```
NotebookEvaluate[NotebookOpen[NotebookDirectory[] <> "definitions.nb"]]
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FeynCalc 9.2.0. For help, use the documentation center, check out the wiki or write to the mailing list.

See also the supplied examples. If you use FeynCalc in your research, please cite

- V. Shtabovenko, R. Mertig and F. Orellana,
  Comput. Phys. Commun., 207C, 432–444, 2016, arXiv:1601.01167
- R. Mertig, M. Böhm, and A. Denner, Comput. Phys. Commun., 64, 345–359, 1991.

Electron propagator in E_p – representation satisfies the equation

$S^c(p,q) = (2\pi)^4 \delta(p-q) S^c(p)$

$[\gamma p - m - M(p)] S^c(p) = i$

Let

$$D(p) = \gamma p - m - M(p) = S + \gamma V + \sigma T + \gamma A \gamma^5$$

$$S = m\, s\left(p^2, \chi_p\right),$$

$$V^\mu = p^\mu v_1\left(p^2, \chi_p\right) + \frac{e^2 \left(F^2 p\right)^\mu}{m^4 \chi^2} v_2\left(p^2, \chi_p\right),$$

$$T_{\mu\nu} = \frac{eF_{\mu\nu}}{m\,\chi} t\left(p^2, \chi_p\right),$$

$A^\mu = \dfrac{e\,(F^* p)^\mu}{m^2 \chi} a_s\left(p^2, \chi_p\right)$, where s stands for ' scalar';

then

$$S^c(p) = \mathbb{i} D^{-1}(p) = \frac{\mathbb{i}}{2}\left(S - \gamma V - \sigma T + \gamma A \gamma^5\right)\Bigg[\frac{1}{D_+\left(p^2, \chi_p\right)}\left(1 + \gamma \epsilon^{(2)} \gamma^5\right) + \frac{1}{D_-\left(p^2, \chi_p\right)}\left(1 - \gamma \epsilon^{(2)} \gamma^5\right)\Bigg] =$$

$$= \frac{\mathbb{i}}{2}\Bigg[m\, s\left(p^2, \chi_p\right) - (\gamma p)\, v_1\left(p^2, \chi_p\right) - \frac{e^2\left(\gamma F^2 p\right)}{m^4} v_2\left(p^2, \chi_p\right) - \frac{e\,\sigma F}{m} t\left(p^2, \chi_p\right) + \frac{e\,(\gamma F^* p)\,\gamma^5}{m^2} a_s\left(p^2, \chi_p\right)\Bigg] \times$$

$$\Bigg[\frac{1}{D_+\left(p^2, \chi_p\right)}\left(1 + \gamma \epsilon^{(2)} \gamma^5\right) + \frac{1}{D_-\left(p^2, \chi_p\right)}\left(1 - \gamma \epsilon^{(2)} \gamma^5\right)\Bigg],$$

$$\epsilon^{(2)}{}_\mu = \frac{e\,(F^* p)^\mu}{m^3 \chi_p},$$

Electron propagator

$$S^c(x_2, x_1) = \Lambda^{4-D} \int \frac{\mathbb{d}^D p}{(2\pi)^D} E_p(x_2)\, S^c(p)\, \overline{E}_p(x_1)$$

$$x = x_2 - x_1,$$

$$X = \frac{1}{2}(x_1 + x_2),$$

$$\xi^2 = -\frac{e^2 a^2}{m^2},$$

$[\Lambda] = m$ – mass scale,

$$E_p(x_2) = \left[1 - \frac{e\,(\gamma k)\,(\gamma a)}{2\,(kp)}(k x_2)\right]$$

$$\mathrm{Exp}\left[-\mathbb{i}\,(p\,x_2)+\mathbb{i}\,\frac{e\,(a\,p)}{2\,(k\,p)}\,(k\,x_2)^2+\mathbb{i}\,\frac{a^2\,e^2}{6\,(k\,p)}\,(k\,x_2)^3\right];$$

```
NewMomentum["p"]
NewCoordinate["x1"]
NewCoordinate["x2"]
NewCoordinate["x"]
NewCoordinate["X"]
```

$$\left\{p^\alpha,\ p^2,\ k\cdot p,\ \mathrm{Fp}^\alpha,\ \mathrm{FFp}^\alpha,\ \mathrm{FDp}^\alpha,\ a\cdot p,\ 0,\ 0,\ 0,\ -a^2\,(k\cdot p),\ 0,\ 0,\ -\frac{m^6\,\chi\mathrm{p}^2}{e^2},\ -\frac{m^6\,\chi\mathrm{p}^2}{e^2},\ \frac{m^6\,\chi\mathrm{p}^2}{e^2},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{\mathrm{x1}^\alpha,\ \mathrm{x1}^2,\ k\cdot\mathrm{x1},\ a\cdot\mathrm{x1},\ \mathrm{Fx1}^\alpha,\ \mathrm{FFx1}^\alpha,\ \mathrm{FDx1}^\alpha,\ k\cdot\mathrm{x1},\ 0,\ 0,\ 0,\ -a^2\,(k\cdot\mathrm{x1}),\ 0,\ 0,\ -\frac{m^2\,\xi^2\,(k\cdot\mathrm{x1})^2}{e^2},\ -\frac{m^2\,\xi^2\,(k\cdot\mathrm{x1})^2}{e^2},\ \frac{m^2\,\xi^2\,(k\cdot\mathrm{x1})^2}{e^2},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{\mathrm{x2}^\alpha,\ \mathrm{x2}^2,\ k\cdot\mathrm{x2},\ a\cdot\mathrm{x2},\ \mathrm{Fx2}^\alpha,\ \mathrm{FFx2}^\alpha,\ \mathrm{FDx2}^\alpha,\ k\cdot\mathrm{x2},\ 0,\ 0,\ 0,\ -a^2\,(k\cdot\mathrm{x2}),\ 0,\ 0,\ -\frac{m^2\,\xi^2\,(k\cdot\mathrm{x2})^2}{e^2},\ -\frac{m^2\,\xi^2\,(k\cdot\mathrm{x2})^2}{e^2},\ \frac{m^2\,\xi^2\,(k\cdot\mathrm{x2})^2}{e^2},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{x^\alpha,\ x^2,\ k\cdot x,\ a\cdot x,\ \mathrm{Fx}^\alpha,\ \mathrm{FFx}^\alpha,\ \mathrm{FDx}^\alpha,\ k\cdot x,\ 0,\ 0,\ 0,\ -a^2\,(k\cdot x),\ 0,\ 0,\ -\frac{m^2\,\xi^2\,(k\cdot x)^2}{e^2},\ -\frac{m^2\,\xi^2\,(k\cdot x)^2}{e^2},\ \frac{m^2\,\xi^2\,(k\cdot x)^2}{e^2},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\left\{X^\alpha,\ X^2,\ k\cdot X,\ a\cdot X,\ \mathrm{FX}^\alpha,\ \mathrm{FFX}^\alpha,\ \mathrm{FDX}^\alpha,\ k\cdot X,\ 0,\ 0,\ 0,\ -a^2\,(k\cdot X),\ 0,\ 0,\ -\frac{m^2\,\xi^2\,(k\cdot X)^2}{e^2},\ -\frac{m^2\,\xi^2\,(k\cdot X)^2}{e^2},\ \frac{m^2\,\xi^2\,(k\cdot X)^2}{e^2},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0\right\}$$

$$\mathrm{DdInv}[\mathrm{sgn}] == \mathrm{D}_{\mathrm{sgn}}\left(\mathrm{p}^2,\ \chi_{\mathrm{p}}\right)$$

$$\epsilon == \epsilon^{(2)}$$

```
FToak = {Ft[α_, β_] → kv[α] av[β] - av[α] kv[β], DiracGamma[Momentum[Fp, D], D] →
    DiracGamma[Momentum[k, D], D] Pair[Momentum[a, D], Momentum[p, D]] -
     DiracGamma[Momentum[a, D], D] Pair[Momentum[k, D], Momentum[p, D]],
   DiracGamma[Momentum[FFp, D], D] → -av2 DiracGamma[Momentum[k, D], D]
     Pair[Momentum[k, D], Momentum[p, D]],
   FFpv[μ_] → -av2 kp kv[μ]}
FToEps =
  {FDpv[μ_] → Contract[1/2 Eps[LorentzIndex[μ, D], LorentzIndex[ν, D], LorentzIndex[
        α2, D], LorentzIndex[α3, D]] (kv[α2] av[α3] - av[α2] kv[α3]) pv[ν]]}
Gamma5toTrippleGamma = {GAD[μ_].GA[5] Eps[LorentzIndex[μ_, D],
      Momentum[a_, D], Momentum[b_, D], Momentum[c_, D]] →
    Contract[I Pair[LorentzIndex[α1, D], Momentum[a, D]] Pair[LorentzIndex[α2, D],
       Momentum[b, D]] Pair[LorentzIndex[α3, D], Momentum[c, D]] (GAD[α1, α2, α3] -
        (MTD[α1, α2] GAD[α3] + MTD[α2, α3] GAD[α1] - MTD[α1, α3] GAD[α2]))]}
```

$$\left\{F(\alpha\_, \beta\_) \to a^{\beta}\, k^{\alpha} - a^{\alpha}\, k^{\beta},\ \gamma\cdot\mathrm{Fp} \to (a\cdot p)\,\gamma\cdot k - \gamma\cdot a\,(k\cdot p),\ \gamma\cdot\mathrm{FFp} \to a^2\,(-(\gamma\cdot k))\,(k\cdot p),\ \mathrm{FFp}^{\mu\_} \to a^2\,(-k^{\mu})\,(k\cdot p)\right\}$$

$$\left\{\mathrm{FDp}^{\mu\_} \to -\epsilon^{\mu\,\overline{a}\,\overline{k}\,\overline{p}}\right\}$$

$$\left\{\gamma^{\mu\_}.\overline{\gamma}^{5}\,\epsilon^{\mu\_\,\overline{\mathrm{a}\_}\,\overline{\mathrm{b}\_}\,\overline{\mathrm{c}\_}} \to -i\,(a\cdot b)\,\gamma\cdot c + i\,(a\cdot c)\,\gamma\cdot b - i\,\gamma\cdot a\,(b\cdot c) + i\,(\gamma\cdot a).(\gamma\cdot b).(\gamma\cdot c)\right\}$$

```
FxToak = {Ft[α_, β_] → kv[α] av[β] - av[α] kv[β], DiracGamma[Momentum[Fx, D], D] →
    DiracGamma[Momentum[k, D], D] Pair[Momentum[a, D], Momentum[x, D]] -
     DiracGamma[Momentum[a, D], D] Pair[Momentum[k, D], Momentum[x, D]],
   DiracGamma[Momentum[FFx, D], D] → -av2 DiracGamma[Momentum[k, D], D]
     Pair[Momentum[k, D], Momentum[x, D]],
   FFxv[μ_] → -av2 kx kv[μ], σF →
    -2 I DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[k, D], D] }
FxToEps = {FDx[μ_] → Contract[1/2 Eps[LorentzIndex[μ, D], LorentzIndex[ν, D],
       LorentzIndex[α2, D], LorentzIndex[α3, D]] (kv[α2] av[α3] - av[α2] kv[α3])
      xv[ν]], DiracGamma[Momentum[FDx, D], D].DiracGamma[5] →
    Contract[1/2 Eps[LorentzIndex[μ, D], LorentzIndex[ν, D],
       LorentzIndex[α2, D], LorentzIndex[α3, D]]
      (kv[α2] av[α3] - av[α2] kv[α3]) xv[ν] GAD[μ].DiracGamma[5]]}
Gamma5toTrippleGammax = {DiracGamma[LorentzIndex[μ_, D], D].DiracGamma[5]
     Eps[LorentzIndex[μ_, D], Momentum[a_, D], Momentum[b_, D], Momentum[c_, D]] →
    Contract[I Pair[LorentzIndex[α1, D], Momentum[a, D]] Pair[LorentzIndex[α2, D],
       Momentum[b, D]] Pair[LorentzIndex[α3, D], Momentum[c, D]] (GAD[α1, α2, α3] -
        (MTD[α1, α2] GAD[α3] + MTD[α2, α3] GAD[α1] - MTD[α1, α3] GAD[α2]))]}
```

$$\{F(\alpha\_, \beta\_) \to a^\beta k^\alpha - a^\alpha k^\beta,\ \gamma\cdot \mathrm{Fx} \to (a\cdot x)\,\gamma\cdot k - \gamma\cdot a\,(k\cdot x),$$
$$\gamma\cdot\mathrm{FFx} \to a^2\,(-(\gamma\cdot k))\,(k\cdot x),\ \mathrm{FFx}^{\mu\_} \to a^2\,(-k^\mu)\,(k\cdot x),\ \sigma\mathrm{F} \to -2\,i\,(\gamma\cdot a).(\gamma\cdot k)\}$$

$$\left\{\mathrm{FDx}(\mu\_) \to -\epsilon^{\mu\,\overline{a}\,\overline{k}\,\overline{x}},\ (\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5 \to -\gamma^\mu.\overline{\gamma}^5\,\epsilon^{\mu\,\overline{a}\,\overline{k}\,\overline{x}}\right\}$$

$$\left\{\gamma^{\mu\_}.\overline{\gamma}^5\,\epsilon^{\mu\_\,\overline{\mathrm{a\_}}\,\overline{\mathrm{b\_}}\,\overline{\mathrm{c\_}}} \to -i\,(a\cdot b)\,\gamma\cdot c + i\,(a\cdot c)\,\gamma\cdot b - i\,\gamma\cdot a\,(b\cdot c) + i\,(\gamma\cdot a).(\gamma\cdot b).(\gamma\cdot c)\right\}$$

```
S = m sf
V[μ_] = pv[μ] v1 + e^2 FFpv[μ] / m^4 / χp^2 v2
T[μ_, ν_] = e Ft[μ, ν] / m / χp tf
A[μ_] = e FDpv[μ] / m^2 / χp af
ϵ[μ_] = e FDpv[μ] / m^3 / χp
```

$m\,\mathrm{sf}$

$$\frac{e^2\,\mathrm{v2}\,\mathrm{FFp}^\mu}{m^4\,\chi\mathrm{p}^2} + \mathrm{v1}\,p^\mu$$

$$\frac{e\,\mathrm{tf}\,F(\mu,\nu)}{m\,\chi\mathrm{p}}$$

$$\frac{\mathrm{af}\,e\,\mathrm{FDp}^\mu}{m^2\,\chi\mathrm{p}}$$

$$\frac{e\,\mathrm{FDp}^\mu}{m^3\,\chi\mathrm{p}}$$

