Disc Orbital Precession Around Eccentric Binaries: Application to the GG Tau A System

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Aly H., Lodato G.,Cazzoletti P., MNRAS, submitted

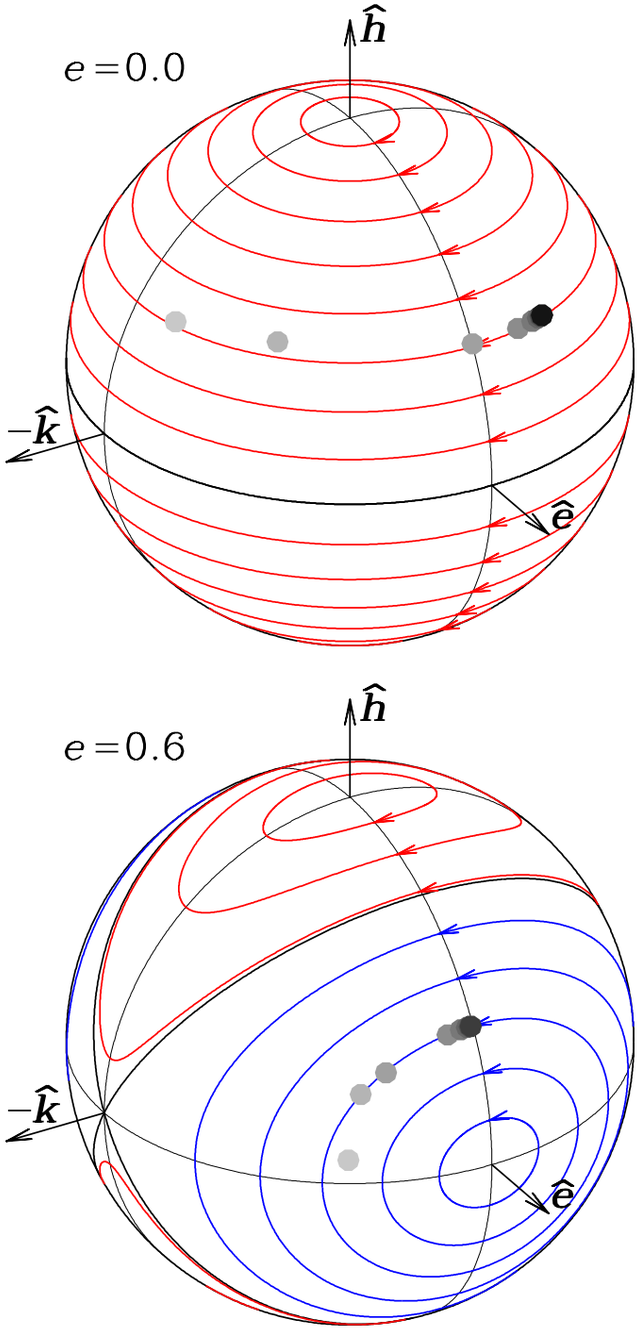
Background: GG Tau

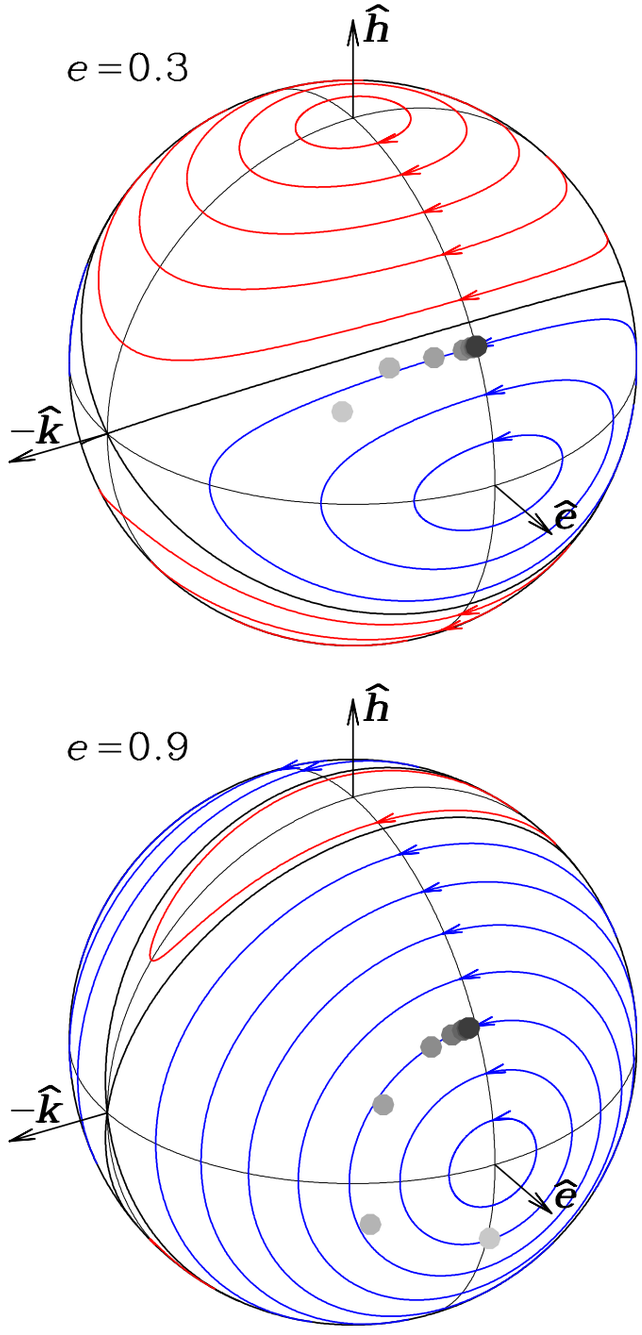
- Quadruple system ~ 140pc
- Dust ring observed around GG Tau A at radius ~ 235AU (Andrews et al 2014)
- Fits to proper motion constrain disc inclination and SMA:

Co-planar —> SMA = 34AU
Inclined (~ 25°) —> SMA= 60AU
(Köhler 2011)

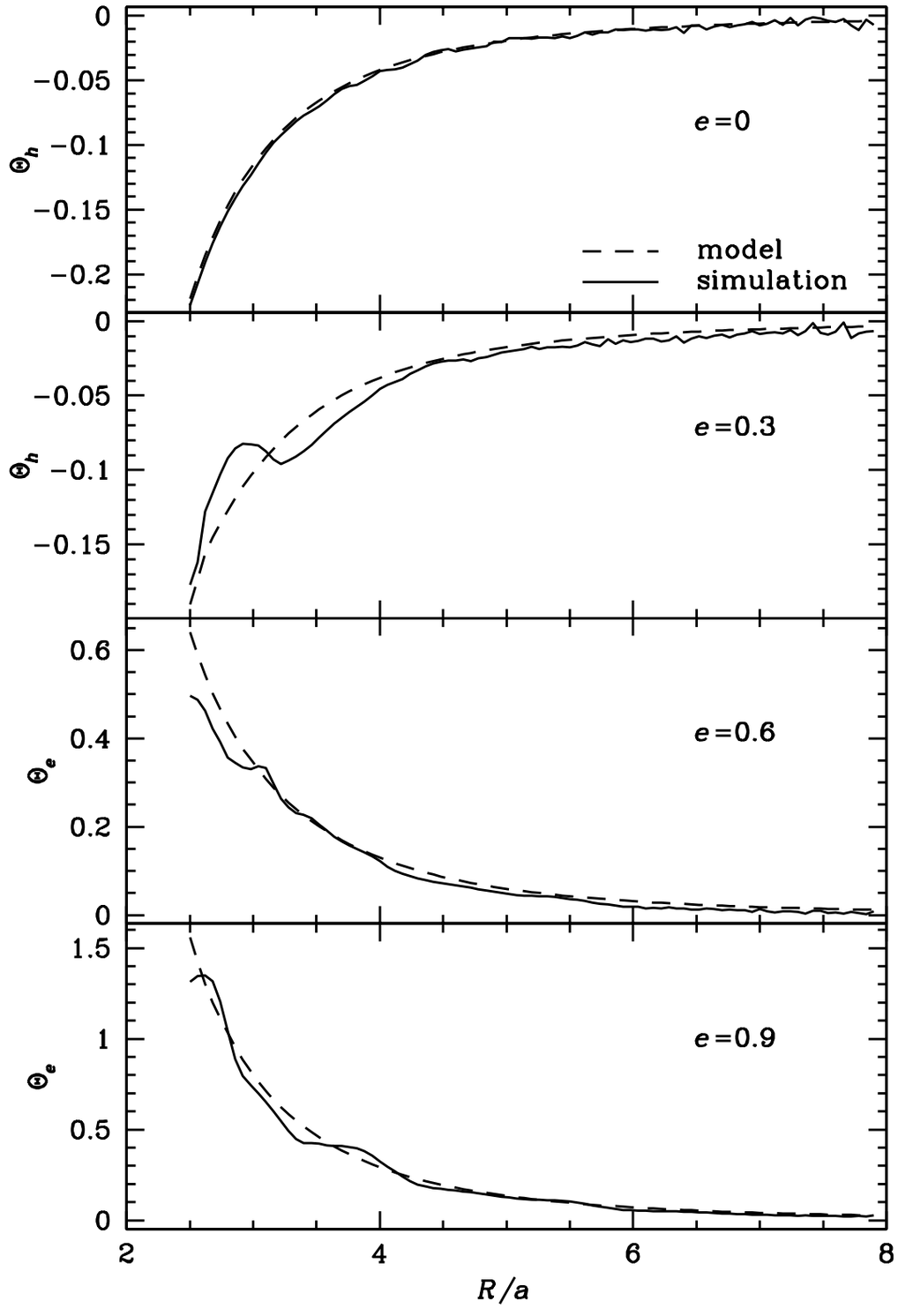
- Co-planar: Density peak at ~150AU (Cazzoletti et al 2017)

