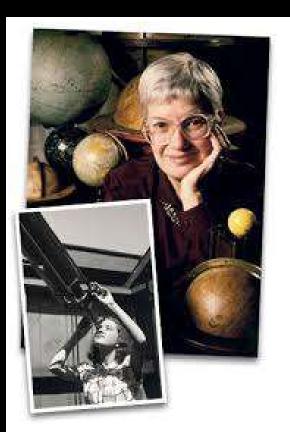
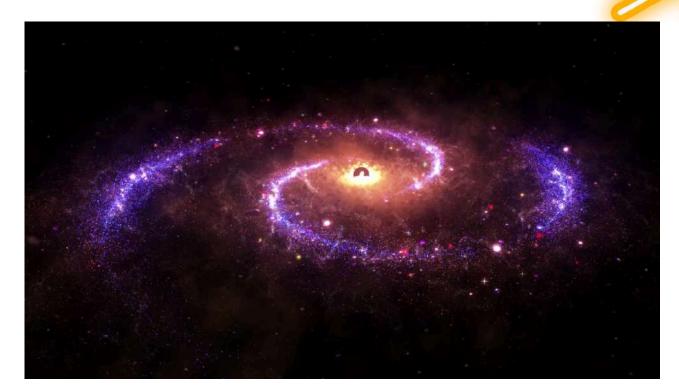
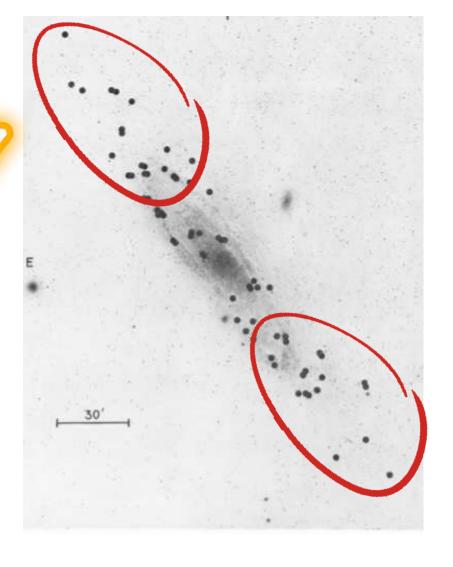
Farinaldo Queiroz, UFRN



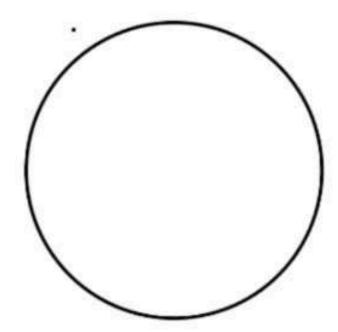
In 1970 eles mediram a velocidade de 67 regiões a 2-24kpc de distância do centro da M31 (Andromeda). In 1980 mediram a curva de rotação de 21 galáxias.





