

Chiral-odd generalized parton distributions for the low-lying octet baryons

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We have studied the chiral-odd generalized parton distributions (GPDs) for the octet baryons within the framework of diquark spectator model, emphasizing the difference arising from different quark flavors of proton p and light hyperons Σ^+ and Ξ^0 . The equation of quark-quark correlator for the tensor current has been solved to investigate the transversely polarized quark dynamics using light-cone wave functions. In the forward limit, transversity distributions of all the constituent quark flavors of proton, Σ^+ and Ξ^0 , have been studied. Additionally, the first moment of GPD H_T and the combination of GPDs E_T and $\tilde{H}_T$ have also been investigated. Our results are comparable with other available model predictions and lattice data for the proton. Furthermore, we have presented a comparative analysis of tensor charges and anomalous tensor magnetic moments for all the constituent quark flavors of the considered baryons, comparing them with available data obtained from different approaches.

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I. INTRODUCTION

Parton distributions provide a fundamental description of the hadron structure in terms of partons, which are the elementary degrees of freedom in quantum chromodynamics (QCD). At the level of leading twist, the distribution $h_1(x)$ represents the difference between the number densities of quarks whose polarization aligns with the hadron and those with opposite polarization in a transversely polarized hadron and thus, termed as transversity distribution. Being chiral odd in nature and linked to the tensor current of a hadron, this distribution is accessible experimentally only when coupled to another chiral-odd quantity in the cross section of a scattering process. The azimuthal single spin asymmetry in semi-inclusive deep inelastic scattering (SIDIS) [1,2], the transverse spin asymmetry Drell-Yan process in proton-antiproton reactions [3–5], selected photoproduction reactions of lepton pairs [6], and diffractive exclusive production of two vector mesons [7,8] are considered as valuable processes to gain fruitful insights on the hadron transversity [9–14].

Number of experimental facilities and collaborations have contributed substantially to advancing our understanding of transversity distributions, offering constraints for validating GPDs in the forward limit. Experimental

results on $h_1(x)$ [15] have been extracted through the combined SIDIS data from HERMES [16] and COMPASS [17,18] by utilizing the Collins fragmentation function reported by Belle Collaboration [19]. They have also measured the values of tensor charge for the constituent quark flavors of proton and reported it as $0.39^{+18}_{-0.12}$ and $-0.25^{+30}_{-0.10}$ for u and d quark flavors, respectively [15]. Based on the investigation of pion-pair production in DIS of transversely polarized targets, the valence quark transversity distributions and tensor charges have been extracted [20] using the released data from the HERMES [21] and COMPASS [22] Collaborations, combined with the Belle data of e^+e^- annihilations [23]. In Ref. [24], the valence quark contributions to the nucleon tensor charge were also estimated, along with their transversity distribution, by studying the transverse momentum-dependent evolution of the Collins azimuthal asymmetries in e^+e^- annihilations and semi-inclusive hadron production in DIS, including the approximate next-to-leading-logarithmic order. Lattice calculations have also investigated the valence quark transversity distributions and tensor charges in Refs. [25,26] for proton. In a relativistic quark model [27] and Schwinger-Dyson formalism [28,29], nucleon tensor charges have also been predicted.

The helicity dependent three-dimensional (3D) structure interpretation of a hadron can be interpreted through chiral-odd generalized parton distributions (GPDs) in the momentum space. Depending on the different helicity orientations of the initial and final state of a hadron and constituent quarks, there are four different chiral-odd GPDs: H_T , E_T , $\tilde{H}_T$, and $\tilde{E}_T$. At zero skewness, the last GPD $\tilde{E}_T$ gives zero value as it is an odd function of skewness due to the time-reversal invariance. On the other hand, at finite skewness,

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it contributes nontrivially [30]. These GPDs depend on the momentum transferred in the process along with the average longitudinal momentum fraction x . In the forward limit, when momentum transfer becomes zero, the GPD H_T reduces to transversity distribution $h_1(x)$. The first moment of these GPDs correspond to the tensor form factors. Specifically, at zero momentum transfer, the first moment of GPD H_T results in the tensor charge, and the combination of GPDs E_T and $\tilde{H}_T$ leads to the anomalous tensor magnetic moment. The role of chiral-odd GPDs in vector (or pseudoscalar)-meson leptonproduction has also been discussed in Refs. [31–34] to investigate the cross sections, spin density matrix elements, and transverse target spin asymmetries.

To interpret the 3D structure, chiral-odd GPDs for the case of proton have been studied in constituent quark model [35], lattice QCD [36], quark-diquark model (inspired from the soft-wall AdS/QCD [37,38] and proton-quark-diquark vertex [39]), basis light-front quantization (BLFQ) [40], bag model [41], and reggeized diquark model [42,43]. Hence, extensive work has been conducted on the case of proton to study the chiral-odd GPDs and transversity distributions. For hyperons in the chiral-odd sector, the tensor form factors of the octet baryons in the self-consistent SU(3) chiral quark-soliton model (χ QSM) [44], and their transition tensor form factors using leading order light-cone QCD sum rules [45] have only been studied. Beyond the scope of chiral-odd sector for hyperons, chiral-even GPDs with and without skewness parameter, electromagnetic form factors, and charge densities have been explored for the case of low-lying octet baryons [46,47]. The electric and magnetic form factors of the octet baryons have been explored by using lattice QCD (chiral extrapolation) [48,49] and a covariant quark model [50,51]. The leading-twist light-cone distribution amplitudes as well as quasidistribution amplitudes for octet and decuplet baryons within large momentum effective theory have also been studied [52]. In Refs. [53,54], octet and decuplet baryon magnetic moments in the chiral quark model have been investigated. The flavor nondiagonal GPDs also provide the nonperturbative structure of various nucleon-hyperon transitions with help of flavor SU(3) relations [55]. Hard exclusive mesons and baryons electroproduction, such as $\gamma_L^* + p \rightarrow K^0 + \Sigma^+$, provide access to the strange baryon quark densities [56,57].

In recent years, the elastic form factors of hyperons in the timelike region and their transition form factors have been analyzed at BABAR [58], CLEO [59], Belle [60], and BESIII [61–63]. Upcoming measurements at PANDA are also set to expand the current dataset [64]. The study of hyperon dynamics provides valuable contributions to hypernuclear physics [65] and plays a crucial role in exploring neutron and strange stars where hyperons populate the inner core at high baryonic densities [66]. By incorporating effective hyperon and its constituent quark

masses, along with the effective momentum into the vacuum quark distributions, the influence of the dense medium on a hyperon in these stars can be investigated as predicted for the lightest strange meson, i.e., kaon [67] and the octet baryons [68,69]. Drawing motivation from these studies, we have presented the comparative analysis of chiral-odd GPDs, form factors, tensor charges, and anomalous tensor magnetic moment among the constituent quark flavors of octet baryons, including proton p and light hyperons such as Σ^+ and Ξ^0 .

In the present calculations, we have used the diquark spectator model based on the light-cone dynamics. The choice of the light-cone framework is driven by its inherent ability to account for relativistic motion and boosts, making it well suited for studying quark dynamics within hadrons [70,71]. In the diquark spectator model, three valence quark flavors of a baryon are treated as an active quark (participating in the process), while the other two form a spectator diquark. In addition to the scalar diquark, we have also assumed the axial-vector diquarks. Further, we have considered the axial-vector diquarks as isoscalar and isovector spectator diquarks to achieve realistic flavor analysis. To derive the light-cone wave functions (LCWFs), we have chosen the dipolar form for the baryon-quark-diquark vertex over the pointlike form to prevent divergence. Different choices are available while summing over the complete set of axial-vector diquark polarization states. For example, Ref. [39] includes only transversely polarized axial-vector diquarks with scalar diquark to investigate GPDs. This study adopts the sum over transverse and longitudinal polarization, skipping an unphysical timelike polarization state. This diquark spectator model has been used successfully to investigate the transverse momentum-dependent parton distributions [72], fragmentation functions [73], Sivers functions [74], and flavor dependence of the Boer-Mulders function [75] with different summations over polarization of axial-vectors diquarks.

The paper is organized as follows. In Sec. II, the formalism adopted to calculate the chiral-odd GPDs has been discussed for the dipolar baryon-quark-diquark vertex form. In Sec. III, numerical parameters used in the present calculations have been presented. Chiral-odd GPDs have been calculated and discussed in Sec. IV. We have presented the form factors and their comparison with available data in Sec. V, along with the tensor charges and anomalous tensor magnetic moments. The work has been summarized in Sec. VI.

