In the Name of GOD

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4th ISRD

The Imprint of Primordial Magnetic Field on the Morphology of 21-cm Fluctuations

2nd of July (12th of Tir)

Road Map

- Primordial Magnetic Field
- Spectral Index
- 21-cm Waves

Primordial Magnetic Field

$10^{-5}\ G$ for $z \ll 3$

10^{-6}~$10^{-8}\ G$ for $10 \sim 50\ kpc$ scale

$sub - nG$ for 0.1~1 Mpc

Generation of small-scale matter density perturbation

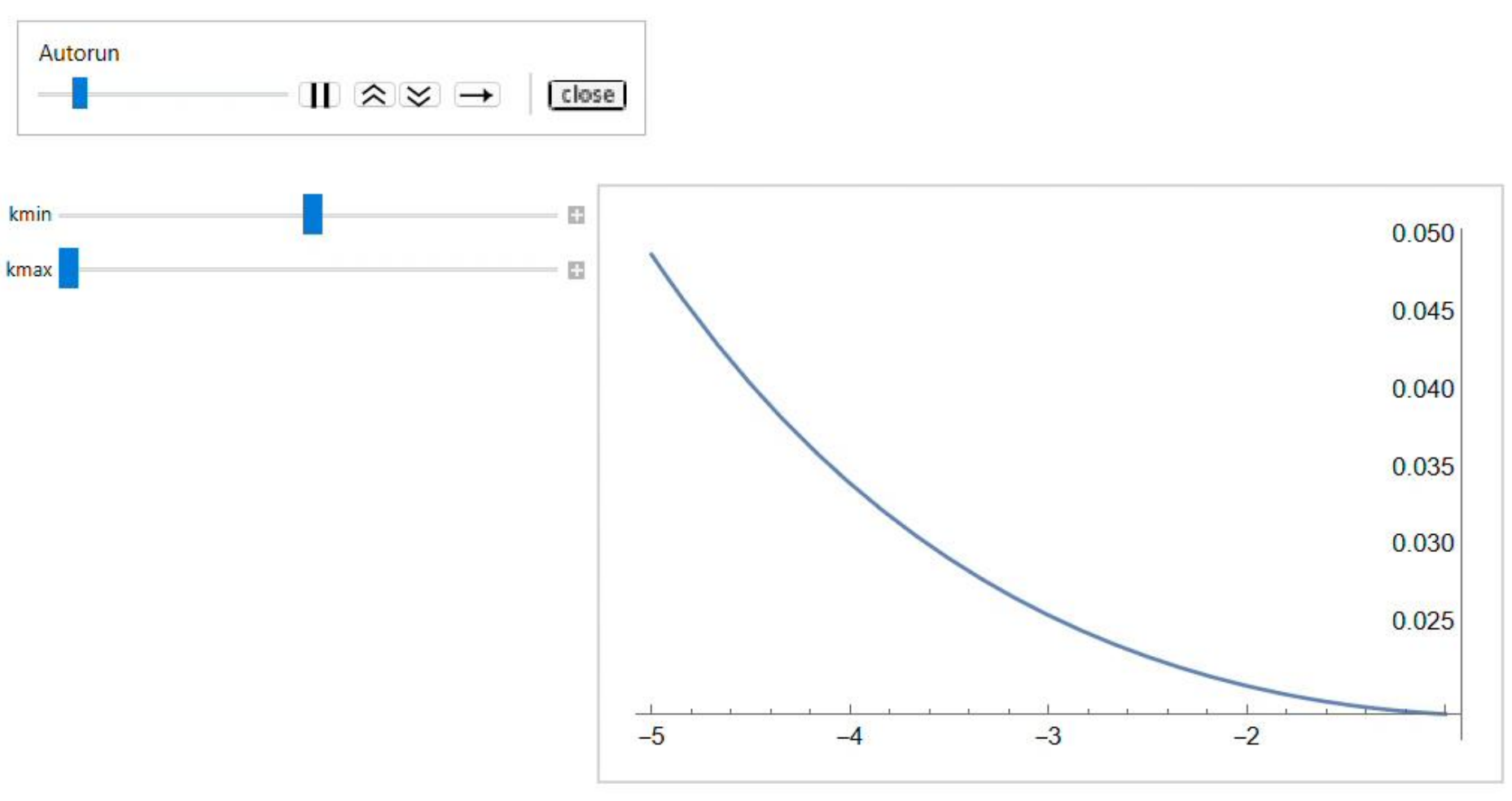
Cruz et al, Physical Review D, 2024

Spectral Index

- $a^2(t)\,\overrightarrow{B}(\vec{x}\,,t) = \overrightarrow{B}(\vec{x}\,,t_0) \equiv \overrightarrow{B_0}(\vec{x}),$
