

# High finesse cavity for Polarised Positron Source on ILC.



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**LAL – ORSAY  
PLIC**

## Pulse Laser Injected Cavity

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Jehanno D., Soskov V., Variola A., Zomer F.,

# Logic of a laser choice.

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**Object:** train of particles bunches



**Gain=duty factor**

**Pulse laser**

**Small cross-section of the interaction**

**Gain=** $10^3$ - $10^4$

**Gain=** $N_{IP}$

**Locking technique**

**One IP  
Multiple used each of the pulses  
inside the cavity**

**One laser pulse  
Multiple IP**

**Cavity without locking**

## Present R&D at Orsay (funded by EUROTEV & IN2P3:CNRS)

- Goal: operate a very high finesse Fabry-Perot cavity in pulsed regime
  - 2 and 4 mirrors cavities
  - Gain:  $10^4$ - $10^5$
- Previously: cw 2m long cavity installed at HERA with gain= $10^4$ 
  - Our R&D is an extention of the cw mode to pulsed mode

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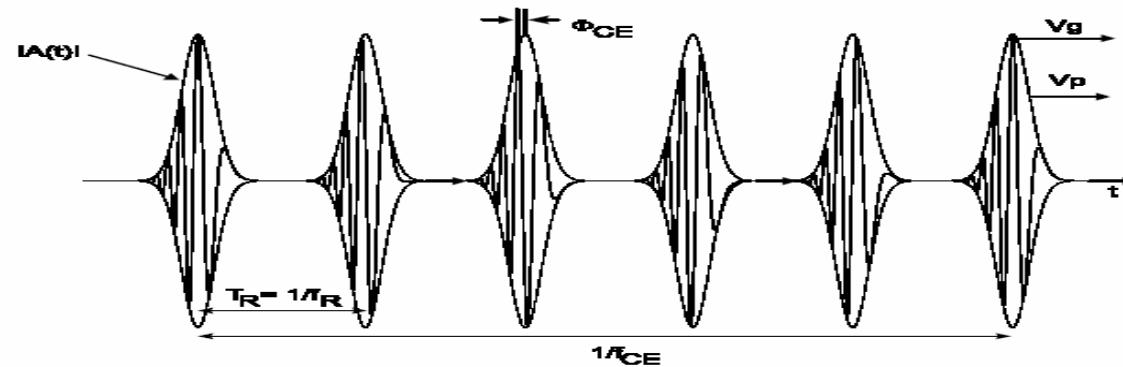
# Optical pulse train description

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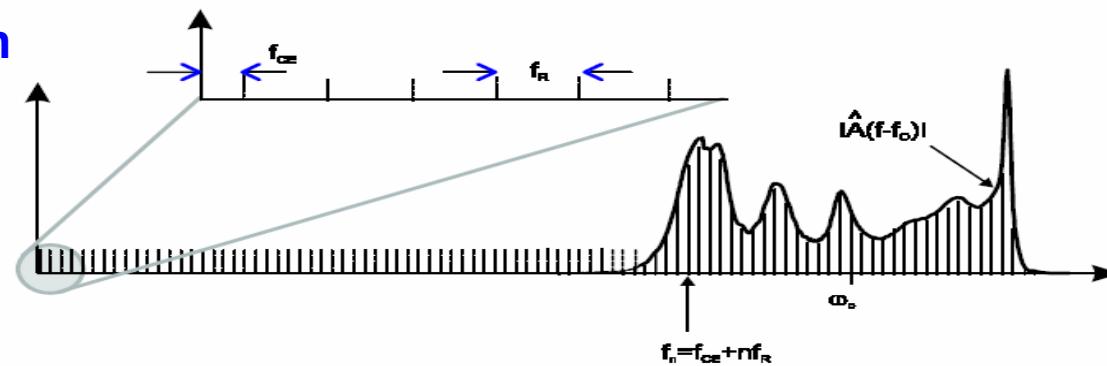
$$A(T, t) = \sum_{m=-\infty}^{+\infty} a(T = mT_r, t) e^{j[\omega_c(t - mT_r + (\frac{1}{v_g} - \frac{1}{v_p}) 2mL)]}$$

$$\frac{1}{V_g} = \frac{1}{V_p} + \frac{\omega \partial n(\omega)}{c} \quad \Delta\phi_{CE} = \int_0^L \frac{\omega^2}{c} \frac{\partial n(\omega, x)}{\partial \omega} dx$$

