

Magnetic noise



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Introduction

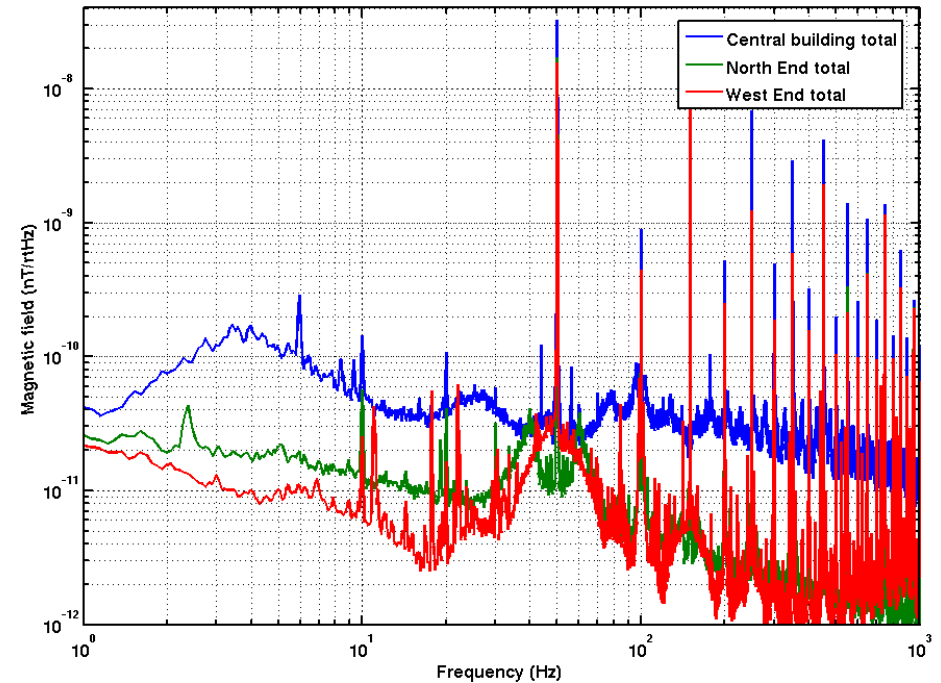
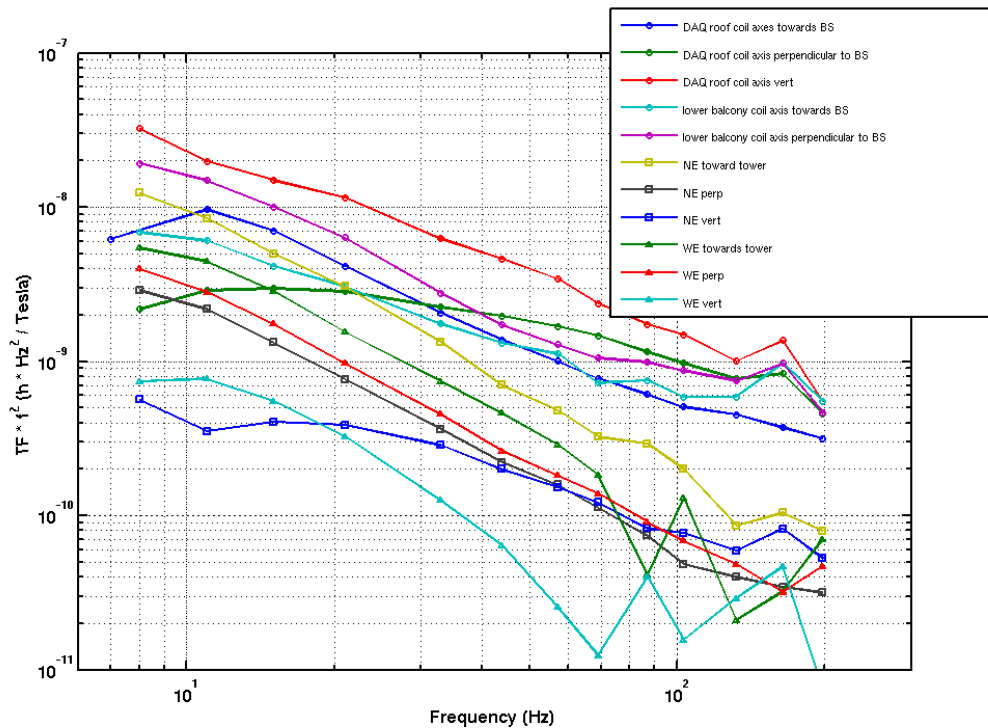
- Magnetic injections
 - far-field -> noise projection
 - near-field -> relative contribution of mirrors
- Noise projections based on coherence with magnetometers
- Noise sources
 - Mode cleaner air-conditioning
 - Central building UPS
- Conclusions
- Outlook for Virgo+MS

