E7 Line Noise Investigation

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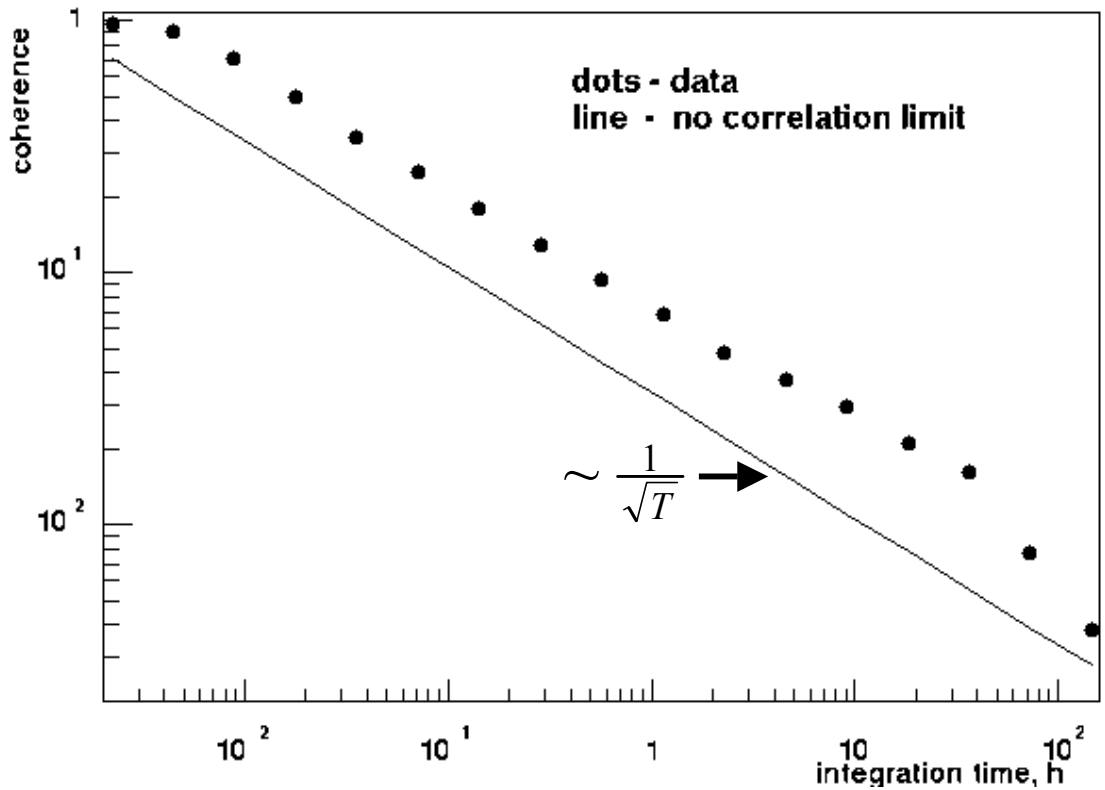
- **Coherence of L-H Power Monitors** (Jason's talk, DC)
  - **L1-H2 Correlated Noise** (Klimenko's talk, SUL group)
    - **Violin Modes in E7 Run** (this talk)

- **Outline**
  - **Introduction**
  - **L1 violin modes**
  - **H2 violin modes**
  - **Conclusion**

Coherence (T)

- $\gamma(T)=const$, (small $T<1min$)
- $\gamma(T) \sim \frac{1}{\sqrt{T}}$, (large T)

