Počítačové algebraické systémy

Prezi

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Běžné programovací jazyky

```
> 23/7
« 3.2857142857142856
> Math.sin(2*Math.PI)
« -2.4492127076447545e-16
```

Počítačové algebraické systémy

In[2]:= 23 / 7

Out[2]= $\frac{23}{7}$

In[4]:= 9 / 6

Out[4]= $\frac{3}{2}$

In[1]:= Sin[2 Pi]

Out[1]= 0

In[5]:= Sqrt[8]

Out[5]= $2\sqrt{2}$

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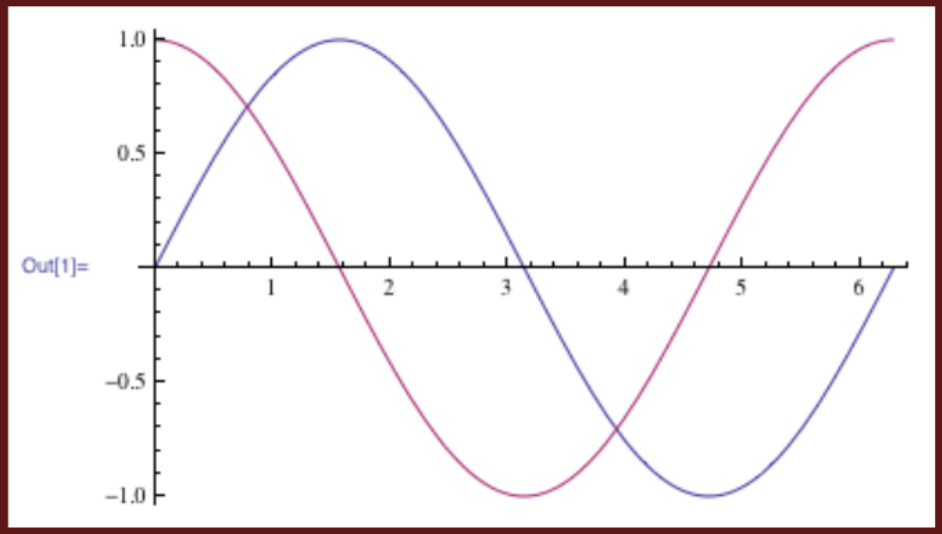
Využití

- matematické výpočty
- vizualizace dat
- simulace fyzikálních problémů



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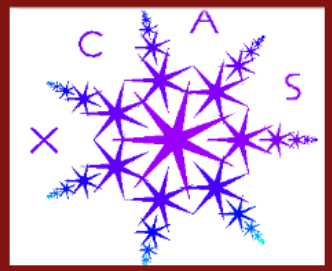
Příklady

axiom™

Wolfram Mathematica®



Maplesoft
Mathematics • Modeling • Simulation
A Cybernet Group Company

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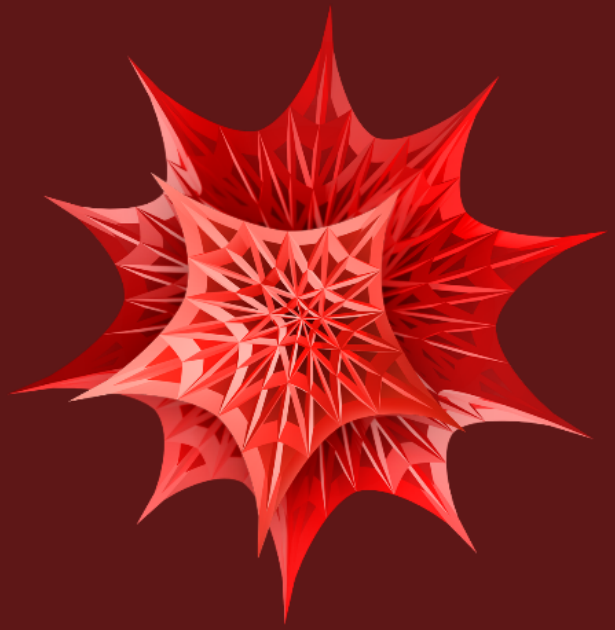
Wolfram Mathematica