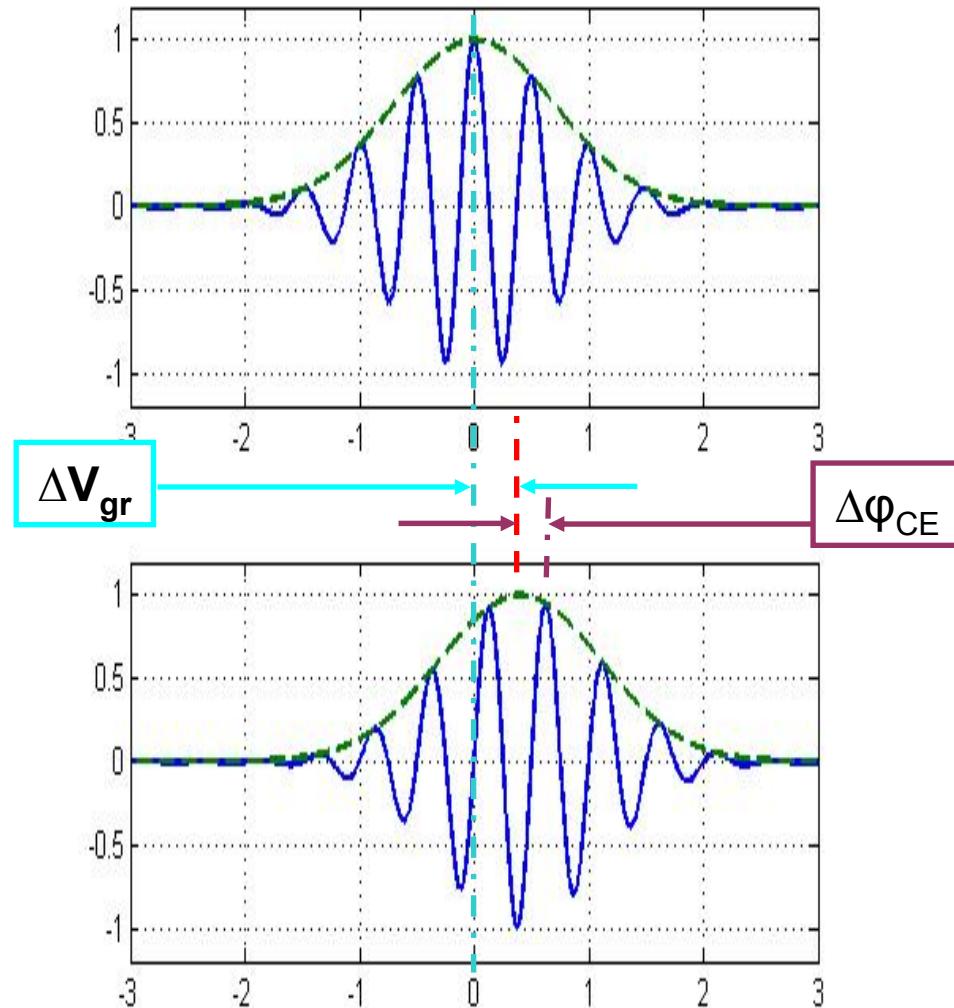
## Time Domain



## Frequency Domain



# Build-up process in Cavity

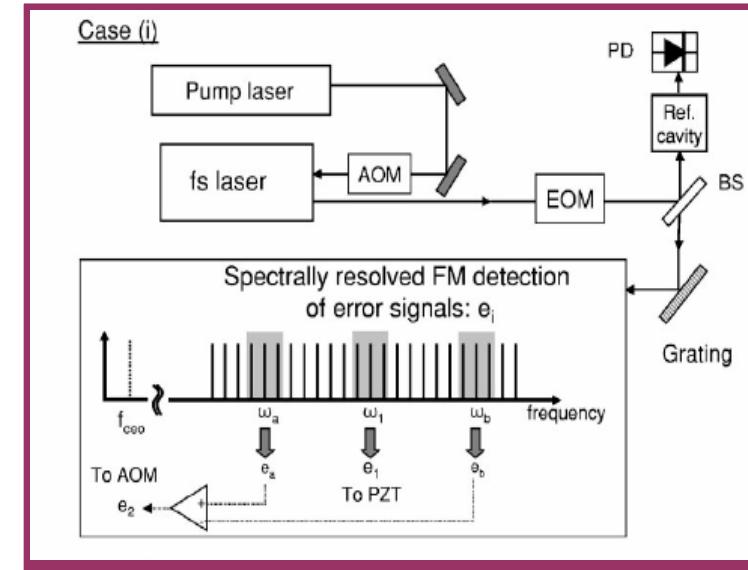
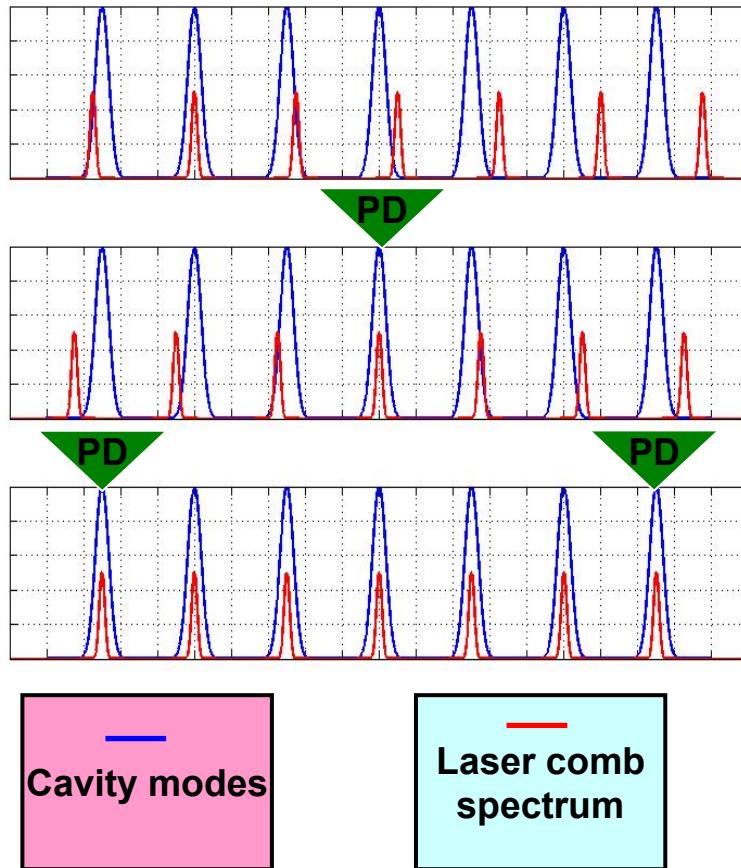


$$N = T_d \cdot F_{REP} = \frac{F}{2 \cdot \pi}$$

$$T_d = \frac{F}{\pi} \times \frac{L}{c} = \frac{F}{2 \cdot \pi} \times \frac{1}{F_{REP}}$$

