The Propagation of Light

All calculations below belong to the book:

Rising of the James Webb Space Telescope
and its Fundamental Blindness:

All Calculations for Gravitational Intensity Shift
and Gravitational RedShift can be downloaded from the

Download Site: ***https://quantumlight.science/***

{ev} symbol for Electric Field Intensity Vector

{mv} symbol for Magnetic Field Intensity Vector

Run program by : Edit / Select All / Shift + Return

Example 1

(Propagation in the z direction of a Laser – Beam with the speed of light: $c = \frac{1}{\sqrt{\epsilon 0\, \mu 0}}$)

Book : ***Rising of the James Webb Space Telescope***
and its Fundamental Blindness

Page 15, Equation (19)

$$-\frac{1}{c^2}\frac{\partial(\bar{\bar{E}}\times\bar{H})}{\partial t}+\varepsilon_0\,\bar{E}\,(\nabla.\bar{E})-\varepsilon_0\,\bar{E}\times(\nabla\times\bar{E})+\mu_0\,\bar{H}\,(\nabla.\bar{H})-\mu_0\,\bar{H}\times(\nabla\times\bar{H})=0 \qquad (19)$$

Example of a LASER –

BEAM with a Gaussian Intensity divison $e^{-K2\sqrt{x^2+y^2}}$,
combined with an arbitrary division g[x, y] in the (x, y) plane,

propagating in the z – direction with the speed of light $c = \frac{1}{\sqrt{\epsilon 0\, \mu 0}}$.

In[ ]:=

In[ ]:=
```
Needs["DifferentialEquations`NDSolveUtilities`"]
```

```
In[∘]:= Needs["DifferentialEquations`InterpolatingFunctionAnatomy`"]

In[∘]:= ϵ0 =.

In[∘]:= μ0 =.

In[∘]:= x =.

In[∘]:= y =.

In[∘]:= z =.

In[∘]:= t =.

In[∘]:= Get["VectorAnalysis`"]

General: VectorAnalysis` is now obsolete. The legacy version being loaded may conflict with
current functionality. See the Compatibility Guide for updating information.

In[∘]:= InverseFunctions → True

Out[∘]= InverseFunctions → True

In[∘]:= Needs["DifferentialEquations`NDSolveProblems`"]

In[∘]:= Needs["DifferentialEquations`NDSolveUtilities`"]

In[∘]:= Needs["DifferentialEquations`InterpolatingFunctionAnatomy`"]

In[∘]:= SetCoordinates[Cartesian[x, y, z]]

Out[∘]= Cartesian[x, y, z]

In[∘]:= {Coordinates[Cartesian], CoordinateRanges[Cartesian]}

Out[∘]= {{x, y, z}, {-∞ < x < ∞, -∞ < y < ∞, -∞ < z < ∞}}

In[∘]:= K2 = .
```

In[∘]:= $f[x, y] = g[x, y]\, e^{-K2 \sqrt{x^2+y^2}}$

Out[∘]= $e^{-K2 \sqrt{x^2+y^2}}\, g[x, y]$

In[∘]:= `ev = {f[x, y] * g[t - (K1 / z + 1) * z * Sqrt[ϵ0] * Sqrt[μ0]] , 0, 0}`

Out[∘]= $\left\{e^{-K2 \sqrt{x^2+y^2}}\, g\left[t - \left(1 + \frac{K1}{z}\right) z \sqrt{\epsilon 0}\, \sqrt{\mu 0}\right] \times g[x, y], 0, 0\right\}$

In[∘]:= `mv = (1 / Sqrt[μ0]) * Sqrt[ϵ0] *`
`{0, f[x, y] * g[t - (K1 / z + 1) * z * Sqrt[ϵ0] * Sqrt[μ0]], 0}`

Out[∘]= $\left\{0, \frac{e^{-K2 \sqrt{x^2+y^2}} \sqrt{\epsilon 0}\, g\left[t - \left(1 + \frac{K1}{z}\right) z \sqrt{\epsilon 0}\, \sqrt{\mu 0}\right] \times g[x, y]}{\sqrt{\mu 0}}, 0\right\}$

Book : *Rising of the James Webb Space Telescope and its Fundamental Blindness* :

Page 15, Equation (19)

Example of a LASER –
BEAM with a Gaussian Intensity divison $e^{-K2\sqrt{x^2+y^2}}$,
combined with an arbitrary division g[x, y] in the (x, y) plane ,
propagating in the z –
direction with the speed of light $c = \frac{1}{\sqrt{\epsilon 0\,\mu 0}}$.

