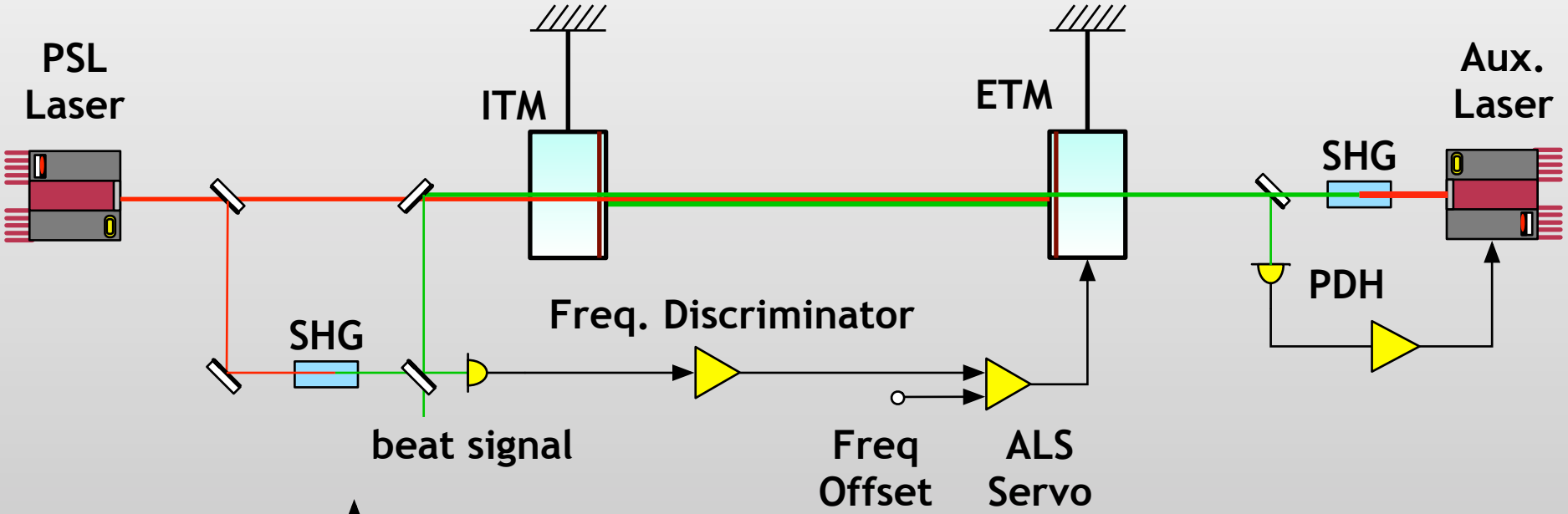
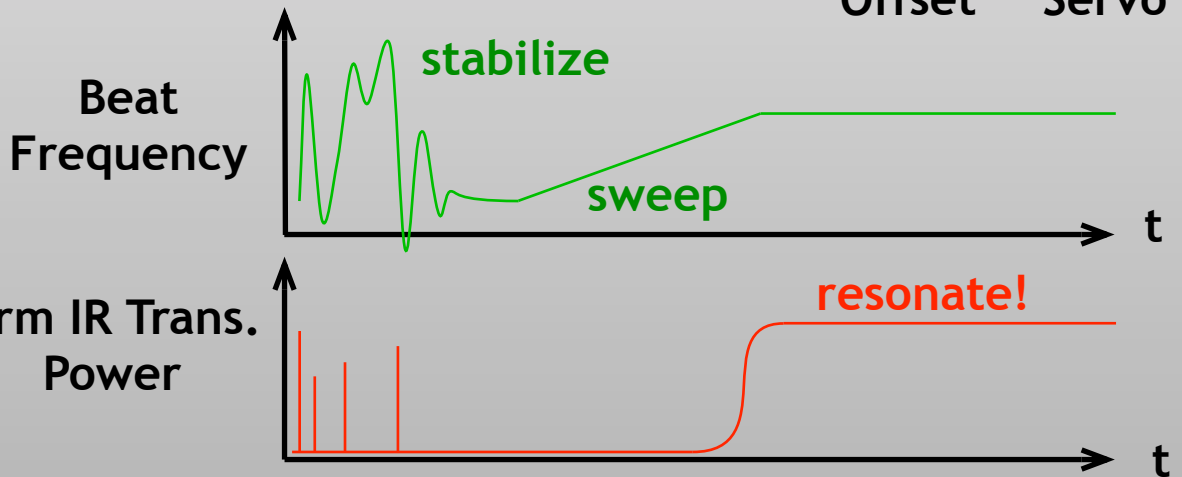
ALS at the 40m

Koji Arai LIGO-G1100127

Stabilizes the arm lengths by green beams

- Stabilizes arm fluctuation: from ~1um to <~100pm
- For deterministic lock acquisition



