Wydruk programu ,,Krata” do wytworzenia rysunków do siatki zagęszczeń gradientu współczynnika załamania

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Exit[]
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```
KadaptRK3BS[XY_] :=
 Module[{k1, k2, k3, k4, x = First@XY, Y = Drop[XY, 1], ΔY23, Δk, hstare},
  hstare = h;
  k1 = h FIO;
  k2 = h F[x + 1/2 h, ##] &@@ (Y + 1/2 k1);
  k3 = h F[x + 3/4 h, ##] &@@ (Y + 3/4 k2);
  Y3 = Y + (2/9 k1 + 1/3 k2 + 4/9 k3);
  FIO = F[x + h, ##] &@@ Y3;
  k4 = h FIO;
  ΔY23 = Abs[1/72 (5 k1 - 6 k2 - 8 k3 + 9 k4)];
  Δk = Max@(ΔY23/(Abs[Y3] + Abs[Y3 - Y]));
  h = hstare If[δ > Δk, Min[(δ/Δk)^(1/3), 5], Max[(δ/Δk)^(1/3), 1/5]];
  ndone++;
  Flatten@{x + hstare, Y3}]
```

```
makeGraph[iniDat_: {-6, -1.5, π/180 80, 0}, P_: 0.8, λ_: 400] :=
 Module[{graf, hstart, ν, dνx, dνy, λ1 = 400, λ2 = 720,
   ϵ = 0.2, kolor = ColorData["VisibleSpectrum"][λ]},
  {w = 9, An = 1, ξ = 8/10, Ay = 1, Ax = Ay Sqrt[1 - ξ^2]};
  n1 = 1 + P (2 An/(2 + (Ay)^2/Ax^2 + y^2/Ay^2) + 2 An/(2 + (Ay)^2/Ax^2 + y^2/Ay^2) + 4 Sin[x]^12 + 4 Sin[y]^12);
  nn[x_, y_] = n1 + (-1 + n1) ϵ (λ^2 - λ1^2) λ2^2/(λ^2 (λ1^2 - λ2^2));
  gWsp = Plot[nn[x, 0], {x, -w, w}, PlotRange → {All, {0, 3}}];
  tlo = ContourPlot[nn[x, y],
    {x, -w, w}, {y, -w, w}, Contours → 29, PlotPoints → 39];

  ν[x_, y_] = Log@(nn[x, y]);
  dνx[x_, y_] = D[ν[x, y], x];
  dνy[x_, y_] = D[ν[x, y], y];
  F[s_, x_, y_, ϕ_, t_] = {Cos[ϕ], Sin[ϕ],
     dνy[x, y] Cos[ϕ] - dνx[x, y] Sin[ϕ], Exp@(ν[x, y])} // Simplify;

  {s0, s1} = {0, ∞};
  {x0, y0, ϕ0, t0} = iniDat;

  hstart[] := Module[{f, df, fdf, Y0, x, y, ϕ, t, s, tmp},
    Y0 = Abs[{x0, y0, ϕ0}];
    f = Take[F[s0, x0, y0, ϕ0, t0], 3];
    df = Transpose[(D[Take[F[s, x, y, ϕ, t], 3], #] & /@ {x, y, ϕ}) /. s → s0 /.
         x → x0 /. y → y0 /. ϕ → ϕ0];
    fdf = Abs[f.df];
    tmp = Flatten@
      Table[If[fdf[[i]] > 0, Min[Sqrt[2 Y0[[i]]/fdf[[i]]], Abs[f[[i]]]/fdf[[i]]], ∞], {i, 1, 3}];
    Sqrt[δ] Min@tmp];
Clear[sol, tor];
  {δ = 10^-8, h = hstart[], hmax = ∞, nmax = 10000, ndone = 0,};
  FIO = F[s0, x0, y0, ϕ0, 0];
  sol = NestWhileList[KadaptRK3BS, {s0, x0, y0, ϕ0, t0},
    (w ≥ Abs[#[[2]]] && w ≥ Abs[#[[3]]] && #[[1]] < s1 && ndone < nmax) &];
  Print["ndone= ", ndone];
  tor[tkolor_] :=
   ListPlot[{#[[2]], #[[3]]} & /@ sol, Joined → True, PlotStyle → tkolor];
  graf = Show[tor[kolor], PlotRange → All, AspectRatio → 1];
  Print[Show[{tlo, graf}]];
  graf]
```

Rysunek 7.23

