Status Update of aLIGO Lock Acquisition Simulation

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LIGO-G1400419-v1

ISC modeling meeting Apr/4/2014

Overview

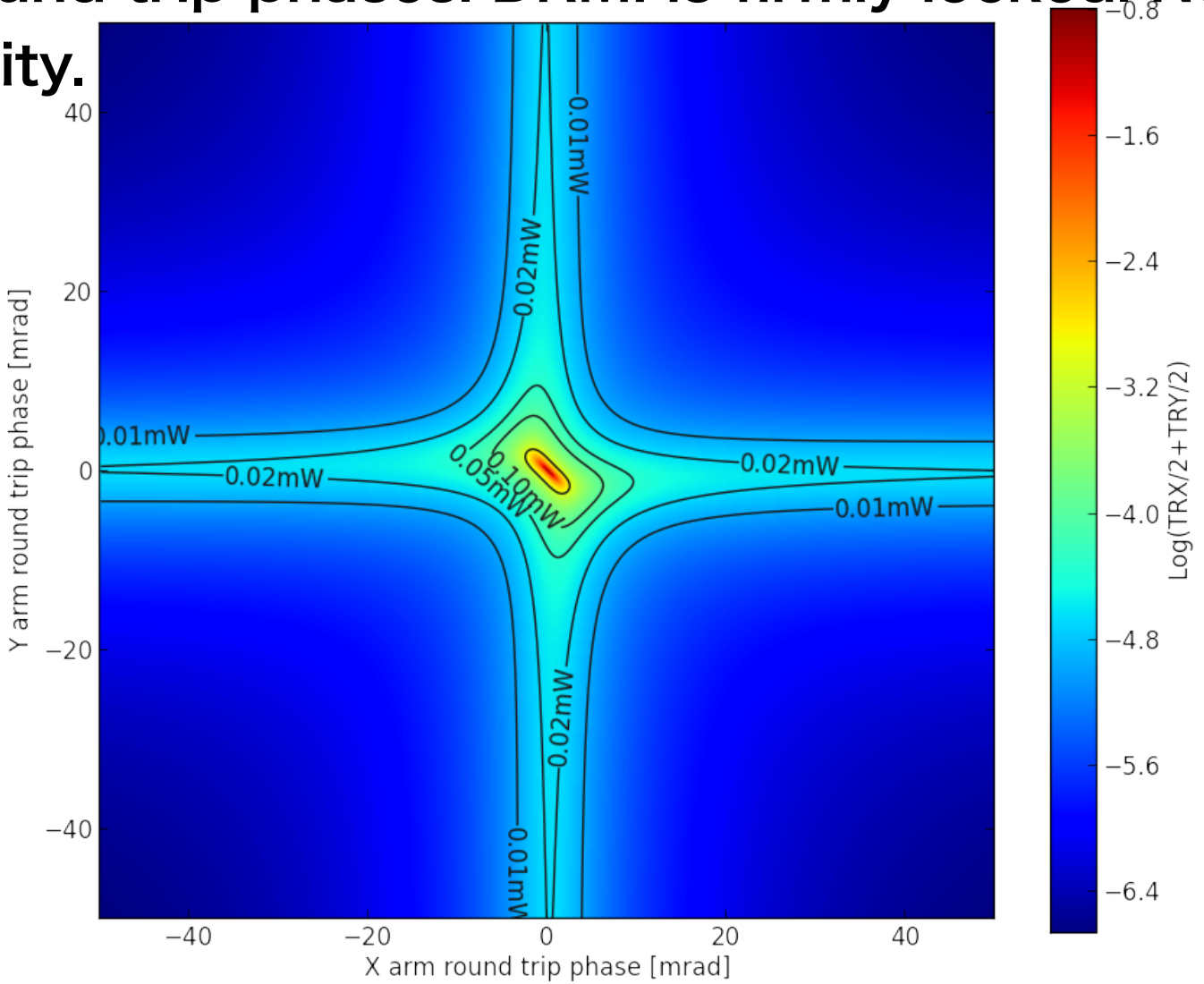
- No useful simulation result yet.
  Still in the process of dry runs.

- There seem several ways to bring the arms to the resonance.
  => I attempt to summarize them by introducing a 2D map.

Mapping

- Draw contour of (TRX+TRY)/2 as a function of x and y arm round trip phases. DRMI is firmly locked. No SRM for simplicity.