$$\gamma = \frac{1}{N}\left|\sum_{k=1}^{N} \exp(i\Delta\phi_k)\right|$$

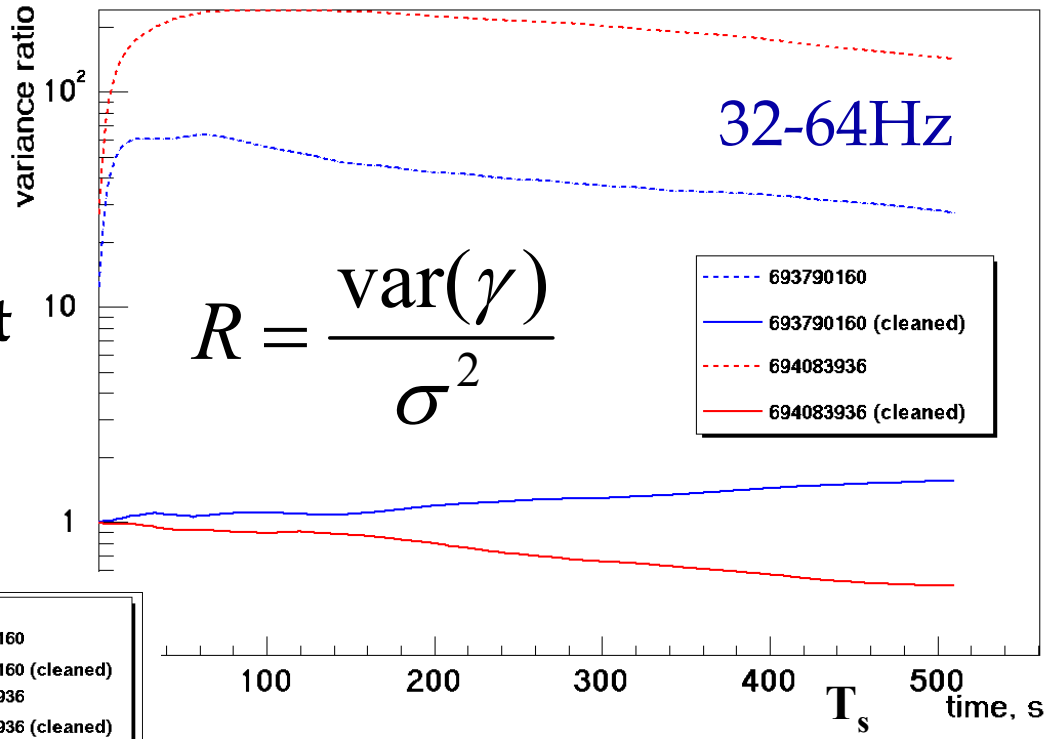


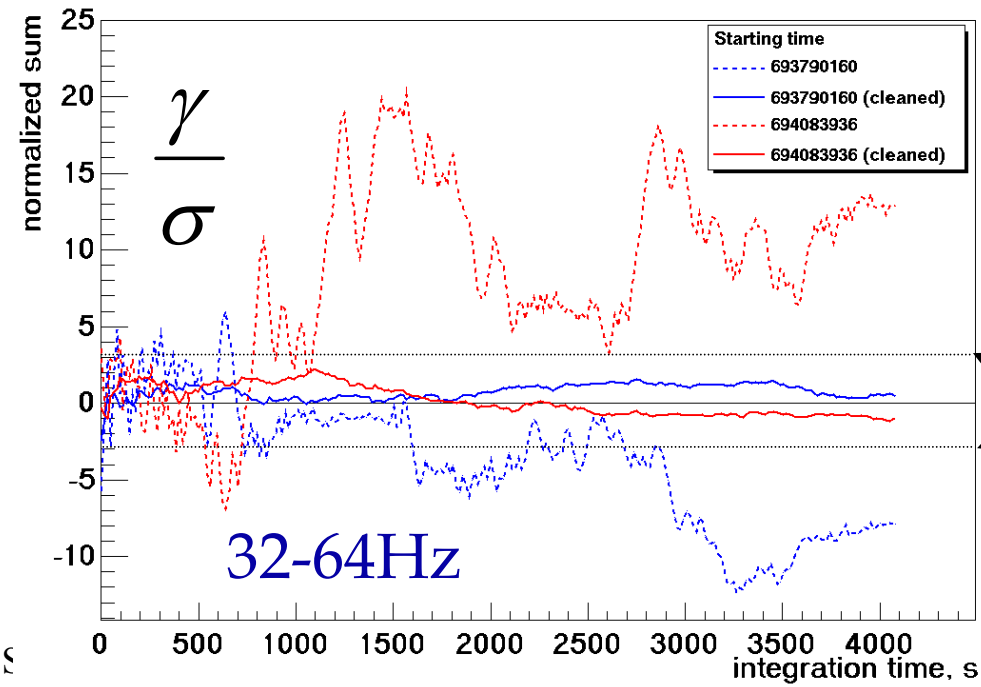
- Conclusion: **no long time coherent terms are observed on 17 days data.**

S.Klimenko, LSC meeting, March 2002

Data with Lines Removed

- γ – correlation coefficient
- σ - rms for uncorrelated noise
- R = 1 if no © noise present





