QUENCHING REACTION

Differential equation for the excess temperature $u = \theta - 1$:

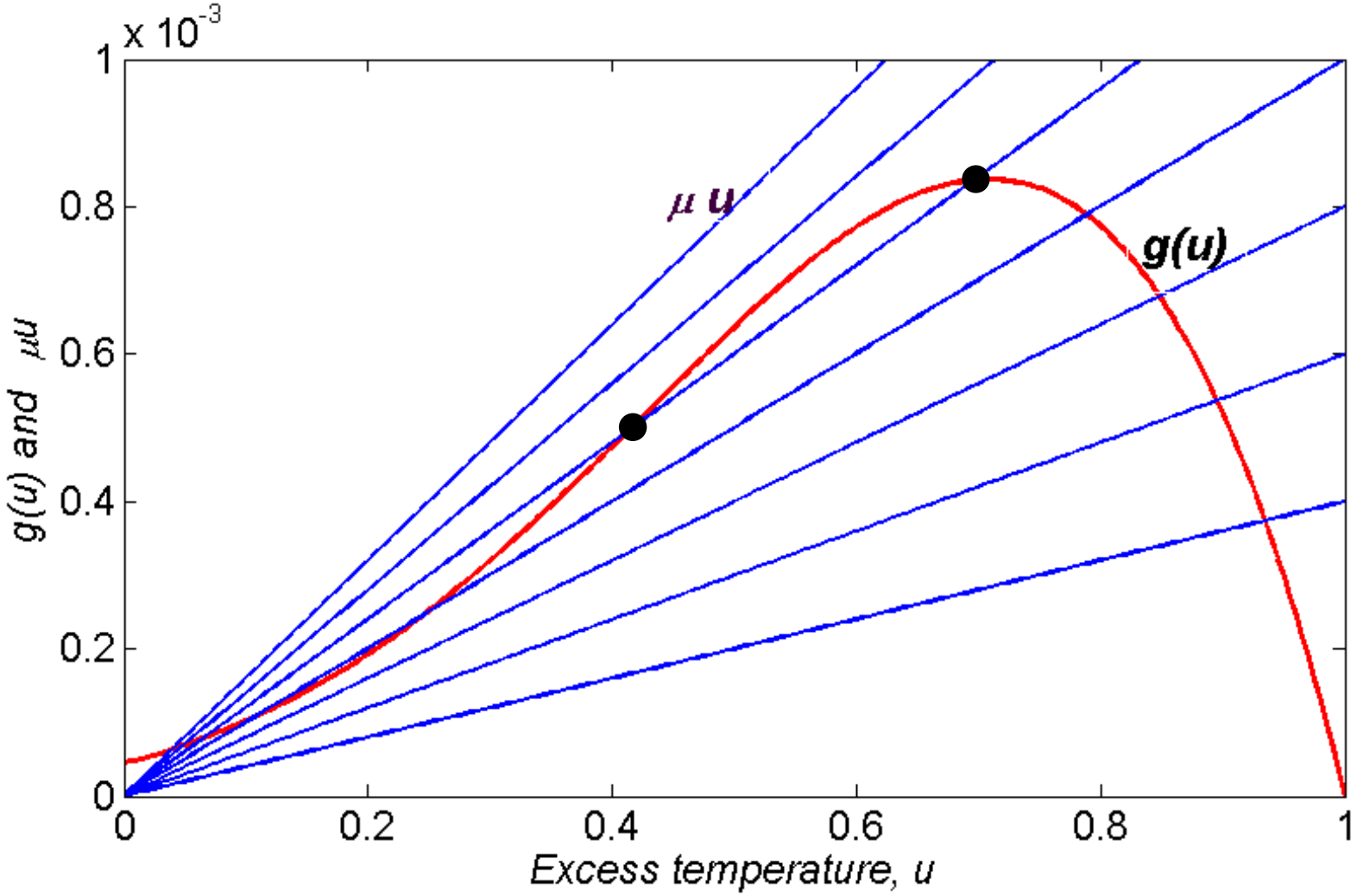
$$\frac{du}{dt} = f(u,\mu) = -u + \frac{b-u}{\mu} e^{-\gamma/(u+1)}$$

