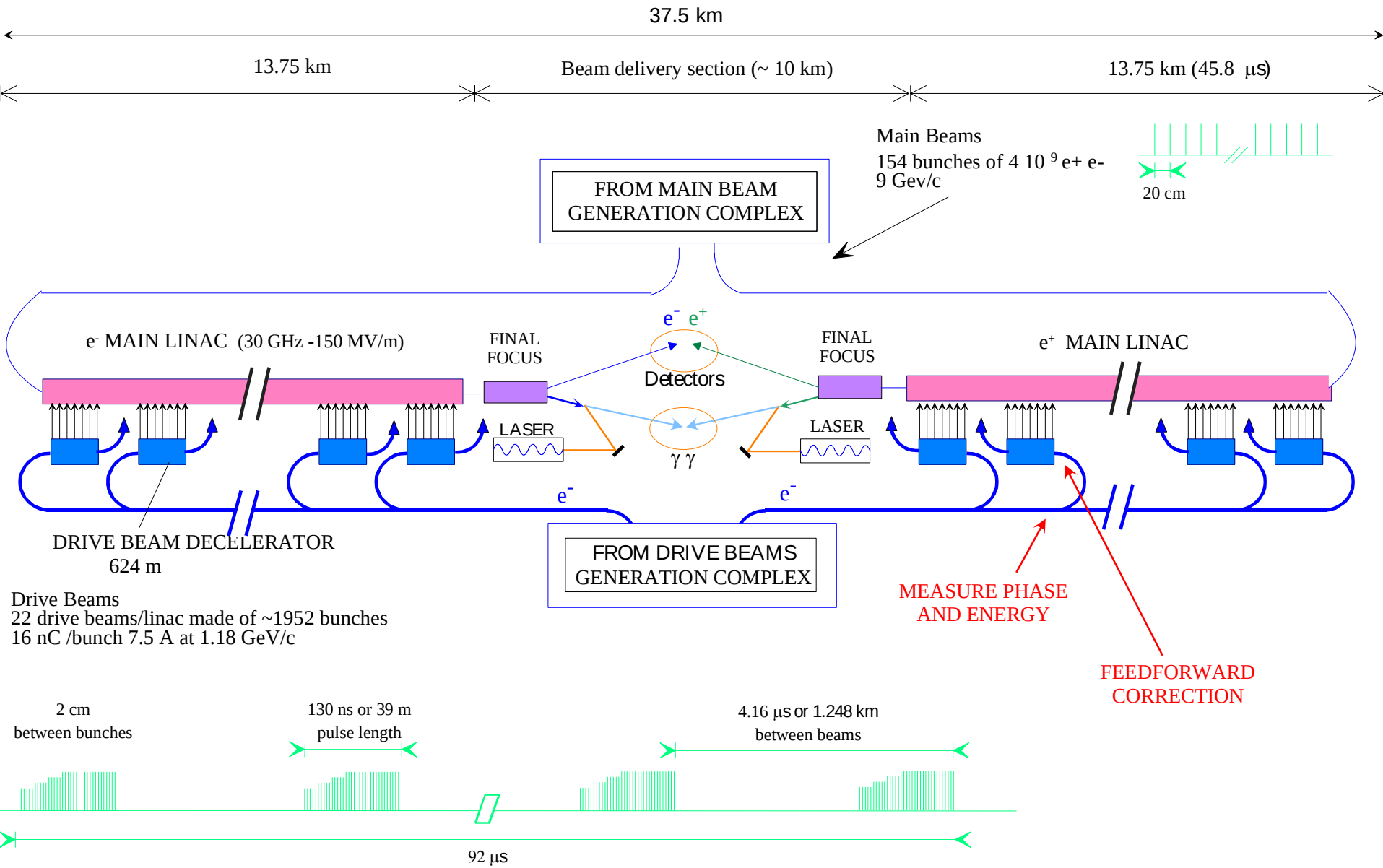
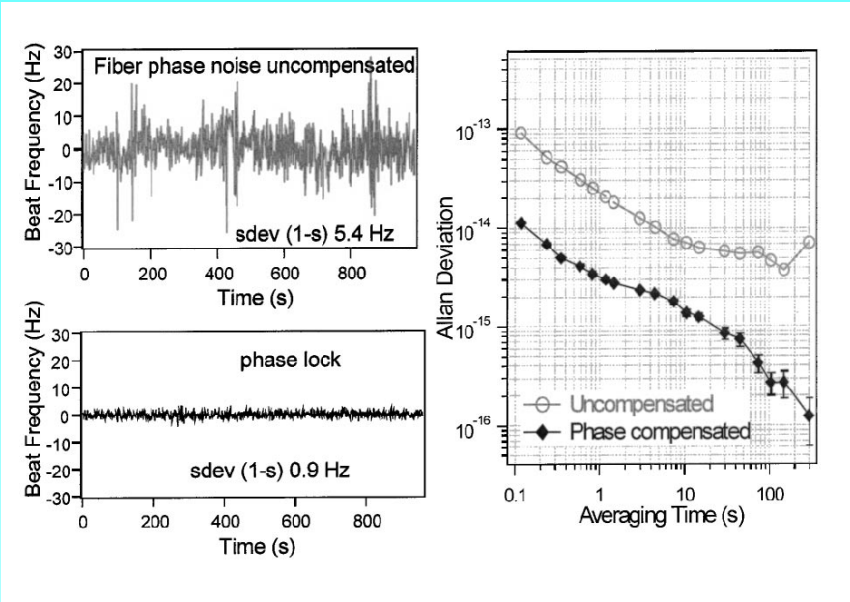