Far-field injections 1



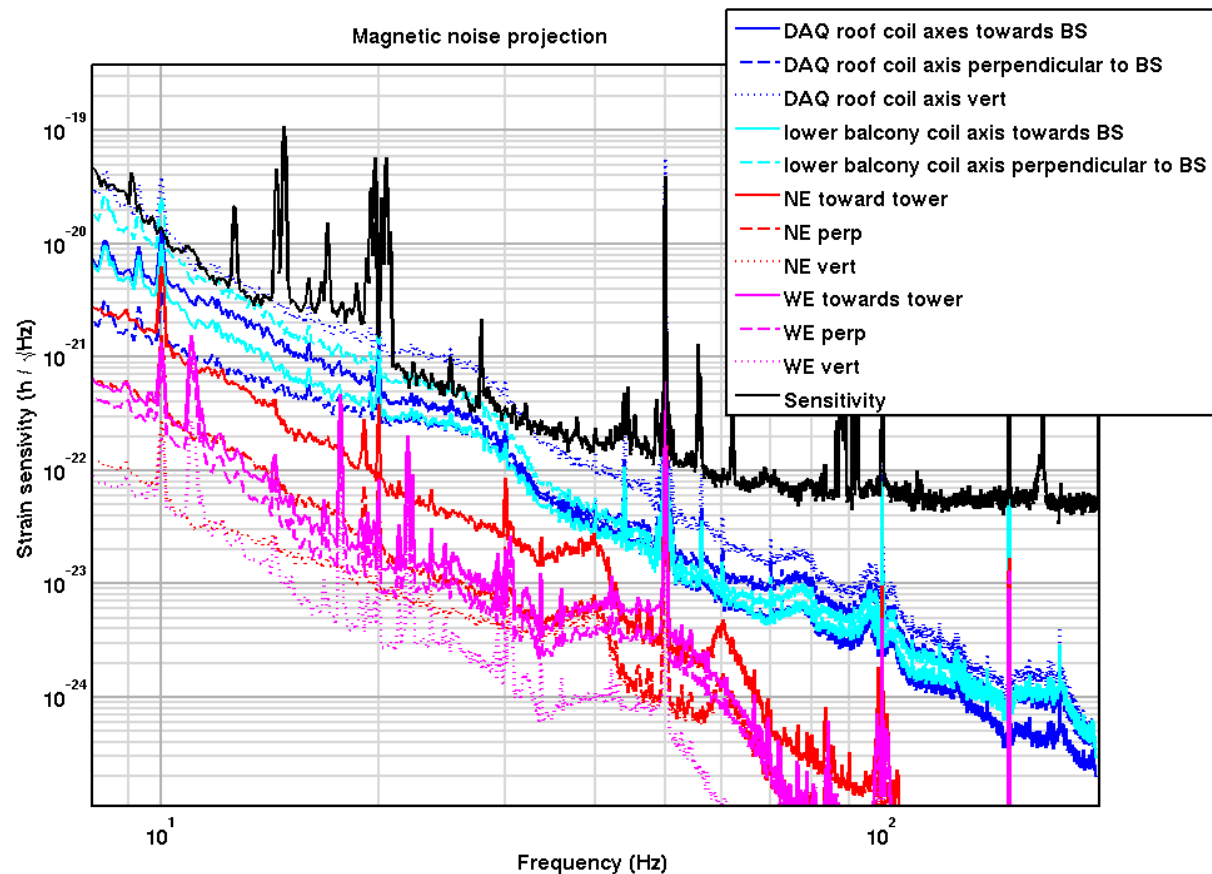
- Built a new coil, optimized for strongest field: 1m diameter, 50 turns
- Inject magnetic fields from a large distance
- Assume mirror and magnetometer see same field

