



Somos todos  
**PARAÍBA**  
Governo do Estado



MINISTÉRIO DA  
CIÊNCIA, TECNOLOGIA  
E INOVAÇÃO



# Astro, CosmoS e o Telescópio BINGO/ABDUS

João Rafael L Santos

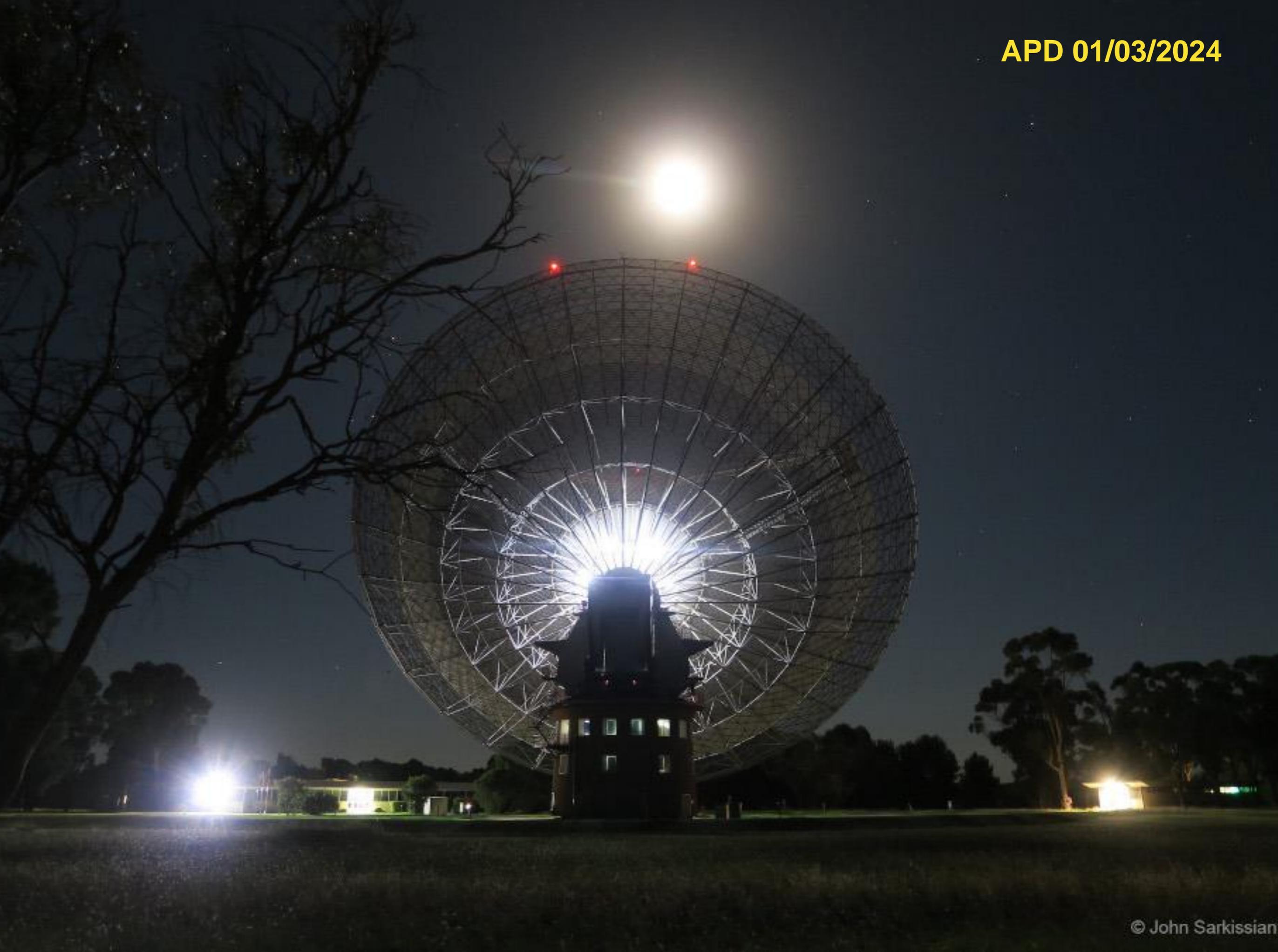
BINGO / Unidade Acadêmica de Física UFCG

Fórum de Internacionalização Paraíba Sem Fronteiras

2024



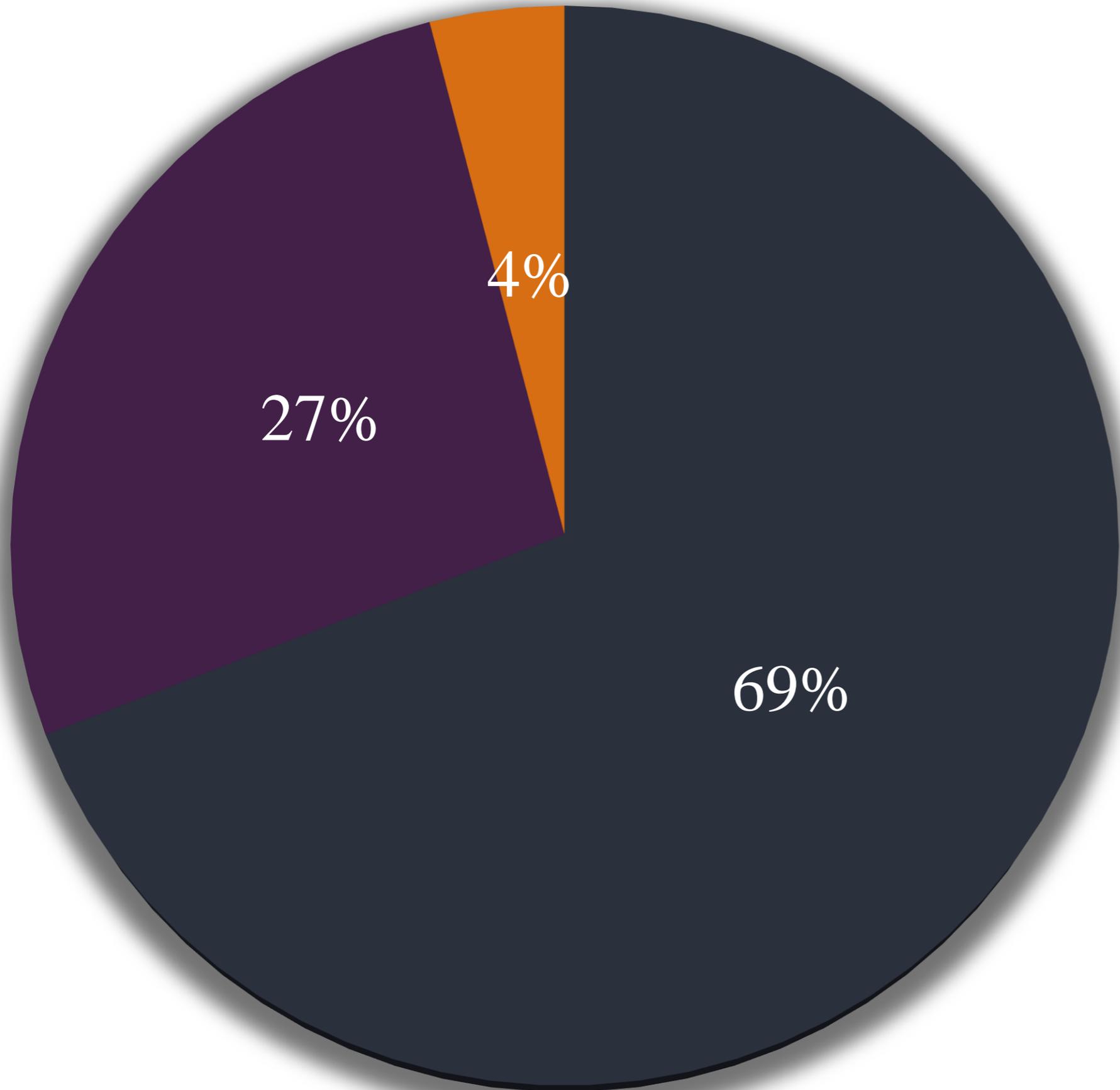
APD 01/03/2024



A visualization of the cosmic web, showing a complex network of blue filaments and clusters of galaxies against a black background. The filaments are interconnected, forming a web-like structure that spans the entire frame. The galaxies are represented as small blue dots and larger, more diffuse blue clouds, primarily concentrated along the filaments and at their intersections.

