# Prediction of octet hyperon EM FFs behavior by the unitary and analytic model

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# Outline

# INTRODUCTION

I would like to present an idea:

how to **predict octet hyperon EM FFs** $G_E^Y(t), G_M^Y(t)$ **behavior theoretically**, provided **sufficient experimental information on the nucleon EM structure** exists.

For this aim our **universal Unitary&Analytic approach**, representing a **consistent unification of all known fundamental features** of baryon EM FFs, will be applied.

# INTRODUCTION

They are

- hypothetical **analytic properties** of $G_E^Y(t)$, $G_M^Y(t)$ on the first (physical) sheet of the Riemann surface with cuts from $t_0$ to $+\infty$, by means of which just the **contributions of continua** are taken into account
- an experimental fact of a **creation of unstable vector-meson resonances in $e^+e^-$ annihilation into hadrons** to be represented in EM FFs by complex poles on unphysical sheets of the Riemann surface
- the **normalizations** of $G_E^Y(0) = Q$, $G_M^Y(0) = Q + \mu_Y$ at $t = 0$
- the **asymptotic behaviors** $G_E^Y(t)_{|t|\to\infty} \sim \frac{1}{t^2}$, $G_M^Y(t)_{|t|\to\infty} \sim \frac{1}{t^2}$ as predicted by the quark model of hadrons.

# INTRODUCTION

The Sachs FFs $G_E^Y(t)$, $G_M^Y(t)$ are **suitable in extracting experimental information on the EM structure of octet hyperons** from $\sigma_{tot}(e^+e^- \to Y\bar{Y})$ and also from $\frac{d\sigma(e^+e^-\to Y\bar{Y})}{d\Omega}$. However, **for a construction of various theoretical models the Dirac and Pauli FFs are more proper**. Both sets of FFs are related as follows

$$G_E^Y(t) = F_1^Y(t) + \frac{t}{4m_Y^2} F_2^Y(t) \quad (1)$$
$$G_M^Y(t) = F_1^Y(t) + F_2^Y(t)$$

with adjusted asymptotic behaviors of $F_1^Y(t)$, $F_2^Y(t)$

$$F_1^Y(t)_{|t|\to\infty} \sim \frac{1}{t^2} \quad F_2^Y(t)_{|t|\to\infty} \sim \frac{1}{t^3}. \quad (2)$$

# INTRODUCTION

**Analyticity** of EM FFs, of course, is **valid also for Dirac and Pauli FFs** and in our **universal Unitary&Analytic approach** is taken into account in the form of the **two cut approximation**.

The **first cut is generated by the fixed lowest branch point** $t_0$ corresponding to opening of the process in $e^+e^- \to \pi^+\pi^-$ and a **second cut is generated by some effective inelastic branch point** $t_{in}$, which is representing contributions of all opened higher channels in $e^+e^- \to hadrons$ effectively, therefore in an analysis of data $t_{in}$ is **left as a free parameter of the model**.

# INTRODUCTION

The form of EM FF of any hadron is **directly related to complex conjugate pairs of poles on unphysical sheets of the Riemann surface in $t$ variable**, corresponding to unstable true neutral vector mesons $\rho, \omega, \phi$ with quantum numbers of the photon to be revealed experimentally in $e^+e^-$ annihilation processes into hadrons.

The PDG(2016) provides **just three experimentally confirmed sets of such trinities**:

- in ground state $V = \rho(770), \omega(782), \phi(1020)$
- in first excited state $V' = \rho'(1450), \omega'(1420), \phi'(1680)$
- in second excited state $V'' = \rho''(1700), \omega''(1650), \phi''(2170)$,

which are **utilized in construction of our model**.

# INTRODUCTION

Since, according to the isospin, vector mesons are divided into:

- **isovector group** $\rho(770), \rho'(1450), \rho''(1700)$
- **isoscalar group** $\omega(782), \Phi(1020), \omega'(1420), \Phi'(1680), \omega''(1670), \Phi''(2189)$

the **Dirac and Pauli FFs - also split into isovector** $F_{1v}^Y(t), F_{2v}^Y(t)$ **and isoscalar** $F_{1s}^Y(t), F_{2s}^Y(t)$ **parts**, containing contributions of these resonances. Therefore in the considered model **there are four independent free positions of effective inelastic thresholds** $t_{in}^{1s}, t_{in}^{2s}, t_{in}^{1v}, t_{in}^{2v}$, to be **determined numerically by a comparison of the resultant model with existing data on the total cross section of the** $e^+e^- \to Y\bar{Y}$ **process**, and the **positions of the lowest branch points** are $t_0^v = 4m_\pi^2$ in $F_{1v}^Y(t), F_{2v}^Y(t)$ and $t_0^s = 9m_\pi^2$ in $F_{1s}^Y(t), F_{2s}^Y(t)$.

# INTRODUCTION

As a result all **EM FFs of $1/2^+$ octet hyperons** can be expressed **through isoscalar and isovector Dirac and Pauli FFs** as follows

$$\begin{aligned} G_E^{\Lambda}(t) &= F_{1s}^{\Lambda}(t) + \frac{t}{4m_{\Lambda}^2} F_{2s}^{\Lambda}(t) \\ G_M^{\Lambda}(t) &= F_{1s}^{\Lambda}(t) + F_{2s}^{\Lambda}(t) \end{aligned} \tag{3}$$

$$\begin{aligned} G_E^{\Sigma^+}(t) &= [F_{1s}^{\Sigma}(t) + F_{1v}^{\Sigma}(t)] + \frac{t}{4m_{\Sigma^+}^2}[F_{2s}^{\Sigma}(t) + F_{2v}^{\Sigma}(t)] \\ G_M^{\Sigma^+}(t) &= [F_{1s}^{\Sigma}(t) + F_{1v}^{\Sigma}(t)] + [F_{2s}^{\Sigma}(t) + F_{2v}^{\Sigma}(t)] \end{aligned} \tag{4}$$

$$\begin{aligned} G_E^{\Sigma^0}(t) &= F_{1s}^{\Sigma}(t) + \frac{t}{4m_{\Sigma^0}^2} F_{2s}^{\Sigma}(t) \\ G_M^{\Sigma^0}(t) &= F_{1s}^{\Sigma}(t) + F_{2s}^{\Sigma}(t) \end{aligned} \tag{5}$$

