READING for Weds.

(to post tonight)

HODGKIN-HUXLEY model

$$\frac{dV}{dt} = \frac{-1}{C}\left(g_{Na}(V-V_{Na}) + g_K(V-V_K) + g_L(V-V_L)\right)$$

$$g_{Na} = \bar{g}_{Na}\, m^3 h; \quad g_K = \bar{g}_K\, n^4$$

$$\frac{dm}{dt} = \alpha_m(v)(1-m) + \beta_m(v)\, m \qquad m \in \{n, m, h\}$$

$$\alpha_m(v) = \frac{0.1\,(\boxed{v+25})}{\exp\left((v+25)/10\right)-1}$$

$v = -25$

$\alpha_m, \beta_m, \alpha_n, \beta_n, \alpha_n, \beta_n.$

DERIVED from voltage clamp
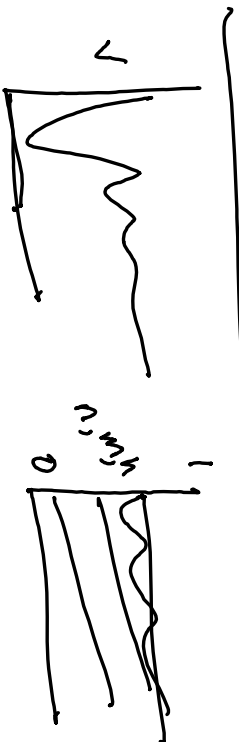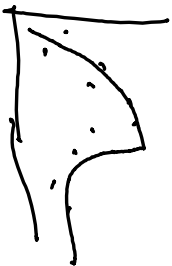
when $I = 0$
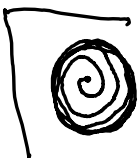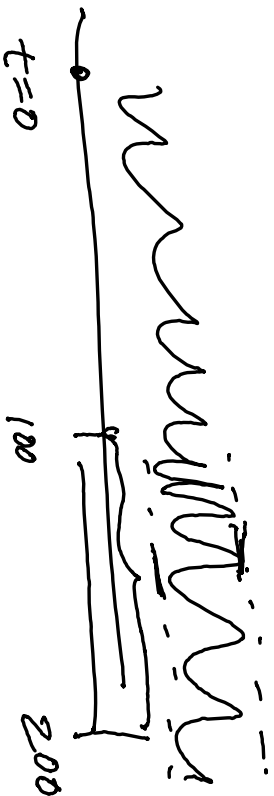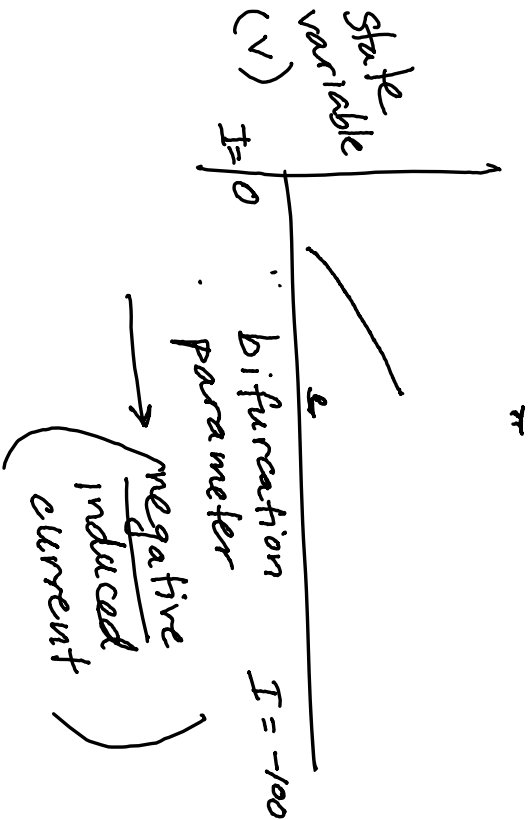this is not very
exciting

$I \rightarrow 0$

LIMIT cycle

BIFURCATION diagram ?

State variable (V)

I=0

bifurcation parameter (negative induced current)

I = -100

t=0

100

200

CO-DIMENSION ONE

(changing one parameter)

HOPF bifurcation

stable limit cycles

stable
ε_{ξ} . . . . a

$\lambda = a \pm b i$

SIGN of a changing
at bifurcation point
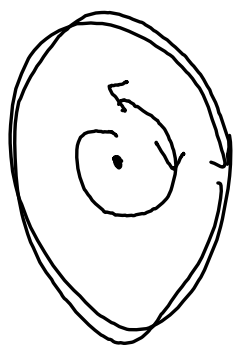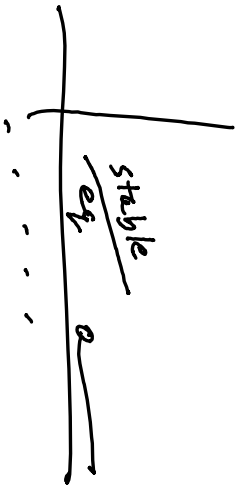
- $\{V, m\}$ phase plane of H-H (h, n change slowly)

nullclines
flow fields

- Fitzhugh-
Nagumo

m

V

SADDLE ($+/-$) $\rightsquigarrow$
separatrix

Fitz-Nagumo : 2D · LIMIT cycles
Poincaré-Bendixson

[Hindmarsh-Rose ; 3D · ⇝ Allows chaotic solution .

H-H 4D . Biologically realistic

trajectories of a deterministic continuous time ;
autonomous system can't cross

1D ; no limit cycles ←
2D ; no chaos