Status Update of a LIGO Lock Acquisition Simulation

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Summary

- Transition from green to infrared sensor was achieved in CARM control.

- CARM can be locked by REFL9I directly a new concept => **"Self locking"**

- DRMI locked by 3fs

- SRCL is the only difficult DOF in DRMI

Important Quantities

- **Single arm full linewidth ~ 80 Hz(or ~ 1 nm)**

- **Power recycled CARM linewidth ~ 1 Hz (or ~ 14 pm)**

- **ALS CARM loop provides 6 Hz RMS (at best so far)**

Current Sim. Settings

- **DRMI**

  locked by 3fs. Seismic noise present.

- **DARM**

  magically **stays locked with zero noise**
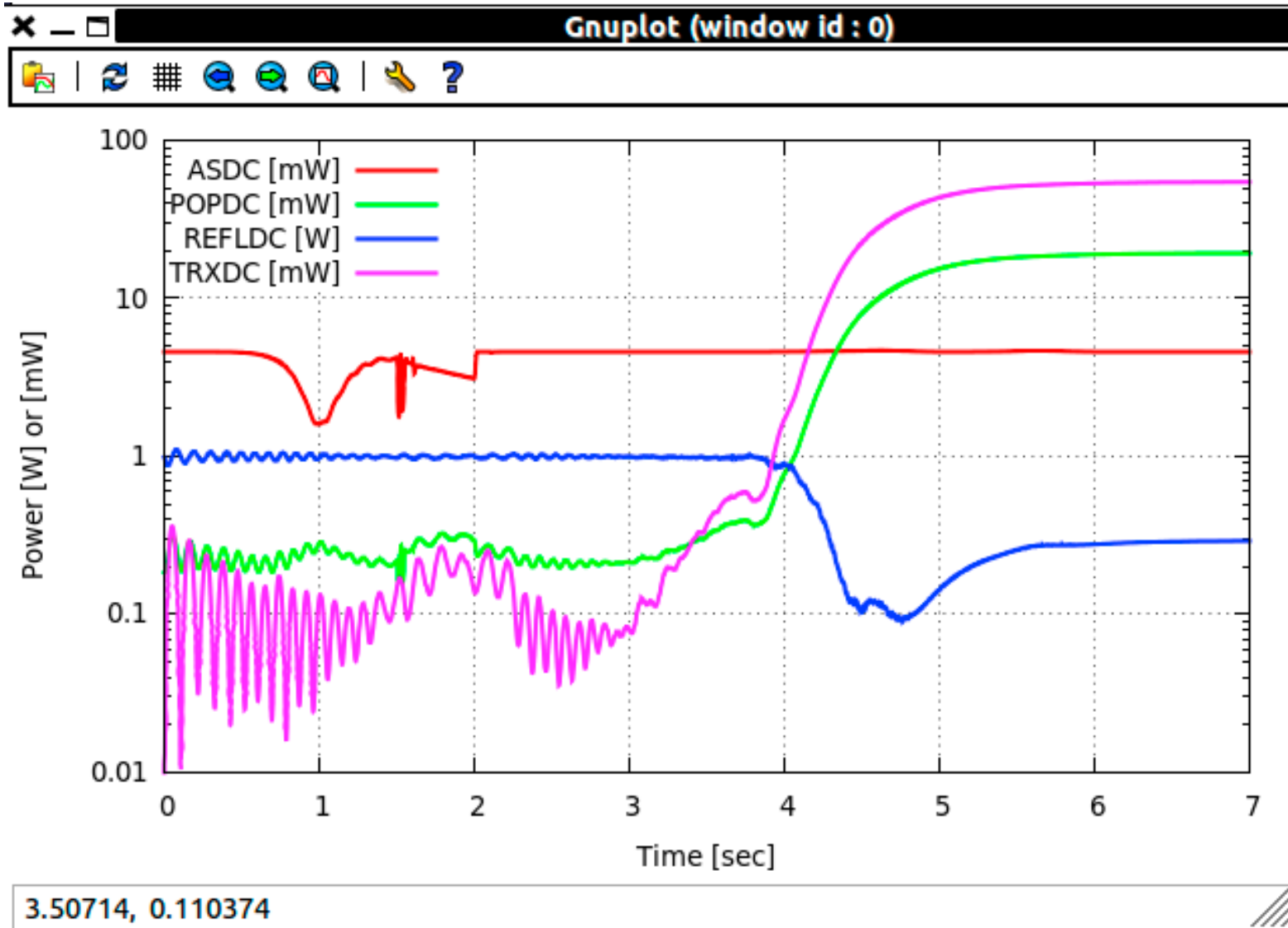
- **CARM**

  locked by ALS feeding signals back to PSL. Sensor noise dominant (6 Hz RMS).

Sim. Settings (cntn'd)

