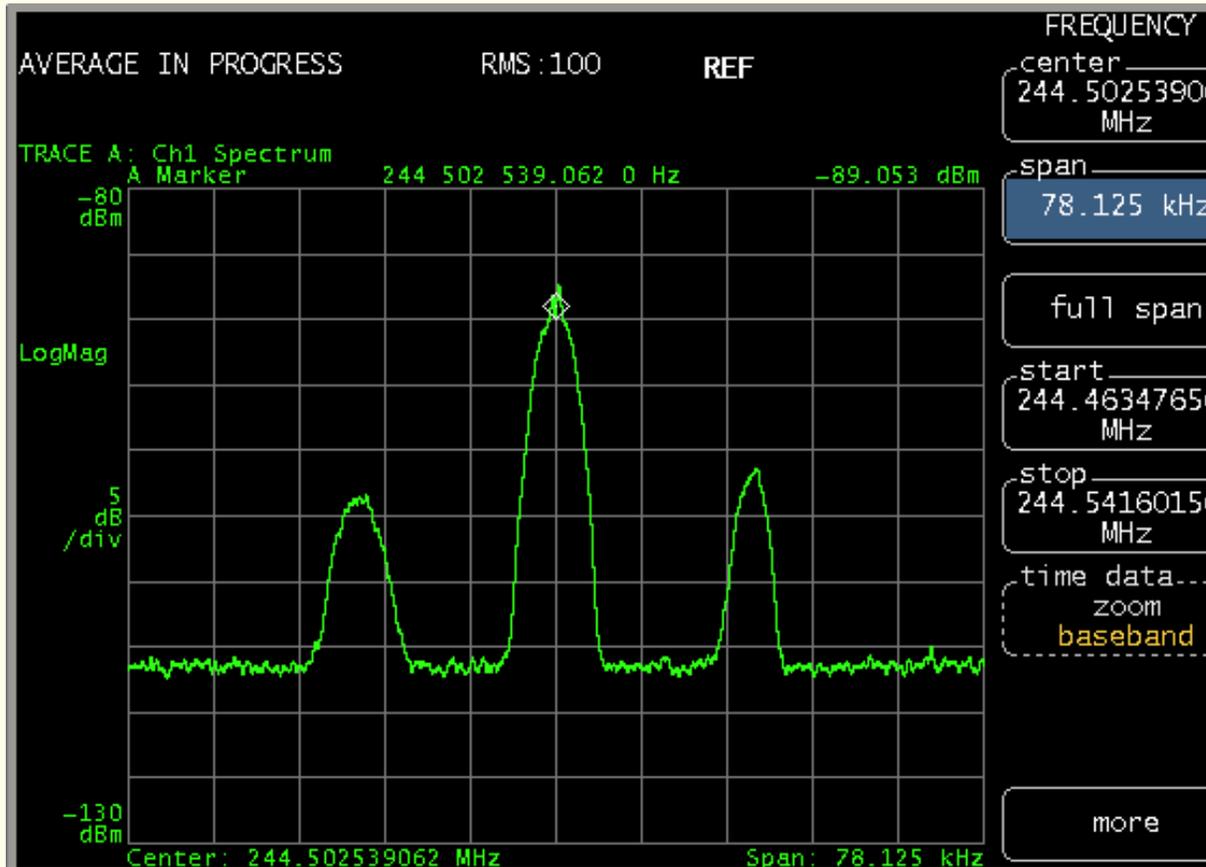


# Tune spread measurement methods

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- Sliding window fit to response to Artus kick
  - gives amplitude dependence of coherent tune
- Schottky
  - (upper  $\beta$  width + lower  $\beta$  width) - (2 x rev width)
  - gives tune spread due to octupole and higher, (plus beam-beam,...)
- Zoomed Schottky
  - width of central line of incoherent betatron distribution
  - gives tune spread due to all contributions (sextupole, octupole, beam-beam,...)
- Central Frequency - all contributions