V. Rubin et al, Astrophys.J. 159 (1970) 379-403V. Rubin et al, Astrophys.J. 238 (1980) 471

Farinaldo Queiroz, UFRN

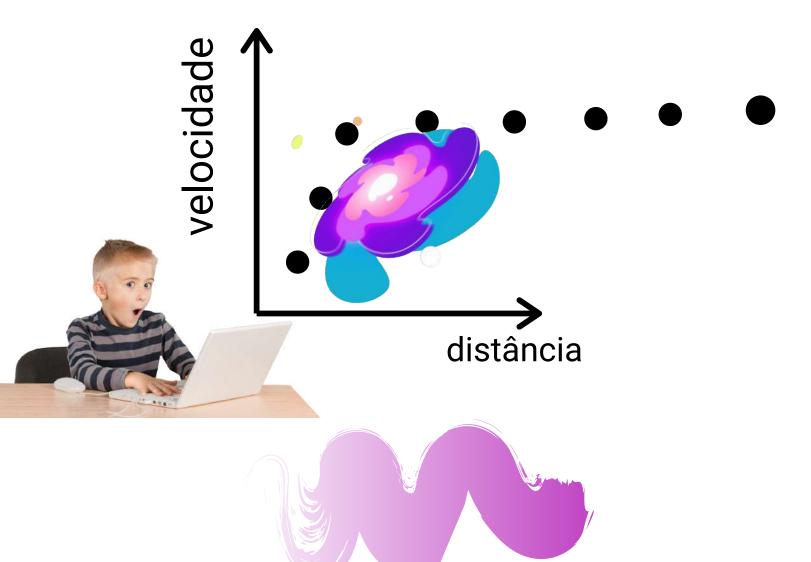


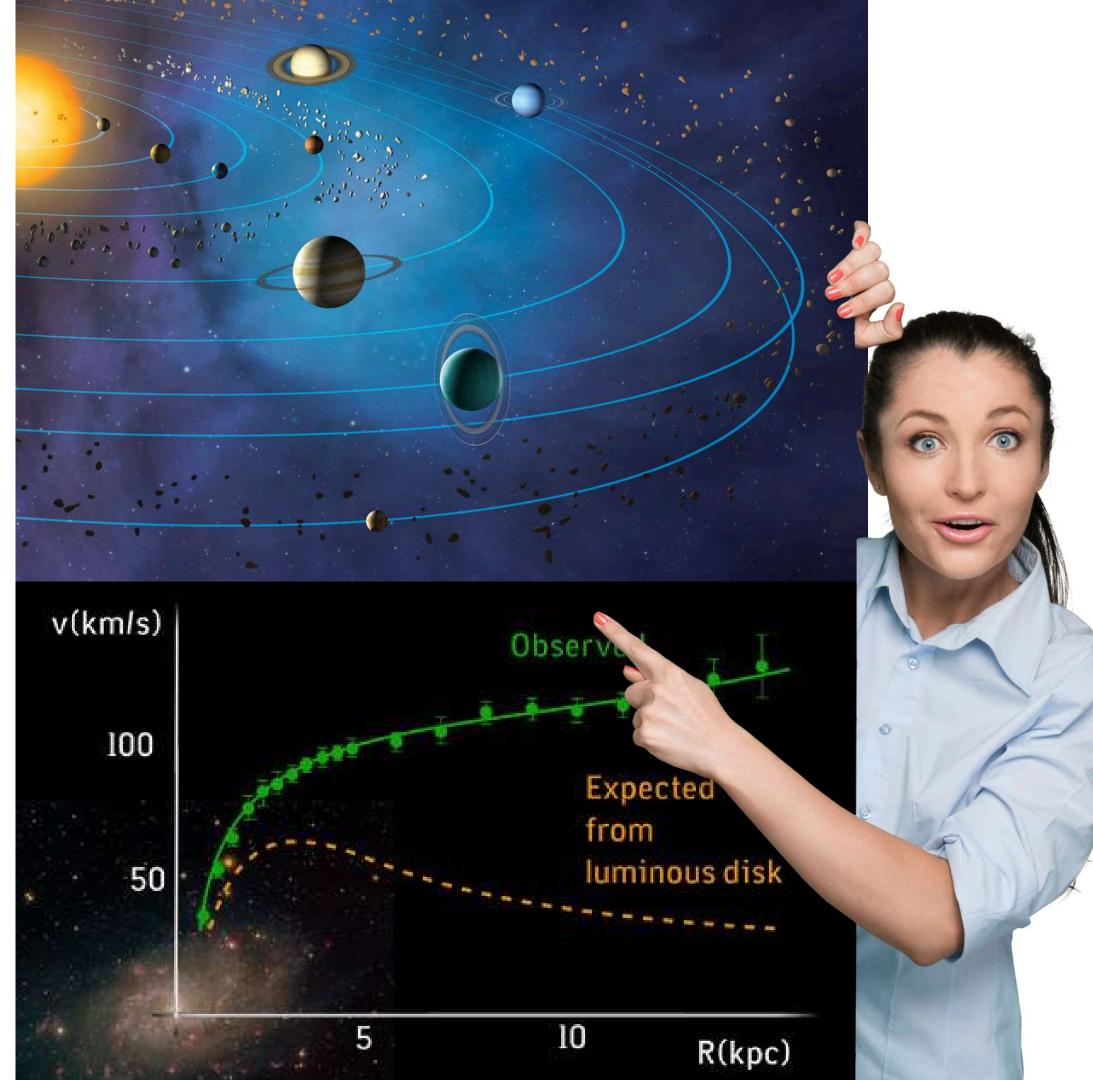
O que está escrito nas estrelas?

