



上田研 ゼミ

# Hybrid系の運動について —flowとtransitionの時系列—



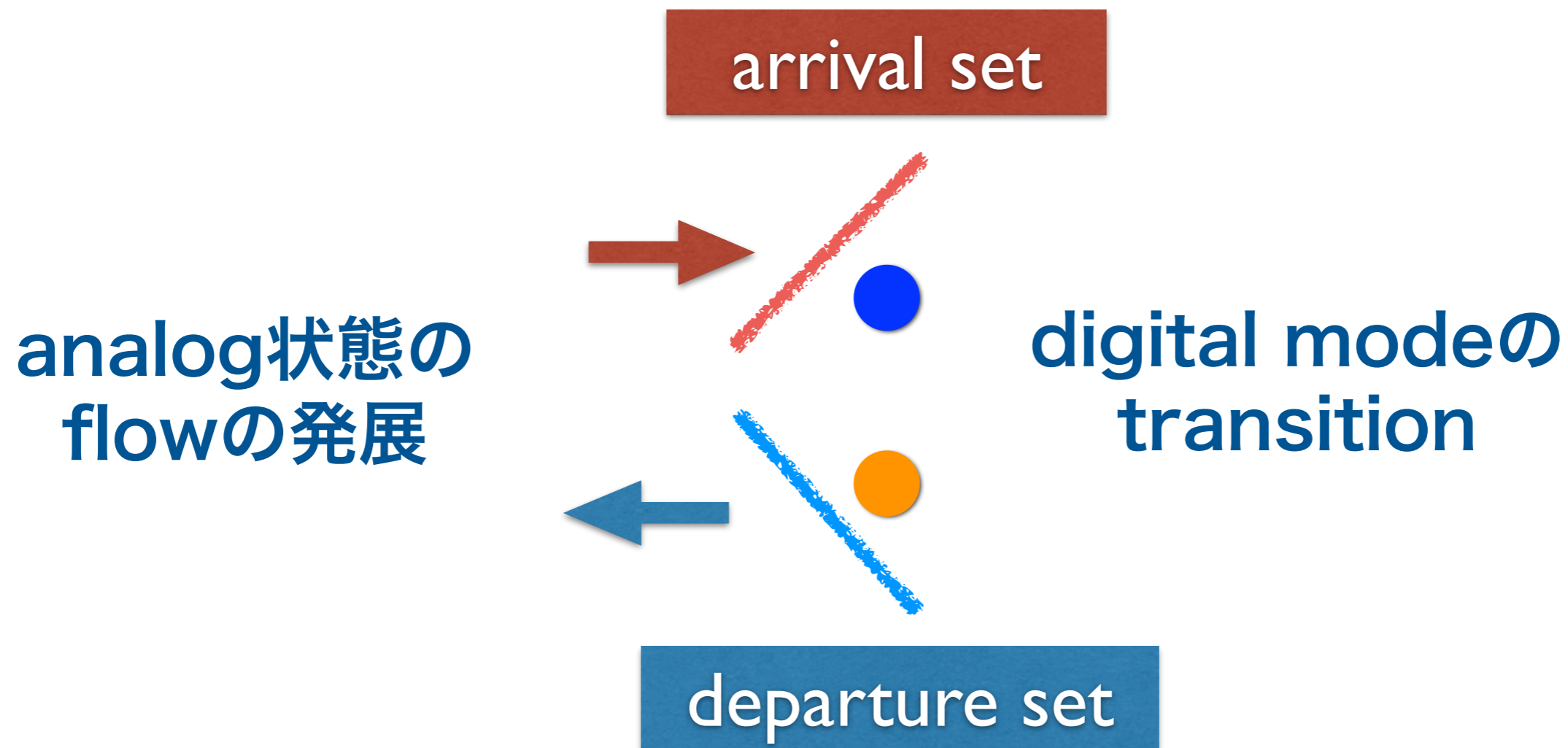
川上 博

2014(H26).05.07



# Hybridの運動とは？

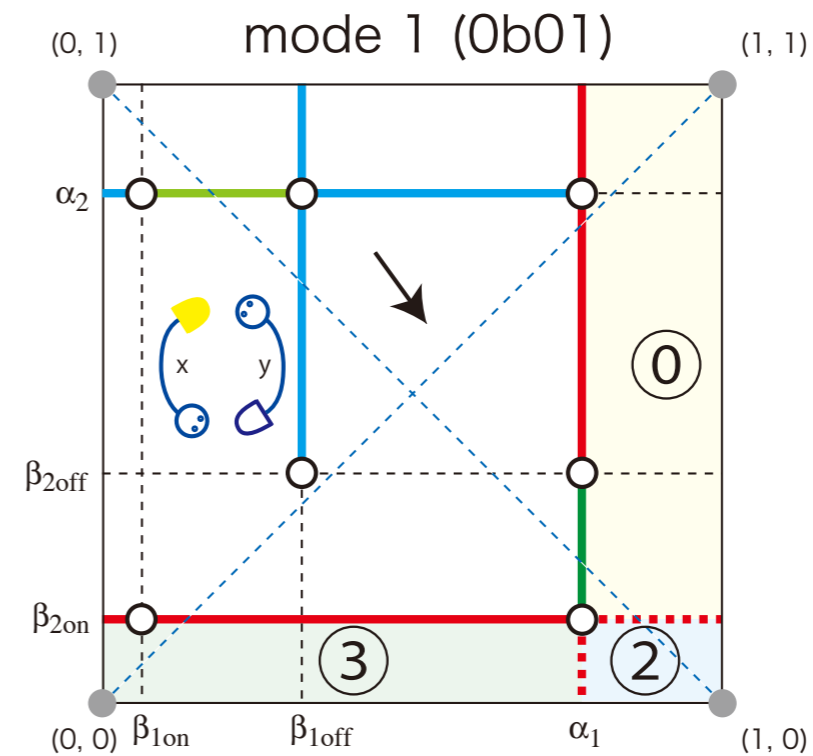
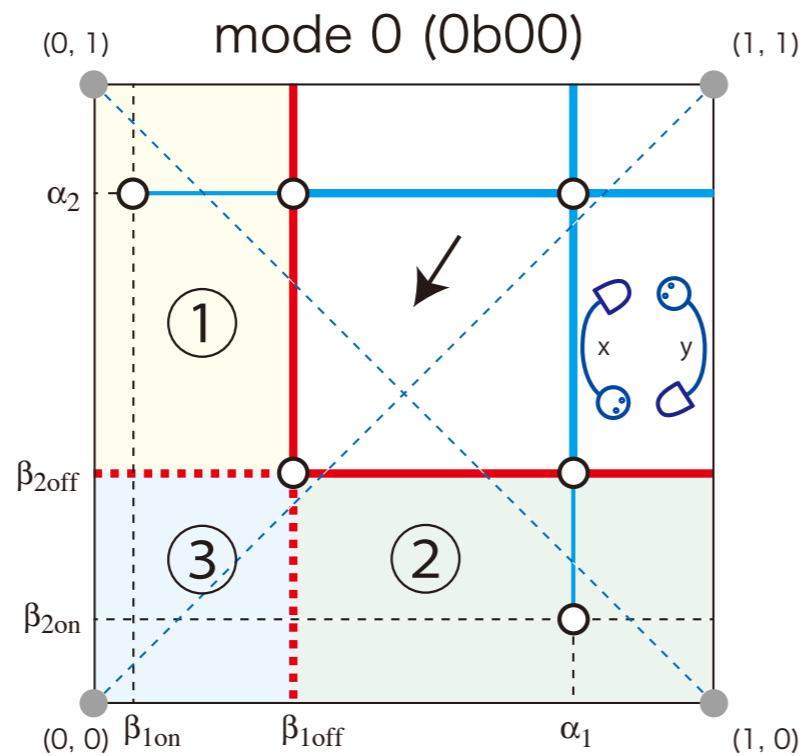
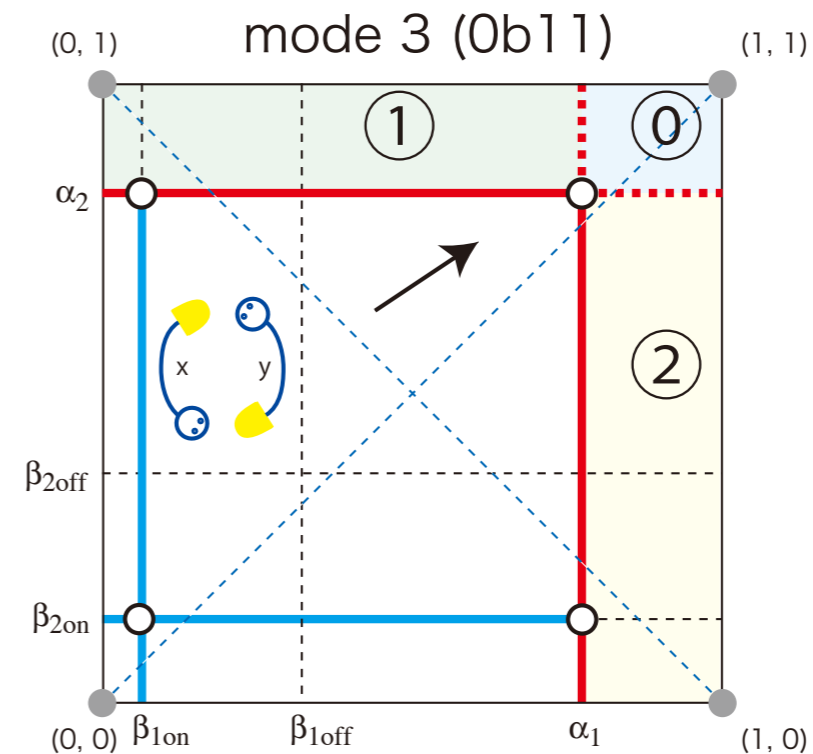
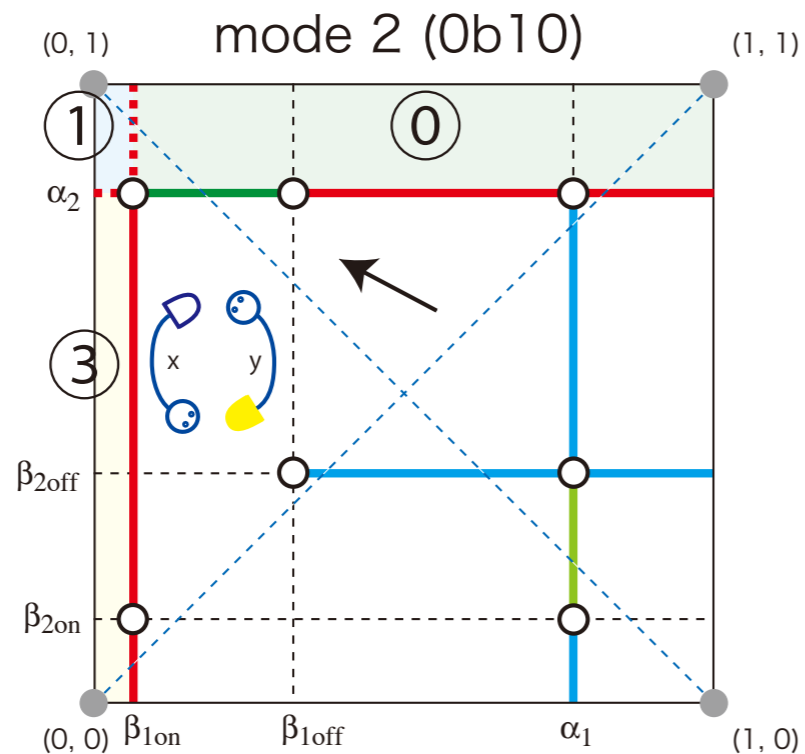
---