- no radiation pressure
- no IMC or FSS
- 1 W incident on PRM
- mod. depth = 0.1 for both 9 and 45 MHz
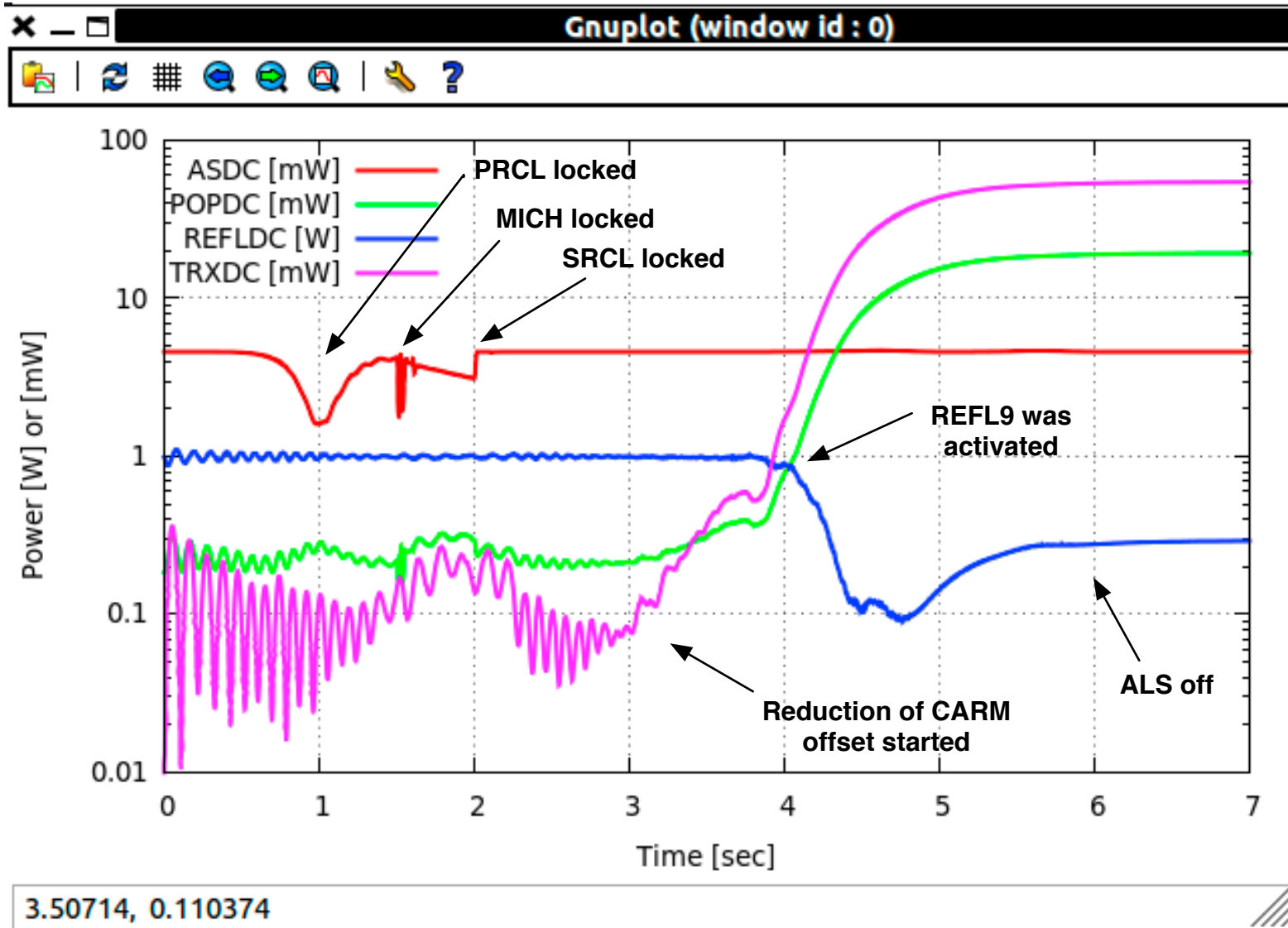- lower reflectivity in SRM : T = 0.35

Overview

It starts from a CARM offset of 10 Hz

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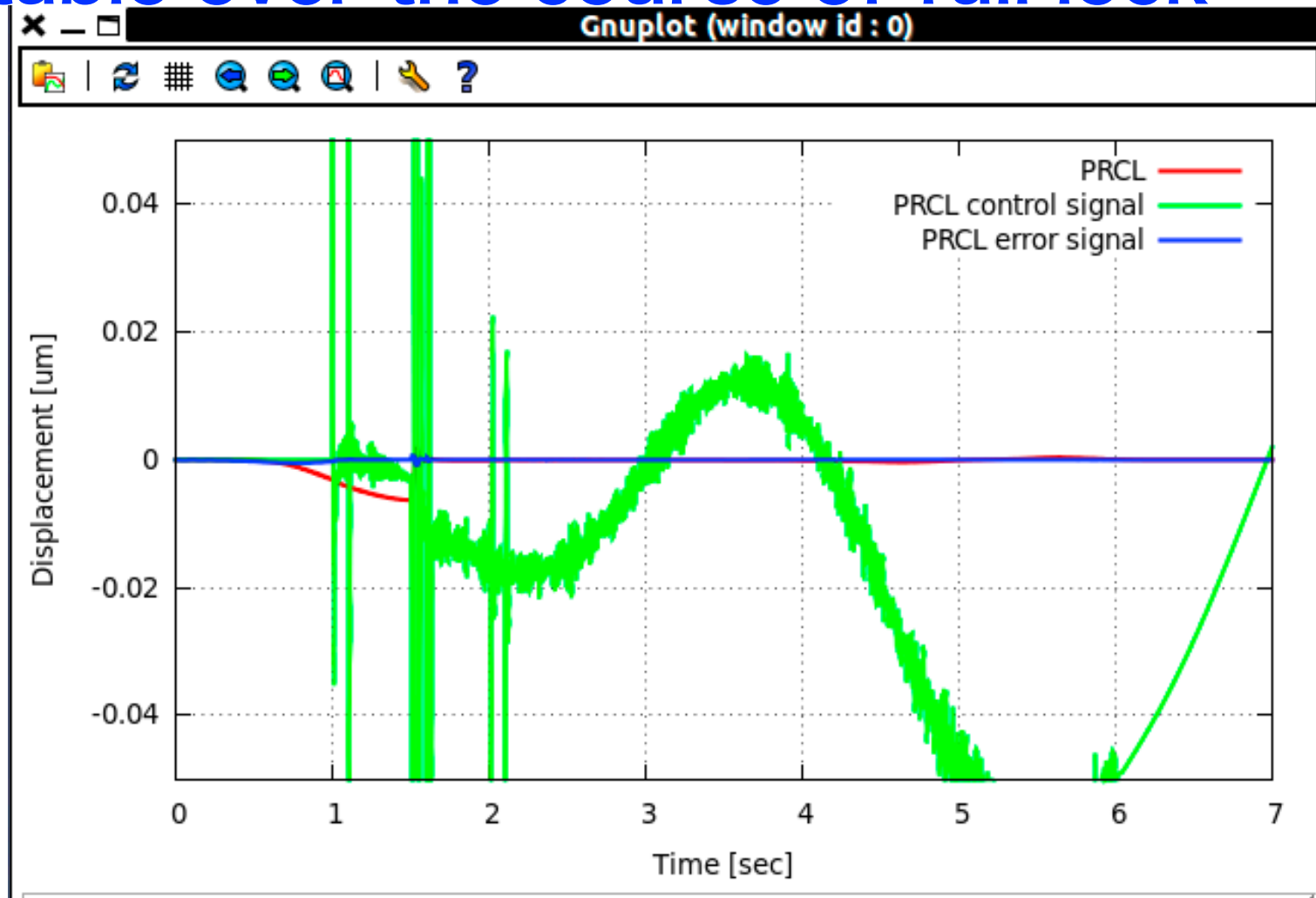
DRMI lock

- **3f technique works OK so far.**
- **3f can hold DRMI until the end**
  - PRCL -> REFL27_I

