

***Status Update of
aLIGO Lock Acquisition
Simulation***

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on behalf of the simulation team**

LIGO-G1301185-v1

ISC call or simulation meeting Oct/25/2013

Overview

- ALS is good.

But how exactly do we lock the full IFO ?

- Especially CARM seems tough as its line width is the **narrowest (~ 1 Hz)** while **ALS provides 8-10 Hz stability.**

- According to a time domain simulation we can directly hand over CARM from ALScomm to REFL9 signal

IFO configuration

- Power-recycled Fabry-Perot Michelson enhanced with RSE(Resonant Sideband Extraction) = Broadband DRFPMI
- $T_{SRM} = 35 \%$ (Early SRM)
- Schnupp asymmetry = 8 cm (nominal)
- No radiation pressure effect for now
- DARM is magically locked with no noise

Length Control

 **CARM**



ALS_comm

UGF = 200 Hz (2 kHz after hand-off)

 **DARM**



ALS_diff

magically locked for now

 **PRCL**



REFL27_I

UGF = 40 Hz

 **MICH**



REFL135Q

UGF = 10 Hz

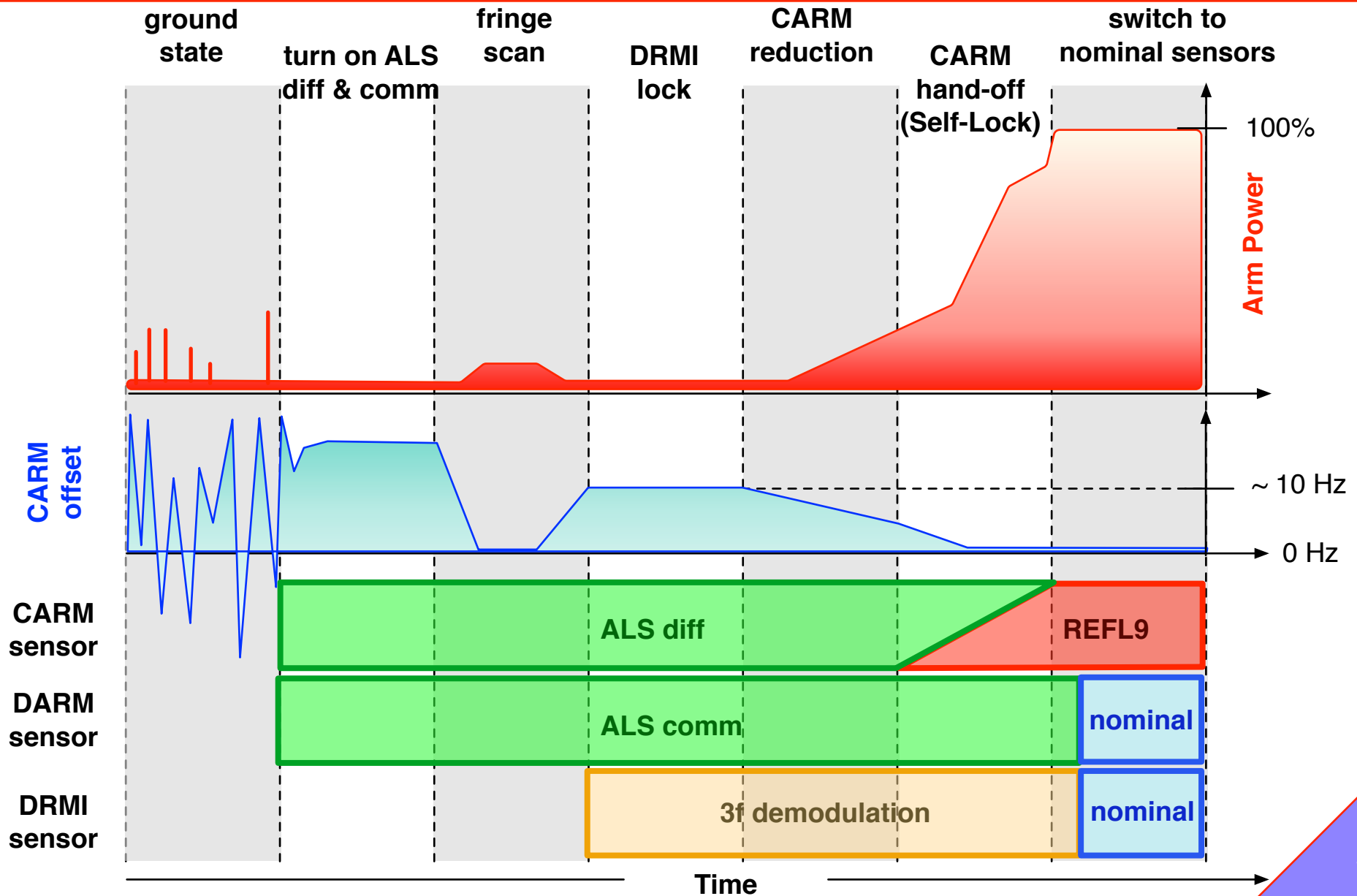
 **SRCL**



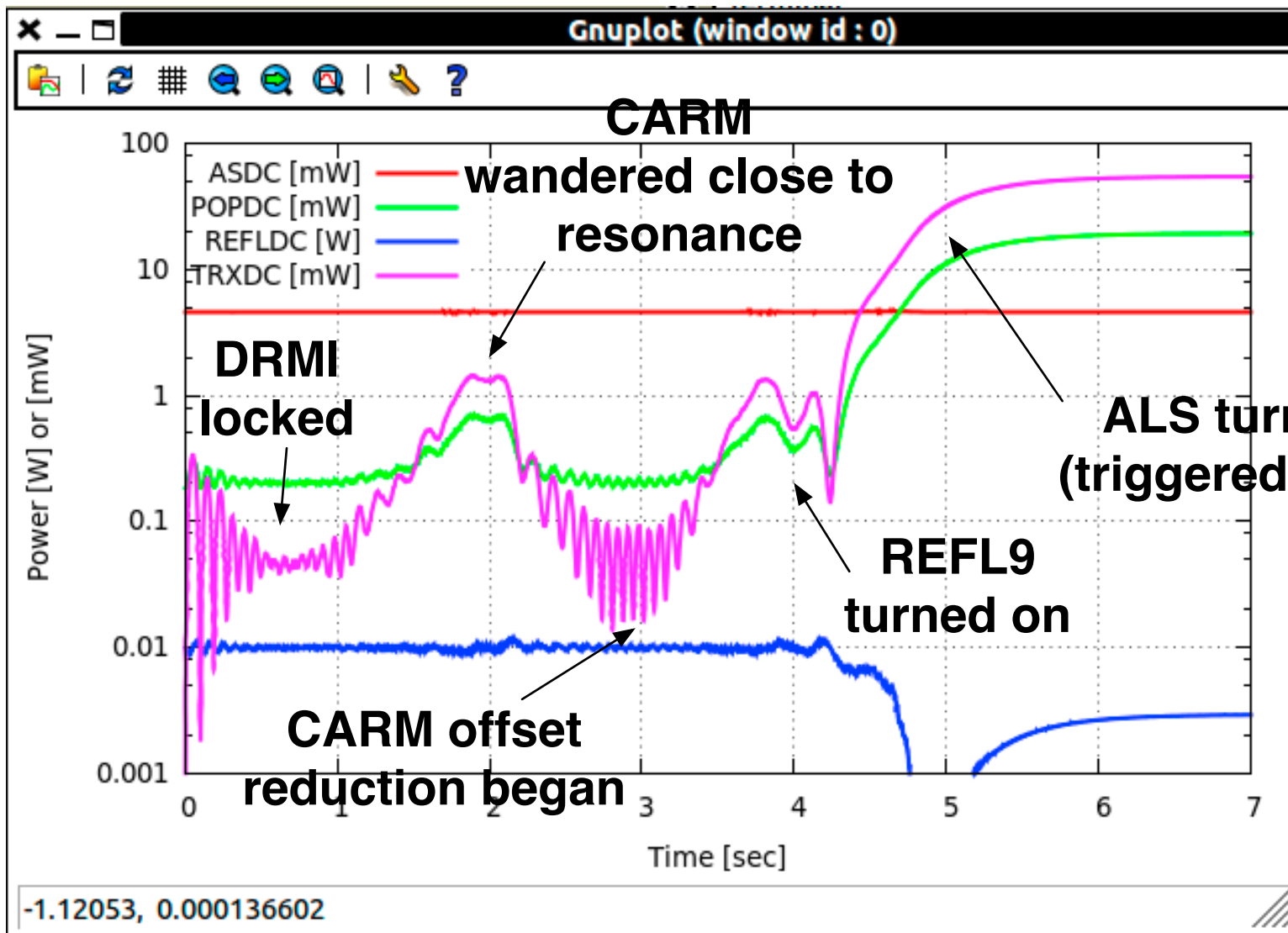
REFL135I - REFL9

UGF = 20 Hz

How do we lock ?