II. FORMALISM

A. Kinematics

In the light-cone framework, we describe a generic four-vector notation for coordinates as $a = [a^+, a^-, a_\perp]$. We choose a convenient asymmetric frame in which the

respective initial and final state four-vector momentum coordinates of a baryon X are expressed as

$$P_X = \left(P_X^+, \frac{M_X^2}{P_X^+}, \mathbf{0}_\perp \right),$$

$$P'_X = \left((1-\zeta)P_X^+, \frac{M_X^2 + \Delta_\perp^2}{(1-\zeta)P_X^+}, -\Delta_\perp \right), \quad (1)$$

where M_X refers to the baryon mass and ζ as the skewness parameter [43,76]. The momentum transfer throughout the process in terms of four-vector notation is described by

$$\Delta = P_X - P'_X = \left(\zeta P_X^+, \frac{t + \Delta_\perp^2}{\zeta P_X^+}, \Delta_\perp \right). \quad (2)$$

Here, the negative component of momentum transfer connects $\Delta_\perp$, ζ , and t by the following relation:

$$t = 2P_X \cdot \Delta = -\frac{\zeta^2 M_X^2 + \Delta_\perp^2}{1-\zeta}. \quad (3)$$

In the present calculations, we restrict ourselves to the case of zero skewness ($\zeta = 0$), and thus, $t = \Delta^2 = -\Delta_\perp^2$, which corresponds to the transverse momentum transfer only. The coordinates of the initial and final state of an active quark are, respectively, expressed by

$$k = (xP_X^+, k^-, \mathbf{k}_\perp),$$

$$k' = (x'P_X^+, k'^-, \mathbf{k}'_\perp). \quad (4)$$

In the final state, the longitudinal momentum fraction and transverse momentum carried by an active quark are, respectively, defined as $x' = x$ and $\mathbf{k}'_\perp = \mathbf{k}_\perp - (1-x)\Delta_\perp$.

B. Light-cone wave functions for baryons

For a two-body system of a spin- $\frac{1}{2}$ baryon, the instant form SU(6) quark-diquark wave function can be defined as

$$|\mathcal{B}\rangle^{\lambda_X} = \cos\theta \sum_q a_q |q_1 \mathfrak{s}(q_2 q_3)\rangle^{\lambda_X}$$

$$+ \sin\theta \sum_{q'} b'_{q'} |q'_1 \mathfrak{a}(q'_2 q'_3)\rangle^{\lambda_X}, \quad (5)$$

where the summation is over different quark-diquark components [77]. Fock state $|q_1 \mathfrak{s}(q_2 q_3)\rangle$ corresponds to the q_1 quark and $\mathfrak{s}(q_2 q_3)$ scalar diquark. Similarly, $|q'_1 \mathfrak{a}(q'_2 q'_3)\rangle$ represents the Fock state of q'_1 quark and an axial-vector diquark $\mathfrak{a}(q'_2 q'_3)$. The quantity λ_X labels the light-cone spin projections of the baryon and can be categorized as $\uparrow$ or $\downarrow$. The coefficients a_q and $b_{q'}$ satisfy the normalization condition $\cos^2\theta \sum_q a_q + \sin^2\theta \sum_{q'} b'_{q'} = 1$. For nucleons and hyperons, belonging to the same octet of spin- $\frac{1}{2}$ baryons, the associated

coefficients have different values. The spin-flavor SU(6) symmetry breaking introduces a mixing angle, θ , which is taken as $\pi/4$ in the symmetric case. The instant form wave functions for the proton in the form of quark-diquark pair can be expanded as

$$|p\rangle^{\uparrow,\downarrow} = \frac{1}{\sqrt{2}} |u \mathfrak{s}(ud)\rangle^{\uparrow,\downarrow} - \frac{1}{\sqrt{6}} |u \mathfrak{a}(ud)\rangle^{\uparrow,\downarrow}$$

$$+ \frac{1}{\sqrt{3}} |d \mathfrak{a}(uu)\rangle^{\uparrow,\downarrow}, \quad (6)$$

where $\mathfrak{s}$ and $\mathfrak{a}$ denote the scalar (spin = 0) and axial-vector (spin = 1) diquarks, respectively. The probabilistic weight distribution among the scalar isoscalar [quark u with diquark $\mathfrak{s}(ud)$], vector isoscalar [quark u with diquark $\mathfrak{a}(ud)$], and vector isovector [quark d with diquark $\mathfrak{a}(uu)$] configurations comes out to be 3:1:2 with respect to the charge-isospin symmetry. For the case of proton, the flavor decomposition for an GPDs and form factors can be expressed as

$$f^{p_u} = \frac{3}{2} f^{\mathfrak{s}} + \frac{1}{2} f^{\mathfrak{a}},$$

$$f^{p_d} = f^{\mathfrak{a}}, \quad (7)$$

which implies that the valence quark distribution of u quark flavor can be interpreted by involving both scalar and axial-vector diquarks, whereas for d quark flavor, the involvement of solely axial-vector diquark is needed [73,78]. In a similar way, the instant form wave functions for the hyperons Σ^+ and Ξ^0 in the form of quark-diquark pair can be expanded as [77]

$$|\Sigma^+\rangle^{\uparrow,\downarrow} = \frac{1}{\sqrt{2}} |u \mathfrak{s}(us)\rangle^{\uparrow,\downarrow} - \frac{1}{\sqrt{6}} |u \mathfrak{a}(us)\rangle^{\uparrow,\downarrow}$$

$$+ \frac{1}{\sqrt{3}} |s \mathfrak{a}(uu)\rangle^{\uparrow,\downarrow}, \quad (8)$$

$$|\Xi^0\rangle^{\uparrow,\downarrow} = \frac{1}{\sqrt{2}} |s \mathfrak{s}(us)\rangle^{\uparrow,\downarrow} + \frac{1}{\sqrt{6}} |s \mathfrak{a}(us)\rangle^{\uparrow,\downarrow}$$

$$- \frac{1}{\sqrt{3}} |u \mathfrak{a}(ss)\rangle^{\uparrow,\downarrow}. \quad (9)$$

In analogy with proton, depending on their quark flavor structure, the flavor decomposition of different hyperons can be considered. The two particle Fock state expansion for the case of scalar [71] and axial-vector diquark [72] is, respectively, expressed as

$$|q \mathfrak{s}\rangle_{X_{qs}}^{\uparrow,\downarrow} = \int \frac{dx d^2 \mathbf{k}_\perp}{16\pi^3 \sqrt{x(1-x)}}$$

$$\times \sum_{\lambda_q} \psi_{\lambda_q}^{\uparrow,\downarrow X_{qs}}(x, \mathbf{k}_\perp) |\lambda_q, xP_X^+, \mathbf{k}_\perp\rangle, \quad (10)$$

$$|qa\rangle_{Xqa}^{\uparrow,\downarrow} = \int \frac{dx d^2\mathbf{k}_\perp}{16\pi^3 \sqrt{x(1-x)}} \times \sum_{\lambda_q} \sum_{\lambda_a} \psi_{\lambda_q \lambda_a}^{\uparrow,\downarrow Xqa}(x, \mathbf{k}_\perp) |\lambda_q \lambda_a, x P_X^+, \mathbf{k}_\perp\rangle, \quad (11)$$

where $\lambda_q (= \uparrow, \downarrow)$ and $\lambda_a (= \pm, 0)$ denote the helicity of an active quark and axial-vector diquark. The transverse and longitudinal polarization is expressed by the symbols $\pm$ and 0 , respectively. In general, the LCWFs for a scalar diquark can be defined as

$$\psi_{\lambda_q}^{\lambda_X X q \bar{s}}(x, \mathbf{k}_\perp) = \sqrt{\frac{k^+}{(P_X - k)^+ k^2 - m_q^2}} \bar{u}(k, \lambda_q) \mathcal{Y}_{\bar{s}} U(P_X, \lambda_X), \quad (12)$$

where the scalar vertex has the form $\mathcal{Y}_{\bar{s}} = i g_{\bar{s}}^X(k^2) \mathbf{1}$, and m_q corresponds to the mass of an active quark. $u(k, \lambda_q)$ and $U(P, \lambda_X)$ represent the spin- $\frac{1}{2}$ Dirac spinors for an active quark q and baryon, respectively. In the similar vein, the LCWFs for an axial-vector diquark can be defined as

$$\psi_{\lambda_q \lambda_a}^{\lambda_X X q a}(x, \mathbf{k}_\perp) = \sqrt{\frac{k^+}{(P_X - k)^+ k^2 - m_q^2}} \bar{u}(k, \lambda_q) \times \epsilon_\mu^*(P_X - k, \lambda_a) \cdot \mathcal{Y}_a^\mu U(P_X, \lambda_X). \quad (13)$$

The four-vector polarization of spin-1 diquark with total momentum $(P_X - k)$ is denoted by the term $\epsilon_\mu(P_X - k, \lambda_a)$. To uphold the spin sum rule, helicities must adhere to the constraint $\lambda_X = \lambda_q + \lambda_D + L_z$, dictated by the angular momentum conservation. Here, the symbol $D(= \bar{s}, a)$ denotes the diquark that can be a scalar $\bar{s}$ or axial-vector a . The relative orbital angular momentum projection between the quark and the diquark is expressed by the quantity L_z . For the axial-vector diquark, the vertex has the form $\mathcal{Y}_a^\mu = i g_a^X(k^2) \gamma^\mu \gamma_5 / \sqrt{2}$. For the dipolar vertex, the form factor g_D^X can be expressed as

$$g_D^X(k^2) = g_D^X \frac{(k^2 - m_q^2)(1-x)^2}{(\mathbf{k}_\perp^2 + L_{XD}^2)}, \quad (14)$$

where g_D^X is a coupling constant for a given diquark D of a baryon X . From Eq. (12), we obtain LCWFs for scalar diquark as

$$\begin{aligned} \psi_{\uparrow}^{\uparrow X q \bar{s}}(x, \mathbf{k}_\perp) &= \frac{m_q + x M_X}{x} \phi_{q \bar{s}}^X, \\ \psi_{\downarrow}^{\uparrow X q \bar{s}}(x, \mathbf{k}_\perp) &= -\frac{k_r}{x} \phi_{q \bar{s}}^X, \\ \psi_{\uparrow}^{\downarrow X q \bar{s}}(x, \mathbf{k}_\perp) &= -\left[\psi_{\downarrow}^{\uparrow X q \bar{s}}(x, \mathbf{k}_\perp) \right]^*, \\ \psi_{\downarrow}^{\downarrow X q \bar{s}}(x, \mathbf{k}_\perp) &= \psi_{\uparrow}^{\uparrow X q \bar{s}}(x, \mathbf{k}_\perp). \end{aligned} \quad (15)$$

