Seismic Diagrams for β Cephei Stars

A database for COROT

A. Thoul + BAG

BAG

- Stellar Evolution Code: CLES
- Adiabatic oscillation code: OSC
- Non Adiabatic oscillation code: MAD
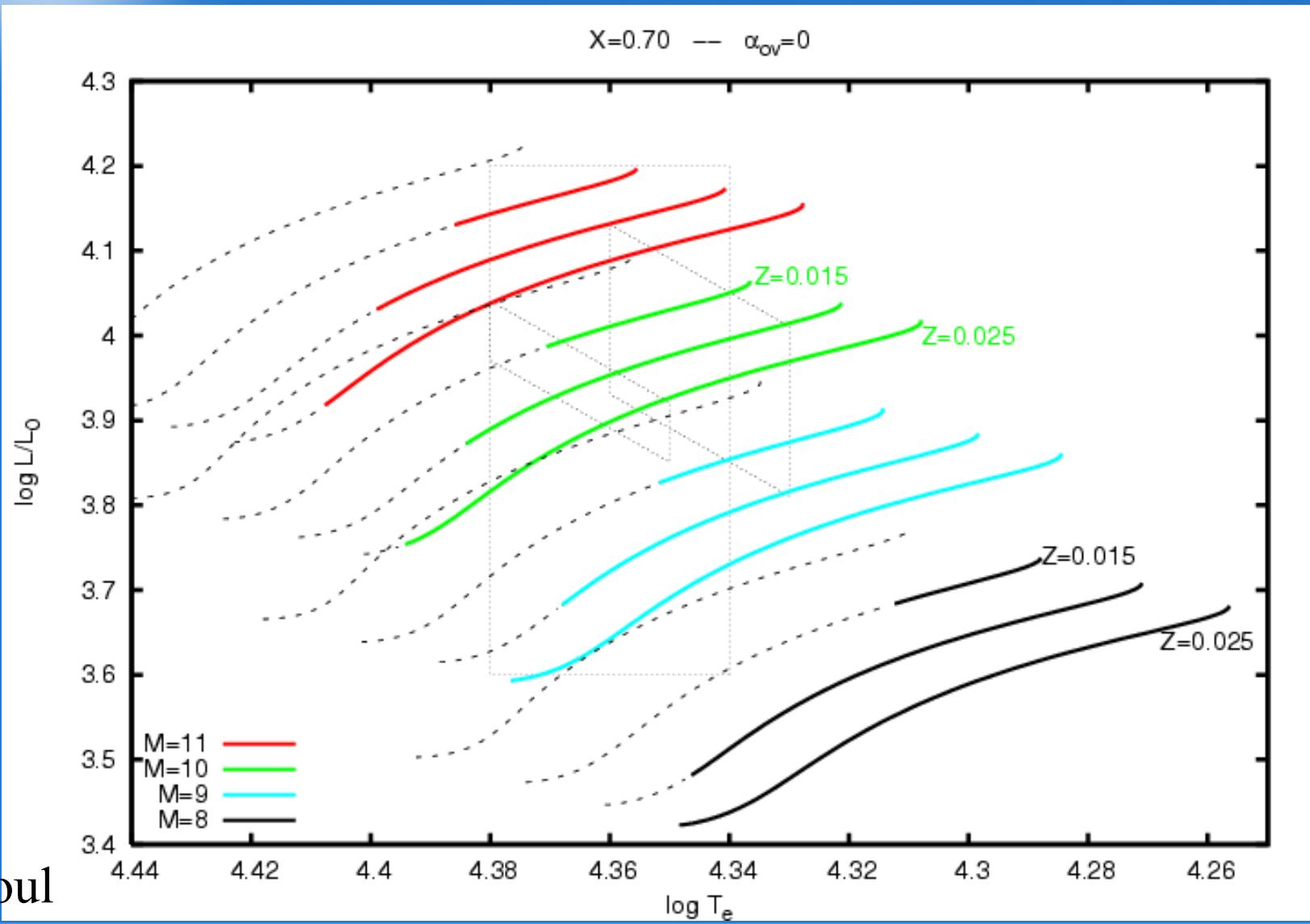
Grid of models

- Model parameters:
  - Mass   M: 8 to 11 M_0
  - Metallicity   Z: 0.010 to 0.025
  - Hydrogen Abundance   X: 0.6 to 0.7
  - Overshooting Parameter α_{ov}:   0 to 0.2

A. Thoul

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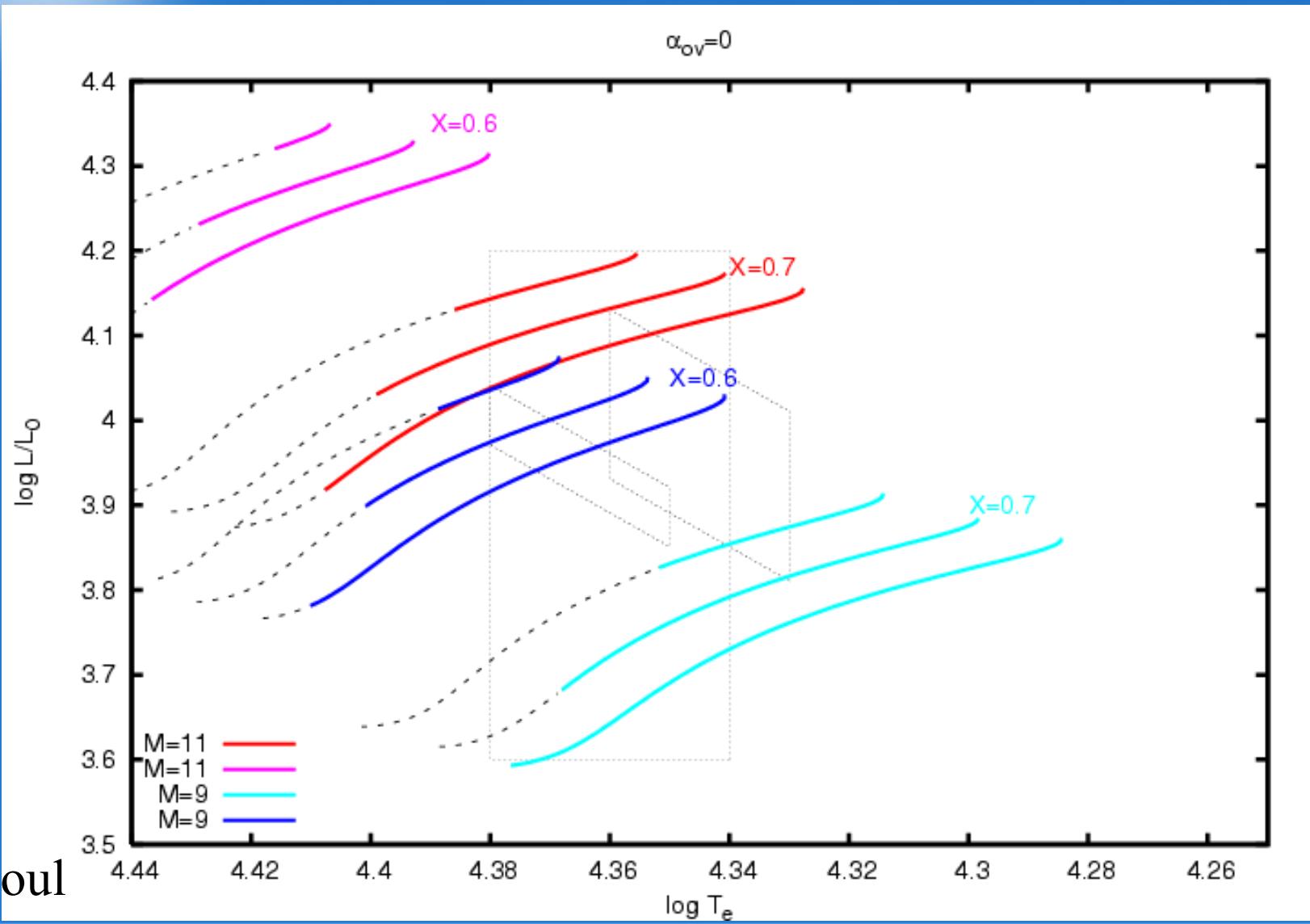
Excited zone on the Main Sequence:

Depends mostly on the metallicity Z
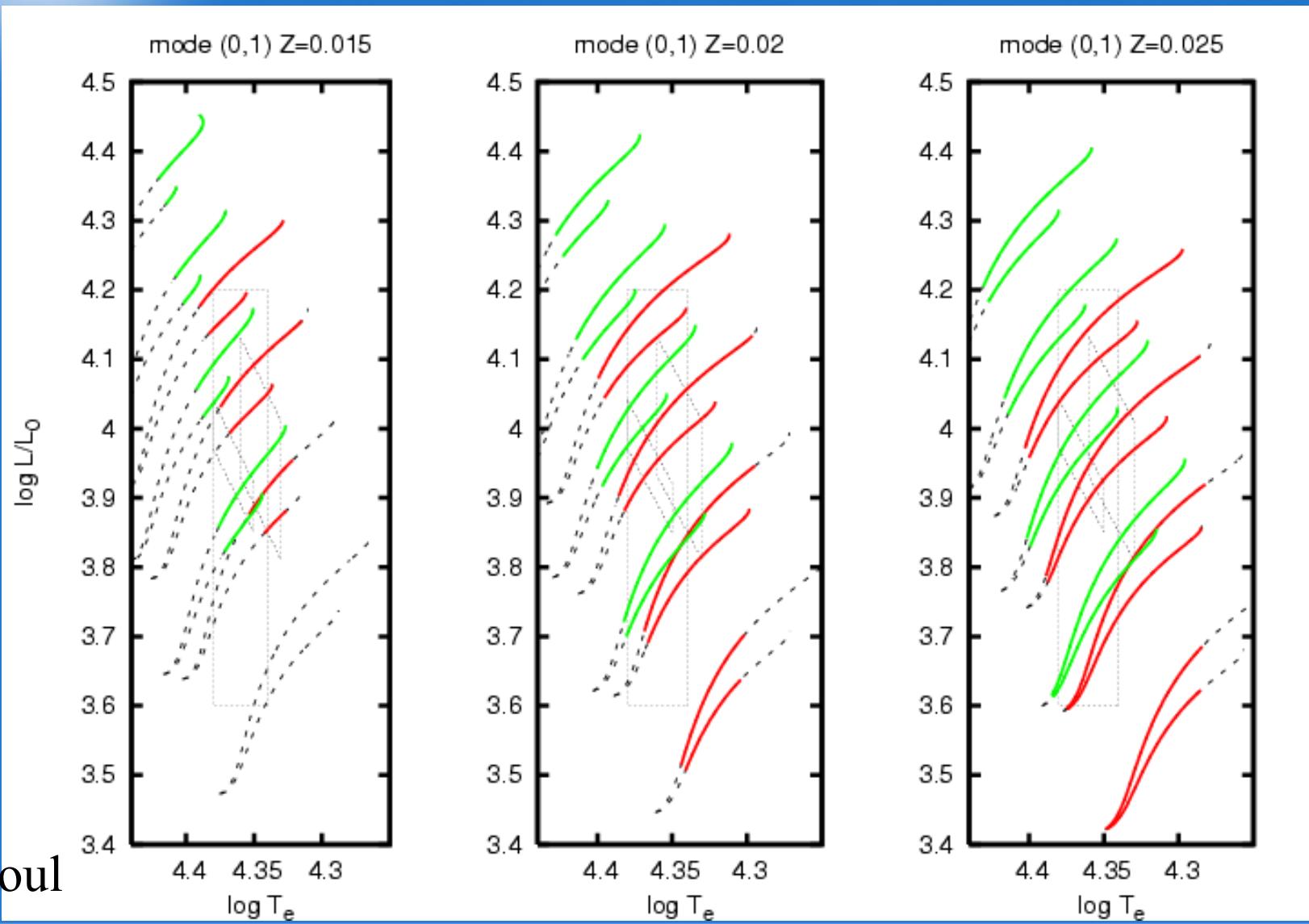
Which modes are excited?

Degree l
Order   n

Which modes are excited?
## l=0, n=1
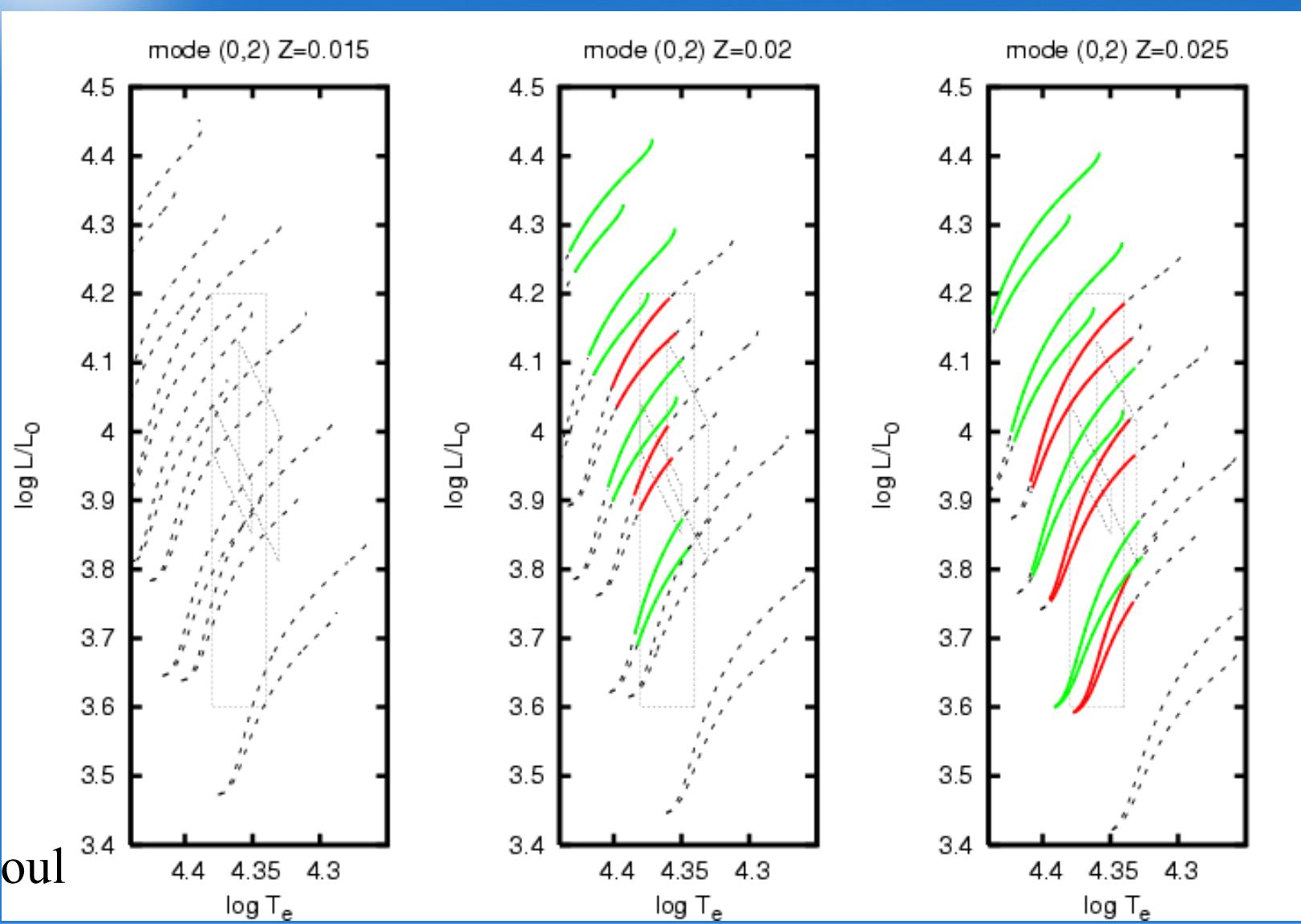
A. Thoul

Which modes are excited?
l=0, n=2
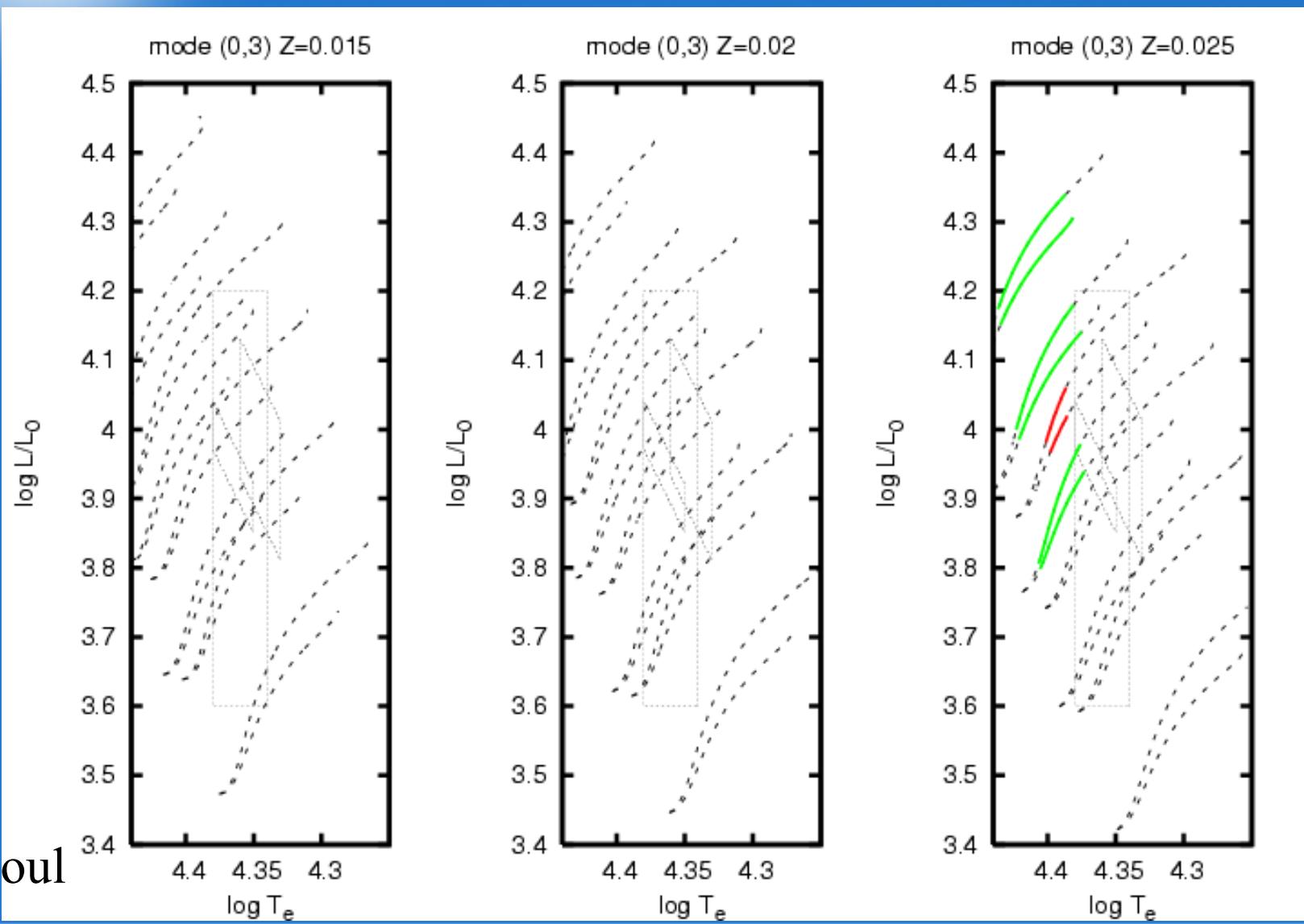
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Which modes are excited?
l=0, n=3

