# SHAFT POTENTIAL INFLATION

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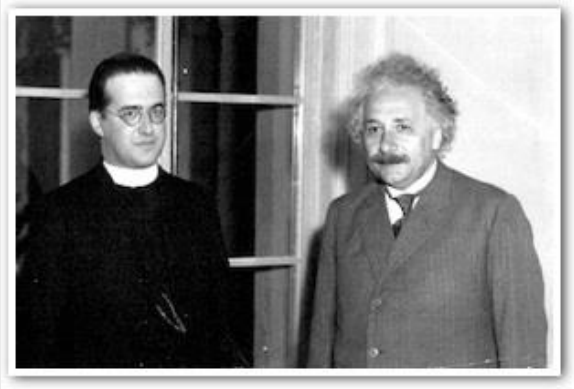
# OUTLINE

- SHORT HISTORY OF UNIVERSE
- INFLATION'S BASICS
- RESEARCH DISCUSSION
- SUMMARY OF TALK

# BIG BANG

- First general relativistic models by Einstein Predicted a contracting universe (1917)
- George Lemaitre was the first who proposed a "primeval atom" theory, later know as Big Bang Theory.
- Cosmic Microwave Background (CMB) discovered in 1964 by radio astronomers Arno Penzias and Robert Wilson.
- CMB caused most cosmologists to accept “Big Bang”.



# SOLUTION WITH INFLATION

- FLATNESS:

**Inflation pushes universe towards flatness.**

**Longer Inflation ⇨ Flatter Universe**

- HORIZON:

**Observable universe was extremely small before inflation ⇨ all regions could be in contact.**

- RELIC:

**Inflation massively dilutes any relics ⇨ we should not observe them today.**

# TACHYONIC FIELD INFLATION

**In flat FRW metric, Friedmann equation is**

$$H^2 = \frac{8\pi}{3M_p^2}(\rho_\phi + \rho_\gamma),$$

**The energy density and pressure of tachyon scalar field are defined as follows**

$$\rho_\phi = \frac{V(\phi)}{\sqrt{1-\dot{\phi}^2}}, \quad p_\phi = -V(\phi)\sqrt{1-\dot{\phi}^2}.$$

# TACHYONIC FIELD INFLATION

**The second conservation equation provided as**

$$3H(1+R)\dot{\phi} = -\frac{V'(\phi)}{V(\phi)}, \quad \text{where } \ddot{\phi} \ll \left(3H + \frac{\Gamma}{V}\right)\dot{\phi},$$

**The slow-roll parameters can also be deduced in the form of scalar field and thermalization according to the tachyon field,**

$$\epsilon = \frac{M_p^2}{2(1+R)}\left(\frac{V'^2}{V^3}\right), \quad \eta = \frac{M_p^2}{(1+R)}\left(\frac{V''}{V^2}\right).$$

# SHAFT INFLATIONARY PARAMETERS

**The generalized form of shaft potential is**

$$V(\phi) = \frac{M_p^4 \phi^{2n-2}}{(\phi^n + m^n)^{2-\frac{2}{n}}},$$

**The number of e-folds can be calculated with the help of tachyon field and under shaft potential**

$$N = \frac{M_p^2}{(2-2n)m^n} \int_{\phi_i}^{\phi_f} \phi^{-1+2n}(m^n + \phi^n)^{-1+\frac{2}{n}}(1+R)d\phi.$$

# SHAFT INFLATIONARY PARAMETERS

**Tensor to scalar ratio with the help of shaft potention with respect to techyonic field**

$$r = \frac{5123^{-\frac{-3+q}{2(-4+q)}} am^{3n}(-1+n)^3\phi^{4-6n-q}(m^n+\phi^n)^{3-\frac{6}{n}}}{C_\gamma M_p^8(1+R)^{11/2}}$$