Similarly, from Eq. (13), the LCWFs for axial-vector diquark come out to be

$$\begin{aligned} \psi_{\uparrow+}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= \frac{k_l}{x(1-x)} \phi_{qa}^X, \\ \psi_{\uparrow-}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= -x \frac{k_r}{x(1-x)} \phi_{qa}^X, \\ \psi_{\downarrow+}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= \frac{m_q + x M_X}{x} \phi_{qa}^X, \\ \psi_{\downarrow-}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= 0, \\ \psi_{\uparrow+}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= 0, \\ \psi_{\uparrow-}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= -\psi_{\downarrow+}^{\uparrow X qa}(x, \mathbf{k}_\perp), \\ \psi_{\downarrow+}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= \left[\psi_{\uparrow-}^{\uparrow X qa}(x, \mathbf{k}_\perp) \right]^*, \\ \psi_{\downarrow-}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= \left[\psi_{\uparrow+}^{\uparrow X qa}(x, \mathbf{k}_\perp) \right]^*, \\ \psi_{\uparrow 0}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= \frac{\mathbf{k}_\perp^2 - x m_a^2 - m_q M_X (1-x)^2}{\sqrt{2} x (1-x) m_a} \phi_{qa}^X, \\ \psi_{\downarrow 0}^{\uparrow X qa}(x, \mathbf{k}_\perp) &= \frac{(m_q + M_X) k_r}{\sqrt{2} x m_a} \phi_{qa}^X, \\ \psi_{\uparrow 0}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= \left[\psi_{\downarrow 0}^{\uparrow X qa}(x, \mathbf{k}_\perp) \right]^*, \\ \psi_{\downarrow 0}^{\downarrow X qa}(x, \mathbf{k}_\perp) &= -\psi_{\uparrow 0}^{\uparrow X qa}(x, \mathbf{k}_\perp). \end{aligned} \quad (16)$$

The quantities k_r and K_l used in above equations are defined as $k_{r(l)} = k_1 \pm i k_2$. The momentum space wave function $\phi_{qD(=\bar{s}/a)}^X$ written in above mentioned LCWFs can be expressed as

$$\phi_{qD}^X = -\frac{g_D^X}{\sqrt{1-x}} \frac{x(1-x)^2}{[\mathbf{k}_\perp^2 + L_{XD}^2]}, \quad (17)$$

with $L_{XD}^2 = x m_D^2 + (1-x)(\Lambda_{qD}^X)^2 - x(1-x) M_X^2$. Here, m_D denotes the mass of a diquark D , and Λ_{qD}^X (GeV) is an appropriate cutoff to avoid the singularity and satisfy the relation $m_D > M_X - \Lambda_{qD}^X$ [73].

III. NUMERICAL PARAMETERS

The key input parameters involved in our calculations are the baryon masses M_X , quark masses m_q , and the spectator diquark masses m_D . Following Ref. [73] for proton, particle data group and Ref. [78] for other particles, the values of the masses of baryons are taken as $M_p = 0.938$ GeV, $M_{\Sigma^+} = 1.189$ GeV, and $M_{\Xi^0} = 1.314$ GeV, whereas the masses of quarks and diquarks are summarized in Table I. The quantity Λ_{qD}^X is another parameter of the model in the dipolar form factor of the baryon-quark-diquark vertex. Since the first moment of GPDs serve as boundary

TABLE I. Masses of quark flavors $m_{q(=u,d,s)}$ as well as their scalar $m_{\mathfrak{s}}$ and axial-vector $m_{\mathfrak{a}}$ diquark systems used in the present calculations.

Quantity	$m_{u/d}$	m_s	$m_{\mathfrak{s}(uu/ud)}$	$m_{\mathfrak{a}(uu/ud)}$	$m_{\mathfrak{s}(us/ds)}$	$m_{\mathfrak{a}(us/ds)}$	$m_{\mathfrak{a}(ss)}$
Values (GeV)	0.36	0.48	0.60	0.80	0.75	0.95	1.10

TABLE II. Values of coupling constant $C_{X_{qD}}$ used in the present calculations.

Coupling	$C_{P_{u\mathfrak{s}(ud)}}$	$C_{P_{u\mathfrak{a}(ud)}/d\mathfrak{a}(uu)}$	$C_{\Sigma^+_{u\mathfrak{s}(us)}}$	$C_{\Sigma^+_{u\mathfrak{a}(us)}}$	$C_{\Sigma^+_{s\mathfrak{a}(uu)}}$	$C_{\Xi^0_{s\mathfrak{s}(us)}}$	$C_{\Xi^0_{s\mathfrak{a}(us)}}$	$C_{\Xi^0_{u\mathfrak{a}(ss)}}$
Values	1.49	2.60	1.93	4.62	5.05	1.51	2.45	2.76

conditions, we fix the parameter Λ_{qD}^X (GeV) to obtain reasonable estimates of tensor charge $g_T^{X_q}$ and anomalous tensor magnetic moment $\kappa_T^{X_q}$ of each constituent quark flavors of a considered baryon X . Any value of Λ_{qD}^X (GeV) satisfying the condition $m_D > M_X - \Lambda_{qD}^X$ yields physically reasonable estimates of $g_T^{X_q}$ and $\kappa_T^{X_q}$ with marginal variation across different choices of Λ_{qD}^X (GeV). To show this, we consider three different sets of Λ_{qD}^X (GeV) and tabulated their corresponding values of $g_T^{X_q}$ and $\kappa_T^{X_q}$ in the Appendix. However, for consistency and interpretability, it is necessary to select specific values of Λ_{qD}^X (GeV) that produce phenomenologically relevant results of $g_T^{X_q}$ and $\kappa_T^{X_q}$ for each quark flavors of a baryon X .

For the proton, we found that set 2 of Λ_{qD}^P (GeV) mentioned in Table IV in the Appendix section provides the most comparable values of $g_T^{P_u}$, $g_T^{P_d}$, $\kappa_T^{P_u}$, and $\kappa_T^{P_d}$ to the phenomenological model results, except lattice simulated and experimentally evaluated data. The discrepancy with lattice result arises because lattice results are generally computed at a higher scale and include heavy pion mass, which leads to smaller values of $g_T^{X_q}$ and $\kappa_T^{X_q}$. Experimentally, tensor charges for the u and d quark flavors of proton have been calculated either by computing the integral upon the accessible low x range of experimental data (truncated tensor charge) or by extrapolating the transversity to the full support $[0,1]$ in the parton fractional momentum x . It has been mentioned in Ref. [79] that these options obviously induce significant errors that somewhat decrease the relevance of the observed quantity. For Σ^+ , we again consider three different sets of $\Lambda_{qD}^{\Sigma^+}$ (GeV),

corresponding to which the values of $g_T^{\Sigma^+}$, $g_T^{\Sigma^+}$, $\kappa_T^{\Sigma^+}$, and $\kappa_T^{\Sigma^+}$ are tabulated in Table V in the Appendix. The set 2 of $\Lambda_{qD}^{\Sigma^+}$ gives reasonable estimate of $g_T^{\Sigma^+}$ and $g_T^{\Sigma^+}$ with available model calculations of Ref. [44], and with the same set of $\Lambda_{qD}^{\Sigma^+}$, we predict the values of $\kappa_T^{\Sigma^+}$ and $\kappa_T^{\Sigma^+}$. On the similar pattern of Σ^+ , set 2 of $\Lambda_{qD}^{\Xi^0}$ (GeV) values has been chosen from Table VI (expressed in the Appendix section) that provides comparable results of $g_T^{\Xi^0}$ and $g_T^{\Xi^0}$ with Ref. [44] and predicts the values of $\kappa_T^{\Xi^0}$ and $\kappa_T^{\Xi^0}$. Hence, set 2 from each table has been chosen from the Appendix section to constrain the chiral-odd GPDs of the proton and both of the light hyperons.

For these set of parameters, the valence quark parton distribution functions (PDFs) $f_1^{X_q}$ must also be normalized such that their integrals correspond to the valence quark content of the baryon, ensuring quark number conservation. Therefore, for each quark content of all baryons, the $f_1^{X_q}$ is normalized by $f_{1\text{norm}}^{X_q} = N_{X_{qD}}^2 / (g_D^X)^2 f_1^{X_q}$, where $N_{X_{qD}}$ is the normalization constant [47,72]. The explicit expression of PDF can be found in Ref. [72]. Henceforth, in numerical results, instead of g_D^X in Eq. (17), a new coupling constant $C_{X_{qD}}$ is used that differs from the original couplings g_D^X by the normalization constants $N_{X_{qD}}$, and the evaluated numerical values of constant $C_{X_{qD}}$ are tabulated in Table II.