37.5 km
13.75 km
Beam delivery section (~ 10 km)
13.75 km (45.8 μs)
Main Beams
154 bunches of 4 10 9 e+ e-
9 Gev/c
20 cm
FROM MAIN BEAM
GENERATION COMPLEX
e- MAIN LINAC (30 GHz -150 MV/m)
FINAL
FOCUS
e- e+
Detectors
FINAL
FOCUS
e+ MAIN LINAC
LASER
LASER
γ γ
e-
e-
DRIVE BEAM DECELERATOR
624 m
FROM DRIVE BEAMS
GENERATION COMPLEX
Drive Beams
22 drive beams/linac made of ~1952 bunches
16 nC /bunch 7.5 A at 1.18 GeV/c
MEASURE PHASE
AND ENERGY
FEEDFORWARD
CORRECTION
2 cm
between bunches
130 ns or 39 m
pulse length
4.16 μs or 1.248 km
between beams
92 μs

Stabilized fibre optic reference distribution



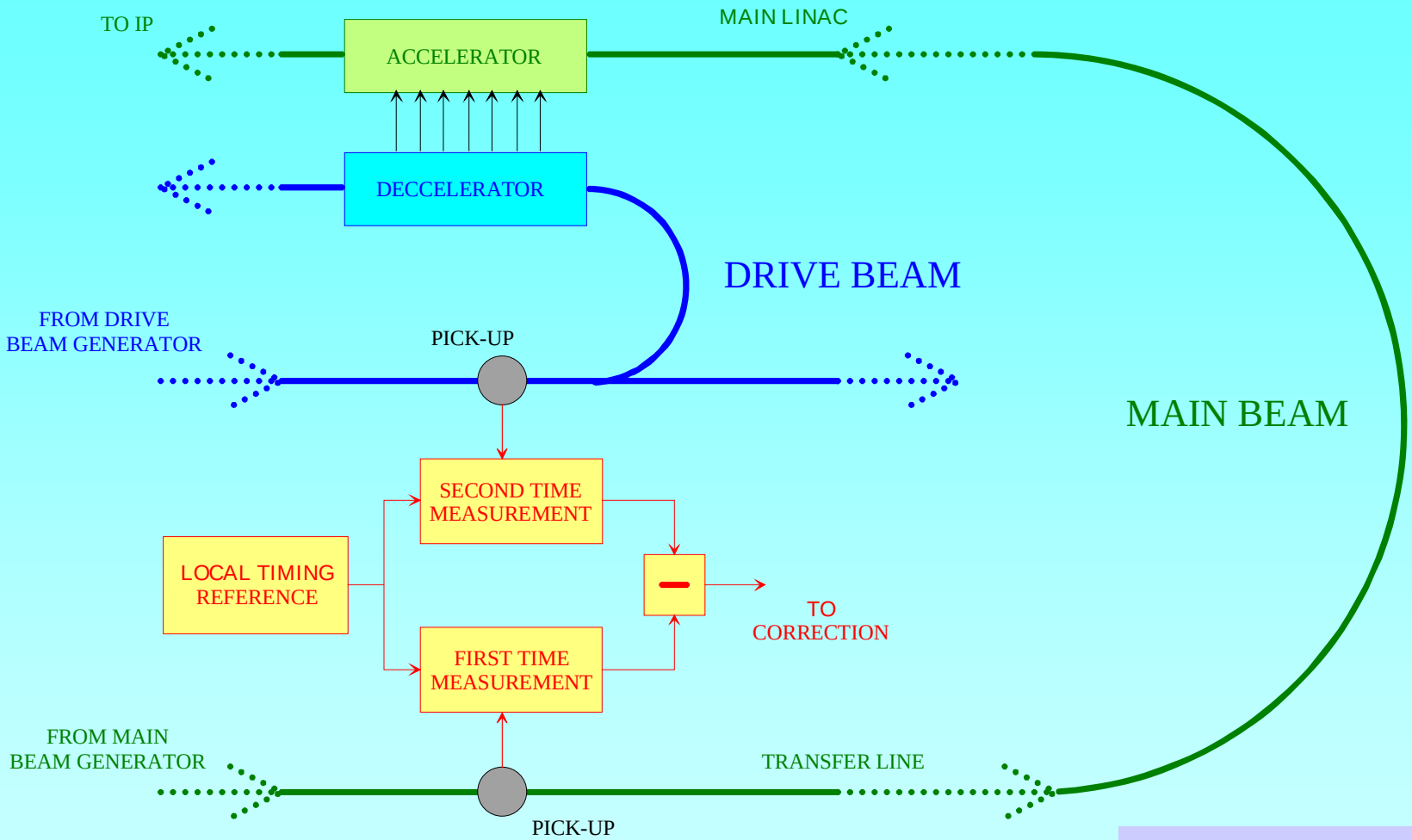
Done

- NLC 300 fs in 1 minute
- JPL/NASA 60 fs in 1 minute
- NIST 30 fs in 1 minute

Ongoing at NIST/MIT

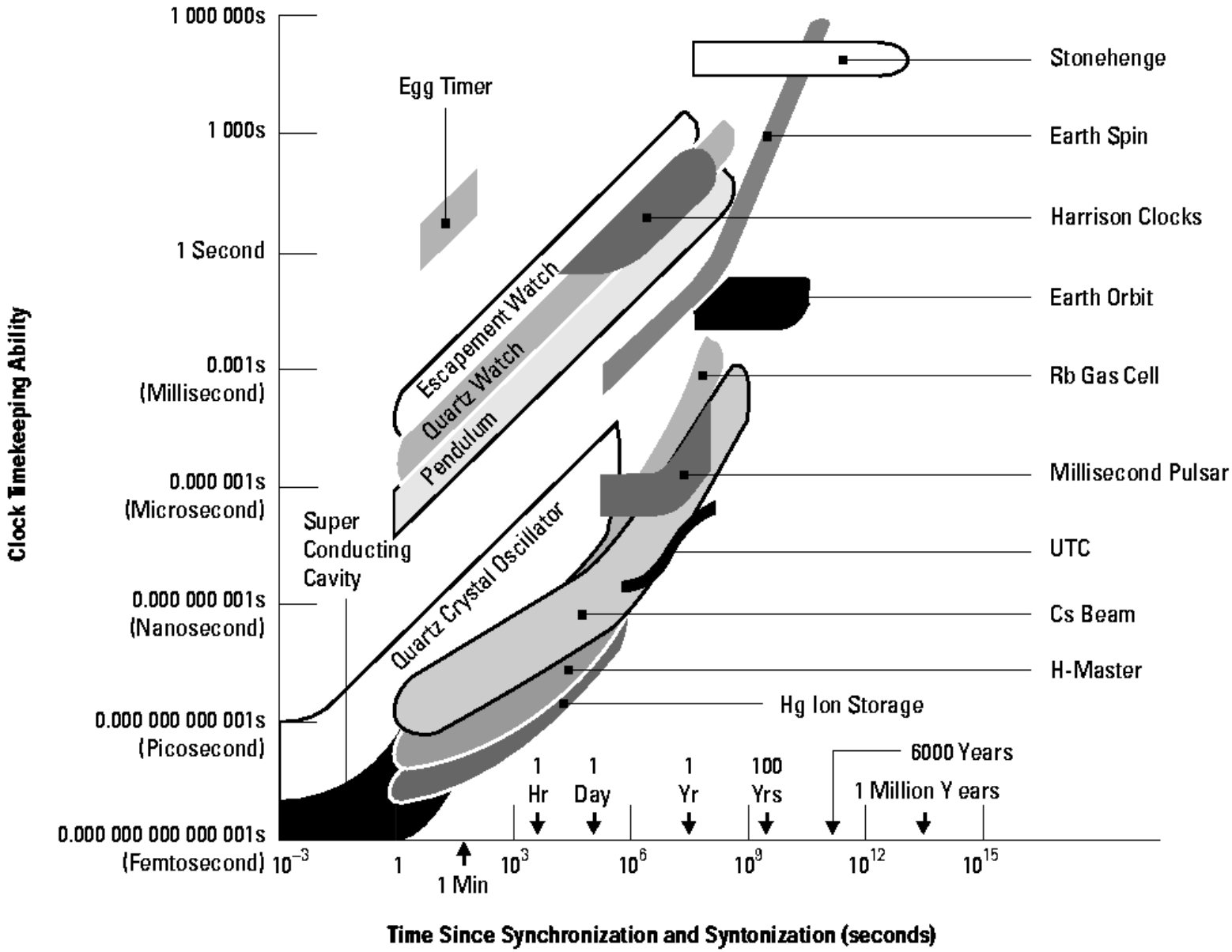
- Aiming for < 10 fs synchronization with
  - 1.5 μm mode-locked laser
  - Optical derivation of error signal
  - RF transmission using laser repetition frequency
  - Time-to-amplitude conversion before photo-detection