# the formation of the universe

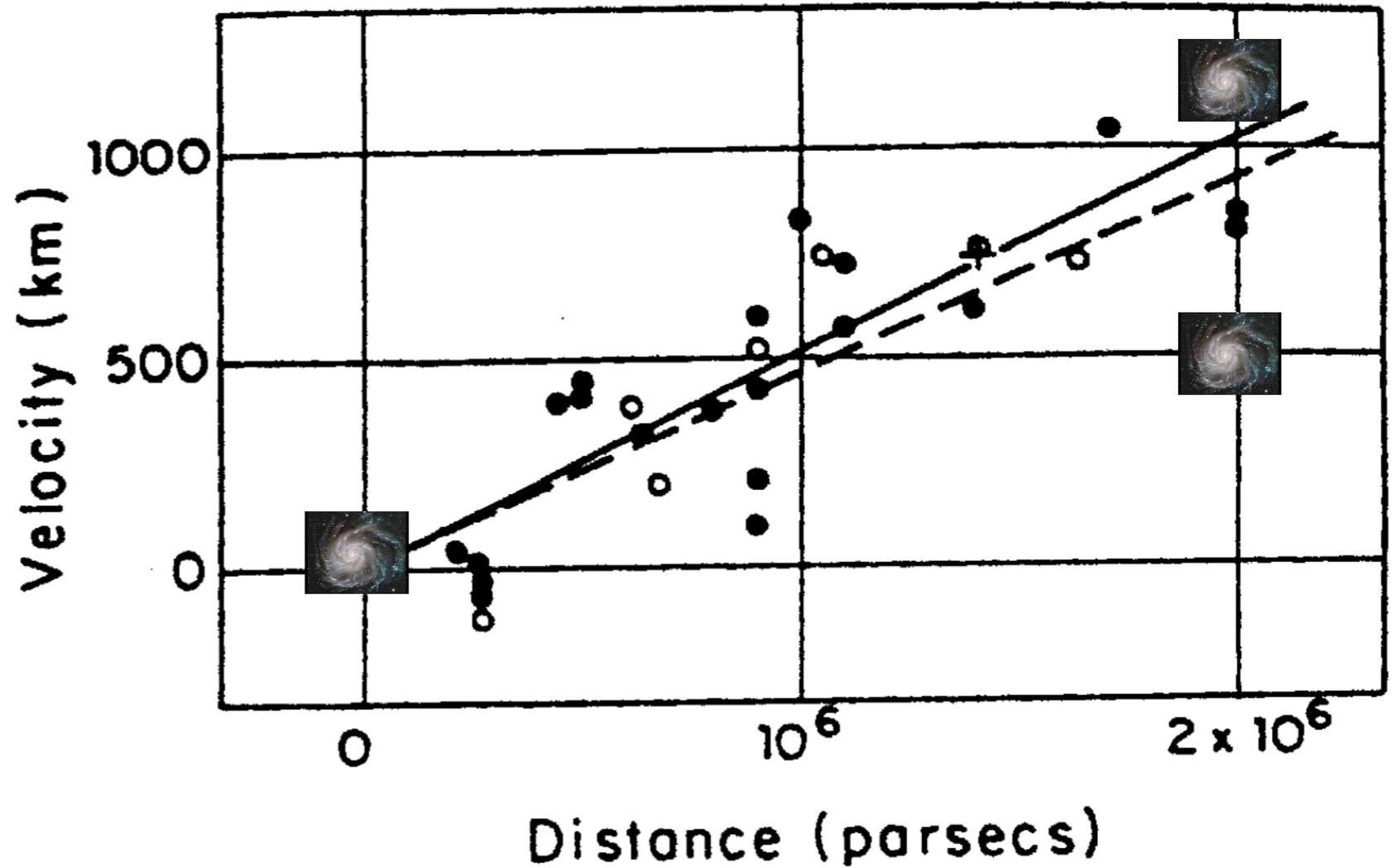
Time since the Big Bang: 1.1 billion years



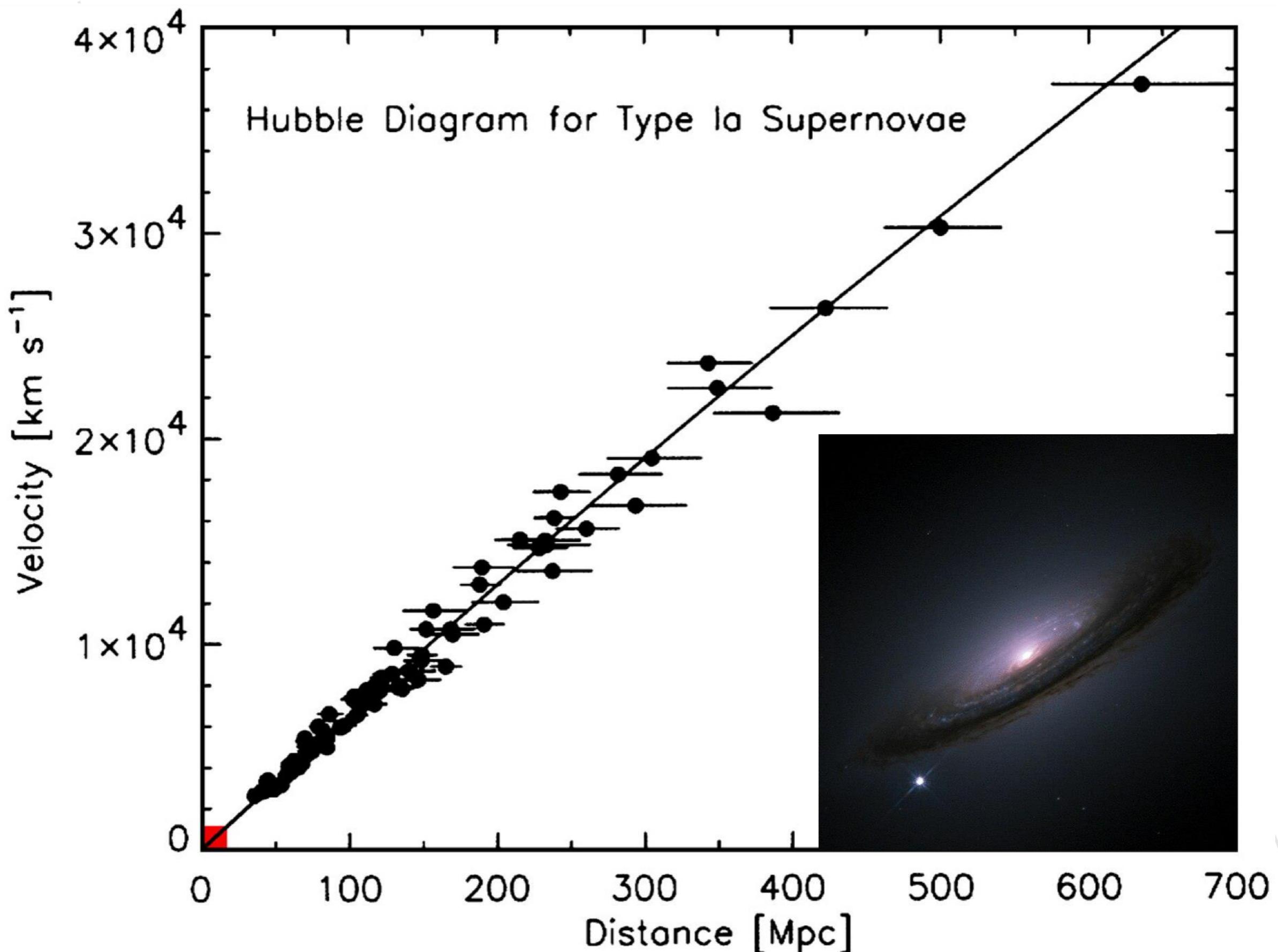
- Energia Escura
- Matéria Escura
- Matéria Bariônica



# Lei de Hubble



PNAS 15 (3), 168 (1929).



white dwarf mass



## Hubble's Law

$$v = H_0 d$$

$v$  = recession velocity in km/sec

$d$  = distance in Mpc

$H_0$  = expansion rate today (*Hubble Parameter*)

In words:

The more *distant* a galaxy, the *faster* its recession velocity.

$$H_0 = 71 \frac{\text{km} / \text{s}}{\text{mpc}} = 2.3 \times 10^{-18} \text{ s}^{-1}$$

$$t = \frac{1}{H_0} = 13.8 \times 10^9 \text{ years}$$

# Gravity Slows Down Universe

Accelerometer



Speedometer



Chronometer

0.00 billion years







# Faça o seu em casa



SMA Male



4G/Antenna

GWS 4G LTE Antena 10dbi SMA Macho Aéreo 698-960/1700 2700Mhz base magnética IOT 3M Otário Antena modem s roteador repetidor

★★★★★ 5.0 1 avaliação 31 Vendidos

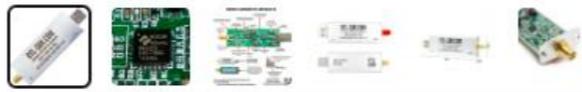
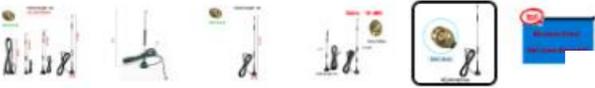
**R\$21,14** ~~R\$24,85~~ 15% desc.