IV. CHIRAL-ODD GPDS

The nonforward matrix elements of lightlike correlation functions of the tensor current are termed as chiral-odd GPDs and can be defined as

$$F_{\lambda_X \lambda'_X} = \frac{1}{2} \int \frac{dz^-}{2\pi} e^{ix\bar{P}_X^+ z^-} \left\langle P'_X, \lambda'_X \left| \bar{\psi} \left(-\frac{z}{2} \right) \sigma^{+j} \gamma_5 \psi \left(\frac{z}{2} \right) \right| P_X, \lambda_X \right\rangle \Big|_{z^+=0, \mathbf{z}_\perp=0}, \quad (18)$$

where $j(=1,2)$ corresponds to the transverse index [30,39,80], and $\bar{P}_X$ represents the average baryon momentum. The gauge link appearing in between the initial and final state quark field operators $[\psi(z/2)$ and $\bar{\psi}(-z/2)$, respectively] becomes unity as we choose the light-cone gauge $A^+ = 0$. Further, the chiral-odd GPDs can be parametrized as

$$\begin{aligned}
F_{\lambda_X \lambda'_X} &= \frac{1}{2P_X^+} \bar{U}(P'_X, \lambda'_X) \left[H_T^{X_q}(x, \zeta, t) \sigma^{+i} \gamma_5 \right. \\
&\quad + \tilde{H}_T^{X_q}(x, \zeta, t) \frac{\epsilon^{+j\alpha\beta} \Delta_\alpha \bar{P}_{X\beta}}{M_X^2} + E_T^{X_q}(x, \zeta, t) \frac{\epsilon^{+j\alpha\beta} \Delta_\alpha \gamma_\beta}{2M_X} \\
&\quad \left. + \tilde{E}_T^{X_q}(x, \zeta, t) \frac{\epsilon^{+j\alpha\beta} \bar{P}_{X\alpha} \gamma_\beta}{M_X} \right] U(P_X, \lambda_X). \quad (19)
\end{aligned}$$

Depending on the various helicity configurations of the baryon and its constituent valence quarks, the chiral-odd GPDs can be correlated to the following matrix elements:

$$\begin{aligned}
A_{\lambda'_X \uparrow, \lambda_X \downarrow} &= \int \frac{dz^-}{2\pi} e^{i\bar{x}\bar{P}_X^+ z^-} \langle P'_X, \lambda'_X | \mathcal{O}_{\uparrow, \downarrow}(z) | P_X, \lambda_X \rangle|_{z^+=0, \mathbf{z}_\perp=0}, \\
A_{\lambda'_X \downarrow, \lambda_X \uparrow} &= \int \frac{dz^-}{2\pi} e^{i\bar{x}\bar{P}_X^+ z^-} \langle P'_X, \lambda'_X | \mathcal{O}_{\downarrow, \uparrow}(z) | P_X, \lambda_X \rangle|_{z^+=0, \mathbf{z}_\perp=0}, \quad (20)
\end{aligned}$$

where the operators have the form

$$\begin{aligned}
\mathcal{O}_{\uparrow, \downarrow} &= \frac{i}{4} \bar{\psi} \sigma^{+1} (1 - \gamma_5) \psi, \\
\mathcal{O}_{\downarrow, \uparrow} &= -\frac{i}{4} \bar{\psi} \sigma^{+1} (1 + \gamma_5) \psi. \quad (21)
\end{aligned}$$

The quark field operators appearing in Eq. (18) can be expressed using the quark creation and annihilation operators (as detailed in Ref. [30]). The baryon state, in turn, can be expanded over a complete basis consisting of N constituent eigenstates [71]. By considering various helicity configurations (λ_X and λ'_X) and substituting both the quark field operators and the baryon state into Eqs. (18) and (19), we get the following relations:

$$H_T^{X_q}(x, \zeta, t) = \frac{T_1^{X_q}}{\sqrt{1-\zeta^2}} - \frac{2M_X \zeta}{\epsilon \sqrt{t_0-t}(1-\zeta^2)} T_3^q, \quad (22)$$

$$\begin{aligned}
E_T^{X_q}(x, \zeta, t) &= \frac{2M_X}{\epsilon \sqrt{t_0-t}(1-\zeta^2)} (\zeta T_3^{X_q} + T_4^{X_q}) \\
&\quad - \frac{4M_X^2}{(t_0-t)(1-\zeta^2)\sqrt{1-\zeta^2}} (T_2^{X_q} - T_1^{X_q}), \quad (23)
\end{aligned}$$

$$\tilde{H}^{X_q}(x, \zeta, t) = \frac{2M_X^2}{(t_0-t)\sqrt{1-\zeta^2}} (T_2^{X_q} - T_1^{X_q}), \quad (24)$$

$$\begin{aligned}
\tilde{E}^{X_q}(x, \zeta, t) &= \frac{2M_X}{\epsilon \sqrt{t_0-t}(1-\zeta^2)} (\zeta T_4^{X_q} + T_3^{X_q}) \\
&\quad - \frac{4M_X^2}{(t_0-t)(1-\zeta^2)\sqrt{1-\zeta^2}} (T_2^{X_q} - T_1^{X_q}), \quad (25)
\end{aligned}$$

where t_0 represents the minimum value of t and $\epsilon = \text{sgn}(D^1)$, with D^1 as the x component of $D^\alpha = \bar{P}^+ \Delta^\alpha - \Delta^+ \bar{P}^\alpha$ [37]. The matrix elements in terms of helicity basis can be expressed as $T_{1(2)}^{X_q} = A_{\uparrow\uparrow, \downarrow\downarrow} \pm A_{\downarrow\uparrow, \uparrow\downarrow}$, $T_{3(4)}^{X_q} = A_{\uparrow\uparrow, \uparrow\downarrow} \mp A_{\downarrow\uparrow, \downarrow\downarrow}$. The kinematical region $0 < x < 1$ at zero skewness ($\zeta = 0$) corresponds to the situation in which an active quark emission and reabsorption takes place with the same longitudinal momentum fraction x . Henceforth, we will present GPDs without incorporating the skewness parameter as our results focus solely on chiral-odd GPDs and the observables that can be derived from them in the absence of skewness. The matrix elements in the overlap form of LCWFs for the case of scalar diquark are given as

$$T_{1(2)}^{X_{q\bar{s}}} = \int \frac{d^2 \mathbf{k}_\perp}{16\pi^3} \left[\psi_{\uparrow}^{\uparrow X_{q\bar{s}}}(x, \mathbf{k}'_\perp) \psi_{\downarrow}^{\downarrow X_{q\bar{s}}}(x, \mathbf{k}_\perp) \pm \psi_{\uparrow}^{\downarrow X_{q\bar{s}}}(x, \mathbf{k}'_\perp) \psi_{\downarrow}^{\uparrow X_{q\bar{s}}}(x, \mathbf{k}_\perp) \right], \quad (26)$$

$$T_{3(4)}^{X_{q\bar{s}}} = \int \frac{d^2 \mathbf{k}_\perp}{16\pi^3} \left[\psi_{\uparrow}^{\uparrow X_{q\bar{s}}}(x, \mathbf{k}'_\perp) \psi_{\downarrow}^{\uparrow X_{q\bar{s}}}(x, \mathbf{k}_\perp) \mp \psi_{\uparrow}^{\downarrow X_{q\bar{s}}}(x, \mathbf{k}'_\perp) \psi_{\downarrow}^{\downarrow X_{q\bar{s}}}(x, \mathbf{k}_\perp) \right]. \quad (27)$$

For the case of axial-vector diquarks, the matrix elements in the overlap form of LCWFs are defined as

$$\begin{aligned}
T_{1(2)}^{X_{qa}} &= \int \frac{d^2 \mathbf{k}_\perp}{16\pi^3} \left[\left\{ \psi_{\uparrow+}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow+}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow-}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow-}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow 0}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow 0}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) \right\} \right. \\
&\quad \left. \pm \left\{ \psi_{\uparrow+}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow+}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow-}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow-}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow 0}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow 0}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) \right\} \right], \quad (28)
\end{aligned}$$

$$\begin{aligned}
T_{3(4)}^{X_{qa}} &= \int \frac{d^2 \mathbf{k}_\perp}{16\pi^3} \left[\left\{ \psi_{\uparrow+}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow+}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow-}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow-}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow 0}^{\uparrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow 0}^{\uparrow X_{qa}}(x, \mathbf{k}_\perp) \right\} \right. \\
&\quad \left. \mp \left\{ \psi_{\uparrow+}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow+}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow-}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow-}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) + \psi_{\uparrow 0}^{\downarrow X_{qa}}(x, \mathbf{k}'_\perp) \psi_{\downarrow 0}^{\downarrow X_{qa}}(x, \mathbf{k}_\perp) \right\} \right]. \quad (29)
\end{aligned}$$