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# Locking of $F_{ce}$ and $F_{rep}$



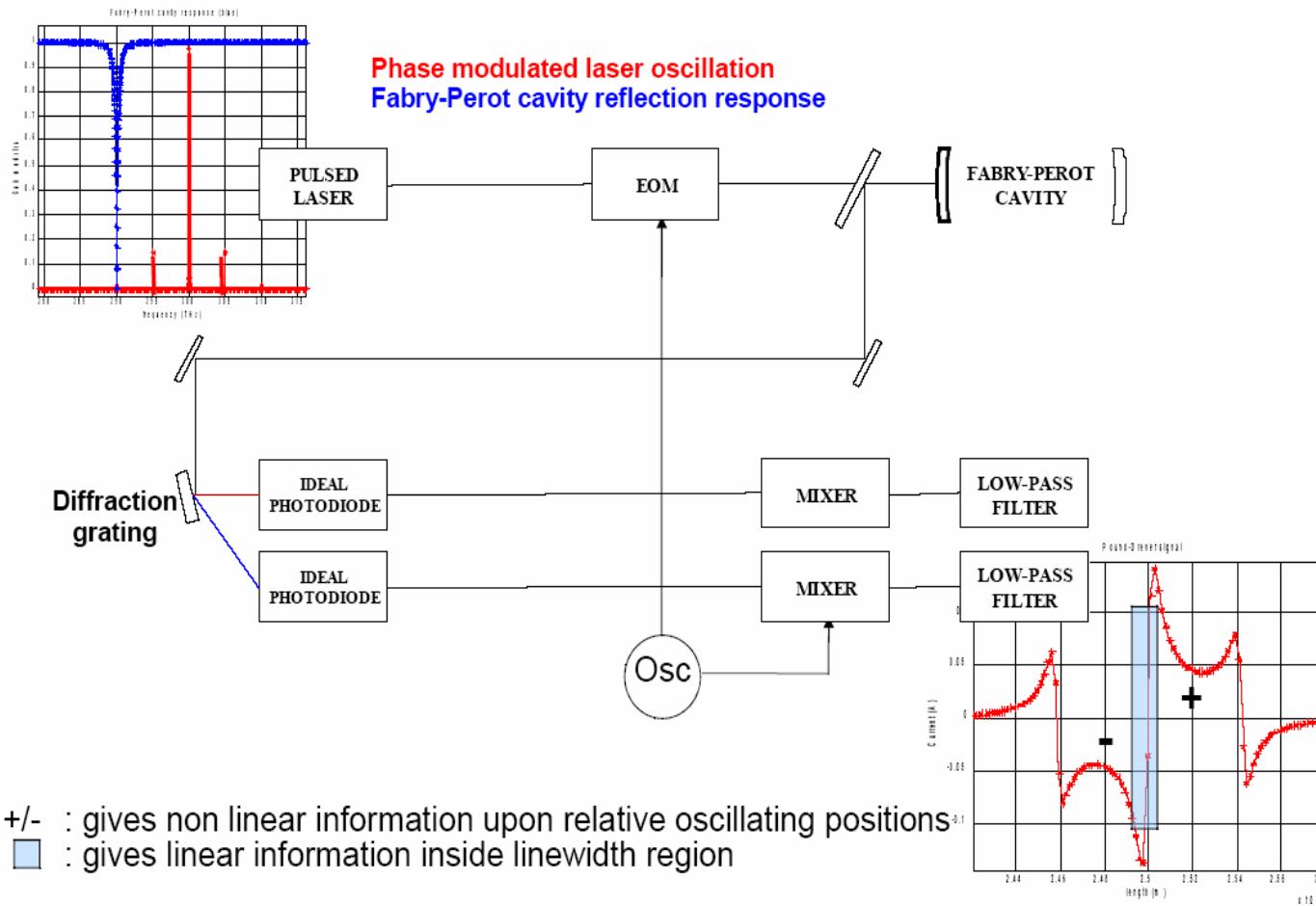
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Physical Review A, vol.69, 051803(R),  
(2004)