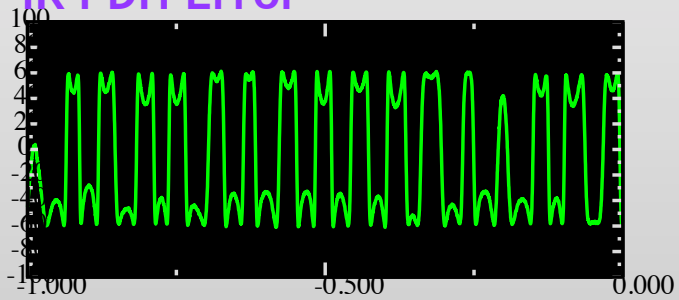


ALS@40m: Recent development

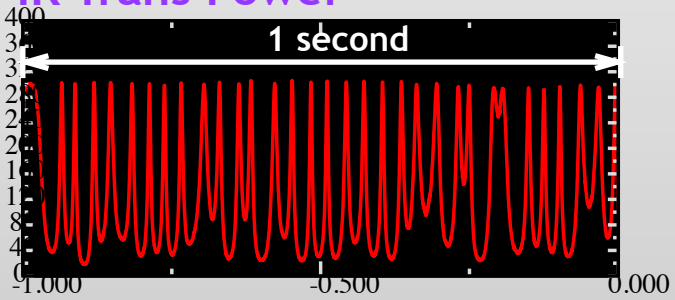
- Locked a dichroic arm cavity with IR/green
  Obtained the beat note at the vertex (Mid-Jan.)

- Performed the first scan of the beat note freq (Mid-Jan.)
  Residual arm motion with ALS (~7nm$_{RMS}$)
  Not sufficiently small for the IR PDH (~+/-0.6nm)

