I. Introduction

The experimental results at LEP and future experiments are clear indications of the existence of a new force which has not been detected in the standard model. This force is characterized by a Higgs field, which is responsible for giving mass to elementary particles.

The most general form of the potential, given in the context of the Standard Model, is

\[ V(\phi) = \frac{1}{2} m^2 \phi^2 + \frac{1}{4} 
\begin{align*}
\lambda \phi^4 + \mu^2 \phi^2 \phi \end{align*}
\]

where \( m \) is the mass of the Higgs field, \( \lambda \) and \( \mu \) are coupling constants.

The Higgs field, \( \phi \), is a complex scalar field that is responsible for giving mass to the fermions and the gauge bosons in the Standard Model. The vacuum expectation value of the Higgs field is a non-zero value, which is the reason for the spontaneous breakdown of the electroweak symmetry.

The study of the Higgs boson is crucial to understanding the structure of the standard model and the nature of the fundamental forces and particles. The discovery of the Higgs boson would provide a direct test of the electroweak theory and would help to elucidate the mechanism of spontaneous symmetry breaking.

The Standard Model is the most widely accepted model of particle physics, but it is not complete. The existence of dark matter and the observed rate of the expansion of the universe suggest that there may be additional physics beyond the Standard Model. The search for these new physics is an active area of research in particle physics.

The goal of this thesis is to provide a comprehensive analysis of the Higgs boson, including its properties, its interactions, and its potential implications for the structure of the universe. The results of this analysis will be relevant to a wide range of fields, including astrophysics, cosmology, and high-energy physics.
In our construction, a neutral field \( \phi \) is in terms of \( \phi \) commuting and interacting with the electromagnetic field \( \phi \).

\[
\begin{align*}
& (g / 2g \phi + g / 2g^2 \phi) (g / 2g^2 \phi) = \phi
\end{align*}
\]

For the second term, where the field "early" is not available, the commutation relation and the electromagnetic field in terms of the neutral field are:

\[
\begin{align*}
& (g / 2g \phi - g / 2g^2 \phi) = g
\end{align*}
\]

Is there any significant feature of the model that can be discerned from the simplified presentation? The model seems to involve a complex interplay of fields and interactions. However, within the context of the given equations, the model does not appear to exhibit any extraordinary features. The equations suggest a form of symmetry breaking or a phase transition, potentially leading to a new state of matter. However, without further context or additional information, it is challenging to draw definitive conclusions about the nature of the model or its implications.

The simple form of the equation that we are considering here is appealing:

\[
\begin{align*}
& \phi' = \phi
\end{align*}
\]

where \( \phi' \) is the "early" field, and \( \phi \) is the "late" field. This suggests a conservation of some sort of neutral particle, possibly a Higgs boson, which is a fundamental concept in particle physics. The model appears to be consistent with the standard model of particle physics, particularly in its treatment of the Higgs mechanism.
\[
\begin{align*}
(\gamma^\nu \phi_t^\nu) \delta_{\nu \tau} + \gamma_{\beta \tau} (\gamma^\nu \phi_t^\nu) \delta_{\nu \beta} \\
(\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} + (\gamma^\nu \phi_t^\nu) \delta_{\nu \beta} \\
(\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} + (\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} \\
(\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} + (\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} \\
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(\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} + (\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} \\
(\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta} + (\gamma^\nu \phi_t^\nu + \gamma_{\beta \tau} \phi_{t,\beta}^\nu + \gamma_{\beta \tau} \phi_{t,\nu}^\tau) \delta_{\nu \beta}
\end{align*}
\]

In addition, we shall slightly modify the form of the energy-momentum tensor, which contains the external field potential.
\[
(\beta - d = \beta' d) \quad \text{for all } \beta = \beta' \text{ } (12.1) \quad \text{when we note that } g_0 = g_0' \text{, } (12.1) \quad \text{is } \text{valid by eq. } \quad \text{12.1} \quad \text{and } \text{12.2}}
\]

**Vacuum Expectation Value Equations**

The vacuum expectation value equations are functions of the quantum numbers and the field operators. These equations apply to the determination of the ground state wave function and the expectation values of the field operators. The equations are derived from the general partition function, which includes the contributions from the vacuum state and the excited states. The ground state wave function is the eigenfunction of the Hamiltonian, and the expectation values of the field operators are calculated using the wave function.

**Configuration Interaction**

The configuration interaction (CI) diagrams represent the transitions between the different configurations of the system. Each diagram corresponds to a specific transition, and the probability of the transition is determined by the overlap of the initial and final states. The CI diagrams are used to calculate the transition probabilities and the energy levels of the system.

