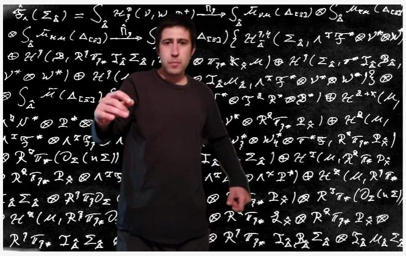
Boris Stoyanov

Subjects: Physics, Particles & Fields | Physics, Mathematical | Physics, Nuclear

Contributor: Boris Stoyanov

Membrane Theory Supergravity Superstring Theory Theoretical Physicist Mathematical Physicist

Basic Information



Name: Boris Stoyanov (Jan 1984–)

Birth Location:	Sliven, Bulgaria
Title:	Theoretical Physicist
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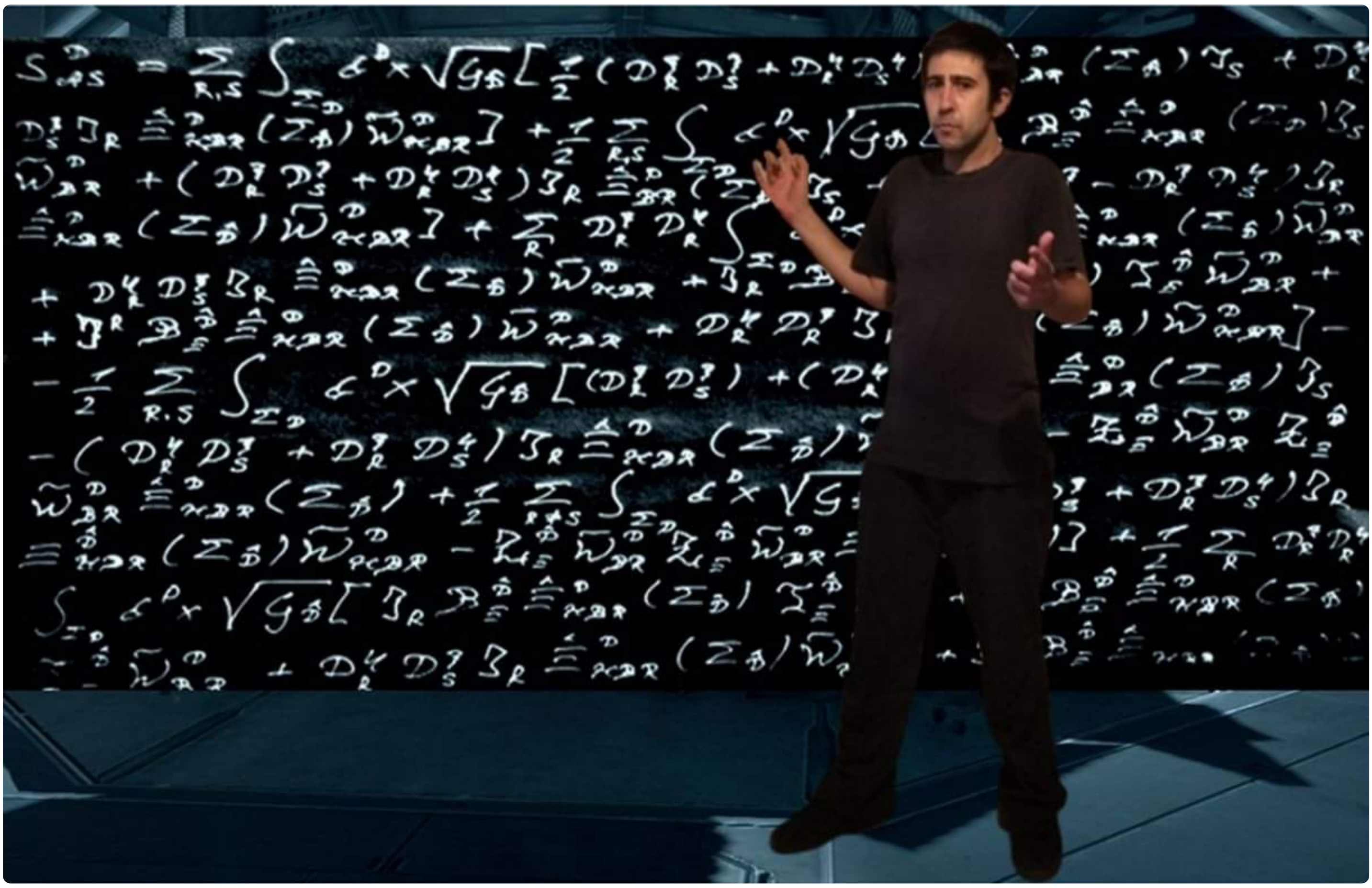
Honors:	Professor of Membrane Theory at DARK MODULI INSTITUTE Principal and Permanent Member of SUGRA INSTITUTE Executive and Research Director of BRANE HEPLAB

1. Introduction

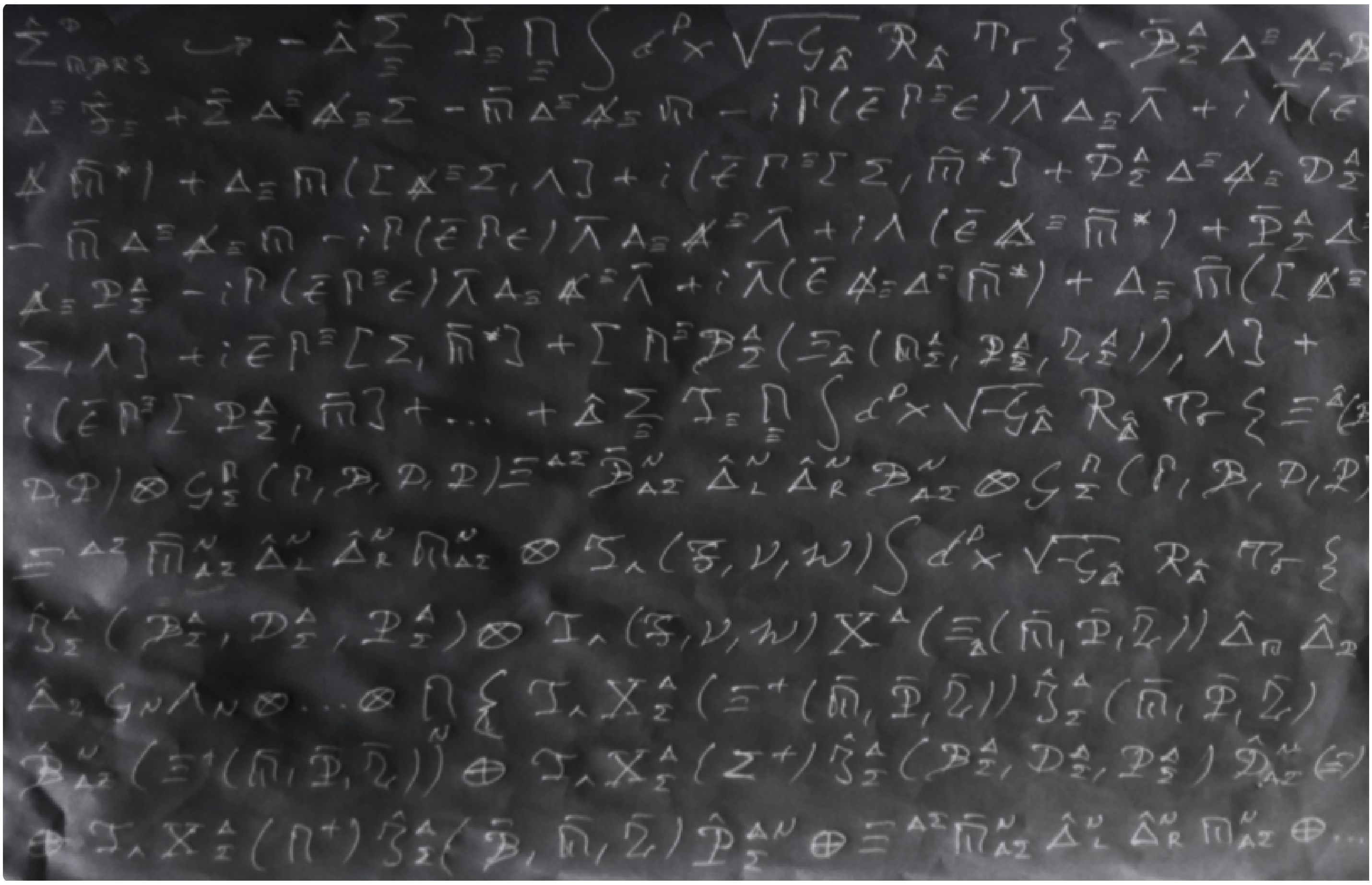
Boris Stoyanov is a theoretical physicist working on **Membrane Theory**, **Supergravity** and **Superstring Theory**. He is the Principal and Permanent Member of **SUGRA INSTITUTE**, Executive Director of **BRANE HEPLAB** and the Giordano Bruno Professor of Membrane Theory at **DARK MODULI INSTITUTE**. **Boris Stoyanov** is a relatively young theoretical physicist dealing with the exclusive theories of supergravity, superstrings and all supersymmetric models of fundamental membrane theories. Main research interests are related to gauged supergravity, conformal supergravity and the full range of models with consistent supergravities in diverse spacetime dimensions. Main works include all known consistent supergravity theories and different views to the presence of supergravity including superstrings in fundamental supermembranes.



