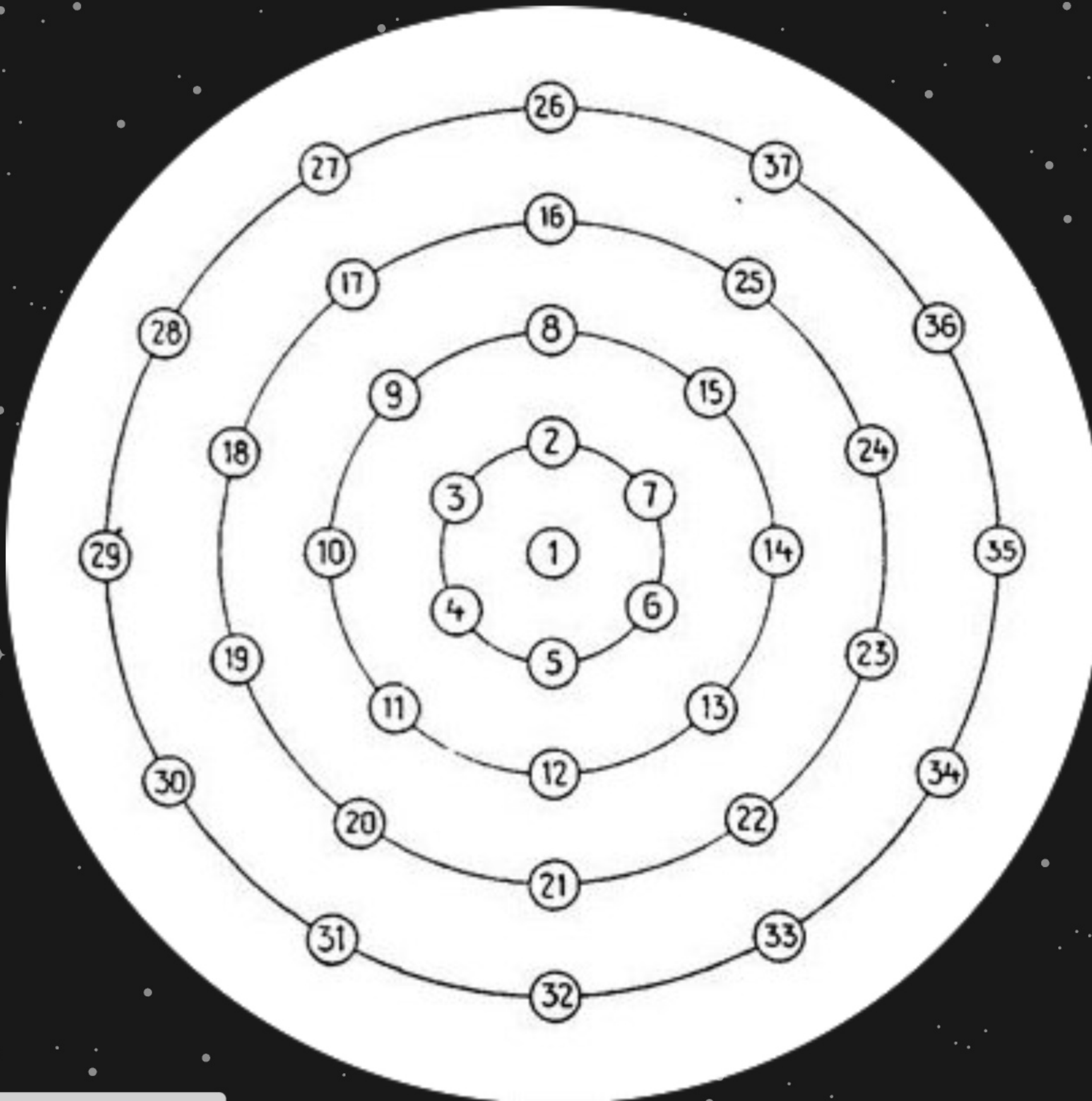


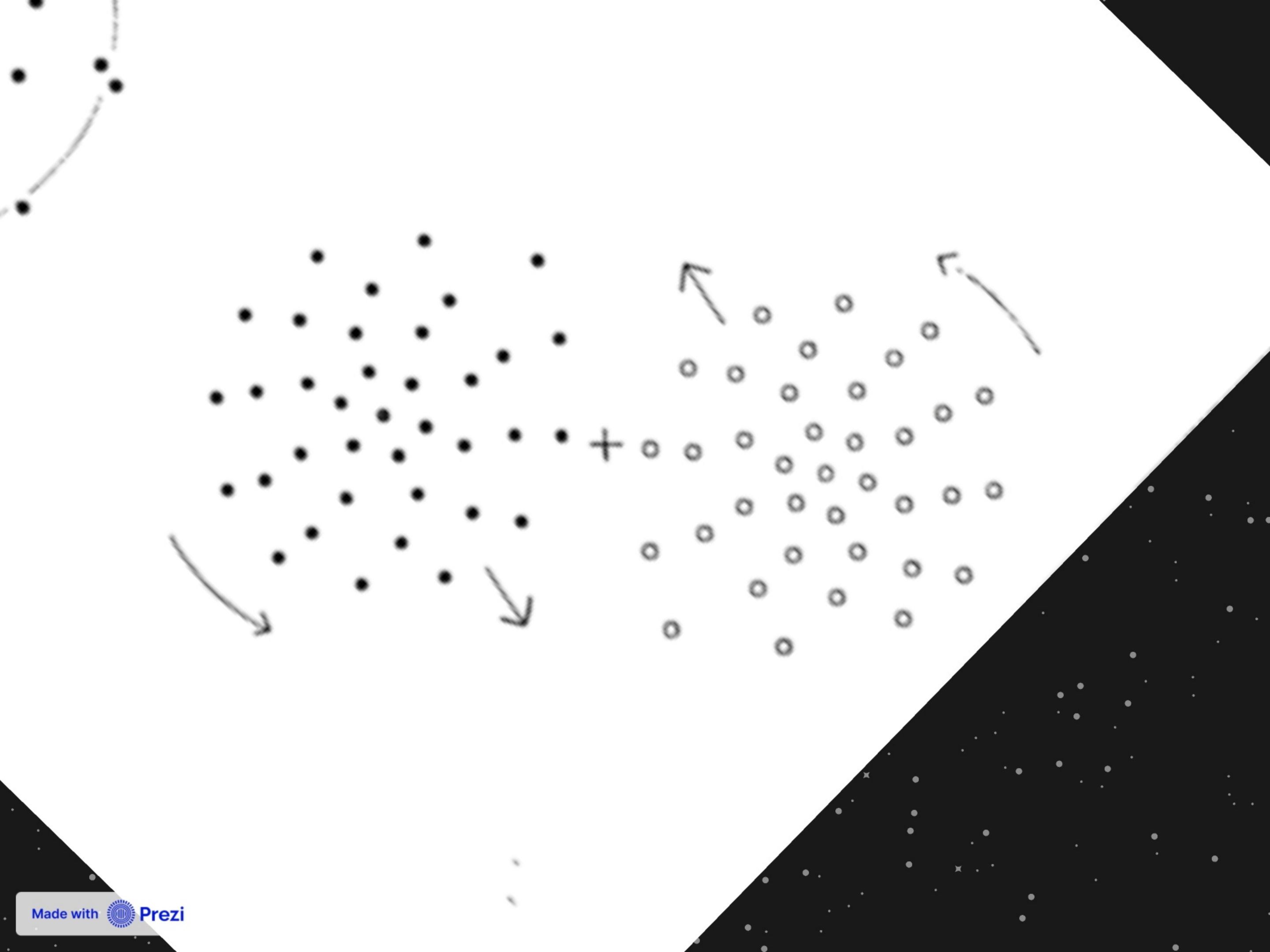
Galaxis ütközések

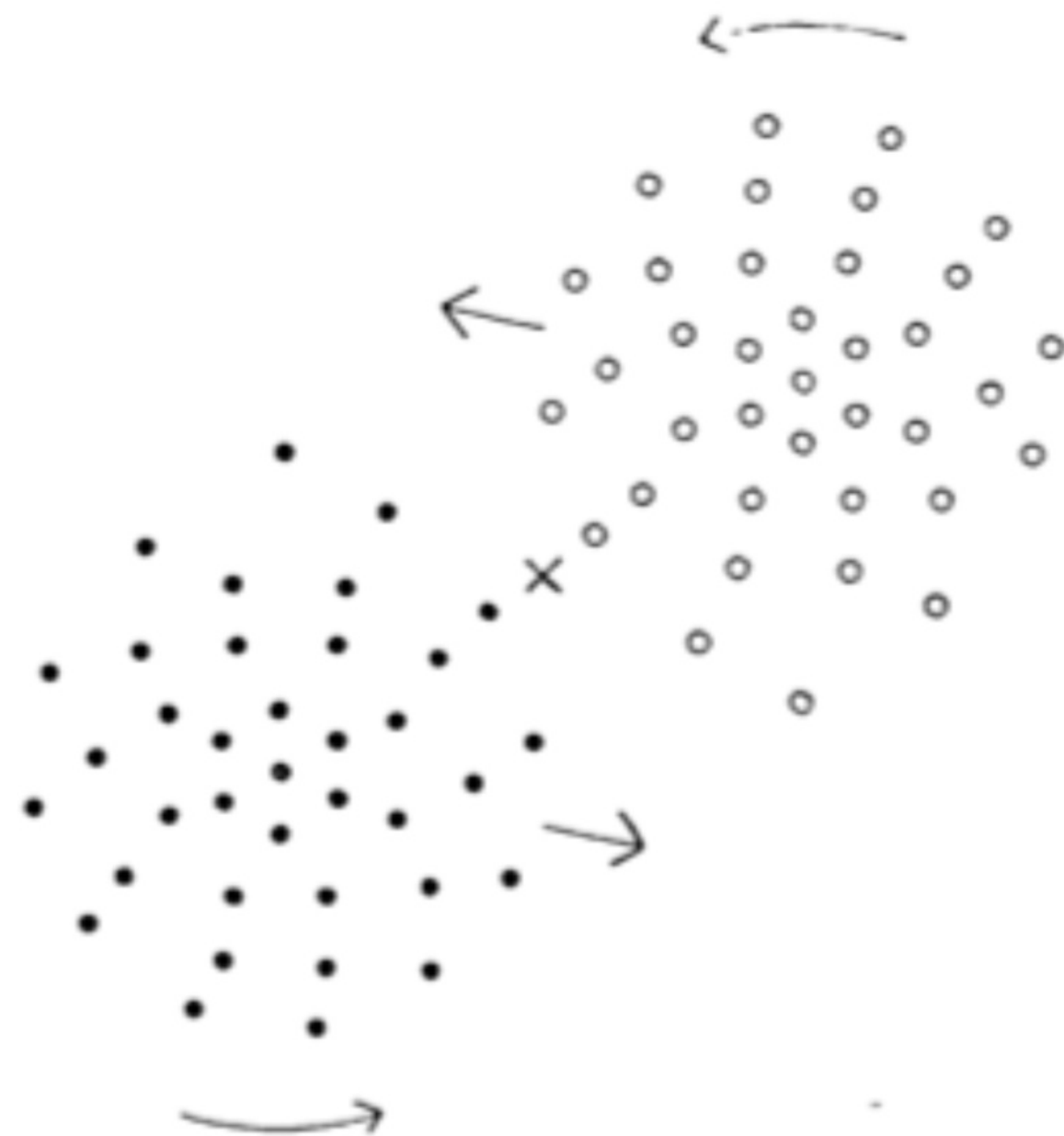


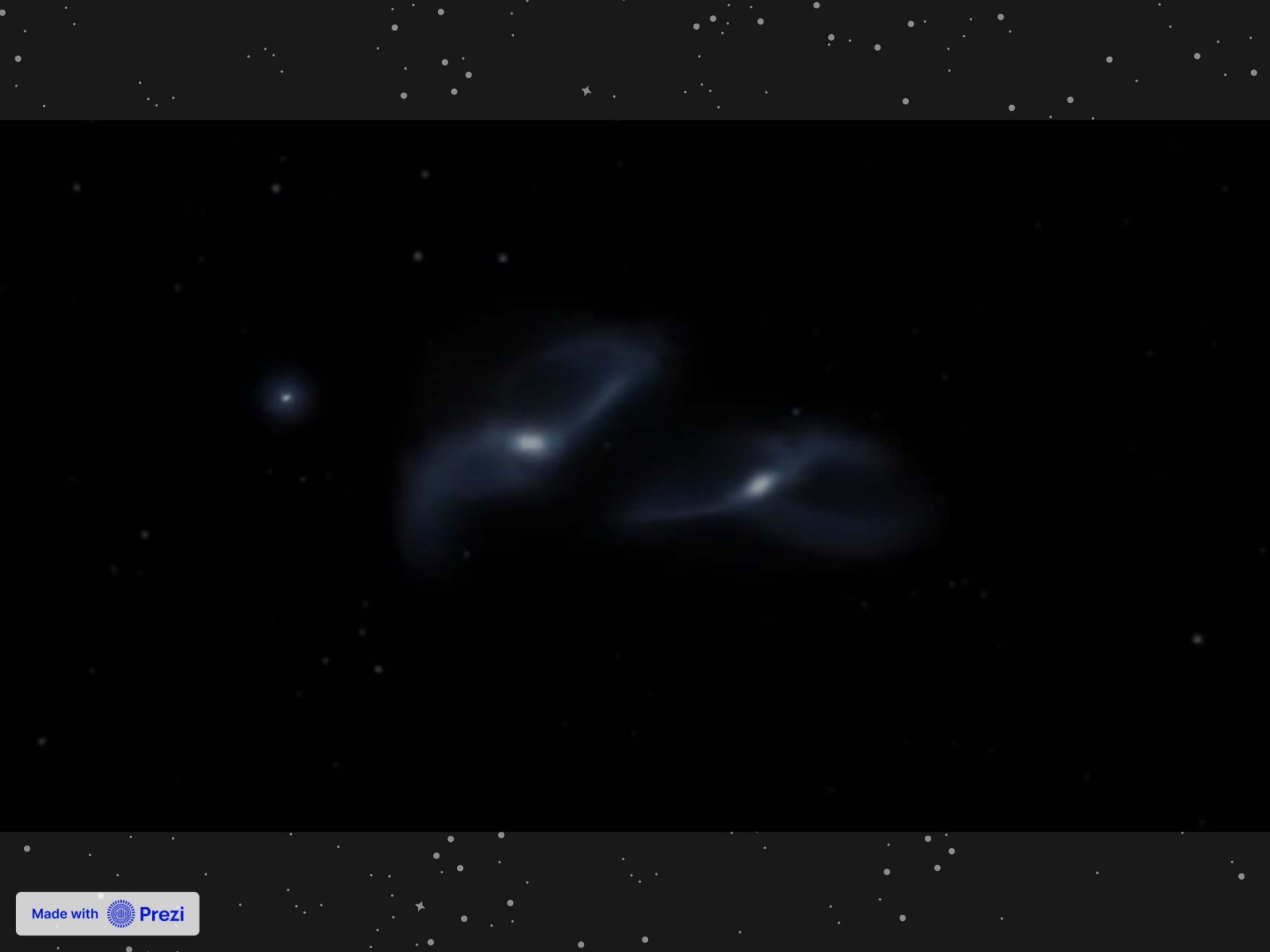
Erik
Holmberg

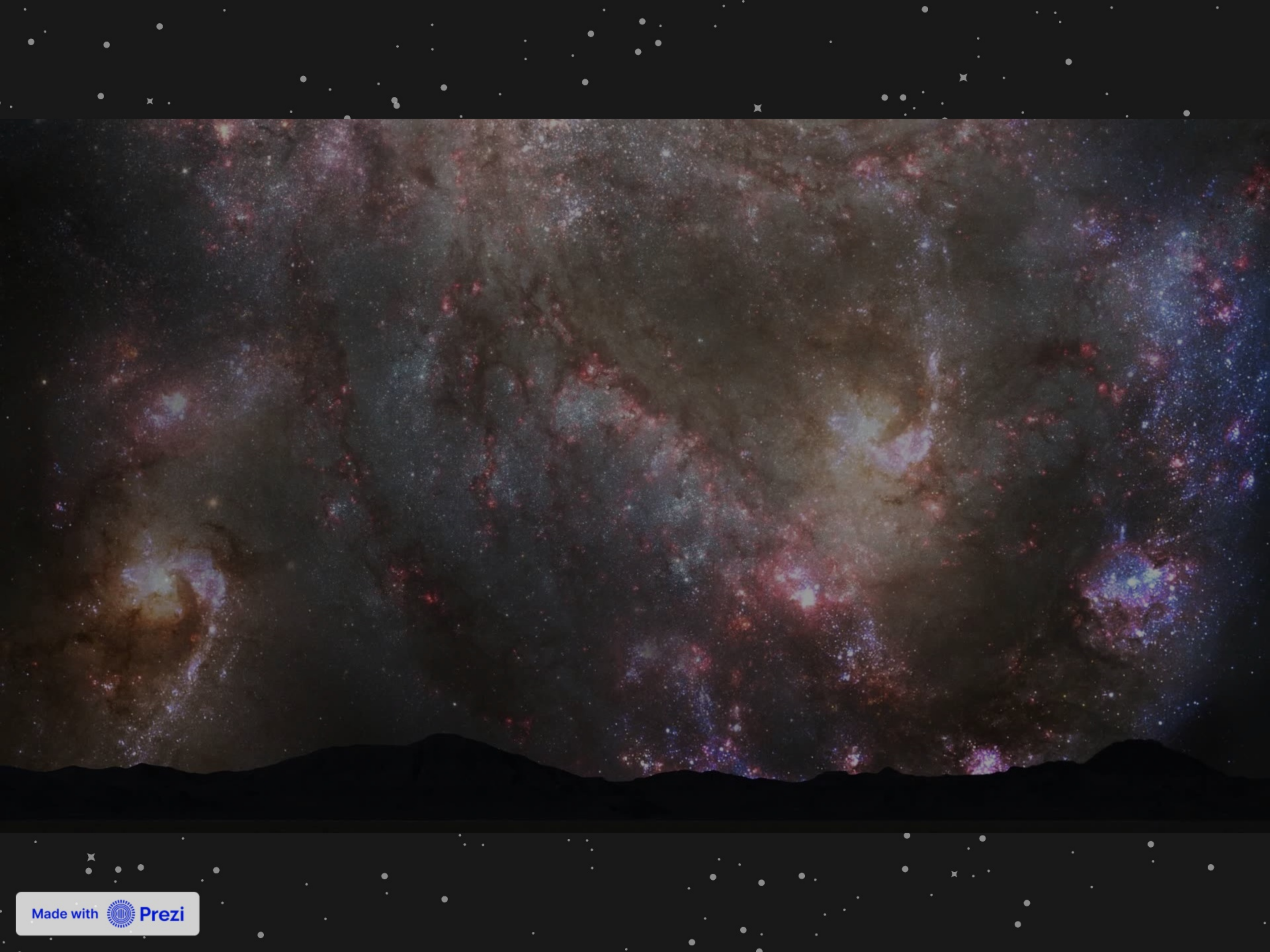
Szimulált
galaxis
37
villanykörte
1940



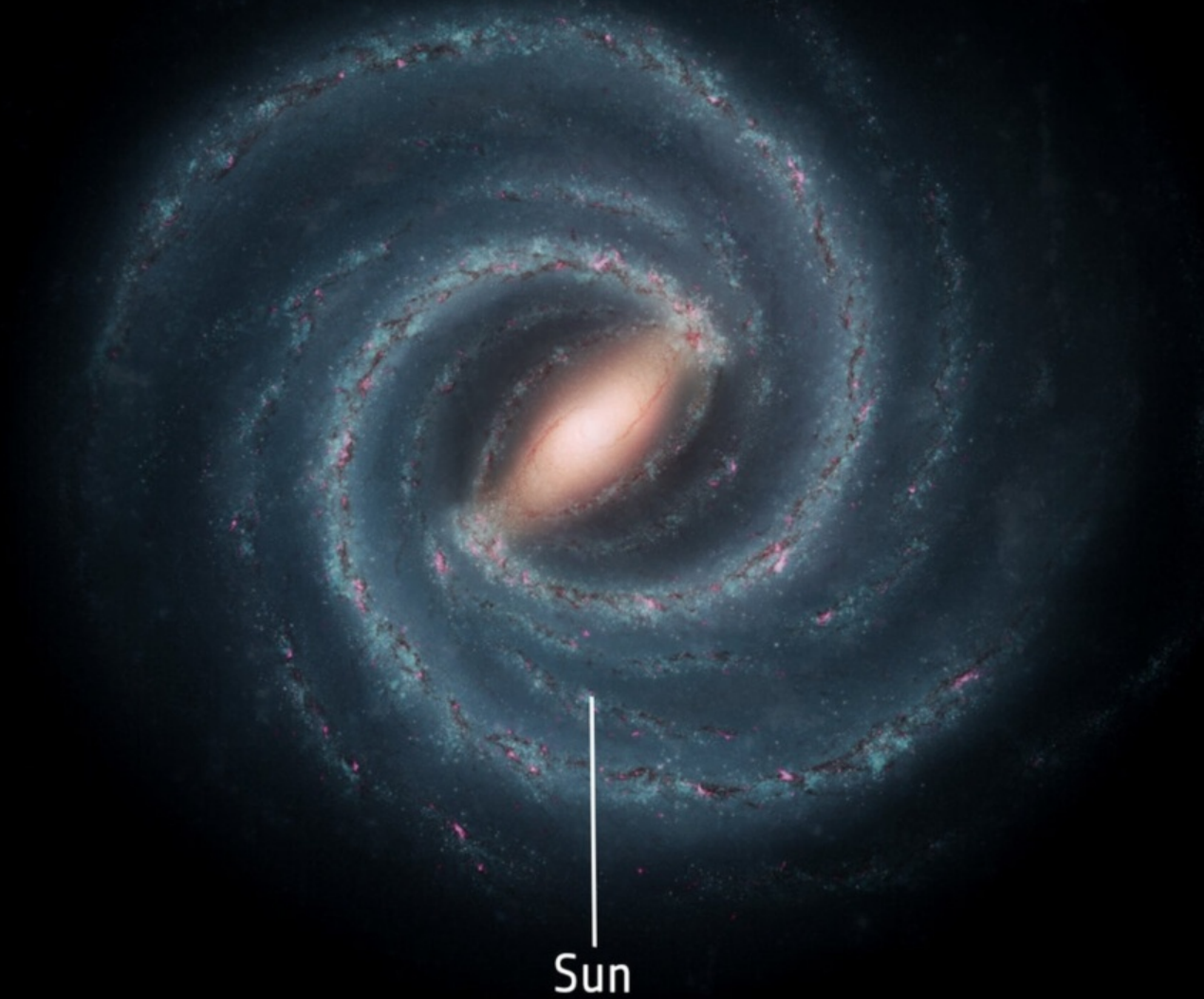




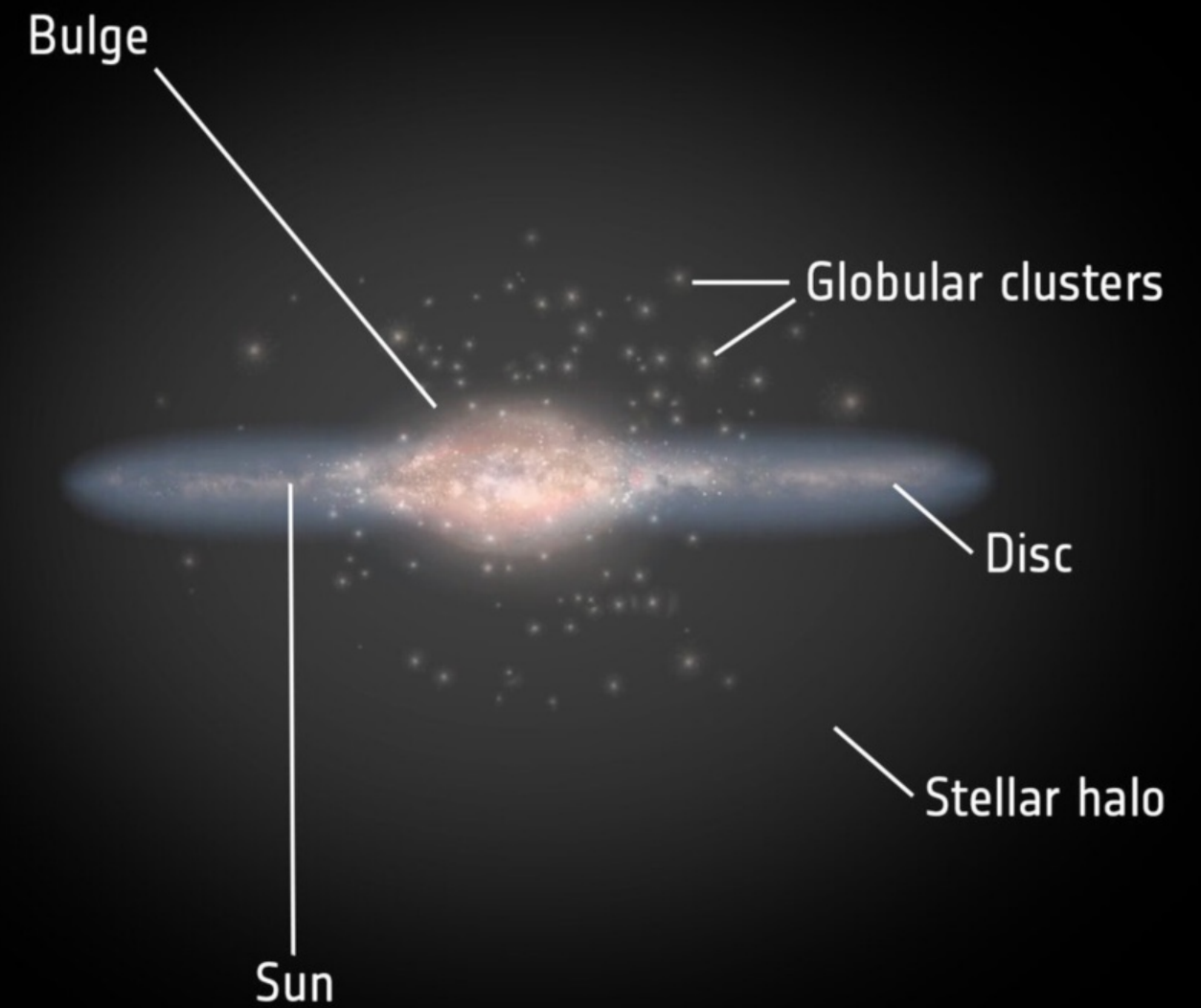




→ ANATOMY OF THE MILKY WAY



www.esa.int



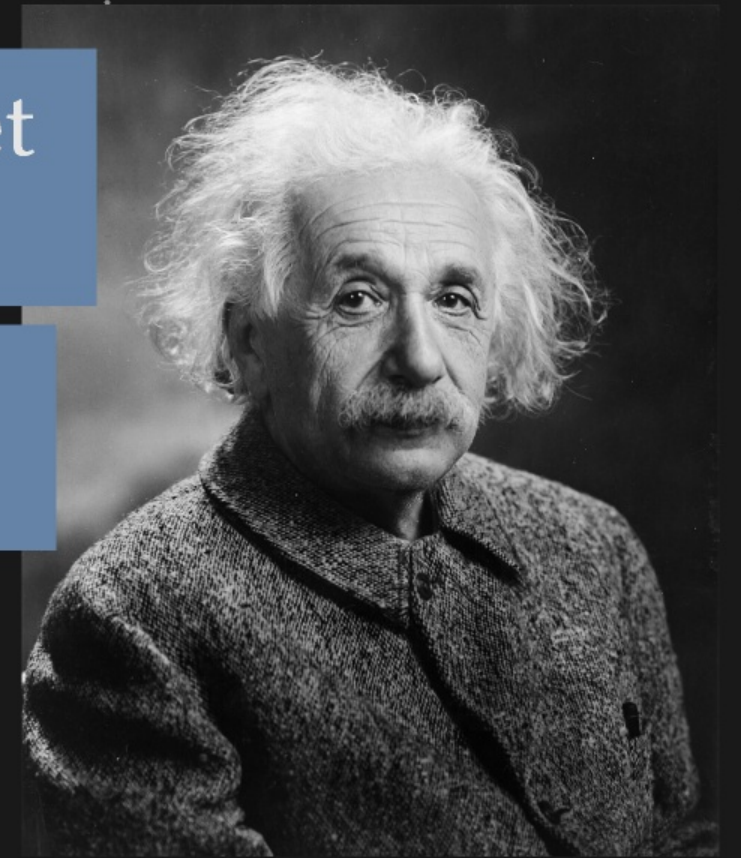
European Space Agency



Minden relatív! Na jó, szinte minden...

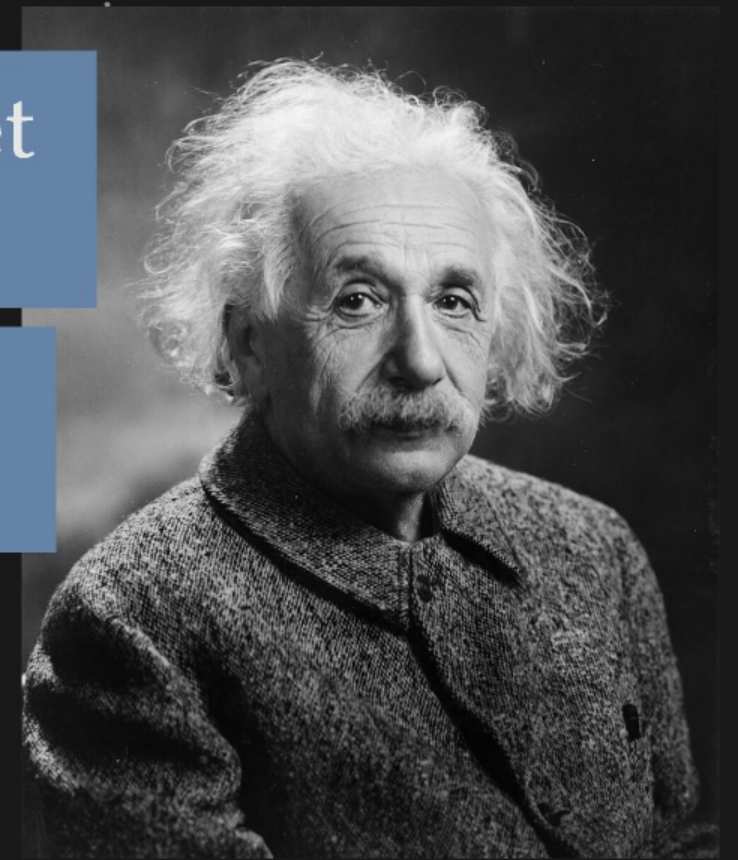
Speciális relativitáselmélet 1905

Albert
Einstein