    UGF = 40 Hz

  - MICH -> REFL135_Q

    UHF = 30-ish Hz

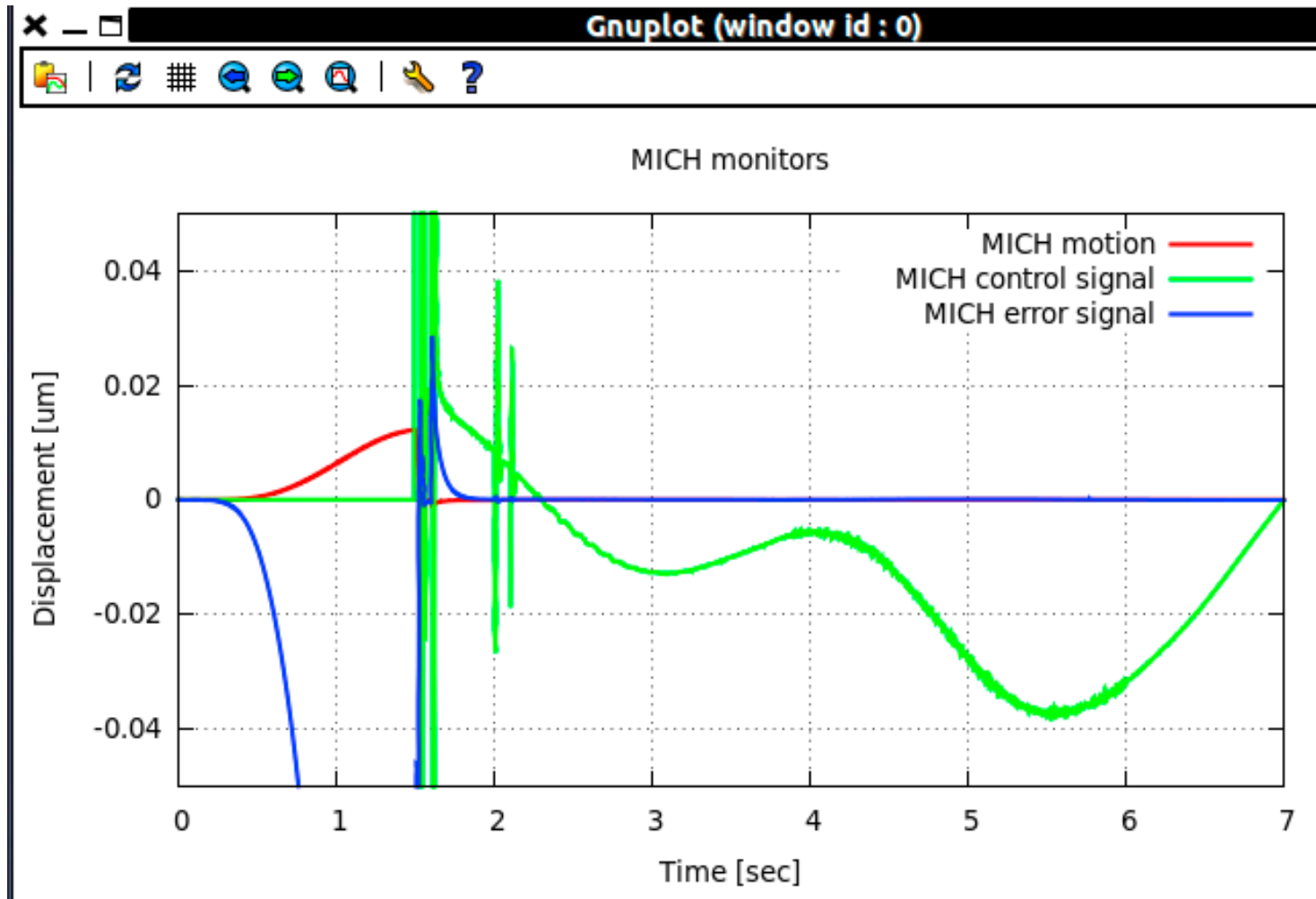 - SRCL -> REFL135_I

    UHF = 20-ish Hz

PRCL locking : good

- **Slight contamination from CARM noise**
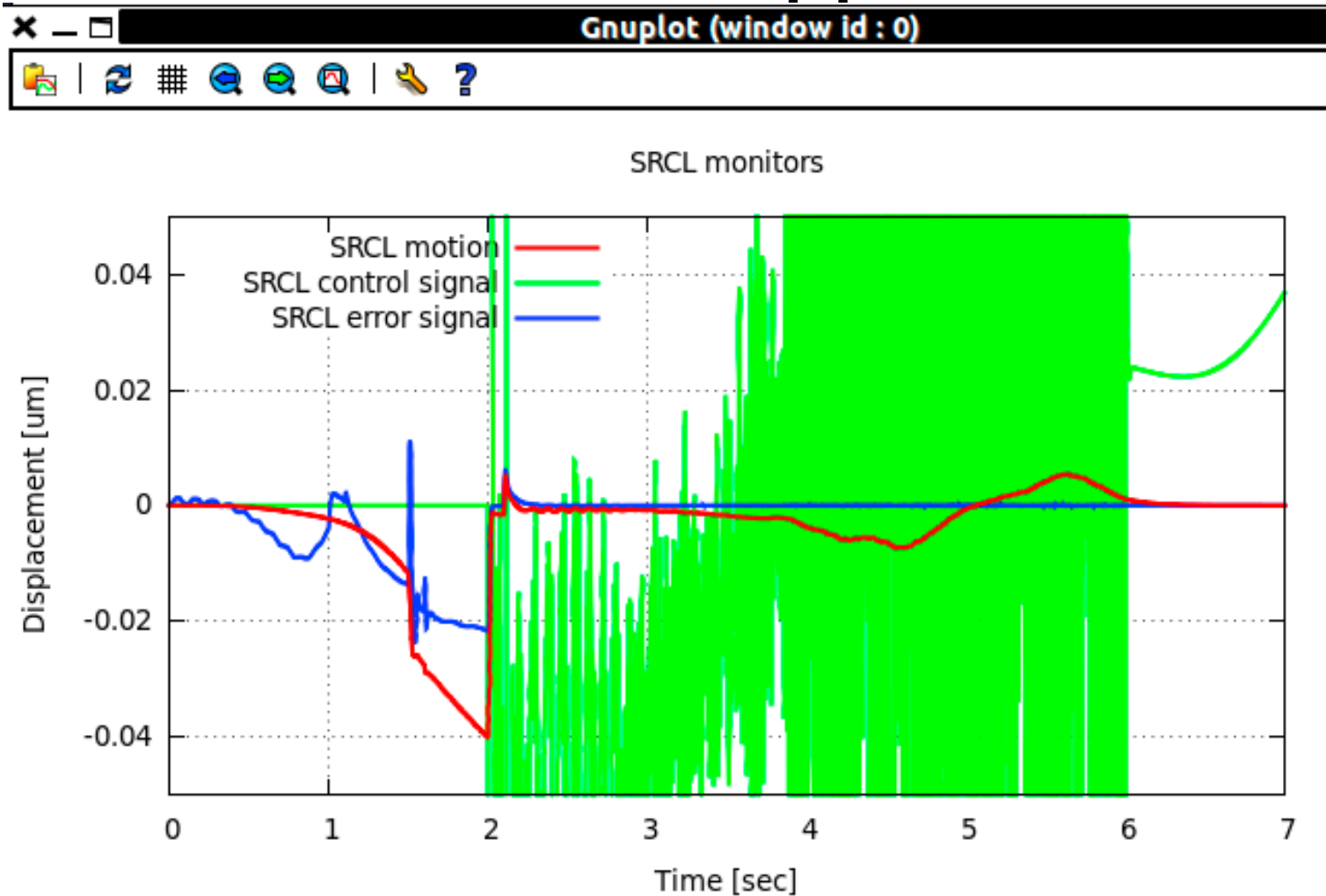- **Stable over the course of full lock**