2. Biography

Boris Stoyanov was born in Sliven, Bulgaria at the end of the past millennium. As a kid he has strong interests in science, art and music. He graduated from the prestigious High School of Mathematics and Natural Sciences in Sliven, Bulgaria with profile **Chemistry** included intensive study of **Physics** and **Mathematics**. He is Master of Science in **Theoretical and Mathematical Physics** from **Sofia University** with a master's thesis on the subject and special topic "Covariant and Consistent Anomalies in Gauded Supergravity", created in a two-year research study conducted at **INRNE /Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences/** with deep results elegantly presented in his research master thesis. After graduation he actively works on gauge and gravitational anomalies in quantum and supersymmetric gauge theories, including exploring their participation in supergravity, superstring and M-Theory. In the current time of the present it deals with Consistent Supergravity Theories in Diverse Dimensions of higher-dimensional spacetime. Discusses unique applications of supergravity in superstrings and membrane theory. Applies his supergravity searches and solutions to the theory of fundamental supermembranes. Looks for a different type of supergravity in M-Theory and F-Theory in order to create a unique and complete unifying theory of fundamental interactions. **Boris Stoyanov** graduated with the Master of Liberal Arts in Mathematics from **Harvard University** with a diploma thesis on a special topic in **Mathematical Physics**: "The Structures of Symplectic Scalar Supercurvature on Supermanifolds". He is a Doctor of Philosophy in **Theoretical Physics** with studies of Supergravity Constructions in Membrane Theory completed at **MIT / SUGRA INSTITUTE** with the topic: "The Exclusive Higher Dimensional Constructions of Supegravity with

Multiple Brane Systems". In 2017 he created his own Institute of Theoretical and Mathematical Physics for research in Supergravity, Superstring Theory and Supersymmetry, registered in Cambridge, Massachusetts, United States, with the unique name **SUGRA INSTITUTE**. Boris Stoyanov is Executive Director of the high-energy physics laboratory in Cambridge, United Kingdom called **BRANE HEPLAB** and Full Professor at **DARK MODULI INSTITUTE** in London, United Kingdom. In the scientific community he is known for special applications of Supergravity and Superstring Theory in the construction of fundamental supermembranes.



3. Scientific Research

Boris Stoyanov start the consideration and examination on the higher-dimensional theories of supergravity with the elegant participation and inclusion of Type IIA, Type IIB and Heterotic Superstrings in different backgrounds of the higher-dimensional spacetime supermanifolds plus inclusion of hypermanifolds of different membrane models. The first stage in the study of **Boris Stoyanov** on these extraordinary magical theories is the presentation and construction of 10-dimensional Type IIA, Type IIB and Heterotic Supergravities, where elegantly being included in superfield actions, constructions of superstrings with the participation of exceptional supersymmetric transformations in the higher-dimensional curved spacetime. The researcher in Theoretical Physics resolve some problems in the literature and find that the positivity of energy holds in much broader class of Type IIA, Type IIB and Heterotic supergravity theories including exclusive membrane models than previously studied from the theoretical physicists. Supergravity theories in the higher spacetime dimensions play nowadays an important role as low-energy effective field theories of different superstring and membrane theories. Explicit knowledge of this set of theories gives us a powerful tool for exploring the connection between string theory, low-energy physics and membrane theory. On the other hand, the higher supergravity theory could encompass all known supergravities, in the spirit of the membrane theory. The behavior of the bulk and brane systems has been an important ingredient in understanding and quantifying the supergravity, superstring theory and equivalently the higher-dimensional membrane models of supergravity coupled to matter and other special fundamental interactions. The special feature of higher-dimensions which is useful for the study of membranes is that some models admit their interpretation as supergravity and superstring theories in higher dimensional superspace.

3.1. Membrane Constructions

The philosophy of the present constructions, pioneered in this advanced research, is to embed the fundamental interactions of heterotic superstrings in supergravity backgrounds with higher-dimensional supermanifold framework in hyperspace constructions of various supermembrane models. This approach therefore circumvents the necessity of working on supermanifolds with non-trivial fundamental global symmetry of heterotic supergravity and opens up the way for heterotic model building on much more supermanifolds with supergravity backgrounds in general case of the theoretical construction. All mathematical and engineering details are explained in a technical and structured way, providing the theoretical framework for constructing heterotic supergravity theories in higher-dimensional spacetime supermanifolds with elegant inclusion of fundamental supermembranes. Based on the methods developed in this advanced research, an alternative to this procedure has recently been presented in heterotic supergravities in D-dimensional spacetime superspace. Inserting the various Lagrangians with the appropriate superfield identifications into this expression then provides us with the final results in D-dimensional heterotic supergravity theories with membrane models. We systematically compute the higher-dimensional effective actions of heterotic supergravity in theoretical constructions with superstrings including fundamental supermembranes with the exclusive and extremely important bulk and brane systems.

The bulk and brane system in the heterotic moduli superspace is combination of the bulk lagrangian, brane, hidden brane lagrangian and the brane fields coupling action expressed with the equation

$$S_{\mathcal{M}_{\mathcal{D}}} = \int d^D x \sqrt{-\mathcal{G}} \mathcal{R} \mathcal{L}_{\mathcal{B}} + \int d^D x \sqrt{-\mathcal{G}} \mathcal{R} \mathcal{L}_{\mathcal{BR}} + \int d^D x \sqrt{-\mathcal{G}} \mathcal{R} \mathcal{L}_{\mathcal{HBR}} + \int d^D x \sqrt{-\mathcal{G}} \mathcal{R} \mathcal{L}_{\mathcal{BFC}}$$

The construction of local moduli superspace emerged in the process of investigation the heterotic supergravity bulk moduli with the higher-dimensional curved backgrounds in heterotic supergravity bulk moduli the supergeometry of heterotic supermultiplets and supermanifolds from the exceptional type is presented

$$\begin{aligned} \widetilde{\mathcal{M}}_{\mathcal{T}}(\Delta_{[\Xi]}) \;\; \hookrightarrow \;\; & \widetilde{\mathcal{M}}_{\mathcal{BR}}(\Delta_{[\Xi]}) \oplus \widetilde{\mathcal{M}}_{\mathcal{HBR}}(\Delta_{[\Xi]}) \;\hookrightarrow\; \widetilde{\mathcal{M}}_{\Xi\mathcal{H}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{NS}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{KR}}(\Delta_{[\Xi]}) \\ \otimes \;\; & \widetilde{\mathcal{M}}_{\mathcal{DBI}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{WZ}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{GFC}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{BFC}}(\Delta_{[\Xi]}) \otimes \widetilde{\mathcal{M}}_{\mathcal{HBC}}(\Delta_{[\Xi]}) \end{aligned}$$

The most general superpotential captured by the relative cohomology group includes also a non-trivial closed superstring flux and the two contributions can be combined in the general linear combination of relative period integrals

$$
\begin{aligned}
\mathcal{W}^{\mathcal{D}}_{\Xi\mathcal{F}\mathcal{F}}(\mathcal{Z},\hat{\mathcal{Z}}) \quad &\xrightarrow{\hat{\Pi}_\xi} \sum_{\xi_\Sigma\in\mathcal{H}^3(\mathcal{Z}^*,\mathcal{D})} \hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \hat{\Pi}^\Sigma(\mathcal{Z},\hat{\mathcal{Z}}) \xrightarrow{\hat{\Pi}_\xi} \mathcal{W}^{\mathcal{D}}_{\mathcal{CL}}(\mathcal{Z}) \oplus \mathcal{W}^{\mathcal{D}}_{\mathcal{OP}}(\mathcal{Z},\hat{\mathcal{Z}}) \oplus \mathcal{W}^{\mathcal{D}}_{\mathcal{BR}}(\mathcal{R}) \\
&\xrightarrow{\hat{\Pi}_\xi} \sum_{\xi_\Sigma,\Pi\xi_{\Sigma=0}} \hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \hat{\Pi}^\Sigma(\mathcal{Z}) \otimes \hat{\Lambda}_\Sigma \oplus \sum_{\xi_\Sigma,\Pi\xi_\Sigma\neq 0} \hat{\Sigma}_\Sigma\hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \hat{\Pi^\Sigma}(\mathcal{Z}) \otimes \hat{\Xi}_\Sigma \\
&\oplus \sum_{\xi_\Sigma\in\mathcal{H}^3(\mathcal{P}^*,\mathcal{Z}^*,\mathcal{D})} \hat{\Delta}_\Sigma \otimes (\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \Pi^\Sigma(\mathcal{Z})) \oplus \hat{\Xi}_\Sigma \otimes (\hat{\mathcal{P}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \Pi^\Sigma(\mathcal{Z})) \\
&\xrightarrow{\hat{\Pi}_\xi} \xi_\Sigma\hat{\mathcal{N}}_\Sigma \int_{\xi_\Sigma} \hat{\Sigma} \oplus \int_{\xi_\Sigma} (\hat{\Lambda}_\Sigma \otimes \hat{\Sigma}_\Sigma \otimes \hat{\Xi}_\Sigma) \sum_{\xi_\Sigma\in\mathcal{H}_{\mathcal{D}}(\mathcal{P}^*{}_\xi)} \hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \int_{\xi_\Sigma} \hat{\Sigma} \oplus (\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{P}}_\Sigma) \\
&\oplus \sum_{\xi_\Sigma\in\mathcal{H}_{\mathcal{D}}(\mathcal{Z}^*)} \int_{\xi_\Sigma} (\hat{\Lambda}_\Sigma \otimes \hat{\Sigma}_\Sigma \otimes \hat{\Xi}_\Sigma) \oplus \hat{\Delta}_\Sigma \otimes (\hat{\mathcal{B}}_\Sigma \oplus \hat{\mathcal{P}}_\Sigma \oplus \hat{\mathcal{N}}_\Sigma \oplus \mathcal{R}\hat{\mathcal{M}}_\Sigma) \otimes \hat{\Pi^\Sigma}(\mathcal{Z}) \\
&\oplus \xi_\Sigma\hat{\mathcal{N}}_\Sigma \int_\xi \hat{\Delta}_\Sigma \otimes \sum_{\xi_\Sigma\in\mathcal{H}_{\mathcal{D}}(\mathcal{Z}^*,\mathcal{D})} \int_\xi (\hat{\Sigma}_\Sigma \otimes \hat{\Xi}_\Sigma) \oplus \hat{\Delta}_\Sigma \otimes (\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \Pi^\Sigma(\mathcal{Z},\mathcal{D})) \\
&\oplus \hat{\Delta}_\Sigma \otimes (\hat{\mathcal{P}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \Pi^\Sigma(\mathcal{Z},\mathcal{D})) \oplus \hat{\Delta}_\Sigma \otimes (\hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \Pi^\Sigma(\mathcal{Z},\mathcal{D})) \\
&\oplus \sum_{\xi_\Sigma\in\mathcal{H}_{\mathcal{D}}(\mathcal{P}^*,\mathcal{Z}^*,\mathcal{D})} \int_{\xi_\Sigma} \hat{\Delta}_\Sigma \otimes (\mathcal{T}_{\hat{\Delta}}\mathcal{B}_{\hat{\Delta}}\Sigma_{\hat{\Delta}} \otimes \mathcal{T}_{\hat{\Delta}}\mathcal{P}_{\hat{\Delta}}\Sigma_{\hat{\Delta}} \otimes \mathcal{T}_{\hat{\Delta}}\mathcal{R}\mathcal{M}_{\hat{\Delta}}\Sigma_{\hat{\Delta}}) \\
&\oplus \Delta_\Sigma \otimes (\hat{\mathcal{B}}_\Sigma \oplus \hat{\mathcal{P}}_\Sigma \oplus \hat{\mathcal{N}}_\Sigma \oplus \mathcal{R}\hat{\mathcal{M}}_\Sigma) \otimes \hat{\Pi^\Sigma}(\mathcal{Z},\mathcal{D}) \otimes \mathcal{T}_{\hat{\Delta}}\mathcal{R}\mathcal{M}_{\hat{\Delta}}\Sigma_{\hat{\Delta}} \\
&\oplus \sum_{\xi_\Sigma\in\mathcal{H}_{\mathcal{D}}(\mathcal{P}^*{}_\xi,\mathcal{Z}^*{}_\eta,\mathcal{D})} \hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \int_{\xi_\Sigma} \hat{\Sigma}_\Sigma \oplus (\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{P}}_\Sigma) \oplus \mathcal{T}_{\hat{\Delta}}\mathcal{R}(\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{P}}_\Sigma)\Sigma_{\hat{\Delta}} \\
&\oplus \Delta_\Sigma \otimes (\hat{\mathcal{B}}_\Sigma \oplus \hat{\mathcal{P}}_\Sigma \oplus \hat{\mathcal{N}}_\Sigma \oplus \mathcal{R}\hat{\mathcal{M}}_\Sigma) \oplus \mathcal{T}_{\hat{\Delta}}\mathcal{R}(\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{P}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \otimes \hat{\mathcal{N}}_\Sigma)\Sigma_{\hat{\Delta}} \\
&\oplus \hat{\mathcal{N}}_\Sigma \otimes \hat{\mathcal{M}}_\Sigma \int_{\xi_\Sigma} \hat{\Sigma}_\Sigma \oplus (\hat{\mathcal{B}}_\Sigma \otimes \hat{\mathcal{P}}_\Sigma) \oplus \dots
\end{aligned}
$$