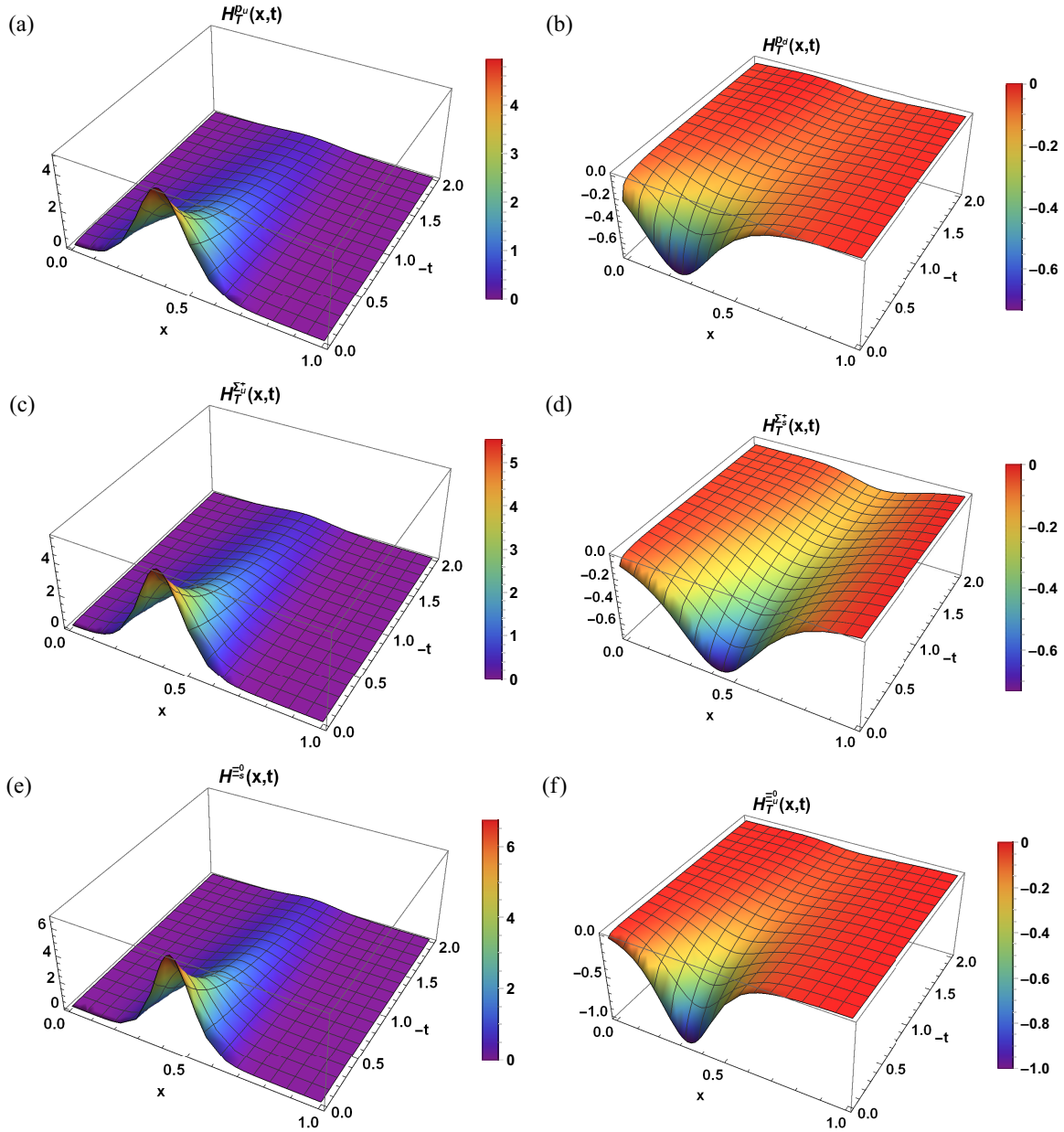


FIG. 1. Chiral-odd GPDs $H_T^{X_q}(x, t)$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV^2) for (a) u and (b) d quark flavors of proton, (c) u and (d) s quark flavors of Σ^+ , and (e) s and (f) u quark flavors of Ξ^0 .

In order to study the dependence of the GPDs on the longitudinal momentum fraction and transverse momentum transfer, in Fig. 1, the 3D distributions of GPD $H_T^{X_q}$ are presented as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV^2) for all the constituent quark flavors of proton, Σ^+ and Ξ^0 . According to the flavor decomposition scheme mentioned in Eq. (7), the quark flavor distributions in the left panel incorporate contributions from both the scalar and axial-vector diquarks, while the right panel involves distributions arising solely from axial-vector diquark contribution. All the distributions show an intense peak when there is no

transverse momentum transfer throughout the process; i.e., $t = 0$. With the increase in the value of transverse momentum transfer $-t$ (GeV^2), the magnitude of the distribution scales down, and the peak of the distribution gets shifted on higher values of x . On comparing the distributions of the left panel, it has been found that, as a function of $-t$, the distributions of Σ^+ and Ξ^0 fall off comparatively slower than proton. At $t = 0$, GPD $H_T^{X_q}$ reduces to the $h_1(x)$ transversity distribution, which corresponds to the probability of finding an active quark with spin-polarized along the transverse spin of a polarized baryon minus the probability of finding it polarized oppositely.

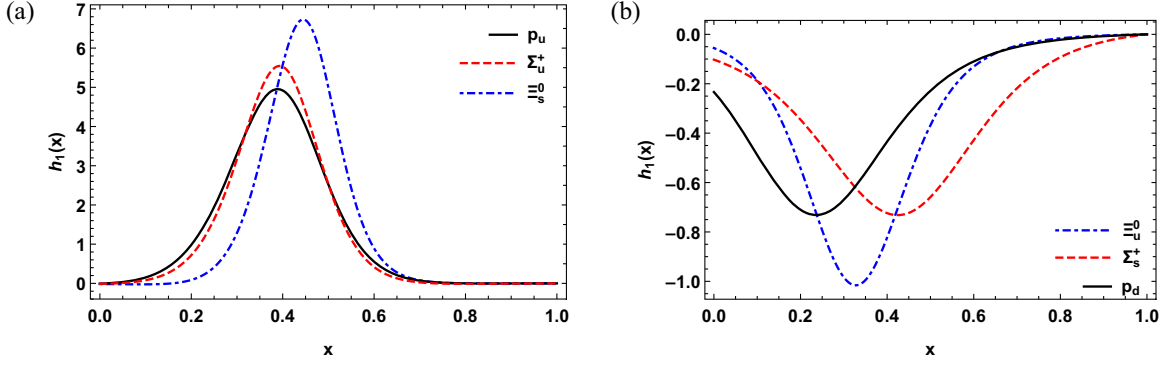


FIG. 2. Comparison of transversity distributions $h_1(x)$ as a function of longitudinal momentum fraction x among all the constituent quark flavors of proton, Σ^+ , and Ξ^0 which involves the contribution from (a) both scalar and axial-vector diquarks and (b) axial-vector diquarks only.

A comparative analysis among p_u , Σ_u^+ , and Ξ_u^0 is presented in Fig. 2(a), which involves the contributions from both scalar and axial-vector diquarks. The results indicate that the peak of transversity distribution is located at relatively higher values of the longitudinal momentum fraction x for hyperons. This implies that the transverse polarization of an active quark flavor of hyperon is prominent when it carries a larger momentum fraction of the parent hyperon momentum. The magnitude of the distributions of both hyperons Σ^+ and Ξ^0 is observed to be more than that of proton. A comparative analysis of 3D distributions arising only from axial-vector diquark contributions in the right panel of Fig. 1 show negative distributions as a function of x and $-t$. Among hyperons, the distribution for Ξ_u^0 is found to be narrower than Σ_s^+ . Quantitatively, as a function of $-t$, distributions are found to fall faster for the case of p_d , and 56% change has been found when $-t$ reaches 0.2 GeV from zero. For the same value of $-t$, the distributions of Σ_s^+ and Ξ_u^0 decrease by 29% and 45%, respectively. At $t = 0$, the results of transversity distribution show the peak at significantly higher values of x for the case of hyperons as compared to proton in Fig. 2(b). The likelihood of getting a transversely polarized active quark flavor of Ξ^0 is higher as their magnitudes are much more than proton and Σ^+ . As expected, s quark (being heavier) is found to carry more longitudinal momentum fraction x than its partner u quark flavor within the same hyperon. Specifically, for the case of proton, the results for both quark flavors are found to be consistent qualitatively with Refs. [35,40,41] as the magnitude of distribution is found to be more for the case of u quark flavor than d . However, the dependence over the range of x is found to be completely model dependent.

The 3D distributions of GPD $E_T^{X_q}$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV²) for all the constituent quark flavors of proton, Σ^+ and Ξ^0 , are shown in Fig. 3. The left panel displays quark flavor distributions incorporating contributions from both scalar and axial-vector diquarks, whereas the right panel solely accounts for distributions arising from

an axial-vector diquark contribution. For the case of u constituent quark of proton, the distribution is predominantly localized within the range $0 < x < 0.6$ at $t = 0$. This characteristic dependence of the GPD $E_T^{p_u}$ over x has also been observed in Ref. [35]. However, Refs. [40,41] show a finite value of the distribution at $x = 0$. On comparing the distributions presented in the left panel, we found that u and s quark flavors of Σ^+ and Ξ^0 have comparatively more magnitude of the distributions, along with their peaks at higher values of x , as compared to u quark flavor of proton at $t = 0$. Between u and s quark flavors of hyperons, Ξ^0 is observed to have a narrower distribution. The d quark flavor of proton is found to have distribution even at a smaller region of x than u quark flavor of proton with a peak at $x = 0$, which is consistent with the result obtained in Ref. [40], but zero crossing points are not observed in our model results. On comparing the distributions presented in the right panel of Fig. 3 (comprising of contribution from axial-vector diquarks only), we found that the Σ_u^+ and Ξ_s^0 have peaks at a finite value of x , instead of zero. As a function of $-t$, the magnitude of the peaks fall off comparatively faster for the case of proton than hyperons, and the shifting of the peak toward a larger value of x is consistent for all the constituent quark flavors of baryons.