Equilibrium solutions satisfy

$$\mu u_0 = g(u_0) = (b - u_0) e^{-\gamma/(u_0+1)}$$

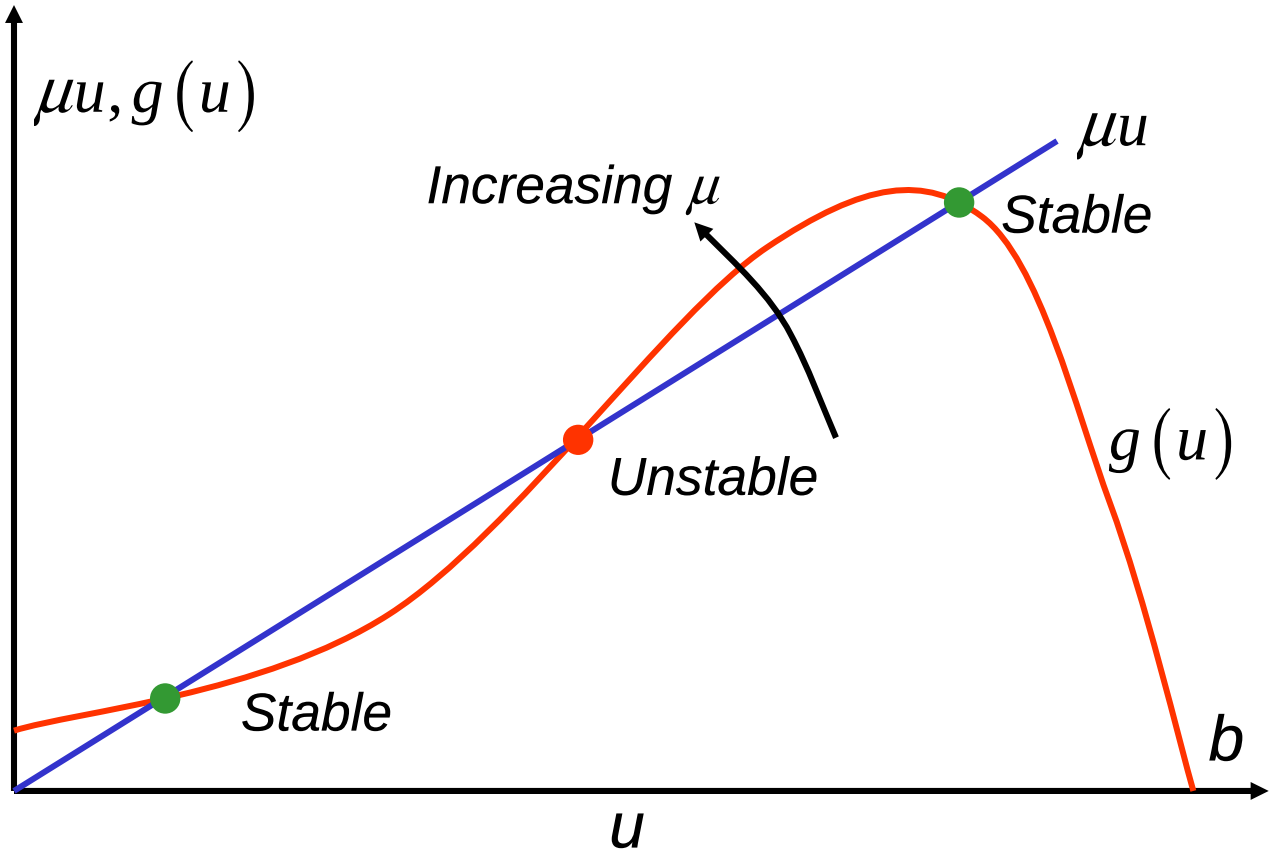
$$g(u) = (1-u) \times e^{-10/(u+1)} \qquad (b=1, \gamma=10)$$