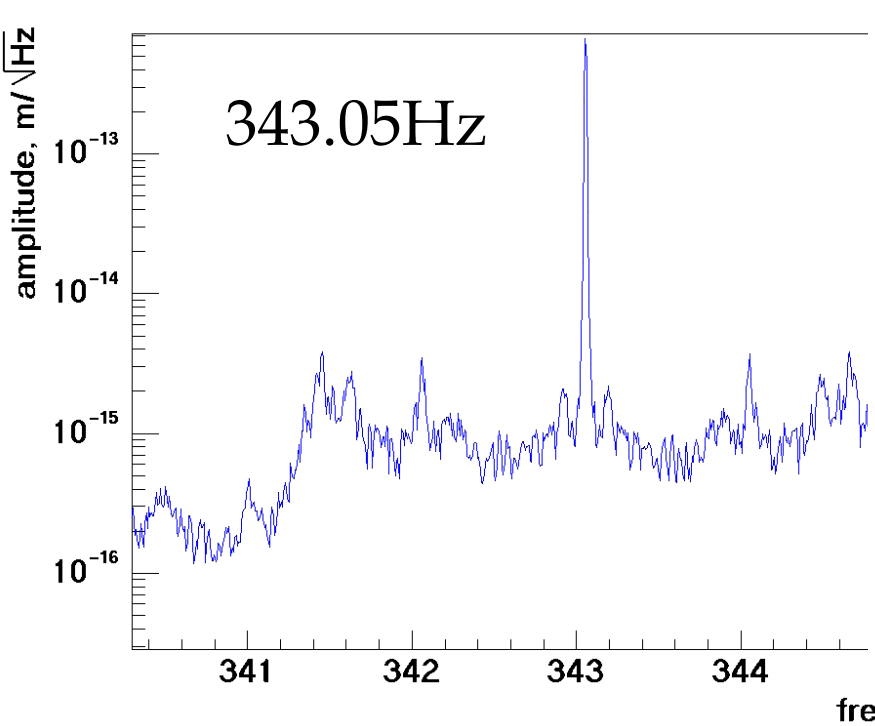
$\pm 3\sigma$

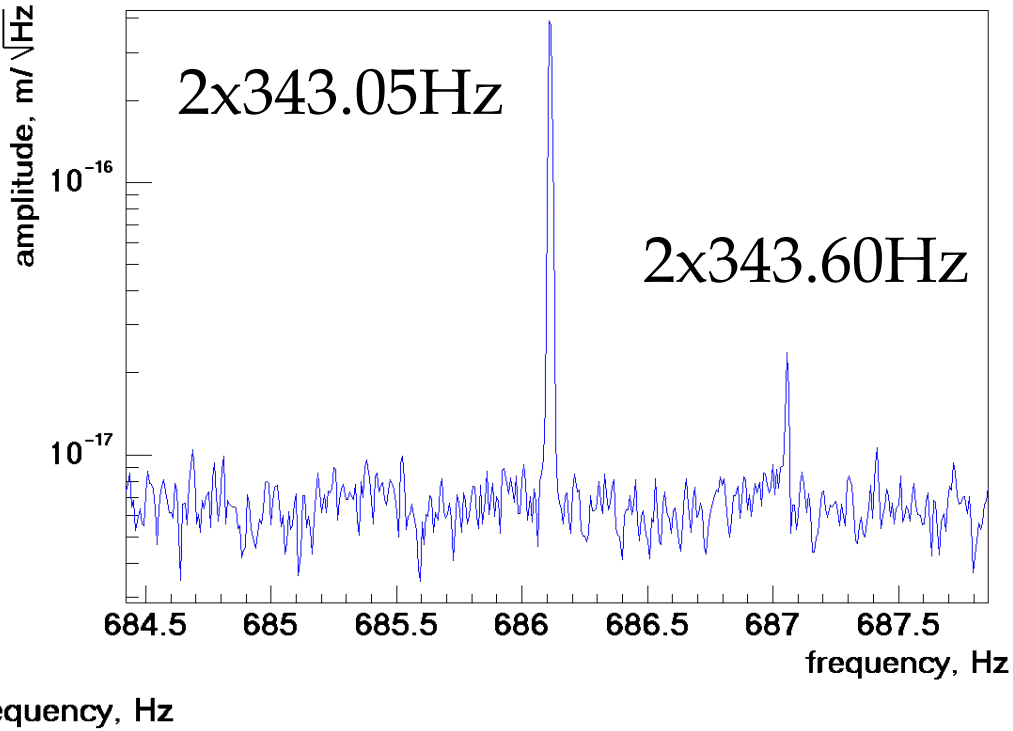
2 segments

4096 sec long

Total ~12h of F7 data

Introduction

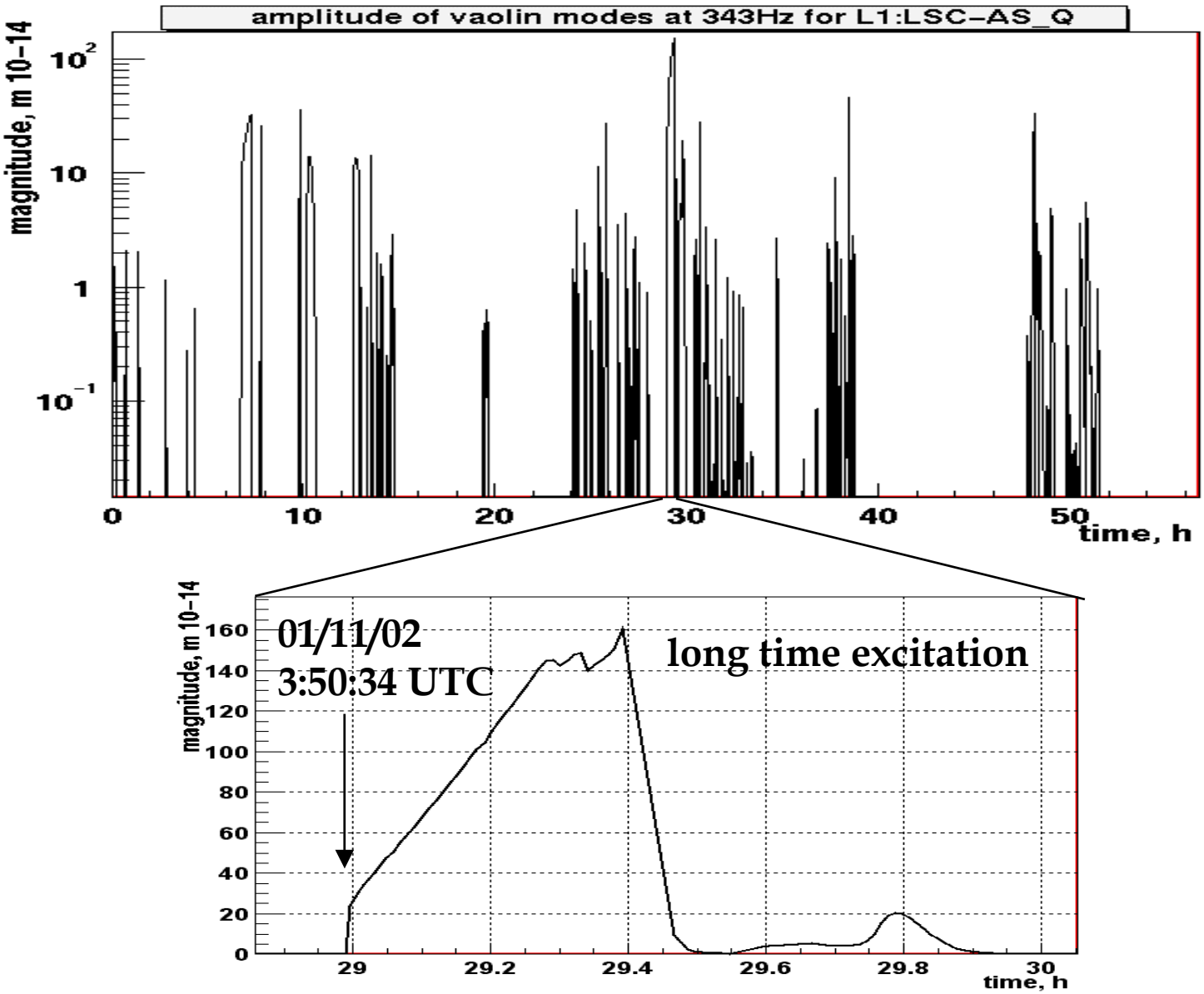