- komerční program
- první verze - 1988
- široké spektrum využití

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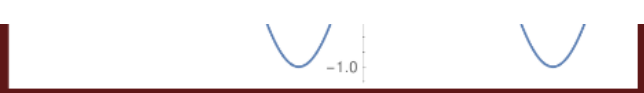

Funkce programu Mathematica

```
In[35]:= ρ = Quantity[1500, "kg/m^3"];
         v = Quantity[300, "dm^3"];

         m = v * ρ
Out[37]=
         450 kg

In[38]:= UnitConvert[m, "t"]
Out[38]=
         9/20 t
```

```
In[46]:= Integrate[Sin[Log[x]], x]
Out[46]=
         -1/2 x Cos[Log[x]] + 1/2 x Sin[Log[x]]
```

```
In[51]:= Solve[x^3 + 2 x^2 + 16 x + 4 == 0, x]
Out[51]=
         {{x → -2/3 + 11 × 2^(2/3) (1 + i √3) / (3 (41 + 3 √2553)^(1/3)) - (1 - i √3) (41 + 3 √2553)^(1/3) / (3 × 2^(2/3))},
          {x → -2/3 + 11 × 2^(2/3) (1 - i √3) / (3 (41 + 3 √2553)^(1/3)) - (1 + i √3) (41 + 3 √2553)^(1/3) / (3 × 2^(2/3))},
          {x → 1/3 (-2 - 22 × 2^(2/3) / (41 + 3 √2553)^(1/3) + (2 (41 + 3 √2553))^(1/3))}}
```

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In[35]:=
```
ρ = Quantity[1500, "kg/m^3"];
v = Quantity[300, "dm^3"];

m = v * ρ
```

Out[37]=

450 kg

In[38]:=
```
UnitConvert[m, "t"]
```

Out[38]=

$\frac{9}{20}$ t

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Mathematica

In[46]:=
```
Integrate[Sin[Log[x]], x]
```

Out[46]=

$$-\frac{1}{2}\,x\,\text{Cos}[\text{Log}[x]]+\frac{1}{2}\,x\,\text{Sin}[\text{Log}[x]]$$

In[51]:=
```
Solve[x^3 + 2 x^2 + 16 x + 4 == 0, x]
```

Out[51]=

$$\left\{\left\{x\to -\frac{2}{3}+\frac{11\times 2^{2/3}\left(1+i\sqrt{3}\right)}{3\left(41+3\sqrt{2553}\right)^{1/3}}-\frac{\left(1-i\sqrt{3}\right)\left(41+3\sqrt{2553}\right)^{1/3}}{3\times 2^{2/3}}\right\},\right.$$

Prezi

$$-\frac{1}{2}x\,\text{Cos}[\text{Log}[x]]+\frac{1}{2}x\,\text{Sin}[\text{Log}[x]]$$

In[51]:=
```
Solve[x^3 + 2 x^2 + 16 x + 4 == 0, x]
```

Out[51]=

$$\left\{\left\{x\to -\frac{2}{3}+\frac{11\times 2^{2/3}\left(1+i\sqrt{3}\right)}{3\left(41+3\sqrt{2553}\right)^{1/3}}-\frac{\left(1-i\sqrt{3}\right)\left(41+3\sqrt{2553}\right)^{1/3}}{3\times 2^{2/3}}\right\},\right.$$

$$\left\{x\to -\frac{2}{3}+\frac{11\times 2^{2/3}\left(1-i\sqrt{3}\right)}{3\left(41+3\sqrt{2553}\right)^{1/3}}-\frac{\left(1+i\sqrt{3}\right)\left(41+3\sqrt{2553}\right)^{1/3}}{3\times 2^{2/3}}\right\},$$

$$\left.\left\{x\to \frac{1}{3}\left(-2-\frac{22\times 2^{2/3}}{\left(41+3\sqrt{2553}\right)^{1/3}}+\left(2\left(41+3\sqrt{2553}\right)\right)^{1/3}\right)\right\}\right\}$$