Eccentric Binaries: Precession





Aly et al 2015



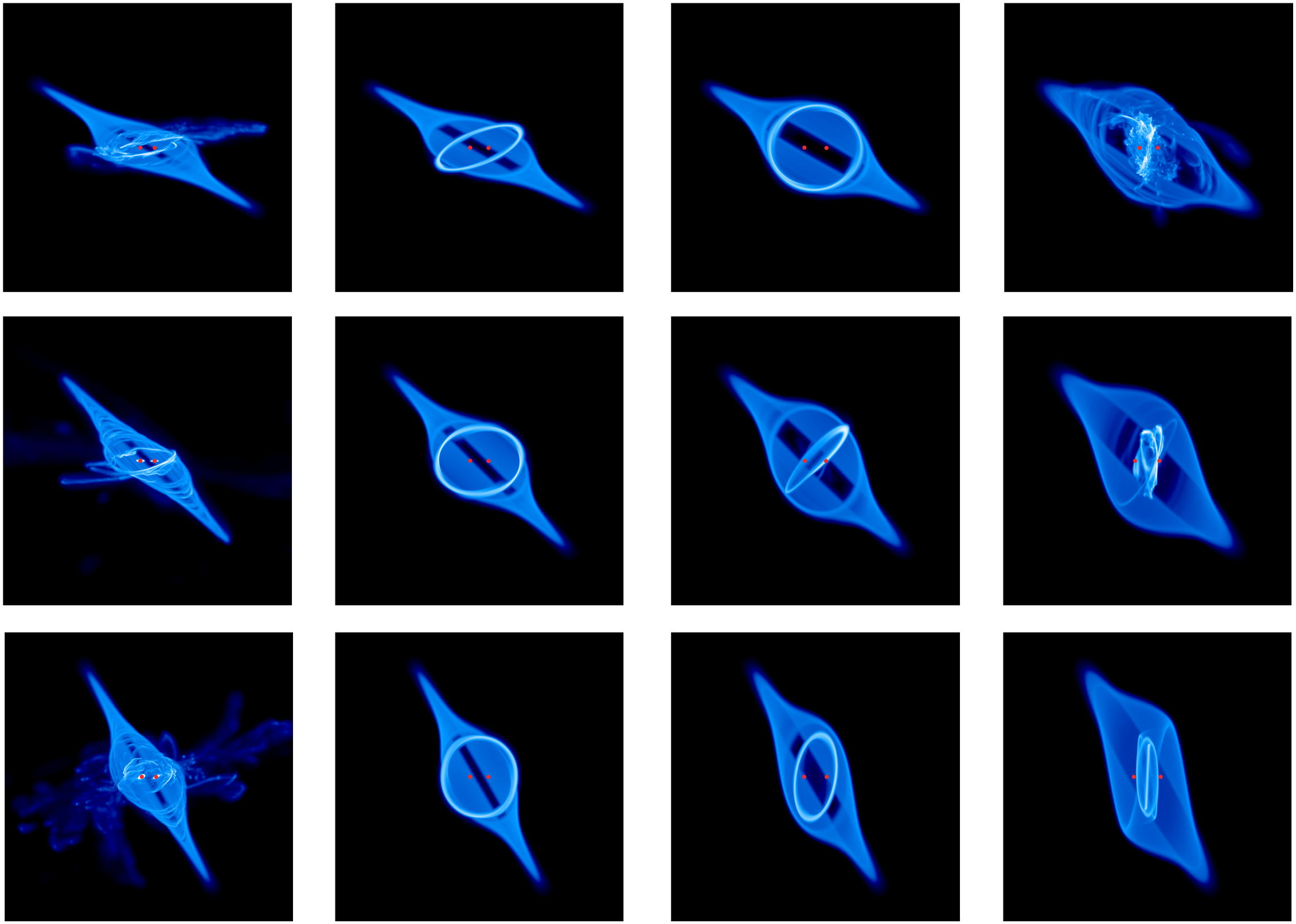
Eccentric Binaries: Disc Tearing

e=0 e=0.3 e=0.6 e=0.9

θ=30

θ=45

θ=60

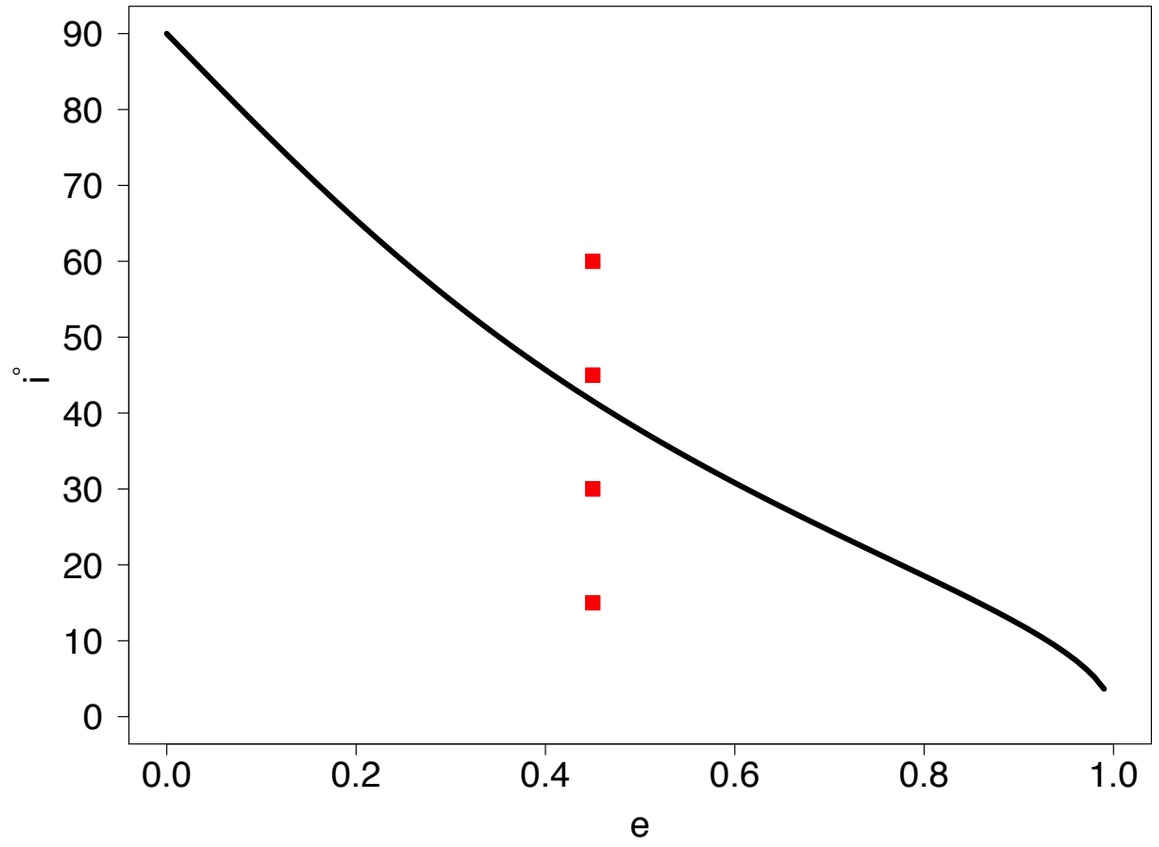