# LF Schottky at Injection

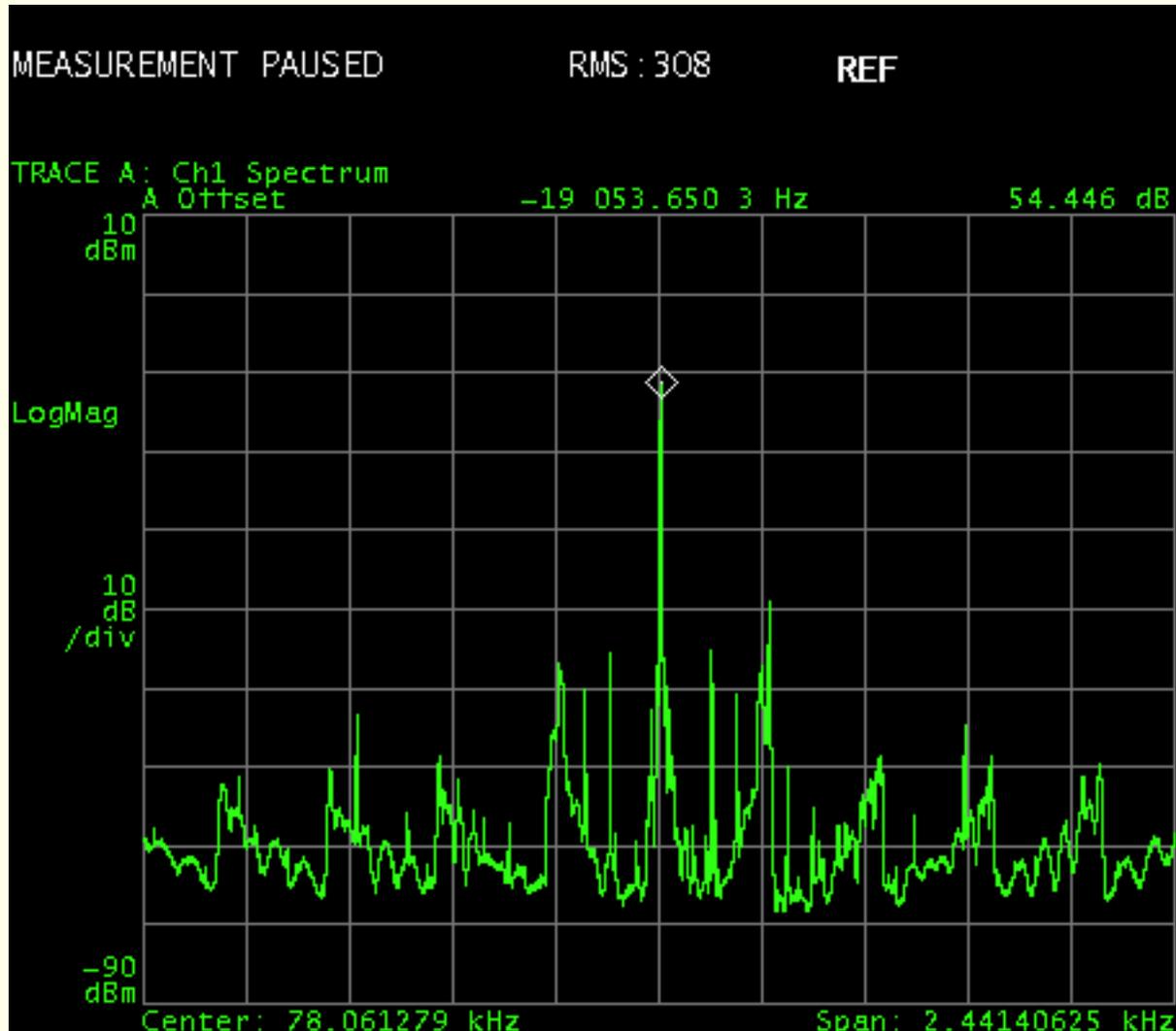


$\text{chrom} = (\text{lower} - \text{upper}) / dp/p$

$\text{tune spread} = (\text{lower} + \text{upper}) - (2 \times \text{rev})$

gives tune spread due to octupole and higher, (plus beam-beam,...)

# zoomed HF Schottky - revolution line

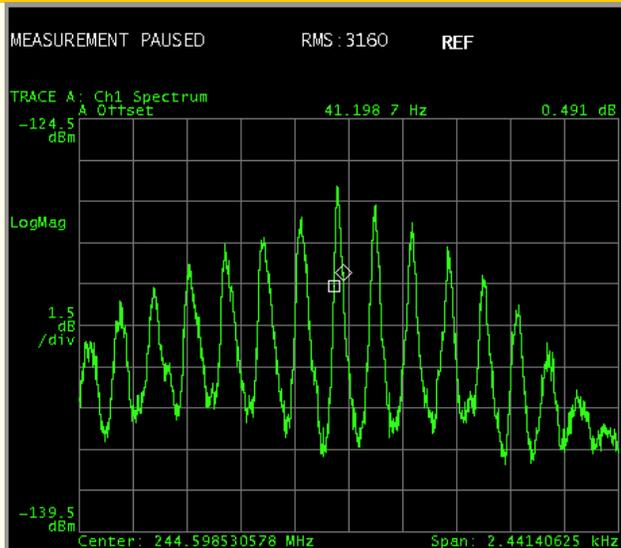


At store with  
storage RF on

central line  
'infinitely narrow'