MICH locking : very good

- almost no contamination from CARM
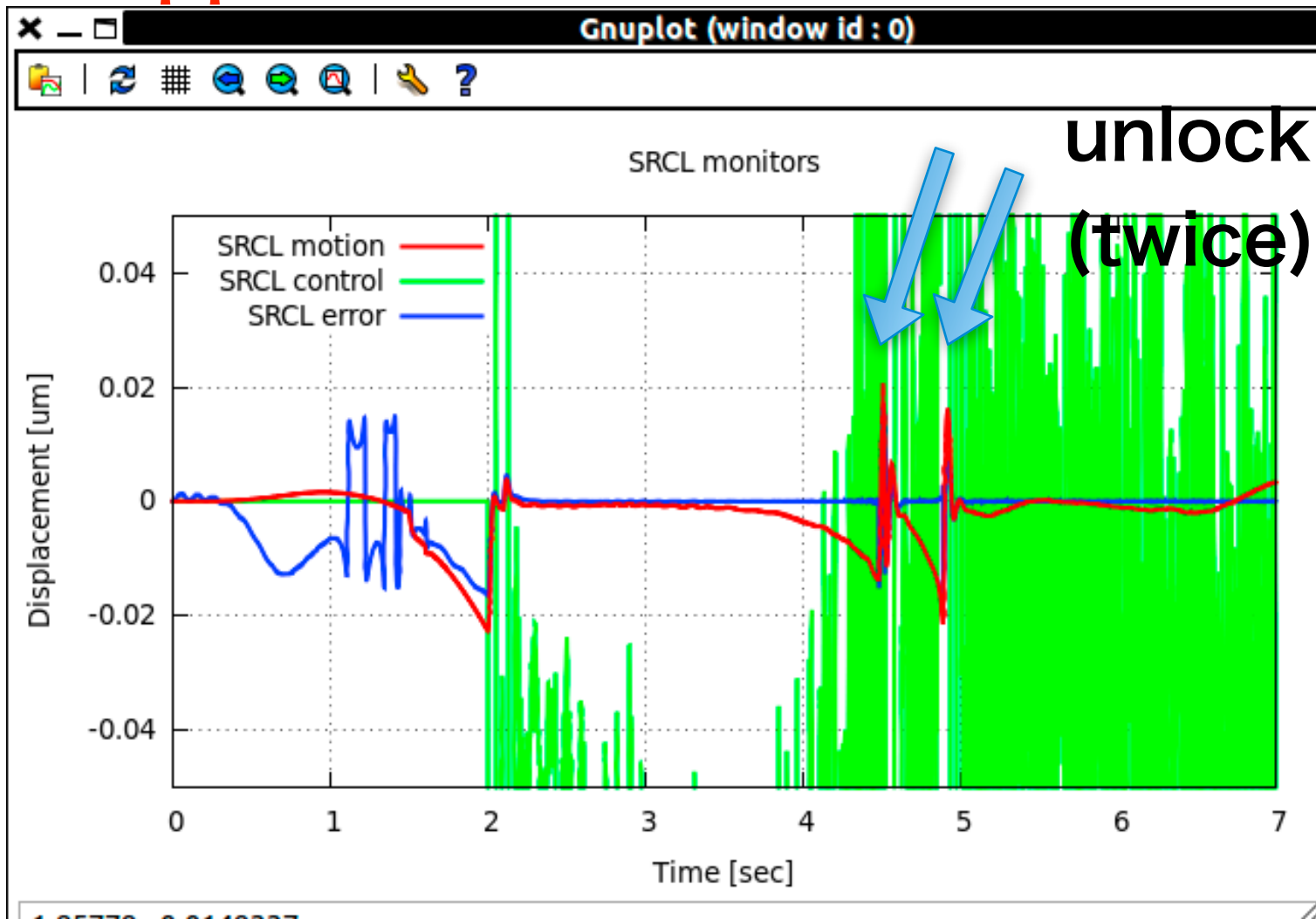- Stable over the course of full lock