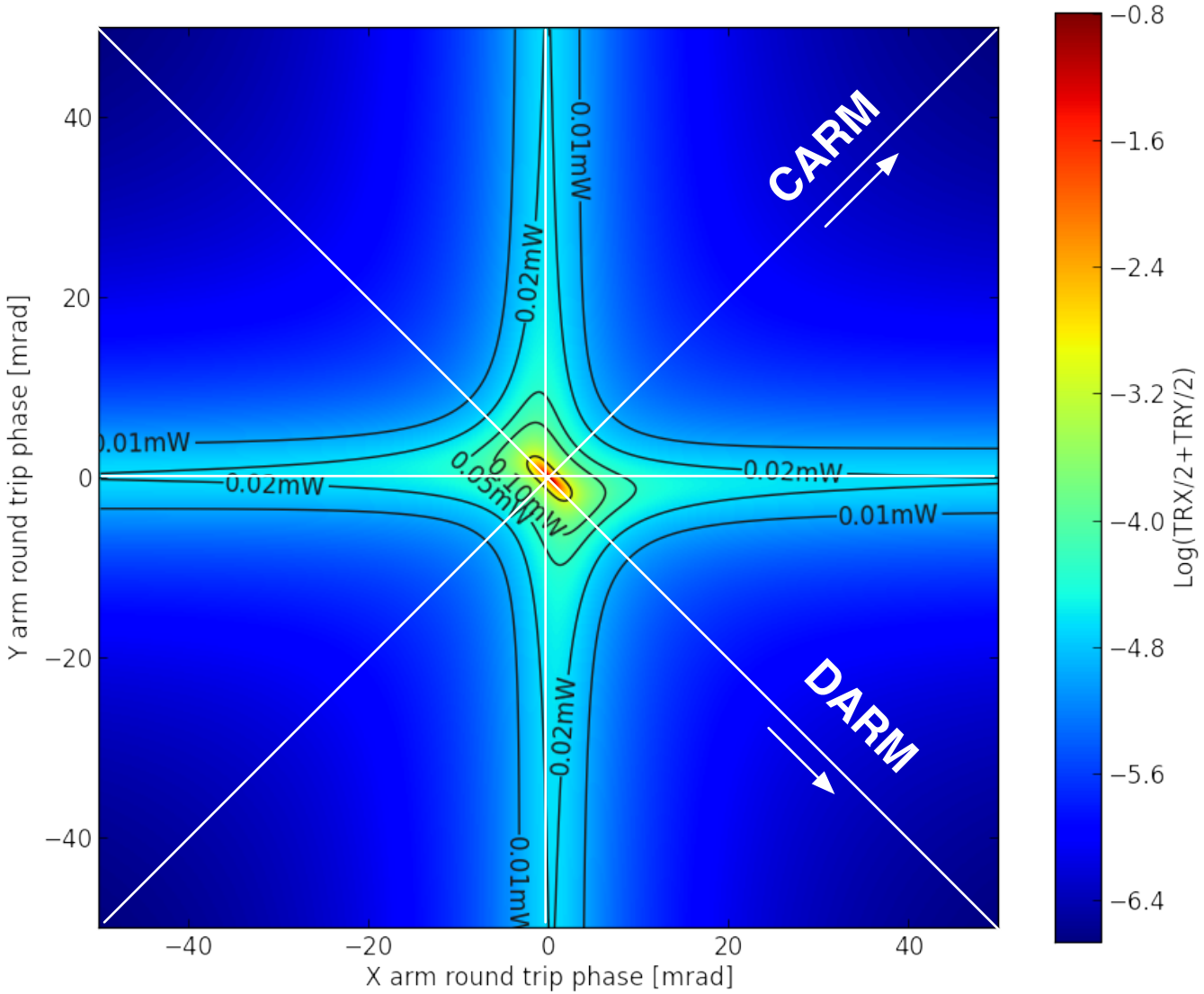
11 mrad
= 1 nm



Mapping

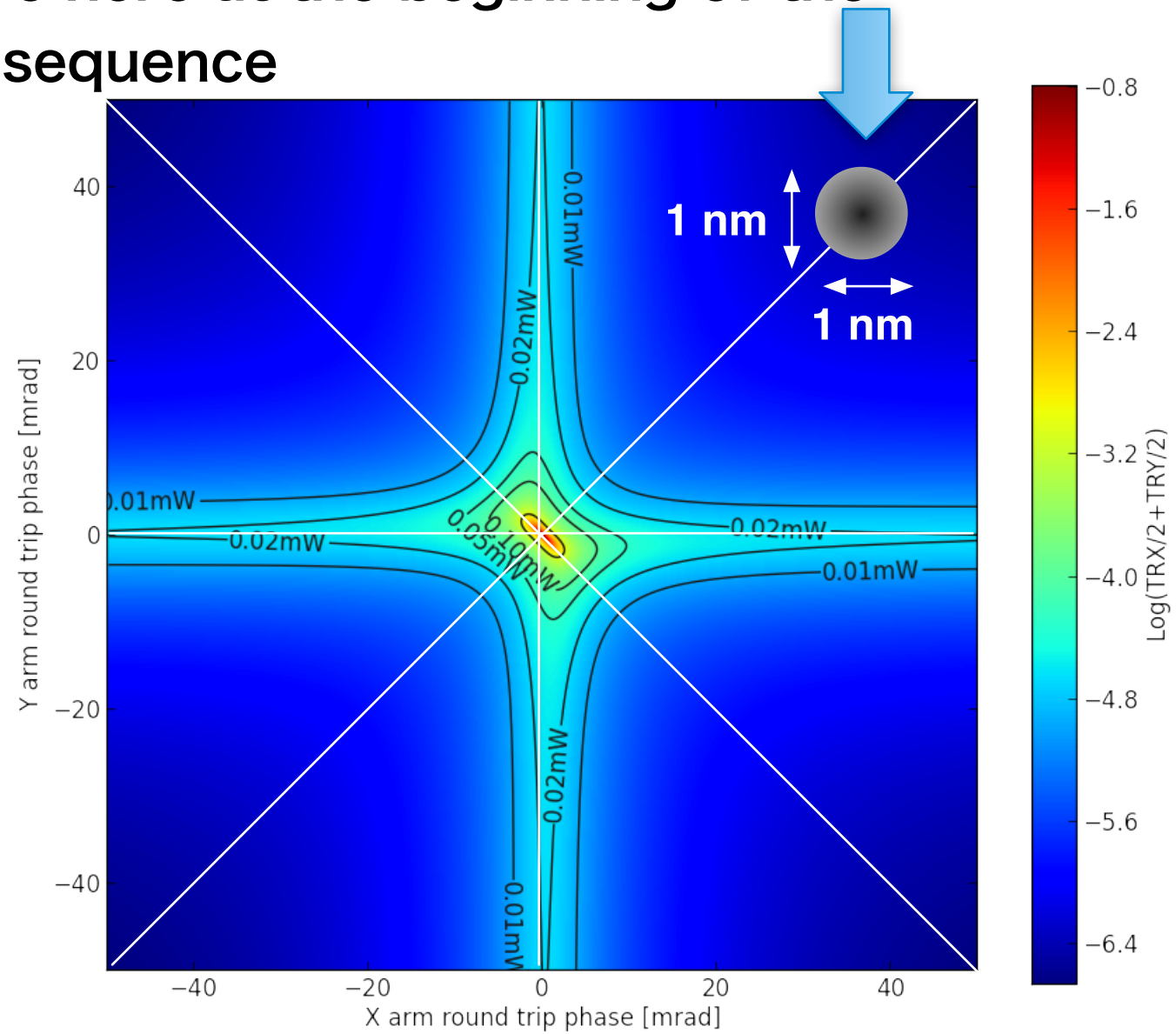
