

```

In[277]:= (* stability matrix *)
M = {{-Du * k^2, chi * k^2, 0}, {0, -k^2, 0}, {0, 0, -Dw * k^2}}

In[278]:= (* jacobian matrix *)
J = {{0, 0, 0}, {fu, fv, fw}, {gu, gv, gw}}

In[279]:= (* characteristic polynomial *)
P[x_] = -Collect[Det[(M + gamma * J) - x * IdentityMatrix[3]], x]

In[280]:= (* parameters *)

In[281]:= (* Schnackenberg *)

(* plotting regions *)

In[282]:= fv = -1 + 2 v0 w0

In[283]:= fw = v0^2

In[284]:= fu = a * e1

In[285]:= gu = c * e2

In[286]:= gv = -2 * v0 * w0

In[287]:= gw = -v0^2

In[288]:=

In[289]:= (* the polynomial coefficients *)
Ak = Collect[-(fv gamma + gamma gw - k^2 - Du k^2 - Dw k^2), {k^2, gamma, chi, Du}]

In[290]:= 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[291]:= 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[292]:= (* conditions for NOT having PATTERNS *)
(* Ck > 0 *)

In[293]:= b1 = gamma (-chi Dw fu + Du (-Dw fv - gw))

In[294]:= c1 = gamma^2 (chi (-fw gu + fu gw) + Du (-fw gv + fv gw))

In[295]:= a1 = Dw

In[296]:= Ckmin = -(b1^2 - 4 * a1 * c1) / 4 * a1

In[297]:= (* (AB-C)_k > 0 *)

In[298]:= ABmC = Collect[Ak * Bk - Ck, {k^2}]

In[299]:= a2 = (2 + 4 Dw + 2 Dw^2)

```

```

In[300]:= 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[301]:= 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[302]:= (*turning point coordinate *)
q1 = (-b2 + Sqrt[b2^2 - 3 * a2 * c2]) / (3 * a2)

In[303]:= 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

In[ ]:=

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a = 0.2
c = 1.3
Du = 1
gamma = 2200
u0 = 1
v0 = a + c + a * e1 + c * e2
w0 = c * (1 + e2) / (v0^2)

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In[ ]:= fs = 28
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```
In[ ]:= f1[Dw_, chi_] = c1;
        f2[Dw_, chi_] = b1;
        f3[Dw_, chi_] = Ckmin;
        nn = 200;
        nnch = 4;
```

```
nnch2 = 1;
nnch3 = 0.2;
```

```
tab = Table[(Evaluate[f1[Dw, chi]] ≤ 0 || Evaluate[f2[Dw, chi]] ≤ 0) &&
            Evaluate[f3[Dw, chi]] ≤ 0, {e1, {0, 1.5, 6, 2000}}];

plotss1 = Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 4}, PlotStyle →
    Directive[RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.2]],
    BoundaryStyle → Directive[RGBColor[0.47000000000000003, 0.44, 0.71],
    Thickness[0.006]], FrameStyle → Directive[GrayLevel[0],
    fs, FontFamily → "Helvetica", AbsoluteThickness[0.8]],
    FrameTicks → {{#, ToString[#]} & /@ Range[0, nnch, nnch / 2], None},
    {{#, ToString[#]} & /@ Range[0, nn, nn / 2], None}},
    FrameLabel → {{HoldForm[χ], None}, {HoldForm[Dw], None}}, {e2, {0}}];
```

```
comb1 = Show[plotss1];
```

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In[ ]:=
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plotss2 =
  Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 1}, PlotStyle → Directive[
    RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.2]], 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 / 2], None}},
    FrameLabel → {{HoldForm[ $\chi$ ], None}, {HoldForm[ $D_w$ ], None}}, {e2, {0}}];

```

```
comb2 = Show[plotss2];
```

```

plotss3 = Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 0, 0.2}, PlotStyle →
  Directive[RGBColor[0.47000000000000003, 0.44, 0.71], Opacity[0.2]],
  BoundaryStyle → Directive[RGBColor[0.47000000000000003, 0.44, 0.71],
    Thickness[0.006]], FrameStyle → Directive[GrayLevel[0], fs,
    FontFamily → "Helvetica", AbsoluteThickness[0.8]], FrameTicks →
    {{{0, 0.1, 0.2}, None}, {{#, ToString[#]} & /@ Range[0, nn, nn / 2], None}},
    FrameLabel → {{HoldForm[ $\chi$ ], None}, {HoldForm[ $D_w$ ], None}}, {e2, {12}}];

```

```
comb3 = Show[plotss3];
```

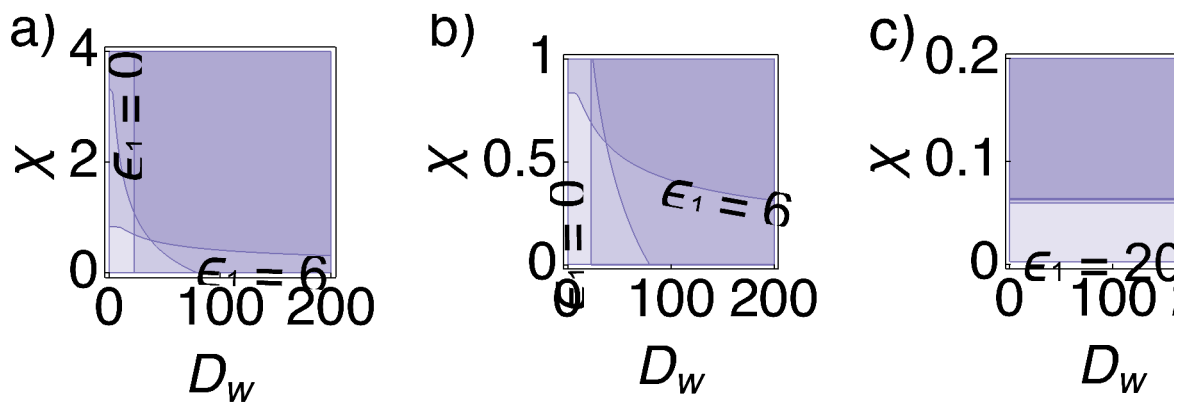
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In[ ]:=
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In[ ]:= new = {Show[comb1], Show[comb2], Show[comb3]};
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In[ ]:= Show[GraphicsRow[new, Spacings → Scaled[0.15], ImageSize → 1000]]
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