Força Centrípeta = Força Gravitacional

$$m\frac{v^2}{R} = \frac{GMm}{R^2}$$

$$v \propto \frac{1}{\sqrt{R}}$$



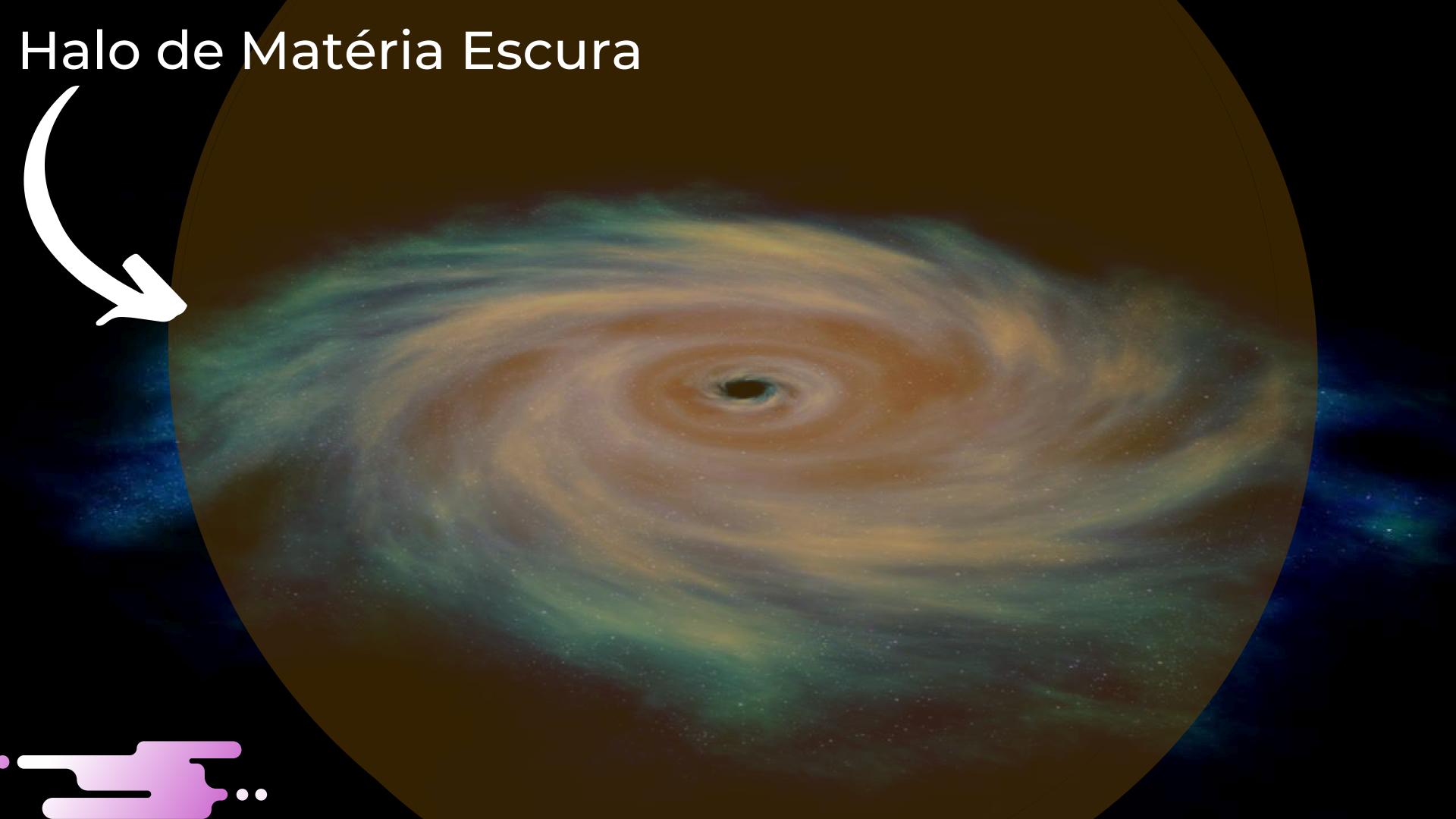






Arealidade







Evidência 2

Cosmic Microwave Background

Cosmic Microwave Background

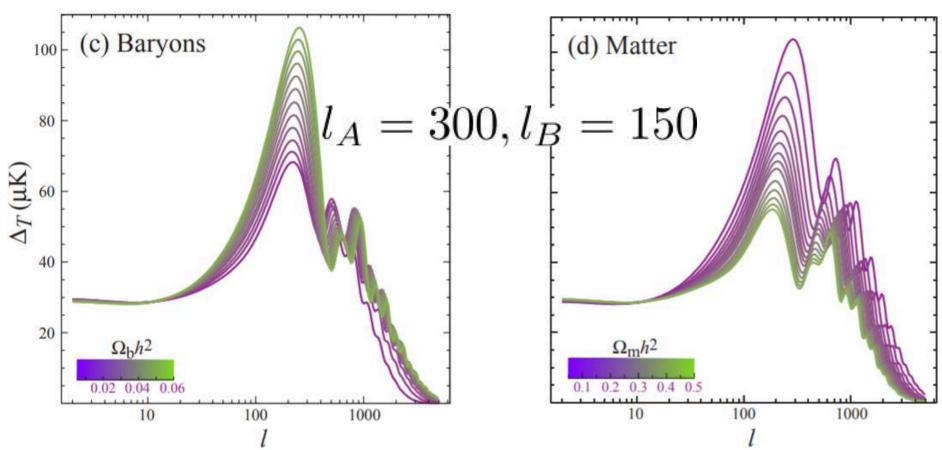


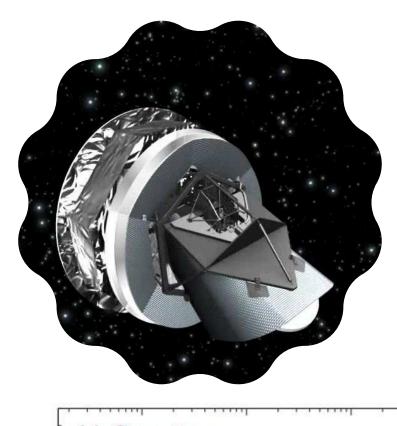


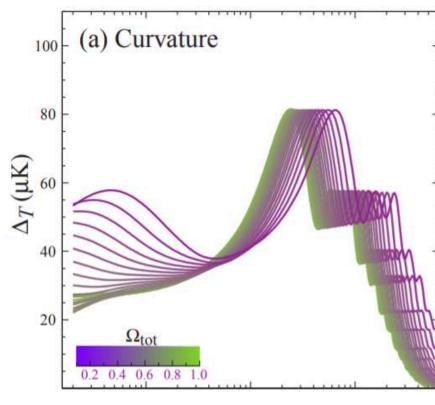
Precisamos de Matéria Escura

PLANCK Collaboration arXiv:1807.06209

$$\frac{\Delta l_A}{l_A} \propto -0.24 \frac{\Delta \Omega_m}{\Omega_m} - 1.1 \frac{\Delta \Omega_{tot}}{\Omega_{tot}} \qquad \frac{\Delta l_B}{l_B} \propto 0.5 \frac{\Delta \Omega_m}{\Omega_m} - 1.1 \frac{\Delta \Omega_{tot}}{\Omega_{tot}}$$