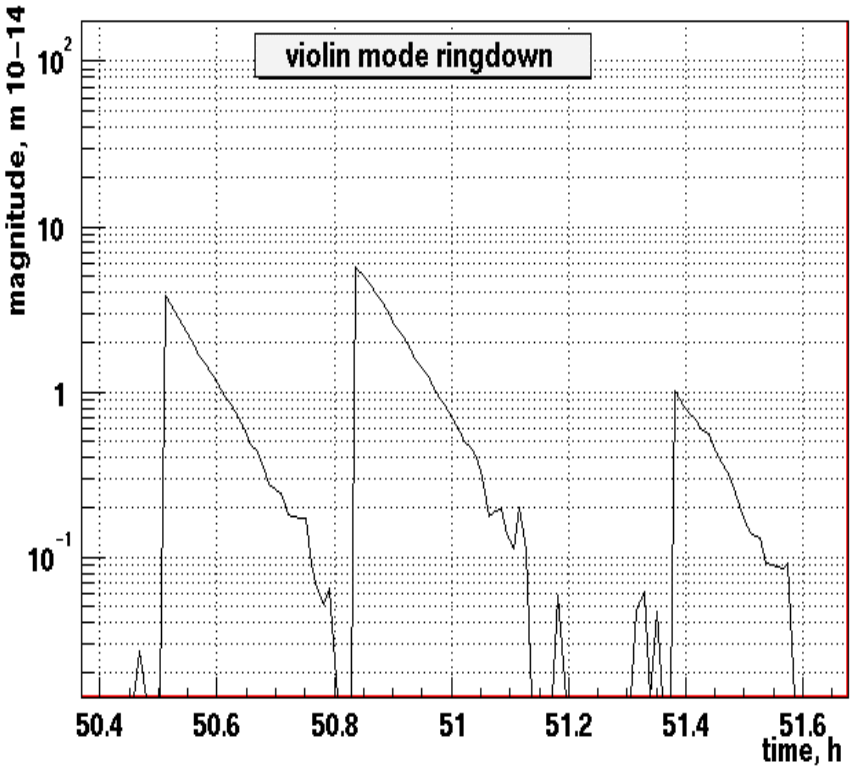
L1, Jan 10, 2002 05:39:47 UTC

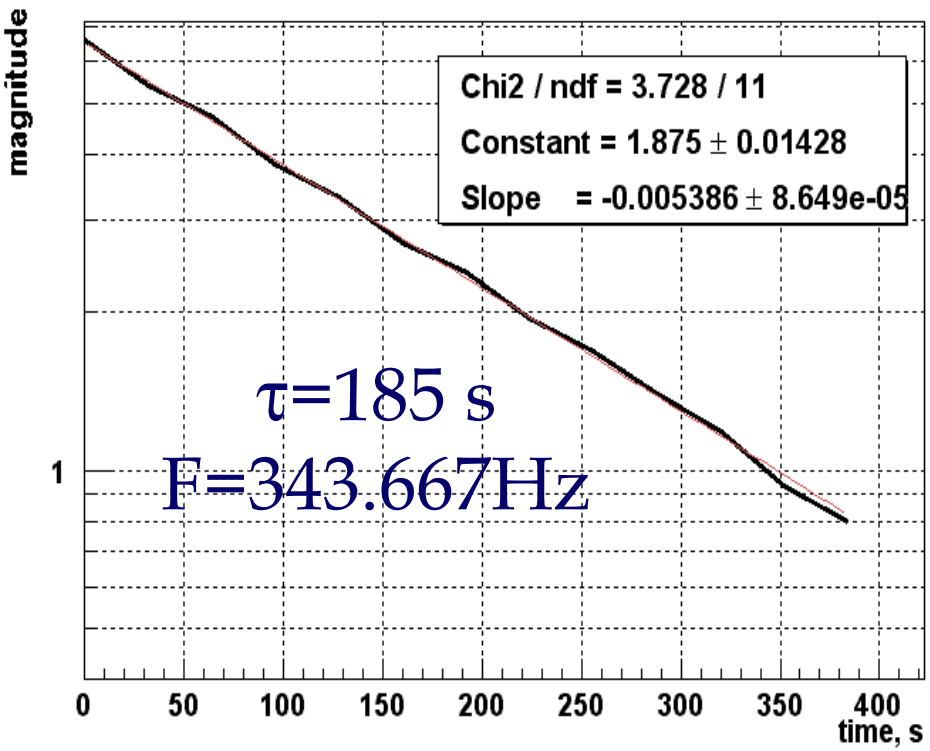
- **Tracked violin resonances with Line Monitor during E7**