Far-field noise projection 1



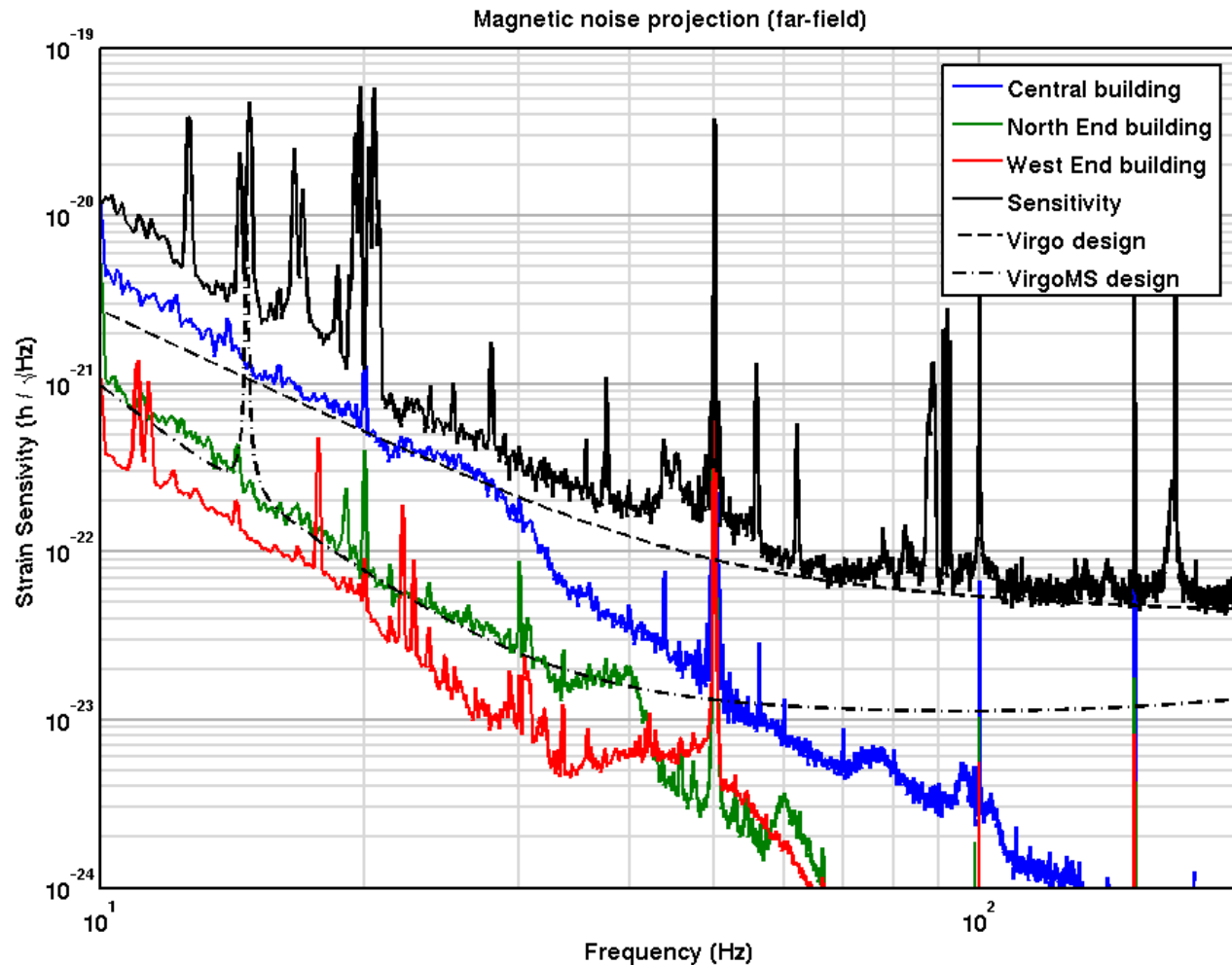
- Measure transfer-functions from magnetometers to B1*calibration
- Combine with magnetic field in quiet conditions

