

Simulation study for SRC mode hopping issue

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Simulation meeting
LIGO-G1401340-v1

Context

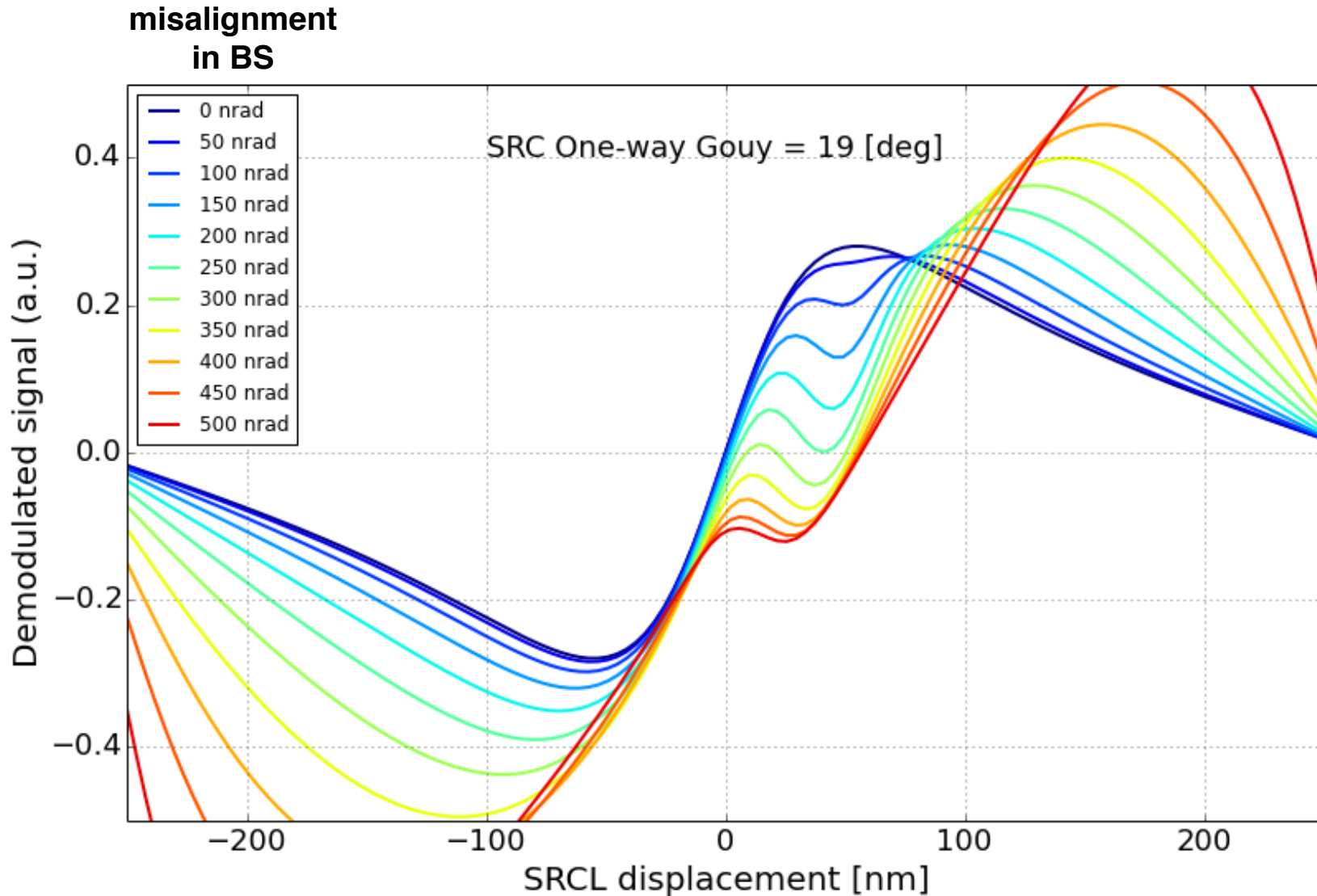
- It is still unclear why our SRC hops.
- A finesse simulation (G1401276)
=> 01 mode could not produce
another zero crossing point !?
- I wanted to cross check with
a simpler model.

My model

- No curvature mismatch between ITMs
- Perfect mode matching everywhere
- No losses.
- Only the fundamental and 1st HOM modes are included.
- Schnupp = 9.5 cm (measured value)
- PRC, SRC lengths = designed values
- PRC Gouy phase = 25 deg

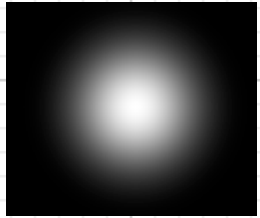
see, we get hops

REFL 45 I [W-ish]



What is happening?

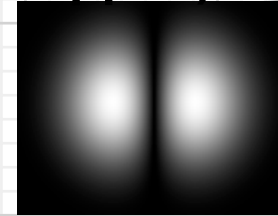
incident



mostly TEM00,
almost no carrier

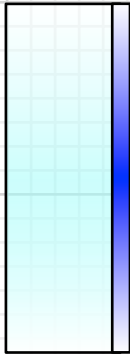
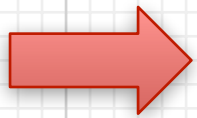


mostly TEM01
(when hopped)

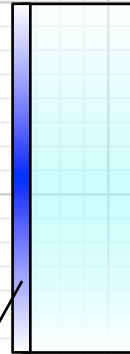
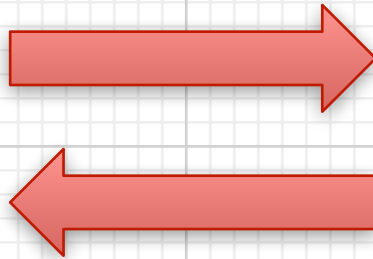


single trip gouy
= 19 deg

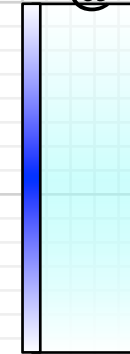
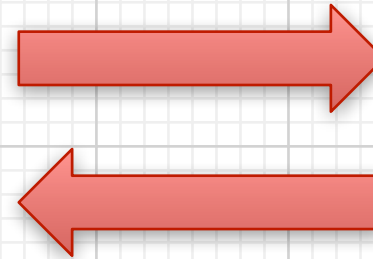
01 resonance
@ SRCL=59nm



