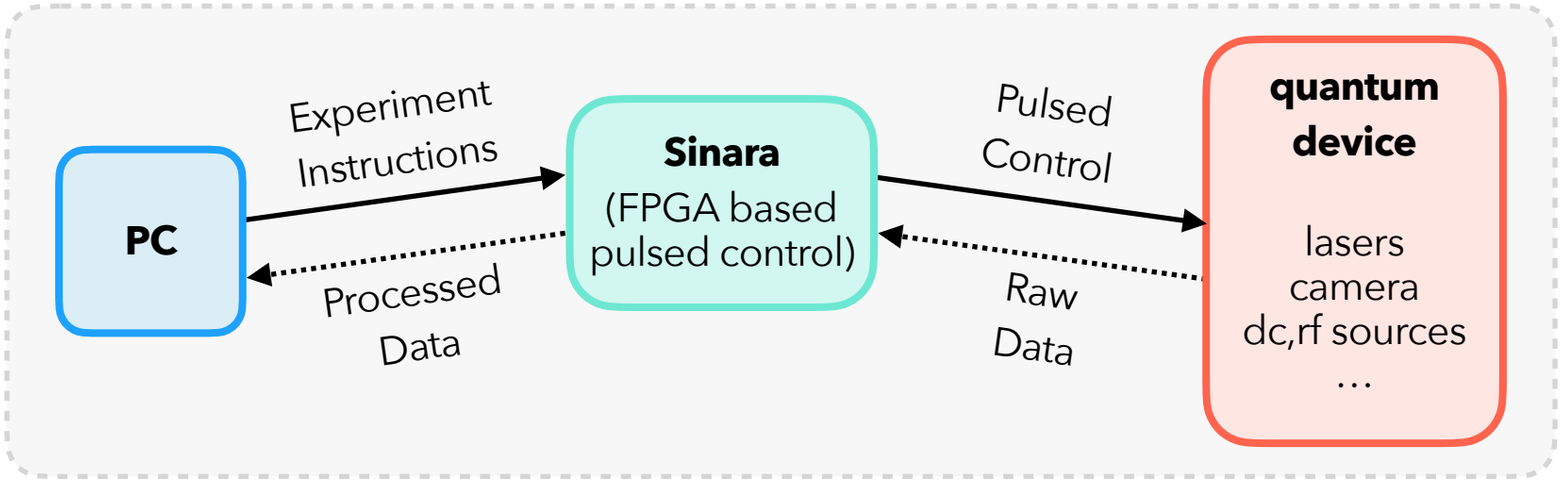
Current Experiment



PC - artiq

Python based infrastructure:
- Defining experiments
- Uploading to the Sinatra hardware
- Manipulating and storing data

Sinara

- Kasli carrier
  - Artix-7 100T FPGA
  - DDR3 SDRAM
  - 4 SFP connectors
  - Can control 12 daughter cards

