

Report on Task 2

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- Introduction (Codes involved and procedure)
 - Frequency comparison
 - Additional studies
- Conclusions and further work



INTRODUCTION

Equilibrium model

M/M_{\odot}	$\log T_{\text{eff}}$	$\log g$	$\log L/L_{\odot}$	R/R_{\odot}	X_{C}	Age (My)	τ_{dyn} (s)
1.5	3.830	4.141	0.739	1.724	0.40	1366	2945



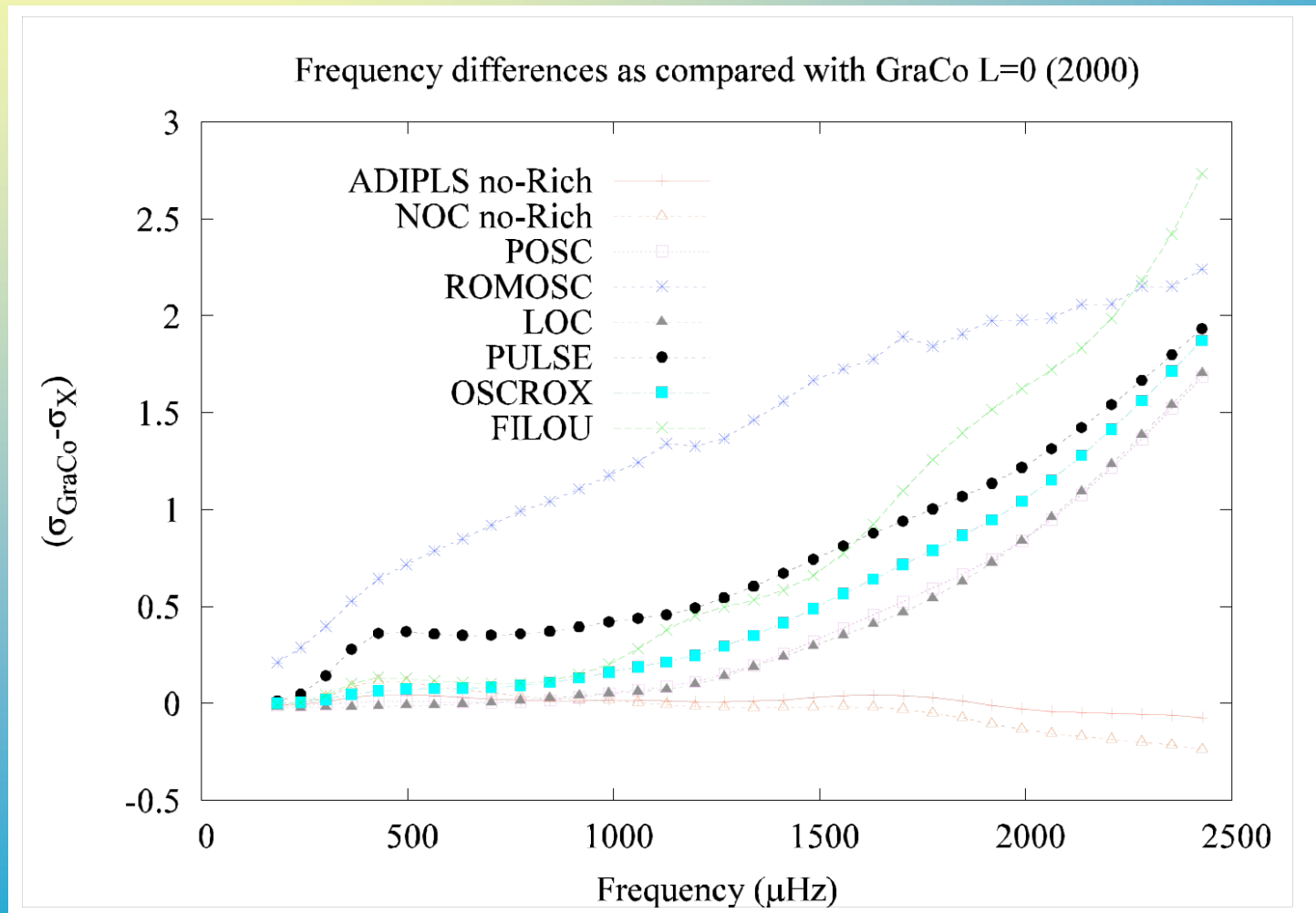
	ADIPLS	POSC	NOC	GraCo	FILOU
PI	J. Christensen-Dalsgaard	M. Monteiro	J. Provost	A. Moya	J.C. Suárez
	LOC	OSCROX	ROMOSC	PULSE	
PI	R. Scufaire	I. Roxburgh	M. Suran	S. Charpinet	