# INTRODUCTION

$$G_E^{\Sigma^-}(t) = [F_{1s}^{\Sigma}(t) - F_{1v}^{\Sigma}(t)] + \frac{t}{4m_{\Sigma^-}^2}[F_{2s}^{\Sigma}(t) - F_{2v}^{\Sigma}(t)] \quad (6)$$

$$G_M^{\Sigma^-}(t) = [F_{1s}^{\Sigma}(t) - F_{1v}^{\Sigma}(t)] + [F_{2s}^{\Sigma}(t) - F_{2v}^{\Sigma}(t)]$$

$$G_E^{\Xi^0}(t) = [F_{1s}^{\Xi}(t) + F_{1v}^{\Xi}(t)] + \frac{t}{4m_{\Xi^0}^2}[F_{2s}^{\Xi}(t) + F_{2v}^{\Xi}(t)] \quad (7)$$

$$G_M^{\Xi^0}(t) = [F_{1s}^{\Xi}(t) + F_{1v}^{\Xi}(t)] + [F_{2s}^{\Xi}(t) + F_{2v}^{\Xi}(t)]$$

$$G_E^{\Xi^-}(t) = [F_{1s}^{\Xi}(t) - F_{1v}^{\Xi}(t)] + \frac{t}{4m_{\Xi^-}^2}[F_{2s}^{\Xi}(t) - F_{2v}^{\Xi}(t)] \quad (8)$$

$$G_M^{\Xi^-}(t) = [F_{1s}^{\Xi}(t) - F_{1v}^{\Xi}(t)] + [F_{2s}^{\Xi}(t) - F_{2v}^{\Xi}(t)],$$

# INTRODUCTION

with the following **normalizations of hyperon isoscalar and isovector Dirac and Pauli FFs**

$$F_{1s}^{\Lambda}(0) = 0; F_{2s}^{\Lambda}(0) = \mu_{\Lambda} \tag{9}$$

$$F_{1s}^{\Sigma}(0) = 0; F_{1v}^{\Sigma}(0) = 1; F_{2s}^{\Sigma}(0) = \frac{1}{2}(\mu_{\Sigma^+} + \mu_{\Sigma^-}); F_{2v}^{\Sigma}(0) = \frac{1}{2}(\mu_{\Sigma^+} - \mu_{\Sigma^-}) \tag{10}$$

$$F_{1s}^{\Xi}(0) = -\frac{1}{2}; F_{1v}^{\Xi}(0) = +\frac{1}{2}; F_{2s}^{\Xi}(0) = \frac{1}{2}(\mu_{\Xi^0} + \mu_{\Xi^-}); F_{2v}^{\Xi}(0) = \frac{1}{2}(\mu_{\Xi^0} - \mu_{\Xi^-}) \tag{11}$$

$\mu_Y$ is the **anomalous magnetic moment of the hyperon**.

# UNIVERSAL UNITARY&ANALYTIC MODEL

In the Unitary&Analytic model of hyperon EM structure, **every hyperon iso-scalar and iso-vector Dirac and Pauli FF** can be expressed by **one analytic and smooth from $-\infty$ to $+\infty$ function** in the form

$$F_{1s}^Y[V(t)] = \left(\frac{1-V^2}{1-V_N^2}\right)^4 \Big\{ F_{1s}^Y[V(0)]H_{\omega''}(V)H_{\phi''}(V) + \tag{12}$$

$$+\Big[H_{\phi''}(V)H_{\omega'}(V)\frac{(C^{1s}_{\phi''}-C^{1s}_{\omega'})}{(C^{1s}_{\phi''}-C^{1s}_{\omega''})} + H_{\omega''}(V)H_{\omega'}(V)\frac{(C^{1s}_{\omega''}-C^{1s}_{\omega'})}{(C^{1s}_{\omega''}-C^{1s}_{\phi''})} -$$

$$-H_{\omega''}(V)H_{\phi''}(V)\Big](f^{(1)}_{\omega' YY}/f_{\omega'}) +$$

$$+\Big[H_{\phi''}(V)H_{\phi'}(V)\frac{(C^{1s}_{\phi''}-C^{1s}_{\phi'})}{(C^{1s}_{\phi''}-C^{1s}_{\omega''})} + H_{\omega''}(V)H_{\phi'}(V)\frac{(C^{1s}_{\omega''}-C^{1s}_{\phi'})}{(C^{1s}_{\omega''}-C^{1s}_{\phi''})} -$$

$$-H_{\omega''}(V)H_{\phi''}(V)\Big](f^{(1)}_{\phi' YY}/f_{\phi'}) +$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$
\begin{aligned}
&+\Bigg[H_{\phi''}(V)L_\omega(V)\frac{(C^{1s}_{\phi''}-C^{1s}_{\omega})}{(C^{1s}_{\phi''}-C^{1s}_{\omega''})}+H_{\omega''}(V)L_\omega(V)\frac{(C^{1s}_{\omega''}-C^{1s}_{\omega})}{(C^{1s}_{\omega''}-C^{1s}_{\phi''})}- \\
&\qquad -H_{\omega''}(V)H_{\phi''}(V)\Bigg](f^{(1)}_{\omega YY}/f_\omega)+ \\
&+\Bigg[H_{\phi''}(V)L_\phi(V)\frac{(C^{1s}_{\phi''}-C^{1s}_{\phi})}{(C^{1s}_{\phi''}-C^{1s}_{\omega''})}+H_{\omega''}(V)L_\phi(V)\frac{(C^{1s}_{\omega''}-C^{1s}_{\phi})}{(C^{1s}_{\omega''}-C^{1s}_{\phi''})}- \\
&\qquad -H_{\omega''}(V)H_{\phi''}(V)\Bigg](f^{(1)}_{\phi YY}/f_\phi)\Bigg\}
\end{aligned}
\tag{13}
$$

dependent on **5 free physically interpretable parameters**, $(f^{(1)}_{\omega' YY}/f_{\omega'}), (f^{(1)}_{\phi' YY}/f_{\phi'}), (f^{(1)}_{\omega YY}/f_\omega), (f^{(1)}_{\phi YY}/f_\phi), t^{1s}_{in}$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$F_{1v}^Y[W(t)] = \left(\frac{1-W^2}{1-W_N^2}\right)^4 \Bigg\{ F_{1v}^Y[W(0)] L_\rho(W) L_{\rho'}(W) + \tag{14}$$