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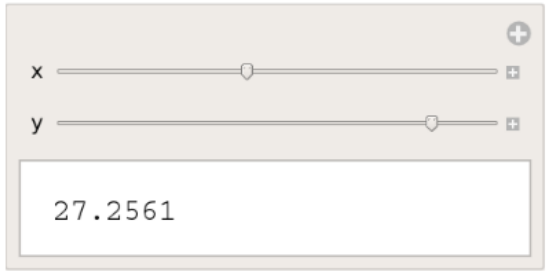
Interaktivita a vizualizace

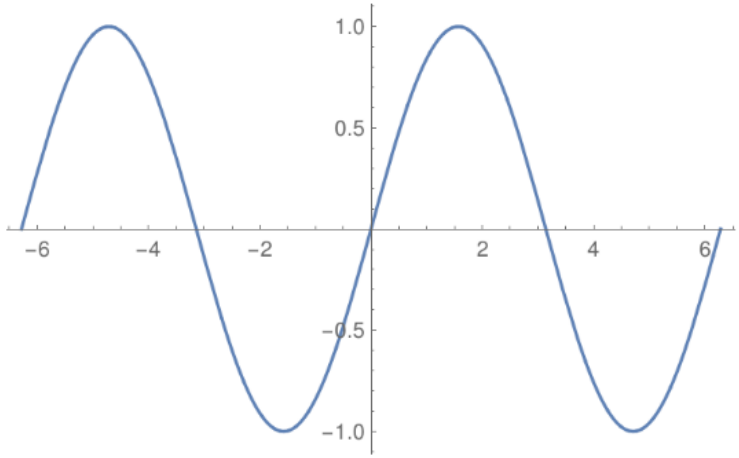
```
In[53]:= Manipulate[x^2 + y, {x, 0, 10}, {y, 0, 10}]
```