- CARM and DARM are on diagonal axes

11 mrad
= 1 nm

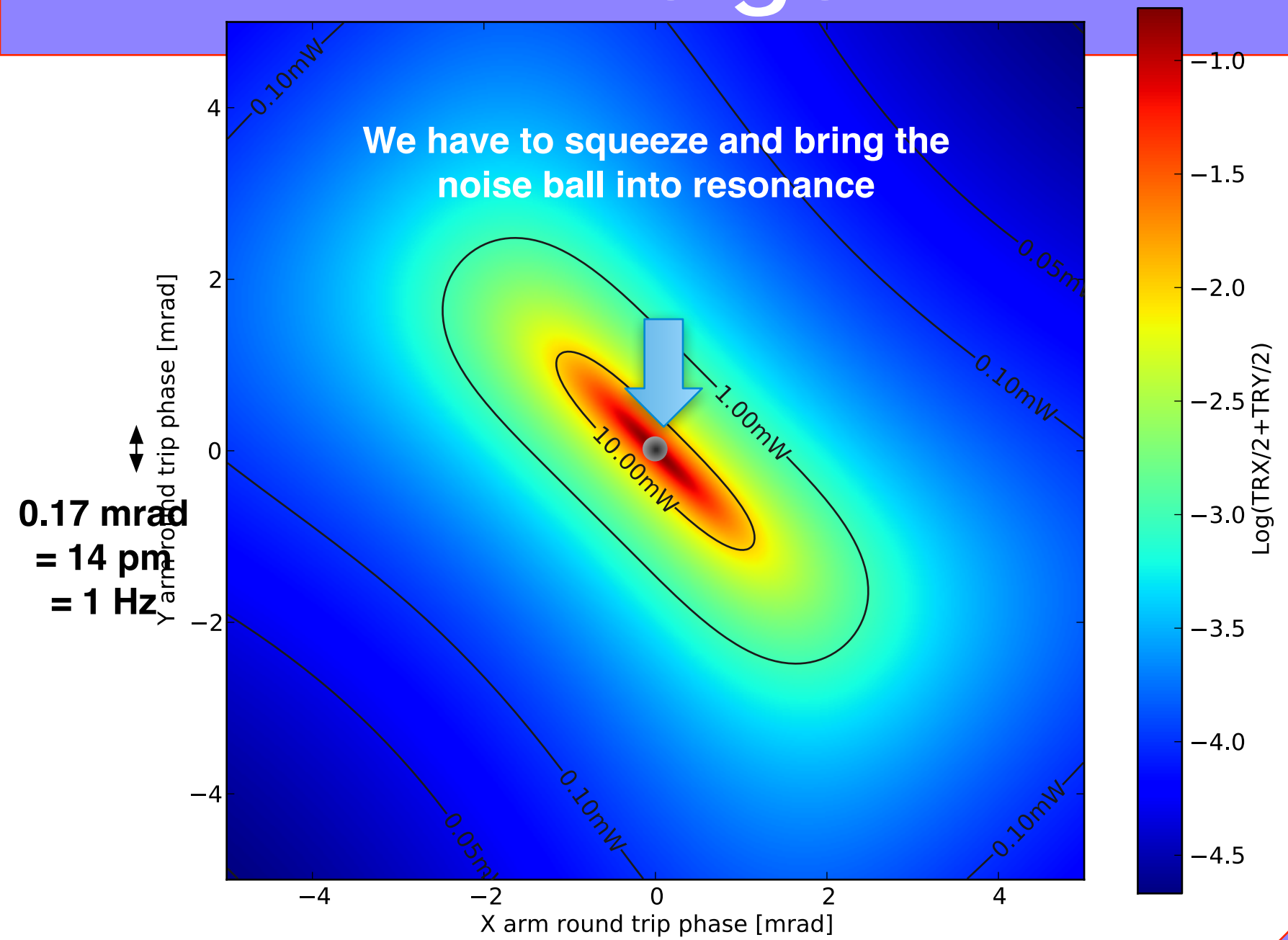


Noise representation