The input for the Electric Field Intensity {E (x, y, z,) = ev } and the Magnetic Field Intensity {H (x, y, z,) = mv} has been substituted in the Field Equation for the Electromagnetic Field (Book Equation 19, page 16).

$$-\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}+\varepsilon_0\,\bar{E}\,(\nabla.\bar{E})-\varepsilon_0\,\bar{E}\times(\nabla\times\bar{E})+\mu_0\,\bar{H}\,(\nabla.\bar{H})-\mu_0\,\bar{H}\times(\nabla\times\bar{H})=0$$

Equation (19)

Which can be written as :

$$\text{term1} = -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}$$

$$\text{term 2} = \varepsilon_0\,\bar{E}\,(\nabla.\bar{E})$$

$$\text{term3} = -\varepsilon_0\,\bar{E}\times(\nabla\times\bar{E})$$

$$\text{term4} = \mu_0\,\bar{H}\,(\nabla.\bar{H})$$

$$\text{term5} = -\mu_0\,\bar{H}\times(\nabla\times\bar{H})$$

Equation (19) equals:

$$\text{term1} + \text{term2} + \text{term3} + \text{term4} + \text{term5} = 0$$

In[ ]:=
```
Div[ev]
```

Out[ ]= $$-\frac{e^{-K2\sqrt{x^2+y^2}}\ K2\ x\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]}{\sqrt{x^2+y^2}}+ e^{-K2\sqrt{x^2+y^2}}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g^{(1,0)}[x,y]$$

In[ ]:= **Div[mv]**

Out[ ]= $$-\frac{e^{-K2\sqrt{x^2+y^2}}\ K2\ y\sqrt{\epsilon 0}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]}{\sqrt{x^2+y^2}\sqrt{\mu 0}}+\frac{e^{-K2\sqrt{x^2+y^2}}\sqrt{\epsilon 0}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g^{(0,1)}[x,y]}{\sqrt{\mu 0}}$$

In[ ]:= **FullSimplify[%]**

Out[ ]= $$\frac{e^{-K2\sqrt{x^2+y^2}}\sqrt{\epsilon 0}\ g\left[t-(K1+z)\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\left(-K2\ y\ g[x,y]+\sqrt{x^2+y^2}\ g^{(0,1)}[x,y]\right)}{\sqrt{x^2+y^2}\sqrt{\mu 0}}$$

In[ ]:= **term1a = D[Cross[ev, mv], t]**

Out[ ]= $$\left\{0,0,\frac{2\,e^{-2K2\sqrt{x^2+y^2}}\sqrt{\epsilon 0}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g[x,y]^2\ g'\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]}{\sqrt{\mu 0}}\right\}$$

$$\text{term1} = -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}$$

In[ ]:= **term1 = ((-ϵ0) * μ0) * D[Cross[ev, mv], t]**

Out[ ]= $$\left\{0,0,-2\,e^{-2K2\sqrt{x^2+y^2}}\ \epsilon 0^{3/2}\sqrt{\mu 0}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g[x,y]^2\ g'\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\right\}$$

In[ ]:=

$$\text{term 2} = \varepsilon_0\,\bar{E}\,(\nabla.\bar{E}).$$

In[ ]:= **term2 = ϵ0 * ev * Div[ev]**

Out[ ]= $$\left\{e^{-K2\sqrt{x^2+y^2}}\ \epsilon 0\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]\left(-\frac{e^{-K2\sqrt{x^2+y^2}}\ K2\ x\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]}{\sqrt{x^2+y^2}}+e^{-K2\sqrt{x^2+y^2}}\ g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g^{(1,0)}[x,y]\right),0,0\right\}$$

$$term3 = -\varepsilon_0 \, \overline{E} \times (\nabla \times \overline{E})$$

In[ ]:= `term3 = (-ϵ0) * Cross[ev, Curl[ev]]`

Out[ ]= $$\left\{0,\ -\epsilon 0 \left(-\frac{e^{-2\,K2\,\sqrt{x^2+y^2}}\,K2\,y\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]^2 g[x,y]^2}{\sqrt{x^2+y^2}} + e^{-2\,K2\,\sqrt{x^2+y^2}}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]^2 g[x,y]\,g^{(0,1)}[x,y]\right),\ e^{-2\,K2\,\sqrt{x^2+y^2}}\,\epsilon 0^{3/2}\sqrt{\mu 0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g[x,y]^2\,g'\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\right\}$$