Out[53]=




```
In[59]:= Plot[Sin[x], {x, -2 Pi, +2 Pi}]
```

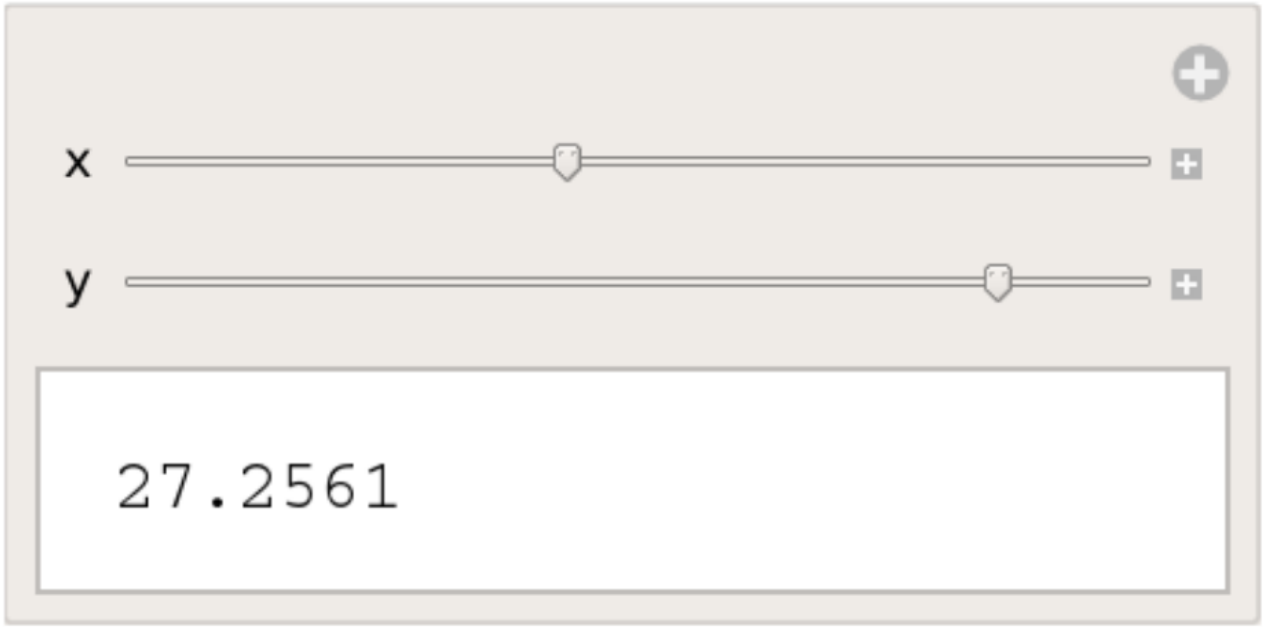
Out[59]=



Prezi

In[53]:=
```
Manipulate[x^2 + y, {x, 0, 10}, {y, 0, 10}]
```

Out[53]=



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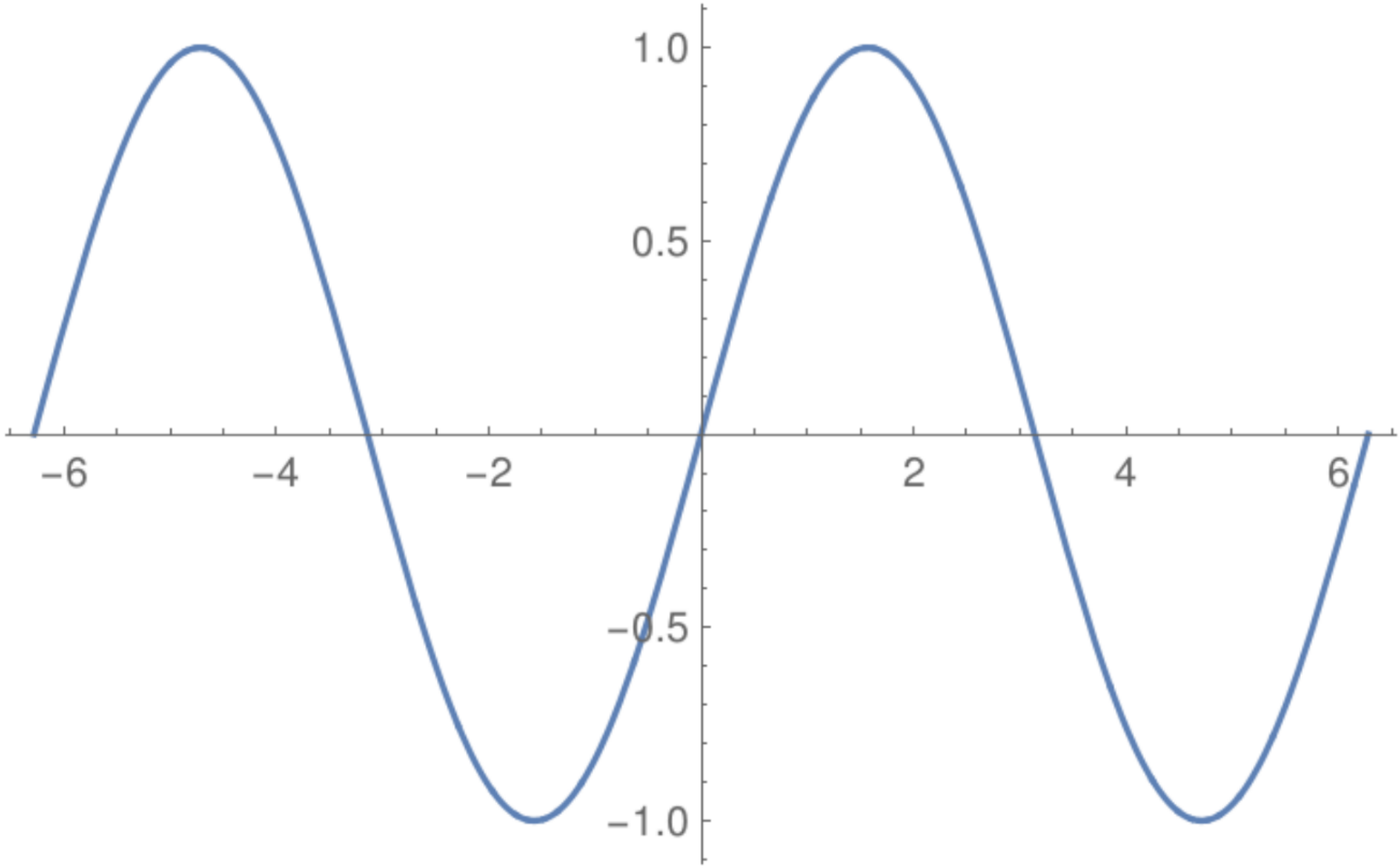
In[59]:=
```
Plot[Sin[x], {x, -2 Pi, +2 Pi}]
```