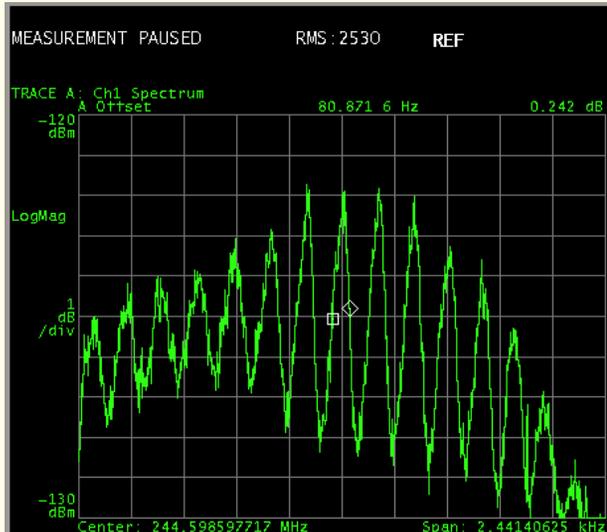
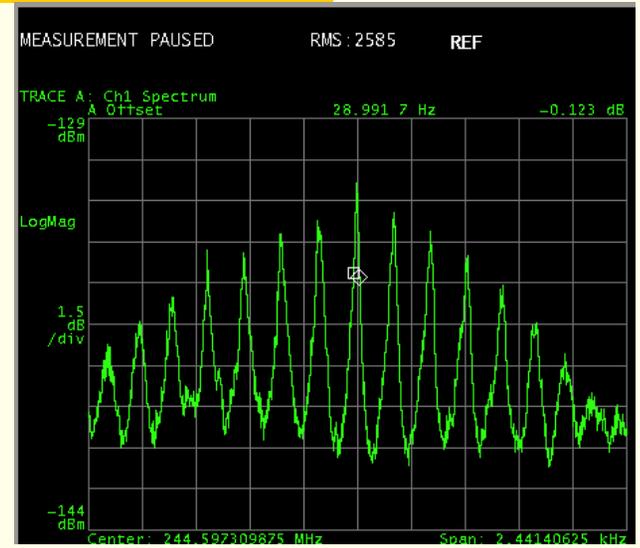
Synchrotron freq  
~ 250Hz