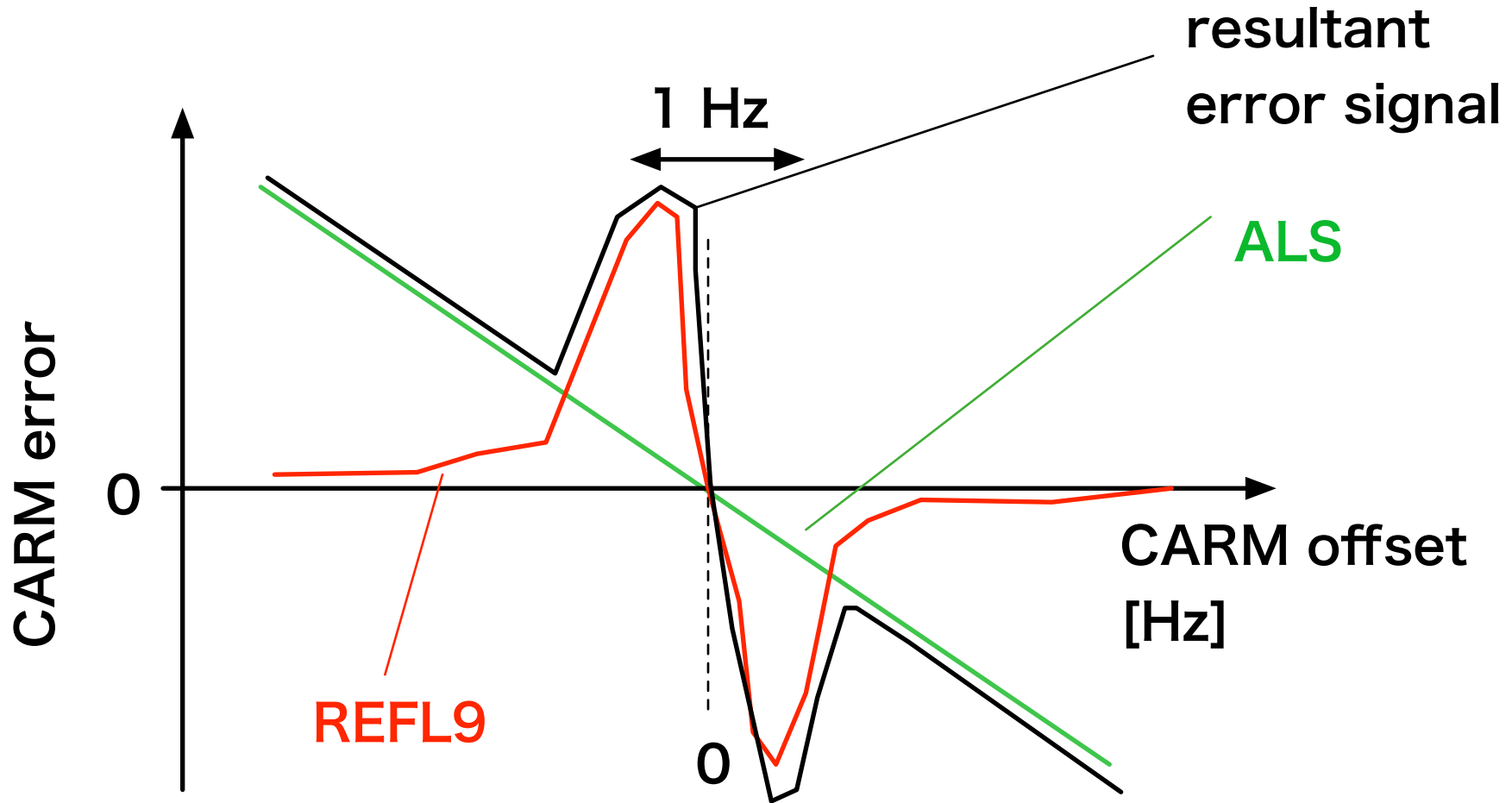


Simulated lock sequence