Speciális relativitáselmélet 1905

Albert
Einstein



1676

Ole Roemer





1676

Ole Roemer





Christian
Huygens
1690



Thomas
Young
1801

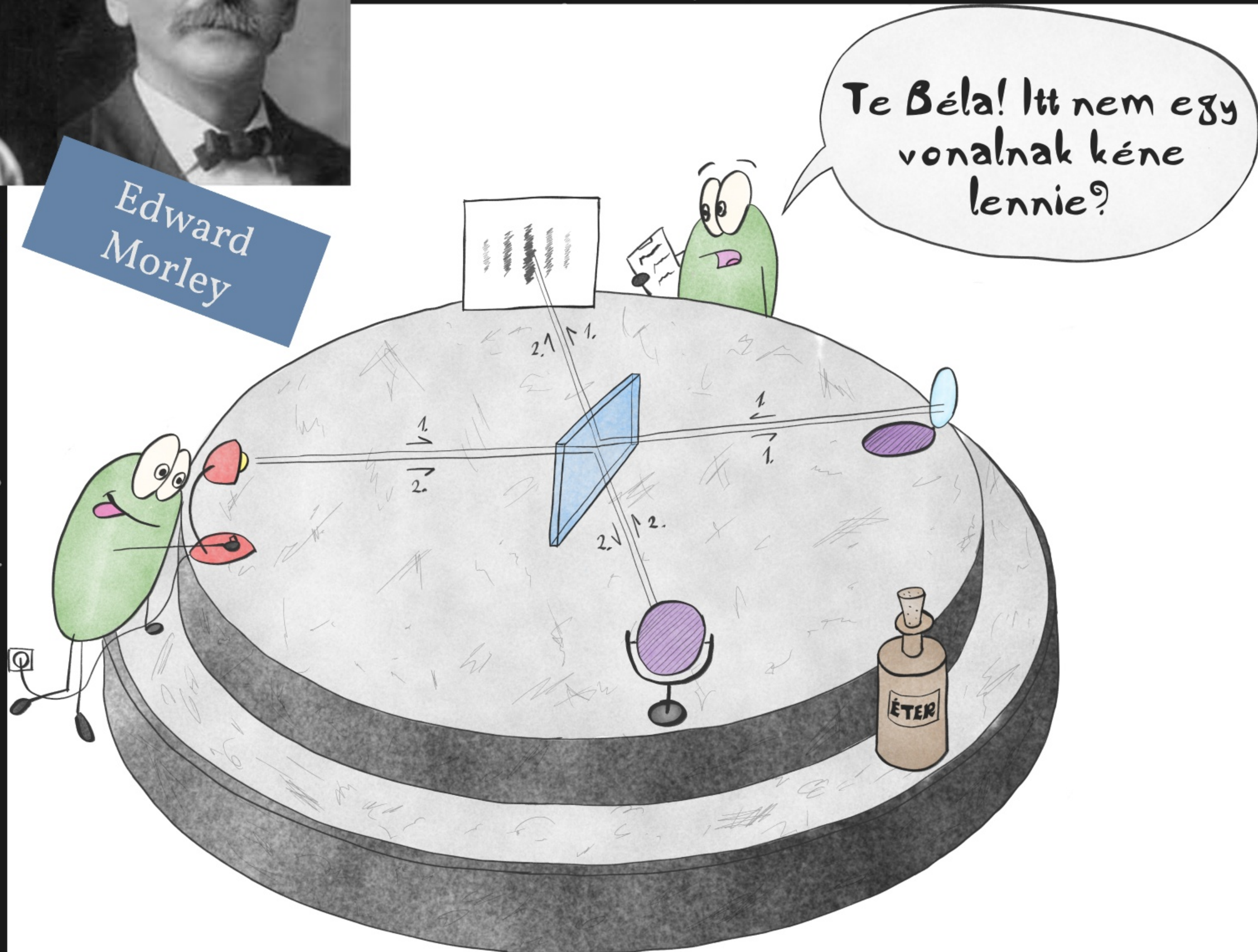
Éter ?

Éter ?



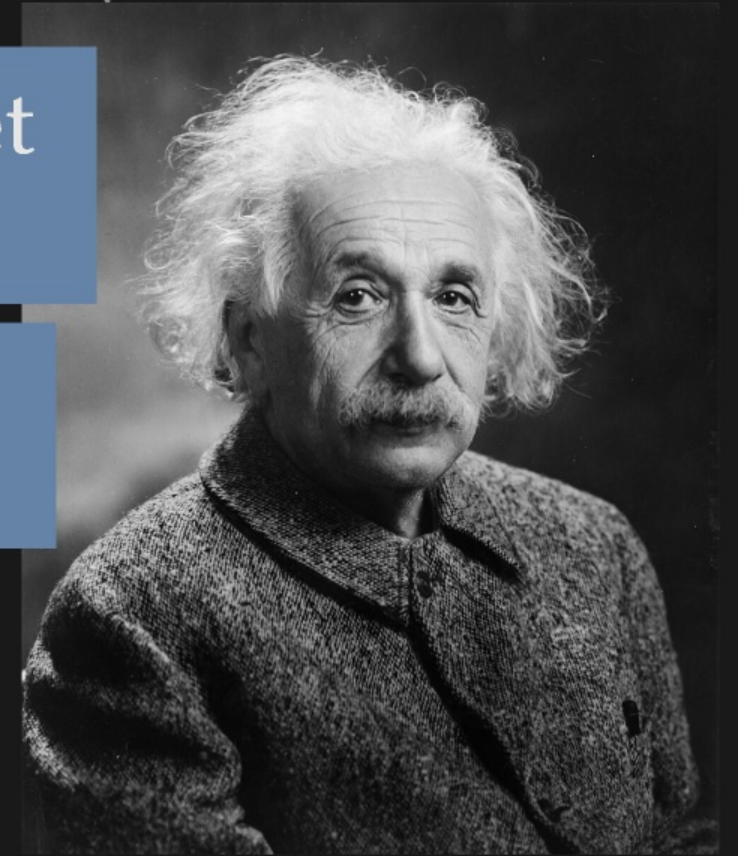
Albert
Michelson

Edward
Morley



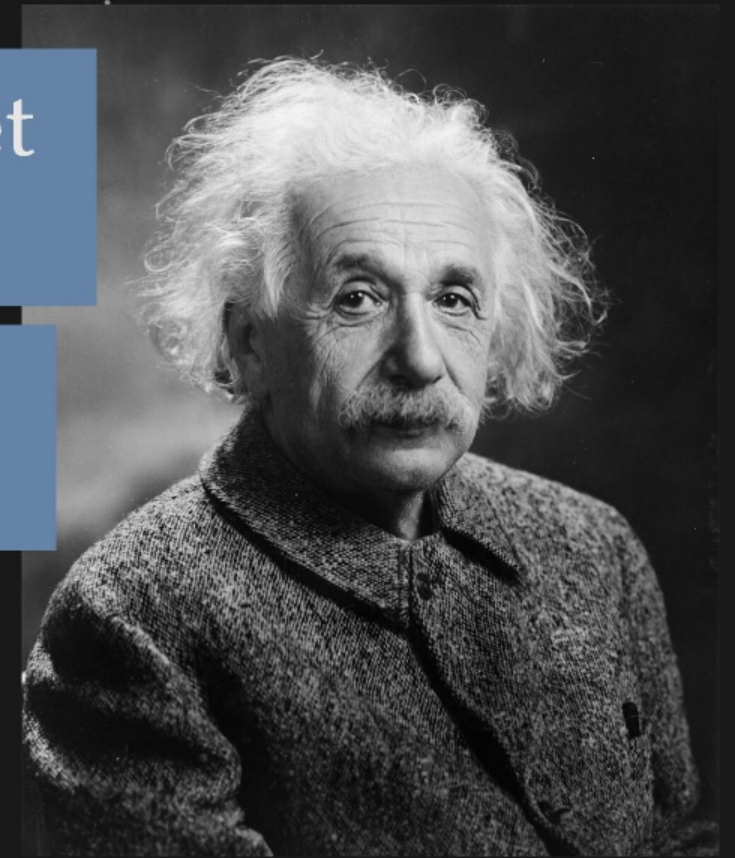
Speciális relativitáselmélet 1905

Albert
Einstein



Speciális relativitáselmélet 1905

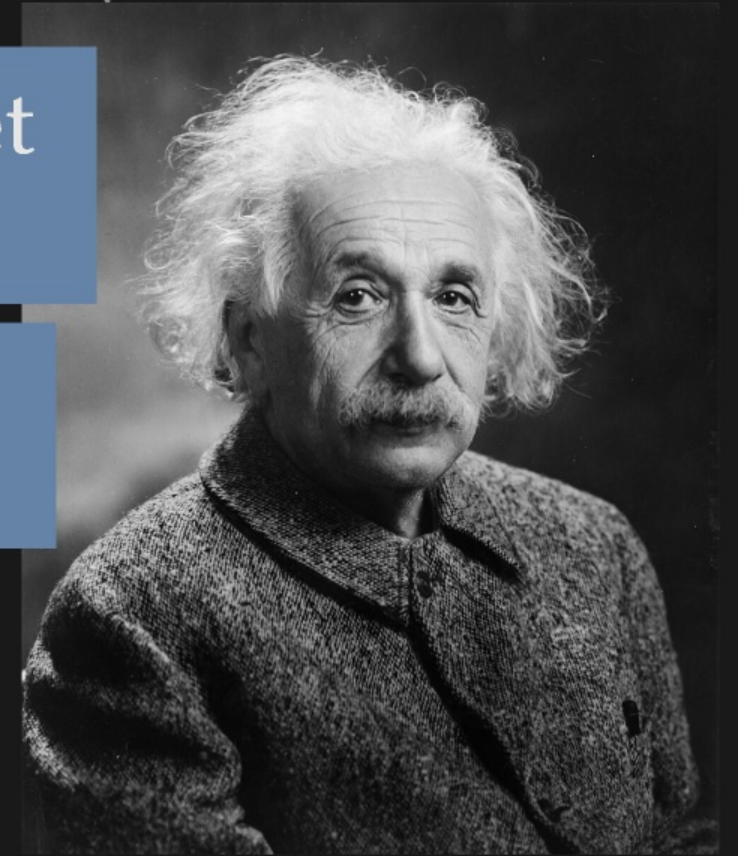
Albert
Einstein



$$\text{SEBESSÉG} = \frac{\text{ÚT}}{\text{IDŐ}}$$

Speciális relativitáselmélet 1905

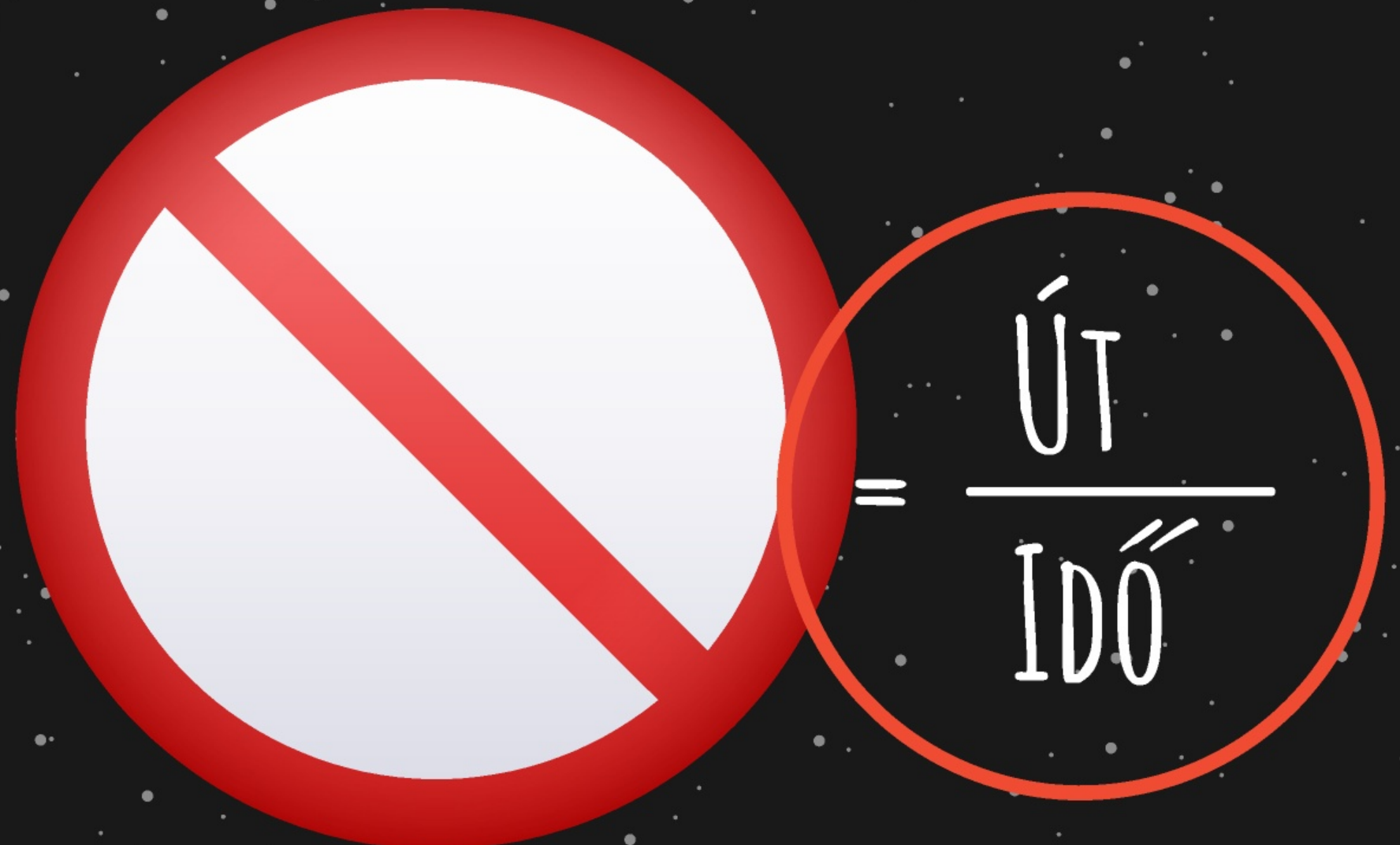
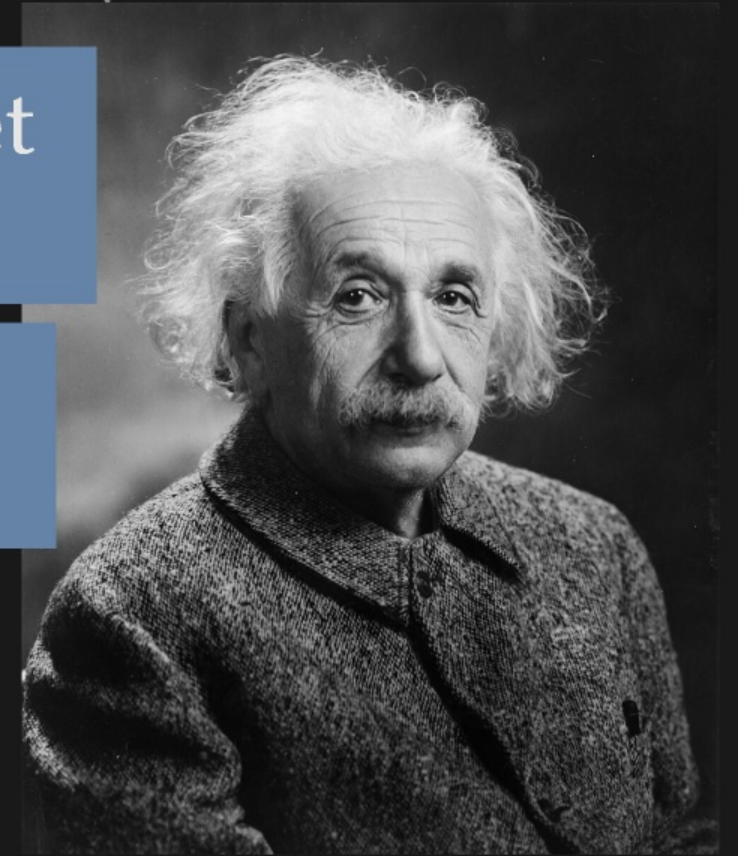
Albert
Einstein



