Wydruk programu ,,Kropla_wody” do wytworzenia rysunków do kropli wody

```
Exit[]
```

```
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 + Min[hstare, hmax], Y3}]
```

```
makeKropla[P_: 0.8, λ_: 400, wdth_: 0.1] :=
 Module[{λ1 = 400, λ2 = 720, n1, ϵ = 0.5},
  n1 = 1 + P (1/2 + 1/2 ArcTan[(Sqrt[x^2 + y^2] - 1)/wdth]/ArcTan[(0 - 1)/wdth]);

  n1 + (-1 + n1) ϵ (λ^2 - λ1^2) λ2^2/(λ^2 (λ1^2 - λ2^2)) // Simplify
 ]
```

```
makeGraph[iniDat_: {-6, -1.5, π/180 80, 0},
  P_: 0.2, λ_: 401, wdth_: 0.1] := Module[
  {graf, hstart, ν, dνx, dνy, kolor = ColorData["VisibleSpectrum"][λ], w = 4},
  nn[x_, y_] = Evaluate@makeKropla[P, λ, wdth];
  tlo = DensityPlot[nn[x, y], {x, -w, w},
    {y, -w, w}, PlotRange → All, PlotPoints → 80, ColorFunction →
     (Which[# ≤ 1, Black, 1 < # < 2, GrayLevel[3 (# - 1)], # ≥ 2, Blue] &),
    ColorFunctionScaling → False];
  circ = ParametricPlot[{Cos[ϕ], Sin[ϕ]}, {ϕ, 0, 2 π},
    PlotStyle → {Green, Thin}];
  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[√(2 Y0[[i]] / fdf[[i]]), Abs[f[[i]]] / fdf[[i]]], ∞], {i, 1, 3}];
    √δ Min@tmp];

  {δ = 10^-8, hmax = 1/1000, h = Min[hstart, hmax], nmax = 100 000, ndone = 0,};
  (*Print["hstart= ",h];*)
  Clear[sol, tor];
  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, PlotRange → All];
  graf = Show[tor[kolor], PlotRange → All, AspectRatio → 1];
  Print[Show[{tlo, graf}]];
  graf]
```

Rysunek 7.27

```
wd = 0.05;
gr1 = makeGraph[{-2, 0.001, π/180 (3299/100), 0}, 1/3, 650, wd];
go1 = makeGraph[{-2, 0.001, π/180 (828/25), 0}, 1/3, 615, wd];
gy1 = makeGraph[{-2, 0.001, π/180 (1661/50), 0}, 1/3, 590, wd];
gg1 = makeGraph[{-2, 0.001, π/180 (3363/100), 0}, 1/3, 510, wd];
gb1 = makeGraph[{-2, 0.001, π/180 (847/25), 0}, 1/3, 470, wd];
gi1 = makeGraph[{-2, 0.001, π/180 (1709/50), 0}, 1/3, 430, wd];
gp1 = makeGraph[{-2, 0.001, π/180 (3443/100), 0}, 1/3, 400, wd];
Show[{tlo, gr1, go1, gy1, gg1, gb1, gi1, gp1}]
```

Rysunek 7.28

```
Do[Print@ind; ini = {-2, 0.001, π/180 32.91, 0};
 wd = 0.05;
 gr85 = makeGraph[ini, 1/3, 650, wd];
 go85 = makeGraph[ini, 1/3, 615, wd];
 gy85 = makeGraph[ini, 1/3, 590, wd];
 gg85 = makeGraph[ini, 1/3, 510, wd];
 gb85 = makeGraph[ini, 1/3, 470, wd];
 gi85 = makeGraph[ini, 1/3, 430, wd];
 gp85 = makeGraph[ini, 1/3, 400, wd];
 Print@Show[{tlo, gr85, go85, gy85, gg85, gb85, gi85, gp85}]]
```

Rysunek 7.29a

```
Do[Print@ind; ini = {-2, 0.001, π/180 32.91, 0};
 wd = 0.08;
 gr85 = makeGraph[ini, 1/3, 650, wd];
 go85 = makeGraph[ini, 1/3, 615, wd];
 gy85 = makeGraph[ini, 1/3, 590, wd];
 gg85 = makeGraph[ini, 1/3, 510, wd];
 gb85 = makeGraph[ini, 1/3, 470, wd];
 gi85 = makeGraph[ini, 1/3, 430, wd];
 gp85 = makeGraph[ini, 1/3, 400, wd];
 Print@Show[{tlo, gr85, go85, gy85, gg85, gb85, gi85, gp85}]]
```

Rysunek 7.29b

```
Do[Print@ind; ini = {-2, 0.001, π/180 32.91, 0};
 wd = 0.07;
 gr85 = makeGraph[ini, 1/3, 650, wd];
 go85 = makeGraph[ini, 1/3, 615, wd];
 gy85 = makeGraph[ini, 1/3, 590, wd];
 gg85 = makeGraph[ini, 1/3, 510, wd];
 gb85 = makeGraph[ini, 1/3, 470, wd];
 gi85 = makeGraph[ini, 1/3, 430, wd];
 gp85 = makeGraph[ini, 1/3, 400, wd];
 Print@Show[{tlo, gr85, go85, gy85, gg85, gb85, gi85, gp85}]]
```

Rysunki 7.30a - 7.30g

```
Do[Print@ind; ini = {-2, 0.001, π/180 (ind), 0};
 wd = 0.05;
 gr85 = makeGraph[ini, 1/3, 650, wd];
 go85 = makeGraph[ini, 1/3, 615, wd];
 gy85 = makeGraph[ini, 1/3, 590, wd];
 gg85 = makeGraph[ini, 1/3, 510, wd];
 gb85 = makeGraph[ini, 1/3, 470, wd];
 gi85 = makeGraph[ini, 1/3, 430, wd];
 gp85 = makeGraph[ini, 1/3, 400, wd];
 Print@Show[{tlo, gr85, go85, gy85, gg85, gb85, gi85, gp85}],
 {ind, -35, -33, 1/10}]
```