Simulations Setup

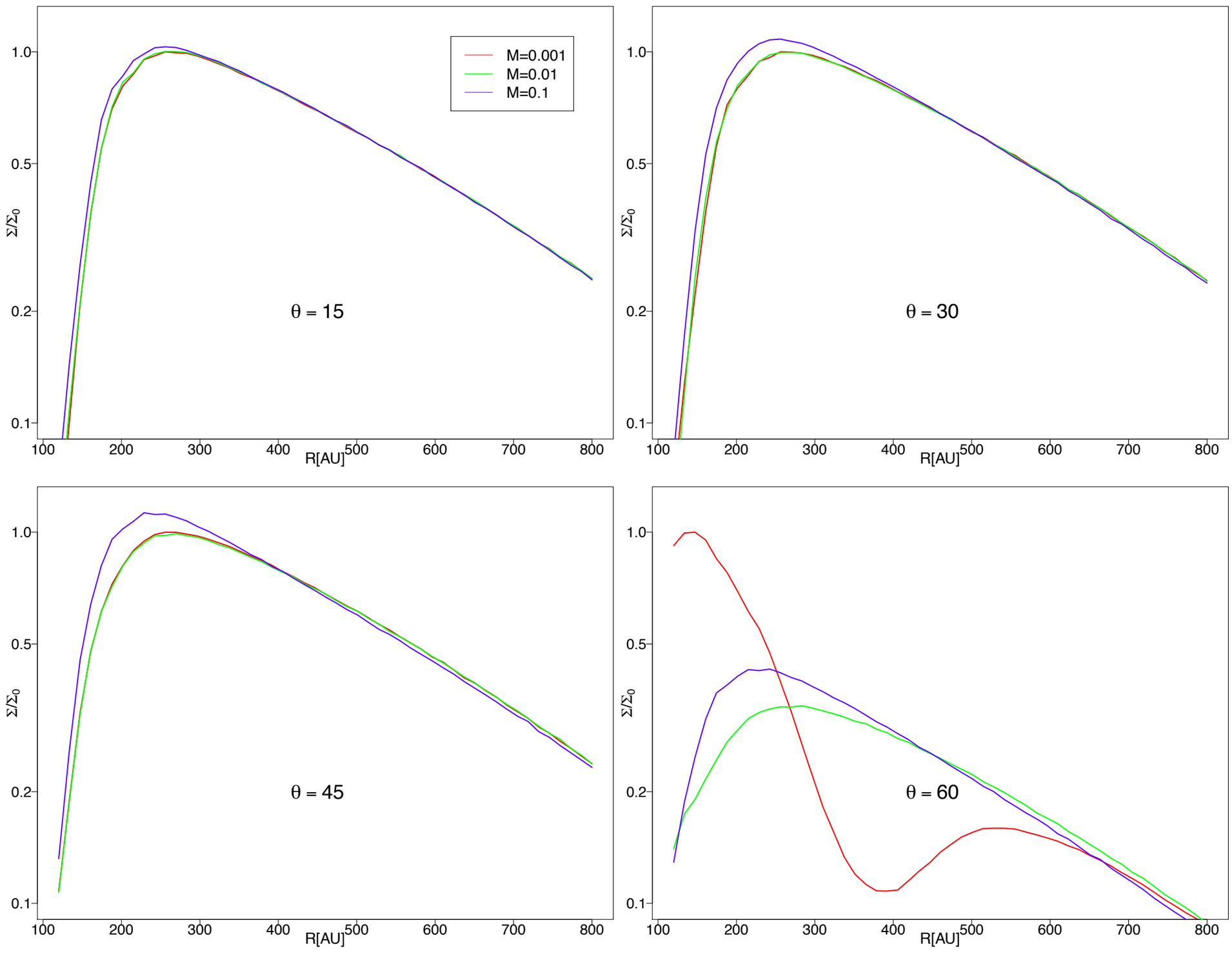
- Performed 12 simulations varying the disc mass and inclination (Md=0.1, 0.01, 0.001; i^{o}= 15, 30, 45, 60)