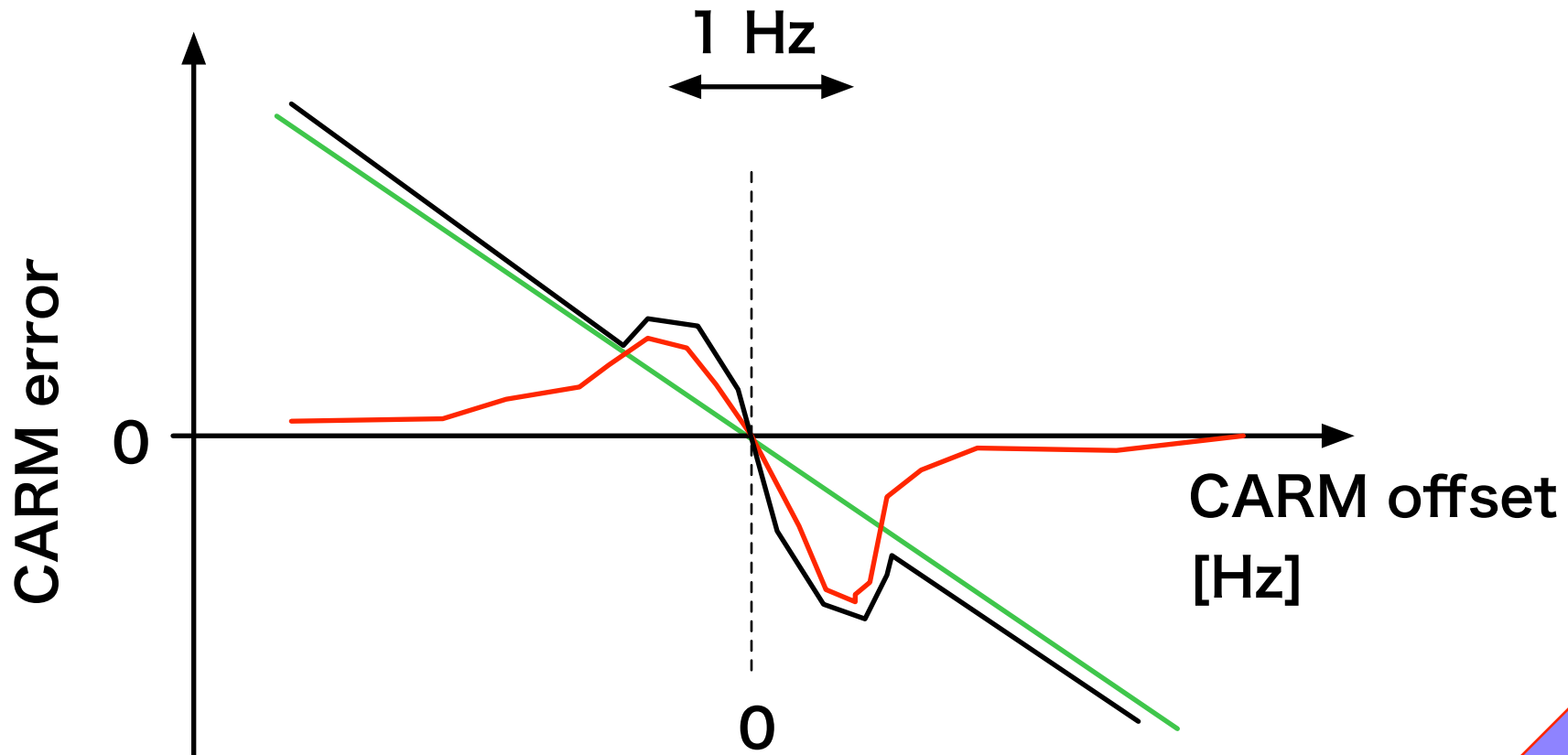
Self locking of CARM

■ Simply add REFL9 to ALS and let them go.