In Fig. 4, the 3D distributions of GPD $\tilde{H}_T^{X_q}$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV²) for all the constituent quark flavors of proton, Σ^+ and Ξ^0 , are illustrated. On comparing the distributions presented on the left panel, we found that for the quark flavor incorporating contributions from both scalar and axial-vector diquarks, $\tilde{H}_T^{X_q}$ presents a similar trend as shown by $H_T^{X_q}$ and $E_T^{X_q}$ as a function of $-t$. However, these distributions are negative and have a zero crossover in the small x value. Qualitatively, a similar kind of distribution concentrated on the smaller region of x has also been presented in Refs. [35,40], but without zero crossover. The results observed are found to be completely model dependent toward $x \rightarrow 0$. The distributions presented in the right panel solely have the contribution of

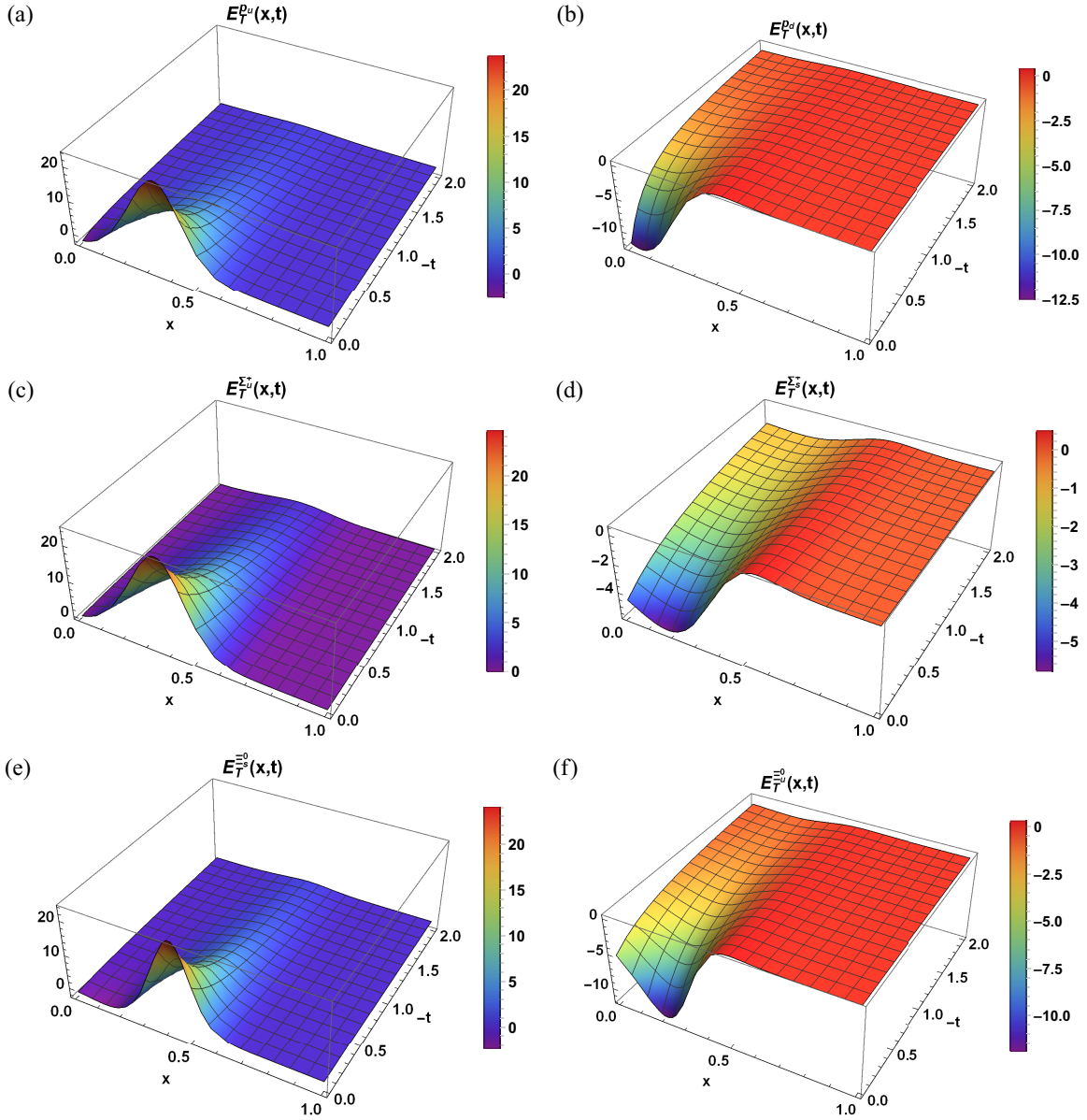


FIG. 3. Chiral-odd GPDs $E_T^{Xq}(x, t)$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV^2) for (a) u and (b) d quark flavors of proton, (c) u and (d) s quark flavors of Σ^+ , and (e) s and (f) u quark flavors of Ξ^0 .

axial-vector diquarks, and a comparable pattern to E_T^{Xq} emerges in the distributions over x with an opposite sign. The distribution $\tilde{H}_T^{p,d}$ demonstrates a resemblance to the structure presented by Ref. [40], but not with the results of Ref. [35], particularly for $x \rightarrow 0$. On comparing it with hyperons, the distributions are found to be localized on the smaller region of x for the constituent quarks of Ξ than Σ , and as a function of $-t$, $\tilde{H}_T^{Xq}$ exhibits a pattern akin to E_T^{Xq} , but with opposite polarity.

V. TENSOR FORM FACTORS

The moments of the GPDs, depending on their helicity configurations, provide a comprehensive insight into

different form factors. Particularly, the first moment of chiral-odd GPD H_T^{Xq} encodes the tensor form factor, and the combination of $\tilde{H}_T^{Xq}$ and E_T^{Xq} presents the anomalous tensor magnetic form factor as

$$A_{T10}^{Xq}(t) = \int dx H_T^{Xq}(x, t), \quad (30)$$

$$\bar{B}_{T10}^{Xq}(t) = \int dx (E_T^{Xq}(x, t) + 2\tilde{H}_T^{Xq}(x, t)). \quad (31)$$

Since we are dealing with zero skewness, we have represented the GPDs in above equations as a function

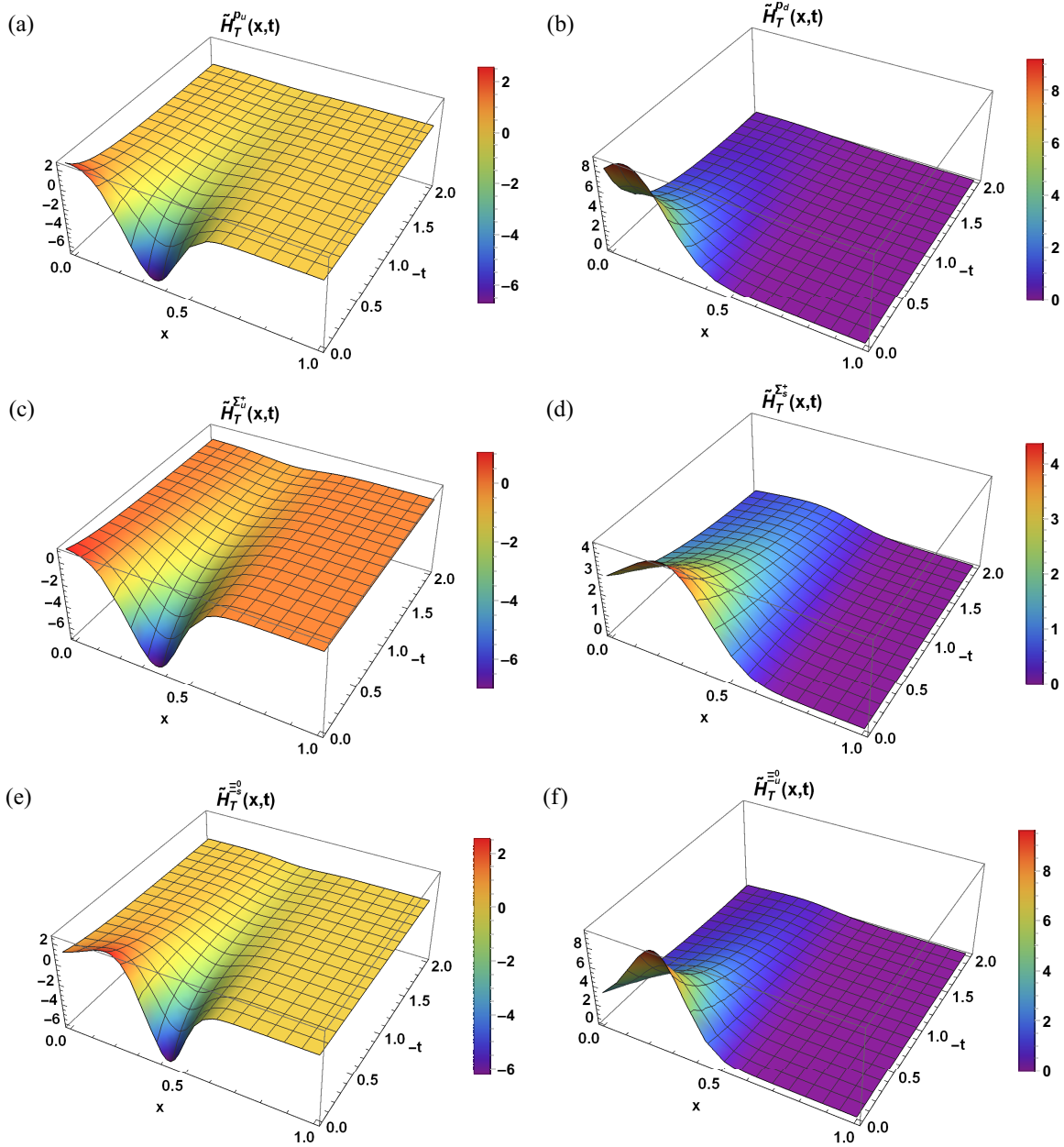


FIG. 4. Chiral-odd GPDs $\tilde{H}_T^{Xq}(x, t)$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV^2) for (a) u and (b) d quark flavors of proton, (c) u and (d) s quark flavors of Σ^+ , and (e) s and (f) u quark flavors of Ξ^0 .

