STRING COSMOLOGY

This is the author's manuscript

Original Citation:

Availability:
This version is available http://hdl.handle.net/2318/1504422 since 2016-01-13T22:36:43Z

Publisher:
Springer Verlag

Terms of use:
Open Access
Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)
String Cosmology

Carlo Angelantonj\(^1\) and Marco Litterio\(^2\)

\(^1\) Dipartimento di Fisica, Università degli Studi L’Aquila, Via Vetoio, 67010 Coppito (AQ), Italy
\(^2\) Istituto Astronomico, Università degli Studi “La Sapienza”, Via Lancisi 29, 00161 Roma, Italy

At present only String Theory (ST) treats gravity consistently with quantum mechanics. In the low energy limit ST gives back a Brans-Dicke version of General Relativity, described by the action [1]

\[
S = \int d^D x \sqrt{g} \left\{ -\frac{1}{2\kappa^2} e^{-\Phi} \left[ R + (\partial\Phi)^2 + V \right] + \mathcal{L}_m[g, \psi] \right\}
\]  

(1)

where \(\Phi\) is the dilaton field and \(\mathcal{L}_m\) represents a matter source term.

The cosmological equations, obtained from (1) for a homogeneous and spatially flat background and a matter contribution in the form of string gas with an energy-momentum tensor typical of a perfect fluid, are characterized by a symmetry called Scale Factor Duality (SFD) [2]. This symmetry naturally introduces a minimal length scale, suggesting then a possible solution to the singularity problem (SP) [3]. Really, we find [4] that, besides offering a natural solution to the SP, ST strongly modifies the standard lore of the cosmological evolution of the early universe. In particular, we report here an example where the early history of the visible universe is characterized by a smooth transition expansion-contraction-expansion (fig. 1).

In our solution the outstanding problem of multi-dimensional and scalar-tensor cosmologies, i.e. to keep constant Newton’s constant, is automatically solved. In fact, as shown in fig. 2, the combination \(G_N \sim b^{-n} e^\Phi\) (\(b\) is the scale factor of the \(n\)-dimensional internal space), after experiencing a non-trivial dynamics, converges towards a constant value. At the same time the internal radius stabilizes too and with it all the fundamental constants of physics which depend on it. The external scale factor, \(a(t)\), before converging to the standard radiation dominated solution, displays, see fig. 3, three different phases of accelerated evolution (expansion-contraction-expansion). As accelerated contraction is equivalent to accelerated expansion (inflation) for the solution of the kinematical problems [5], our scenario naturally offers a suitable framework for the realization of multiple-inflation, a mechanism for breaking the scale invariance in the pertur-
bation spectrum.

References

   M. Gasperini, these Proceedings;
4. C. Angelantonj, Diploma Thesis, University of L’Aquila (1994);
   C. Angelantonj, L. Amendola, M. Litterio and F. Occhionero, in preparation;

This article was processed using the \LaTeX\X macro package with LMAMULT style