Frequency comparison

Direct comparison

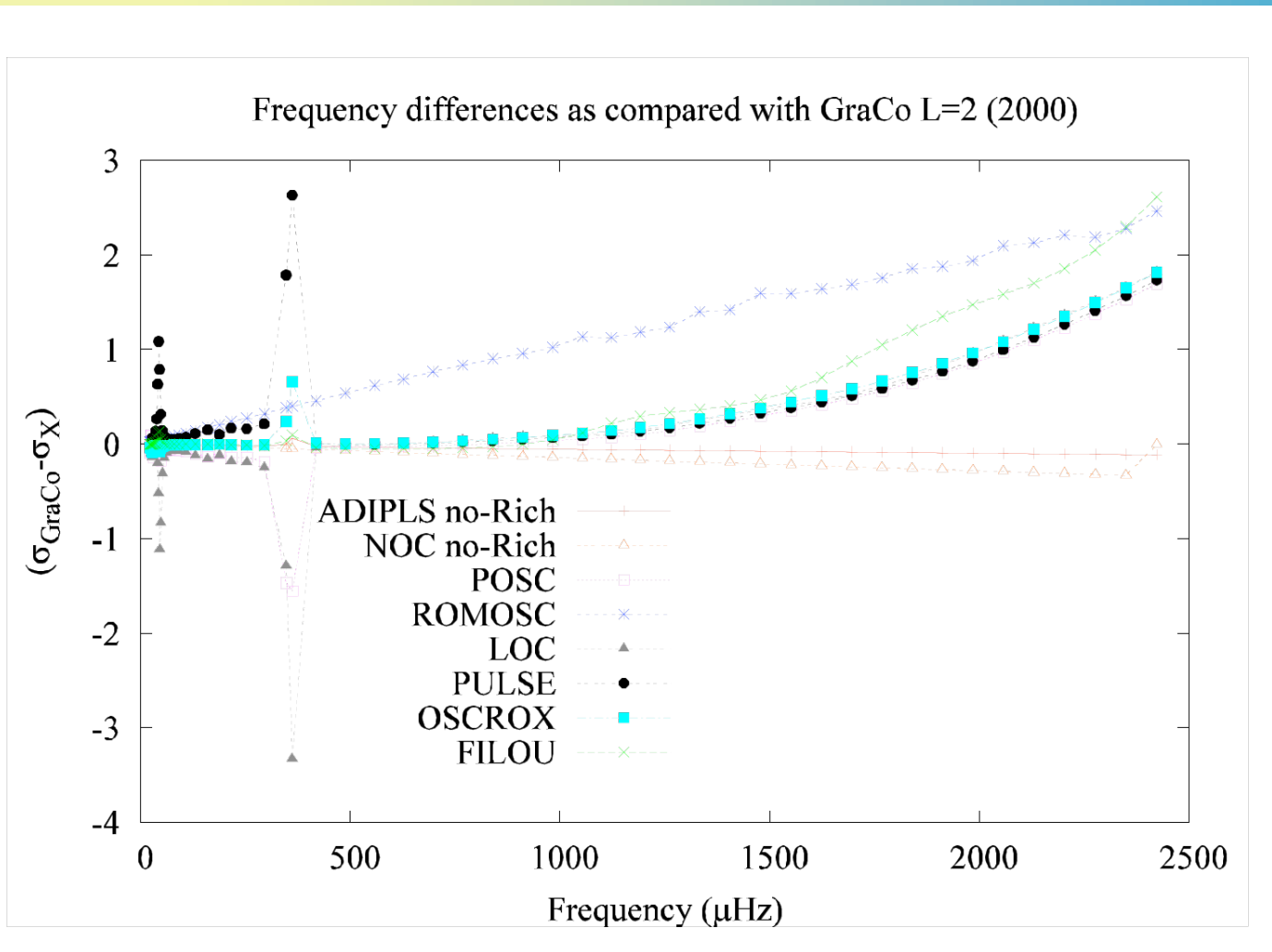
$\ell = 0$



Frequency comparison

Direct comparison

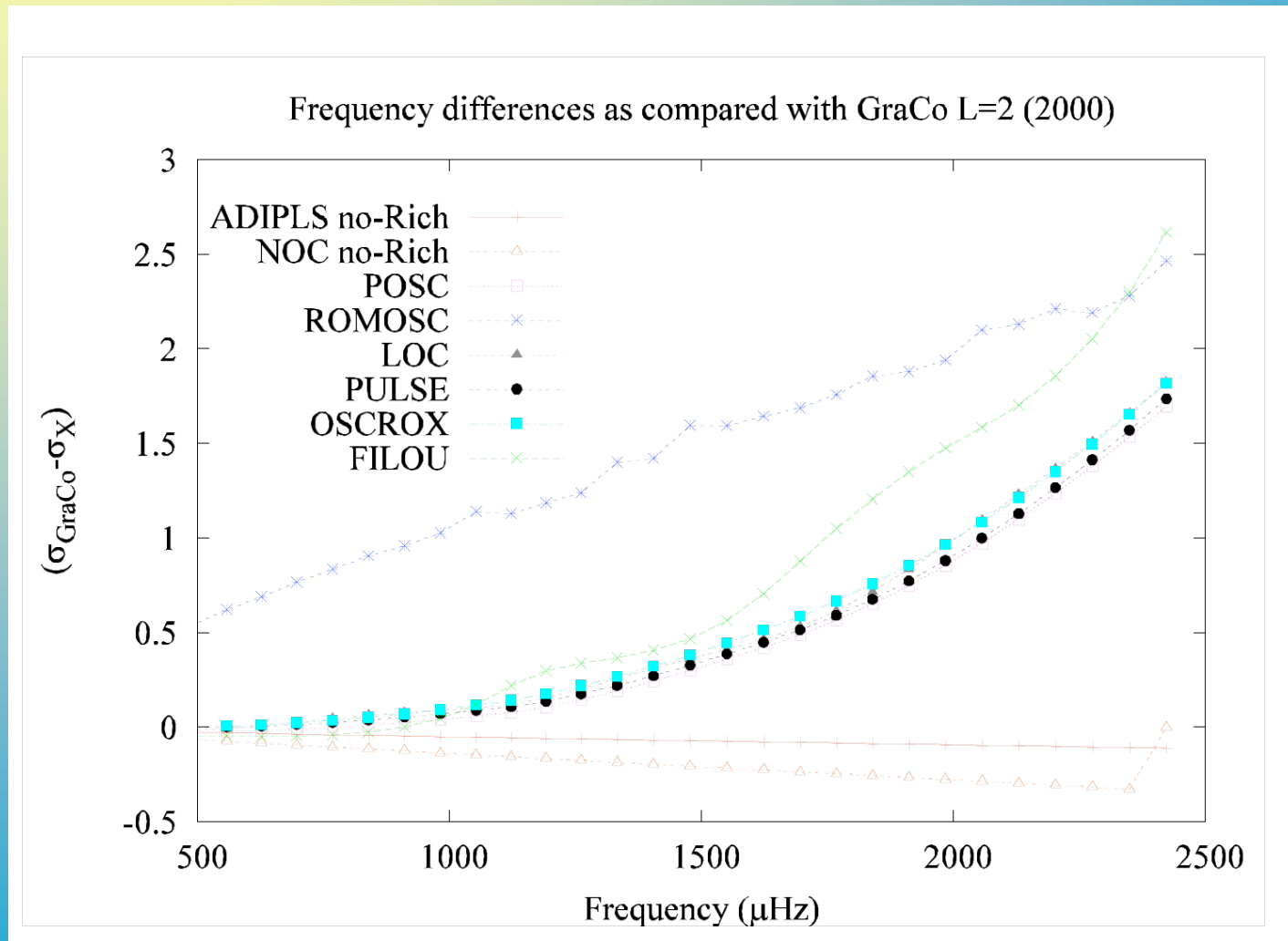
$\ell = 2$



Frequency comparison

Direct comparison

$\ell = 2$

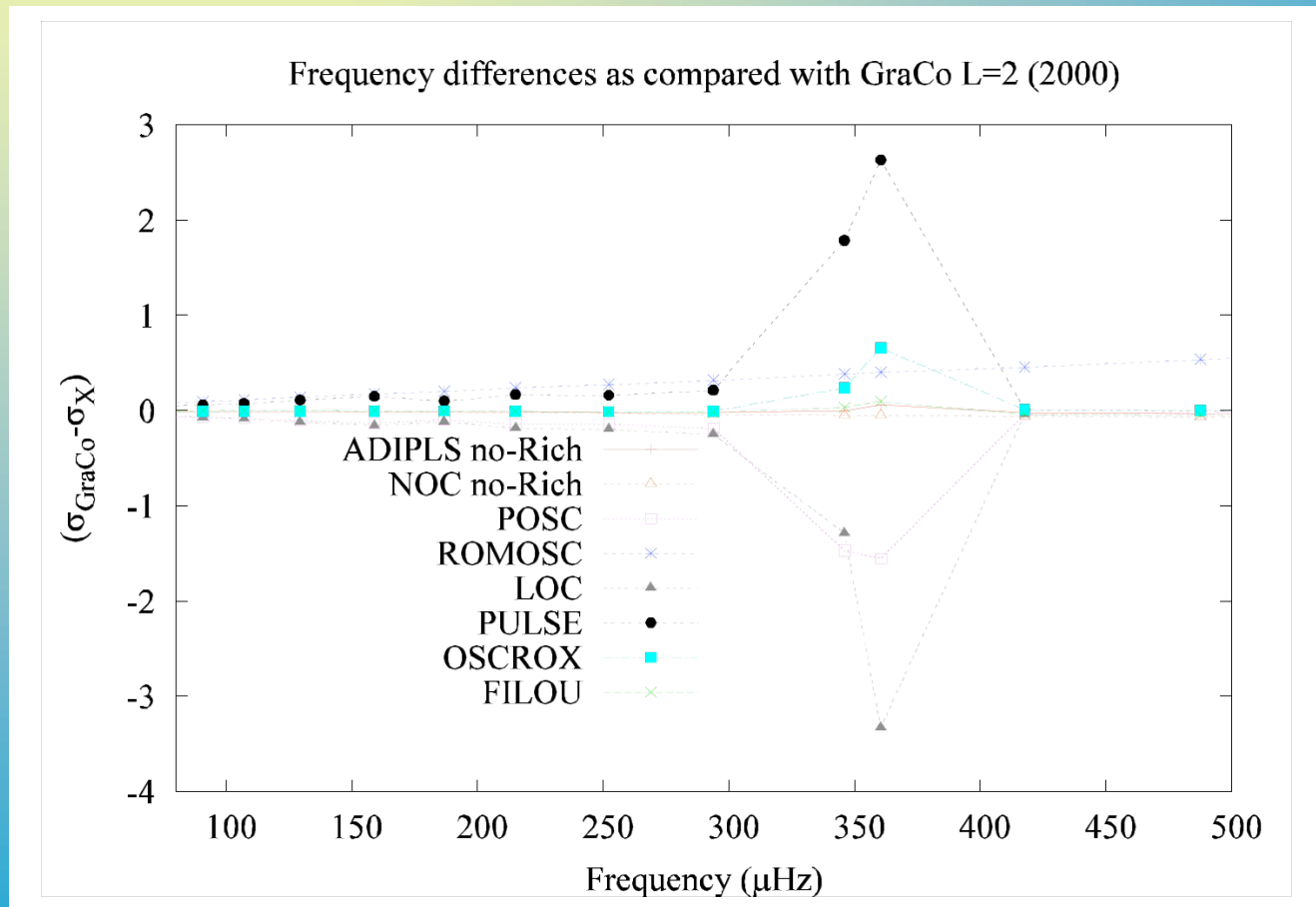


Frequency comparison

Direct comparison

$\ell = 2$

central spectrum

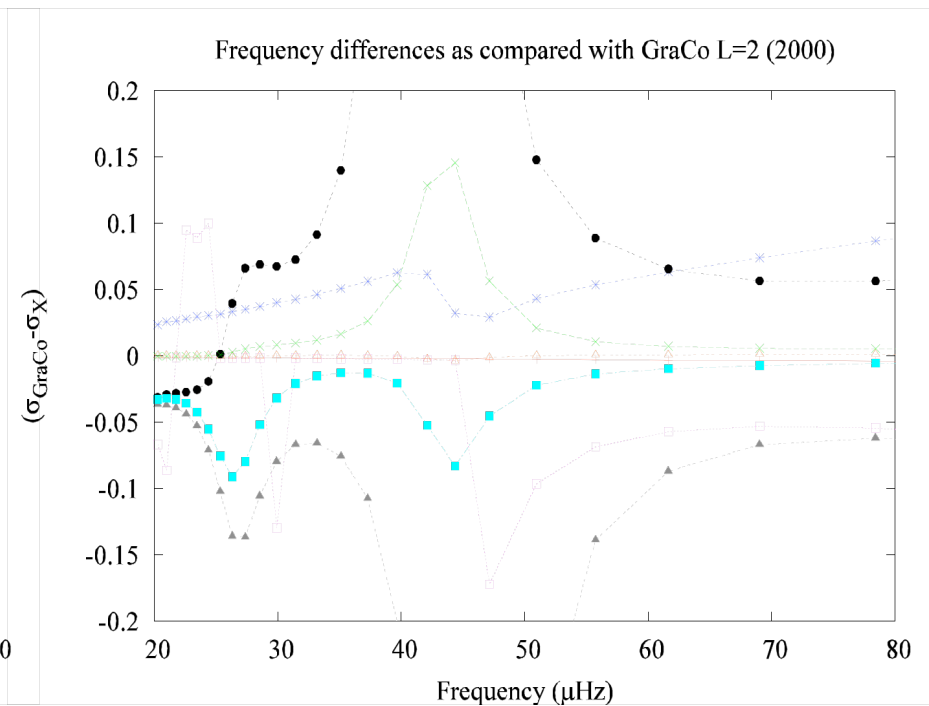
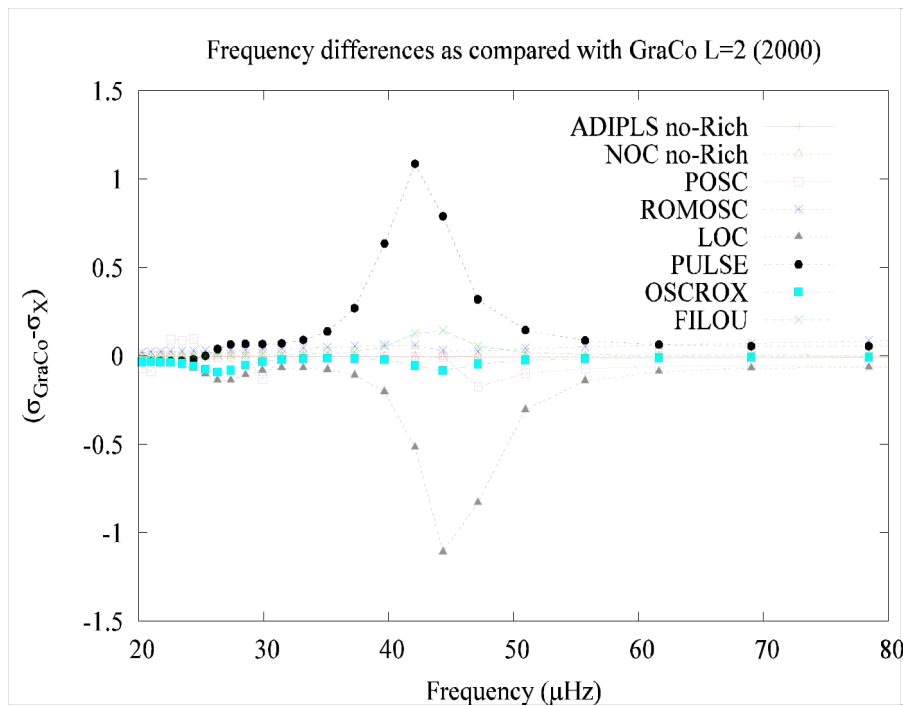


