In[806]:=
```
(* stability matrix *)
M = {{-Du * k^2, chi * k^2, 0}, {0, -k^2, 0}, {0, 0, -Dw * k^2}}
```

In[807]:=
```
(* jacobian matrix *)
J = {{0, 0, 0}, {fu, fv, fw}, {gu, gv, gw}}
```

In[808]:=
```
(* characteristic polynomial *)
P[x_] = -Collect[Det[(M + gamma * J) - x * IdentityMatrix[3]], x]
```

In[809]:=
```
(* parameters *)
```

In[810]:=
```
(* Schnackenberg *)

(* plotting regions *)
```

In[811]:=
```
fv = -1 + 2 v0 w0
```

In[812]:=
```
fw = v0^2
```

In[813]:=
```
fu = a * e1
```

In[814]:=
```
gu = c * e2
```

In[815]:=
```
gv = -2 * v0 * w0
```

In[816]:=
```
gw = -v0^2
```

In[817]:=

In[818]:=
```
(* the polynomial coefficients *)
Ak = Collect[-(fv gamma + gamma gw - k^2 - Du k^2 - Dw k^2), {k^2, gamma, chi, Du}]
```

In[819]:=
```
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[820]:=
```
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[821]:=
```
(* conditions for NOT having PATTERNS *)
(* Ck > 0*)
```

In[822]:=
```
b1 = gamma (-chi Dw fu + Du (-Dw fv - gw))
```

In[823]:=
```
c1 = gamma^2 (chi (-fw gu + fu gw) + Du (-fw gv + fv gw))
```

In[824]:=
```
a1 = Dw
```

In[825]:=
```
Ckmin = -(b1^2 - 4 * a1 * c1) / 4 * a1
```

In[826]:=
```
(* (AB-C)_k> 0*)
```

In[827]:=
```
ABmC = Collect[Ak * Bk - Ck, {k^2}]
```

In[828]:=
```
a2 = (2 + 4 Dw + 2 Dw^2)
```

In[829]:=
```
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[830]:=
```
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[831]:=
```
(*turning point coordinate *)
q1 = (- b2 + Sqrt[b2^2 - 3 * a2 * c2]) / (3 * a2)
```

In[832]:=
```
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[833]:=

```
(* plotting *)


(*RegionPlot[(c1<=0||b1<=0)&&Ckmin<=0, {Dw,0,100},{chi,0,6},
 FrameLabel→{Dw,ToExpression["\chi",TeXForm,HoldForm]},
 BaseStyle→{FontWeight→"Bold",FontSize→16}]*)
```

In[ ]:=

In[ ]:=
```
(*Table[i*0.1,{i,0,10}]*)
```

In[ ]:=

In[ ]:=

In[ ]:=

```
(*Table[RegionPlot[(c1<=0||b1<=0)&&Ckmin<=0,
  {Dw,0,100},{chi,0,6},ImageSize→150],{e1,0,1}]
```

In[ ]:=
```
(*Table[Plot[Sin[n x],{x,0,Pi},ImageSize→150],{n,4}]
```

In[•]:=
```
a = 1
c = 0.5
(*e1=1*)
(*e2=1*)
Du = 1
gamma = 2200
u0 = 1
v0 = a + c + a * e1 + c * e2
w0 = c * (1 + e2) / (v0^2)
```

In[•]:=

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```
fs = 28
```

In[•]:=
```
f1[Dw_, chi_] = c1;
f2[Dw_, chi_] = b1;
f3[Dw_, chi_] = Ckmin;
nn = 2000;
nnch = 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, 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 → {{{#, 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];
```

In[ ]:=

In[ ]:=

```
plotss2 =
  Table[RegionPlot[Evaluate@tab, {Dw, 0, nn}, {chi, 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, 1, 2}, None}, {{#, ToString[#]} & /@ Range[0, nn, nn / 2], None}},
     FrameLabel → {{HoldForm[χ], None}, {HoldForm[Dw], None}}], {e2, {1.5}}];

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[χ], None}, {HoldForm[Dw], None}}], {e2, {12}}];
```

In[ ]:=

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

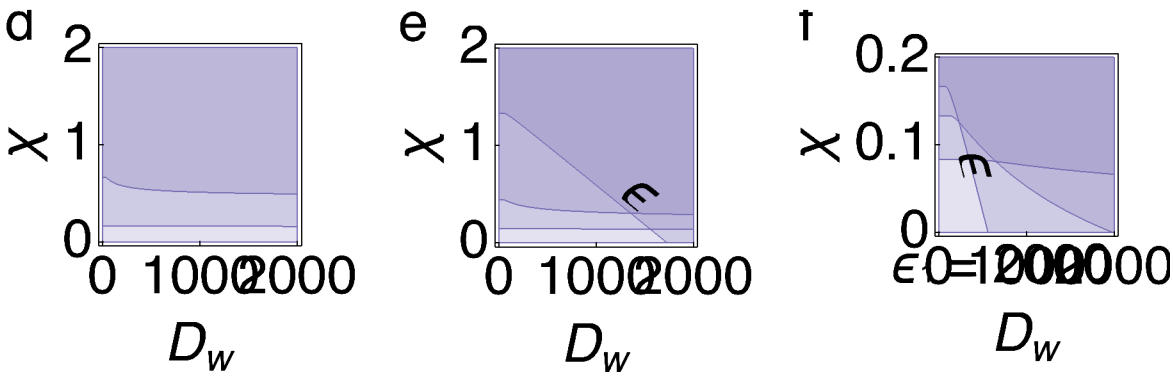
In[ ]:=

In[ ]:=

```
new = {Show[comb1], Show[comb2], Show[comb3]};

Show[GraphicsRow[new, Spacings → Scaled[0.15], ImageSize → 1000]]
```

In[•]:=



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