PRM



Michelson



SRM

- ✓ When transmitting, MICH converts TEM00(TEM01) to TEM01(TEM00) effectively
- ✓ When reflecting, it does not significantly convert their modes

A good agreement

Here are the amount of misalignment to cause hoppings/instability.

measured

(alog 14577)

To produce another zero crossing in simulation

- BS = ± 0.2 urad (± 0.3 urad)
- ITMX = ± 0.4 urad (± 0.5 urad)
- SR3 = ± 0.5 urad (N/A)
- SR2 = ± 4 urad (N/A)
- SRM = 16 urad (N/A)

Why no hop in LLO

■ Due to Gouy phase ?

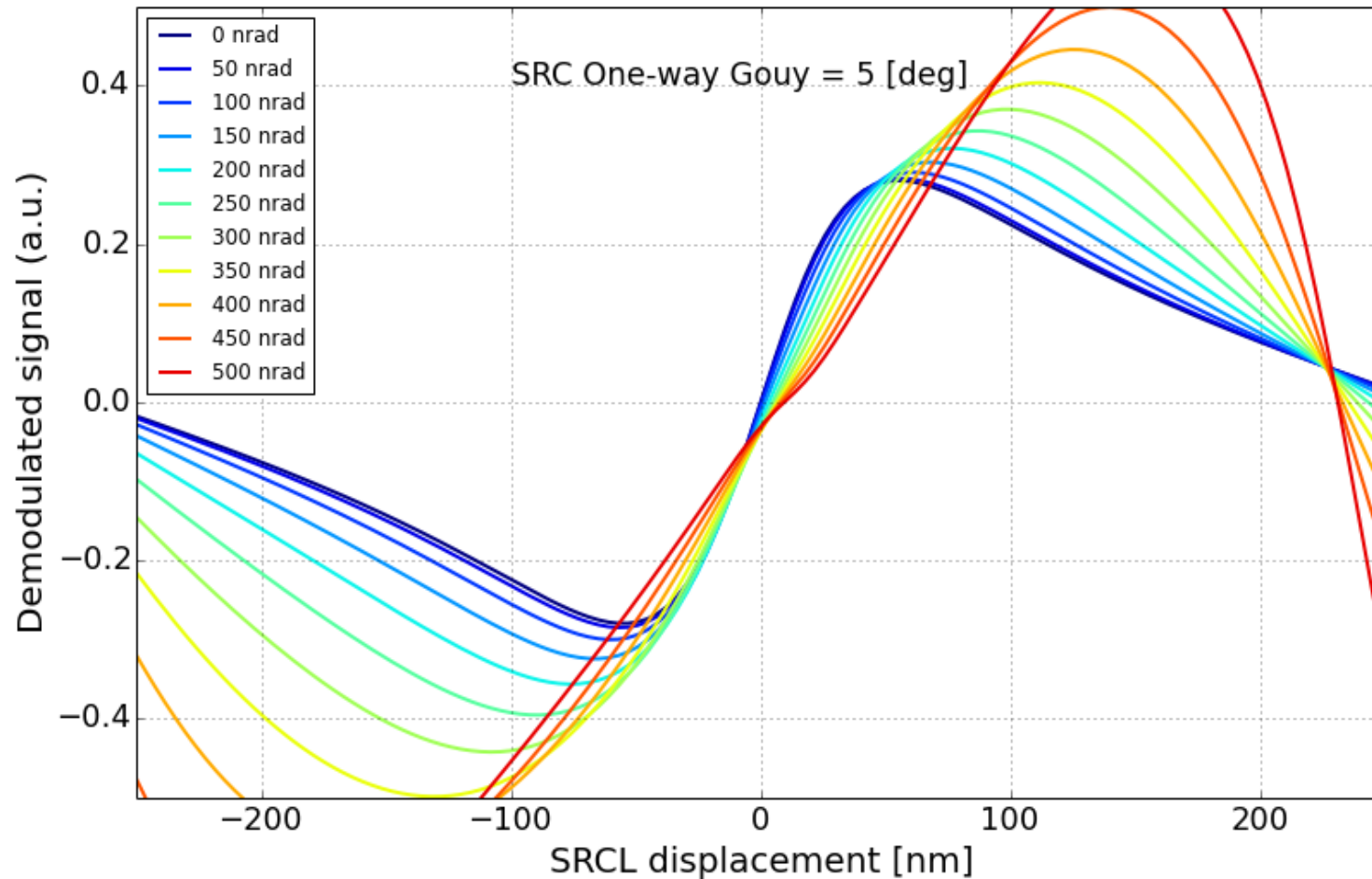
see the plots in the following pages.

■ Due to ITM curvature mismatch ?