of remaining two variables only. Figure 5 presents the comparative analysis of tensor form factor for the constituent quark flavors of p with lattice calculations [36], BLFQ [40], and χ QSM [44] model results. The u quark flavor of proton has a comparable trend to other model predictions as a function of $-t$ (GeV^2). However, a fast falloff has been observed in our model results for the case of d quark flavor of proton. For anomalous tensor magnetic form factor, the distribution is shown in Fig. 6 for both constituent quark flavors of proton with their comparison with lattice calculations [81], BLFQ [40], and χ QSM [82] model results. Compared to tensor form factors, anomalous

tensor magnetic form factors are more consistent with the BLFQ and χ QSM model results. The form factors obtained from lattice QCD are computed at a higher scale and include heavy pion mass, as a result of which the resulting form factors are straight.

In Fig. 7, tensor form factors of u and s quark flavors of both hyperons are presented in subplots (a) and (c). The trend for both Σ_u^+ and Ξ_s^0 looks identical as both contain the contributions of scalar as well as axial-vector diquarks. A similar trend of negative distribution between Σ_s^+ and Ξ_u^0 has also been observed. These role reversal tensor form factors for the u and s quark flavors of hyperons are

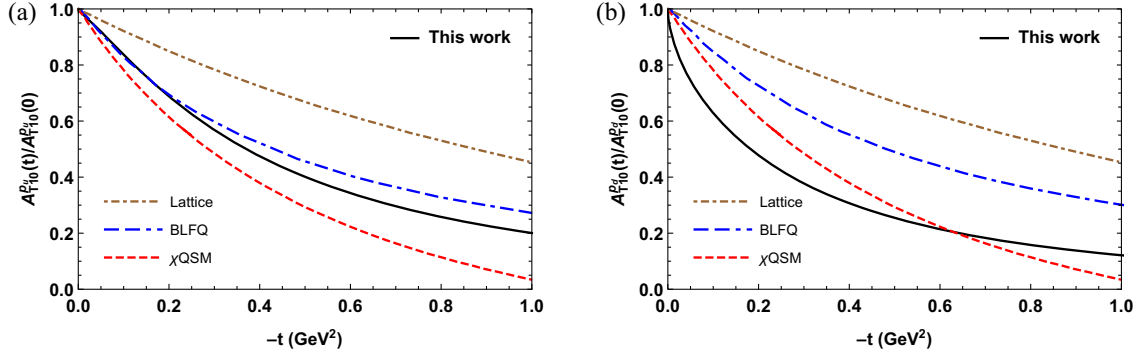


FIG. 5. Comparison of normalized tensor form factor $A_{T10}^{p_q}(t)$ as a function of transverse momentum transfer $-t$ (GeV²) for (a) u and (b) d quark of a proton with lattice calculations [36], BLFQ [40], and χ QSM [44] model results.

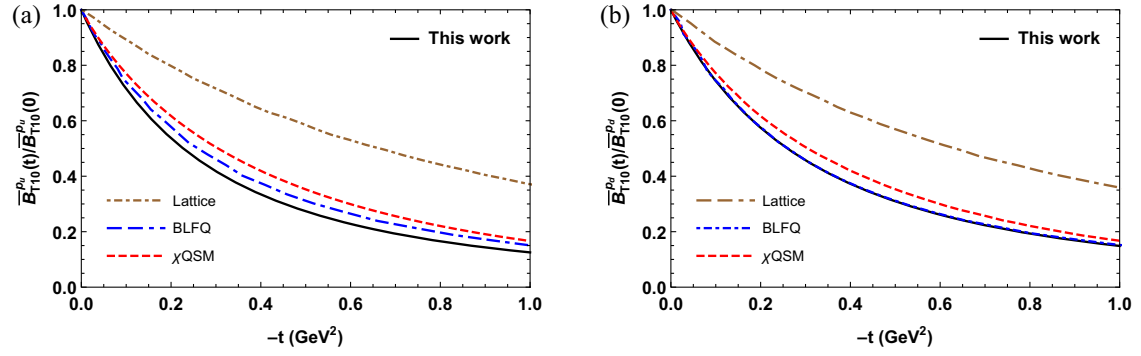


FIG. 6. Comparison of normalized anomalous tensor magnetic form factor $B_{T10}^{p_q}(t)$ as a function of transverse momentum transfer $-t$ (GeV²) for (a) u and (b) d quark of a proton with lattice calculations [81], BLFQ [40], and χ QSM [82] model results.

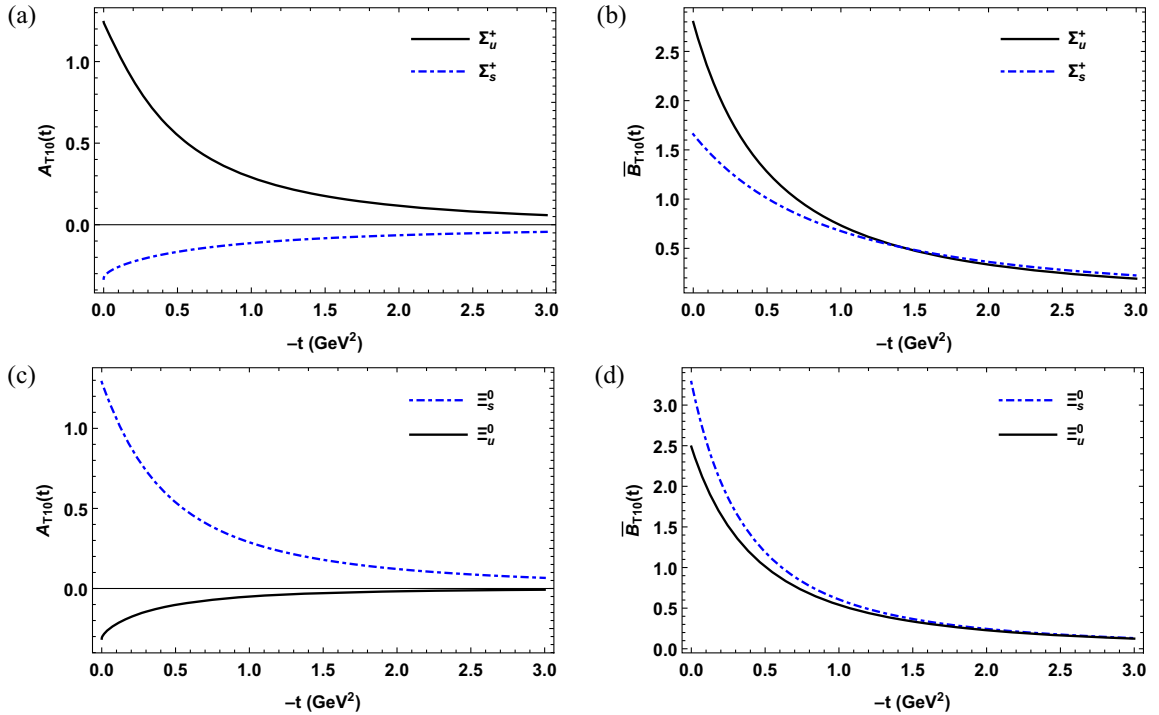


FIG. 7. Comparison of tensor form factor $A_{T10}^{X_q}(t)$ for u and s constituent quark flavors of (a) Σ^+ and (c) Ξ^0 , along with the anomalous tensor magnetic form factor $B_{T10}^{X_q}(-t)$ for u and s constituent quark flavors of (b) Σ^+ and (d) Ξ^0 as a function of transverse momentum transfer $-t$ (GeV²).

TABLE III. Comparison of tensor charge $g_T^{X_q}$ and anomalous tensor magnetic moment $\kappa_T^{X_q}$ for all the constituent quark flavors of baryons with available data.