- Disc parameters:
H/R=0.12
Alpha=0.01

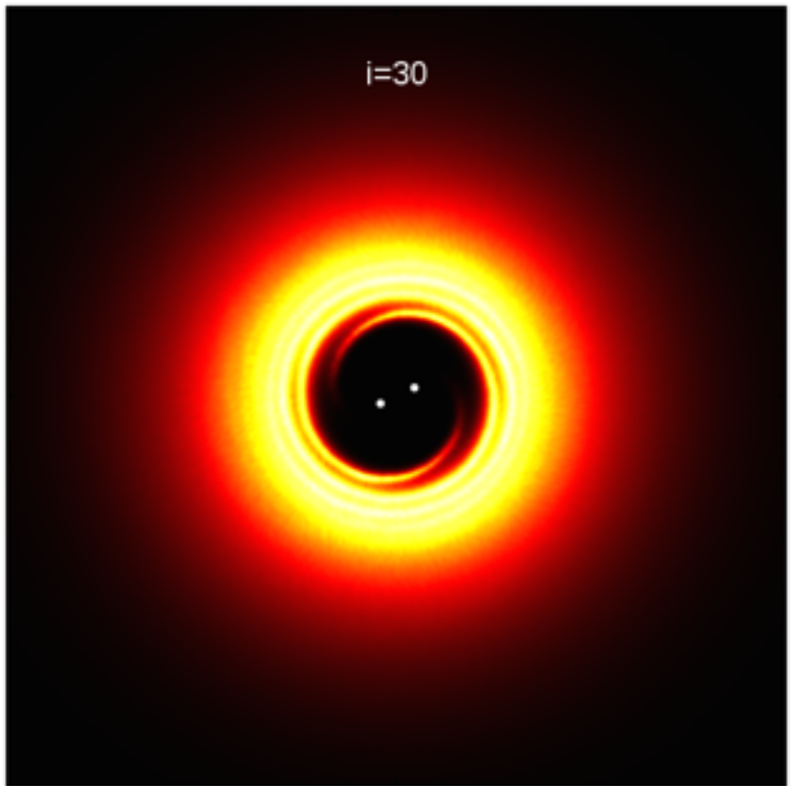
- Binary parameters:
e=0.45 a=60AU

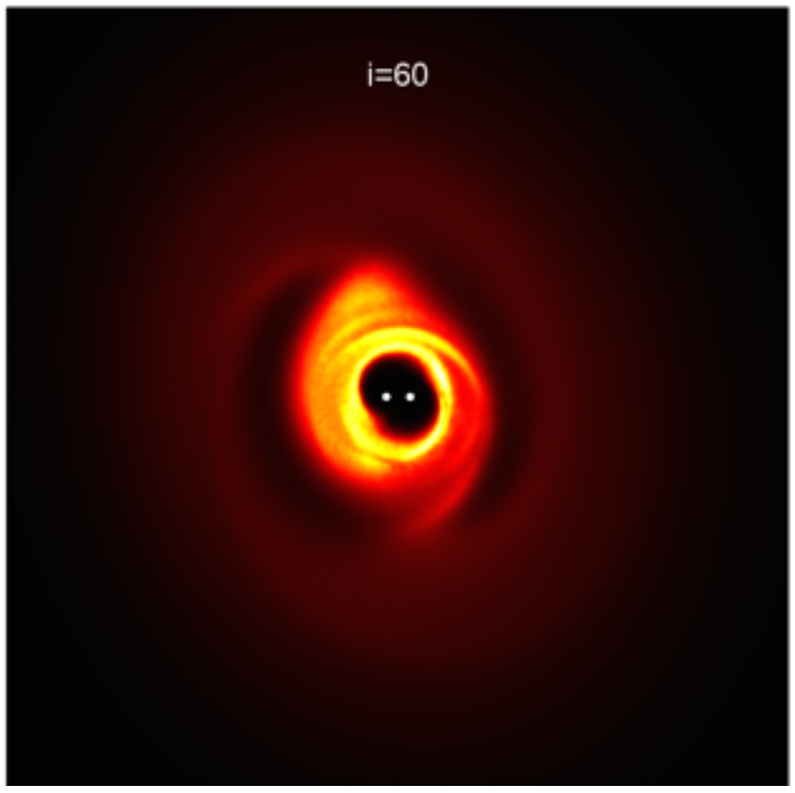


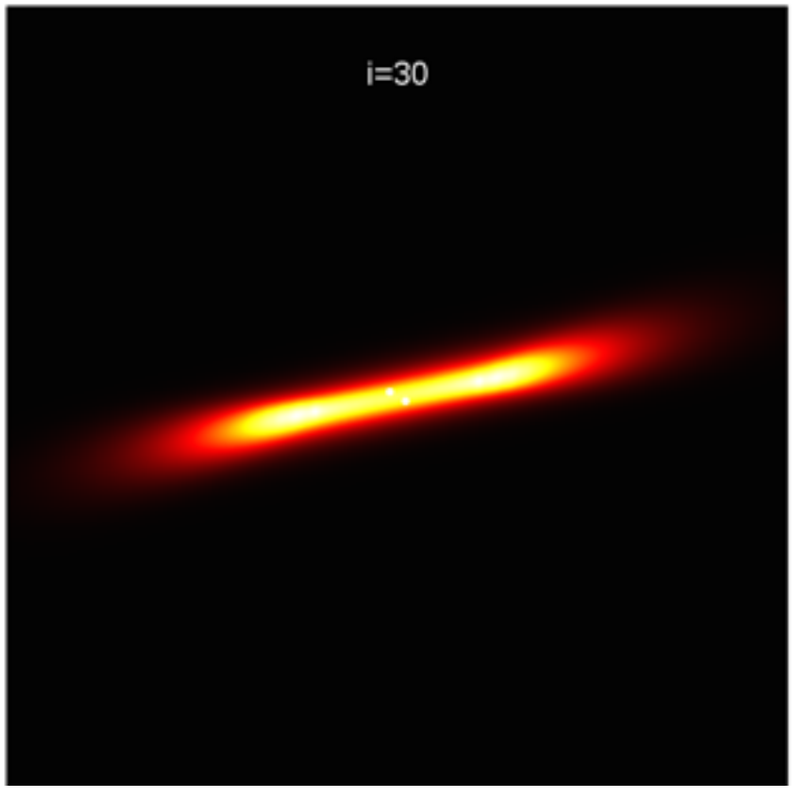
Results

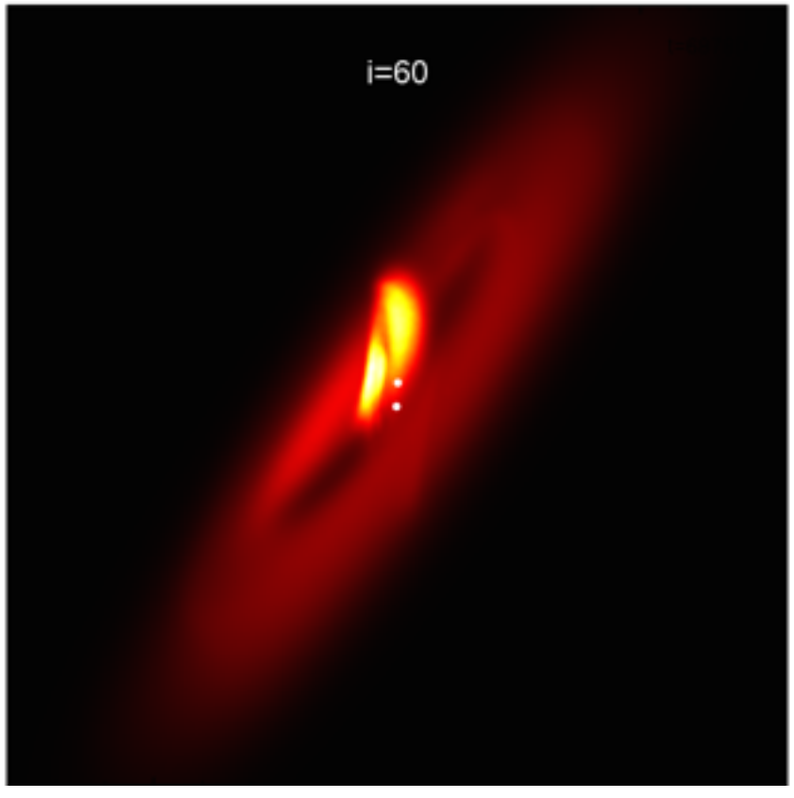

M=0.001
M=0.01
M=0.1
θ = 15
θ = 30
θ = 45
θ = 60
Σ/Σ0
R[AU]
1.0
0.5
0.2
0.1
100
200
300
400
500
600
700
800