$$+ \Bigg[ L_{\rho'}(W) L_{\rho''}(W) \frac{(C_{\rho'}^{1v} - C_{\rho''}^{1v})}{(C_{\rho'}^{1v} - C_{\rho}^{1v})} + L_\rho(W) L_{\rho''}(W) \frac{(C_{\rho}^{1v} - C_{\rho''}^{1v})}{(C_{\rho}^{1v} - C_{\rho'}^{1v})} -$$

$$- L_\rho(W) L_{\rho'}(W) \Bigg] (f_{\rho YY}^{(1)}/f_\rho) \Bigg\}$$

dependent on **2 free physically interpretable parameters** $(f_{\rho YY}^{(1)}/f_\rho)$, $t_{in}^{1v}$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$F_{2s}^Y[U(t)] = \left(\frac{1-U^2}{1-U_N^2}\right)^6 \Bigg\{ F_{2s}^Y[U(0)] H_{\omega''}(U) H_{\phi''}(U) H_{\omega'}(U) + \tag{15}$$

$$+\left[ H_{\phi''}(U) H_{\omega'}(U) H_{\phi'}(U) \frac{(C_{\phi''}^{2s} - C_{\phi'}^{2s})(C_{\omega'}^{2s} - C_{\phi'}^{2s})}{(C_{\phi''}^{2s} - C_{\omega''}^{2s})(C_{\omega'}^{2s} - C_{\omega''}^{2s})} + \right.$$

$$+ H_{\omega''}(U) H_{\omega'}(U) H_{\phi'}(U) \frac{(C_{\omega''}^{2s} - C_{\phi'}^{2s})(C_{\omega'}^{2s} - C_{\phi'}^{2s})}{(C_{\omega''}^{2s} - C_{\phi''}^{2s})(C_{\omega'}^{2s} - C_{\phi''}^{2s})} +$$

$$+ H_{\omega''}(U) H_{\phi''}(U) H_{\phi'}(U) \frac{(C_{\omega''}^{2s} - C_{\phi'}^{2s})(C_{\phi''}^{2s} - C_{\phi'}^{2s})}{(C_{\omega''}^{2s} - C_{\omega'}^{2s})(C_{\phi''}^{2s} - C_{\omega'}^{2s})} -$$

$$\left. - H_{\omega''}(U) H_{\phi''}(U) H_{\omega'}(U) \right] (f_{\phi' YY}^{(2)} / f_{\phi'}) +$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$
\begin{aligned}
&+\Bigg[H_{\phi''}(U)H_{\omega'}(U)L_{\omega}(U)\frac{(C^{2s}_{\phi''}-C^{2s}_{\omega})(C^{2s}_{\omega'}-C^{2s}_{\omega})}{(C^{2s}_{\phi''}-C^{2s}_{\omega''})(C^{2s}_{\omega'}-C^{2s}_{\omega''})}+\\
&+H_{\omega''}(U)H_{\omega'}(U)L_{\omega}(U)\frac{(C^{2s}_{\omega''}-C^{2s}_{\omega})(C^{2s}_{\omega'}-C^{2s}_{\omega})}{(C^{2s}_{\omega''}-C^{2s}_{\phi''})(C^{2s}_{\omega'}-C^{2s}_{\phi''})}+\\
&+H_{\omega''}(U)H_{\phi''}(U)L_{\omega}(U)\frac{(C^{2s}_{\omega''}-C^{2s}_{\omega})(C^{2s}_{\phi'}-C^{2s}_{\omega})}{(C^{2s}_{\omega''}-C^{2s}_{\omega'})(C^{2s}_{\phi''}-C^{2s}_{\omega'})}-\\
&-H_{\omega''}(U)H_{\phi''}(U)H_{\omega'}(U)\Bigg](f^{(2)}_{\omega YY}/f_{\omega})+
\end{aligned}
\tag{16}
$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$
\begin{aligned}
&+\Bigg[H_{\phi''}(U)H_{\omega'}(U)L_{\phi}(U)\frac{(C^{2s}_{\phi''}-C^{2s}_{\phi})(C^{2s}_{\omega'}-C^{2s}_{\phi})}{(C^{2s}_{\phi''}-C^{2s}_{\omega''})(C^{2s}_{\omega'}-C^{2s}_{\omega''})}+\\
&+H_{\omega''}(U)H_{\omega'}(U)L_{\phi}(U)\frac{(C^{2s}_{\omega''}-C^{2s}_{\phi})(C^{2s}_{\omega'}-C^{2s}_{\phi})}{(C^{2s}_{\omega''}-C^{2s}_{\phi''})(C^{2s}_{\omega'}-C^{2s}_{\phi''})}+\\
&+H_{\omega''}(U)H_{\phi''}(U)L_{\phi}(U)\frac{(C^{2s}_{\omega''}-C^{2s}_{\phi})(C^{2s}_{\phi''}-C^{2s}_{\phi})}{(C^{2s}_{\omega''}-C^{2s}_{\omega'})(C^{2s}_{\phi''}-C^{2s}_{\omega'})}-\\
&-H_{\omega''}(U)H_{\phi''}(U)H_{\omega'}(U)\Bigg](f^{(2)}_{\phi YY}/f_{\phi})\Bigg\}
\end{aligned}
\tag{17}
$$

dependent on **4 free physically interpretable parameters** $(f^{(2)}_{\phi' YY}/f_{\phi'}), (f^{(2)}_{\omega YY}/f_{\omega}), (f^{(2)}_{\phi YY}/f_{\phi}), t^{2s}_{in}$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$F_{2v}^Y[X(t)] = \left(\frac{1-X^2}{1-X_N^2}\right)^6 \left\{ F_{2v}^Y[X(0)] L_\rho(U) L_{\rho'}(U) H_{\rho''}(U) \right\} \quad (18)$$

dependent on **1 free physically interpretable parameter** $t_{in}^{2v}$, with

$$L_r(V) = \frac{(V_N - V_r)(V_N - V_r^*)(V_N - 1/V_r)(V_N - 1/V_r^*)}{(V - V_r)(V - V_r^*)(V - 1/V_r)(V - 1/V_r^*)}, \quad (19)$$

$$C_r^{1s} = \frac{(V_N - V_r)(V_N - V_r^*)(V_N - 1/V_r)(V_N - 1/V_r^*)}{-(V_r - 1/V_r)(V_r - 1/V_r^*)}, r = \omega, \phi \quad (20)$$