```
Scp[sgn_] = (S - GAD[α] V[α] - I / 2 (GAD[α, β] - GAD[β, α]) T[α, β] + A[α] GAD[α].GA[5]).
    (1 + sgn ϵ[μ] GAD[μ].GA[5]) /. FToEps /. FToak /. Gamma5toTrippleGamma
```

$$\left(-\frac{\mathrm{af}\, e\, (i\, (a\cdot p)\, \gamma\cdot k - i\, \gamma\cdot a\, (k\cdot p) + i\, (\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p))}{m^2\, \chi\mathrm{p}} - \gamma^{\alpha}\left(\mathrm{v1}\, p^{\alpha} - \frac{a^2\, e^2\, \mathrm{v2}\, k^{\alpha}\, (k\cdot p)}{m^4\, \chi\mathrm{p}^2}\right) - \frac{i\, e\, \mathrm{tf}\left(\gamma^{\alpha}.\gamma^{\beta} - \gamma^{\beta}.\gamma^{\alpha}\right)\left(a^{\beta}\, k^{\alpha} - a^{\alpha}\, k^{\beta}\right)}{2\, m\, \chi\mathrm{p}} + m\, \mathrm{sf}\right).\left(1 - \frac{e\, \mathrm{sgn}\, (i\, (a\cdot p)\, \gamma\cdot k - i\, \gamma\cdot a\, (k\cdot p) + i\, (\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p))}{m^3\, \chi\mathrm{p}}\right)$$

```
Epx2 = Ep[x2, p]
EpBarx1 = EpC[x1, p]
```

$$\left\{1 - \frac{e\, (k\cdot \mathrm{x2})\, (\gamma\cdot k).(\gamma\cdot a)}{2\, (k\cdot p)},\ \frac{a^2\, e^2\, (k\cdot \mathrm{x2})^3}{6\, (k\cdot p)} + \frac{e\, (a\cdot p)\, (k\cdot \mathrm{x2})^2}{2\, (k\cdot p)} - p\cdot \mathrm{x2}\right\}$$

$$\left\{1 - \frac{e\, (k\cdot \mathrm{x1})\, (\gamma\cdot a).(\gamma\cdot k)}{2\, (k\cdot p)},\ -\frac{a^2\, e^2\, (k\cdot \mathrm{x1})^3}{6\, (k\cdot p)} - \frac{e\, (a\cdot p)\, (k\cdot \mathrm{x1})^2}{2\, (k\cdot p)} + p\cdot \mathrm{x1}\right\}$$

```
Matrix = Epx2[[1]].Scp[ζ].EpBarx1[[1]]
Coeff = i / 2 Λ^ (4 - D) / (2 π) ^D / DdInv[ζ]
Phase = Epx2[[2]] + EpBarx1[[2]]
```

$$\left(1 - \frac{e\, (k\cdot \mathrm{x2})\, (\gamma\cdot k).(\gamma\cdot a)}{2\, (k\cdot p)}\right).\left(-\frac{\mathrm{af}\, e\, (i\, (a\cdot p)\, \gamma\cdot k - i\, \gamma\cdot a\, (k\cdot p) + i\, (\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p))}{m^2\, \chi\mathrm{p}} - \gamma^{\alpha}\left(\mathrm{v1}\, p^{\alpha} - \frac{a^2\, e^2\, \mathrm{v2}\, k^{\alpha}\, (k\cdot p)}{m^4\, \chi\mathrm{p}^2}\right) - \frac{i\, e\, \mathrm{tf}\left(\gamma^{\alpha}.\gamma^{\beta} - \gamma^{\beta}.\gamma^{\alpha}\right)\left(a^{\beta}\, k^{\alpha} - a^{\alpha}\, k^{\beta}\right)}{2\, m\, \chi\mathrm{p}} + m\, \mathrm{sf}\right).\left(1 - \frac{e\, \zeta\, (i\, (a\cdot p)\, \gamma\cdot k - i\, \gamma\cdot a\, (k\cdot p) + i\, (\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p))}{m^3\, \chi\mathrm{p}}\right).\left(1 - \frac{e\, (k\cdot \mathrm{x1})\, (\gamma\cdot a).(\gamma\cdot k)}{2\, (k\cdot p)}\right)$$

$$\frac{i\, 2^{-D-1}\, \pi^{-D}\, \Lambda^{4-D}}{\mathrm{DdInv}(\zeta)}$$

$$-\frac{a^2\, e^2\, (k\cdot \mathrm{x1})^3}{6\, (k\cdot p)} + \frac{a^2\, e^2\, (k\cdot \mathrm{x2})^3}{6\, (k\cdot p)} - \frac{e\, (a\cdot p)\, (k\cdot \mathrm{x1})^2}{2\, (k\cdot p)} + \frac{e\, (a\cdot p)\, (k\cdot \mathrm{x2})^2}{2\, (k\cdot p)} + p\cdot \mathrm{x1} - p\cdot \mathrm{x2}$$

```
Matrix1 = Contract[DiracSimplify[Matrix]]
Coeff1 = Coeff;
Phase1 = Phase;
```

$$\frac{i\,\text{v2}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,a^2\,(k\cdot p)^2\,e^3}{m^7\,\chi\text{p}^3}+\frac{\text{af}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot p)\,(k\cdot\text{x1})\,e^3}{2\,m^5\,\chi\text{p}^2}+\frac{\text{af}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,a^2\,(k\cdot p)\,(k\cdot\text{x2})\,e^3}{2\,m^5\,\chi\text{p}^2}-$$
$$\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot\text{x1})\,(k\cdot\text{x2})\,e^3}{2\,m^3\,\chi\text{p}}-\frac{\text{af}\,\zeta\,a^2\,(k\cdot p)^2\,e^2}{m^5\,\chi\text{p}^2}+\frac{\text{v2}\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\text{p}^2}+\frac{2\,\text{tf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\text{p}^2}-$$
$$\frac{\text{af}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot p)\,(k\cdot p)\,e^2}{m^5\,\chi\text{p}^2}-\frac{\text{af}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,(a\cdot p)\,(k\cdot p)\,e^2}{m^5\,\chi\text{p}^2}+\frac{i\,\text{sf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot\text{x1})\,e^2}{2\,m^2\,\chi\text{p}}+$$
$$\frac{i\,\text{af}\,\gamma\cdot k\,a^2\,(k\cdot\text{x1})\,e^2}{2\,m^2\,\chi\text{p}}-\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,a^2\,(k\cdot\text{x1})\,e^2}{2\,m^3\,\chi\text{p}}-\frac{i\,\text{sf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot\text{x2})\,e^2}{2\,m^2\,\chi\text{p}}-\frac{i\,\text{af}\,\gamma\cdot k\,a^2\,(k\cdot\text{x2})\,e^2}{2\,m^2\,\chi\text{p}}+$$
$$\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,a^2\,(k\cdot\text{x2})\,e^2}{2\,m^3\,\chi\text{p}}+\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot p)\,(k\cdot\text{x2})\,e^2}{m^3\,\chi\text{p}}+\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,(a\cdot p)\,(k\cdot\text{x2})\,e^2}{m^3\,\chi\text{p}}+$$
$$\frac{\text{v1}\,\gamma\cdot k\,a^2\,(k\cdot\text{x1})\,(k\cdot\text{x2})\,e^2}{2\,(k\cdot p)}+\frac{i\,\text{tf}\,(\gamma\cdot a).(\gamma\cdot k)\,e}{m\,\chi\text{p}}-\frac{i\,\text{tf}\,(\gamma\cdot k).(\gamma\cdot a)\,e}{m\,\chi\text{p}}-\frac{i\,\text{sf}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p)\,e}{m^2\,\chi\text{p}}-$$
$$\frac{i\,\text{af}\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p)\,e}{m^2\,\chi\text{p}}-\frac{i\,\text{sf}\,\zeta\,\gamma\cdot k\,(a\cdot p)\,e}{m^2\,\chi\text{p}}-\frac{i\,\text{af}\,\gamma\cdot k\,(a\cdot p)\,e}{m^2\,\chi\text{p}}+\frac{2\,i\,\text{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,(a\cdot p)\,e}{m^3\,\chi\text{p}}+$$
$$\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,(a\cdot p)\,e}{m^3\,\chi\text{p}}+\frac{i\,\text{sf}\,\zeta\,\gamma\cdot a\,(k\cdot p)\,e}{m^2\,\chi\text{p}}+\frac{i\,\text{af}\,\gamma\cdot a\,(k\cdot p)\,e}{m^2\,\chi\text{p}}-\frac{2\,i\,\text{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot p)\,e}{m^3\,\chi\text{p}}-$$
$$\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot a)\,(k\cdot p)\,e}{m^3\,\chi\text{p}}-\frac{m\,\text{sf}\,(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot\text{x1})\,e}{2\,(k\cdot p)}+\frac{\text{v1}\,(\gamma\cdot p).(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot\text{x1})\,e}{2\,(k\cdot p)}-$$
$$\frac{m\,\text{sf}\,(\gamma\cdot k).(\gamma\cdot a)\,(k\cdot\text{x2})\,e}{2\,(k\cdot p)}+\frac{\text{v1}\,(\gamma\cdot k).(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot\text{x2})\,e}{2\,(k\cdot p)}+\frac{i\,\text{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,p^2\,e}{m^3\,\chi\text{p}}+m\,\text{sf}-\text{v1}\,\gamma\cdot p$$

```
(*a small test*)
((Matrix1 /. {sf → 1, v1 → -1, v2 → 0, t → 0, af → 0, ξ → 1}) +
   (Matrix1 /. {sf → 1, v1 → -1, v2 → 0, t → 0, af → 0, ξ → -1})) / 2
```

$$\frac{1}{2}\left(-\frac{a^2\,e^2\,\gamma\cdot k\,(k\cdot\text{x1})\,(k\cdot\text{x2})}{k\cdot p}-\frac{e\,m\,(k\cdot\text{x1})\,(\gamma\cdot a).(\gamma\cdot k)}{k\cdot p}-\frac{e\,m\,(k\cdot\text{x2})\,(\gamma\cdot k).(\gamma\cdot a)}{k\cdot p}+\frac{2\,i\,e\,\text{tf}\,(\gamma\cdot a).(\gamma\cdot k)}{m\,\chi\text{p}}-\right.$$
$$\left.\frac{2\,i\,e\,\text{tf}\,(\gamma\cdot k).(\gamma\cdot a)}{m\,\chi\text{p}}-\frac{e\,(k\cdot\text{x1})\,(\gamma\cdot p).(\gamma\cdot a).(\gamma\cdot k)}{k\cdot p}-\frac{e\,(k\cdot\text{x2})\,(\gamma\cdot k).(\gamma\cdot a).(\gamma\cdot p)}{k\cdot p}+2\,m+2\,\gamma\cdot p\right)$$

```
Matrix2 = Expand[ExpandScalarProduct[
    Matrix1 /. {Momentum[x1, D] → Momentum[X, D] - Momentum[x, D] / 2,
      Momentum[x2, D] → Momentum[X, D] + Momentum[x, D] / 2}]]
Coeff2 = Coeff1;
Phase2 = Expand[
   ExpandScalarProduct[Phase1 /. {Momentum[x1, D] → Momentum[X, D] - Momentum[x, D] / 2,
      Momentum[x2, D] → Momentum[X, D] + Momentum[x, D] / 2}]]
```

$$\frac{i\,\mathrm{v2}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,a^2\,(k\cdot p)^2\,e^3}{m^7\,\chi\mathrm{p}^3}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot x)^2\,e^3}{8\,m^3\,\chi\mathrm{p}}-\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot X)^2\,e^3}{2\,m^3\,\chi\mathrm{p}}-$$
$$\frac{\mathrm{af}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot p)\,(k\cdot x)\,e^3}{4\,m^5\,\chi\mathrm{p}^2}+\frac{\mathrm{af}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,a^2\,(k\cdot p)\,(k\cdot x)\,e^3}{4\,m^5\,\chi\mathrm{p}^2}+\frac{\mathrm{af}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot p)\,(k\cdot X)\,e^3}{2\,m^5\,\chi\mathrm{p}^2}+$$
$$\frac{\mathrm{af}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,a^2\,(k\cdot p)\,(k\cdot X)\,e^3}{2\,m^5\,\chi\mathrm{p}^2}-\frac{\mathrm{af}\,\zeta\,a^2\,(k\cdot p)^2\,e^2}{m^5\,\chi\mathrm{p}^2}-\frac{\mathrm{v1}\,\gamma\cdot k\,a^2\,(k\cdot x)^2\,e^2}{8\,(k\cdot p)}+\frac{\mathrm{v1}\,\gamma\cdot k\,a^2\,(k\cdot X)^2\,e^2}{2\,(k\cdot p)}+$$
$$\frac{\mathrm{v2}\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\mathrm{p}^2}+\frac{2\,\mathrm{tf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\mathrm{p}^2}-\frac{\mathrm{af}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot p)\,(k\cdot p)\,e^2}{m^5\,\chi\mathrm{p}^2}-\frac{\mathrm{af}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,(a\cdot p)\,(k\cdot p)\,e^2}{m^5\,\chi\mathrm{p}^2}-$$
$$\frac{i\,\mathrm{sf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot x)\,e^2}{2\,m^2\,\chi\mathrm{p}}-\frac{i\,\mathrm{af}\,\gamma\cdot k\,a^2\,(k\cdot x)\,e^2}{2\,m^2\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,a^2\,(k\cdot x)\,e^2}{4\,m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,a^2\,(k\cdot x)\,e^2}{4\,m^3\,\chi\mathrm{p}}+$$
$$\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot p)\,(k\cdot x)\,e^2}{2\,m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,(a\cdot p)\,(k\cdot x)\,e^2}{2\,m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,a^2\,(k\cdot X)\,e^2}{2\,m^3\,\chi\mathrm{p}}-$$
$$\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,a^2\,(k\cdot X)\,e^2}{2\,m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot p)\,(k\cdot X)\,e^2}{m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot a)\,(a\cdot p)\,(k\cdot X)\,e^2}{m^3\,\chi\mathrm{p}}+$$
$$\frac{i\,\mathrm{tf}\,(\gamma\cdot a).(\gamma\cdot k)\,e}{m\,\chi\mathrm{p}}-\frac{i\,\mathrm{tf}\,(\gamma\cdot k).(\gamma\cdot a)\,e}{m\,\chi\mathrm{p}}-\frac{i\,\mathrm{sf}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p)\,e}{m^2\,\chi\mathrm{p}}-\frac{i\,\mathrm{af}\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot p)\,e}{m^2\,\chi\mathrm{p}}-$$
$$\frac{i\,\mathrm{sf}\,\zeta\,\gamma\cdot k\,(a\cdot p)\,e}{m^2\,\chi\mathrm{p}}-\frac{i\,\mathrm{af}\,\gamma\cdot k\,(a\cdot p)\,e}{m^2\,\chi\mathrm{p}}+\frac{2\,i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,(a\cdot p)\,e}{m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,(a\cdot p)\,e}{m^3\,\chi\mathrm{p}}+$$
$$\frac{i\,\mathrm{sf}\,\zeta\,\gamma\cdot a\,(k\cdot p)\,e}{m^2\,\chi\mathrm{p}}+\frac{i\,\mathrm{af}\,\gamma\cdot a\,(k\cdot p)\,e}{m^2\,\chi\mathrm{p}}-\frac{2\,i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot p)\,e}{m^3\,\chi\mathrm{p}}-\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot a)\,(k\cdot p)\,e}{m^3\,\chi\mathrm{p}}+$$
$$\frac{m\,\mathrm{sf}\,(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot x)\,e}{4\,(k\cdot p)}-\frac{m\,\mathrm{sf}\,(\gamma\cdot k).(\gamma\cdot a)\,(k\cdot x)\,e}{4\,(k\cdot p)}+\frac{\mathrm{v1}\,(\gamma\cdot k).(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot x)\,e}{4\,(k\cdot p)}-$$
$$\frac{\mathrm{v1}\,(\gamma\cdot p).(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot x)\,e}{4\,(k\cdot p)}-\frac{m\,\mathrm{sf}\,(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot X)\,e}{2\,(k\cdot p)}-\frac{m\,\mathrm{sf}\,(\gamma\cdot k).(\gamma\cdot a)\,(k\cdot X)\,e}{2\,(k\cdot p)}+$$
$$\frac{\mathrm{v1}\,(\gamma\cdot k).(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot X)\,e}{2\,(k\cdot p)}+\frac{\mathrm{v1}\,(\gamma\cdot p).(\gamma\cdot a).(\gamma\cdot k)\,(k\cdot X)\,e}{2\,(k\cdot p)}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,p^2\,e}{m^3\,\chi\mathrm{p}}+m\,\mathrm{sf}-\mathrm{v1}\,\gamma\cdot p$$

$$\frac{a^2\,e^2\,(k\cdot x)\,(k\cdot X)^2}{2\,(k\cdot p)}+\frac{a^2\,e^2\,(k\cdot x)^3}{24\,(k\cdot p)}+\frac{e\,(a\cdot p)\,(k\cdot x)\,(k\cdot X)}{k\cdot p}-p\cdot x$$

