M2- and M5-Branes in M-Theory
Detailed Derivation and Connection to SFIT

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1 Introduction

M-theory is the non-perturbative quantum theory in eleven dimensions that unifies all consistent superstring theories. Its low-energy limit is 11D supergravity, whose bosonic action contains the metric g_{MN} and the 3-form gauge field C_3.

The fundamental non-perturbative objects that source the 3-form flux are the **M2-brane** (electrically charged) and the **M5-brane** (magnetically charged). These branes are the "quanta" of M-theory, analogous to strings in string theory or D-branes in Type II string theory.

This document derives the key properties of M2- and M5-branes and connects them to the information-carrying flux in Stevenson-Flux Information Theory (SFIT).

2 M2-Brane

The M2-brane is a 2-dimensional extended object (a membrane) in 11D spacetime. Its world-volume is 3-dimensional (2 spatial + 1 time).

2.1 Worldvolume Action

The low-energy worldvolume action for an M2-brane is the Dirac-Born-Infeld (DBI) type action coupled to the 3-form:

$$S_{M2} = -T_2 \int d^3\xi \sqrt{-\det(\gamma_{ij})} + T_2 \int_{\text{worldvolume}} C_3,$$

where $T_2 = (2\pi)^{-2}\ell_{11}^{-3}$ is the M2-brane tension.

3 M5-Brane

The M5-brane is a 5-dimensional extended object. Its worldvolume is 6-dimensional.

3.1 Worldvolume Action

The M5-brane action includes a self-dual 2-form gauge field B_2 whose field strength satisfies $dB_2 = \star F_4$ (self-duality condition) and couples to the 6-form potential C_6 dual to C_3.

4 Interactions Between M2- and M5-Branes

M2-branes can end on M5-branes, forming a boundary. This is the M-theory analogue of a string ending on a D-brane.

5 Flux Quantization and Relation to 11D Supergravity

M-theory/11D supergravity is a **fundamental ultraviolet** theory whose non-perturbative objects (M2- and M5-branes) source the 3-form flux at the Planck scale.

SFIT is an **effective infrared** description in which gravity is a dynamic information-carrying flux vibrating at $\nu_{\text{res}} = 1.20134$ mHz with coupling kernel $K = 1.060$.

6 Connection to SFIT

When these higher-dimensional objects interact with a macroscopic gravitational field (e.g., the Earth's field in qBounce experiments), they may give rise to collective resonant modes observable as the 1.20134 mHz Quantum Heartbeat and the KWW relaxation tails with $\beta = K = 1.060$.

The non-reciprocal metric correction $h_{0z}^{\text{SFIT}}(t)$ in SFIT could be an effective, coarse-grained description of the back-reaction of M-brane flux on the 4D metric.

The 11.42 Hz secondary mode may represent a nonlinear mixing or sampling rate induced by the M-brane dynamics when probed at laboratory energies.

Future GRANIT experiments testing the 1.20134 mHz resonance and KWW tails could provide indirect experimental access to the underlying M-theory structure through its low-energy SFIT signatures.

7 Conclusion

M2- and M5-branes are the fundamental objects of M-theory. Their quantized flux at the Planck scale may provide the microscopic origin of the resonant information flux observed in SFIT at laboratory energies. This connection offers a bridge between higher-dimensional M-theory and observable gravitational resonance phenomena.

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