$$= \frac{\text{ÚT}}{\text{IDŐ}}$$

Speciális relativitáselmélet 1905

Albert
Einstein

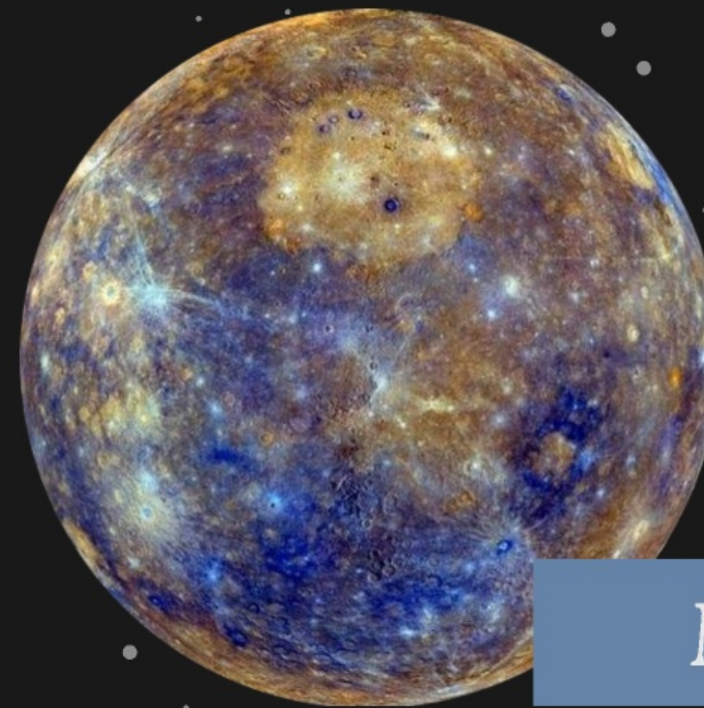


A nap amikor Einstein meggörbítette a világot



Urbain
Le Verrier

1859

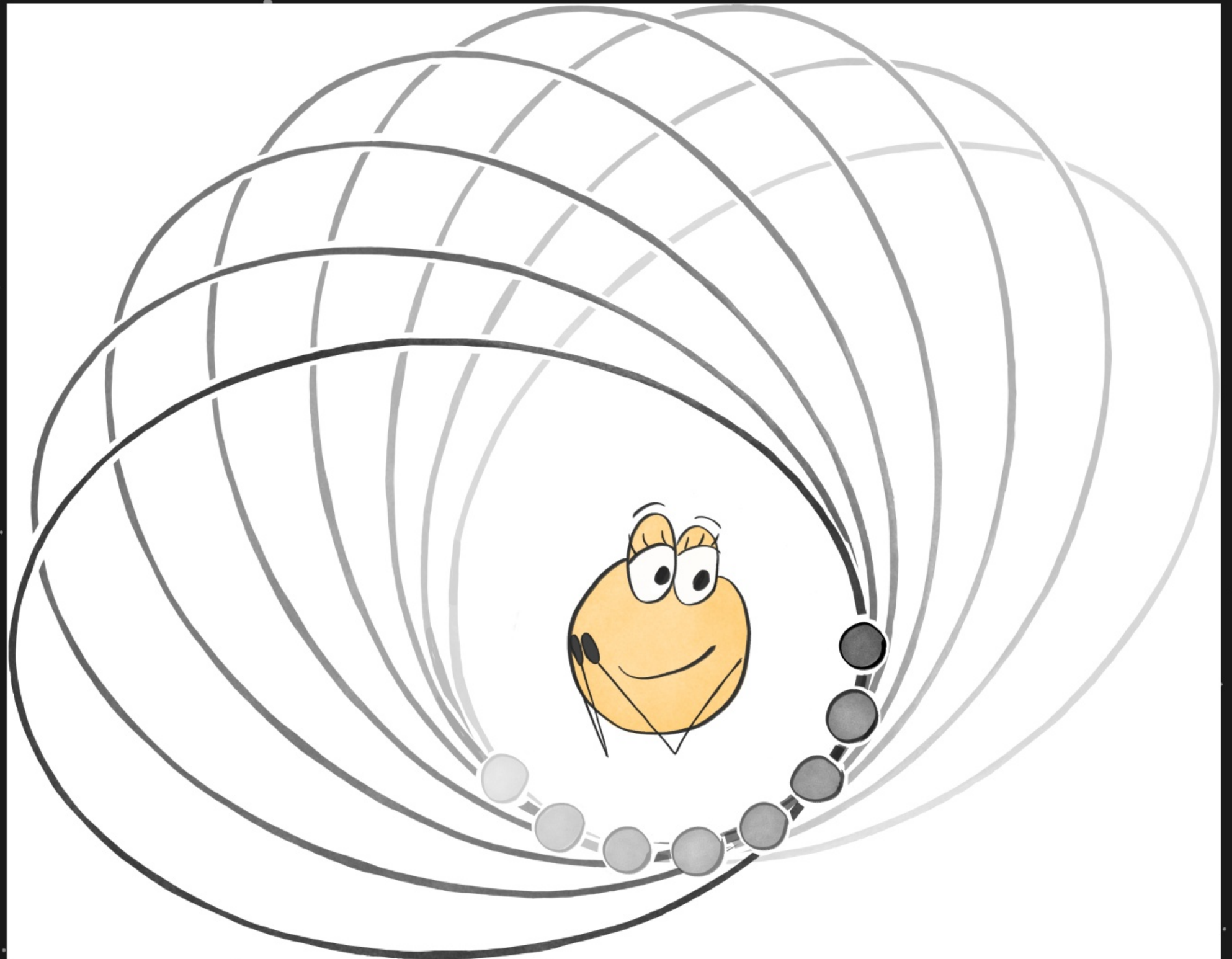


Merkúr

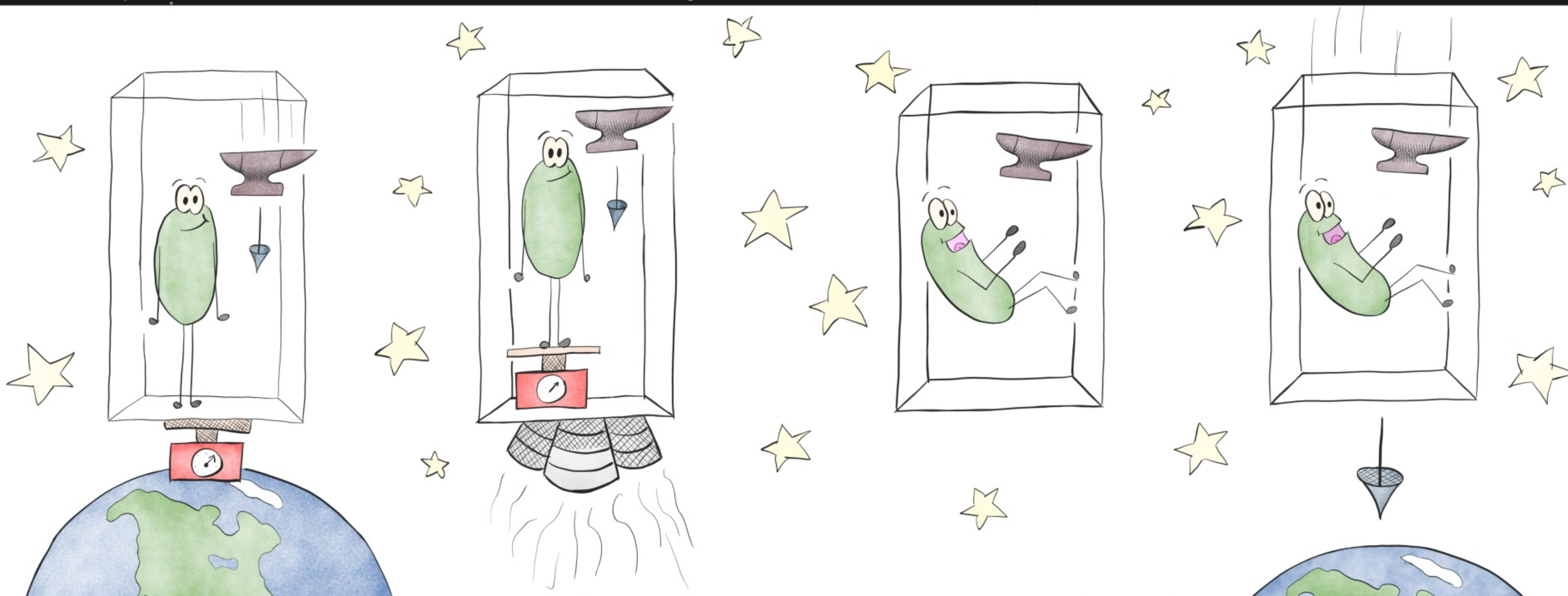


Urbain
Le Verrier

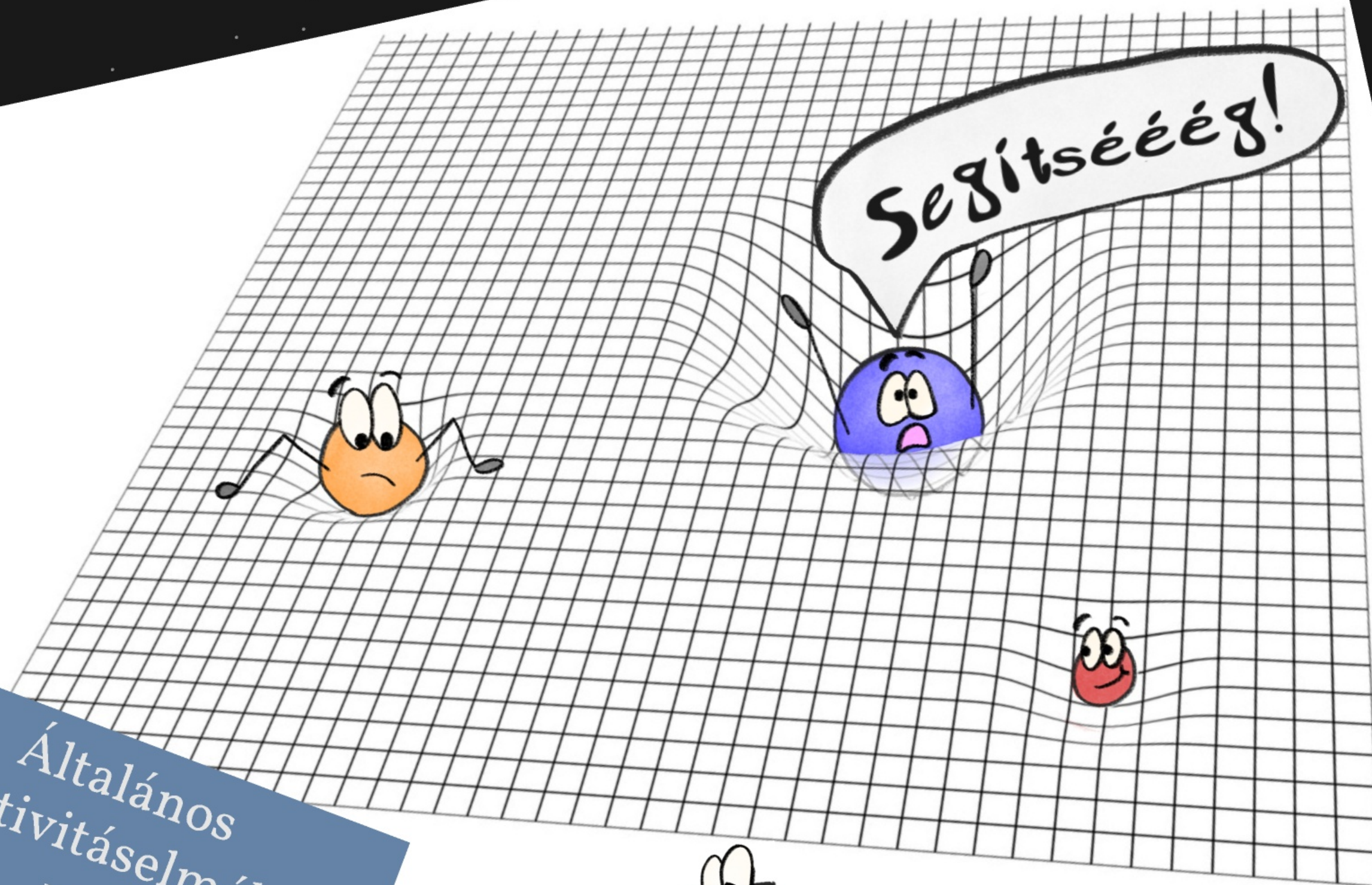
1859







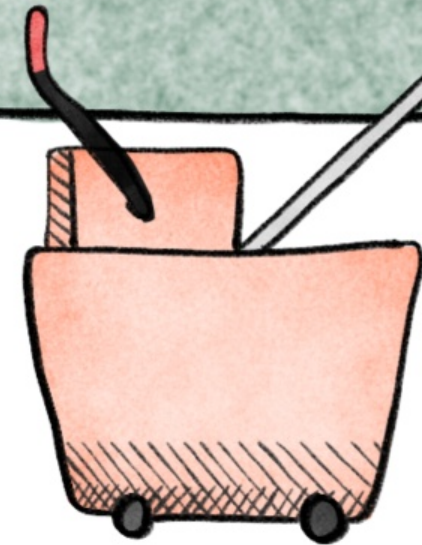
Erős ekvivalencia elv

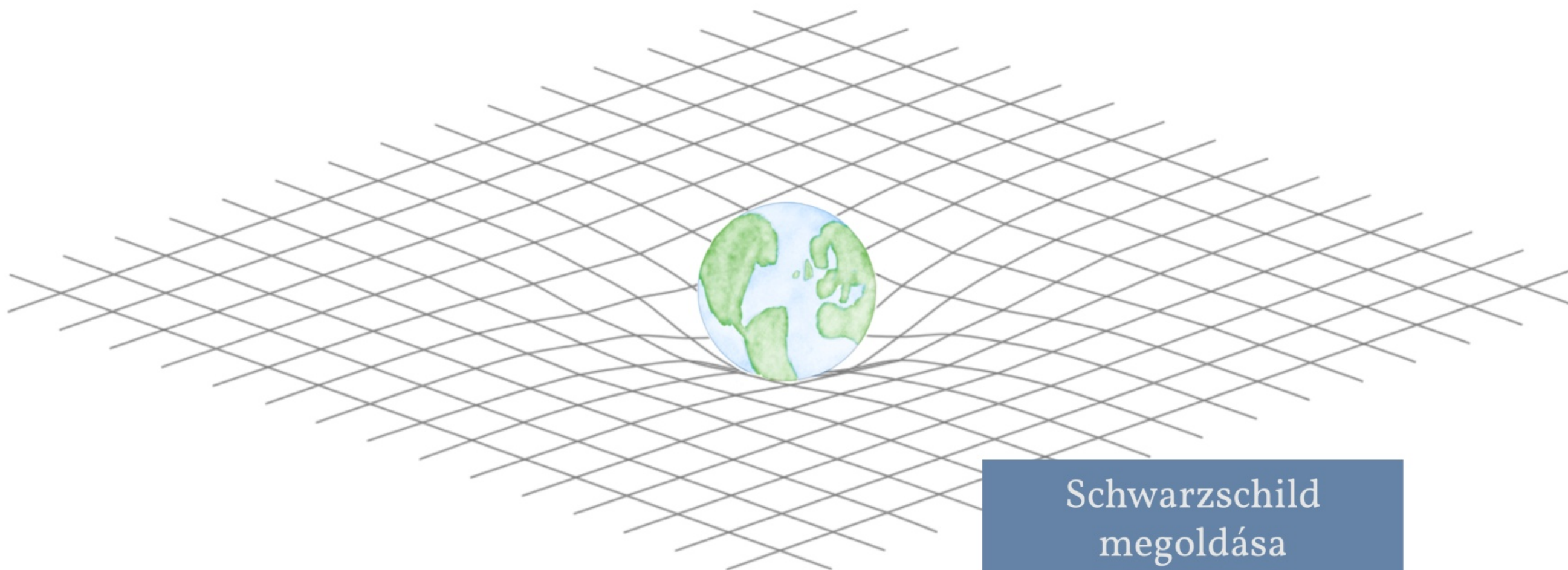


Általános
relativitáselmélet
1915

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

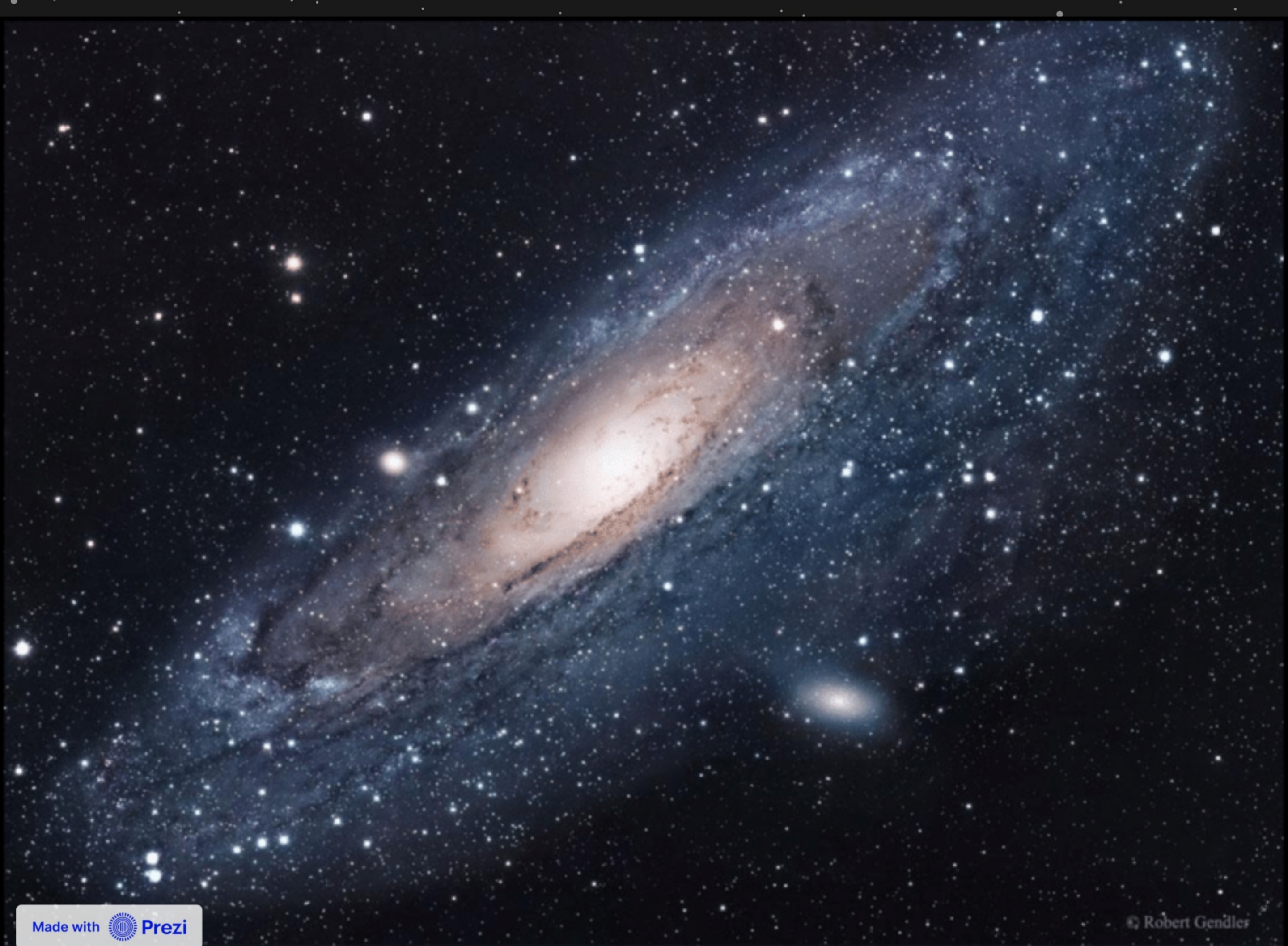
$$\begin{aligned}
& \frac{1}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\alpha} \partial_{\mu} g_{\beta\nu} + \frac{1}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\alpha} \partial_{\nu} g_{\mu\beta} - \frac{1}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\alpha} \partial_{\beta} g_{\mu\nu} - \frac{3}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\mu} \partial_{\nu} g_{\alpha\beta} \\
& - \frac{1}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 \sum_{\rho=0}^3 \sum_{\lambda=0}^3 g^{\beta\lambda} g^{\alpha\rho} \partial_{\alpha} g_{\rho\lambda} \partial_{\mu} g_{\beta\nu} - \frac{1}{2} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 \sum_{\rho=0}^3 \sum_{\lambda=0}^3 g^{\beta\lambda} g^{\alpha\rho} \partial_{\alpha} g_{\rho\lambda} \partial_{\nu} g_{\mu\beta} \\
& + \frac{1}{4} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 \sum_{\rho=0}^3 \sum_{\lambda=0}^3 g^{\beta\lambda} g^{\alpha\rho} \partial_{\nu} g_{\alpha\lambda} \partial_{\mu} g_{\rho\beta} + \frac{1}{4|g|} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\beta} |g| \partial_{\nu} g_{\mu\alpha} \\
& - \frac{1}{4|g|} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\beta} |g| \partial_{\alpha} g_{\mu\nu} - \frac{1}{4|g|} \sum_{\alpha=0}^3 \sum_{\beta=0}^3 g^{\alpha\beta} \partial_{\beta} |g| \partial_{\mu} g_{\alpha\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}
\end{aligned}$$