- **Goal: characterize violin modes for L1 & H2 interferometers.**

Violin Amplitude



Violin Ringdown





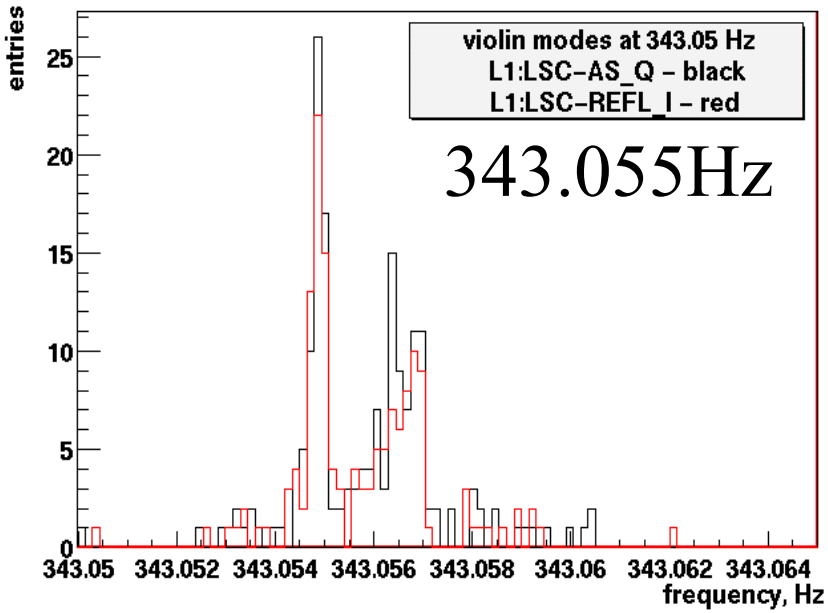
- **Externally excited**
- **Can measure decay time and Q**