IR PDH Error



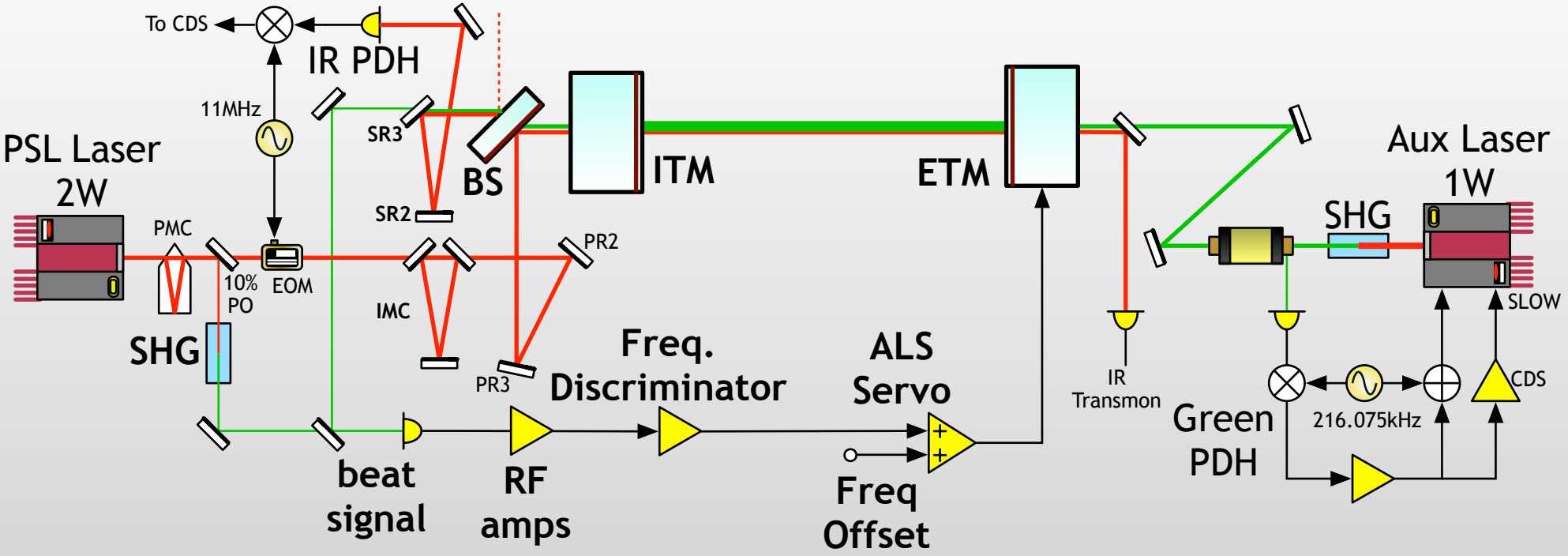
IR Trans Power

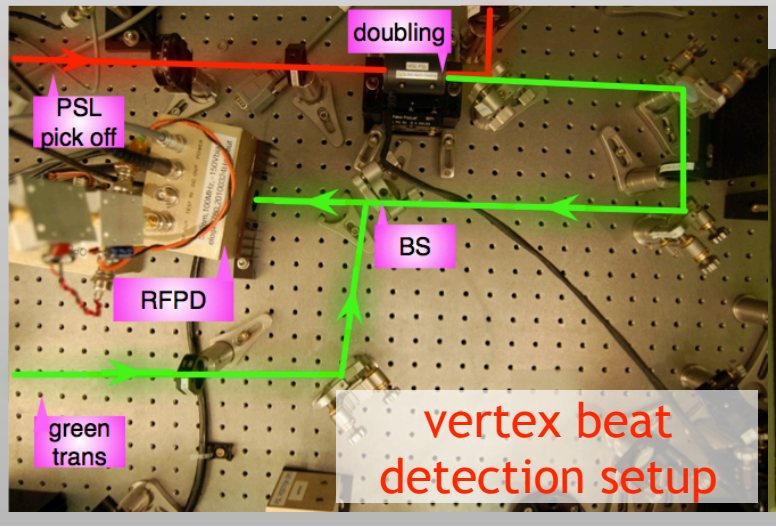


- Improved the residual motion (End-Feb.)
  Residual arm motion with ALS (~0.2nm$_{RMS}$)
  => Inside of the linear region for the IR PDH

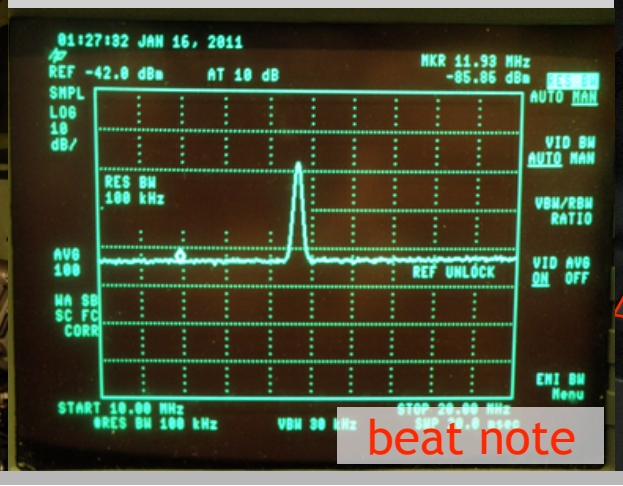
- ALS Noise budget (Early-Mar.)
  Limiting noise: Intensity noise of the green transmission

ALS@40m: Setup

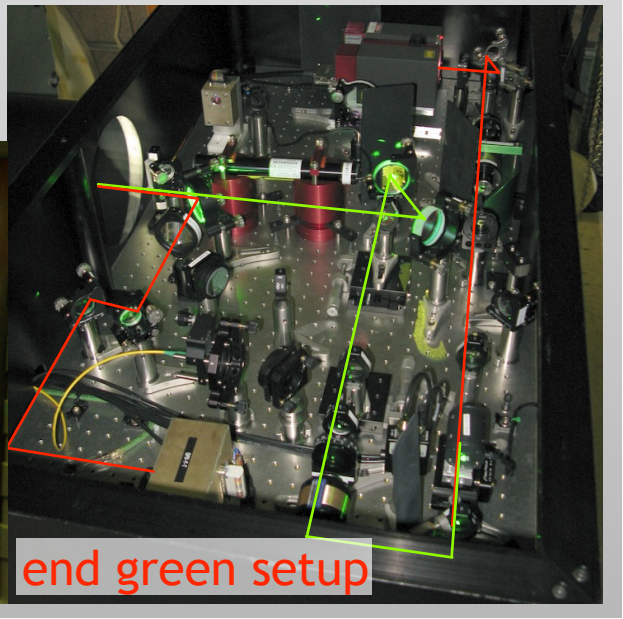




vertex beat detection setup



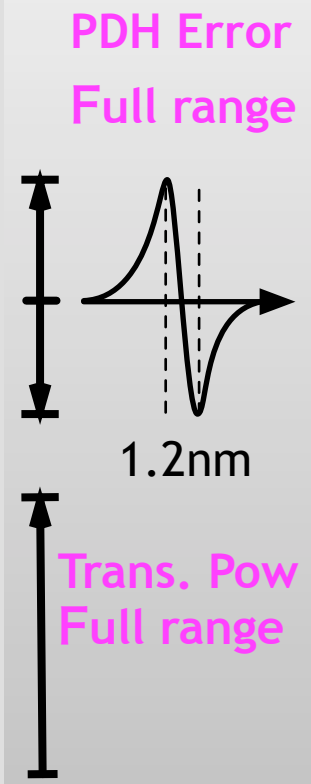
beat note



end green setup

ALS@40m: Improvement

After the adjustment of angle-to-length (A2L)
and length-to-angle (f2p), out-of-loop noise got improved

