Calculation of the lepton bremsstrahlung

https://github.com/gramolin/esepp/

The FeynCalc package:

In[1]:= `<< HighEnergyPhysics`FeynCalc``

The squares of the four-momenta:

In[2]:= `ScalarProduct[l, l] = m`^{2}`;`
`ScalarProduct[p, p] = M`^{2}`;`
`ScalarProduct[l', l'] = m`^{2}`;`
`ScalarProduct[p', p'] = M`^{2}`;`
`ScalarProduct[k, k] = 0;`

The lepton tensor:

In[7]:= L_1 = $\frac{1}{2}$ `Tr`$\left[\right.$`(GS[l'] + m).GA[`α`].`$\frac{\text{GS[l' + k] + m}}{2\,\text{ScalarProduct[k, l']}}$`.GA[`$\mu$`].(GS[l] + m).GA[`$\alpha$`].`$\frac{\text{GS[l - k] + m}}{2\,\text{ScalarProduct[k, l]}}$`.GA[`$\nu$`]`$\left.\right]$`;`

In[8]:= L_2 = $-\frac{1}{2}$ `Tr`$\left[\right.$`(GS[l'] + m).GA[`α`].`$\frac{\text{GS[l' + k] + m}}{2\,\text{ScalarProduct[k, l']}}$`.GA[`$\mu$`].(GS[l] + m).GA[`$\nu$`].`$\frac{\text{GS[l' + k] + m}}{2\,\text{ScalarProduct[k, l']}}$`.GA[`$\alpha$`]`$\left.\right]$`;`

In[9]:= L_3 = L_1 /. {l → -l', l' → -l};

In[10]:= L_4 = L_2 /. {l → -l', l' → -l};

The proton tensor:

In[11]:= `P` = $\frac{1}{2}$ `Tr`$\left[\right.$`(GS[p] + M).`$\left(\right.$`(F11 + F21) GA[`ν`] - `$\frac{\text{F21}}{2\,\text{M}}$` FourVector[p + p', `$\nu$`]`$\left.\right)$`.(GS[p'] + M).`$\left(\right.$`(F11 + F21) GA[`$\mu$`] - `$\frac{\text{F21}}{2\,\text{M}}$` FourVector[p + p', `$\mu$`]`$\left.\right)\left.\right]$`;`

Contraction of the lepton and proton tensors:

In[12]:= `Output = FullSimplify[Contract[`L_1` P] + Contract[`L_2` P] + Contract[`L_3` P] + Contract[`L_4` P]];`

Convenient notations for the products of the four-momenta:

```
In[13]:= ScalarProduct[k, l] = kfli;
         ScalarProduct[k, l'] = kflf;
         ScalarProduct[k, p] = kfpi;
         ScalarProduct[k, p'] = kfpf;
         ScalarProduct[l, l'] = lilf;
         ScalarProduct[l, p] = lipi;
         ScalarProduct[l, p'] = lipf;
         ScalarProduct[p, p'] = pipf;
         ScalarProduct[l', p] = lfpi;
         ScalarProduct[l', p'] = lfpf;
```

Output to the text file:

```
In[23]:= CForm[Output] >> "cform_lepton.txt";
```