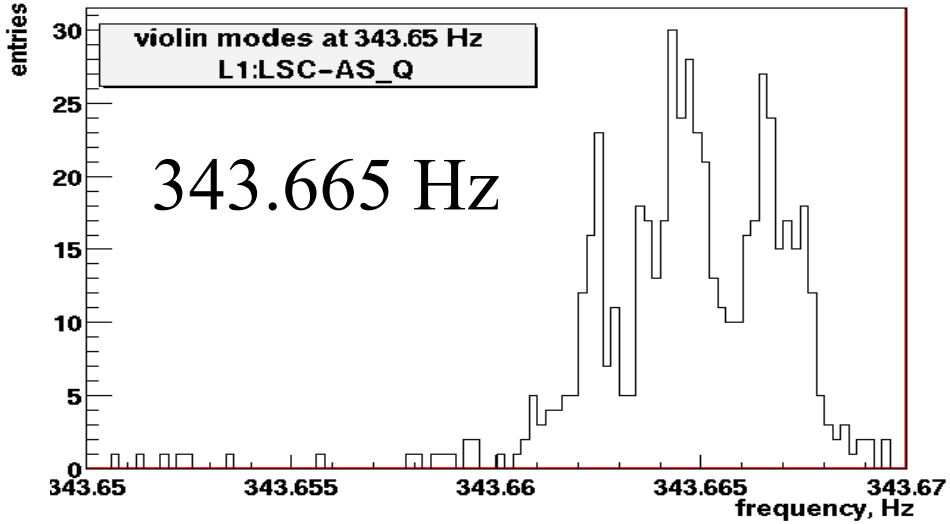
$$Q = 2\pi f \tau$$

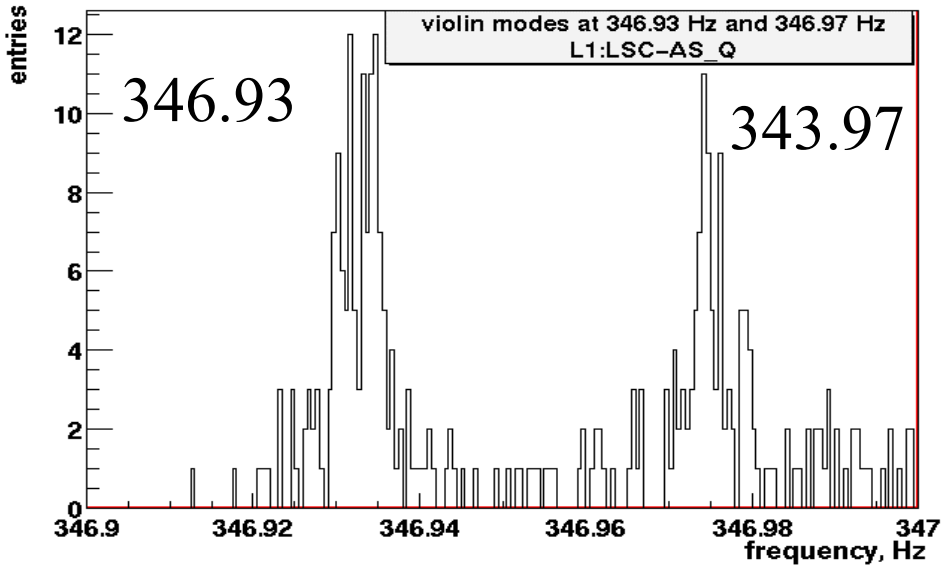
S.Klimenko, LSC meeting, March 2002

L1 Violin Resonances

- 4 groups of resonances
  - 4 modes expected
  - small frequency depletion







L1 Violin Frequencies & Qs

very preliminary

group	343.05	343.66	346.93	346.96
	343.055	343.662	346.931	346.975
modes	343.057	343.665	343.935	346.980(?)
		343.667		