Using main beam as phase reference



Must keep time for up to 92 μs

Keeping 5 fs for 100 μs



Low noise microwave source

Jitter 10kHz to 50MHz from carrier:

- Best commercial synthesizer 15fs
- Best dielectric resonator 6fs
- Sapphire loaded cavity oscillator 3fs

Typical

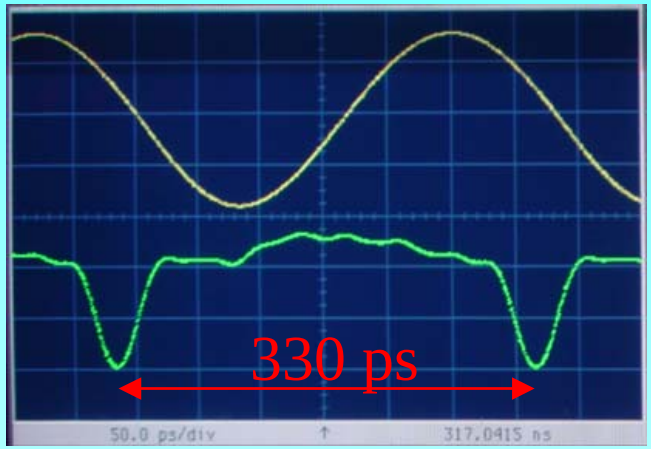
For long term stability should be locked to a reference:

- Cesium standard
- GPS-controlled quartz
- CLIC master oscillator through reasonably stable distribution line