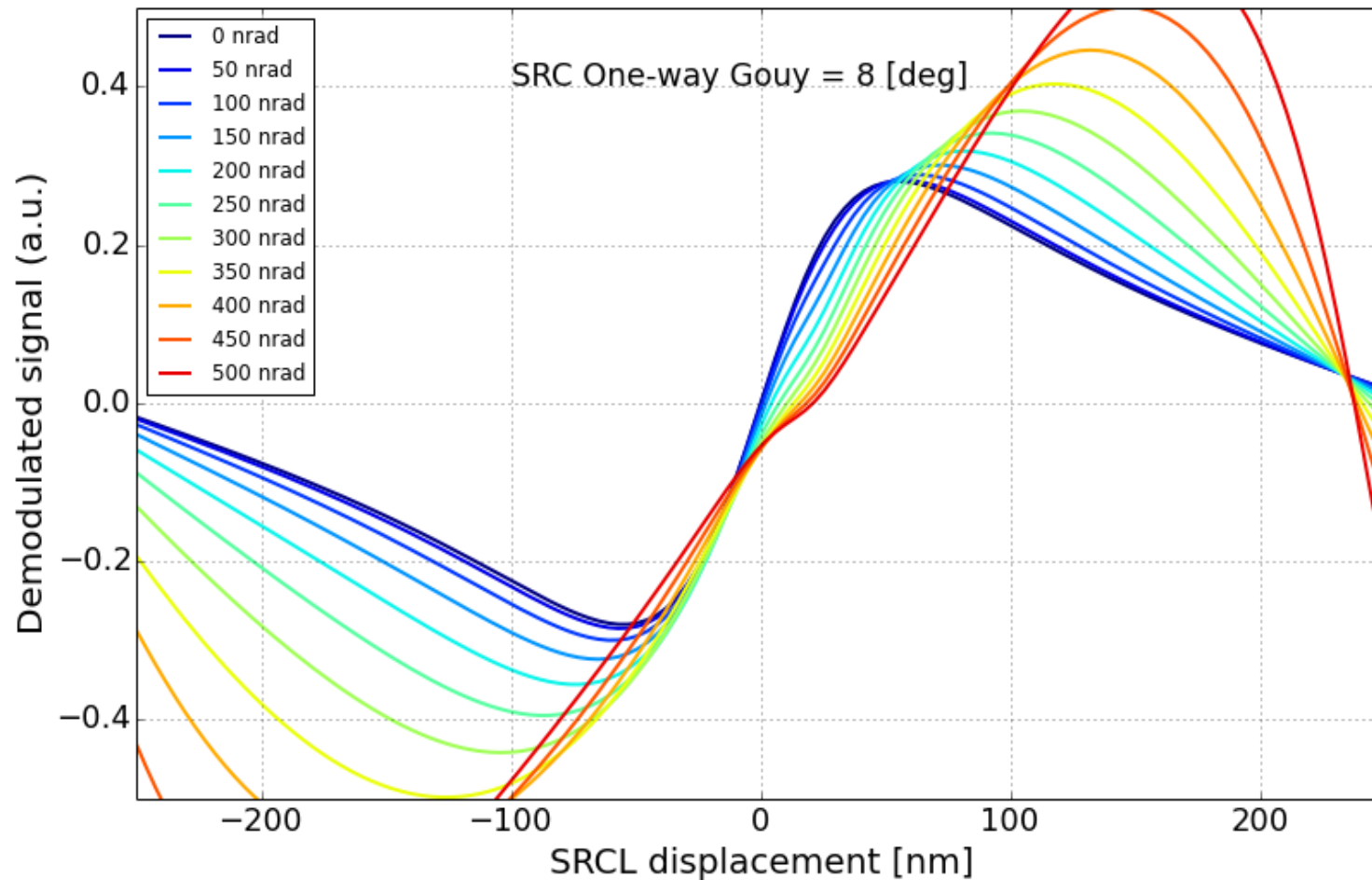
Paul's finesse simulation

■ Much less angular motions in optics ?