```
Matrix3 =
  (((Expand[Matrix2 /. TripleGamma]) /. EpsToF) /. FieldSubstitutions) /. akToF
Coeff3 = Coeff2;
Phase3 = Phase2;
```

$$
\begin{aligned}
&\frac{\mathrm{v2}\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot p)^2\,e^3}{2\,m^7\,\chi\mathrm{p}^3}-\frac{\mathrm{v1}\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot x)^2\,e^3}{16\,m^3\,\chi\mathrm{p}}+\frac{\mathrm{v1}\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot X)^2\,e^3}{4\,m^3\,\chi\mathrm{p}}-\frac{i\,\mathrm{af}\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot p)\,(k\cdot x)\,e^3}{4\,m^5\,\chi\mathrm{p}^2}-\\
&\quad\frac{\mathrm{af}\,\zeta\,a^2\,(k\cdot p)^2\,e^2}{m^5\,\chi\mathrm{p}^2}-\frac{\mathrm{v1}\,\gamma\cdot k\,a^2\,(k\cdot x)^2\,e^2}{8\,(k\cdot p)}+\frac{\mathrm{v1}\,\gamma\cdot k\,a^2\,(k\cdot X)^2\,e^2}{2\,(k\cdot p)}+\frac{\mathrm{v2}\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\mathrm{p}^2}+\\
&\quad\frac{2\,\mathrm{tf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot p)\,e^2}{m^4\,\chi\mathrm{p}^2}-\frac{i\,\mathrm{sf}\,\zeta\,\gamma\cdot k\,a^2\,(k\cdot x)\,e^2}{2\,m^2\,\chi\mathrm{p}}-\frac{i\,\mathrm{af}\,\gamma\cdot k\,a^2\,(k\cdot x)\,e^2}{2\,m^2\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,a^2\,(k\cdot x)\,e^2}{4\,m^3\,\chi\mathrm{p}}+\\
&\quad\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,a^2\,(k\cdot x)\,e^2}{4\,m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,a^2\,(k\cdot X)\,e^2}{2\,m^3\,\chi\mathrm{p}}-\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,a^2\,(k\cdot X)\,e^2}{2\,m^3\,\chi\mathrm{p}}+\\
&\quad\frac{\mathrm{sf}\,\zeta\,\gamma^{\beta}.\overline{\gamma}^{5}\,\mathrm{FDp}^{\beta}\,e}{m^2\,\chi\mathrm{p}}+\frac{\mathrm{af}\,\gamma^{\beta}.\overline{\gamma}^{5}\,\mathrm{FDp}^{\beta}\,e}{m^2\,\chi\mathrm{p}}+\frac{2\,i\,\mathrm{v1}\,\zeta\,(\gamma\cdot k).(\gamma\cdot p)\,(a\cdot p)\,e}{m^3\,\chi\mathrm{p}}+\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot k)\,(a\cdot p)\,e}{m^3\,\chi\mathrm{p}}-\\
&\quad\frac{2\,i\,\mathrm{v1}\,\zeta\,(\gamma\cdot a).(\gamma\cdot p)\,(k\cdot p)\,e}{m^3\,\chi\mathrm{p}}-\frac{i\,\mathrm{v1}\,\zeta\,(\gamma\cdot p).(\gamma\cdot a)\,(k\cdot p)\,e}{m^3\,\chi\mathrm{p}}+\frac{i\,m\,\mathrm{sf}\,\sigma\mathrm{F}\,(k\cdot x)\,e}{4\,(k\cdot p)}-\frac{i\,\mathrm{v1}\,\gamma^{\beta}.\overline{\gamma}^{5}\,\mathrm{FDp}^{\beta}\,(k\cdot x)\,e}{2\,(k\cdot p)}-\\
&\quad\mathrm{v1}\,\gamma\cdot a\,(k\cdot X)\,e+\frac{\mathrm{v1}\,\gamma\cdot k\,(a\cdot p)\,(k\cdot X)\,e}{k\cdot p}-\frac{\mathrm{v1}\,\zeta\,\sigma\mathrm{F}\,p^2\,e}{2\,m^3\,\chi\mathrm{p}}-\frac{\mathrm{tf}\,\sigma\mathrm{F}\,e}{m\,\chi\mathrm{p}}+m\,\mathrm{sf}-\mathrm{v1}\,\gamma\cdot p
\end{aligned}
$$

```
Matrix4 = Contract[
  DiracOrder[
    Matrix3 /. {DiracGamma[LorentzIndex[β, D], D].DiracGamma[5]
        Pair[LorentzIndex[β, D], Momentum[FDp, D]] → FVD[γγ5FD, α] pv[α]}
   ] /. {
    DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[p, D], D] → FVD[γaγ, α] pv[α],
    DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[p, D], D] → FVD[γkγ, α] pv[α]}
 ]
Coeff4 = Coeff3;
Phase4 = Phase3;
```

$$-\frac{a^2\,\mathrm{af}\,e^2\,\zeta\,(k\cdot p)^2}{m^5\,\chi\mathrm{p}^2}+\frac{a^2\,e^3\,\zeta\,\sigma\mathrm{F}\,\mathrm{v2}\,(k\cdot p)^2}{2\,m^7\,\chi\mathrm{p}^3}-\frac{a^2\,e^3\,\zeta\,\sigma\mathrm{F}\,\mathrm{v1}\,(k\cdot x)^2}{16\,m^3\,\chi\mathrm{p}}+\frac{a^2\,e^3\,\zeta\,\sigma\mathrm{F}\,\mathrm{v1}\,(k\cdot X)^2}{4\,m^3\,\chi\mathrm{p}}-$$
$$\frac{a^2\,e^2\,\mathrm{v1}\,\gamma\cdot k\,(k\cdot x)^2}{8\,(k\cdot p)}+\frac{a^2\,e^2\,\mathrm{v1}\,\gamma\cdot k\,(k\cdot X)^2}{2\,(k\cdot p)}-\frac{i\,a^2\,\mathrm{af}\,e^3\,\zeta\,\sigma\mathrm{F}\,(k\cdot p)\,(k\cdot x)}{4\,m^5\,\chi\mathrm{p}^2}-\frac{i\,a^2\,\mathrm{af}\,e^2\,\gamma\cdot k\,(k\cdot x)}{2\,m^2\,\chi\mathrm{p}}+$$
$$\frac{2\,a^2\,e^2\,\zeta\,\mathrm{tf}\,\gamma\cdot k\,(k\cdot p)}{m^4\,\chi\mathrm{p}^2}+\frac{a^2\,e^2\,\mathrm{v2}\,\gamma\cdot k\,(k\cdot p)}{m^4\,\chi\mathrm{p}^2}+\frac{i\,a^2\,e^2\,\zeta\,\mathrm{v1}\,(k\cdot p)\,(k\cdot x)}{2\,m^3\,\chi\mathrm{p}}+\frac{i\,a^2\,e^2\,\zeta\,\mathrm{v1}\,(k\cdot X)\,(p\cdot\gamma\mathrm{k}\gamma)}{m^3\,\chi\mathrm{p}}-$$
$$\frac{i\,a^2\,e^2\,\zeta\,\mathrm{v1}\,(k\cdot p)\,(k\cdot X)}{m^3\,\chi\mathrm{p}}-\frac{i\,a^2\,e^2\,\zeta\,\mathrm{sf}\,\gamma\cdot k\,(k\cdot x)}{2\,m^2\,\chi\mathrm{p}}+\frac{e\,\mathrm{v1}\,(a\cdot p)\,\gamma\cdot k\,(k\cdot X)}{k\cdot p}-e\,\mathrm{v1}\,\gamma\cdot a\,(k\cdot X)+$$
$$\frac{i\,e\,\zeta\,\mathrm{v1}\,(a\cdot p)\,(p\cdot\gamma\mathrm{k}\gamma)}{m^3\,\chi\mathrm{p}}+\frac{\mathrm{af}\,e\,(p\cdot\gamma\gamma5\mathrm{FD})}{m^2\,\chi\mathrm{p}}-\frac{i\,e\,\zeta\,\mathrm{v1}\,(k\cdot p)\,(p\cdot\gamma\mathrm{a}\gamma)}{m^3\,\chi\mathrm{p}}+\frac{i\,e\,m\,\mathrm{sf}\,\sigma\mathrm{F}\,(k\cdot x)}{4\,(k\cdot p)}-$$
$$\frac{i\,e\,\mathrm{v1}\,(k\cdot x)\,(p\cdot\gamma\gamma5\mathrm{FD})}{2\,(k\cdot p)}-\frac{e\,\zeta\,p^2\,\sigma\mathrm{F}\,\mathrm{v1}}{2\,m^3\,\chi\mathrm{p}}+\frac{e\,\zeta\,\mathrm{sf}\,(p\cdot\gamma\gamma5\mathrm{FD})}{m^2\,\chi\mathrm{p}}-\frac{e\,\sigma\mathrm{F}\,\mathrm{tf}}{m\,\chi\mathrm{p}}+m\,\mathrm{sf}-\mathrm{v1}\,\gamma\cdot p$$

Expanding scalar products into components and changing variables

$p \to \{p_- = 1/2\,(p^0 - p^3),\ p_+ = p^0 + p^3,\ p_\perp\}$

$p_- = x_- / 2\,s$

$p_+ = (p^2 + p_\perp{}^2) / 2\,p_- = s\,(p^2 + p_\perp{}^2) / x_-$

Integration measure

$\int \mathbb{d}^D \mathbf{p} \ldots = \int \frac{\mathbb{d}s}{2\,s}\,\mathbb{d}p^2\,\mathbb{d}^{D-2}p_\perp$

$x_- = kx / m$

$p_- = kx / 2\,m\,s$

$kp = m\,p_- = m\,xm / 2\,s = kx / 2\,s$

$ap = -at\,pt$

$\gamma p = \gamma_-\,p_+ + \gamma_+\,p_- - \gamma_\perp\,p_\perp = Gm\,\frac{s}{x_-}\,(p^2 + p_\perp{}^2) + Gp\,\frac{x_-}{2\,s} - Gt\,pt$

$\gamma k = \gamma_-\,k_+ = m\,Gm$

$kx = k_+\,x_- = m\,xm$

$(\gamma F^*)^\mu.\gamma^5 \to \{(\gamma F^*)_-.\gamma^5 = 0,\ (\gamma F^*)_+.\gamma^5,\ (\gamma F^*)_\perp.\gamma^5\} = \{0,\ \gamma\gamma 5FDp,\ \gamma\gamma 5FDt\}$

$(\gamma F^*)_\mu\,k^\mu = 0 \to (\gamma F^*)_- = 0$

$(\gamma F^*)_\mu\,a^\mu = 0 \to \gamma\gamma 5FDt\,at = 0$

$(\gamma F^*)^\mu.\gamma^5\,p_\mu = \gamma\gamma 5FDm * pp$

$\gamma k \gamma_- = (\gamma k)^2 / m = 0$

```
D[{xm/2/s, s (p2 + pt2)/xm}, {{s, p2}}]
Abs[Det[%]]
```

$$\begin{pmatrix} -\frac{xm}{2\,s^2} & 0 \\ \frac{p2+pt2}{xm} & \frac{s}{xm} \end{pmatrix}$$

$$\frac{1}{2\,|s|}$$