Frequency comparison

Direct comparison

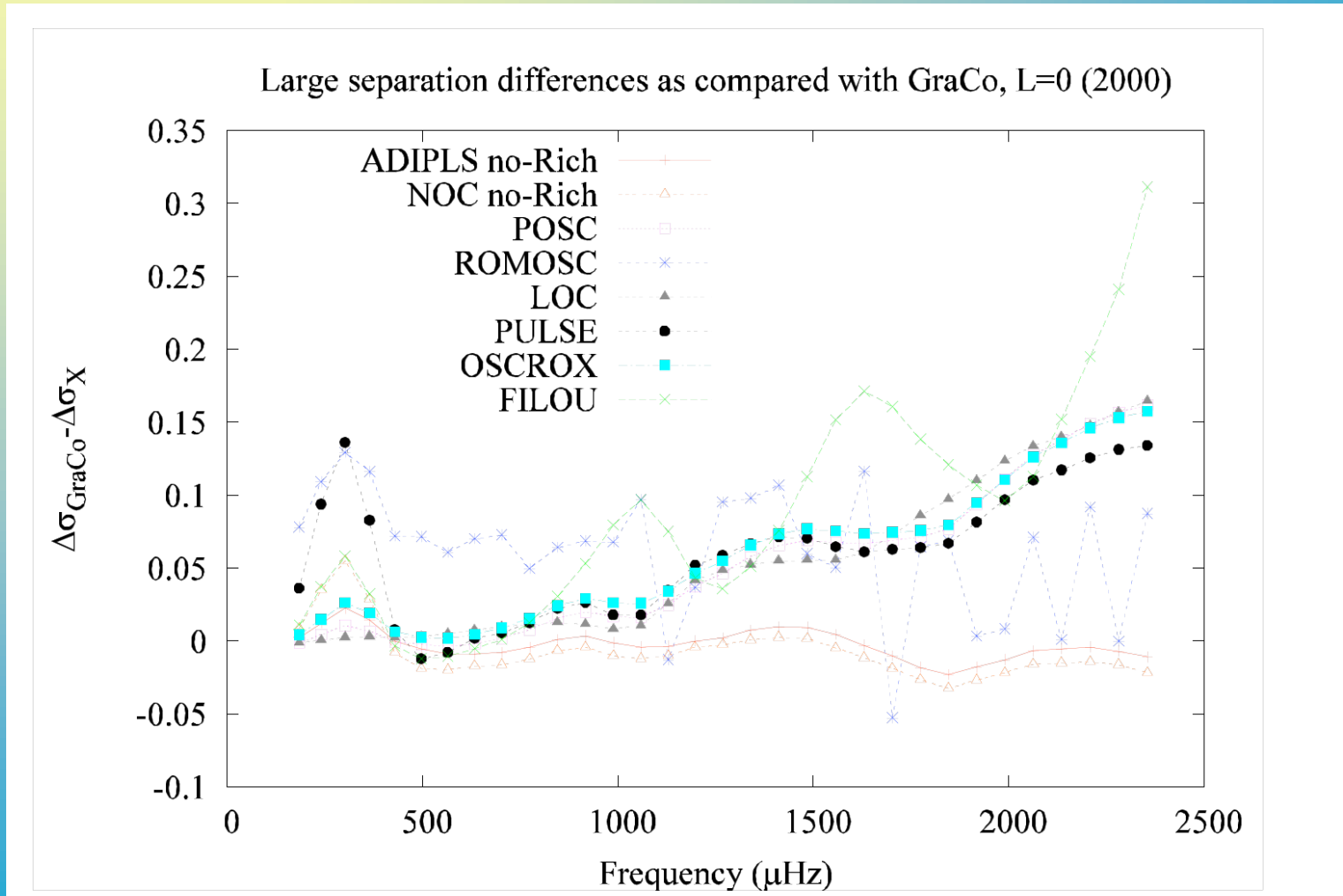
$\ell = 2$

g-modes



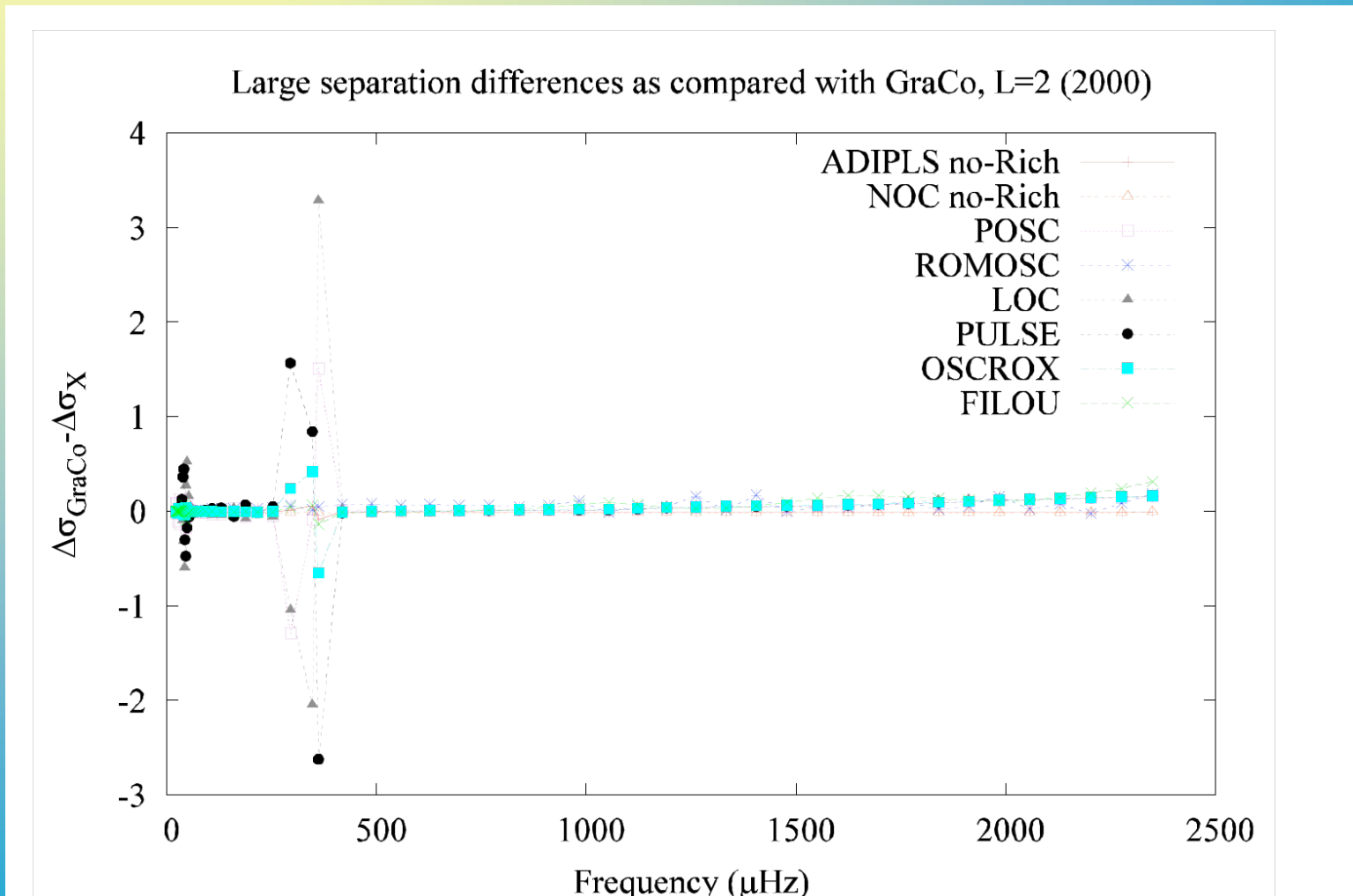
Asymptotic properties comparison

Large separation $\ell = 0$



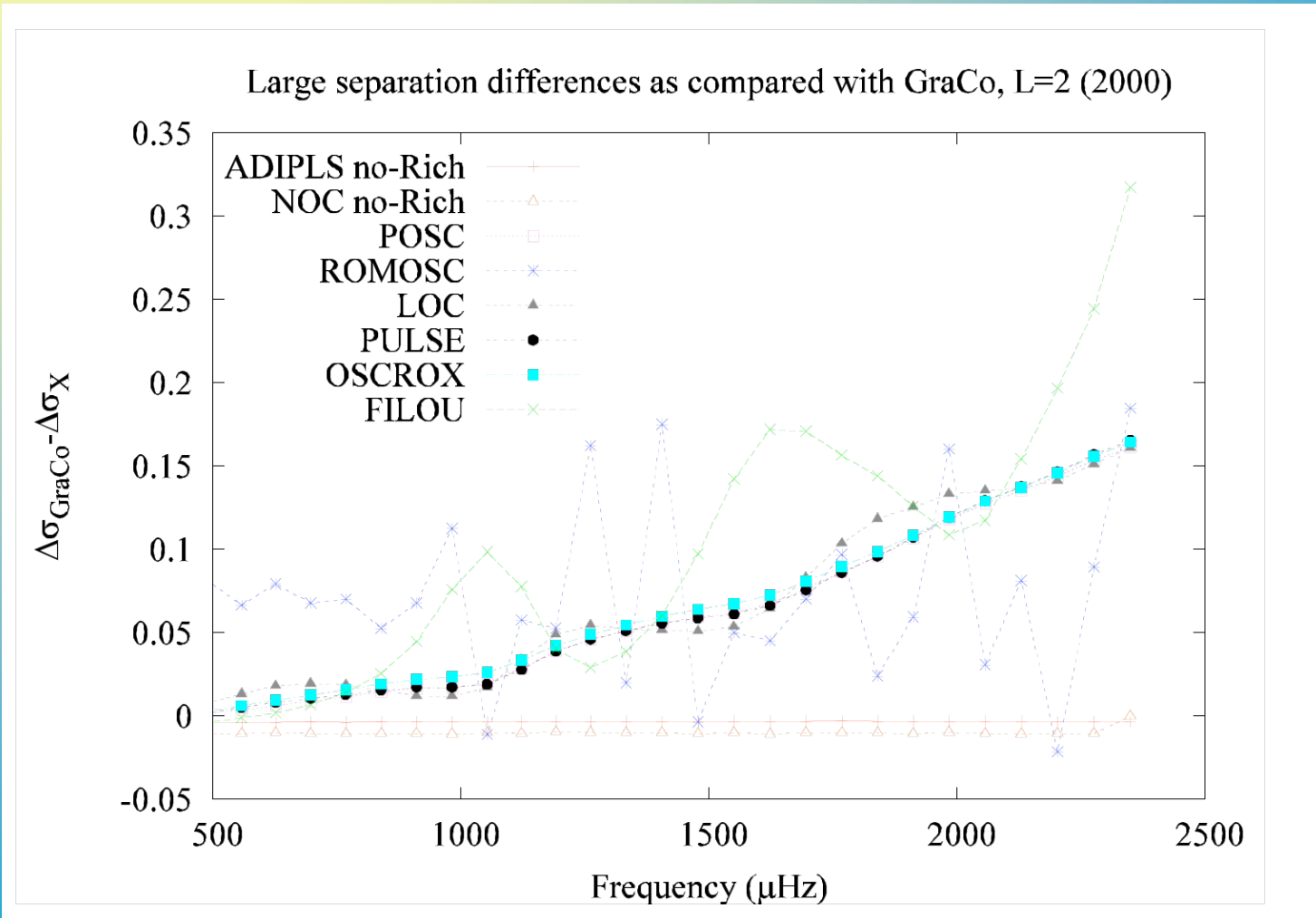
Asymptotic properties comparison

Large separation $\ell = 2$



Asymptotic properties comparison

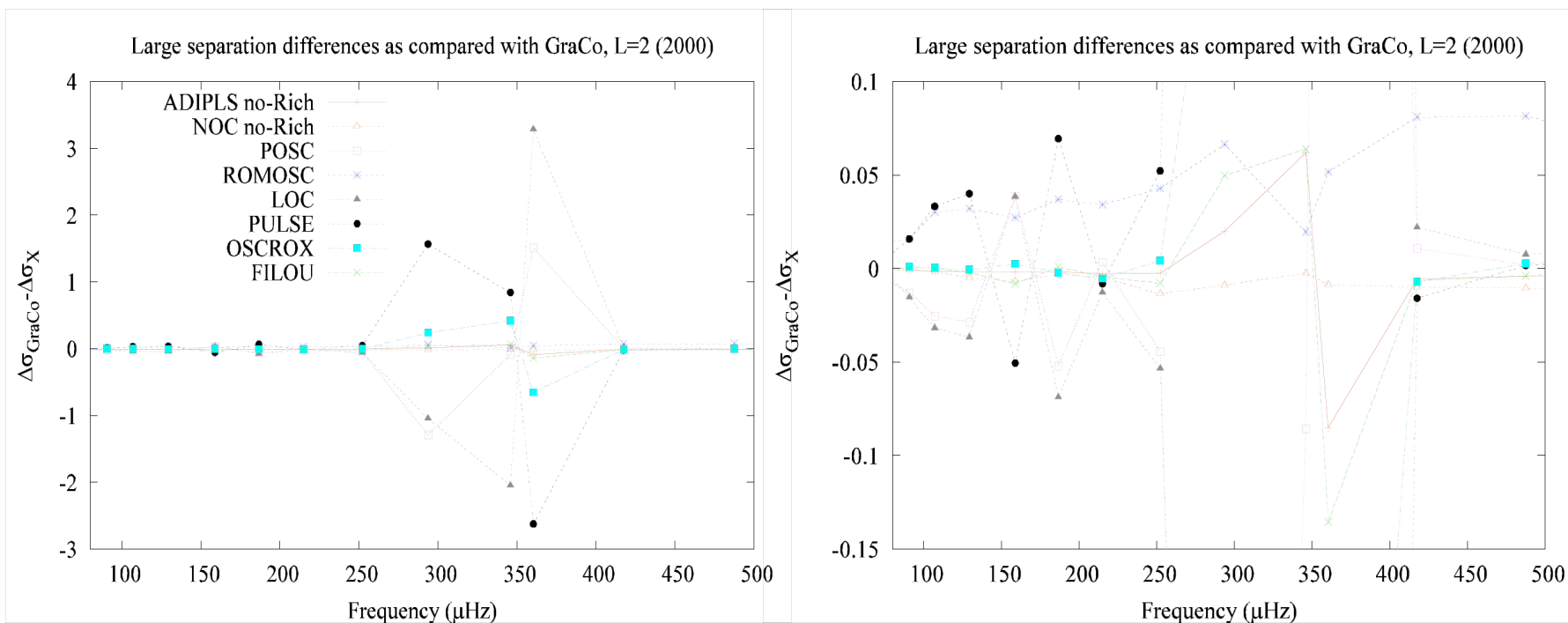
Large separation



Asymptotic properties comparison

Large separation

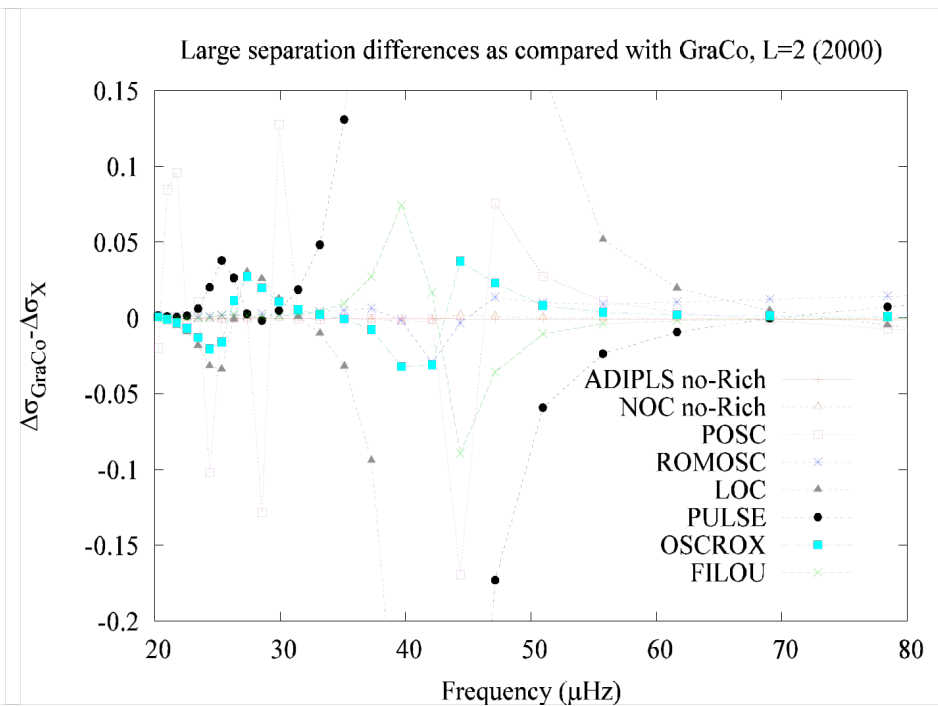
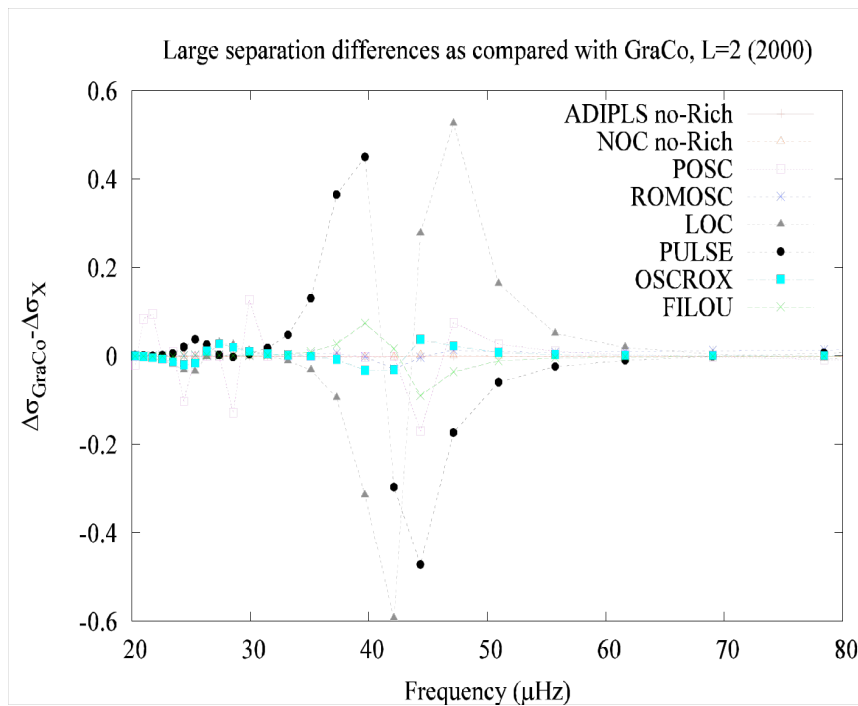
$$\ell = 2$$