SRCL locking : acceptable

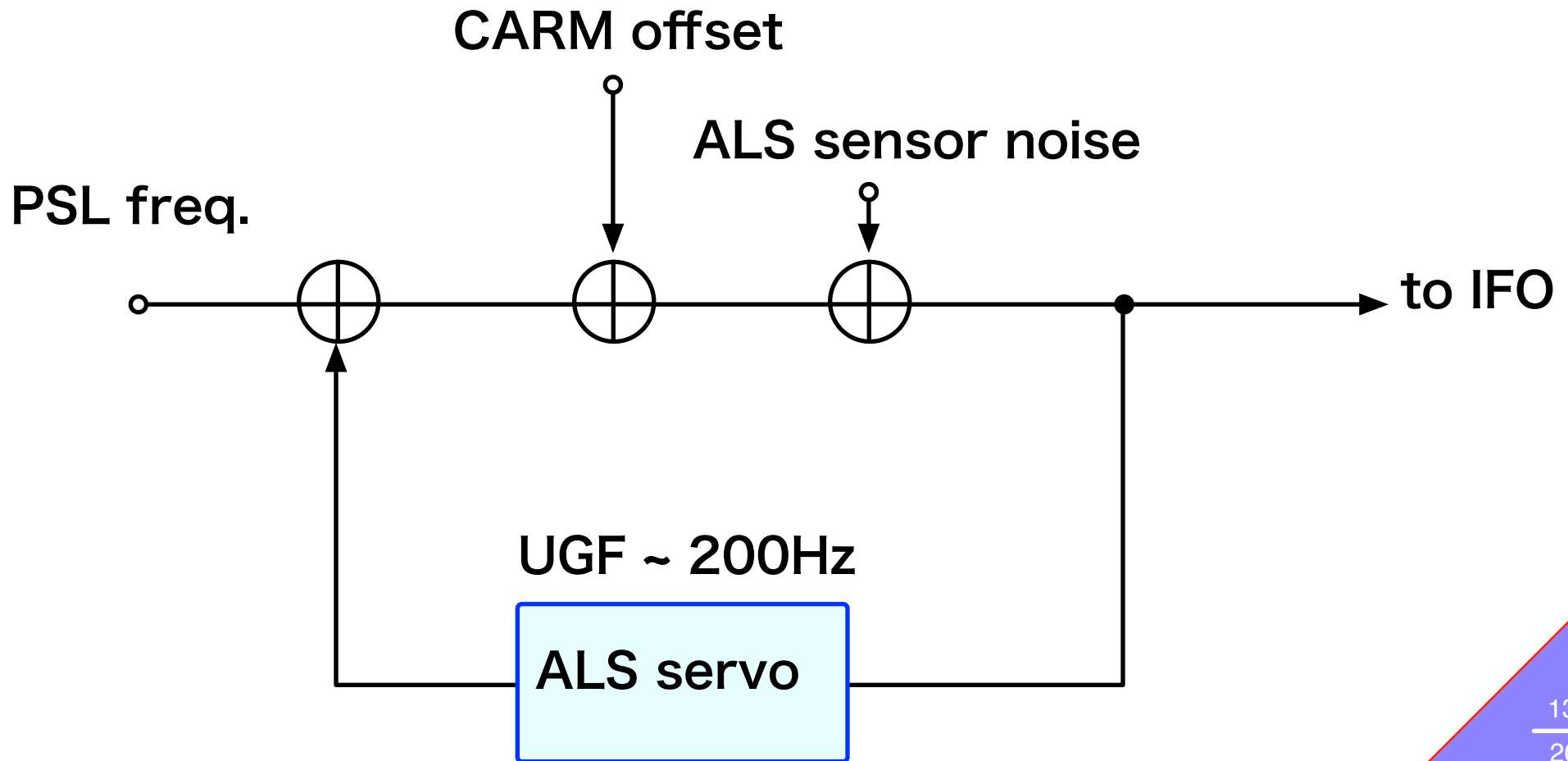- contamination from CARM
- disturbance as CARM approaches 0 offset

Occasional unlock of SRCL

- somehow it came back to operating point
- this happened once out of five trials

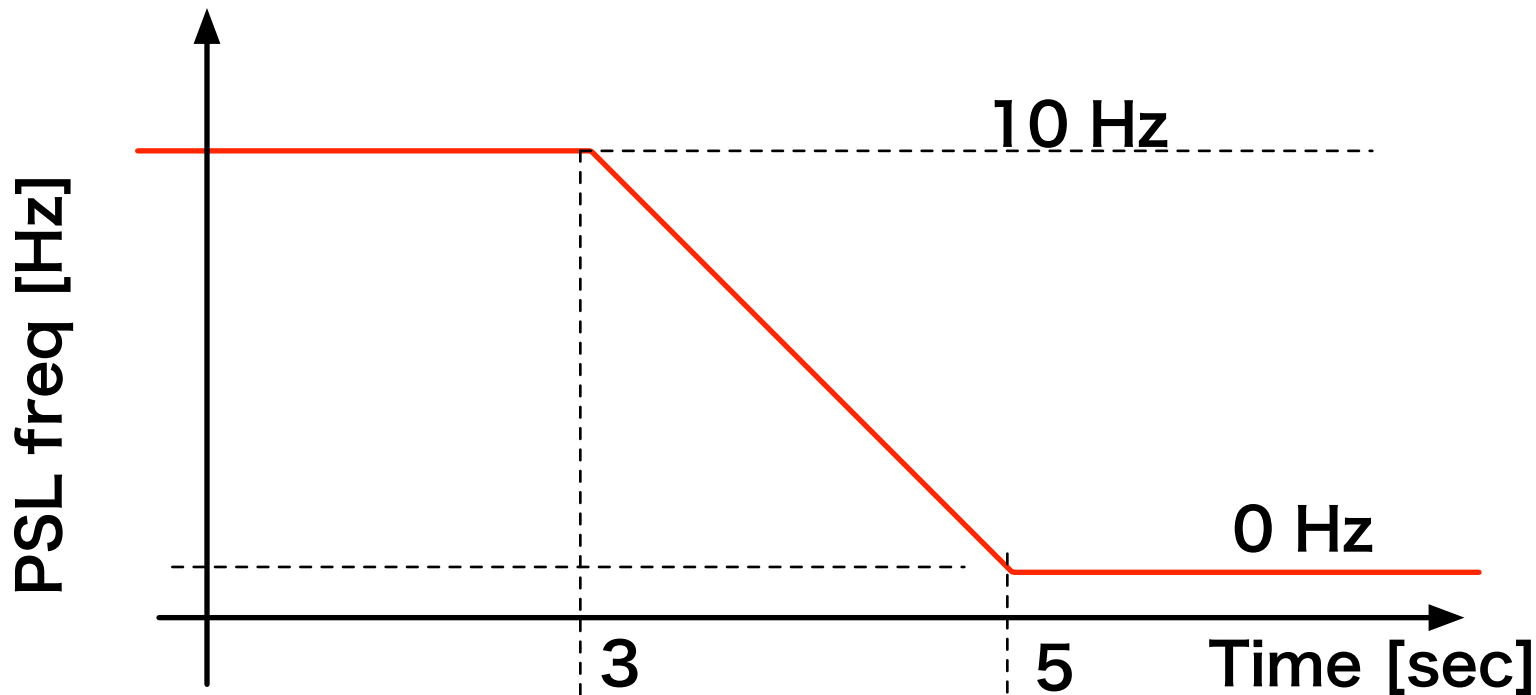■ **Active PSL frequency control is newly implemented to simulate ALS**

CARM offset

ALS sensor noise

PSL freq.