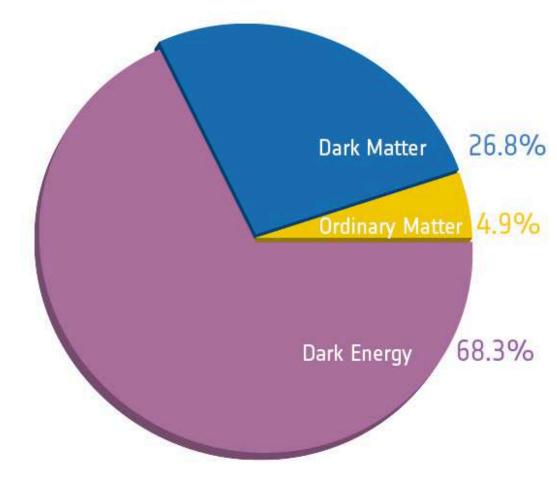


W. Hu, Annals Phys. 303 (2003) 203-225

Os dados exigem Matéria Escura

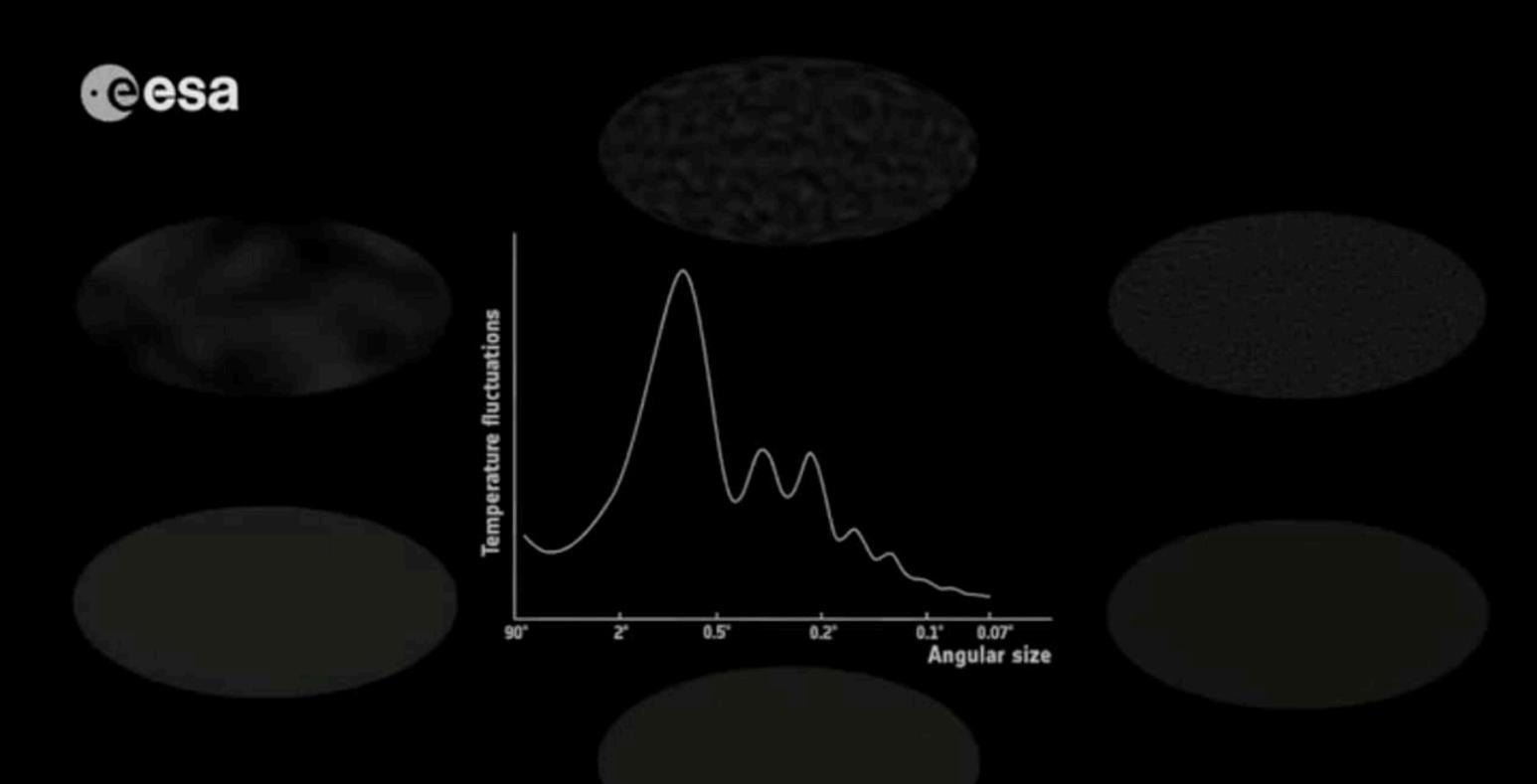
PLANCK Collaboration arXiv:1807.06209

$$\frac{\Delta l_A}{l_A} \propto -0.24 \frac{\Delta \Omega_m}{\Omega_m} - 1.1 \frac{\Delta \Omega_{tot}}{\Omega_{tot}}$$