Out[59]=



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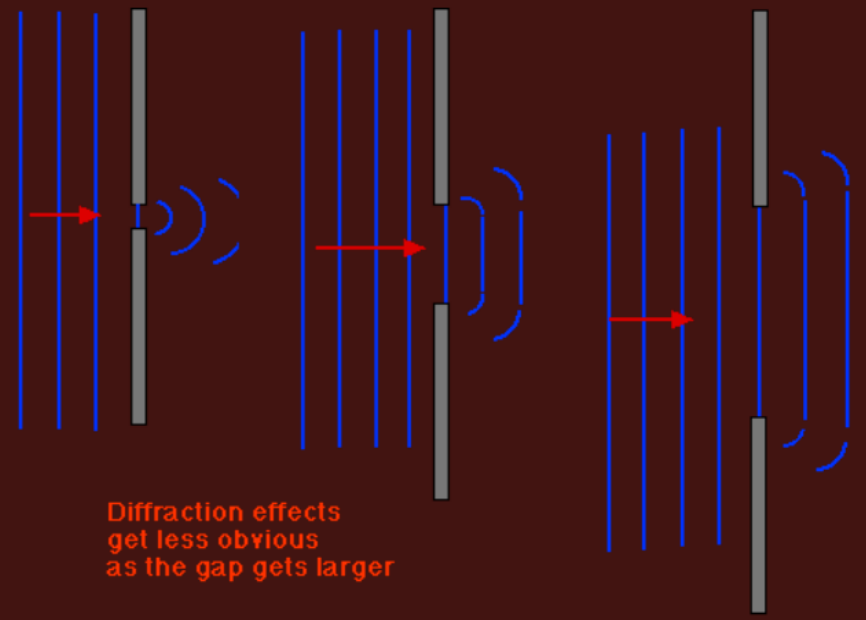
Fraunhoferova difrakce

- Difrakce - ohyb světla při průchodu štěrbinou o velikosti srovnatelné s vlnovou délkou světla
- Fraunhoferova difrakce - nastává při velké vzdálenosti stínítka od štěrbiny, je matematicky popsatelná



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Vzorec Fraunhoferovy difrakce (pro obdélníkovou štěrbinu)

$$\Psi = C \int_a^{-a} \int_b^{-b} e^{-ik(\theta_x x + \theta_y y)} dy\ dx = 4Cab \frac{\sin(\theta_x ka)}{\theta_x ka} \frac{\sin(\theta_y kb)}{\theta_y kb}$$

$$I = 16C^2 a^2 b^2 \left(\frac{\sin(\theta_x ka)}{\theta_x ka} \right)^2 \left(\frac{\sin(\theta_y kb)}{\theta_y kb} \right)^2$$

