In[4370]:=

```
minxplot = -5;
maxxplot = 5;
minyplot = -5;
maxyplot = 5;

μ = 1;

sol[u_, v_] :=
 NDSolve[{x'[t] == μ * x[t] - 5 y[t] - x[t]^3, y'[t] == 5 x[t] + μ * y[t] + 3 y[t]^3,
   x[0] == u, y[0] == v}, {x, y}, {t, 10}, Method → "StiffnessSwitching"]

miny = -0.01;
maxy = 0.01;
minx = -0.01;
maxx = 0.01;
step = 0.005;

Table11 = Table[{minx, y}, {y, miny, maxy, step}];
Table21 = Table[{x, maxy}, {x, minx, maxx, step}];
Table31 = Table[{maxx, y}, {y, miny, maxy, step}];
Table41 = Table[{x, miny}, {x, minx, maxx, step}];

miny = -4;
maxy = 4;
minx = -4;
maxx = 4;
step = 0.2;

Table12 = Table[{minx, y}, {y, miny, maxy, step}];
Table22 = Table[{x, maxy}, {x, minx, maxx, step}];
Table32 = Table[{maxx, y}, {y, miny, maxy, step}];
Table42 = Table[{x, miny}, {x, minx, maxx, step}];

TableFinal = Join[Table11, Table21, Table31, Table41, Table12, Table32];

Show[Table[ParametricPlot[
    Evaluate[{x[t], y[t]} /. sol[TableFinal[[i, 1]], TableFinal[[i, 2]]]],
    {t, 0, 5}, PlotRange → {{minxplot, maxxplot}, {minyplot, maxyplot}},
    PlotLabel → Style["System 1. μ = 1. Arrows denote starting
        points and direction. Unstable origin.", FontSize → 15]] /.
   Line[x_] :↦ {Arrowheads[{0.01, 0.}], Arrow[x]}, {i, Length[TableFinal]}]]
```

... NDSolve: At t == 4.13400248900072`, step size is effectively zero; singularity or stiff system suspected.

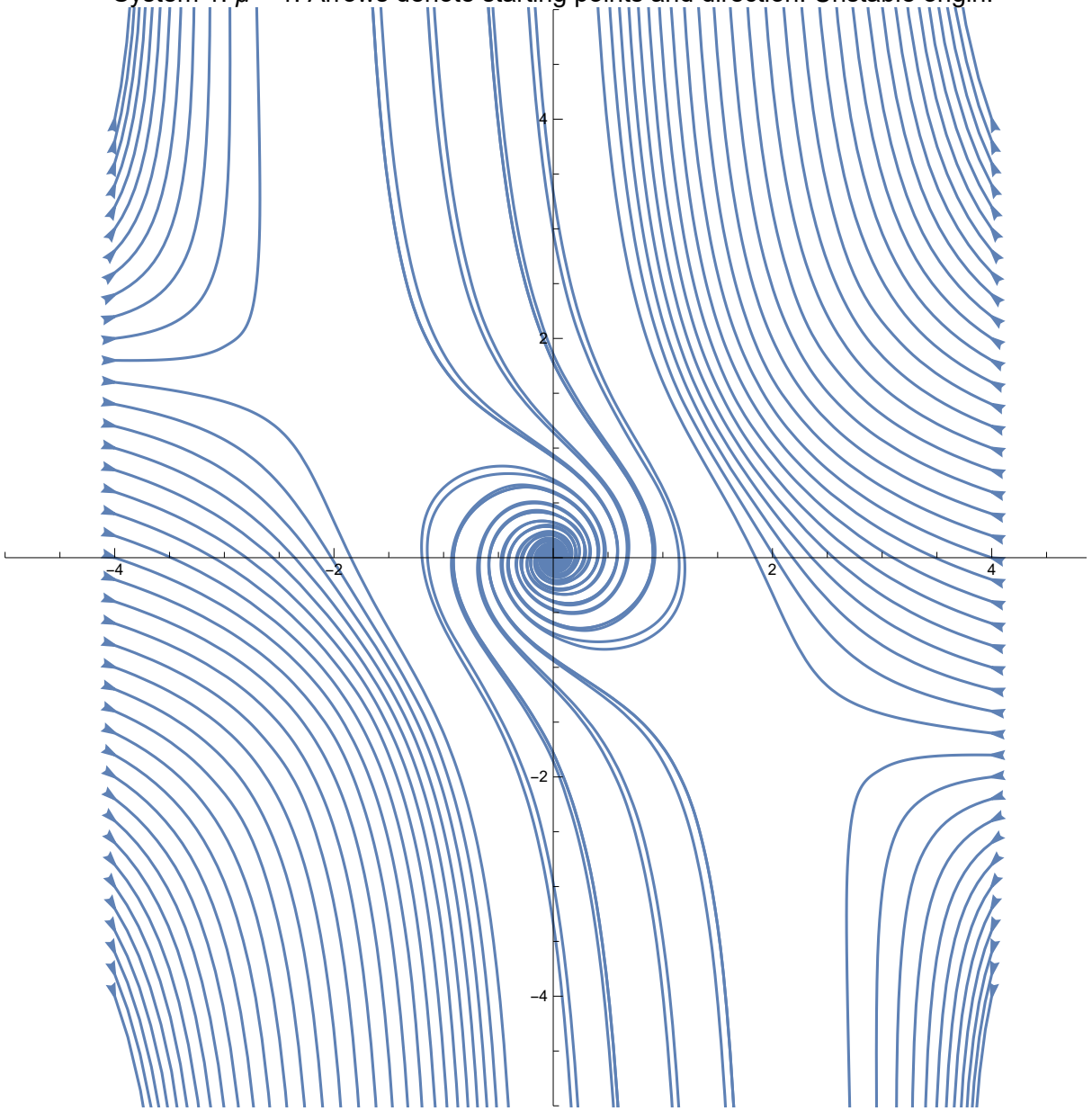
... NDSolve: At t == 4.622847994309177`, step size is effectively zero; singularity or stiff system suspected.