**運動 = flowとtransitionの時系列**



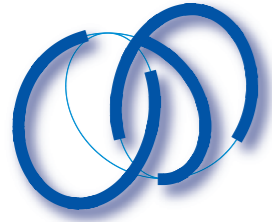
# type A1-A1 circuit : phase portrait



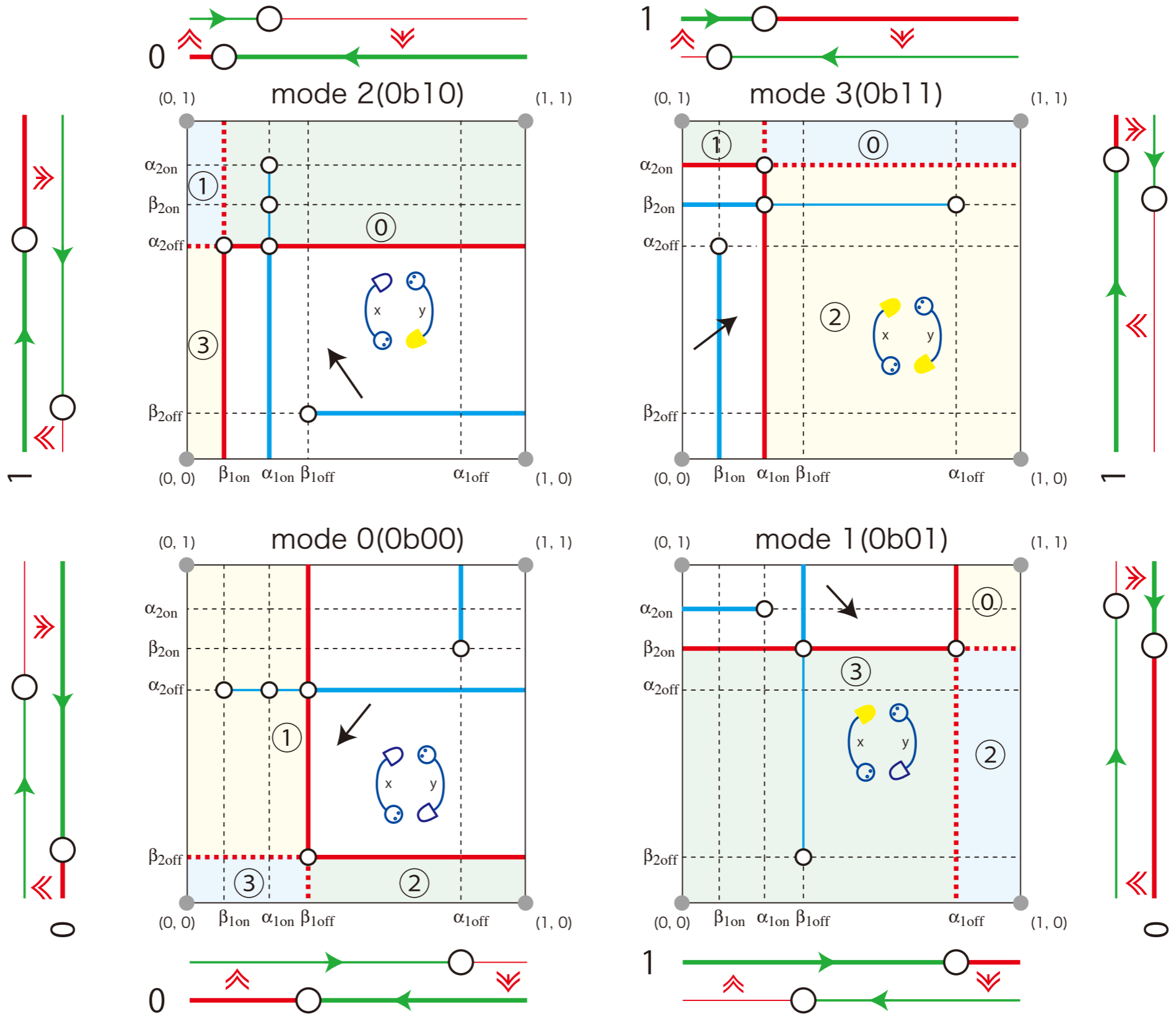
— arrival set

— departure set

— codimension 2 property



# type C1- D1 circuit : phase portrait



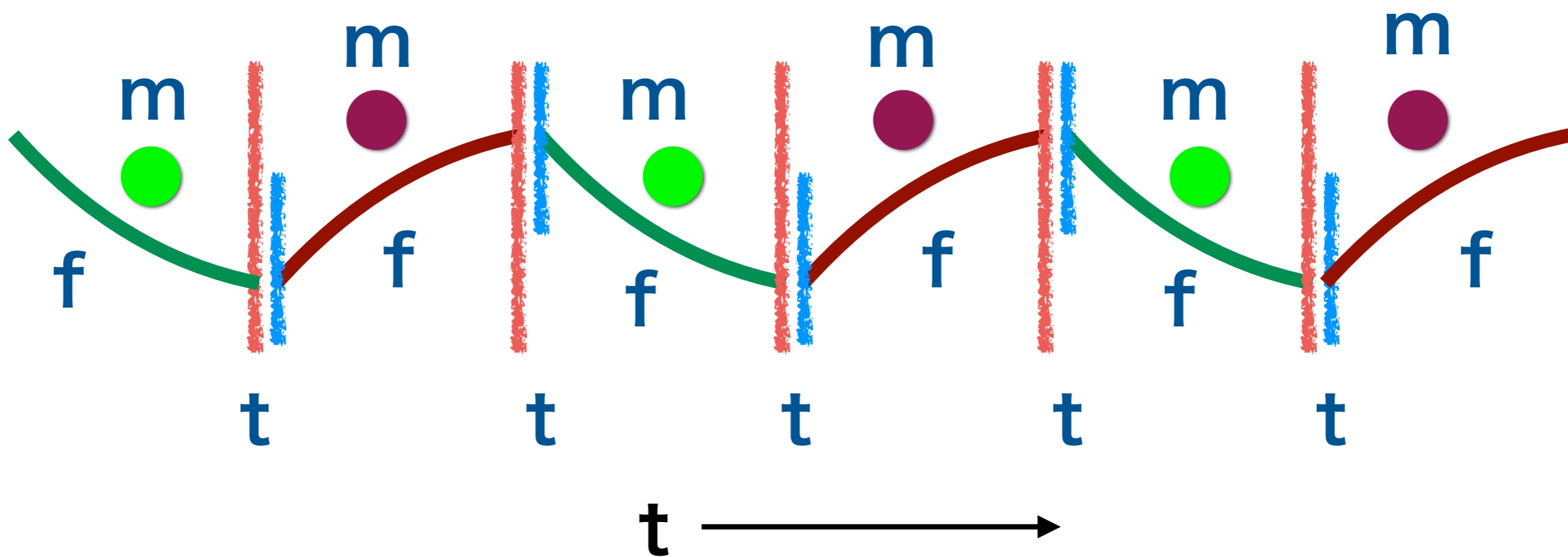


# Hybrid系の状態の時系列

f: flow    t: transition

ftftftft...

