Brane inflation models

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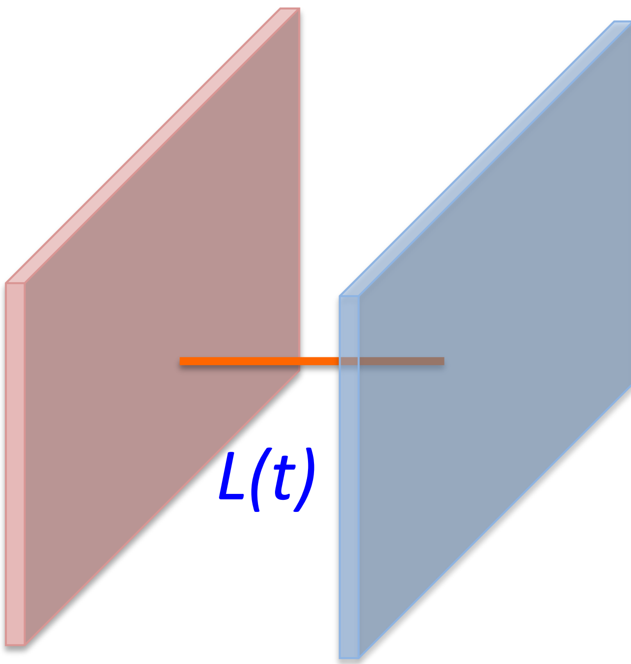
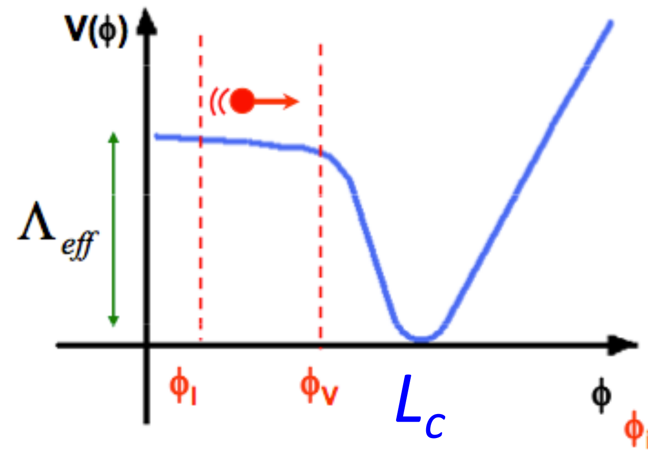
Dvali & Tye (PLB 1999)
Randall and R. Sundrum (PRL 1999)
Goldberger & Wise (PRL 1999)
Kallosh, Linde, Roest & Yamada (JHEP 2017)

Brane inflation

$\phi \approx M^2_p L(t)$





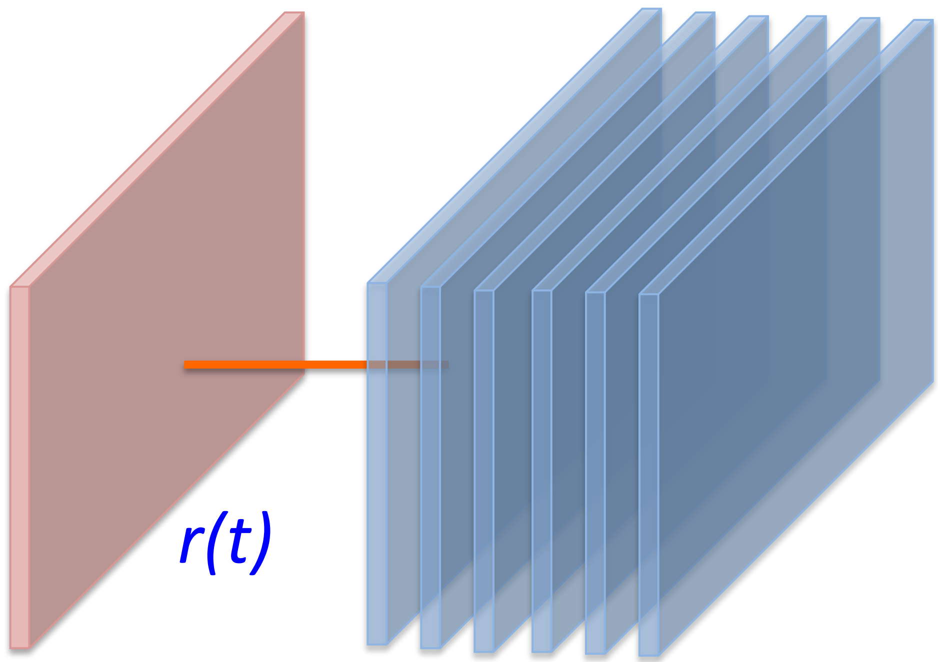
visible brane

hidden brane

Brane inflation

Dvali & Tye's scenario

$\phi \approx M^2_p\, r(t)$



Brane inflation

Dvali & Tye's scenario

$\phi \approx M^2_p r(t)$, N=number of extra dimensions

$$V(r) = T(\alpha - f(r/r_0) + b_i \frac{e^{-m_i r}}{r^{N-2}} + \frac{c}{r^{N-2}} + kr)$$