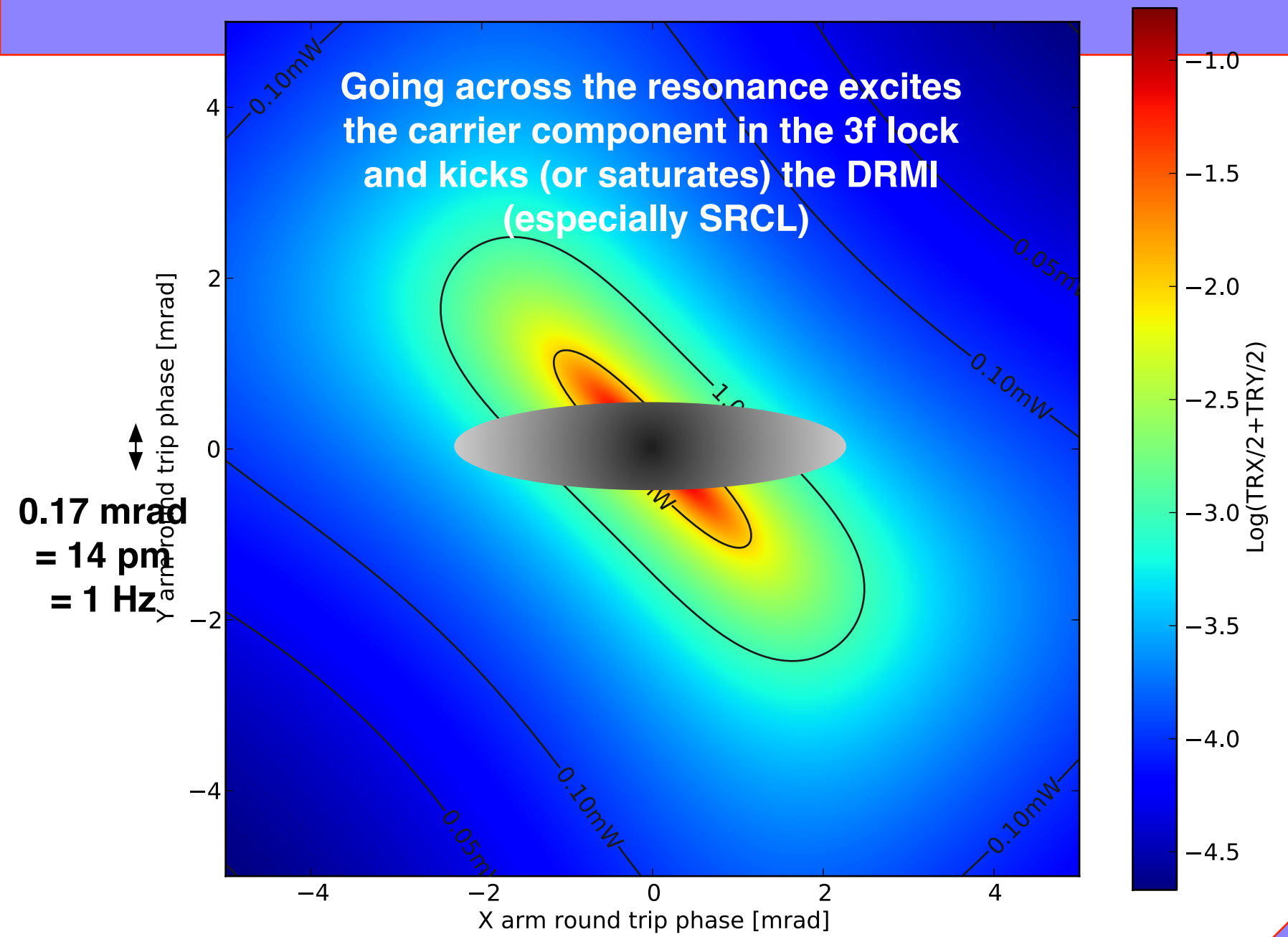
- You are here at the beginning of the locking sequence