flowとtransitionの繰り返し

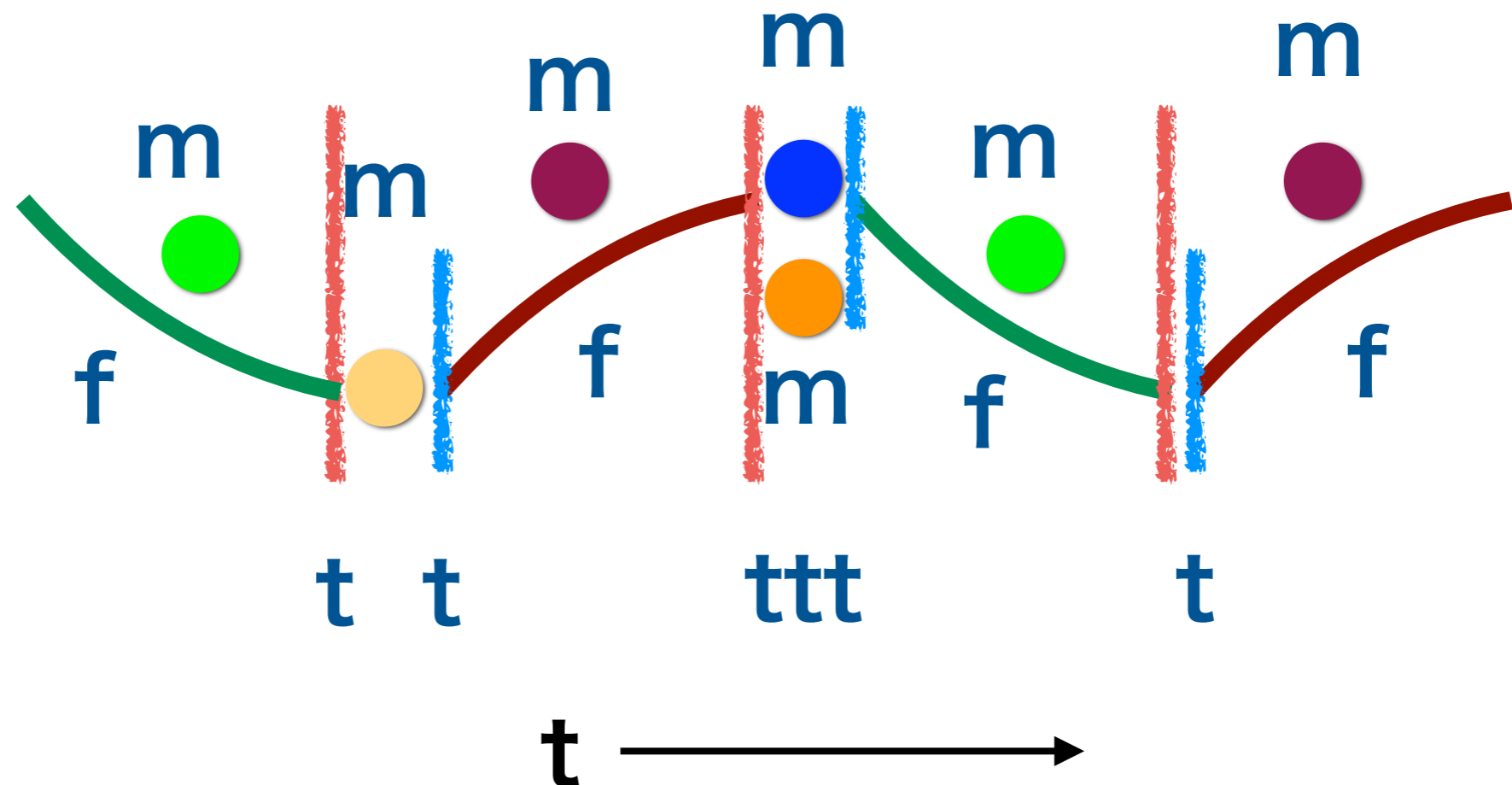


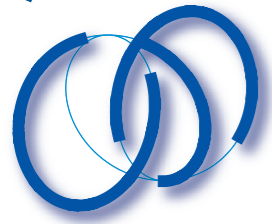


# Hybrid系：状態の進展と遷移

flowが進展している時は、modeは固定されている  
modeが遷移している時は、flowは固定されている  
**meta-stable state**

fttftttft...