$$H_l(V) = \frac{(V_N - V_l)(V_N - V_l^*)(V_N + V_l)(V_N + V_l^*)}{(V - V_l)(V - V_l^*)(V + V_l)(V + V_l^*)}, \quad (21)$$

$$C_l^{1s} = \frac{(V_N - V_l)(V_N - V_l^*)(V_N + V_l)(V_N + V_l^*)}{-(V_l - 1/V_l)(V_l - 1/V_l^*)}, l = \omega'', \phi'', \omega', \phi' \quad (22)$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$L_k(W) = \frac{(W_N - W_k)(W_N - W_k^*)(W_N - 1/W_k)(W_N - 1/W_k^*)}{(W - W_k)(W - W_k^*)(W - 1/W_k)(W - 1/W_k^*)}, \tag{23}$$

$$C_k^{1v} = \frac{(W_N - W_k)(W_N - W_k^*)(W_N - 1/W_k)(W_N - 1/W_k^*)}{-(W_k - 1/W_k)(W_k - 1/W_k^*)}, k = \rho'', \rho', \rho \tag{24}$$

$$L_r(U) = \frac{(U_N - U_r)(U_N - U_r^*)(U_N - 1/U_r)(U_N - 1/U_r^*)}{(U - U_r)(U - U_r^*)(U - 1/U_r)(U - 1/U_r^*)}, \tag{25}$$

$$C_r^{2s} = \frac{(U_N - U_r)(U_N - U_r^*)(U_N - 1/U_r)(U_N - 1/U_r^*)}{-(U_r - 1/U_r)(U_r - 1/U_r^*)}, r = \omega, \phi \tag{26}$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$H_l(U) = \frac{(U_N - U_l)(U_N - U_l^*)(U_N + U_l)(U_N + U_l^*)}{(U - U_l)(U - U_l^*)(U + U_l)(U + U_l^*)}, \tag{27}$$

$$C_l^{2s} = \frac{(U_N - U_l)(U_N - U_l^*)(U_N + U_l)(U_N + U_l^*)}{-(U_l - 1/U_l)(U_l - 1/U_l^*)}, l = \omega'', \phi'', \omega', \phi' \tag{28}$$

$$L_k(X) = \frac{(X_N - X_k)(X_N - X_k^*)(X_N - 1/X_k)(X_N - 1/X_k^*)}{(X - X_k)(X - X_k^*)(X - 1/X_k)(X - 1/X_k^*)}, \tag{29}$$

$$C_k^{2v} = \frac{(X_N - X_k)(X_N - X_k^*)(X_N - 1/X_k)(X_N - 1/X_k^*)}{-(X_k - 1/X_k)(X_k - 1/X_k^*)}, k = \rho', \rho \tag{30}$$

$$H_{\rho''}(X) = \frac{(X_N - X_{\rho''})(X_N - X_{\rho''}^*)(X_N + X_{\rho''})(X_N + X_{\rho''}^*)}{(X - X_{\rho''})(X - X_{\rho''}^*)(X + X_{\rho''})(X + X_{\rho''}^*)}, \tag{31}$$

$$C_{\rho''}^{2v} = \frac{(X_N - X_{\rho''})(X_N - X_{\rho''}^*)(X_N + X_{\rho''})(W_X + X_{\rho''}^*)}{-(X_{\rho''} - 1/X_{\rho''})(X_{\rho''} - 1/X_{\rho''}^*)}. \tag{32}$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

The

$$V(t) = i\frac{\sqrt{(\frac{t_{in}^{1s}-t_0^s}{t_0^s})^{1/2}+(\frac{t-t_0^s}{t_0^s})^{1/2}}-\sqrt{(\frac{t_{in}^{1s}-t_0^s}{t_0^s})^{1/2}-(\frac{t-t_0^s}{t_0^s})^{1/2}}}{\sqrt{(\frac{t_{in}^{1s}-t_0^s}{t_0^s})^{1/2}+(\frac{t-t_0^s}{t_0^s})^{1/2}}+\sqrt{(\frac{t_{in}^{1s}-t_0^s}{t_0^s})^{1/2}-(\frac{t-t_0^s}{t_0^s})^{1/2}}}, \quad (33)$$

and similarly W(t), U(t) and X(t) are **comformal mappings of four sheeted Riemann surfaces in $t$-variable always into one plane**.

The latter universal Unitary&Analytic model is **valid for any member of the $1/2^+$ octet of baryons** and the **models for individual members of the octet under consideration differ each from others by the different values of free parameters**.

# UNIVERSAL UNITARY&ANALYTIC MODEL

So, **if there are known numerical values of free parameters of the general forms of the iso-scalar and iso-vector Dirac and Pauli FFs**, then we are able to **predict EM FFs** $G_E^Y(t), G_M^Y(t)$ **behaviors of any** $\frac{1}{2}^+$ **octet hyperon**.

Free parameters for nucleons are found in a very simple way.

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# UNIVERSAL UNITARY&ANALYTIC MODEL

The comparison of the **adjusted Unitary&Analytic model to nucleons** with 11 sets of data on nucleon EM structure from more than 40 independent experiments (all together 534 reliable experimental points) leads to the **following values of free parameters**

$$
\begin{aligned}
t_{in}^{1s} &= (1.0442 \pm 0.0200) GeV^2; \\
t_{in}^{2s} &= (1.0460 \pm 0.1399) GeV^2; \\
t_{in}^{1v} &= (2.9506 \pm 0.5326) GeV^2; \\
t_{in}^{2v} &= (2.3449 \pm 0.7656) GeV^2;
\end{aligned}
\tag{34}
$$

# UNIVERSAL UNITARY&ANALYTIC MODEL

$$
\begin{aligned}
(f^{(1)}_{\omega NN}/f_\omega) &= (1.5717 \pm 0.0022) \\
(f^{(1)}_{\phi NN}/f_\phi) &= (-1.1247 \pm 0.0011) \\
(f^{(1)}_{\omega' NN}/f_{\omega'}) &= (0.0418 \pm 0.0065) \\
(f^{(1)}_{\phi' NN}/f_{\phi'}) &= (0.1879 \pm 0.0010) \\
(f^{(2)}_{\omega NN}/f_\omega) &= (-0.2096 \pm 0.0067) \\
(f^{(2)}_{\phi NN}/f_\phi) &= (0.2657 \pm 0.0067) \\
(f^{(2)}_{\phi' NN}/f_{\phi'}) &= (0.1781 \pm 0.0029) \\
(f^{(1)}_{\rho NN}/f_\rho) &= (0.3747 \pm 0.0022)
\end{aligned}
\qquad (35)
$$

whereby the **results are not very sensitive on the position of the effective inelastic thresholds** $t_{in}^{1s}$, $t_{in}^{2s}$, $t_{in}^{1v}$, $t_{in}^{2v}$.