```
gr355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 650];
go355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 615];
gy355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 590];
gg355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 510];
gb355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 470];
gp355 = makeGraph[{-7.8, 7.8, π/180 355, 0}, 0.1, 410];
gr340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 650];
go340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 615];
gy340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 590];
gg340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 510];
gb340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 470];
gp340 = makeGraph[{-7.8, 7.8, π/180 340, 0}, 0.1, 410];
gr325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 650];
go325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 615];
gy325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 590];
gg325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 510];
gb325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 470];
gp325 = makeGraph[{-7.8, 7.8, π/180 325, 0}, 0.1, 410];
gr310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 650];
go310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 615];
gy310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 590];
gg310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 510];
gb310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 470];
gp310 = makeGraph[{-7.8, 7.8, π/180 310, 0}, 0.1, 410];
gr300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 650];
go300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 615];
gy300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 590];
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gg300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 510];
gb300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 470];
gp300 = makeGraph[{-7.8, 7.8, π/180 300, 0}, 0.1, 410];
gr285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 650];
go285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 615];
gy285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 590];
gg285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 510];
gb285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 470];
gp285 = makeGraph[{-7.8, 7.8, π/180 285, 0}, 0.1, 410];
```

```
Show[{tlo, gr355, go355, gy355, gg355, gb355, gp355, gr340, go340,
  gy340, gg340, gb340, gp340, gr325, go325, gy325, gg325, gb325,
  gp325, gr310, go310, gy310, gg310, gb310, gp310, gr300, go300, gy300,
  gg300, gb300, gp300, gr285, go285, gy285, gg285, gb285, gp285}]
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Rysunek 7.24

```
gr0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 650];
go0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 615];
gy0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 590];
gg0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 510];
gb0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 470];
gp0 = makeGraph[{-0.001, 0.001, π/180 10, 0}, 0.1, 410];
gr70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 650];
go70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 615];
gy70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 590];
gg70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 510];
gb70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 470];
gp70 = makeGraph[{-0.001, 0.001, π/180 70, 0}, 0.1, 410];
gr130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 650];
go130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 615];
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gy130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 590];
gg130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 510];
gb130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 470];
gp130 = makeGraph[{-0.001, 0.001, π/180 130, 0}, 0.1, 410];
gr190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 650];
go190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 615];
gy190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 590];
gg190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 510];
gb190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 470];
gp190 = makeGraph[{-0.001, 0.001, π/180 190, 0}, 0.1, 410];
gr250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 650];
go250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 615];
gy250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 590];
gg250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 510];
gb250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 470];
gp250 = makeGraph[{-0.001, 0.001, π/180 250, 0}, 0.1, 410];
gr310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 650];
go310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 615];
gy310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 590];
gg310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 510];
gb310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 470];
gp310 = makeGraph[{-0.001, 0.001, π/180 310, 0}, 0.1, 410];
```

```
Show[{tlo, gr0, go0, gy0, gg0, gb0, gp0, gr70, go70, gy70,
  gg70, gb70, gp70, gr130, go130, gy130, gg130, gb130, gp130,
  gr190, go190, gy190, gg190, gb190, gp190, gr250, go250, gy250,
  gg250, gb250, gp250, gr310, go310, gy310, gg310, gb310, gp310}]
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Rysunek 7.25

```
gr1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 650];
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```
go1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 615];
gy1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 590];
gg1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 510];
gb1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 470];
gp1 = makeGraph[{-9, -9, π/180 0.1, 0}, 0.1, 410];
gr15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 650];
go15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 615];
gy15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 590];
gg15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 510];
gb15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 470];
gp15 = makeGraph[{-9, -9, π/180 15, 0}, 0.1, 410];
gr30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 650];
go30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 615];
gy30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 590];
gg30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 510];
gb30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 470];
gp30 = makeGraph[{-9, -9, π/180 30, 0}, 0.1, 410];
gr45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 650];
go45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 615];
gy45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 590];
gg45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 510];
gb45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 470];
gp45 = makeGraph[{-9, -9, π/180 44.9, 0}, 0.1, 410];
gr60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 650];
go60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 615];
gy60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 590];
gg60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 510];
gb60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 470];
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gp60 = makeGraph[{-9, -9, π/180 60, 0}, 0.1, 410];
gr75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 650];
go75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 615];
gy75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 590];
gg75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 510];
gb75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 470];
gp75 = makeGraph[{-9, -9, π/180 75, 0}, 0.1, 410];
gr90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 650];
go90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 615];
gy90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 590];
gg90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 510];
gb90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 470];
gp90 = makeGraph[{-9, -9, π/180 89.9, 0}, 0.1, 410];
```

```
Show[{tlo, gr1, go1, gy1, gg1, gb1, gp1, gr15, go15, gy15,
  gg15, gb15, gp15, gr30, go30, gy30, gg30, gb30, gp30, gr45, go45,
  gy45, gg45, gb45, gp45, gr60, go60, gy60, gg60, gb60, gp60, gr75,
  go75, gy75, gg75, gb75, gp75, gr90, go90, gy90, gg90, gb90, gp90}]
```