The goal


We have to squeeze and bring the noise ball into resonance
0.17 mrad
= 14 pm
= 1 Hz
0.10mW
0.05mW
1.00mW
10.00mW
Y arm round trip phase [mrad]
X arm round trip phase [mrad]
Log(TRX/2+TRY/2)
4
2
0
−2
−4
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5

What is bad?


Going across the resonance excites the carrier component in the 3f lock and kicks (or saturates) the DRMI (especially SRCL)
0.17 mrad
= 14 pm
= 1 Hz
0.10mW
0.05mW
Y arm round trip phase [mrad]
X arm round trip phase [mrad]
Log(TRX/2+TRY/2)
4
2
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−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
−4.5

ALS_diff limits approaches

- You have to move around the noise ball and eventually squeeze the ball into the resonance by switching the sensors to low noise ones.

- ALS_diff noise is not great (~ 1 nm)

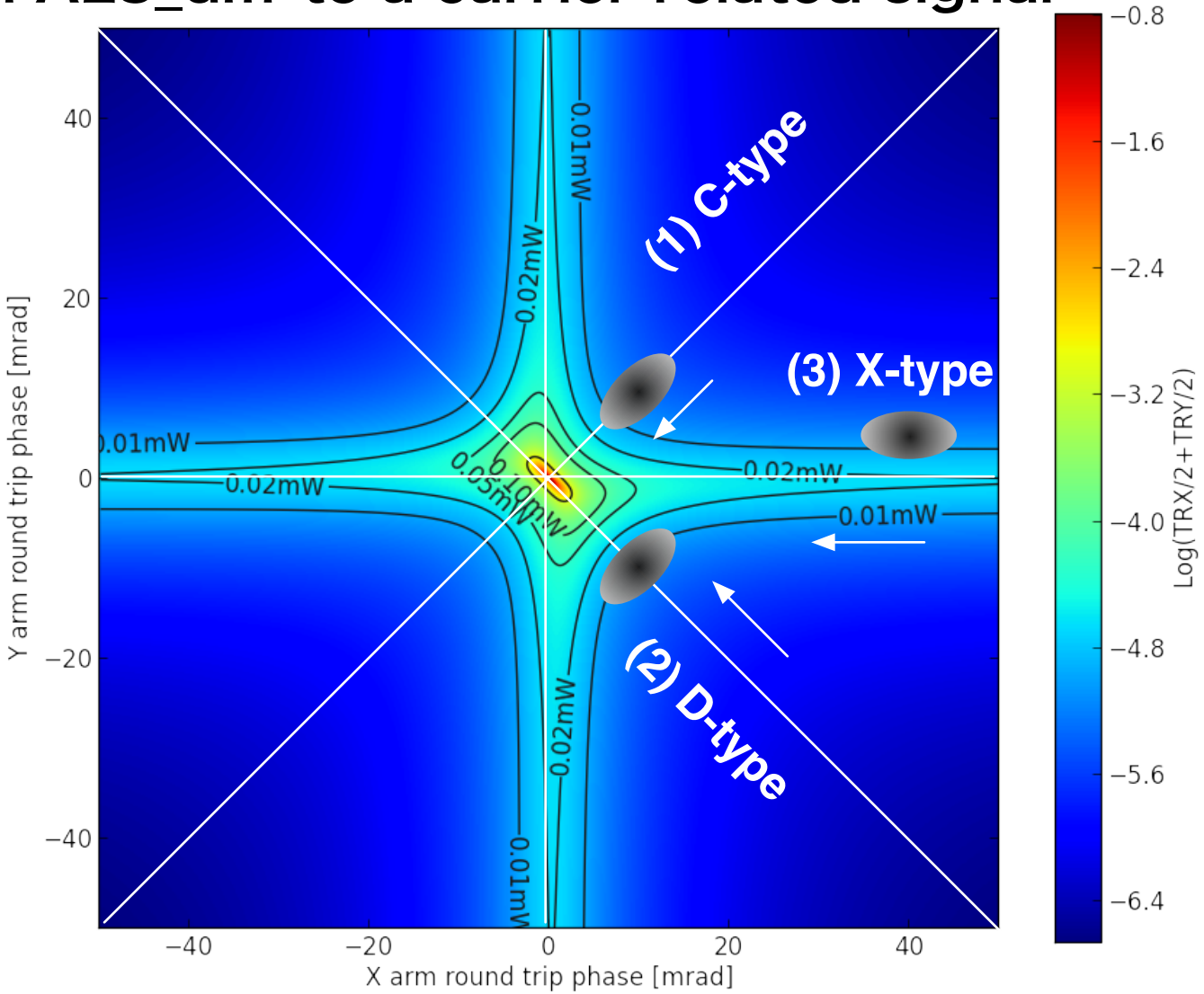
  => needs to be switched to a carrier-related sensor at the beginning.