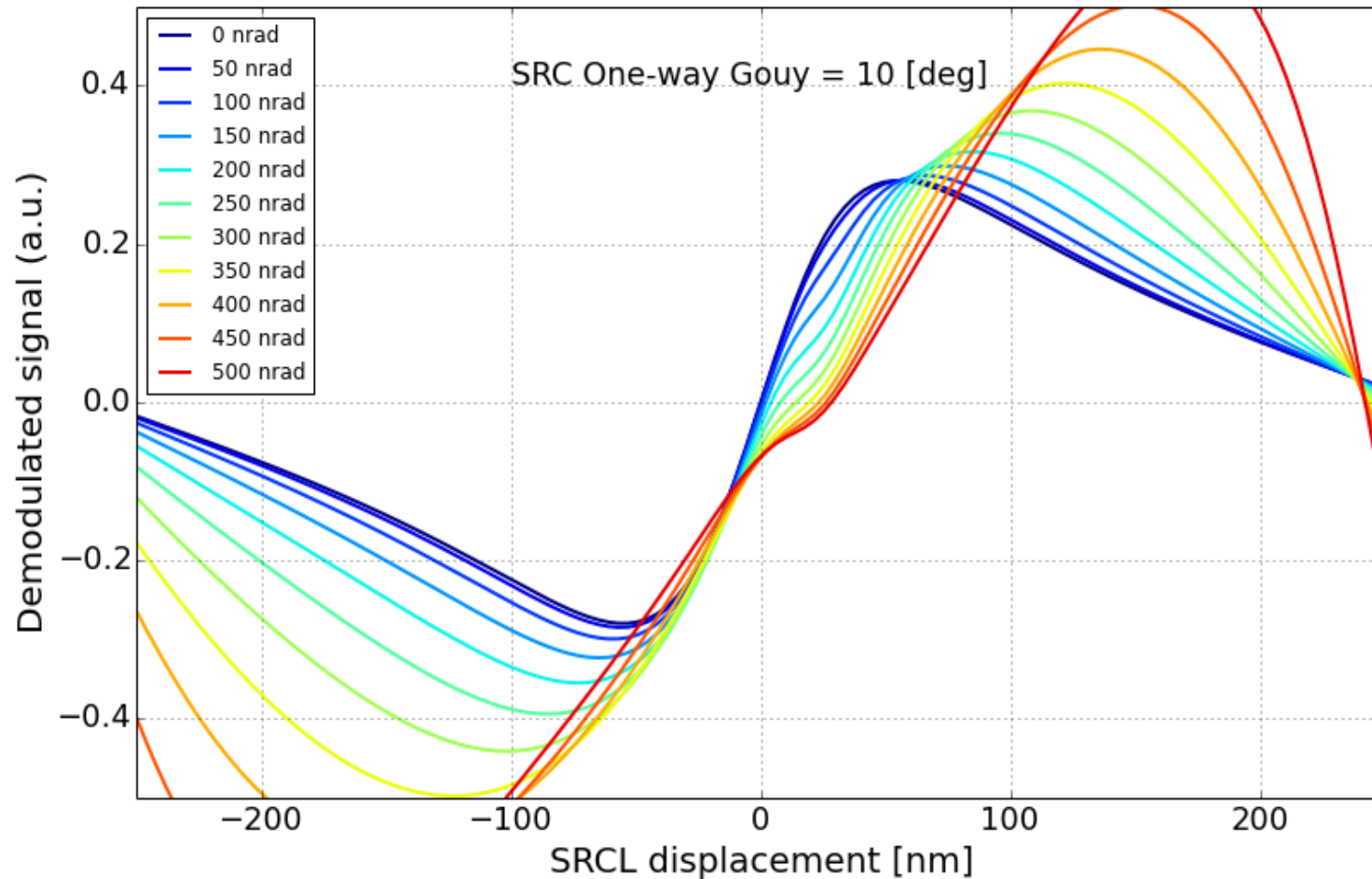
Effect from Gouy phase



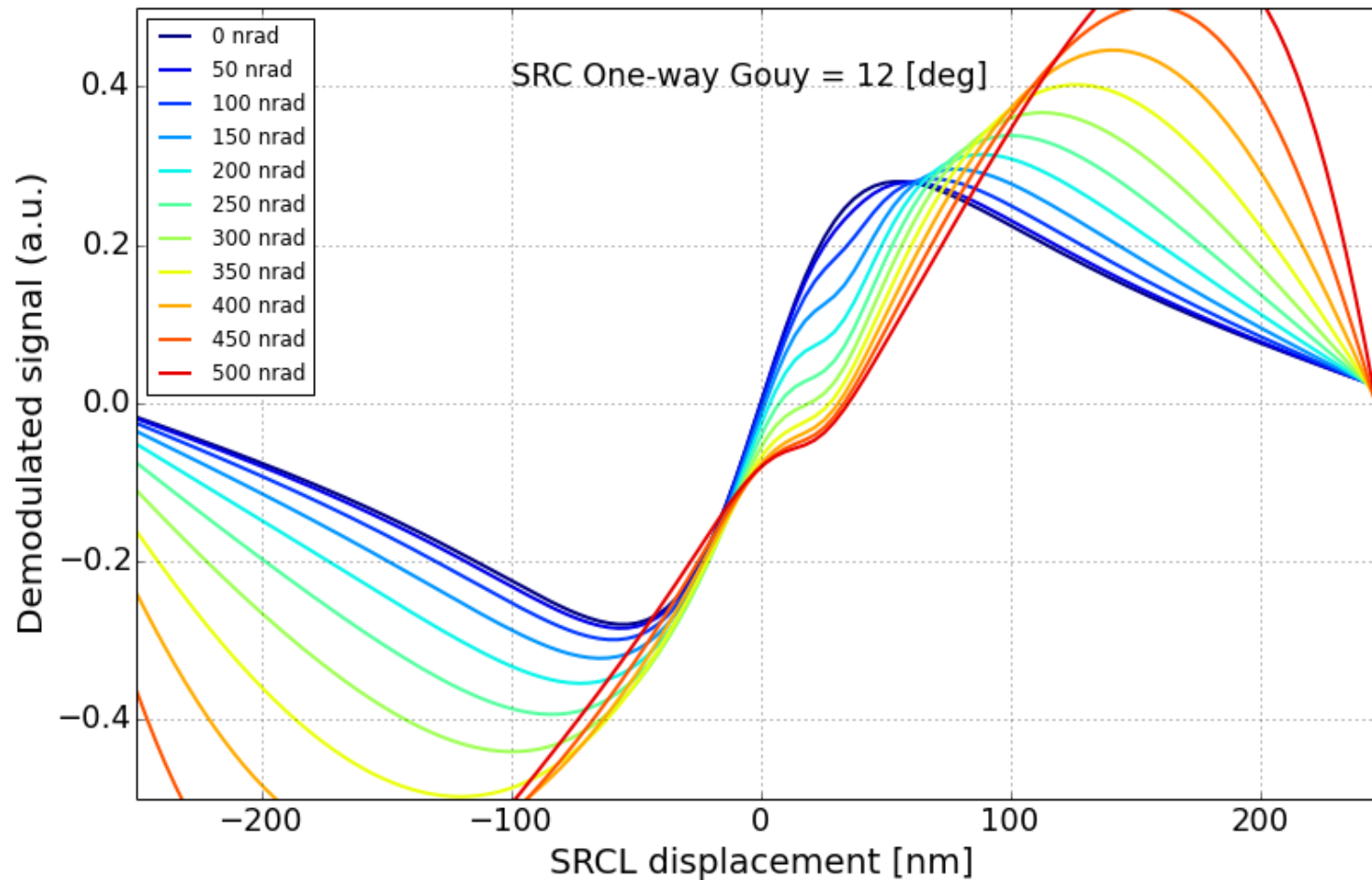
Effect from Gouy phase



