respectively, in the one-loop approximation in the framework of "jet calculus" [33], using the MLLA techniques of coherent parton evolution including soft-gluon interference [31]. The associated quark and gluon self energies Σ and Π include both the one-loop quark-gluon self interaction through real and virtual emission and absorption, and the effective interaction with the confining background field $\overline{\chi}$ [8]. Similarly, the self-energy Ξ of the χ field embodies the self interaction and the coupling to the U field, as contained in the effective potential (11), as well as contributions from quark and gluon recombination to χ excitations. Correspondingly, the function $\tilde{\Xi}$ of the U field incorporates its self interaction and the interaction with the χ field.

4.2 The kinetic equations for real-time evolution in phase space

As a consequence of the prescriptions (i)-(iii), and of exploiting in the present $e^+e^- \to$ *hadrons* case the special property of translation invariance of the parton evolution in the perturbative vacuum, one finds after a lengthy calculation [19] that the transport equations (34) and the constraint equations (35) can be combined in a single set of coupled integro-differential equations for the phase-space densities $F_\alpha(r,p)$ defined by (37) and (38). Introducing the usual light-cone variables

$$p^\mu \;=\; (p^+, p^-, \vec{p}_\perp) \;, \qquad p^\pm \;=\; p_0 \pm p_z \;, \qquad \vec{p}_\perp \;=\; (p_x, p_y) \tag{43}$$

and

$$x \;=\; \frac{p^+}{Q} \quad , \quad p_\perp \;=\; \sqrt{p_x^2 + p_y^2} \quad , \quad p^2 \;=\; p_\mu p^\mu \;. \tag{44}$$

where Q is the hard scale of the initial $q\bar{q}$ pair created by the photon, and $r \equiv r^\mu = (t, \vec{r})$, we write

$$F_\alpha \equiv F_\alpha(r,p) \;=\; F_\alpha(t, \vec{r}; x, p_\perp^2, p^2) \;. \tag{45}$$

The kinetic equations which one obtains from the transport equations (34) by implementing the constraints (35) can now be summarized compactly as follows (see Fig. 6):

$$\hat{\mathcal{K}}\, F_q \;=\; +\, \hat{A}_q^{qg}\, F_q \;+\; \hat{A}_g^{q\bar{q}}\, F_g \;-\; \hat{B}_{qg}^{q\chi}\, F_q F_g \;-\; \hat{B}_{q\bar{q}}^{\chi\chi}\, F_q F_{\bar{q}} \tag{46}$$

$$\hat{\mathcal{K}}\, F_g \;=\; +\, \hat{A}_g^{gg}\, F_g \;-\; \hat{A}_g^{q\bar{q}}\, F_g \;+\; \sum_f \hat{A}_q^{gq}\, F_{q+\bar{q}} \;-\; \hat{B}_{gg}^{\chi\chi}\, F_g F_g \;-\; \sum_f \hat{B}_{gq}^{\chi q}\, F_g F_{q+\bar{q}} \tag{47}$$

$$\hat{\mathcal{K}}\, F_\chi \;=\; +\, \hat{C}_{gg}^{\chi\chi}\, F_g F_g + \sum_f \hat{C}_{gq}^{\chi q}\, F_g F_{q+\bar{q}} + \sum_f \hat{C}_{q\bar{q}}^{\chi\chi}\, F_q F_{\bar{q}} - \hat{D}_\chi^U\, F_\chi - \hat{E}_\chi^h\, F_\chi \tag{48}$$

$$\hat{\mathcal{K}}\, F_U \;=\; +\, \hat{D'}_\chi^U\, F_\chi \;-\; \hat{E'}_U^h\, F_U \;\;, \tag{49}$$