$$term4 = \mu_0 \, \overline{H} \, (\nabla . \overline{H})$$

In[ ]:= `term4 = μ0 * mv * Div[mv]`

Out[ ]= $$\left\{0,\ e^{-K2\,\sqrt{x^2+y^2}}\sqrt{\epsilon 0}\sqrt{\mu 0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]\left(-\frac{e^{-K2\,\sqrt{x^2+y^2}}\,K2\,y\sqrt{\epsilon 0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\times g[x,y]}{\sqrt{x^2+y^2}\sqrt{\mu 0}} + \frac{e^{-K2\,\sqrt{x^2+y^2}}\sqrt{\epsilon 0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g^{(0,1)}[x,y]}{\sqrt{\mu 0}}\right),\ 0\right\}$$

$$term5 = -\mu_0 \, \overline{H} \times (\nabla \times \overline{H})$$

In[ ]:= `term5 = (-μ0) * Cross[mv, Curl[mv]]`

Out[ ]= $$\left\{-\mu 0 \left(-\frac{e^{-2\,K2\,\sqrt{x^2+y^2}}\,K2\,x\,\epsilon 0\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]^2 g[x,y]^2}{\sqrt{x^2+y^2}\,\mu 0} + \frac{e^{-2\,K2\,\sqrt{x^2+y^2}}\,\epsilon 0\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]^2 g[x,y]\,g^{(1,0)}[x,y]}{\mu 0}\right),\ 0,\ e^{-2\,K2\,\sqrt{x^2+y^2}}\,\epsilon 0^{3/2}\sqrt{\mu 0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]g[x,y]^2\,g'\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon 0}\sqrt{\mu 0}\right]\right\}$$

$$-\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}+\varepsilon_0\,\bar{E}\,(\nabla.\bar{E})-\varepsilon_0\,\bar{E}\times(\nabla\times\bar{E})+\mu_0\,\bar{H}\,(\nabla.\bar{H})-\mu_0\,\bar{H}\times(\nabla\times\bar{H})=0 \;:$$

Book : *Page 16, Equation (19)*

Which can be written as :

$$\text{term1} = -\frac{1}{c^2}\frac{\partial(\bar{E}\times\bar{H})}{\partial t}$$

$$\text{term 2} = \varepsilon_0\,\bar{E}\,(\nabla.\bar{E})$$

$$\text{term3} = -\varepsilon_0\,\bar{E}\times(\nabla\times\bar{E})$$

$$\text{term4} = \mu_0\,\bar{H}\,(\nabla.\bar{H})$$

$$\text{term5} = -\mu_0\,\bar{H}\times(\nabla\times\bar{H})$$

Equation (19) equals :

$$\text{term1} + \text{term2} + \text{term3} + \text{term4} + \text{term5} = 0$$

In[ ]:= **vergelijking = term1 + term2 + term3 + term4 + term5**

Out[ ]=

$$\Big\{e^{-K2\sqrt{x^2+y^2}}\,\epsilon0\,g\Big[t-\Big(1+\frac{K1}{z}\Big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\Big]\times g[x,y]\left(-\frac{e^{-K2\sqrt{x^2+y^2}}\,K2\,x\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]\times g[x,y]}{\sqrt{x^2+y^2}}+e^{-K2\sqrt{x^2+y^2}}\,g\Big[t-\Big(1+\frac{K1}{z}\Big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\Big]\,g^{(1,0)}[x,y]\right)-$$

$$\mu0\left(-\frac{e^{-2K2\sqrt{x^2+y^2}}\,K2\,x\,\epsilon0\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]^2\,g[x,y]^2}{\sqrt{x^2+y^2}\,\mu0}+\frac{e^{-2K2\sqrt{x^2+y^2}}\,\epsilon0\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]^2\,g[x,y]\,g^{(1,0)}[x,y]}{\mu0}\right),$$

$$e^{-K2\sqrt{x^2+y^2}}\,\sqrt{\epsilon0}\,\sqrt{\mu0}\,g\Big[t-\Big(1+\frac{K1}{z}\Big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\Big]\times g[x,y]\left(-\frac{e^{-K2\sqrt{x^2+y^2}}\,K2\,y\,\sqrt{\epsilon0}\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]\times g[x,y]}{\sqrt{x^2+y^2}\,\sqrt{\mu0}}+\frac{e^{-K2\sqrt{x^2+y^2}}\,\sqrt{\epsilon0}\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]\,g^{(0,1)}[x,y]}{\sqrt{\mu0}}\right)-$$