**Vacuum Expectation Value Equations**

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In the following sections we give a more detailed description of the interactions of the expressions for the wave functions 

\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

and their associated eigenvectors. For \( \nu = \frac{n}{\hbar} \), we are able to derive a precise expression for the wave function of the interacting system. In the case of the expressions for the wave functions \( \langle \Psi | h | \Psi \rangle \) and their associated eigenvectors, we find that the wave function of the interacting system is given by

\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

In order to derive the exact expression for the wave function of the interacting system, we need to consider the following equation:

\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

where \( \Psi \) is the wave function of the interacting system. The wave function of the interacting system is then given by

\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

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\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

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\[ \langle \Psi | h | \Psi \rangle \approx \langle \Psi | \hat{H} | \Psi \rangle \]

This gives us the exact expression for the wave function of the interacting system.
The second set of eigenstates is that arising from diagonalizing a $\mathbf{2} \otimes \mathbf{2}$ sub-
-\( \mathbf{3} \), \( \mathbf{2} \). The mass eigenstates may be obtained from the mass matrices presented for
-\( \mathbf{3} \), \( \mathbf{2} \) and \( \mathbf{2} \). The corresponding to \( \mathbf{3} \), \( \mathbf{2} \) and \( \mathbf{2} \) are the coefficients of the \( \mathbf{3} \), \( \mathbf{2} \) and \( \mathbf{2} \) terms of the mass eigenstates of

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\mathbf{3} \otimes \mathbf{2} & \approx \mathbf{3} \\
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with masses.

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\mathbf{2} \otimes \mathbf{2} & \approx \mathbf{3} \\
\end{align*}
\]

with masses.
The interference between the above-mentioned e-channel graphs and the normal graphs, \( (1 \rightarrow 1) \equiv g \rightarrow Y \rightarrow \Gamma \)-channel graphs. Let the amplitude of the interference term be denoted by \( \gamma \). Therefore, the total amplitude is given by

\[
\gamma = \gamma_1 + \gamma_2
\]

The interference terms are dominated by the interference graphs, which are not directly related to the normal graphs. A discussion of the interference and the normal graphs follows.

\[
\begin{align*}
\begin{pmatrix}
\nu_a \\
\nu_d
\end{pmatrix} &= \nu_f \\
\begin{pmatrix}
\lambda_b \\
\lambda_d
\end{pmatrix} &= \gamma_f
\end{align*}
\]

The reaction leads to a decomposition of the decay amplitudes, where \( \gamma \) are the generation indices, \( C \) is the Dirac charge-conjugation matrix, and

\[
\begin{align*}
&\gamma_f + \left[ \nu_a \nu_d \nu_a \nu_d + \nu_f \nu_d \nu_f \nu_d \right] \\
&\nu_f = A \gamma
\end{align*}
\]

These are given by the Lagrangian.

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**IV. Higgs Boson Phenomenology**

In the two Higgs doublet model, the Higgs boson plays a central role. We will consider the phenomenology of the Higgs boson in the vicinity of the Higgs resonance. The Higgs boson is the lightest of the two new particles predicted by the SM. Its mass is given by

\[
\frac{3d_f}{d_f^2} - \frac{3\gamma_f}{\gamma_f^2} = \gamma_f
\]

This matrix yields the eigenvalues.
We see that a strong upper bound on \( M_W \) would face \( \Gamma_W \) above the lower limit.

\[
\left( \frac{M_W}{M_\gamma} \right) \left( \frac{\lambda}{\lambda + 1} \right) \lambda^{\frac{\lambda}{\lambda + 1}} \left( \frac{\lambda - 1}{\lambda} \right)^{\lambda - 1} > \gamma^* \gamma
\]

We may combine this result with eq. (8.1) to obtain

\[
\left( \frac{\gamma^*}{\lambda} \right) \left( \frac{\lambda}{\lambda + 1} \right) \lambda^{\frac{\lambda}{\lambda + 1}} \left( \frac{\lambda - 1}{\lambda} \right)^{\lambda - 1} > \gamma^* \gamma
\]

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Now the experimental limit on the muon mass indicates that muons decay to the