- $P_{B,prim}(k,t) = A_B(t)k^{n_B},$
- $(\sigma_m)^2 = \int \frac{d^3\vec{k}}{(2\pi)^3} \left|\vec{k}\right|^{2m} P(\vec{k})\widetilde{W}^2\,,\ *$
- $\widetilde{W} = \exp\left(-\frac{k^2\lambda^2}{2}\right).$

*:Jalali et al, The Astrophysical Journal, 2024

the rest: Cruz et al, Physical Review D, 2024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kmin
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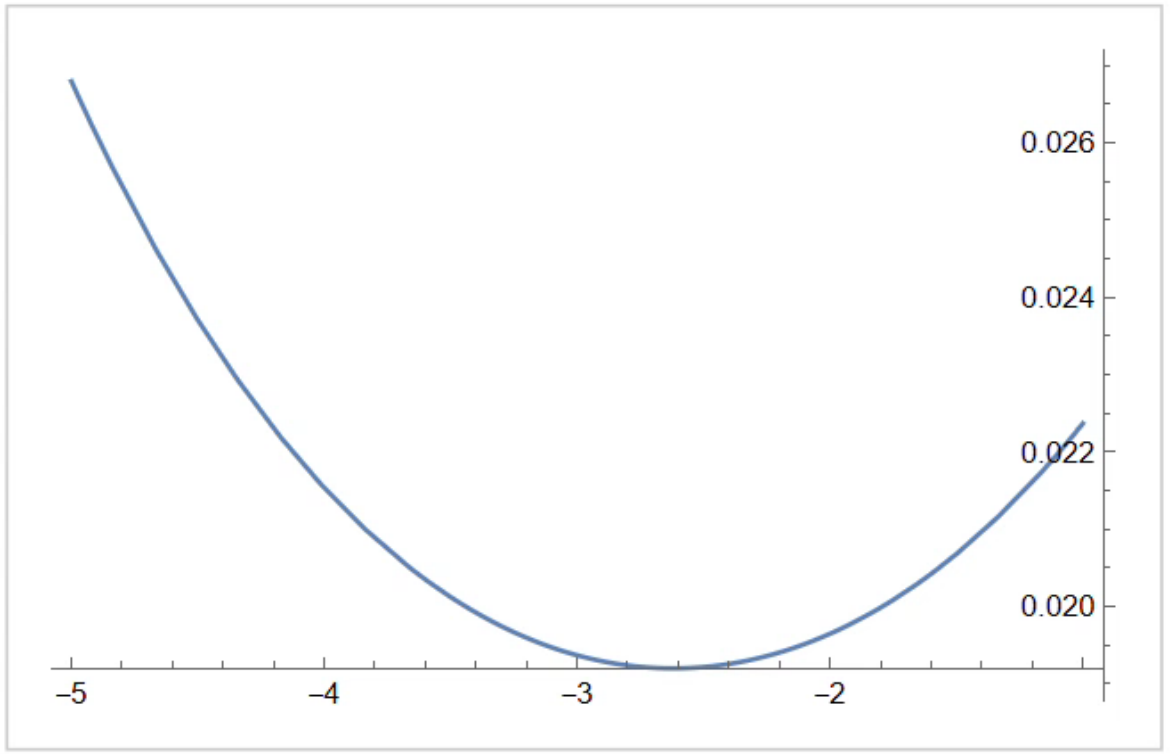
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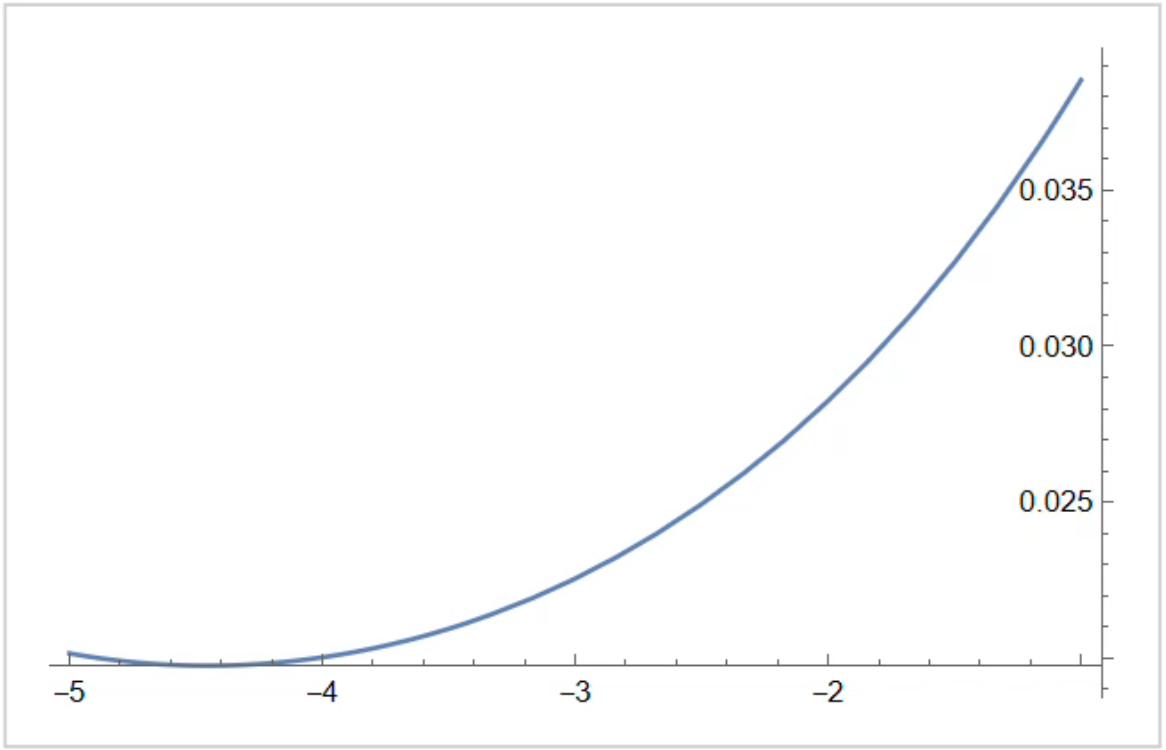