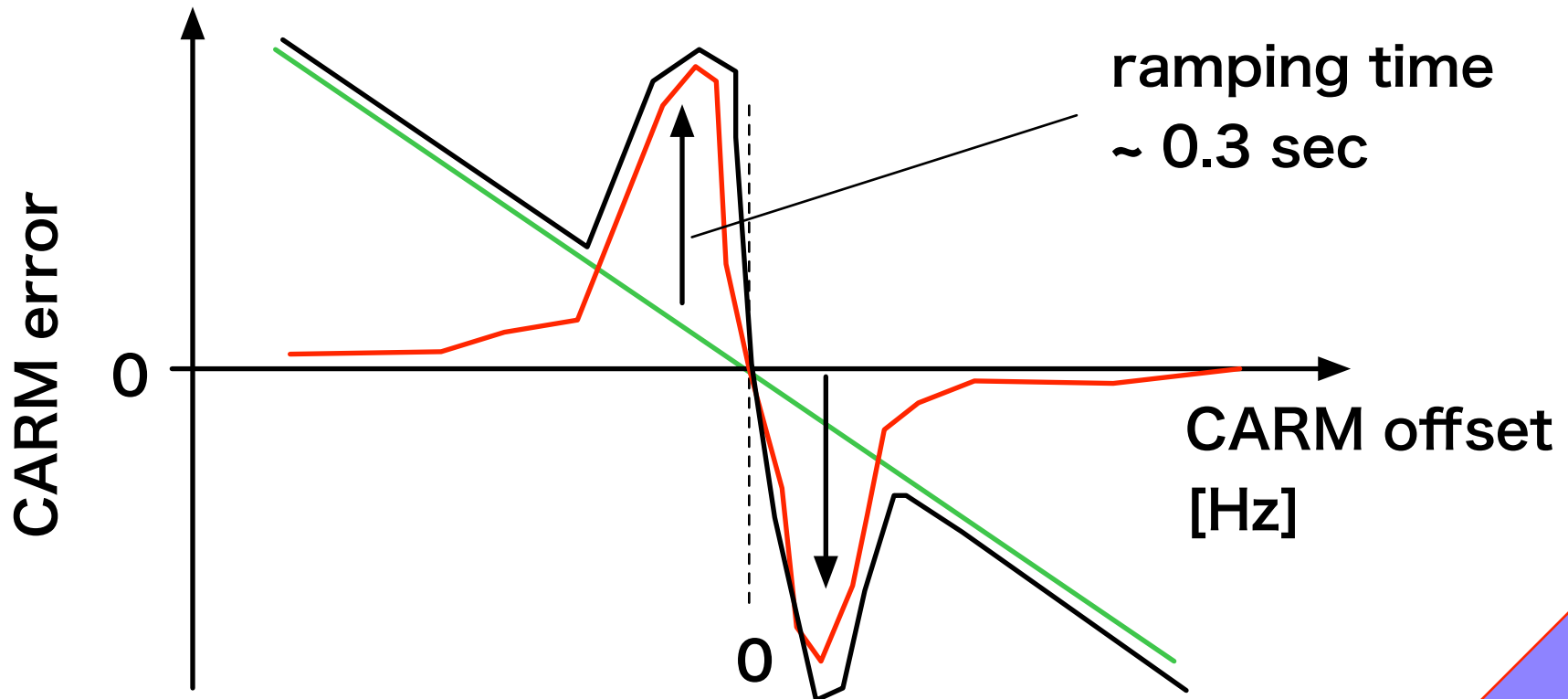
Self locking of CARM

- Small REFL9 signal when high fringe speed
 - \Rightarrow ALS dominates the control
 - \Rightarrow ALS gives REFL9 opportunities to try