## Hybrid系の定常状態

---

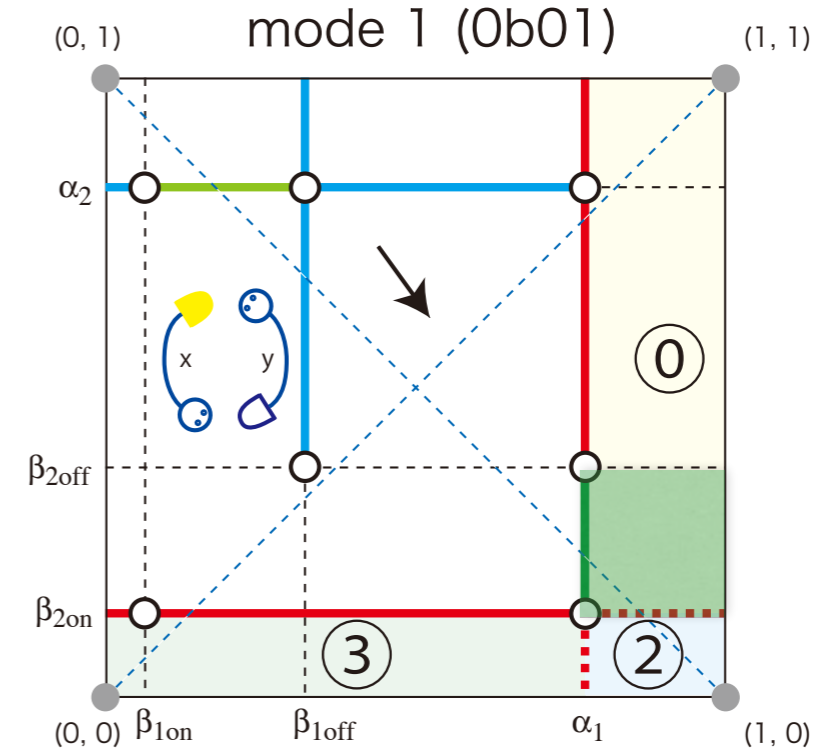
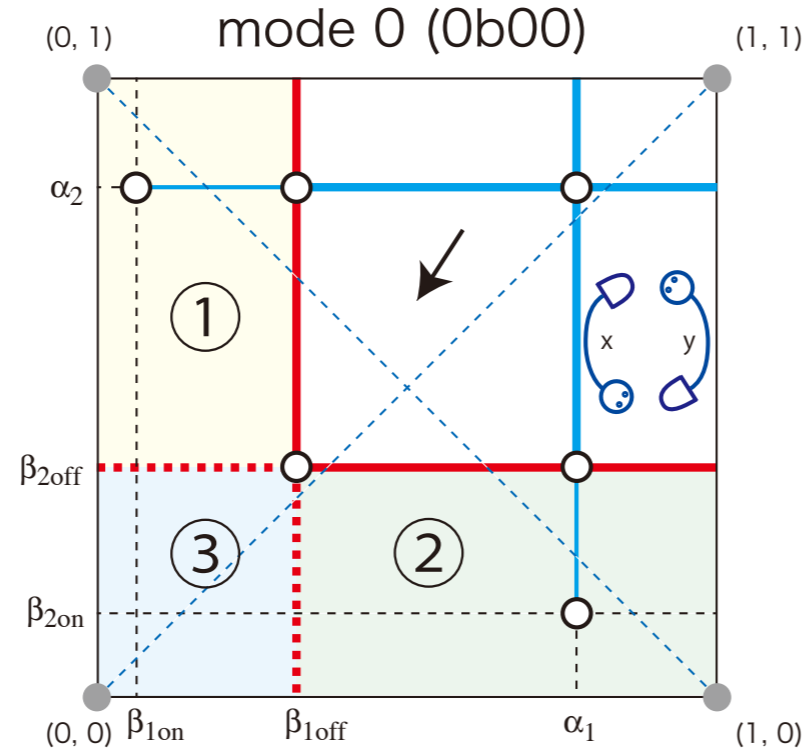
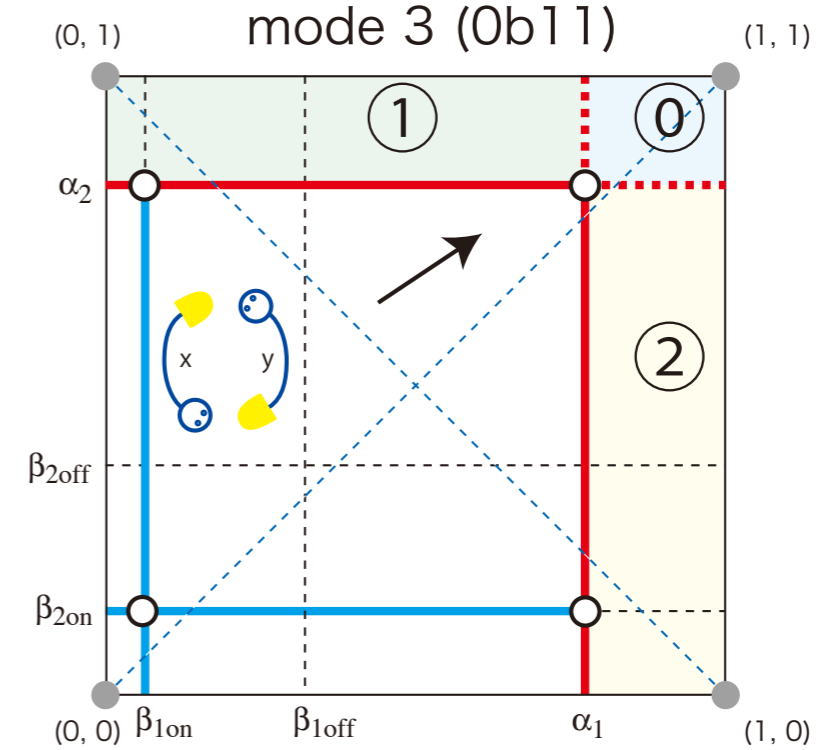
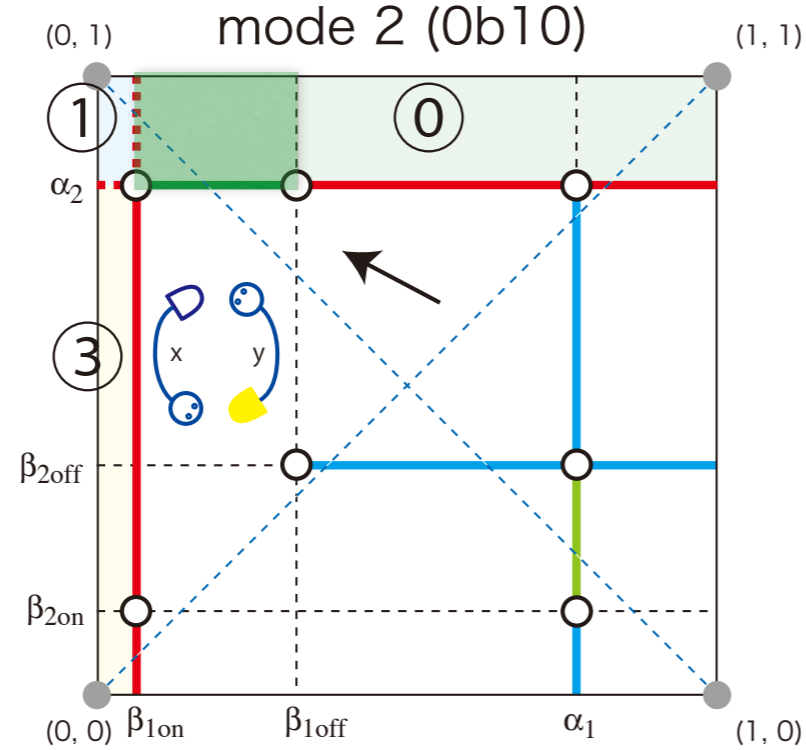
f: flow    t: transition

- 1) fffffff...      flowのattractorに収束
- 2) ftftftft...      flowとeventの繰り返し