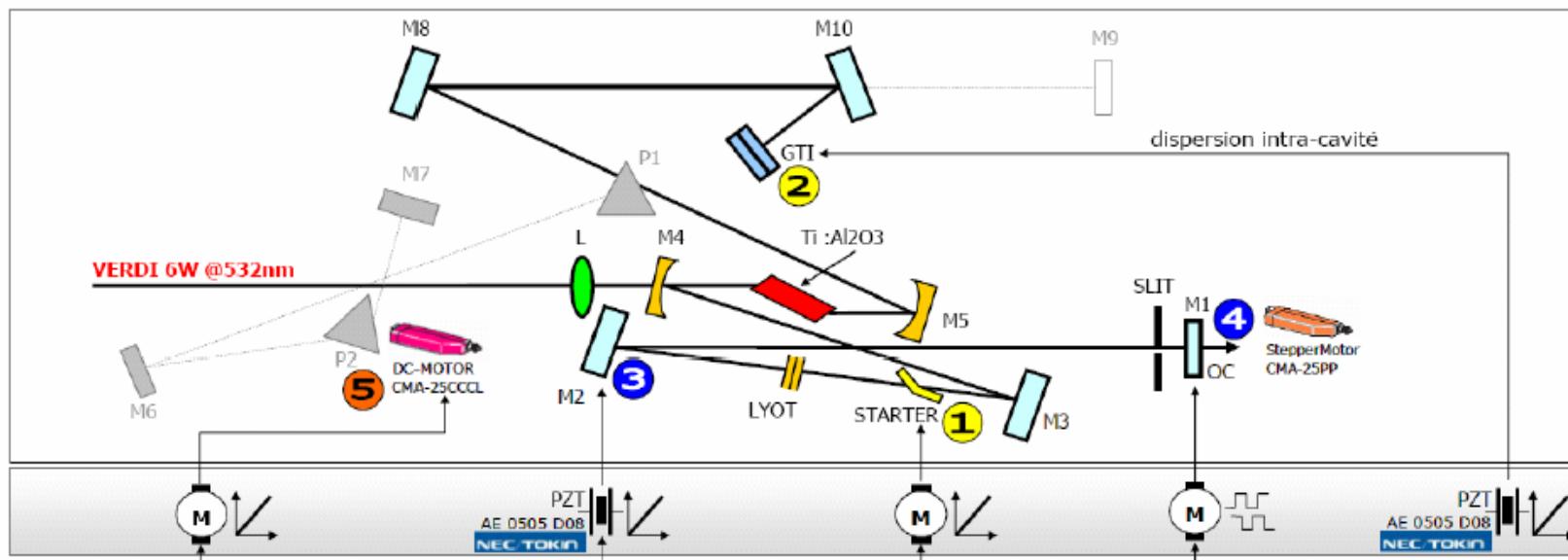
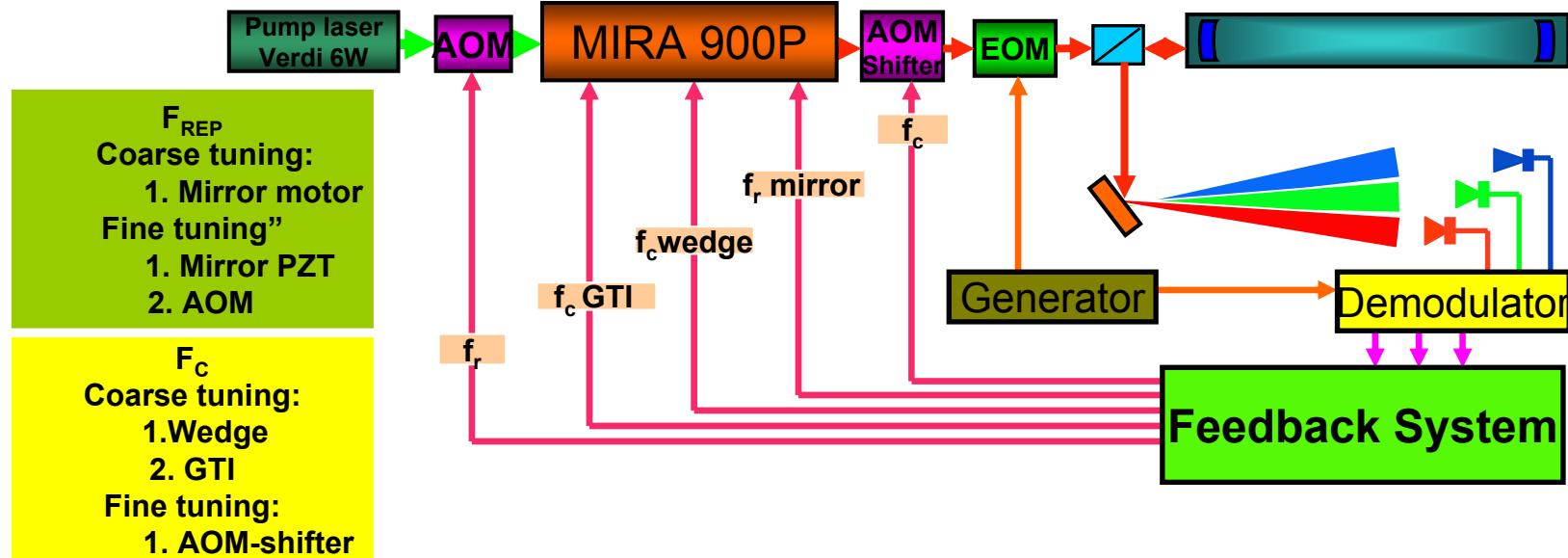
# Pound-Drever-Hall technique