BAG
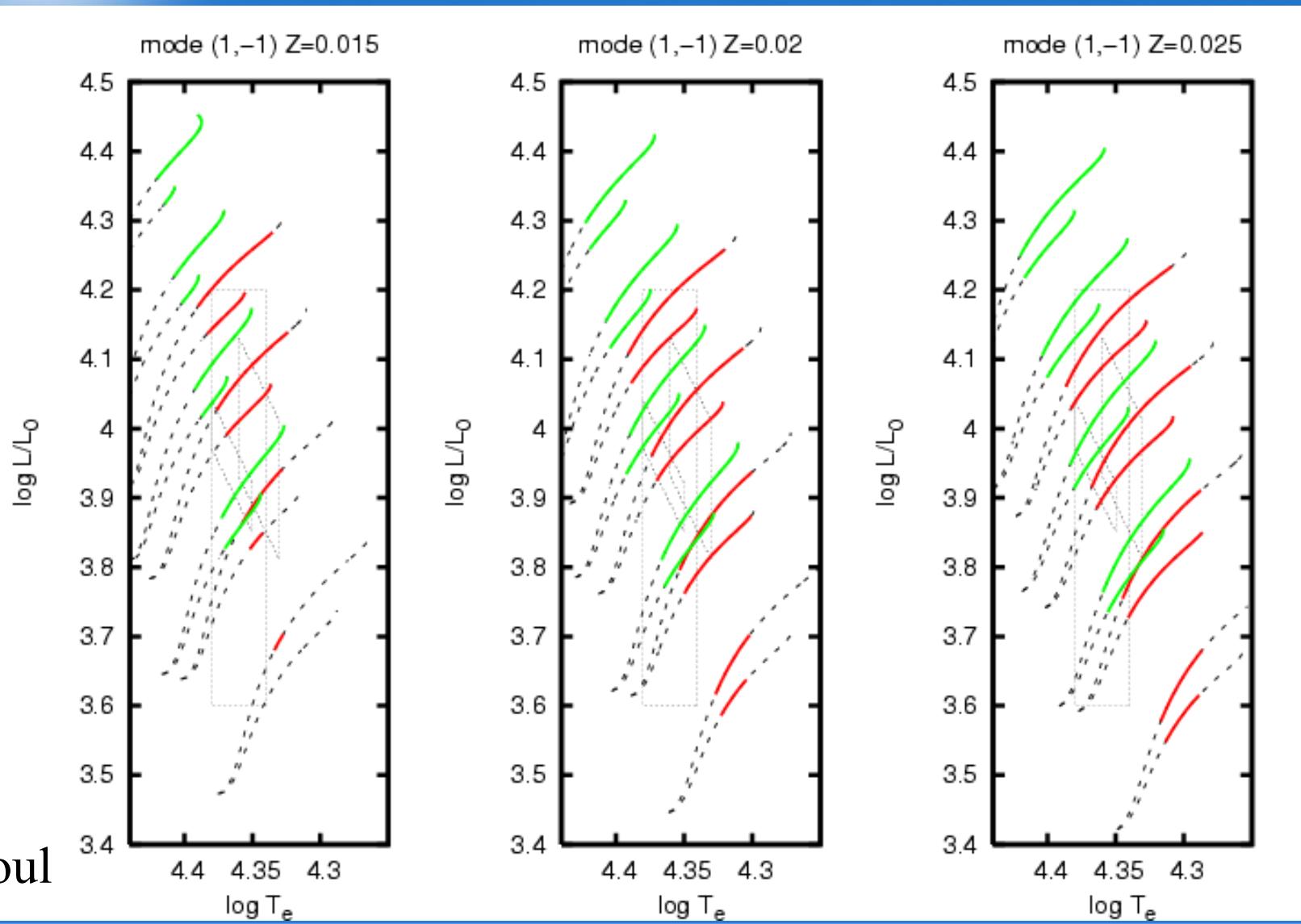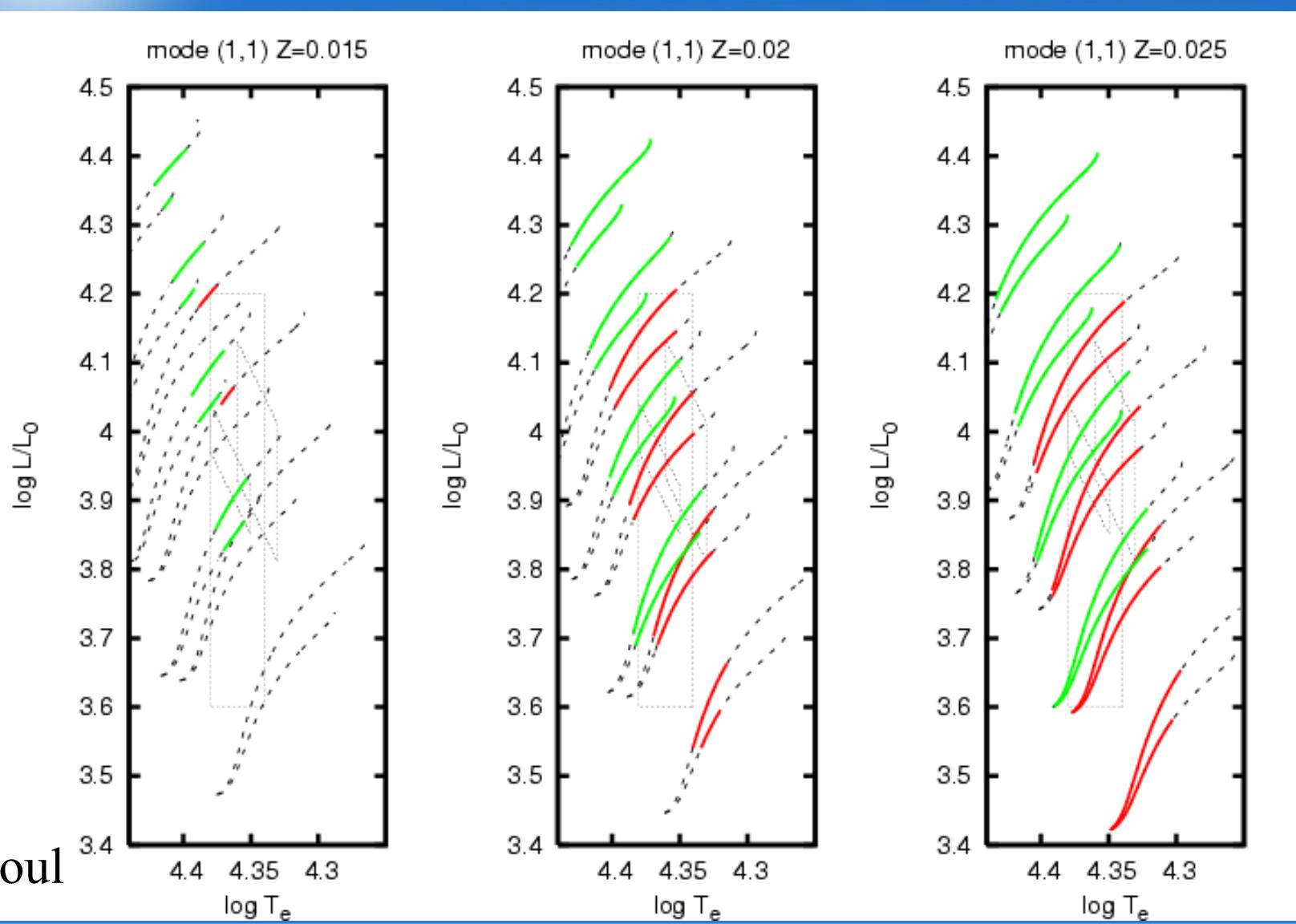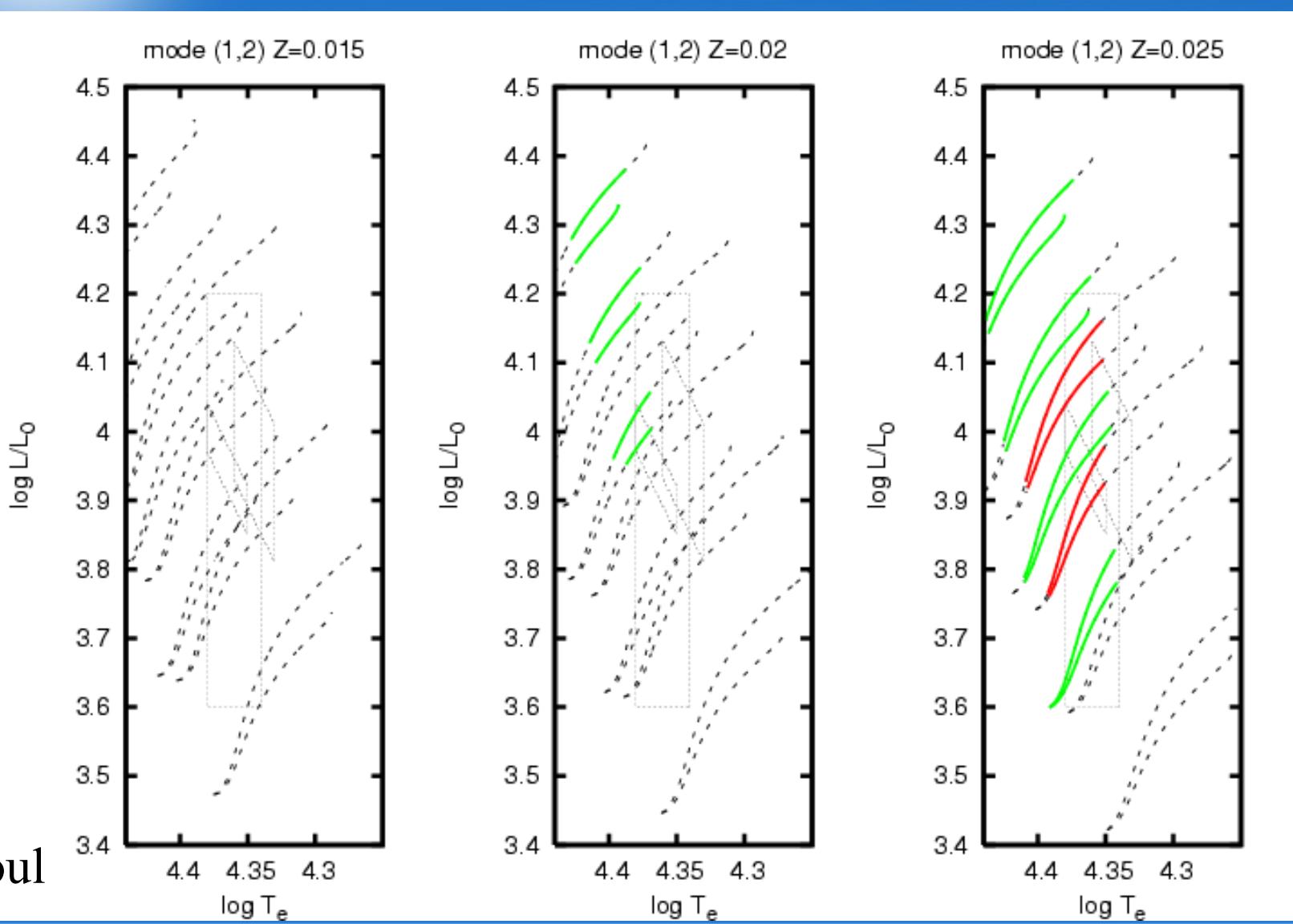
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Which modes are excited?
l=1, n=-1

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A. Thoul

Which modes are excited?
l=1, n=2

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mode (1,2) Z=0.015   mode (1,2) Z=0.02   mode (1,2) Z=0.025

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mode (2,−4) Z=0.015   mode (2,−4) Z=0.02   mode (2,−4) Z=0.025

A. Thoul

Which modes are excited?
l=2, n=-3

A. Thoul

Which modes are excited?
l=2, n=-2

mode (2,−2) Z=0.015   mode (2,−2) Z=0.02   mode (2,−2) Z=0.025

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Which modes are excited?
l=2, n=-1

A. Thoul

Which modes are excited?
l=2, n=0

mode (2,0) Z=0.015   mode (2,0) Z=0.02   mode (2,0) Z=0.025
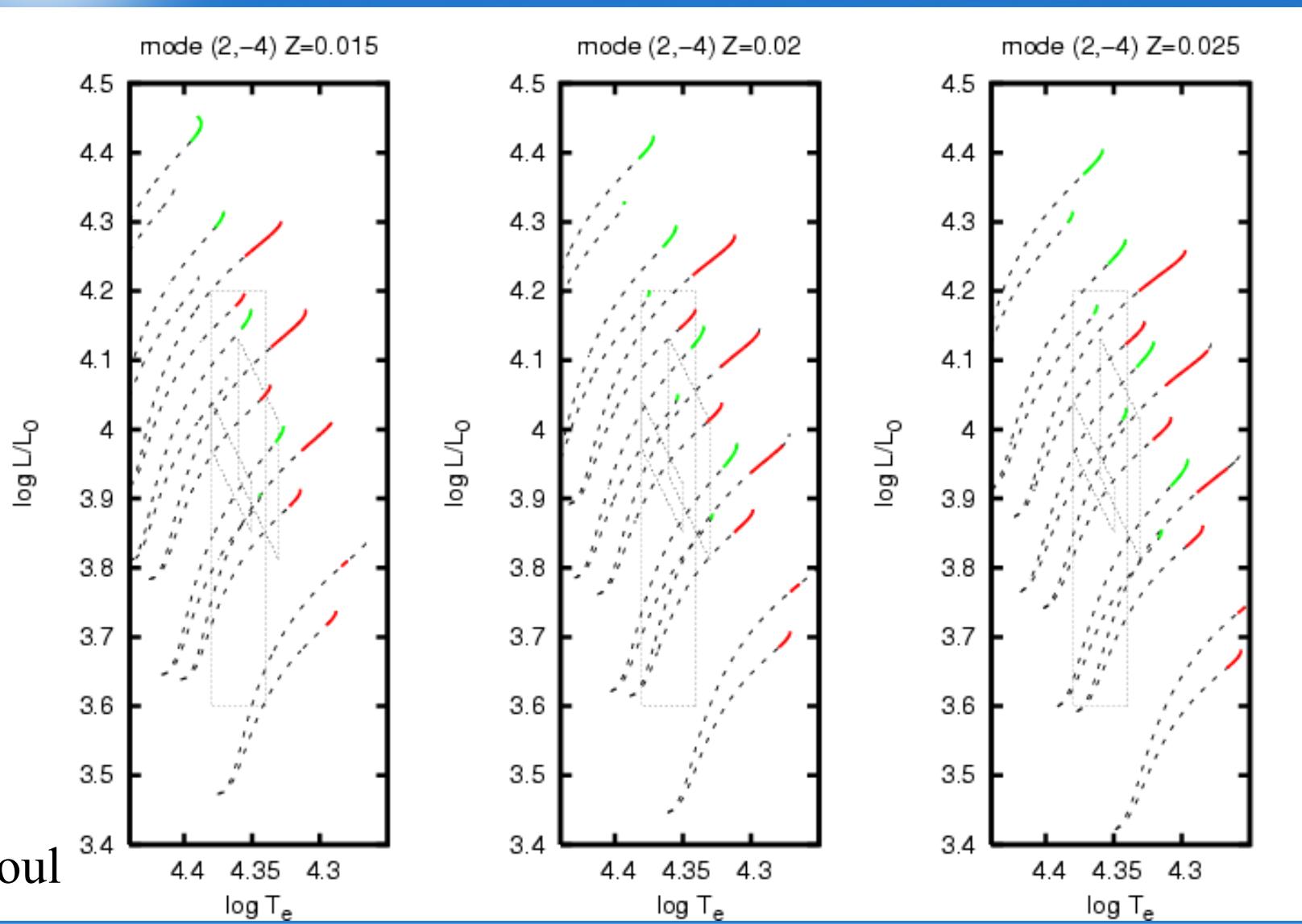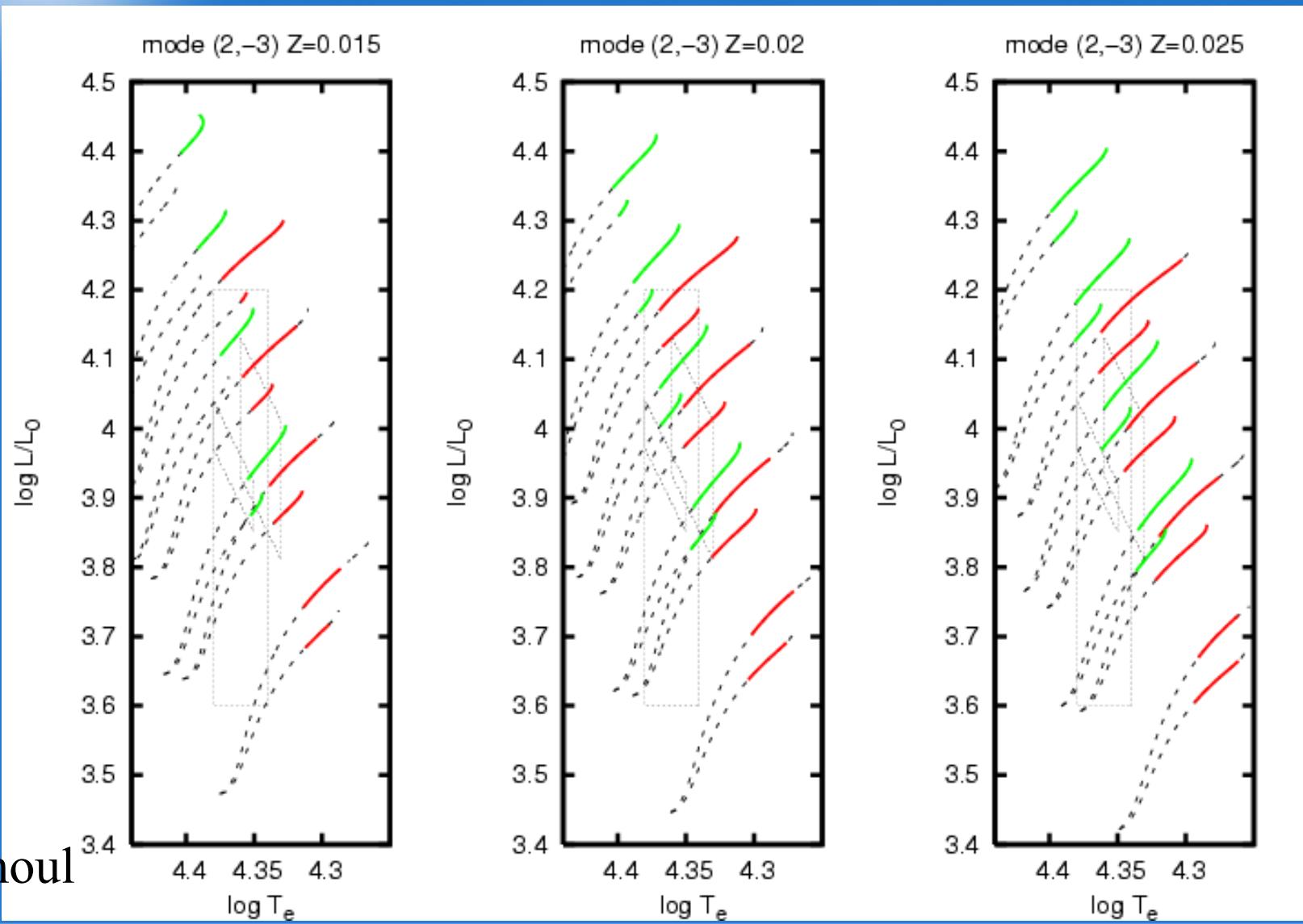
A. Thoul