More specifically in the exceptional case, any brane effective action will have the structure

$$
S_{\mathcal{BRANE}} = -\mathcal{T}_{\mathcal{BRANE}} \int d^{D+1}x \Big(\mathcal{L}_{\mathcal{DBI}} - \Xi_\Sigma \mathcal{L}_{\mathcal{WZ}} \Big)
$$

Assuming the higher derivative couplings on the world-volume of Dp-brane are also independent of the dimension of the brane, one expects the effective action of Dp-brane at any order to be covariant under the T-duality transformation. Using this constraint, **Boris Stoyanov** is going to study the corrections to the DBI action in this advanced scientific research. The consistency of couplings with the T-duality and S-duality symmetries can be used to determine the gauge field couplings in action

$$
\begin{aligned}
S_{\mathcal{DBI}} \;=\; & -\mathcal{T}_{\mathcal{DBI}} \int d^{p+1}\sigma \sqrt{-\mathcal{G}} \Big[\mathcal{R}_{BD}(\mathcal{D}_A\mathcal{F}^{AB}\mathcal{D}_C\mathcal{F}^{CD} - \mathcal{D}_A F_C{}^D \mathcal{D}^C F^{AB}) + \frac{1}{2} R_{BDCE}\mathcal{D}^C F^{AB}\mathcal{D}^E F_A{}^D \\
& -R_{CIDE}\Omega^C{}_A{}^I\mathcal{D}_B F^{DE} + R_D{}^E{}_{EI}\Omega^{DCI}\mathcal{D}_C F_{AB} + R_{BEDI}\Omega^{DCI}\mathcal{D}_C F_A{}^E - 3R_{BIDE}\Omega^{DCI}\mathcal{D}_C F_A{}^E \\
& -2R_D{}^E{}_{EI}\Omega^C{}_A{}^I\mathcal{D}_C F_B{}^D + 2R_C{}^E{}_{EI}\Omega^C{}_A{}^I\mathcal{D}_D F_B{}^D - R_{AEBI}\Omega^{DCI}\mathcal{D}_D F_C{}^E + R_{AEBI}\Omega_C{}^{CI}\mathcal{D}_D F^{DE} \\
& +R_{BICE}\Omega^C{}_A{}^I\mathcal{D}_D F^{DE} - 2R_{BCDI}\Omega^{DCI}\mathcal{D}_E F_A{}^E - R_{ADBI}\Omega^{DCI}\mathcal{D}_E F_C{}^E - R_{CEDI}\Omega^{DCI}\mathcal{D}^E F_{AB} \\
& +3R_{BEDI}\Omega^{DCI}\mathcal{D}^E F_{AC} - R_{BIDE}\Omega^{DCI}\mathcal{D}^E F_{AC} - 2R_{BEDI}\Omega_C{}^{CI}\mathcal{D}^E F_A{}^D + R_{BIDE}\Omega_C{}^{CI}\mathcal{D}^E F_A{}^D \\
& -2R_{CEDI}\Omega^C{}_A{}^I\mathcal{D}^E F_B{}^D + R_{BEDI}\Omega^C{}_A{}^I\mathcal{D}^E F_C{}^D - 2R_{BIDE}\Omega^C{}_A{}^I\mathcal{D}^E F_C{}^D H_{CIJ}\Omega^{BAI}\Omega^C{}_A{}^J\mathcal{D}_D F_B{}^D \\
& +F^{AB}\mathcal{D}_D F_C{}^E\mathcal{D}^D F_A{}^C\mathcal{D}_F H_{BE}{}^F - F^{AB}\mathcal{D}^D F_A{}^C\mathcal{D}^E F_{CD}\mathcal{D}_F H_{BE}{}^F - F^{AB}\mathcal{D}^D F_A{}^C\mathcal{D}_E H_{BDF}\mathcal{D}^F F_C{}^E \\
& -H_{BDF}\mathcal{D}^C F^{AB}\mathcal{D}^E F_A{}^D\mathcal{D}^F F_{CE} + F^{AB}\mathcal{D}^D F_A{}^C\mathcal{D}_F H_{BCE}\mathcal{D}^F F_D{}^E + \frac{1}{2}H_{DIJ}\Omega^{BAI}\Omega^C{}_A{}^J\mathcal{D}^D F_{BC} \\
& +\frac{1}{2}H_{DIJ}\Omega^{BAI}\Omega^C{}_A{}^J\mathcal{D}^D F_{BC} - H_{DIJ}\Omega^{BAI}\Omega^{DCJ}\mathcal{D}_B F_{AC} - 3H_{CIJ}\Omega_A{}^{AI}\Omega^{CBJ}\mathcal{D}_D F_B{}^D \\
& +5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_B H_{CIJ} + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_B H_{DIJ} - 5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_C H_{BIJ} \\
& -3F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_D H_{BIJ} - 5H_{CDE}\Omega_A{}^{AI}\Omega^{CB}{}_I\mathcal{D}_B F^{DE} - 5H_{DIJ}\Omega^{BAI}\Omega^C{}_A{}^J\mathcal{D}_C F_B{}^D \\
& +3F^{AB}\Omega^C{}_A{}^I\Omega^{ED}{}_I\mathcal{D}_E H_{BCD} - F^{AB}\Omega^C{}_A{}^I\Omega_D{}^D{}_I\mathcal{D}_E H_{BC}{}^E + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_{CI}\mathcal{D}_E H_{BD}{}^E \\
& +5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_I H_{BCJ} + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_I H_{BDJ} + F^{AB}\Omega_C{}^{CI}\Omega_D{}^{DJ}\mathcal{D}_J H_{ABI} \\
& -F^{AB}\Omega_{DC}{}^J\Omega^{DCI}\mathcal{D}_J H_{ABI} - 5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_J H_{BCI} - F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_J H_{BDI} \\
& +\frac{1}{2}F^{AB}\Omega_C{}^{CI}\Omega_D{}^D{}_I\mathcal{D}_E H_{AB}{}^E - \frac{1}{2}F^{AB}\Omega_{DCI}\Omega^{DCI}\mathcal{D}_E H_{AB}{}^E - \frac{1}{2}H_{BDE}\Omega^{BAI}\Omega^{DC}{}_I\mathcal{D}_C F_A{}^E \\
& -H_{DIJ}\Omega^{BAI}\Omega^{DCJ}\mathcal{D}_B F_{AC} - 3H_{CIJ}\Omega_A{}^{AI}\Omega^{CBJ}\mathcal{D}_D F_B{}^D + 3H_{CDE}\Omega_{BAI}\Omega^{BAI}\mathcal{D}^E F^{CD} \\
& +5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_B H_{CIJ} + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_B H_{DIJ} - 5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_C H_{BIJ} \\
& -3F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_D H_{BIJ} - 5H_{CDE}\Omega_A{}^{AI}\Omega^{CB}{}_I\mathcal{D}_B F^{DE} - 5H_{DIJ}\Omega^{BAI}\Omega^C{}_A{}^J\mathcal{D}_C F_B{}^D \\
& +3F^{AB}\Omega^C{}_A{}^I\Omega^{ED}{}_I\mathcal{D}_E H_{BCD} - F^{AB}\Omega^C{}_A{}^I\Omega_D{}^D{}_I\mathcal{D}_E H_{BC}{}^E + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_{CI}\mathcal{D}_E H_{BD}{}^E \\
& +5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_I H_{BCJ} + F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_I H_{BDJ} + F^{AB}\Omega_C{}^{CI}\Omega_D{}^{DJ}\mathcal{D}_J H_{ABI} \\
& -F^{AB}\Omega_{DC}{}^J\Omega^{DCI}\mathcal{D}_J H_{ABI} - 5F^{AB}\Omega^C{}_A{}^I\Omega_D{}^{DJ}\mathcal{D}_J H_{BCI} - F^{AB}\Omega^C{}_A{}^I\Omega^D{}_C{}^J\mathcal{D}_J H_{BDI} \\
& +\frac{1}{2}F^{AB}\Omega_C{}^{CI}\Omega_D{}^D{}_I\mathcal{D}_E H_{AB}{}^E - \frac{1}{2}F^{AB}\Omega_{DCI}\Omega^{DCI}\mathcal{D}_E H_{AB}{}^E - \frac{1}{2}H_{BDE}\Omega^{BAI}\Omega^{DC}{}_I\mathcal{D}_C F_A{}^E \\
& +4\Omega_{CD}{}^I\Omega^E{}_{EI}\mathcal{D}_A\mathcal{F}_B{}^D\mathcal{D}^A\mathcal{F}^{BC} - 8\Omega_C{}^{EI}\Omega_{DEI}\mathcal{D}_A\mathcal{F}_B{}^D\mathcal{D}^A\mathcal{F}^{BC} - 4\Omega^D{}_D{}^I\Omega^E{}_{EI}\mathcal{D}^A\mathcal{F}_A{}^B\mathcal{D}^C\mathcal{F}_{BC} \\
& -4\Omega_C{}^{EI}\Omega_{DEI}\mathcal{D}^A\mathcal{F}_A{}^B\mathcal{D}^C\mathcal{F}_B{}^D + 12\Omega_{CD}{}^I\Omega^E{}_{EI}\mathcal{D}^A\mathcal{F}_A{}^B\mathcal{D}^C\mathcal{F}_B{}^D + 8\Omega_{AC}{}^I\Omega_{DEI}\mathcal{D}^A\mathcal{F}^{BC}\mathcal{D}^D\mathcal{F}_B{}^E \\
& +4\Omega^{ABI}\Omega_{AB}{}^J\Omega^{CD}{}_I\Omega_{CDJ} - 4\Omega^{ABI}\Omega_A{}^C{}_I\Omega_B{}^{DJ}\Omega_{CDJ} + 4\Omega^A{}_A{}^I\Omega^{BC}{}_I\Omega_B{}^{DJ}\Omega_{CDJ} \\
& -6\Omega^A{}_A{}^I\Omega^B{}_B{}^J\Omega^{CD}{}_I\Omega_{CDJ} + 2\Omega^A{}_A{}^I\Omega^B{}_{BI}\Omega^C{}_C{}^J\Omega^D{}_{DJ} + \Omega_A{}^{AI}\mathcal{D}_D H_C{}^D{}_I\mathcal{D}_B F^{BC} \\
& -\Omega^{BAI}\Big(\mathcal{D}_B F_A{}^C\mathcal{D}_D H_C{}^D{}_I + \mathcal{D}^D F_A{}^C\mathcal{D}_I H_{BCD} - \frac{1}{2}\mathcal{D}^D F_A{}^C\mathcal{D}_C H_{BDI}\Big) \Big]
\end{aligned}
$$