```
Matrix5 = Collect[
  Expand[Matrix4 /. {DiracGamma[Momentum[p, D], D] → Gp * pm + Gm * pp - Gt[i] * pt[i],
        Pair[Momentum[a, D], Momentum[p, D]] → -at[i1] pt[i1],
        Pair[Momentum[p, D], Momentum[γγ5FD, D]] → γγ5FDp * pm,
        Pair[Momentum[p, D], Momentum[γaγ, D]] →
         γaγp * pm + γaγm * pp - γaγt[i] * pt[i],
        Pair[Momentum[p, D], Momentum[γkγ, D]] → γkγp * pm - γkγt[i] * pt[i],
        (*av2→-at^2,*)
        DiracGamma[Momentum[k, D], D] → m Gm} /. {γkγm → 0} /. {χp → ξ kp / m^2} /.
     {kp → kx / 2 / s, pm → xm / 2 / s} /. {kx → m xm} /. {pp → s (pv2 + pt[i2]^2) / xm}],
  {v1, pt[i2] pt[i], pt[i2], pt[i_], pv2, γγ5FDm, γγ5FDp, γγ5FDt[i],
   γkγm, γkγp, γkγt[i], γaγm, γaγp, γaγt[i]}]
Coefficient[Matrix5, γkγt[i]]
Coeff5 = Coeff4 / 2 / s
Phase5 = Collect[
  Expand[Phase4 /. {Pair[Momentum[p, D], Momentum[x, D]] → pp xm + pm xp - pt * xt,
       kp → m pm, Pair[Momentum[a, D], Momentum[p, D]] → -at pt } /. {kp → kx / 2 / s,
      pm → xm / 2 / s} /. {pp → s ( pv2 + pt^2) / xm} /. {xm → kx / m}], {pt, pp}]
```

$$\begin{aligned}
&\mathrm{v1}\Bigg(\frac{a^2 e^3 \zeta s \sigma\mathrm{F} (k\cdot X)^2}{2 m^2 \xi\, \mathrm{xm}}+\frac{a^2 e^2 \mathrm{Gm}\, s (k\cdot X)^2}{\mathrm{xm}}+\\
&\quad \mathrm{pt}(i)\left(-\frac{2 i a^2 e^2 \zeta s\, \gamma\mathrm{k}\gamma\mathrm{t}(i) (k\cdot X)}{m^2 \xi\, \mathrm{xm}}+\frac{2 i e \zeta s\, \mathrm{at}(\mathrm{i1})\, \gamma\mathrm{k}\gamma\mathrm{t}(i)\, \mathrm{pt}(\mathrm{i1})}{m^2 \xi\, \mathrm{xm}}+\frac{i e \zeta\, \gamma\mathrm{a}\gamma\mathrm{t}(i)}{m \xi}+\mathrm{Gt}(i)\right)-\\
&\quad \frac{a^2 e^3 \zeta s \sigma\mathrm{F}\, \mathrm{xm}}{8 \xi}-\frac{1}{4} a^2 e^2 \mathrm{Gm}\, m^2 s\, \mathrm{xm}+\frac{i a^2 \gamma\mathrm{k}\gamma\mathrm{p}\, e^2 \zeta (k\cdot X)}{m^2 \xi}-\frac{i a^2 e^2 \zeta (k\cdot X)}{m \xi}+\frac{i a^2 e^2 \zeta\, \mathrm{xm}}{2 \xi}-\\
&\quad e \gamma\cdot a (k\cdot X)+\mathrm{pt}(\mathrm{i1})\left(-\frac{2 e \mathrm{Gm}\, s\, \mathrm{at}(\mathrm{i1}) (k\cdot X)}{\mathrm{xm}}-\frac{i \gamma\mathrm{k}\gamma\mathrm{p}\, e \zeta\, \mathrm{at}(\mathrm{i1})}{m^2 \xi}\right)+\mathrm{pt}(\mathrm{i2})^2\left(-\frac{\mathrm{Gm}\, s}{\mathrm{xm}}-\frac{i \gamma\mathrm{a}\gamma\mathrm{m}\, e \zeta s}{m \xi\, \mathrm{xm}}\right)+\\
&\quad p^2\left(-\frac{e \zeta s \sigma\mathrm{F}}{m^2 \xi\, \mathrm{xm}}-\frac{i \gamma\mathrm{a}\gamma\mathrm{m}\, e \zeta s}{m \xi\, \mathrm{xm}}-\frac{\mathrm{Gm}\, s}{\mathrm{xm}}\right)-\frac{i \gamma\mathrm{a}\gamma\mathrm{p}\, e \zeta\, \mathrm{xm}}{2 m \xi s}-\frac{1}{2} i \gamma\gamma5\mathrm{FDp}\, e\, \mathrm{xm}-\frac{\mathrm{Gp}\, \mathrm{xm}}{2 s}\Bigg)-\\
&\frac{i a^2 \mathrm{af}\, e^3 \zeta s \sigma\mathrm{F}}{2 m \xi^2}-\frac{i a^2 \mathrm{af}\, e^2 \mathrm{Gm}\, m s}{\xi}-\frac{a^2 \mathrm{af}\, e^2 \zeta}{m \xi^2}+\frac{a^2 e^3 \zeta s \sigma\mathrm{F}\, \mathrm{v2}}{m^2 \xi^3\, \mathrm{xm}}-\\
&\frac{i a^2 e^2 \zeta \mathrm{Gm}\, m s\, \mathrm{sf}}{\xi}+\\
&\frac{4 a^2 e^2 \zeta \mathrm{Gm}\, s\, \mathrm{tf}}{\xi^2\, \mathrm{xm}}+\\
&\frac{2 a^2 e^2 \mathrm{Gm}\, s\, \mathrm{v2}}{\xi^2\, \mathrm{xm}}+\gamma\gamma5\mathrm{FDp}\left(\frac{\mathrm{af}\, e}{m \xi}+\frac{e \zeta\, \mathrm{sf}}{m \xi}\right)+\\
&\frac{1}{2} i e m s\, \mathrm{sf}\, \sigma\mathrm{F}-\frac{2 e s \sigma\mathrm{F}\, \mathrm{tf}}{\xi\, \mathrm{xm}}+m\, \mathrm{sf}
\end{aligned}$$

$$\frac{2 i e \zeta s\, \mathrm{v1}\, \mathrm{at}(\mathrm{i1})\, \mathrm{pt}(i)\, \mathrm{pt}(\mathrm{i1})}{m^2 \xi\, \mathrm{xm}}-\frac{2 i a^2 e^2 \zeta s\, \mathrm{v1}\, \mathrm{pt}(i) (k\cdot X)}{m^2 \xi\, \mathrm{xm}}$$

$$\frac{i\, 2^{-D-2}\, \pi^{-D}\, \Lambda^{4-D}}{s\, \mathrm{DdInv}(\zeta)}$$

$$\frac{1}{12}\, a^2\, e^2\, s\, (\, k\cdot x\,)^2 + a^2\, e^2\, s\, (\, k\cdot X\,)^2 + \mathrm{pt}\, (\mathrm{xt} - 2\ \mathrm{at}\ e\, s\, (k\cdot X)) - \frac{\mathrm{xp}\, (k\cdot x)}{2\, m\, s} - p^2\, s + \mathrm{pt}^2\, (-s)$$

Integration over
$\int d\!\!1^{D-2} p_\perp \ldots$

$$I_0 = \int d^{D-2} p_\perp \, \mathrm{Exp}\left[-I\, A\, p_\perp^2 + I\,(J.p_\perp)\right] =$$

$$= \mathrm{Exp}\left[-I\,\frac{\pi}{2}\,\frac{D-2}{2}\right] \pi^{\frac{D-2}{2}} (\det A)^{-\frac{1}{2}}\, \mathrm{Exp}\left[I\,\frac{1}{4}\, J.A^{-1}.J\right]$$

$$I_{1\,i} = \int d^{D-2} p_\perp \, p_{\perp i}\, \mathrm{Exp}\left[-I\, A\, p_\perp^2 + I\,(J.p_\perp)\right] =$$

$$= \frac{1}{2}\left(A^{-1}.J\right)_i I_0$$

$$I_2 = \int d^{D-2} p_\perp \, p_\perp{}^2\, \mathrm{Exp}\left[-I\, A\, p_\perp^2 + I\,(J.p_\perp)\right] =$$

$$= \left[-i\,\frac{1}{2}\,\mathrm{Tr}\, A^{-1} + \left(\frac{1}{2}\, A^{-1}.J\right)^2\right]$$

$$I_{2\,ij} = \int d^{D-2} p_\perp \, p_{\perp i}\, p_{\perp j}\, \mathrm{Exp}\left[-I\, A\, p_\perp^2 + I\,(J.p_\perp)\right] =$$

$$= \left[-i\,\frac{1}{2}\, A^{-1}{}_{ij} + \left(\frac{1}{2}\, A^{-1}.J\right)_i \left(\frac{1}{2}\, A^{-1}.J\right)_j\right] I_0$$

$$I_{3\,i} = -i\,\frac{\partial}{\partial J_i} I_2 = \int d^{D-2} p_\perp \, p_\perp{}^2\, p_{\perp i}\, \mathrm{Exp}\left[-I\, A\, p_\perp^2 + I\,(J.p_\perp)\right] =$$

$$= \left\{\left[-i\,\frac{1}{2}\,\mathrm{Tr}\, A^{-1} + \left(\frac{1}{2}\, A^{-1}.J\right)^2\right] \frac{1}{2}\left(A^{-1}.J\right)_i - i\,\frac{1}{2}\left(A^{-1\,T} A^{-1}.J\right)_i\right\} I_0 =$$

$$= \left(\frac{1}{2}\, A^{-1}.J\right)_i I_2 - i\left(A^{-1\,T}\right)_{ij} I_{1\,j}$$

where
$A = s$,
$J = x_\perp - 2\, e a_\perp\, s\, kX$,
$\det A = s^{D-2}$,
$A^{-1} = 1/s$

We perform integrations
Integrations changes the coefficient (Coeff) and phase
Then recollect some scalar products
$a_\perp^2 = -a^2$
$a_\perp\, x_\perp = -(ax)$
$x_\perp^2 = 2\, x_-\, x_+ - x^2$

```
Clear[J]
Amatr = -Coefficient[Phase5, pt^2]
J[i_] = Coefficient[Phase5, pt] /. {at → at[i], xt → xt[i]}
CI0 = Exp[-I Pi / 2 (D / 2 - 1)] Pi^(D / 2 - 1) / Amatr^(D / 2 - 1)
```

s

$\mathrm{xt}(i) - 2\, e\, s\, \mathrm{at}(i)\, (k\cdot X)$

$e^{-\frac{1}{2} i \pi \left(\frac{D}{2}-1\right)} \pi^{\frac{D}{2}-1} s^{1-\frac{D}{2}}$

```
Phase6 = Expand[Expand[((Phase5 /. {pt → 0}) + 1 / 4 J[i]^2 / Amatr)] /.
     { at[i]^2 → -av2, at[i] xt[i] → -ax, xt[i]^2 → 2 xm xp - xv2} /. {xm → kx / m}]
Coeff6 = Coeff5 * CI0
Expand[
  Expand[Matrix5] /.
      {pt[i2_]^2 pt[i1_] → ((-I / 2 * (D - 2) / Amatr + (1 / 2 / Amatr * J[i2])^2) *
           1 / 2 / Amatr * J[i1] - I * 1 / 2 / Amatr^2 * J[i1])} /. {pt[i_] pt[i1_] →
        (- I / 2 / Amatr δ[i, i1] + (1 / 2 / Amatr * J[i]) * (1 / 2 / Amatr * J[i1]))} /.
    {pt[i_]^2 → (-I / 2 * (D - 2) / Amatr + (1 / 2 / Amatr * J[i])^2) } /.
   {pt[i_] → (1 / 2 / Amatr * J[i])}
 ];
% - Coefficient[%, δ[i, i1]] δ[i, i1] + (Coefficient[%, δ[i, i1]] /. {i1 → i});
Matrix6 =
 Collect[% /. {γγ5FDt[i_] at[i_] → 0 } /. { at[i_]^2 → -av2} /. {at[i_] xt[i_] → -ax} /.
     { xt[i_]^2 → 2 xm xp - xv2} /. {at[i_] ax kX xt[i_] → -ax ax kX},
  {v1, pt[i2] pt[i], pt[i2], pt[i_], pv2, γγ5FDm, γγ5FDp,
   γγ5FDt[i], γkγm, γkγp, γkγt[i], γaγm, γaγp, γaγt[i]}]
(*Matrix6=Collect[Expand[Expand[(Matrix5/.{pt[i_]→0})+
       Coefficient[Matrix5,pt]*1/2/Amatr*J+
       Coefficient[Matrix5,pt^2]*(-I/2*(D-2)/Amatr+( 1/2/Amatr*J)^2)+
       Coefficient[Matrix5,pt^3]((-I/2*(D-2)/Amatr+( 1/2/Amatr*J)^2)*1/2/Amatr*J+
          1/2/Amatr^2*J)]/.{γγ5FDt at→ 0, at^4→ av2^2 ,
     at^3→ -av2 at, at^2→-av2,at xt→ -ax, xt^2→ 2xm xp -xv2}],
  {p2,Gm,Gp,Gt,γγ5FDm,γγ5FDp,γγ5FDt,γkγm,γkγp,γkγt,γaγm,γaγp,γaγt}]*)
```

$$\frac{1}{12} a^2 e^2 s\,(k\cdot x)^2 + e\,(a\cdot x)\,(k\cdot X) - p^2 s - \frac{x^2}{4 s}$$

$$\frac{i\, 2^{-D-2} e^{-\frac{1}{2} i \pi \left(\frac{D}{2}-1\right)} \pi^{-\frac{D}{2}-1} \Lambda^{4-D} s^{-D/2}}{\mathrm{DdInv}(\zeta)}$$

$$\text{v1}\left(\gamma\text{a}\gamma\text{m}\left(\frac{i\,a^2\,e^3\,\zeta\,s\,(k\cdot X)^2}{m\,\xi\,\text{xm}}-\frac{i\,e^2\,\zeta\,(a\cdot x)\,(k\cdot X)}{m\,\xi\,\text{xm}}-\frac{D\,e\,\zeta}{2\,m\,\xi\,\text{xm}}-\frac{i\,e\,\zeta\left(2\,\text{xm}\,\text{xp}-x^2\right)}{4\,m\,\xi\,s\,\text{xm}}+\frac{e\,\zeta}{m\,\xi\,\text{xm}}\right)+\right.$$
$$\frac{a^2\,e^3\,\zeta\,s\,\sigma\text{F}\,(k\cdot X)^2}{2\,m^2\,\xi\,\text{xm}}+\gamma\text{k}\gamma\text{t}(i)\left(\frac{i\,e^2\,\zeta\,\text{at}(i)\,(a\cdot x)\,(k\cdot X)}{m^2\,\xi\,\text{xm}}-\frac{i\,e\,\zeta\,\text{xt}(i)\,(a\cdot x)}{2\,m^2\,\xi\,s\,\text{xm}}+\frac{e\,\zeta\,\text{at}(i)}{m^2\,\xi\,\text{xm}}\right)-$$
$$\frac{a^2\,e^3\,\zeta\,s\,\sigma\text{F}\,\text{xm}}{8\,\xi}-\frac{1}{4}\,a^2\,e^2\,\text{Gm}\,m^2\,s\,\text{xm}-\frac{i\,a^2\,e^2\,\zeta\,(k\cdot X)}{m\,\xi}+\frac{i\,a^2\,e^2\,\zeta\,\text{xm}}{2\,\xi}-$$
$$e\,\gamma\cdot a\,(k\cdot X)+\frac{i\,\gamma\text{k}\gamma\text{p}\,e\,\zeta\,(a\cdot x)}{2\,m^2\,\xi\,s}+\gamma\text{a}\gamma\text{t}(i)\left(\frac{i\,e\,\zeta\,\text{xt}(i)}{2\,m\,\xi\,s}-\frac{i\,e^2\,\zeta\,\text{at}(i)\,(k\cdot X)}{m\,\xi}\right)-$$
$$e\,\text{at}(i)\,\text{Gt}(i)\,(k\cdot X)+\frac{i\,D\,\text{Gm}}{2\,\text{xm}}+p^2\left(-\frac{e\,\zeta\,s\,\sigma\text{F}}{m^2\,\xi\,\text{xm}}-\frac{i\,\gamma\text{a}\gamma\text{m}\,e\,\zeta\,s}{m\,\xi\,\text{xm}}-\frac{\text{Gm}\,s}{\text{xm}}\right)-\frac{i\,\gamma\text{a}\gamma\text{p}\,e\,\zeta\,\text{xm}}{2\,m\,\xi\,s}-$$
$$\left.\frac{1}{2}\,i\,\gamma\gamma5\text{FDp}\,e\,\text{xm}-\frac{\text{Gm}\left(2\,\text{xm}\,\text{xp}-x^2\right)}{4\,s\,\text{xm}}-\frac{i\,\text{Gm}}{\text{xm}}-\frac{\text{Gp}\,\text{xm}}{2\,s}+\frac{\text{Gt}(i)\,\text{xt}(i)}{2\,s}\right)-$$
$$\frac{i\,a^2\,\text{af}\,e^3\,\zeta\,s\,\sigma\text{F}}{2\,m\,\xi^2}-\frac{i\,a^2\,\text{af}\,e^2\,\text{Gm}\,m\,s}{\xi}-\frac{a^2\,\text{af}\,e^2\,\zeta}{m\,\xi^2}+\frac{a^2\,e^3\,\zeta\,s\,\sigma\text{F}\,\text{v2}}{m^2\,\xi^3\,\text{xm}}-$$
$$\frac{i\,a^2\,e^2\,\zeta\,\text{Gm}\,m\,s\,\text{sf}}{\xi}+$$
$$\frac{4\,a^2\,e^2\,\zeta\,\text{Gm}\,s\,\text{tf}}{\xi^2\,\text{xm}}+$$
$$\frac{2\,a^2\,e^2\,\text{Gm}\,s\,\text{v2}}{\xi^2\,\text{xm}}+$$
$$\gamma\gamma5\text{FDp}\left(\frac{\text{af}\,e}{m\,\xi}+\frac{e\,\zeta\,\text{sf}}{m\,\xi}\right)+$$
$$\frac{1}{2}\,i\,e\,m\,s\,\text{sf}\,\sigma\text{F}-\frac{2\,e\,s\,\sigma\text{F}\,\text{tf}}{\xi\,\text{xm}}+m\,\text{sf}$$

Next we substitute

$\gamma_\perp\, a_\perp = -\gamma a$

$\gamma_\perp\, x_\perp = \gamma_-\, x_+ + \gamma_+\, x_- - \gamma x$

$\gamma_-\, x_- = \frac{\gamma k}{m}\, x_-$

$x_- = kx\,/\,m$