Which modes are excited?
l=2, n=1

A. Thoul

Which modes are excited?
l=2, n=2

A. Thoul
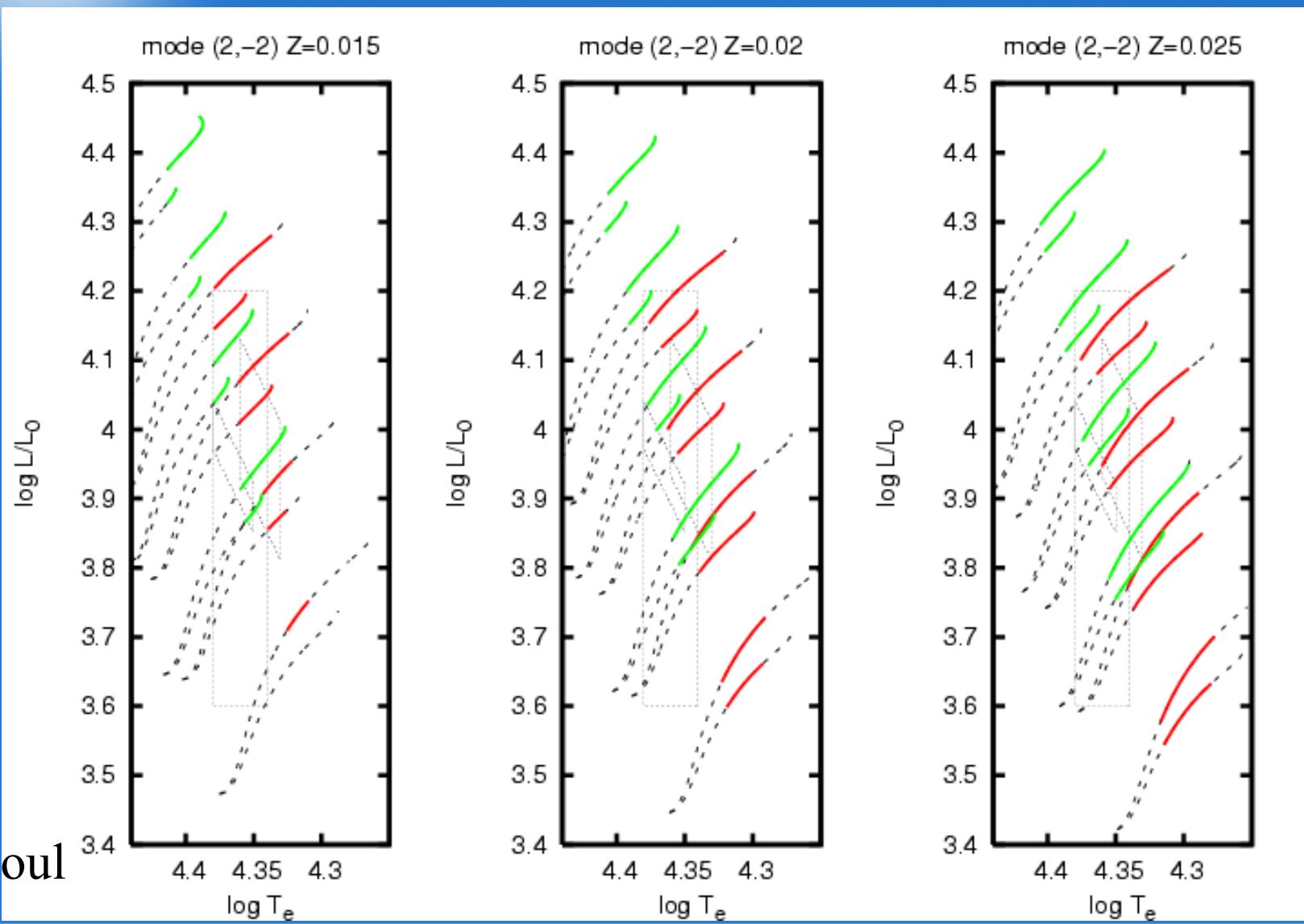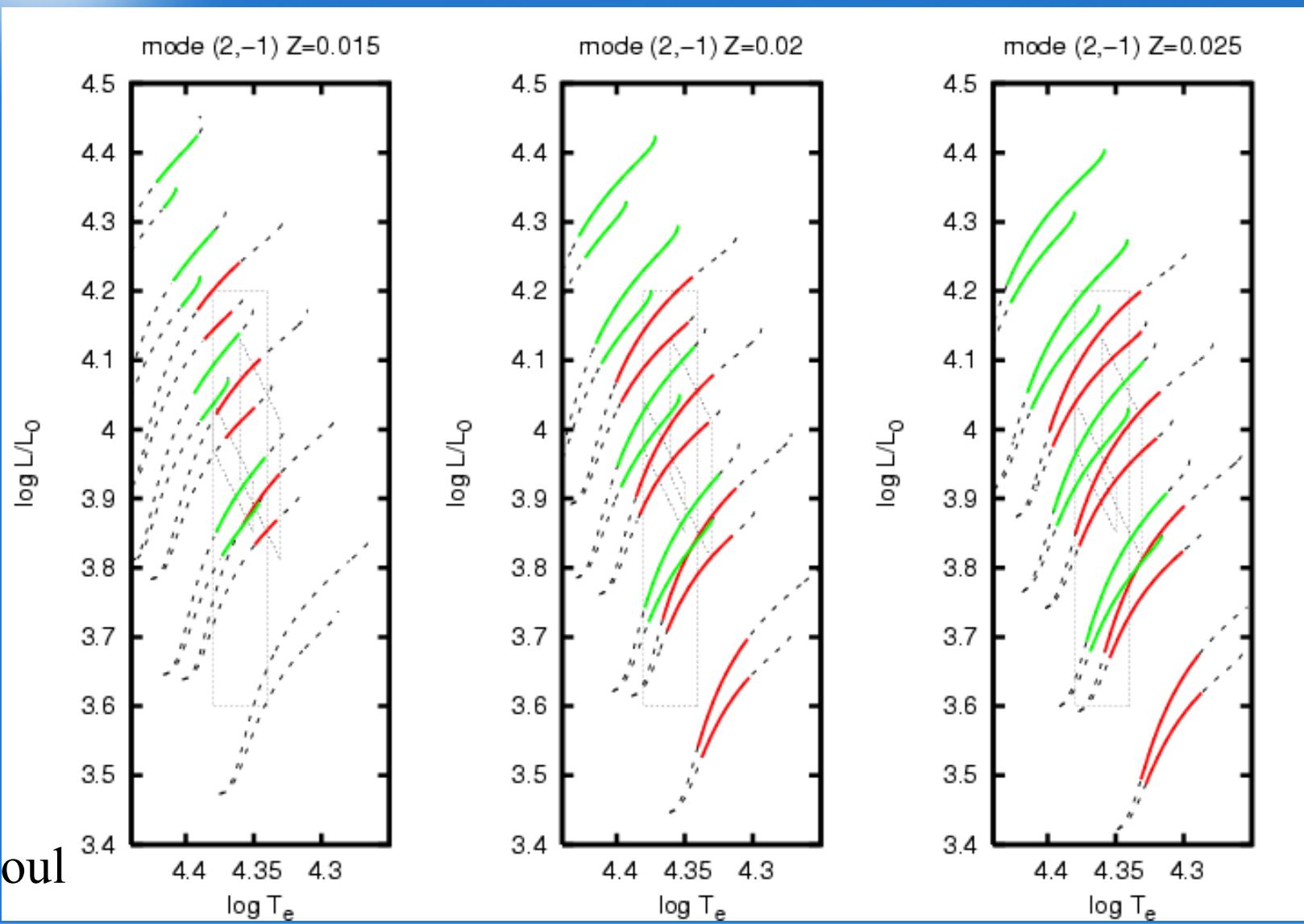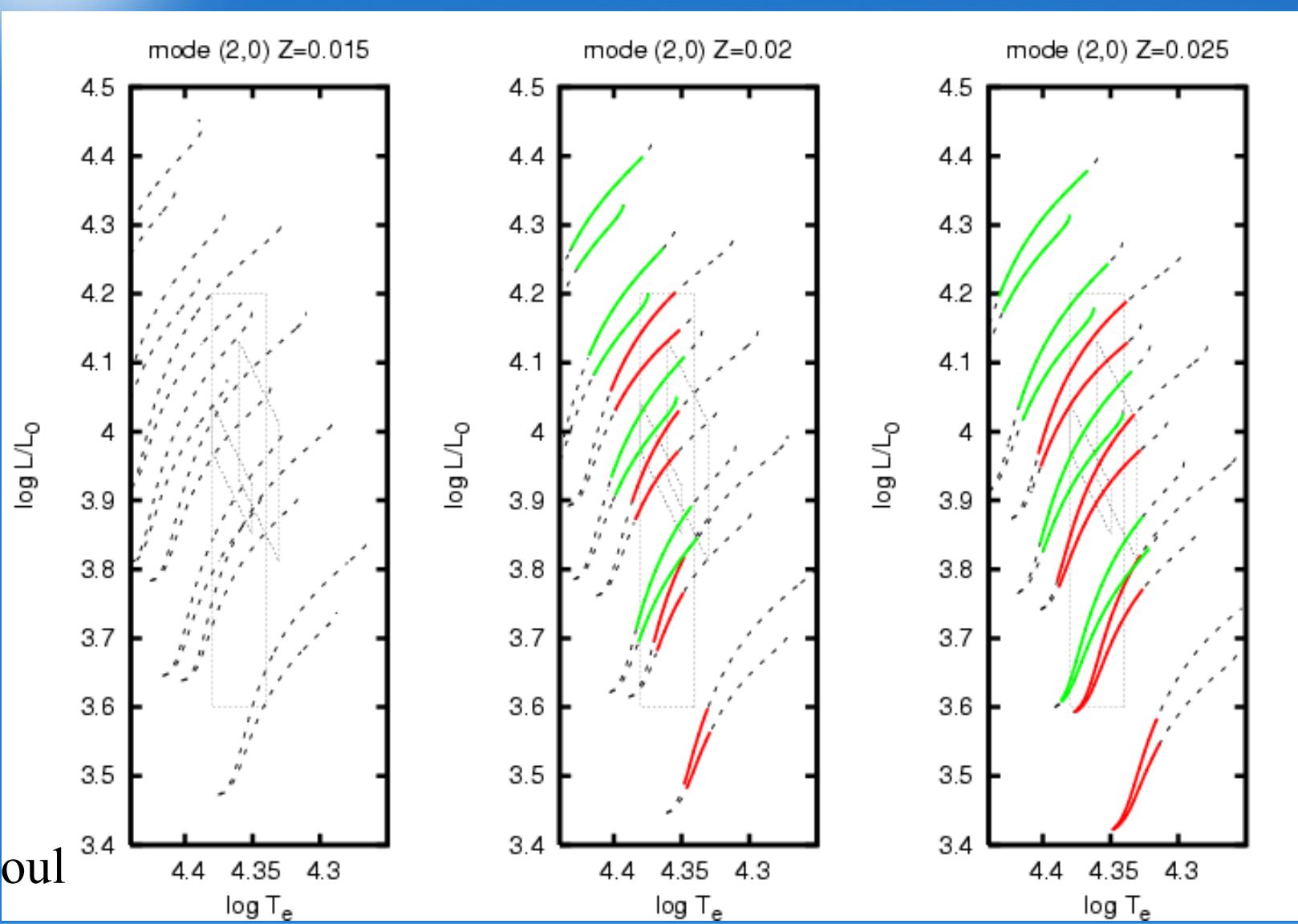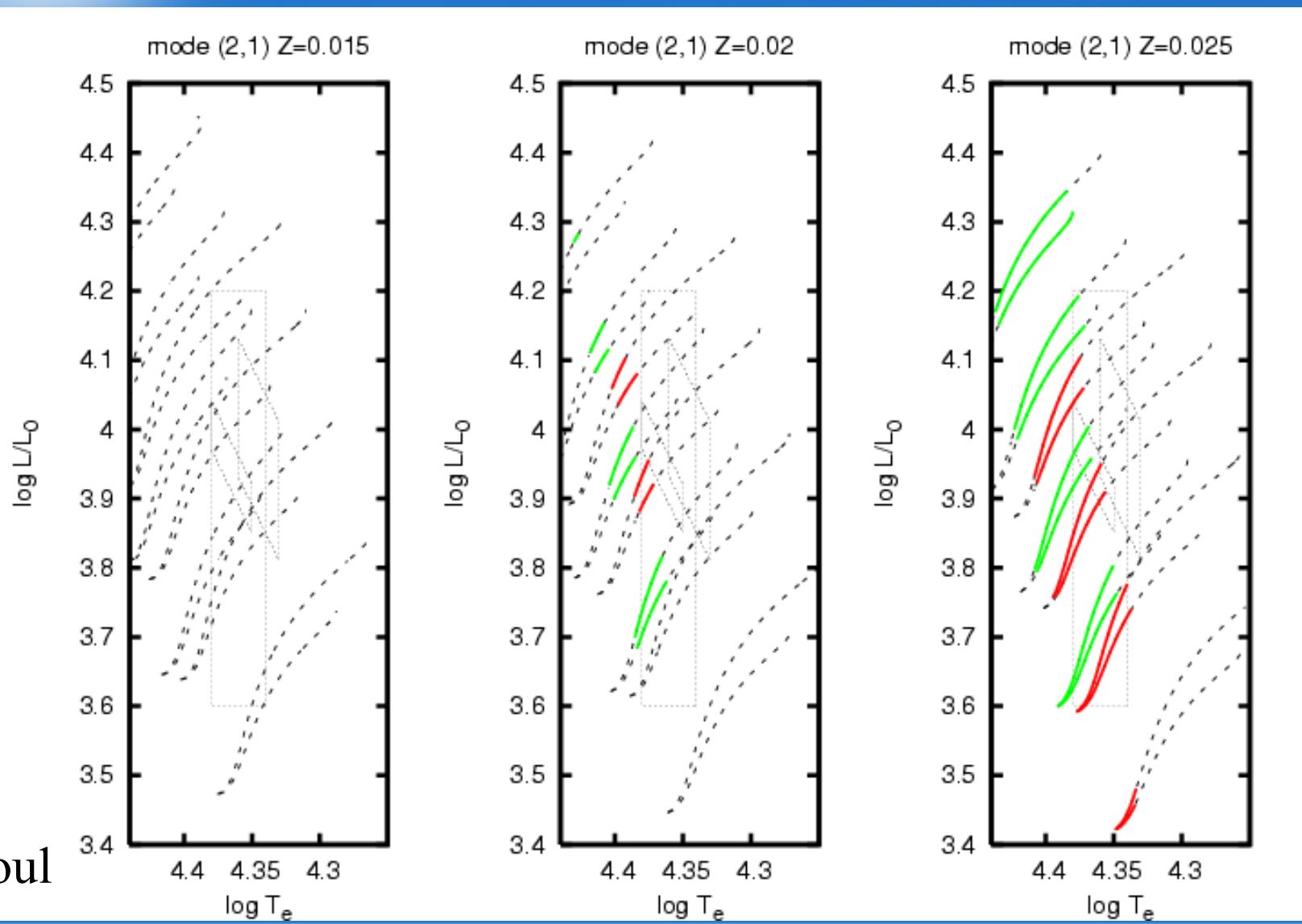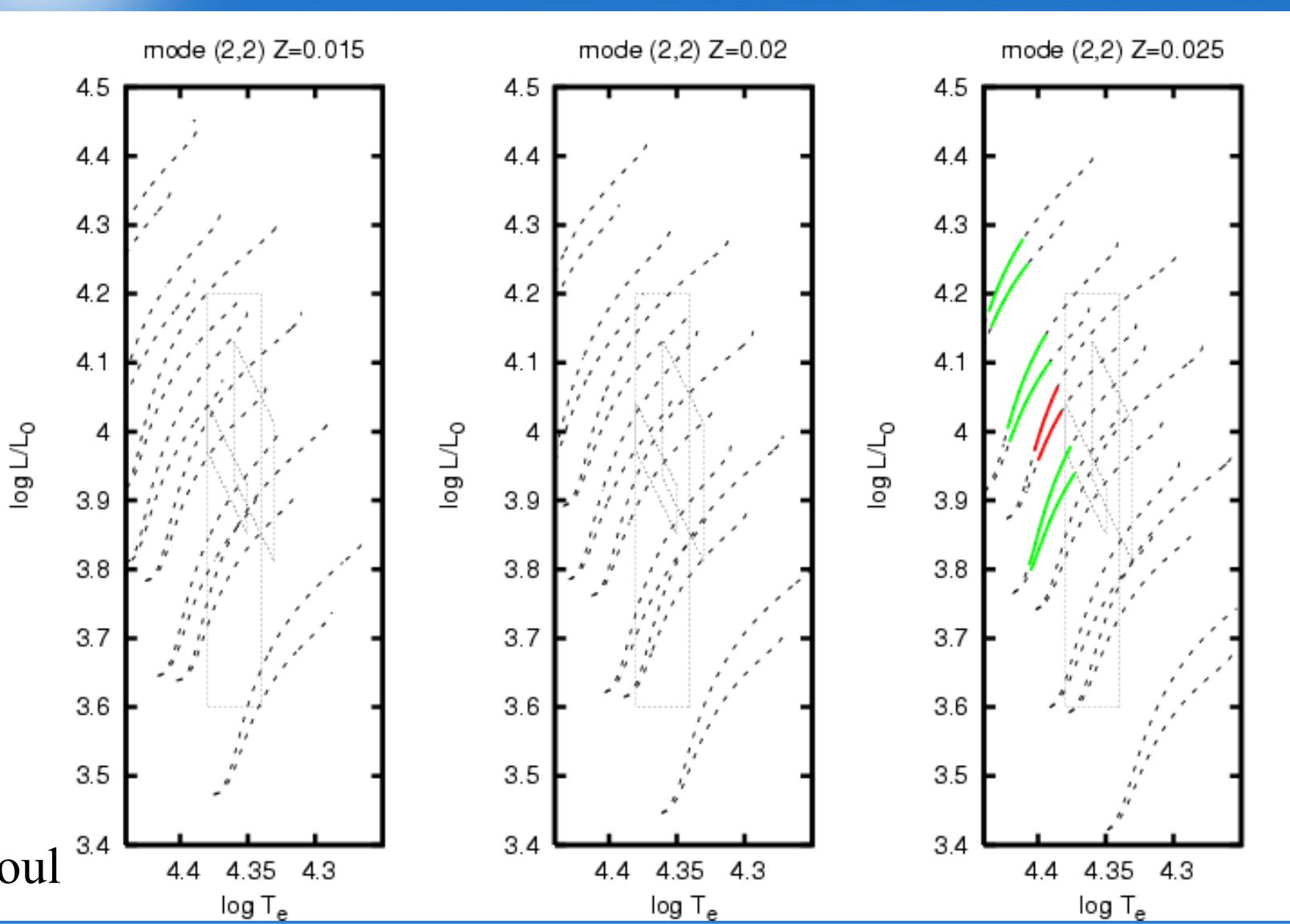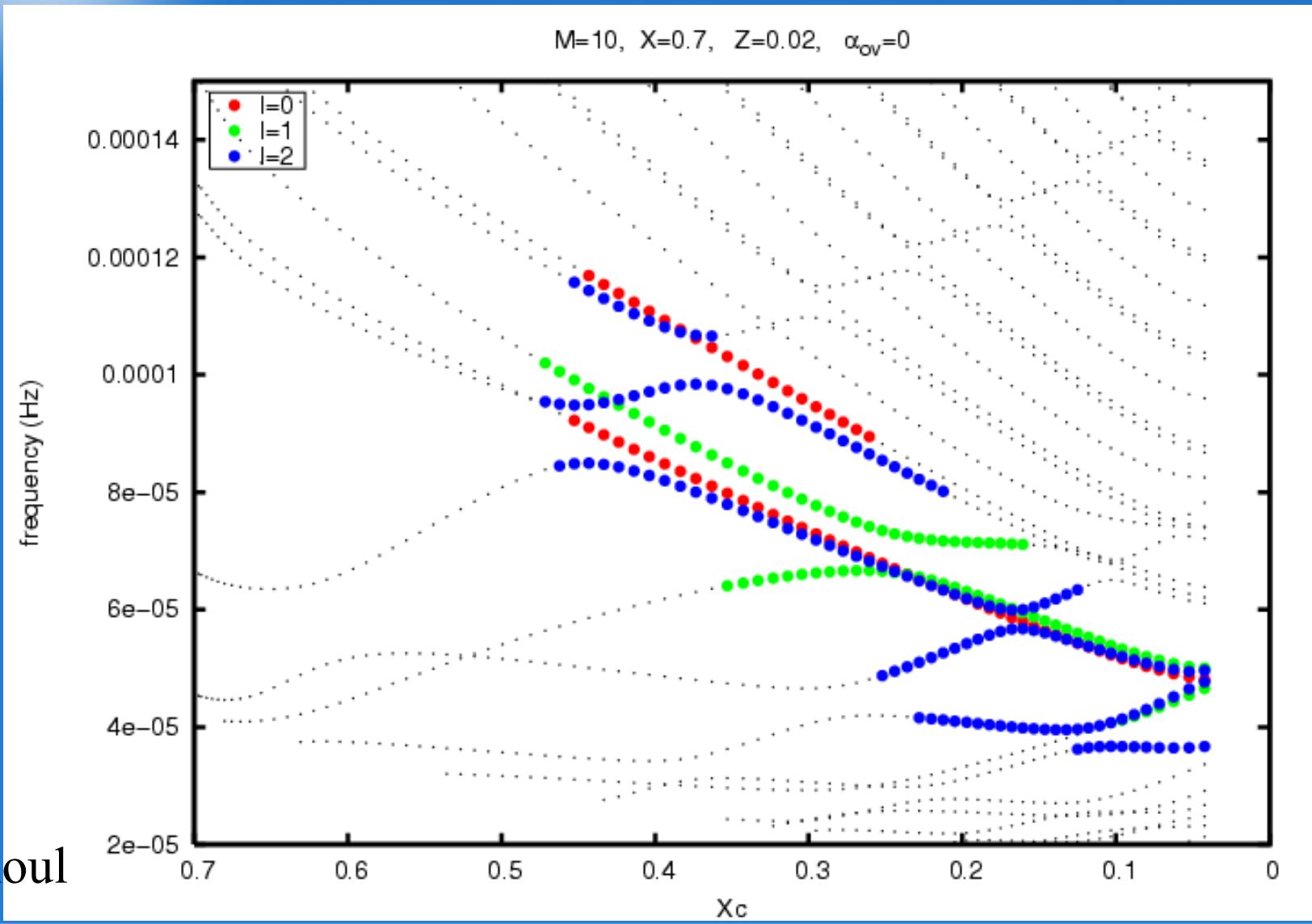
Excited Modes:

l=0	l=1	l=2
1	-1	-3
2	1	-2
3	2	-1
		0
		1

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Seismic Diagrams

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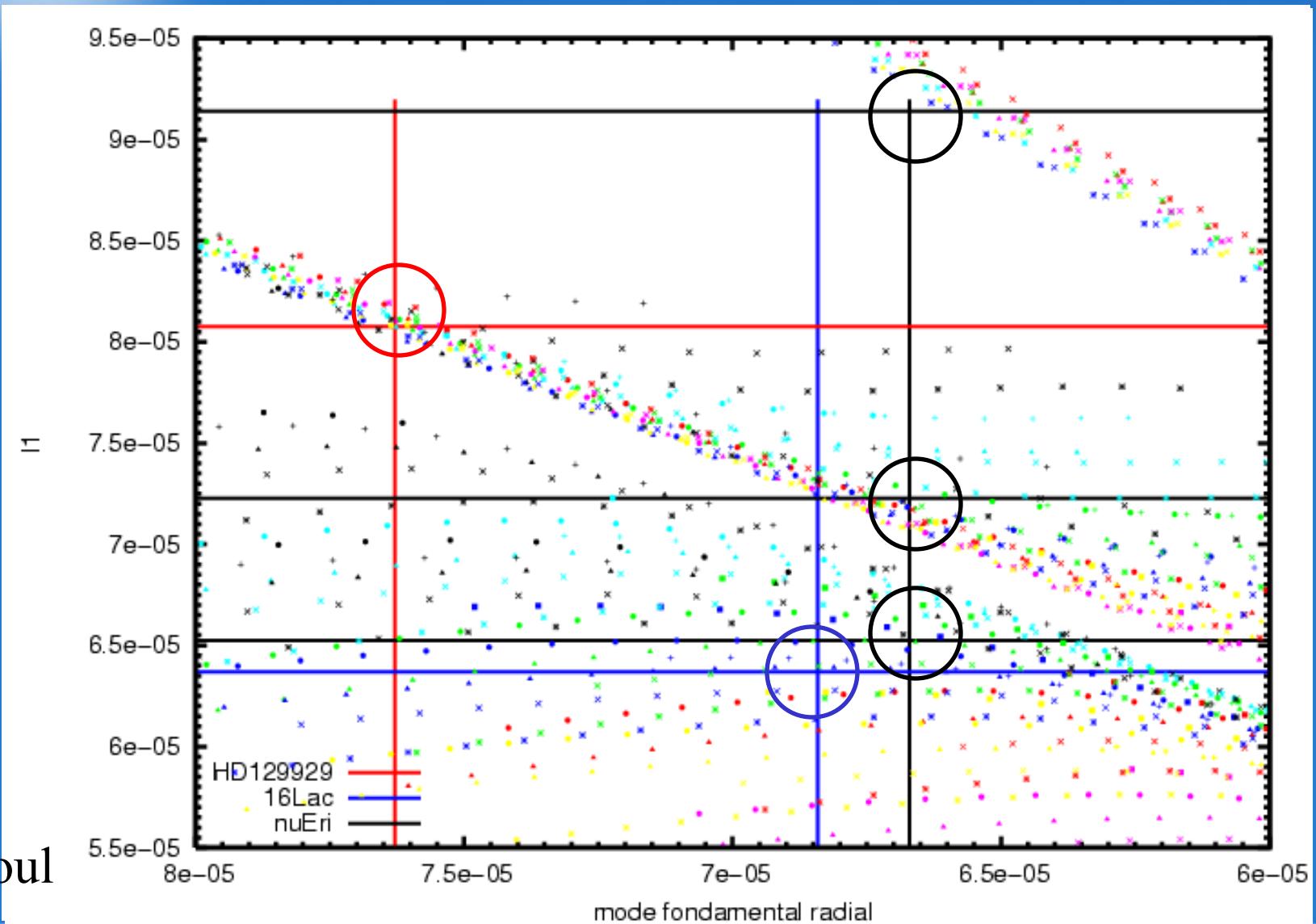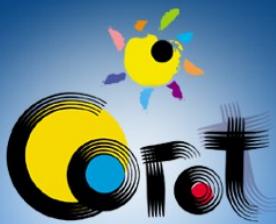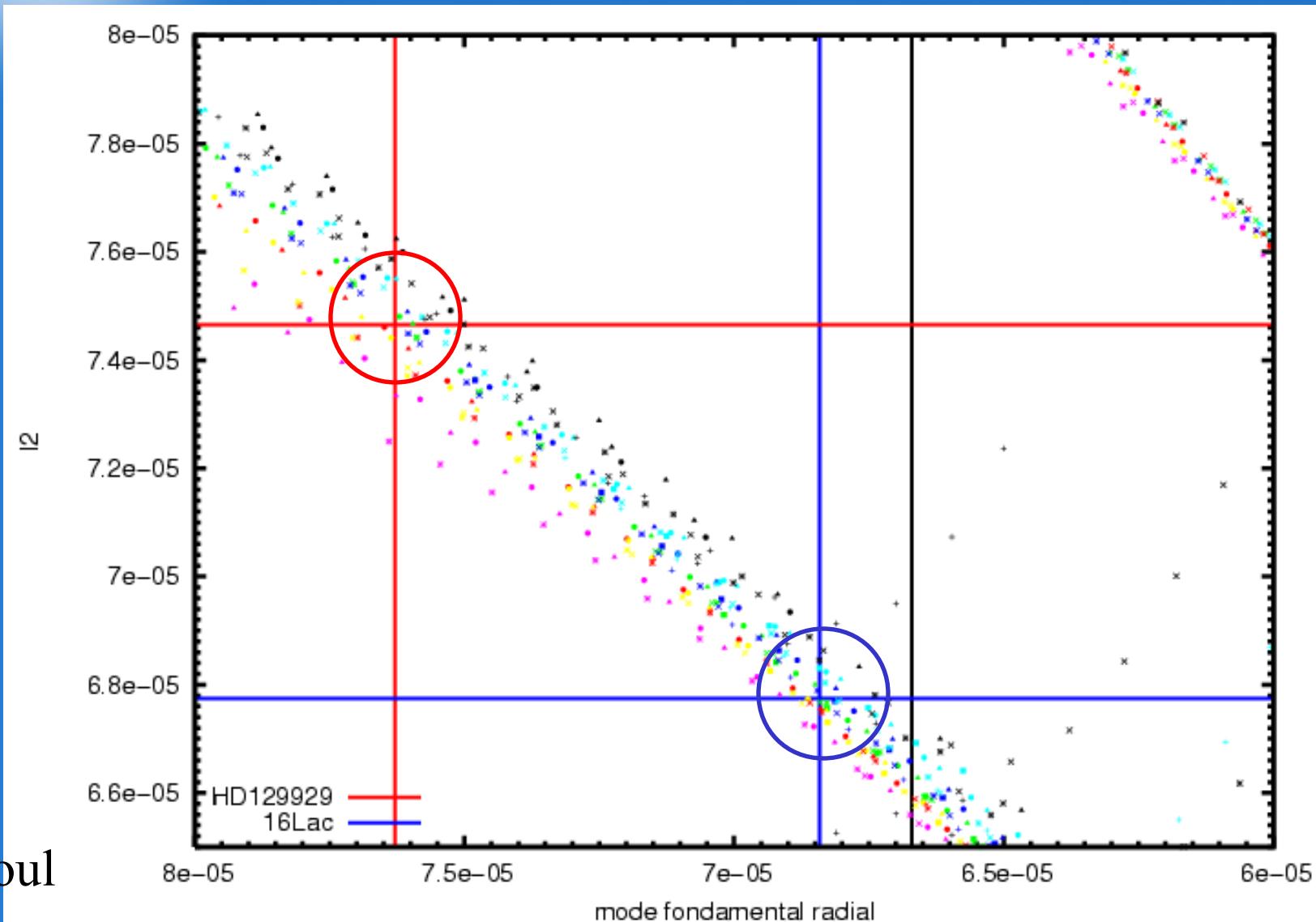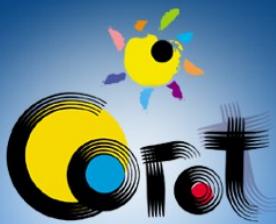
Seismic Diagrams
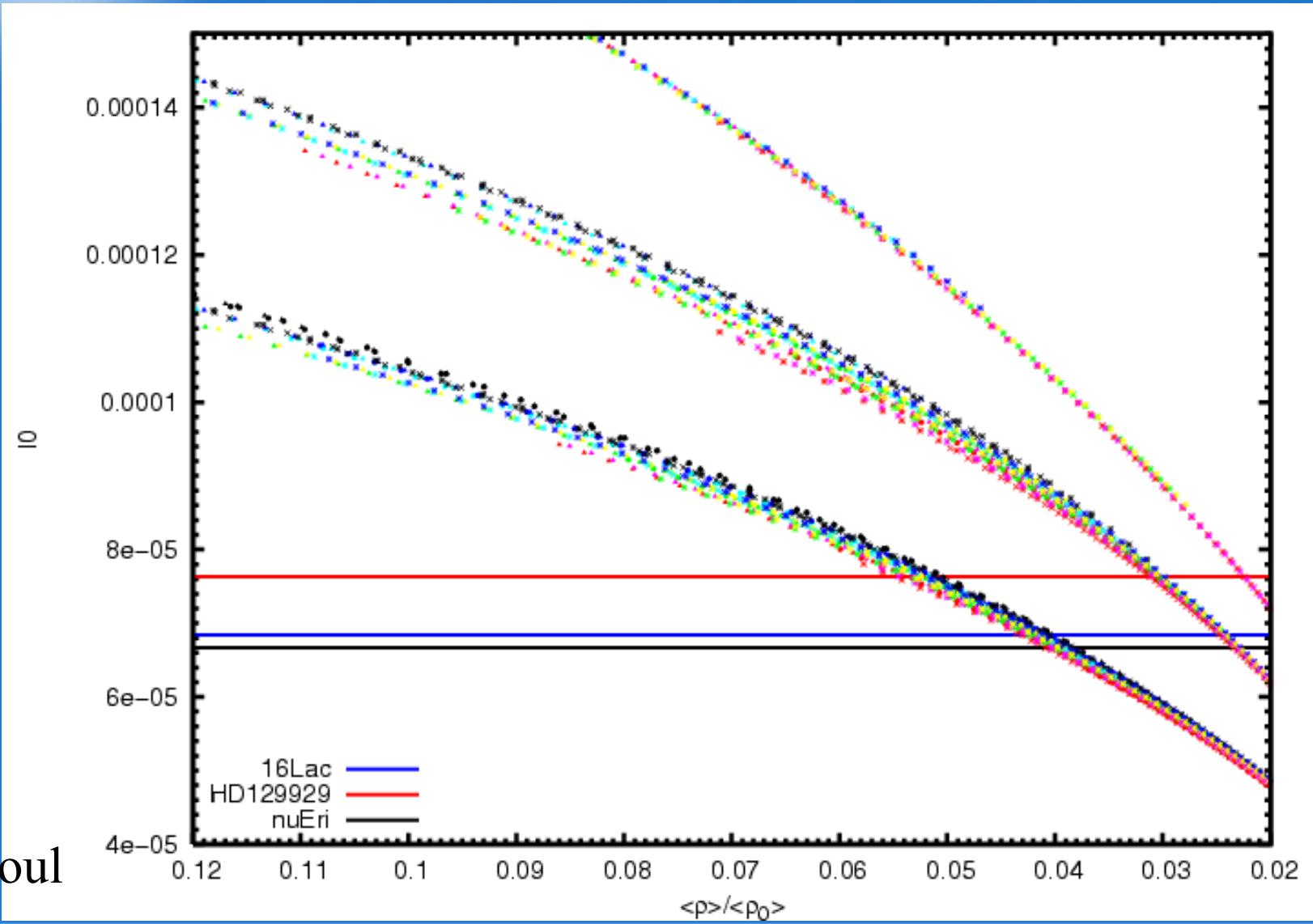
Good approximation for the mass
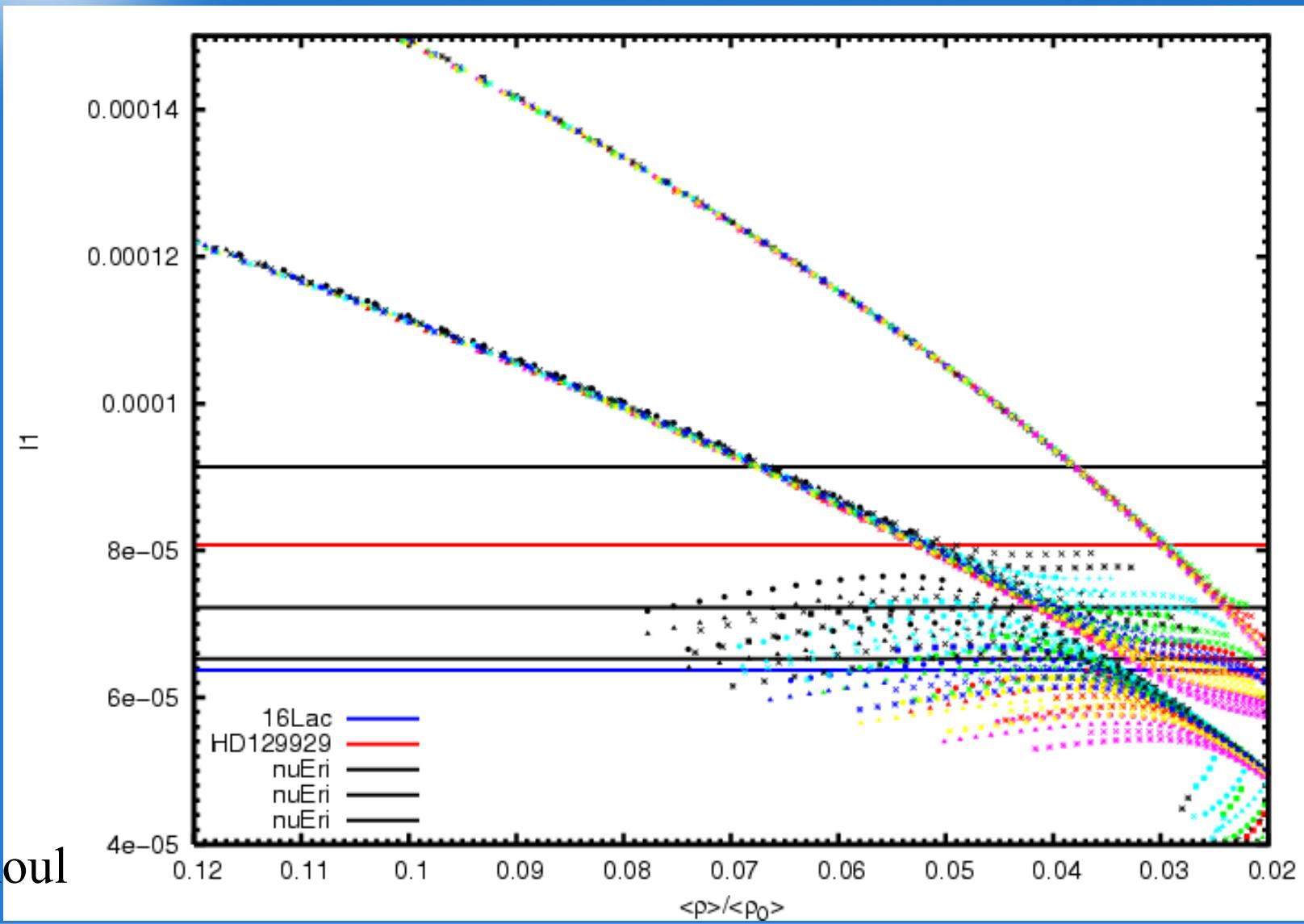
BAG

A. Thoul

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A. Thoul

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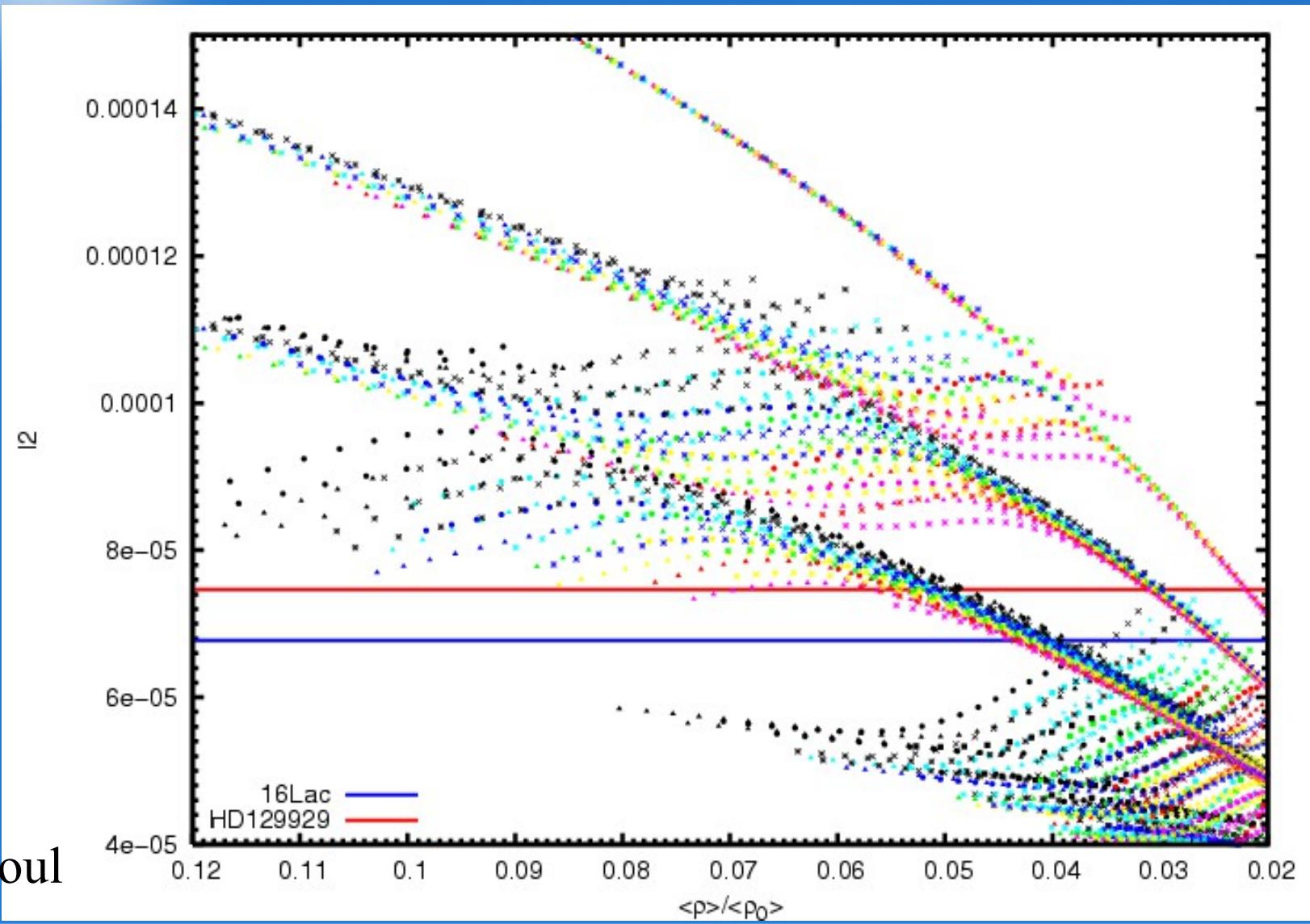
An example: HD129929
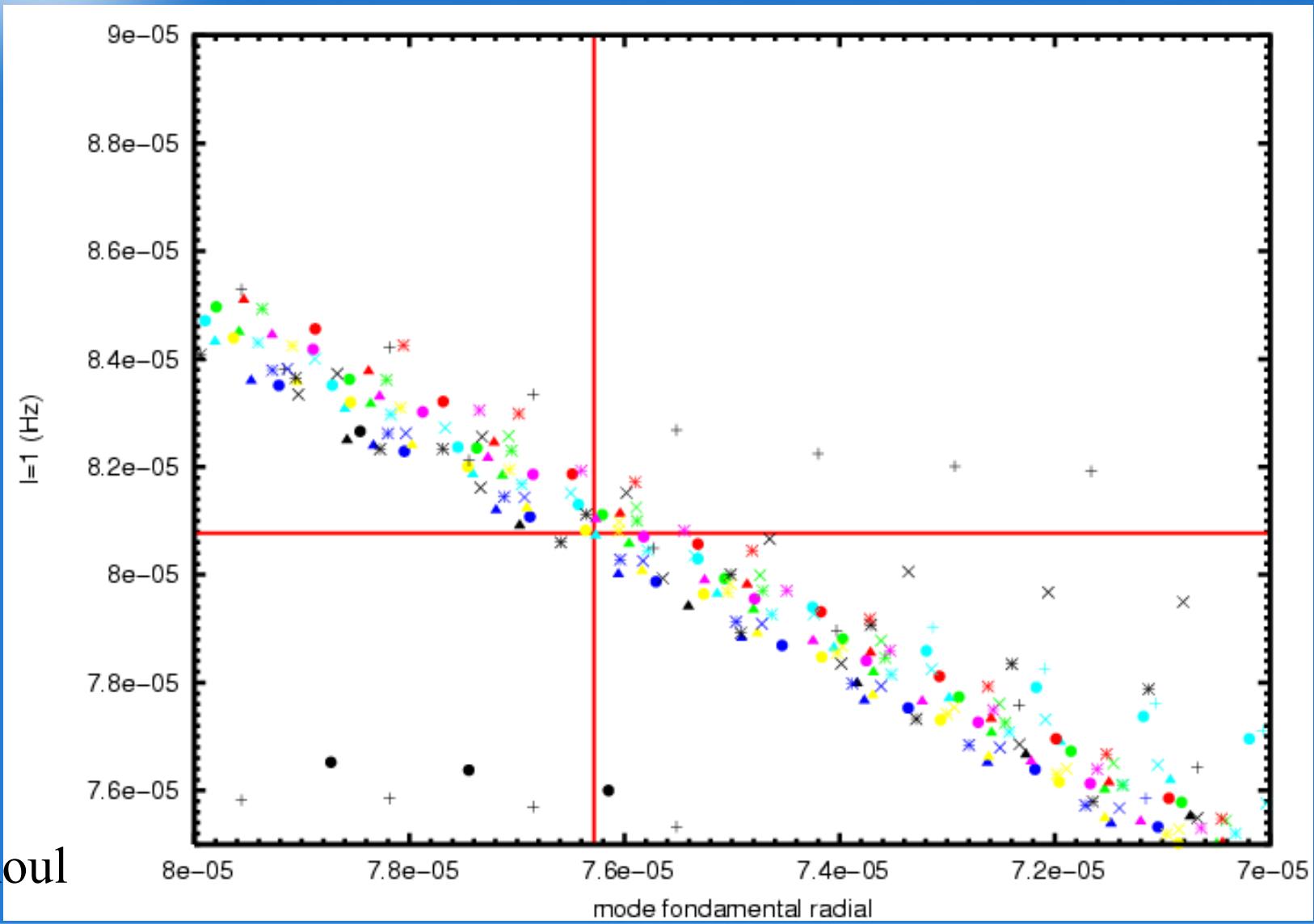
Observed and identified frequencies:

- f_1=76.28403 mHz   mode: l=0 m=0

- f_1=80.76742 mHz   mode: l=1 m=0

- f_1=74.64803 mHz   mode: l=2 m=0?