to IFO

UGF ~ 200Hz

ALS servo

Offset reduction

CARM offset =

- -10 Hz when   t < 3 sec.
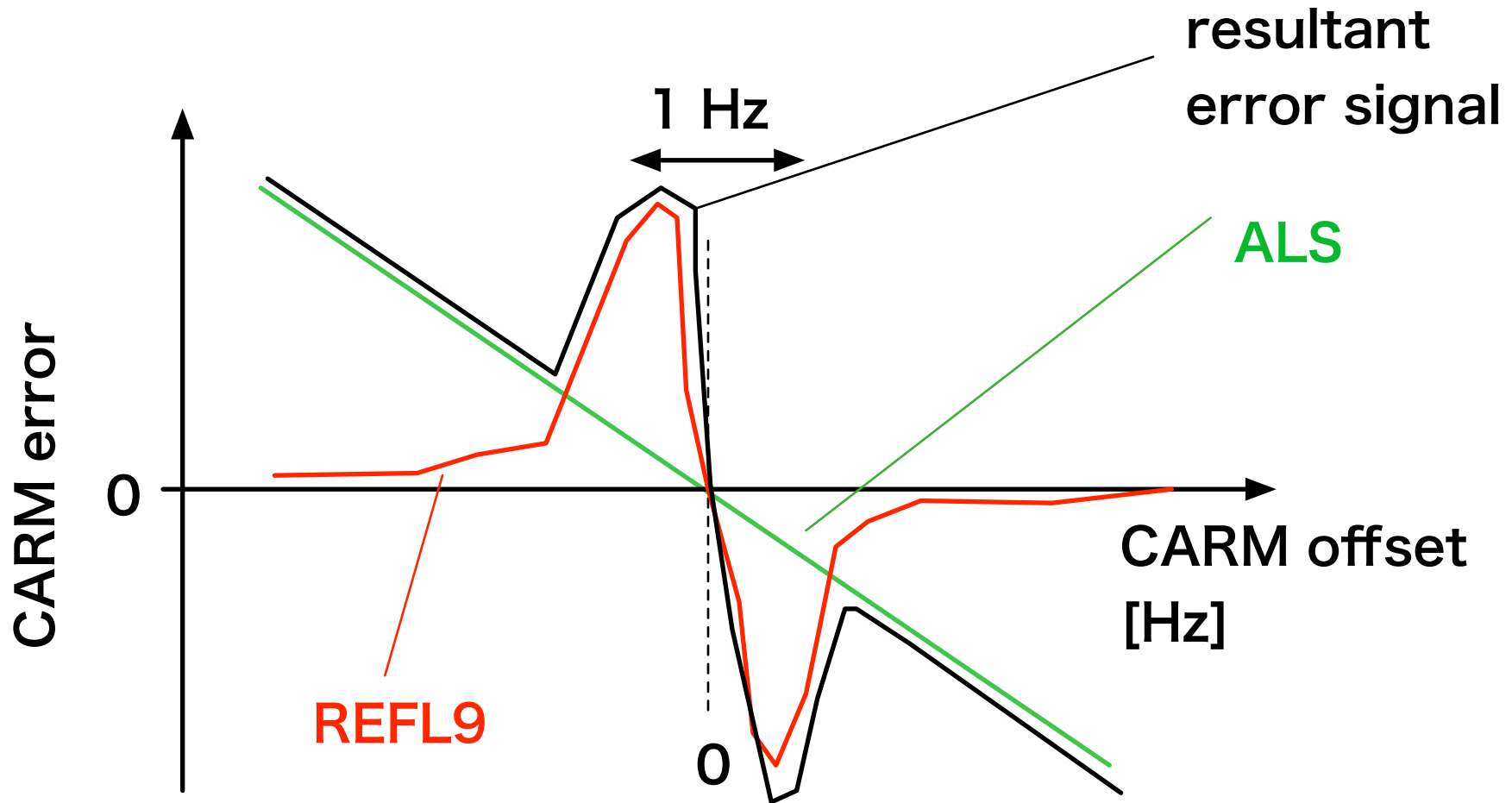- -10 Hz + 5 Hz/sec x (t - 3) when t > 3 sec
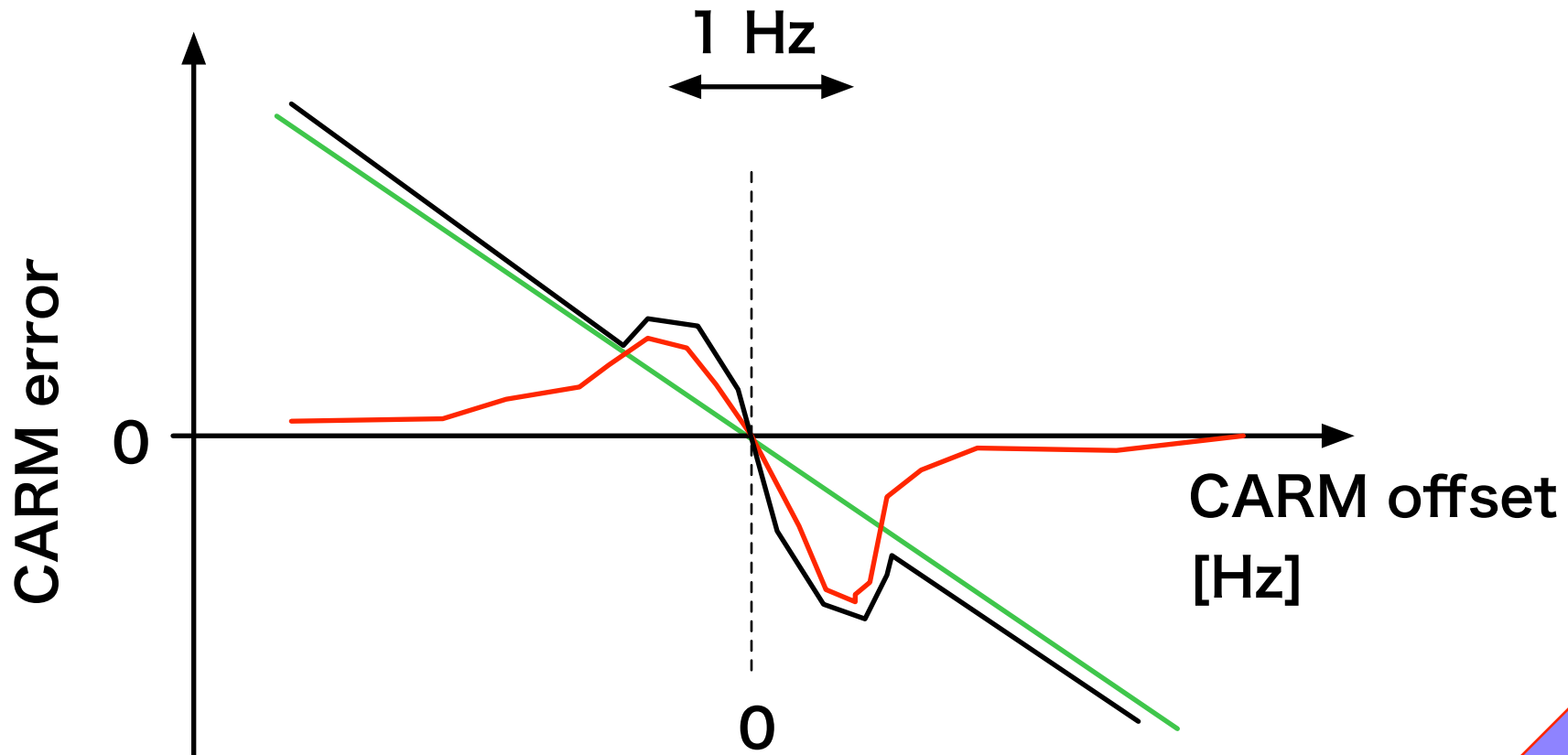- 0   when t > 5 sec