```
Matrix7 = Collect[
  DiracSimplify[
   Expand[Matrix6] /. {Gt[i_] at[i_] → -Contract[GAD[α] av[α]],
        Gt[i_] xt[i_] → Gm xp + Gp xm - Contract[GAD[α] xv[α]] ,
        (*γγ5FDt[i_] xt[i_] →γγ5FDp xm - DiracSlash[FDx,Dimension→D].GA[5],*)
        γγ5FDp  → DiracSlash[FDx, Dimension → D].GA[5] / xm,
        γkγt[i_] xt[i_] → -Pair[Momentum[x, D], Momentum[γkγ, D]] + γkγp * xm,
        γkγt[i_] at[i_] → -Pair[Momentum[a, D], Momentum[γkγ, D]],
        γaγt[i_] xt[i_]  → - Pair[Momentum[x, D], Momentum[γaγ, D]] + γaγp * xm +
          γaγm * xp, γaγt[i_] at[i_]  → - Pair[Momentum[a, D], Momentum[γaγ, D]]} /.
      {Gm →  DiracGamma[Momentum[k, D], D] / m } /. {γkγm → 0} /.
    {γaγm → DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[k, D], D] / m }
   /. {xm →  kx / m}
  ],
  {v1, p2, Gm, Gp, Gt, γγ5FDm, γγ5FDp, γγ5FDt, γkγm, γkγp, γkγt, γaγm, γaγp, γaγt}]
Coeff7 = Coeff6
Phase7 = Phase6
```

$$
\begin{aligned}
&-\frac{i\,\mathrm{af}\,s\,\zeta\,\sigma\mathrm{F}\,a^2\,e^3}{2\,m\,\xi^2}+\frac{s\,\mathrm{v2}\,\zeta\,\sigma\mathrm{F}\,a^2\,e^3}{m\,\xi^3\,(k\cdot x)}-\frac{i\,\mathrm{af}\,s\,\gamma\cdot k\,a^2\,e^2}{\xi}-\frac{i\,s\,\mathrm{sf}\,\zeta\,\gamma\cdot k\,a^2\,e^2}{\xi}-\frac{\mathrm{af}\,\zeta\,a^2\,e^2}{m\,\xi^2}+\frac{2\,s\,\mathrm{v2}\,\gamma\cdot k\,a^2\,e^2}{\xi^2\,(k\cdot x)}+\\
&\frac{4\,s\,\mathrm{tf}\,\zeta\,\gamma\cdot k\,a^2\,e^2}{\xi^2\,(k\cdot x)}+\frac{1}{2}\,i\,m\,s\,\mathrm{sf}\,\sigma\mathrm{F}\,e-\frac{2\,m\,s\,\mathrm{tf}\,\sigma\mathrm{F}\,e}{\xi\,(k\cdot x)}+\frac{\mathrm{af}\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5\,e}{\xi\,(k\cdot x)}+\frac{\mathrm{sf}\,\zeta\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5\,e}{\xi\,(k\cdot x)}+m\,\mathrm{sf}+\\
&\mathrm{v1}\left(\frac{s\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot X)^2\,e^3}{2\,m\,\xi\,(k\cdot x)}+\frac{i\,s\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,a^2\,(k\cdot X)^2\,e^3}{m\,\xi\,(k\cdot x)}-\frac{s\,\zeta\,\sigma\mathrm{F}\,a^2\,(k\cdot x)\,e^3}{8\,m\,\xi}-\frac{1}{4}\,s\,\gamma\cdot k\,a^2\,(k\cdot x)\,e^2+\right.\\
&\quad\frac{i\,\zeta\,a^2\,(k\cdot x)\,e^2}{2\,m\,\xi}-\frac{i\,\zeta\,a^2\,(k\cdot X)\,e^2}{m\,\xi}+\frac{i\,\zeta\,(a\cdot\gamma\mathrm{a}\gamma)\,(k\cdot X)\,e^2}{m\,\xi}-\frac{i\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,(a\cdot x)\,(k\cdot X)\,e^2}{m\,\xi\,(k\cdot x)}-\\
&\quad\frac{i\,\zeta\,(a\cdot x)\,(a\cdot\gamma\mathrm{k}\gamma)\,(k\cdot X)\,e^2}{m\,\xi\,(k\cdot x)}-\frac{1}{2}\,i\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5\,e-\frac{s\,\zeta\,\sigma\mathrm{F}\,p^2\,e}{m\,\xi\,(k\cdot x)}-\frac{i\,s\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,p^2\,e}{m\,\xi\,(k\cdot x)}+\\
&\quad\frac{i\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,x^2\,e}{4\,m\,s\,\xi\,(k\cdot x)}-\frac{i\,\zeta\,(x\cdot\gamma\mathrm{a}\gamma)\,e}{2\,m\,s\,\xi}+\frac{i\,\zeta\,(a\cdot x)\,(x\cdot\gamma\mathrm{k}\gamma)\,e}{2\,m\,s\,\xi\,(k\cdot x)}-\frac{D\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,e}{2\,m\,\xi\,(k\cdot x)}+\\
&\quad\left.\frac{\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,e}{m\,\xi\,(k\cdot x)}-\frac{\zeta\,(a\cdot\gamma\mathrm{k}\gamma)\,e}{m\,\xi\,(k\cdot x)}-\frac{\gamma\cdot x}{2\,s}-\frac{s\,\gamma\cdot k\,p^2}{k\cdot x}+\frac{\gamma\cdot k\,x^2}{4\,s\,(k\cdot x)}+\frac{i\,D\,\gamma\cdot k}{2\,(k\cdot x)}-\frac{i\,\gamma\cdot k}{k\cdot x}\right)
\end{aligned}
$$

$$
\frac{i\,2^{-D-2}\,e^{-\frac{1}{2}i\pi\left(\frac{D}{2}-1\right)}\,\pi^{-\frac{D}{2}-1}\,\Lambda^{4-D}\,s^{-D/2}}{\mathrm{DdInv}(\zeta)}
$$

$$
\frac{1}{12}\,a^2\,e^2\,s\,(k\cdot x)^2+e\,(a\cdot x)\,(k\cdot X)-p^2\,s-\frac{x^2}{4\,s}
$$

```
Matrix8 = Collect[
  Expand[
   DiracSimplify[
       Matrix7 /.
        {Pair[Momentum[x, D], Momentum[γkγ, D]] →
          DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[x, D], D],
         Pair[Momentum[a, D], Momentum[γkγ, D]] →
          DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[a, D], D],
         Pair[Momentum[x, D], Momentum[γaγ, D]] →
          DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[x, D], D],
         Pair[Momentum[a, D], Momentum[γaγ, D]] →
          DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[a, D], D]}
      ] /. FieldSubstitutions /. akToF /. {av2 → -ξ^2 m^2 / e^2}
  ],
  {sf, v1, v2, tf, af, ξ, σF}]
Coeff8 = Coeff7
Phase8 = Phase7 /. {av2 → -ξ^2 m^2 / e^2}
```

$$\text{v1}\left(-\frac{1}{2} i\, e (\gamma\cdot \text{FDx}).\overline{\gamma}^5+\zeta \left(\frac{i\, e (a\cdot x) (\gamma\cdot k).(\gamma\cdot x)}{2\, m \xi\, s (k\cdot x)}-\frac{i\, e (\gamma\cdot a).(\gamma\cdot x)}{2\, m \xi\, s}+\sigma\text{F} \left(-\frac{i\, D e}{4\, m \xi (k\cdot x)}-\frac{e p^2 s}{2\, m \xi (k\cdot x)}+\frac{1}{8} e\, m \xi\, s (k\cdot x)-\frac{e x^2}{8\, m \xi\, s (k\cdot x)}+\frac{i\, e}{m \xi (k\cdot x)}\right)-\frac{1}{2} i\, m \xi (k\cdot x)\right)+\frac{i\, D \gamma\cdot k}{2 (k\cdot x)}+\frac{1}{4} m^2 \xi^2 s \gamma\cdot k (k\cdot x)-\frac{p^2 s \gamma\cdot k}{k\cdot x}+\frac{x^2 \gamma\cdot k}{4\, s (k\cdot x)}-\frac{i\, \gamma\cdot k}{k\cdot x}-\frac{\gamma\cdot x}{2\, s}\right)+$$
$$\text{af}\left(\frac{e (\gamma\cdot \text{FDx}).\overline{\gamma}^5}{\xi (k\cdot x)}+\zeta \left(m+\frac{1}{2} i\, e\, m\, s\, \sigma\text{F}\right)+i\, m^2 \xi\, s\, \gamma\cdot k\right)+$$
$$\text{sf}\left(\zeta \left(\frac{e (\gamma\cdot \text{FDx}).\overline{\gamma}^5}{\xi (k\cdot x)}+i\, m^2 \xi\, s\, \gamma\cdot k\right)+\frac{1}{2} i\, e\, m\, s\, \sigma\text{F}+m\right)+$$
$$\text{tf}\left(-\frac{2\, e\, m\, s\, \sigma\text{F}}{\xi (k\cdot x)}-\frac{4\, \zeta\, m^2 s\, \gamma\cdot k}{k\cdot x}\right)+$$
$$\text{v2}\left(-\frac{e \zeta\, m\, s\, \sigma\text{F}}{\xi (k\cdot x)}-\frac{2\, m^2 s\, \gamma\cdot k}{k\cdot x}\right)$$

$$\frac{i\, 2^{-D-2}\, e^{-\frac{1}{2} i \pi \left(\frac{D}{2}-1\right)} \pi^{-\frac{D}{2}-1} \Lambda^{4-D} s^{-D/2}}{\text{DdInv}(\zeta)}$$

$$-\frac{1}{12} m^2 \xi^2 s (k\cdot x)^2+e (a\cdot x) (k\cdot X)-p^2 s-\frac{x^2}{4\, s}$$

```
(*a small test*)Expand[((Matrix8 /. {sf → 1, v1 → -1, v2 → 0, tf → 0, af → 0, ξ → 1}) +
    (Matrix8 /. {sf → 1, v1 → -1, v2 → 0, tf → 0, af → 0, ξ → -1})) / 2]
```

$$\frac{1}{2} i\, e (\gamma\cdot \text{FDx}).\overline{\gamma}^5-\frac{i\, D \gamma\cdot k}{2 (k\cdot x)}+\frac{1}{2} i\, e\, m\, s\, \sigma\text{F}-\frac{1}{4} m^2 \xi^2 s\, \gamma\cdot k (k\cdot x)+\frac{p^2 s\, \gamma\cdot k}{k\cdot x}-\frac{x^2 \gamma\cdot k}{4\, s (k\cdot x)}+\frac{i\, \gamma\cdot k}{k\cdot x}+m+\frac{\gamma\cdot x}{2\, s}$$

```
DiracSimplify[
 DiracGamma[Momentum[Fx, D], D].DiracGamma[Momentum[x, D], D] /. FxToak]
DiracSimplify[
 I DiracGamma[Momentum[FDx, D], D].DiracGamma[5].DiracGamma[Momentum[x, D], D] /.
    FxToEps /. FxToak /. Gamma5toTrippleGammax]
```

$(a\cdot x)\,(\gamma\cdot k).(\gamma\cdot x)-(k\cdot x)\,(\gamma\cdot a).(\gamma\cdot x)$

$(a\cdot x)\,(\gamma\cdot k).(\gamma\cdot x)-(k\cdot x)\,(\gamma\cdot a).(\gamma\cdot x)+x^2\,(\gamma\cdot a).(\gamma\cdot k)$