It was shown in deep detail, that the bosonic couplings described above were consistent with all the linear couplings of closed superstring background fields with higher-dimensional heterotic supergravity theory including exceptional degrees of freedom of multiple D-branes. These couplings were originally computed in the current literature and then extended to Dp-branes with using T-duality symmetries. **Boris Stoyanov** review the illustration of the general formalism with presentation of the WZ term for multiple D-branes that is required to do such matching

$$
\begin{aligned}
S_{\mathcal{WZ}} \;=\;& \Xi_\Sigma \int \mathrm{Tr}\Big[\mathcal{P} \wedge \big(\mathcal{D}^{(\mathcal{R})} + \Delta(\Xi_\Sigma)\big(\mathcal{D}^{(\mathcal{V})} \wedge \mathcal{B}\big) - \Delta(\Xi_\Sigma)\left(\mathcal{D}^{(\mathcal{U})} \wedge \mathcal{B} + \frac{1}{2}\mathcal{D}^{(\mathcal{R})} \wedge \mathcal{B} \wedge \mathcal{B}\right) \\
& -\Delta(\Xi_\Sigma)\left(\mathcal{D}^{(\mathcal{Z})} + \mathcal{D}^{(\mathcal{T})} \wedge \mathcal{B} + \frac{1}{2}\mathcal{D}^{(\mathcal{V})} \wedge \mathcal{B} \wedge \mathcal{B} + \frac{1}{6}\mathcal{D}^{(\mathcal{R})} \wedge \mathcal{B} \wedge \mathcal{B} \wedge \mathcal{B}\right) \wedge \mathcal{B} \wedge \mathcal{D}^{(\mathcal{Z})} \\
& -\Delta(\Xi_\Sigma)\left(\mathcal{D}^{(\mathcal{Z})} + \frac{1}{2}\mathcal{D}^{(\mathcal{T})} \wedge \mathcal{B} + \frac{1}{6}\mathcal{D}^{(\mathcal{R})} \wedge \mathcal{B} \wedge \mathcal{B} + \frac{1}{24}\mathcal{D}^{(\mathcal{Z})} \wedge \mathcal{B} \wedge \mathcal{B} \wedge \mathcal{B}\right) \wedge \mathcal{B} \wedge \mathcal{D}^{(\mathcal{Z})} \\
& +\Delta(\Xi_\Sigma)\Big(\mathcal{D}^{(\mathcal{U})} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{U})} \wedge \mathcal{G} \wedge \mathcal{K}^{(\mathcal{R})} - \mathcal{D}^{(\mathcal{T})} \wedge \mathcal{K}^{(\mathcal{R})} - \mathcal{D}^{(\mathcal{T})} \wedge \mathcal{K}^{(\mathcal{R})} \wedge \mathcal{G} \wedge \mathcal{K}^{(\mathcal{T})}\Big) \\
& +\Delta(\Xi_\Sigma)\left(\mathcal{D}^{(\mathcal{T})} + \mathcal{B} \wedge \mathcal{D}^{(\mathcal{V})} - \mathcal{D}^{(\mathcal{V})} \wedge \mathcal{K}^{(\mathcal{R})} \wedge \mathcal{G} - \mathcal{B} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{V})} \wedge \mathcal{K}^{(\mathcal{R})}\right) \wedge \mathcal{K}^{(\mathcal{V})} \\
& -(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B}) + \mathcal{B} \wedge \mathcal{L}^{(\mathcal{Z})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} - \mathcal{B} \wedge \mathcal{L}^{(\mathcal{R})} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{G} \wedge \mathcal{L}^{(\mathcal{W})} \\
& -\Delta(\Xi_\Sigma)\left(\mathcal{B} - \mathcal{D}^{(\mathcal{Z})} \wedge \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{L}^{(\mathcal{W})} \wedge \mathcal{L}^{(\mathcal{V})}\right) + \left(\mathcal{B}^{(\mathcal{X})} - \frac{1}{2}\mathcal{B} \wedge \mathcal{D}^{(\mathcal{Z})} \wedge \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{L}^{(\mathcal{Z})}\right) \\
& +\left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B}\right) \wedge \mathcal{L}^{(R)} + \left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{W})} \wedge \mathcal{L}^{(\mathcal{V})}\right) \wedge \mathcal{L}^{(\mathcal{Z})} \wedge \mathcal{G} \\
& +\left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{R})} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{Z})} \wedge \mathcal{L}^{(\mathcal{R})} \wedge \mathcal{G}\right) \wedge \mathcal{L}^{(\mathcal{W})} \\
& -\Delta(\Xi_\Sigma)\left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} - \mathcal{B} \wedge \mathcal{L}^{(\mathcal{R})} + \mathcal{B} \wedge \mathcal{L}^{(\mathcal{R})} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{G}\right) \wedge \mathcal{L}^{(\mathcal{R})} \\
& +\left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B}\right) \wedge \mathcal{L}^{(R)} + \left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{W})} \wedge \mathcal{L}^{(\mathcal{V})}\right) \wedge \mathcal{L}^{(\mathcal{Z})} \wedge \mathcal{G} \\
& +\left(\mathcal{D}^{(\mathcal{W})} + \mathcal{D}^{(\mathcal{S})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{R})} \wedge \mathcal{G} + \mathcal{D}^{(\mathcal{W})} \wedge \mathcal{B} \wedge \mathcal{L}^{(\mathcal{Z})} \wedge \mathcal{G}\right) \wedge \mathcal{L}^{(\mathcal{W})} \wedge \mathcal{L}^{(\mathcal{V})}\Big]
\end{aligned}
$$

Boris Stoyanov summarise the main theoretical facts regarding the exclsuive magical description of multiple brane systems with D-branes and special Reissner-Nordström branes constructions extended with dyonic, black and ghost brane systems. Regarding D-branes, this includes an introduction to Super Yang-Mills theories in D+1 dimensions, a summary of statements regarding higher order corrections in these effective actions and the more relevant results and dificulties regarding the attempts to covariantise these gauge superfield couplings to arbitrary higher-dimensional curved spacetime backgrounds. Regarding ghost branes, **Boris Stoyanov** review the more recent supersymmetric Chern-Simons matter theories describing their low energy dynamics, using field theory of heterotic supergravity with superstrings in hypermanifolds and extreme brane systems construction considerations. The latter allows to provide an explicit example of the geometrisation of supersymmetric field theories provided by the exceptional supermembrane theory. The advanced research projects of **Boris Stoyanov** will shows that we have advanced interpretations of the supergravity transformations plus supertstring interactions on a supermanifolds and moduli superspaces solutions, with the possibility that suitable combinations of these transformations in the higher-dimensional interactions directly give rise to advanced membrane models consructions and interpretations. In the presented theoretical framework on exclusive structures of heterotic supergravity with membrane theory, **Boris Stoyanov** continue the accelerated attempt to consider a satisfactory part of hyperspace with brane systems in the visible and hidden sectors made with consistent structures of dyonic, black and ghost branes including elegantly interacting systems with heterotic supergravity backgrounds. The higher-dimensional supergravity theory could encompass all known supergravities and superstrings, in the spirit of fundamental membrane theory. The behavior of the bulk and brane systems has been an important ingredient in understanding and quantifying the supergravity, superstring theory and equivalently the higher-dimensional membrane models of supergravity coupled to matter and other special fundamental interactions. The special feature of higher dimensions which is useful for the study of membranes is that some models admit their interpretation as supergravity and superstring theories in higher dimensional superspace moduli constructions with magical hypermanifolds interpretations.