# LF Schottky at injection - 9 Dec 03



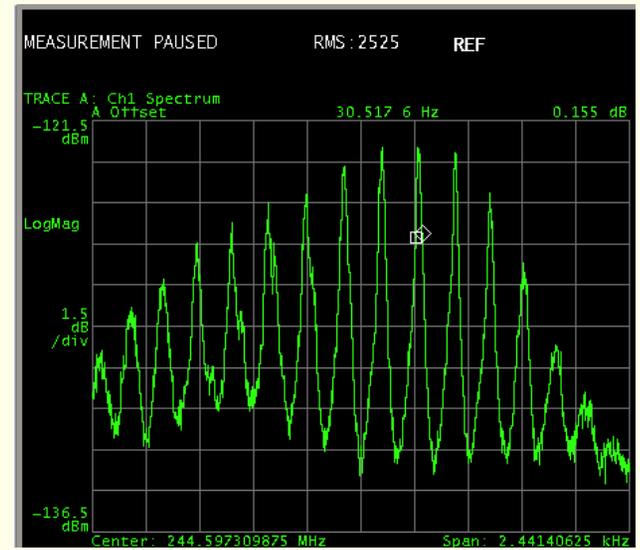
BH ~ 41 Hz  
~ .0005

BV ~ 29 Hz  
~ .0003

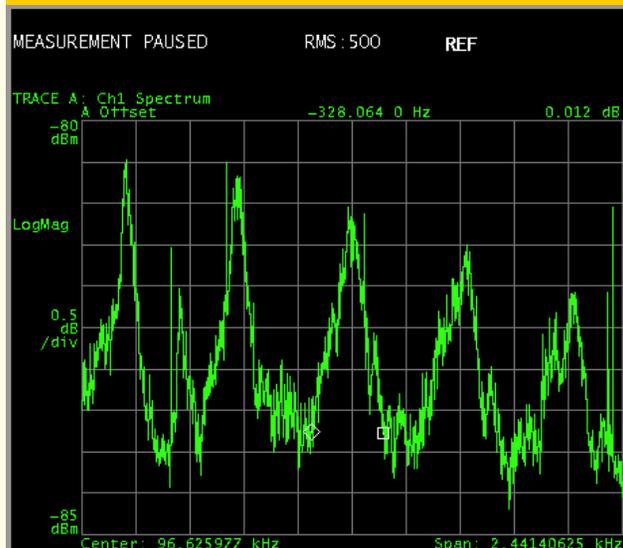


YH ~ 81 Hz  
~ .001

YV ~ 30 Hz  
~ .0003

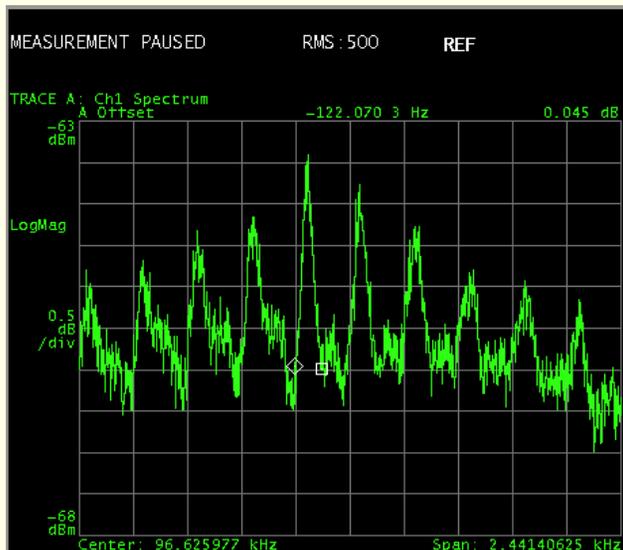
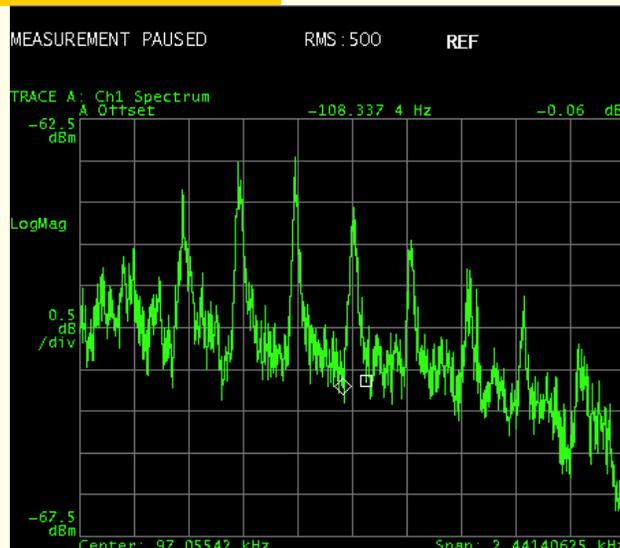