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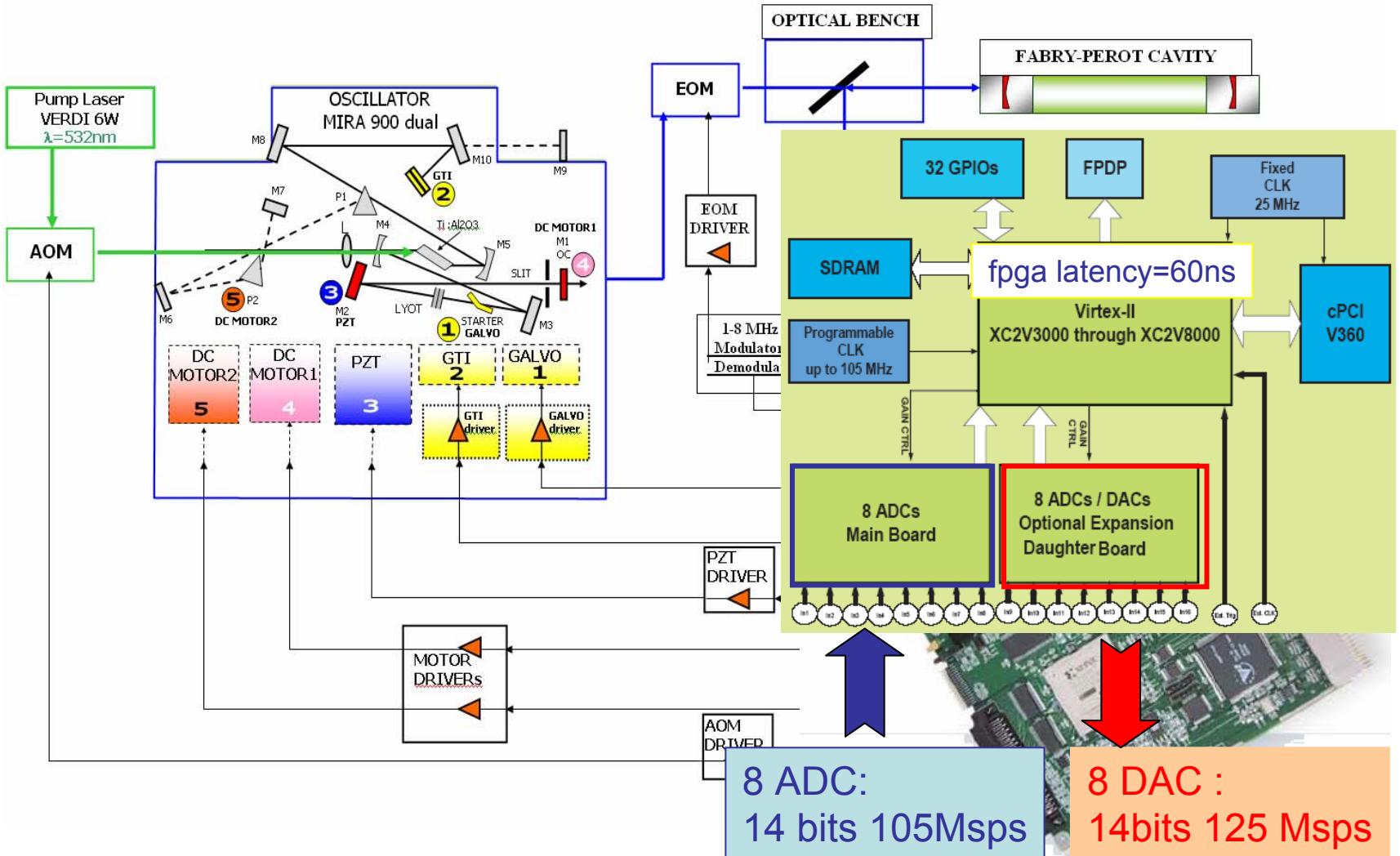
Use the well known "continuous wave laser" technique to measure field tuning with cavity