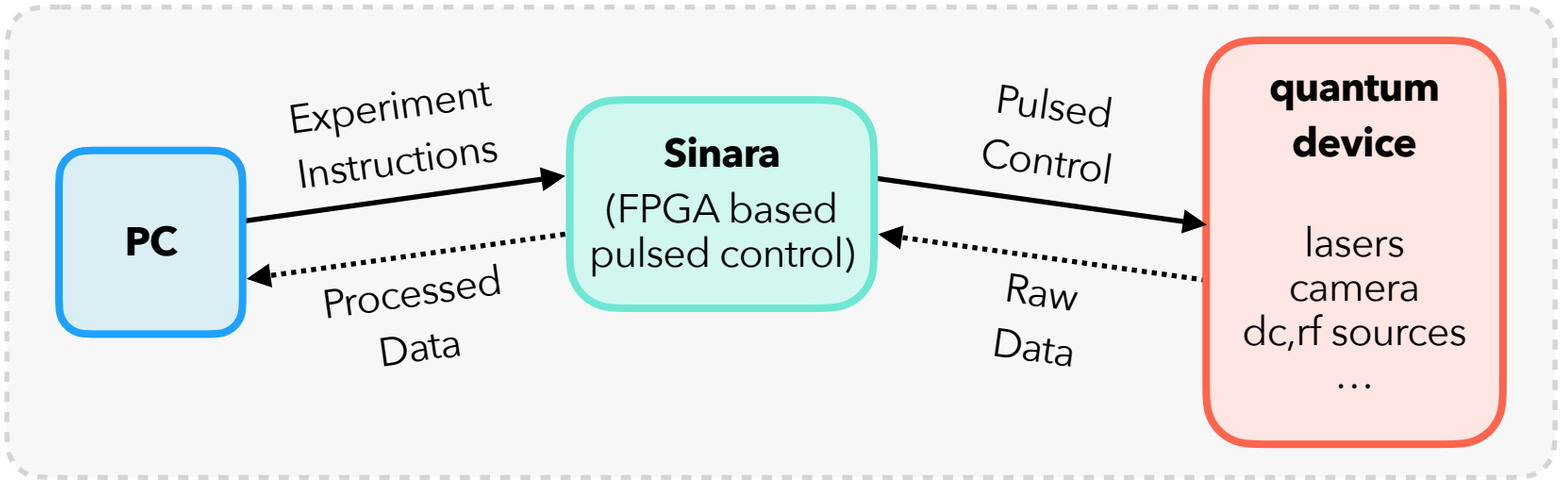
- 1x32 16 bit DAC (1MSPS total)
- 3x4 DDS channels (AD9910)
- 2x8 TTL channels
- 1x8 16 bit ADC (1.5MSPS / channel)
- Camera input + processing (in development)

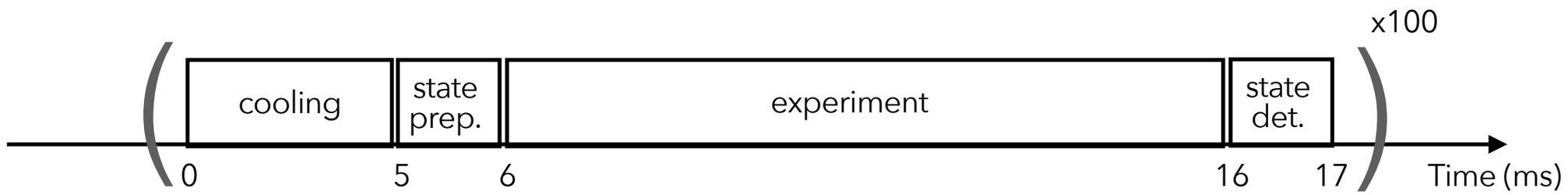
quantum device

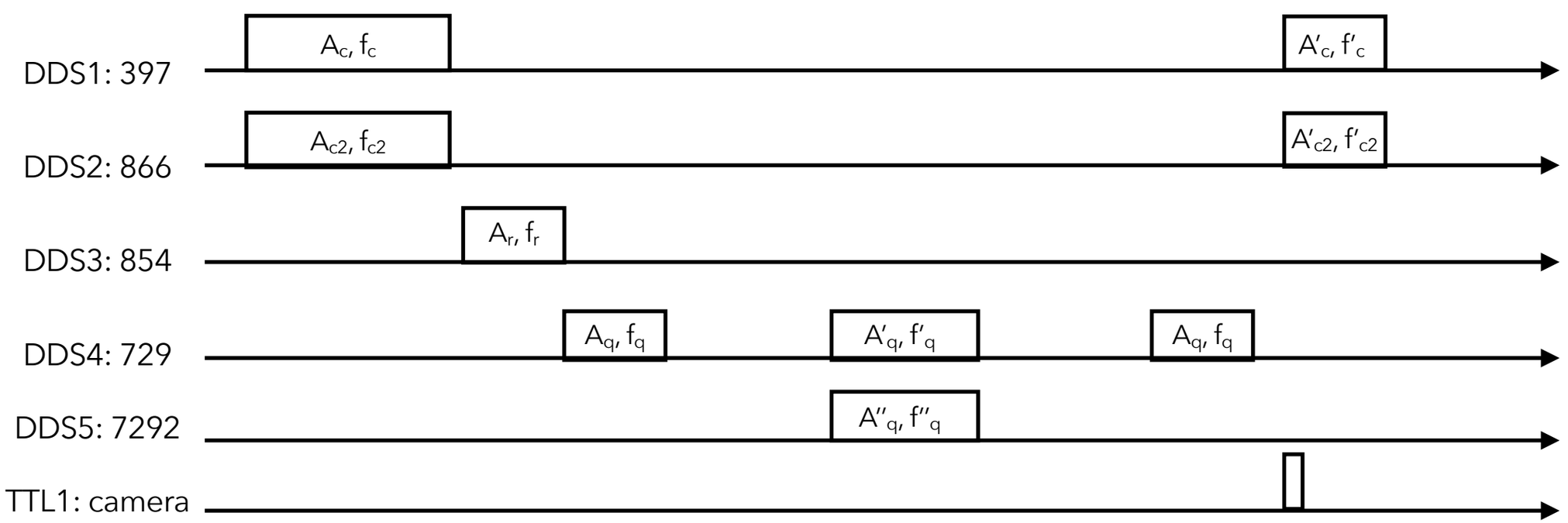
- Ion Trap (rf, dc fields)
- 3+ global cooling + repump lasers
- 2+ gate lasers per qubit
- Camera