$$\mu = .4 \times 10^{-3} \quad - \quad 1.6 \times 10^{-3}$$

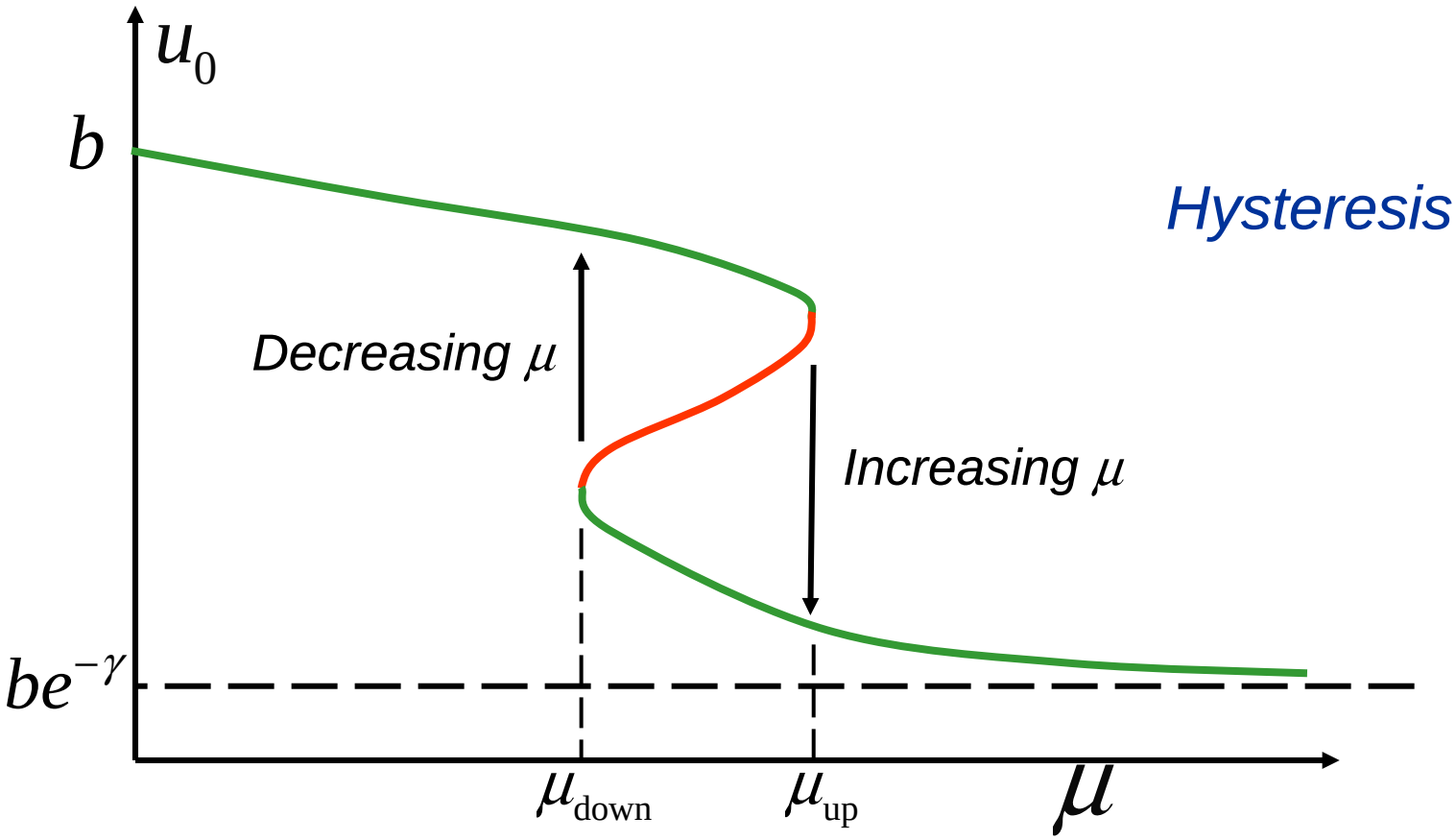


$$\frac{du}{dt} = f(u,\mu) = -u + \frac{b-u}{\mu} e^{-\gamma/(u+1)}$$

$$\frac{df(u)}{du} = -1 + \frac{1}{\mu}\frac{dg(u)}{du} = \begin{cases} > 0 & \text{if } g'(u) > \mu \\ < 0 & \text{if } g'(u) < \mu \end{cases}$$



BIFURCATION DIAGRAM:



Consider a *slowly time-varying* μ :

$$\frac{du}{dt} = f\left(u, \mu(t)\right) = -u + \frac{b-u}{\mu(t)} e^{-\gamma/(u+1)}$$

