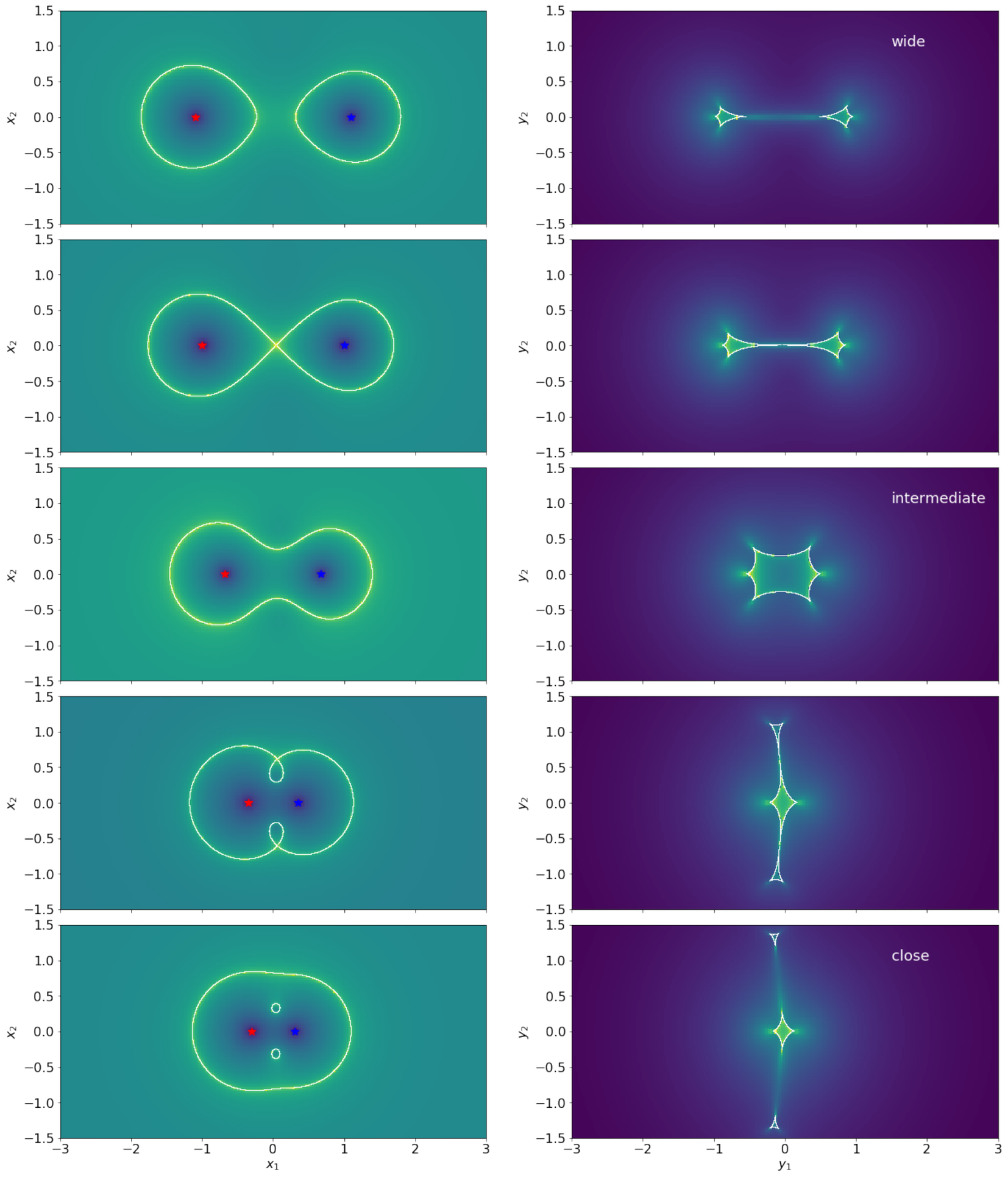
GRAVITATIONAL LENSING

16 – BINARY LENSES: PLANETARY MICROLENSING

Massimo Meneghetti
AA 2018-2019


wide
intermediate
close
x_1
x_2
y_1
y_2

PLANETARY MICROLENSING

- Let us consider the system consisting of an host star and a planet orbiting around it.
- This is an example of **binary** lens
- The host star is of course much heavier than the planet!
  - example: for a Jupiter-like planet q=0.001 (solar mass star)
  - example: for a Earth-like planet q=0.000003

WHAT KIND OF SIGNAL?

- **The light curve is that of the star…**
- The planet produces only a small perturbation to the magnification pattern, localized in a small region around the caustics
- Must cross one of these perturbed regions in order for the planet to be detected.
- The shape of the perturbation is determined by the caustic configuration…

a

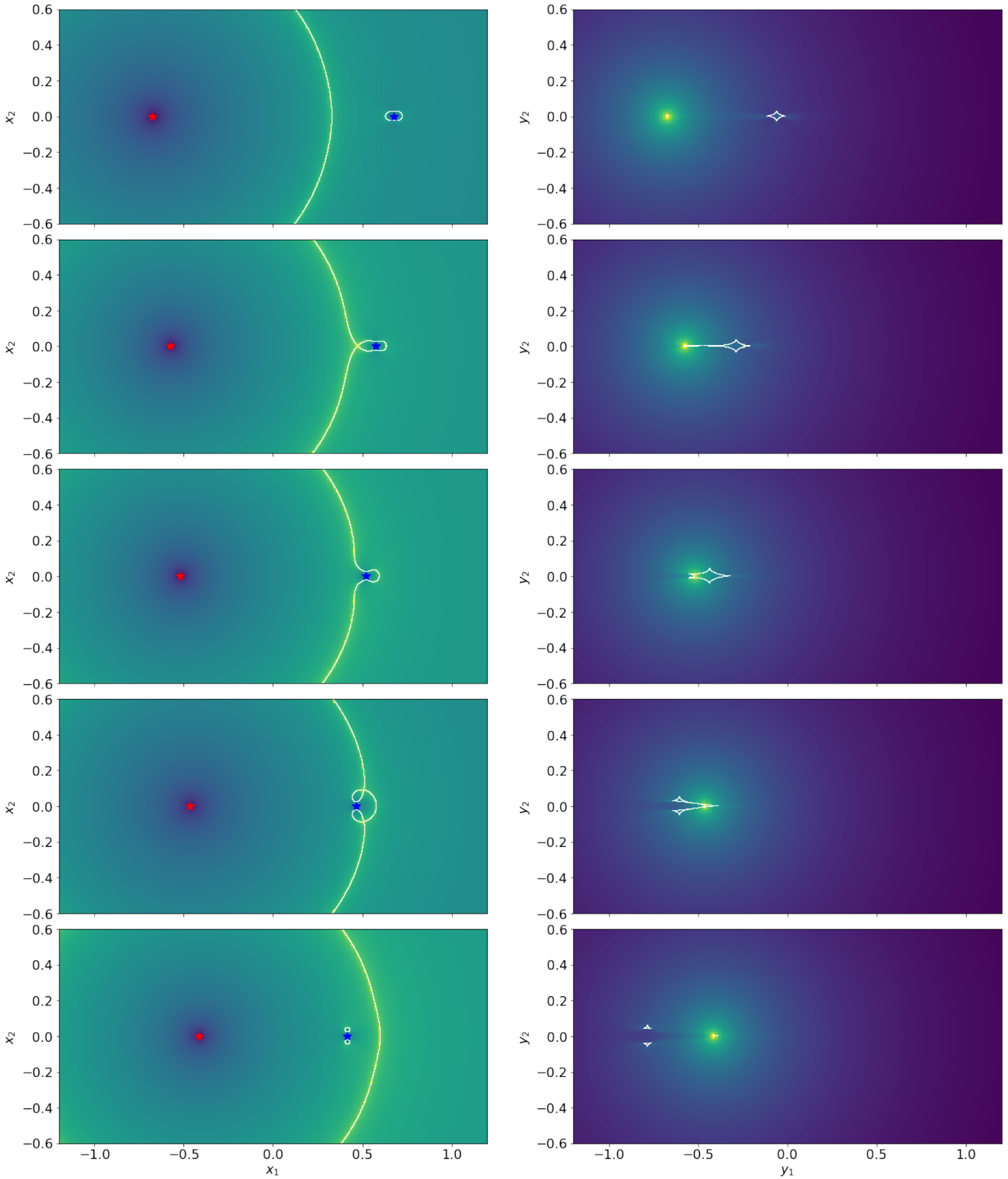
b

β_y (θ_E)

β_x (θ_E)

Caustics: Intermediate, Wide, Close

Gaudi 2013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0.4
0.2
0.0
−0.2
−0.4
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x_2
y_2
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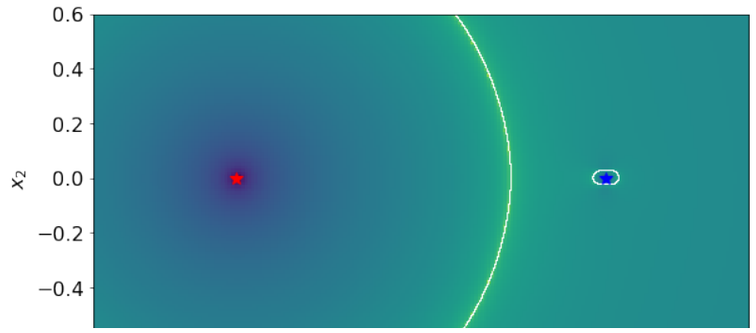
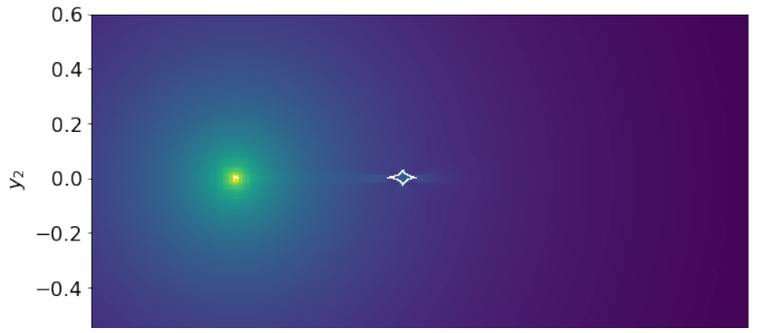
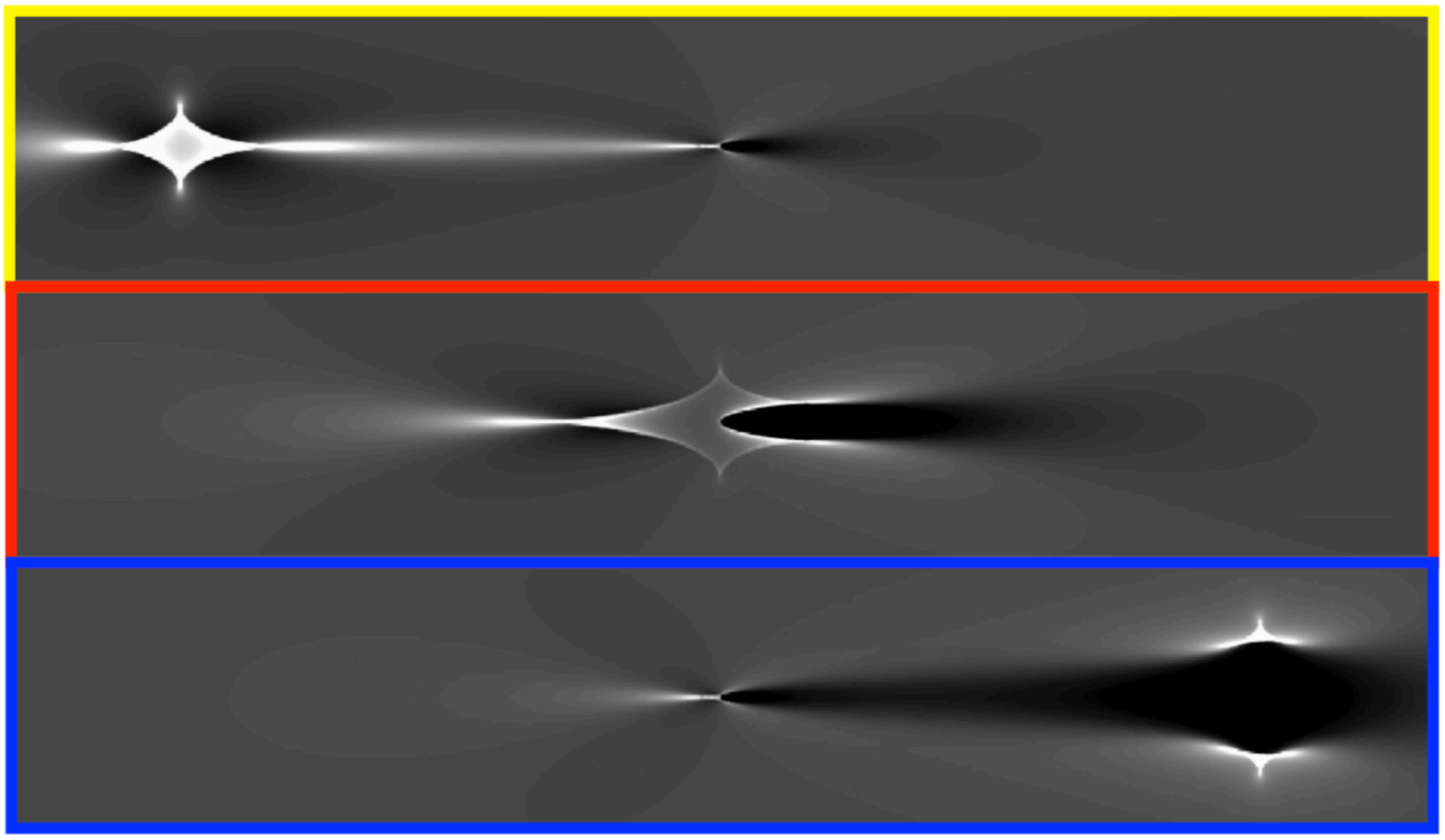
−0.5
0.0
0.5
1.0
x_1
y_1