```
Matrix9 = Collect[
  Expand[
   Matrix8 /. {ax DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[x, D], D] →
        I DiracGamma[Momentum[FDx, D], D].DiracGamma[5].DiracGamma[Momentum[x, D],
            D] + kx DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[x, D], D] -
          (xv2 DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[k, D], D] /. akToF),
       DiracGamma[Momentum[k, D], D] → - DiracGamma[Momentum[FFx, D], D] / av2 / kx} /.
     {av2 → -ξ^2 m^2 / e^2}
  ],
  {sf, v1, v2, tf, af, ζ, e σF / m / ξ / kx, σF,
   e^2 DiracGamma[Momentum[FFx, D], D] / m^2 / ξ^2 / kx^2}]
Coeff9 = Coeff8
Phase9 = Phase8
```

$$\mathrm{v1}\left(\zeta\left(-\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^{5}.(\gamma\cdot x)}{2\,m\,\xi\,s\,(k\cdot x)}+\frac{e\,\sigma\mathrm{F}\left(-\frac{i\,D}{4}-\frac{p^2\,s}{2}+\frac{x^2}{8\,s}+i\right)}{m\,\xi\,(k\cdot x)}+\frac{1}{8}\,e\,m\,\xi\,s\,\sigma\mathrm{F}\,(k\cdot x)-\frac{1}{2}\,i\,m\,\xi\,(k\cdot x)\right)-\frac{1}{2}\,i\,e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^{5}+\frac{e^2\,\gamma\cdot \mathrm{FFx}\left(\frac{i\,D}{2}-p^2\,s+\frac{x^2}{4\,s}-i\right)}{m^2\,\xi^2\,(\,k\cdot x\,)^2}+\frac{1}{4}\,e^2\,s\,\gamma\cdot \mathrm{FFx}-\frac{\gamma\cdot x}{2\,s}\right)+$$
$$\mathrm{af}\left(\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^{5}}{\xi\,(k\cdot x)}+\frac{i\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{\xi\,(k\cdot x)}+\zeta\left(m+\frac{1}{2}\,i\,e\,m\,s\,\sigma\mathrm{F}\right)\right)+$$
$$\mathrm{sf}\left(\zeta\left(\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^{5}}{\xi\,(k\cdot x)}+\frac{i\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{\xi\,(k\cdot x)}\right)+\frac{1}{2}\,i\,e\,m\,s\,\sigma\mathrm{F}+m\right)+$$
$$\mathrm{tf}\left(-\frac{4\,e^2\,\zeta\,s\,\gamma\cdot \mathrm{FFx}}{\xi^2\,(\,k\cdot x\,)^2}-\frac{2\,e\,m\,s\,\sigma\mathrm{F}}{\xi\,(k\cdot x)}\right)+\mathrm{v2}\left(-\frac{2\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{\xi^2\,(\,k\cdot x\,)^2}-\frac{e\,\zeta\,m\,s\,\sigma\mathrm{F}}{\xi\,(k\cdot x)}\right)$$

$$\frac{i\,2^{-D-2}\,e^{-\frac{1}{2}\,i\,\pi\left(\frac{D}{2}-1\right)}\,\pi^{-\frac{D}{2}-1}\,\Lambda^{4-D}\,s^{-D/2}}{\mathrm{DdInv}(\zeta)}$$

$$-\frac{1}{12}\,m^2\,\xi^2\,s\,(\,k\cdot x\,)^2+e\,(a\cdot x)\,(k\cdot X)-p^2\,s-\frac{x^2}{4\,s}$$

```
Collect[Expand[Simplify[D[Coeff8 s f[χ[s]] Exp[I Phase8], s] / Exp[I Phase8] / Coeff8]],
  f[χ[s]]]
pv2Sol = pv2 /. Solve[% == dfds, pv2][[1]]
```

$$s\,\chi'(s)\,f'(\chi(s)) + f(\chi(s))\left(-\frac{1}{12}\,i\,m^2\,\xi^2\,s\,(\,k\cdot x\,)^2 - \frac{D}{2} - i\,p^2\,s + \frac{i\,x^2}{4\,s} + 1\right)$$

$$\frac{1}{12\,s^2\,f(\chi(s))}\left(-m^2\,\xi^2\,s^2\,f(\chi(s))\,(\,k\cdot x\,)^2 + 6\,i\left(D\,s\,f(\chi(s)) + 2\,\text{dfds}\,s - 2\,s^2\,\chi'(s)\,f'(\chi(s)) - 2\,s\,f(\chi(s))\right) + 3\,x^2\,f(\chi(s))\right)$$

Let

$f\left(\zeta,\ p^2,\ \chi\,(s)\right) = v_1\left(p^2,\ \chi\,(s)\right)\,D_{\zeta}^{-1}\left(p^2,\ \chi\,(s)\right)$

```
Matrix9pv2 =
 Coefficient[Matrix9, pv2] /. {v1 → f[ζ, pv2, χ[s]]} /. {χ[s] → ξ kx / 2 / m^2 / s}
CoeffNoD = Coeff9 * DdInv[ζ]
PhaseNopv2 = Phase9 - Coefficient[Phase9, pv2] pv2
Collect[
 Expand[
  Simplify[
   -I D[Matrix9pv2 * CoeffNoD * Exp[I PhaseNopv2], s] / (CoeffNoD * Exp[I PhaseNopv2])
  ]
 ],
 {f[ζ, pv2, ξ kx / 2 / m^2 / s]}]
Matrix91 = Coefficient[%, f[ζ, pv2, ξ kx / 2 / m^2 / s]] v1
Matrix92 = %% - Matrix91 / v1 * f[ζ, pv2, ξ kx / 2 / m^2 / s]
```

$$-\frac{e^2\, s\, \gamma\cdot \mathrm{FFx}\, f\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{m^2\, \xi^2\, (k\cdot x)^2} - \frac{e\, \zeta\, s\, \sigma \mathrm{F}\, f\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{2\, m\, \xi\, (k\cdot x)}$$

$$i\, 2^{-D-2}\, e^{-\frac{1}{2} i \pi \left(\frac{D}{2}-1\right)}\, \pi^{-\frac{D}{2}-1}\, \Lambda^{4-D}\, s^{-D/2}$$

$$-\frac{1}{12}\, m^2\, \xi^2\, s\, (k\cdot x)^2 + e\,(a\cdot x)\,(k\cdot X) - \frac{x^2}{4\, s}$$

$$f\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)\left(-\frac{i\, D\, e^2\, \gamma\cdot \mathrm{FFx}}{2\, m^2\, \xi^2\, (k\cdot x)^2} - \frac{e^2\, x^2\, \gamma\cdot \mathrm{FFx}}{4\, m^2\, \xi^2\, s\, (k\cdot x)^2} + \frac{i\, e^2\, \gamma\cdot \mathrm{FFx}}{m^2\, \xi^2\, (k\cdot x)^2} - \frac{i\, D\, e\, \zeta\, \sigma \mathrm{F}}{4\, m\, \xi\, (k\cdot x)} + \frac{1}{12}\, e^2\, s\, \gamma\cdot \mathrm{FFx} + \frac{1}{24}\, e\, \zeta\, m\, \xi\, s\, \sigma \mathrm{F}\, (k\cdot x) - \frac{e\, \zeta\, \sigma \mathrm{F}\, x^2}{8\, m\, \xi\, s\, (k\cdot x)} + \frac{i\, e\, \zeta\, \sigma \mathrm{F}}{2\, m\, \xi\, (k\cdot x)}\right) - \frac{i\, e^2\, \gamma\cdot \mathrm{FFx}\, f^{(0,0,1)}\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{2\, m^4\, \xi\, s\,(k\cdot x)} - \frac{i\, e\, \zeta\, \sigma \mathrm{F}\, f^{(0,0,1)}\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{4\, m^3\, s}$$

$$\mathrm{v1}\left(-\frac{i\, D\, e^2\, \gamma\cdot \mathrm{FFx}}{2\, m^2\, \xi^2\, (k\cdot x)^2} - \frac{e^2\, x^2\, \gamma\cdot \mathrm{FFx}}{4\, m^2\, \xi^2\, s\, (k\cdot x)^2} + \frac{i\, e^2\, \gamma\cdot \mathrm{FFx}}{m^2\, \xi^2\, (k\cdot x)^2} - \frac{i\, D\, e\, \zeta\, \sigma \mathrm{F}}{4\, m\, \xi\, (k\cdot x)} + \frac{1}{12}\, e^2\, s\, \gamma\cdot \mathrm{FFx} + \frac{1}{24}\, e\, \zeta\, m\, \xi\, s\, \sigma \mathrm{F}\, (k\cdot x) - \frac{e\, \zeta\, \sigma \mathrm{F}\, x^2}{8\, m\, \xi\, s\, (k\cdot x)} + \frac{i\, e\, \zeta\, \sigma \mathrm{F}}{2\, m\, \xi\, (k\cdot x)}\right)$$

$$-\frac{i\, e^2\, \gamma\cdot \mathrm{FFx}\, f^{(0,0,1)}\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{2\, m^4\, \xi\, s\,(k\cdot x)} - \frac{i\, e\, \zeta\, \sigma \mathrm{F}\, f^{(0,0,1)}\left(\zeta, p^2, \frac{\xi\,(k\cdot x)}{2\, m^2\, s}\right)}{4\, m^3\, s}$$

```
Matrix101 = Collect[
   (Expand[Matrix9] - Coefficient[Matrix9, pv2] pv2 + Matrix91) / m,
   {sf, v1, v2, tf, af, ξ, σF, DiracGamma[Momentum[FFx, D], D],
    DiracGamma[Momentum[x, D], D], DiracGamma[Momentum[FDx, D], D]}, Simplify]
Matrix102 = Expand[Matrix92 / m]
(*Matrix101=Collect[Matrix9/m,{sf,v1,v2,tf,af,ξ,σF, DiracGamma[Momentum[FFx,D],D],
      DiracGamma[Momentum[x,D],D],DiracGamma[Momentum[FDx,D],D]},Simplify]
   Matrix102=0*)
Coeff10 = Coeff9 * m
Phase10 = Phase9
```

$$\mathrm{af}\left(\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^5}{m\,\xi\,(k\cdot x)}+\frac{i\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{m\,\xi\,(k\cdot x)}+\zeta\left(1+\frac{1}{2}\,i\,e\,s\,\sigma\mathrm{F}\right)\right)+$$
$$\mathrm{v1}\left(\zeta\left(-\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^5.(\gamma\cdot x)}{2\,m^2\,\xi\,s\,(k\cdot x)}+\sigma\mathrm{F}\left(\frac{1}{6}\,e\,\xi\,s\,(k\cdot x)-\frac{i\,(D-3)\,e}{2\,m^2\,\xi\,(k\cdot x)}\right)-\frac{1}{2}\,i\,\xi\,(k\cdot x)\right)-\right.$$
$$\left.\frac{i\,e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^5}{2\,m}+\frac{e^2\,s\,\gamma\cdot \mathrm{FFx}}{3\,m}-\frac{\gamma\cdot x}{2\,m\,s}\right)+\mathrm{sf}\left(\zeta\left(\frac{e\,(\gamma\cdot \mathrm{FDx}).\overline{\gamma}^5}{m\,\xi\,(k\cdot x)}+\frac{i\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{m\,\xi\,(k\cdot x)}\right)+\frac{1}{2}\,i\,e\,s\,\sigma\mathrm{F}+1\right)+$$
$$\mathrm{tf}\left(-\frac{4\,e^2\,\zeta\,s\,\gamma\cdot \mathrm{FFx}}{m\,\xi^2\,(k\cdot x)^2}-\frac{2\,e\,s\,\sigma\mathrm{F}}{\xi\,(k\cdot x)}\right)+\mathrm{v2}\left(-\frac{2\,e^2\,s\,\gamma\cdot \mathrm{FFx}}{m\,\xi^2\,(k\cdot x)^2}-\frac{e\,\zeta\,s\,\sigma\mathrm{F}}{\xi\,(k\cdot x)}\right)$$

$$-\frac{i\,e^2\,\gamma\cdot \mathrm{FFx}\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{2\,m^5\,\xi\,s\,(k\cdot x)}-\frac{i\,e\,\zeta\,\sigma\mathrm{F}\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{4\,m^4\,s}$$

$$\frac{i\,2^{-D-2}\,e^{-\frac{1}{2}\,i\,\pi\left(\frac{D}{2}-1\right)}\,\pi^{-\frac{D}{2}-1}\,m\,\Lambda^{4-D}\,s^{-D/2}}{\mathrm{DdInv}(\zeta)}$$

$$-\frac{1}{12}\,m^2\,\xi^2\,s\,(k\cdot x)^2+e\,(a\cdot x)\,(k\cdot X)-p^2\,s-\frac{x^2}{4\,s}$$

```
Matrix101 // StandardForm;
```

```
Matrix10 =
 Collect[Expand[Matrix101 + Matrix102], {e^2 DiracGamma[Momentum[FFx, D], D],
   e DiracGamma[Momentum[FDx, D], D].DiracGamma[5],
   e DiracGamma[Momentum[FDx, D], D].DiracGamma[5].DiracGamma[Momentum[x, D], D],
   σF, DiracGamma[Momentum[x, D], D], sf, v1, v2, tf, af, ξ}]
```

$$e(\gamma\cdot\text{FDx}).\bar{\gamma}^5\left(\frac{\text{af}}{m\,\xi\,(k\cdot x)}+\frac{\zeta\,\text{sf}}{m\,\xi\,(k\cdot x)}-\frac{i\,\text{v1}}{2\,m}\right)-\frac{e\,\zeta\,\text{v1}\,(\gamma\cdot\text{FDx}).\bar{\gamma}^5.(\gamma\cdot x)}{2\,m^2\,\xi\,s\,(k\cdot x)}+$$
$$e^2\,\gamma\cdot\text{FFx}\left(-\frac{i\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{2\,m^5\,\xi\,s\,(k\cdot x)}-\frac{4\,\zeta\,s\,\text{tf}}{m\,\xi^2\,(k\cdot x)^2}-\frac{2\,s\,\text{v2}}{m\,\xi^2\,(k\cdot x)^2}+\frac{i\,\text{af}\,s}{m\,\xi\,(k\cdot x)}+\frac{i\,\zeta\,s\,\text{sf}}{m\,\xi\,(k\cdot x)}+\frac{s\,\text{v1}}{3\,m}\right)+$$
$$\sigma\text{F}\left(-\frac{i\,e\,\zeta\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{4\,m^4\,s}+\frac{1}{2}\,i\,\text{af}\,e\,\zeta\,s+\zeta\,\text{v1}\left(-\frac{i\,D\,e}{2\,m^2\,\xi\,(k\cdot x)}+\frac{3\,i\,e}{2\,m^2\,\xi\,(k\cdot x)}+\frac{1}{6}\,e\,\xi\,s\,(k\cdot x)\right)-\right.$$
$$\left.\frac{2\,e\,s\,\text{tf}}{\xi\,(k\cdot x)}-\frac{e\,\zeta\,s\,\text{v2}}{\xi\,(k\cdot x)}+\frac{1}{2}\,i\,e\,s\,\text{sf}\right)+\text{af}\,\zeta-\frac{1}{2}\,i\,\zeta\,\xi\,\text{v1}\,(k\cdot x)-\frac{\text{v1}\,\gamma\cdot x}{2\,m\,s}+\text{sf}$$