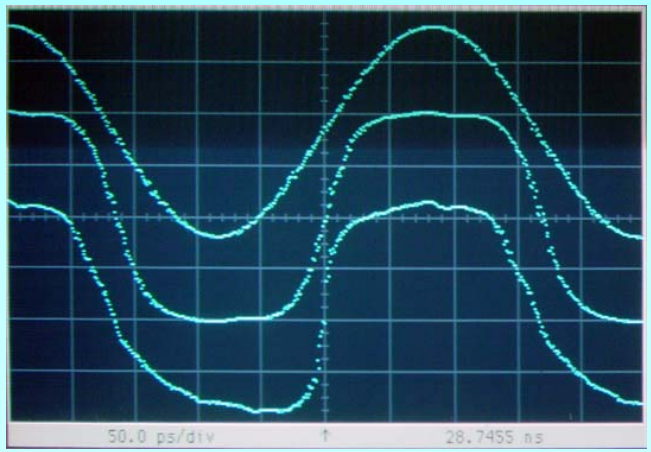
Multiplication 3GHz to 30GHz

Measured jitter of:

Step recovery diode
0.05 degree



Edge compressor diode
0.1 degree



Phase detection

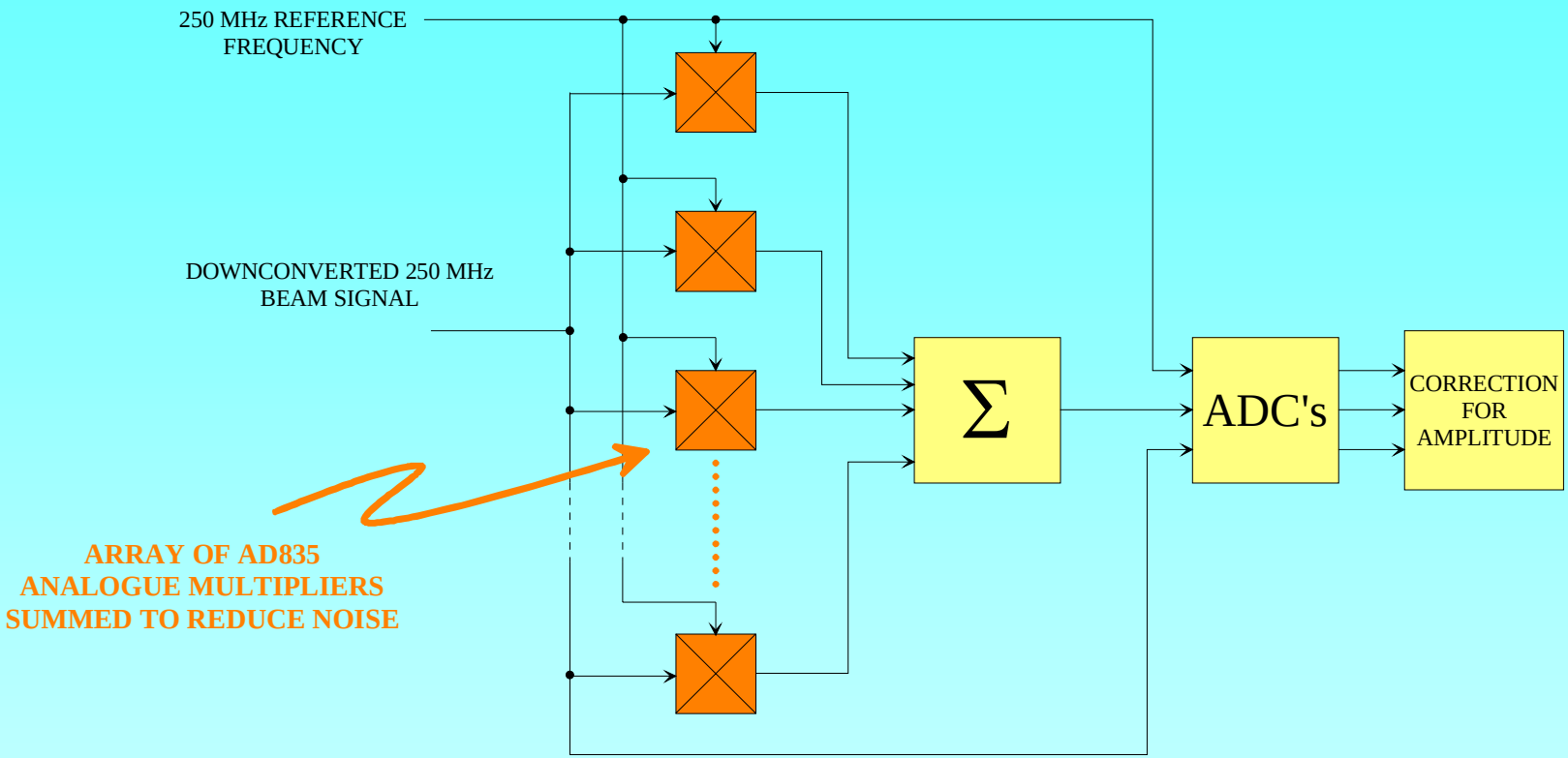
Requirements

- Single-shot
- ± 50MHz bandwidth
- 0.1 degree resolution
- Limited linear range OK
- Amplitude range?

Mix down to some intermediate frequency and then

- ADC
  - ☹ 2005 < 1 degree, 2007 < 0.25 degree
- Analogue mixer
  - ☹ amplitude dependence very strong
    (~ 0.1 degree for 1%)
- Analogue multiplier
  - ☹ amplitude dependence