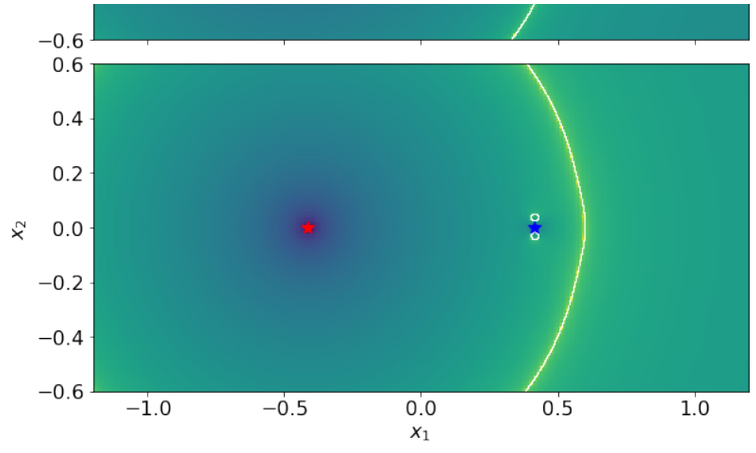


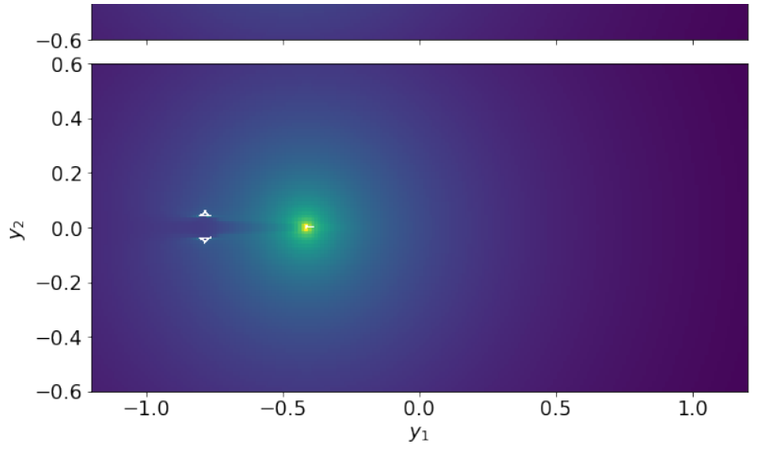


Wide

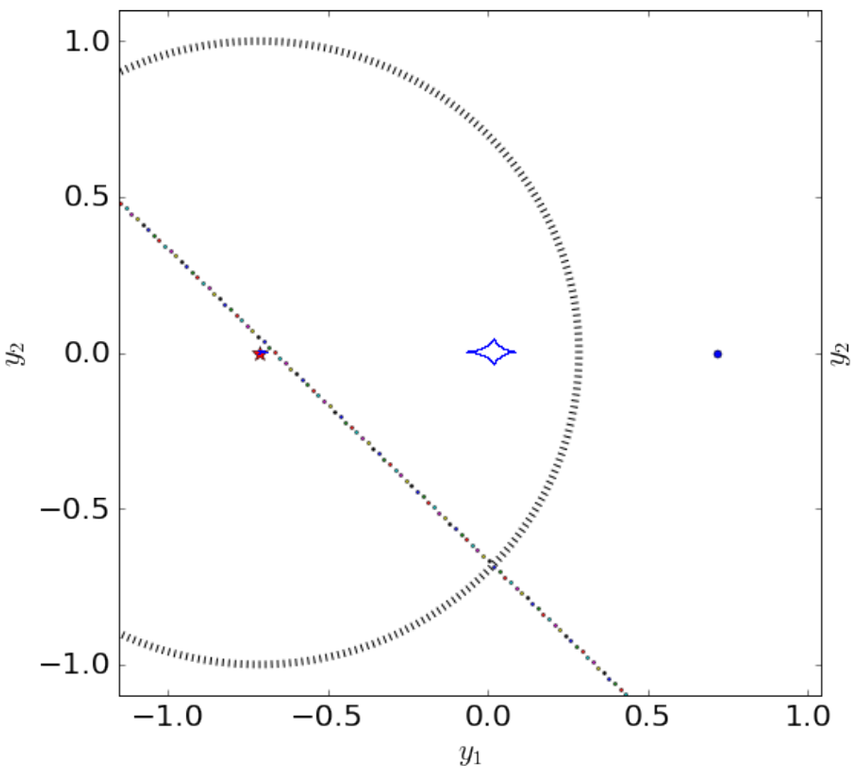
Intermediate/
Resonant

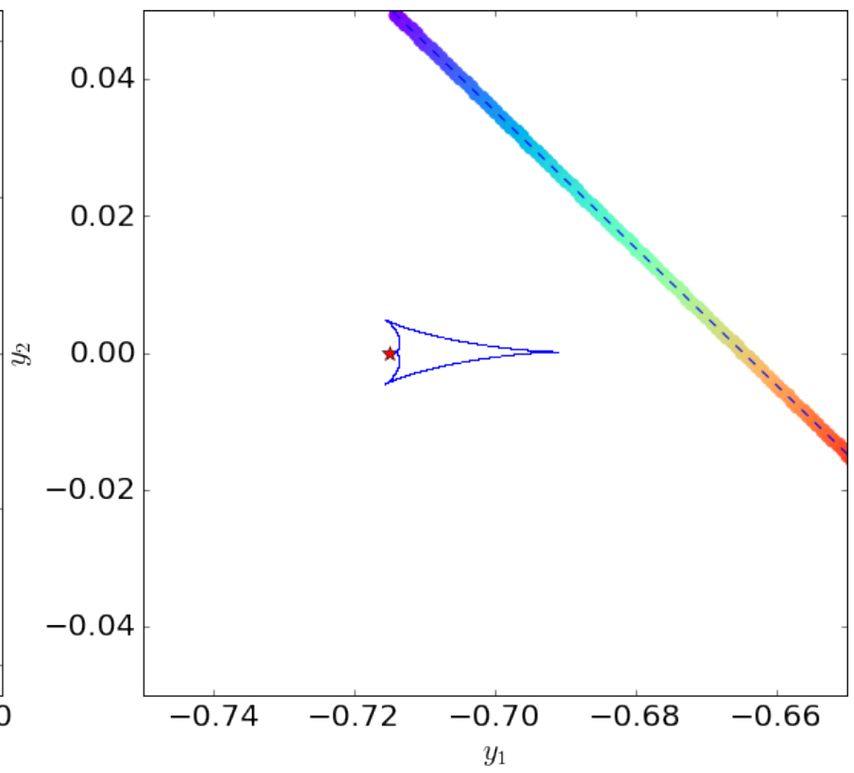
Close

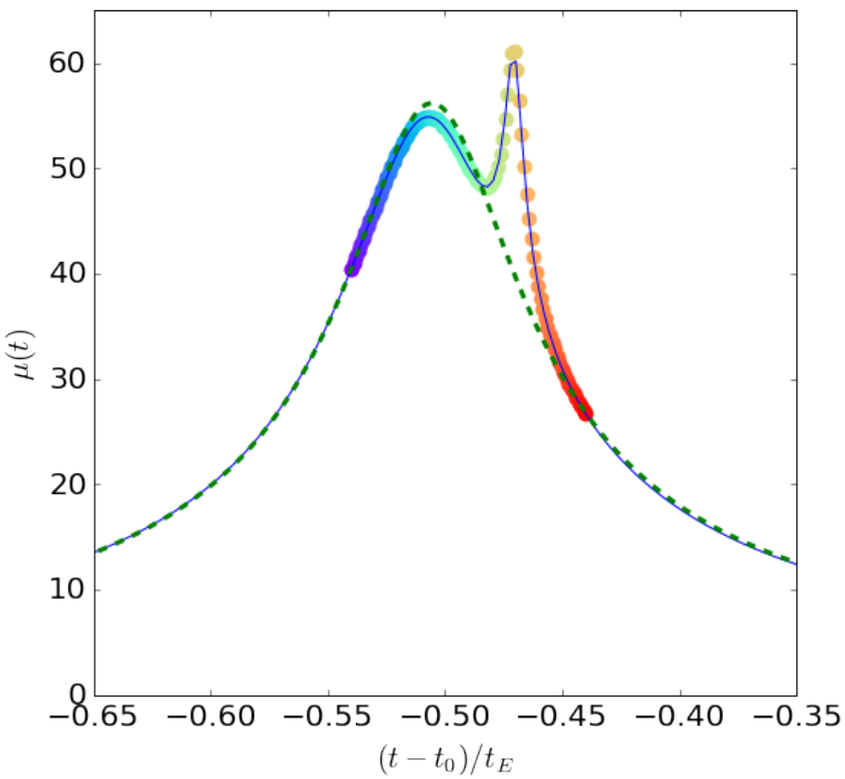


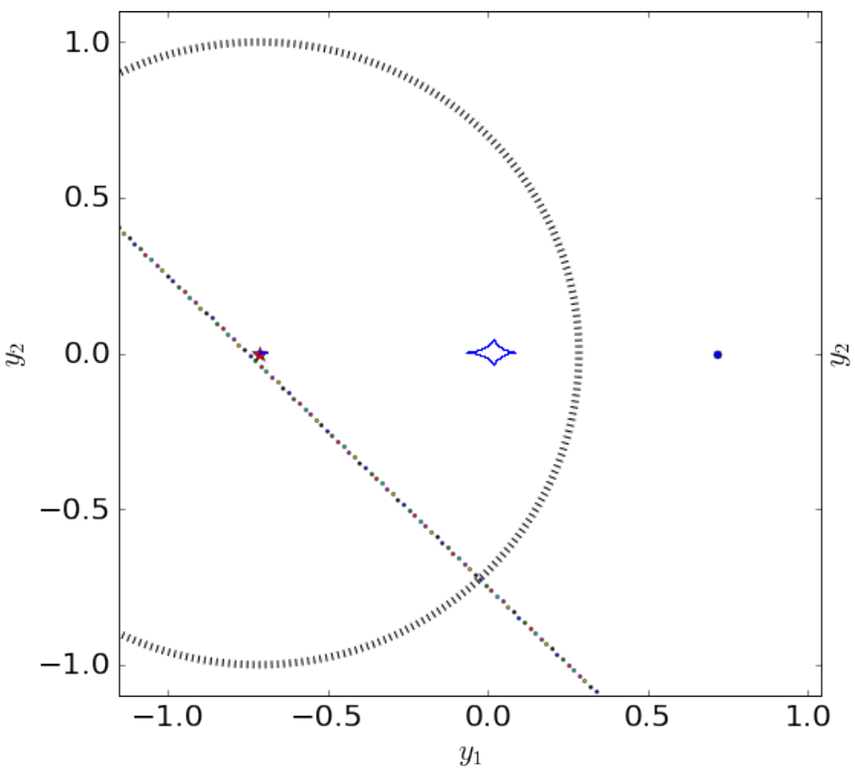


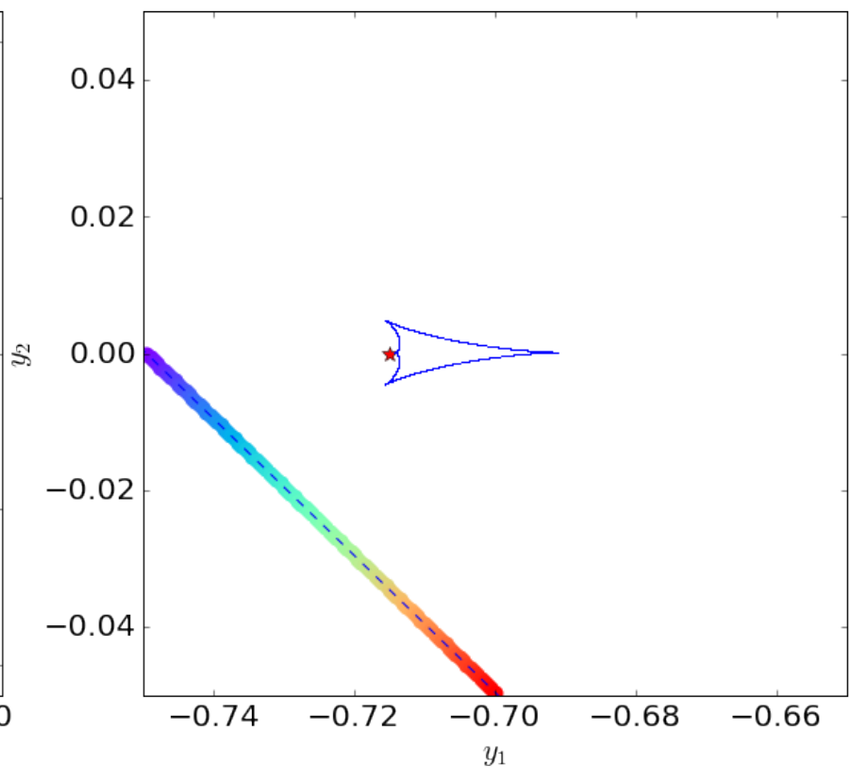
CENTRAL CAUSTIC PERTURBATIONS

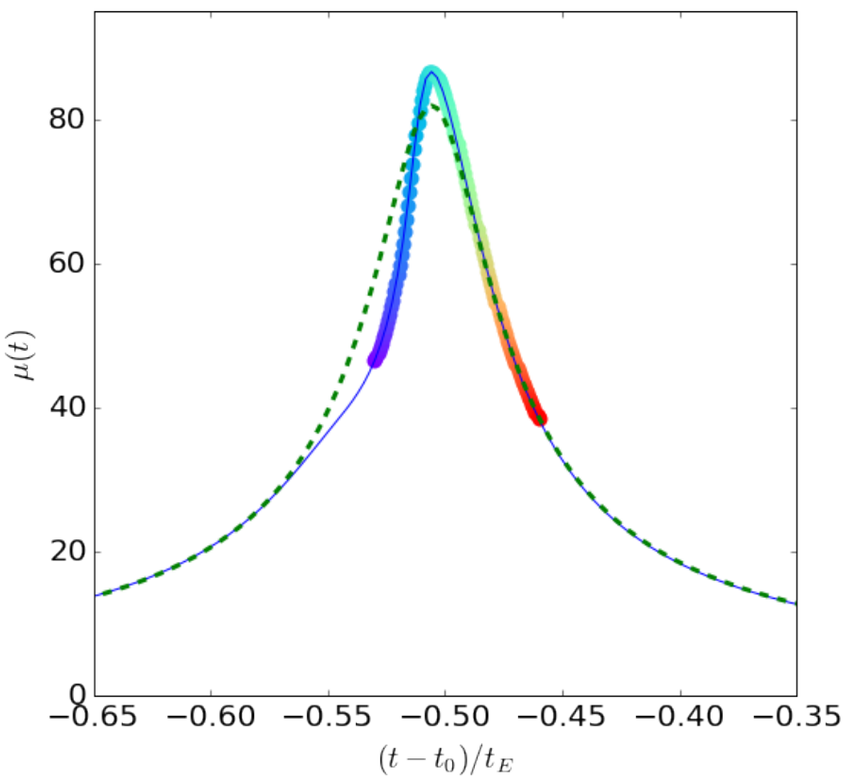












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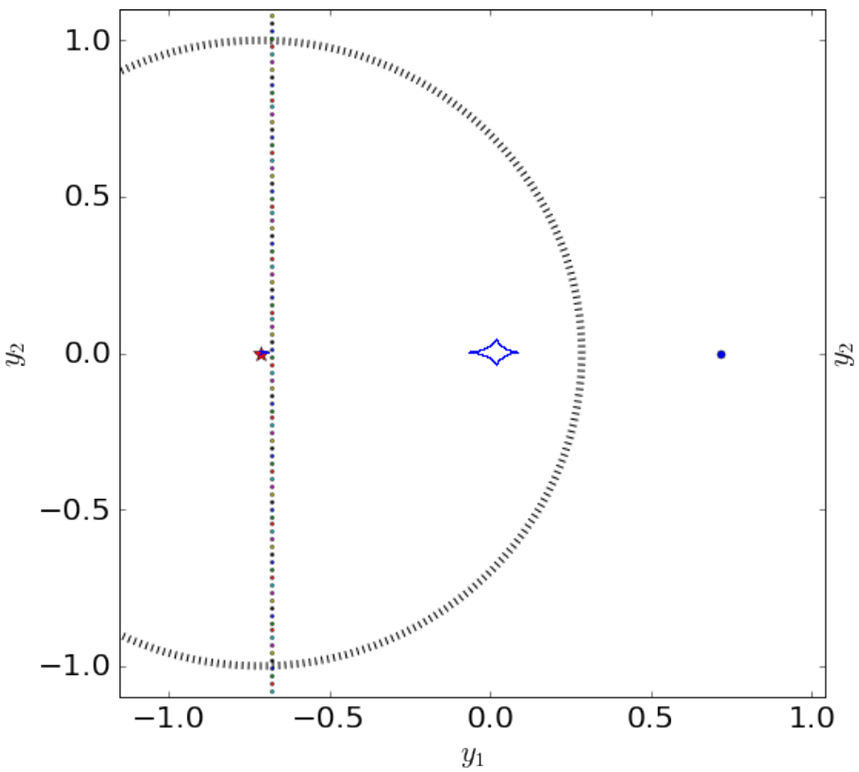