12 channels ~ 4 qubits maximum

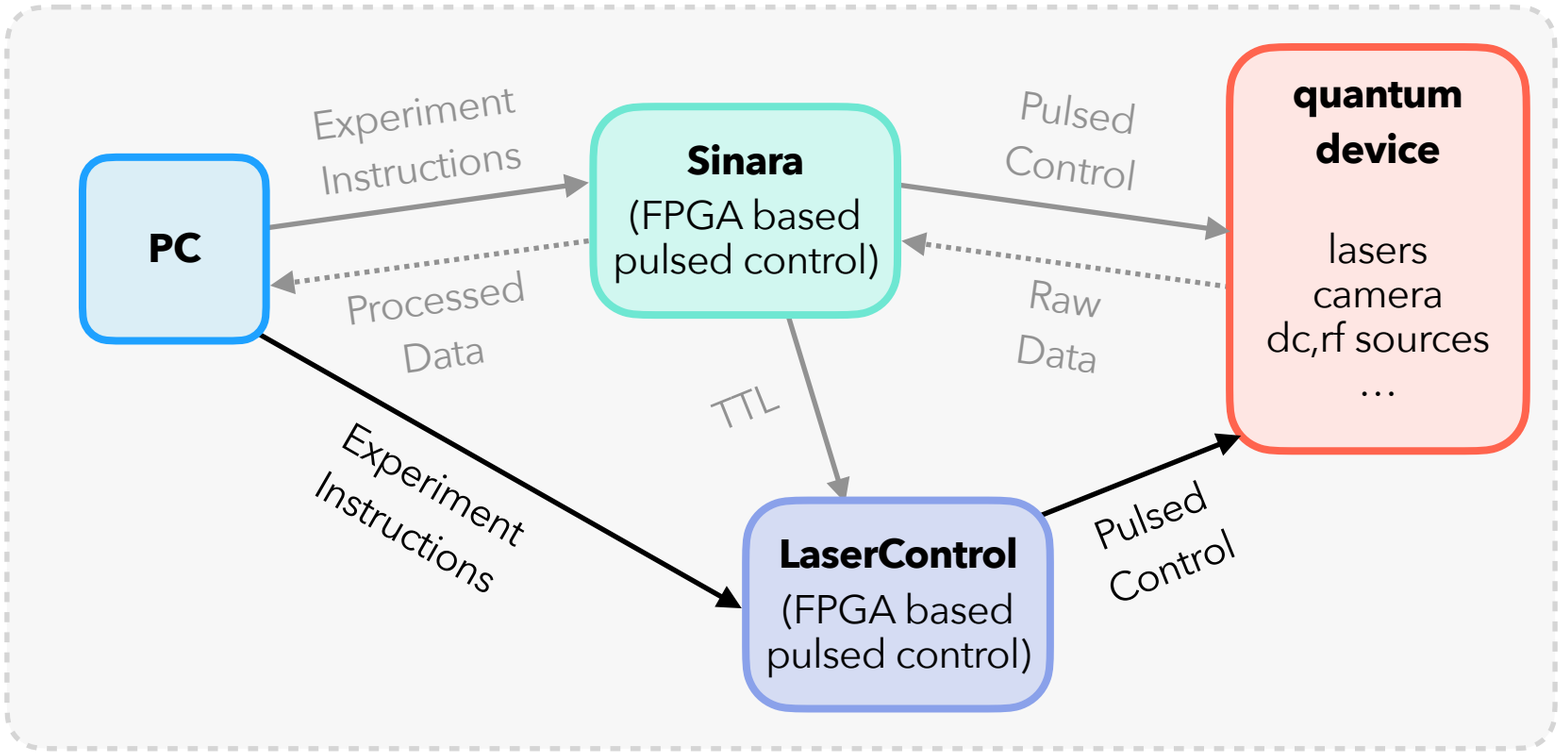
Current Experiment







Proposed Improvement

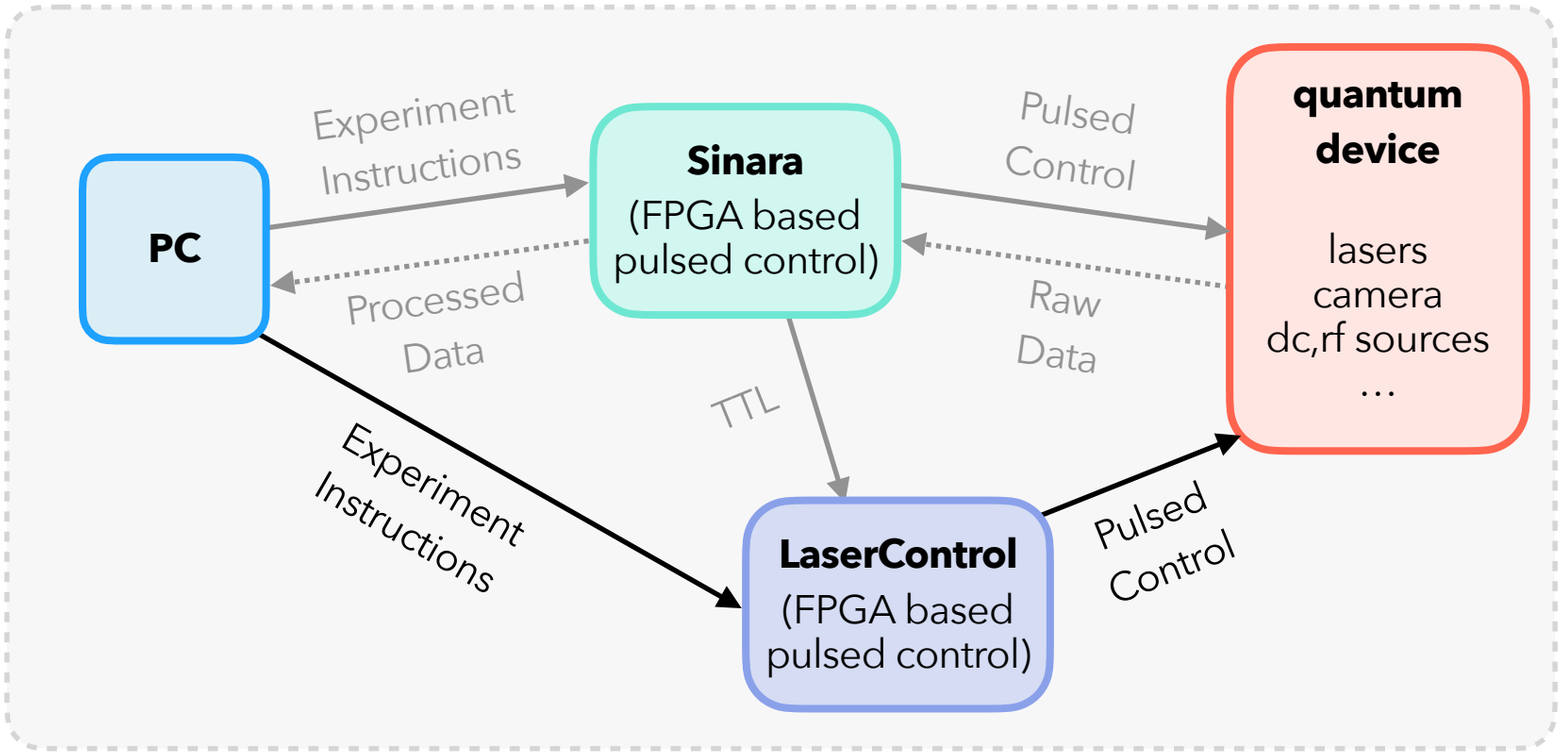


1. Optical hardware change (SQRLab specialty)
   Currently: AOMS
   - Bulky (~1 cubic foot for each channel, if you try hard)
   - Need high rf power (100MHz, ~1W per channel)
   - Can control amplitude, frequency, phase of laser by controlling rf signal

   New: Integrated Photonics