2% off extra

**R\$5,16 desc.**  
Desconto na Loja

**3% desc.**  
Desconto na Loja

cor: 1PCS 22CM



Choice Frete grátis · Devolução gratuita

Rádio Definido por Software, Lista de Dongles Apenas, Frequências até 3.2 MHz, RTL SDR, V3, RTL2832U, 1PPM, TCXO, HF, SMA

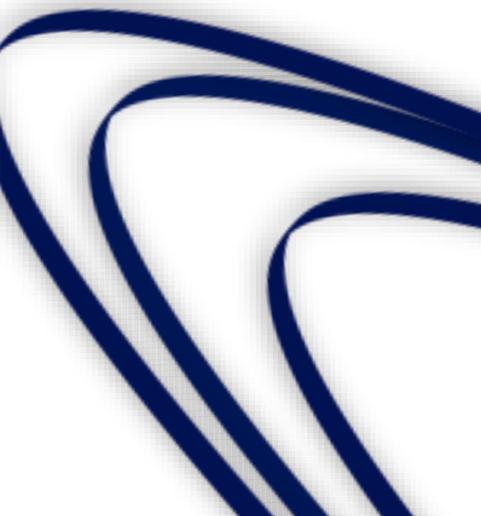
6 Vendidos

**R\$146,17** ~~R\$417,63~~ 65% desc.

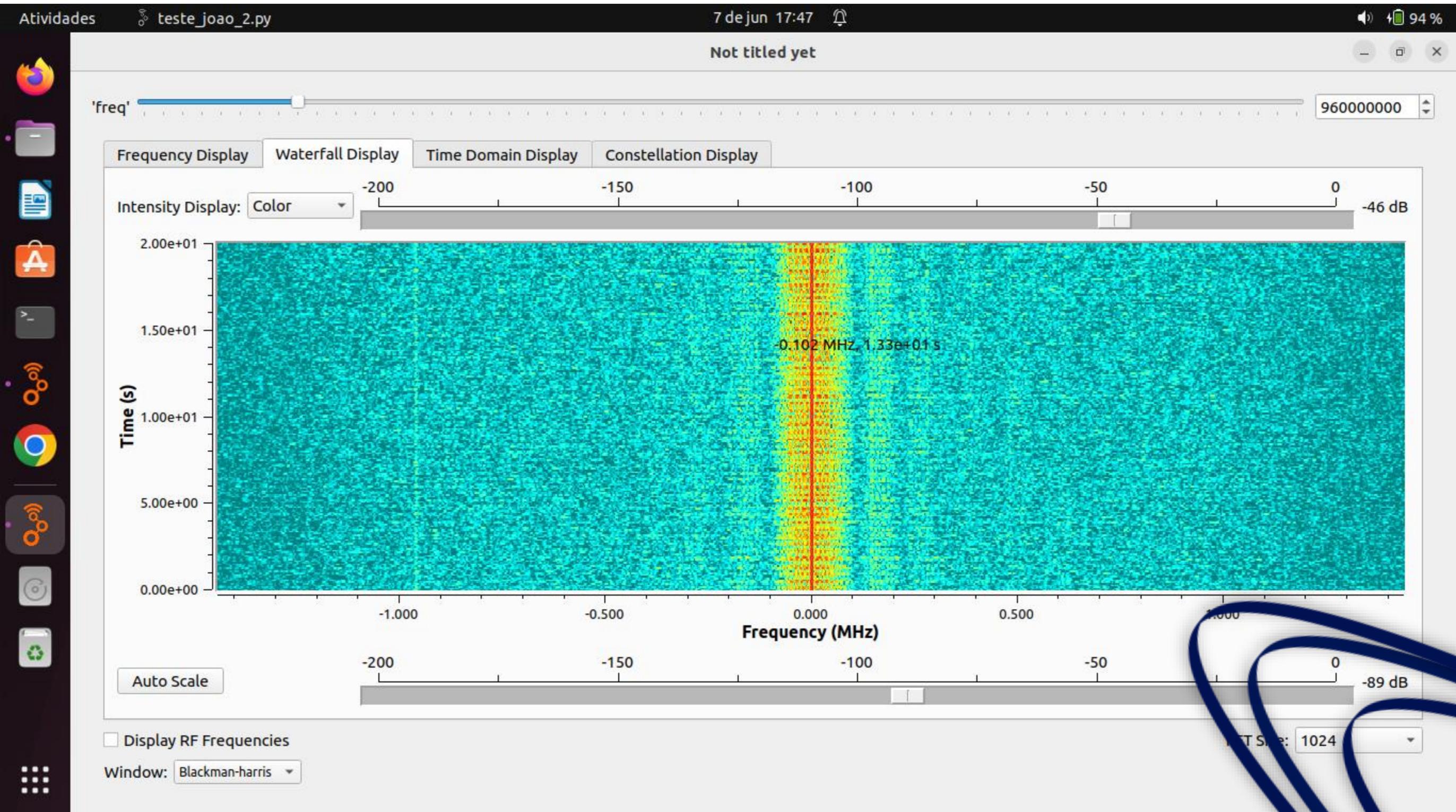