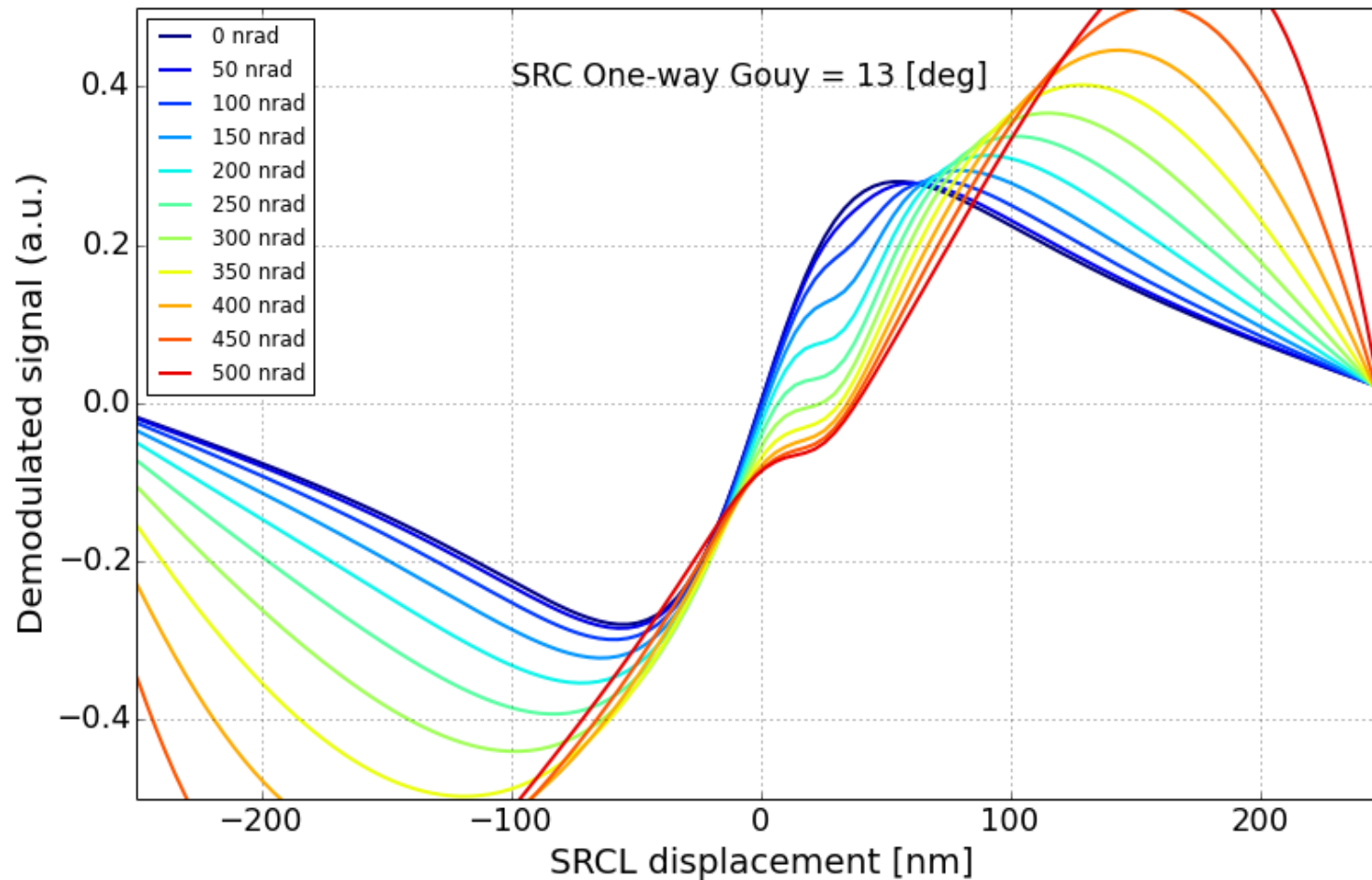
Effect from Gouy phase



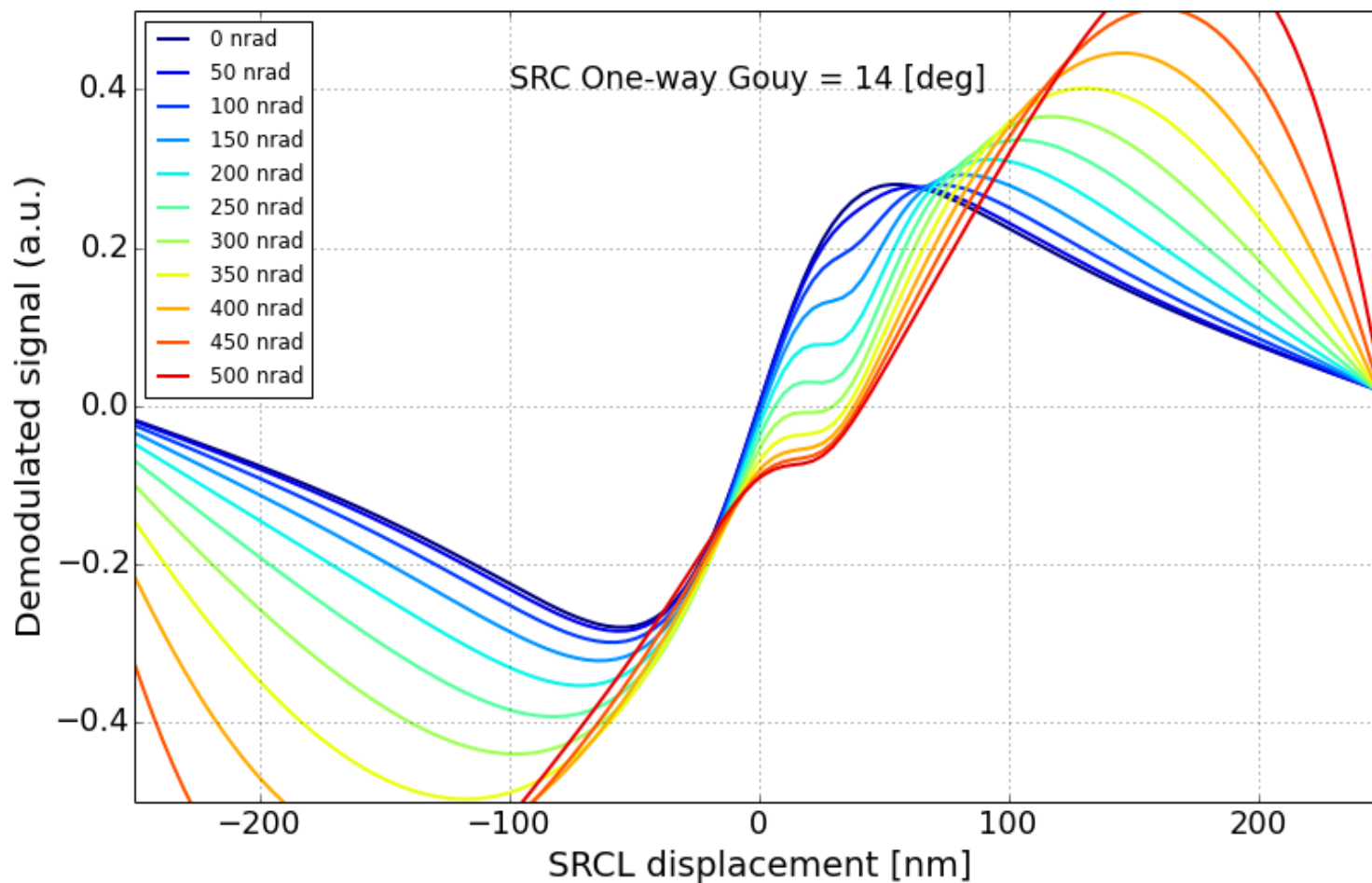