τ, sec
56
57
62

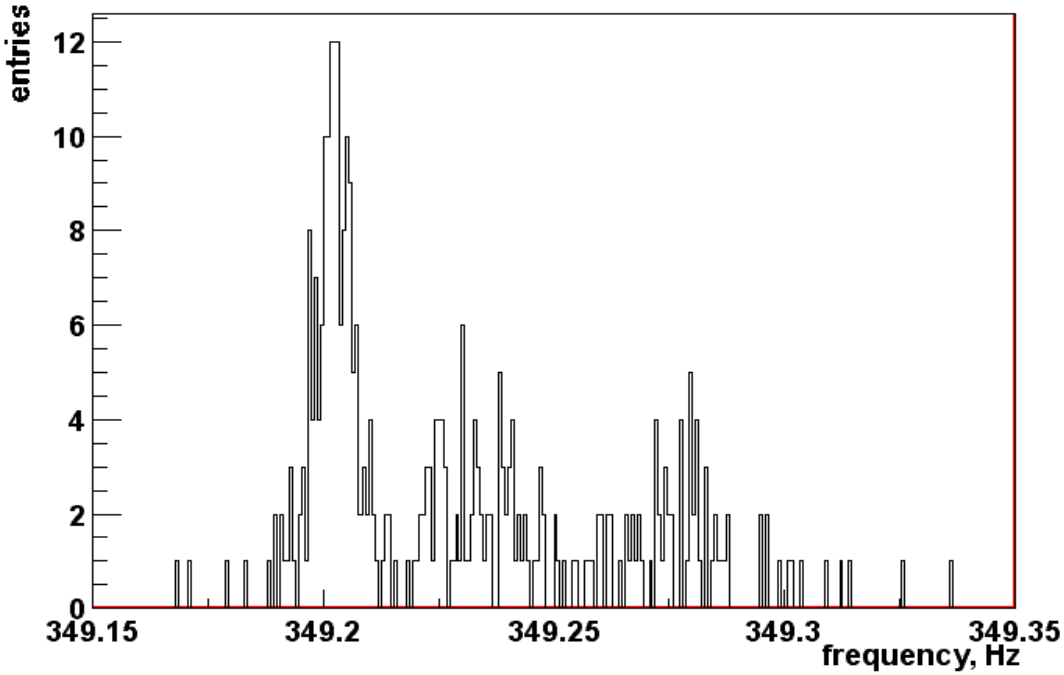
τ, sec	
185	132
184	147
178	151
200	133

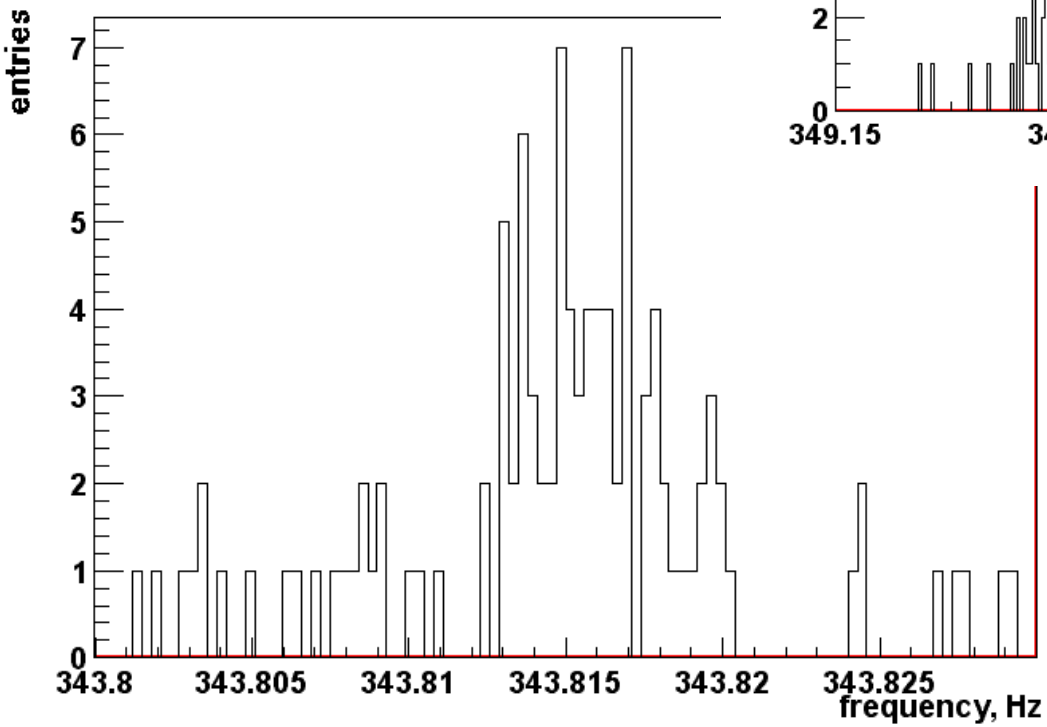
τ, sec
63
65
62

Q: $1.3 \cdot 10^5$ $4 \cdot 10^5$ $3 \cdot 10^5$ $1.4 \cdot 10^5$

H2 Violin Modes

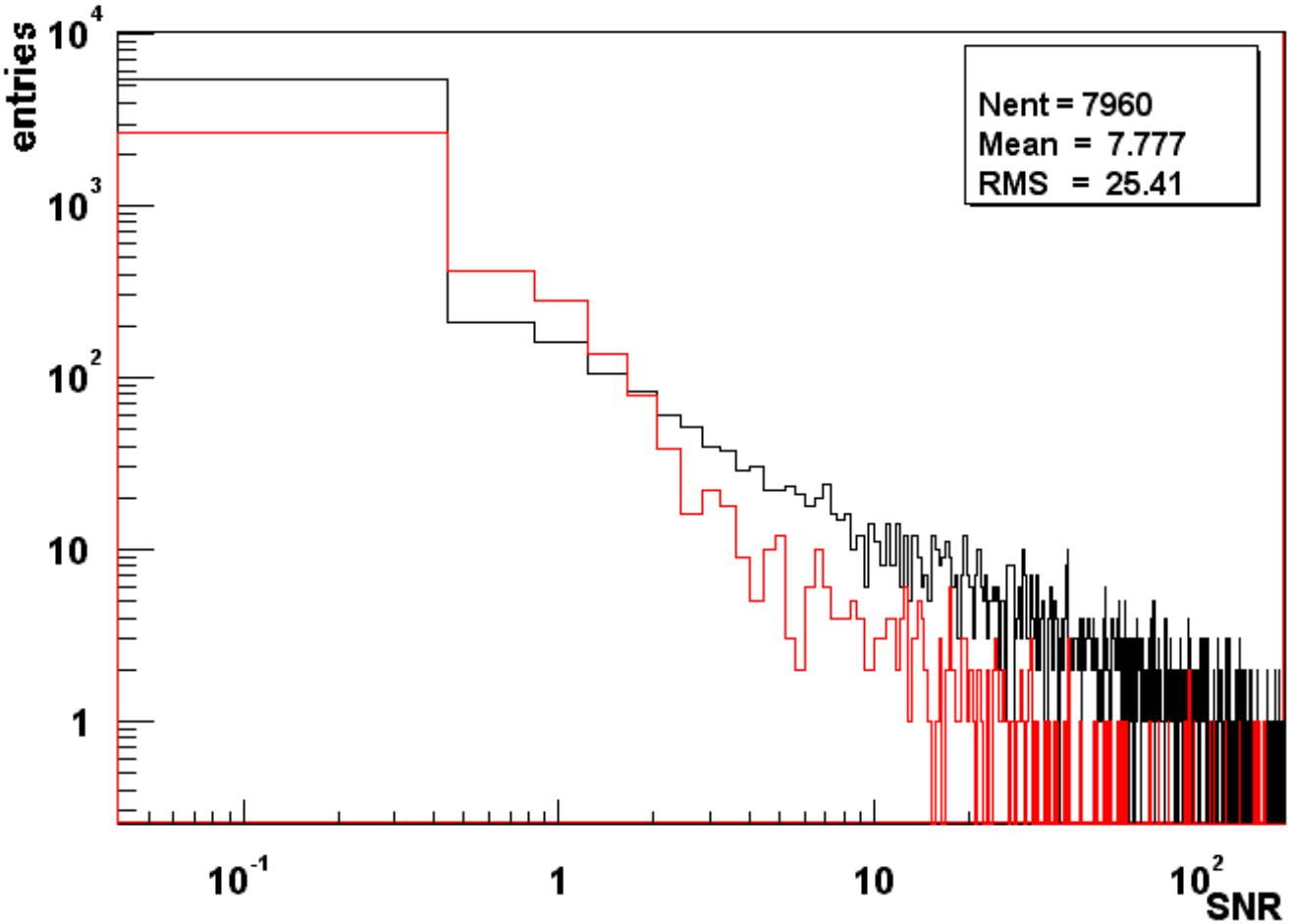
- Perhaps we see 4 groups of resonances
- Need to process more E7 data





H2 Violin Amplitude

- With time resolution of 32 sec, we can't see ringdown
  - too large noise:
    SNR=(violin_PSD/noise_PSD) 5 times less then for L1
  - decay time <32 sec



Conclusion

- violin resonances are clearly seen in E7 data
  - excited by external events (usually start of lock)
  - long time excitation (~1hour) are observed
  - four groups of resonances corresponds to 4 test masses
    - measured frequencies & Qs of some violin modes
  - More analysis & data needed to get a complete picture
- violin resonances are included in the LineMonitor list to be monitored during LIGO runs