2x R\$73,81 com juros Saiba Mais

Ganhe um cupom de 8% off

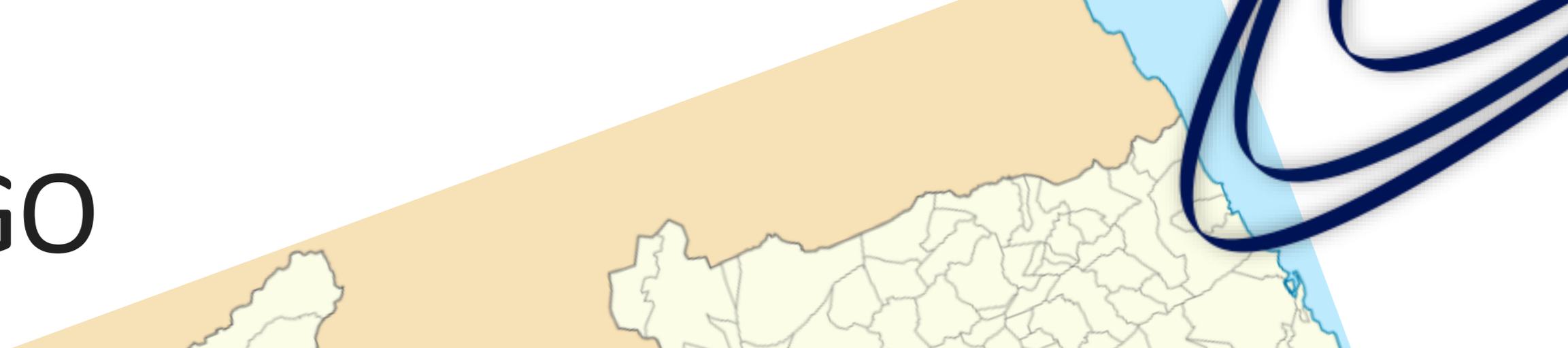
Color: White



# Gnuradio



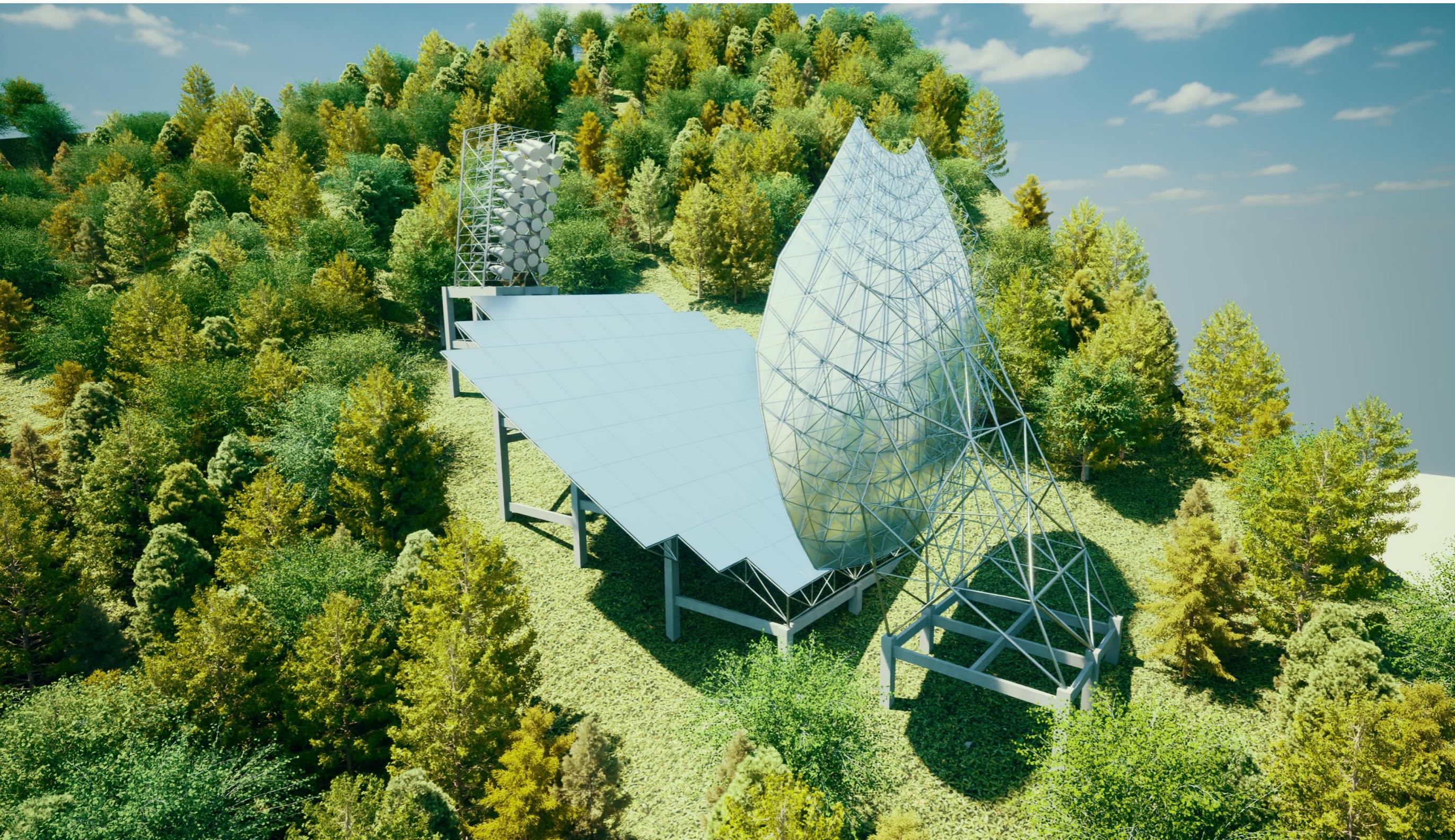
**BINGO**



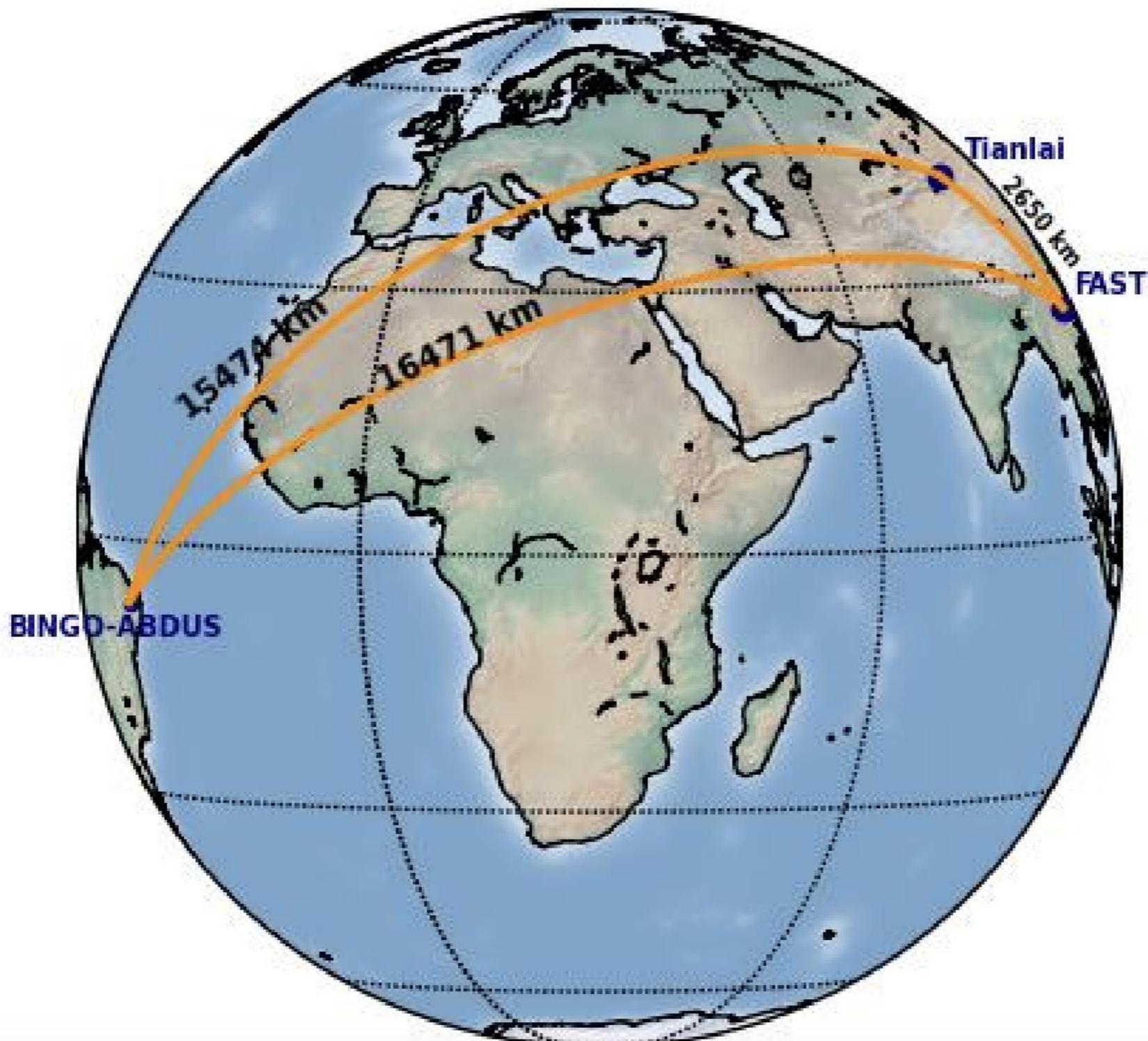
# BINGO: Baryon acoustic oscillations from Integrated Neutral Gas

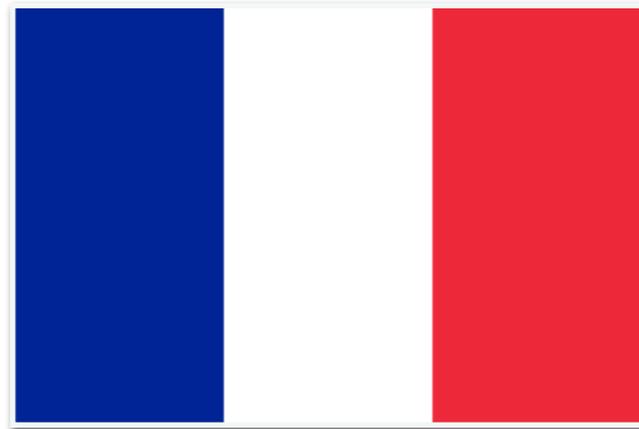
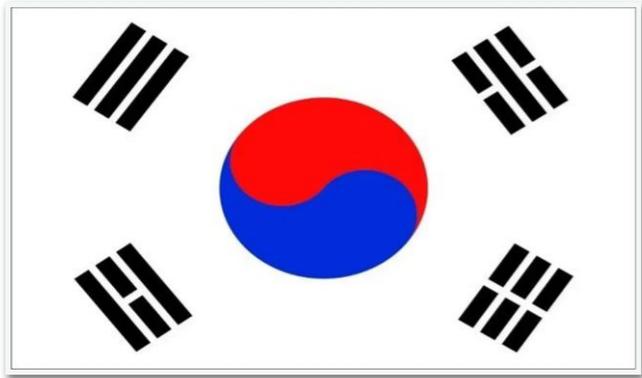