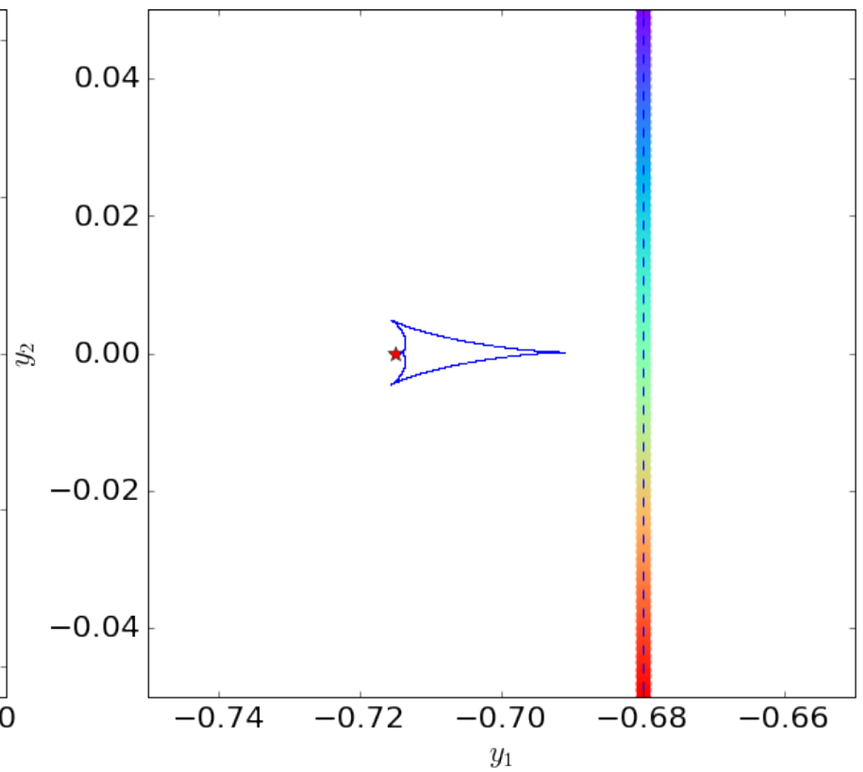

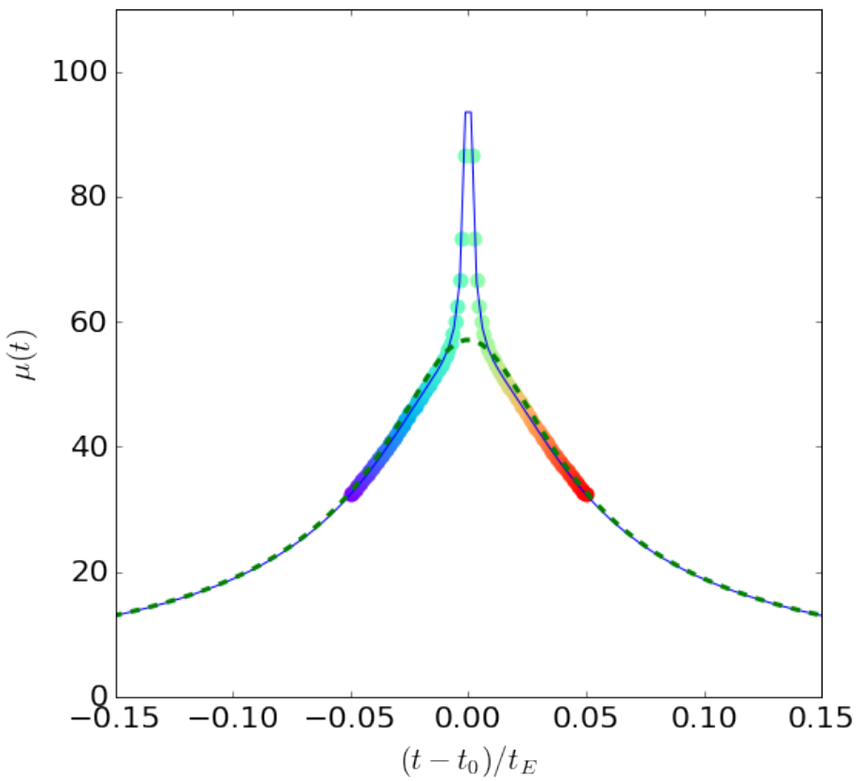

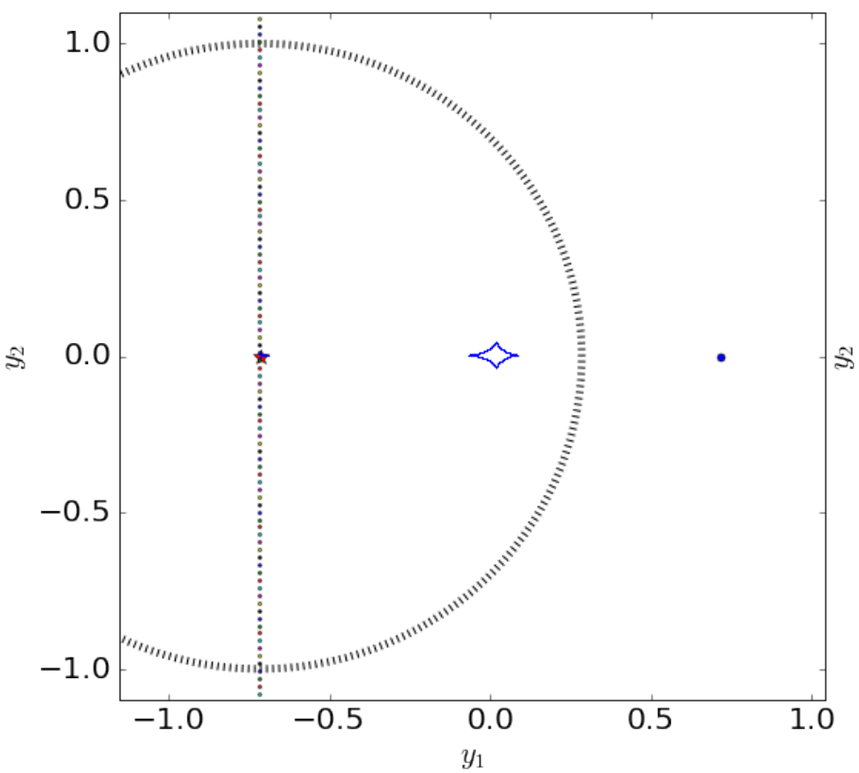

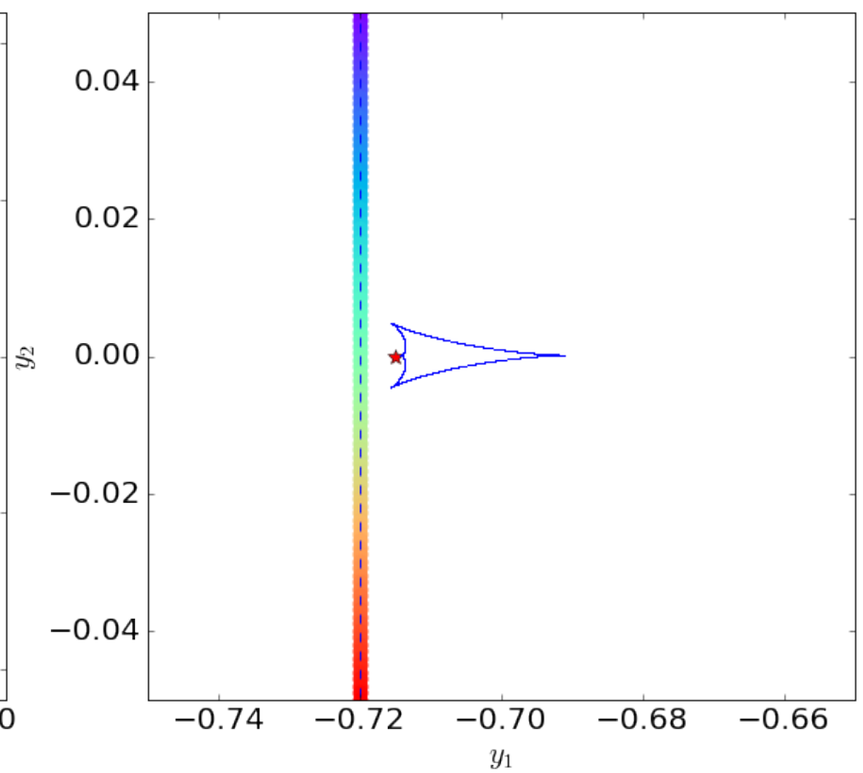

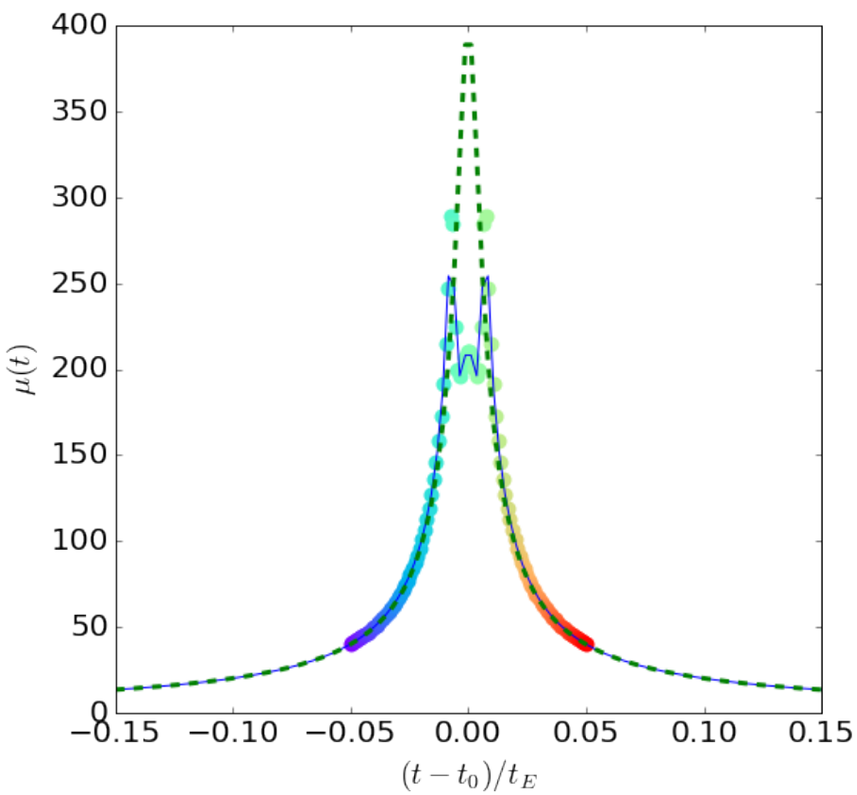

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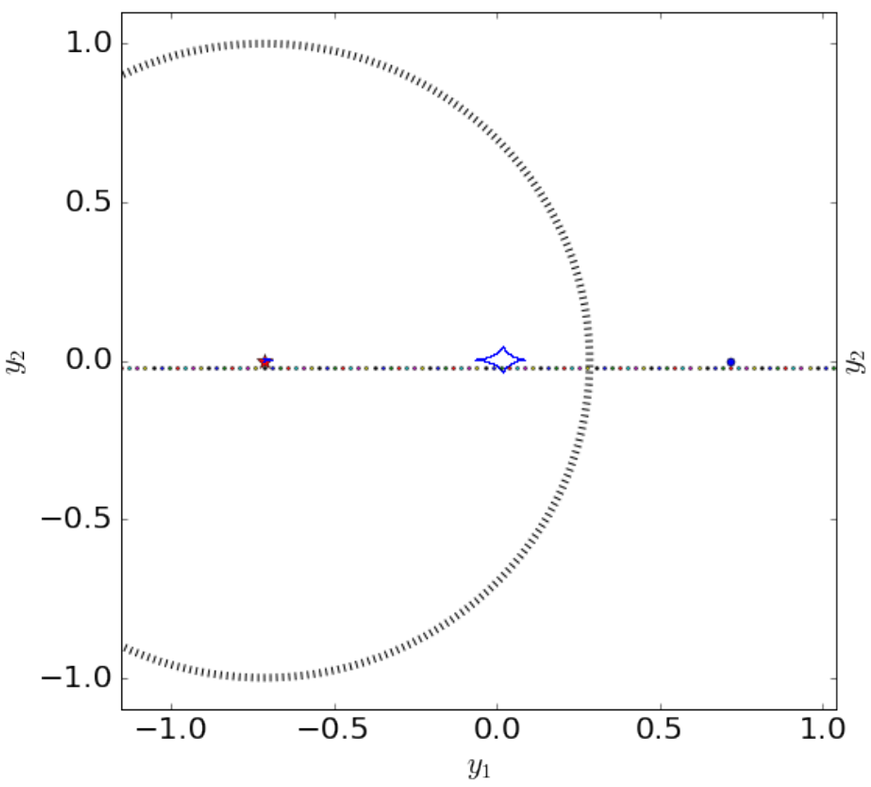
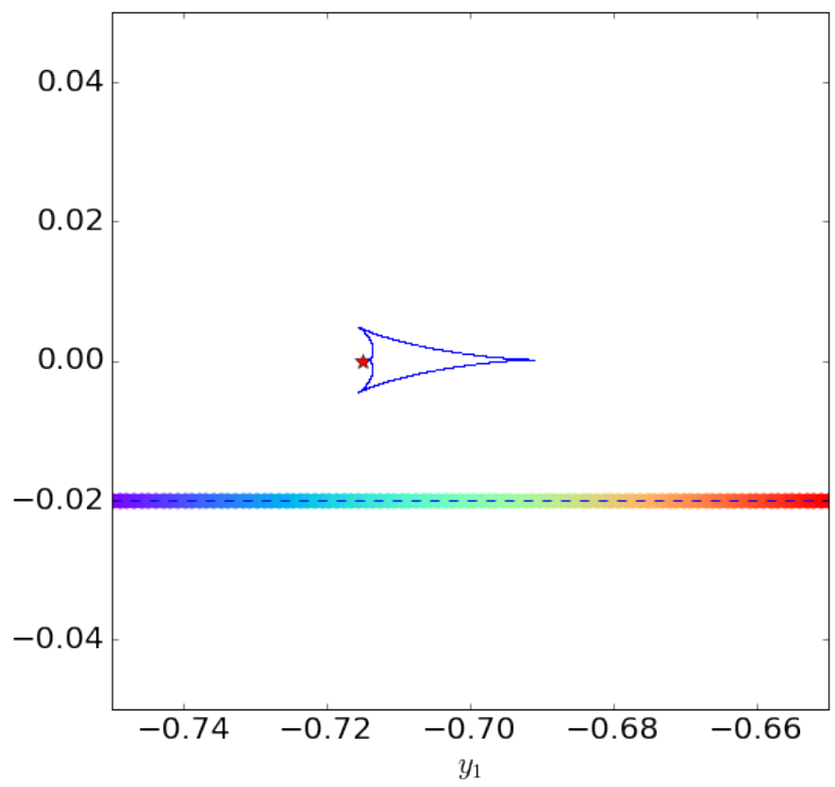
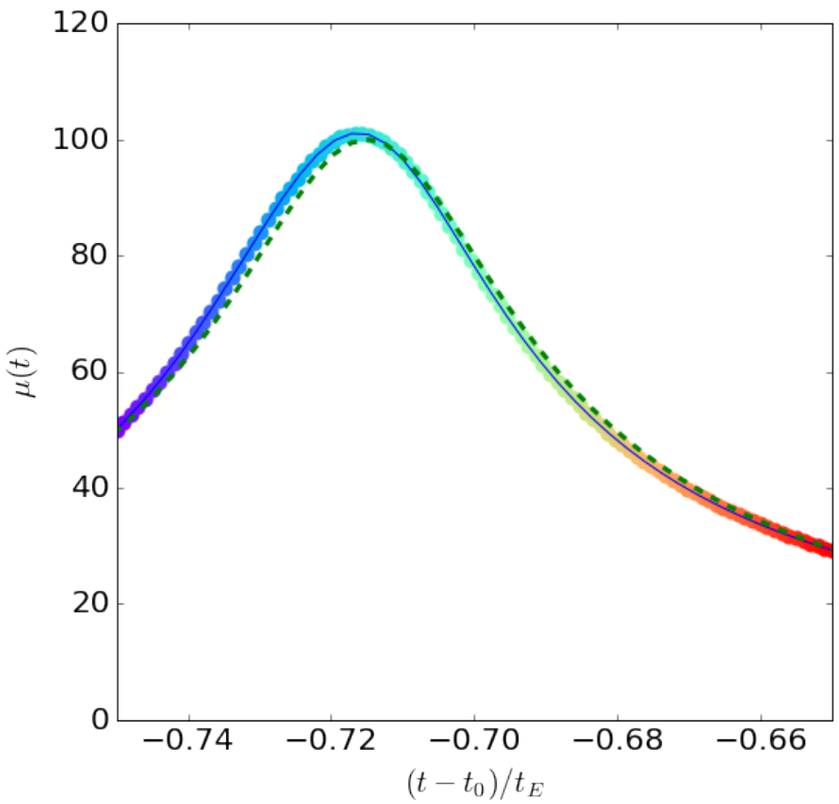


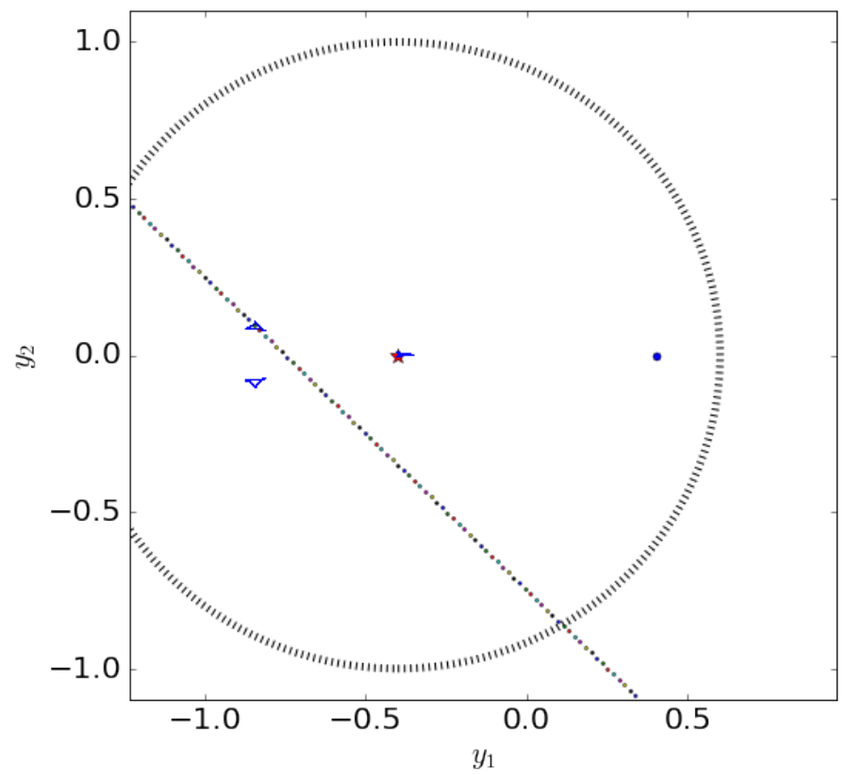


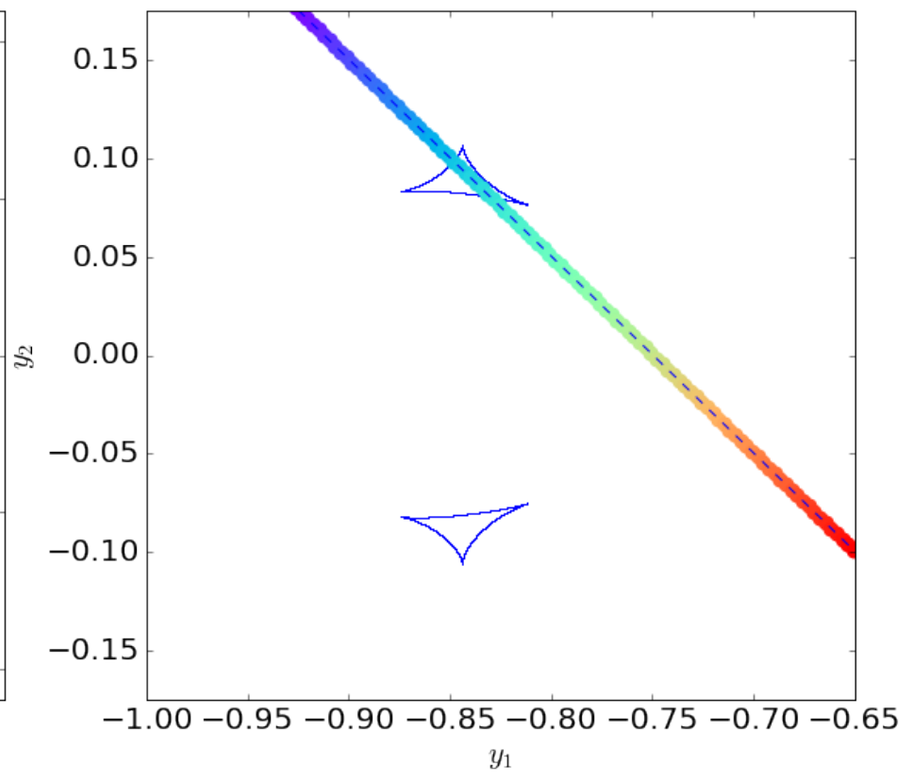


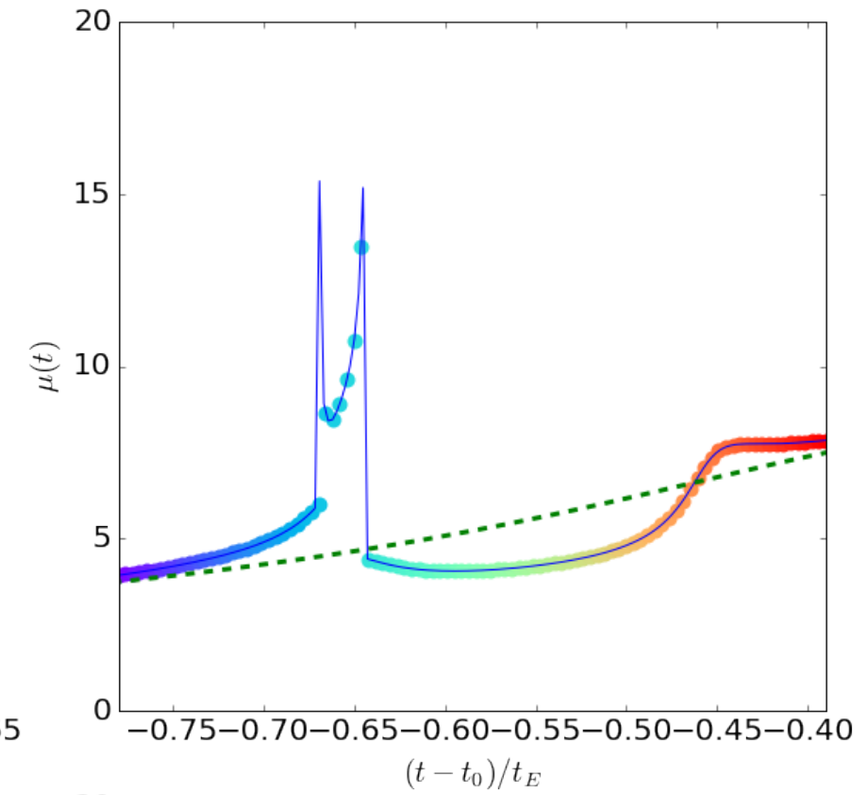
PLANET DETECTION THROUGH CENTRAL CUSP PERTURBATIONS

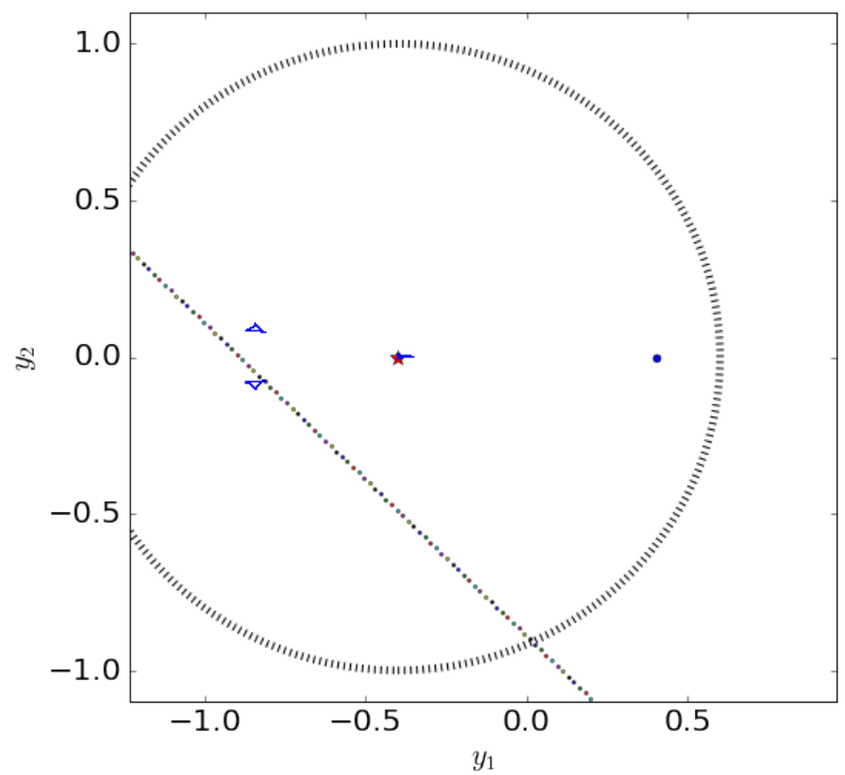
- Only possible in the case of high magnification events (sources passing very close to the host stars)
- For this reason, they are rare events
- Advantages:
  - near the peak of the event
  - can sometimes be predicted in advance
  - high magnification makes possible to follow-up the events using small telescopes
  - more accurate photometry (and easier separation of source and lens)
- Disadvantages:
  - degeneracy wide-close topologies

