```
In[133]:=  (* stability matrix *)
           M = {{-Du * k^2, chi * k^2, 0}, {0, -k^2, 0}, {0, 0, -Dw * k^2}}

In[134]:=  (* jacobian matrix *)
           J = {{0, 0, 0}, {fu, fv, fw}, {gu, gv, gw}}

In[135]:=  (* characteristic polynomial *)
           P[x_] = -Collect[Det[(M + gamma * J) - x * IdentityMatrix[3]], x]

In[136]:=  (* parameters *)

In[137]:=  (* Schnackenberg *)


           (* plotting regions *)


In[138]:=  fv = -1 + 2 v0 w0 * e3

In[139]:=  fw = v0^2 * e3

In[140]:=  fu = a * e1

In[141]:=  gu = c * e2

In[142]:=  gv = -2 * v0 * w0 * e3

In[143]:=  gw = -v0^2 * e3

In[144]:=

In[145]:=  (* the polynomial coefficients *)
           Ak = Collect[-(fv gamma + gamma gw - k^2 - Du k^2 - Dw k^2), {k^2, gamma, chi, Du}]

In[146]:=  Bk =
             Collect[-(fw gamma^2 gv - fv gamma^2 gw + chi fu gamma k^2 + Du fv gamma k^2 + Dw fv gamma k^2 +
                gamma gw k^2 + Du gamma gw k^2 - Du k^4 - Dw k^4 - Du Dw k^4), {k^2, gamma, chi, Du}]

In[147]:=  Ck = Collect[
               -chi fw gamma^2 gu k^2 - Du fw gamma^2 gv k^2 + chi fu gamma^2 gw k^2 + Du fv gamma^2 gw k^2 -
                chi Dw fu gamma k^4 - Du Dw fv gamma k^4 - Du gamma gw k^4 + Du Dw k^6, {k^2}]

In[148]:=  (* conditions for NOT having PATTERNS *)
           (* Ck > 0*)

In[149]:=  b1 = gamma (-chi Dw fu + Du (-Dw fv - gw))

In[150]:=  c1 = gamma^2 (chi (-fw gu + fu gw) + Du (-fw gv + fv gw))

In[151]:=  a1 = Dw

In[152]:=  Ckmin = -(b1^2 - 4 * a1 * c1) / 4 * a1

In[153]:=  (* (AB-C)_k> 0*)

In[154]:=  ABmC = Collect[Ak * Bk - Ck, {k^2}]

In[155]:=  a2 = (2 + 4 Dw + 2 Dw^2)
```

```
In[156]:= b2 = Collect[gamma (chi Dw fu + (Dw + Du (1 + Dw)) (-fv - gw) -
             Du (-Dw fv - gw) + (1 + Du + Dw) (-chi fu - Dw fv + Du (-fv - gw) - gw)), {gamma}]
```

```
In[157]:= c2 =
           Collect[gamma^2 ((-fv - gw) (-chi fu - Dw fv + Du (-fv - gw) - gw) - chi (-fw gu + fu gw) -
             Du (-fw gv + fv gw) + (1 + Du + Dw) (-fw gv + fv gw)), {gamma}]
```

```
In[158]:= (*turning point coordinate *)
       q1 = (-b2 + Sqrt[b2^2 - 3 * a2 * c2]) / (3 * a2)
```

```
In[159]:= ABCmin = fv fw gv - fv^2 gw + fw gv gw - fv gw^2 +
           (chi fu fv + fv^2 + Dw fv^2 + chi fw gu - fw gv - Dw fw gv + 4 fv gw + 2 Dw fv gw + 2 gw^2) q1 +
           (-2 chi fu - 3 fv - 4 Dw fv - Dw^2 fv - 4 gw - 4 Dw gw) q1^2 + (2 + 4 Dw + 2 Dw^2) q1^3
```

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```
In[ ]:=
       a = 0.2
       c = 0.2