# BINGO: Baryon acoustic oscillations from Integrated Neutral Gas

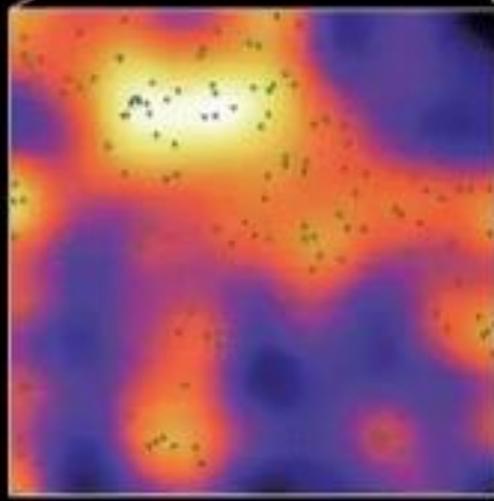
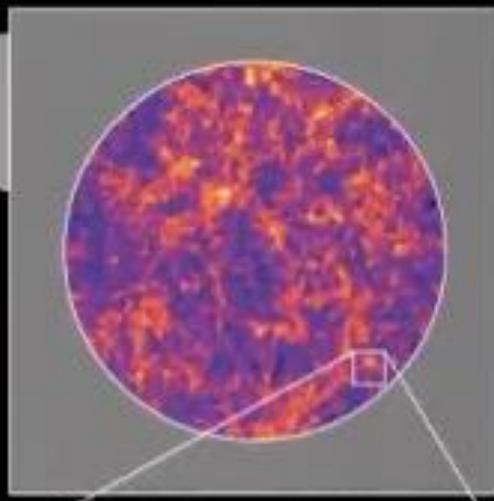
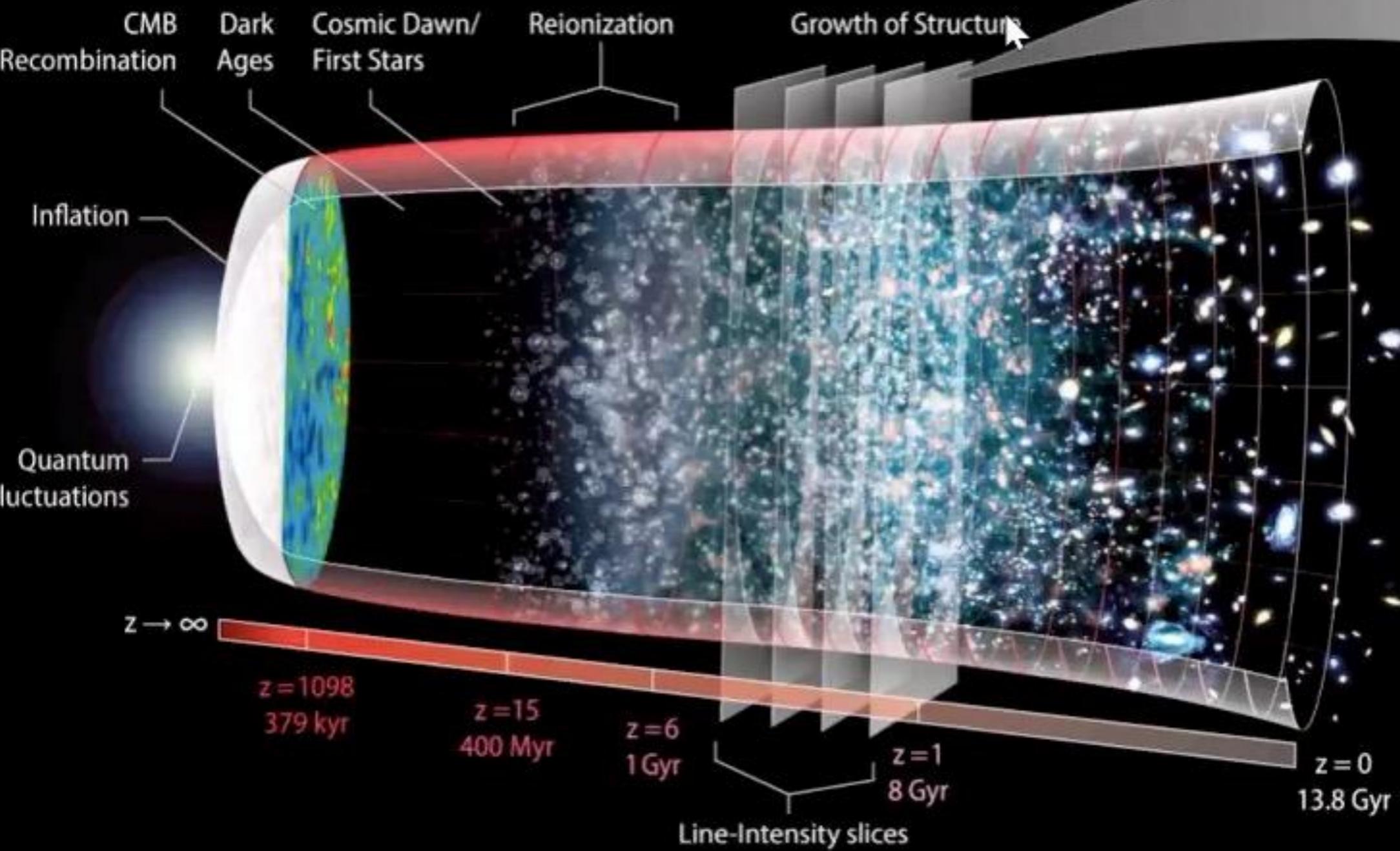