	Baryon	p_u	p_d	Σ_u^+	Σ_s^+	Ξ_u^0	Ξ_s^0
$g_T^{X_q}$	This work	1.249	-0.285	1.243	-0.331	-0.313	1.323
	χ QSM [44]	1.08	-0.32	1.08	-0.29	-0.32	1.06
	HYP model [35]	0.97	-0.24	...	...	...	...
	HO model [35]	1.17	-0.29	...	...	...	...
	NR model [35]	4/3	-1/3	...	...	...	...
	Relativistic model [83]	1.008	-0.247	...	...	...	...
	LFQM [27]	1.167	-0.292	...	...	...	...
	Chiral soliton model [84]	1.12	-0.42	...	...	...	...
	MIT bag model [85]	1.105	-0.275	...	...	...	...
	Lattice QCD [86]	0.84	-0.23	...	...	...	...
	Lattice QCD [87]	0.791 ± 0.053	-0.236 ± 0.033	...	...	...	...
	Meson electroproduction [32]	0.876	-0.251	...	...	...	...
	BLFQ [40]	1.251	-0.270	...	...	...	...
	Data analysis [15]	$0.39^{+18}_{-0.12}$	$-0.25^{+30}_{-0.10}$	...	...	...	...
	Data analysis [24]	$0.39^{+16}_{-0.20}$	$-0.22^{+31}_{-0.10}$	...	...	...	...
	Data analysis [79]	0.39 ± 0.15	-0.41 ± 0.52	...	...	...	...
$6^*\kappa_T^{X_q}$	This work	3.64	2.41	3.65	1.658	2.489	3.284
	HYP model [35]	1.98	1.17	...	...	...	...
	HO model [35]	3.60	2.36	...	...	...	...
	BLFQ [40]	3.208	2.432	...	...	...	...
	Relativistic model [83]	4.065	1.961	...	...	...	...
	Reggeized model [88]	3.43 ± 0.26	1.37 ± 0.34	...	...	...	...

expected due to their analogous wave functions as expressed in Eqs. (8) and (9). Further, the anomalous tensor magnetic form factor of both the constituent quark flavors of Σ^+ and Ξ^0 are presented in (b) and (d) subplots of Fig. 7, respectively. The u quark contributes a larger anomalous tensor magnetic moment compared to the s quark in Σ^+ hyperon, and a vice versa trend between quark flavors of Ξ^0 is observed. In both hyperons, s quark flavor being a heavier one decays slower than u quark flavor. As the transverse momentum transfer increases, the difference between the quark flavors starts diminishing.

At $t = 0$, the form factors expressed in Eqs. (30) and (31) can be reduced to the tensor charge $g_T^{X_q}$ and anomalous tensor magnetic moment $\kappa_T^{X_q}$, respectively. $g_T^{X_q}$ quantifies the total count of transversely polarized quark flavors q in a transversely polarized baryon X . A comparative analysis of $g_T^{X_q}$ and $\kappa_T^{X_q}$ values from this work and other approaches is provided in Table III. Reference [44] employs the chiral quark-soliton model to compute $g_T^{X_q}$ for octet baryons, and our results align well with their results, showing minimal deviations. For the case of proton, as extensive work has been done, we have compared our results for $g_T^{p_{u(d)}}$ with different SU(6)-symmetric constituent quark models: the nonrelativistic (NR), the harmonic oscillator (HO) and the hypercentral (HYP) [35], relativistic confined quark model [83], light-front quark model (LFQM) [27], chiral soliton model [84], MIT bag model [85], lattice QCD [86,87],

BLFQ [40], accounts from the electroproduction of pseudoscalar mesons [32], and data analysis [15,24,79]. The values of $g_T^{p_{u(d)}}$ computed within the theoretical framework correspond well to each other than with those derived from data analysis. $\kappa_T^{X_q}$ determines the transverse spin-flavor dipole moment in an unpolarized baryon and serves a comparable role to the anomalous magnetic moment $\kappa_q^{X_q}$, computed from the Pauli form factor. To the best of our knowledge, anomalous tensor magnetic moment values of constituent quark flavor of proton are only available, and the comparison shows well the agreement with the results of SU(6)-symmetric HO model [35] and BLFQ [40], whereas the results of SU(6)-symmetric HYP model [35] and relativistic confined quark model [83] for both p_u and p_d and reggeized diquark model [88] for p_d exhibit deviations.

VI. SUMMARY AND CONCLUSION

In this work, chiral-odd generalized parton distributions (GPDs) have been investigated for nucleons and the hyperons that belong to the same octet baryon of spin- $\frac{1}{2}$ hadrons. The light-cone dynamics is used to account the quark dynamics of proton p and light hyperons Σ^+ and Ξ^0 by treating them as two-body systems comprising a quark and a spectator diquark. A dipolar form factor for the baryon-quark-diquark vertex has been considered for computing the light-cone wave functions within the diquark

spectator model. The chiral-odd GPDs are determined by solving the equation of quark-quark correlator with a tensor current. The nonforward matrix elements of the lightlike correlation function are expressed explicitly in the overlap form of light-cone wave functions.

The results obtained for the chiral-odd GPDs H_T , E_T , and $\tilde{H}_T$ as a function of longitudinal momentum fraction x and transverse momentum transfer $-t$ (GeV^2) at zero skewness is portrayed. For the case of proton, the results are consistent with other model predictions. As a function of $-t$, the distributions corresponding to hyperons exhibit a slower decline than proton. Among constituent quark flavors of hyperons, u and s quark flavors of Σ^+ are found to have a slower pace of decrement than Ξ^0 as $-t$ increases. The characteristic property of shifting of the peak toward a higher value of x is also found in all the distributions with falling down as a function of $-t$. The dependence over x is visualized through the transversity distributions of constituent quark flavors of considered octet baryons. The s quark flavor being heavier than u quark flavor in Σ^+ and Ξ^0 is found to carry larger values of x .

The tensor form factor and anomalous tensor magnetic form factors for the u and d quark flavors of proton show qualitative consistency when compared with self-consistent SU(3) chiral quark-soliton model, basis light-front quantization, and lattice calculations. Likewise, these form factors are computed for u and s quark flavors of both hyperons. As expected, the heavier s quark flavor is found to decrease slower than the lighter u quark flavor. Further, tensor charge and anomalous tensor magnetic moment are also computed. For comparison, the values of tensor charges are tabulated with the available data. Regarding

the anomalous tensor magnetic moment, we have predicted the values obtained in this work for light hyperons and compared the values for the case of proton with existing data. Recent investigations by *BABAR*, *CLEO*, *Belle*, and *BESIII* of hyperon elastic and transition form factors set the stage for further studies of these hadrons. Our theoretical predictions offer insight into tensor currents in hadrons, contributing to the study of chiral-odd distributions.

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DATA AVAILABILITY

The data that support the findings of this article are not publicly available. The data are available from the authors upon reasonable request.

APPENDIX: CUTOFF PARAMETER AND THE FIRST MOMENTS OF CHIRAL-ODD GPDs

To show the dependence of the first moment of chiral-odd GPDs on the cutoff parameter to avoid any singularity, we have tabulated the model dependent values of tensor charge g_T^{Xq} and anomalous tensor magnetic moment κ_T^{Xq} for each constituent quark flavor of proton and light hyperons Σ^+ and Ξ^0 in Tables IV–VI, respectively.

TABLE IV. Values of tensor charge g_T^{Pq} and anomalous tensor magnetic moment κ_T^{Pq} for both u and d constituent quark flavors of proton for three different sets of cutoff parameters.

Different Sets	Cutoff parameters (GeV)		g_T^{Pq}		κ_T^{Pq}	
	$\Lambda_{u\bar{s}(ud)}^P$	$\Lambda_{ua(uu/ud)}^P$	u Quark	d Quark	u Quark	d Quark
1	0.35	0.30	1.345	−0.287	4.059	2.972
2	0.45	0.40	1.249	−0.285	3.636	2.414
3	0.55	0.50	1.143	−0.306	3.180	1.932

TABLE V. Values of tensor charge $g_T^{\Sigma^+q}$ and anomalous tensor magnetic moment $\kappa_T^{\Sigma^+q}$ for both u and s constituent quark flavors of Σ^+ for three different sets of cutoff parameters.

Different Sets	Cutoff parameters (GeV)		$g_T^{\Sigma^+q}$		$\kappa_T^{\Sigma^+q}$	
	$\Lambda_{u\bar{s}(us)}^{\Sigma^+} = \Lambda_{ua(us)}^{\Sigma^+}$	$\Lambda_{sa(uu)}^{\Sigma^+}$	u Quark	s Quark	u Quark	s Quark
1	0.45	0.60	1.342	−0.315	4.14	1.967
2	0.55	0.70	1.243	−0.331	3.65	1.658
3	0.65	0.80	1.139	−0.359	3.346	1.379

TABLE VI. Values of tensor charge $g_T^{\Xi^0}$ and anomalous tensor magnetic moment $\kappa_T^{\Xi^0}$ for both u and s constituent quark flavors of Ξ^0 for three different sets of cutoff parameters.

Different Sets	Cutoff parameters (GeV)		$g_T^{\Xi^0}$		$\kappa_T^{\Xi^0}$	
	$\Lambda_{s\bar{s}(us)}^{\Xi^0}$	$\Lambda_{sa(us)}^{\Xi^0} = \Lambda_{ua(ss)}^{\Xi^0}$	u Quark	s Quark	u Quark	s Quark
1	0.60	0.45	-0.317	1.319	2.953	3.466
2	0.65	0.55	-0.313	1.323	2.489	3.284
3	0.75	0.65	-0.325	1.218	2.066	3.043

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