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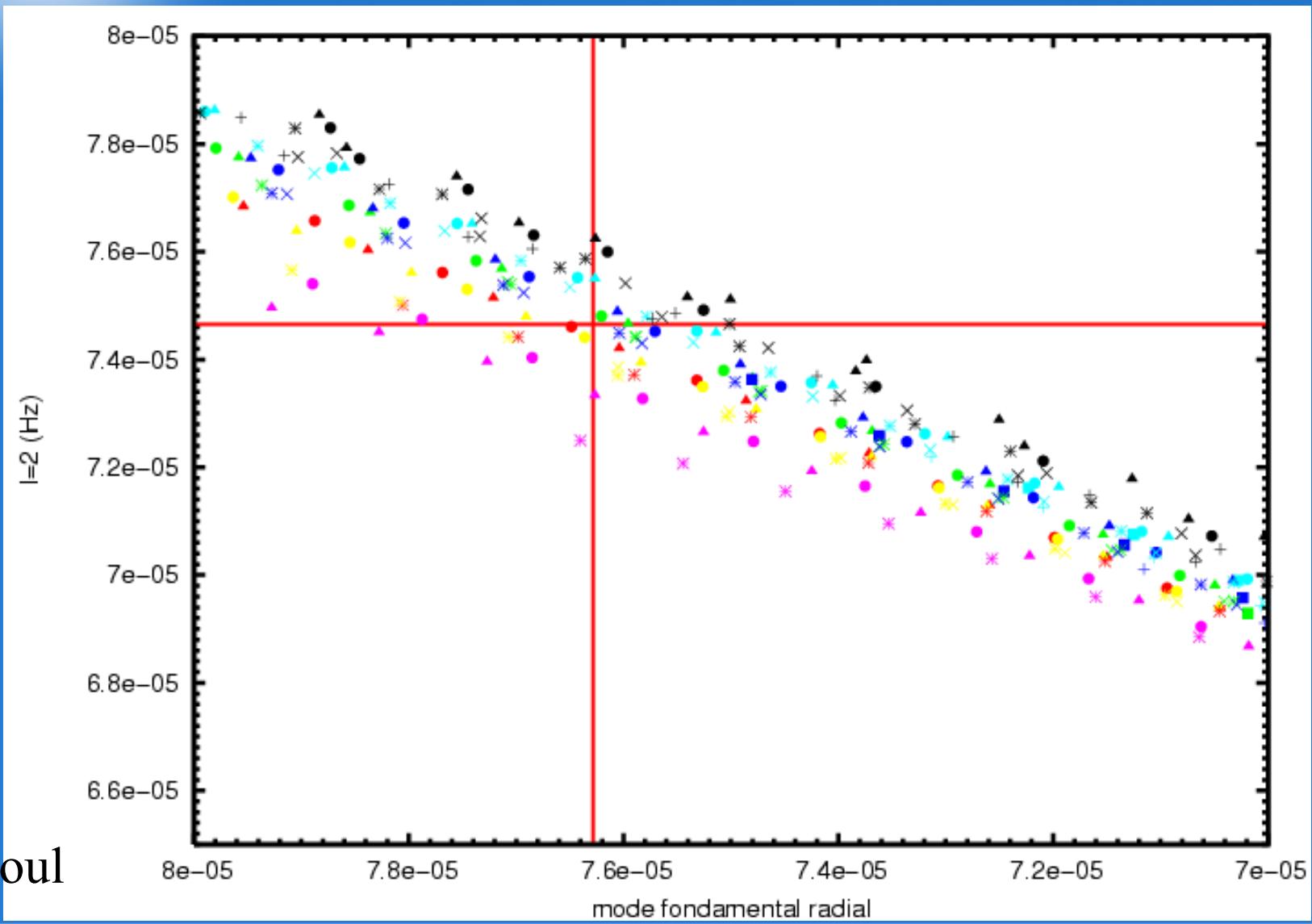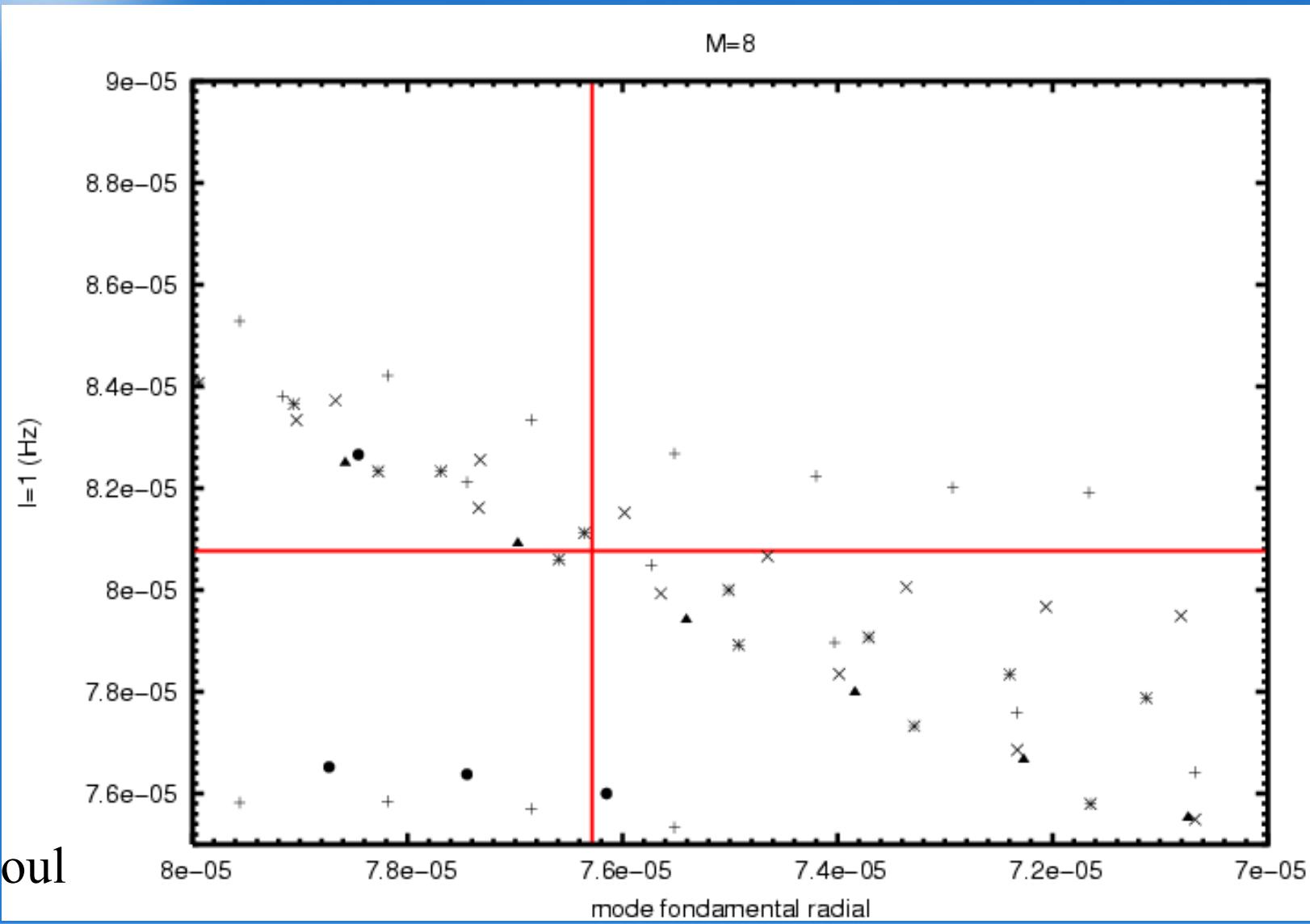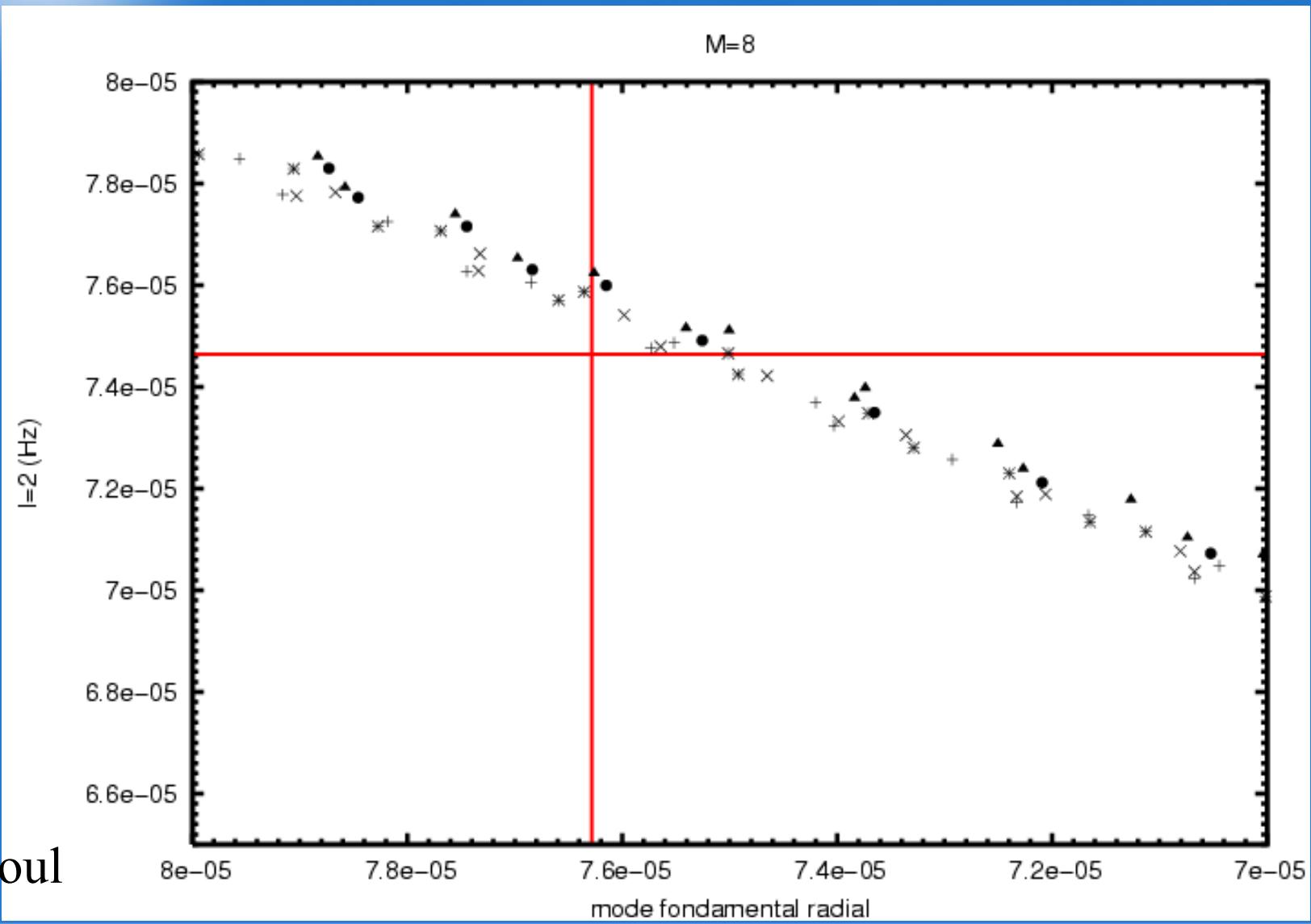
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An example: HD129929