Asymptotic properties comparison

Large separation

$$\ell = 2$$

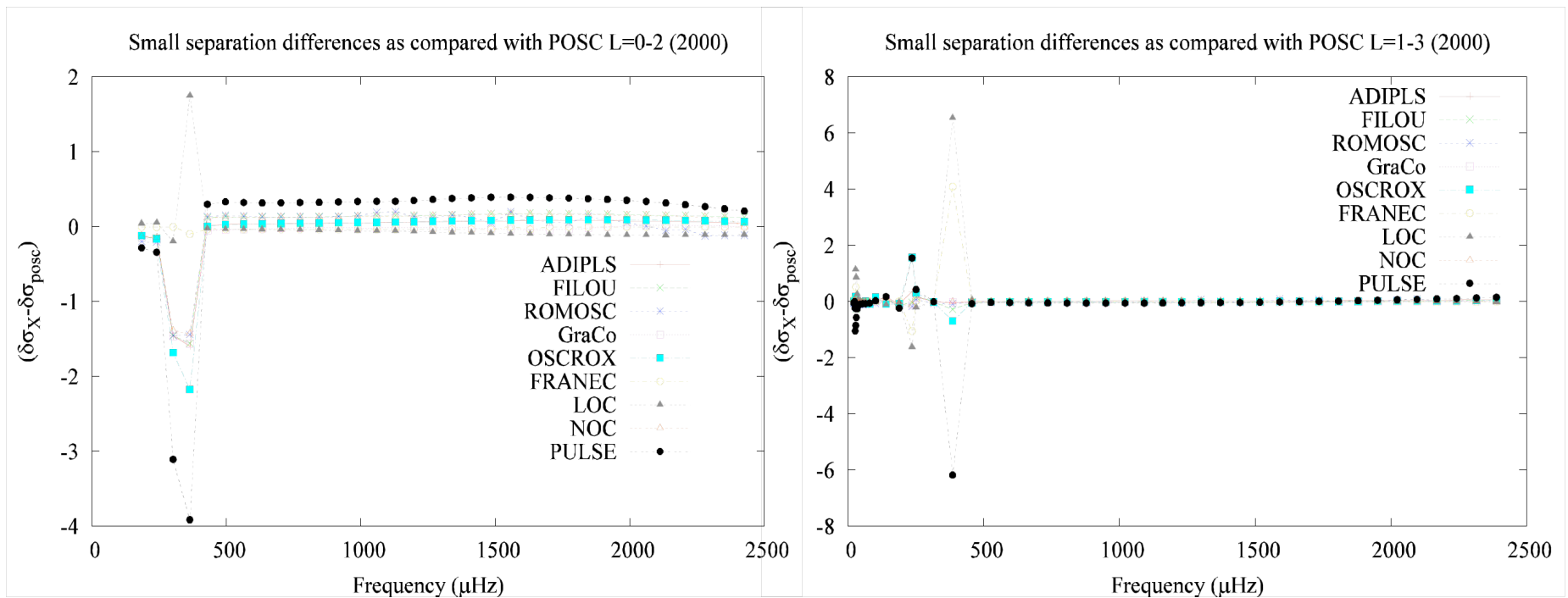


Asymptotic properties comparison

Small separation

0-2

1-3

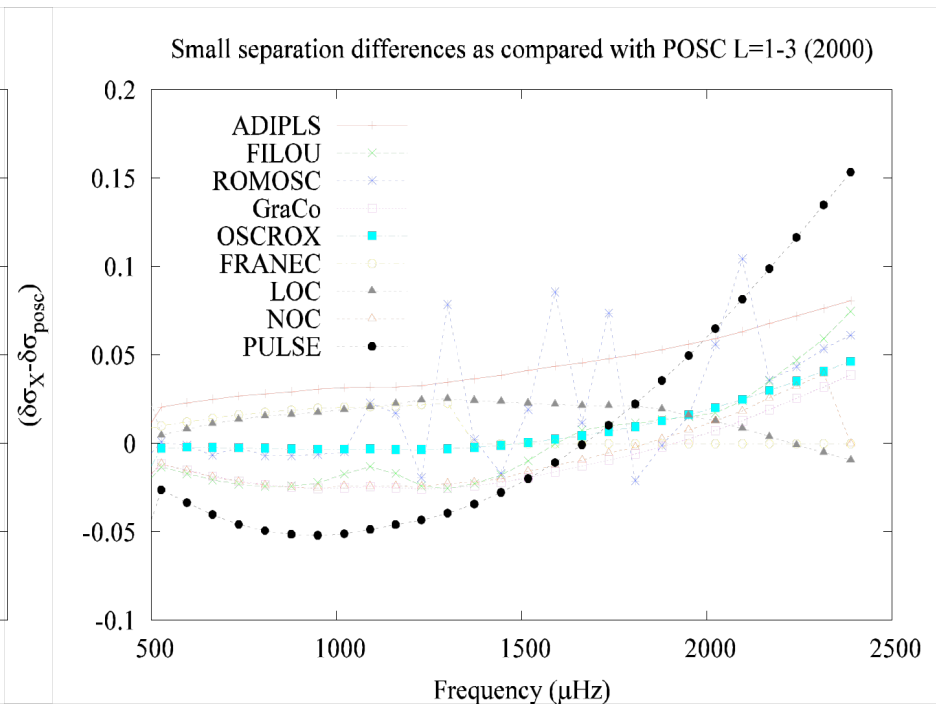
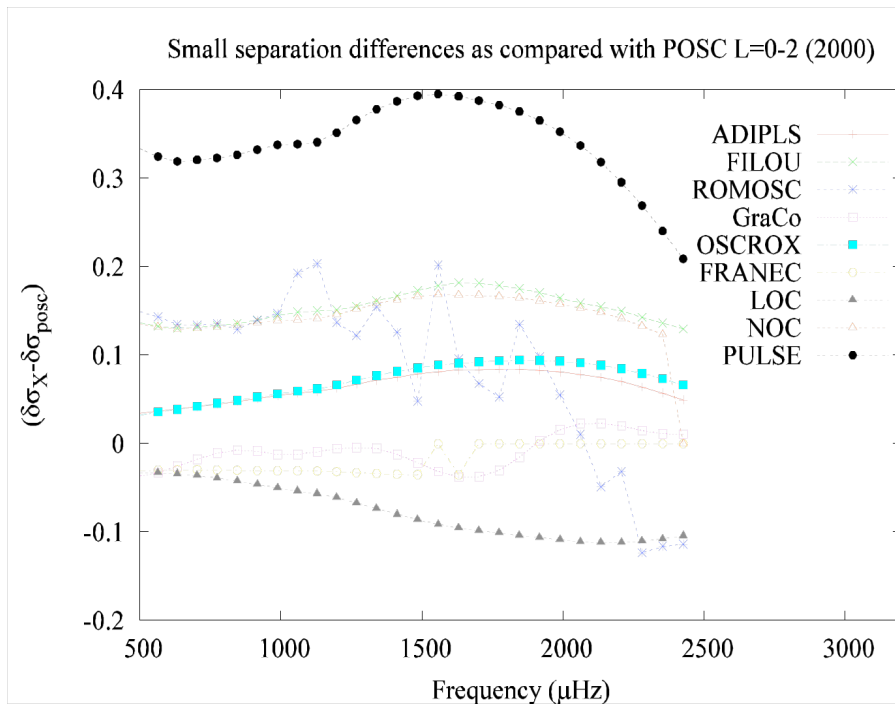


Asymptotic properties comparison

Small separation

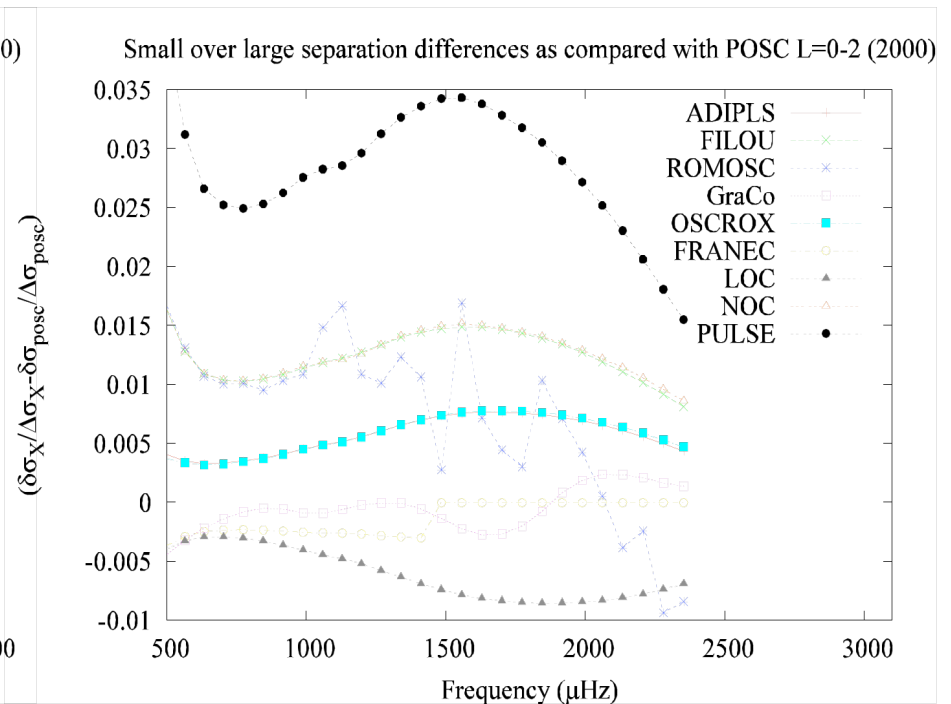
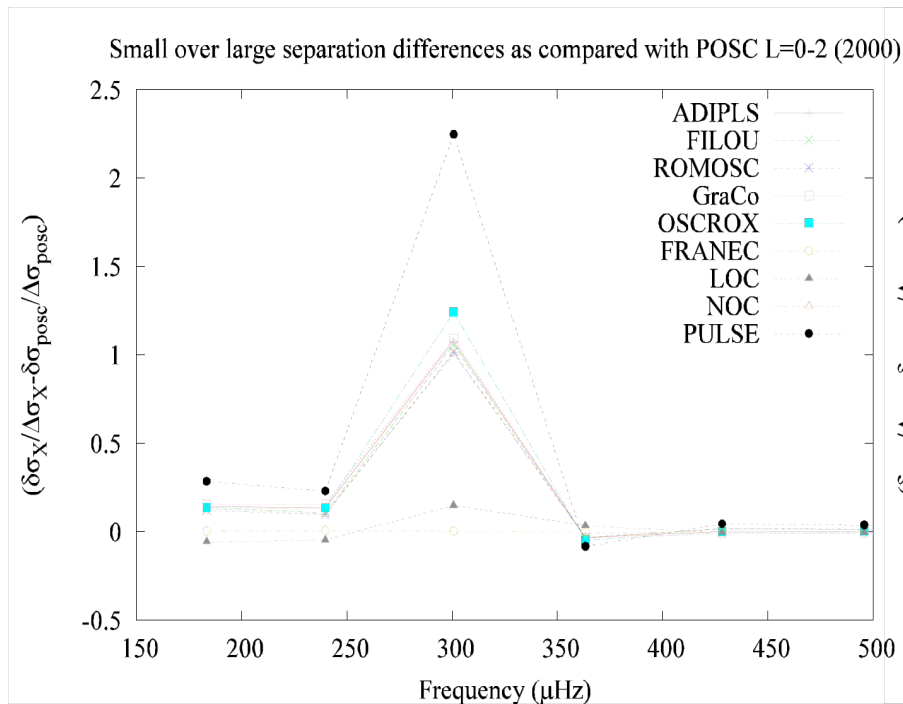
0-2