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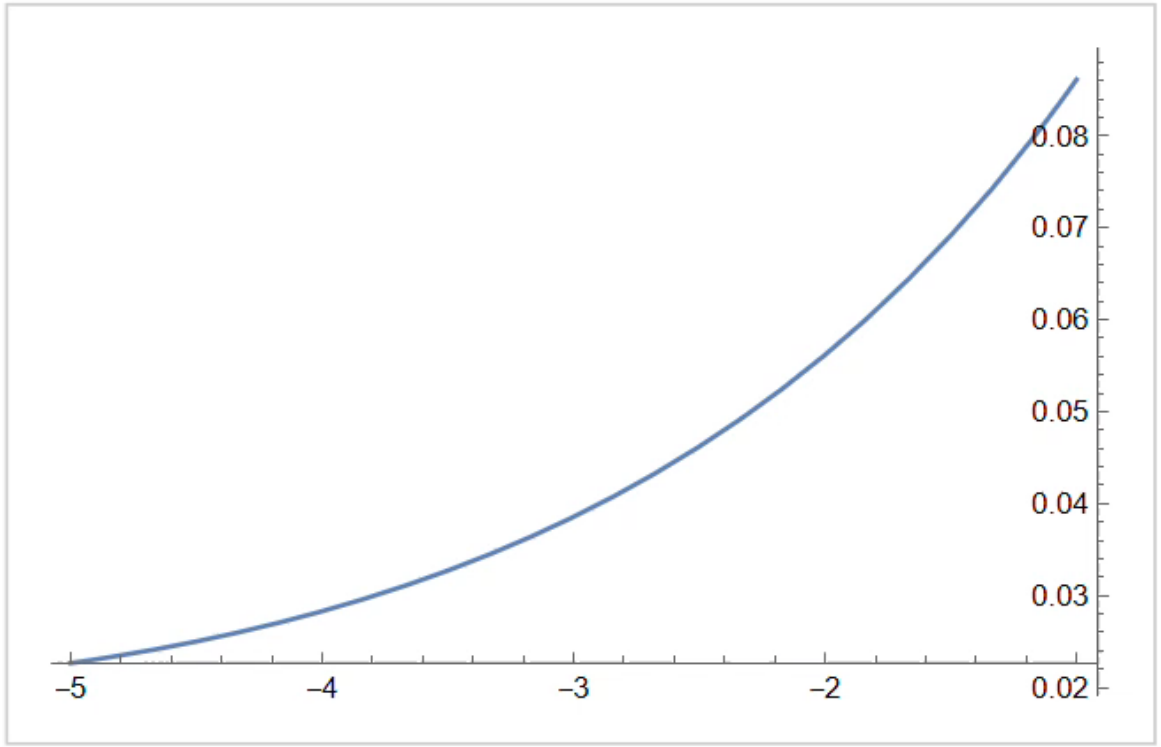