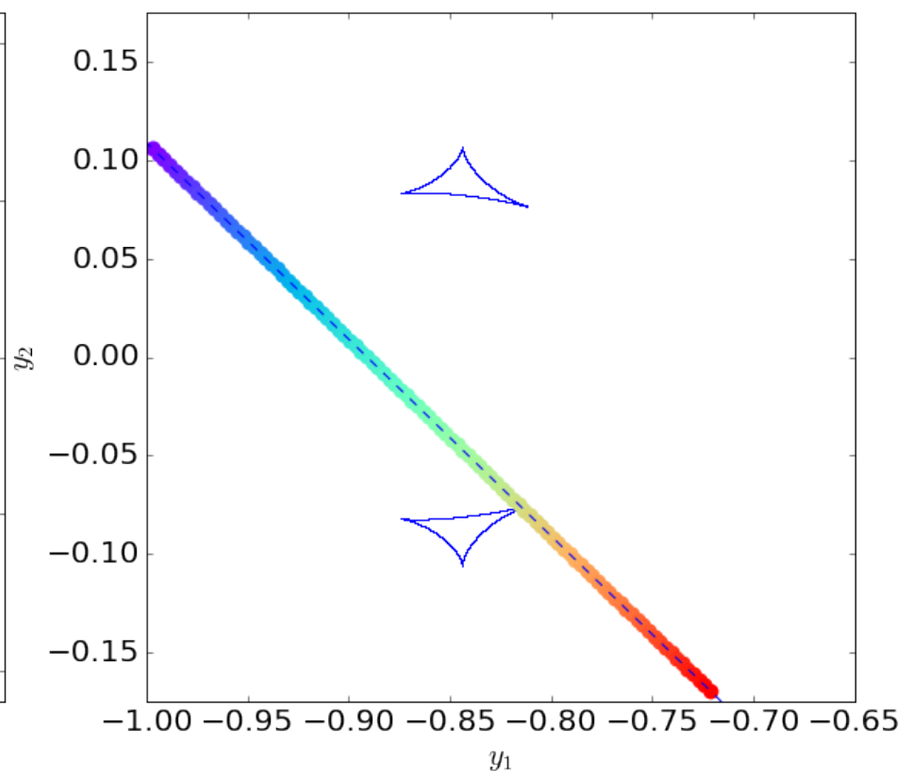
PLANETARY CAUSTICS PERTURBATIONS IN CLOSE TOPOLOGIES

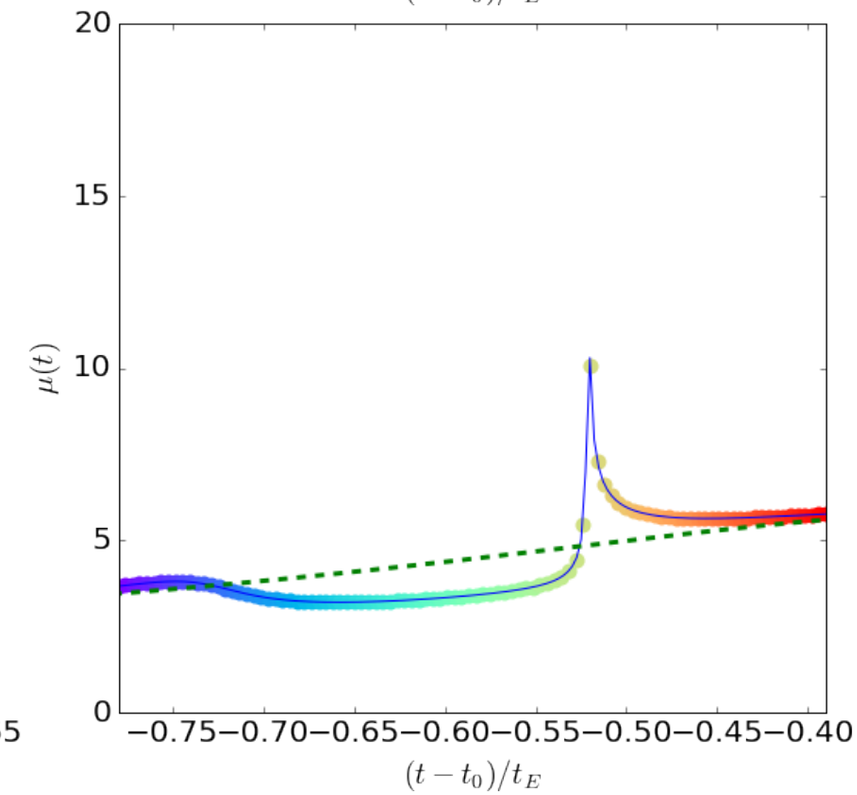












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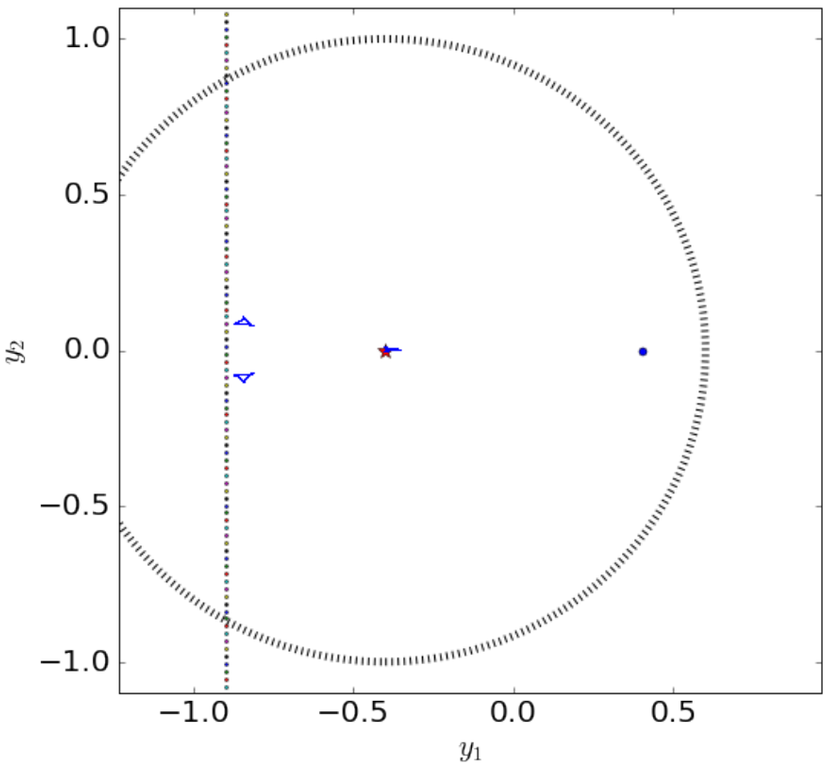
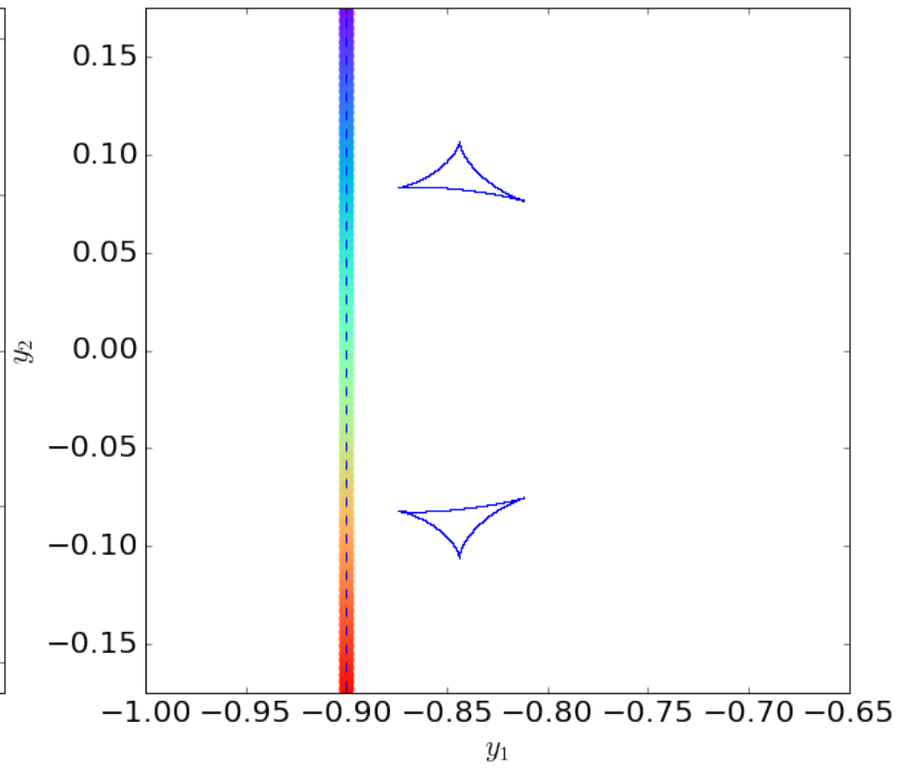
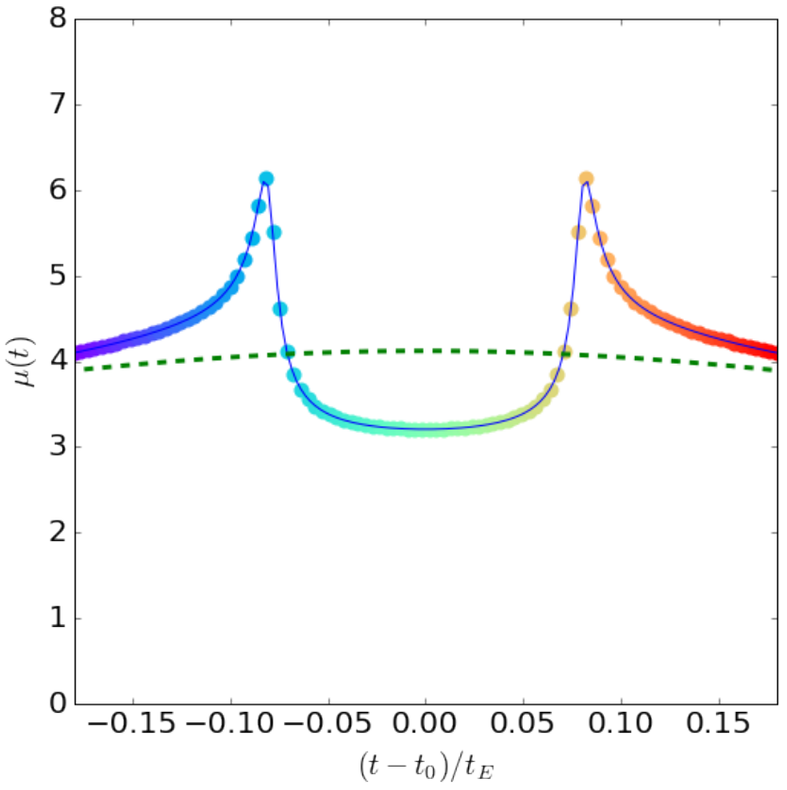
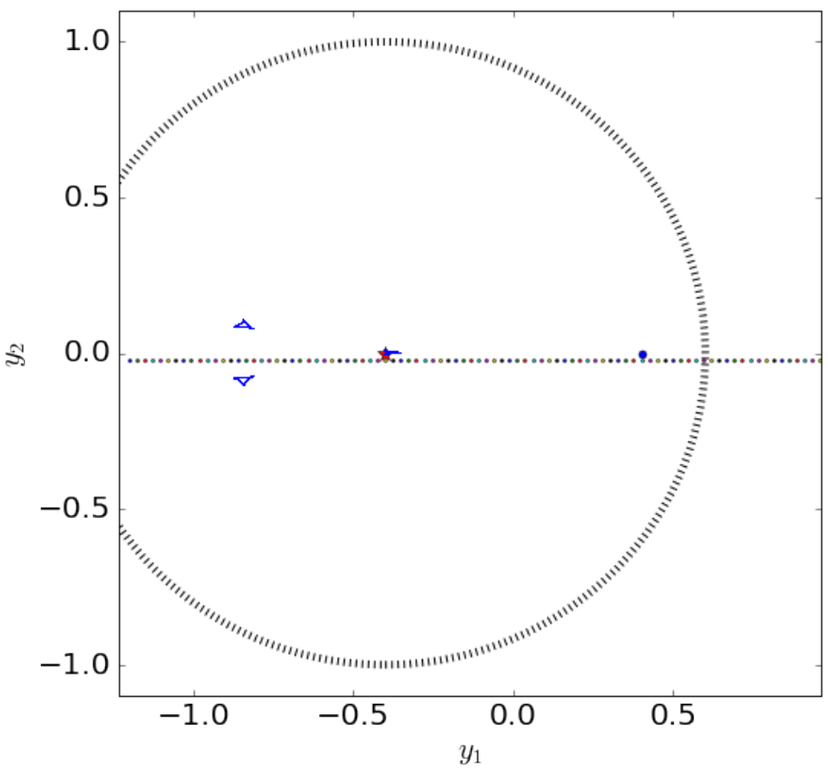
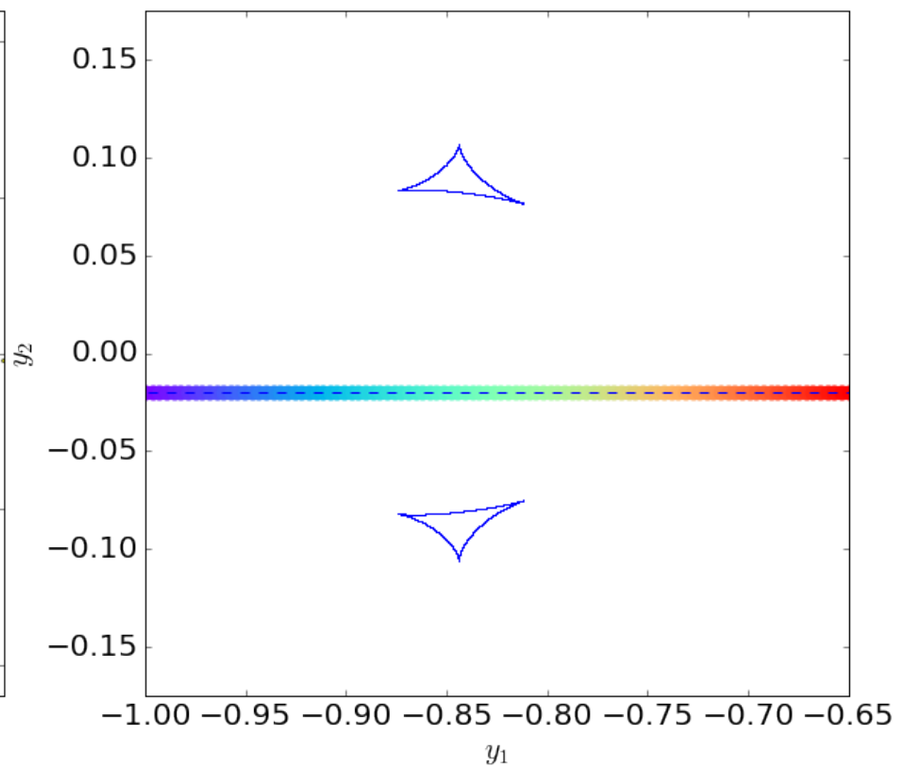
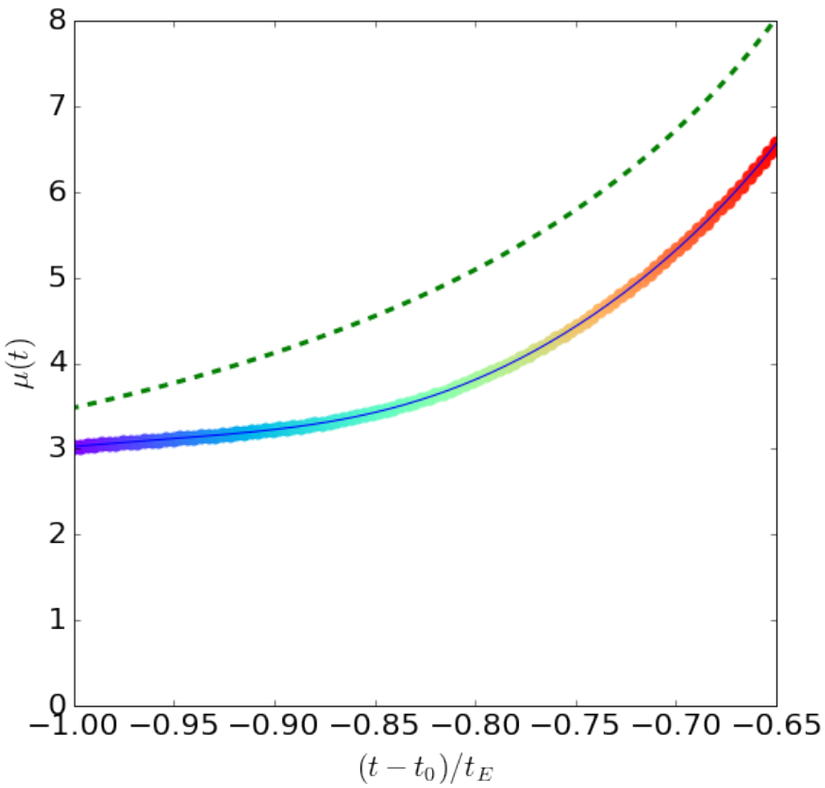