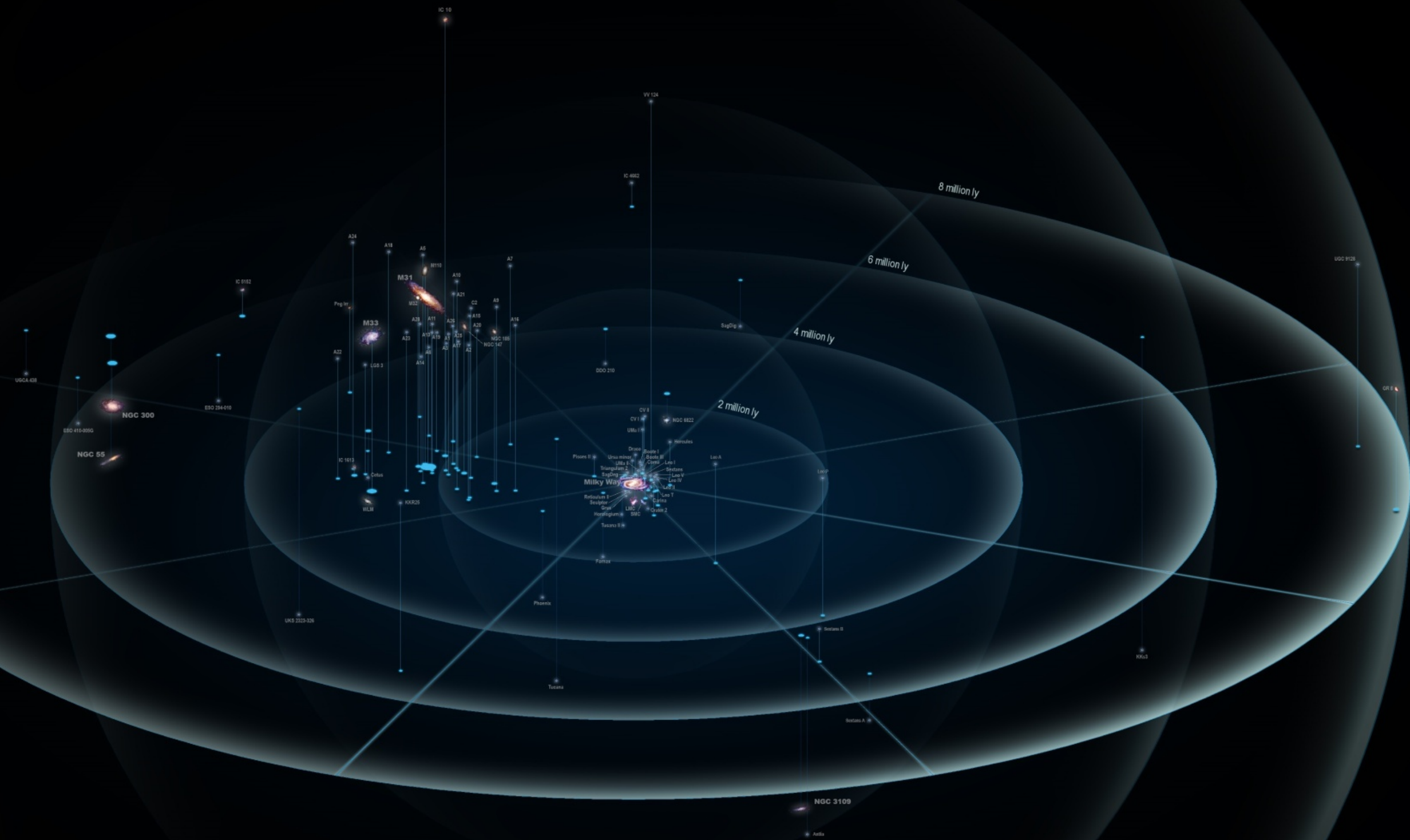


Schwarzschild
megoldása

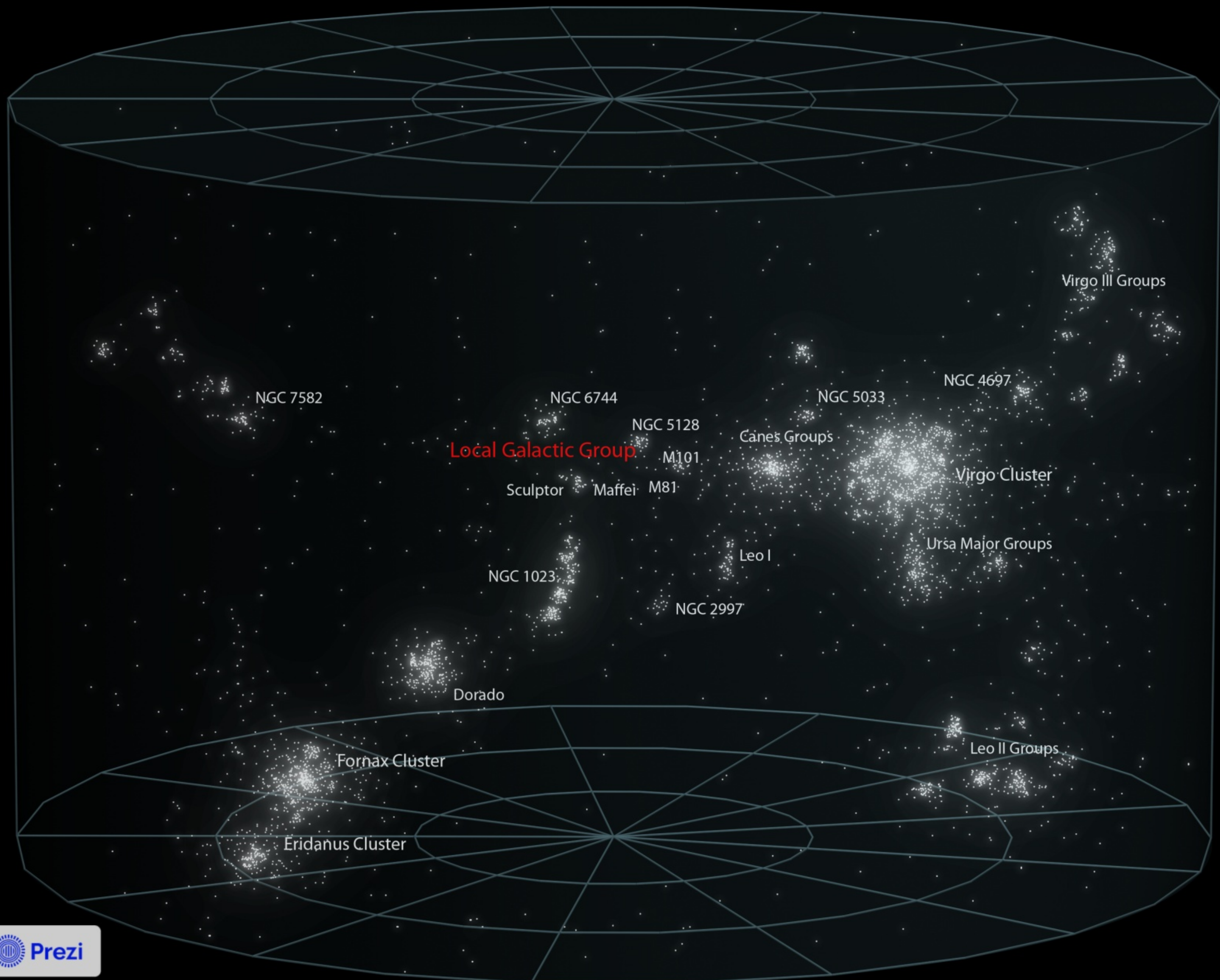


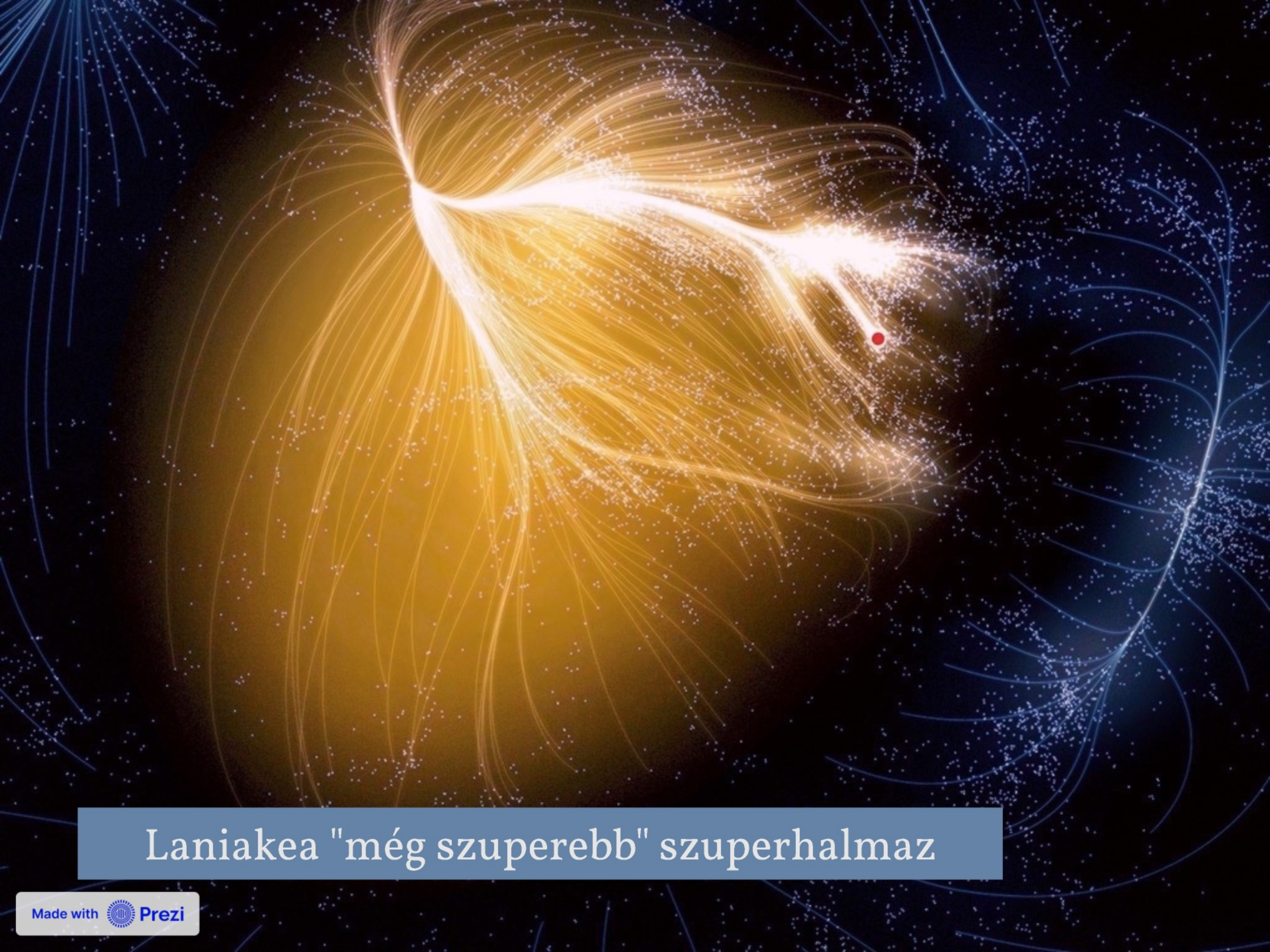


Lokális csoport

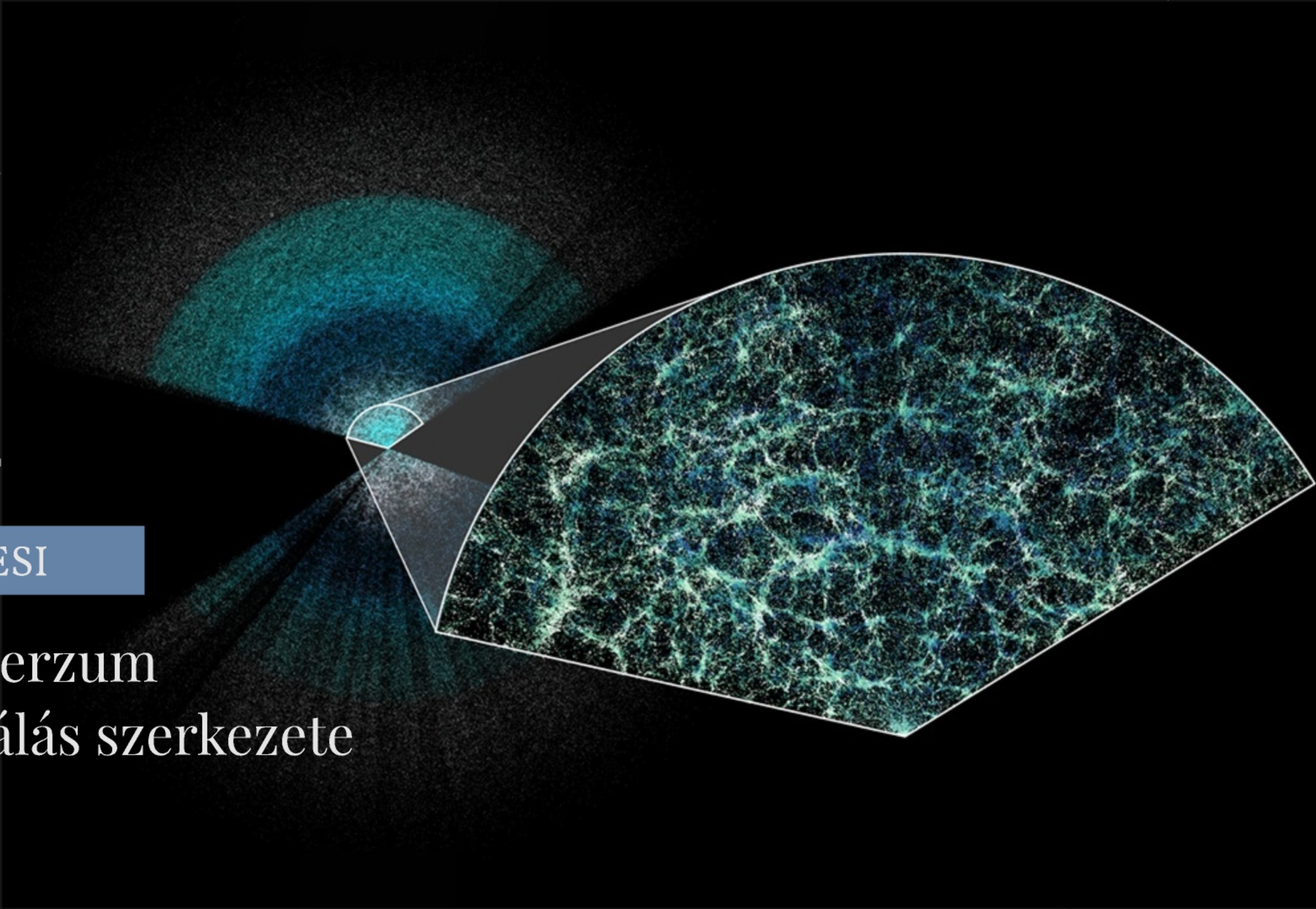


Virgo superhalmaz



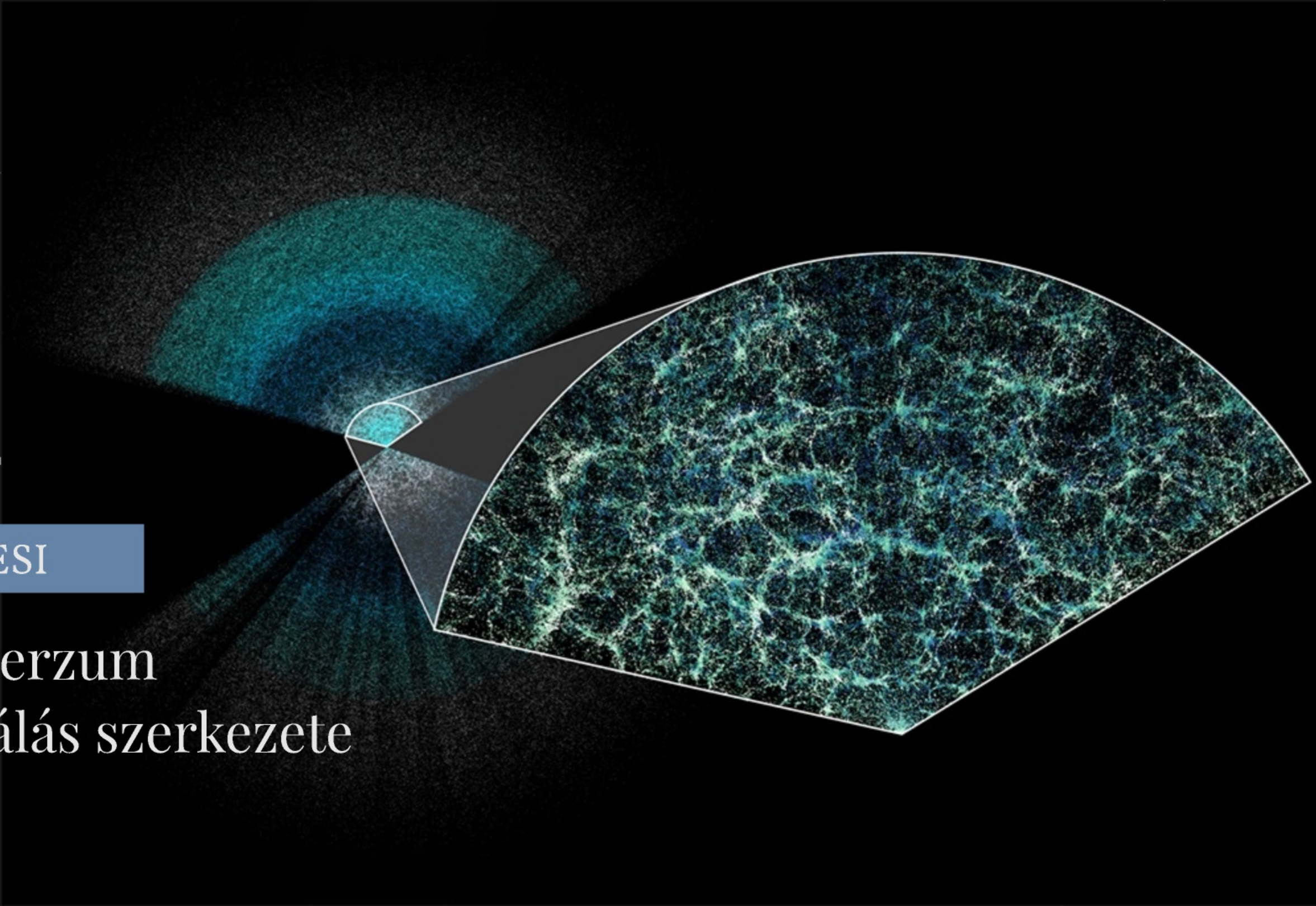
A visualization of the cosmic web, showing a dense, glowing yellow and orange filamentary structure against a dark blue background. The structure is composed of numerous thin, curved lines that converge and diverge, creating a complex, web-like pattern. A small red dot is visible on the right side of the main structure. The overall effect is one of vastness and complexity, representing the large-scale structure of the universe.

Laniakea "még szuperebb" superhalmaz



DESI

Az univerzum nagyiskálás szerkezete



DESI

Az univerzum nagyiskálás szerkezete



Georges
Lemaitre
1927



Alexand
Fridman
1922

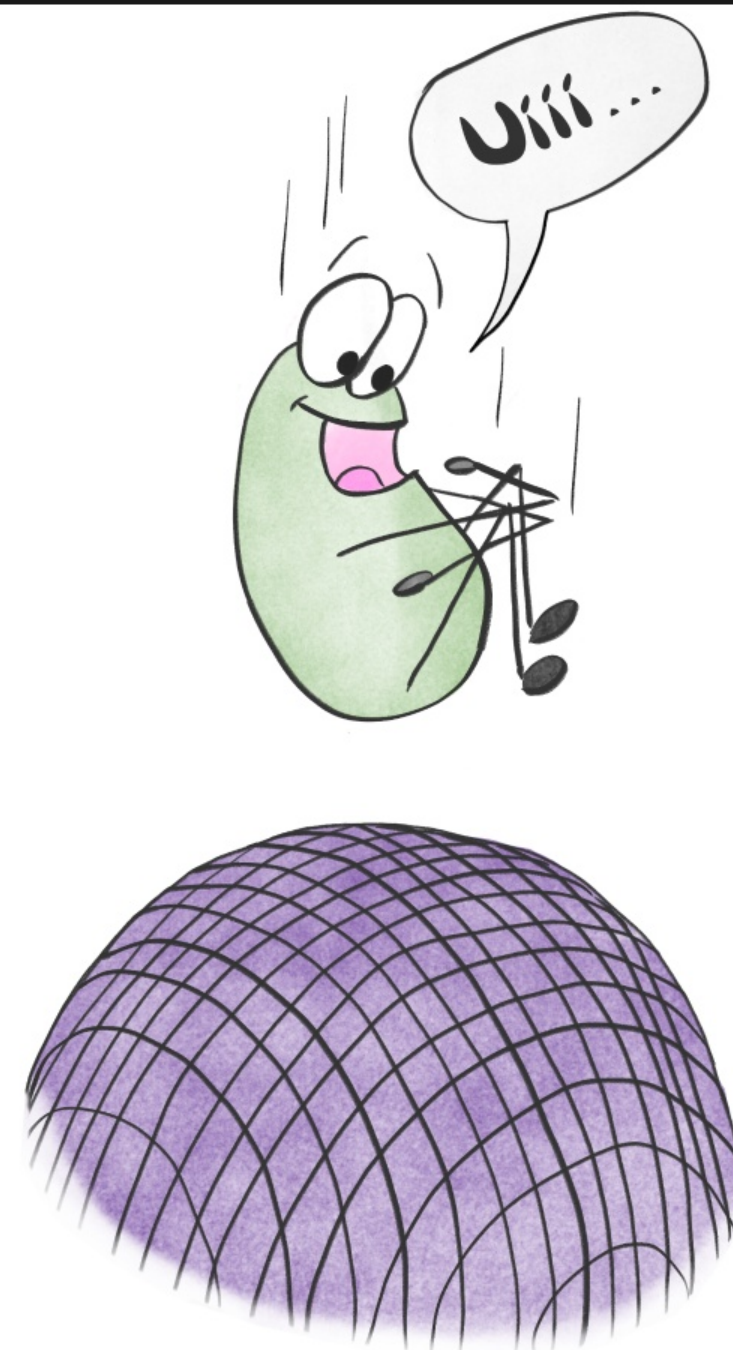
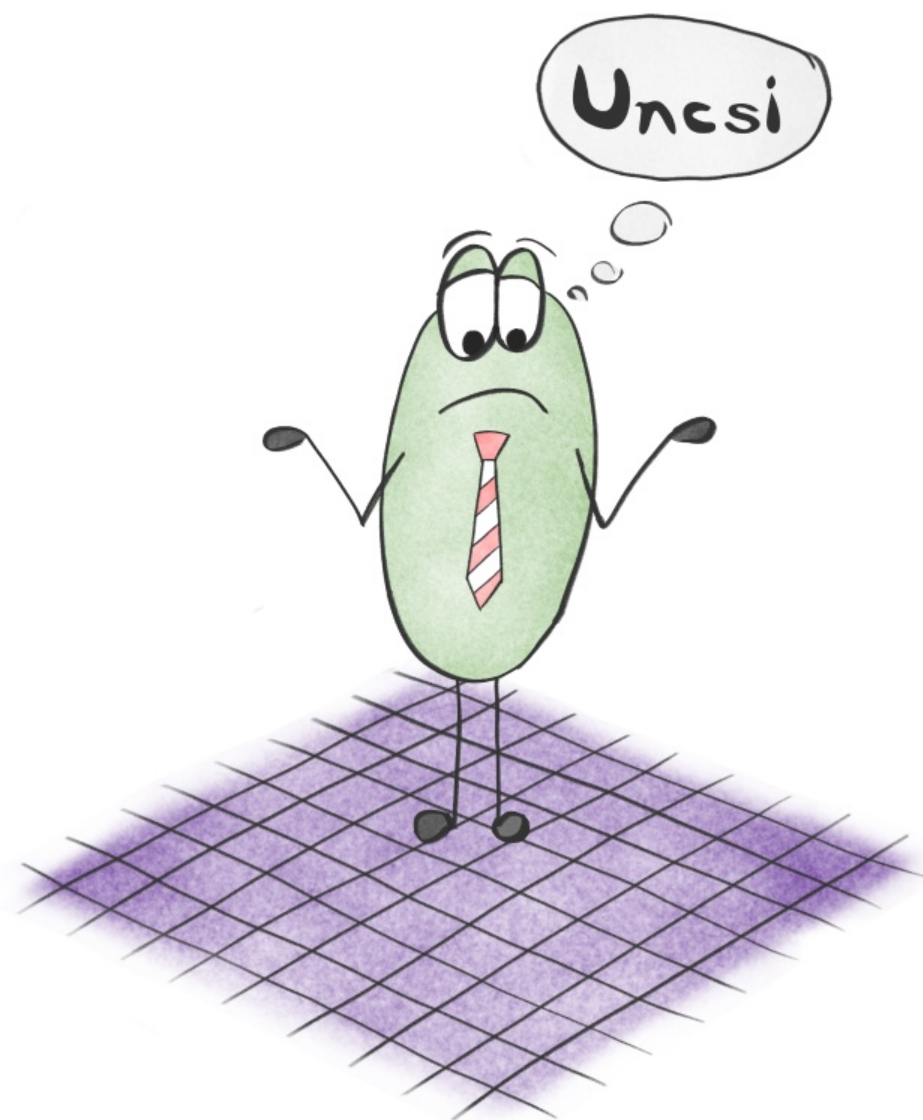
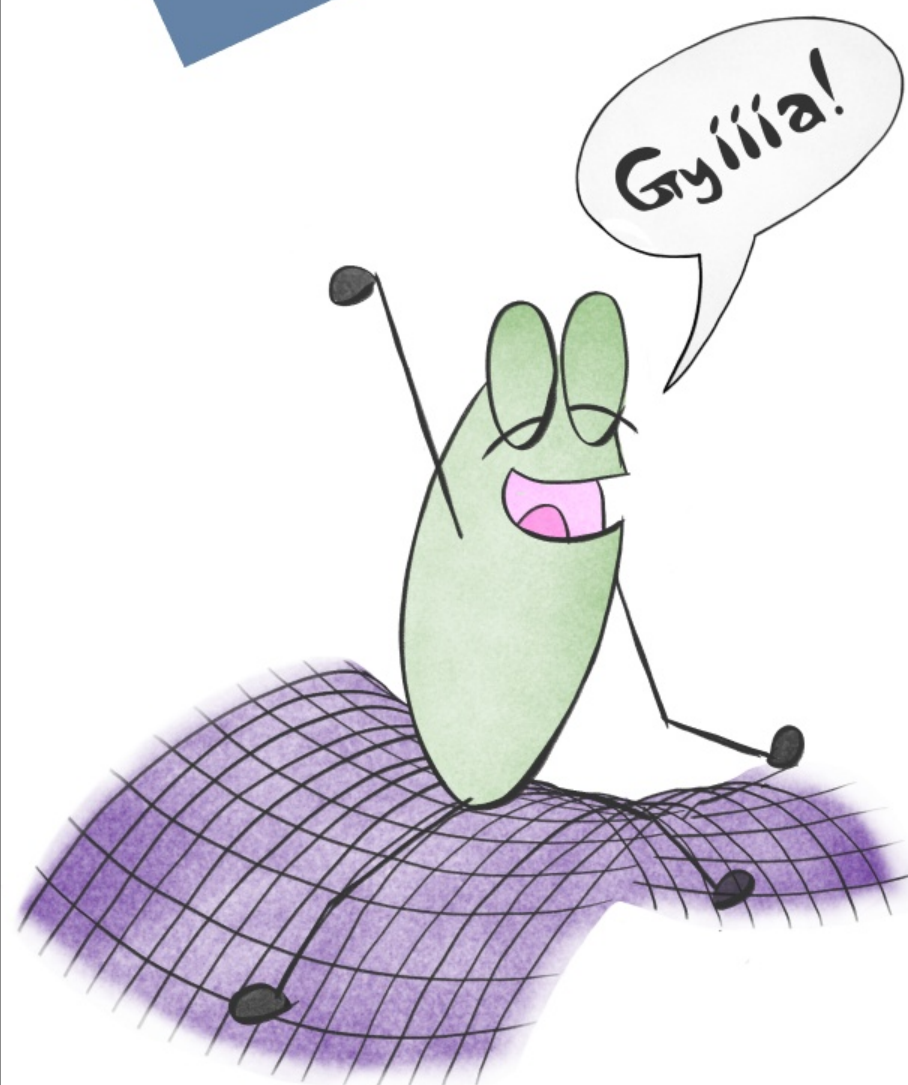