- 3) fttftttftt...      flowと event<sup>n</sup> の繰り返し
- 4) fttttfttt...      flowと event<sup>n</sup> の繰り返し
- 5) tttttt...      transition loop

## type A1-A1 circuit : phase portrait



(ftt)



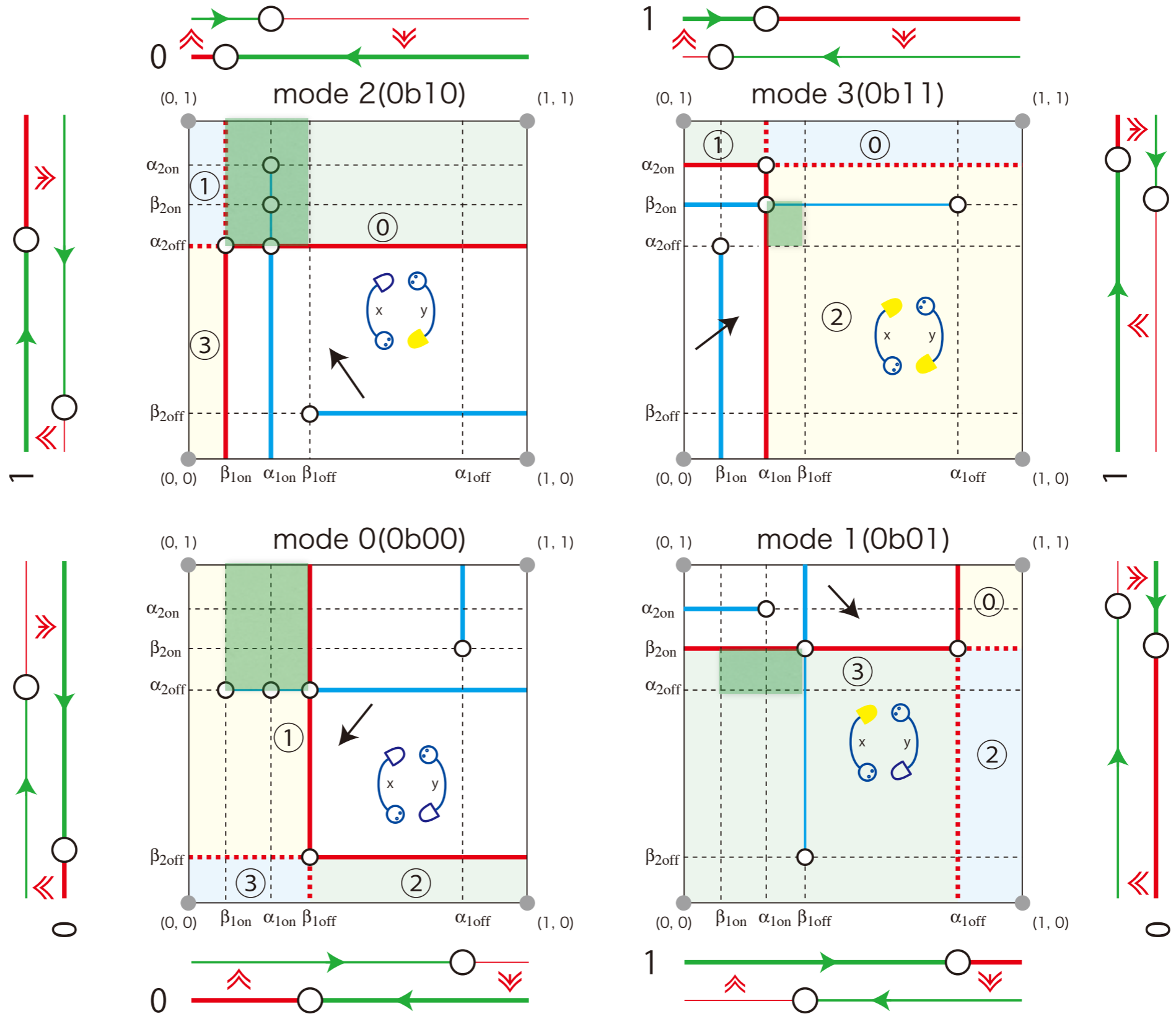
— arrival set      — departure set      — codimension 2 property