  - ☹ noisy (~ 0.2 degree RMS in 50 MHz)

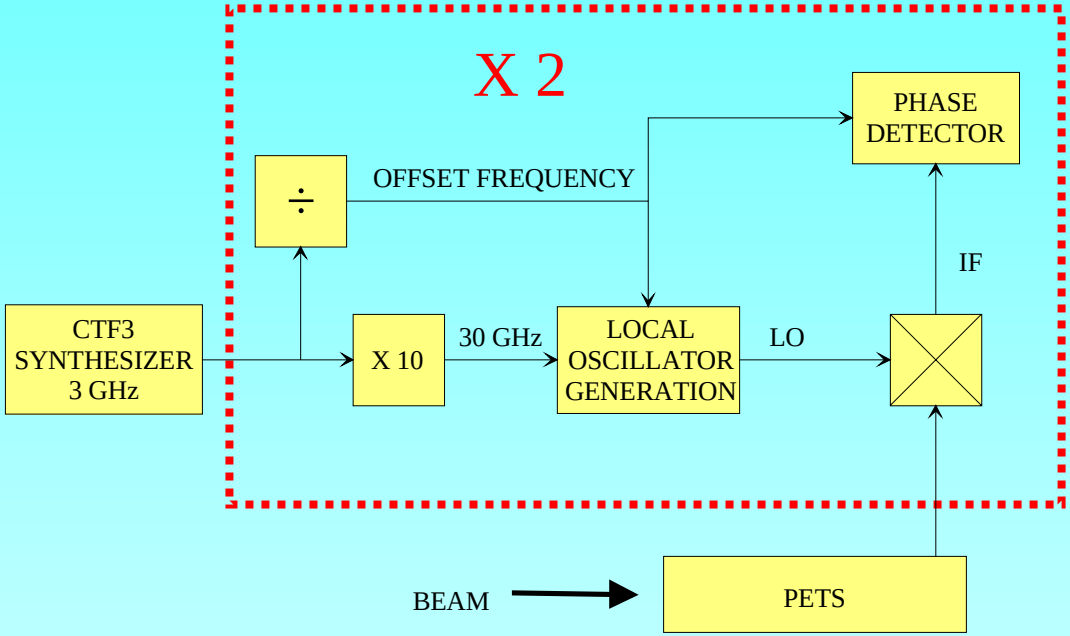
Possible phase detection scheme



Measured performance of two devices summed:

- Noise 0.12 degree RMS in 50 MHz
- Amplitude dependence 2.5 degrees for 6 dB

Test in CTF3


X 2
PHASE DETECTOR
÷
OFFSET FREQUENCY
IF
CTF3 SYNTHESIZER 3 GHz
X 10
30 GHz
LOCAL OSCILLATOR GENERATION
LO
BEAM
PETS

Things to do next

- Analogue multiplier
  - Amplitude and phase frequency response
  - 500MHz IF?
  - Lower noise
- Other phase detectors?
  - Higher frequency mixers
  - Limiters
- Choose IF