Results

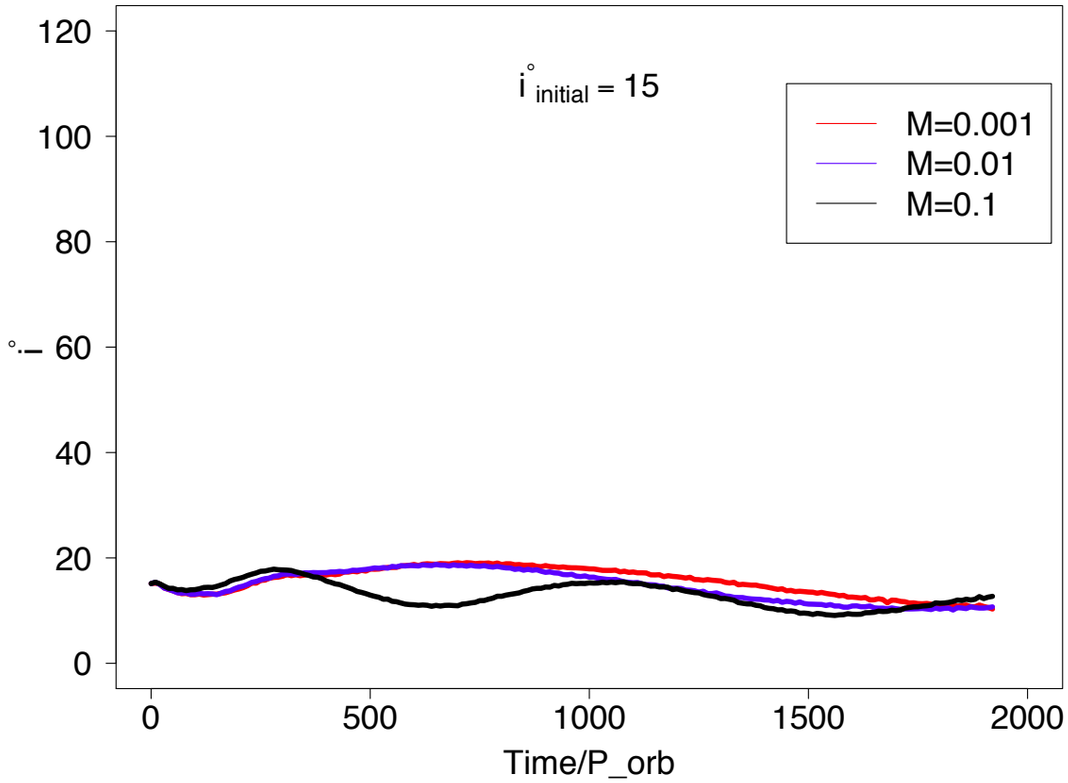


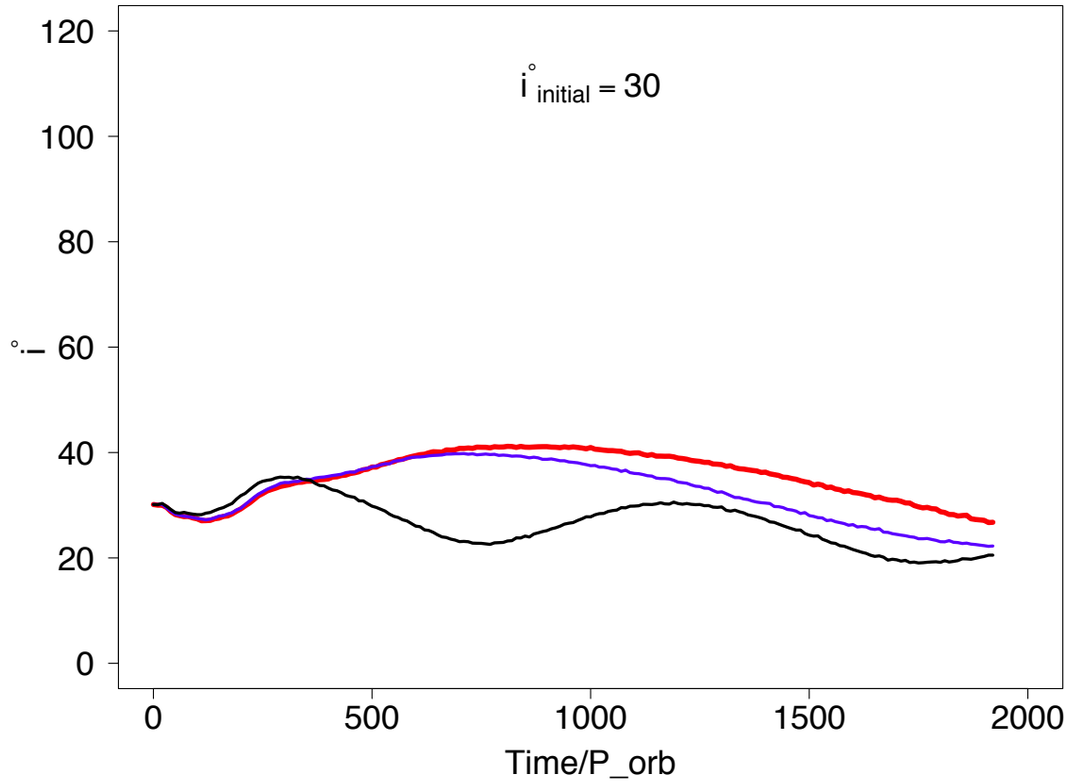


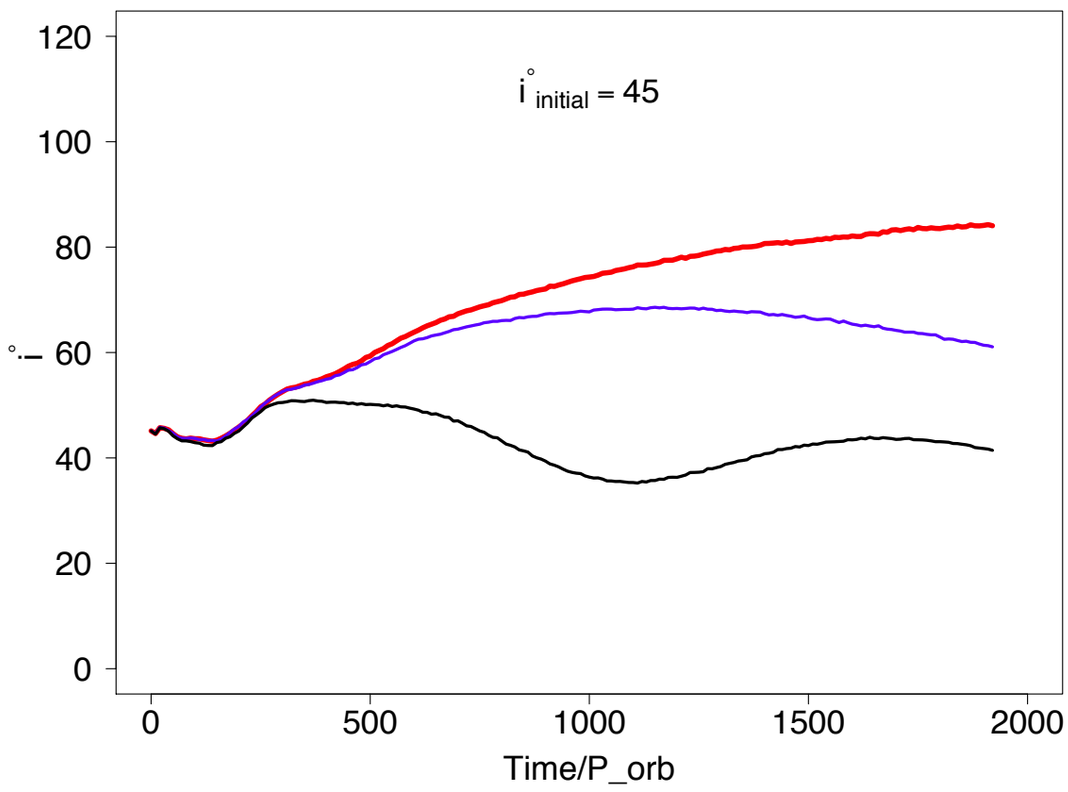


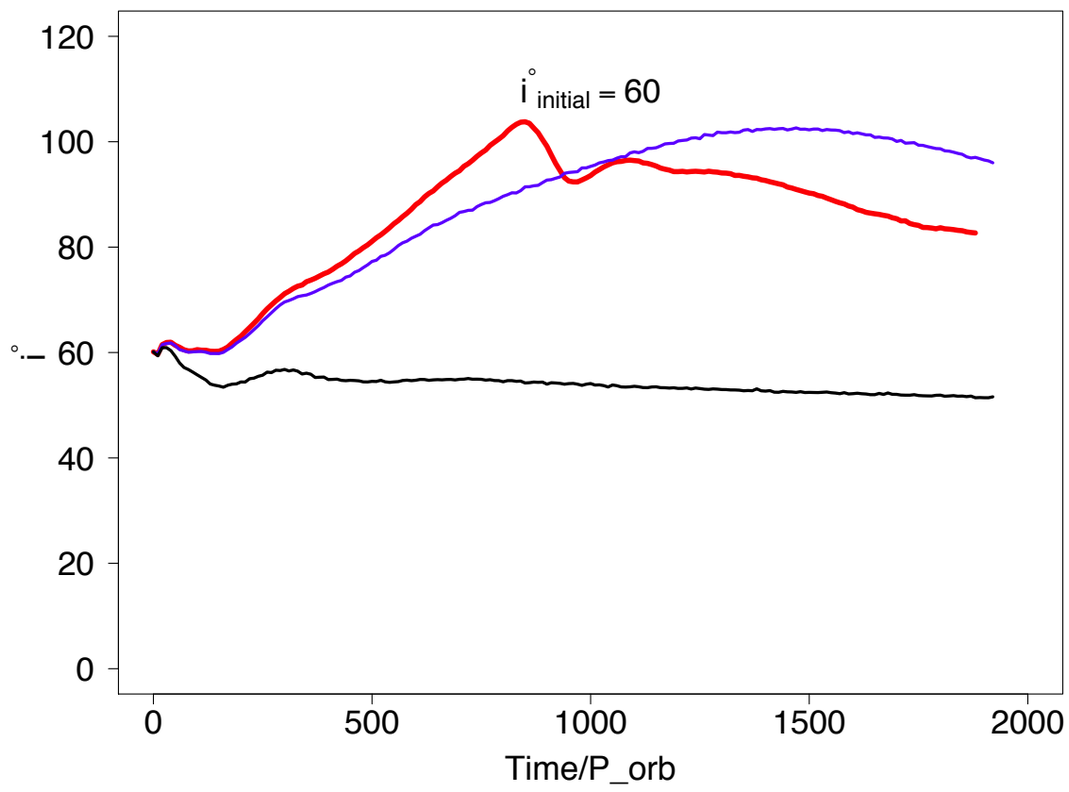


Results

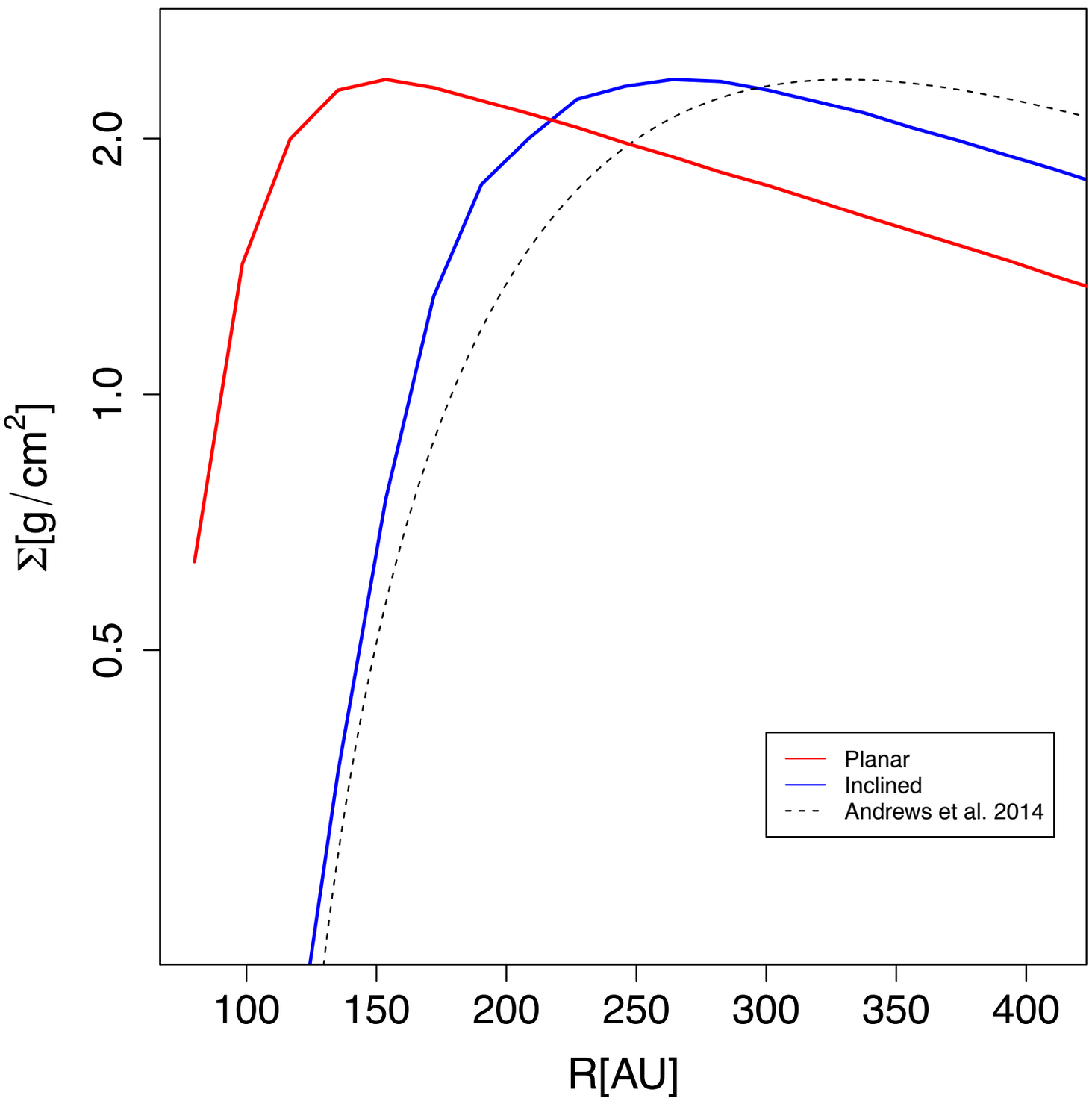

$i^\circ_{initial}$ = 15
M=0.001
M=0.01
M=0.1
120
100
80
60
40
20
0
°
0
500
1000
1500
2000
Time/P_orb


$i^\circ_{initial}$ = 30
120
100
80
60
40
20
0
°
0
500
1000
1500
2000
Time/P_orb


$i^\circ_{initial}$ = 45
120
100
80
60
40
20
0
°
0
500
1000
1500
2000
Time/P_orb


$i^\circ_{initial}$ = 60
120
100
80
60
40
20
0
°
0
500
1000
1500
2000
Time/P_orb

Results


Σ[g/cm²]
0.5
1.0
2.0
100
150
200
250
300
350
400
R[AU]
Planar
Inclined
Andrews et al. 2014