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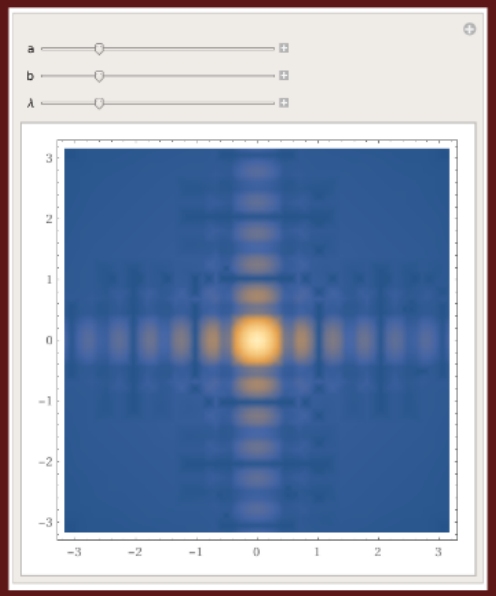
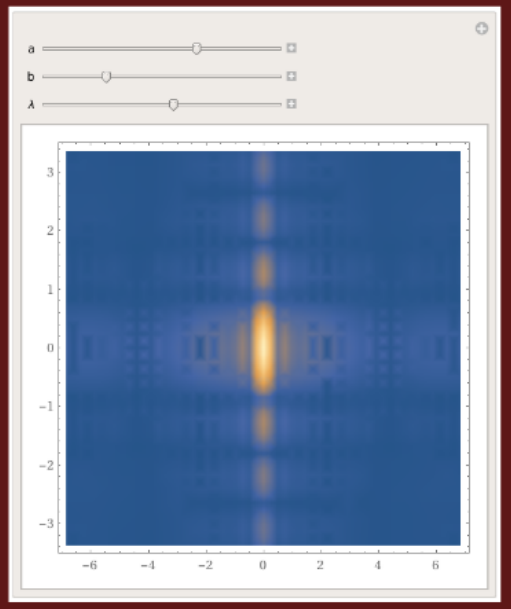
Vytvořený model

```
Manipulate[
 DensityPlot[
  k = (2 Pi) / λ;
  i = a^2 b^2 (Sin[x * k * a] / (x * k * a))^2 (Sin[y * k * b] / (y * k * b))^2;
  i^(1 / 3),
  {x, -a, a}, {y, -b, b},
  PlotRange → All],
 {a, 1, 10}, {b, 1, 10}, {λ, 1, 10} ]
```

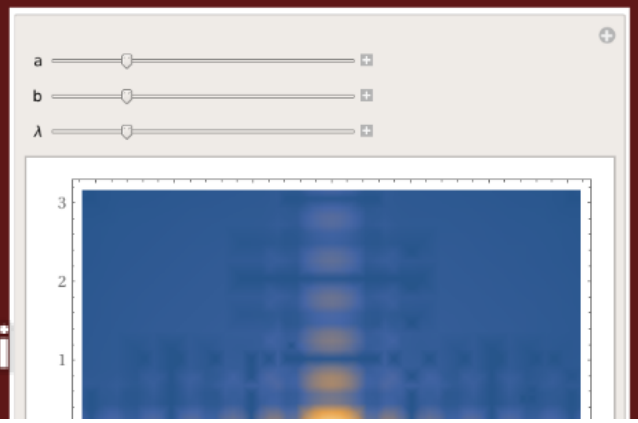


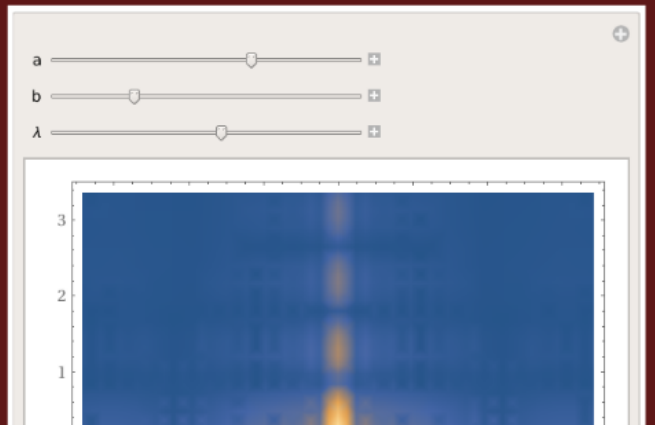


Prezi

Vytvořený model

```
Manipulate[
 DensityPlot[
  k = (2 Pi) / λ;
  i = a^2 b^2 (Sin[x * k * a] / (x * k * a))^2 (Sin[y * k * b] / (y * k * b))^2;
  i^(1 / 3),
  {x, -a, a}, {y, -b, b},
  PlotRange → All],
 {a, 1, 10}, {b, 1, 10}, {λ, 1, 10} ]
```