$$b = 1$$

$$\gamma = 10$$

$$\mu(t) = 1.1\times10^{-3} + 0.3\times10^{-3}\sin(\varepsilon t)$$

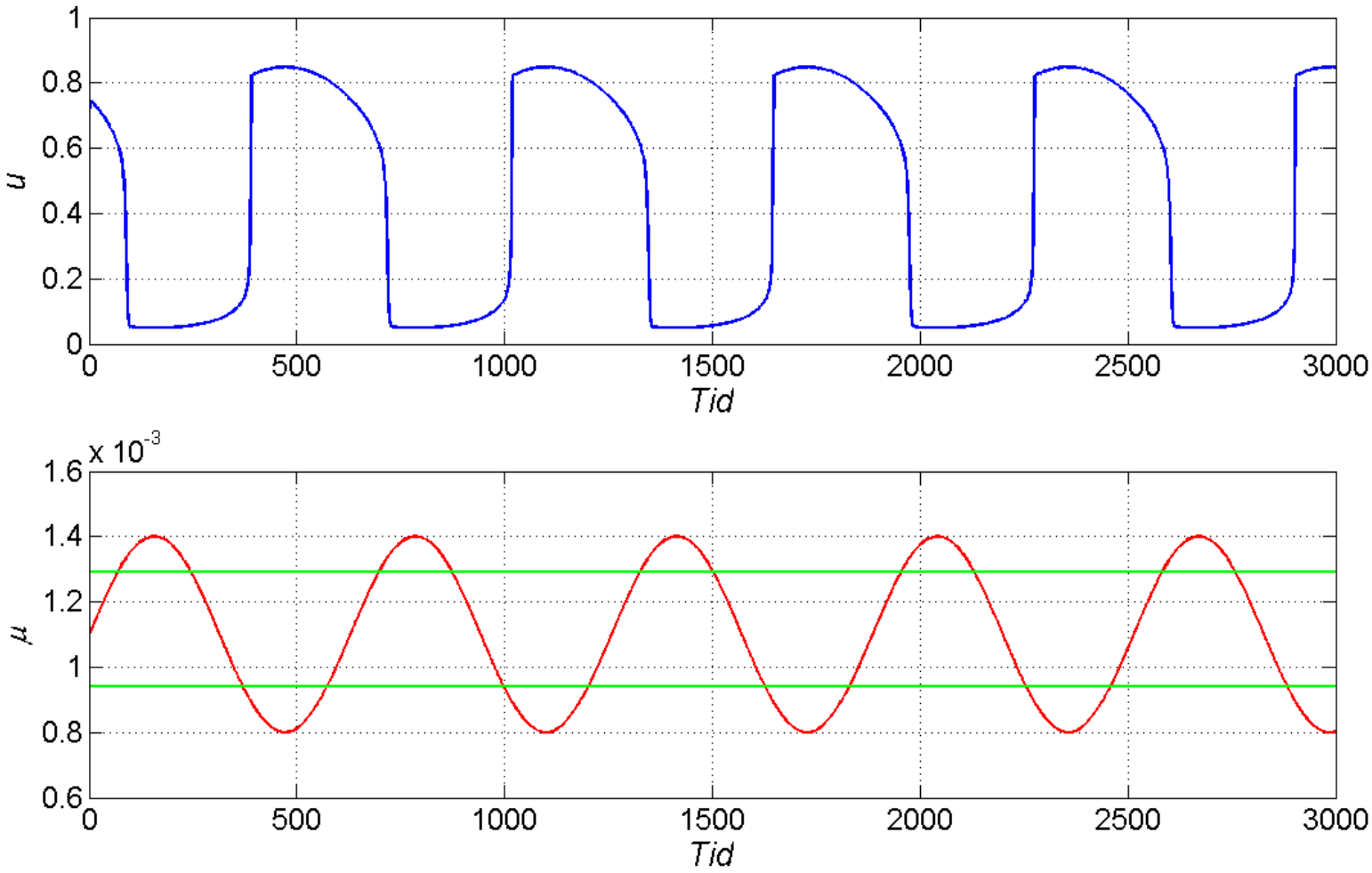
$$\varepsilon = 0.01$$

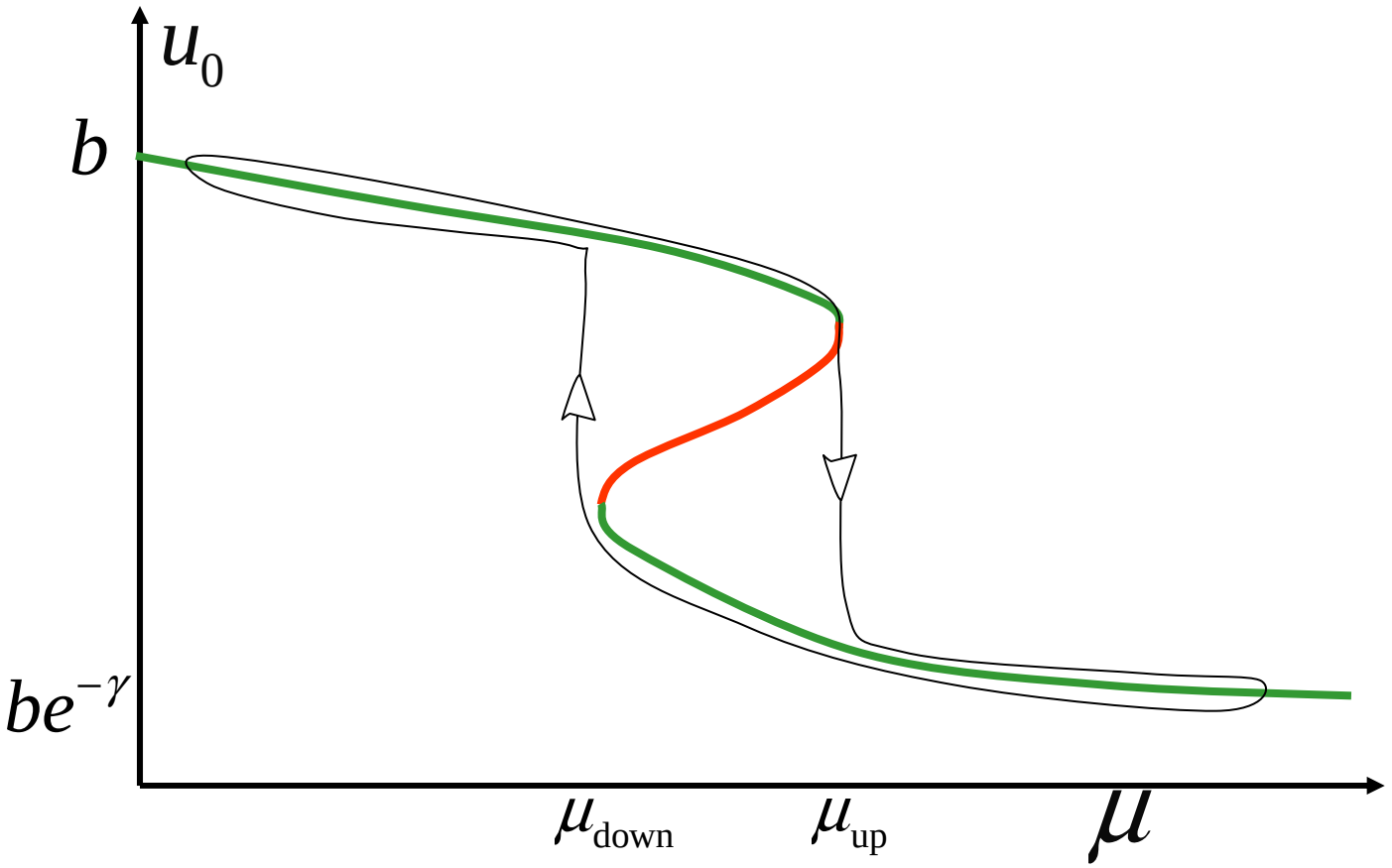
$$\mu_{\text{down}} \approx 0.94\times10^{-3}$$

$$\mu_{\text{up}} \approx 1.29\times10^{-3}$$

```
tspan =[0 3000]; u0 = 0.7;
[t,u]=ode45('quenching',tspan,u0);

subplot(2,1,1)
plot(t,u,'LineWidth',1.5)
grid
axis([0 3000 0 1])
xlabel('Time');
ylabel('u');

mu = 1.1e-3 + 0.3e-3*sin(t/100);

subplot(2,1,2)
plot(t,mu,'r',t,12.9e-4*ones(size(t)),'g',...
     t,9.4e-4*ones(size(t)),'g','LineWidth',1.5)
xlabel('Time'); ylabel('\mu');
grid
axis([0 3000 0.6e-3 1.6e-3])
```

```
function xd=quenching(t,u)
my = 1.1e-3 + 0.3e-3*sin(t/100);
g = (1-u)*exp(-10./(u+1));
xd = -u + g/my;
```


1
0.8
0.6
0.4
0.2
0
u
0
500
1000
1500
2000
2500
3000
Tid
x 10^-3
1.6
1.4
1.2
1
0.8
0.6
μ
0
500
1000
1500
2000
2500
3000
Tid


u_0
b
$be^{-\gamma}$
μ_{down}
μ_{up}
μ