Arthur
Walker
1936

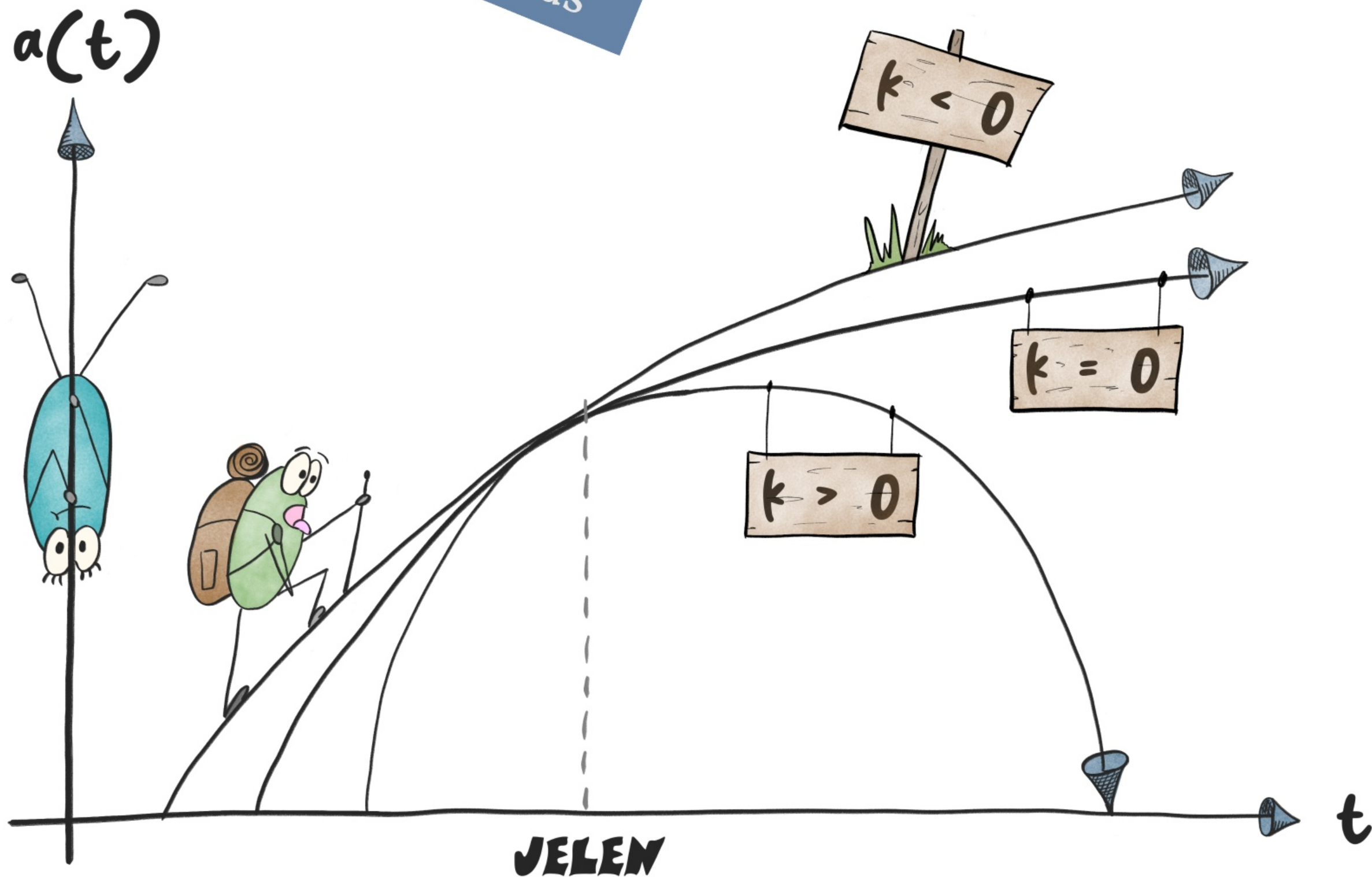


Howard
Robertson
1935

Az univerzum görbületé



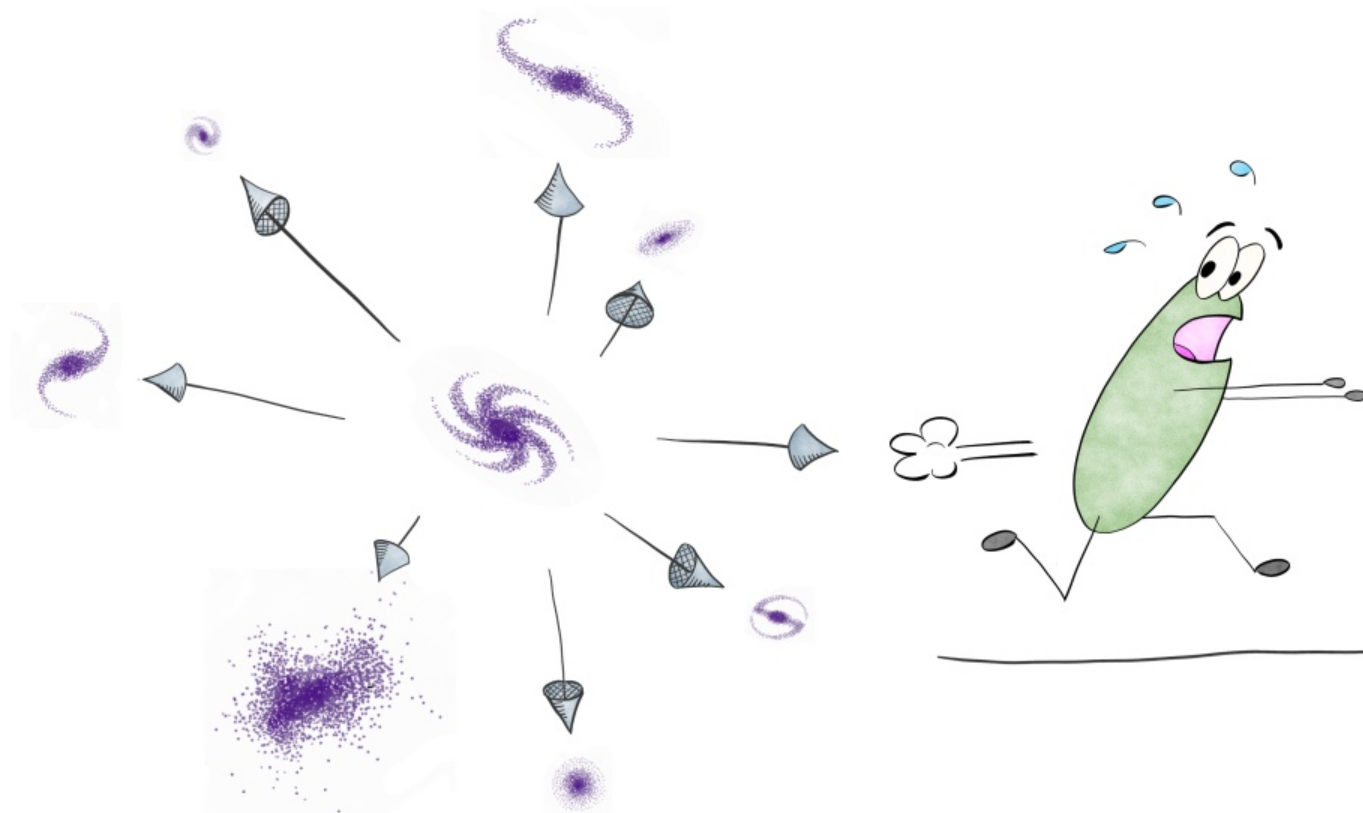
FLRW
megoldás



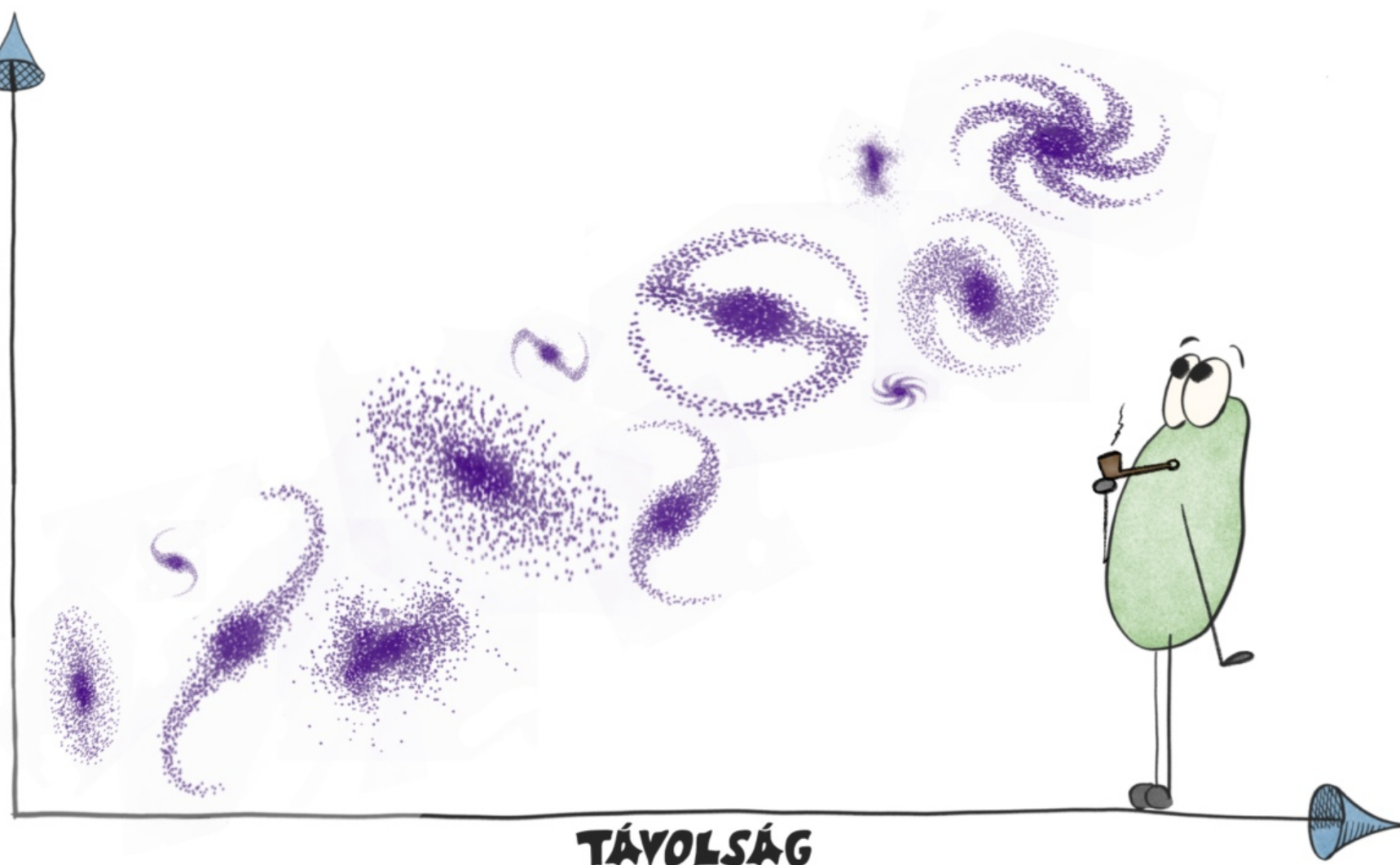


Edwin
Hubble

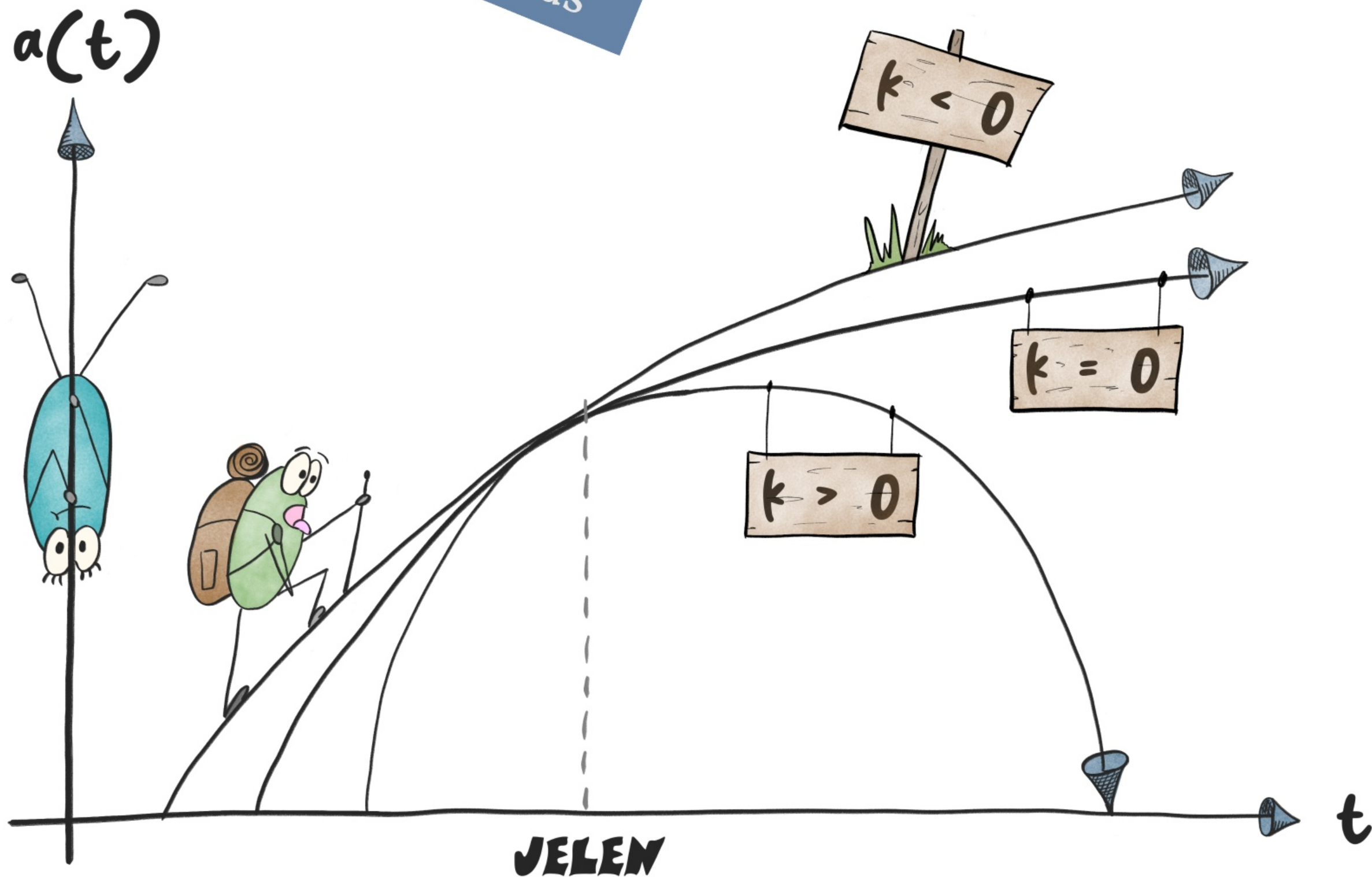
1929

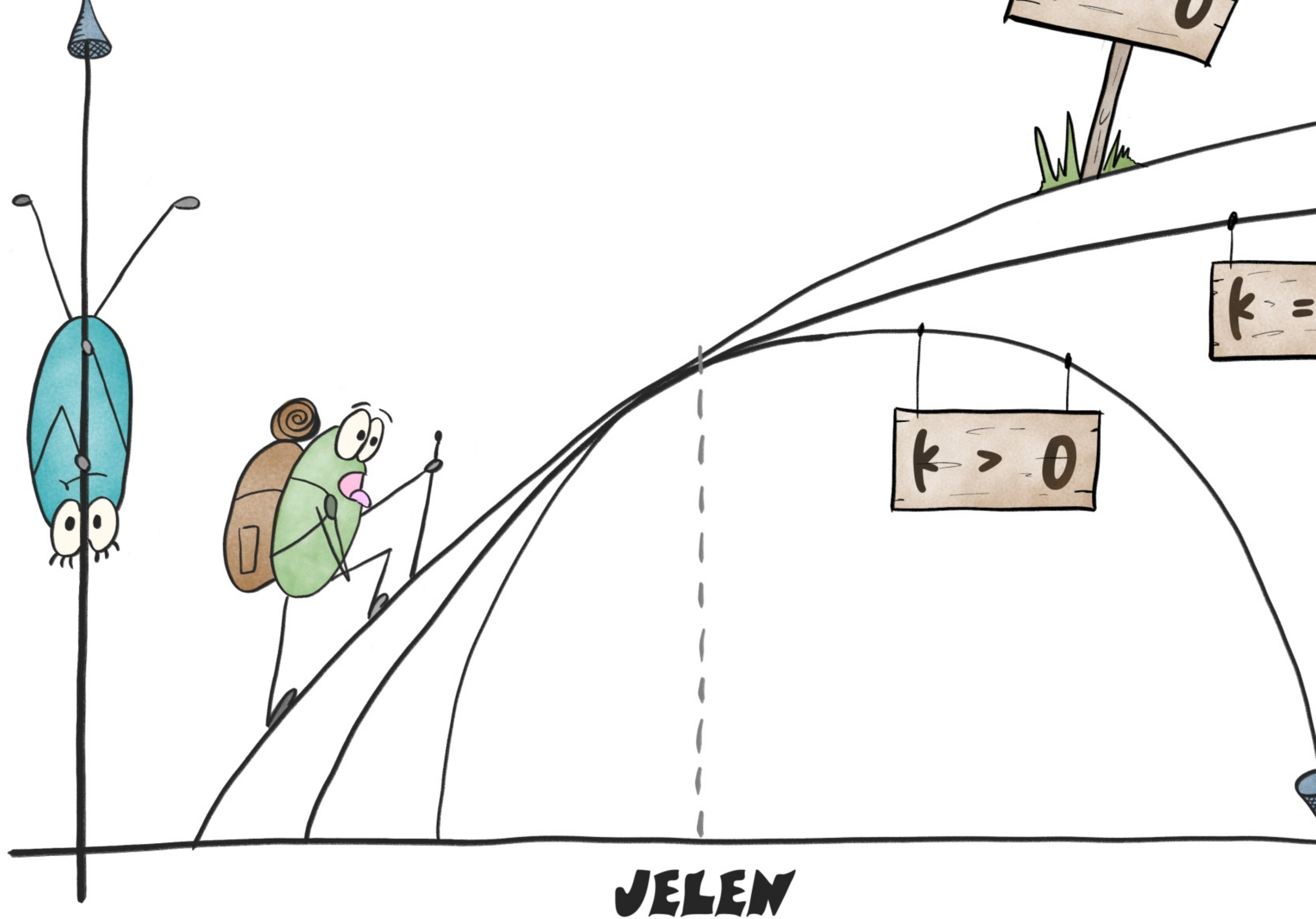


VÖRÖSELTOLÓDÁS