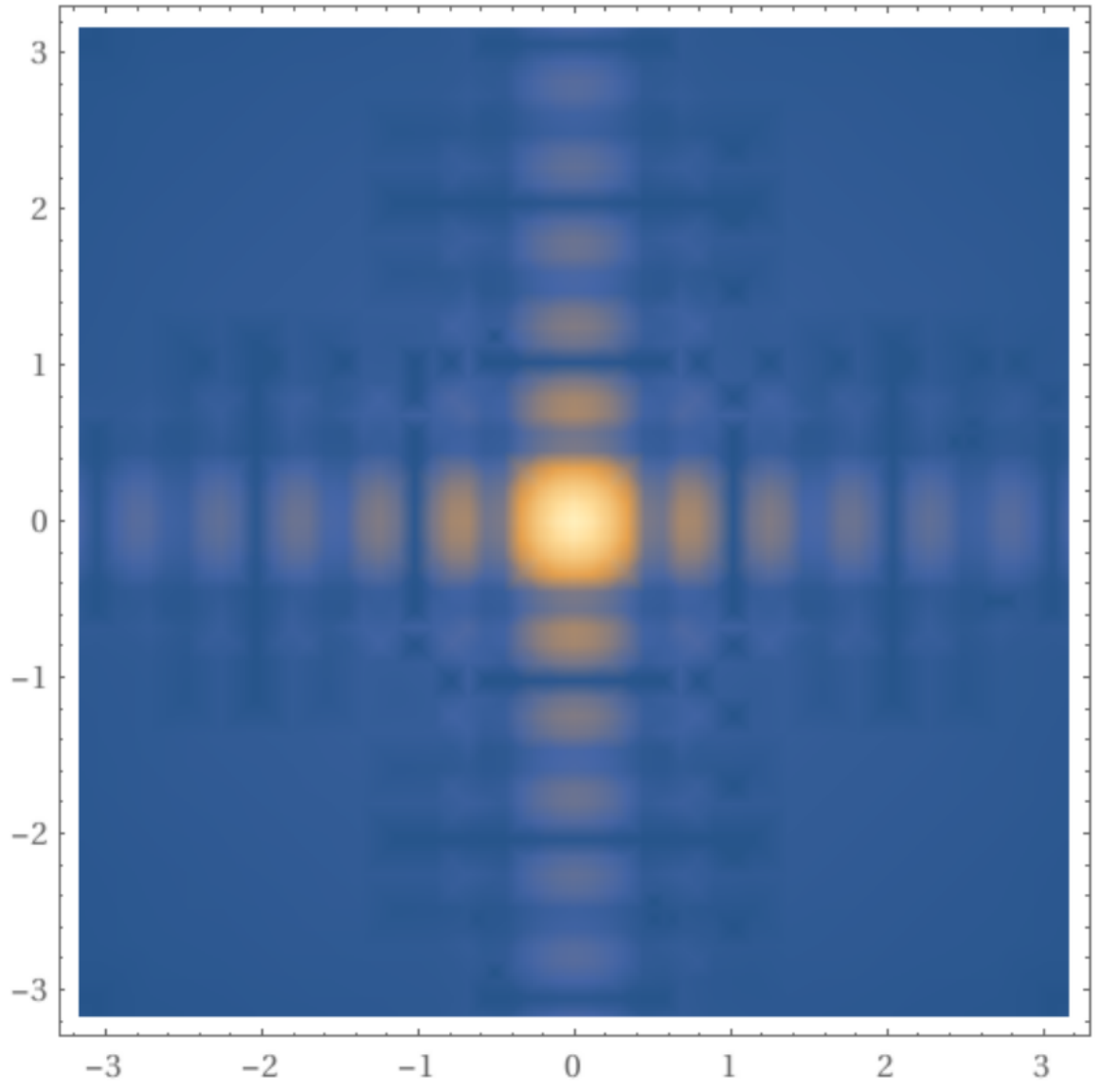


Prezi

a

b

λ

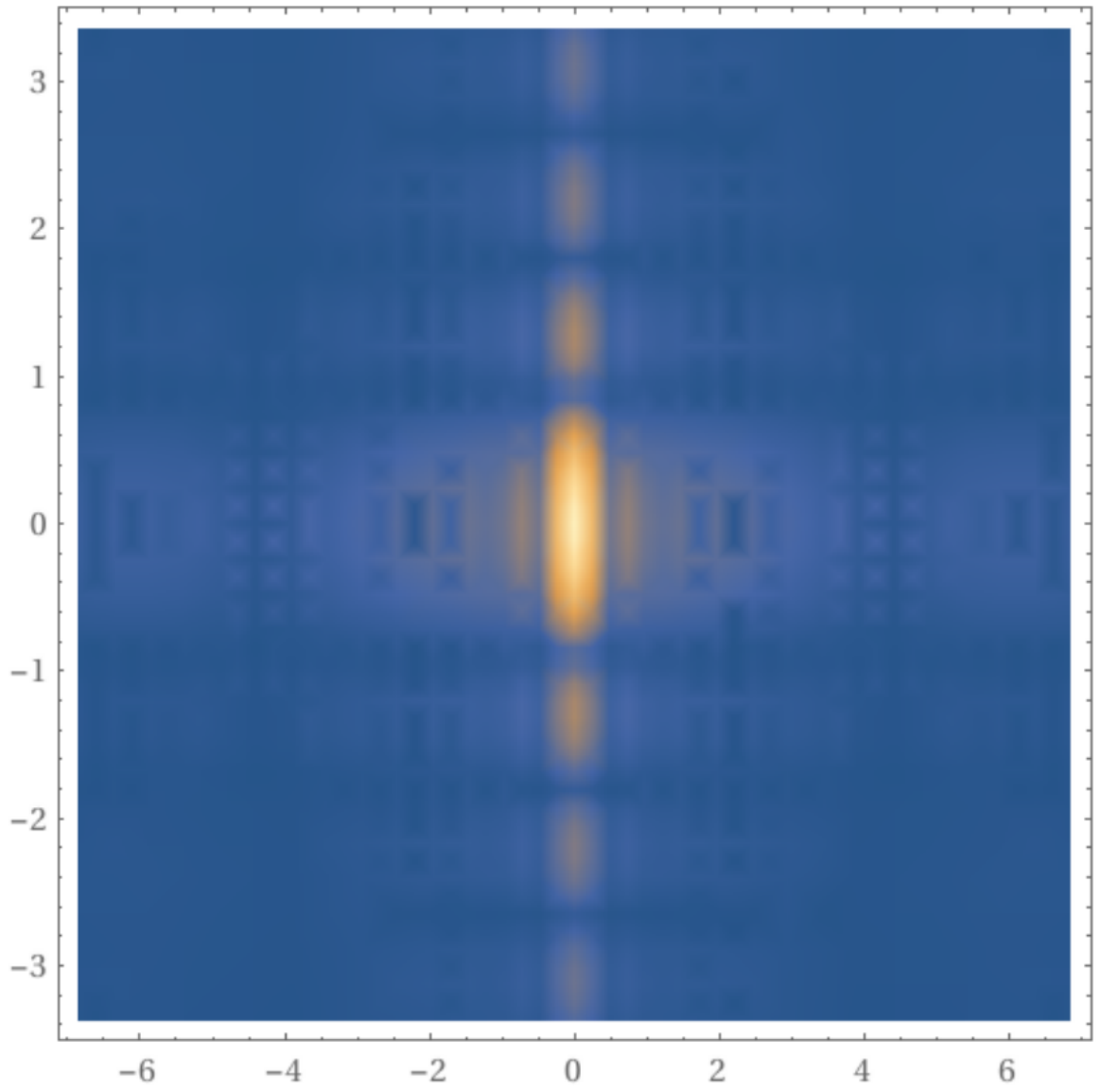


Prezi

a

b

λ



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