How does torsion affect light propagation?

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- The distance duality relation

$$D_L = (1+z)^2 \, D_A,$$

  is based on

$$p'^{\alpha} \frac{D^2 p_{\alpha}}{Dv^2} - p^{\alpha} \frac{D^2 p'_{\alpha}}{Dv^2} = 0.$$

- In presence of torsion the geodesic deviation equation takes the form

$$\frac{D^2 p^{\alpha}}{Dv^2} = G^{\alpha}{}_{\beta\gamma\rho} k^{\beta} k^{\gamma} p^{\rho} - k^{\beta} \frac{D}{Dv} \left(S^{\alpha}{}_{\beta\gamma} p^{\gamma} \right).$$

- Generalised distance duality relation

$$D_L = (1+z)^2 D_A \left(1 + \xi(S)\right).$$