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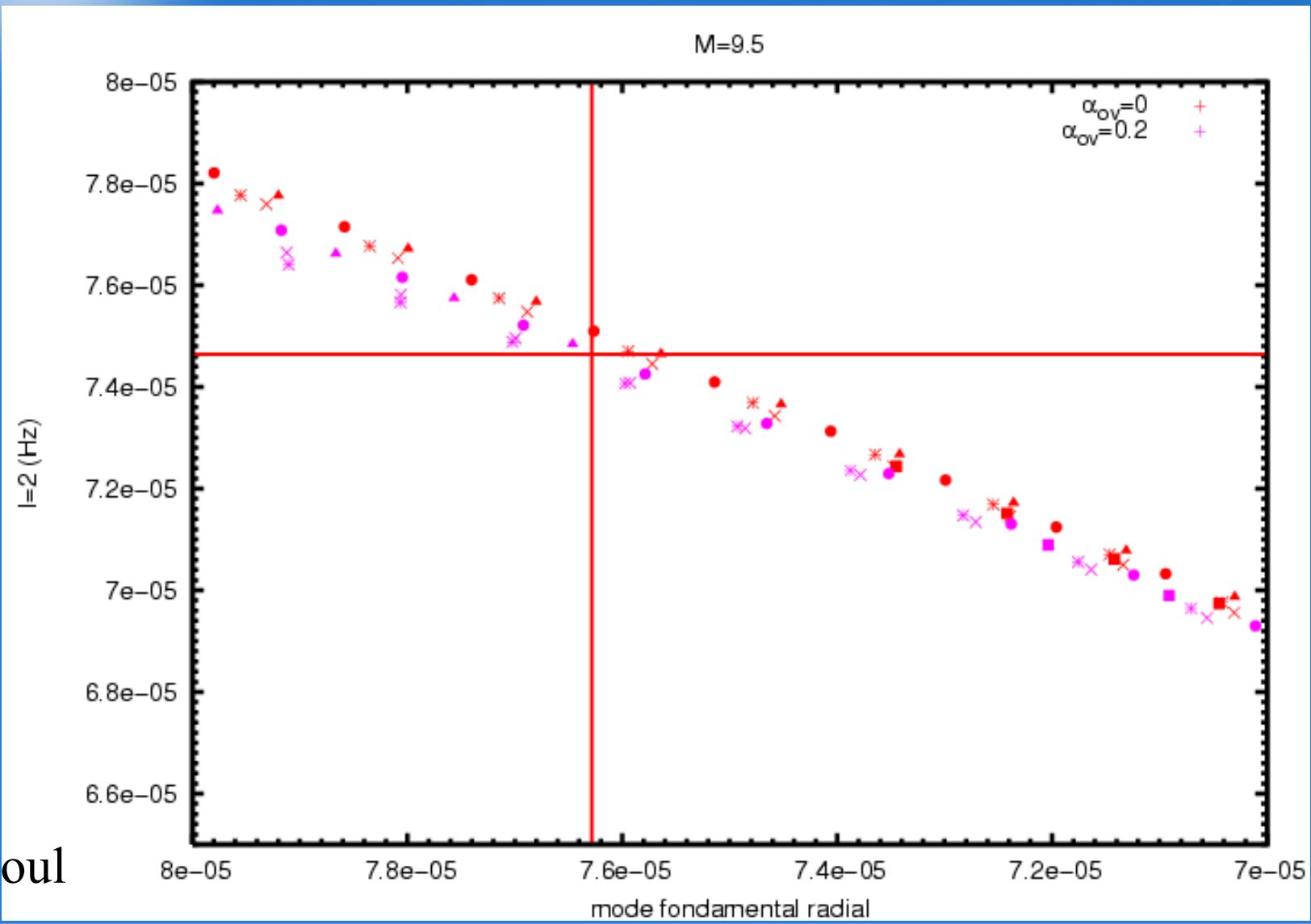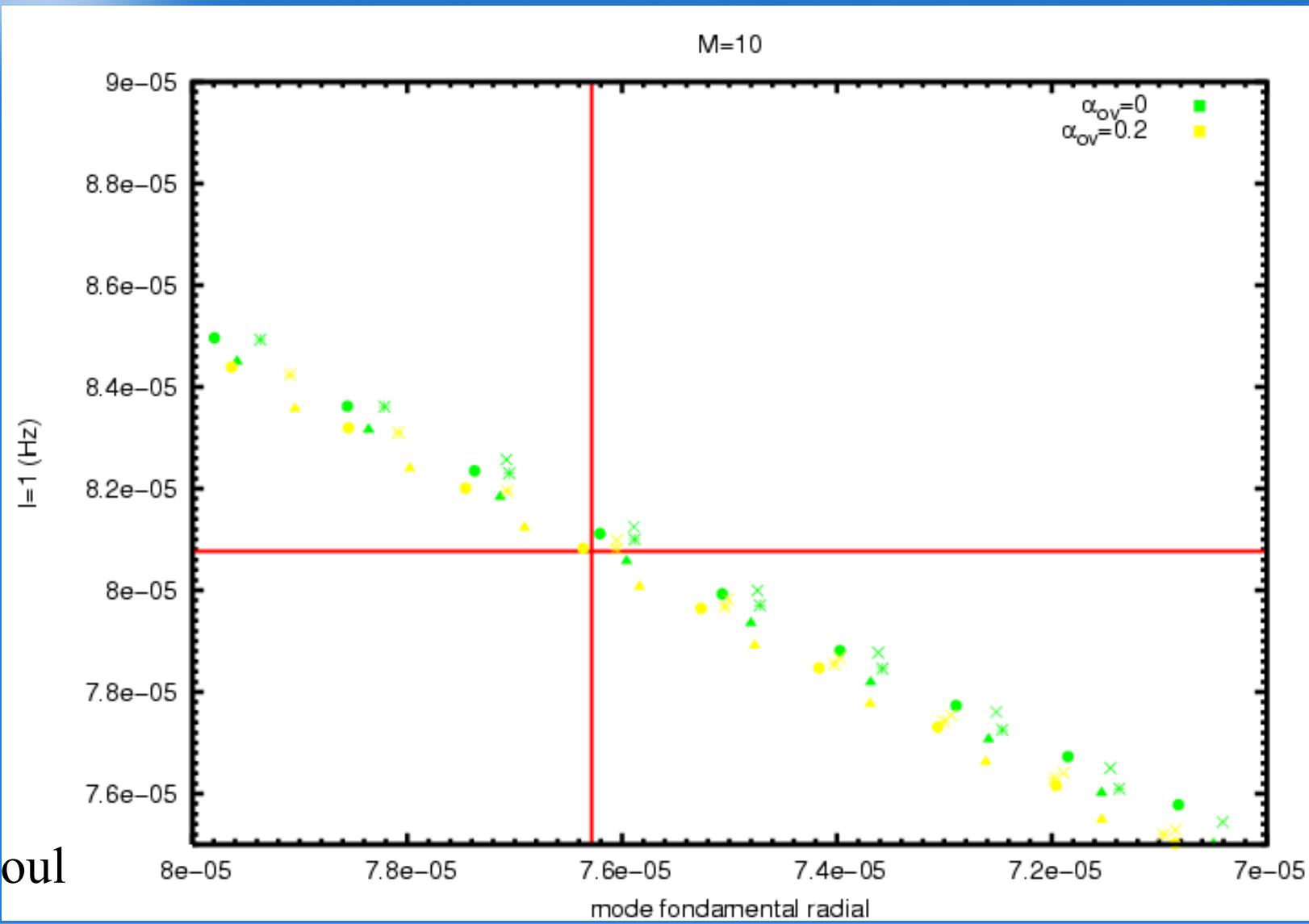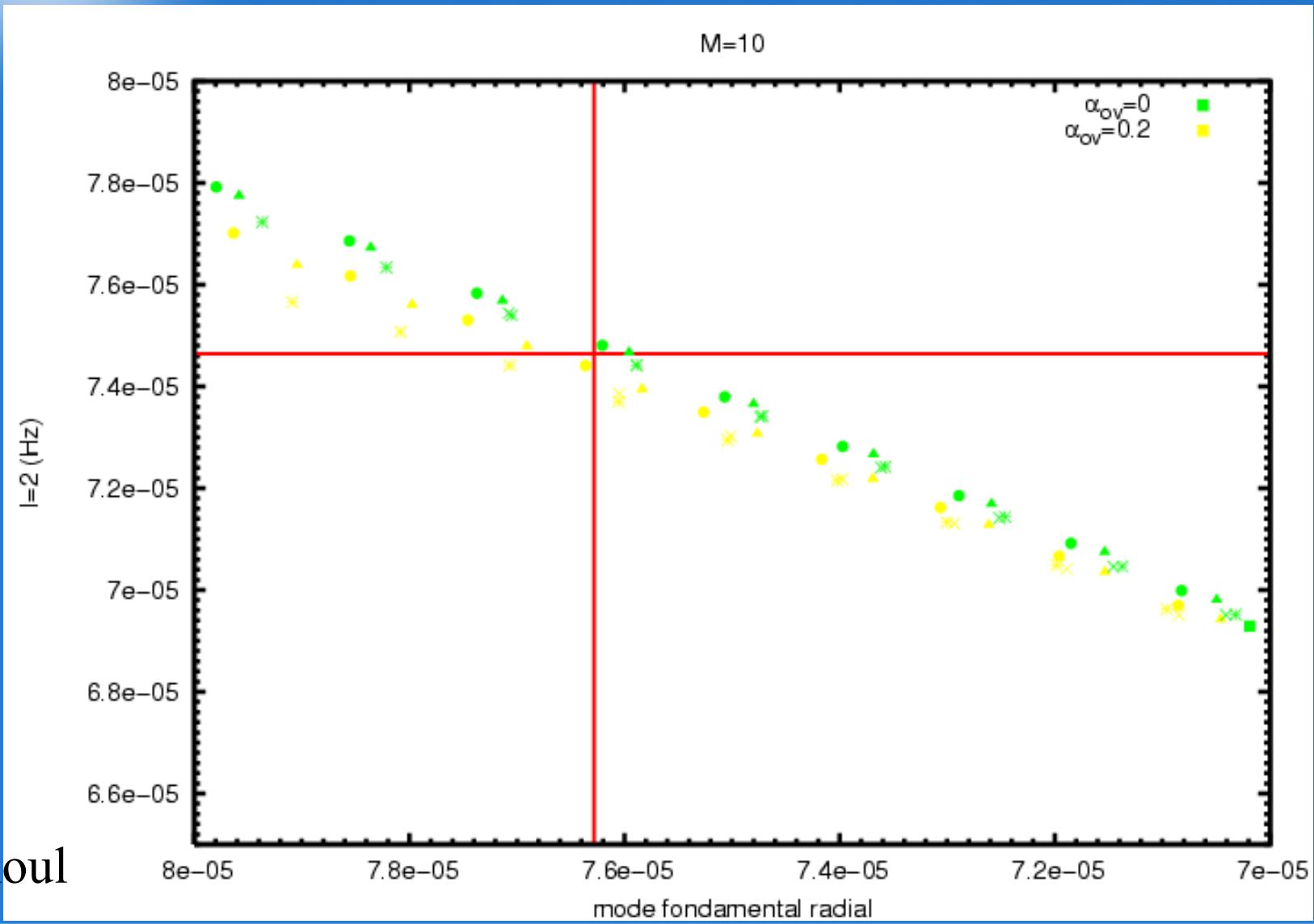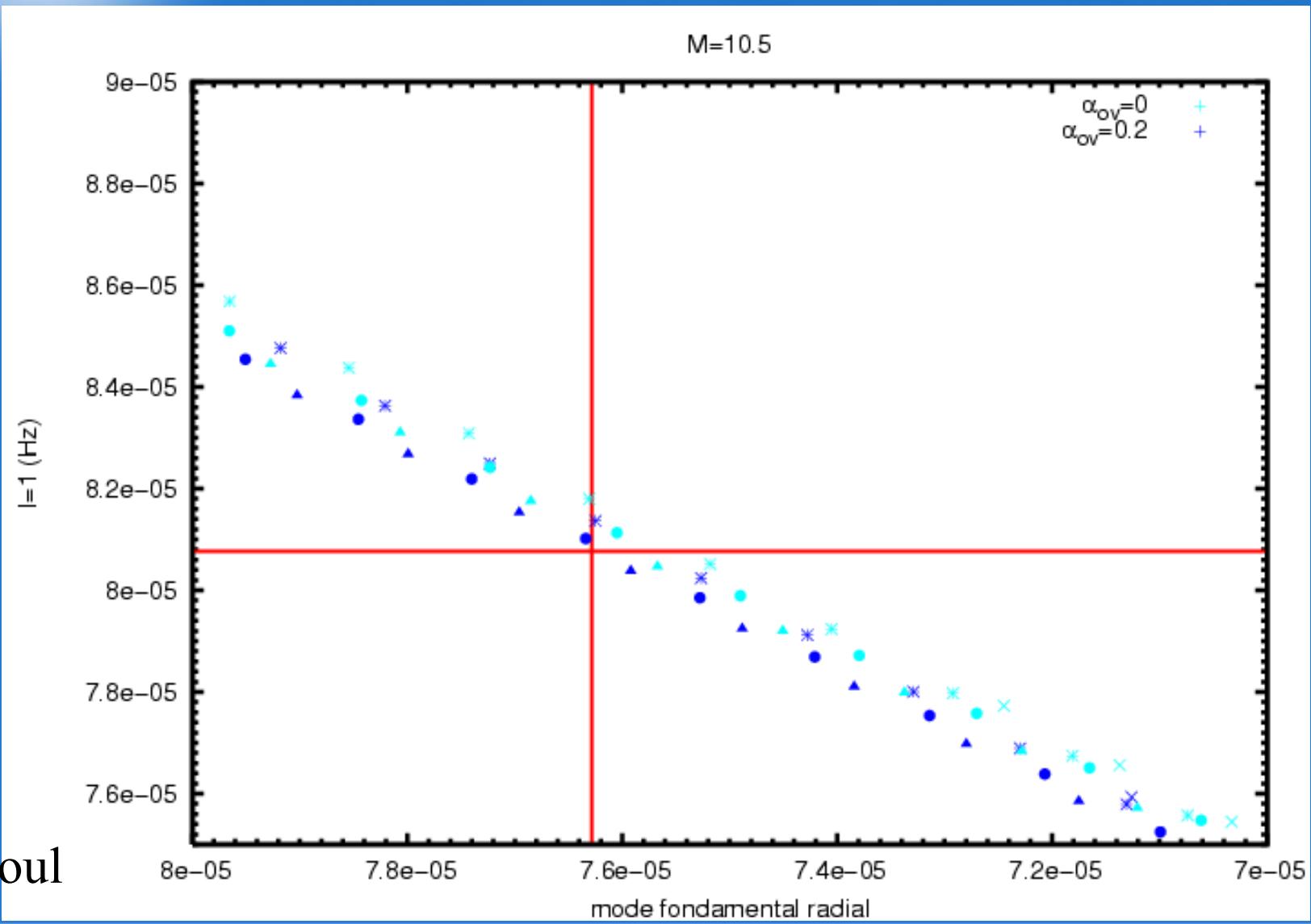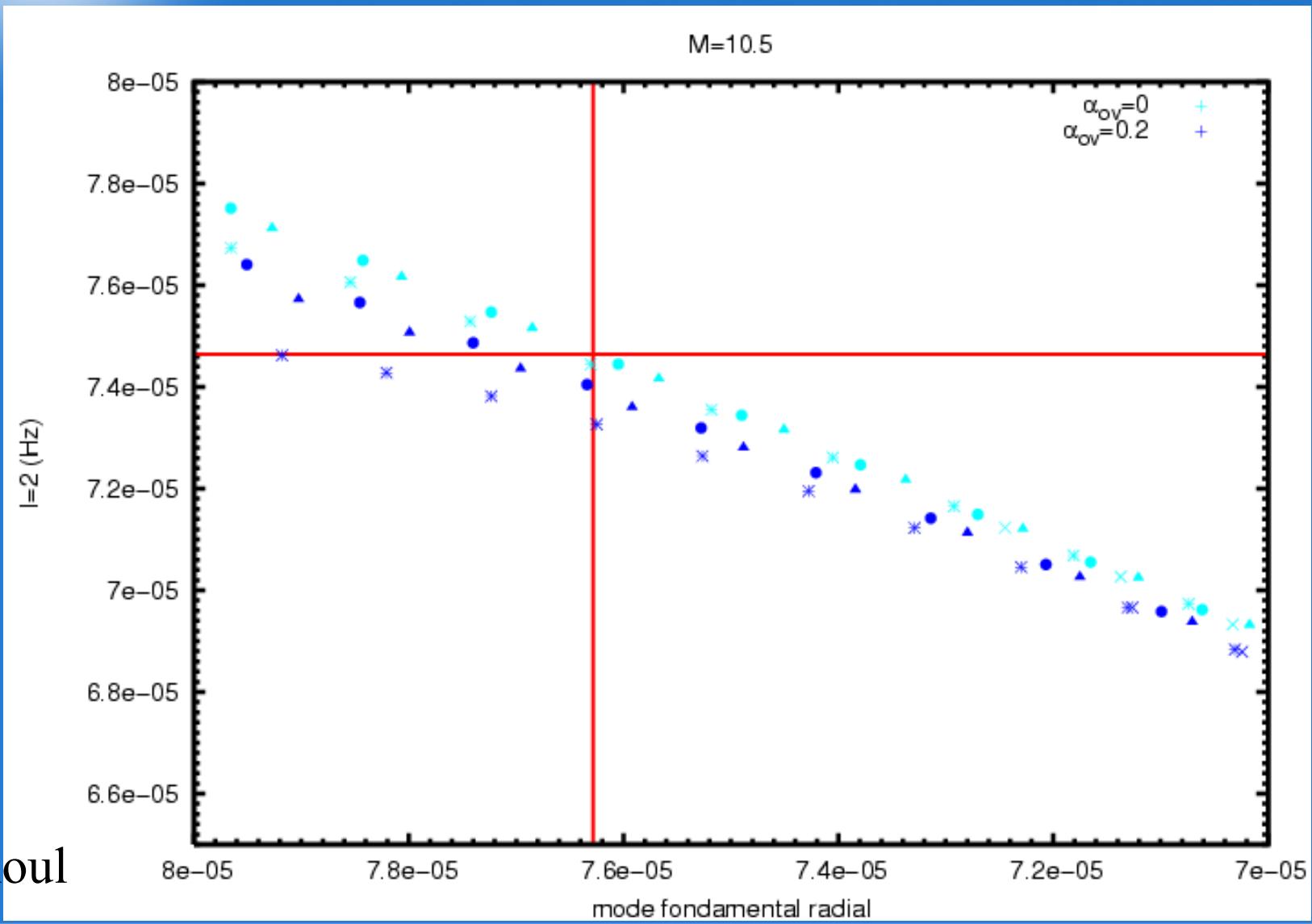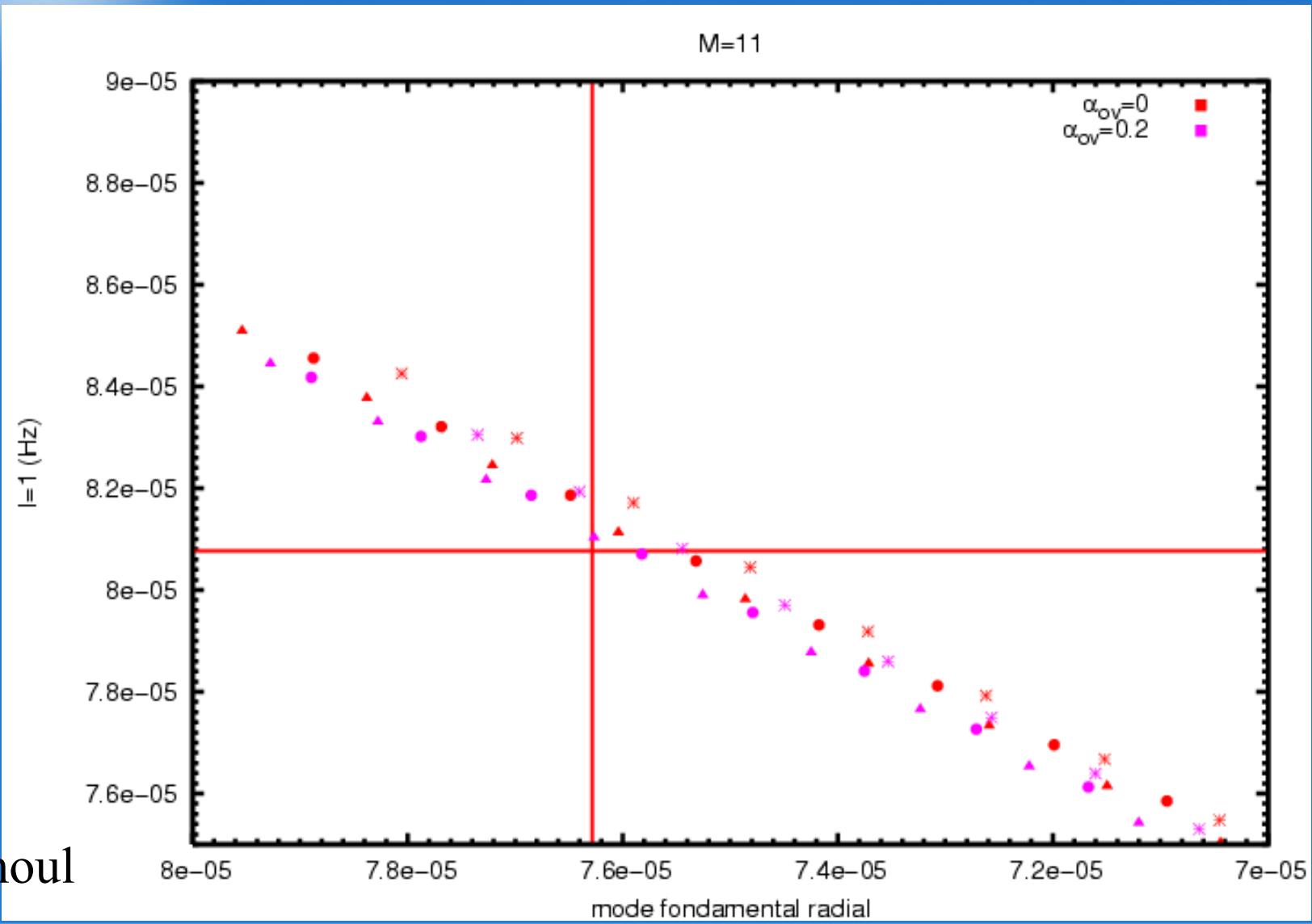
A. Thoul
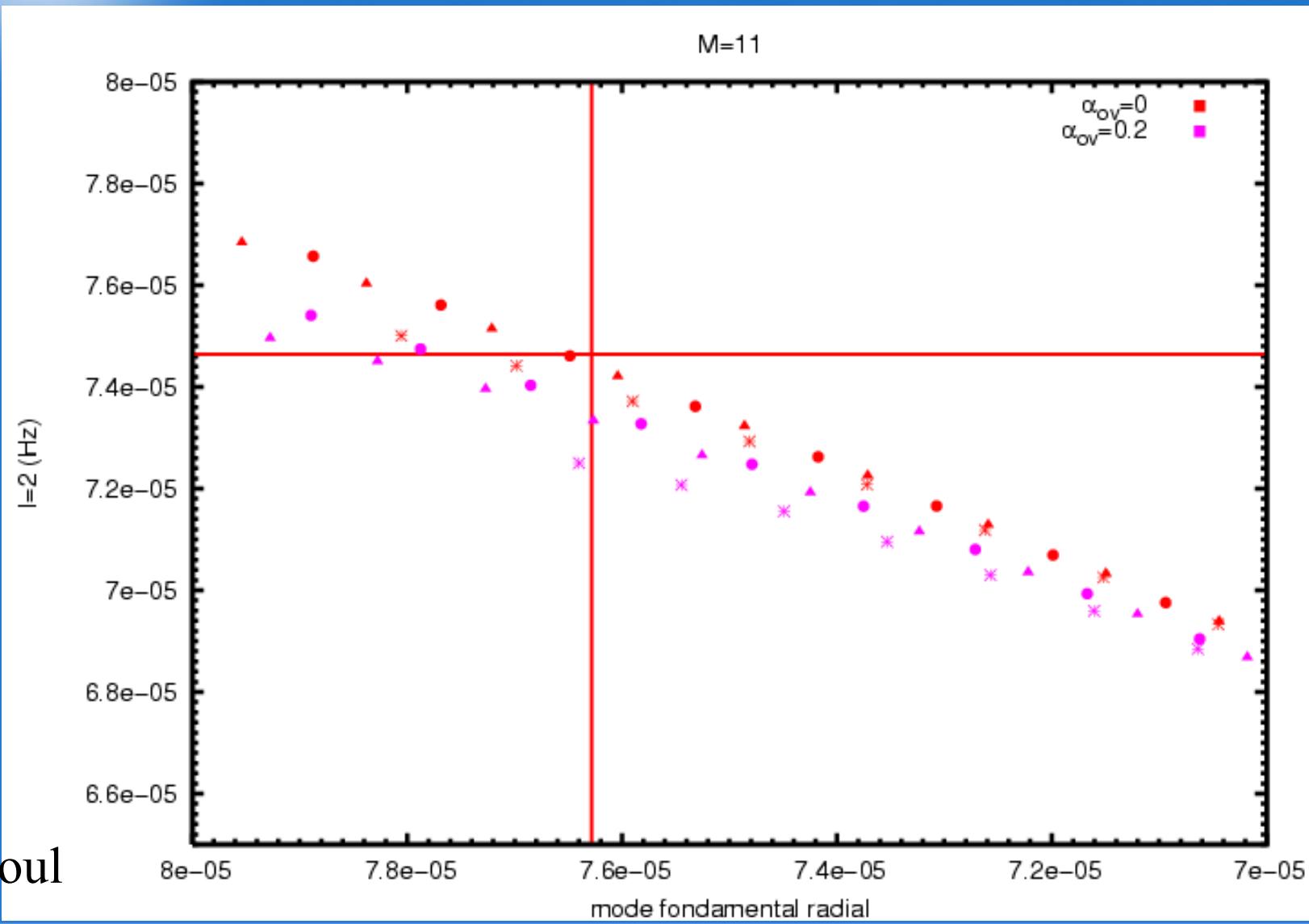
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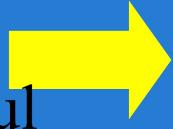
A. Thoul

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An example: HD129929

M=8	NO
M=9	NO
M=9.5	☑
M=10	☑
M=10.5	NO
M=11	NO
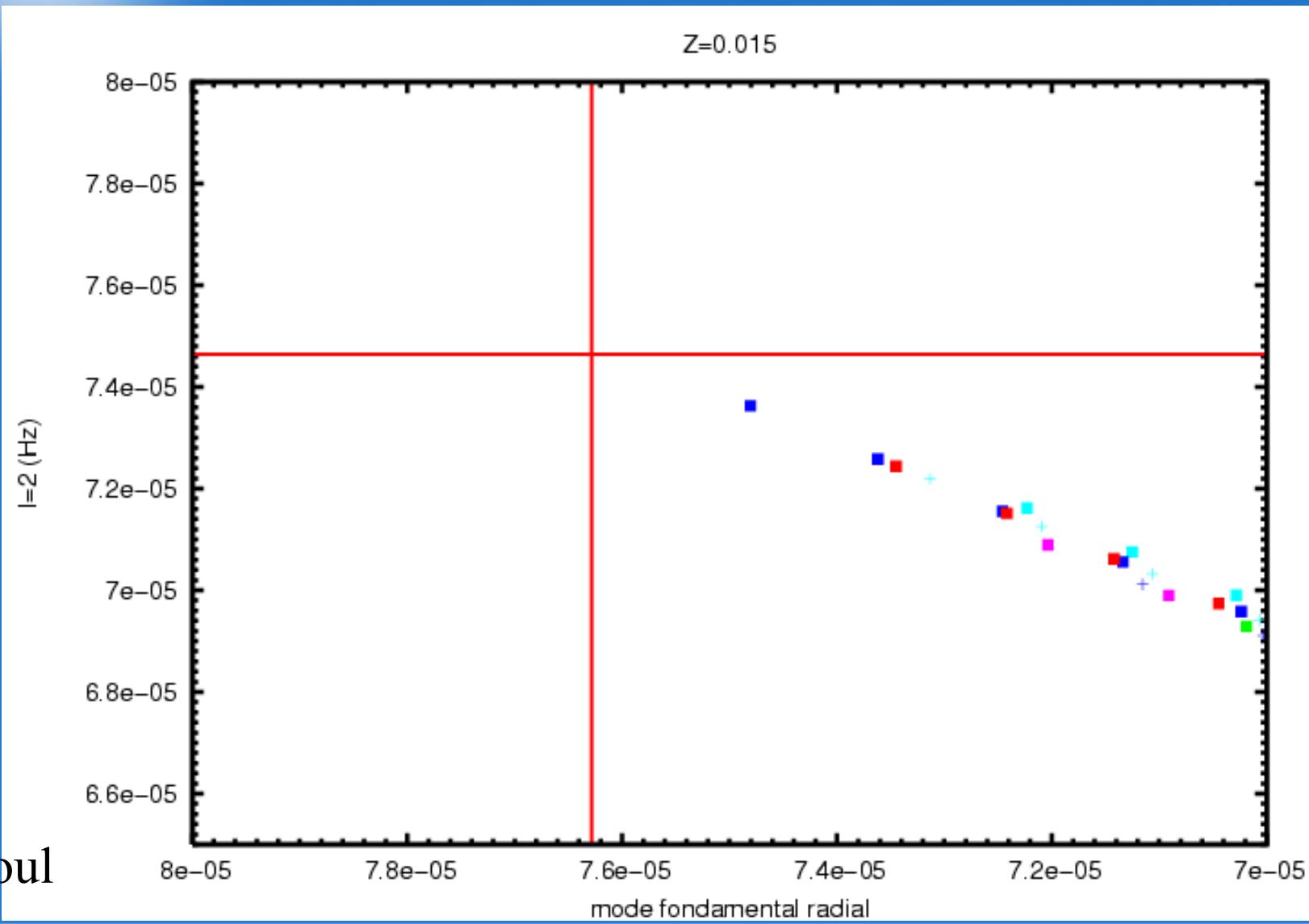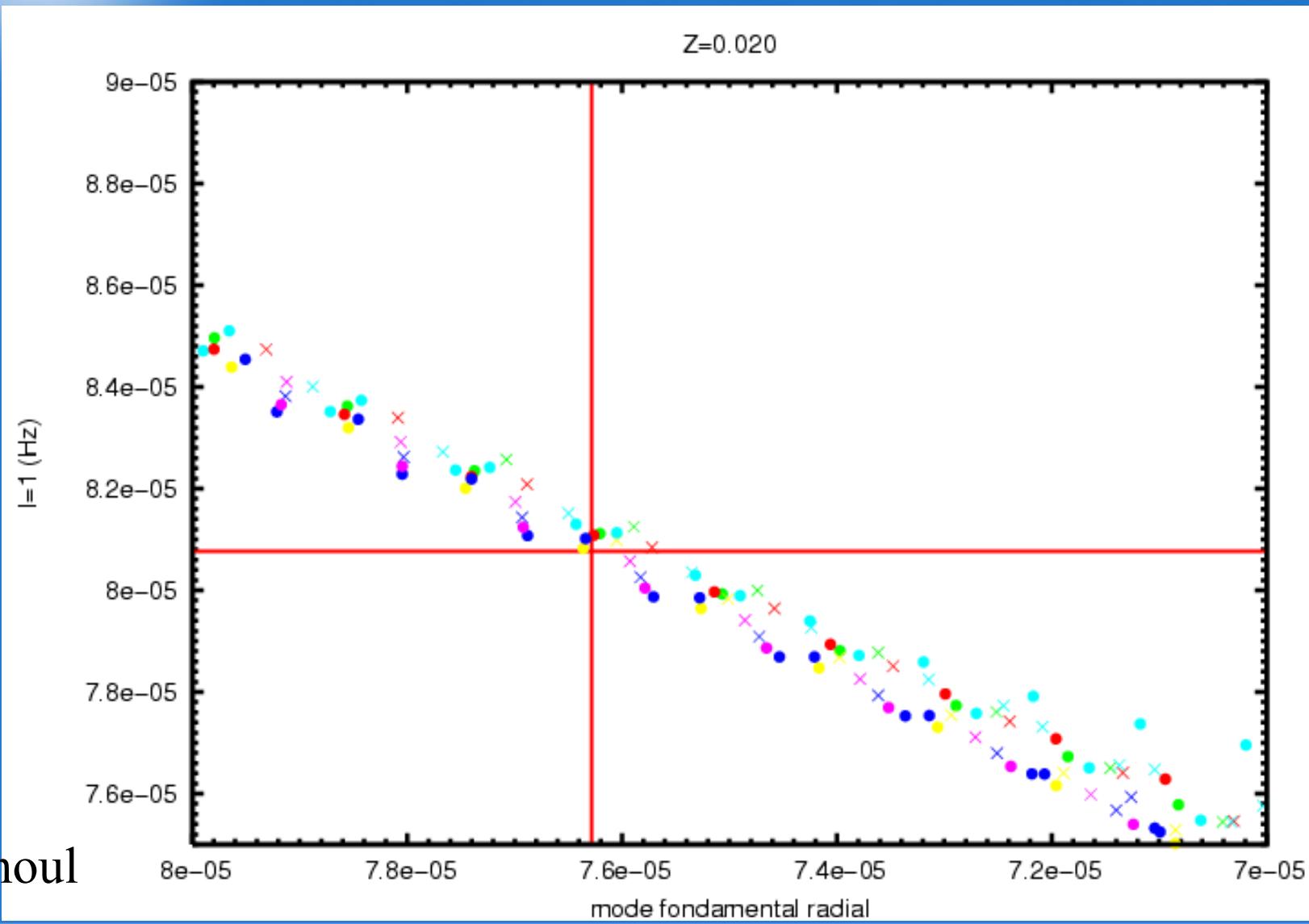
$9 < M < 10.5$