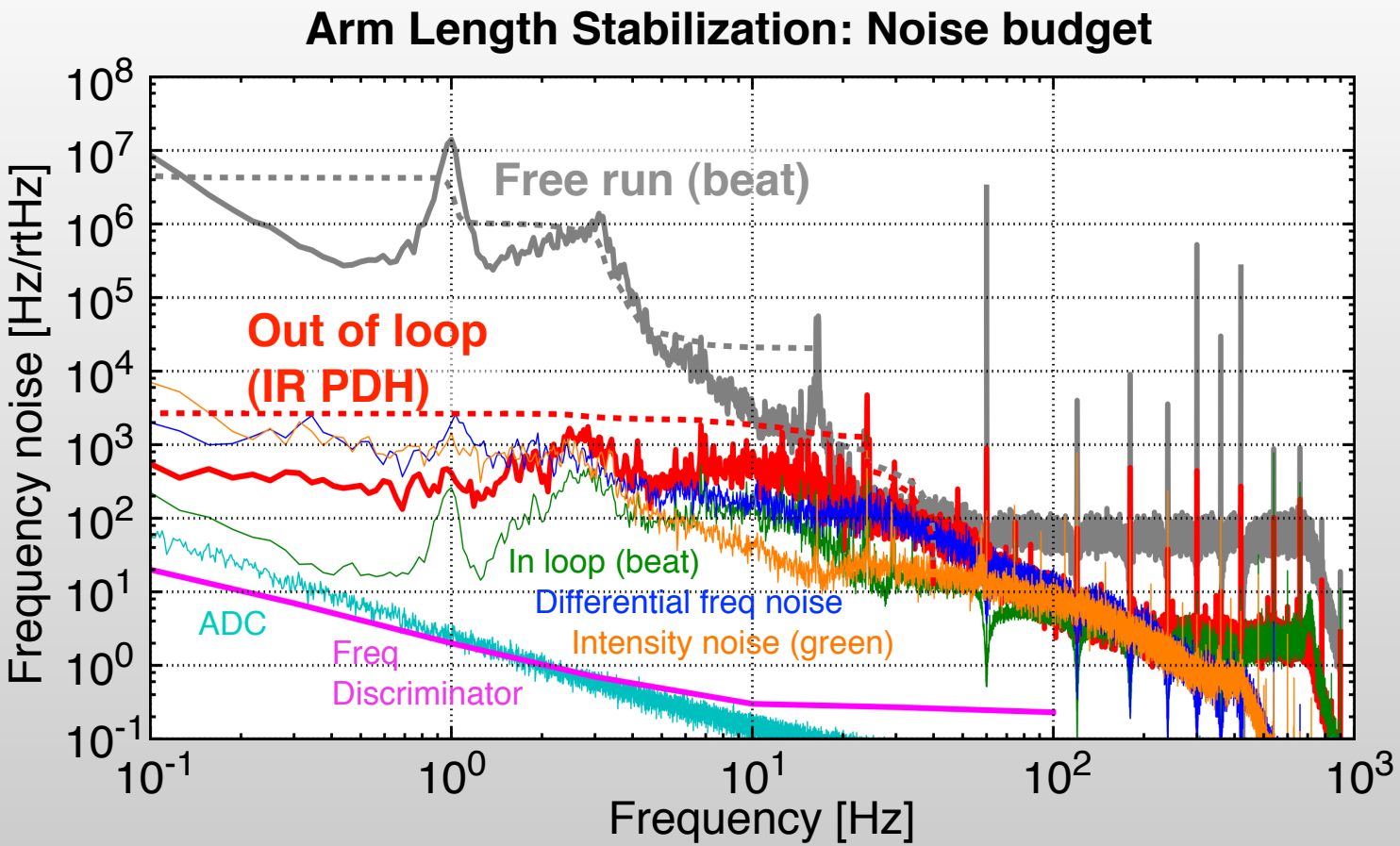


The residual motion got within the linear range of the IR PDH

Residual frequency / displacement noise

==> (df=2.7kHz$_{RMS}$ / dx=0.2nm$_{RMS}$)

ALS@40m: Noise budget



- Currently coupling of the intensity noise to the diff freq noise(*) is the limiting noise source.

(*) Diff freq noise = beat freq noise with both IR and Green locked to the arm

Mixer Frequency Discriminator (MFD)

Basic idea:

Delay: $\Delta t \Rightarrow \phi(f)$

Mixer: $\phi(f) \Rightarrow$ Voltage

2m cable for acquisition
40m cable for low noise mode