Effect from Gouy phase



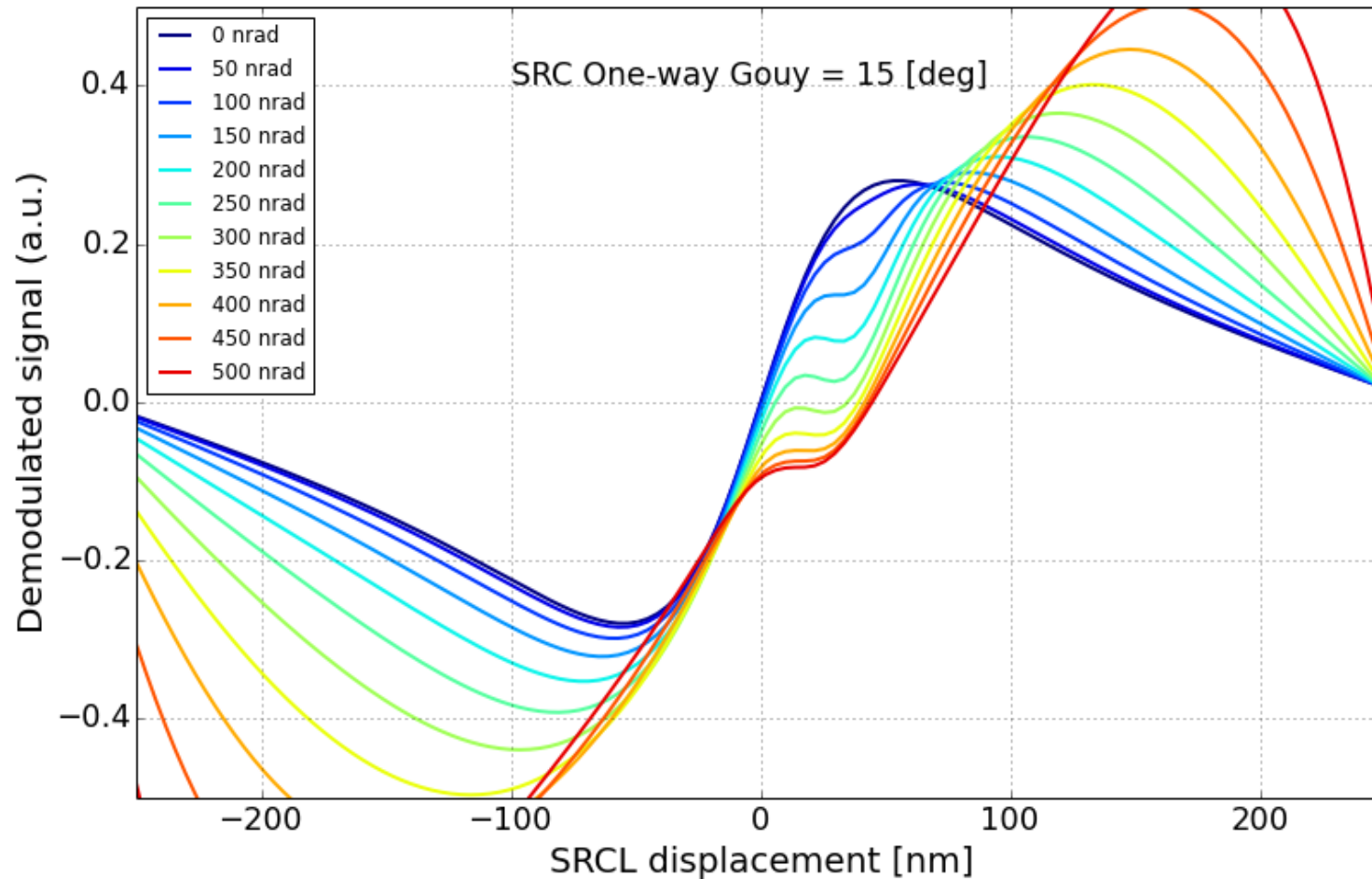
Effect from Gouy phase



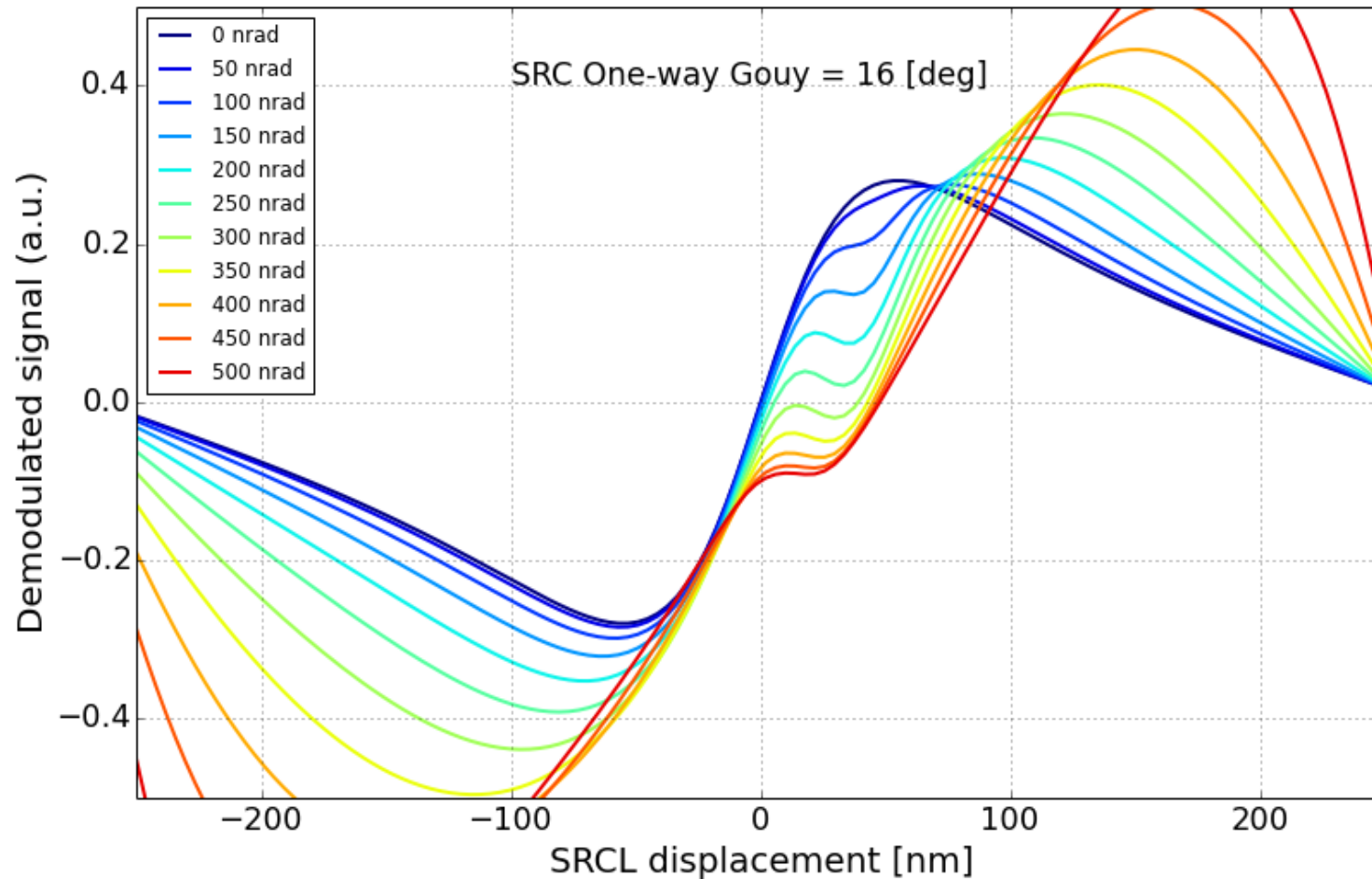