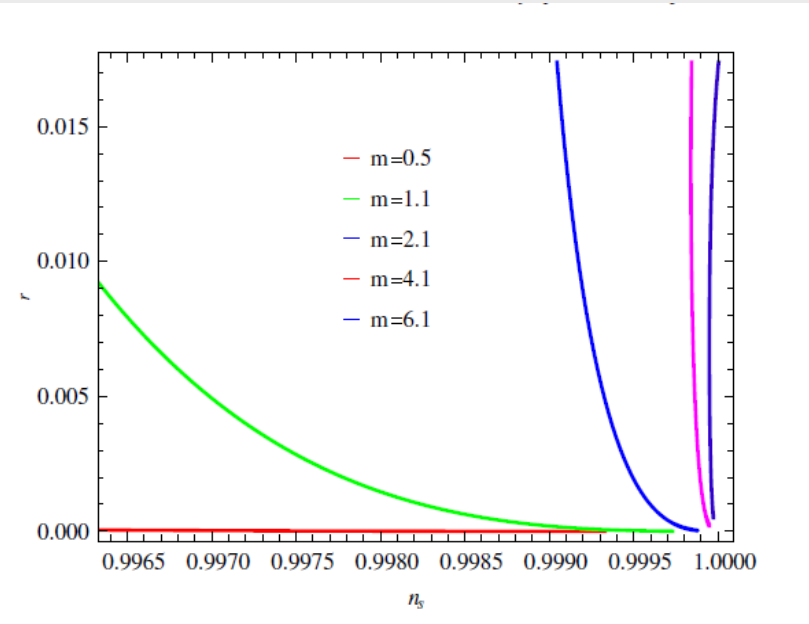
$$\times\left(\frac{am^{2n}M_p^3(-1+n)^2\phi^{-1-q}}{C_\gamma(1+R)^2(m^n+\phi^n)^2(M_p^4\phi^{-2+2n}(m^n+\phi^n)^{-2+\frac{2}{n}})^{3/2}}\right)^{-1+\frac{1}{-4+q}}$$

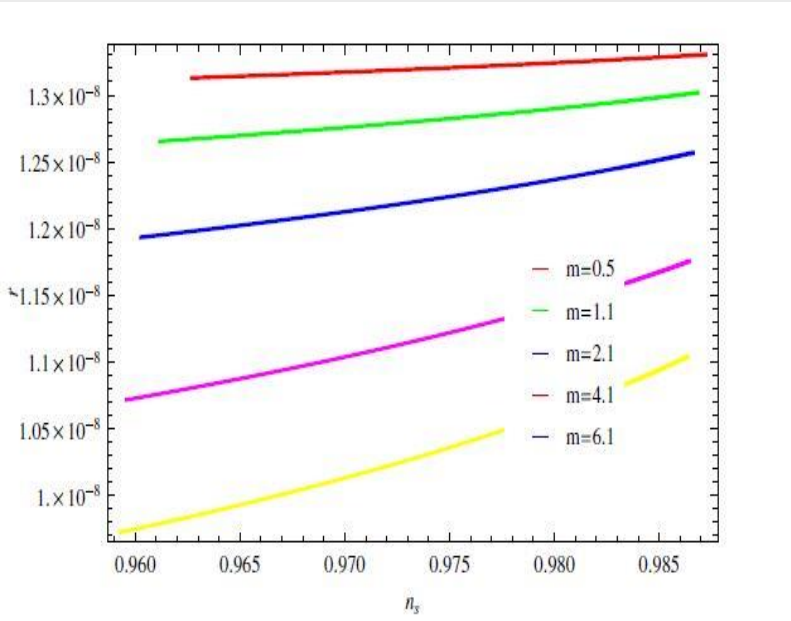
# SHAFT INFLATIONARY PARAMETERS

**However, the spectral index and its running attained the values**

$$n_s = 1 + \frac{1}{M_p^2(-4+q)(1+R)}(2m^n(-1+n)\phi^{-2n}(m^n+\phi^n)^{-2/n}$$
$$\times (m^n(10-17n-2q+5nq)+(-7+2n(-3+q)+3q)\phi^n)),$$
$$\alpha_s = \frac{1}{M_p^2(-4+q)(1+R)}(4m^{2n}(-1+n)^2\phi^{-4n}(m^n+\phi^n)^{-4/n}$$
$$\times (2m^{2n}n(10-17n-2q+5nq)+m^n(-4(-5+q)+n(-21+9q$$
$$+4n(-10+3q)))\phi^n+(2+n)(-7+2n(-3+q)+3q)\phi^{2n})).$$