  => The noise ball must stick to a greenish region in the contour map

Three approaches

- Park the noise ellipse at a greenish point
- Switch ALS_diff to a carrier related signal

11 mrad
= 1 nm



C-type

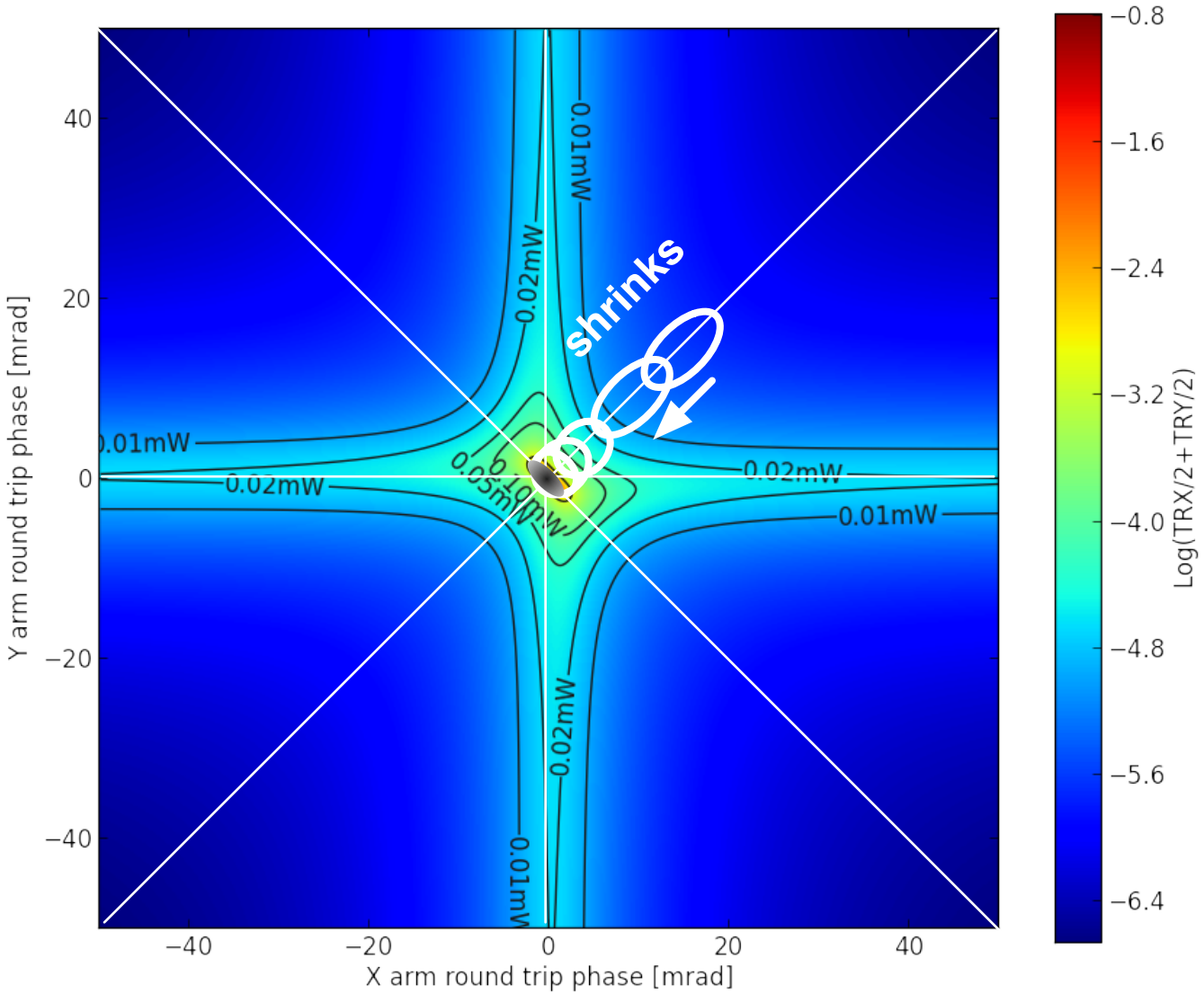
- It is the approach we have been studying in the simulation.