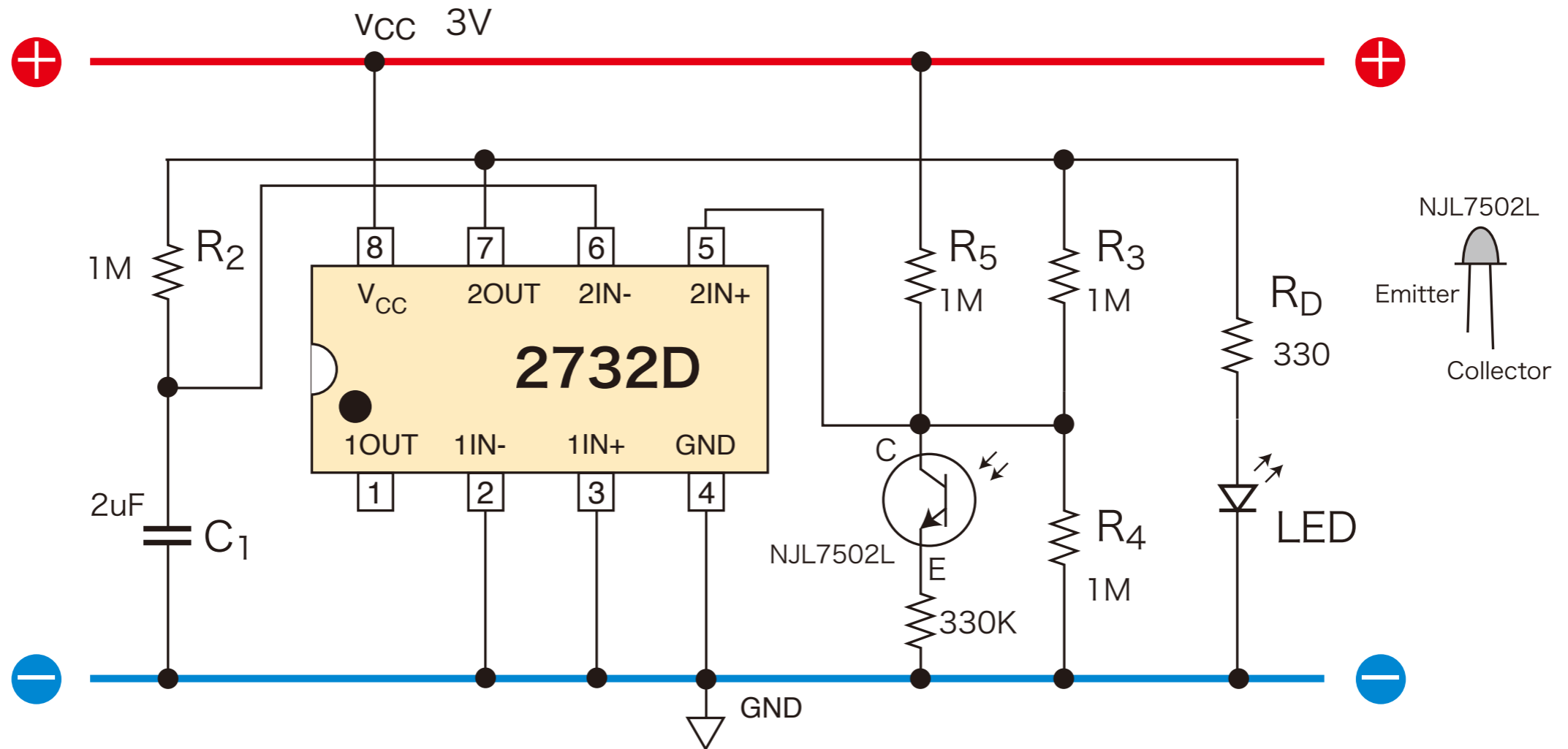
# type C1- D1 circuit : phase portrait

(tttt)