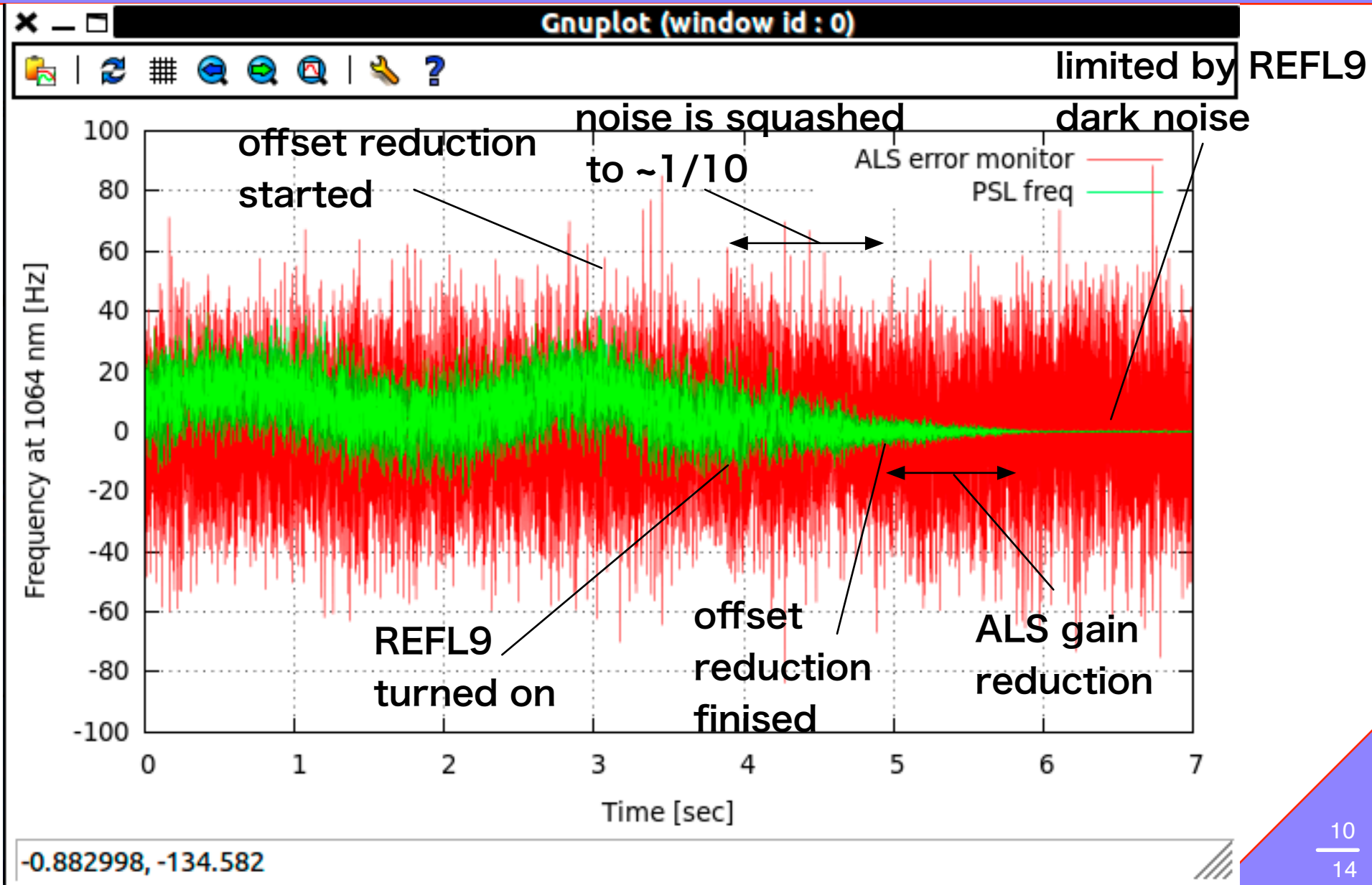


Self locking of CARM

- Big REFL9 signal when low fringe speed
 - ⇒ REFL9 automatically takes over the control like a triggered locking
 - ⇒ auto-gain ramping as power builds up