1-3



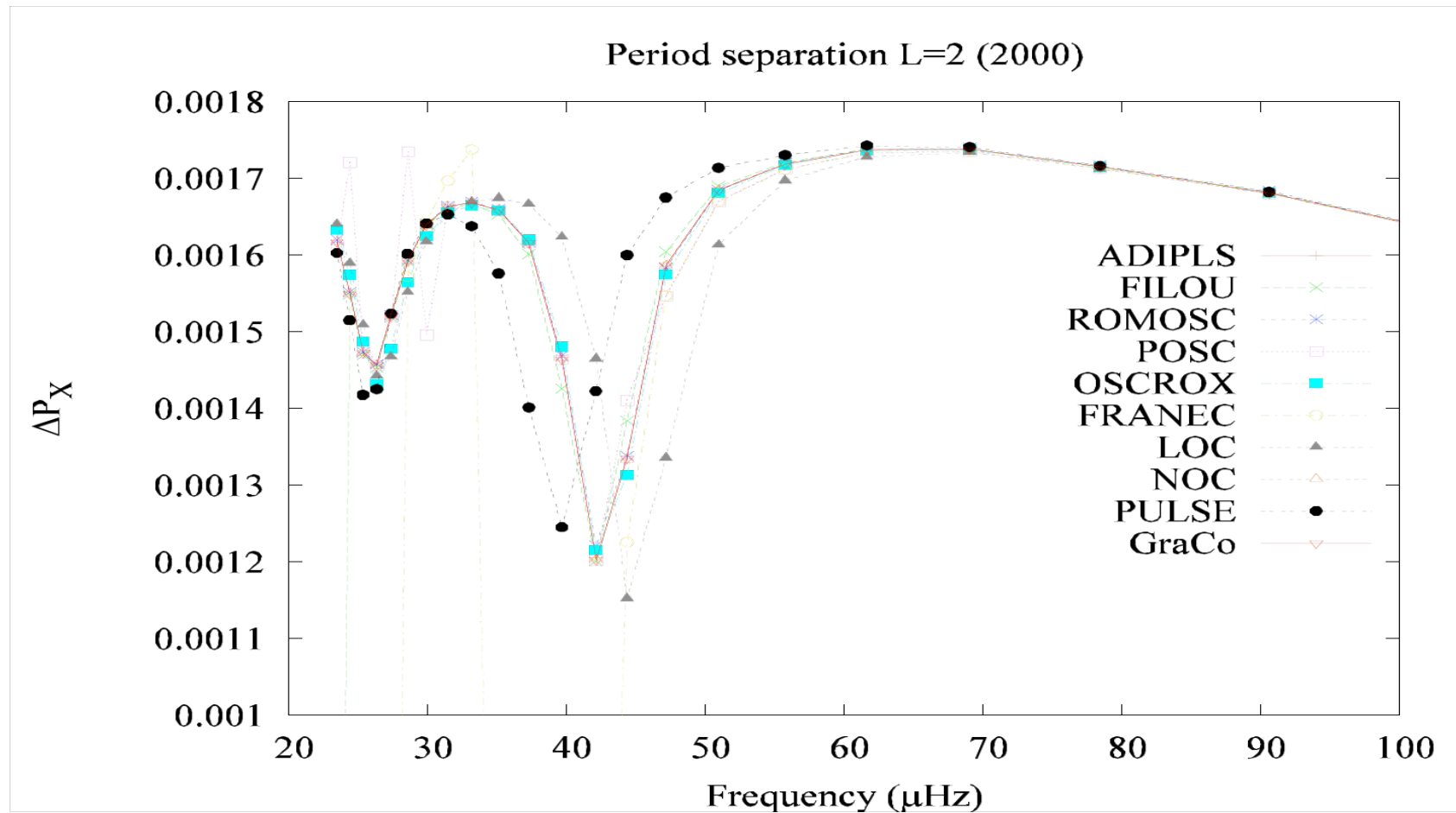
Asymptotic properties comparison

Small over large separation



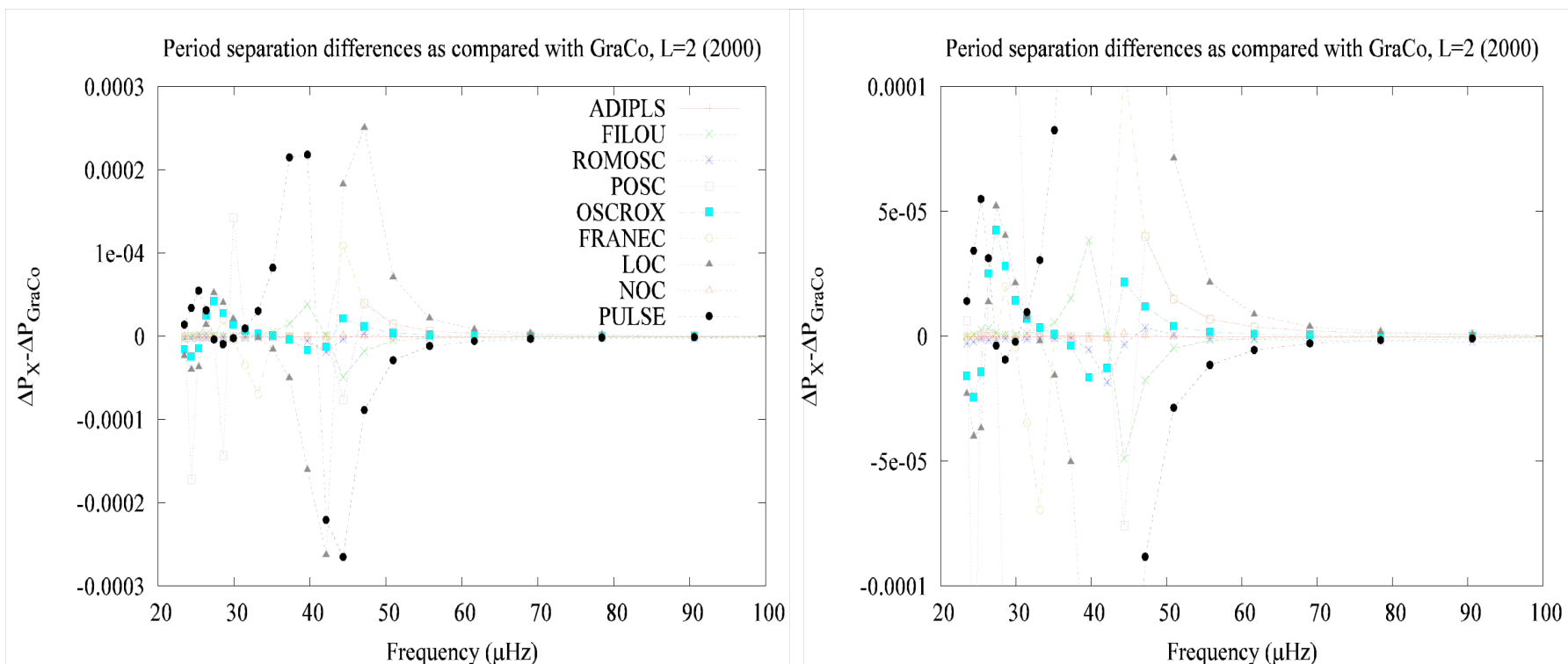
Asymptotic properties comparison

g-mode period separation



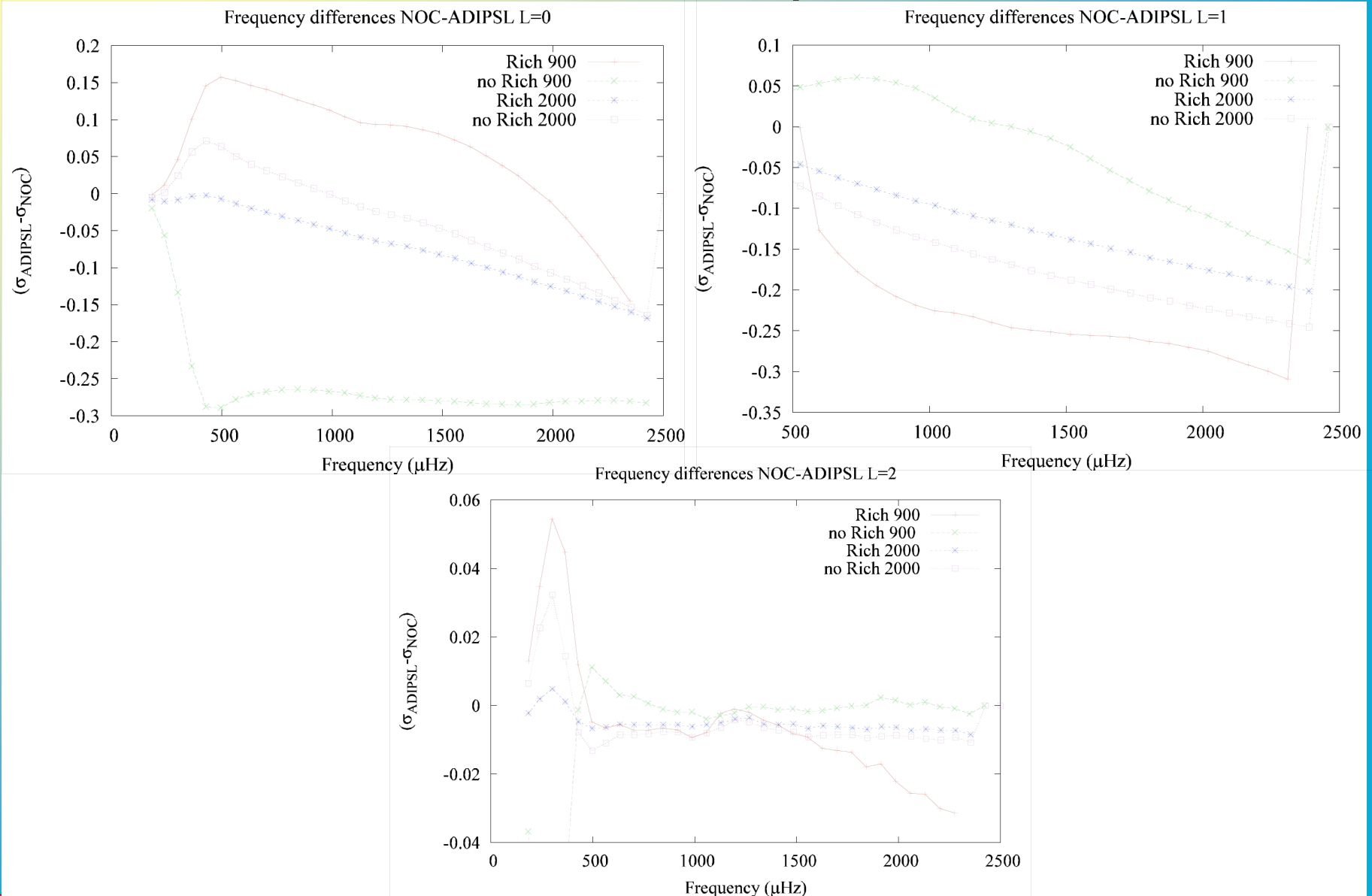
Asymptotic properties comparison

g-mode period separation



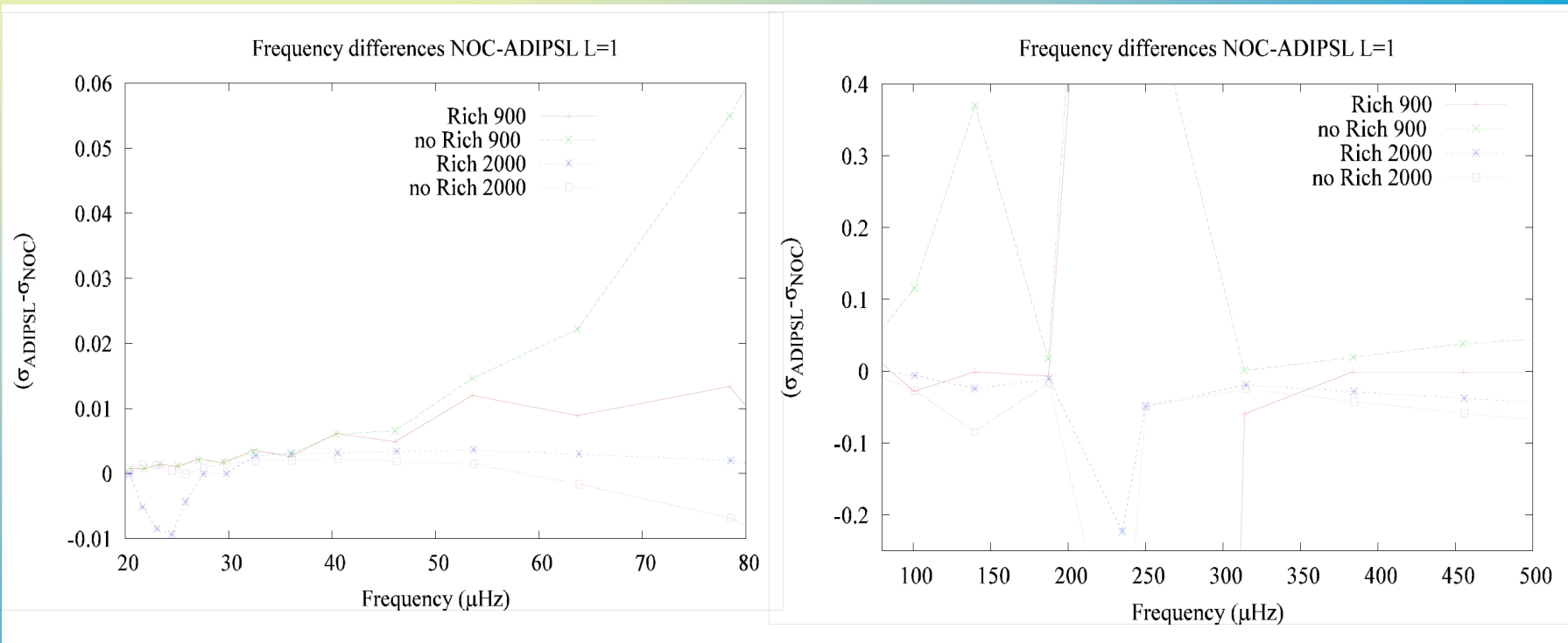
Additional studies

Richardson extrapolation



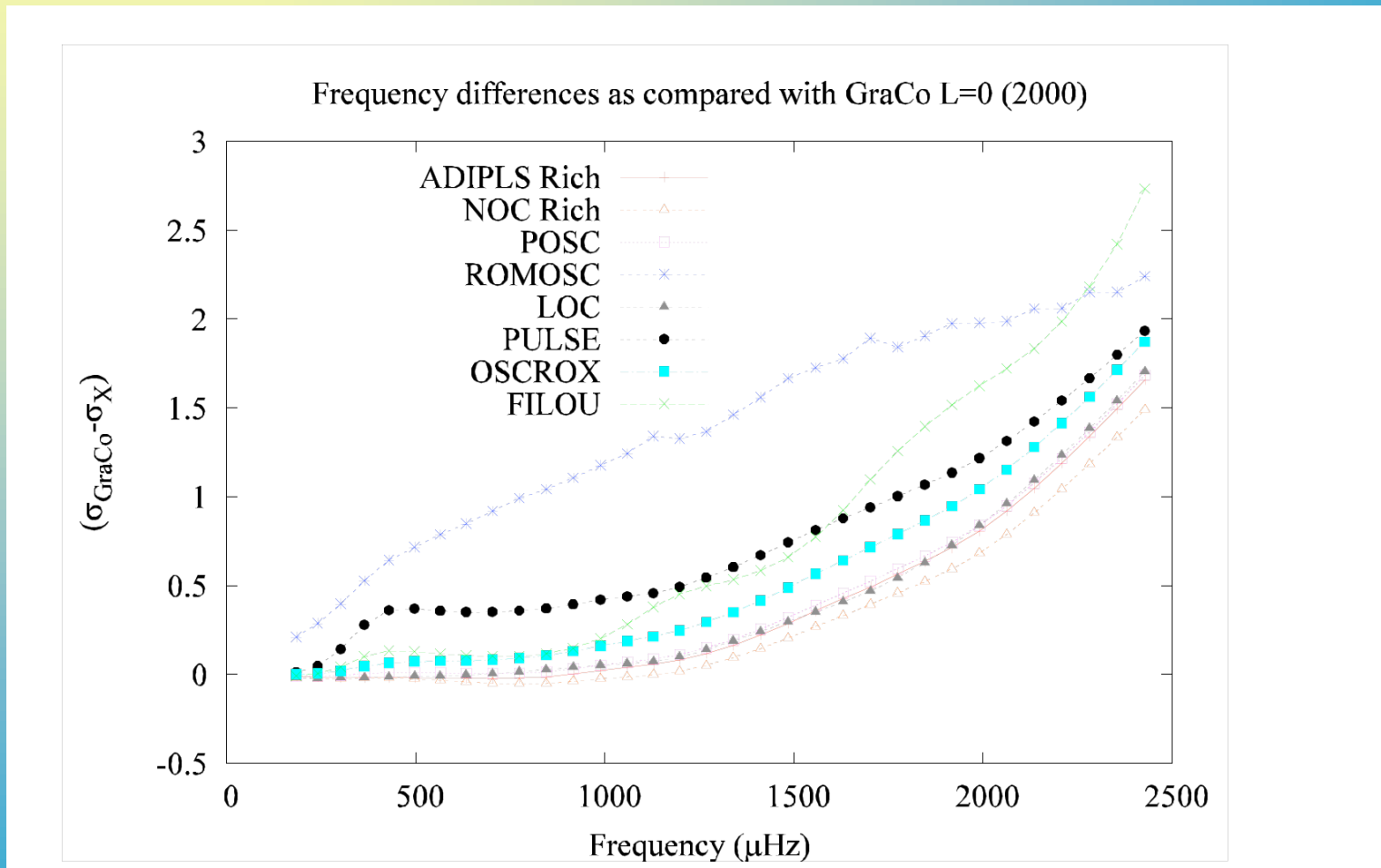
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Richardson extrapolation