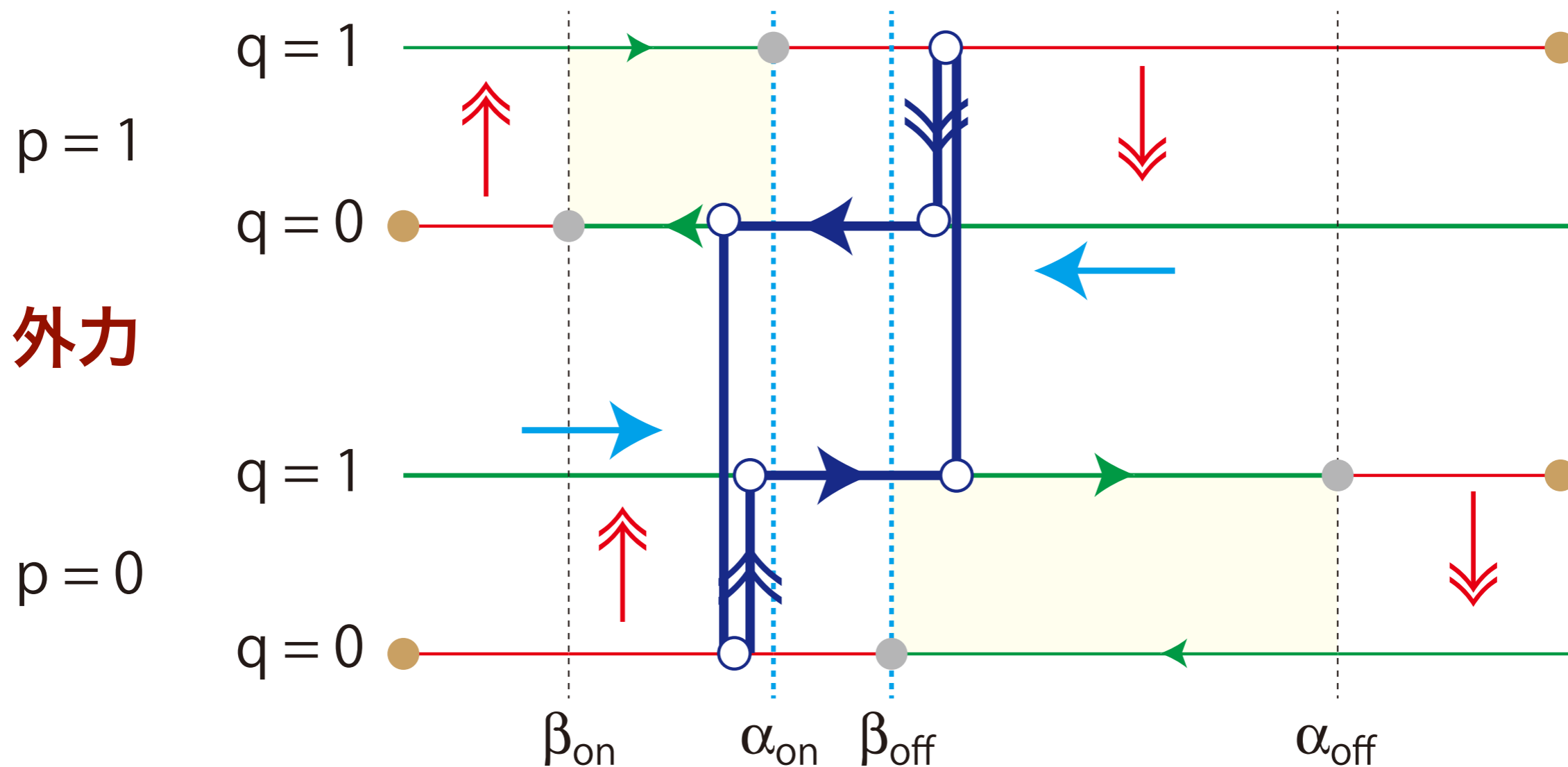
# LEDホタル type CIの回路





# LEDホタルの強制振動

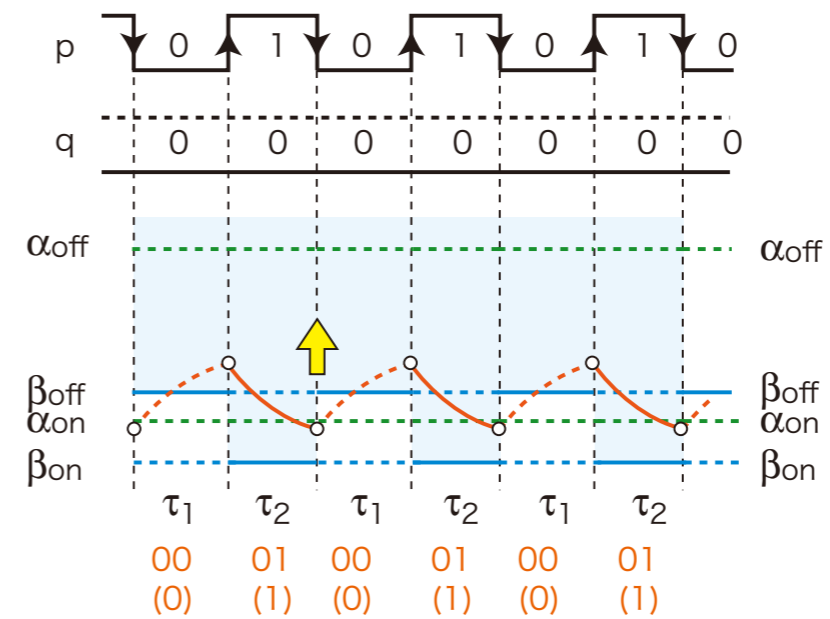
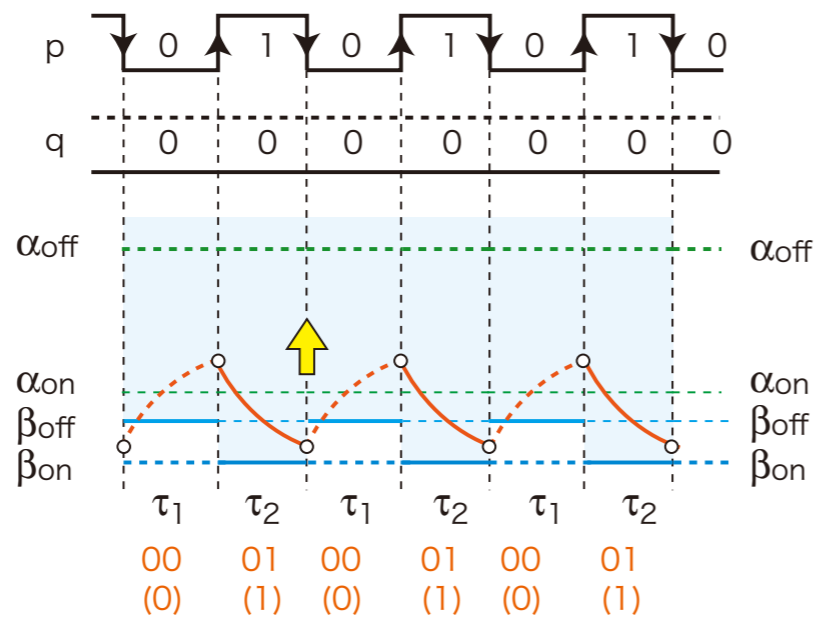
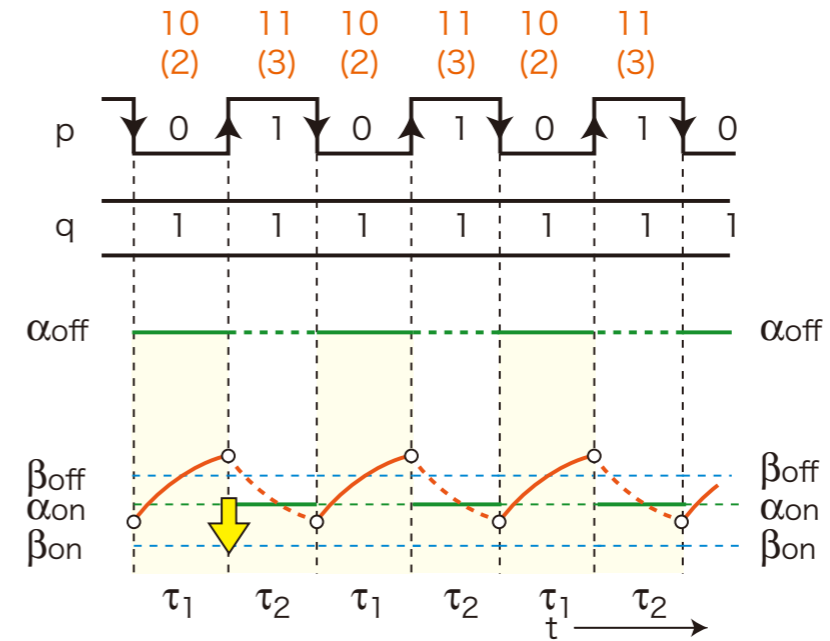
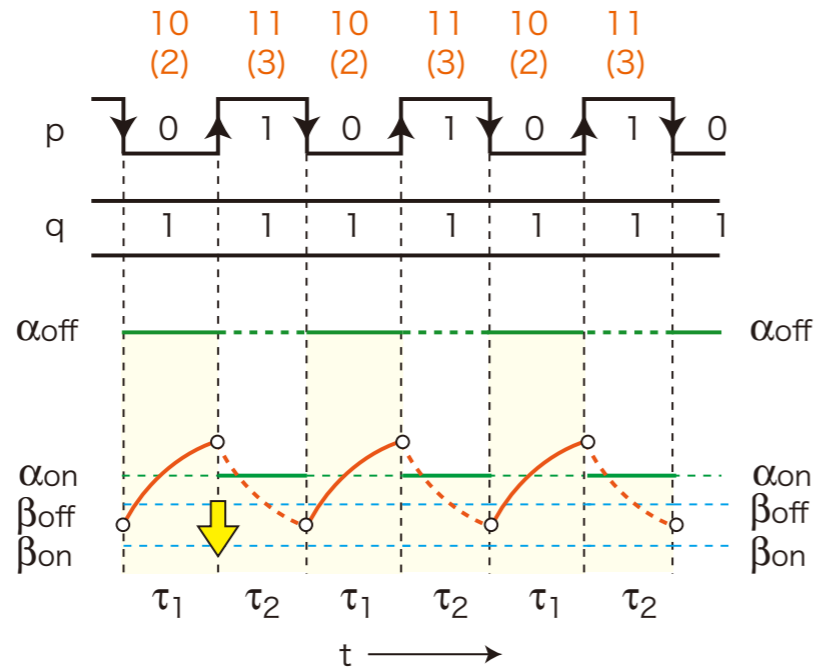
## comparator