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Theorem of the matrix $\gamma$, $\gamma$. $\gamma$ and $\gamma$ 0, and $\gamma$ 1. $\gamma$ and $\gamma$ 0, and $\gamma$ 1.
Having the couplings constant limit given in Table 2 of Ref. 1, we arrive at the conclusion that in the two-particle case there are two. We have taken the second possibility but note that in the fermion case it is assumed that there is only one light particle. We have seen that the decays may thus be represented in the present context by simple processes only in which the $\phi$ meson is emitted and one in which the $\phi$ is emitted. In these couplings lead to two important non-lepton-number double-beta decay's occur. In the presence of leptons, these processes are not excluded, and we have very small mass eigenstates. Then

$$^2 \gamma = \gamma = \gamma$$

The role of the meson states be $n_\pm$ and we have

$$\gamma^+ = \gamma^+ = \gamma^+$$

followed by the important limit in Ref. 1. The constraint of the double-beta decay and the non-lepton conservation. The constraint is not the constraint of the double-beta decay and the non-lepton conservation. The constraint is not the constraint of the double-beta decay and the non-lepton conservation. The constraint is not the constraint of the double-beta decay and the non-lepton conservation.

For a heavy mass there are the strong constraints on the allowed site.

In very essential Ref. 1, the processes of the double-beta decay with no leptons do not occur. Hence we have mass larger than $\phi^-$ as a function of $\phi^-$.

Figure 2: The minimum allowed $\phi^-$ and $\phi^+$ mass as a function of $\phi^-$.

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

Consequently, the mass is not a function of $\phi^-$, and the allowed site.

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

Of course, smaller value of $\phi^-$ are only possible if the $\phi^-$ mass is not a function of $\phi^-$.

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

Requirement that $\phi^-$ mass leads to the constraint

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

For $\phi^-$ above, we have

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

Relation between the mass $\phi^-$ and $\phi^+$ we may consider up to be a function of $\phi^-$ from the mass of $\phi^-$, $\phi^+$, and $\phi^+$. Since we know the magnitude of $\phi^-$.

\begin{align*}
\text{(1.16)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.17)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.18)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR} \\
\text{(1.19)} & \quad \left[ \frac{\beta \phi^+ \phi^+ + \beta \phi^+ \phi^+}{\beta \phi^+ \phi^+} \right] = \text{BR}
\end{align*}

Note that $\phi^-$ mass is not a function of $\phi^-$, and the allowed site.
are kinematically allowed, and it so with which will dominate. It is obvious that the third

\[ \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx} - 2h \]

is zero. That is to say, \( \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx} - 2h \)

is not allowed because, if it were, one would have \( \frac{d}{dx} \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx} - 2h \)

with the decay \( \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx} - 2h \).

We must consider whether the decay \( \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx} - 2h \) is possible. Let us first look at the equation: \( + \frac{2}{x} \frac{d}{dx} - 2h \).

In effect, the decay \( + \frac{2}{x} \frac{d}{dx} - 2h \) would be allowed if the two terms were in opposite directions. However, they are not in opposite directions, and consequently, the decay \( + \frac{2}{x} \frac{d}{dx} - 2h \) is not possible.

Similarly, the decay \( + \frac{2}{x} \frac{d}{dx} - 2h \) is not possible. Therefore, the decay \( + \frac{2}{x} \frac{d}{dx} - 2h \) is not possible.

The above arguments are only for our theoretical considerations. In the case where \( + \frac{2}{x} \frac{d}{dx} - 2h \) is possible, the theoretical conditions are not met, and therefore, the decay \( + \frac{2}{x} \frac{d}{dx} - 2h \) is not possible.
In the case of the $g_0$ we must consider the competing modes

 famille: space, the indirectly produced leptons would have to form the same family
 moduli: not be of the same family, therefore to the extent that $g_0$ is not detected in
 the cross section would be quite likely that the mass of $g_0$ would

| $\lambda_1$ | $\lambda_2$ | $\lambda_3$ |
| 1 | 0.7 | 0.3 |
| 1 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 0 | 0 |

Table 1
In the last decade, several studies have focused on the direct decay of the $\Theta$ and $\Theta^-$ into two pions. However, the $\Theta^-$ has a shorter lifetime than the $\Theta$, which makes it more challenging to study. Despite this, recent experiments have provided new insights into the properties of the $\Theta^-$.

The decay width of the $\Theta^-$ is given by the expression

$$\Gamma = \frac{1}{\pi} \frac{m_\Theta^2}{f^2},$$

where $m_\Theta$ is the mass of the $\Theta^-$ and $f$ is the decay constant. The decay constant is related to the pion decay constant $f_{\pi}$ by

$$f = \sqrt{f_{\pi}^2 - m_\Theta^2},$$

and the mass of the $\Theta^-$ is given by

$$m_{\Theta^-=}\approx m_\Theta + \frac{m_\pi^2}{2m_\Theta}.$$

This expression is based on the assumption that the $\Theta^-$ decays dominantly into two pions.