Contributions from:

1) Modes (massive/massless) localized on the brane

2) Yukawa suppressed potential from

exchange of the massive bulk modes

3) Exchange of the light bulk modes, like graviton or gauge

4) Confining potential ~ kr due to the strings stretching

Brane inflation

Dvali & Tye's scenario

Dvali-Tye "We can find several types of interactions betwen a brane and a stack of brane inflation".

Next ...

Extended-Dvali-Tye "We can effectively correct the Dvali-Tye scenario by including tuneling resonant modes".

Extended "Dvali-Tye" model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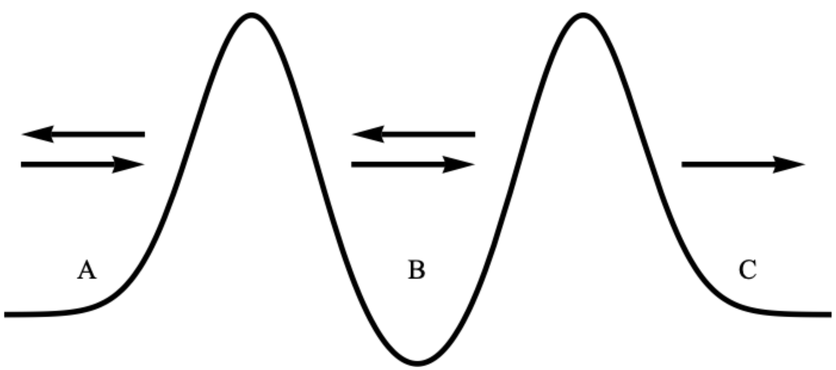
"Naïve WKB"

$$T = T_{A\to B} = T_{B\to C}$$

$$T_{A\to B} = K e^{-S}$$

$$T_{A\to C} \approx T^2$$



Doubly suppressed !

Tye and Wohns, 2009;

Saffin, Padilla and Copeland, 2008

Sarangi, Shiu and Shlaer, 2008

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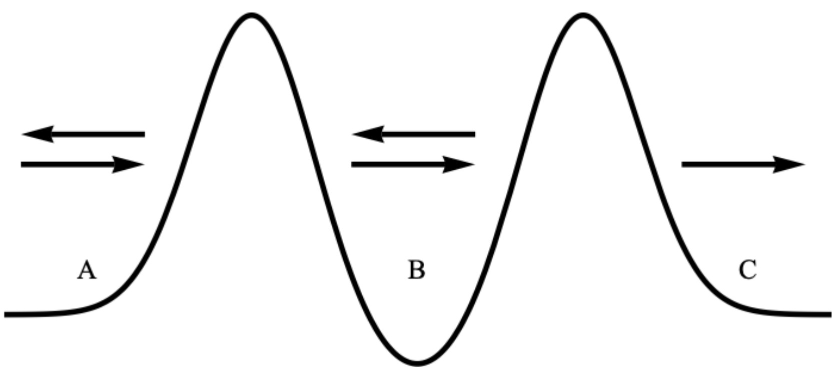

"Naive WKB"

$$T = T_{A\to B} = T_{B\to C}$$

$$T_{A\to B} = K e^{-S}$$

$$T_{A\to C} \approx T^2$$

"Resonant tunneling phenomenon"

$$T_{A\to C} \approx T/2$$

Tye and Wohns, 2009;

Saffin, Padilla and Copeland, 2008

Sarangi, Shiu and Shlaer, 2008

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Transmission coefficient

$$T = \frac{4}{\left(4\theta^2 + \frac{1}{4\theta^2}\right)\cos^2 L + 4\sin^2 L}$$

Quantities dependent on the potential

$$L = \int_{-r}^{r} k(x_5)\,dx_5\,, \qquad \theta = \exp\left(\int_a^b \kappa(x_5)\,dx_5\right)$$