FLRW
megoldás

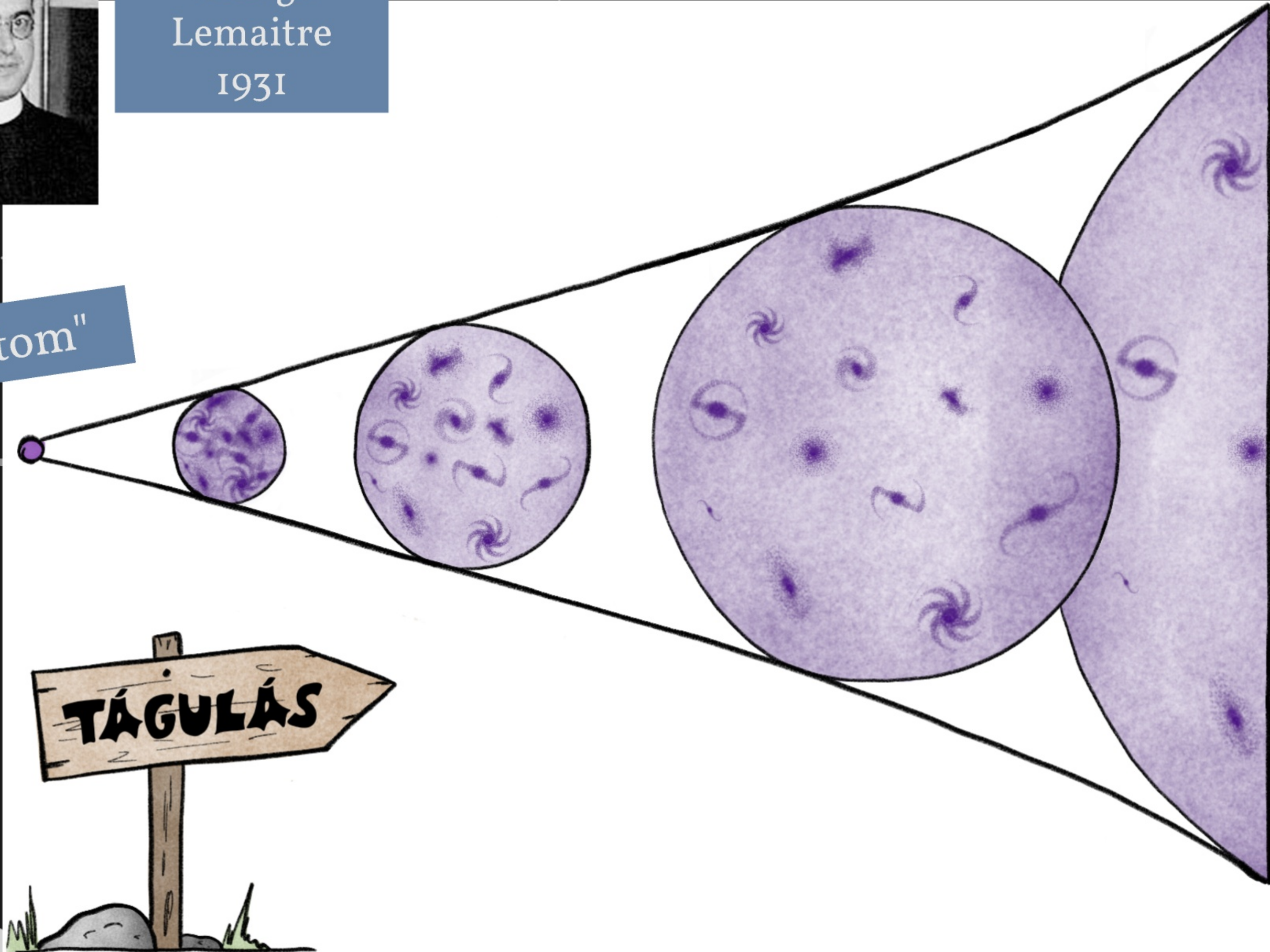






George
Lemaitre
1931

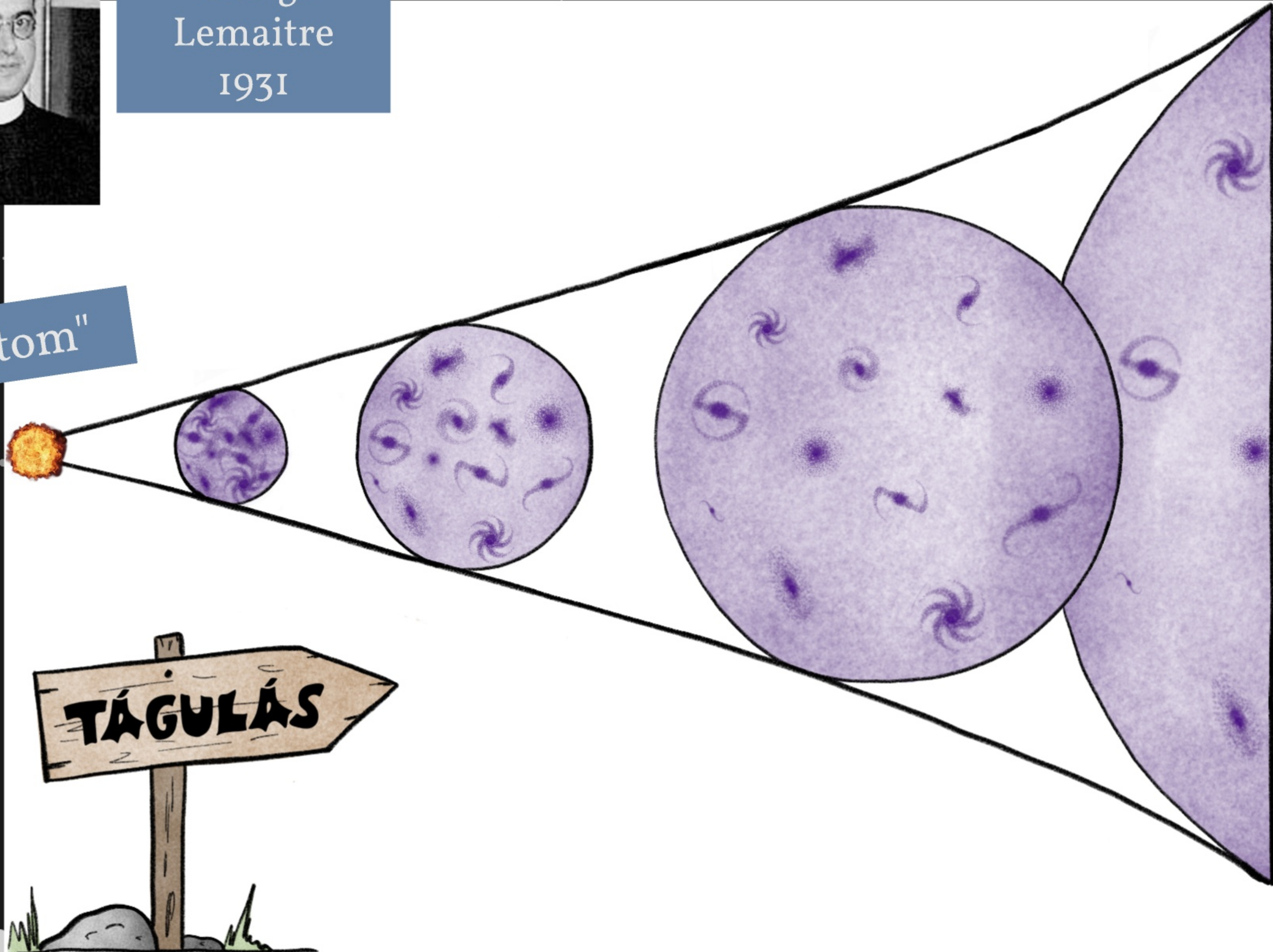
"Ősi atom"





George
Lemaitre
1931

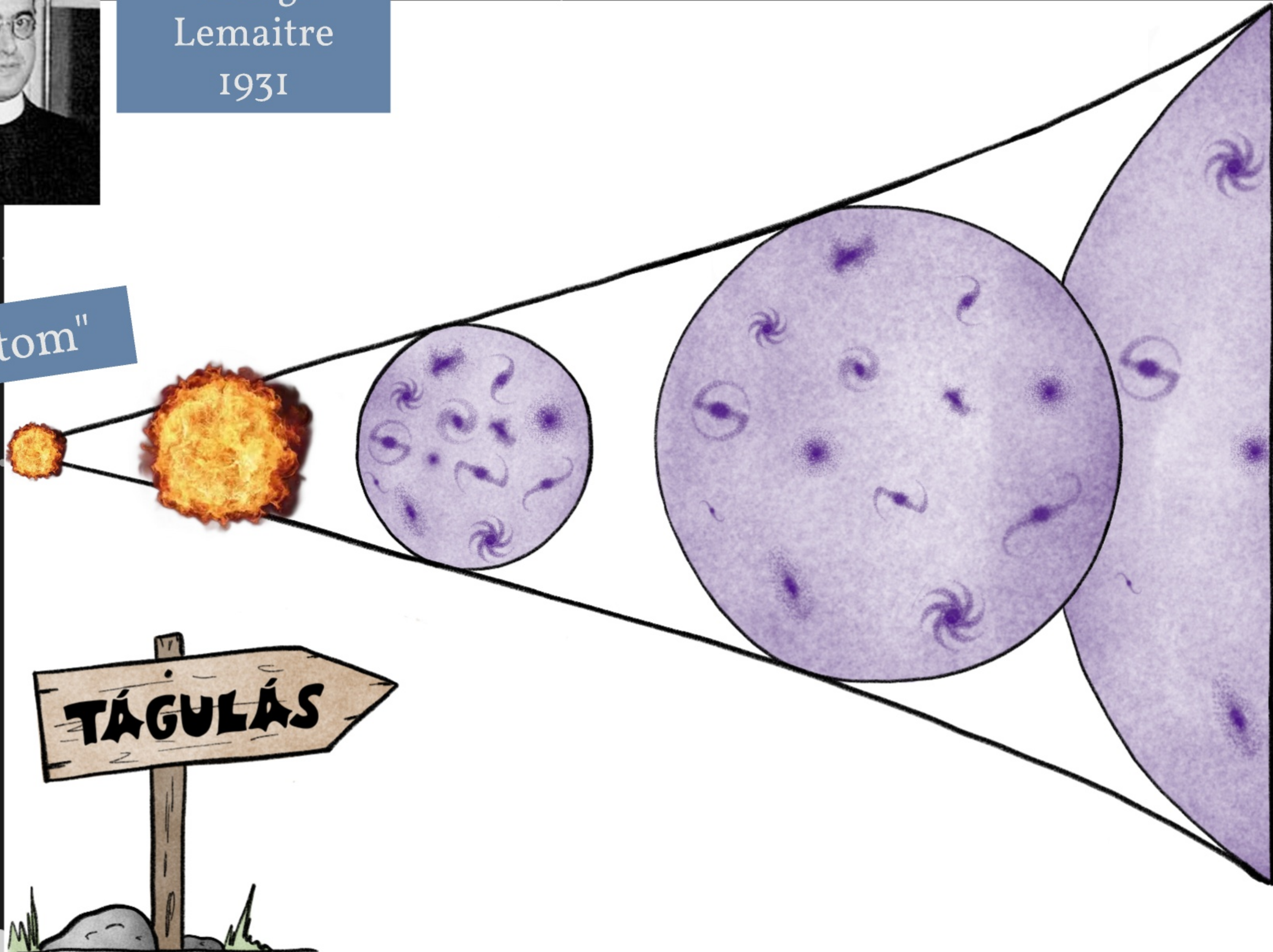
"Ősi atom"

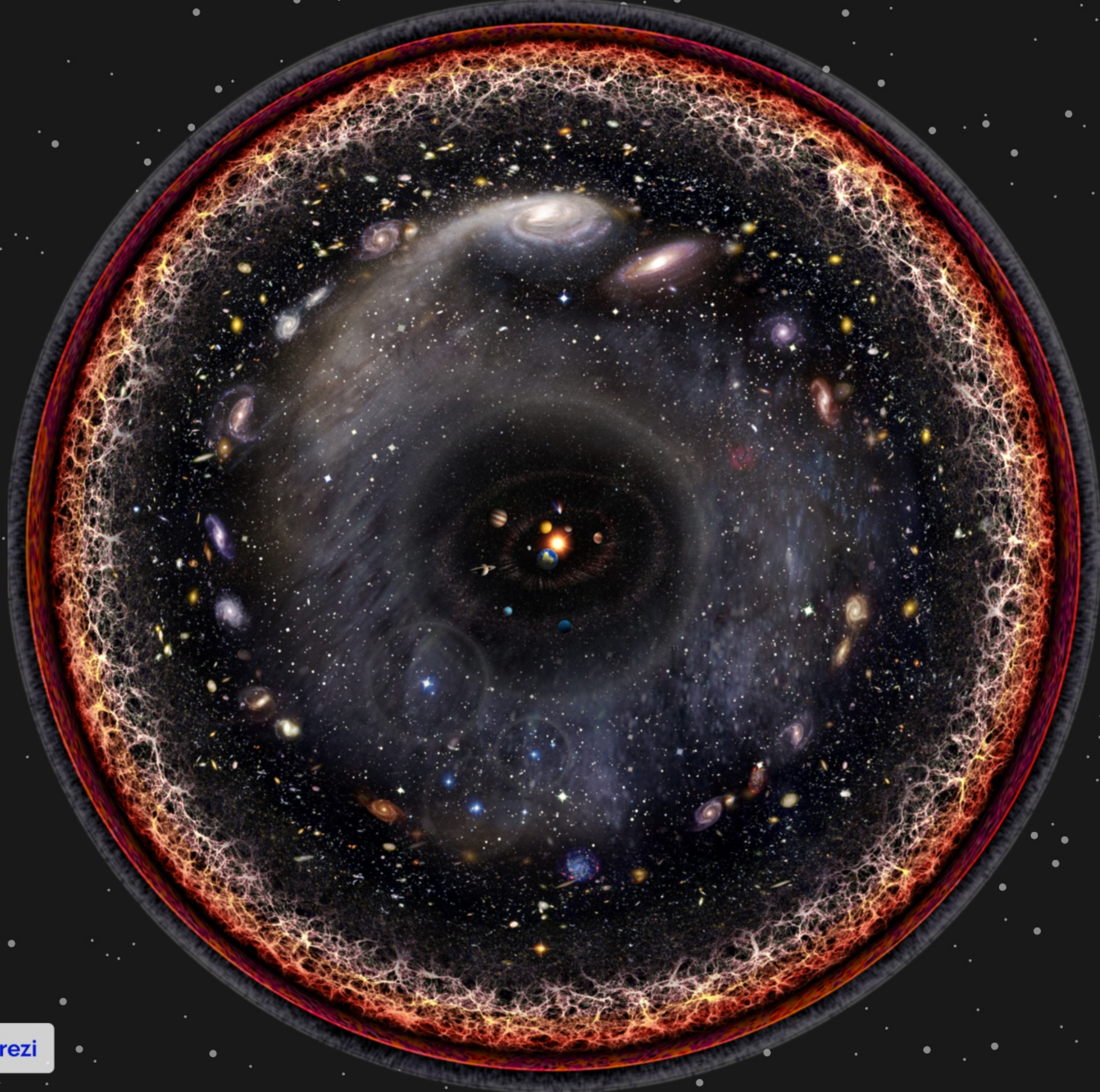


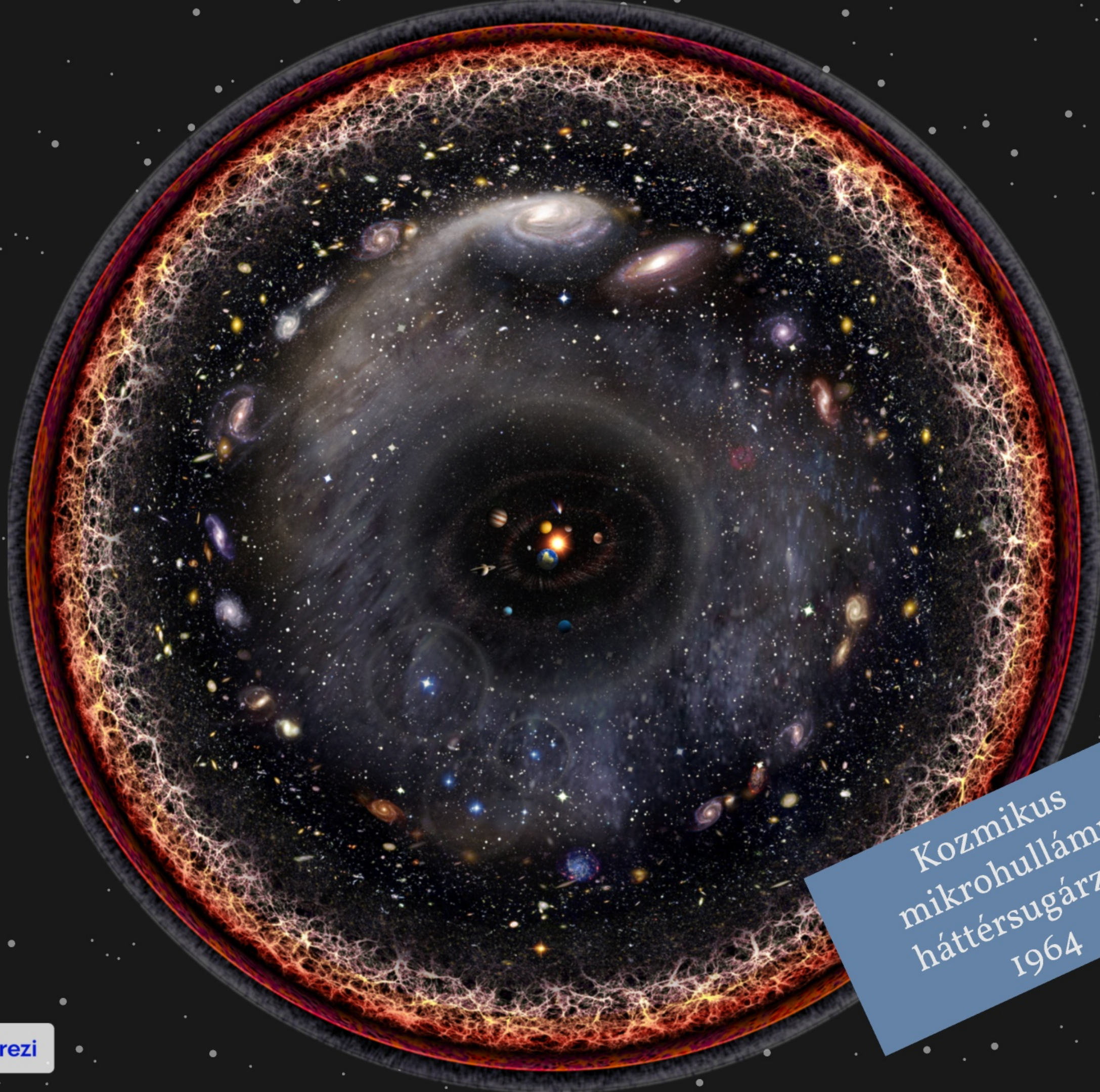


George
Lemaitre
1931

"Ősi atom"