- The noise ellipse is brought along the CARM axis (i.e. CARM has an offset initially)

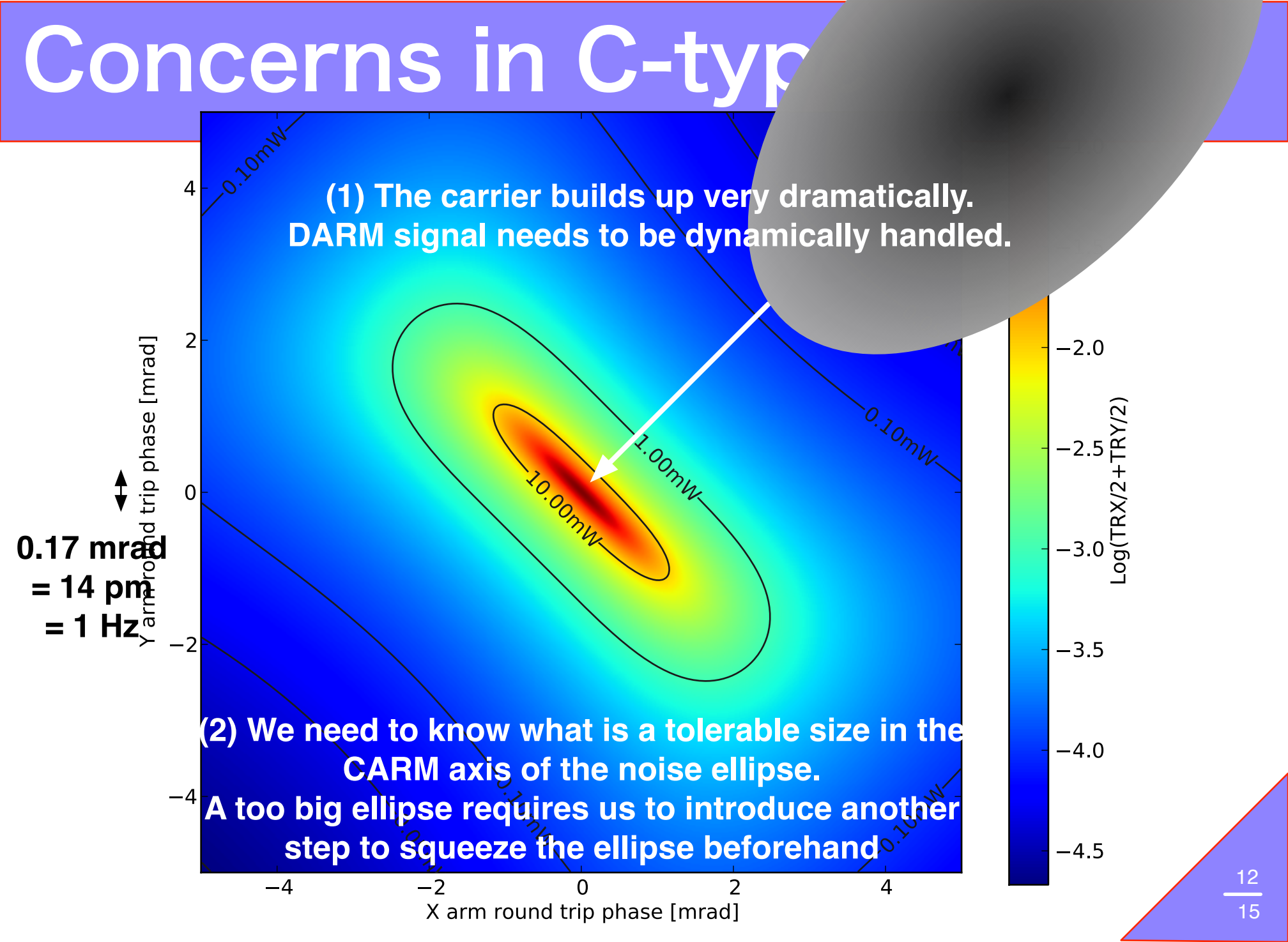
- Self-locking of CARM
  => continuous squeezing of the noise ellipse along the CARM axis as it approaches to the resonance.