# UNIVERSAL UNITARY&ANALYTIC MODEL

For a determination of **hyperon free coupling constant ratios** the **SU(3) invariant Lagrangians of strong interaction of** $\frac{1}{2}^+$ **octet baryons with** $1^-$ **vector mesons** $\mathcal{L}_{V\bar{B}B}$, $\mathcal{L}_{V'\bar{B}B}$, $\mathcal{L}_{V''\bar{B}B}$ will be used, where

$$\begin{aligned}\mathcal{L}_{V\bar{B}B} &= \frac{\mathrm{i}}{\sqrt{2}} f^F[\bar{B}^\alpha_\beta\gamma_\mu B^\beta_\gamma - \bar{B}^\beta_\gamma\gamma_\mu B^\alpha_\beta](V_\mu)^\gamma_\alpha \\ &+ \frac{\mathrm{i}}{\sqrt{2}} f^D[\bar{B}^\beta_\gamma\gamma_\mu B^\alpha_\beta + \bar{B}^\alpha_\beta\gamma_\mu B^\beta_\gamma](V_\mu)^\gamma_\alpha + \frac{\mathrm{i}}{\sqrt{2}} f^S \bar{B}^\alpha_\beta\gamma_\mu B^\beta_\alpha\omega^0_\mu, \qquad (36)\end{aligned}$$

**similarly** $\mathcal{L}_{V'\bar{B}B}$ **and** $\mathcal{L}_{V''\bar{B}B}$; with SU(3) coupling constants $f^F, f^D, f^S$; $f^{F'}, f^{D'}, f^{S'}$; $f^{F''}, f^{D''}, f^{S''}$ to be **unknown**,

# UNIVERSAL UNITARY&ANALYTIC MODEL

$B, \bar{B}$ are baryon, anti-baryon octet matrices

$$B = \begin{pmatrix} \frac{\Sigma^0}{\sqrt{2}} + \frac{\Lambda^0}{\sqrt{6}} & \Sigma^+ & p \\ \Sigma^- & -\frac{\Sigma^0}{\sqrt{2}} + \frac{\Lambda^0}{\sqrt{6}} & n \\ \Xi^- & \Xi^0 & -\frac{2\Lambda^0}{\sqrt{6}} \end{pmatrix}, \quad (37)$$

$$\bar{B} = \begin{pmatrix} \frac{\bar{\Sigma}^0}{\sqrt{2}} + \frac{\bar{\Lambda}^0}{\sqrt{6}} & \bar{\Sigma}^- & \bar{\Xi}^- \\ \bar{\Sigma}^+ & -\frac{\bar{\Sigma}^0}{\sqrt{2}} + \frac{\bar{\Lambda}^0}{\sqrt{6}} & \bar{\Xi}^0 \\ \bar{p} & \bar{n} & -\frac{2\bar{\Lambda}^0}{\sqrt{6}} \end{pmatrix}, \quad (38)$$

$V$ is the 3x3 vector meson octet matrix and $\omega_0$ is singlet

$$V = \begin{pmatrix} \omega_8/\sqrt{6} + \rho^0/\sqrt{2} & \rho^+ & K^{*+} \\ \rho^- & \omega_8/\sqrt{6} - \rho^0/\sqrt{2} & K^{*0} \\ K^{*-} & \bar{K}^{*0} & -2\omega_8/\sqrt{6} \end{pmatrix}, \quad \omega_0. \quad (39)$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

Our aim is to **use the Lagrangian** (36) (**and successively also** $\mathcal{L}_{V'\bar{B}B}$ **and** $\mathcal{L}_{V''\bar{B}B}$) **for a derivation of the relations between the vector meson-baryon-anti-baryon coupling constants and the SU(3) coupling constants** $f^F, f^D, f^S$**.**

## FIRST PROBLEM

Since $\omega_8$ and $\omega_0$ in $\mathcal{L}_{V\bar{B}B}$ are **not experimentally confirmed particles**, unlike $\omega(782)$ and $\phi(1020)$, then in a decomposition of $\mathcal{L}_{V\bar{B}B}$ one has to use mixing between $\omega_8$, $\omega_0$ and $\omega(782)$, $\phi(1020)$.

However, which of them? As **there are 8 completely different** $\omega - \phi$ **mixing forms**!

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$
\begin{array}{lll}
1. & \omega = \omega_8 \sin\theta + \omega_0 \cos\theta & \phi = -\omega_8 \cos\theta + \omega_0 \sin\theta \\
2. & \omega = -\omega_8 \sin\theta + \omega_0 \cos\theta & \phi = -\omega_8 \cos\theta - \omega_0 \sin\theta \\
3. & \omega = \omega_8 \sin\theta - \omega_0 \cos\theta & \phi = \omega_8 \cos\theta + \omega_0 \sin\theta \\
4. & \omega = -\omega_8 \sin\theta - \omega_0 \cos\theta & \phi = \omega_8 \cos\theta - \omega_0 \sin\theta \\
5. & \omega = \omega_8 \sin\theta + \omega_0 \cos\theta & \phi = \omega_8 \cos\theta - \omega_0 \sin\theta \\
6. & \omega = -\omega_8 \sin\theta + \omega_0 \cos\theta & \phi = \omega_8 \cos\theta + \omega_0 \sin\theta \\
7. & \omega = \omega_8 \sin\theta - \omega_0 \cos\theta & \phi = -\omega_8 \cos\theta - \omega_0 \sin\theta \\
8. & \omega = -\omega_8 \sin\theta - \omega_0 \cos\theta & \phi = -\omega_8 \cos\theta + \omega_0 \sin\theta .
\end{array}
\tag{40}
$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

## SECOND PROBLEM

Most of free parameters of the Unitary&Analytic EM structure model are **coupling constat ratios with the universal vector-meson coupling constants** $f_\rho, f_\omega, f_\phi$ **in denominator**.

The **absolute values of these coupling constants** are determined **from the lepton widths of vector mesons** by means of the expression

$$\Gamma(V \to e^+e^-) = \frac{\alpha^2 m_V}{3}(\frac{f_V^2}{4\pi})^{-1} \tag{41}$$

in which $f_V$ is **contained in a quadratic form**.