... NDSolve: At t == 4.717209143655243`, step size is effectively zero; singularity or stiff system suspected.

... General: Further output of NDSolve::ndsz will be suppressed during this calculation.

System 1. μ = 1. Arrows denote starting points and direction. Unstable origin.

Out[•]=



In[707]:=
```
minxplot = -5;
maxxplot = 5;
minyplot = -5;
maxyplot = 5;

μ = -1;

sol[u_, v_] :=
 NDSolve[{x'[t] == μ * x[t] - 5 y[t] - x[t]^3, y'[t] == 5 x[t] + μ * y[t] + 3 y[t]^3,
   x[0] == u, y[0] == v}, {x, y}, {t, 10}, Method → "StiffnessSwitching"]

miny = -2;
maxy = 2;
minx = -2;
maxx = 2;
step = 0.2;
```

```
Table11 = Table[{minx, y}, {y, miny, maxy, step}];
Table21 = Table[{x, maxy}, {x, minx, maxx, step}];
Table31 = Table[{maxx, y}, {y, miny, maxy, step}];
Table41 = Table[{x, miny}, {x, minx, maxx, step}];

miny = -4;
maxy = 4;
minx = -4;
maxx = 4;
step = 0.2;

Table12 = Table[{minx, y}, {y, miny, maxy, step}];
Table22 = Table[{x, maxy}, {x, minx, maxx, step}];
Table32 = Table[{maxx, y}, {y, miny, maxy, step}];
Table42 = Table[{x, miny}, {x, minx, maxx, step}];

miny = -1;
maxy = 1;
minx = -1;
maxx = 1;
step = 0.2;

Table13 = Table[{minx, y}, {y, miny, maxy, step}];
Table23 = Table[{x, maxy}, {x, minx, maxx, step}];
Table33 = Table[{maxx, y}, {y, miny, maxy, step}];
Table43 = Table[{x, miny}, {x, minx, maxx, step}];



TableFinal = Join[Table11, Table21, Table31, Table41, Table12,
   Table22, Table32, Table42, Table13, Table23, Table33, Table43];

Show[Table[ParametricPlot[
    Evaluate[{x[t], y[t]} /. sol[TableFinal[[i, 1]], TableFinal[[i, 2]]]],
    {t, 0, 5}, PlotRange → {{minxplot, maxxplot}, {minyplot, maxyplot}},
    PlotLabel → Style["System 1. μ = -1. Arrows denote starting
        points and direction. Stable origin.", FontSize → 15]] /.
   Line[x_] :↦ {Arrowheads[{0.01, 0.}], Arrow[x]}, {i, Length[TableFinal]}]]
```

... NDSolve: At t == 0.037882367181830655`, step size is effectively zero; singularity or stiff system suspected.