外力の周波数を高くすると閾値を使わない振動となる

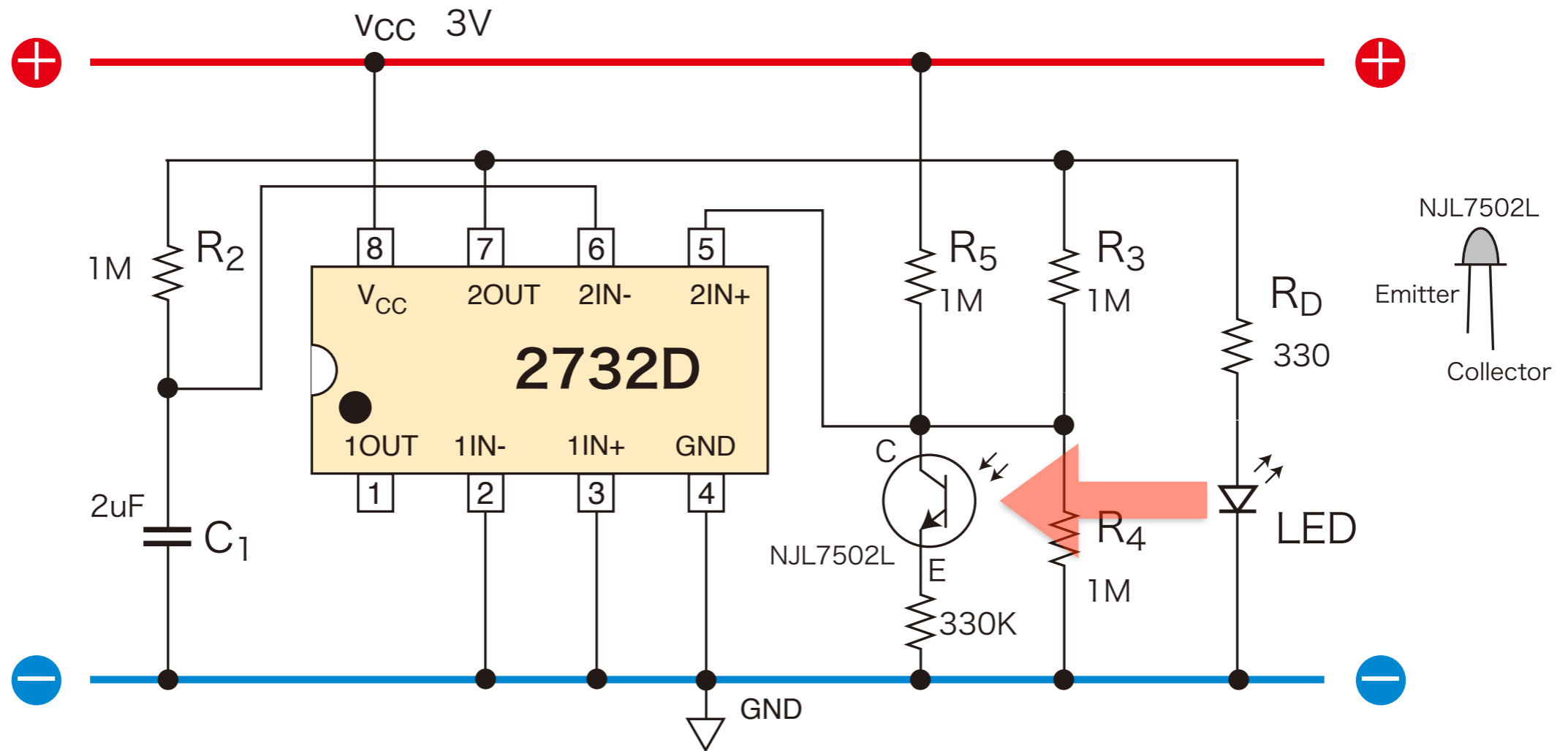


# Forced FF type CI: waveform





# LEDホタル type CIの発振



距離が短くなると発振周波数が高くなる