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

Therefore, practically in this way **one knows only absolute values** $|f_\rho|$=4.9582; $|f_\omega|$=17.0620; $|f_\phi|$=13.4428 of the **universal ground state vector-meson coupling constants**, however, for $|f_{\rho'}|$=?, $|f_{\omega'}|$=?, $|f_{\phi'}|$=? and also for $|f_{\rho''}|$=?, $|f_{\omega''}|$=?, $|f_{\phi''}|$=? **experimental information is (see PDG2016) missing!**

Fortunately **not all coupling constant ratios of considered vector meson trinities appear in our Unitary&Analytic model!**

As we see further, **signs of universal vector meson coupling constants are very important in a determination of the SU(3) coupling constants** $f^F, f^D, f^S$ **values!**

Practically, they can be specified, however, **they depend on the concrete** $\omega - \phi$ **mixing form**.

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

Really, **every $\omega - \phi$ mixing form (40) leads to particular signs of $f_\rho, f_\omega, f_\phi$ coupling constants**.

$$
\begin{aligned}
&1. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : +sin\theta : -cos\theta \\
&2. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : -sin\theta : -cos\theta \\
&3. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : +sin\theta : +cos\theta \\
&4. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : -sin\theta : +cos\theta \\
&5. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : +sin\theta : +cos\theta \\
&6. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : -sin\theta : +cos\theta \\
&7. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : +sin\theta : -cos\theta \\
&8. \quad \frac{1}{f_\rho} : \frac{1}{f_\omega} : \frac{1}{f_\phi} = \sqrt{3} : -sin\theta : -cos\theta
\end{aligned}
\tag{42}
$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

As one can notice, the configuration of signs is repeated, therefore further it is **enough to consider only 1., 4., 5. and 8. configurations.**

By an application of $\omega - \phi$ mixing configurations 1.,4.,5.,8. from (40) in a decomposition of $\mathcal{L}_{V\bar{B}B}$ the following **four different expressions for** $f_{\rho NN}, f_{\omega NN}, f_{\phi NN}$ **coupling constants**

$$\begin{aligned} 1. \quad f_{\rho NN} &= \frac{1}{2}\left[f^F + f^D\right] \\ f_{\omega NN} &= +\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\sin\theta + \frac{1}{\sqrt{2}}f^S\cos\theta)\right] \\ f_{\phi NN} &= -\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\cos\theta - \frac{1}{\sqrt{2}}f^S\sin\theta\right] \end{aligned} \qquad (43)$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$\begin{aligned}
4.\quad f_{\rho NN} &= \frac{1}{2}\left[f^F + f^D\right] \\
f_{\omega NN} &= -\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\sin\theta + \frac{1}{\sqrt{2}}f^S\cos\theta)\right] \\
f_{\phi NN} &= +\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\cos\theta - \frac{1}{\sqrt{2}}f^S\sin\theta\right]
\end{aligned} \tag{44}$$

$$\begin{aligned}
5.\quad f_{\rho NN} &= \frac{1}{2}\left[f^F + f^D\right] \\
f_{\omega NN} &= +\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\sin\theta + \frac{1}{\sqrt{2}}f^S\cos\theta)\right] \\
f_{\phi NN} &= +\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\cos\theta - \frac{1}{\sqrt{2}}f^S\sin\theta\right]
\end{aligned} \tag{45}$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

8.
$$\begin{aligned} f_{\rho NN} &= \frac{1}{2}\left[f^F + f^D\right] \\ f_{\omega NN} &= -\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\sin\theta + \frac{1}{\sqrt{2}}f^S\cos\theta)\right] \\ f_{\phi NN} &= -\left[\frac{1}{2\sqrt{3}}(3f^F - f^D)\cos\theta - \frac{1}{\sqrt{2}}f^S\sin\theta\right] \end{aligned} \tag{46}$$

are found.

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

Then, **by a solution of the previous equations one obtains the** $SU(3)$ $f^F, f^D, f^S$ **coupling constants** as functions of the vector meson-nucleon-antinucleon coupling constants.

$$
\begin{aligned}
1.\quad f^F &= \frac{1}{2}\left[f_{\rho NN} + \sqrt{3}(-f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^D &= \frac{1}{2}\left[3f_{\rho NN} - \sqrt{3}(-f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^S &= \sqrt{2}(f_{\omega NN}\cos\theta + f_{\phi NN}\sin\theta) \qquad (47) \\
4.\quad f^F &= \frac{1}{2}\left[f_{\rho NN} + \sqrt{3}(f_{\phi NN}\cos\theta - f_{\omega NN}\sin\theta)\right] \\
f^D &= \frac{1}{2}\left[3f_{\rho NN} - \sqrt{3}(f_{\phi NN}\cos\theta - f_{\omega NN}\sin\theta)\right] \\
f^S &= -\sqrt{2}(f_{\omega NN}\cos\theta + f_{\phi NN}\sin\theta)
\end{aligned}
$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$\begin{aligned}
5. \quad f^F &= \frac{1}{2}\left[f_{\rho NN} + \sqrt{3}(f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^D &= \frac{1}{2}\left[3f_{\rho NN} - \sqrt{3}(f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^S &= \sqrt{2}(f_{\omega NN}\cos\theta - f_{\phi NN}\sin\theta) \\
8. \quad f^F &= \frac{1}{2}\left[f_{\rho NN} - \sqrt{3}(f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^D &= \frac{1}{2}\left[3f_{\rho NN} + \sqrt{3}(f_{\phi NN}\cos\theta + f_{\omega NN}\sin\theta)\right] \\
f^S &= -\sqrt{2}(f_{\omega NN}\cos\theta - f_{\phi NN}\sin\theta).
\end{aligned} \tag{48}$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

The vector meson-nucleon-antinucleon coupling constants values are calculated e.g. from the vector coupling constant ratios
$\frac{f^{(1)}_{\rho NN}}{f_\rho} = 0.3747; \quad \frac{f^{(1)}_{\omega NN}}{f_\omega} = 1.5717; \quad \frac{f^{(1)}_{\phi NN}}{f_\phi} = -1.1247;$
to be found in a fitting procedure of all existing experimental data on the proton and neutron EM FFs
**by a multiplication of them by the universal vector meson coupling constant values**
$f_\rho = 4.956$, $f_\omega = 17.058$, $f_\phi = 13.542$
**one after the other with signs given in (42)**.