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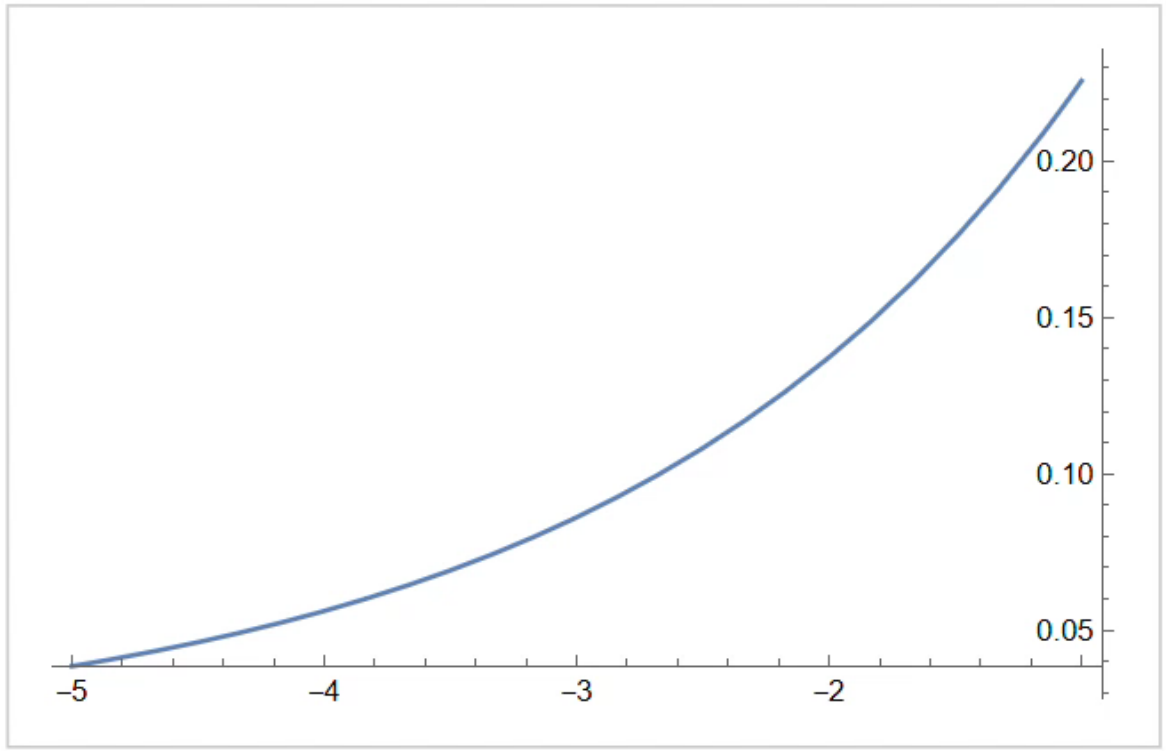

21-cm waves

21-cm Power Spectrum

Brightness Temperature

Conclusion

Finding out what primordial magnetic field is and where it came from using 21-cm waves (Theoretically, Statistically, Numerically, and any other aspect we can :D).

Main References

- 21-cm Fluctuations from Primordial Magnetic Fields, Cruz et al, Physical Review D, 2024

- Probing the Anisotropy and Non-Gaussianity in the Redshift Space through the Conditional Moments of the First Derivative, Jalali et al, The Astrophysical Journal, 2024


Thank you for your attention