# HF Schottky at Store - 20 Jan 04



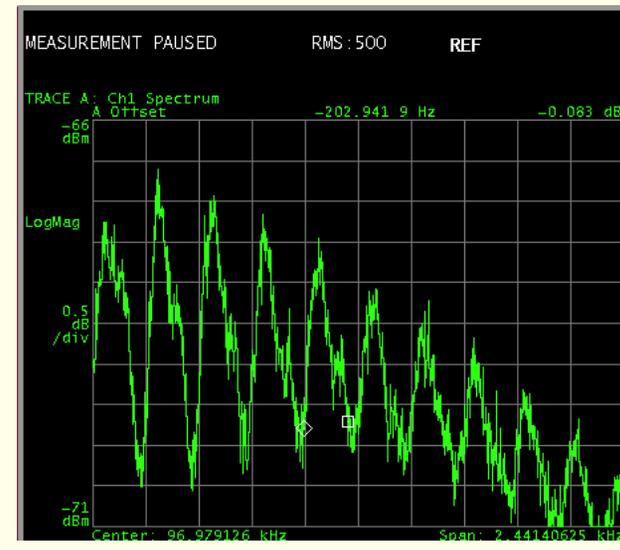
BH ~ 328 Hz  
~ .004

BV ~ 108 Hz  
~ .0014

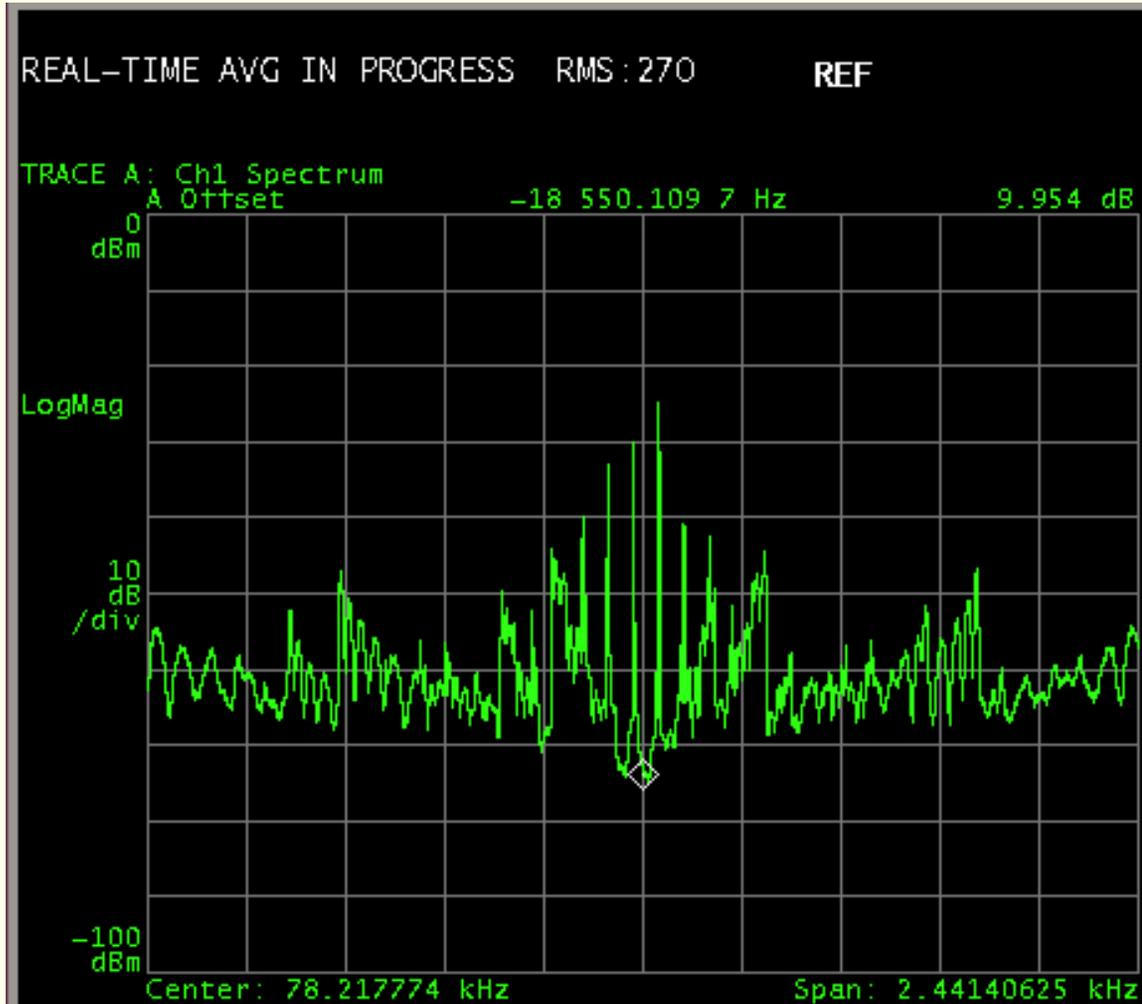


YH ~ 122 Hz  
~ .0015

YV ~ 203 Hz  
~ .0025



