Executive Summary

HSMD: Cosmological Dynamics of the Meshed Hypersphere

HSMD (*Meshed Hypersphere Dynamics*) constitutes the second stage of the HSM (*Meshed Hypersphere*) program. Whereas HSM describes the local properties of the meshed hypersphere—particles, effective fields, and fundamental constants—HSMD investigates the global dynamics of the support itself and its cosmological interpretation.

Starting point: HSM

HSM proposes a mechanical interpretation of fundamental physics based on a compact meshed hypersphere. Within this framework, particles are not introduced as elementary objects independent of the underlying support. Instead, they are associated with localized soliton-like solutions or with composite structures sustained by the nonlinear dynamics of the mesh.

This approach allows masses, charges, effective fields, and certain structural constants to be interpreted as emergent properties of the support. The fundamental constants of the model are calibrated from a limited set of observables and subsequently serve as the starting point for all further developments.

A natural question then arises: if particles and fields are properties of the support, what is the dynamics of the support itself?

Why HSMD?

HSMD addresses this question by assigning a global dynamics to the meshed hypersphere.

The radius of the hypersphere becomes a dynamical quantity capable of evolving with time. Cosmology is therefore no longer described as a kinematics imposed upon an abstract background space, but as the manifestation of the intrinsic dynamics of the HSM support.

In this interpretation, observed cosmological phenomena are viewed as effective manifestations of the global evolution of the mesh: evolution of the radius, elastic response of the support, closure constraints, and global rotation.

Physical hypothesis

HSMD is developed within a scenario in which the meshed hypersphere undergoes a compressed phase followed by a dynamical relaxation.

Within this framework, the localized solutions associated with particles emerge through a phase of soliton genesis resulting from the nonlinear dynamics of the mesh. The present work does not attempt to describe this initial phase in detail. Instead, it focuses on the subsequent stabilized homogeneous branch, where the relevant global coefficients may be treated as effectively constant at the level considered.

The objective is then to determine whether this stabilized branch can account for the main observed cosmological properties.

Method

The manuscript strictly distinguishes three levels:

- a theoretical section devoted to the global dynamics of the meshed hypersphere;
- a calibration section used to determine the branch parameters required for observational confrontation;
- a predictive section in which the outputs of the model are compared with independent observables.

This separation is intended to clearly distinguish theoretical assumptions, observational inputs, and genuinely derived results.

Main results

Applying this framework leads to a homogeneous cosmological branch compatible with the constraints used during calibration.

The resulting dynamics reconstruct an effective cosmological history characterized by:

- a late-time accelerated phase;
- a transition between a decelerated regime and an accelerated regime;
- a cosmological age compatible with current observations;
- an effective radius evolution consistent with the cosmological distances used for calibration.

HSMD also provides a mechanical interpretation of several open questions in contemporary cosmology. The H_0 discrepancy is not treated as a simple inconsistency between redundant measurements. Instead, the model distinguishes the background value associated with the homogeneous branch from the value measured locally by an observer located at a specific angular position on the rotating hypersphere.

In this interpretation, the locally measured value of H_0 depends on the geometric projection associated with the observer's position relative to the global rotation axis. The H_0 tension therefore becomes the difference between a background-average reading and a locally oriented reading of the same geometric support.

The same geometric mechanism is not limited to H_0. Once the observer's angular position on the rotating hypersphere is specified, it also feeds other directional channels, including CMB birefringence and galactic spin asymmetries. HSMD therefore proposes a common interpretation of these signatures as different projections of the same global geometry.

HSMD also addresses the question of cosmological curvature. In this framework, curvature is not introduced as a free independent parameter to be adjusted: it is a structural property of the hyperspherical support itself. The calibrated branch produces a global geometric curvature as a central HSM/HSMD output, while remaining compatible with current observational constraints on effective curvature. This output should not be read as a current detection of cosmological curvature, but as a structural consequence of the compact geometry of the model.

Tests and falsifiability

HSMD is not presented as a complete and universal description of all cosmological regimes. The manuscript deliberately restricts itself to the late homogeneous branch and explicitly identifies the sectors left for future developments.

The theory remains falsifiable because it produces quantitative relations linking several independent observational channels. Cosmological distances, cosmographic parameters, directional observables, and future measurements all provide opportunities to validate or refute the proposed closure relations.

A robust incompatibility between these predictions and observations would directly challenge the underlying closure assumptions.

Conclusion

HSMD extends the logic of HSM to the cosmological scale. Whereas HSM describes the local properties of the solutions supported by the meshed hypersphere, HSMD investigates the global dynamics of the support itself.

Its principal contribution is not merely the reconstruction of a cosmological branch compatible with observed distances. It also proposes a mechanical interpretation of the H_0 discrepancy, late-time acceleration, the constant term commonly associated with dark energy, cosmological curvature, and several directional signatures.

Together, HSM and HSMD form a unified framework in which microscopic properties and cosmological dynamics emerge from the same underlying geometric and mechanical structure.