# Optical Scheme

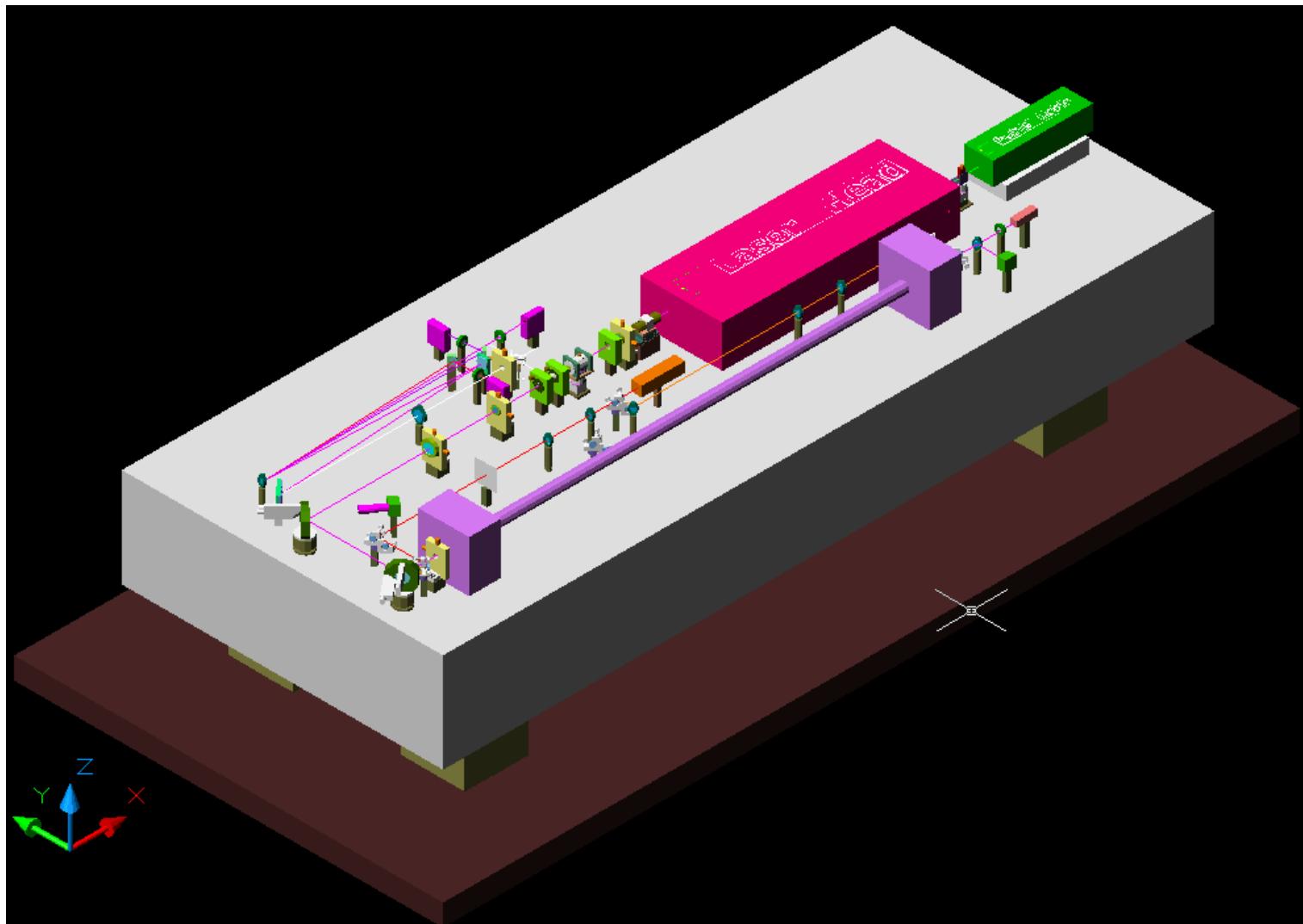


# Digital Feedback Scheme



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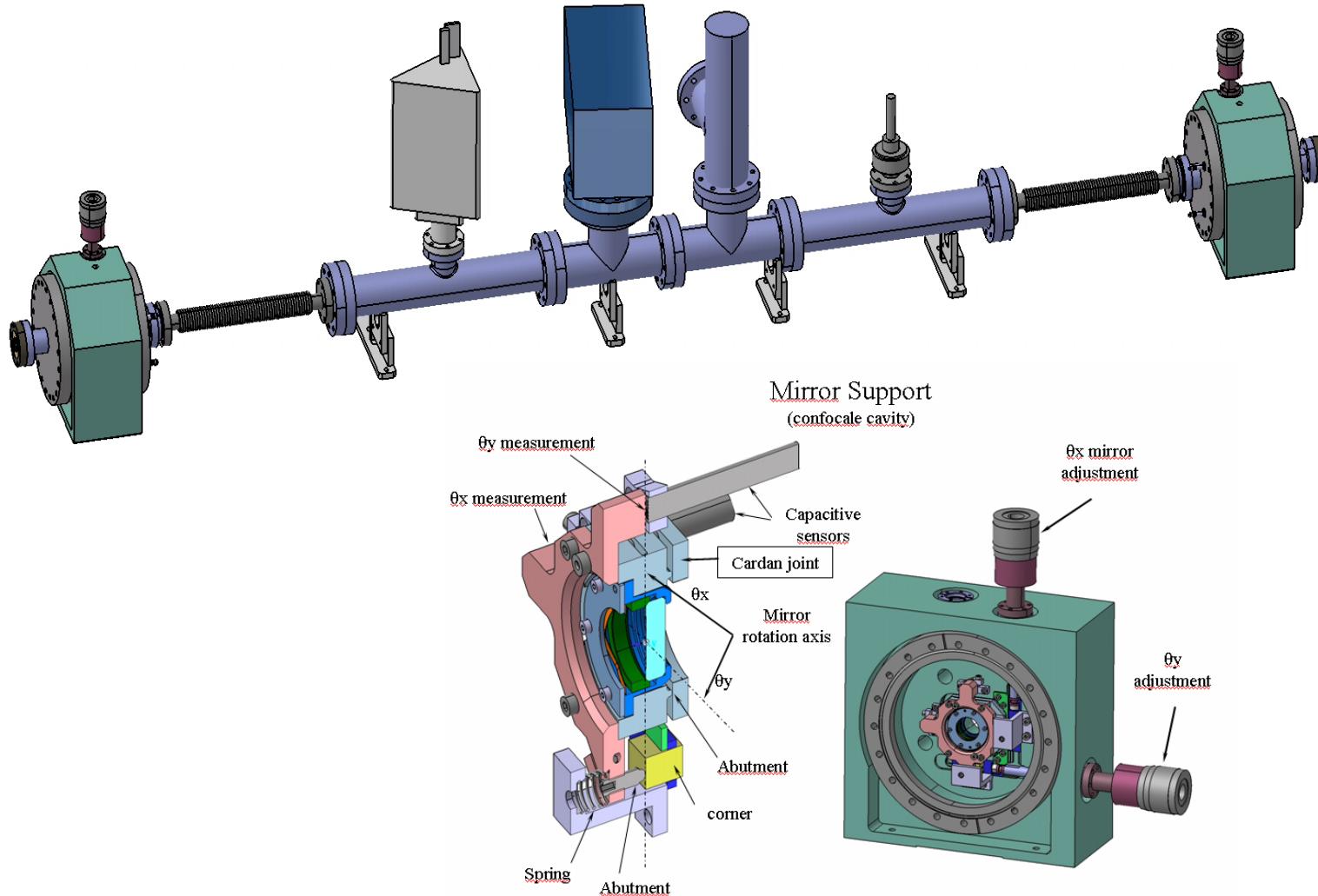
# Optical Setup at Orsay