```
Matrix10ReorderPart1 =
  Collect[Coefficient[Matrix10, e^2 DiracGamma[Momentum[FFx, D], D]] *
      m^1 ξ^2 (kx)^2, {sf, v1, v2, tf, af, ξ}, Simplify]
    e^2 DiracGamma[Momentum[FFx, D], D] / (m^1 ξ^2 (kx)^2) +
   Collect[Coefficient[Matrix10, e DiracGamma[Momentum[FDx, D], D].DiracGamma[5]] *
      m ξ (kx), {sf, v1, v2, tf, af, ξ}, Simplify] e
    DiracGamma[Momentum[FDx, D], D].DiracGamma[5] / (m ξ (kx)) +
   Collect[Coefficient[Matrix10, e σF] * 2 m^0 ξ (kx) / ξ,
     {sf, v1, v2, tf, af, ξ}, Simplify] e σF / (2 m^0 ξ (kx) / ξ) +
   Coefficient[Matrix10, e DiracGamma[Momentum[FDx, D], D].
       DiracGamma[5].DiracGamma[Momentum[x, D], D]] e
    DiracGamma[Momentum[FDx, D], D].DiracGamma[5].DiracGamma[Momentum[x, D], D] +
   Coefficient[Matrix10, DiracGamma[Momentum[x, D], D]]
    DiracGamma[Momentum[x, D], D];
Matrix10Reorder = Matrix10ReorderPart1 + Expand[Matrix10 - Matrix10ReorderPart1] /.
  {1 / ξ → ξ}
Coeff10
Phase10
```

$$\frac{e\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^{5}\left(\mathrm{af}-\frac{1}{2}\,i\,\xi\,\mathrm{v1}\,(k\cdot x)+\zeta\,\mathrm{sf}\right)}{m\,\xi\,(k\cdot x)}-\frac{e\,\zeta\,\mathrm{v1}\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^{5}.(\gamma\cdot x)}{2\,m^{2}\,\xi\,s\,(k\cdot x)}+\frac{1}{2\,\xi\,(k\cdot x)}\,e\,\zeta\,\sigma\mathrm{F}\left(-\frac{i\,\xi\,(k\cdot x)\,f^{(0,0,1)}\!\left(\zeta,\,p^{2},\,\frac{\xi\,(k\cdot x)}{2\,m^{2}\,s}\right)}{2\,m^{4}\,s}+\frac{\mathrm{v1}\left(m^{2}\,\xi^{2}\,s\,(k\cdot x)^{2}-3\,i\,D+9\,i\right)}{3\,m^{2}}+i\,\mathrm{af}\,\xi\,s\,(k\cdot x)+i\,\zeta\,\xi\,s\,\mathrm{sf}\,(k\cdot x)-4\,\zeta\,s\,\mathrm{tf}-2\,s\,\mathrm{v2}\right)+\frac{1}{m\,\xi^{2}\,(k\cdot x)^{2}}\,e^{2}\,\gamma\cdot\mathrm{FFx}\left(-\frac{i\,\xi\,(k\cdot x)\,f^{(0,0,1)}\!\left(\zeta,\,p^{2},\,\frac{\xi\,(k\cdot x)}{2\,m^{2}\,s}\right)}{2\,m^{4}\,s}+\frac{1}{3}\,\xi^{2}\,s\,\mathrm{v1}\,(k\cdot x)^{2}+i\,\mathrm{af}\,\xi\,s\,(k\cdot x)+i\,\zeta\,\xi\,s\,\mathrm{sf}\,(k\cdot x)-4\,\zeta\,s\,\mathrm{tf}-2\,s\,\mathrm{v2}\right)+\mathrm{af}\,\zeta-\frac{1}{2}\,i\,\zeta\,\xi\,\mathrm{v1}\,(k\cdot x)-\frac{\mathrm{v1}\,\gamma\cdot x}{2\,m\,s}+\mathrm{sf}$$

$$\frac{i\,2^{-D-2}\,e^{-\frac{1}{2}\,i\,\pi\left(\frac{D}{2}-1\right)}\,\pi^{-\frac{D}{2}-1}\,m\,\Lambda^{4-D}\,s^{-D/2}}{\mathrm{DdInv}(\zeta)}$$

$$-\frac{1}{12}\,m^{2}\,\xi^{2}\,s\,(k\cdot x)^{2}+e\,(a\cdot x)\,(k\cdot X)-p^{2}\,s-\frac{x^{2}}{4\,s}$$

Matrix10 without removing p^2 with integration by parts

```
sf + af ξ - (v1 DiracGamma[Momentum[x, D], D])/(2 m s) - (e v1 ξ
    DiracGamma[Momentum[FDx, D], D].DiracGamma[5].DiracGamma[Momentum[x, D], D]) /
   (2 m^2 s ξ Pair[Momentum[k, D], Momentum[x, D]]) - 1/2 ⅈ v1 ξ ξ
  Pair[Momentum[k, D], Momentum[x, D]] +
  (e DiracGamma[Momentum[FDx, D], D].DiracGamma[5]
     (af + sf ξ - 1/2 ⅈ v1 ξ Pair[Momentum[k, D], Momentum[x, D]])) /
   (m ξ Pair[Momentum[k, D], Momentum[x, D]]) +
  (e ξ σF (-2 s v2 - 4 s tf ξ + ⅈ af s ξ Pair[Momentum[k, D], Momentum[x, D]] +
        ⅈ s sf ξ ξ Pair[Momentum[k, D], Momentum[x, D]] + 1/(4 m^2 s) v1 (8 ⅈ s - 2 ⅈ D s +
           m^2 s^2 ξ^2 Pair[Momentum[k, D], Momentum[x, D]]^2 - 4 s^2 Pair[Momentum[p, D],
              Momentum[p, D]] + Pair[Momentum[x, D], Momentum[x, D]]))) /
   (2 ξ Pair[Momentum[k, D], Momentum[x, D]]) + (e^2 DiracGamma[Momentum[FFx, D], D]
     (-2 s v2 - 4 s tf ξ + ⅈ af s ξ Pair[Momentum[k, D], Momentum[x, D]] +
       ⅈ s sf ξ ξ Pair[Momentum[k, D], Momentum[x, D]] +
       1/(4 m^2 s) v1 (-4 ⅈ s + 2 ⅈ D s + m^2 s^2 ξ^2 Pair[Momentum[k, D], Momentum[x, D]]^2 -
          4 s^2 Pair[Momentum[p, D], Momentum[p, D]] + Pair[Momentum[x, D],
             Momentum[x, D]]))) / (m ξ^2 Pair[Momentum[k, D], Momentum[x, D]]^2)
```

$$\frac{e\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5\left(\mathrm{af}-\frac{1}{2}\,i\,\xi\,\mathrm{v1}\,(k\cdot x)+\zeta\,\mathrm{sf}\right)}{m\,\xi\,(k\cdot x)}-\frac{e\,\zeta\,\mathrm{v1}\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5.(\gamma\cdot x)}{2\,m^2\,\xi\,s\,(k\cdot x)}+\frac{1}{m\,\xi^2\,(k\cdot x)^2}\,e^2\,\gamma\cdot\mathrm{FFx}\left(\frac{\mathrm{v1}\left(m^2\,\xi^2\,s^2\,(k\cdot x)^2+2\,i\,D\,s-4\,p^2\,s^2-4\,i\,s+x^2\right)}{4\,m^2\,s}+i\,\mathrm{af}\,\xi\,s\,(k\cdot x)+i\,\zeta\,\xi\,s\,\mathrm{sf}\,(k\cdot x)-4\,\zeta\,s\,\mathrm{tf}-2\,s\,\mathrm{v2}\right)+\frac{1}{2\,\xi\,(k\cdot x)}\,e\,\zeta\,\sigma\mathrm{F}\left(\frac{\mathrm{v1}\left(m^2\,\xi^2\,s^2\,(k\cdot x)^2-2\,i\,D\,s-4\,p^2\,s^2+8\,i\,s+x^2\right)}{4\,m^2\,s}+i\,\mathrm{af}\,\xi\,s\,(k\cdot x)+i\,\zeta\,\xi\,s\,\mathrm{sf}\,(k\cdot x)-4\,\zeta\,s\,\mathrm{tf}-2\,s\,\mathrm{v2}\right)+\mathrm{af}\,\zeta-\frac{1}{2}\,i\,\zeta\,\xi\,\mathrm{v1}\,(k\cdot x)-\frac{\mathrm{v1}\,\gamma\cdot x}{2\,m\,s}+\mathrm{sf}$$

```
(*a small test*)
Expand[((Matrix101 /. {sf → 1, v1 → -1, v2 → 0, tf → 0, af → 0, ξ → 1}) +
    (Matrix101 /. {sf → 1, v1 → -1, v2 → 0, tf → 0, af → 0, ξ → -1})) / 2]
```

$$\frac{i\,e\,(\gamma\cdot\mathrm{FDx}).\overline{\gamma}^5}{2\,m}-\frac{e^2\,s\,\gamma\cdot\mathrm{FFx}}{3\,m}+\frac{1}{2}\,i\,e\,s\,\sigma\mathrm{F}+\frac{\gamma\cdot x}{2\,m\,s}+1$$

```
Matrix111 = Collect[
  DiracOrder[DiracSimplify[Expand[Matrix101] /. FxToEps /. FxToak /.
      Gamma5toTrippleGammax /. {av2 → -ξ^2 m^2 / e^2}]],
  {sf, v1, v2, tf, af, ξ}, Simplify]
Matrix112 = Expand[Matrix102 /. FxToEps /. FxToak /. Gamma5toTrippleGammax]
Coeff10
Phase10
```

$$\mathrm{v1}\left(\frac{1}{6\,m\,s}\left(s\left(\gamma\cdot k\left(2\,m^2\,\xi^2\,s\,(k\cdot x)-3\,e\,(a\cdot x)\right)+3\,e\gamma\cdot a\,(k\cdot x)-3\,e\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot x)\right)-3\,\gamma\cdot x\right)-\left(i\,\zeta\left(e\,(\gamma\cdot a).(\gamma\cdot k)\left(2\,m^2\,\xi^2\,s^2\,(k\cdot x)^2-6\,i\,(D-3)\,s-3\,x^2\right)+3\,(k\cdot x)\left(e\,(\gamma\cdot a).(\gamma\cdot x)+m^2\,\xi^2\,s\,(k\cdot x)\right)-3\,e\,(a\cdot x)\,(\gamma\cdot k).(\gamma\cdot x)\right)\right)\Big/\left(6\,m^2\,\xi\,s\,(k\cdot x)\right)\right)+$$

$$\mathrm{af}\left(\zeta\,(e\,s\,(\gamma\cdot a).(\gamma\cdot k)+1)+\frac{1}{m\,\xi\,(k\cdot x)}\,i\left(\gamma\cdot k\left(m^2\,\xi^2\,s\,(k\cdot x)-e\,(a\cdot x)\right)+e\,\gamma\cdot a\,(k\cdot x)-e\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot x)\right)\right)+$$

$$\mathrm{sf}\left(\frac{1}{m\,\xi\,(k\cdot x)}\,i\,\zeta\left(\gamma\cdot k\left(m^2\,\xi^2\,s\,(k\cdot x)-e\,(a\cdot x)\right)+e\,\gamma\cdot a\,(k\cdot x)-e\,(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot x)\right)+e\,s\,(\gamma\cdot a).(\gamma\cdot k)+1\right)+$$

$$\mathrm{tf}\left(-\frac{4\,\zeta\,m\,s\,\gamma\cdot k}{k\cdot x}+\frac{4\,i\,e\,s\,(\gamma\cdot a).(\gamma\cdot k)}{\xi\,(k\cdot x)}\right)+$$

$$\mathrm{v2}\left(-\frac{2\,m\,s\,\gamma\cdot k}{k\cdot x}+\frac{2\,i\,e\,\zeta\,s\,(\gamma\cdot a).(\gamma\cdot k)}{\xi\,(k\cdot x)}\right)$$

$$-\frac{e\,\zeta\,(\gamma\cdot a).(\gamma\cdot k)\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{2\,m^4\,s}+\frac{i\,a^2\,e^2\,\gamma\cdot k\,f^{(0,0,1)}\left(\zeta,\,p^2,\,\frac{\xi\,(k\cdot x)}{2\,m^2\,s}\right)}{2\,m^5\,\xi\,s}$$

$$\frac{i\,2^{-D-2}\,e^{-\frac{1}{2}i\pi\left(\frac{D}{2}-1\right)}\,\pi^{-\frac{D}{2}-1}\,m\,\Lambda^{4-D}\,s^{-D/2}}{\mathrm{DdInv}(\zeta)}$$

$$-\frac{1}{12}\,m^2\,\xi^2\,s\,(k\cdot x)^2+e\,(a\cdot x)\,(k\cdot X)-p^2\,s-\frac{x^2}{4\,s}$$