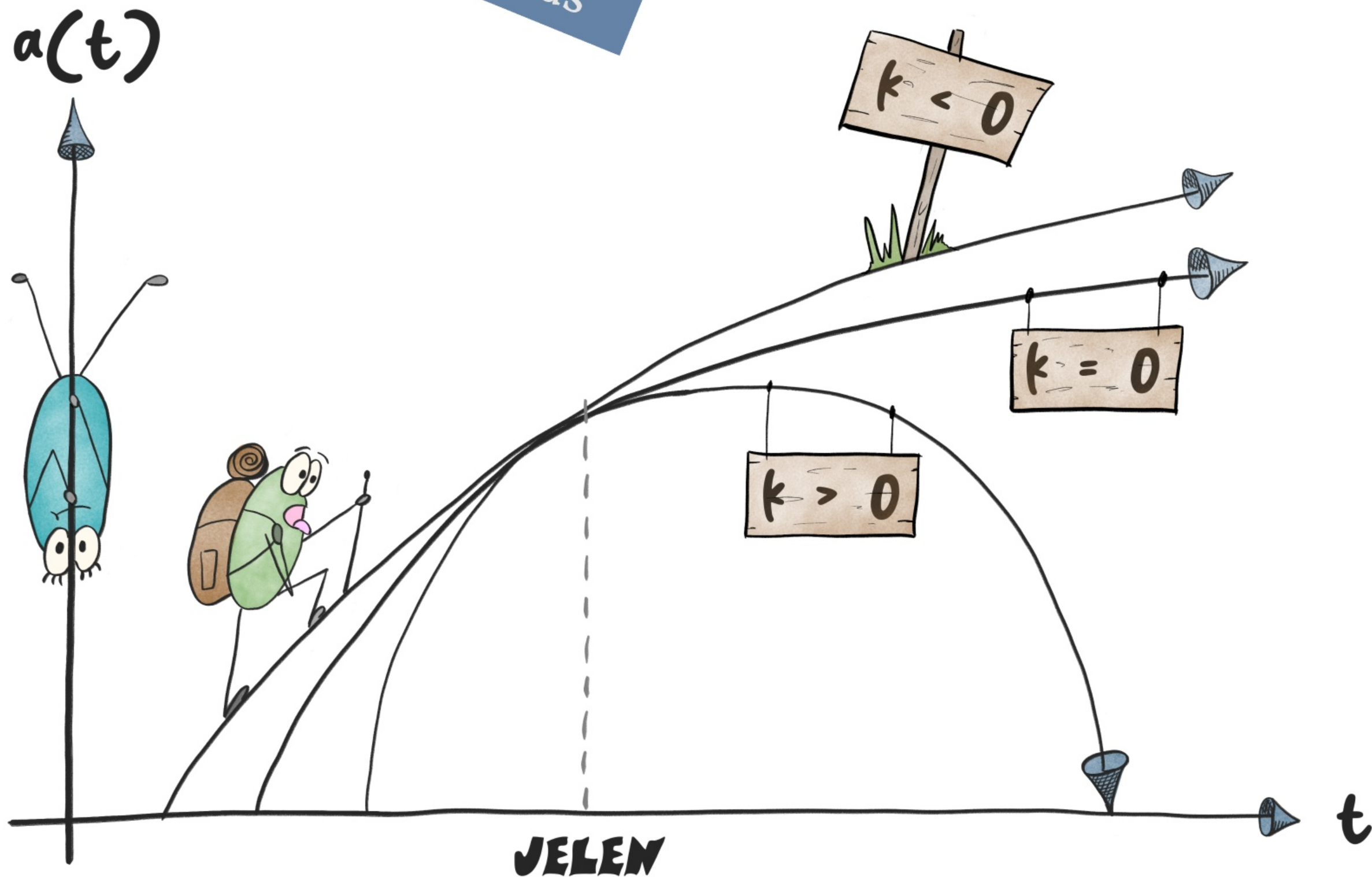




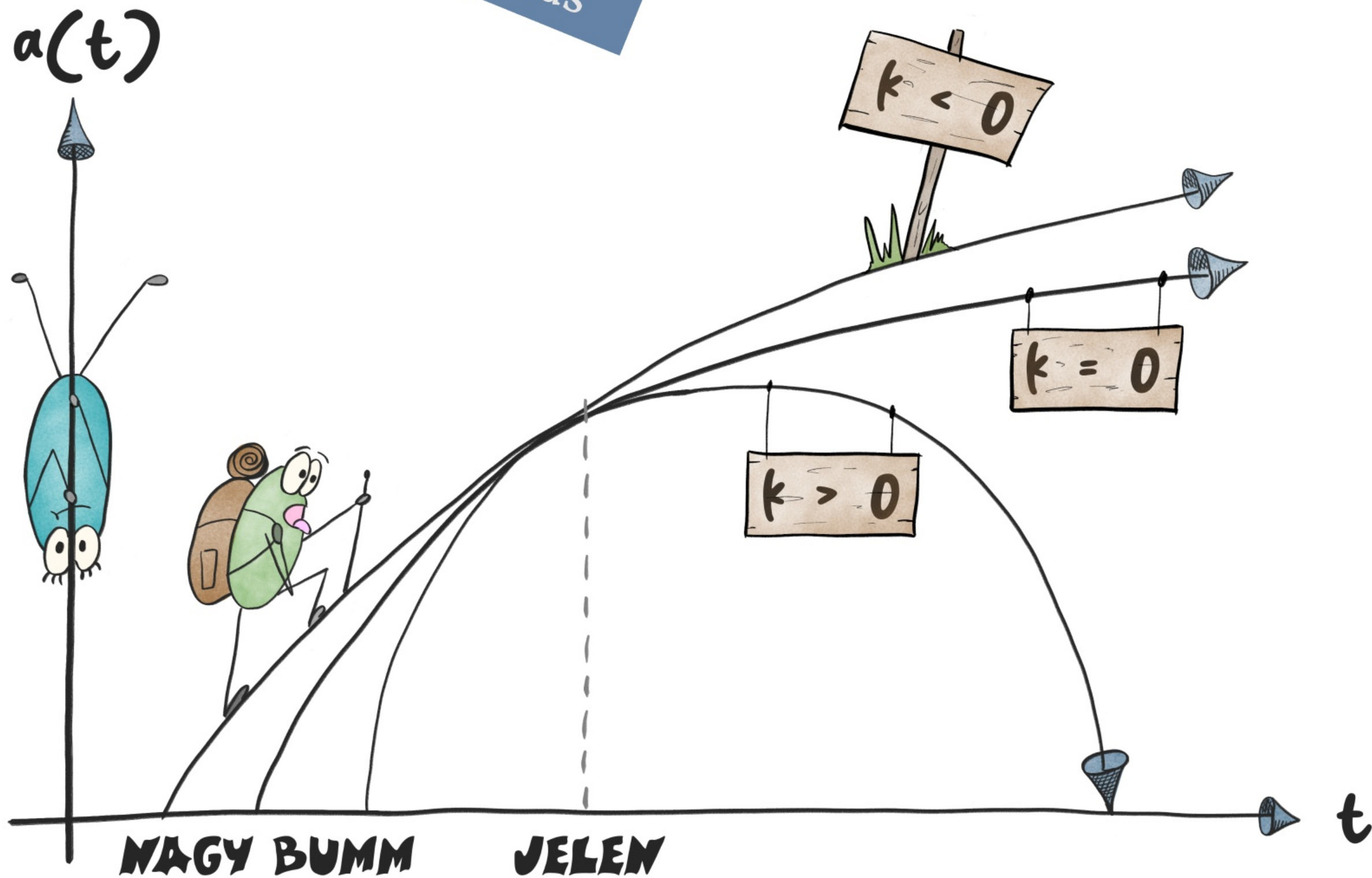


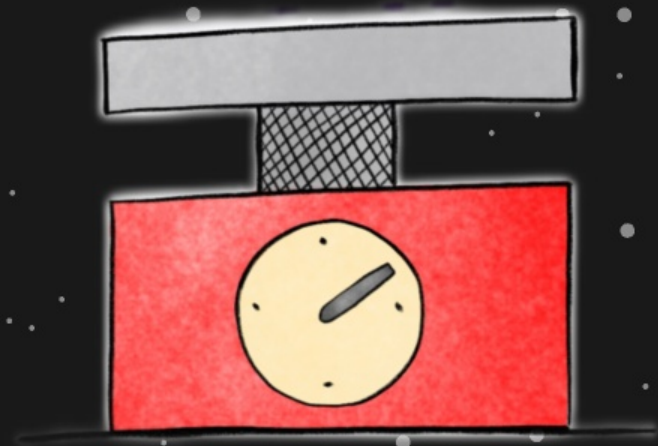
Kozmikus
mikrohullámú
háttérsugárzás
1964

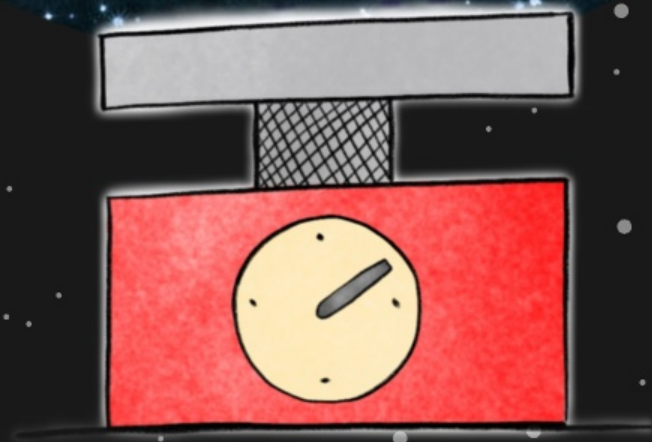
FLRW
megoldás



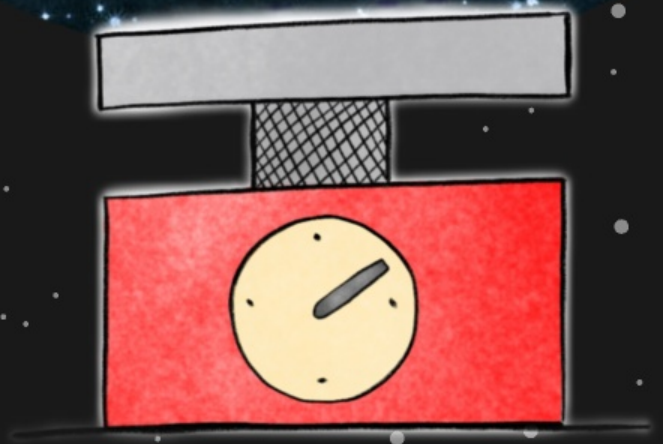
FLRW
megoldás



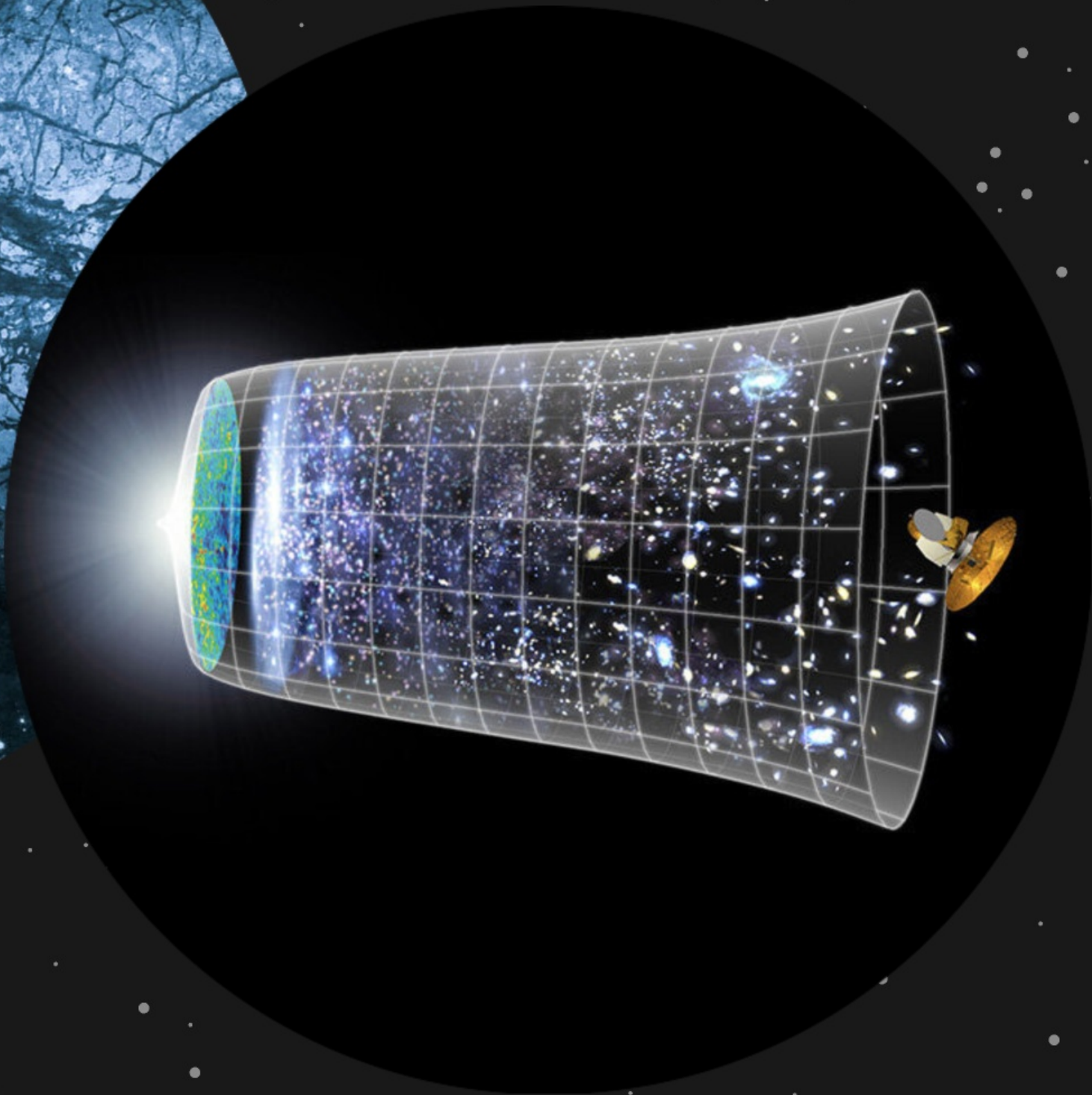
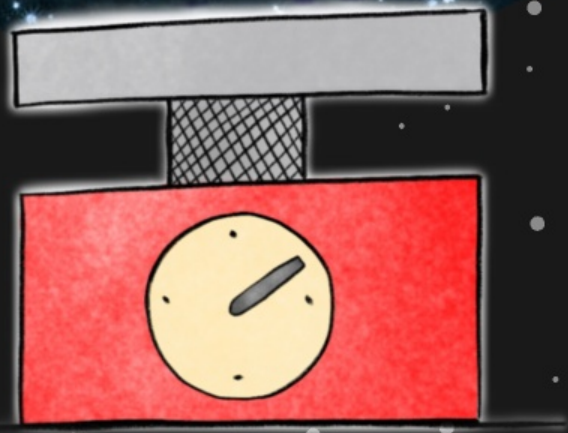
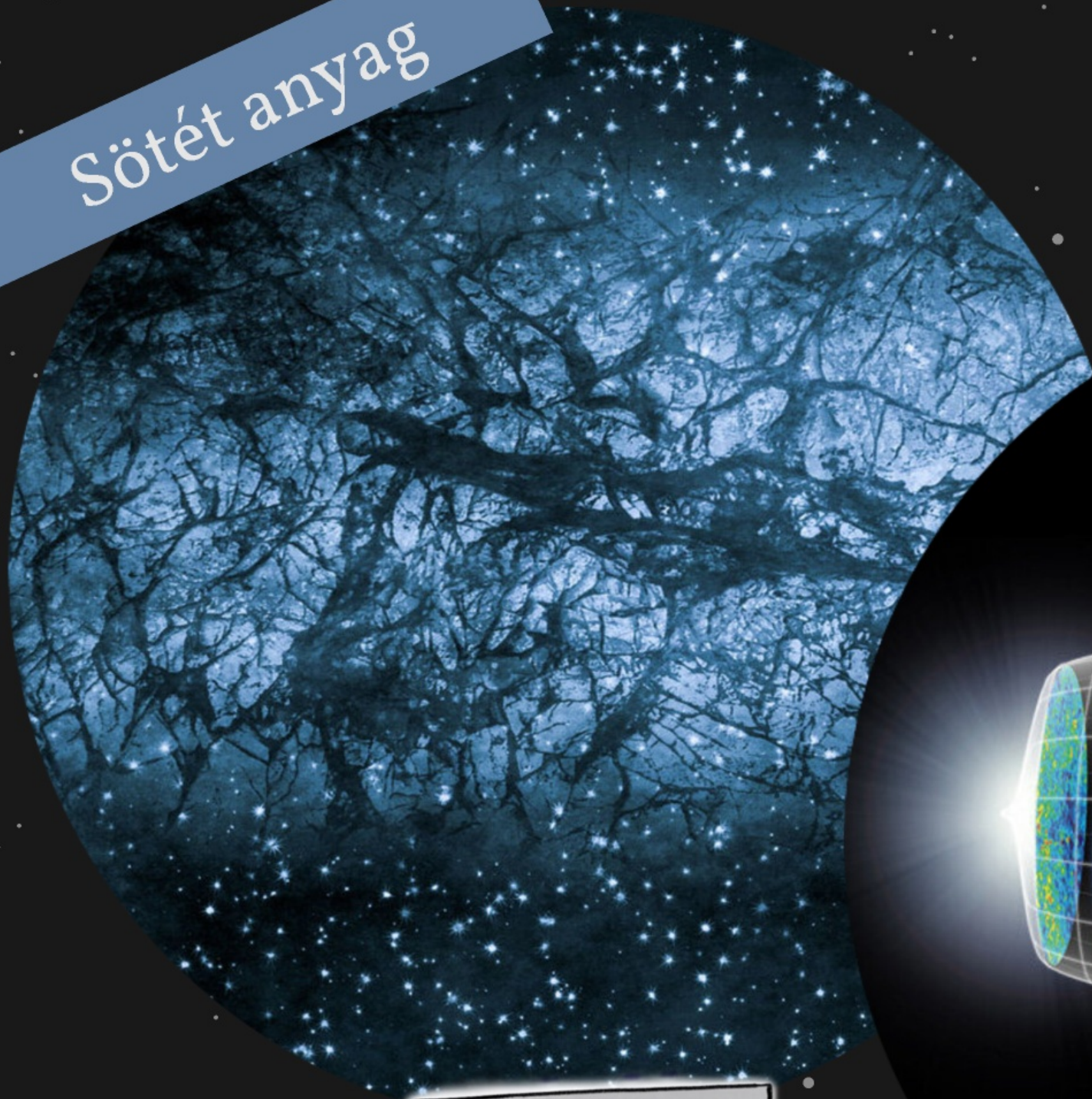




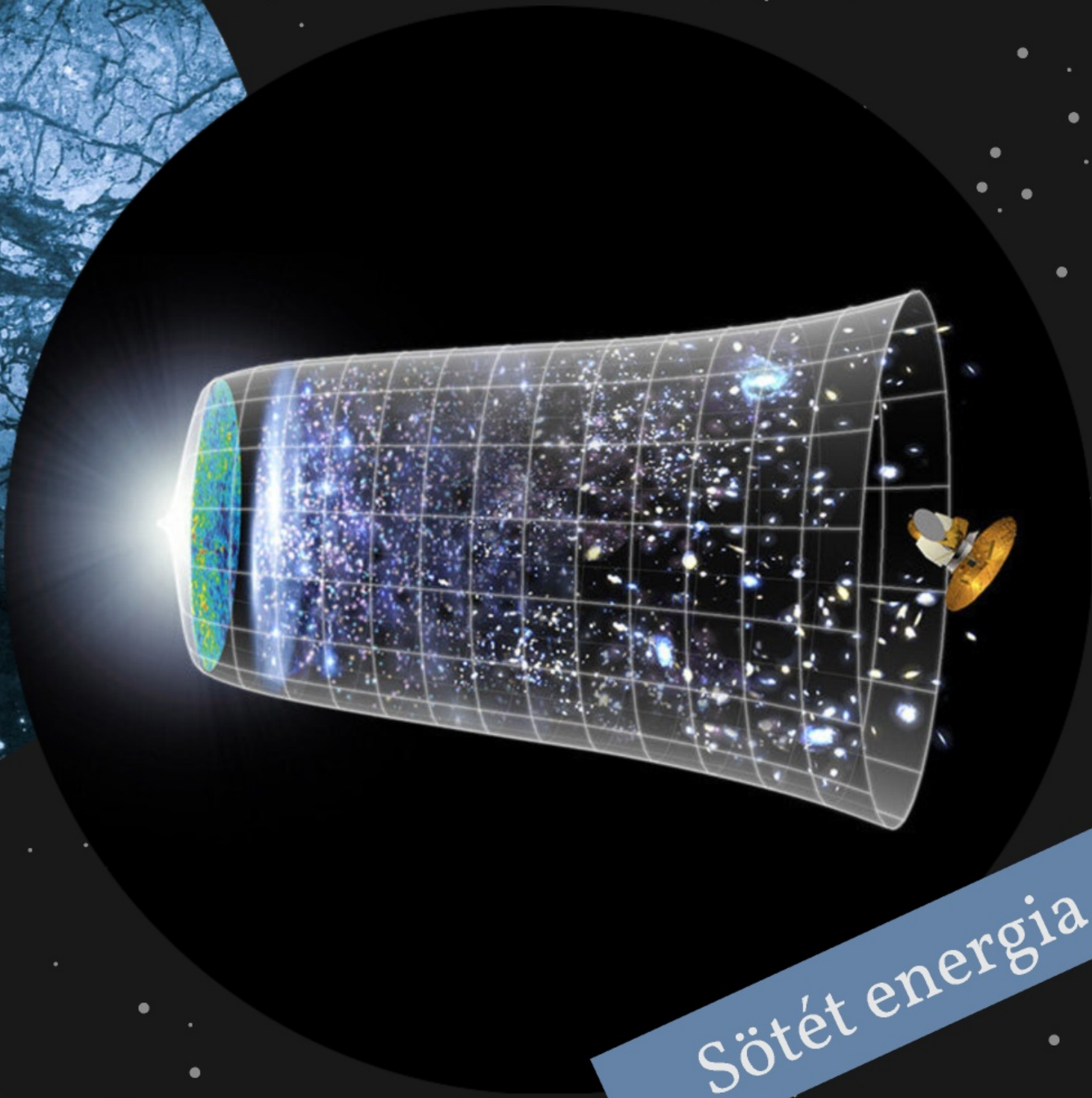
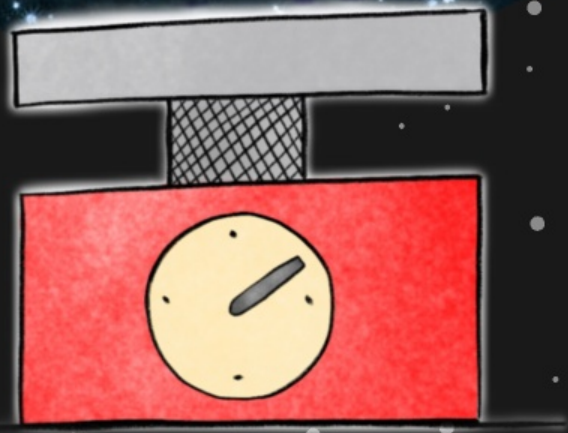
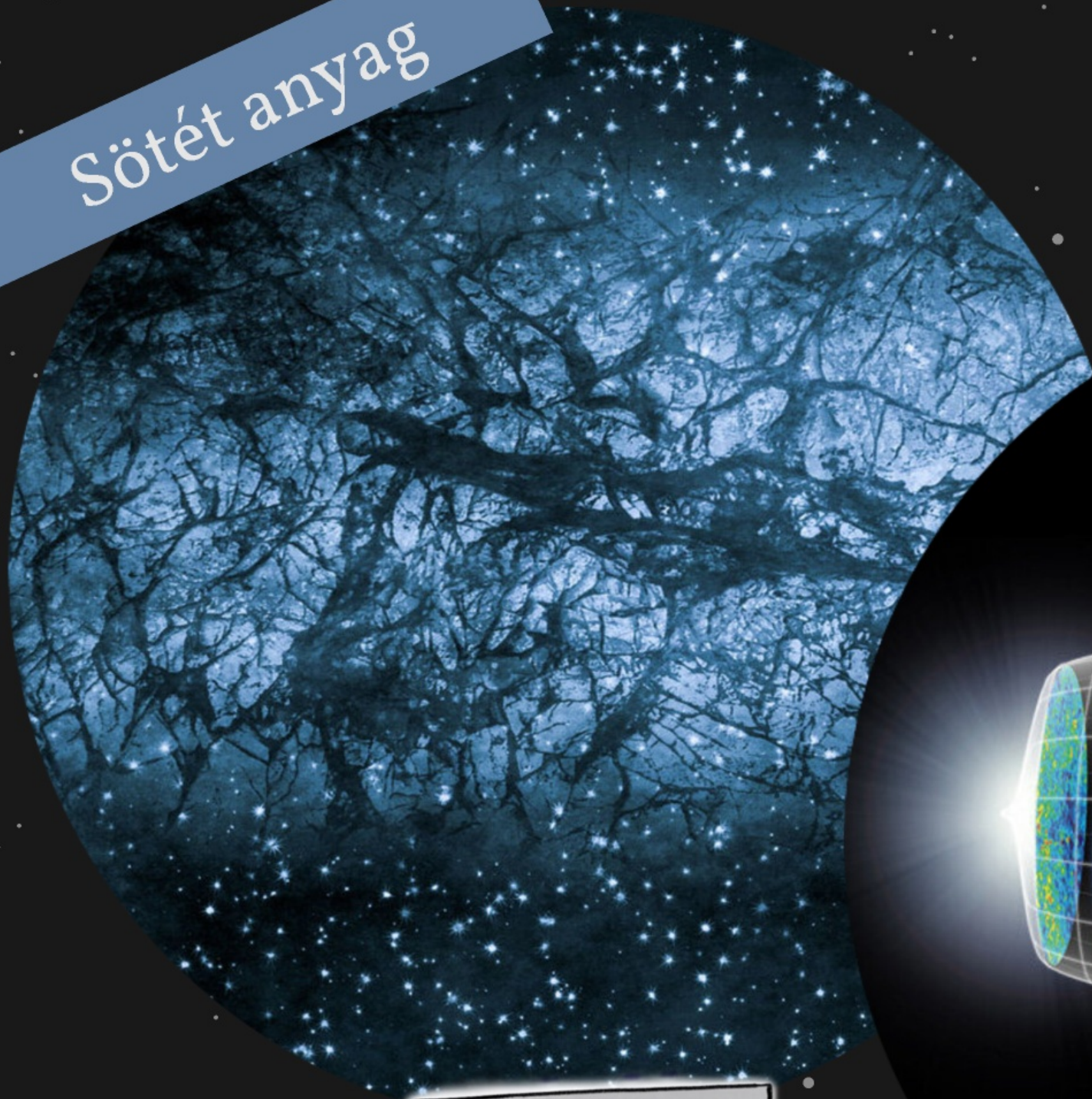
Sötét anyag