# zoomed BH HF Schottky - rev line

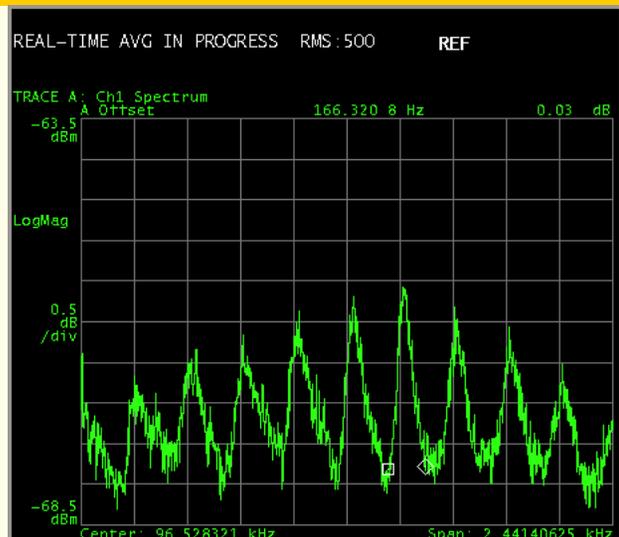


At store with  
storage RF on

No clear central  
line

Missing satellites

# Yellow Octupole scan - 20 Jan 04



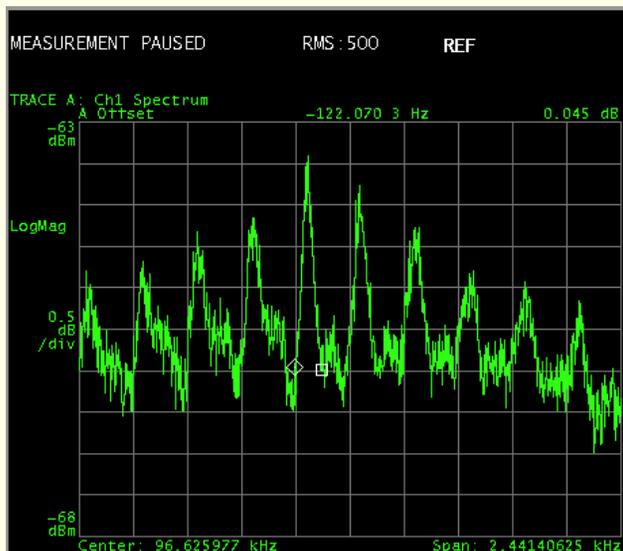
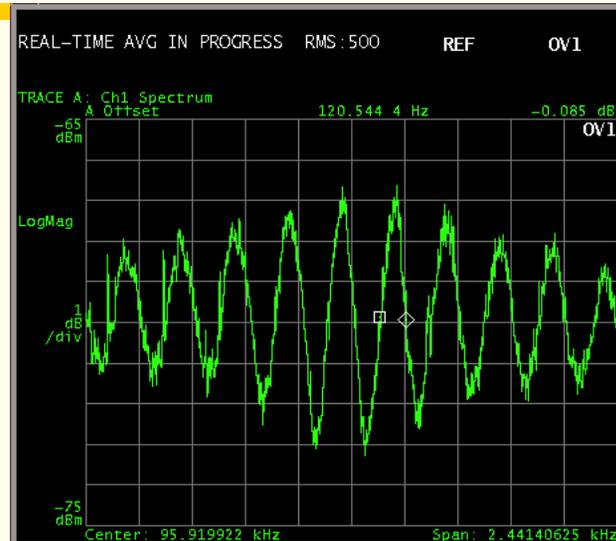
YH ~ 166 Hz