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An example: HD129929

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An example: HD129929

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An example: HD129929

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An example: HD129929

Z=0.010	NO
Z=0.015	NO
Z=0.020	☑
Z=0.025	☑

➡ $0.015 < Z$

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An example: HD129929

Z=0.010	NO
Z=0.015	NO
Z=0.020	☑
Z=0.025	☑

➡ $0.015 < Z$

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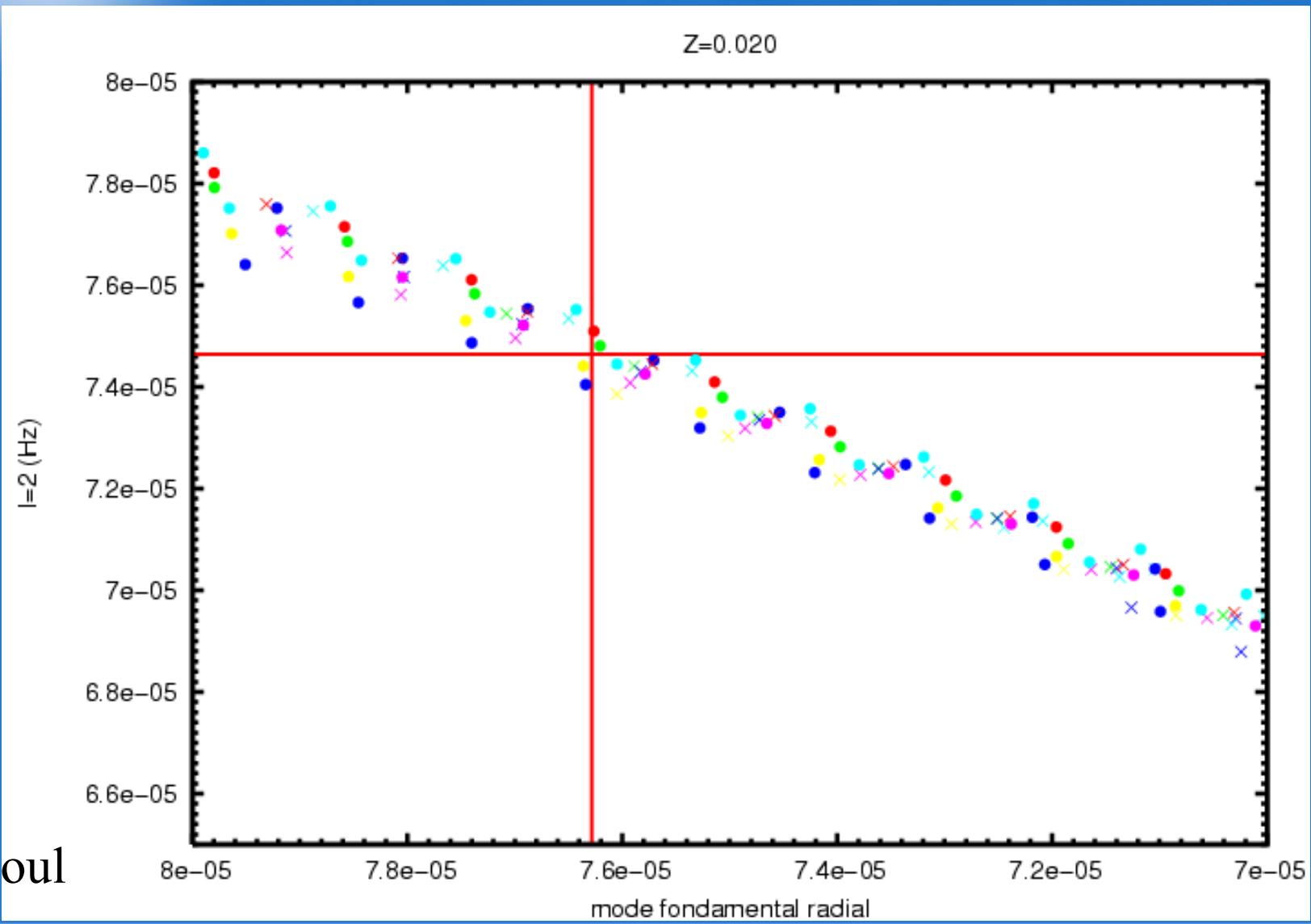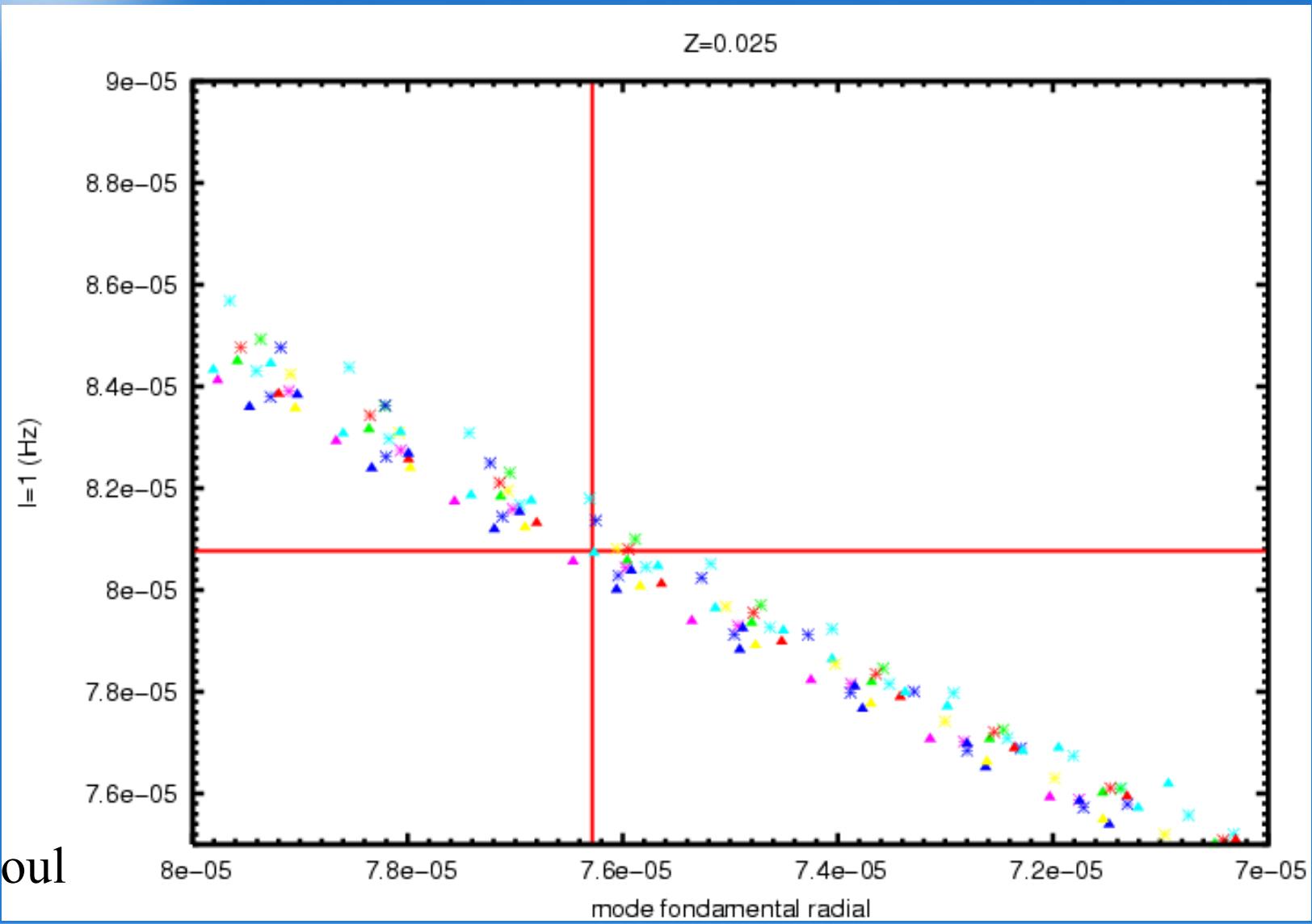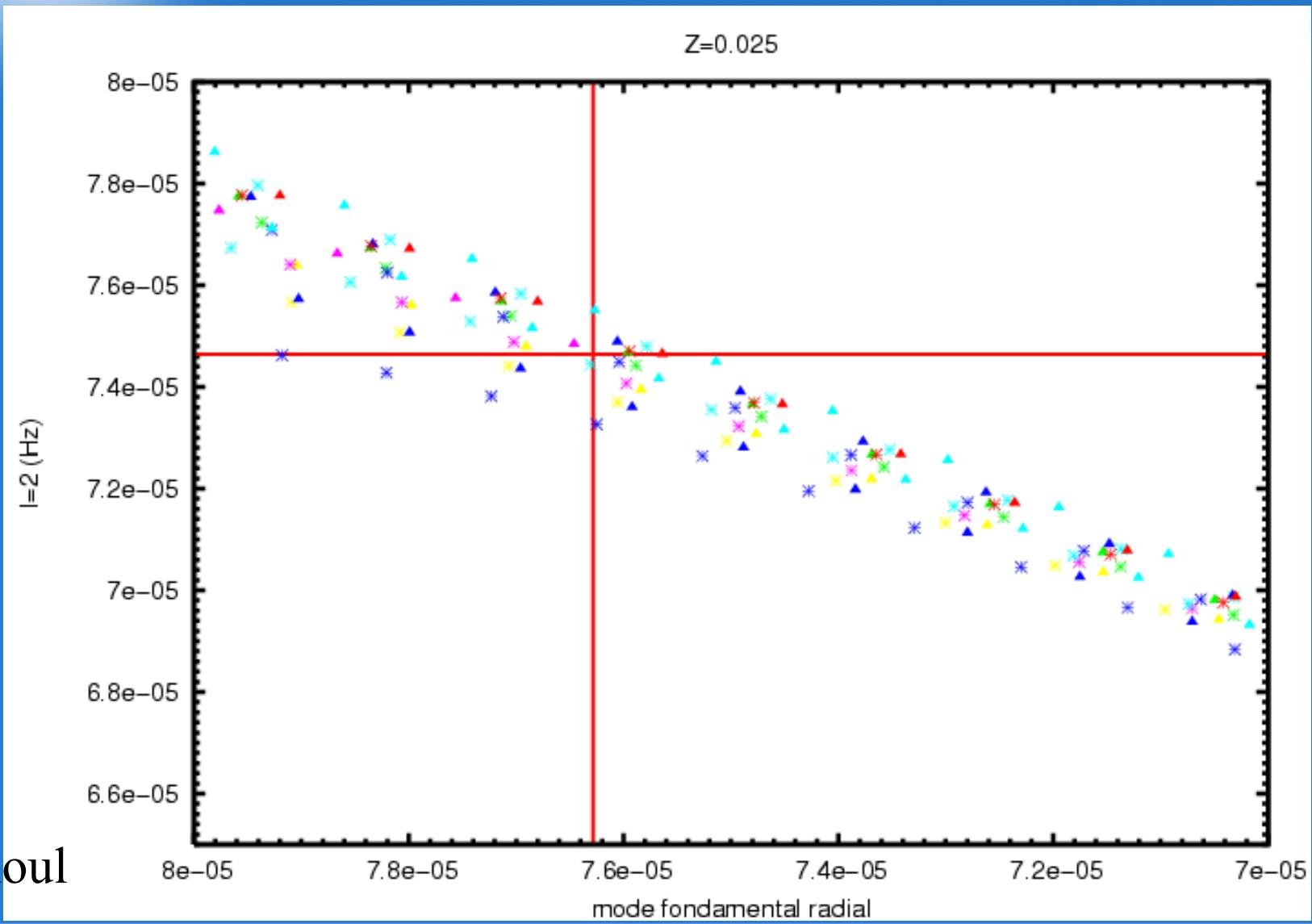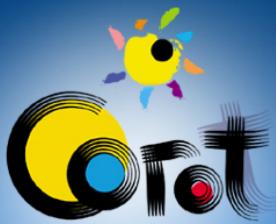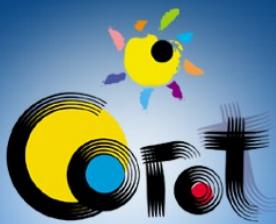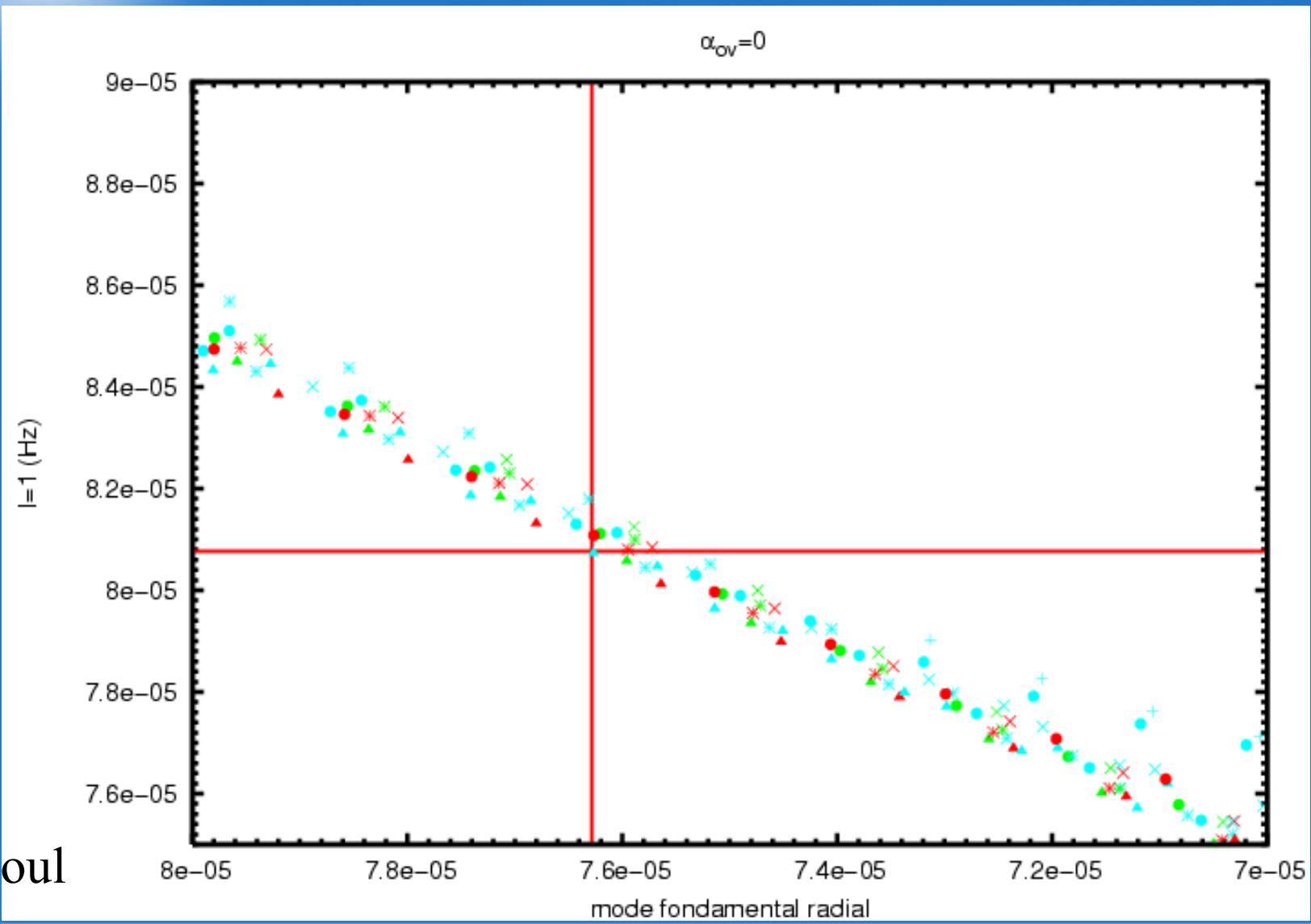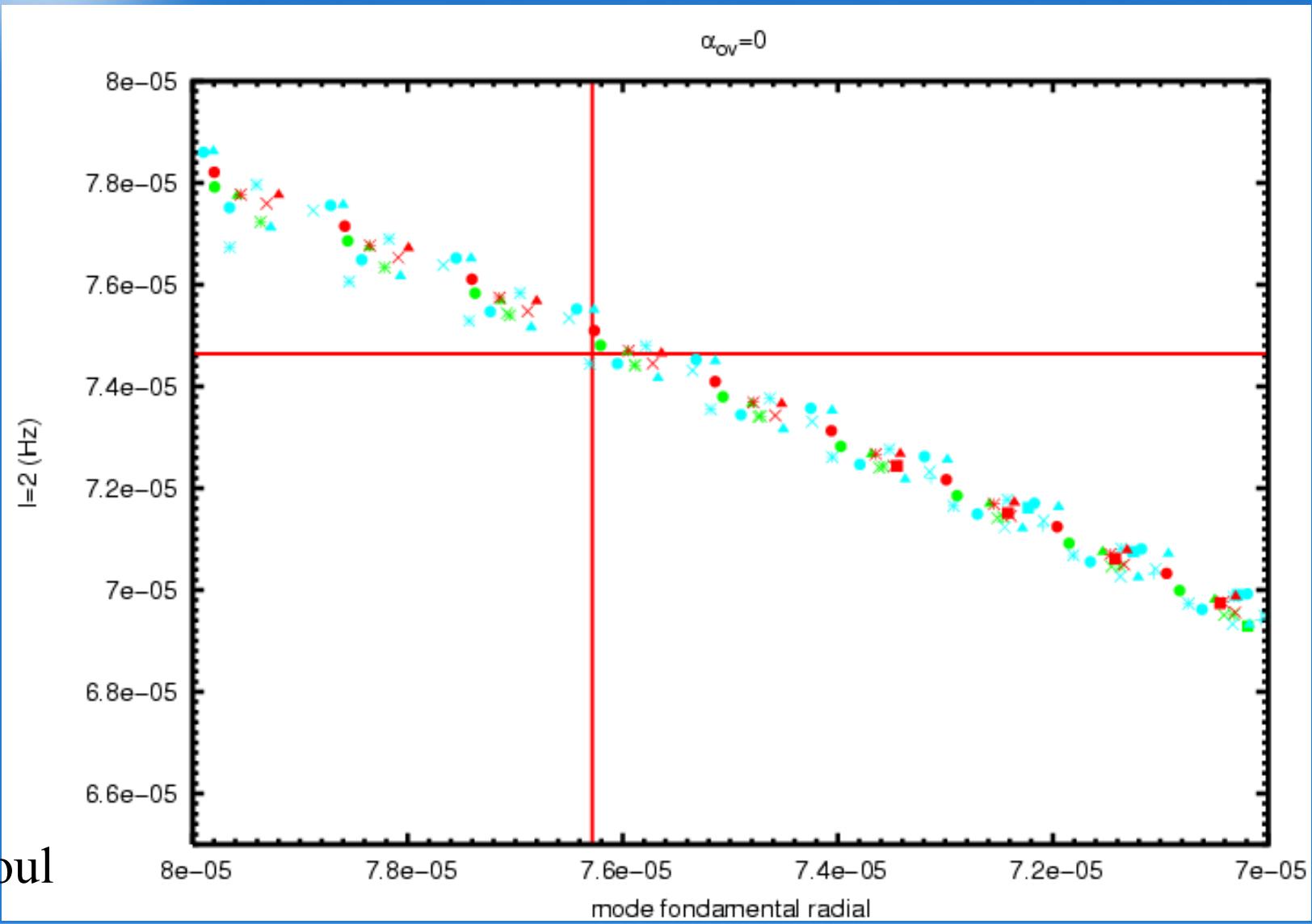
An example:
HD129929