# BINGO/ABDUS



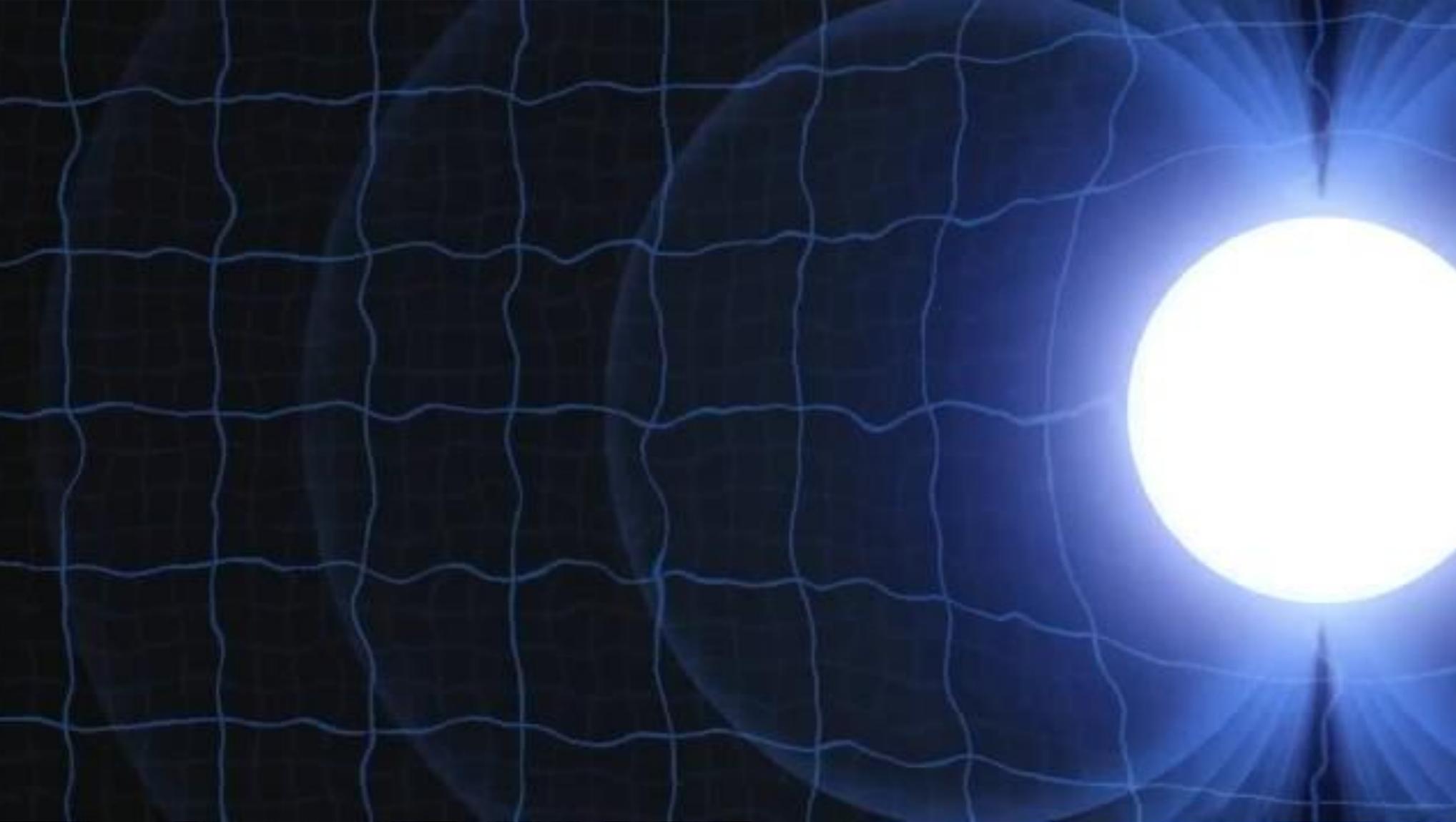


# Line Intensity Mapping (LIM)

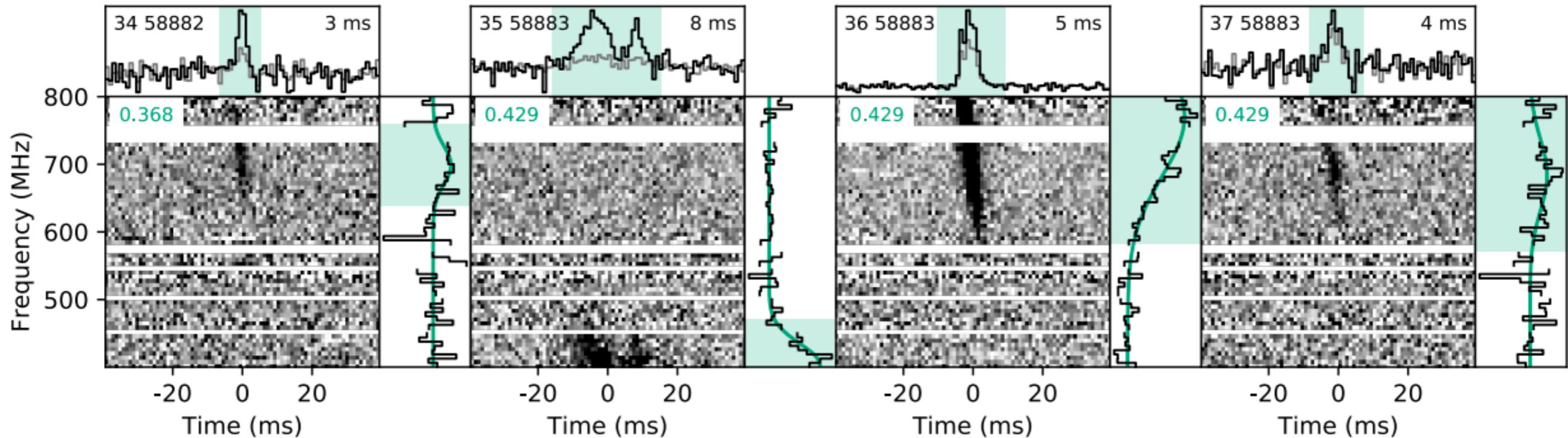


Line-Intensity Mapping simulation with galaxy distributions

# Uirapuru



# FRB

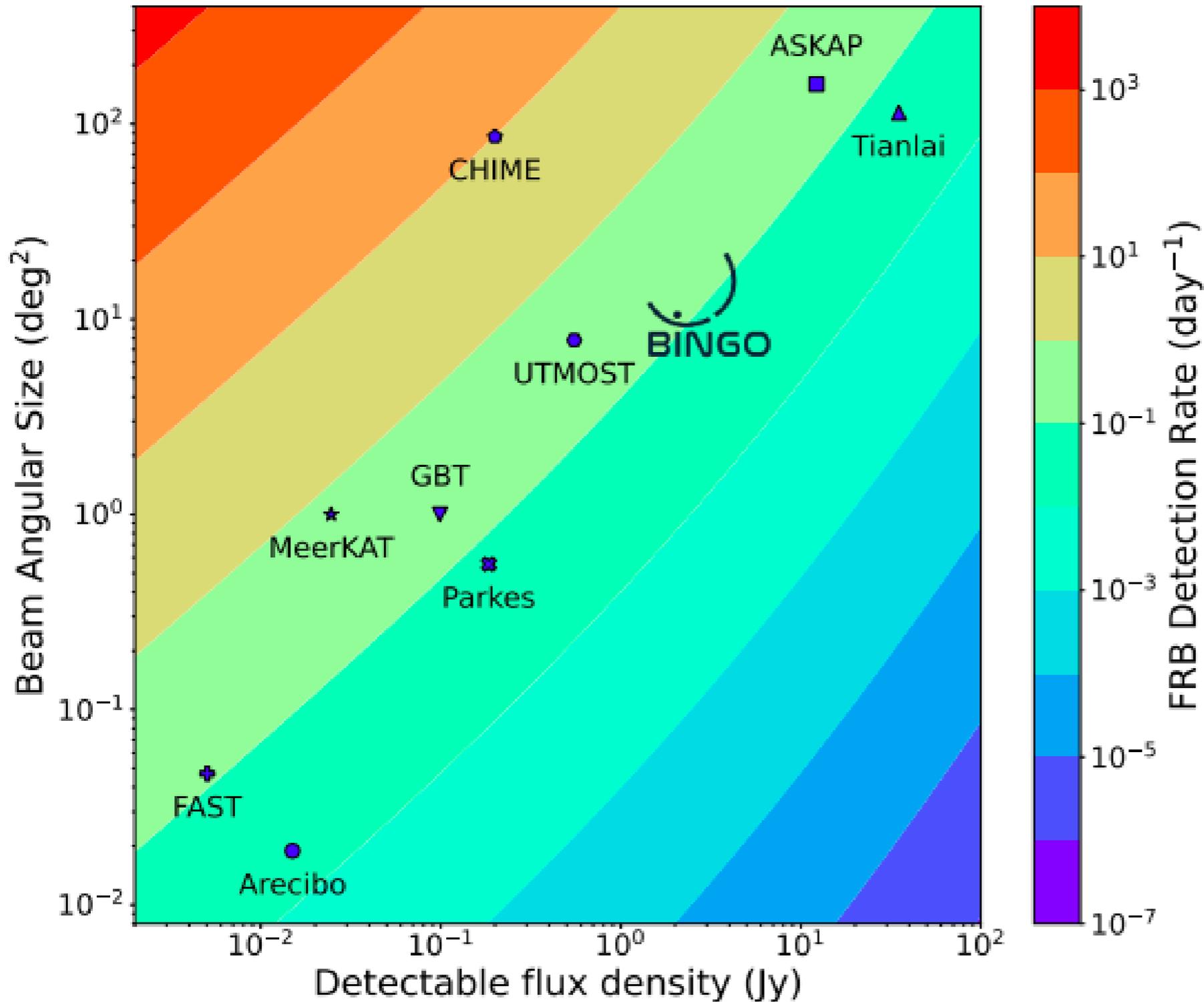


**CHIME, Nature 582, 351 (2020)**



*Equivalem a um trilhão de toneladas de massa convertidos em energia pura ou 3 dias de produção de energia pelo Sol, ejetados em um milissegundo!*