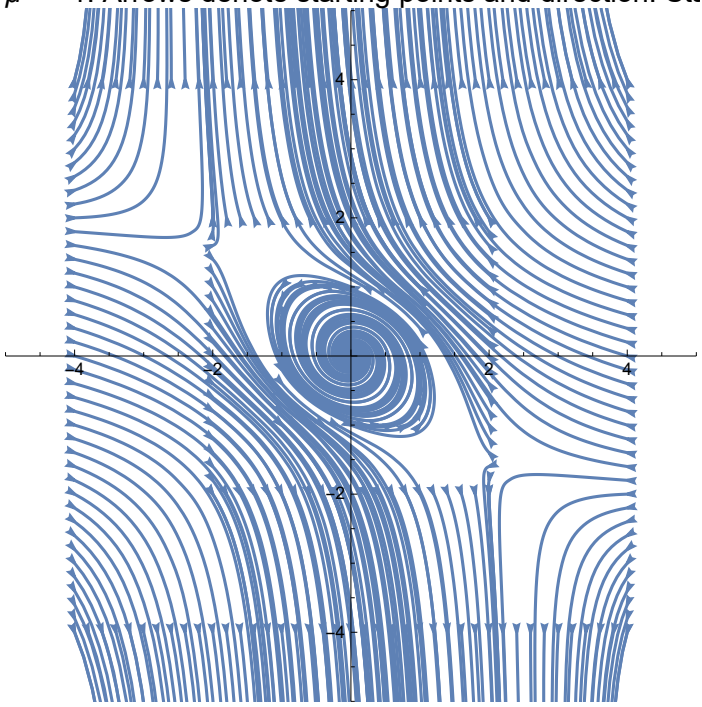
... NDSolve: At t == 0.045258189821241454`, step size is effectively zero; singularity or stiff system suspected.

... NDSolve: At t == 0.05464811135174331`, step size is effectively zero; singularity or stiff system suspected.

... General: Further output of NDSolve::ndsz will be suppressed during this calculation.