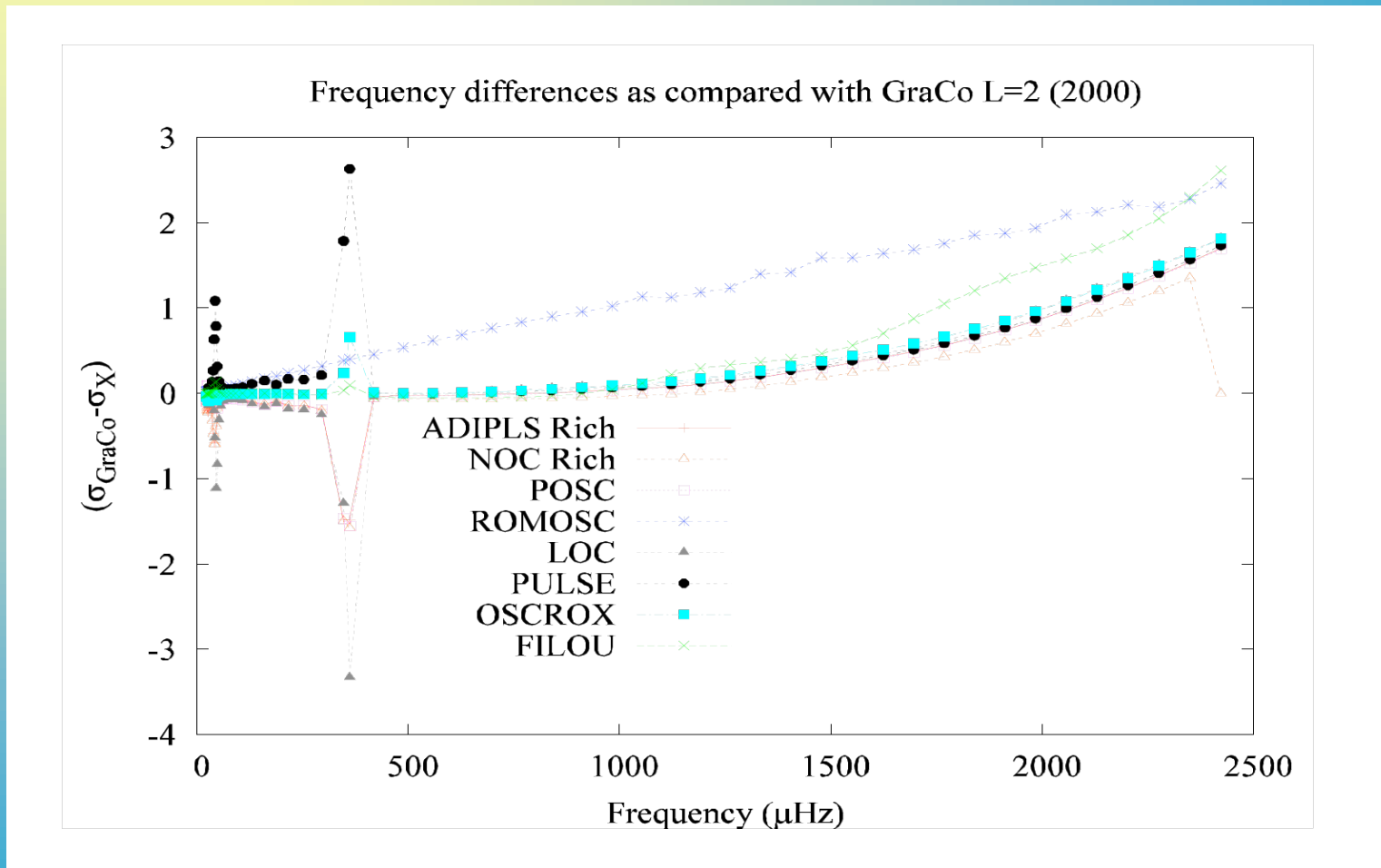
Additional studies

Richardson extrapolation



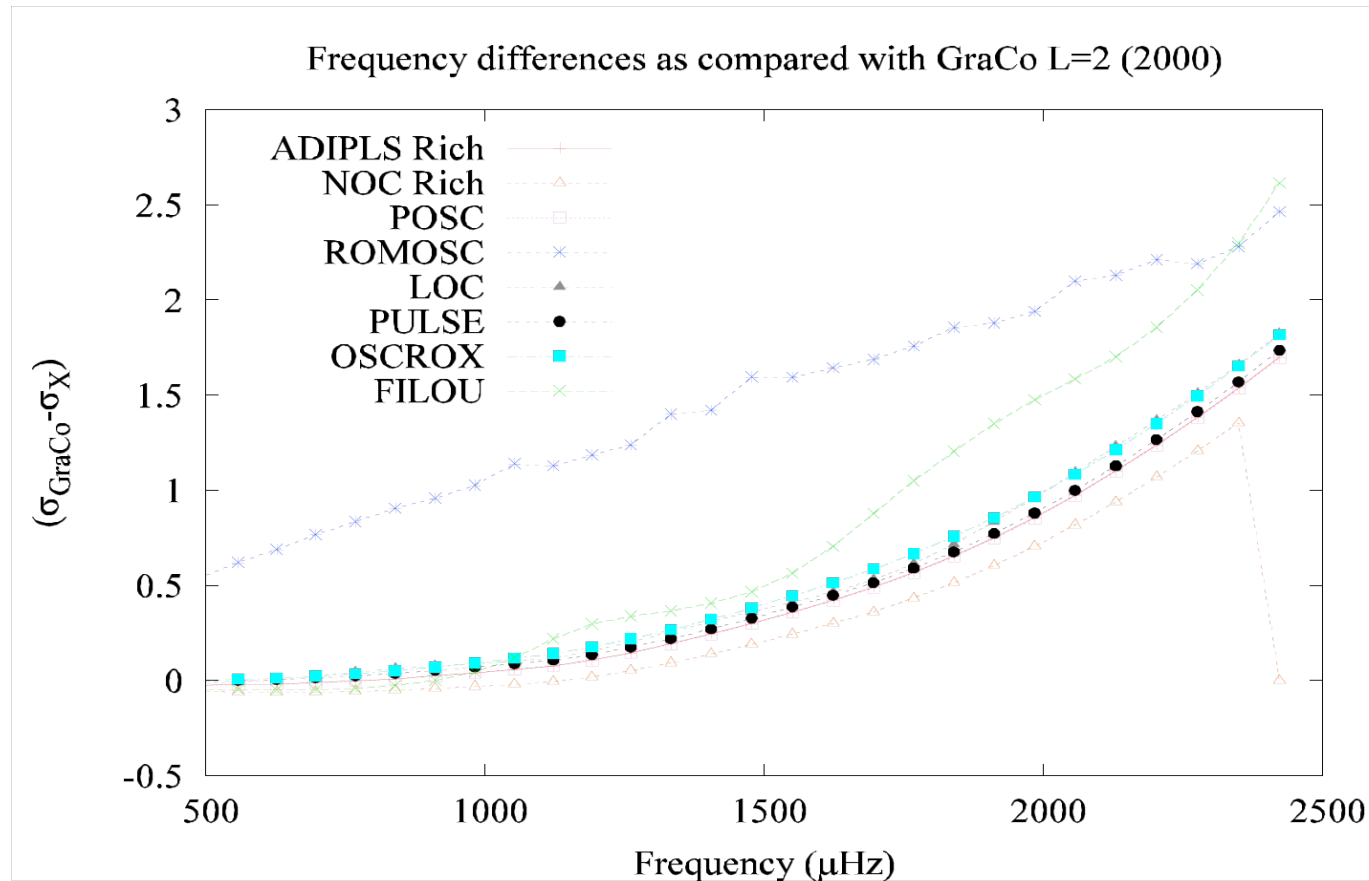
Additional studies

Richardson extrapolation



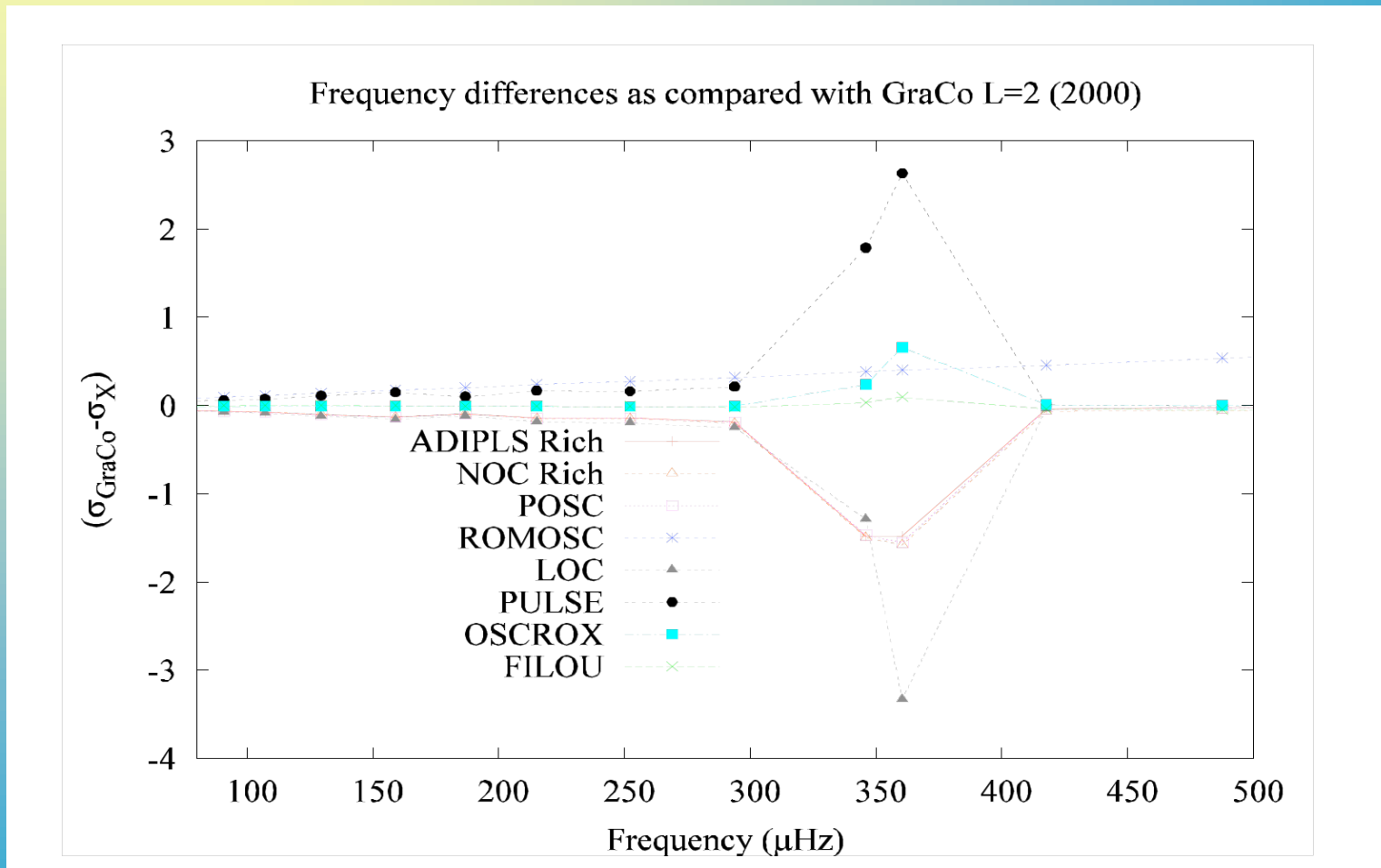
Additional studies

Richardson extrapolation



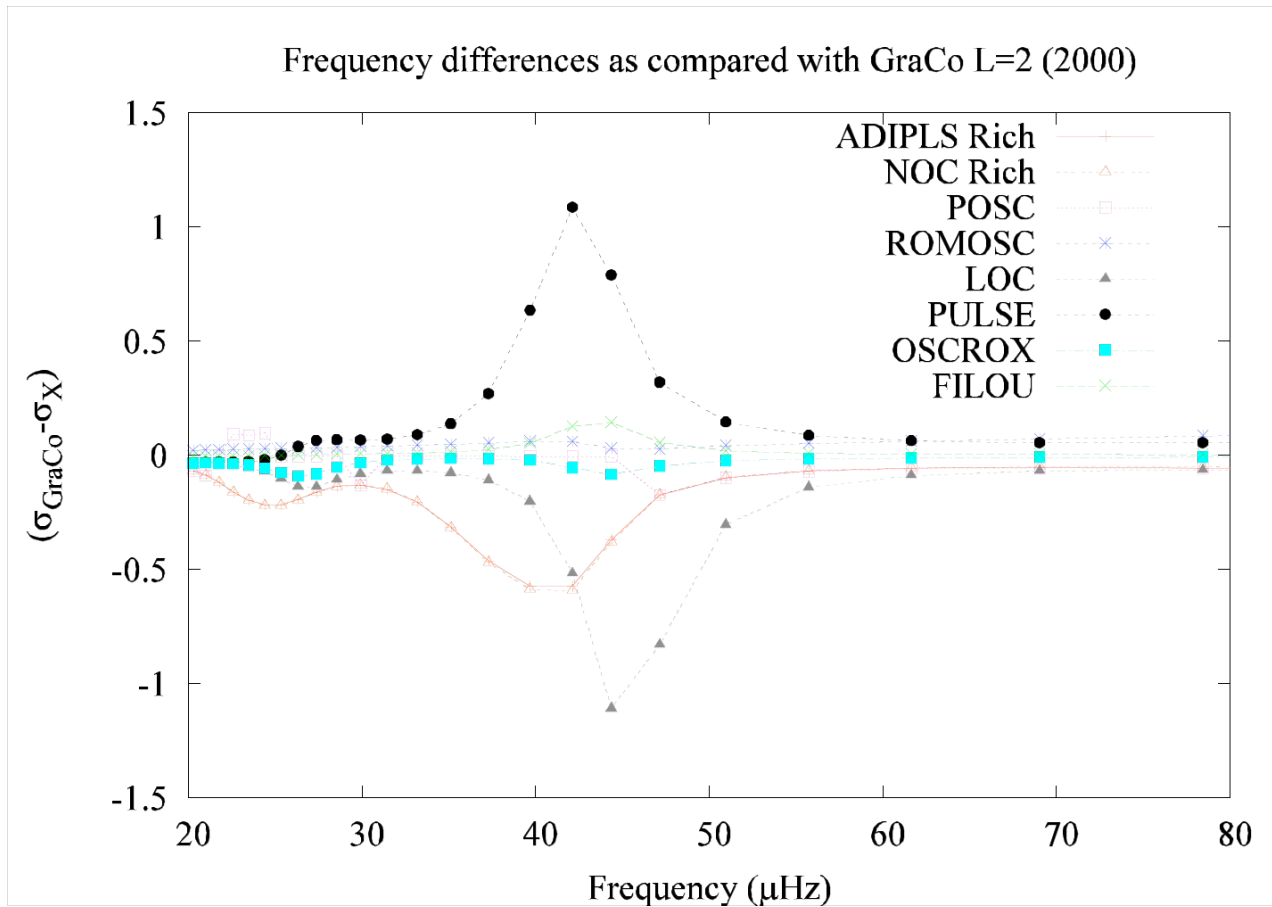
Additional studies

Richardson extrapolation