       e1 = 2
       (*e2=1*)
       Du = 1
       gamma = 2200
       u0 = 1
       v0 = a + c + a * e1 + c * e2
       w0 = c * (1 + e2) / (e3 * v0^2)
```

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Fig4_code_def.nb | **3**

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fs = 28
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```
f1[Dw_, chi_] = c1;
f2[Dw_, chi_] = b1;
f3[Dw_, chi_] = Ckmin;
nn = 80;

tab = Table[(Evaluate[f1[Dw, chi]] ≤ 0 || Evaluate[f2[Dw, chi]] ≤ 0) &&
    Evaluate[f3[Dw, chi]] ≤ 0, {e3, {10^-16, 0.05, 0.1, 1}}];

plotss1 =
  Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 4}, PlotStyle → Directive[
      RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.32]], BoundaryStyle →
     Directive[RGBColor[0.47000000000000003, 0.44, 0.71], Thickness[0.006]],
    FrameStyle → Directive[GrayLevel[0], fs, FontFamily → "Helvetica",
      AbsoluteThickness[0.8]], FrameTicks →
     {{{0, 1, 2, 3, 4}, None}, {{#, ToString[#]} & /@ Range[0, nn, nn / 4], None}},
    FrameLabel → {{HoldForm[χ], None}, {HoldForm[Dw], None}}], {e2, {0}}];

comb1 = Show[plotss1];
```

```
plotss2 =
  Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 2}, PlotStyle → Directive[
      RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.32]], BoundaryStyle →
     Directive[RGBColor[0.47000000000000003, 0.44, 0.71], Thickness[0.006]],
    FrameStyle → Directive[GrayLevel[0], fs, FontFamily → "Helvetica",
      AbsoluteThickness[0.8]], FrameTicks →
     {{{0, 1, 2}, None}, {{#, ToString[#]} & /@ Range[0, nn, nn / 4], None}},
    FrameLabel → {{HoldForm[χ], None}, {HoldForm[Dw], None}}], {e2, {1.5}}];


comb2 = Show[plotss2];



plotss3 =
  Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 1}, PlotStyle → Directive[
      RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.32]], BoundaryStyle →
     Directive[RGBColor[0.47000000000000003, 0.44, 0.71], Thickness[0.006]],
    FrameStyle → Directive[GrayLevel[0], fs, FontFamily → "Helvetica",
      AbsoluteThickness[0.8]], FrameTicks →
     {{{0, 0.5, 1}, None}, {{#, ToString[#]} & /@ Range[0, nn, nn / 4], None}},
    FrameLabel → {{HoldForm[χ], None}, {HoldForm[Dw], None}}], {e2, {12}}];



comb3 = Show[plotss3];

new = {Show[comb1], Show[comb2], Show[comb3]};
Show[GraphicsRow[new, Spacings → Scaled[0.15], ImageSize → 1000]]
```
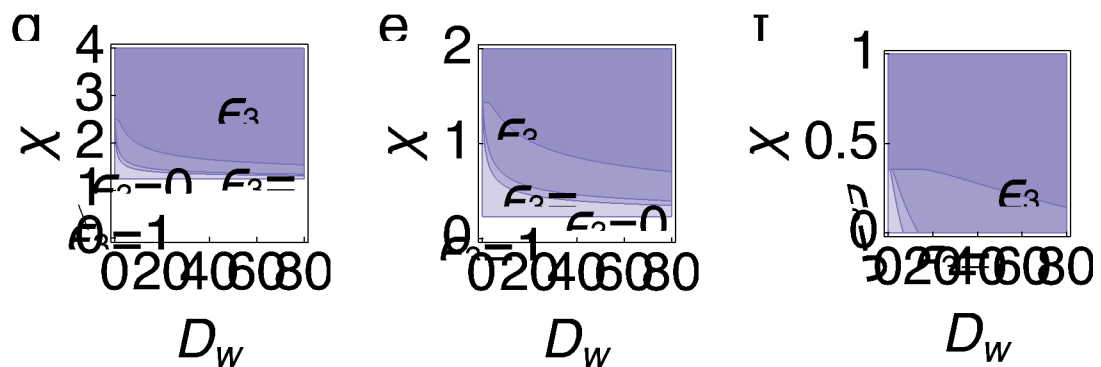
Fig4_code_def.nb | **5**

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