CARM hand-off



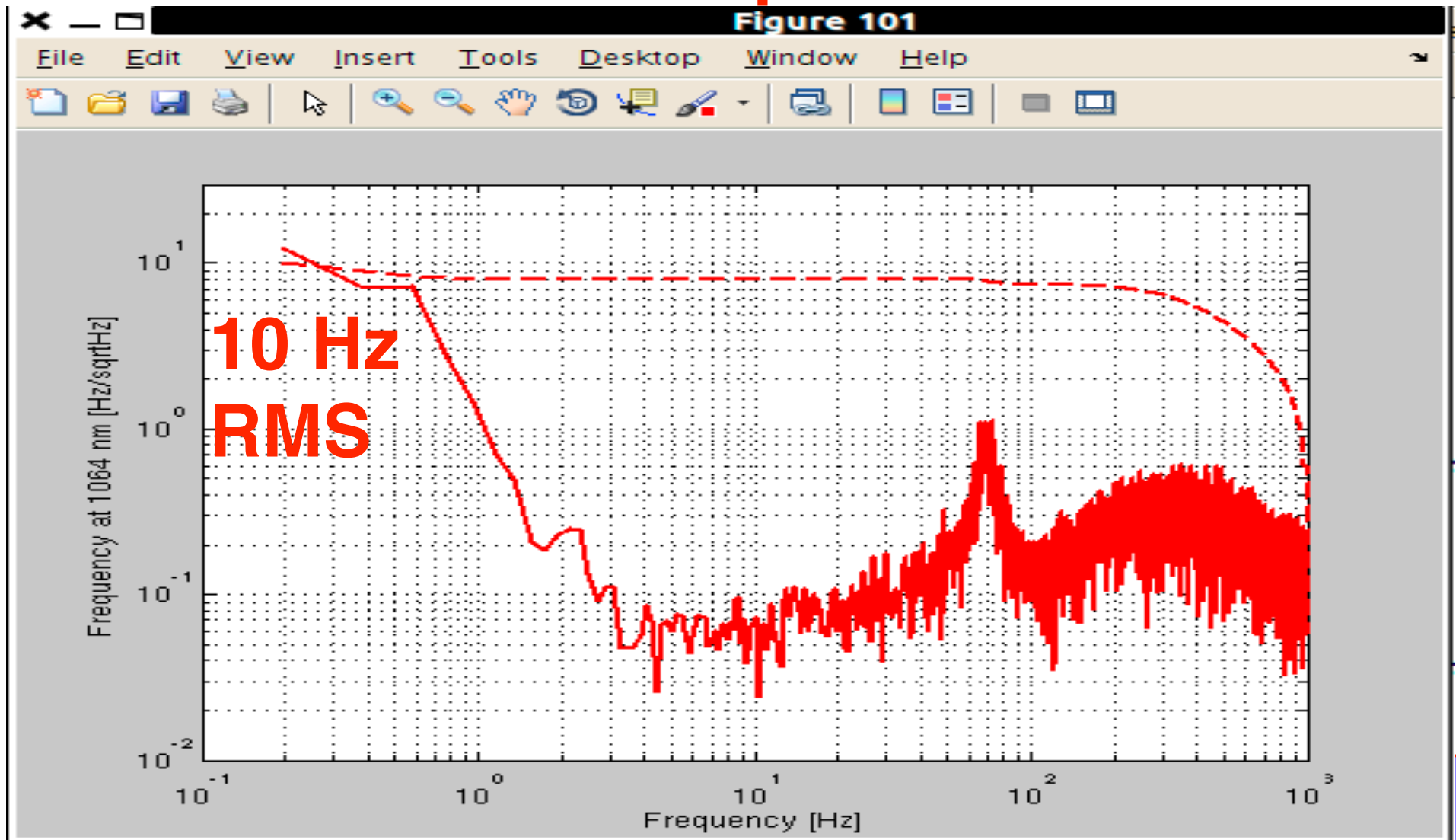
Next

- ▣ Examine how much kick SRC gets during the hand-off process
- ▣ Simulate ALS_diff with a UGF of 10 Hz and QUAD suspension(?)
- ▣ to be continued ...