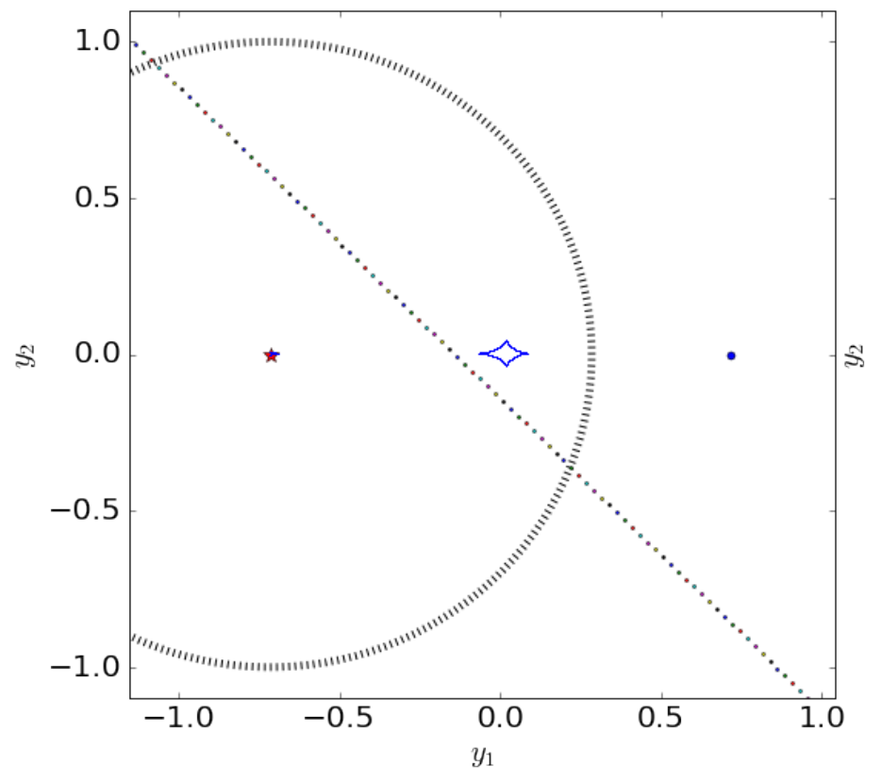


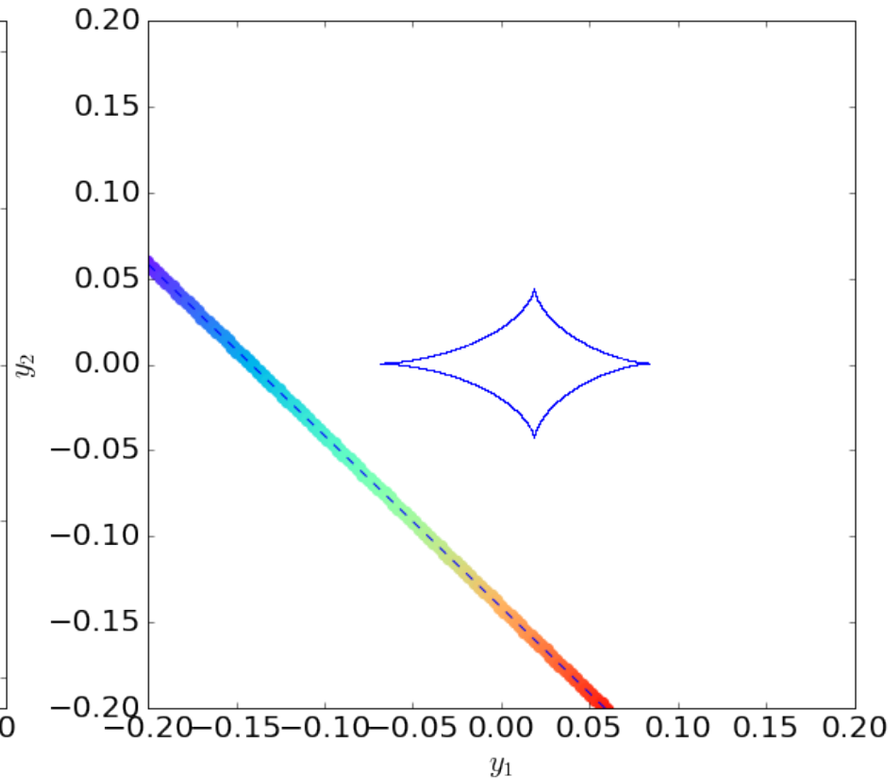


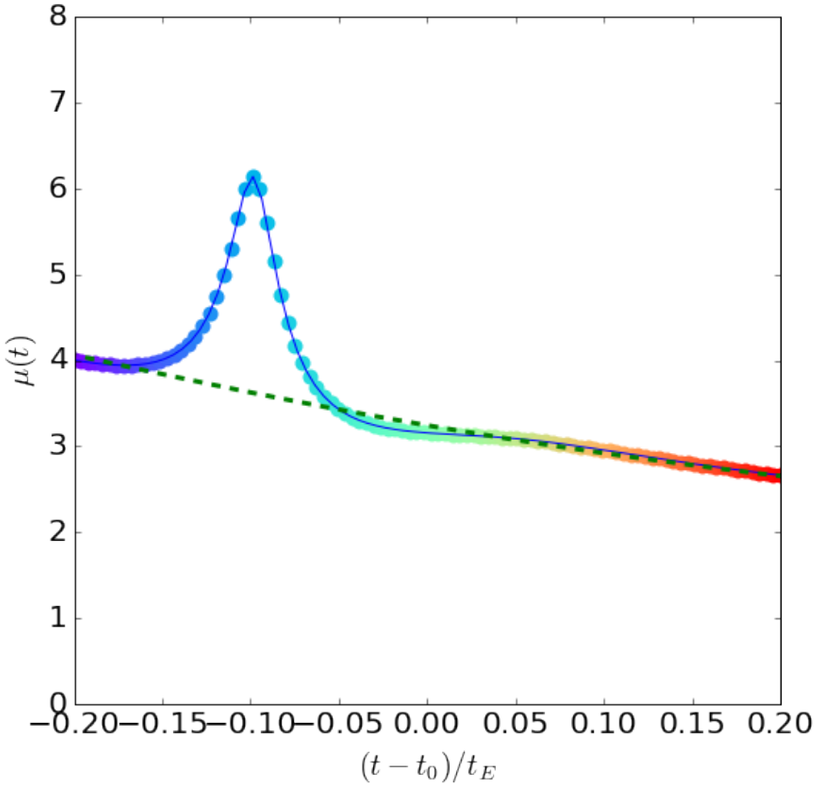


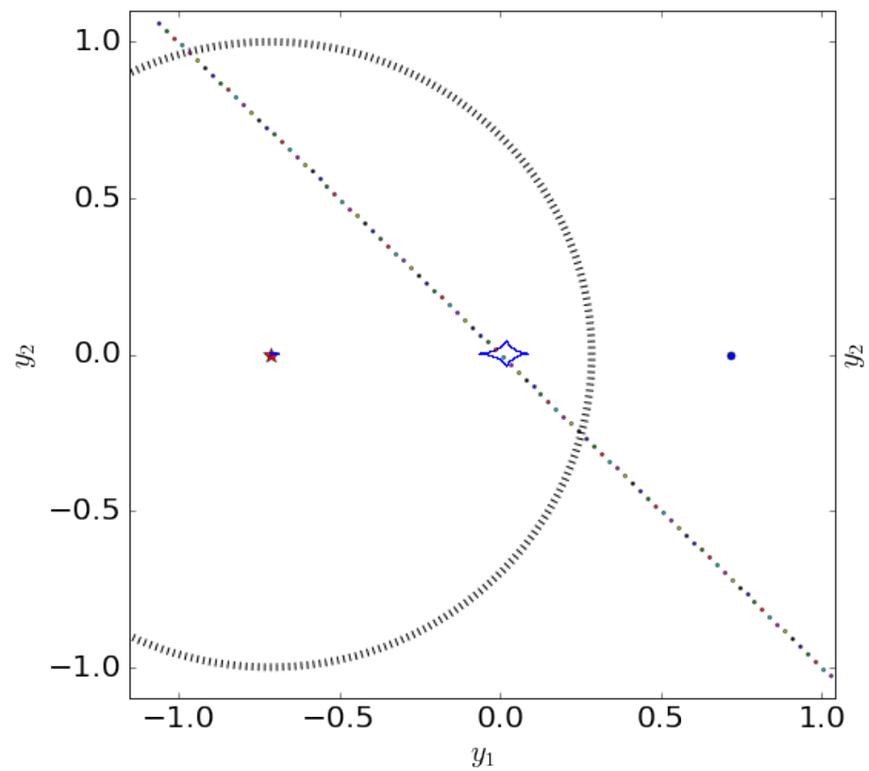


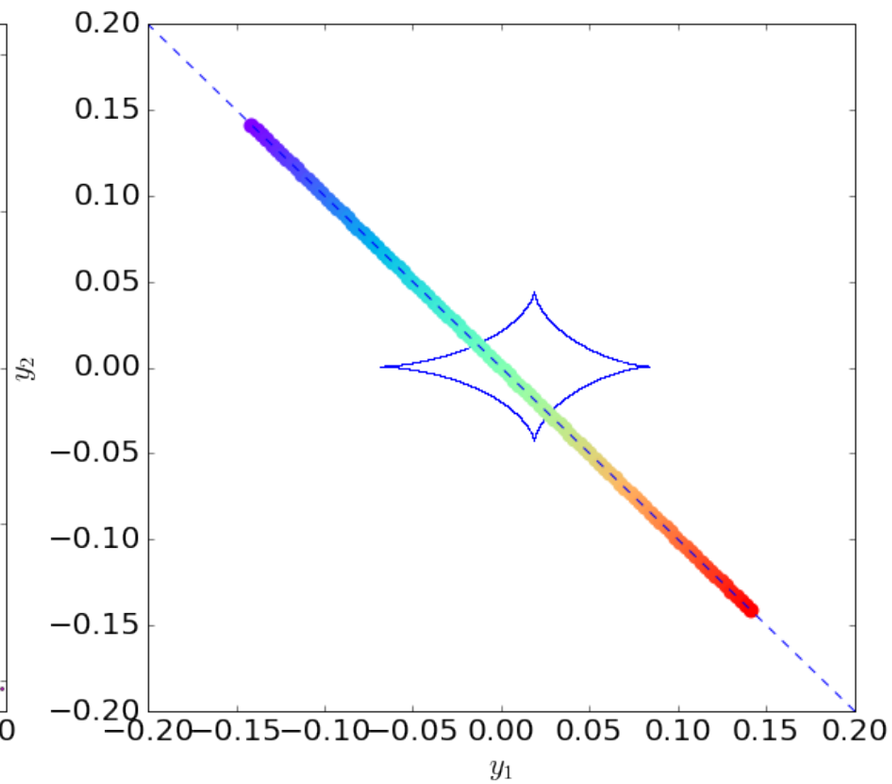
PLANETARY CAUSTICS PERTURBATIONS IN WIDE TOPOLOGIES

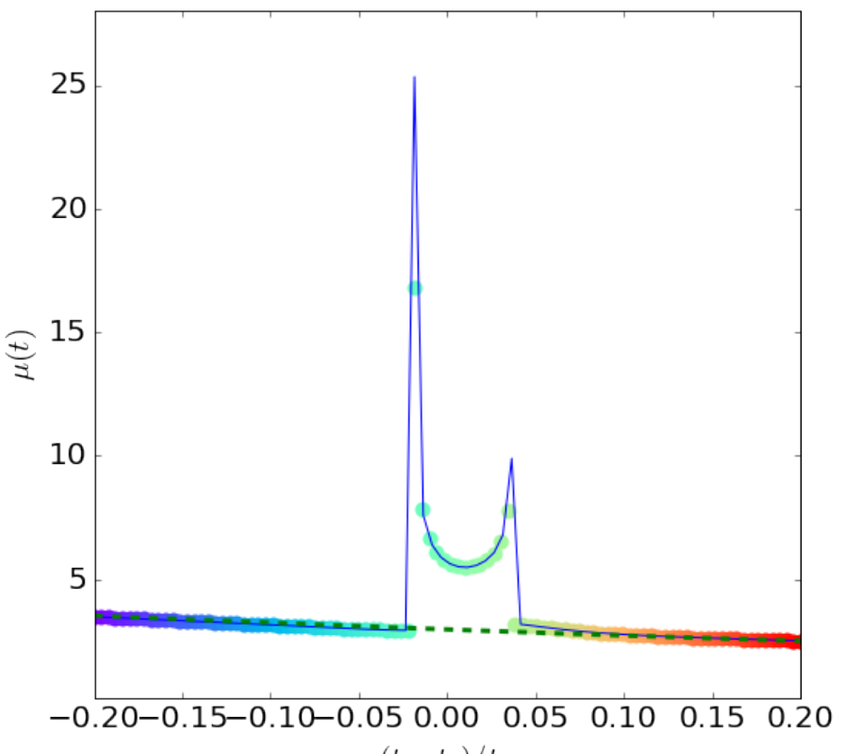












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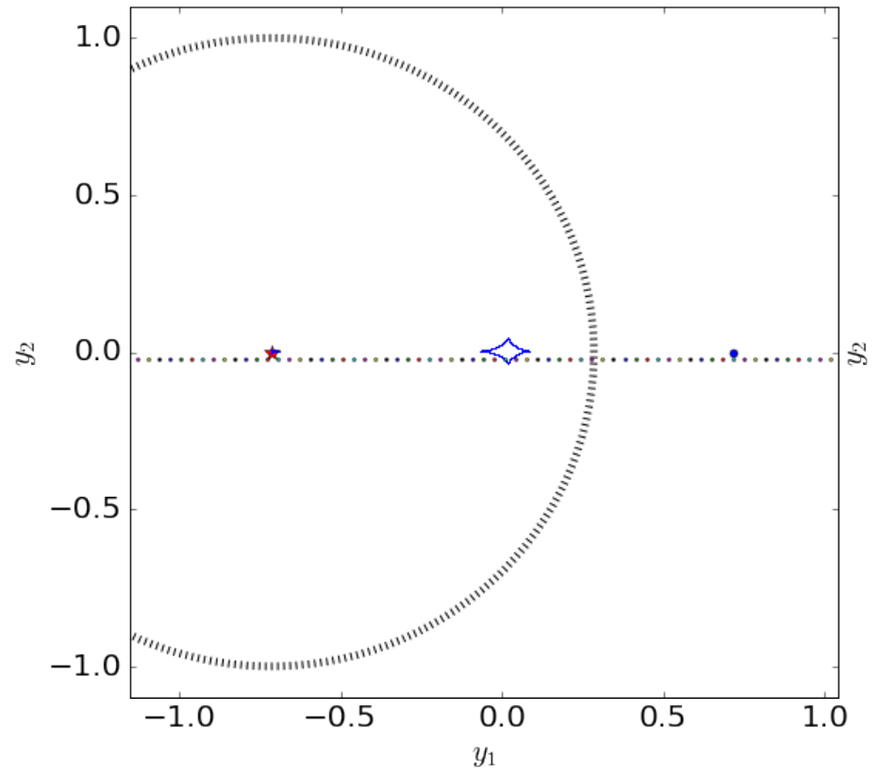

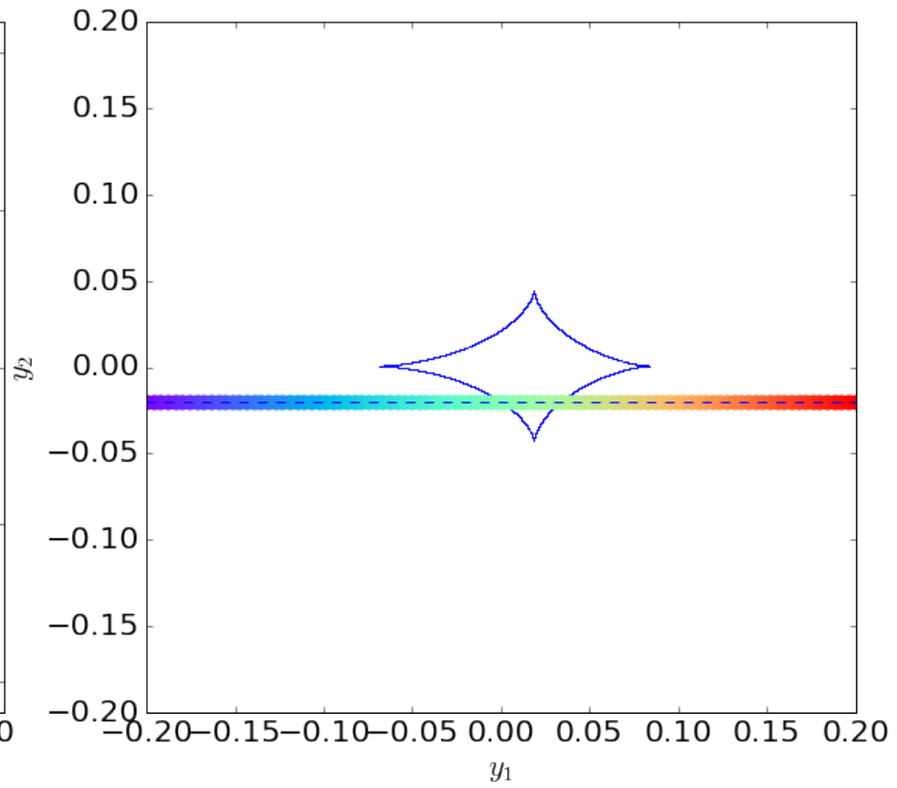

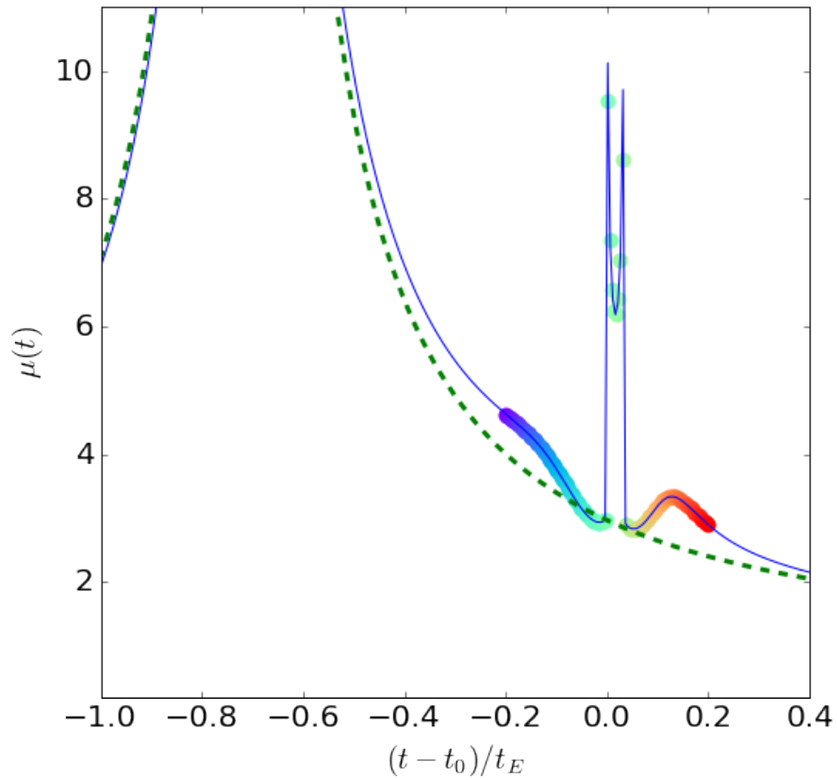

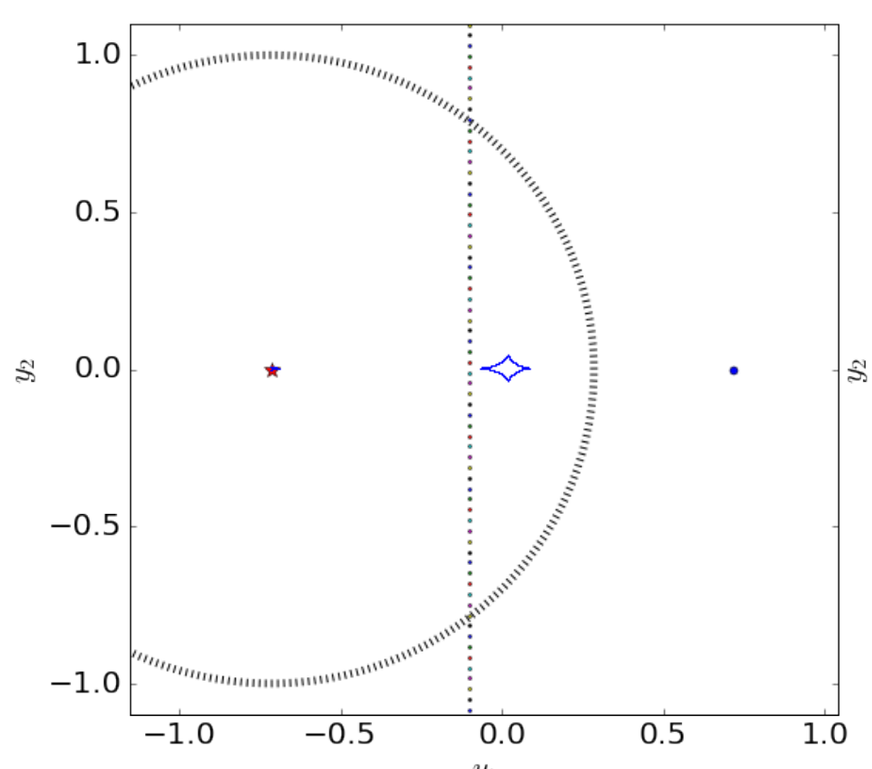

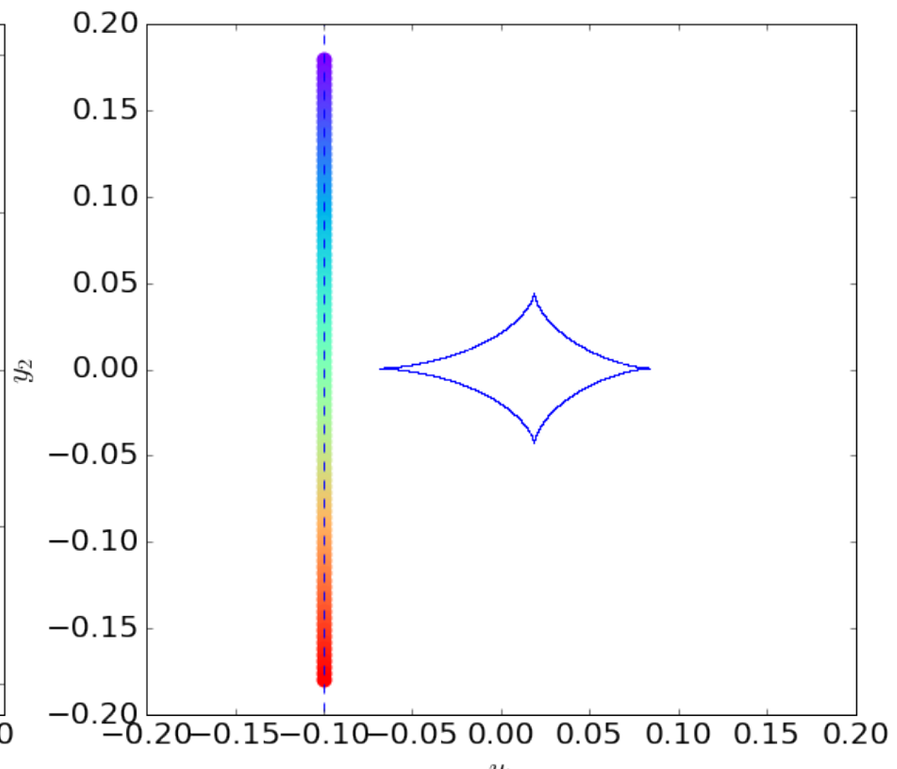

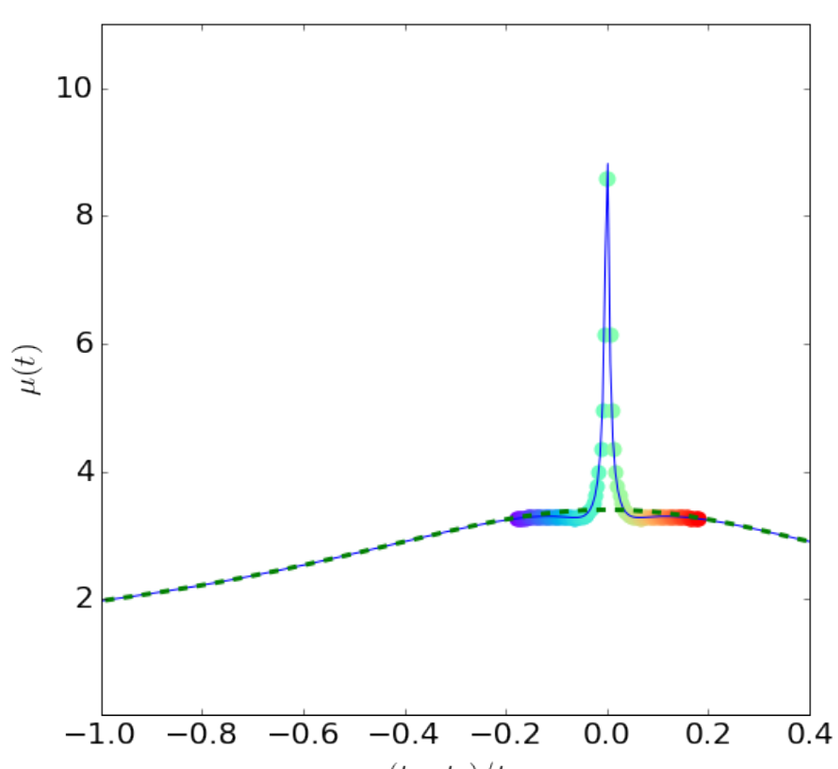

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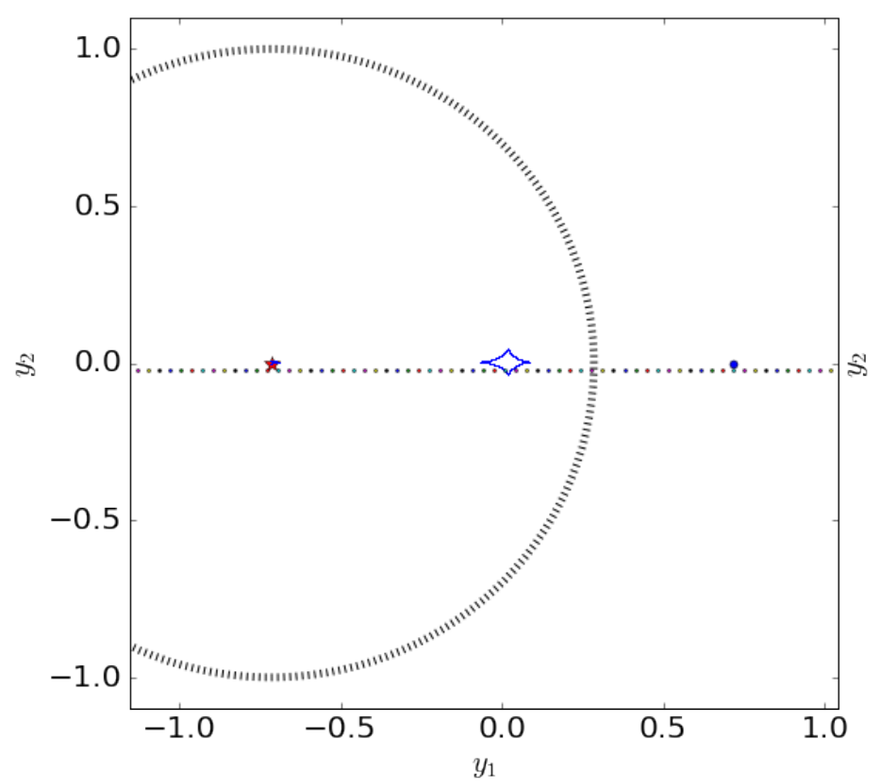