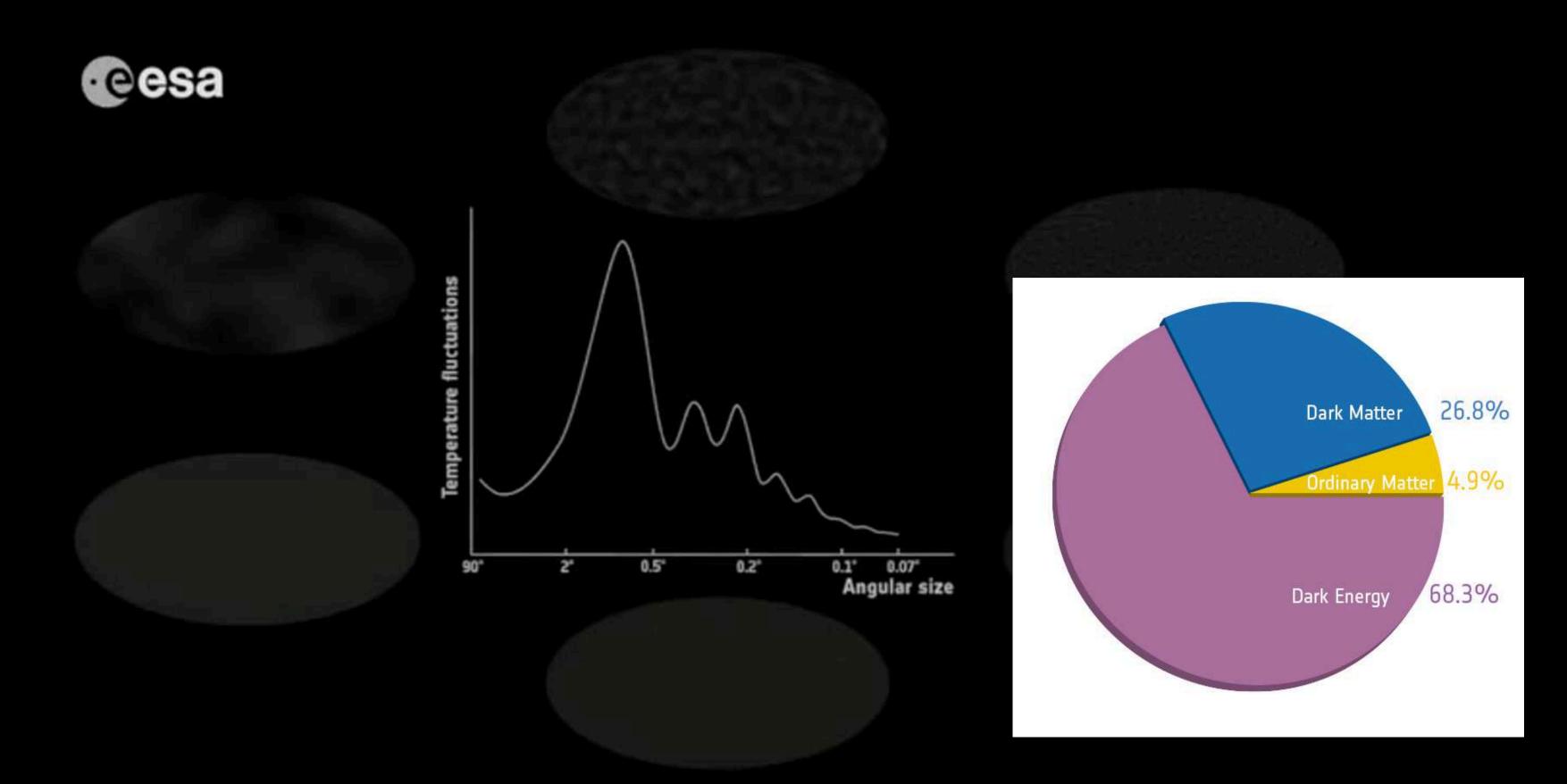




GENTE! EU ESTOU FALANDO QUE AO DETECTAR LUZ EU CONSIGO DIZER TUDO QUE TEM NO UNIVERSO!



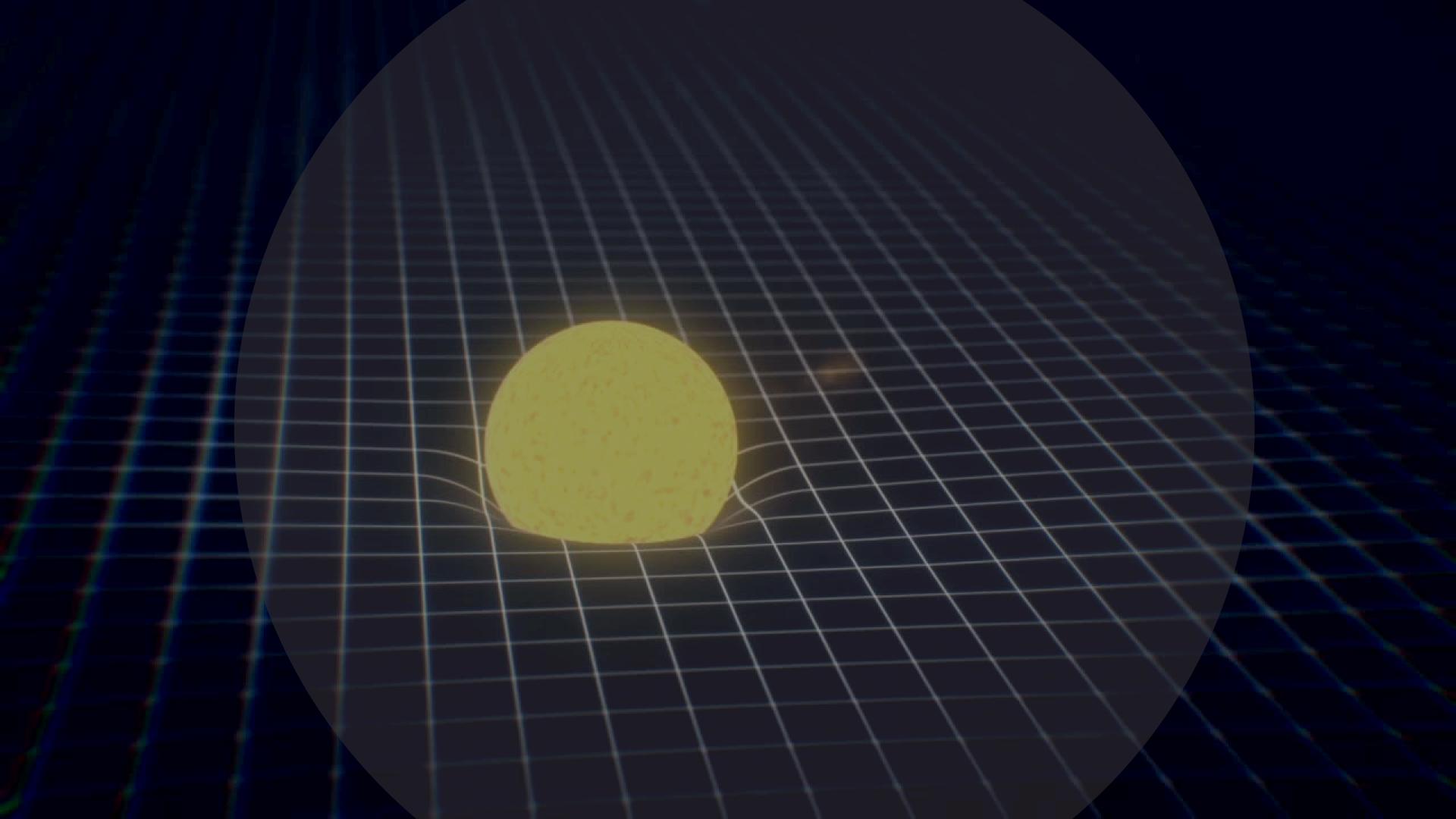
GENTE! EU ESTOU FALANDO QUE AO DETECTAR LUZ EU CONSIGO DIZER TUDO QUE TEM NO UNIVERSO!