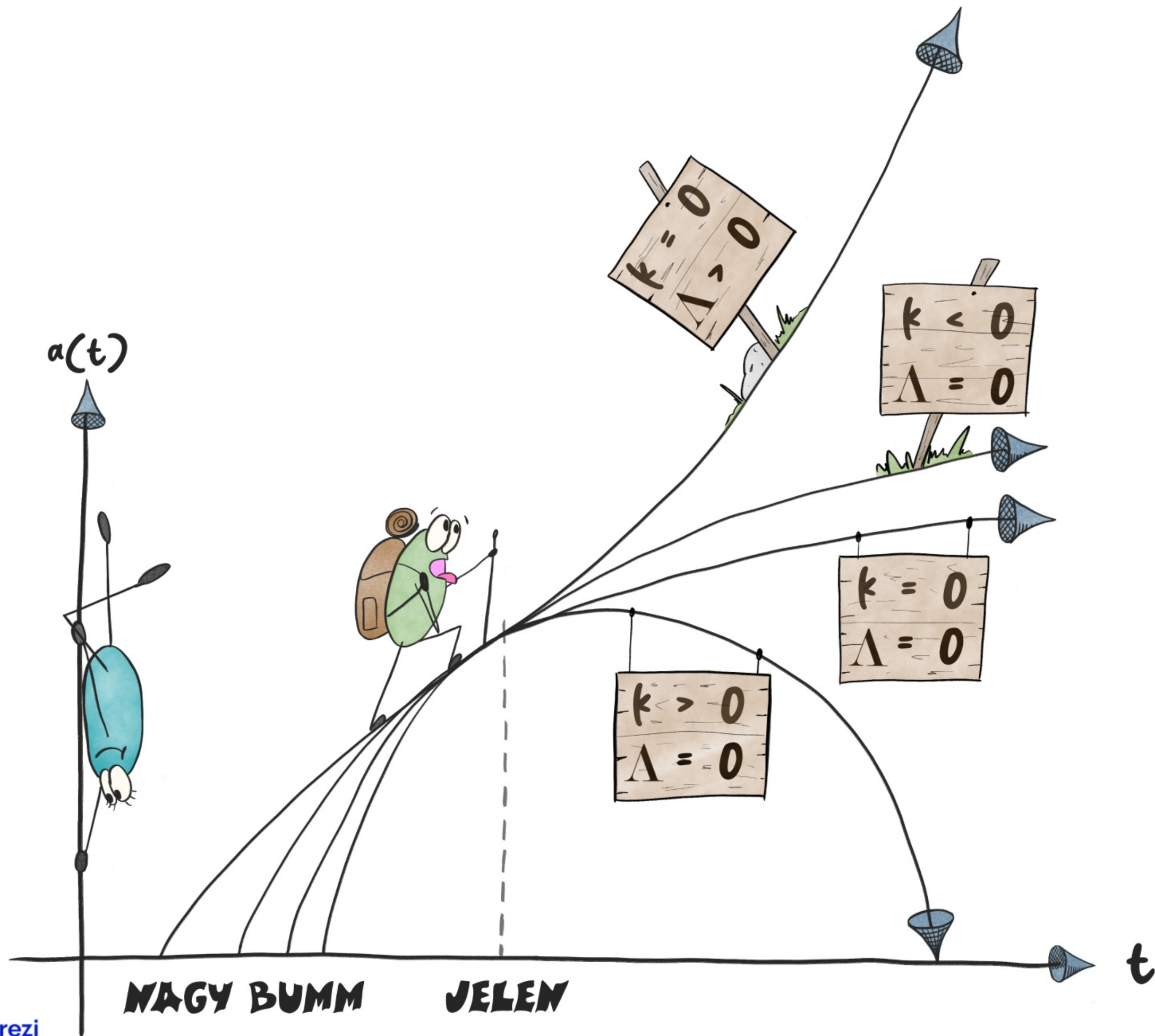
Sötét anyag

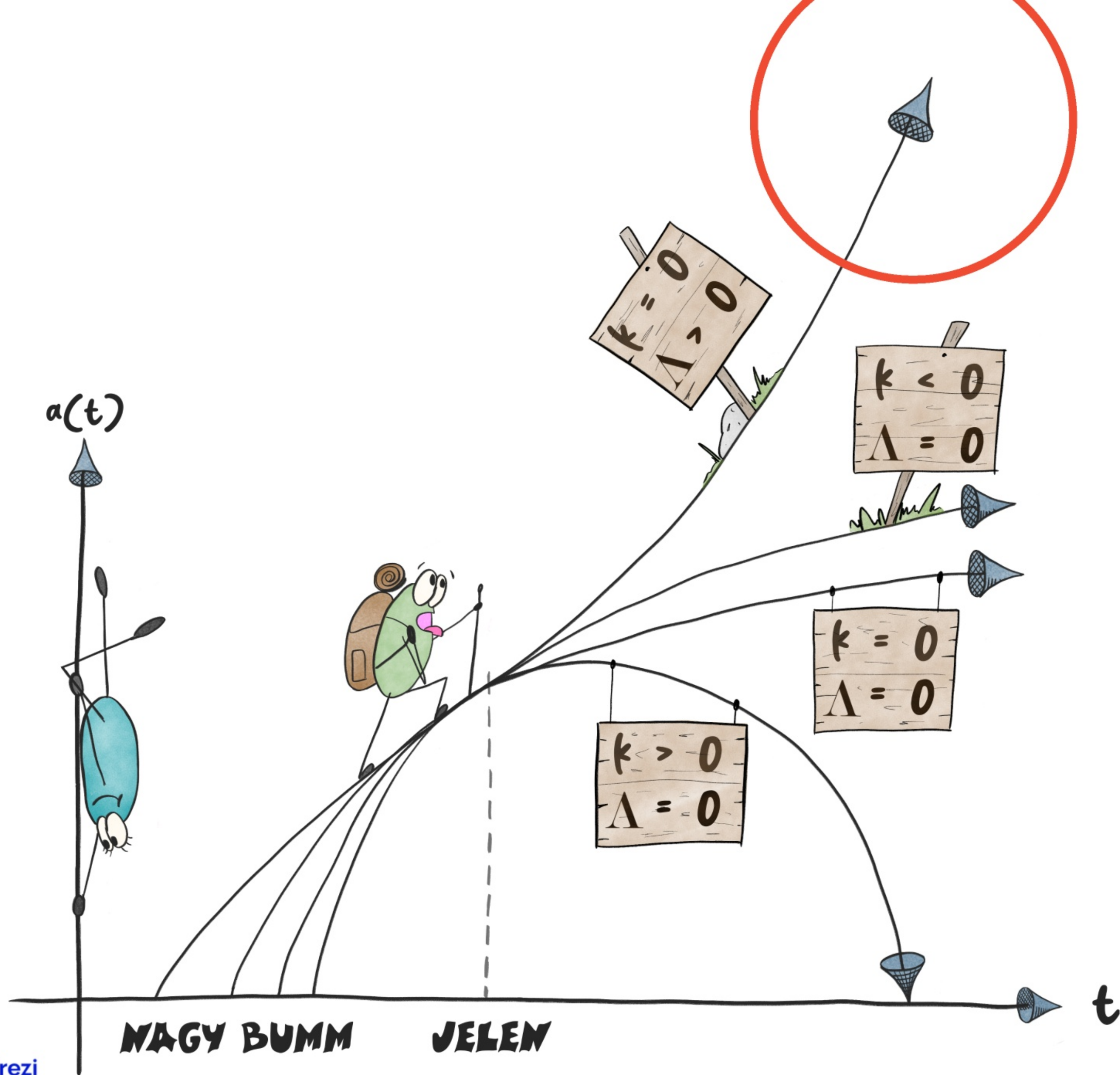


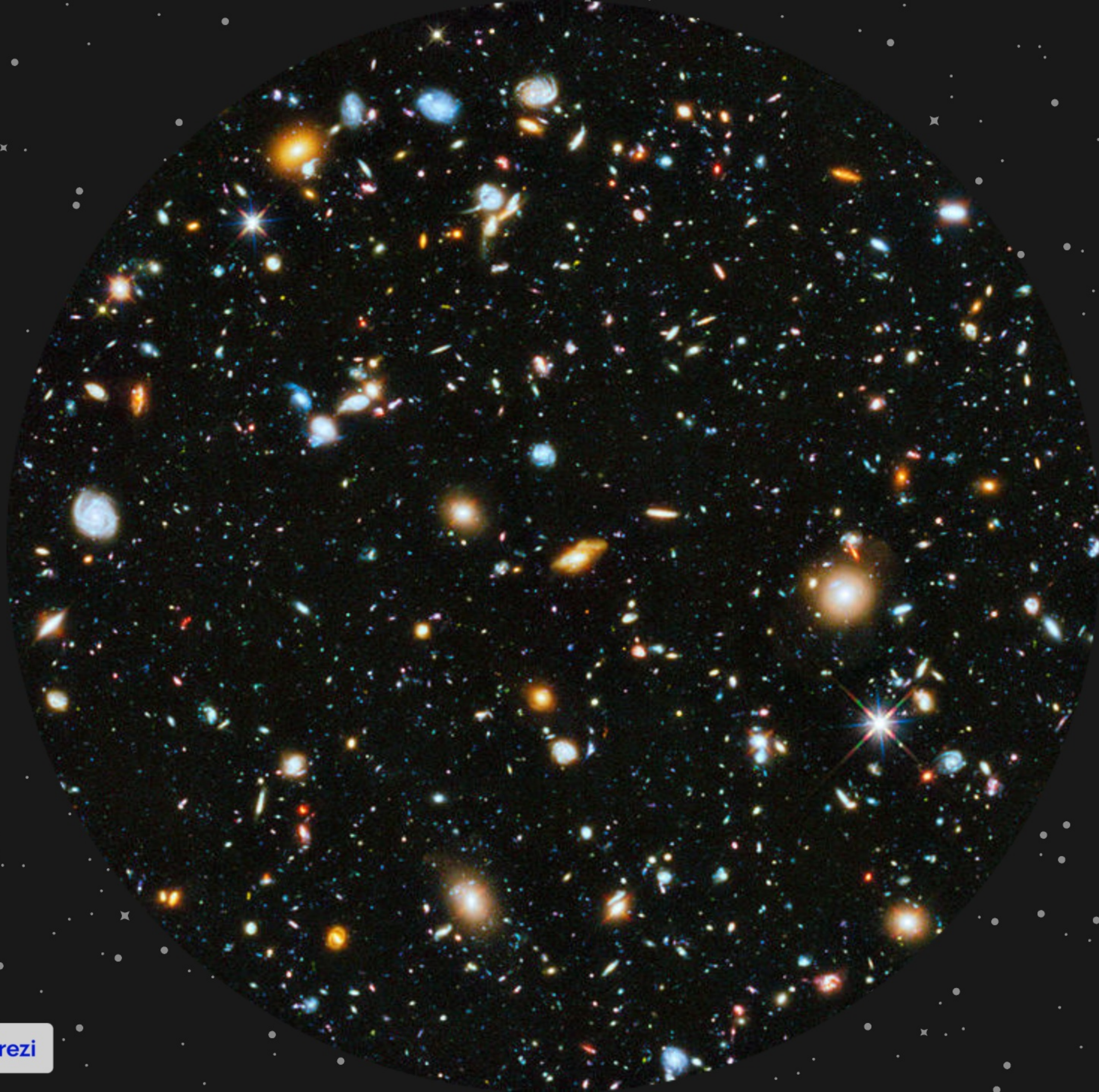
Sötét anyag

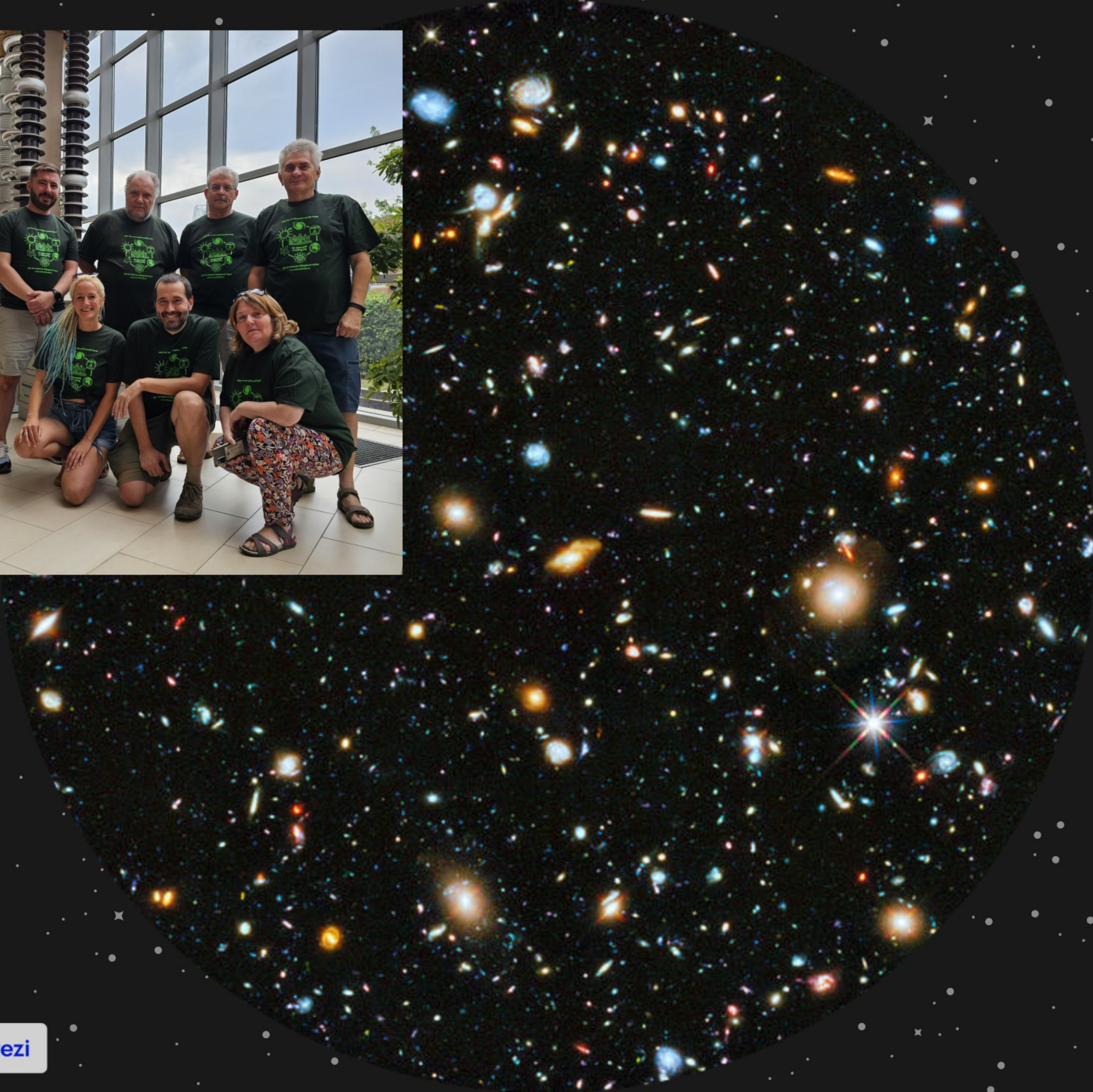


Sötét energia











Felelős szerkesztő: Déri Ákos

Szerkesztő: Leiszter Attila

Korrektor: Török Tünde

Borítóterv: Zatykó Fanny

Belívterv és tördelés:

Kovács Balázs „Kebok”

Marketing és PR: Büchler András

Kiadóvezető: Halmos Ádám



Felelős szerkesztő: Déri Ákos

Szerkesztő: Leiszter Attila

Korrektor: Török Tünde

Borítóterv: Zatykó Fanny

Belívterv és tördelés:

Kovács Balázs „Kebok”

Marketing és PR: Büchler András

Kiadóvezető: Halmos Ádám





Felelős szerkesztő: Déri Ákos

Szerkesztő: Leiszter Attila

Korrektor: Török Tünde

Borítóterv: Zatykó Fanny

Belívterv és tördelés:

Kovács Balázs „Kebok”

Marketing és PR: Büchler András

Kiadóvezető: Halmos Ádám



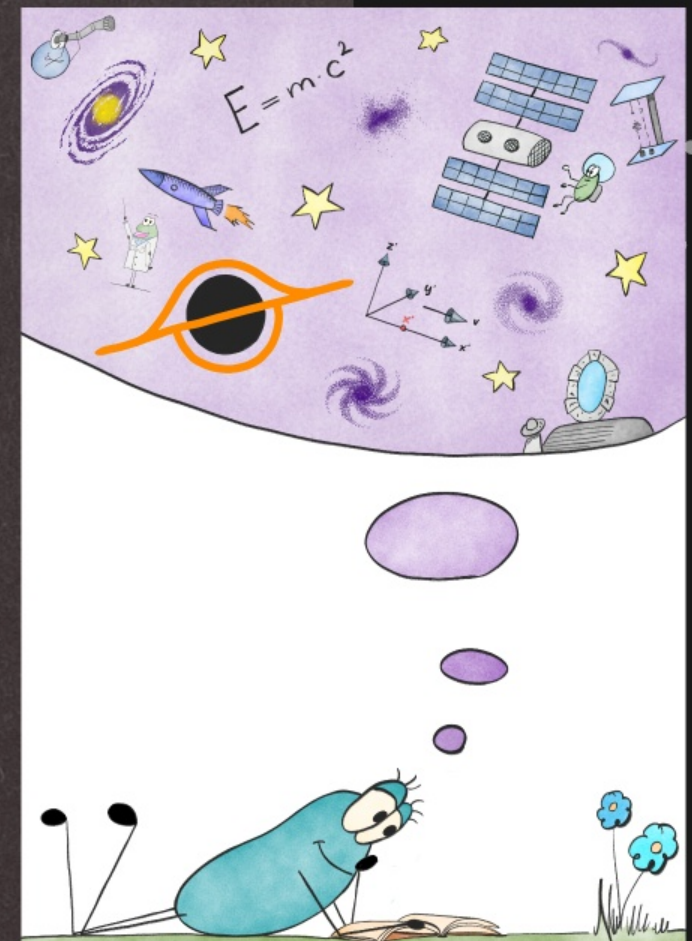
**KIS-TÓTH
ÁGNES**

**RANDEVÚ
A
KOZMOSSZAL**

*Szinte minden,
amit tudni szeretnél
volna az univerzum
felfedezéséről*

Op_{en}

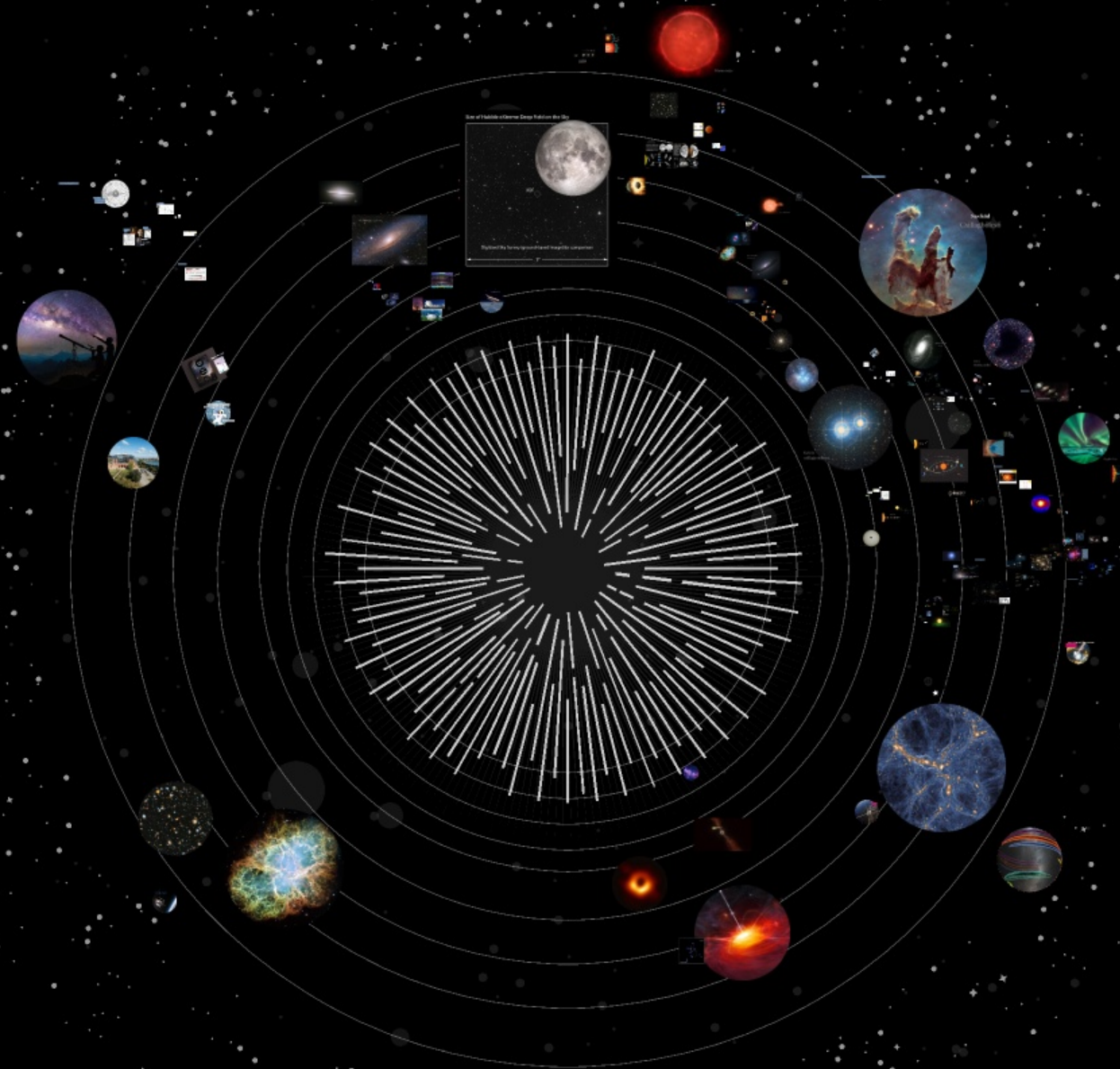
Op_{en} Books



@csillikdavidjanos

Open Books

GetYourScience
ELTETTK



Kis-Tóth Ágnes

Randevú a Kozmoszal



Vigye magával, és nézze meg újra bármikor.

Lemaradt valamiről? Szeretné alaposabban körbejárni a témát? Szkennelje be ezt a kódot vagy kattintson az alábbi gombra a prezentáció megnyitásához. Bármikor, bárhol.

Prezentáció megtekintése