   - Compact (< 1sqmm per channel)
   - Low power, no rf (us-scale switching, few V per channel)
   - Can control amplitude, phase of laser by applied signal… frequency is harder.

2. Control hardware change (your specialty!)
   - Multi-channel DC trimming (PC controlled)
   - Multi-channel fast pulsed control

Proposed Improvement

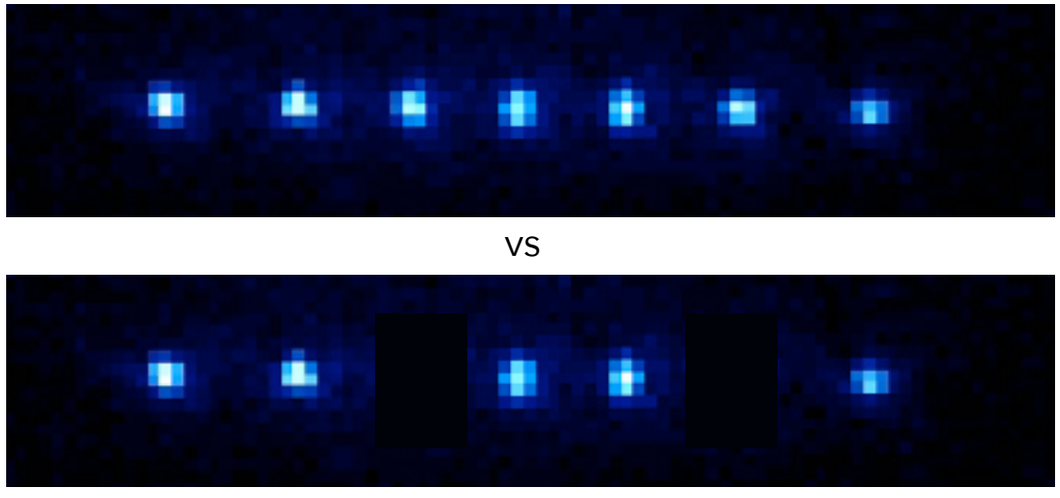


LaserControl
(wish list)

- 32 channels analog dc control