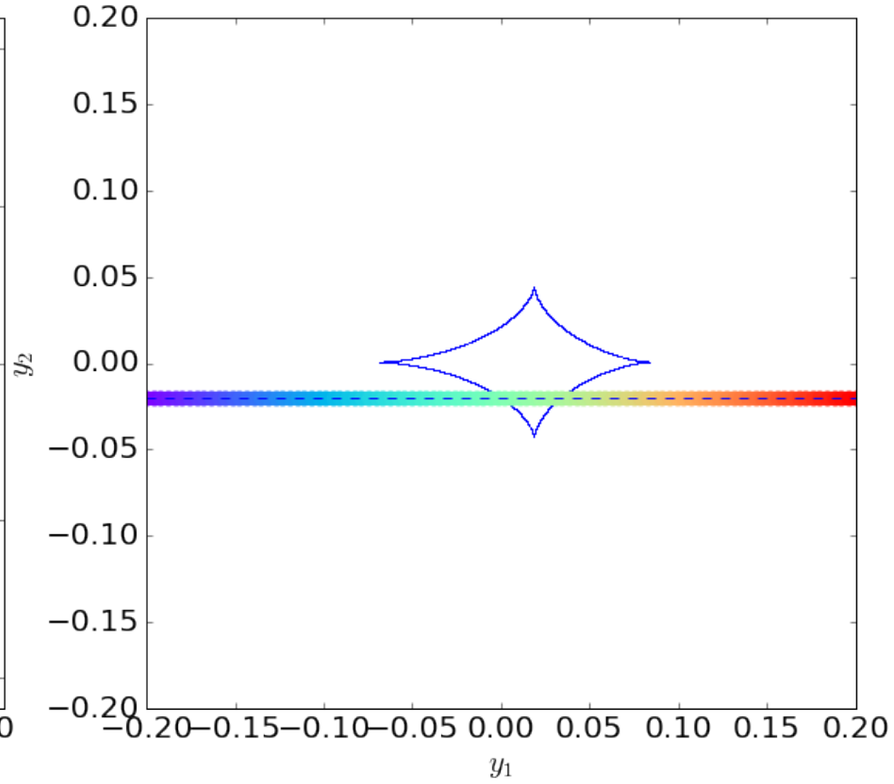

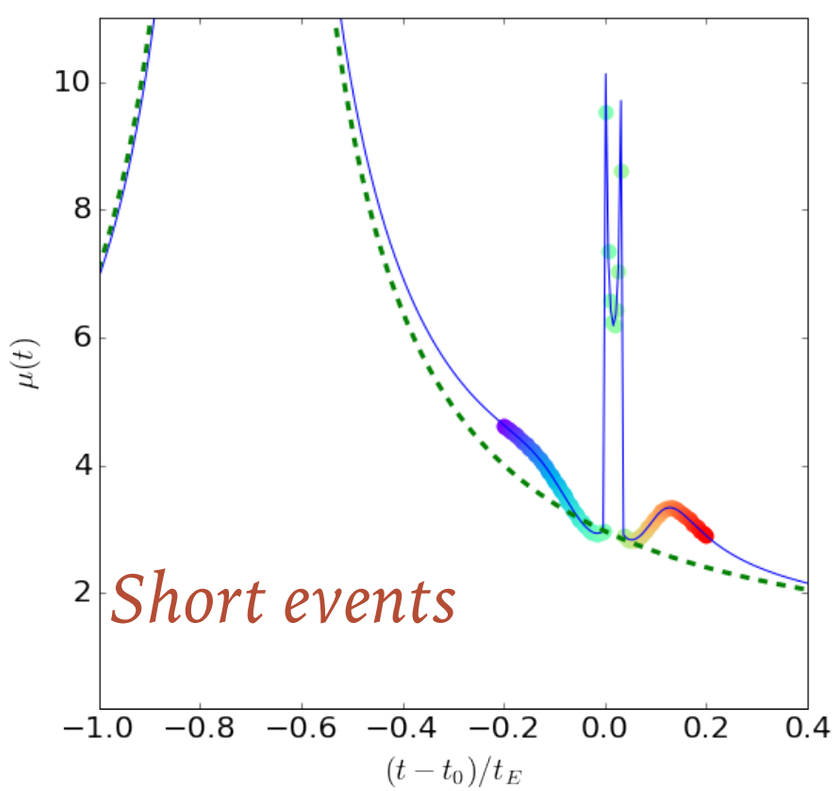

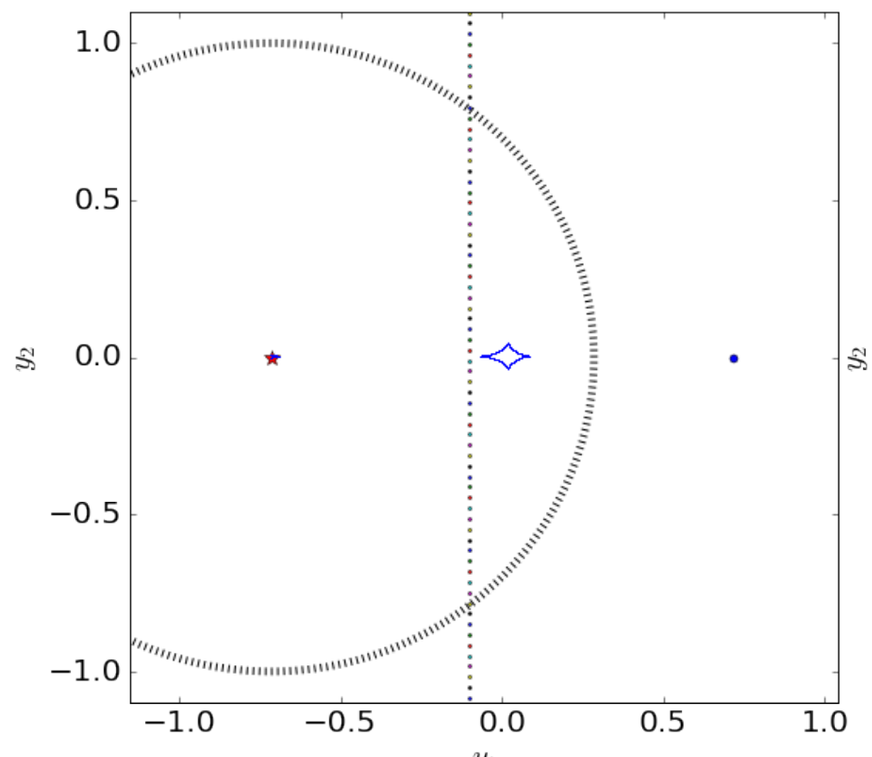

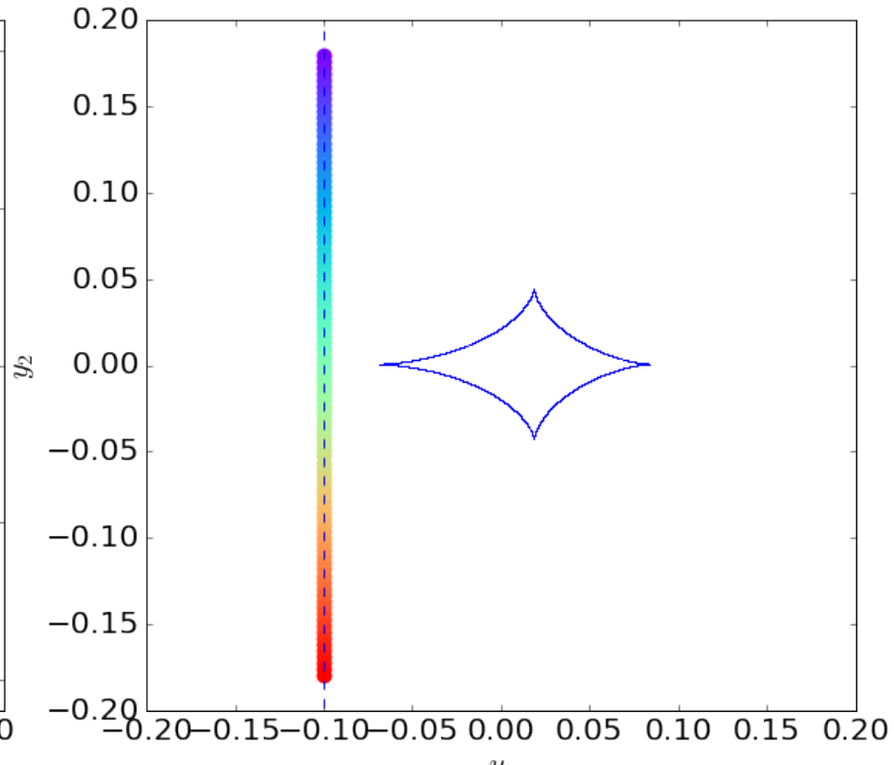

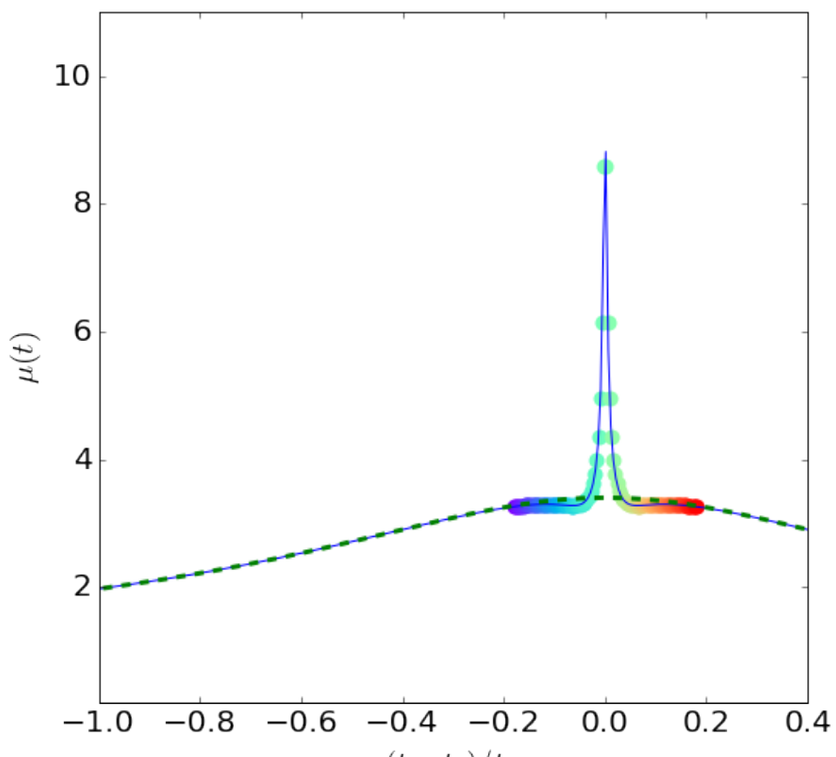

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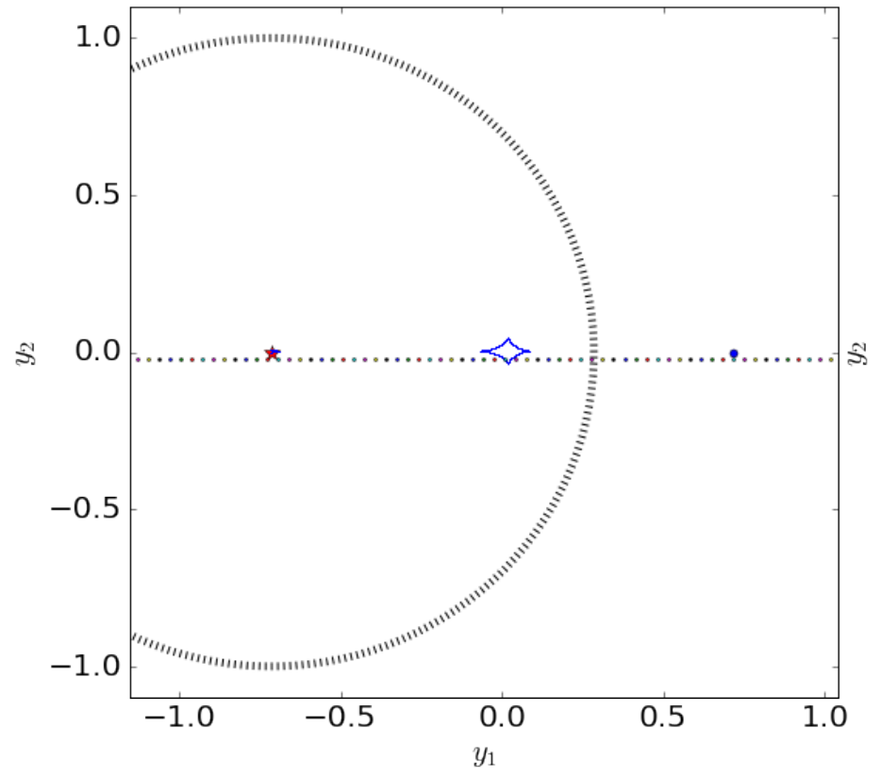