C-type with self-locking

11 mrad = 1 nm



Concerns in C-typ



D-type maybe interesting

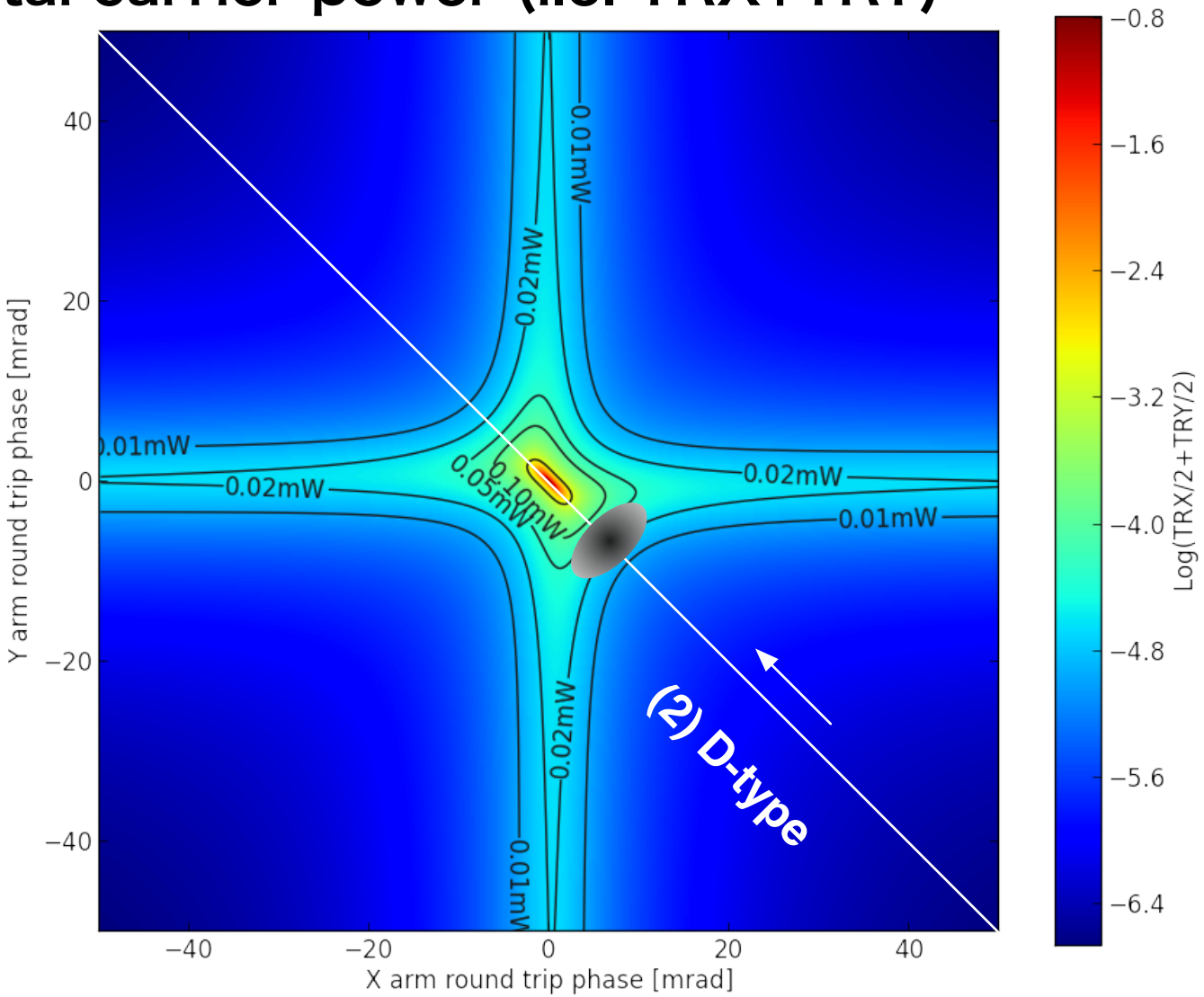
- The carrier seems immune to CARM noise at the initial parking position.

- Less dramatic/dynamic power build-up as the contour is not so steep along the DARM axis.

- However, effects from SRC are not obvious

D-type on map

- Moving along the CARM axis doesn't change the total carrier power (i.e. TRX+TRY)



Next moves

- Test out the C-type.
  See if the latest ALS noise allows the self-locking.
  If not, figure out how many extra steps we need in order to squeeze the noise before the self-locking

- Try D-type if time allows?