Far-field noise projection 2



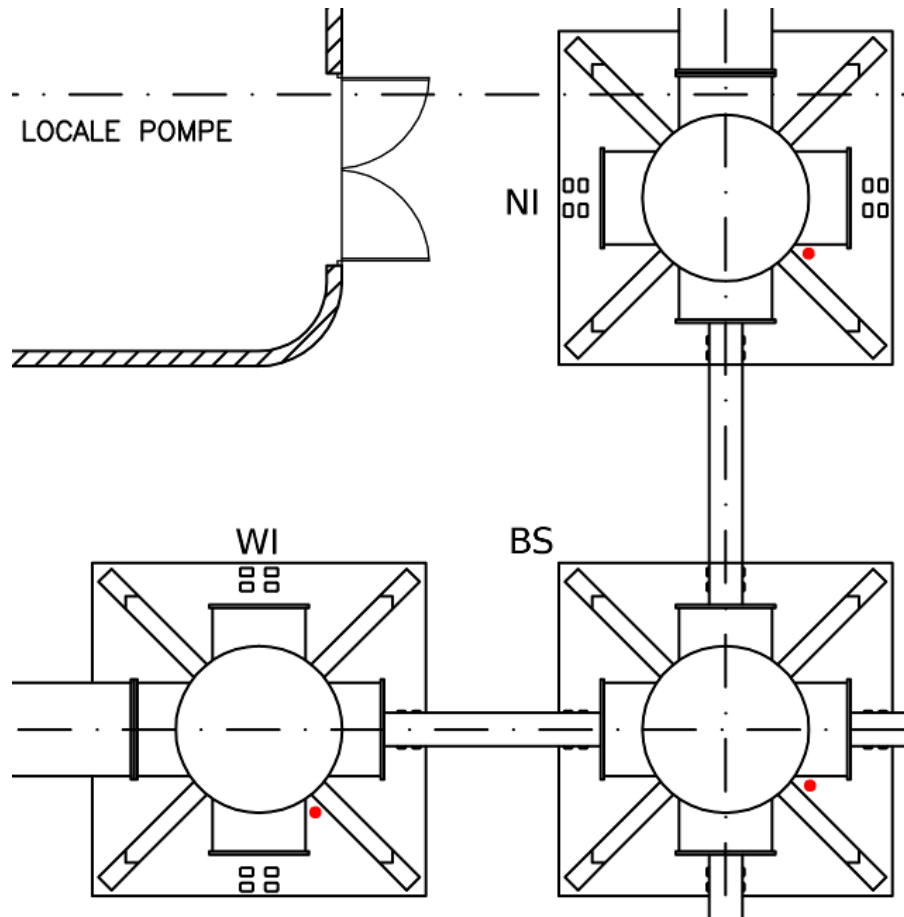
- Some inherent limitations of projections: relatively large errors
- Some projections clearly too high
- Only valid for noise sources in the far-field

Far-field noise projection 3



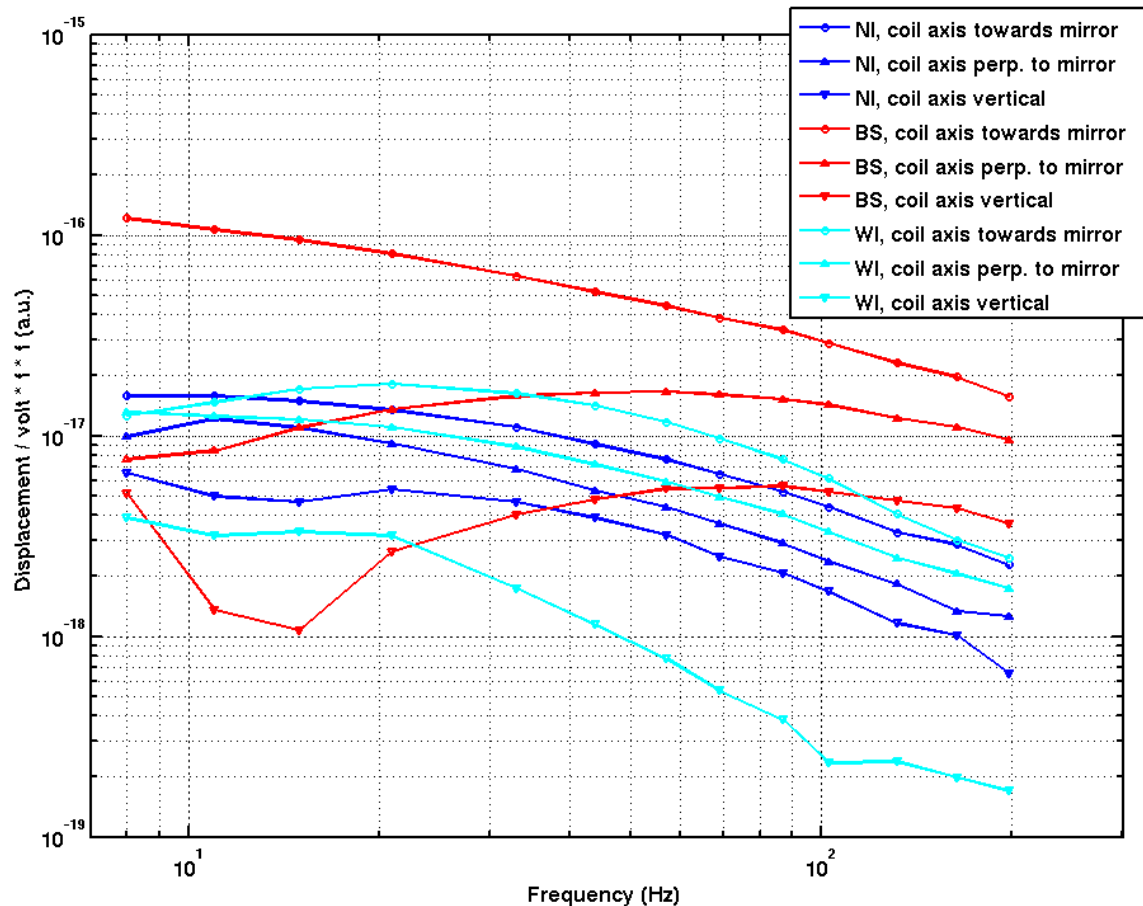
- Pick maximum curves for buildings that are not above current sensitivity
- Above Virgo+MS design, mainly for CB