  - User (PC) controlled
- 32 fast channels
  - Sequence uploaded from pc
  - synchronized with the Sinara-based experiment
  - Sub-microsecond control
  - Near term goal: on-off control
  - Stretch goal: arbitrary amplitude control

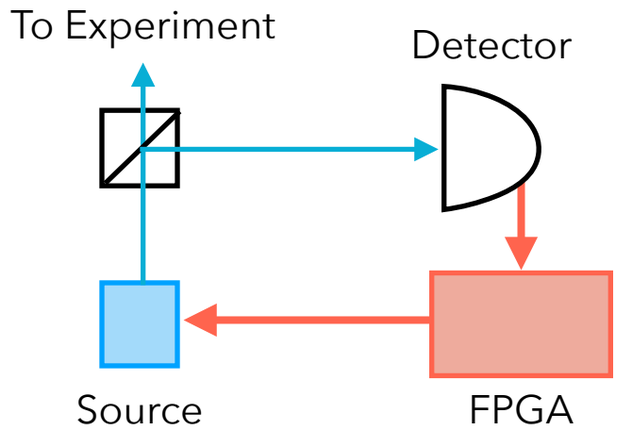
Other FPGA-based ideas:

1) Camera-based state detection
~ ms detection + processing



vs

2) Laser amplitude stabilization



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