Self locking of CARM
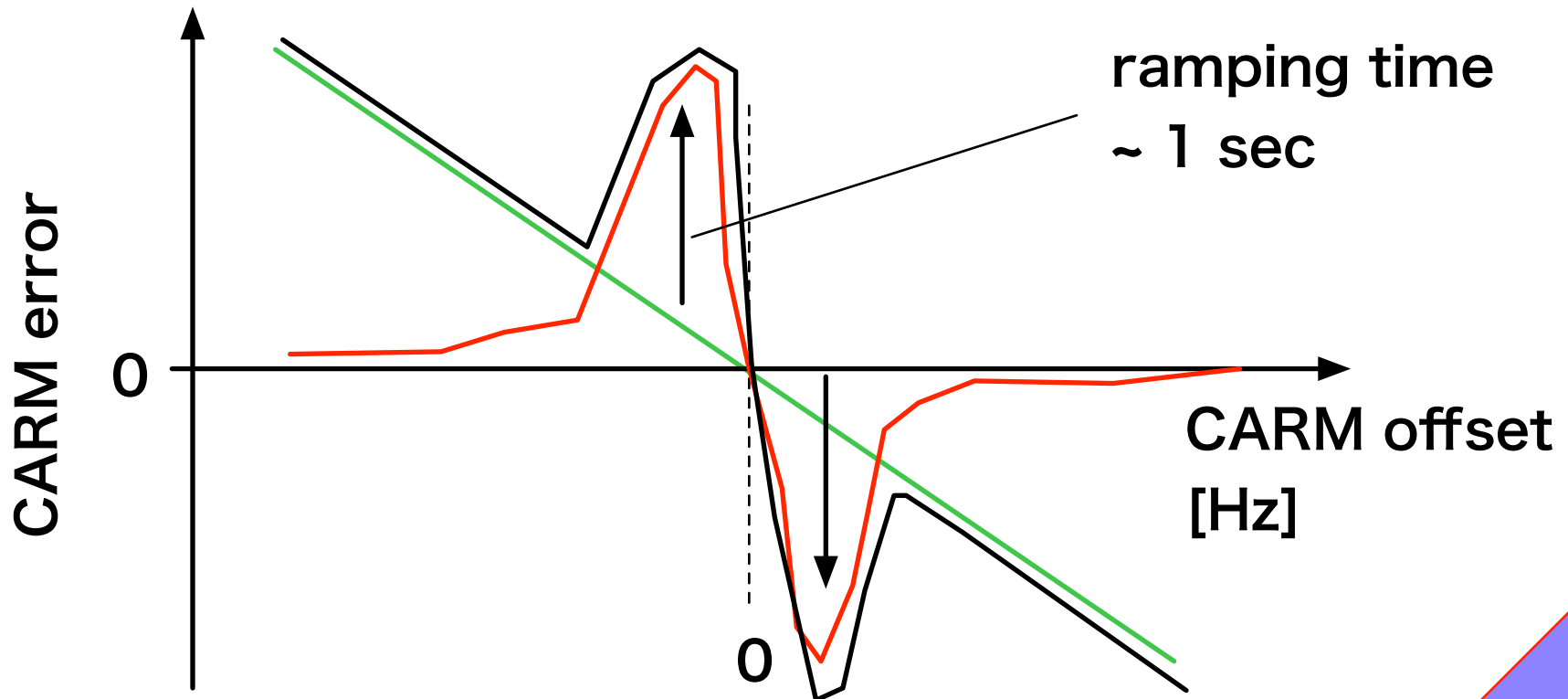
■ add REFL9 to ALS and let them go.