Near-field injections 1



- Use small coil inside ovens, see red dots
- 10 cm diameter, 35 turns, 5 Ohm series resistor, current monitor
- Mainly used for relative comparison of towers in CB

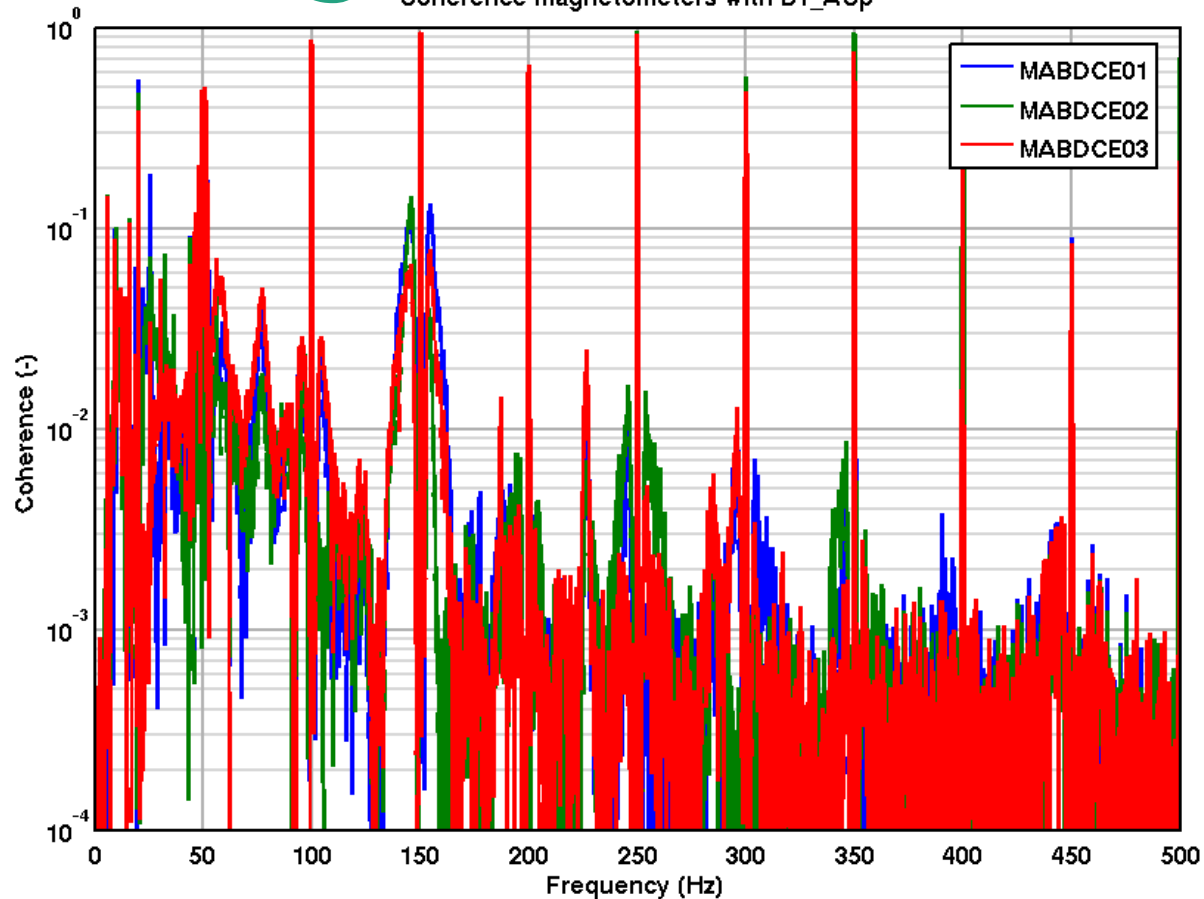
Near-field injections 2



- BS clearly highest contributor, factor 4-8 higher than NI/WI
- Possible mechanism: ty rotation + large mis-centering in x ($> 1\text{cm}$)
- BS has still strong magnets and is 4 times lighter than other mirrors