Boris Stoyanov apply the universal recipe of the preceding section to write the heterotic corresponding action based on the heterotic moduli superspace construction. For the exceptional case of branes/dual branes system the appropriate higher-dimensional theory includes special bulk action asymmetric structure and hidden brane lagrangian, the brane, the brane fields coupling action and hidden brane couplings term where the asymmetric action represents the interaction between branes and heterotic prepotentials in higher-dimensional spacetime supermanifold. The equation is created with the inclusion of ten-dimensional heterotic supergravity, ten-dimensional interaction term, lagrangian of the heterotic superstring and the special term for five-branes. The general representation of the higher-dimensional heterotic corresponding action for the branes/dual branes system is

$$
\begin{aligned}
S_{\mathcal{B}/\mathcal{DB}} \;=\; & \int_{\Sigma_{\hat{\Delta}}} d^D x \sqrt{\mathcal{G}_{\hat{\Delta}}}\, \mathcal{R}_{\hat{\Delta}} \widetilde{\mathcal{L}}_{\Xi\mathcal{FF}} + \sum_{\hat{\Delta}} \Big\{ \hat{\Delta} \int_{\hat{\Delta}} d^D x \sqrt{-\mathcal{G}_{\hat{\Delta}}}\, \mathcal{R}_{\hat{\Delta}}\, \widetilde{\mathcal{L}}_{\mathcal{B}}(\Sigma_{\hat{\Delta}}) + \widetilde{\mathcal{L}}_{\mathcal{BR}}(\Sigma_{\hat{\Delta}}) + \widetilde{\mathcal{L}}_{\mathcal{HBR}}(\Sigma_{\hat{\Delta}}) \\
& + \hat{\Xi}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\Delta}}, \hat{\mathcal{F}}_{\hat{\Delta}}, \hat{\mathcal{V}}_{\hat{\Delta}}, \hat{\mathcal{W}}_{\hat{\Delta}}) \Big\} + \sum_{\hat{\mathcal{D}}} \Big\{ \int_{\Sigma_{\mathcal{D}}} d^D x \sqrt{\mathcal{G}_{\hat{\mathcal{D}}}} \widetilde{\mathcal{L}}^{\mathcal{D}}_{\mathcal{AS}}(\Sigma_{\hat{\mathcal{D}}}) + \int_{\Sigma_{\mathcal{D}}} d^D x \sqrt{\mathcal{G}_{\hat{\mathcal{D}}}} \widetilde{\mathcal{L}}^{\mathcal{D}}_{\mathcal{BFC}}(\Sigma_{\hat{\mathcal{D}}}) \\
& + \int_{\Sigma_{\mathcal{D}}} d^D x \sqrt{\mathcal{G}_{\hat{\mathcal{D}}}} \widetilde{\mathcal{L}}^{\mathcal{D}}_{\mathcal{HBC}}(\Sigma_{\hat{\mathcal{D}}}) + \hat{\Xi}^{\mathcal{D}}_{\mathcal{BR}}(\Sigma_{\hat{\mathcal{D}}}) + \hat{\Xi}^{\mathcal{D}}_{\mathcal{HBR}}(\Sigma_{\hat{\mathcal{D}}}) + \hat{\Xi}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}}, \widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}}, \widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}}, \widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}}) \Big\} \\
& + \int_{\Sigma_{\mathcal{D}10}} d^{10} x \sqrt{\mathcal{G}_{\mathcal{D}10}} \mathcal{R}_{\mathcal{D}10} \widetilde{\mathcal{L}}_{\mathcal{SUGRA}}(\Sigma_{\mathcal{D}10}) + \int_{\Sigma_{\mathcal{D}10}} d^{10} x \sqrt{\mathcal{G}_{\mathcal{D}10}} \mathcal{R}_{\mathcal{D}10} \widetilde{\mathcal{L}}_{\mathcal{INT}}(\Sigma_{\mathcal{D}10}) \\
& + \int_{\Sigma_{\mathcal{D}2}} d^2 x \sqrt{\mathcal{G}_{\mathcal{D}2}} \mathcal{R}_{\mathcal{D}2} \widetilde{\mathcal{L}}_{\mathcal{STR}}(\Sigma_{\mathcal{D}2}) + \int_{\Sigma_{\mathcal{D}6}} d^6 x \sqrt{\mathcal{G}_{\mathcal{D}6}} \mathcal{R}_{\mathcal{D}6} \widetilde{\mathcal{L}}_{5\mathcal{BR}}(\Sigma_{\mathcal{D}6})
\end{aligned}
$$

The current research of **Boris Stoyanov** have shown that there is a large class of solutions to the Type IIA, Type IIB and Heterotic Supergravity formulations including superstrings and fundamental membranes. Boris have a vision for different theoretical developments on the fundamental membrane theories in the higher dimensional curved spacetime in the current issue of supermanifolds based on the superspaces plus their participation in the hyperspace of the multiverse, where swim, interact and live with extreme fundamental development of these membrane parallel universes. The deep relation between superstring theory and the higher dimensional supergravity provides a basis to conjecture the existence of a theory that similarly completes the supergravity constructions in the various fundamental membrane models. Indeed, it was long expected that fundamental membranes play a role analogous to the one that superstrings play in completing ten and eleven dimensional supergravities. This idea was further stimulated by the discovery that when compactifying eleven dimensional supergravity, wrapped membranes naturally turn into the fundamental superstrings of the types IIA, IIB and Heterotic Superstring Theories. All fundamental analysis of **Boris Stoyanov** is performed at the supergravity level using an effective field theory approach in the higher-dimensional constructions. Several simplifying assumptions are made, in order to restrict the possible in future membrane theory to a tractable, flexible and intuitive system.

The integration of ghost shadow hyperspace with inclusion of higher-dimensional constructions on dyonic, black and ghost supermembranes in the exclusive heterotic supergravity framework is presented

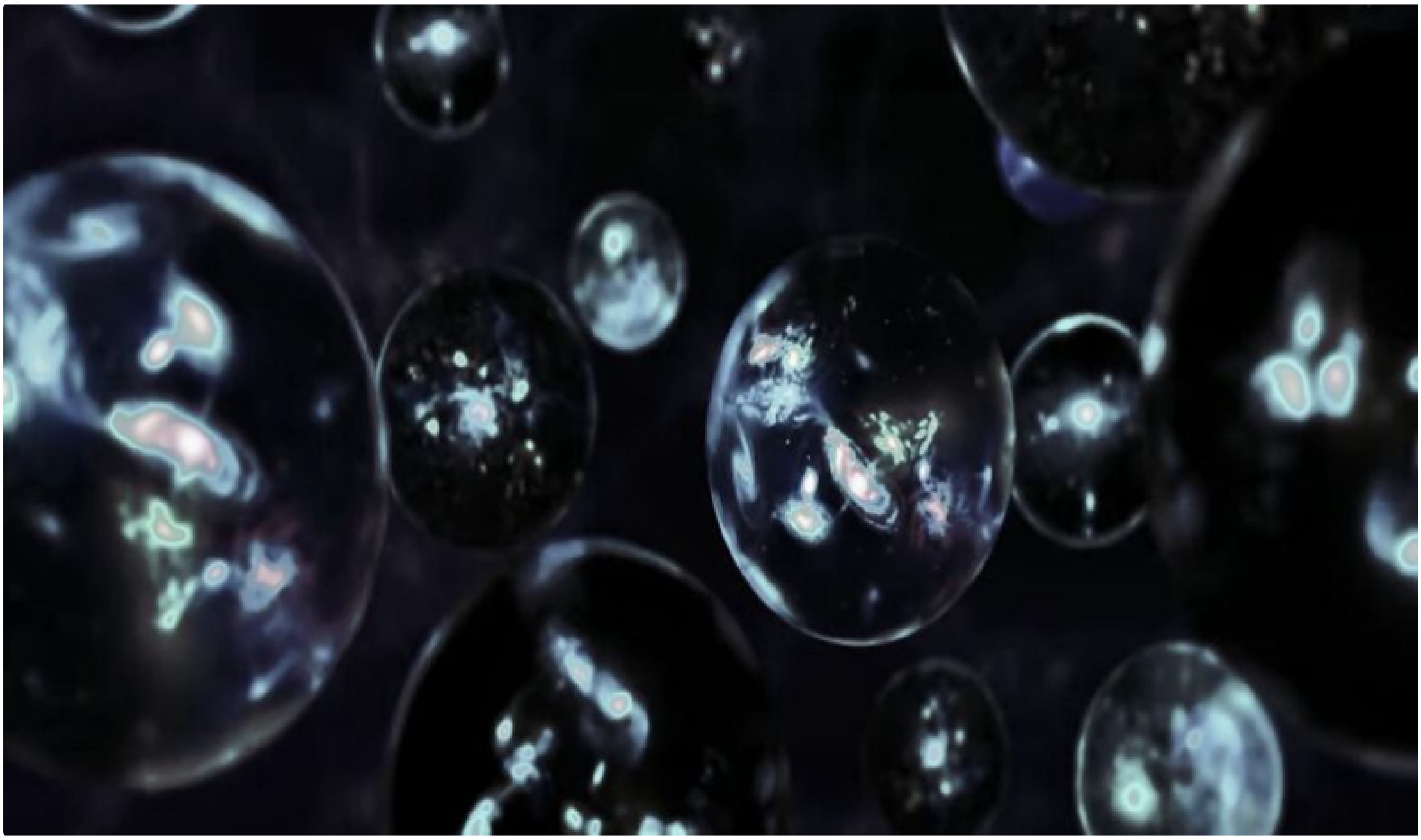
$$\int_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \widetilde{\mathcal{G}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{S}\oplus\mathcal{H}} \left[\Sigma^{\hat{\mathcal{B}}}_{[\Xi]}(\widetilde{\mathcal{D}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{DYB}}, \widetilde{\mathcal{P}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{BLB}}, \widetilde{\mathcal{W}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{GHB}}\right]^{\dagger} \rightsquigarrow \sum_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{N}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{T}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \int_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \widetilde{\mathcal{D}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{DYB}} (\Delta^{\hat{\mathcal{B}}}_{[\Xi]})^{\dagger}$$