$$\epsilon0\left(-\frac{e^{-2K2\sqrt{x^2+y^2}}\,K2\,y\,g\big[t-\big(1+\frac{K1}{z}\big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\big]^2\,g[x,y]^2}{\sqrt{x^2+y^2}}+e^{-2K2\sqrt{x^2+y^2}}\,g\Big[t-\Big(1+\frac{K1}{z}\Big)\,z\,\sqrt{\epsilon0}\,\sqrt{\mu0}\Big]^2\,g[x,y]\,g^{(0,1)}[x,y]\right),\,0\Big\}$$

In[ ]:=

The electromagnetic force density in the x - direction equals :

In[ ]:= `xvergelijking = term1[[1]] + term2[[1]] + term3[[1]] + term4[[1]] + term5[[1]]`

Out[ ]=
$$e^{-K2\sqrt{x^2+y^2}}\,\epsilon0\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]\times g[x,y]\left(-\frac{e^{-K2\sqrt{x^2+y^2}}\,K2\,x\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]\times g[x,y]}{\sqrt{x^2+y^2}}+e^{-K2\sqrt{x^2+y^2}}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]g^{(1,0)}[x,y]\right)-\mu0\left(-\frac{e^{-2K2\sqrt{x^2+y^2}}\,K2\,x\,\epsilon0\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]^2 g[x,y]^2}{\sqrt{x^2+y^2}\,\mu0}+\frac{e^{-2K2\sqrt{x^2+y^2}}\,\epsilon0\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]^2 g[x,y]\,g^{(1,0)}[x,y]}{\mu0}\right)$$

In[ ]:= `FullSimplify[%]`

Out[ ]= 0

In[ ]:= `xvergelijking1 = %`

Out[ ]= 0

The electromagnetic force density in the y - direction equals:

In[ ]:= `yvergelijking = term1[[2]] + term2[[2]] + term3[[2]] + term4[[2]] + term5[[2]]`

Out[ ]=
$$e^{-K2\sqrt{x^2+y^2}}\sqrt{\epsilon0}\sqrt{\mu0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]\times g[x,y]\left(-\frac{e^{-K2\sqrt{x^2+y^2}}\,K2\,y\sqrt{\epsilon0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]\times g[x,y]}{\sqrt{x^2+y^2}\sqrt{\mu0}}+\frac{e^{-K2\sqrt{x^2+y^2}}\sqrt{\epsilon0}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]g^{(0,1)}[x,y]}{\sqrt{\mu0}}\right)-\epsilon0\left(-\frac{e^{-2K2\sqrt{x^2+y^2}}\,K2\,y\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]^2 g[x,y]^2}{\sqrt{x^2+y^2}}+e^{-2K2\sqrt{x^2+y^2}}\,g\left[t-\left(1+\frac{K1}{z}\right)z\sqrt{\epsilon0}\sqrt{\mu0}\right]^2 g[x,y]\,g^{(0,1)}[x,y]\right)$$

In[ ]:= `FullSimplify[%]`

Out[ ]= 0

```
In[∘]:= yvergelijking1 = %
Out[∘]= 0
```

The electromagnetic force density in the z - direction equals :

```
In[∘]:= zvergelijking = term1[[3]] + term2[[3]] + term3[[3]] + term4[[3]] +
          term5[[3]]
Out[∘]= 0
```

```
In[∘]:= FullSimplify[%]
Out[∘]= 0
```

```
In[∘]:= zvergelijking1 = %
Out[∘]= 0
```

Results for the electromagentic force densities in resp x-direction, y-direction, z-direction:

```
In[∘]:= xvergelijking1
Out[∘]= 0
```

```
In[∘]:= yvergelijking1
Out[∘]= 0
```

```
In[∘]:= zvergelijking1
Out[∘]= 0
```

According the force-density equations in the x-direction, y-direction and z-direction, the resulting electromagnetic force density equals zero in every direction. This Perfect Equilibrium does only exist when the Electromagnetic Wave propagates with exactly the speed: $c = \frac{1}{\sqrt{\epsilon 0\, \mu 0}}$. This represents the solution for ***equation (19) on page 16.***