~ .0021

after

YV ~ 120 Hz

~ .0015



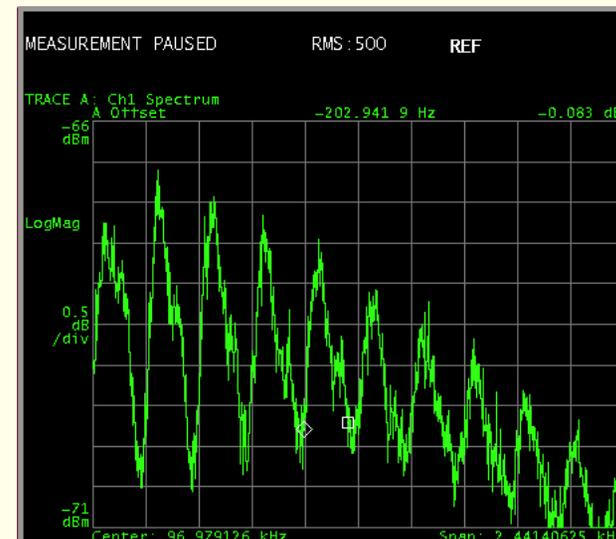
YH ~ 122 Hz

~ .0015

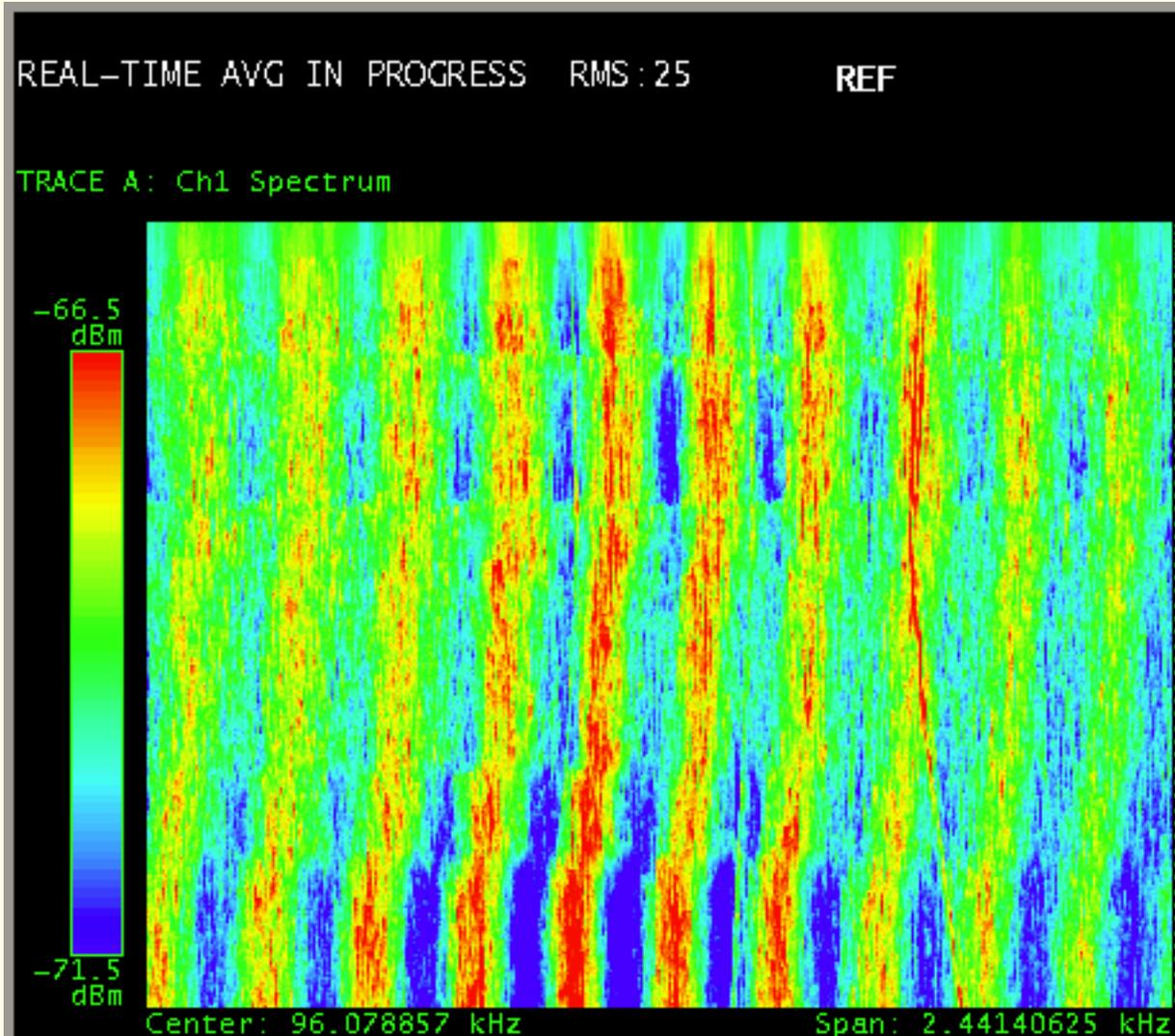
before

YV ~ 203 Hz

~ .0025



# Yellow vert octupole scan



See both  
shift and spread

# Conclusions

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- Various methods measure different things - advantages and disadvantages
- Measured spreads are significant
- Repeat measurement with IR corrections on and off
- central frequency method -
  - contributions other than sextupole limited usefulness in other machines?
  - potential usefulness in RHIC for isolating tune spread by location, type,...