# Uirapuru



# Mini Cornetas, ciência e divulgação

*freq 1485 MHz*

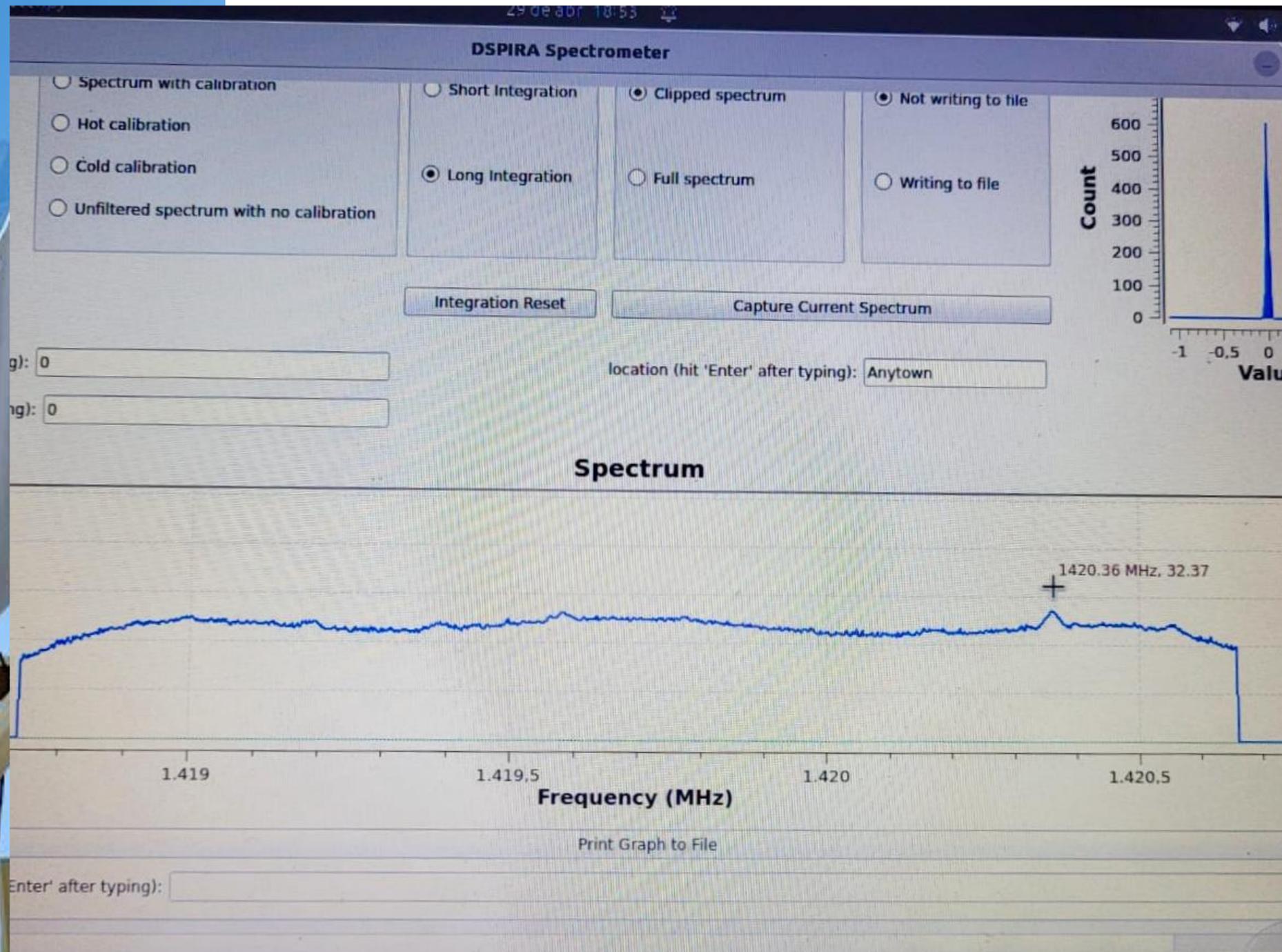
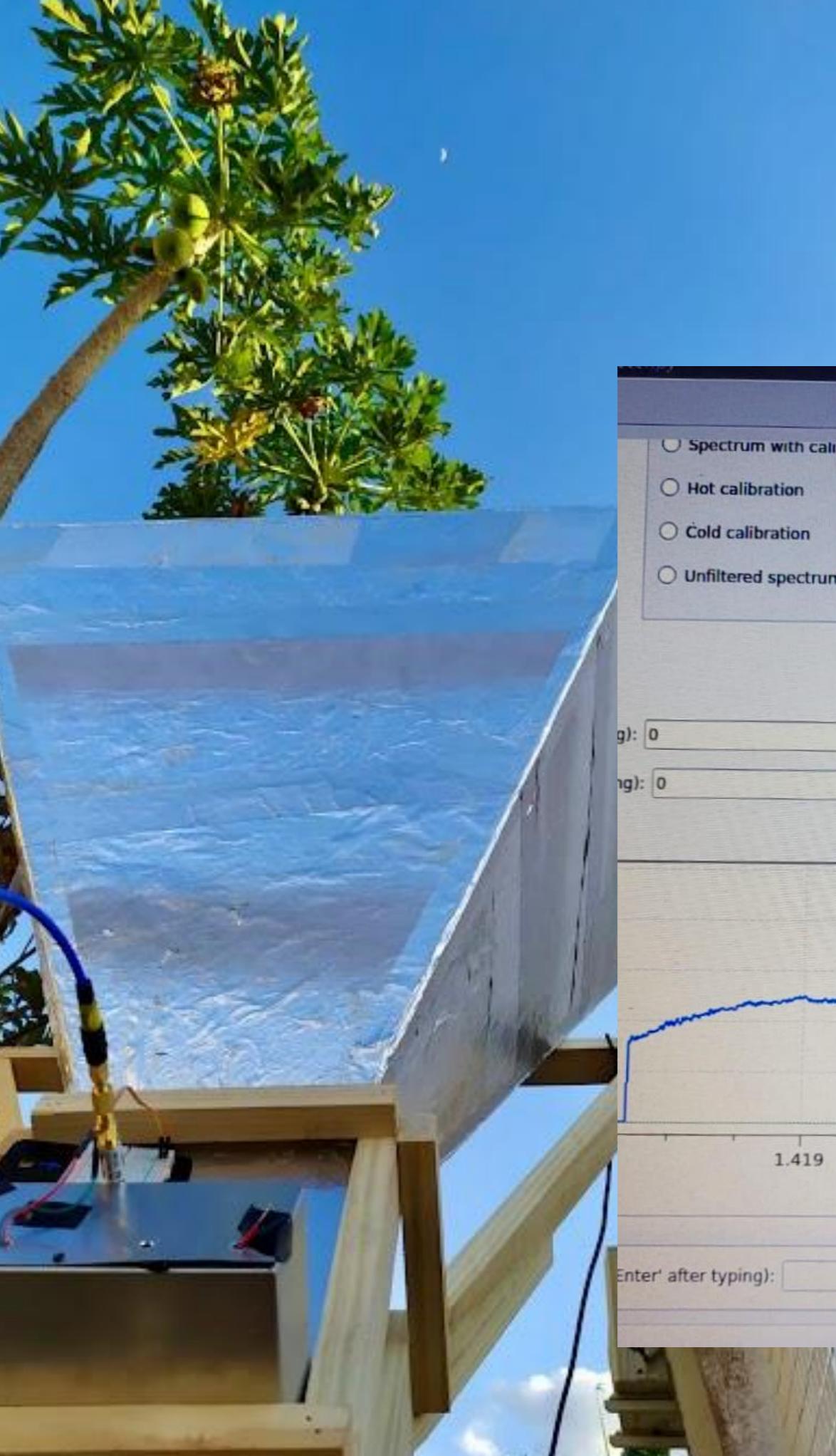
*$\lambda$  210 mm*