$\alpha_{ov}=0$	NO
$\alpha_{ov}=0.1$	☑
$\alpha_{ov}=0.2$	☑
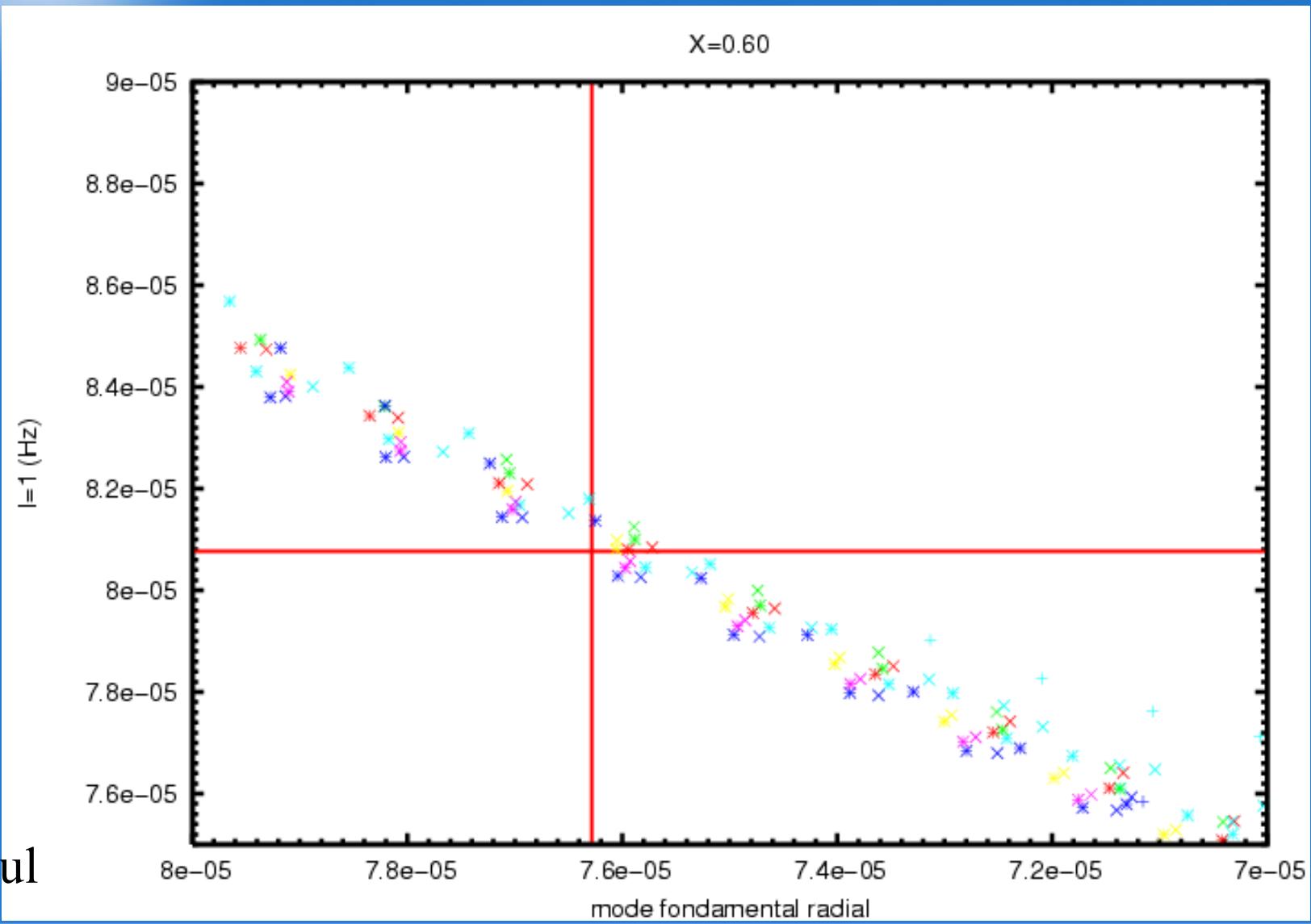
➡ $0.0 < \alpha_{ov}$
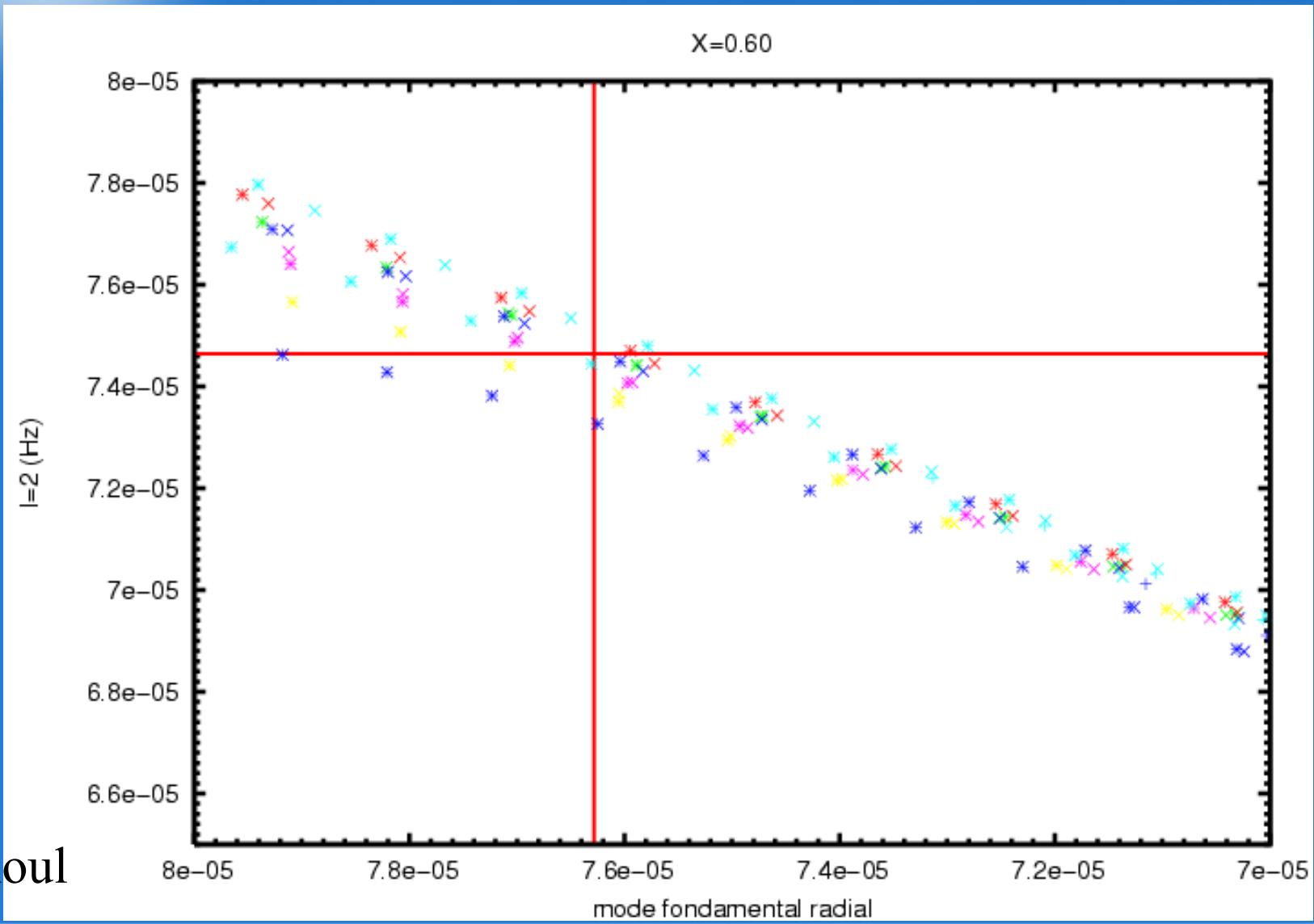
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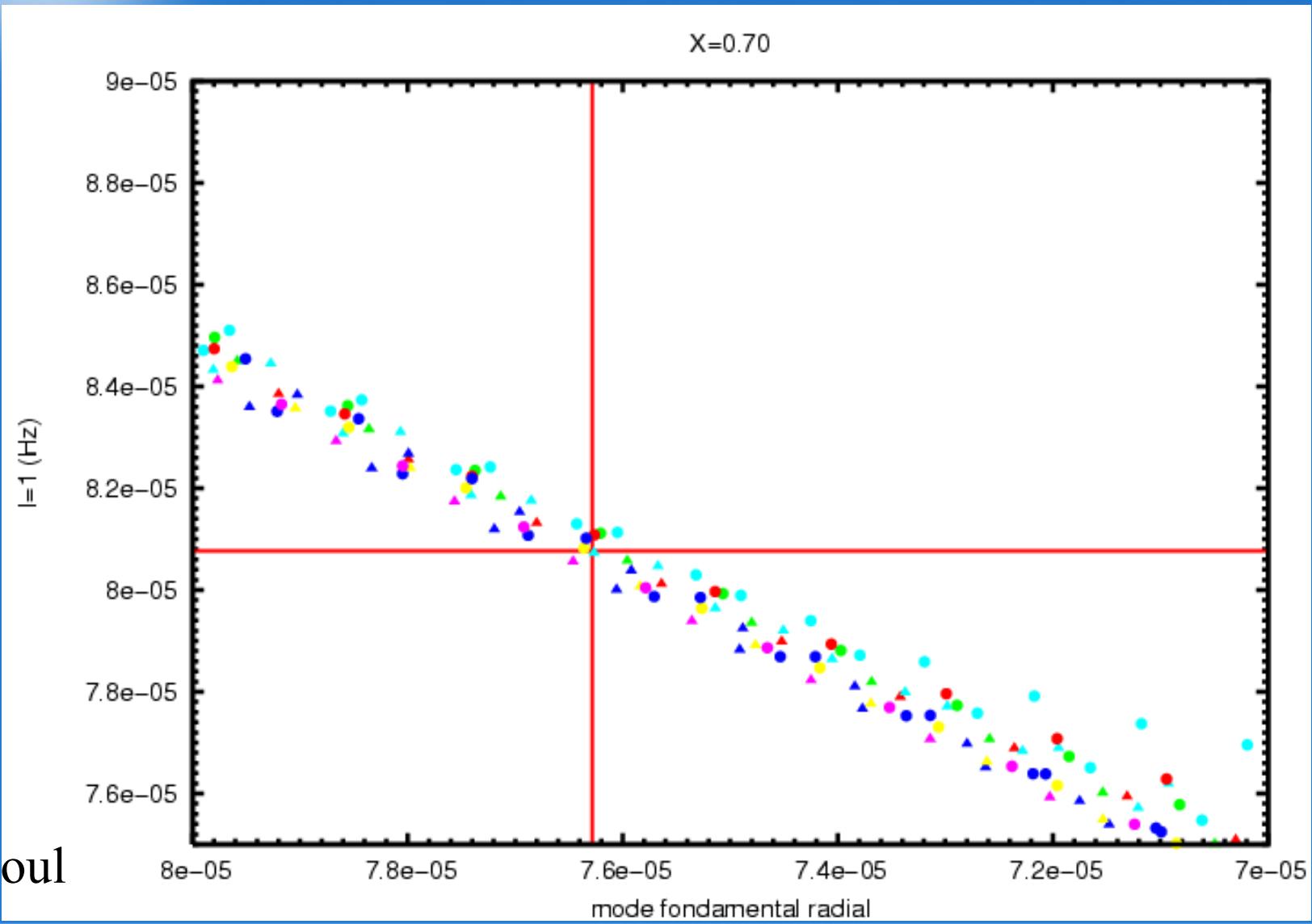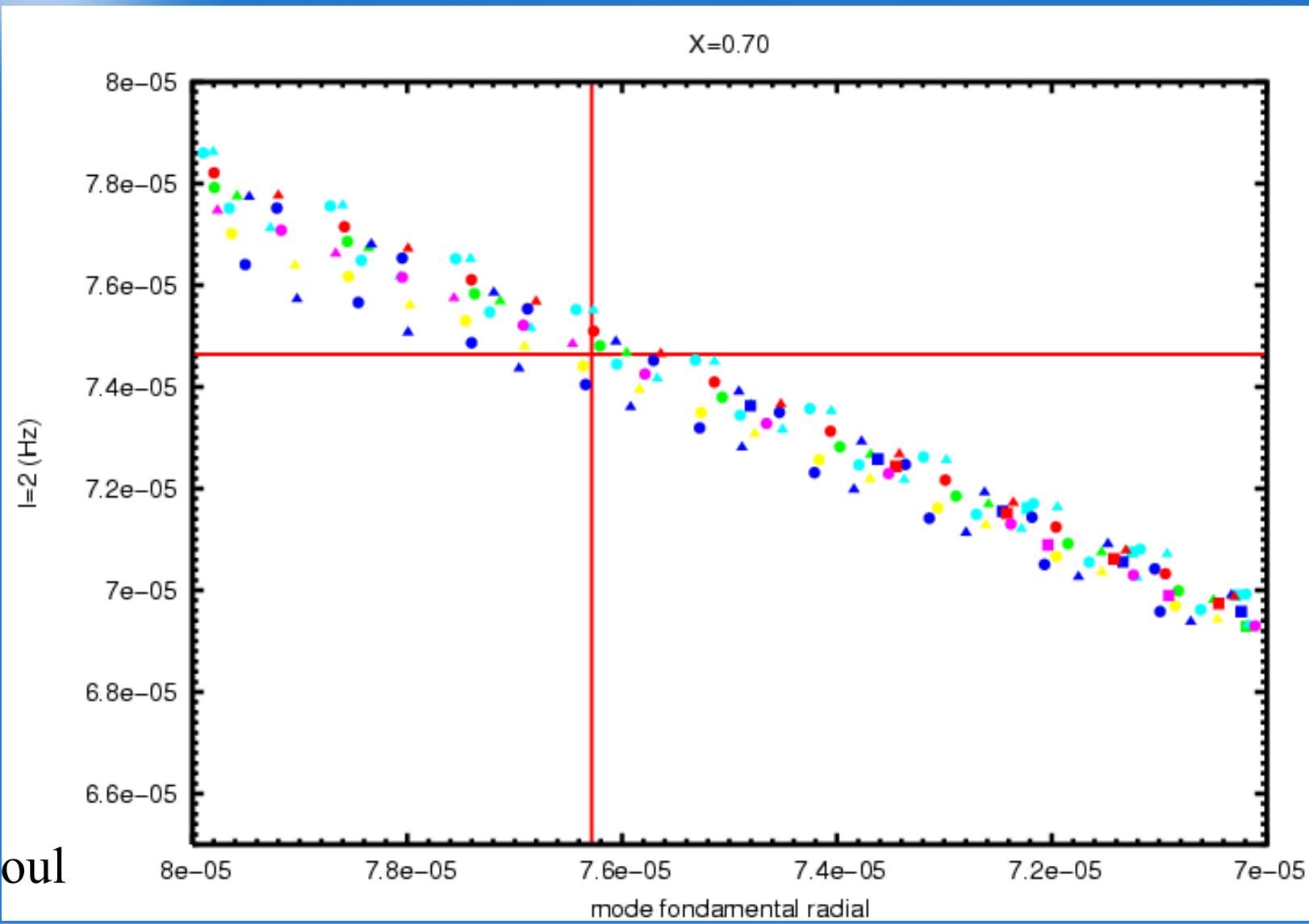
A. Thoul

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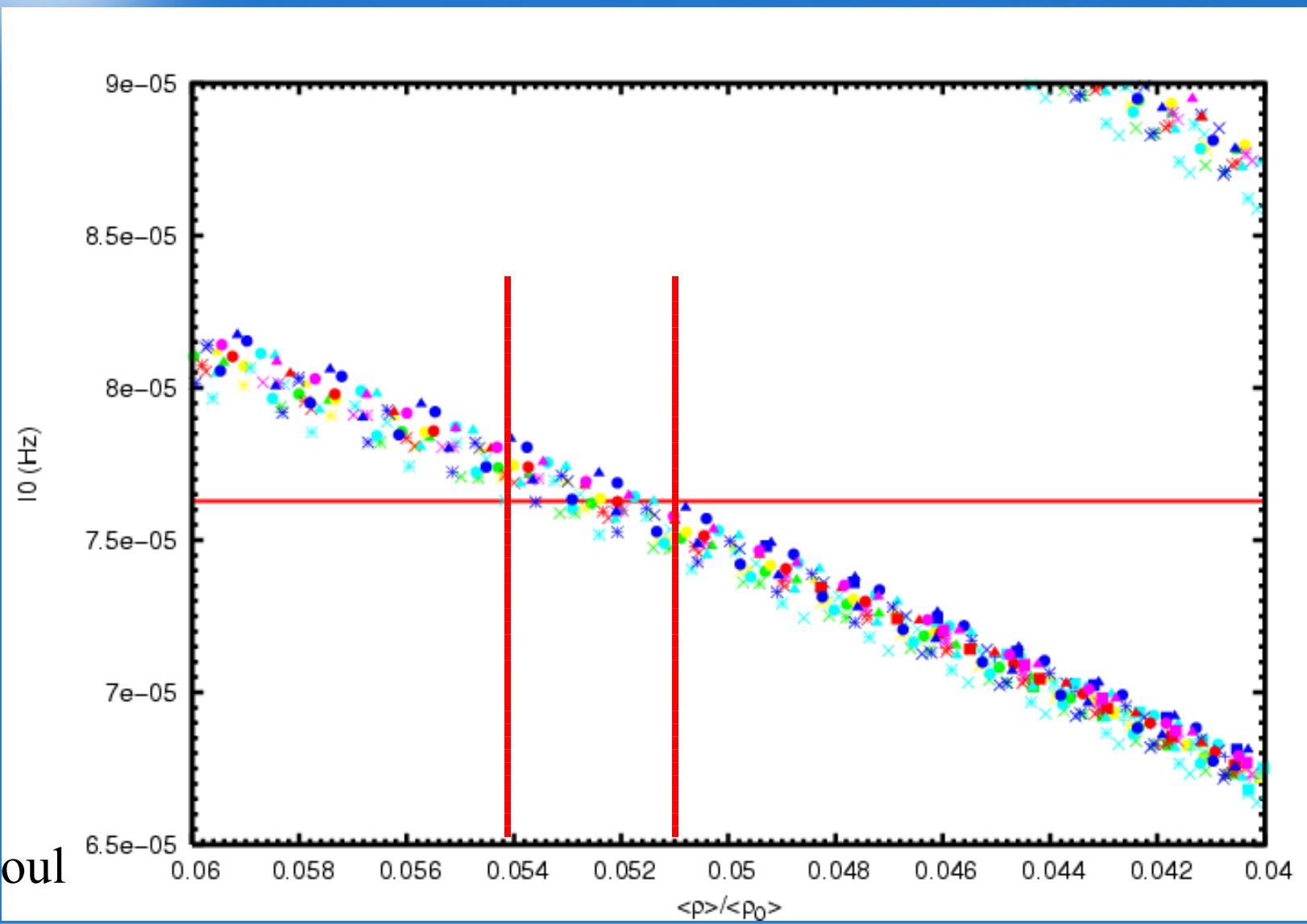
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HD129929:
Determination of $<\rho>$

Mode l=1

$$\downarrow$$

$$<\rho>/<\rho_0> = 0.0520 \pm 0.0008$$
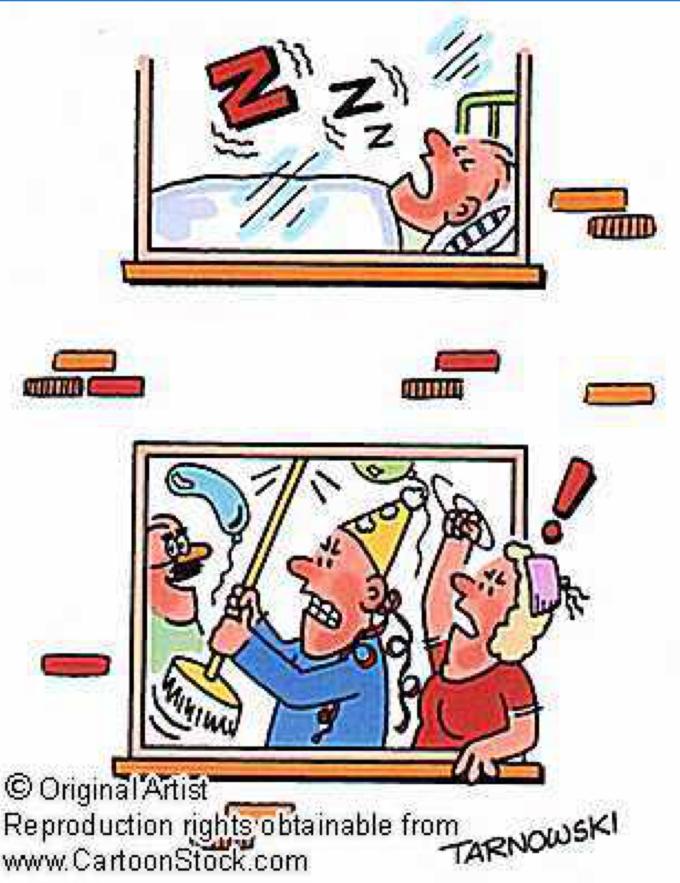
To be continued…

- Continue to build grids of models
  - β Cephei stars
  - SPBs, δ Scuti, …
- Construct additional seismic diagrams
  - Use combination of frequencies
- Find relations between stellar properties and frequencies

A. Thoul

# To be discussed…
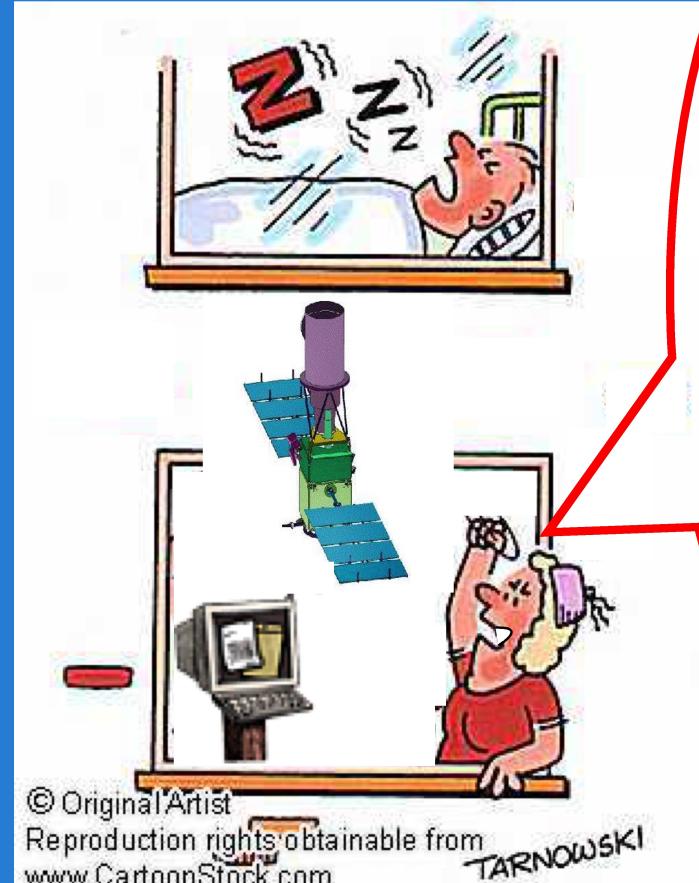
- Interest from the community

- Format of data

- Access to results

- Comparison with other codes

«Normal» people

Asteroseismologist involved in the COROT mission

BAG

M= 81±7.9 kg

Chemical composition

O=0.65
C=0.18
H=0.10

<ρ>~1.1
age=46 ±2yrs

A. Thoul

68