$$\bigoplus \sum_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{N}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{T}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \int_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \widetilde{\mathcal{P}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{BLB}} (\Delta^{\hat{\mathcal{B}}}_{[\Xi]})^{\dagger} \bigoplus \sum_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{N}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \mathcal{T}_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \int_{(\Delta^{\hat{\mathcal{B}}}_{[\Xi]})} \widetilde{\mathcal{W}}^{Z^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}}_{\mathcal{GHB}} (\Delta^{\hat{\mathcal{B}}}_{[\Xi]})^{\dagger}$$

The introduced higher-dimensional hypermanifolds provides an example of a black branes sector with a runaway heterotic prepotential and the moduli supermanifolds whose coupling to matter is very weak, contrary to the usual lore that ghost branes must couple strongly to matter and lead to quantum gravitational inconsistencies. In this respect, extended heterotic supergravity may be particularly interesting as the black and ghost branes hidden sector if the mysterious mass quantization rule has some fundamental meaning and remains stable with respect to the interaction of the ultra-light scalars with the supermanifolds from the observable sector. One may even argue that the reason for using extended heterotic supergravities is due to the nature of quantum gravitational and hypermanifolds that may live in the higher dimensions, where the supergravity generators is the smallest supersymmetry available. However, realistic models of brane systems in the context of supergravity, superstrings and extra dimensions are yet to be elegantly developed. For the time being, one may consider the simple models of black and ghost branes based on supergravity as the special theoretical models with some interesting and very unusual features that could be studied by quantum cosmological observations, where this cosmological picture can be related to supergravity higher-dimensional interactions of the different brane systems. The generic higher-dimensional heterotic supergravity which will be used for the ghost branes hidden sector has part which includes supergravity coupled to complex hypermanifolds and the current heterotic superpotentials in the effective actions. The solution of the higher-dimensional heterotic corresponding action for the dyonic/black/ghost brane system is

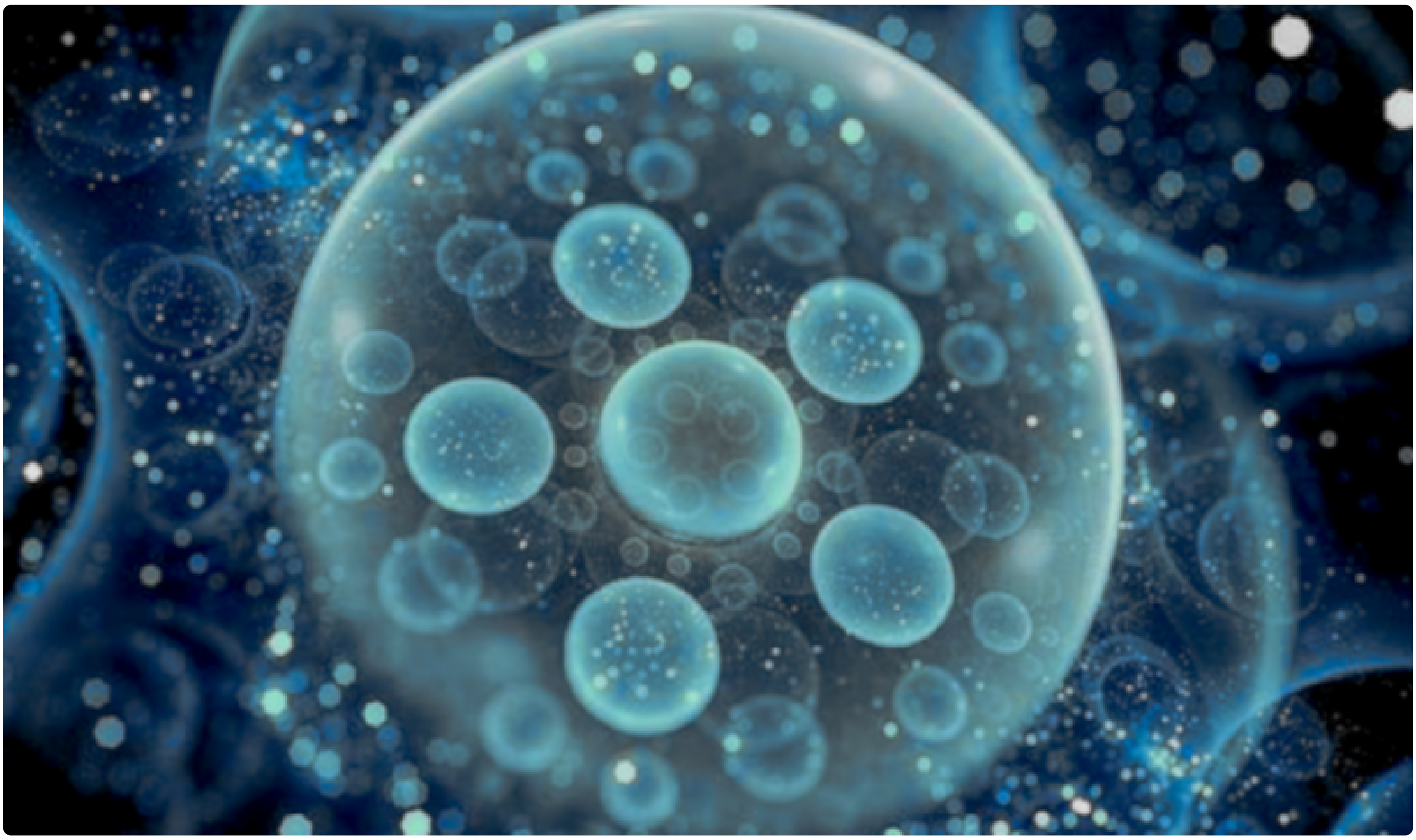
$$
\begin{aligned}
S_{\mathcal{DBG}/\mathcal{BR}} \;=\; & \int_{\Sigma_{\hat{\Delta}}} d^D x\sqrt{\mathcal{G}_{\hat{\Delta}}}\,\mathcal{R}_{\hat{\Delta}}\;\mathcal{I}_{\mathcal{DCB}}(\mathcal{G},\mathcal{A}^{\Lambda},\Phi^{\Lambda})+\sum_{\hat{\Delta}}\Big\{\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{-\mathcal{G}_{\hat{\Delta}}}\;\mathcal{R}_{\hat{\Delta}}\Big[\hat{\Delta}\mathcal{I}_{\mathcal{BR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{HBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{PBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}})+\hat{\Delta}\mathcal{I}_{\mathcal{DBI}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{WZ}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{BPS}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{RNB}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})\Big] \\
& +\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{\mathcal{G}_{\hat{\mathcal{D}}}}\mathcal{R}_{\hat{\Delta}}\Big[\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}})+\hat{\mathcal{D}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}}) \\
& +\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{U}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\mathcal{O}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{Q}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{BR}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{HBR}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{DCB}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{DCB}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})\Big]\Big\} \\
& +\int_{\Sigma_{\hat{\Delta}}} d^D x\,\sqrt{\mathcal{G}_{\hat{\Delta}}}\,\mathcal{R}_{\hat{\Delta}}\mathcal{I}_{\mathcal{BLB}}(\mathcal{G},\mathcal{A}^{\Lambda},\Phi^{\Lambda})+\Sigma_{\hat{\Delta}}\Big\{\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{-\mathcal{G}_{\hat{\Delta}}}\;\mathcal{R}_{\hat{\Delta}}\Big[\hat{\Delta}\mathcal{I}_{\Xi\mathcal{FF}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{AS}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{BR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}})+\hat{\Delta}\mathcal{I}_{\mathcal{HBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{PBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{BPS}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{RNB}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})\Big] \\
& +\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{\mathcal{G}_{\hat{\mathcal{D}}}}\,\mathcal{R}_{\hat{\Delta}}\;\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}})+\hat{\mathcal{D}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}}) \\
& +\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{U}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\mathcal{O}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{Q}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{BR}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{HBR}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{DYB}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{DYB}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})\Big\} \\
& +\int_{\Sigma_{\hat{\Delta}}} d^D x\,\sqrt{\mathcal{G}_{\hat{\Delta}}}\,\mathcal{R}_{\hat{\Delta}}\mathcal{I}_{\mathcal{GHB}}(\mathcal{G},\mathcal{A}^{\Lambda},\Phi^{\Lambda})+\Sigma_{\hat{\Delta}}\Big\{\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{-\mathcal{G}_{\hat{\Delta}}}\;\mathcal{R}_{\hat{\Delta}}\Big[\hat{\Delta}\mathcal{I}_{\Xi\mathcal{FF}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{AS}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{BR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}})+\hat{\Delta}\mathcal{I}_{\mathcal{HBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{BFC}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{DBI}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}})+\hat{\Delta}\mathcal{I}_{\mathcal{WZ}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\Delta}\mathcal{I}_{\mathcal{PBR}}(\mathcal{G},\Phi^{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{BPS}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})+\hat{\Delta}\mathcal{I}_{\mathcal{RNB}}(\mathcal{G},\Phi^{\Lambda},\mathcal{A}_{\Lambda},\mathcal{K}_{\hat{\Delta}},\mathcal{B}_{\hat{\Delta}},\mathcal{P}_{\hat{\Delta}})\Big] \\
& +\hat{\mathcal{T}}_{\hat{\Delta}}\int_{\hat{\Delta}} d^D x\sqrt{\mathcal{G}_{\hat{\mathcal{D}}}}\,\mathcal{R}_{\hat{\Delta}}\;\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}})+\hat{\mathcal{D}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}}) \\
& +\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{U}}^{\mathcal{D}}_{\Lambda}(\Sigma_{\hat{\mathcal{D}}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\Xi\mathcal{FF}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{BR}},\widetilde{\mathcal{W}}^{\mathcal{D}}_{\mathcal{HBR}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{Z}}) \\
& +\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{BR}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{M}}^{\mathcal{D}}_{\mathcal{HBR}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{DYB}}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{N}}^{\mathcal{D}}_{\mathcal{DYB}}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}}) \\
& +\hat{\mathcal{O}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{B}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})+\hat{\mathcal{Q}}^{\mathcal{D}}_{\Lambda}(\hat{\mathcal{P}}^{\mathcal{D}}_{\Lambda},\mathcal{K}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{L}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{W}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}},\mathcal{Z}^{\hat{\Delta}}_{\hat{X}|\mathcal{M}})\Big\}
\end{aligned}
$$