```
Collect[Expand[Matrix111],
 {
  DiracGamma[Momentum[x, D], D],
  DiracGamma[Momentum[k, D], D],
  DiracGamma[Momentum[a, D], D],
  DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[k, D], D] ,
  DiracGamma[Momentum[a, D], D].DiracGamma[Momentum[x, D], D] ,
  DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[x, D], D] ,
  DiracGamma[Momentum[a, D], D].
   DiracGamma[Momentum[k, D], D].DiracGamma[Momentum[x, D], D],
  sf, v1, v2, tf, af, ζ}]
```

$$(\gamma\cdot a).(\gamma\cdot k)\left(\mathrm{af}\,e\,\zeta\,s+\zeta\,\mathrm{v1}\left(-\frac{D\,e}{m^2\,\xi\,(k\cdot x)}+\frac{i\,e\,x^2}{2\,m^2\,\xi\,s\,(k\cdot x)}+\frac{3\,e}{m^2\,\xi\,(k\cdot x)}-\frac{1}{3}\,i\,e\,\xi\,s\,(k\cdot x)\right)+\frac{4\,i\,e\,s\,\mathrm{tf}}{\xi\,(k\cdot x)}+\frac{2\,i\,e\,\zeta\,s\,\mathrm{v2}}{\xi\,(k\cdot x)}+e\,s\,\mathrm{sf}\right)+$$
$$\gamma\cdot k\left(\mathrm{af}\left(i\,m\,\xi\,s-\frac{i\,e\,(a\cdot x)}{m\,\xi\,(k\cdot x)}\right)+\zeta\,\mathrm{sf}\left(i\,m\,\xi\,s-\frac{i\,e\,(a\cdot x)}{m\,\xi\,(k\cdot x)}\right)+\mathrm{v1}\left(\frac{1}{3}\,m\,\xi^2\,s\,(k\cdot x)-\frac{e\,(a\cdot x)}{2\,m}\right)-\right.$$
$$\left.\frac{4\,\zeta\,m\,s\,\mathrm{tf}}{k\cdot x}-\frac{2\,m\,s\,\mathrm{v2}}{k\cdot x}\right)+(\gamma\cdot a).(\gamma\cdot k).(\gamma\cdot x)\left(-\frac{i\,\mathrm{af}\,e}{m\,\xi\,(k\cdot x)}-\frac{i\,e\,\zeta\,\mathrm{sf}}{m\,\xi\,(k\cdot x)}-\frac{e\,\mathrm{v1}}{2\,m}\right)+$$
$$\gamma\cdot a\left(\frac{i\,\mathrm{af}\,e}{m\,\xi}+\frac{e\,\mathrm{v1}\,(k\cdot x)}{2\,m}+\frac{i\,e\,\zeta\,\mathrm{sf}}{m\,\xi}\right)+\frac{i\,e\,\zeta\,\mathrm{v1}\,(a\cdot x)\,(\gamma\cdot k).(\gamma\cdot x)}{2\,m^2\,\xi\,s\,(k\cdot x)}-\frac{i\,e\,\zeta\,\mathrm{v1}\,(\gamma\cdot a).(\gamma\cdot x)}{2\,m^2\,\xi\,s}+$$
$$\mathrm{af}\,\zeta-\frac{1}{2}\,i\,\zeta\,\xi\,\mathrm{v1}\,(k\cdot x)-\frac{\mathrm{v1}\,\gamma\cdot x}{2\,m\,s}+\mathrm{sf}$$

Final result for the electron propagator in a CCF

$$S^c(x_2,x_1)=\Lambda^{4-D}\int\frac{d^Dp}{(2\pi)^D}\,E_p(x_2)$$
$$\sum_{\zeta=+-}\frac{i}{2}\Big[m\,s\left(p^2,\chi_p\right)-(\gamma p)\,v_1\left(p^2,\chi_p\right)-\frac{e^2\left(\gamma F^2\,p\right)}{m^4}\,v_2\left(p^2,\chi_p\right)-$$
$$\frac{e\,\sigma F}{m}\,t\left(p^2,\chi_p\right)+\frac{e\,(\gamma F^*\,p)\,\gamma^5}{m^2}\,a_s\left(p^2,\chi_p\right)\Big]\frac{1+\zeta\,\gamma\epsilon^{(2)}\,\gamma^5}{D_\zeta\left(p^2,\chi_p\right)}\,E_p^{\mathrm{bar}}(x_1)=$$
$$=e^{-i\,\frac{\pi}{2}\left(\frac{D}{2}-2\right)}\,\frac{m\,\Lambda^{4-D}}{2^{D+2}\,\pi^{D/2+1}}\,e^{i\,\eta}\sum_{\zeta=+-}\int_0^\infty\frac{ds}{s^{D/2}}\left(\int_0^\infty\frac{dp^2}{D_\zeta\left(p^2,\chi_p(s)\right)}\,e^{-i\,s\,p^2-i\,\frac{x^2}{4\,s}+i\,\frac{s}{12}\,e^2\,(Fx)^2}\times\right.$$
$$\Big\{s\left(p^2,\chi_p(s)\right)\Big[$$
$$1+\frac{1}{2}\,i\,s\,e\,\sigma F+\zeta\left(\frac{i\,e^2\,s\,(\gamma\,FFx)}{m\,\xi\,(kx)}+\frac{e\,F_{\alpha\beta}{}^*\,x^\beta\,\gamma^\alpha\,\gamma^5}{m\,\xi\,(kx)}\right)\Big]$$
$$+v_1\left(p^2,\chi_p(s)\right)\Big[-\frac{(\gamma x)}{2\,m\,s}+\frac{e^2\,s\,(\gamma\,FFx)}{3\,m}-\frac{i\,e\,F_{\alpha\beta}{}^*\,x^\beta\,\gamma^\alpha\,\gamma^5}{2\,m}$$

$$+\zeta\left(-\frac{1}{2}\,i\,\xi\,(kx)-\frac{e\,\sigma F}{2\,m^2\,\xi\,(kx)}\right.$$

$$\left.\left(i\,(D-3)-\frac{1}{3}\,m^2\,s\,\xi^2\,(kx)^2\right)-\frac{e\,(\gamma F^*\,x)\,\gamma^5\,(\gamma x)}{2\,m^2\,\xi\,s\,(kx)}\right)\Big]$$

$$+v_2\left(p^2,\chi_p\,(s)\right)\Big[-\frac{2\,s\,e^2\,(\gamma\,FFx)}{m\,\xi^2\,(kx)^2}-\zeta\,\frac{s\,e\,\sigma F}{\xi\,(kx)}\Big]$$

$$+t\left(p^2,\chi_p\,(s)\right)\Big[-\frac{2\,s\,e\,\sigma F}{\xi\,(kx)}-\zeta\,\frac{4\,s\,e^2\,(\gamma\,FFx)}{m\,\xi^2\,(kx)^2}\Big]$$

$$+a\left(p^2,\chi_p\,(s)\right)\Big[$$

$$\frac{e\,F_{\alpha\beta}{}^*\,x^\beta\,\gamma^\alpha\,\gamma^5}{m\,\xi\,(kx)}+\frac{i\,s\,e^2\,(\gamma\,FFx)}{m\,\xi\,(kx)}+\zeta\left(1+\frac{1}{2}\,i\,s\,e\,\sigma F\right)\Big]\Big\}$$

$$+\int_0^\infty dp^2\,\frac{\partial}{\partial\chi_p}\left(\frac{v_1\left(p^2,\chi_p\right)}{D_\zeta\left(p^2,\chi_p\right)}\right)e^{-isp^2-i\,\frac{x^2}{4\,s}+i\,\frac{s}{12}\,e^2\,(Fx)^2}\Big[-\frac{i\,e^2\,(\gamma\,FFx)}{2\,m^5\,s\,\xi\,(kx)}-\zeta\,\frac{i\,e\,\sigma F}{4\,m^4\,s}\Big]\Bigg)$$

$$=e^{-i\,\frac{\pi}{2}\left(\frac{D}{2}-2\right)}\,\frac{m\,\Lambda^{4-D}}{2^{D+2}\,\pi^{D/2+1}}\,e^{i\,\eta}\sum_{\zeta=+-}\int_0^\infty\frac{ds}{s^{D/2}}\int_0^\infty\frac{dp^2}{D_\zeta\left(p^2,\chi_p\,(s)\right)}\,e^{-isp^2-i\,\frac{x^2}{4\,s}+i\,\frac{s}{12}\,e^2\,(Fx)^2}\,\Big\{$$

$$s\,(p)+\zeta\Big[a\,(p)-\frac{i}{2}\,\xi\,(kx)\,v_1\,(p)\Big]$$

$$-\frac{(\gamma x)}{2\,m\,s}\,v_1\,(p)$$

$$+\frac{e^2\,\left(\gamma F^2\,x\right)}{m\,\xi^2\,(kx)^2}\Big[i\,\zeta\,\xi\,s\,s\,(p)+\left(\frac{1}{4}\,\xi^2\,s\,(kx)^2-s\,\frac{p^2}{m^2}+\frac{x^2}{4\,m^2\,s}+\frac{i\,(D-2)}{2\,m^2}\right)$$

$$v_1\,(p)-2\,s\,v_2\,(p)-4\,\zeta\,s\,t\,(p)+i\,\xi\,s\,(kx)\,a\,(p)\Big]$$

$$+\zeta\,\frac{e\,\sigma F}{\xi\,(kx)}\Big[i\,\zeta\,\xi\,s\,s\,(p)+\left(\frac{1}{4}\,\xi^2\,s\,(kx)^2-s\,\frac{p^2}{m^2}+\frac{x^2}{4\,m^2\,s}-\frac{i\,(D-4)}{2\,m^2}\right)$$

$$v_1\,(p)-2\,s\,v_2\,(p)-4\,\zeta\,s\,t\,(p)+i\,\xi\,s\,(kx)\,a\,(p)\Big]$$

$$+\frac{e\,(\gamma F^*\,x)\,\gamma^5}{m\,\xi\,(kx)}\Big[\zeta\,s\,(p)-\frac{i}{2}\,\xi\,(kx)\,v_1\,(p)+a\,(p)\Big]$$

$$-\zeta\,\frac{e\,(\gamma F^*\,x)\,\gamma^5\,(\gamma x)}{2\,m^2\,s\,\xi\,(kx)}\,v_1\,(p)\Big\}$$

$$=e^{-i\,\frac{\pi}{2}\left(\frac{D}{2}-2\right)}\,\frac{m\,\Lambda^{4-D}}{2^{D+2}\,\pi^{D/2+1}}\,e^{i\,\eta}\sum_{\zeta=+-}\int_0^\infty\frac{ds}{s^{D/2}}\int_0^\infty\frac{dp^2}{D_\zeta\left(p^2,\chi_p\,(s)\right)}\,e^{-isp^2-i\,\frac{x^2}{4\,s}+i\,\frac{s}{12}\,e^2\,(Fx)^2}\,\Big\{$$

$$s\,(p)+\zeta\Big[a\,(p)-\frac{i}{2}\,\xi\,(kx)\,v_1\,(p)\Big]$$

$$-\frac{(\gamma x)}{2\,m\,s}\,v_1\,(p)$$

$$+\frac{e^2\,\left(\gamma F^2\,x\right)}{m^3\,\xi^2\,(kx)^2}$$

$$m^2\Big[\mathbb{i}\,\zeta\,\xi\,(kx)\,s\,s\,(p)+\frac{1}{3}\,s\,\xi^2\,(kx)^2\,v_1\,(p)-2\,s\,v_2\,(p)-4\,\zeta\,s\,t\,(p)+$$

$$\mathbb{i}\,\xi\,s\,(kx)\,a\,(p)-\frac{\mathbb{i}\,\xi\,(kx)}{2\,m^4\,s}\,D_\zeta\left(p^2,\,\chi_p\,(s)\right)\,\frac{\partial}{\partial\chi_p}\left(\frac{v_1\left(p^2,\,\chi_p\right)}{D_\zeta\left(p^2,\,\chi_p\right)}\right)\Big]$$

$$+\,\zeta\,\frac{e\,\sigma F}{m^2\,\xi\,(kx)}\,m^2\Big[\mathbb{i}\,\zeta\,\xi\,(kx)\,s\,s\,(p)+\left(\frac{1}{3}\,s\,\xi^2\,(kx)^2-\frac{\mathbb{i}\,(D-3)}{m^2}\right)$$

$$v_1\,(p)-2\,s\,v_2\,(p)-4\,\zeta\,s\,t\,(p)+\mathbb{i}\,\xi\,s\,(kx)\,a\,(p)-$$

$$\frac{\mathbb{i}\,\xi\,(kx)}{2\,m^4\,s}\,D_\zeta\left(p^2,\,\chi_p\,(s)\right)\,\frac{\partial}{\partial\chi_p}\left(\frac{v_1\left(p^2,\,\chi_p\right)}{D_\zeta\left(p^2,\,\chi_p\right)}\right)\Big]$$

$$+\,\frac{e\,(\gamma F^*\,x)\,\gamma^5}{m\,\xi\,(kx)}\Big[\zeta\,s\,(p)-\frac{\mathbb{i}}{2}\,\xi\,(kx)\,v_1\,(p)+a\,(p)\Big]$$

$$-\,\zeta\,\frac{e\,(\gamma F^*\,x)\,\gamma^5\,(\gamma x)}{2\,m^2\,s\,\xi\,(kx)}\,v_1\,(p)\Big\}$$

$$=\mathbb{e}^{-\mathbb{i}\,\frac{\pi}{2}\left(\frac{D}{2}-1\right)}\,\frac{\Lambda^{4-D}}{2^D\,\pi^{D/2}}\,m^{D-1}\,\mathbb{e}^{\mathbb{i}\,\eta}$$

$$\int_0^\infty\frac{\mathbb{d}s}{s^{D/2}}\Big[1+\frac{m\,(\gamma x)}{2\,s}+\frac{e\,(\gamma a)\,(kx)}{2\,m}-\frac{e\,(\gamma k)\,(ax)}{2\,m}+\frac{e\,(\gamma x)\,(\gamma a)\,(\gamma k)}{2\,m}+$$

$$\frac{e\,s\,(\gamma a)\,(\gamma k)}{m^2}+\frac{e^2\,a^2\,s\,(\gamma k)\,(kx)}{3\,m^3}\Big]\,\mathbb{e}^{-\mathbb{i}s-\mathbb{i}\,\frac{m^2\,x^2}{4\,s}+\mathbb{i}\,\frac{s}{12}\,\frac{e^2}{m^2}\,(Fx)^2}=$$

$$=\mathbb{e}^{-\mathbb{i}\,\frac{\pi}{2}\left(\frac{D}{2}-1\right)}\,\frac{\Lambda^{4-D}}{2^{D+1}\,\pi^{D/2}}\,m^D\,\mathbb{e}^{\mathbb{i}\,\eta}\int_0^\infty\frac{\mathbb{d}s}{s^{D/2+1}}\Big[\frac{2\,s}{m}+\gamma^\alpha\left(g_{\alpha\beta}-\frac{es}{m^2}\,F_{\alpha\beta}+\frac{e^2\,s^2}{3\,m^4}\,F_{\alpha\lambda}\,F^\lambda{}_\beta\right)\,x^\beta\Big]$$

$$\left(1+\frac{\mathbb{i}es}{2}\,\sigma^{\alpha\beta}\,F_{\alpha\beta}\right)\,\mathbb{e}^{-\mathbb{i}s-\mathbb{i}\,\frac{m^2\,x^2}{4\,s}+\mathbb{i}\,\frac{s}{12}\,\frac{e^2}{m^2}\,(Fx)^2}$$

$\eta=e\,(ax)\,(k,\,(x_1+x_2)/2)$,

$x=x_2-x_1$,

$e>0$,

$\sigma^{\alpha\beta}=\frac{\mathbb{i}}{2}\left(\gamma^\alpha\,\gamma^\beta-\gamma^\beta\,\gamma^\alpha\right)$,

$\gamma^5=i\gamma^0\,\gamma^1\,\gamma^2\,\gamma^3$,

$$\mathbb{e}^{-\mathbb{i}\,\frac{\pi}{2}\left(\frac{D}{2}-1\right)}\,\frac{\Lambda^{4-D}}{2^D\,\pi^{D/2}}\,m^{D-1}\to\frac{(-\mathbb{i})\,m^3}{16\,\pi^2},\quad D\to 4$$