Long coherence 1

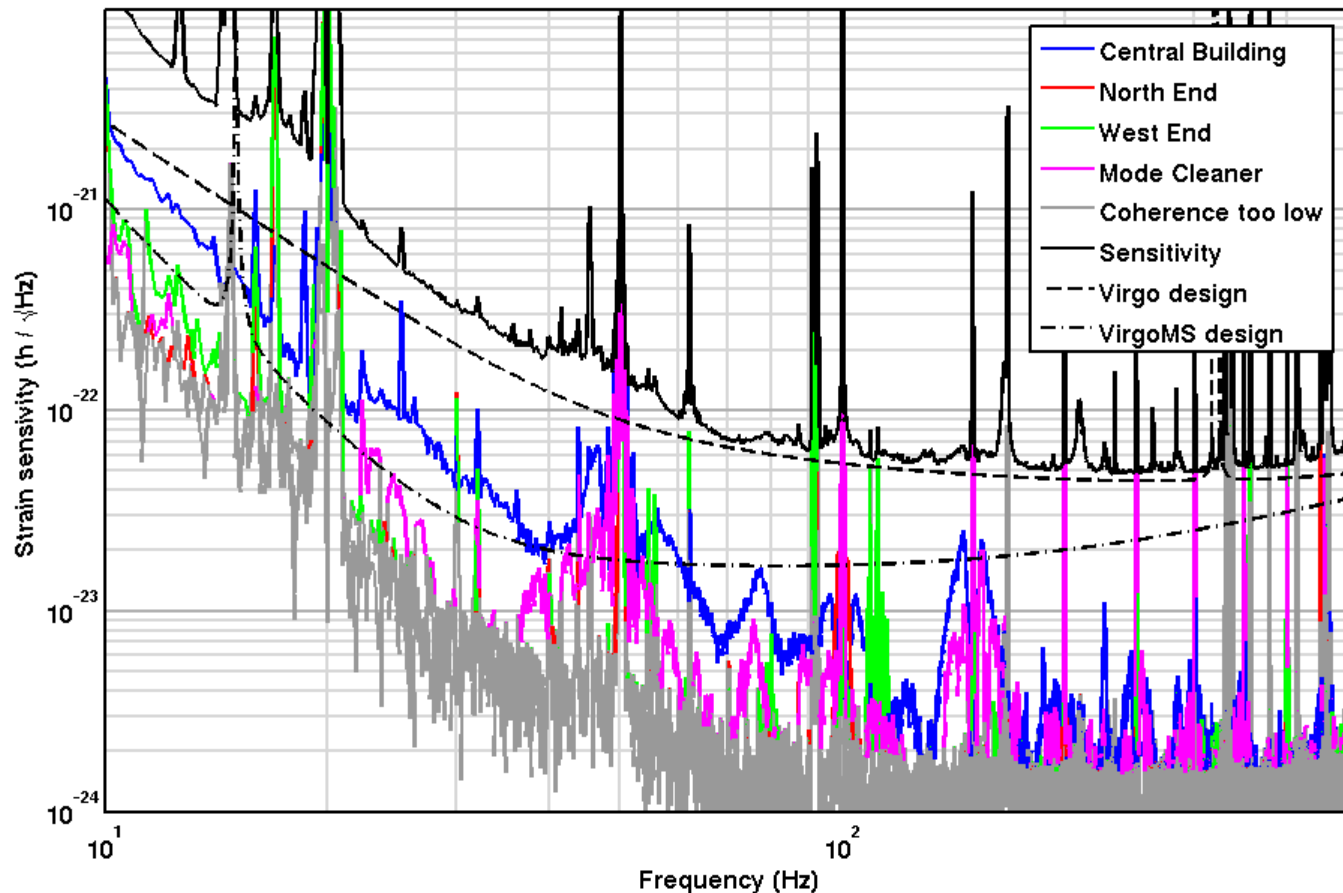
Coherence magnetometers with B1_AcP



- Brute force: 7 hours of data @ 9.5 Mpc, 5400 averages
- Meaningful coherence down to $1e-3$, can resolve sources factor 30 below sensitivity

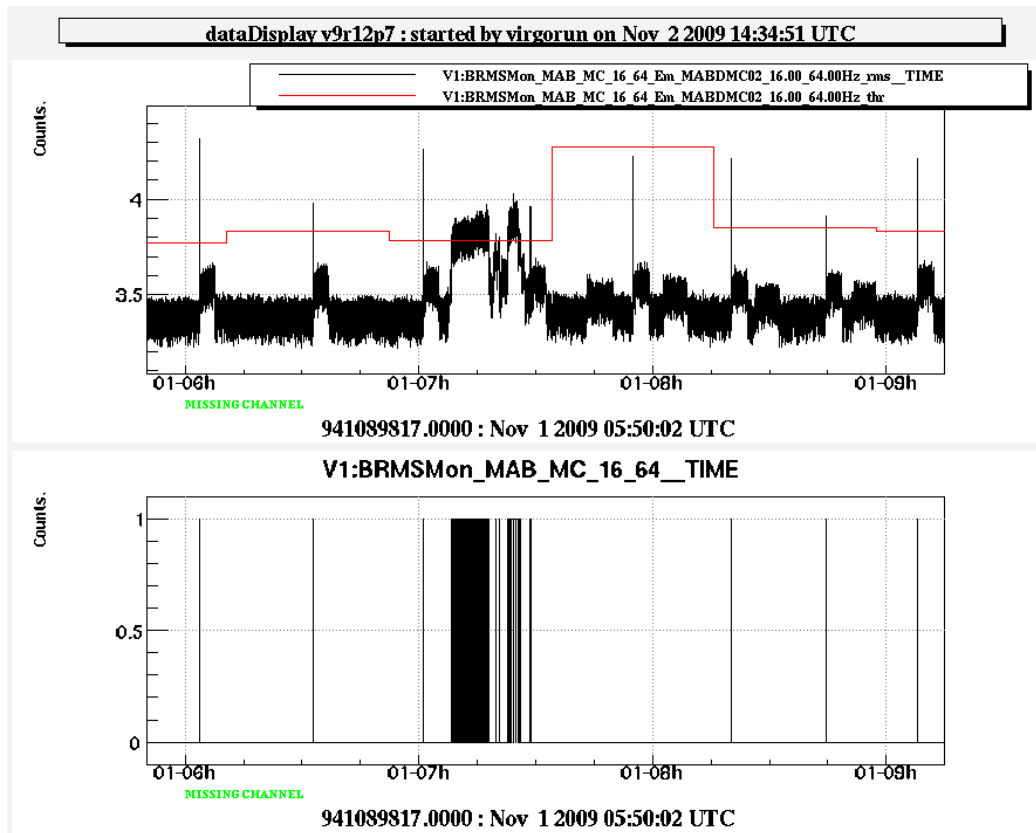
Long coherence 2

Magnetic noise projection based on coherence with magnetometers



- Projected noise = sensitivity * sqrt(coherence), should give correct value for sources clearly seen by magnetometers
- Low frequency: more optimistic result than far-field budget
- High frequency: probably some near-field sources