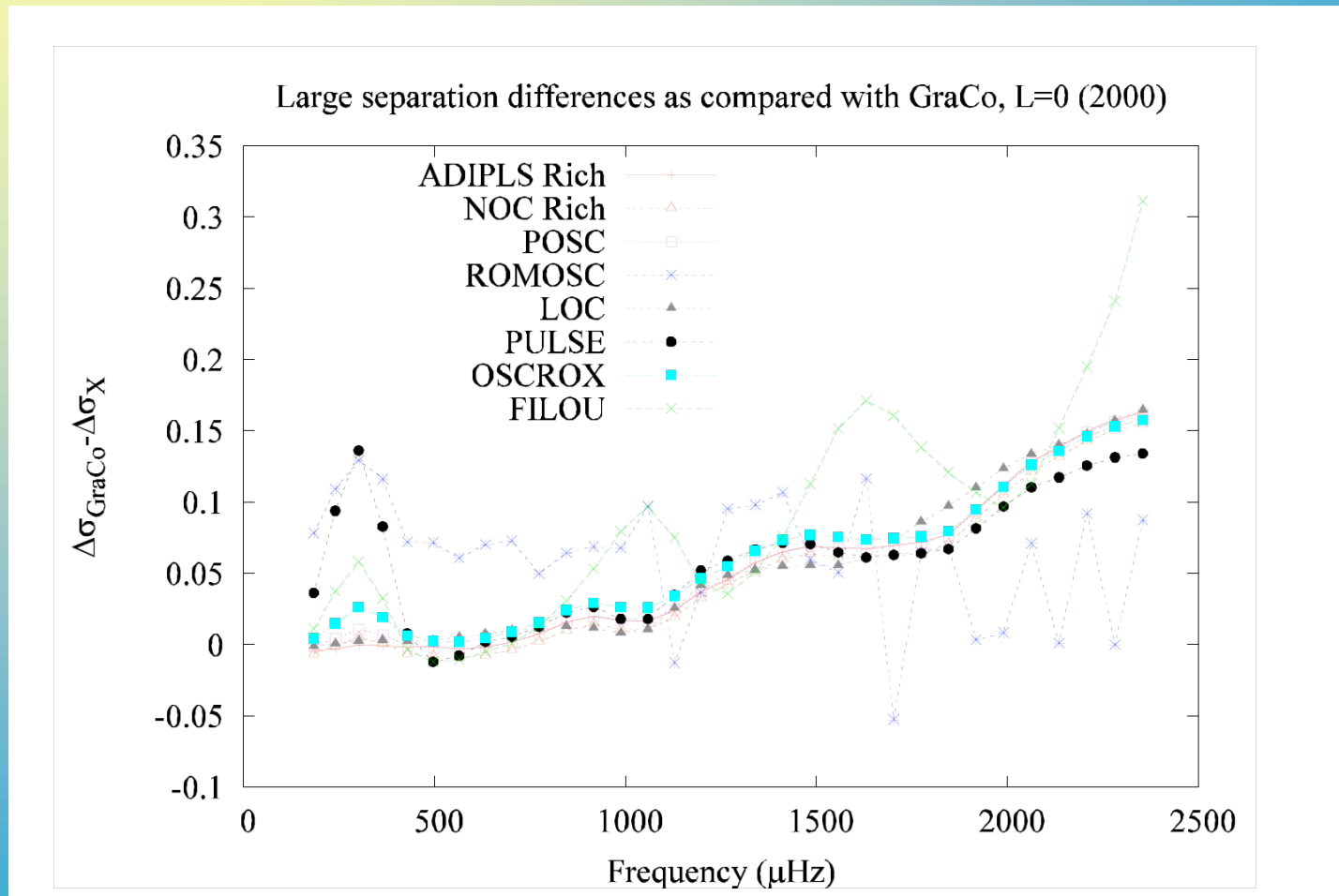
Additional studies

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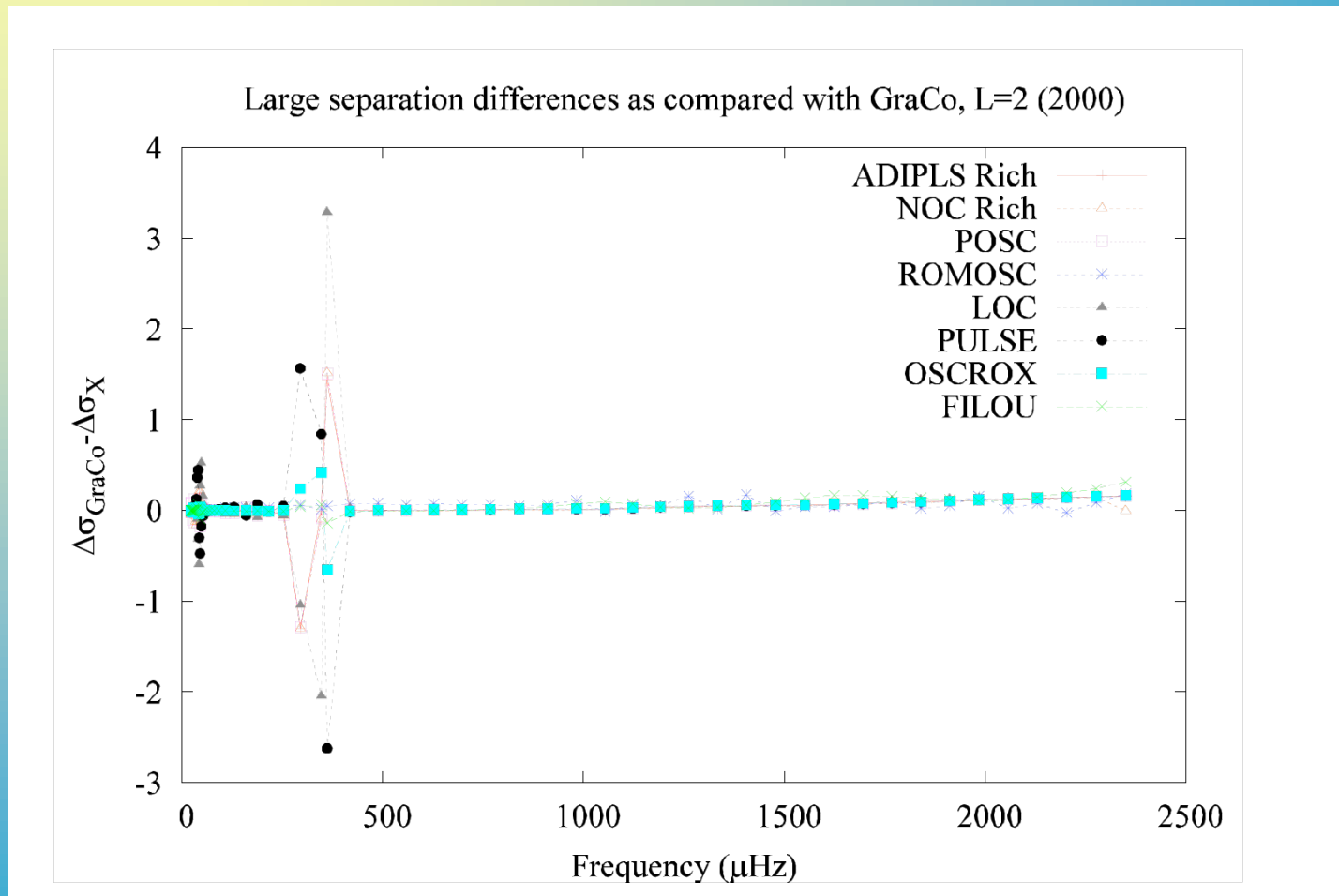
Additional studies

Richardson extrapolation



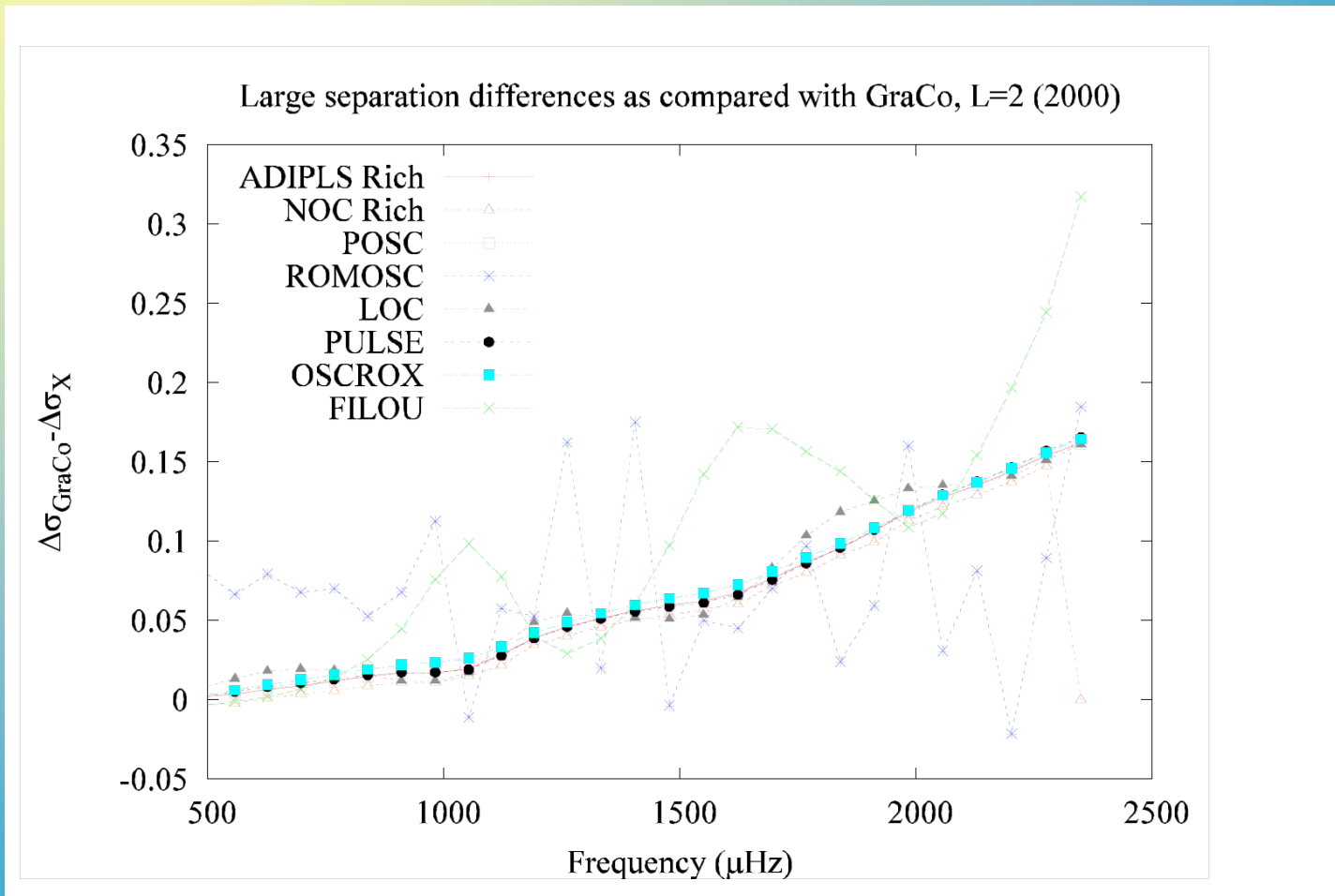
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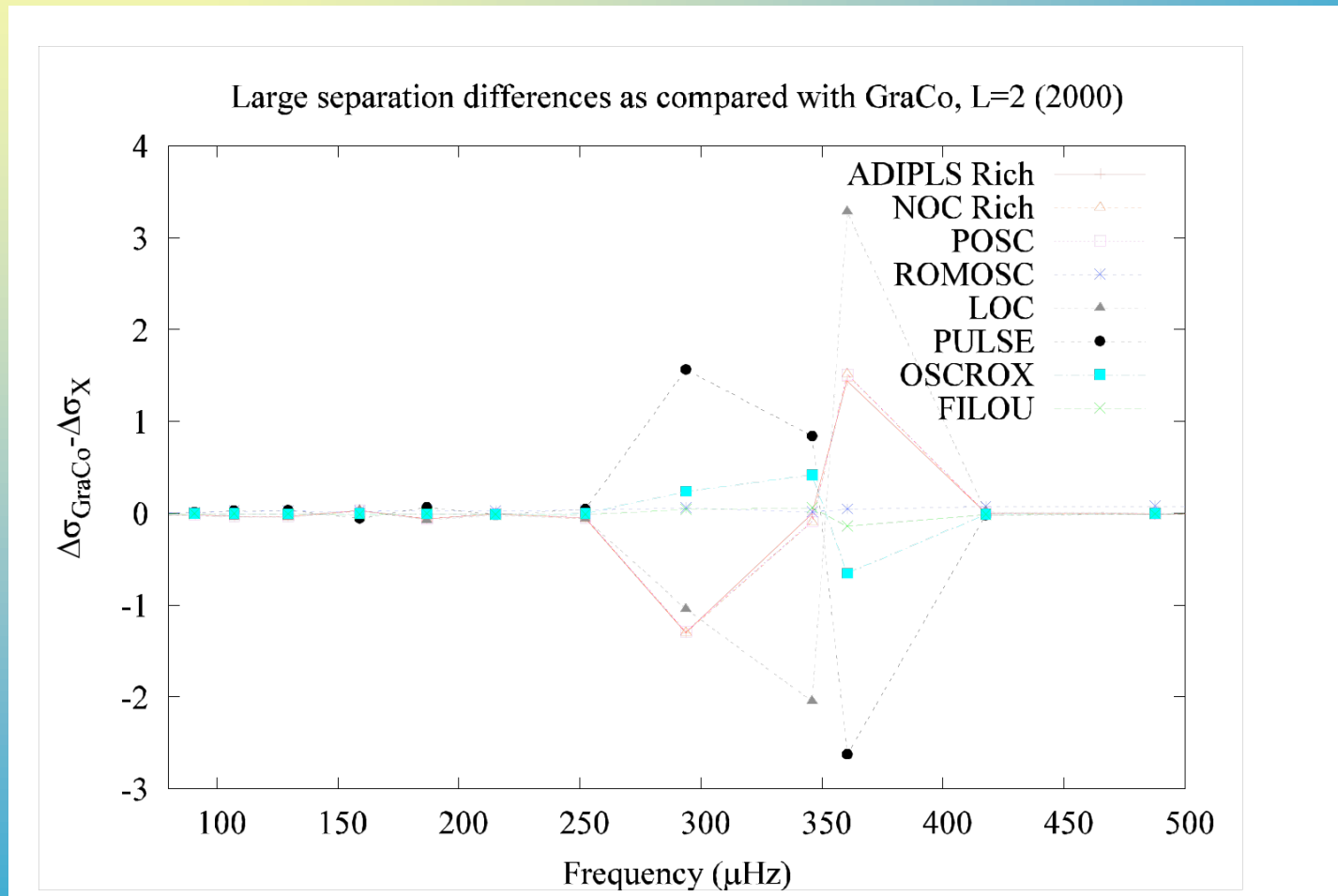
Additional studies