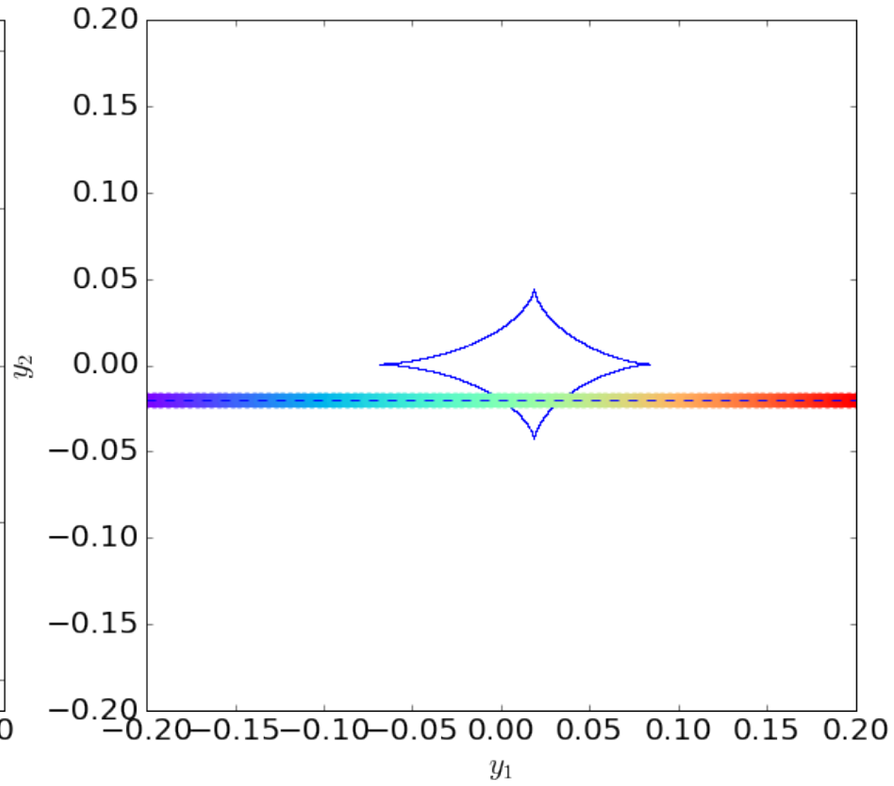

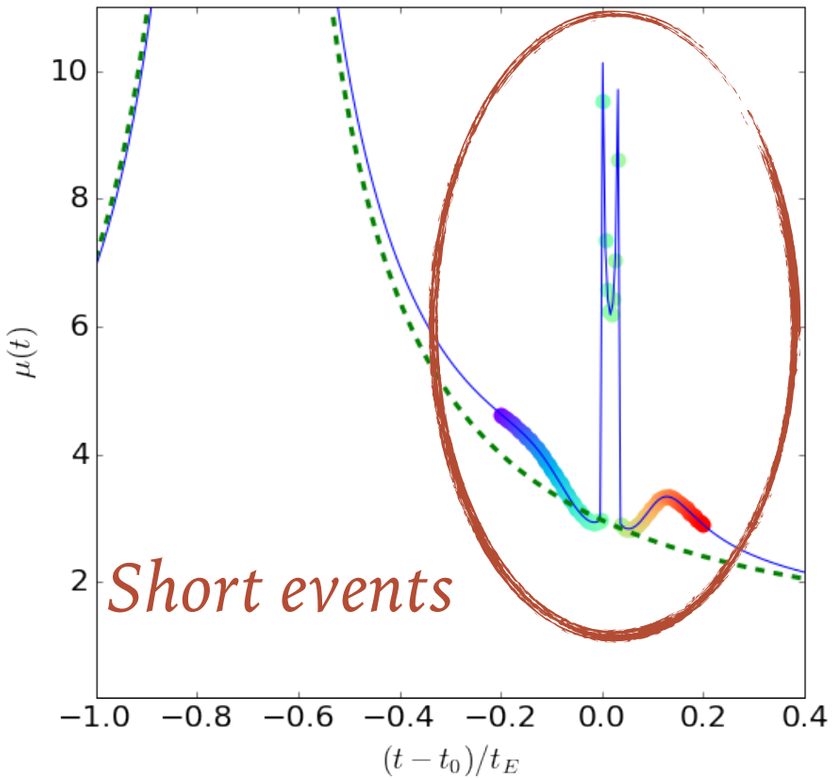

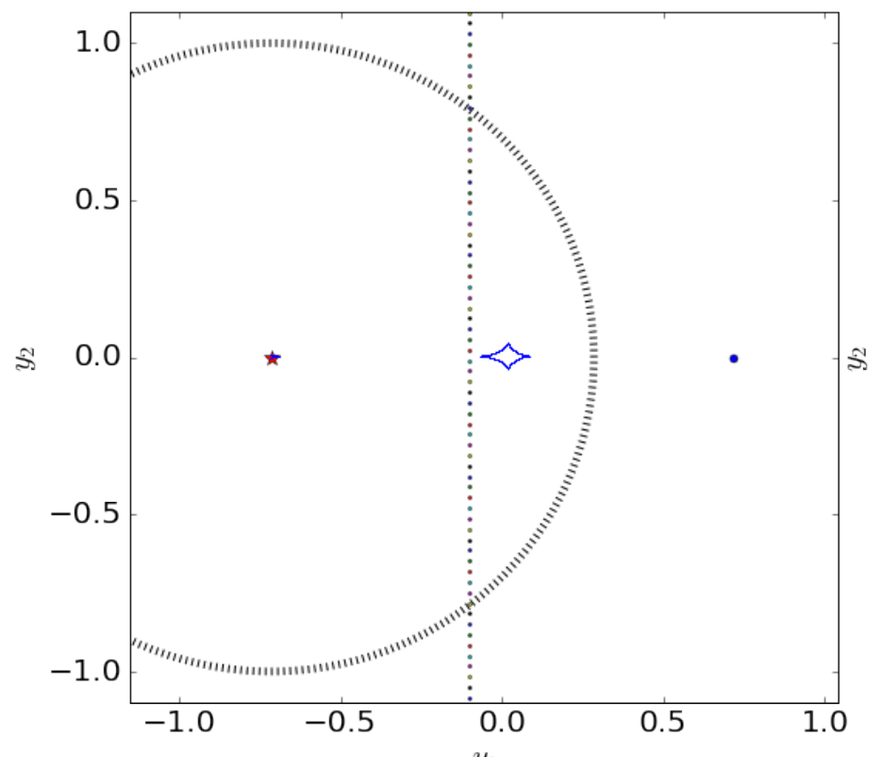

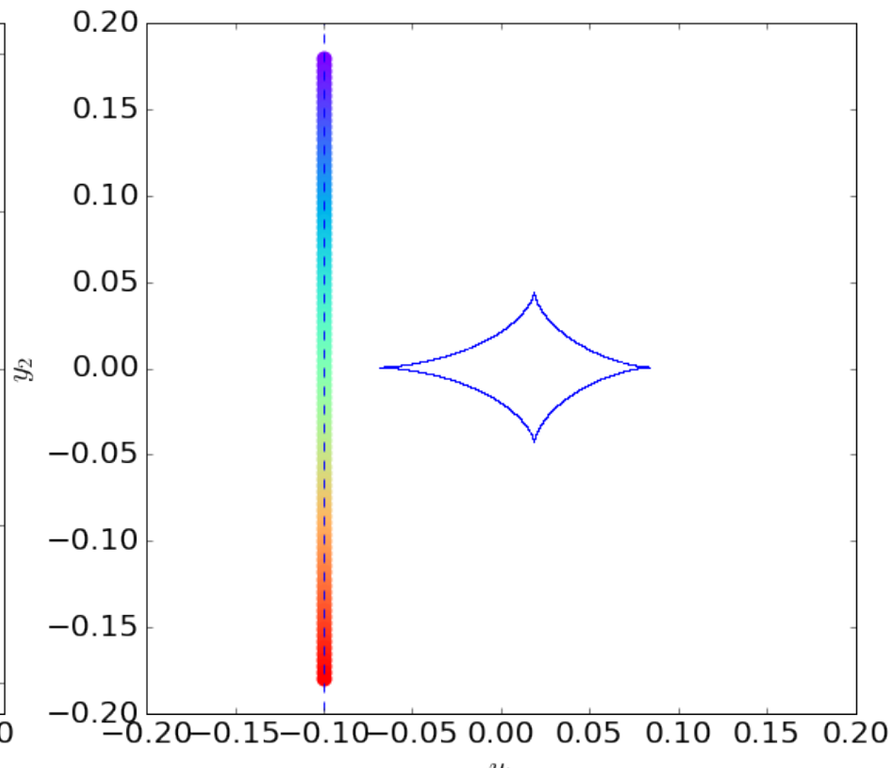

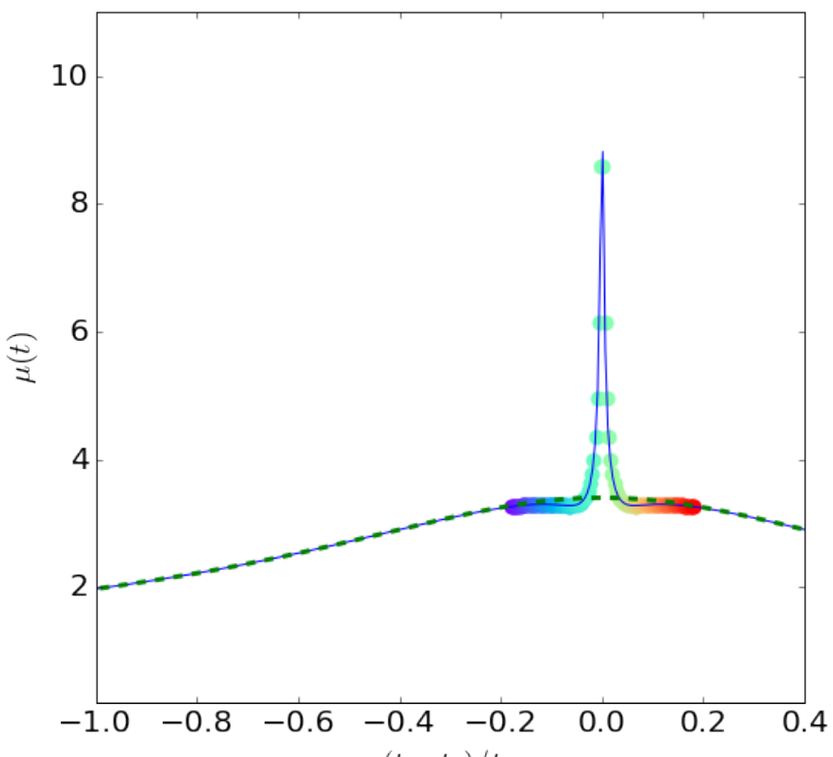

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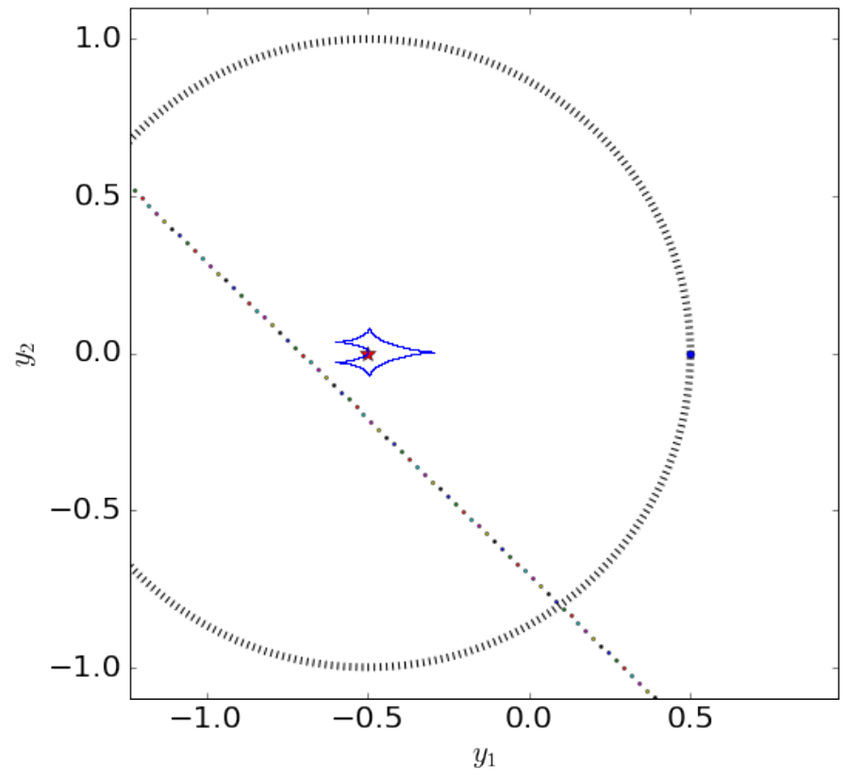

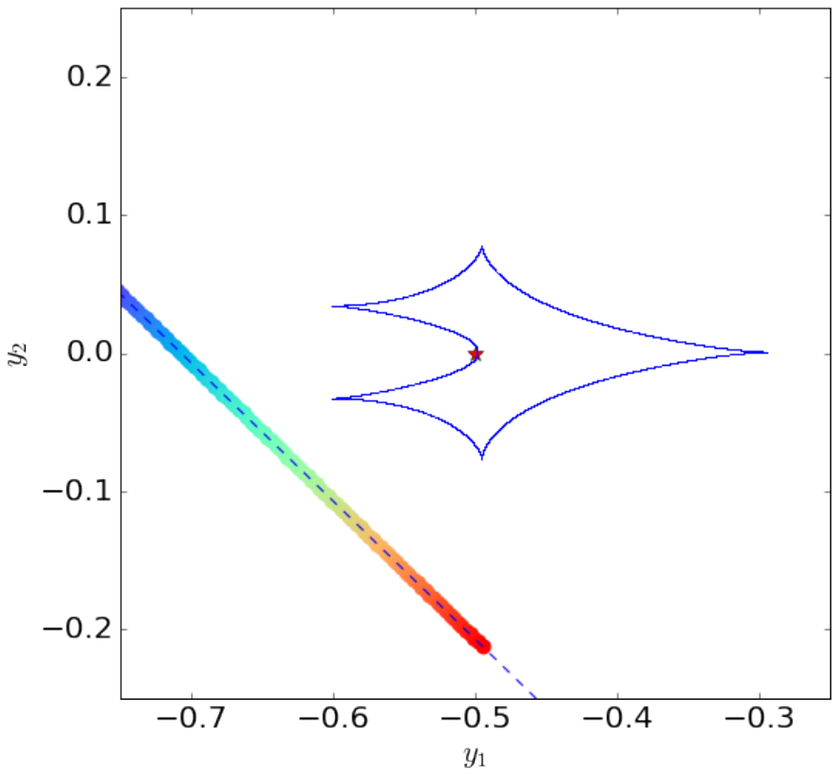

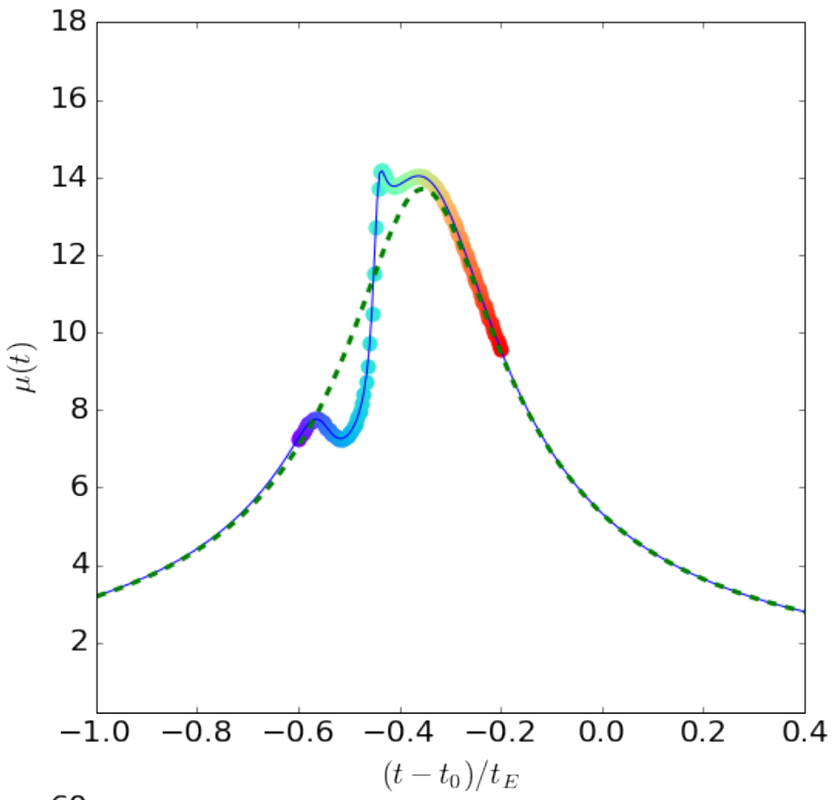

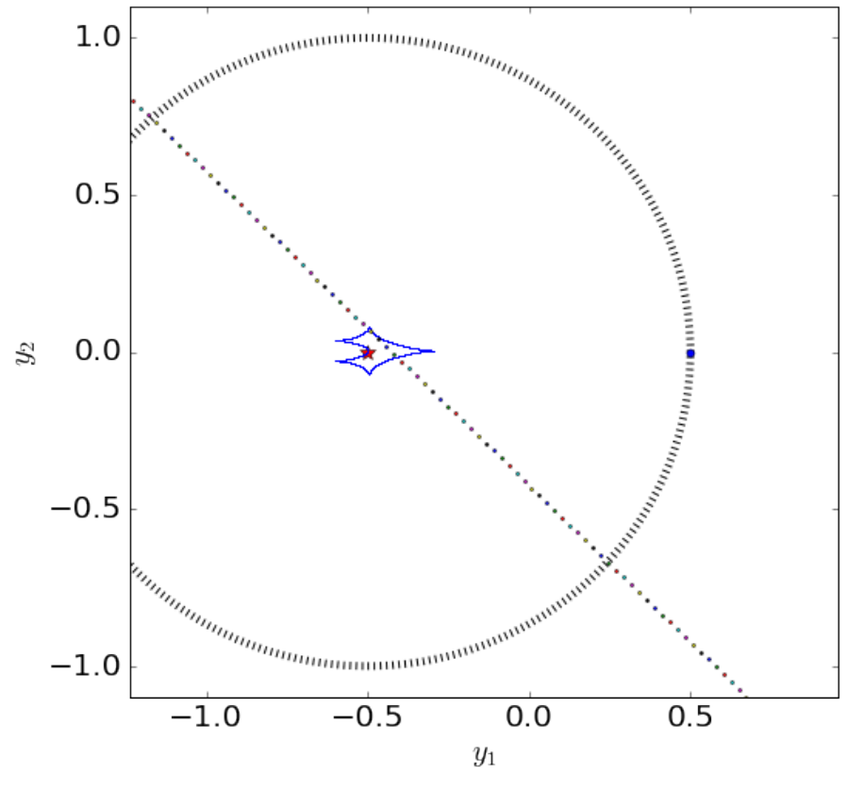

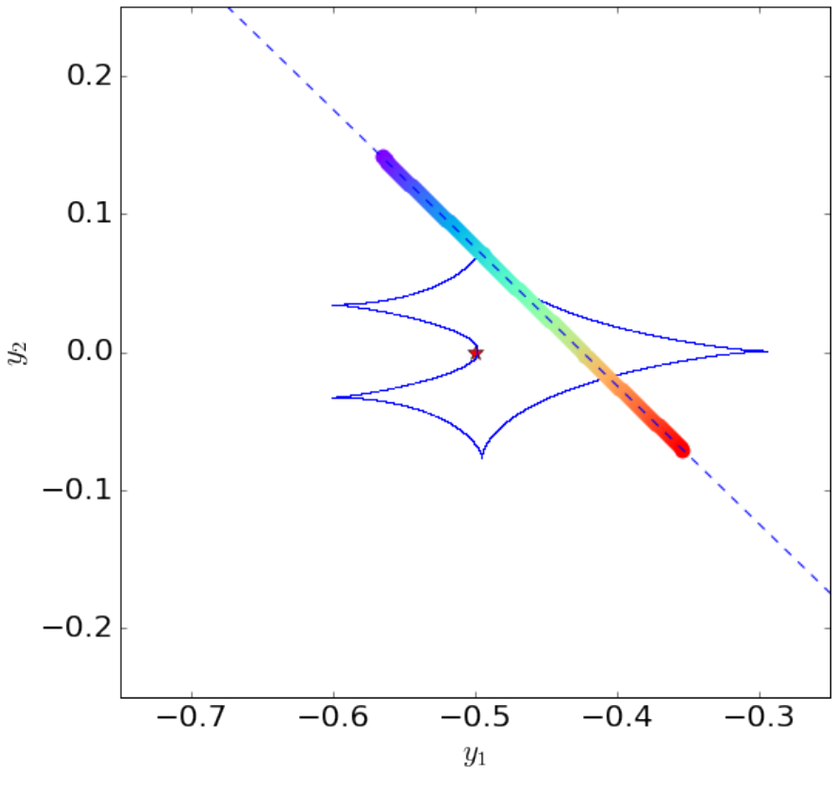

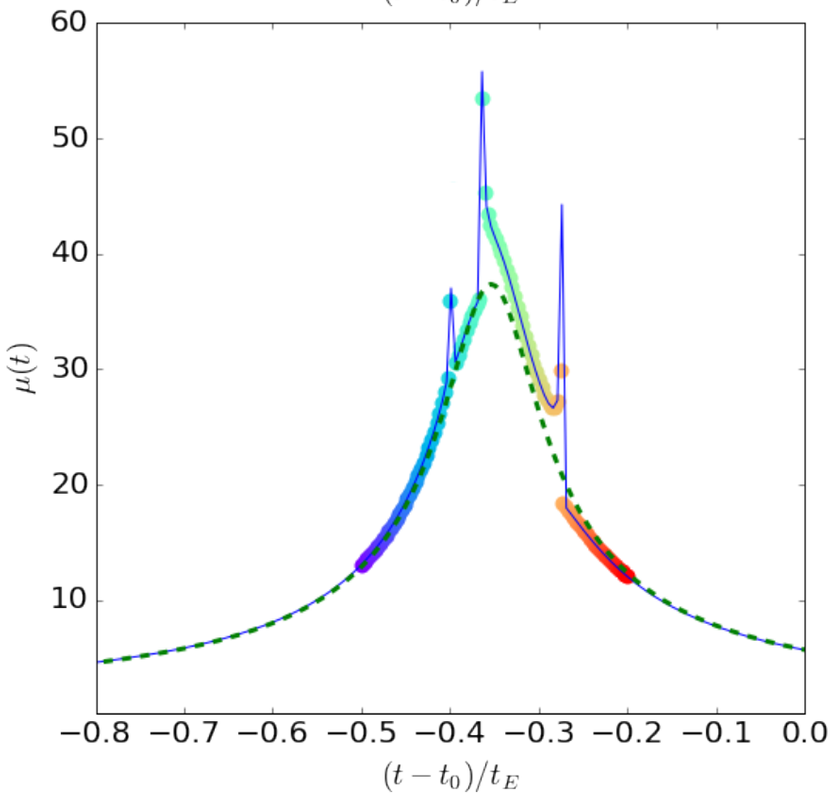

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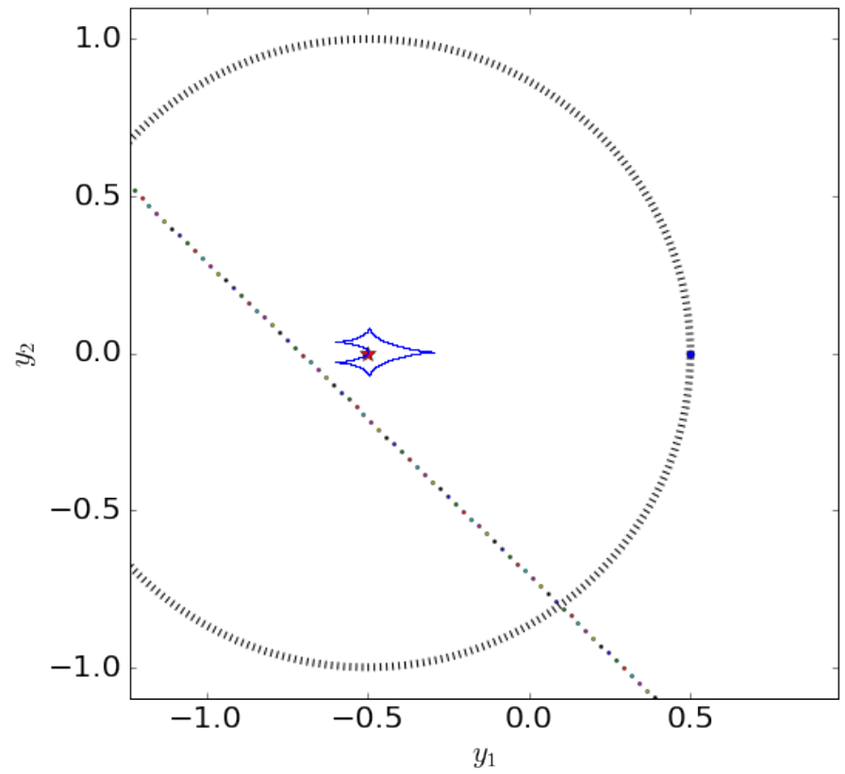