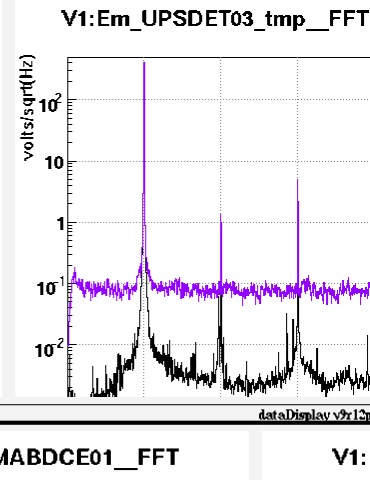
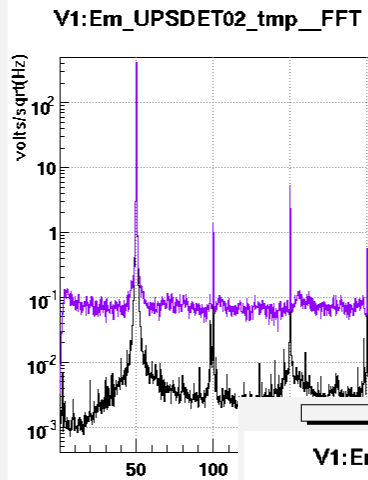
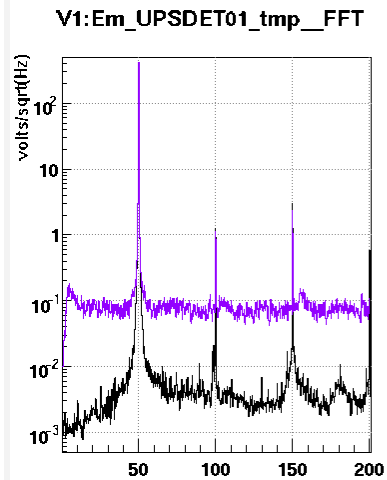
Mode-cleaner chiller



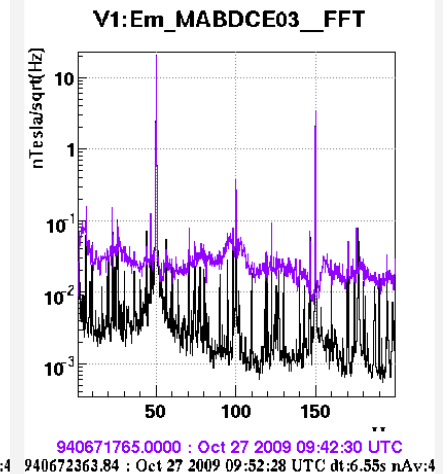
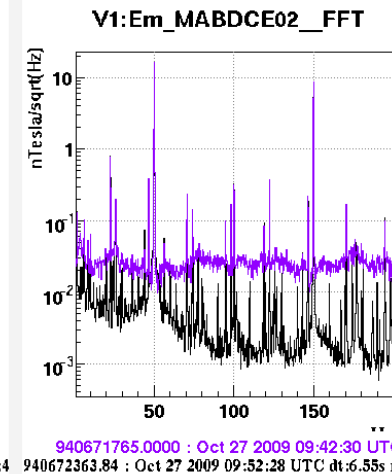
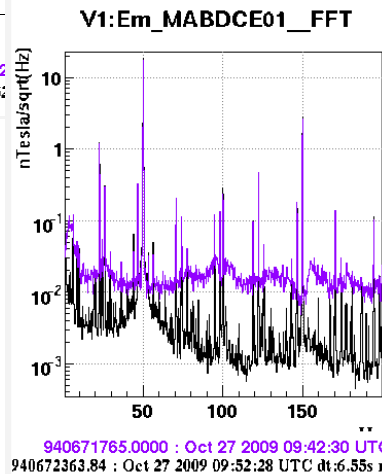
- Glitch in MC magnetometer and dark fringe every 20 min
- Occurs when chiller of the MC switches on, should be easy to fix
- Coupling path probably via IPS, which radiates magnetic noise in CB
- Coupling between buildings should be better understood

UPS noise

dataDisplay v9r12p7 : started by virgorum on Oct 27 2009 10:21:21 UTC



dataDisplay v9r12p7 : started by virgorum on Oct 27 2009 10:28:48 UTC



- UPS of the Central Building much noisier than others
- Switching to grid, magnetic noise reduces by order of magnitude
- Check with manufacturer if problem can be cured

Conclusions

- Far-field injections give rough idea of level of magnetic noise, but some result clearly overestimated and only valid for sources in FF
- Near-field injections identified BS as most sensitive
- Noise-projection based on long coherences with magnetometers/probes seem good tool, also for sources in the near-field
- Noise of central building UPS might be dominant

Outlook

- Noise injections finished for now
- Noise hunting with portable probes should continue
- Reduce sensitivity of magnetometers at NE/WE
- Improvements for Virgo+MS:
 - Magnets on BS will be reduced
 - Dielectric reference mass should help
 - Cure or displace some sources
 - Understand and fix noisy UPS of CB

End