Photon polarization and Wigner's little group

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abstract To discuss one-photon polarization states we find an explicit form of the Wigner's little group element in the massless case for arbitrary Lorentz transformation. As is well known, when analyzing the transformation properties of the physical states, only the value of the phase factor is relevant. We show that this phase factor depends only on the direction of the momentum $\vec{k}/|\vec{k}|$ and does not depend on the frequency $k^0$. Finally, we use this observation to discuss the transformation properties of the linearly polarized photons and the corresponding reduced density matrix. We find that they transform properly under Lorentz group.