$\mu = -1$. Arrows denote starting points and direction. Sta

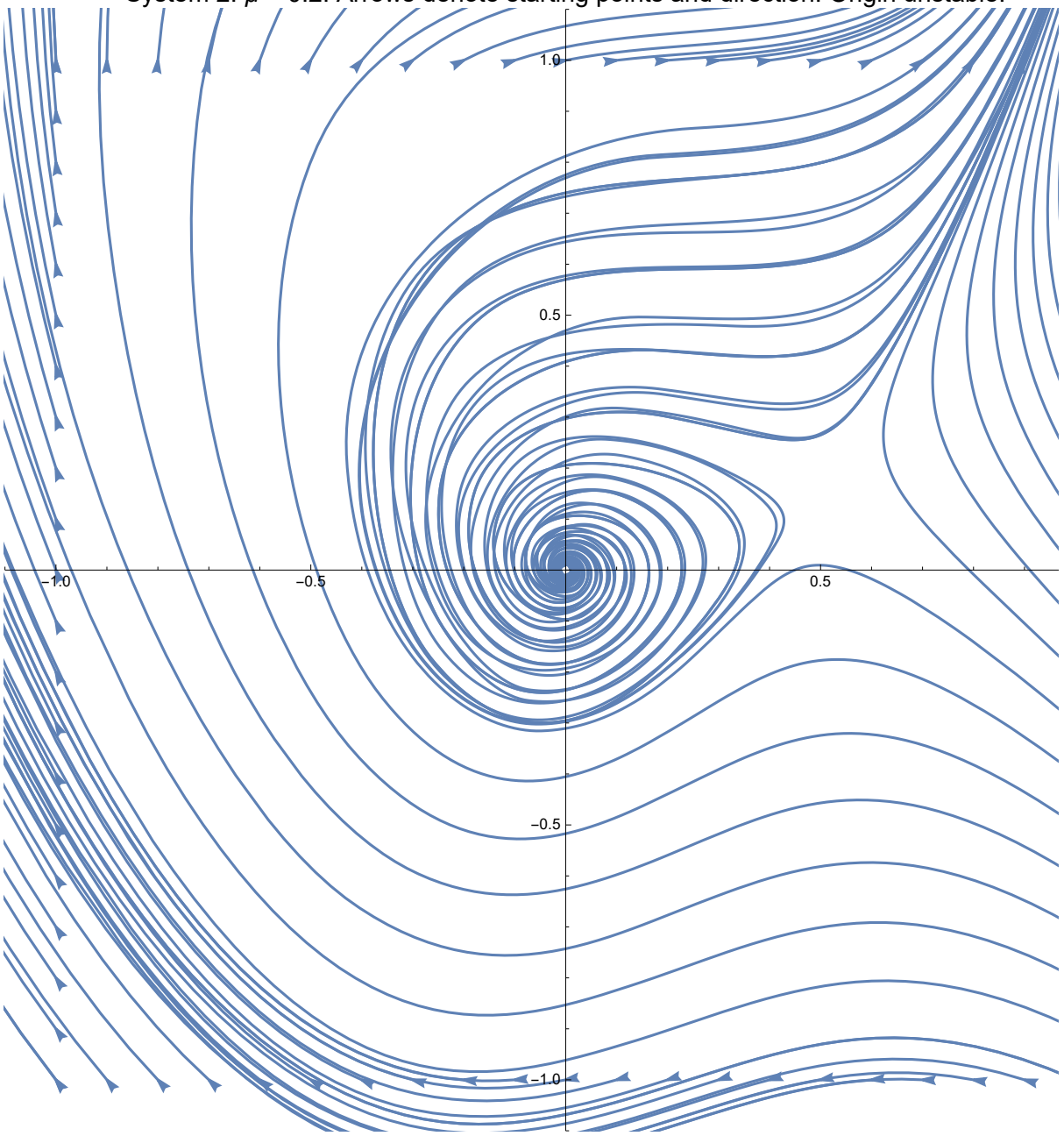
Out[741]=



In[462]:=
```
minxplot = -1.1;
maxxplot = 1.1;
minyplot = -1.1;
maxyplot = 1.1;

μ = 0.2;

sol[u_, v_] :=
 NDSolve[{x'[t] == μ * x[t] + y[t] - x[t]^2, y'[t] == -x[t] + μ * y[t] + 2 * x[t]^2,
   x[0] == u, y[0] == v}, {x, y}, {t, 100}, Method → "StiffnessSwitching"]

miny = -0.01;
maxy = 0.01;
minx = -0.01;
maxx = 0.01;
step = 0.005;

Table11 = Table[{minx, y}, {y, miny, maxy, step}];
Table21 = Table[{x, maxy}, {x, minx, maxx, step}];
Table31 = Table[{maxx, y}, {y, miny, maxy, step}];
Table41 = Table[{x, miny}, {x, minx, maxx, step}];


miny = -1;
maxy = 1;
minx = -1;
maxx = 1;
step = 0.1;

Table13 = Table[{minx, y}, {y, miny, maxy, step}];
Table23 = Table[{x, maxy}, {x, minx, maxx, step}];
Table33 = Table[{maxx, y}, {y, miny, maxy, step}];
Table43 = Table[{x, miny}, {x, minx, maxx, step}];

TableFinal =
  Join[Table11, Table21, Table31, Table41, Table13, Table23, Table33, Table43];

Show[Table[ParametricPlot[
    Evaluate[{x[t], y[t]} /. sol[TableFinal[[i, 1]], TableFinal[[i, 2]]]],
    {t, 0, 100}, PlotRange → {{minxplot, maxxplot}, {minyplot, maxyplot}},
    PlotLabel → Style["System 2. μ = 0.2. Arrows denote starting
        points and direction. Origin unstable.", FontSize → 15]] /.
   Line[x_] :> {Arrowheads[{0.01, 0.}], Arrow[x]}, {i, Length[TableFinal]}]]
```

System 2. μ = 0.2. Arrows denote starting points and direction. Origin unstable.

Out[487]=



In[488]:=
```
minxplot = -1.1;
maxxplot = 1.1;
minyplot = -1.1;
maxyplot = 1.1;

μ = -0.2;

sol[u_, v_] :=
 NDSolve[{x'[t] == μ * x[t] + y[t] - x[t]^2, y'[t] == -x[t] + μ * y[t] + 2 * x[t]^2,
   x[0] == u, y[0] == v}, {x, y}, {t, 100}, Method → "StiffnessSwitching"]



miny = -1;
maxy = 1;
minx = -1;
maxx = 1;
step = 0.1;

Table13 = Table[{minx, y}, {y, miny, maxy, step}];
Table23 = Table[{x, maxy}, {x, minx, maxx, step}];
Table33 = Table[{maxx, y}, {y, miny, maxy, step}];
Table43 = Table[{x, miny}, {x, minx, maxx, step}];



TableFinal = Join[Table13, Table23, Table33, Table43];


Show[Table[ParametricPlot[
    Evaluate[{x[t], y[t]} /. sol[TableFinal[[i, 1]], TableFinal[[i, 2]]]],
    {t, 0, 100}, PlotRange → {{minxplot, maxxplot}, {minyplot, maxyplot}},
    PlotLabel → Style["System 2. μ = -0.2. Arrows denote starting
        points and direction. Origin stable.", FontSize → 15]] /.
   Line[x_] :→ {Arrowheads[{0.01, 0.}], Arrow[x]}, {i, Length[TableFinal]}}]
```

System 2. $\mu = -0.2$. Arrows denote starting points and direction. Origin stable.

Out[504]=