The research article of **Boris Stoyanov** includes brief descriptions and references to the higher-dimensional heterotic supergravity approach to brane effective actions, the description of different brane systems with the magical interpretations of dyonic, black and ghost branes, the exclusive heterotic mirror symmetry invariant brane actions with the prospects to achieve a formulation for multiple brane systems in higher-dimensional spacetime hypermanifolds constructed the visible and hidden sectors of the conventional hyperspaces of supermembranes. Therefore, by the extreme modification of the hidden sector with fundamental supermembranes which we present in the present article, we work in the weak heterotic supergravity coupling regime at the expense of introducing the exclusive hidden higher-dimensional spacetime hypermanifolds as special sector in the conventional hyperspace constructions. **Boris Stoyanov** construct a fully consistent and gauge invariant actions in higher-dimensional heterotic supergravity with presence of backgrounds, superstrings and membrane interpretations in D-dimensional spacetime supermanifolds realized in the theoretical framework. **Boris Stoyanov** discuss and surrendered the challenges involved in the advanced construction of the full higher-dimensional heterotic supergravities in modern and constructive fashion. The main results are both of purely fundamental and mathematical interest and lead, from the physical point of view, to the construction of new realistic heterotic superstring theories in supergravity backgrounds. **Boris Stoyanov** performed dimensional reduction of the higher-dimensional effective actions and displayed the expected global symmetry on the reduced theory of heterotic supergravity. Nowadays, searching for superstrings in supergravity backgrounds directly related to fundamental supermembranes has become a dogma for the theoretical physicists involved. The future of modern theoretical and mathematical physics is dependent on the creation of higher-dimensional models in the theoretical framework used in theories such as supergravity, superstrings and supersymmetric membranes. Based on the methods developed in this advanced research, an alternative to the dimensional reduction procedure has been presented in heterotic supergravities in D-dimensional spacetime supermanifolds with availability of curved backgrounds and a huge number of superfields in the presented fundamental interactions. **Boris Stoyanov** have provided the general technical tools for the computation of higher-dimensional heterotic supergravity theories with inclusion of supermanifolds, superstrings, backgrounds plus fundamental bulk and brane systems. The main objectives of the current research in heteroric supergravity theories are associated with the creation of a unified theoretical framework to explain the structuring and improving the current state of knowledge regarding deep understanding of our elegantly designed world.



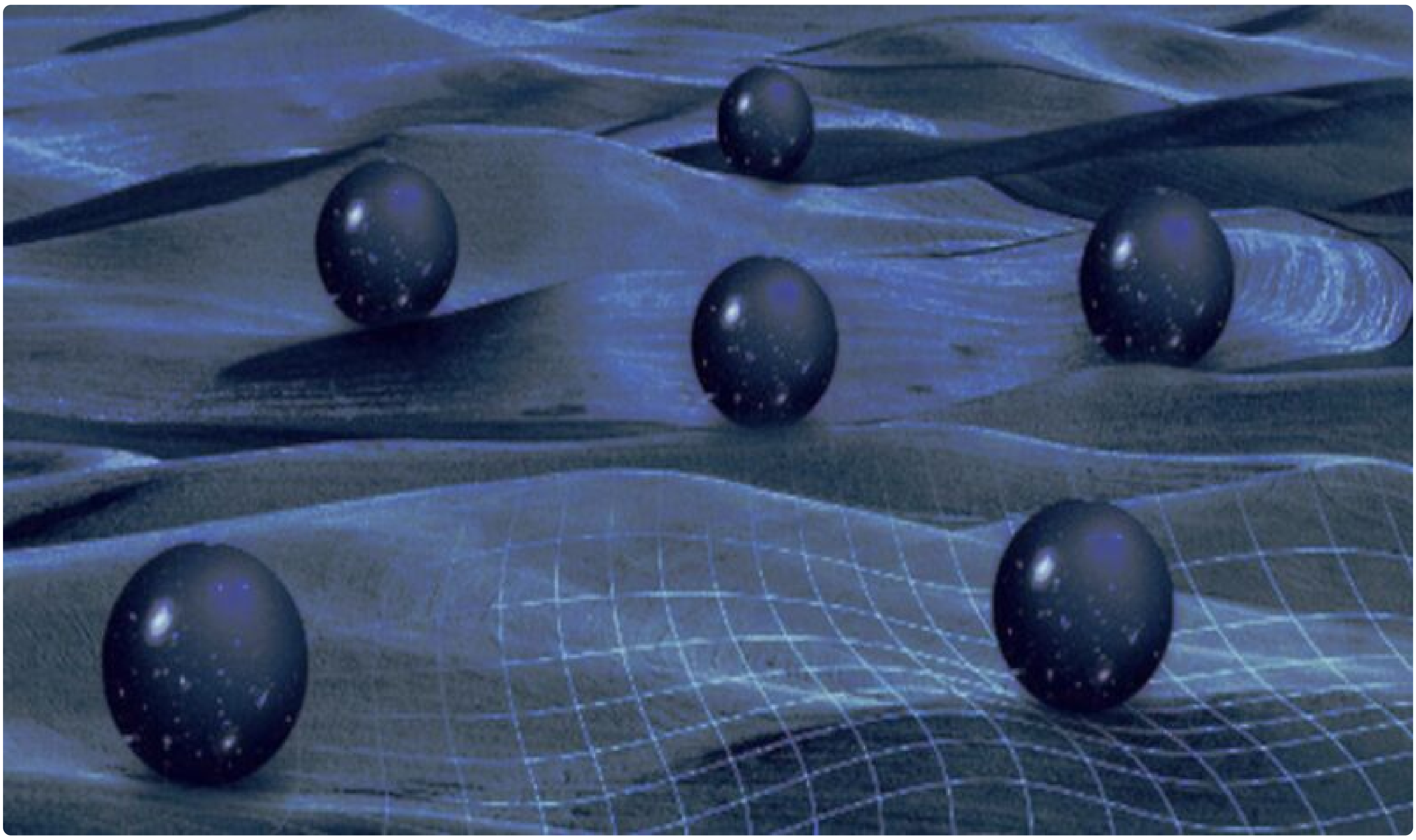
4. Multiversum Doctrina Dominum

Boris Stoyanov is a pioneer, chief ideologue and founder of the last at current stage of human knowledge field of Theoretical and Mathematical Physics called **Multiversum Doctrina Dominum** /MDD-Theory/ with a name derived from Latin, which means the Master Theory of Multiverse. The main idea and goal of the theory is to unite, expand and construct all probable structures of the Multiverse with the exclusive and main component of fundamental membrane systems of parallel universes living in conventional hyperspaces. **Multiversum Doctrina Dominum** by its nature and fundamental structure is a type of Membrane Theory includes realizations, interpretations and constructions of multiple fundamental brane systems, each of them with a different, characteristic and extreme nature. The Philosophy of the introduced theory is to build a complete probabilistic picture of an indefinite number of parallel universes in a vast hyperspace of the multiverse. The special feature of higher-dimensions which is useful for the study of membrane universes is that some models admit their interpretation as supergravity and superstring theories in higher dimensional curved superspace. The MDD-Theory find exclusive sources of interactions between different membrane universes, for any higher-dimensional surface of the curved spacetime in the multiverse hyperspace. Using the results that **Boris Stoyanov** have covered as a starting point the most urgent area of investigation is clearly the dynamics of multiple supermembranes. Here **Boris Stoyanov** have surveyed some recent progress in this direction but it is likely that much more will come in the near future. Using MDD-Theory **Boris Stoyanov** introduces the concepts of mirror, ghost and shadow brane-antibrane systems, brane collections, hyperdomain of hypermanifolds, conventional hyperspaces and a number of higher-dimensional interactions of multiple brane systems in hidden and observable sectors of the multiverse. There are of course many other open questions within the vast and beautiful structure of the modern membrane theory, we hope that their resolution and extreme theoretical framework will continue to benefit the beautiful constructions with both fundamental mathematics and theoretical physics. The physics of fundamental supermembranes of **Multiversum Doctrina Dominum** will develop and reshaped the fundamental picture with the advanced knowledge of the world in which we live and will extremely create the necessary idea of our multiverse in the very near future for the mankind.