Neves, Santos, Brito, 2020

Merzbacher, 1998

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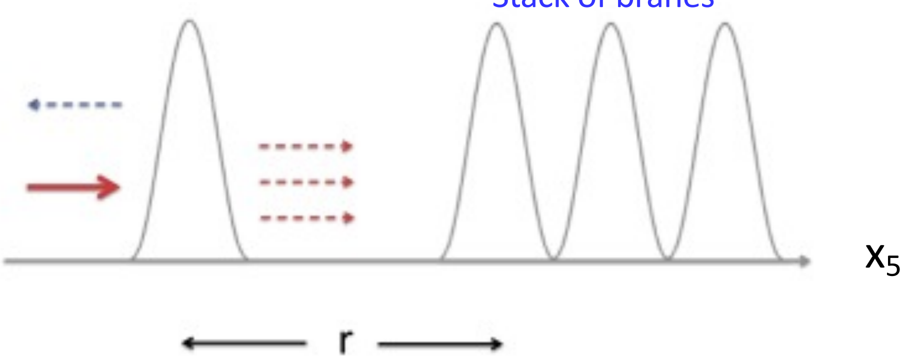
"Stack of branes"



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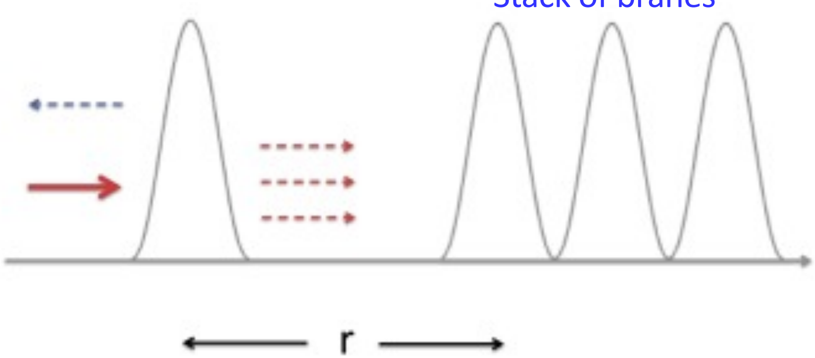

x_5

Induced force in terms of the reflection coefficient R=1-T:

$$F_r = M_{wall}\ddot{r}(t) \simeq KR = -\frac{\partial U}{\partial r}$$

The induced potential on the brane

$$U(r) = Kr_0 \arctan\left(\frac{r}{r_0}\right) - Kr$$

Neves, Santos, Brito, 2020

Vilenkin and Shellard, 1994

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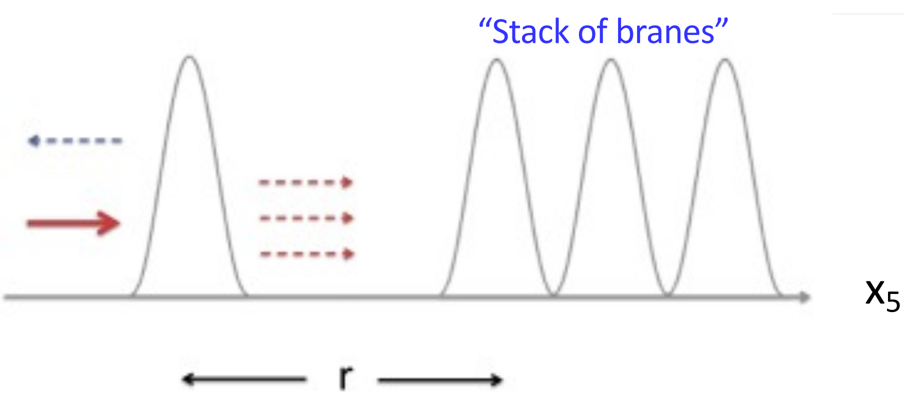


Gravitational and/or electromagnetic linear contribution:

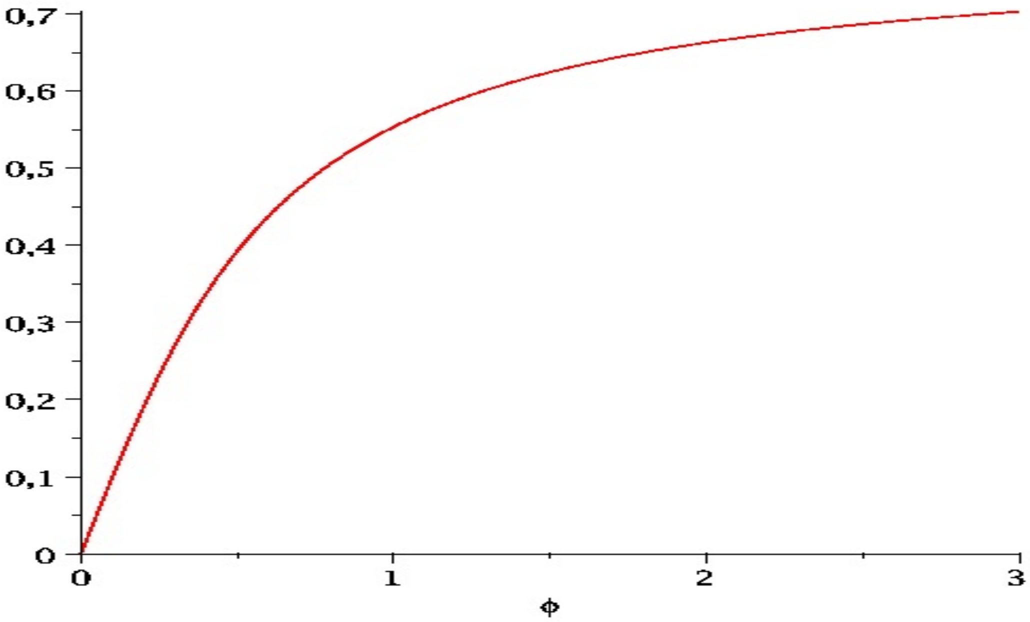
$$U_{eff}(r) = U(r) + \mathcal{E}_0 r$$

The effective induced potential on the brane

$$U_{eff}(r) = K r_0 \arctan\left(\frac{r}{r_0}\right)$$

Neves, Santos, Brito, 2020

Extended "Dvali-Tye" model



Adapting the coordinates suitably:

$$\sqrt{T_{wall}}\, r(t) \longleftrightarrow \phi(t)$$

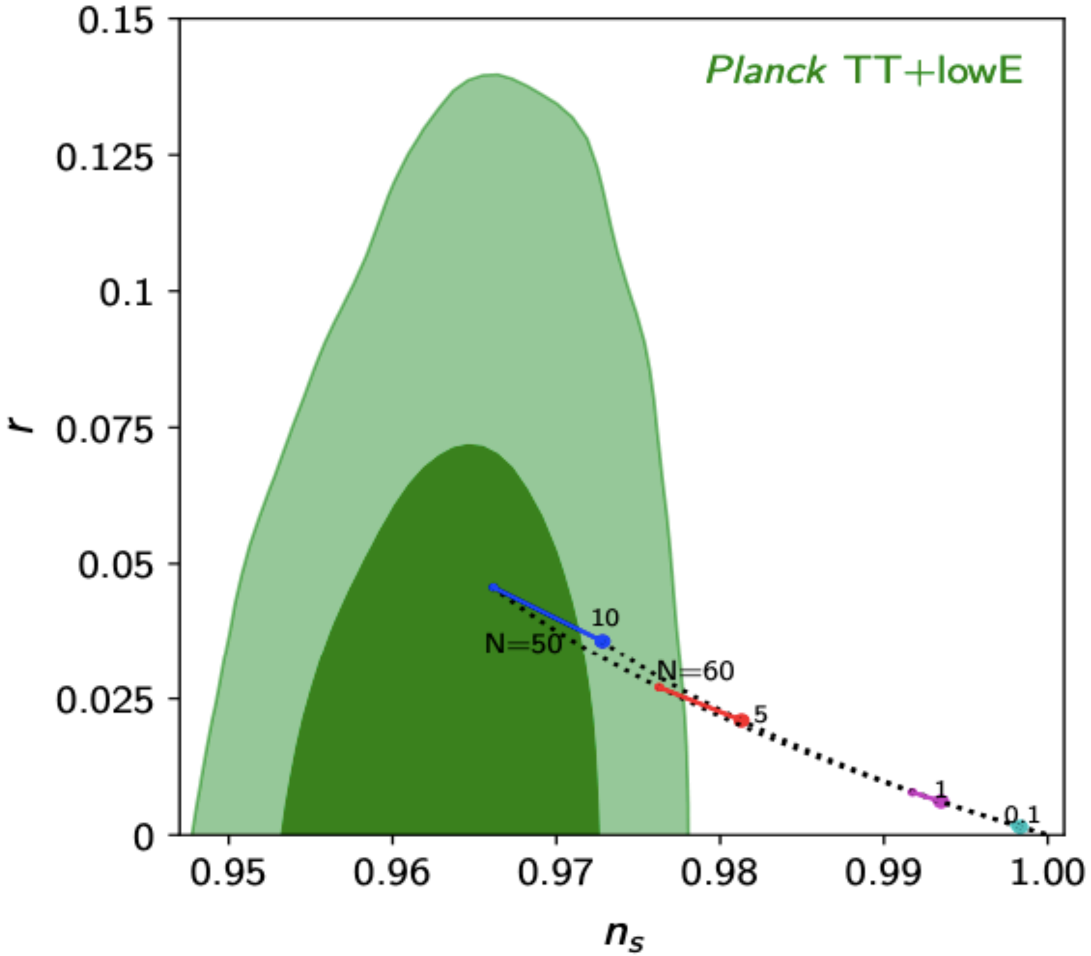
$$\beta = \sqrt{T_{wall}}\, r_0$$

Thus the induced inflaton potential on the brane is

$$V(\phi) = K\beta \arctan\left(\frac{\phi}{\beta}\right)$$

Neves, Santos, Brito, 2020

Extended "Dvali-Tye" model

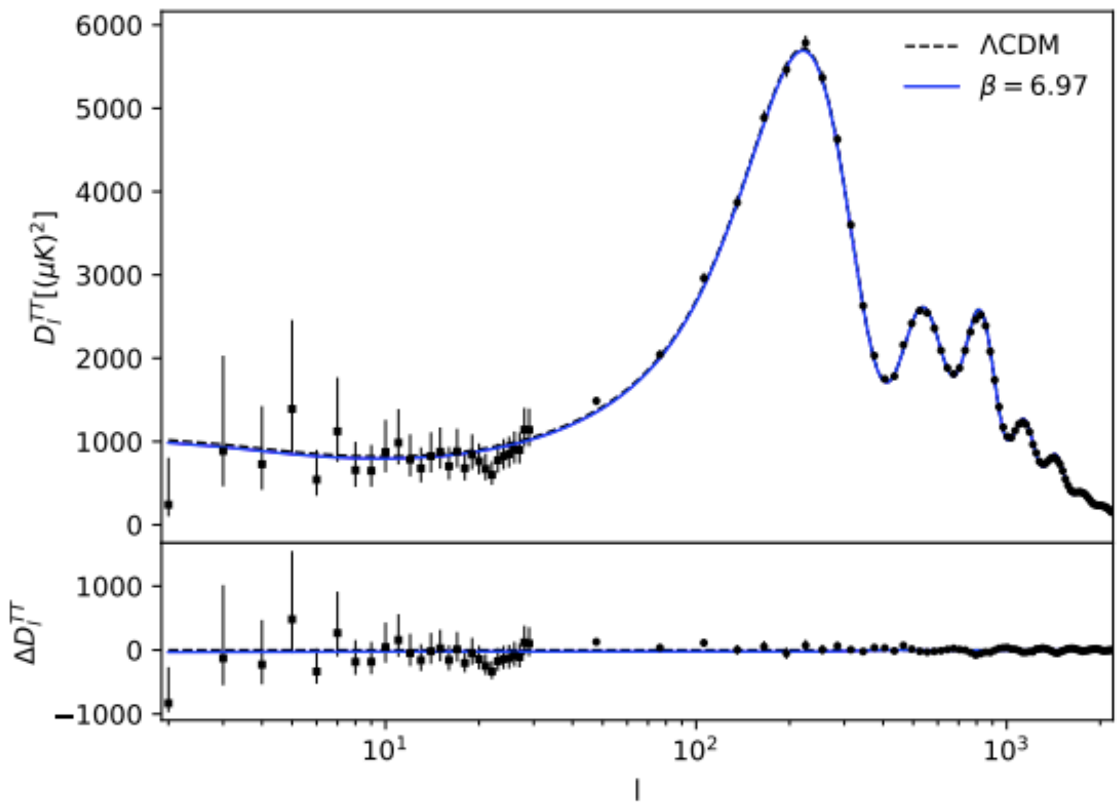


$$V(\phi) = K\beta \arctan\left(\frac{\phi}{\beta}\right)$$

Santos da Costa, Alcaniz, Brito & Neves (2020)

Extended "Dvali-Tye" model

Temperature power spectrum for **Arctan** potential



Conclusions

1. Our analysis shows that the predictions of the Arctan model - **inflation model are very similiar to the ones of the ΛCDM** model (they agree at 68.3% C.L.)

2. The Arctan model is in agreement with the current observational data and can be derived from a ‘fundamental theory’ such as supergravity

3. Large values of β are in agreement with both **observational data and radion stabilization** at finite size in brane inflation scenario

4. Similar agreements were found in supergravity induced β-exponential inflation models studied recently (**Brito *et al*, JCAP 2018**).

Thank you !

Conseho Nacional de Desenvolvimento Científico e Tecnológico

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