Evidência 3

Lentes Gravitacionais

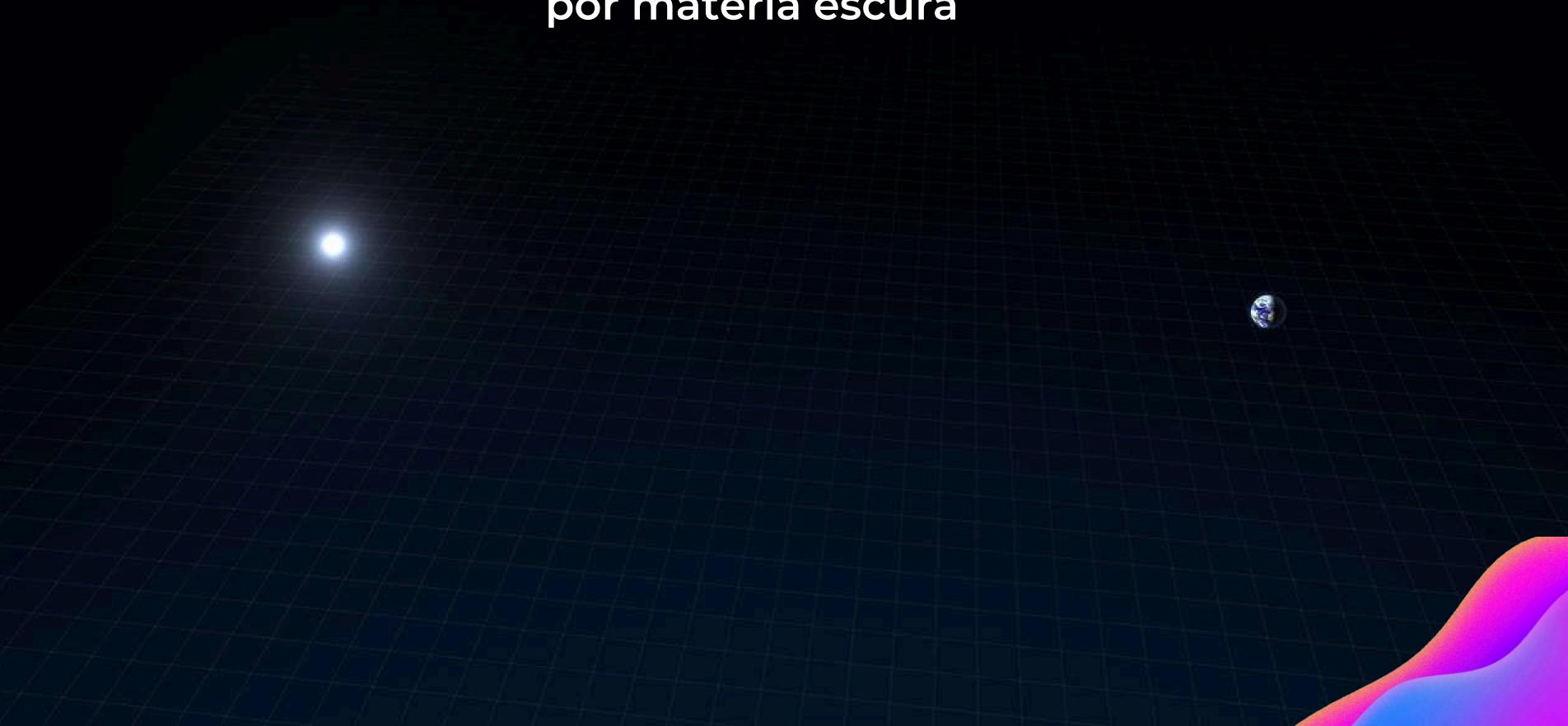


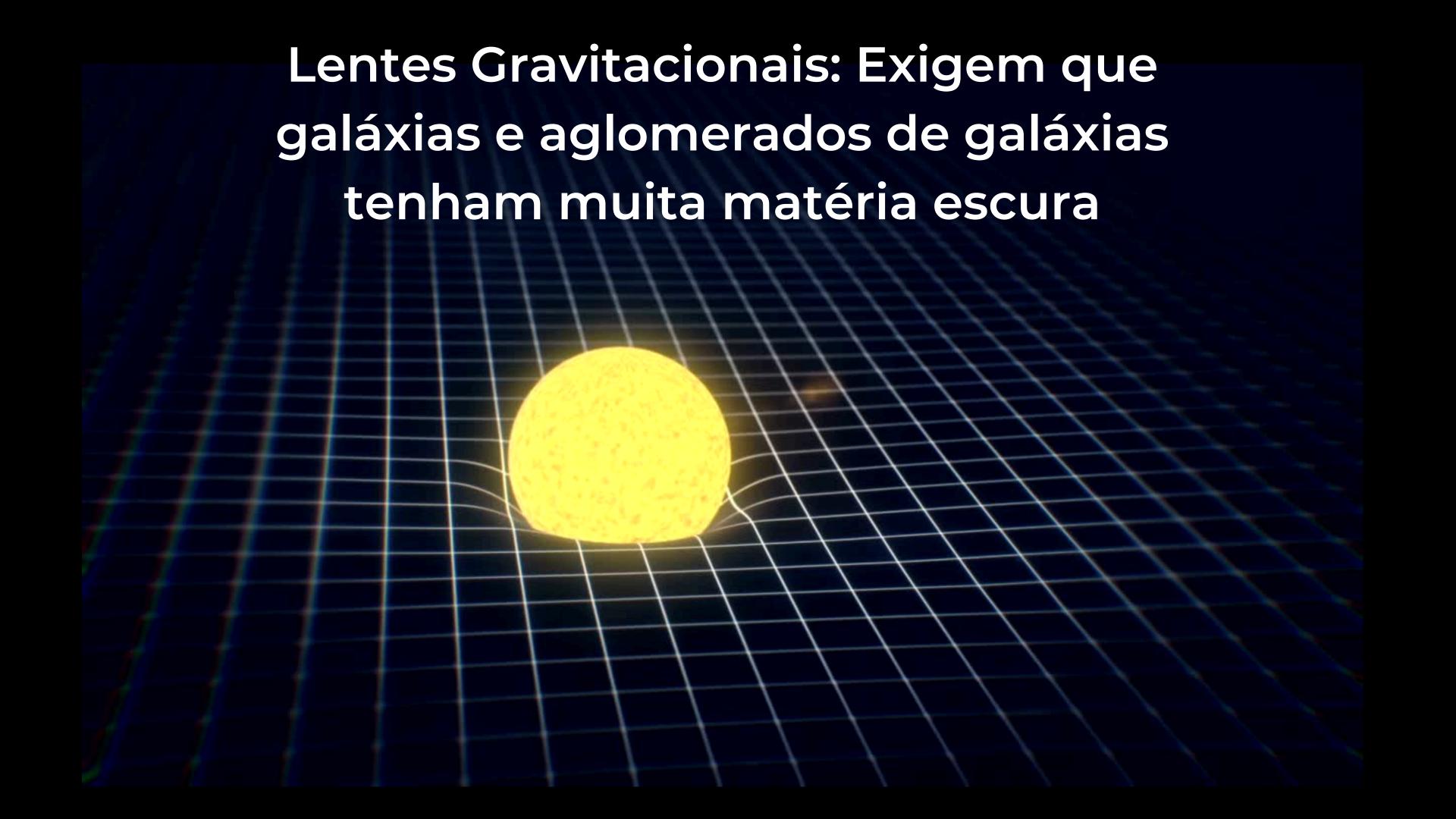




No dia 29 de maio de 1919, o céu amanheceu nublado sobre <u>a cidade cearense de Sobral</u>, a 230 quilômetros da capital, Fortaleza. Tivesse o Sol permanecido encoberto, o esforço da comitiva de astrônomos teria sido em vão. Perderiam o eclipse total e a chance de provar que as ideias de Albert Einstein eram corretas.

Lentes Gravitacionais: Exigem que galáxias e aglomerados de galáxias sejam dominados por matéria escura