Effect from Gouy phase



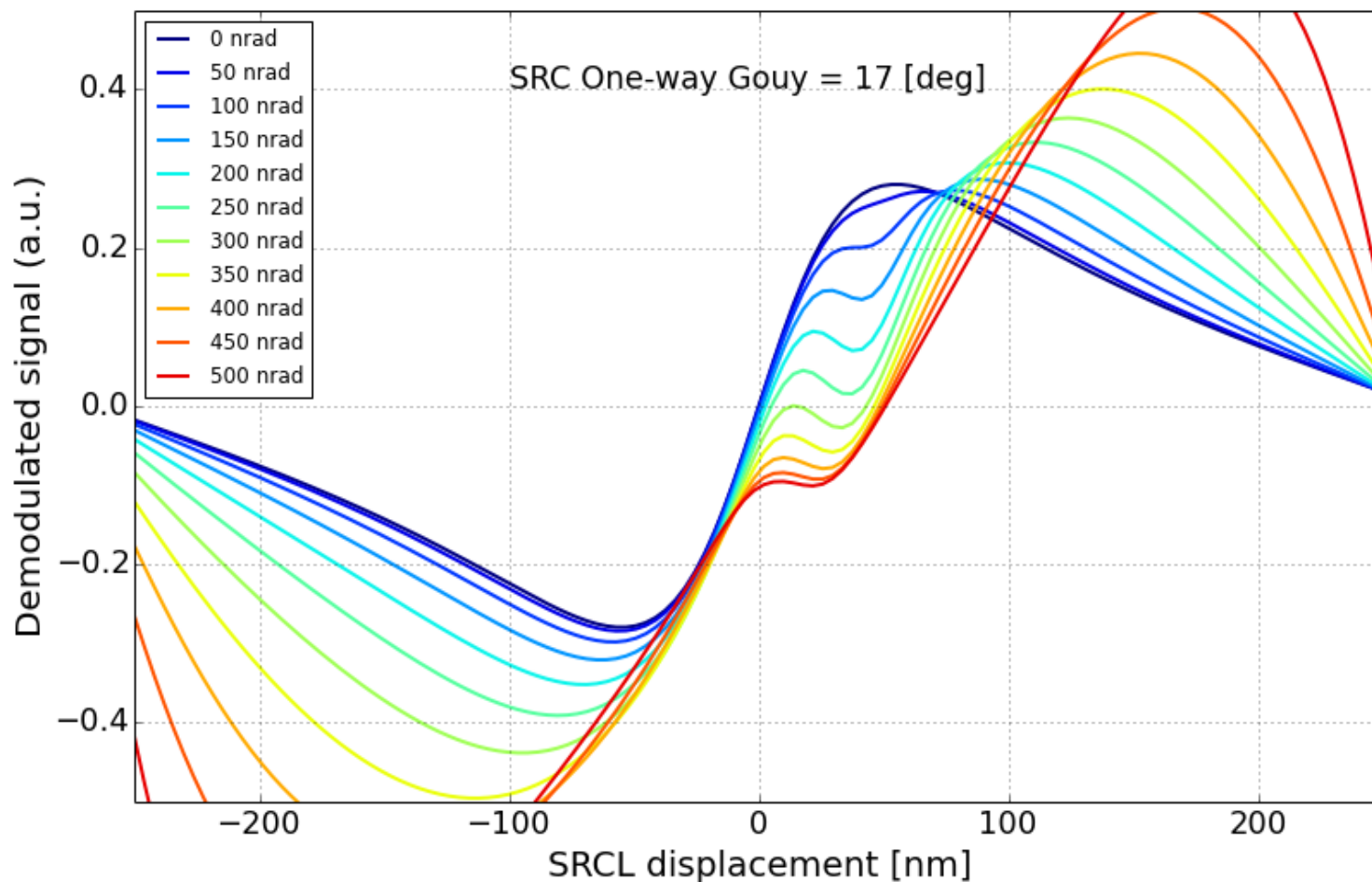
Effect from Gouy phase



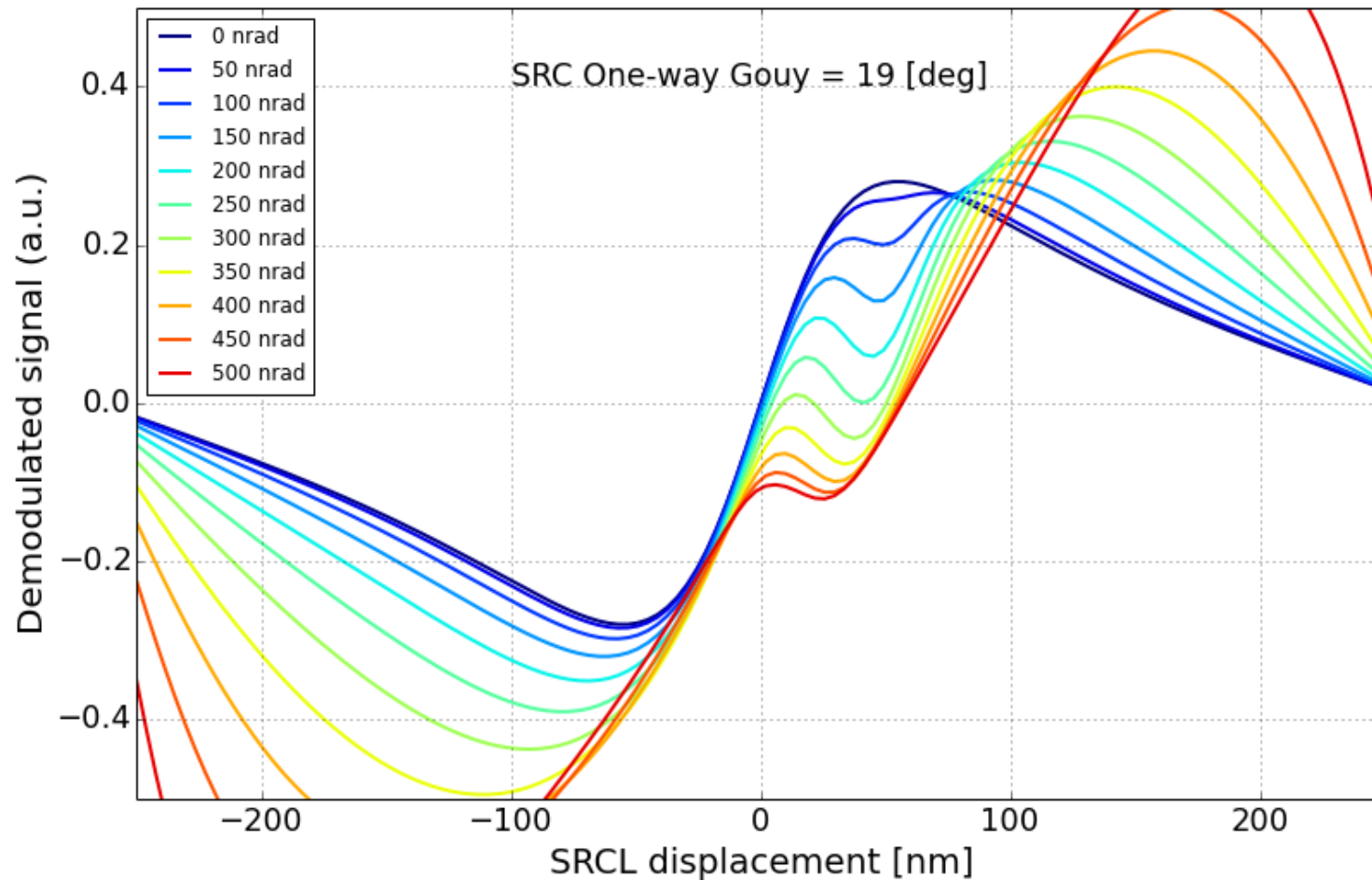
Effect from Gouy phase



Effect from Gouy phase



Effect from Gouy phase



Effect from Gouy phase