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

As a result the values **with the corresponding signs are obtained**

$$\begin{aligned}
1.\quad f^{(1)}_{\rho NN} &= +1.8570;\ f^{(1)}_{\omega NN} = +26.8101;\ f^{(1)}_{\phi NN} = +15.2307;\\
4.\quad f^{(1)}_{\rho NN} &= +1.8570;\ f^{(1)}_{\omega NN} = -26.8101;\ f^{(1)}_{\phi NN} = -15.2307;\\
5.\quad f^{(1)}_{\rho NN} &= +1.8570;\ f^{(1)}_{\omega NN} = +26.8101;\ f^{(1)}_{\phi NN} = -15.2307;\\
8.\quad f^{(1)}_{\rho NN} &= +1.8570;\ f^{(1)}_{\omega NN} = -26.8101;\ f^{(1)}_{\phi NN} = +15.2307,
\end{aligned} \tag{49}$$

respectively.

Substituting them successively into (47) and (48) **the same numerical values**
$f_1^F = 5.2774;\ f_1^D = -1.5634;\ f_1^S = 43.0274$
are found from all four relations for $f^F, f^D, f^S$.

# $\omega-\phi$ MIXING FORMS AND THEIR CONSEQUENCES

Similarly one can find also numerical values of **all other $SU(3)$ coupling constants under consideration**

$$\begin{aligned} f_2^F &= 7.6504;\ f_2^D = 21.0508;\ f_2^S = -7.1320; \\ f_1^{F'} &= 8.2164;\ f_1^{D'} = 12.6258;\ f_1^{S'} = -7.9894; \\ f_2^{F'} &= -30.7398;\ f_2^{D'} = -4.9826;\ f_2^{S'} = -17.6870\,. \end{aligned} \tag{50}$$

Knowing these numbers, by using e.g. the $\omega-\phi$ mixing

configuration 1. **in a decomposition of the corresponding** $\mathcal{L}_{V\bar{B}B}$, the following **relations for vector meson $\Lambda, \Sigma, \Xi$ hyperon coupling constants are found**

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$
\begin{aligned}
f_{\rho\Lambda\Lambda} &= 0 \\
f_{\omega\Lambda\Lambda} &= -\frac{1}{\sqrt{3}} f^D \sin\theta + \frac{1}{\sqrt{2}} f^S \cos\theta \\
f_{\phi\Lambda\Lambda} &= -\frac{1}{\sqrt{3}} f^D \cos\theta + \frac{1}{\sqrt{2}} f^S \sin\theta
\end{aligned}
\tag{51}
$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$\begin{aligned} f_{\rho\Sigma\Sigma} &= f^F \\ f_{\omega\Sigma\Sigma} &= +\frac{1}{\sqrt{3}} f^D \sin\theta + \frac{1}{\sqrt{2}} f^S \cos\theta \\ f_{\phi\Sigma\Sigma} &= +\frac{1}{\sqrt{3}} f^D \cos\theta - \frac{1}{\sqrt{2}} f^S \sin\theta \end{aligned} \tag{52}$$

# $\omega - \phi$ MIXING FORMS AND THEIR CONSEQUENCES

$$
\begin{aligned}
f_{\rho\Xi\Xi} &= \frac{1}{2}(F^F - f^D) \\
f_{\omega\Xi\Xi} &= -\frac{1}{2\sqrt{3}}(3f^F + f^D)\sin\theta + \frac{1}{\sqrt{2}}f^S\cos\theta \\
f_{\phi\Xi\Xi} &= -\frac{1}{2\sqrt{3}}(3f^F + f^D)\cos\theta - \frac{1}{\sqrt{2}}f^S\sin\theta
\end{aligned}
\tag{53}
$$

by means of which **one can determine all free coupling constant ratios** in hyperon Unitary&Analytic EM structure model, and as a result **to predict behaviors of EM FFs of hyperons**.

# $\omega - \phi$ MIXING ANGLES

**The mass of $\omega_8$ particle can be evaluated by means of the Gell-Mann-Okubo quadratic mass relation** for ground state vector mesons

$$m^2(\omega_8) = \frac{4\frac{m^2(K^{*0})+m^2(\bar{K}^{*0})}{2} - m^2(\rho^0)}{3} = (932.14\mathrm{MeV})^2. \quad (54)$$

Then the relation for quadratic masses $m^2_{\omega_8} = m^2_\omega sin^2\theta + m^2_\phi cos^2\theta$ can be derived in a straightforward way, from which the **mixing angle $\theta$ is calculated by means of the relation**

$$sin^2\theta = \frac{m^2_\phi - m^2_{\omega_8}}{m^2_\phi - m^2_\omega}. \quad (55)$$

Similarly also $\theta'$ and $\theta''$ mixing angles.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

Recently **new approach in a determination of the proton $|G_M^p(t)|$ and the ratio $|G_E^p|/|G_M^p|$ for** $t > 4m_p^2$ appeared

*J.Lees et al. (BaBar Collab.), Phys. Rev. D87 (2013) 092005*
*M.Ablikin et al. (BESIII Collab.), Phys. Rev. D91 (2015) 112005*

by a **measurement of the proton polar angle $\theta_p$ distribution** at the SLAC PEP-II asymmetric-energy $e^+e^-$ collider and also at the BEPCII double-ring $e^+e^-$ collider in Beijing.

Expecting that they will continue in similar measurements of the hyperons in final states of $e^+e^-$ annihilation, we have decided also to **predict theoretically just behaviors of $|G_M^Y(t)|$ and** $|G_E^Y(t)|/|G_M^Y(t)|$.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

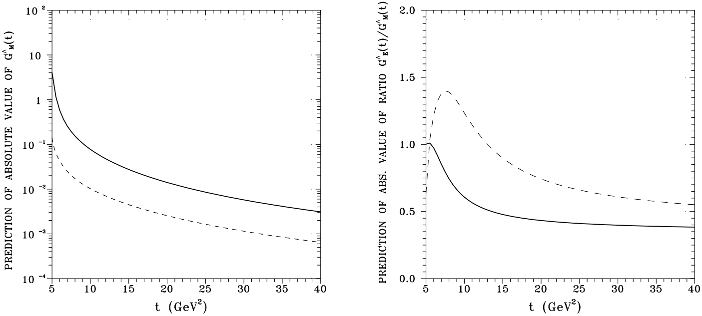


Fig.1: Predicted **behavior of the $\Lambda$ magnetic FF and ratio $|G_E^\Lambda(t)|/|G_M^\Lambda(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