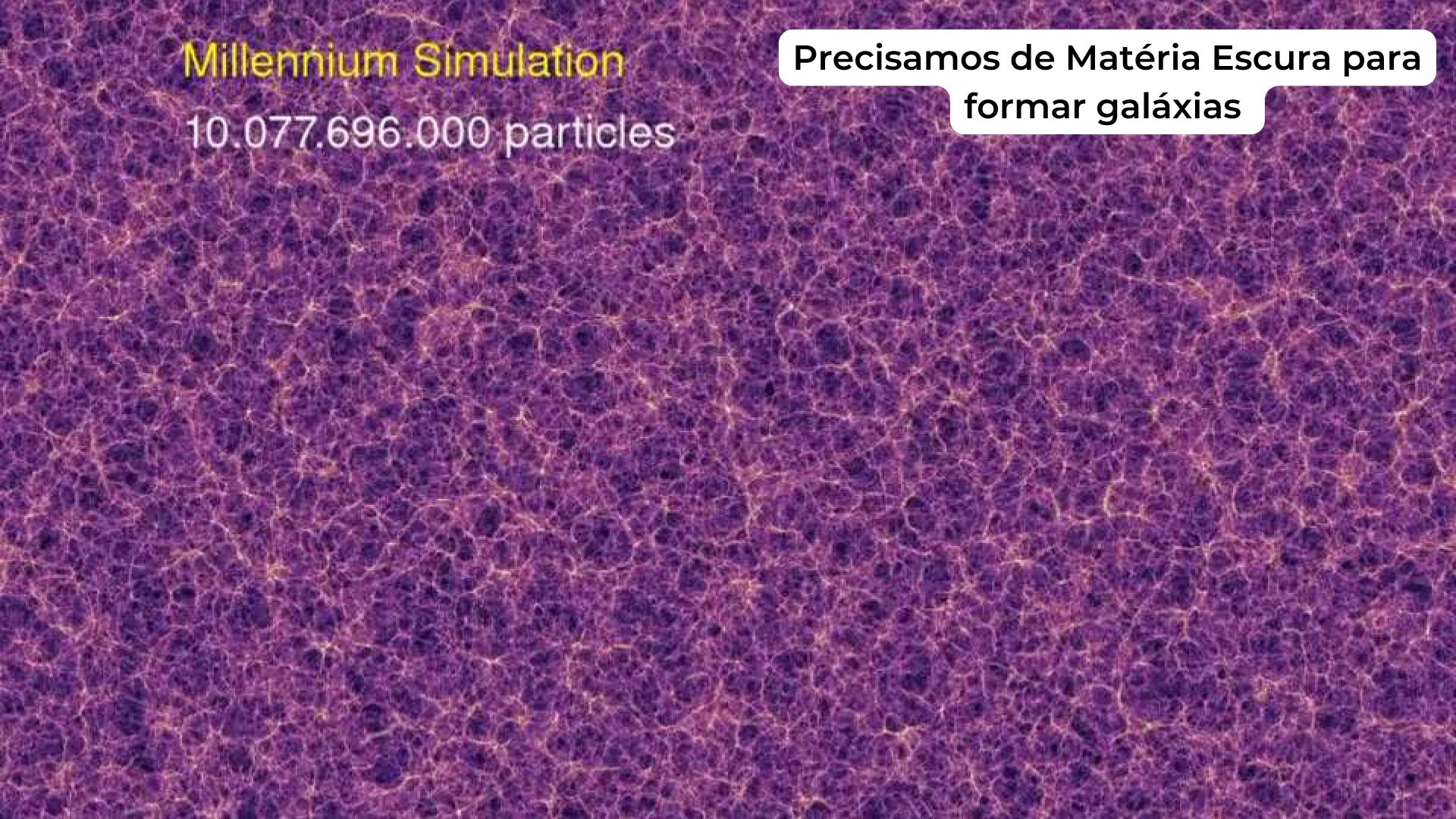






Evidência 4

Formação de Estruturas



Poderia uma teoria alternativa da gravidade substituir Matéria Escura





Teorias da Gravidade Substituindo Matéria Escura

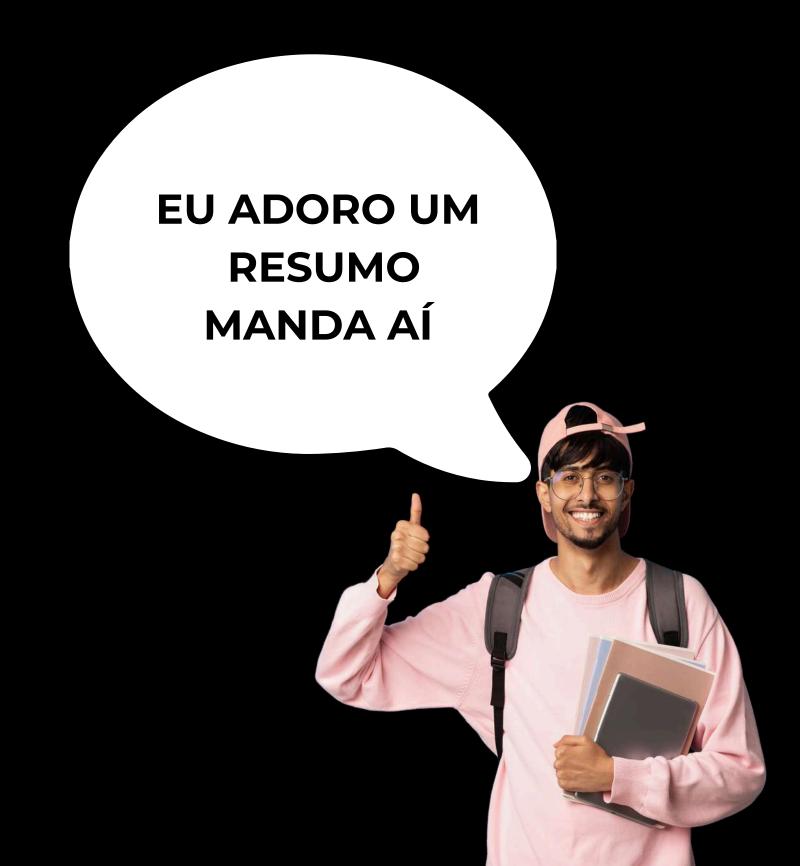


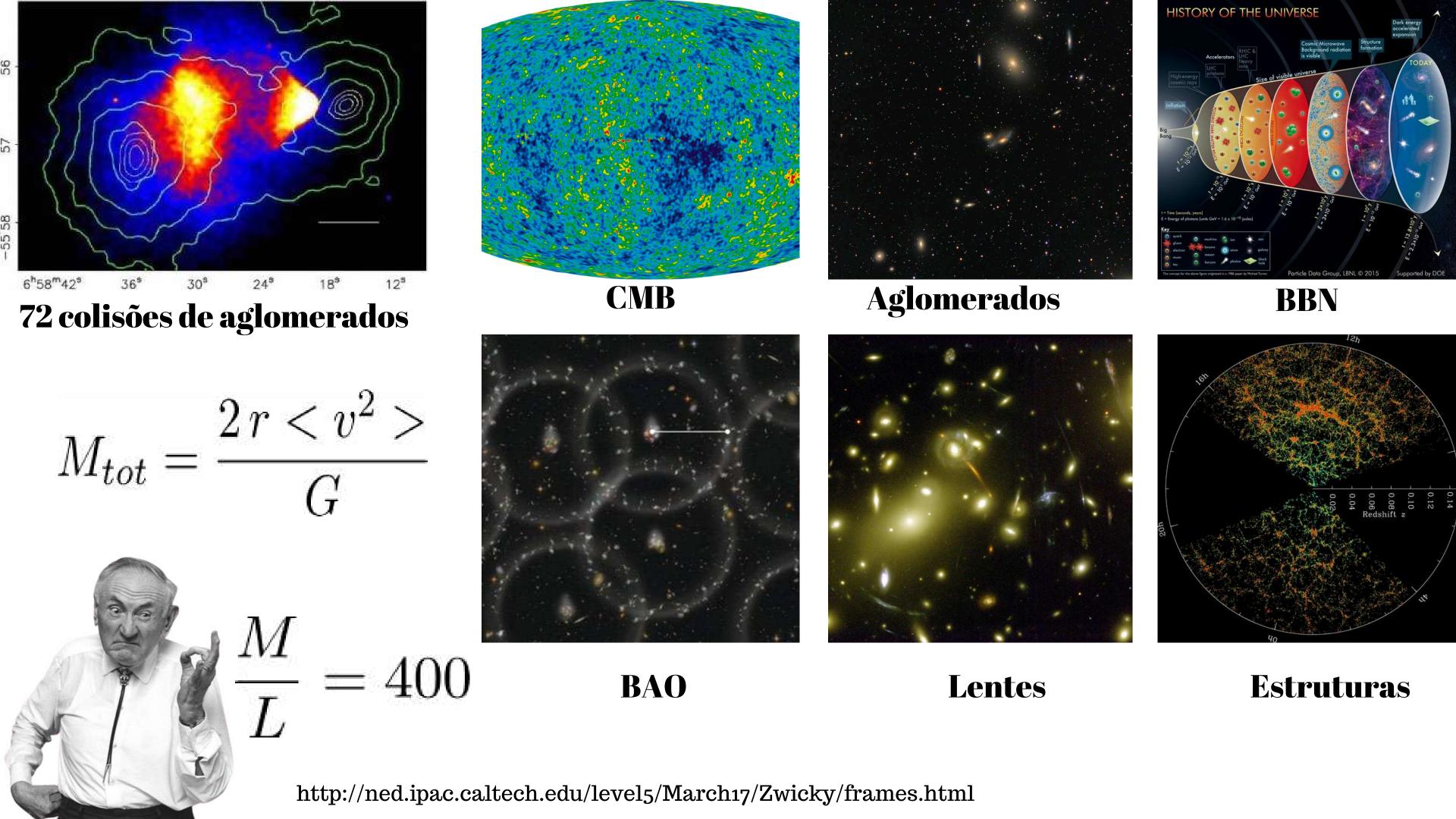
BASTARDOS ESFÉRICOS



"Zwicky was anything but conventional. In addition to his brilliant insights that turned out to be right, he also entertained notions that were merely eccentric. To his senior colleagues he could be arrogant and abrasive. He referred contemptuously to "the useless trash in the bulging astronomical journals." He once said, "Astronomers are spherical bastards. No matter how you look at them they are just bastards." Curriculum Collection.

RESUMO





abundante

Fracamente interagente

Não tem carga elétrica

forma estruturas

RESUMO