Self locking of CARM

- small REFL9 signal when high fringe speed
  - => ALS dominates the control
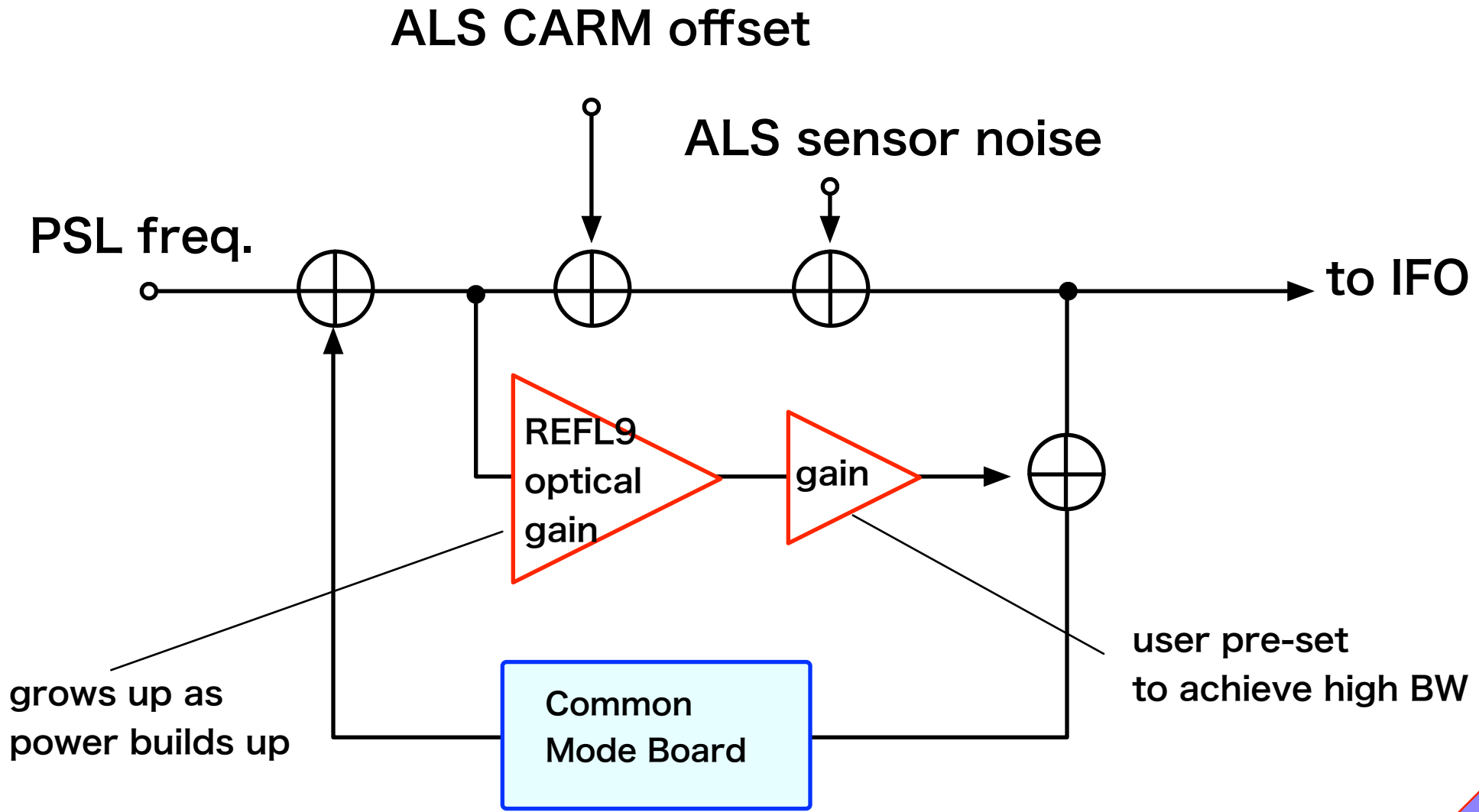 - => gives REFL9 opportunities to catch

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**

ramping time
~ 1 sec

CARM error

0

CARM offset
[Hz]

0

Self locking in block diagram

ALS CARM offset

ALS sensor noise

PSL freq.

to IFO

REFL9
optical
gain

gain

grows up as
power builds up

Common
Mode Board

user pre-set
to achieve high BW

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

CARM locking in Sim.
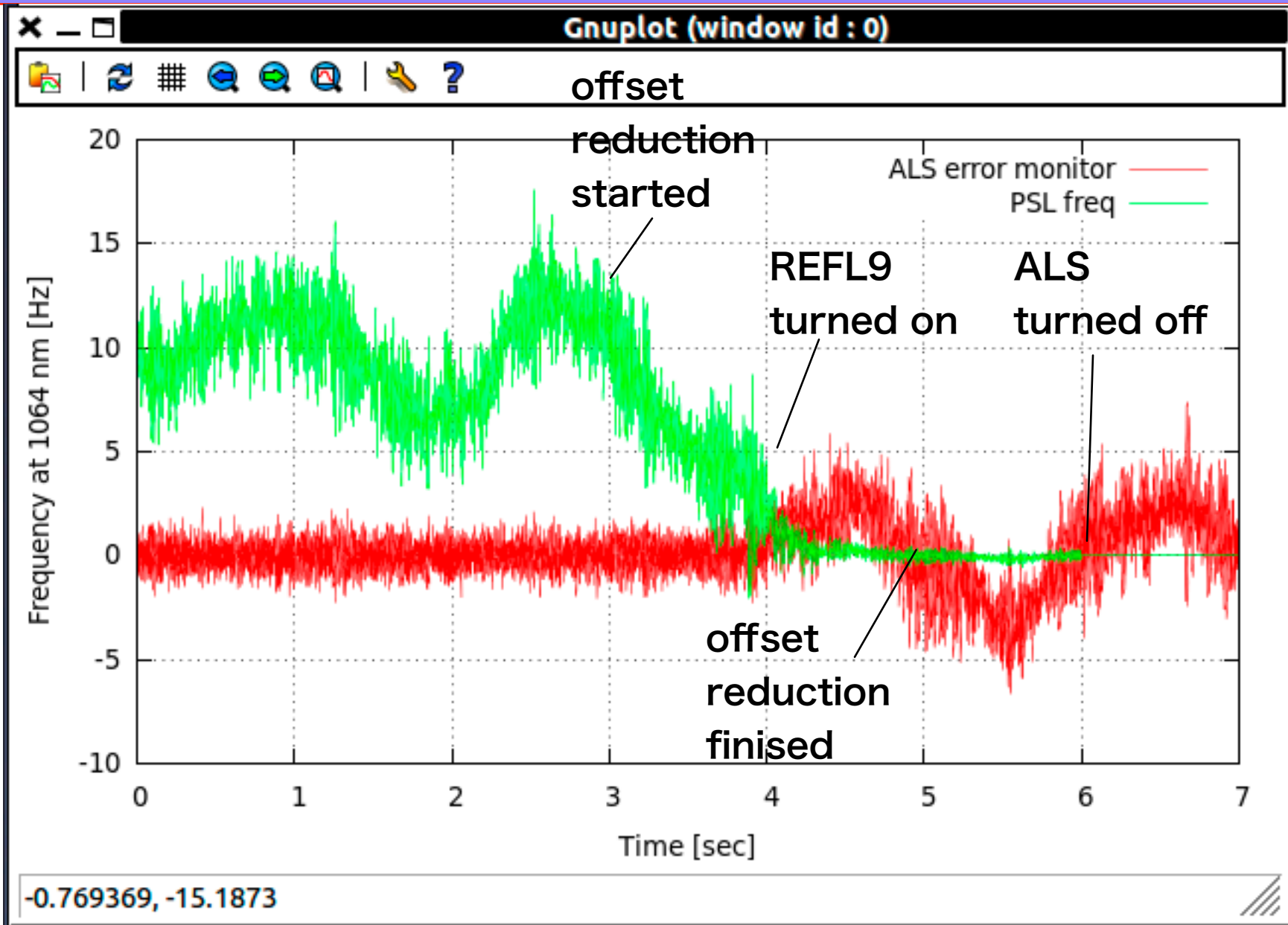
Summary and Plans

- No serious problem in DRMI locking

- SRCL excursion during CARM reduction
  => occasionally SRCL drops its lock

- Self locking engages REFL9-CARM loop
  automatically => seems good so far

- ALS DARM noise will be included