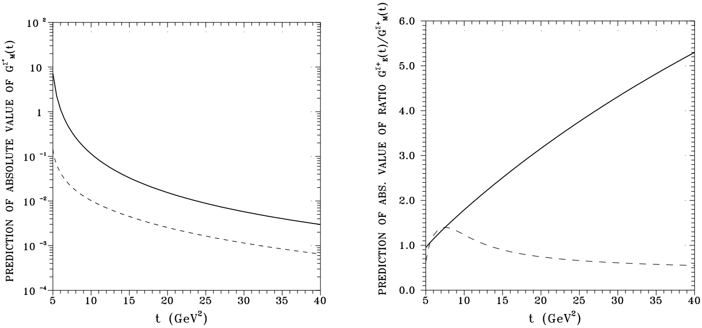


Fig.2: Predicted **behavior of the $\Sigma^+$ magnetic FF and ratio $|G_E^{\Sigma^+}(t)|/|G_M^{\Sigma^+}(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

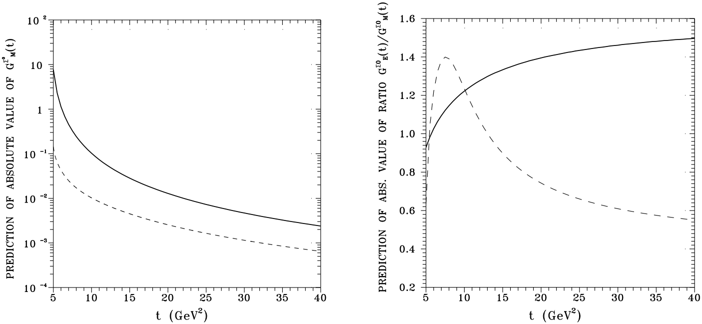


Fig.3: Predicted **behavior of the $\Sigma^0$ magnetic FF and ratio $|G_E^{\Sigma^0}(t)|/|G_M^{\Sigma^0}(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

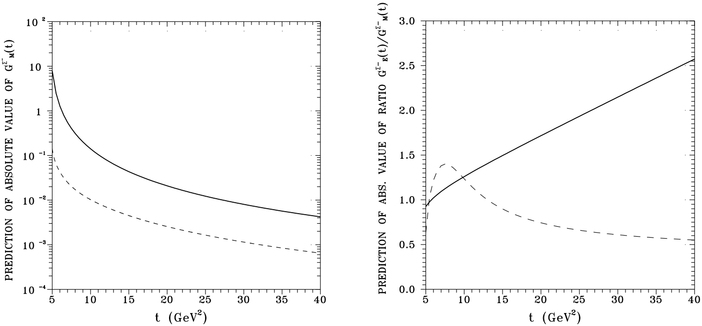


Fig.4: Predicted **behavior of the $\Sigma^-$ magnetic FF and ratio $|G_E^{\Sigma^-}(t)|/|G_M^{\Sigma^-}(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

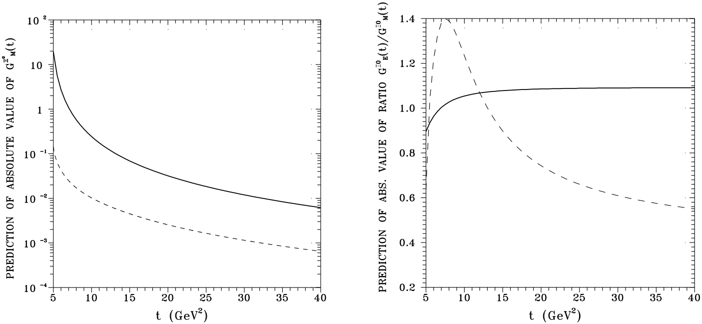


Fig.5: Predicted **behavior of the $\Xi^0$ magnetic FF and ratio $|G_E^{\Xi^0}(t)|/|G_M^{\Xi^0}(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# PREDICTION OF $|G_M^Y(t)|$ AND $|G_E^Y(t)|/|G_M^Y(t)|$

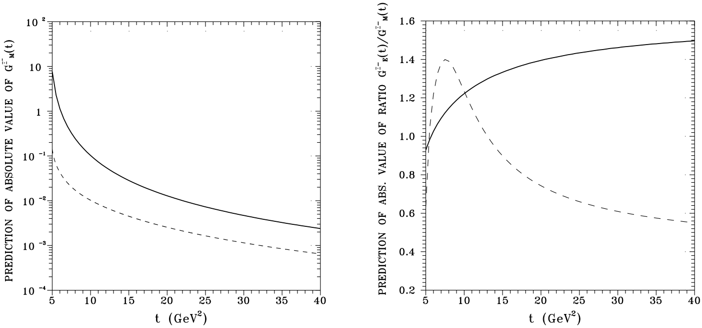


Fig.6: Predicted **behavior of the $\Xi^-$ magnetic FF and ratio $|G_E^{\Xi^-}(t)|/|G_M^{\Xi^-}(t)|$ in $t > 0$ region**. Dashed lines are predictions for the proton.

# CONCLUSIONS

In a realization of **our program of a prediction of the hyperon EM form factors behaviors** one needs:

- **universal Unitary&Analytic model** dependent on some free coupling constant ratios and effective inelastic thresholds

- evaluation of the ratios of vector meson-nucleon-anti-nucleon coupling constants to **universal vector meson coupling constants** $f_\rho, f_\omega, f_\Phi$ **etc** from data on the nucleon EM structure

- experimental values on **leptonic widths of vector mesons under consideration**, from which one can evaluate **universal vector meson coupling constants** up to the "sign"

# CONCLUSIONS

- expressions of the $\omega - \Phi$ mixing forms

- the values of the mixing angles $\theta$, $\theta'$ and $\theta''$

- the reliable data on the total cross sections of $e^+e^- \to Y\bar{Y}$ processes.

Having all this, we were able, with some model ingredients, to **predict theoretically behaviors of** $|G_M^Y(t)|$ **and** $|G_E^Y(t)|/|G_M^Y(t)|$ **for** $Y = \Lambda^0, \Sigma^+, \Sigma^0, \Sigma^-, \Xi^0, \Xi^-$ **hyperons**.

# Thank you for your attention.