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# Confocal cavity

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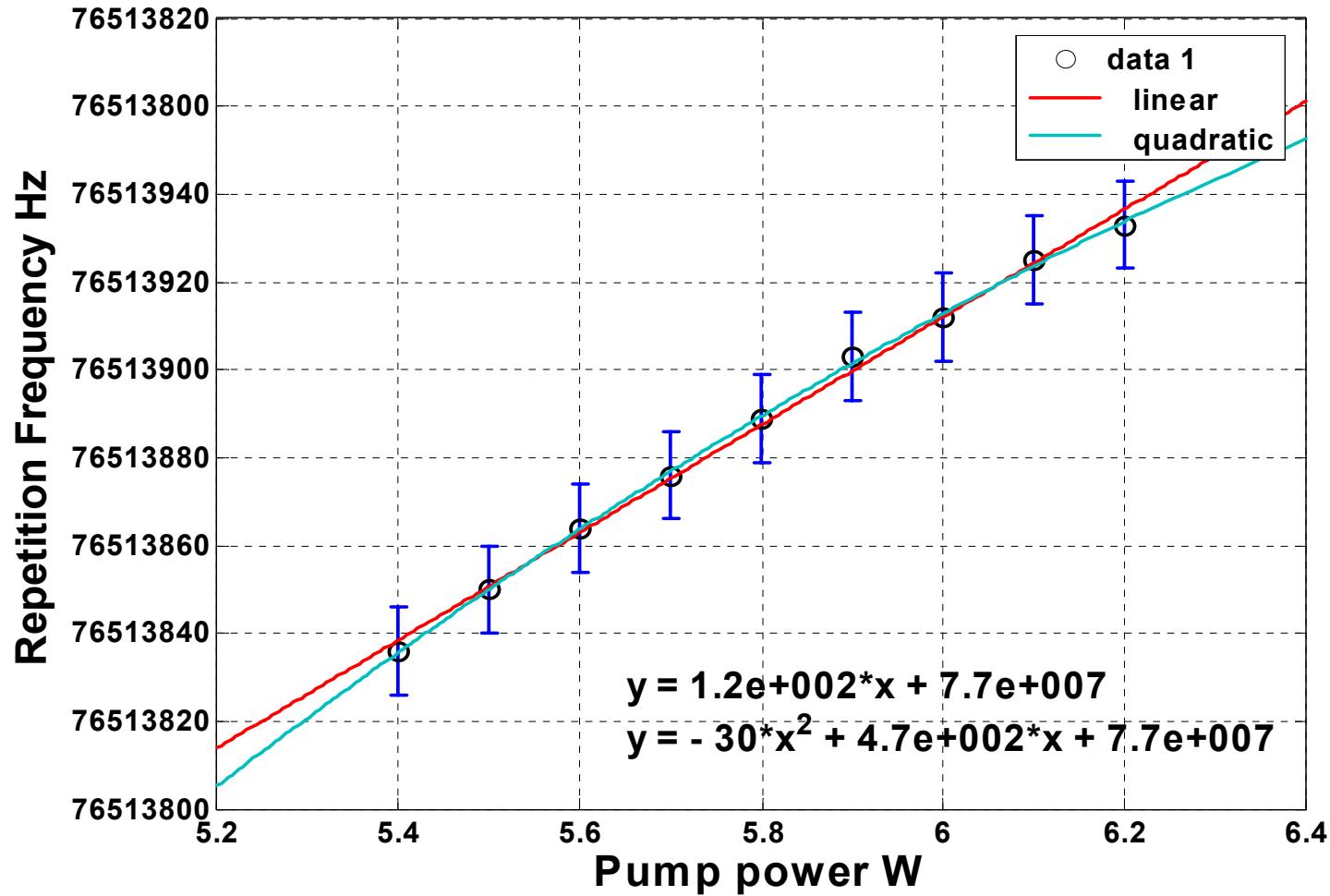
# PLIC Experiment setup.