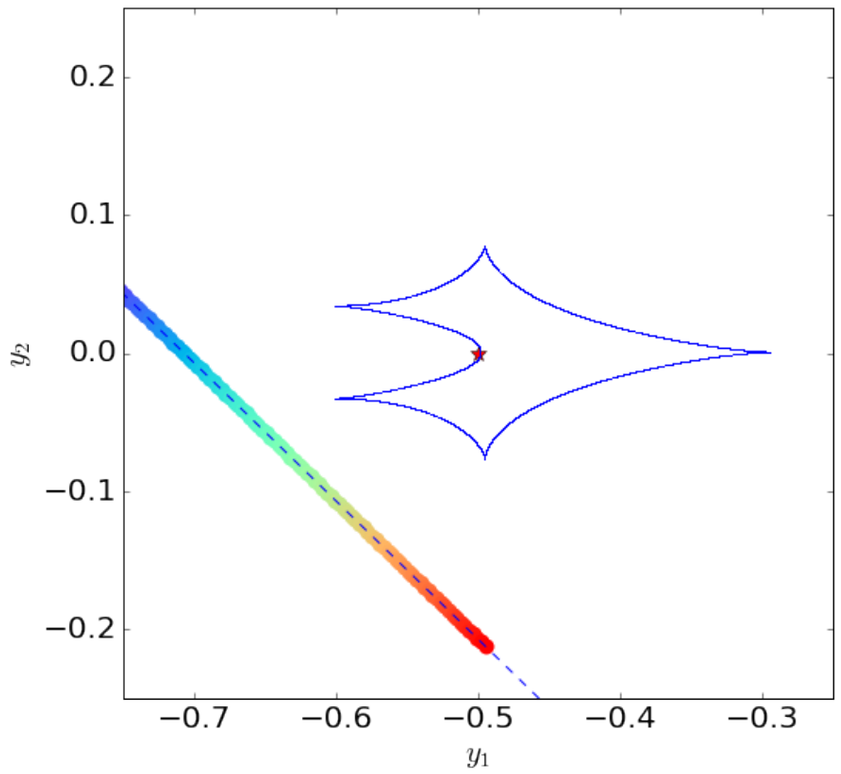

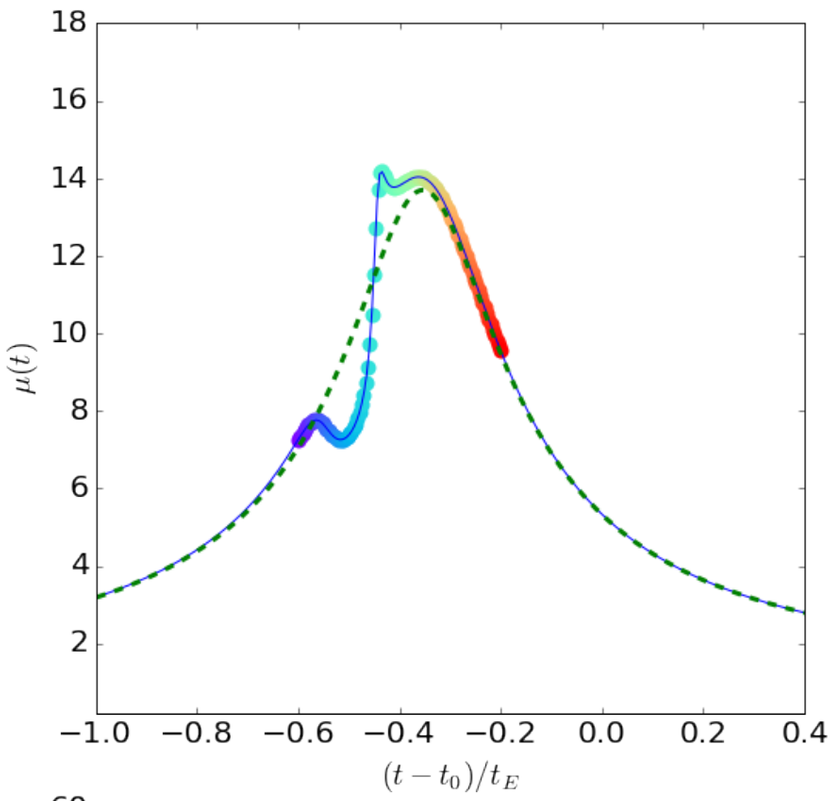

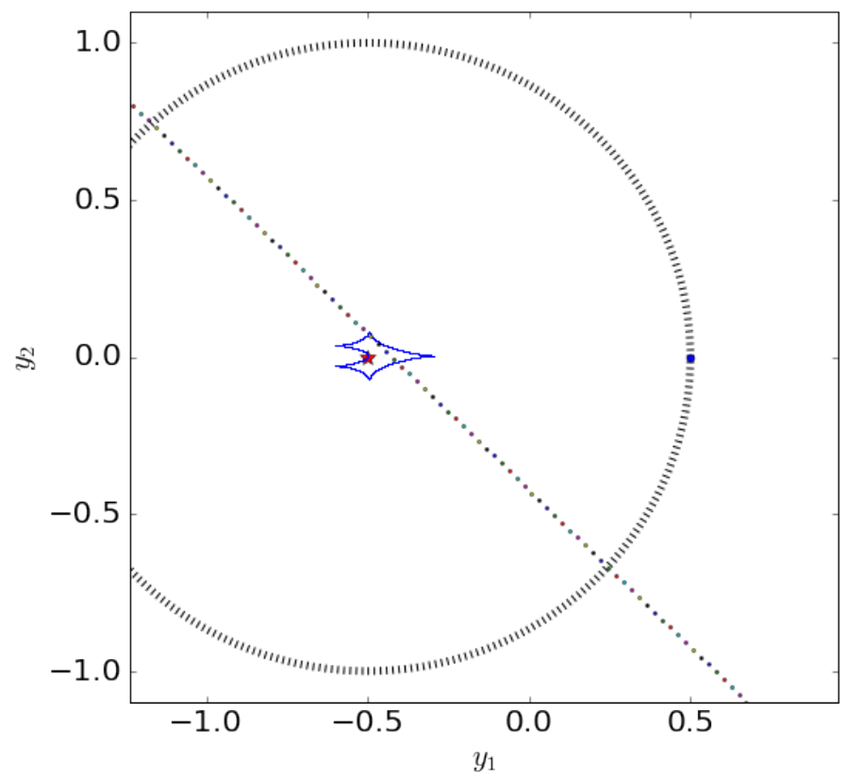

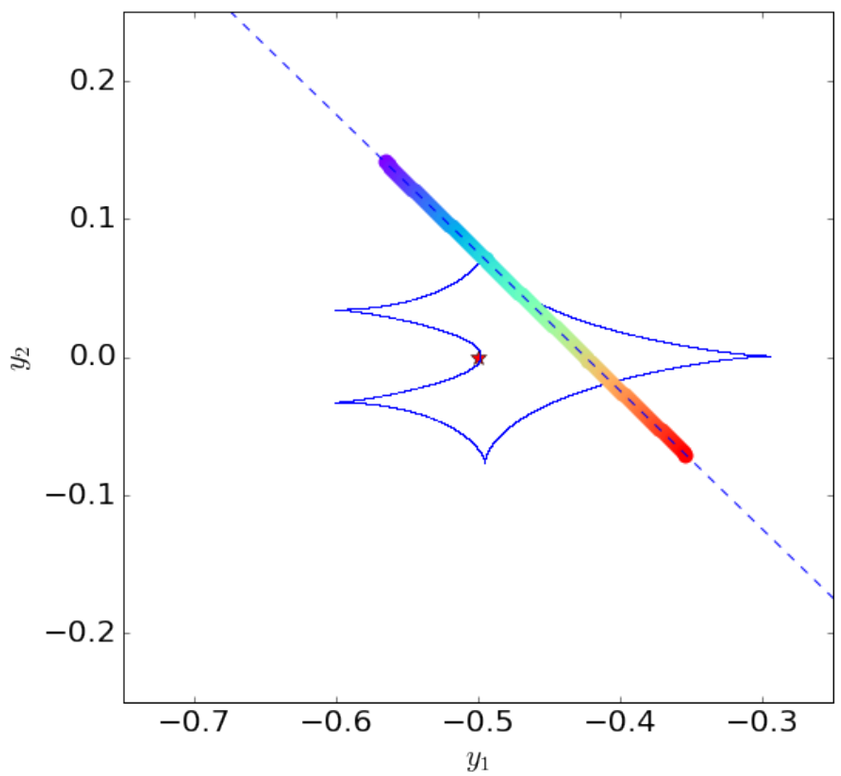

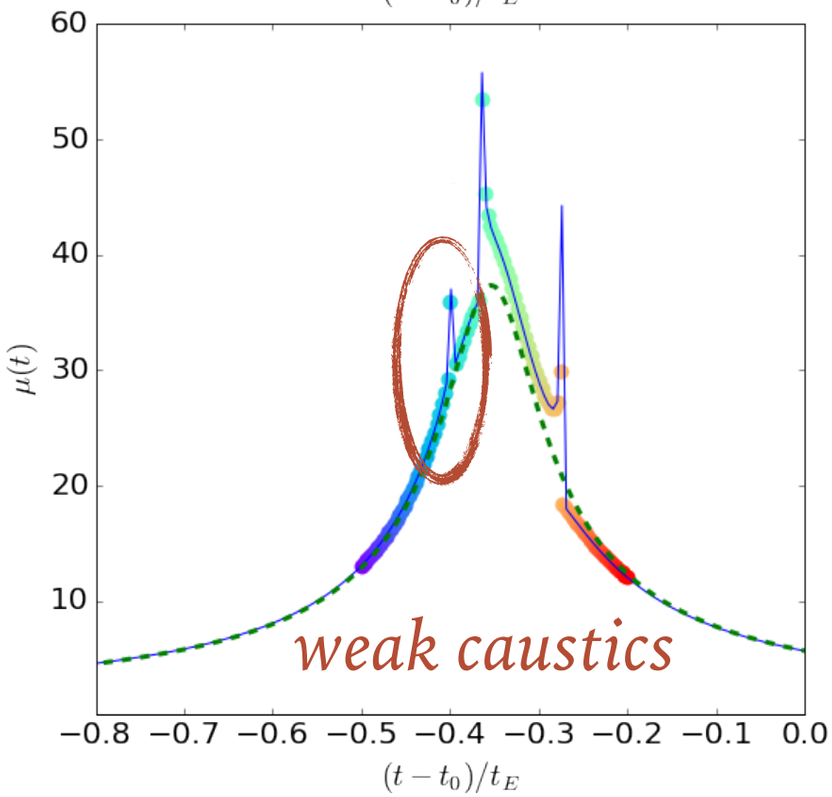

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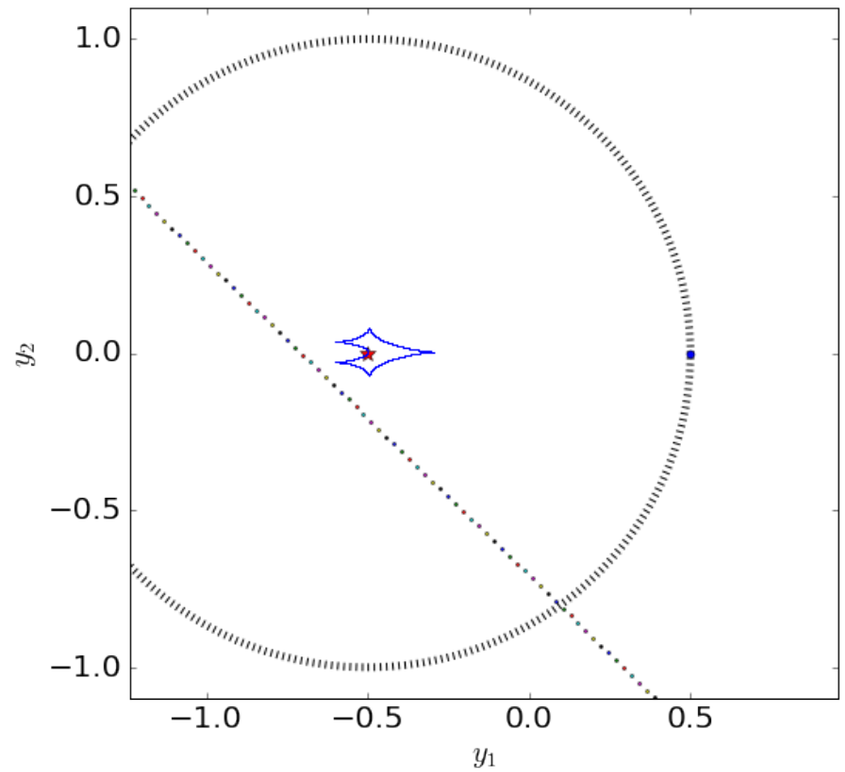

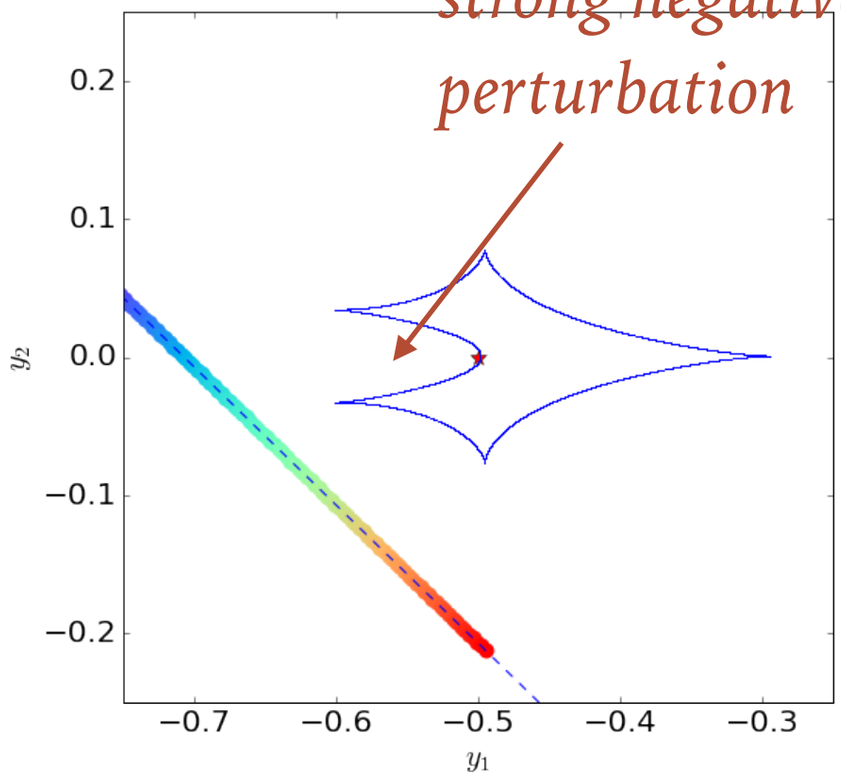

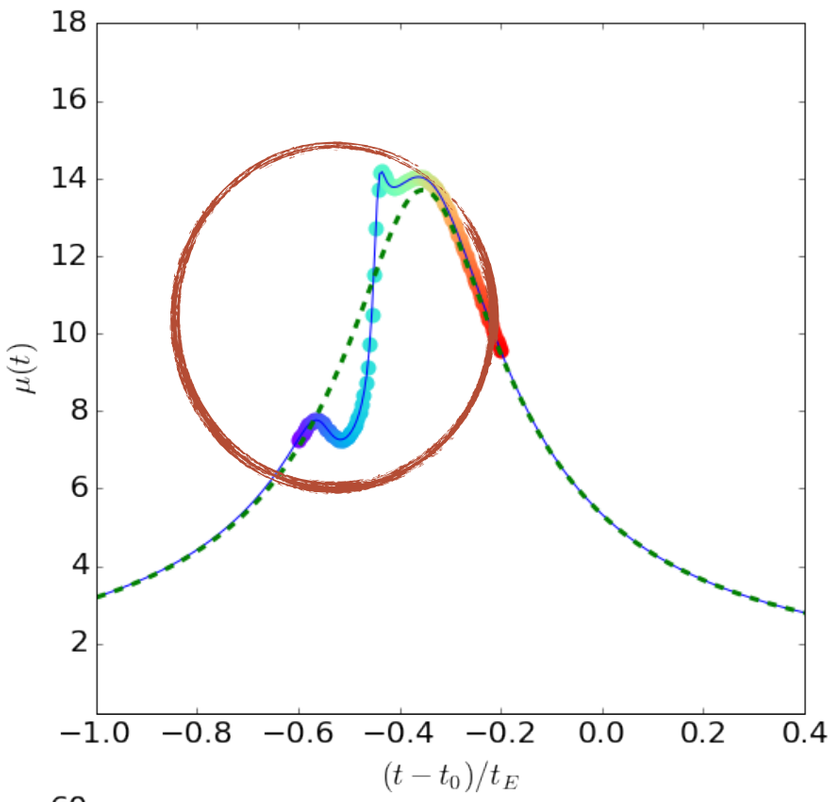

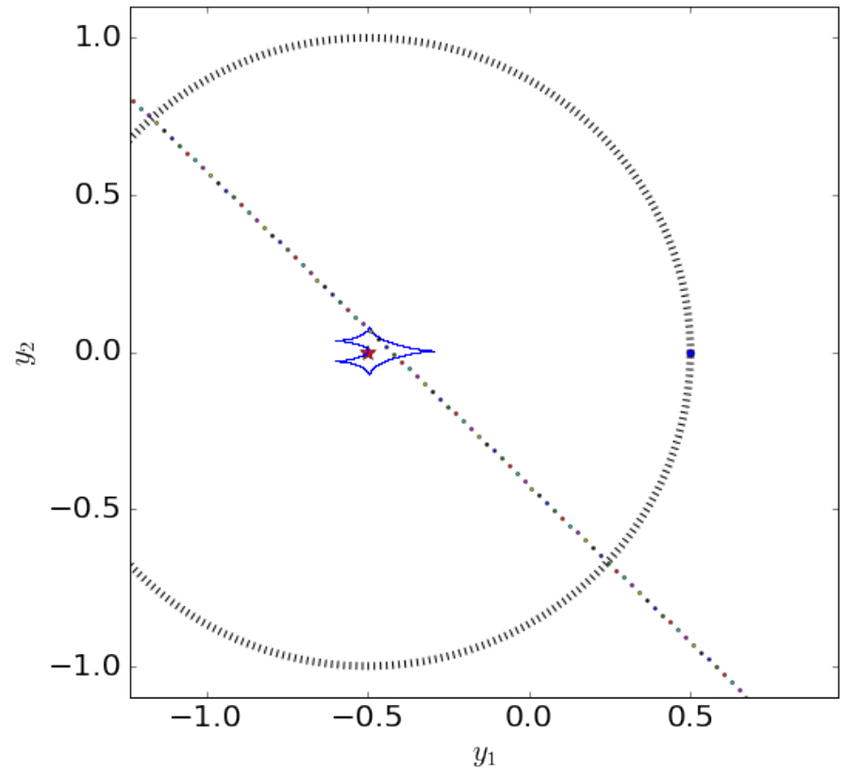

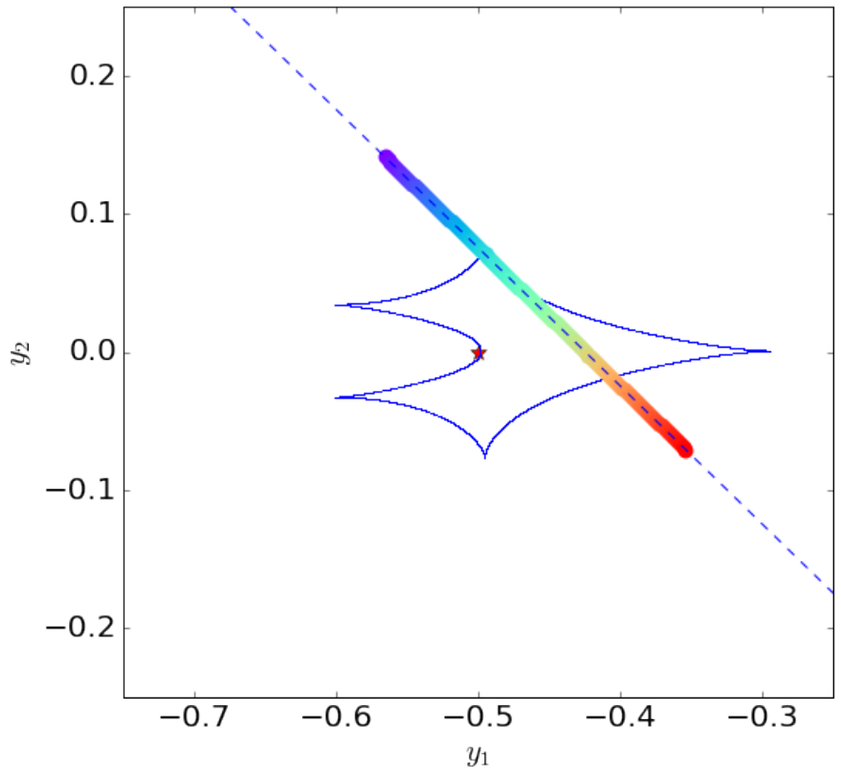

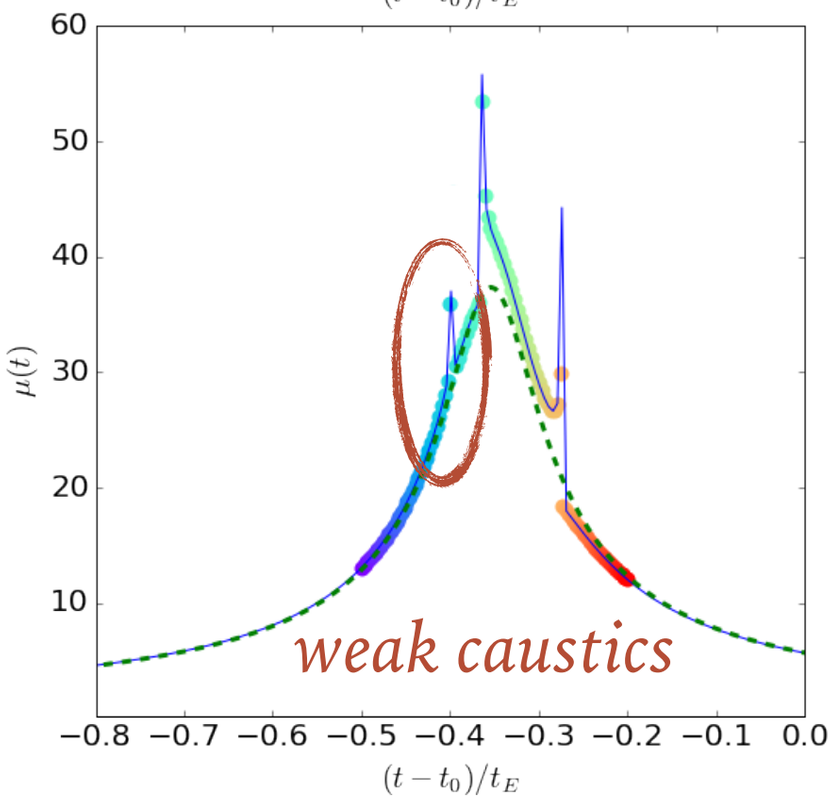

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