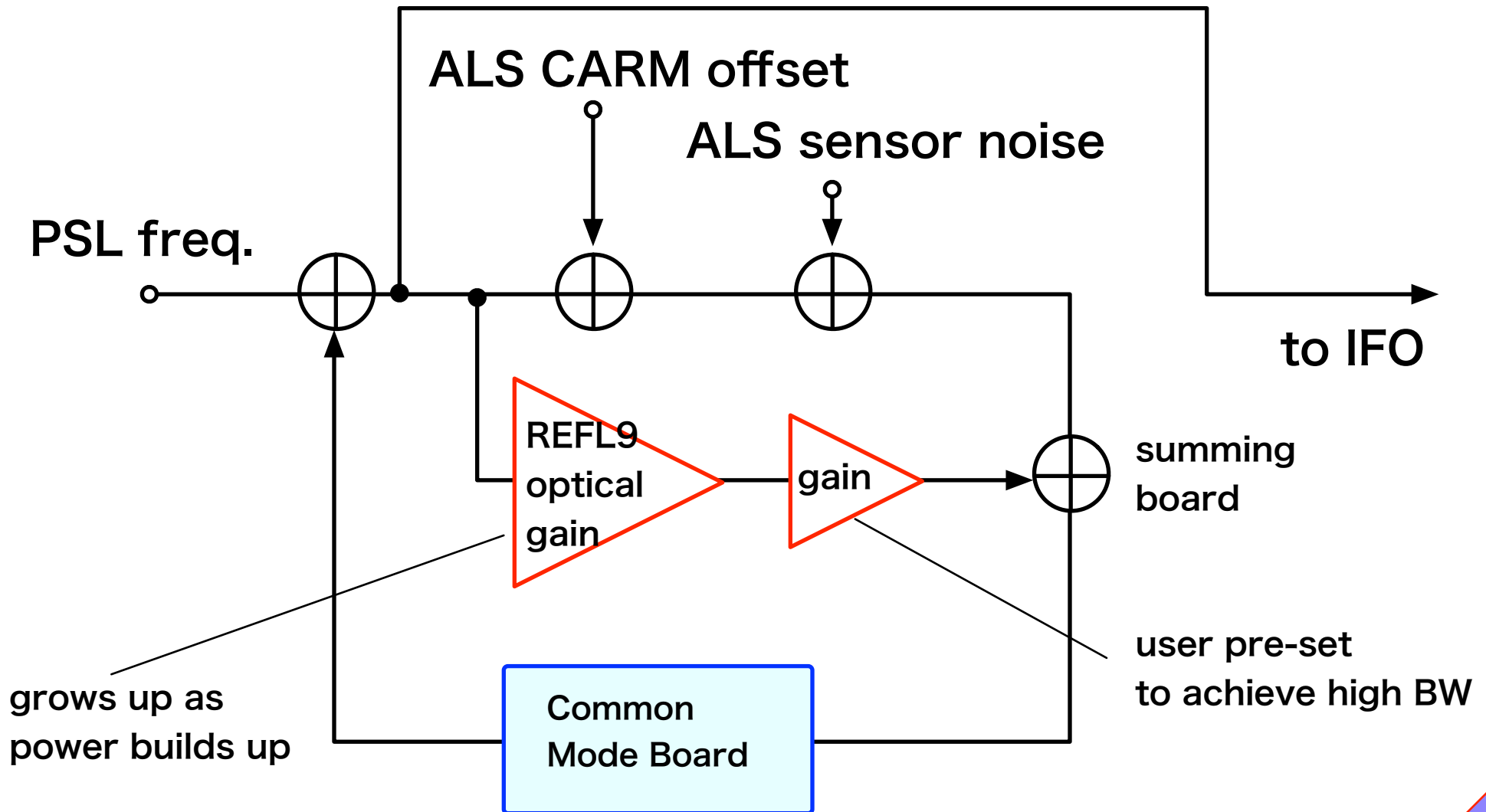
Gallery

Realistic ALS noise

CARM noise spectrum



Self locking in block diagram



REFL9 gain is adjusted so as to have 2 kHz BW resulting in 10 times better noise performance !