25.04.2006



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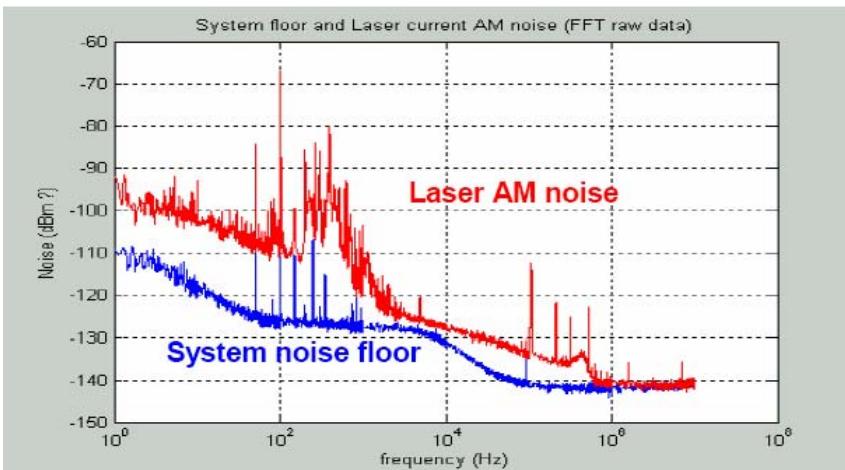
# Pulse-repetition frequency reaction



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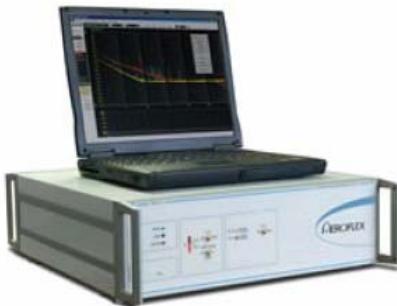
# Amplitude noise measurement

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- Made with "on the shelf" voltage amplifier
- Quickly optimized

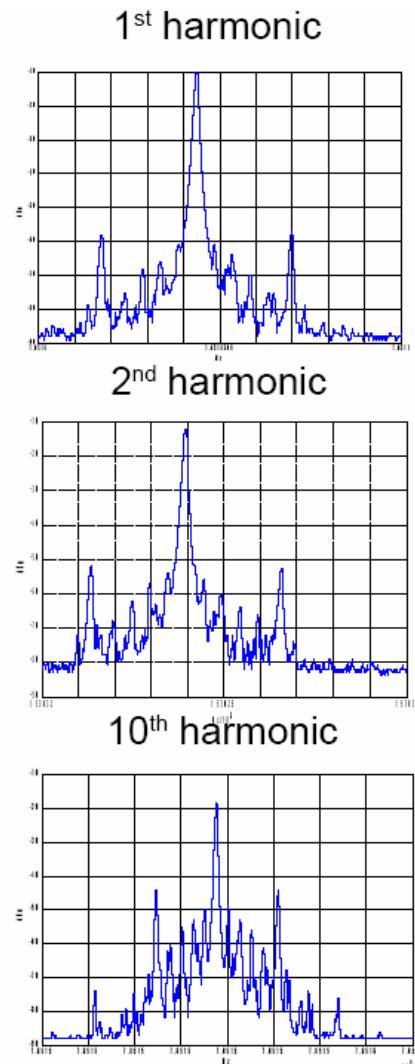
Can be optimized with trans-impedance + voltage amplifier => optimization under studying



+ Envelope detection => Low noise floor AM measurement

Aeroflex PN8000 phase noise analyser

# Phase noise measurement

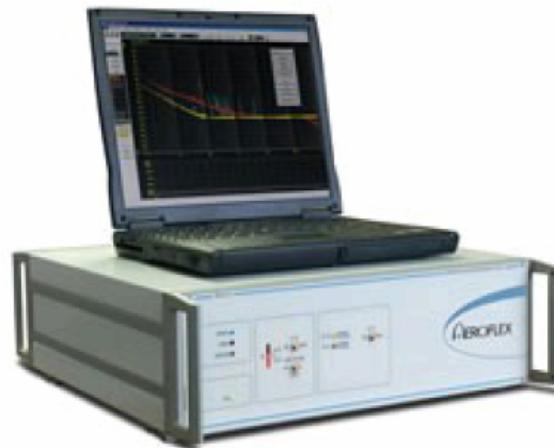


$$\sigma_{n_k}^2 = \sigma_{\hat{E}_k}^2 + (2\pi n f_0) \cdot C_{T\hat{E}_k} + (2\pi n f_0)^2 \cdot \sigma_{J_k}^2$$

Harmonics + Asymmetry measurements  
give information on phase noise

- Unsuccessful due to
- Too much BF noise
  - AM – PM correlation

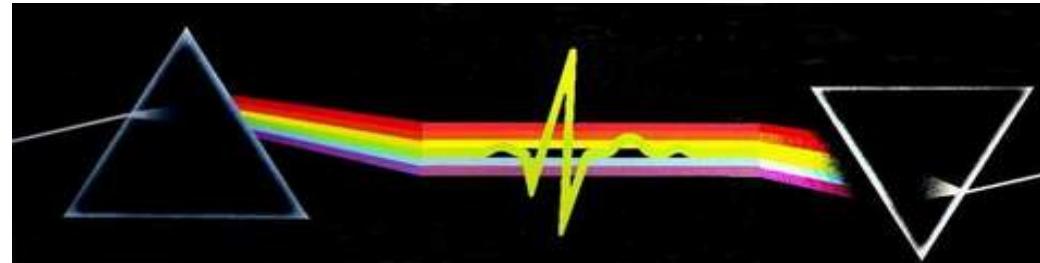
=> Aeroflex PN8000 phase  
noise analyser bought



Noise floor, in dBc/Hz at 1 Hz offset	-130
10 Hz	-140
100 Hz	-150
1 kHz	-160
10 kHz	-168
100 kHz & 20 MHz	-168

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# PLIC - LAL (ORSAY)



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