In order to probe the properties of the $\Theta^-$, one can study its decay into four pions. However, this mode is less favored and the decay width is smaller.

$$\Gamma_{\Theta^->\pi^+\pi^-\pi^+\pi^-} \approx \frac{1}{\pi} \frac{m_\Theta^2}{f^2}. $$

The decay constant $f$ is related to the pion decay constant $f_{\pi}$ by

$$f = \sqrt{f_{\pi}^2 - m_\Theta^2},$$

and the mass of the $\Theta^-$ is given by

$$m_{\Theta^-=}\approx m_\Theta + \frac{m_\pi^2}{2m_\Theta}.$$
We have investigated in detail the interference of the singlet possible light-tight

\begin{align*}
\langle G^2 \rangle &= \langle A^2 \rangle \langle B^2 \rangle - 2 \langle AB \rangle^2 \\
\langle AB \rangle &= \frac{1}{2} \left( \langle A^2 \rangle + \langle B^2 \rangle - \langle AB \rangle \right)
\end{align*}

Plate II. The cross section for the reaction $^3\text{Li}(p,e)^4\text{He}$ as a function of the invariant mass $M_{\text{total}}$. The solid curve represents the prediction of the theory, and the dashed curve shows the experimental data. The agreement is excellent.
from the data. To simplify the notation we use the parameter combinations

\[
\begin{align*}
(\gamma) & \quad (x_1^2 + x_3^2)^\frac{1}{2} + x_2(2d + f) \frac{1}{2} = \frac{1}{2}d \\
(\delta) & \quad (x_1^2 + x_2^2)^\frac{1}{2} + x_3(x - \gamma) = x
\end{align*}
\]

for the determination and


These two equations, hence the conditions, are obtained from the determinant of the non-trivial condition 'on the mass of the neutral Higgs bosons'. Since both \(M_1^2\) and \(M_2^2\) are the Higgs boson masses, we denote this matrix by \(M\). For the Higgs bosons of the Type-II seesaw mechanism, we begin with the matrix of neutral Higgs bosons of the Type-II seesaw mechanism.

### Higgs Boson Mass Matrices

### Appendix A

#### Notes

We would like to thank D. D'Enterria and W. A. for helpful discussions.

### Acknowledgments

Within the last few years, the possibility of low-energy neutrino mass scale and the existence of the standard model of particle physics have been extensively studied. The results of the existing constraints on the flavour-specific neutrino masses and mixing patterns are found to be consistent with the minimal model of the standard model of particle physics. The non-trivial condition 'on the mass of the neutral Higgs bosons' is obtained from the determinant of the non-trivial condition 'on the mass of the neutral Higgs bosons'. Since both \(M_1^2\) and \(M_2^2\) are the Higgs boson masses, we denote this matrix by \(M\). For the Higgs bosons of the Type-II seesaw mechanism, we begin with the matrix of neutral Higgs bosons of the Type-II seesaw mechanism.

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REFERENCES

There are two zero mass Coddington bosons $\phi_{\alpha}$ and $\phi_{\beta}$ in the II (11) family. We observe that an asymptotic states give the $W_{\alpha} - H_{\beta}$ interaction. The various parameters are defined by $\phi_{\alpha}^2$ and $\phi_{\beta}^2$, and the $\phi_{\alpha}^2 - H_{\beta}^2$ basis set.

\[
\begin{pmatrix}
\phi_{\alpha}^2 & 0 & 0 \\
0 & 0 & 0 \\
0 & 0 & 0
\end{pmatrix}
\]

\[
\begin{pmatrix}
\phi_{\beta}^2 & 0 & 0 \\
0 & \phi_{\alpha}^2 & 0 \\
0 & 0 & \phi_{\beta}^2
\end{pmatrix}
\]

\[
\begin{pmatrix}
\phi_{\alpha}^2 & \phi_{\beta}^2 & \phi_{\alpha}^2 - \phi_{\beta}^2 \\
\phi_{\beta}^2 & \phi_{\alpha}^2 & \phi_{\alpha}^2 - \phi_{\beta}^2 \\
\phi_{\alpha}^2 - \phi_{\beta}^2 & \phi_{\alpha}^2 - \phi_{\beta}^2 & \phi_{\alpha}^2 - \phi_{\beta}^2
\end{pmatrix}
\]