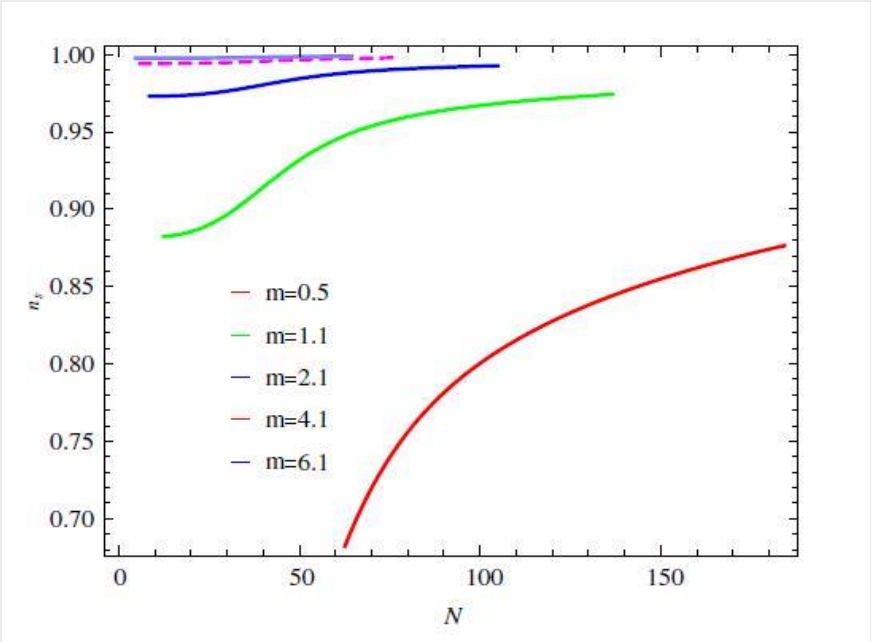
# GRAPHICAL REPRESENTATION

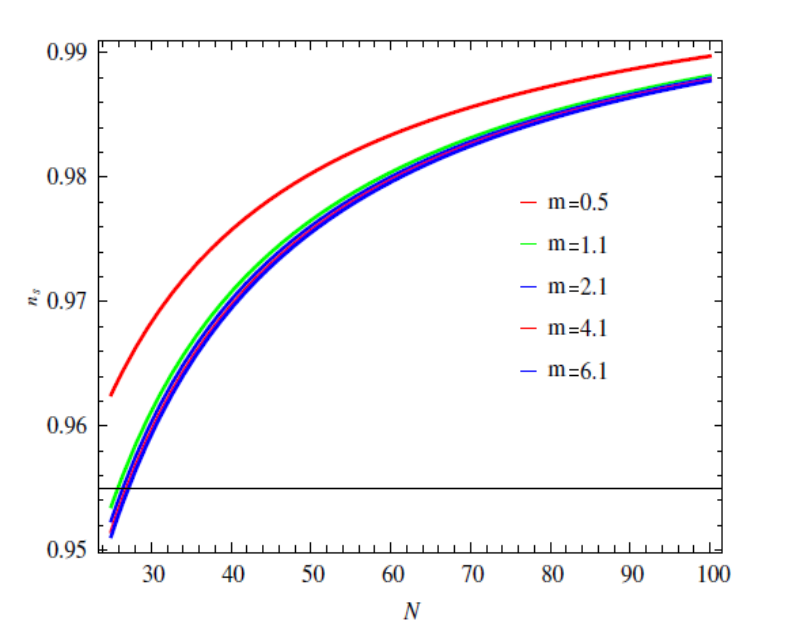



**TENSOR-SCALAR RATIO**

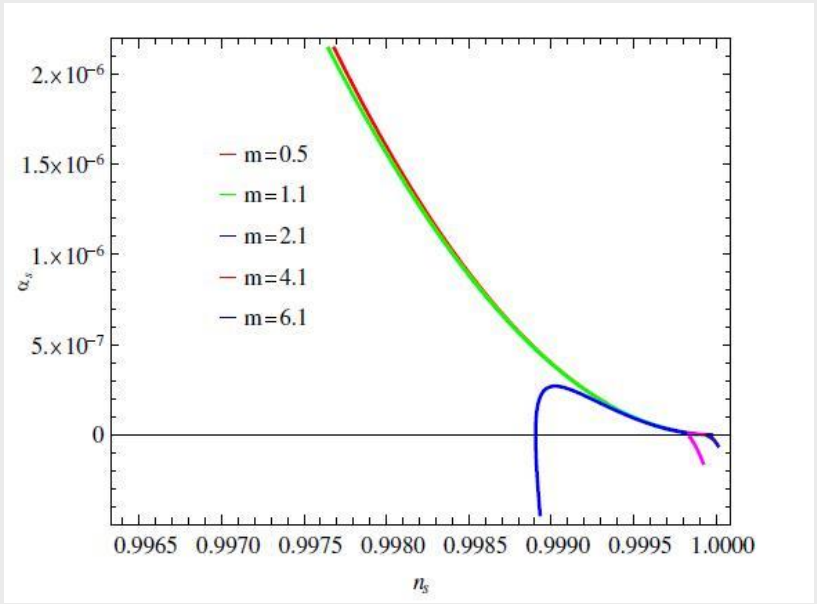
# GRAPHICAL REPRESENTATION

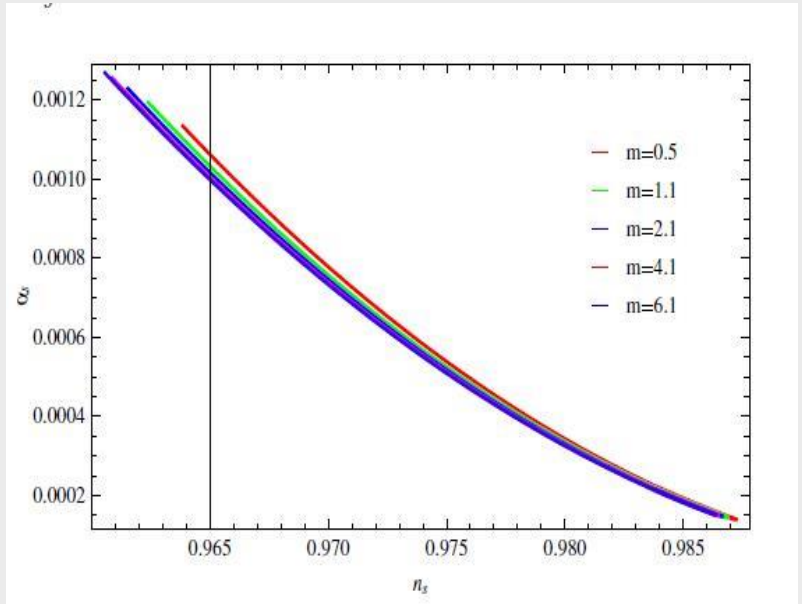



SPECTRAL INDEX

# GRAPHICAL REPRESENTATION




**RUNNING OF SPECTRAL INDEX**

# SUMMARY

- Examined the effect of shaft potential on the warm tachyon fields inflationary scenario.
- We have considered the scalar field decay rate which is proportional to the temperature
- Investigated the inflationary parameters in both strong and weak dissipative regimes.
- Showing consistency with Observational data.


THANK YOU