*Abertura A 754 mm*

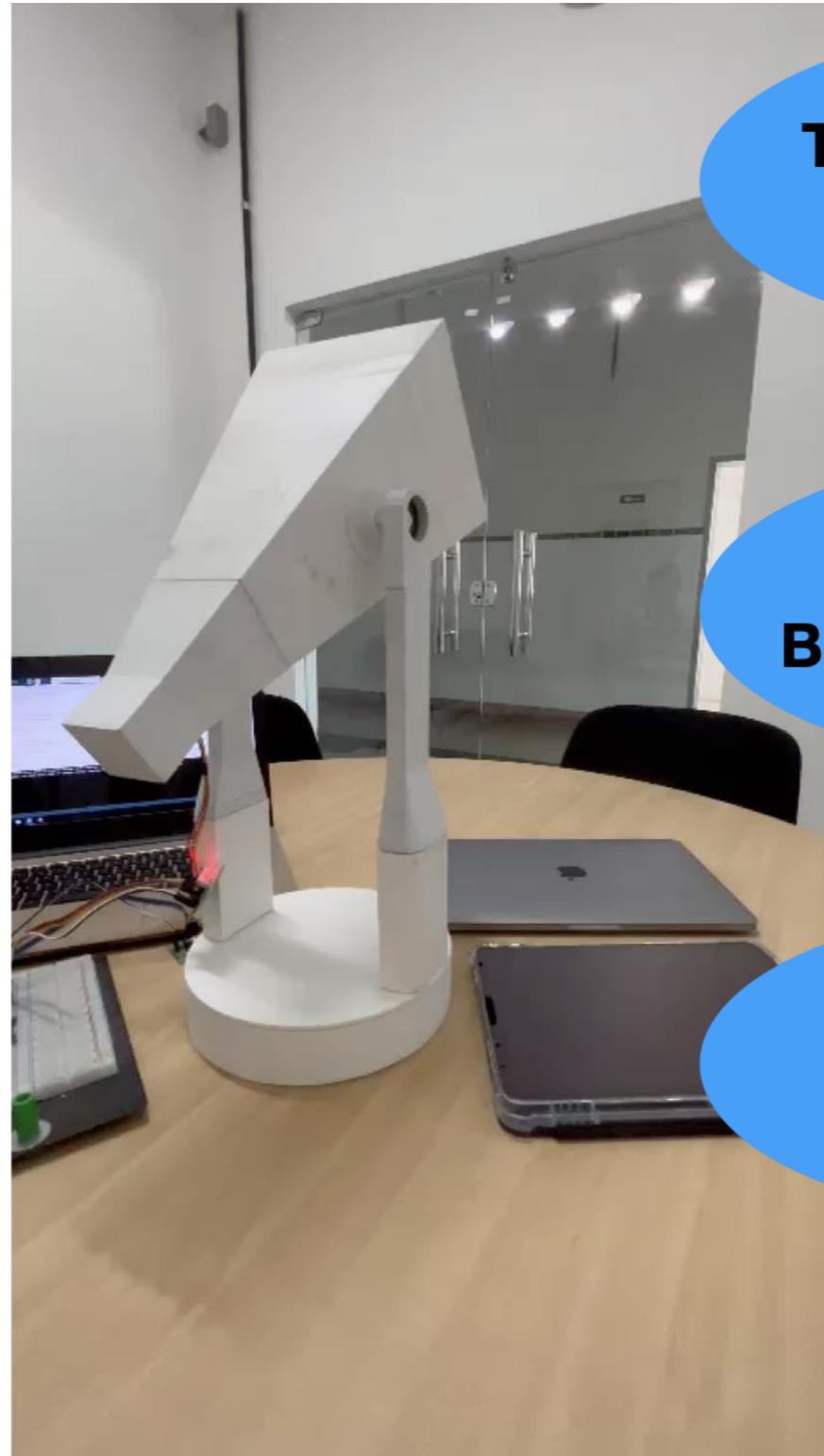
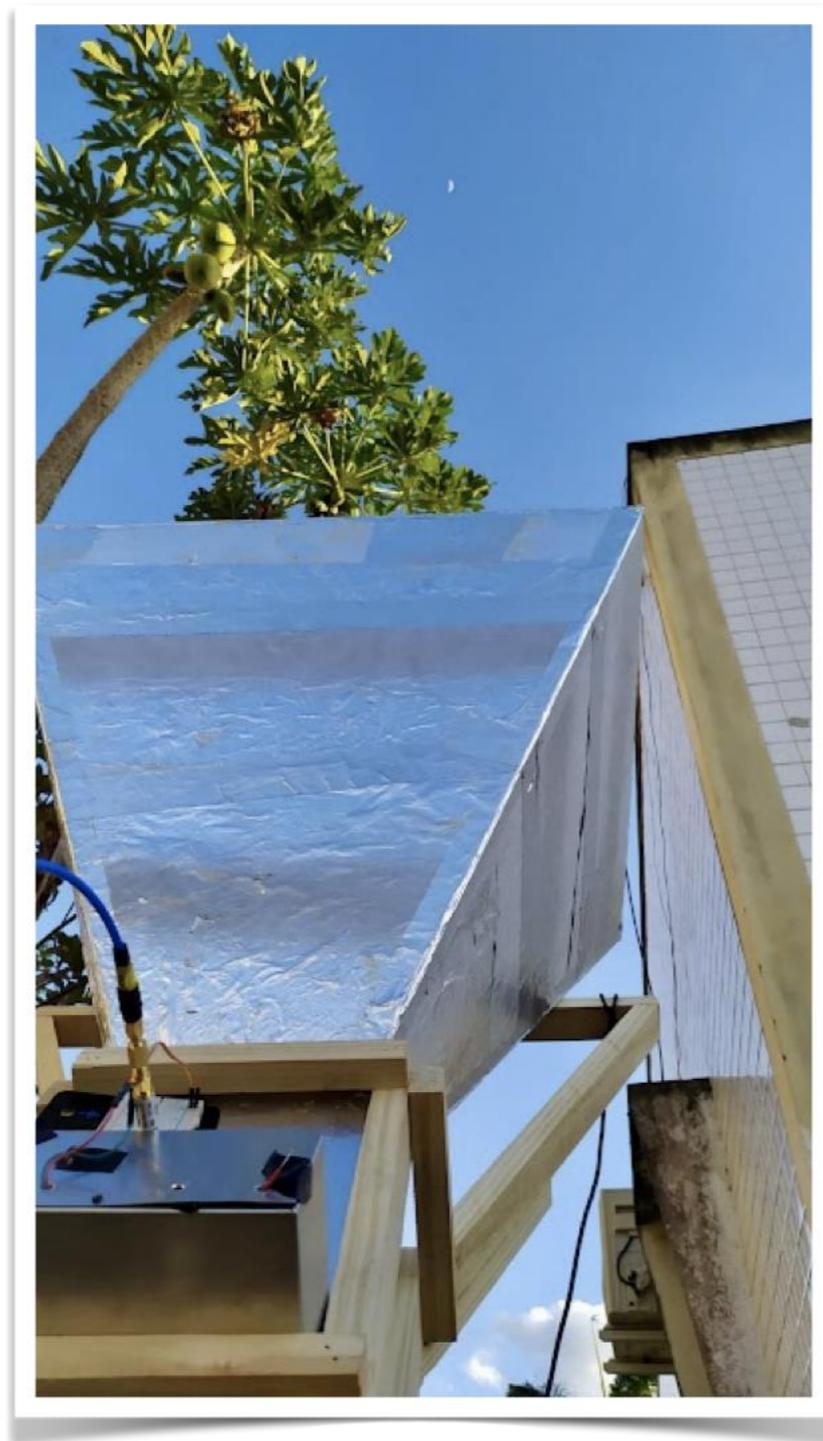
*Abertura B 597 mm*

*Ganho  $\approx$  18 dB*





# Extensão e Inovação



**The BINGO Radio Tracker**

**Patent INPI  
BR512024000407-6**

**IFPB + UFCG**

# Divulgação Científica



# Papers Astronomy & Astrophysics



## Core Papers

A series of 7 papers submitted to Astronomy & Astrophysics Journal describing the developments and status of the different parts of the BINGO project.

- The BINGO Project I: Baryon Acoustic Oscillations from Integrated Neutral Gas Observations, E. Abdalla et al. [ [arXiv:2107.01633](#) ]
- The BINGO Project II: Instrument Description, C. A. Wuensche et al. [ [arXiv:2107.01634](#) ]
- The BINGO Project III: Optical design and optimisation of the focal plane, F. B. Abdalla et al. [ [arXiv:2107.01635](#) ]
- The BINGO Project IV: Simulations for mission performance assessment and preliminary component separation steps, V. Liccardo et al. [ [arXiv:2107.01636](#) ]
- The BINGO Project V: Further steps in Component Separation and Bispectrum Analysis, K. Fornazier et al. [ [arXiv:2107.01637](#) ]
- The BINGO Project VI: Hi Halo Occupation Distribution and Mock Building, J. Zhang et al. [ [arXiv:2107.01638](#) ]
- The BINGO Project VII: Cosmological Forecasts from 21-cm Intensity Mapping, A. A. Costa et al. [ [arXiv:2107.01639](#) ]

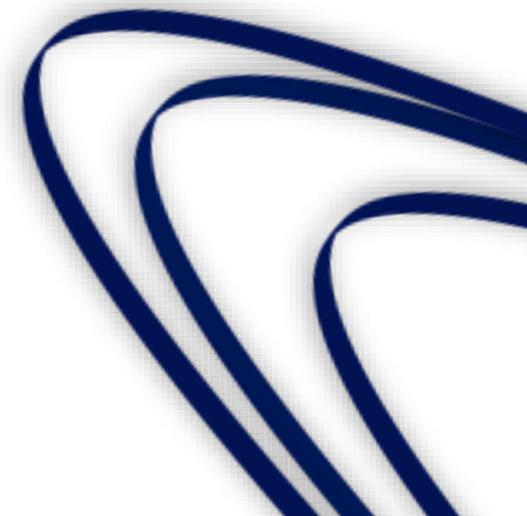
---

**Veja mais em**

**<https://bingotelescope.org/results>**

Artigos apresentam  
atualizações de cada  
estágio do projeto

**Link na Bio**



# BINGO em 2024



- Finalizar a construção do radiotelescópio BINGO
- Início das operações do BINGO
- Ampliar a formação de discentes através do radiotelescópio Uirapuru
- Construção de novos outriggers do BINGO
- Colaborar com o desenvolvimento da radioastronomia no Nordeste
- Ampliar nossas ações de extensão
- Envolver alunos de graduação e de pós-graduação no projeto
- Desenvolver ações multidisciplinares com outras universidades, departamentos e projetos de divulgação



MINISTÉRIO DA  
CIÊNCIA, TECNOLOGIA  
E INOVAÇÃO



OBRIGADO



Somos todos  
**PARAÍBA**  
Governo do Estado

[joaorafael@df.ufcg.edu.br](mailto:joaorafael@df.ufcg.edu.br)



Nos visite em

[bingotelescope.org](http://bingotelescope.org)