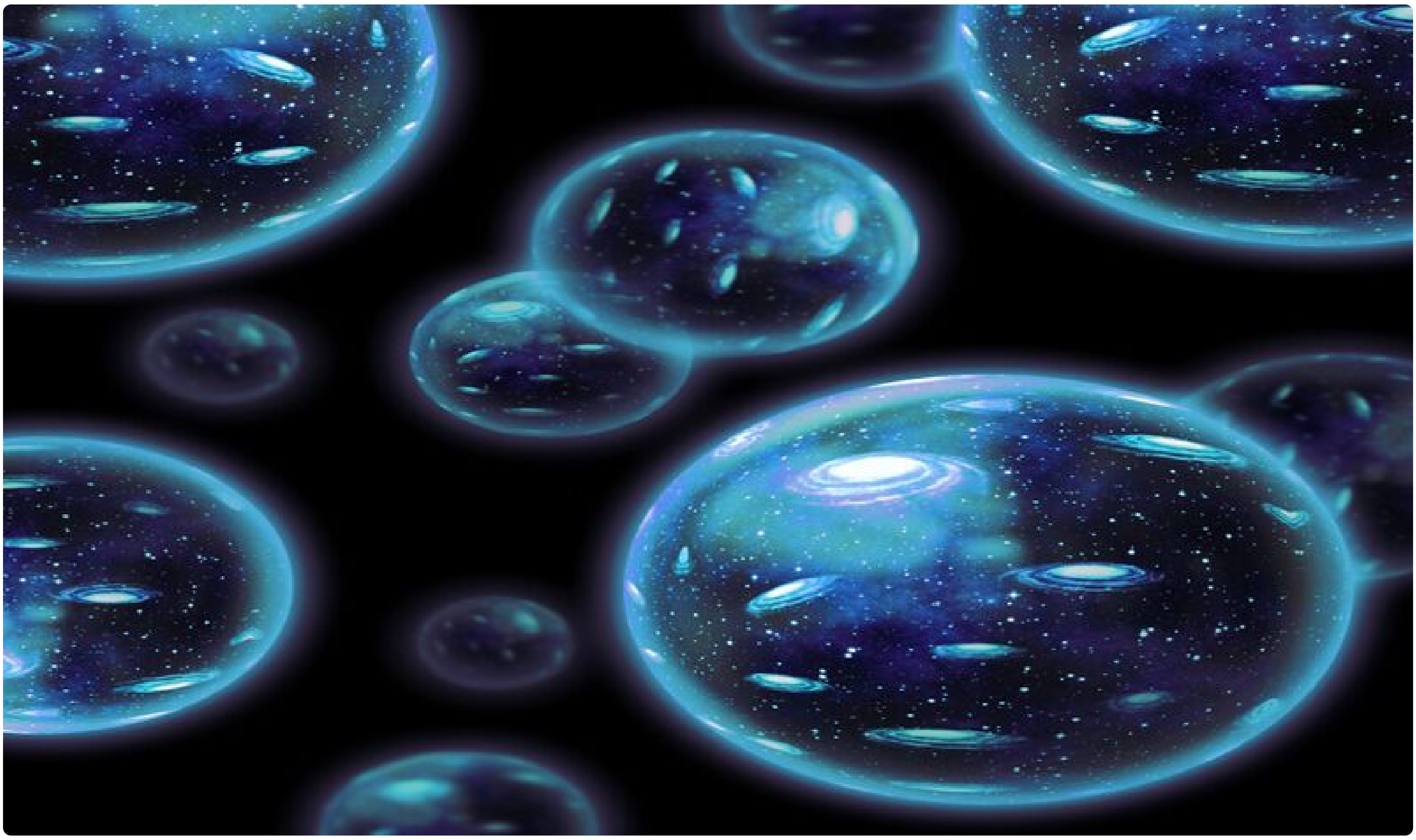
4.1. Geometry of Hypermanifolds

Boris Stoyanov aims to build a fundamentally new field of **Physics** and **Mathematics** considering conventional models of hypermanifolds and hyperspaces, briefly called the Geometry of Hypermanifolds or Hypergeometry. The project for a new type of Mathematical Physics will be a similar consequence of the Geometry of Manifolds and Supermanifolds, already introduced and used successfully by physicists and mathematicians. The aim is to generalize this point of view, introducing hypermanifolds as hyperspaces, which are the hypergeometric counterpart of locally superspaces known so far and presented in contemporary literature. The concept of hypermanifolds will be built in the interior of the hyperdomain with different collections of possible brane systems. These hyperdomains are actually able to construct local conventional hyperspaces with the noninvertible extension of the notion of a hypermanifold with the addition of coordinate hypermaps. The hypermanifold is a specific type of hyperspace, which we describe via alocal hypermodel, namely it is locally isomorphic to the hyperspace introduced previously. Morphisms of hypermanifolds are morphisms of the underlying hyperspaces. The presence of coordinates in special hypermaps steals some of the geometric intuition away from the language of supergeometry and subsequently hypergeometry. Geometric integration theory on hypermanifolds will be presented with the aid of a maximum principle in the complex hyperdomain. Invariant integration on homogeneous and inhomogeneous hypermanifolds will build the overall picture and show the way for the construction of realistic hyperdomains. From the point of view of the geometry and analysis of the hyperspaces, it is desirable to have generalizations of all of these facts to the hypermathematical context to show the way to building a realistic membrane theory with the inclusion of multiple brane systems.



4.2 Theory of Hypergravity

The question **Boris Stoyanov** seek to answer is whether the set of consistent deformations of the free theory leads uniquely to generalized hypergravity. The current approach assumes neither general covariance nor local hypersymmetry or hypergeometry to begin with the outlined hypergravity theory, that to some extend parallels the membrane theories. The advantage of this theoretical approach is that it systematizes the search for all possible consistent interactions in one unified theoretical framework. The hypergravity interaction is defined with the creation of the effective interaction with insertions of indefinite number of the fundamental membranes along the other higher-dimensional hypermanifolds. Aside from the categorical formulation, these ideas are not new in theoretical physics. In particular, the picture of a multiple branes which comes into play only at the membrane theory and softens out short distance behavior is very similar to supersymmetric gravitational and string theories. The task of formulating a unitary renormalizable theory of Quantum Gravity is apparently the most outstanding one in contemporary Theoretical Physics. Numerous various field-theoretical approaches have been proposed, however each one fails to meet all basic physical or mathematical requirements. Simultaneous feature of unitary and renormalizability of such theories has been one of the most difficult requirements. The justification for any fundamental reformulation must be that it opens new possibilities for investigation. There are of course many other open questions within the vast and beautiful structure of the modern membrane theory, and strong hope that their resolution and extreme theoretical framework will continue to benefit the beautiful constructions with both fundamental mathematics and theoretical physics. Further work in this direction has the potential to shed light on the relation to recent advances in our understanding of the hypergravity. Nevertheless, even given the limitations of our computations, the results do have some interesting ranges of validity in the construction of realistic membrane theory with inclusion of hypergravity. It would be interesting to see whether these exceptional cases can be given a higher-dimensional interpretation by some other engineering techniques. In the potencial theory of hypergravity are many technical issues raised by the current computations which should be solved and which moreover can be solved with presently available technology.



5. Realistic Membrane Theory

Boris Stoyanov examine models directly related to membrane universes and a wide range of direct applications of the contemporary theoretical and mathematical physics in its various manifestations, realizations and shapes. He present different supersymmetric membrane solutions of eleven-dimensional supergravity with special realizations of the highly extreme areas of superstring theory, M-Theory and F-Theory. The theory allows for the existence of many parallel universes where the laws of nature are slightly different from ours and describe another type equations. The membranes enable a whole new range of possibilities in the field of physics of extra dimensions, as the particles with their quantum fields limited to the membrane will interact through various fundamental laws of a parallel universes. **Boris Stoyanov** have shown that mirror universes can provide a significant contribution to the energy density of the multiverse, and thus they could represent the component of dark matter and dark energy making up the special type of mirror universes with their fundamental interactions. The significant breakthrough and interpretations with the sense over theories in higher dimensions and the victory of the theory of hyperspace in the identification and examination of higher dimensions of spacetime. Supergravity is comparatively beautiful theory that has long existed in the shadow of superstring theory as a unifying universal theory. Supergravity posits that the universe consists of eleven dimensions. For the eleventh dimension is assumed that there coexist various membranes which are models of parallel universes. **Boris Stoyanov** examine the multiverse of a somewhat different kind envisaged in the supergravity, superstring theory and their higher and elegant extension M-theory. These theories require the presence of ten or eleven spacetime dimensions respectively which elegant give rise to the more fundamental theory of multiverse. In the membrane theory our universe and others are the result of collisions between membranes in eleven dimensional spacetime. The membrane theory allows for the consideration of many different internal spaces in hyperspace - as much as a huge number of different parallel universes exist, interact and swim in the multiverse with its own special set of laws of nature and different physics. Using the results that **Boris Stoyanov** covered as a starting point, the most urgent area of investigation is clearly the dynamics of multiple supermembranes. The problem with realistic construction of membrane theory would arise if higher dimensions are invisible to us, at least in conventional ways to verify the theory. The fundamental interaction between the hidden and dark sectors with branes implies that all the soft higher-dimensional terms acquire a supergravity dependent form and this has a drastic effect on the supergravity theory at low energy scales. **Boris Stoyanov** assumed that the dark energy hidden sector can be successfully incorporated into the theory of elementary particles and that the cosmological inclusion of membranes in the observable sector can somehow be solved in the hyperspace framework. There are two sectors, the observable sector and the hidden sector of black and ghost branes plus the assumption that the two sectors interact quantum gravitationally with the supersymmetric representations of quantum gravity in diverse dimensions. Then, the main issue is to understand how the dyonic, black and ghost branes can be implemented into the theoretical framework. In fact, membrane theory allows for the consideration of many different internal spaces in hyperspace, as much as a huge number of different parallel universes exist, interact and swim in the multiverse with its own special set of laws of nature and different physics. In the membrane theory our universe and others are the result of collisions between membranes in eleven dimensional spacetime. Unlike quantum universes in the multiverse membrane universes can have completely different laws of physics, it no limit and anything is possible, by the theory can realize all the possibilities of their existence and fundamental nature.

Further Reading

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