Richardson extrapolation



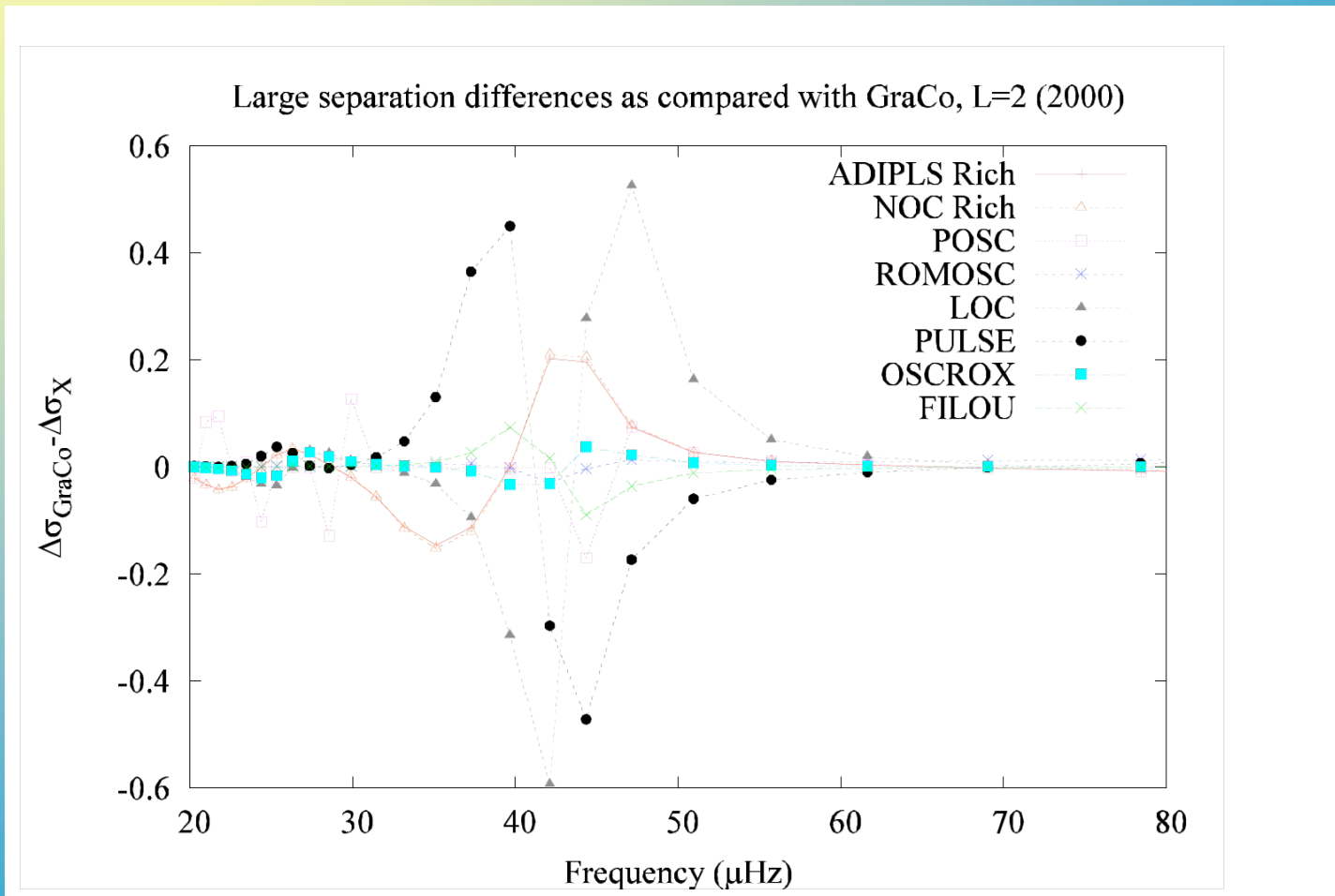
Additional studies

Richardson extrapolation



Additional studies

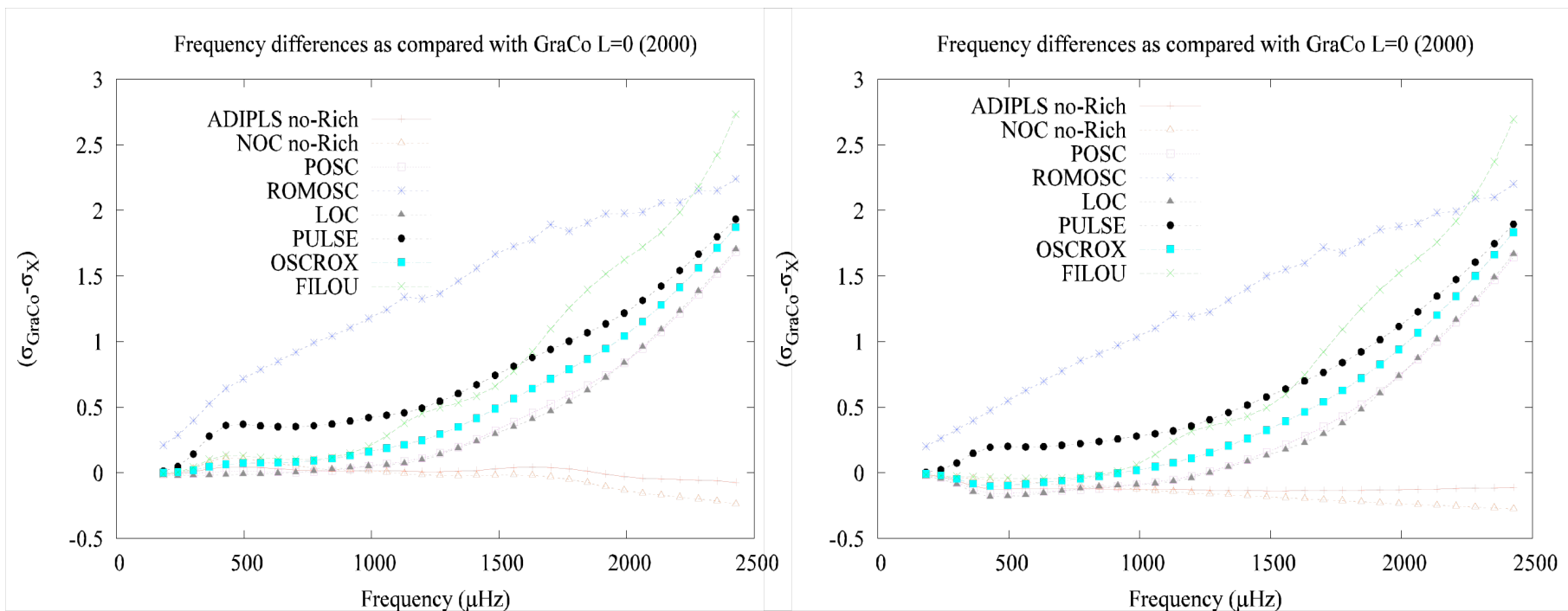
Richardson extrapolation



Additional studies

LAWE

$\ell = 0$ in NRE



Example about Richardson extrapolation:

	LOC	Graco no RI	GraCo with RI
Frequency $l=0, n=23$	2922.45	2925.30	2921.25

$$f(\text{FILOU})=2924.87 \mu\text{Hz}$$

$$f(\text{NOC})=2926.8 \mu\text{Hz}$$

$$f(\text{ADIPLS})=2922.6471 \mu\text{Hz}$$

$$f(\text{POSC})=2923.2584 \mu\text{Hz}$$



Example about constant G:

	Graco $G=6.673 \cdot 10^{-8}$	Graco $G=6.67232 \cdot 10^{-8}$	GraCo $G=6.671682 \cdot 10^{-8}$
Frequency H0	254.0617 μHz	254.0482 μHz	254.0356 μHz

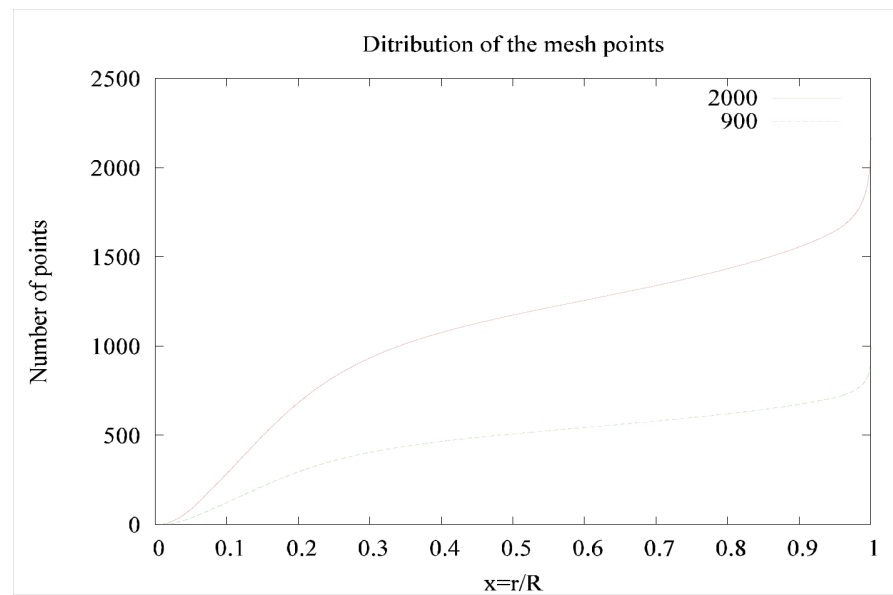
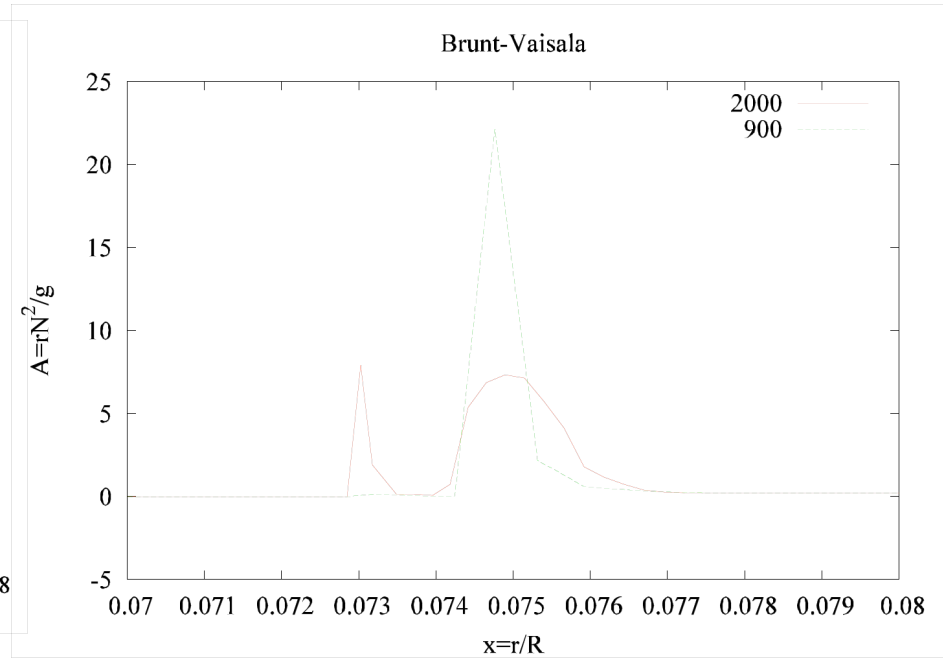
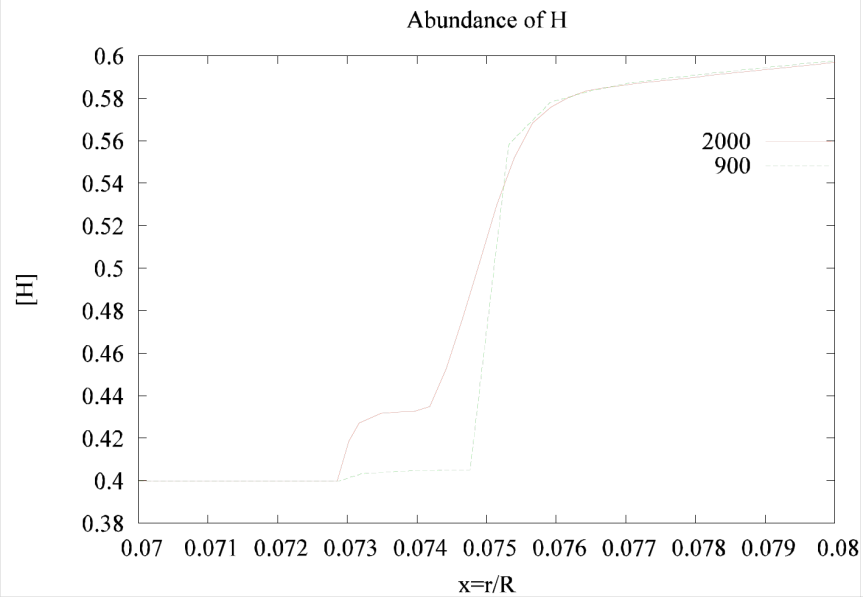
$$f(\text{LOC})=254.0304 \mu\text{Hz}$$

$$f(\text{NOC})=254.05 \mu\text{Hz}$$

$$f(\text{ADIPLS})=254.0438 \mu\text{Hz}$$

$$f(\text{POSC})=254.051 \mu\text{Hz}$$





Groups with similar behaviors

Frequencies	NOC-ADIPLS- OSCROX (linear)- GraCo	POSC-LOC- OSCROX (cubic)- PULSE	Rest of codes different
Large separation L=0	NOC-ADIPLS- OSCROX (linear)- GraCo	POSC-LOC- OSCROX (cubic)- PULSE	Rest of codes different
g-mode period separation	PULSE	LOC	Rest of codes together
Small separation L=0-2	ADIPLS-OSCROX (linear)	GraCo-POSC- OSCROX (cubic)	FILOU-NOC
Small separation L=1-3	OSCROX (lin)- POSC	GraCo-FILOU- NOC	LOC- Franec



Conclusions and further work

1. Differences located in the high frequencies, avoided crossings, and g-mode trapping.
2. In every comparison there are more than one code presenting differences larger than COROT accuracy.
3. For 2000 mesh points Richardson extrapolation does not significantly change differences between codes using the same integration order. But improves accuracy when compare with higher order resolutions.
4. Study other HR diagram positions as β Ceph. or SPB stars to test with other stellar structures.
5. Fix constants, number of mesh points and system of equations.
6. More information and contributions in:
<http://www.astro.up.pt/corot/compfreqs/task2.html>



Work to do:

1. Define the optimum number of mesh points and its distribution
2. How to obtain this mesh (interpolation a posteriori or given by the equilibrium codes)
3. Study different sets of eigenfunctions
4. Comparison of the eigenfunctions
5. Asteroseismological test of the equilibrium codes

