LIGO-III Configuration options

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The problem

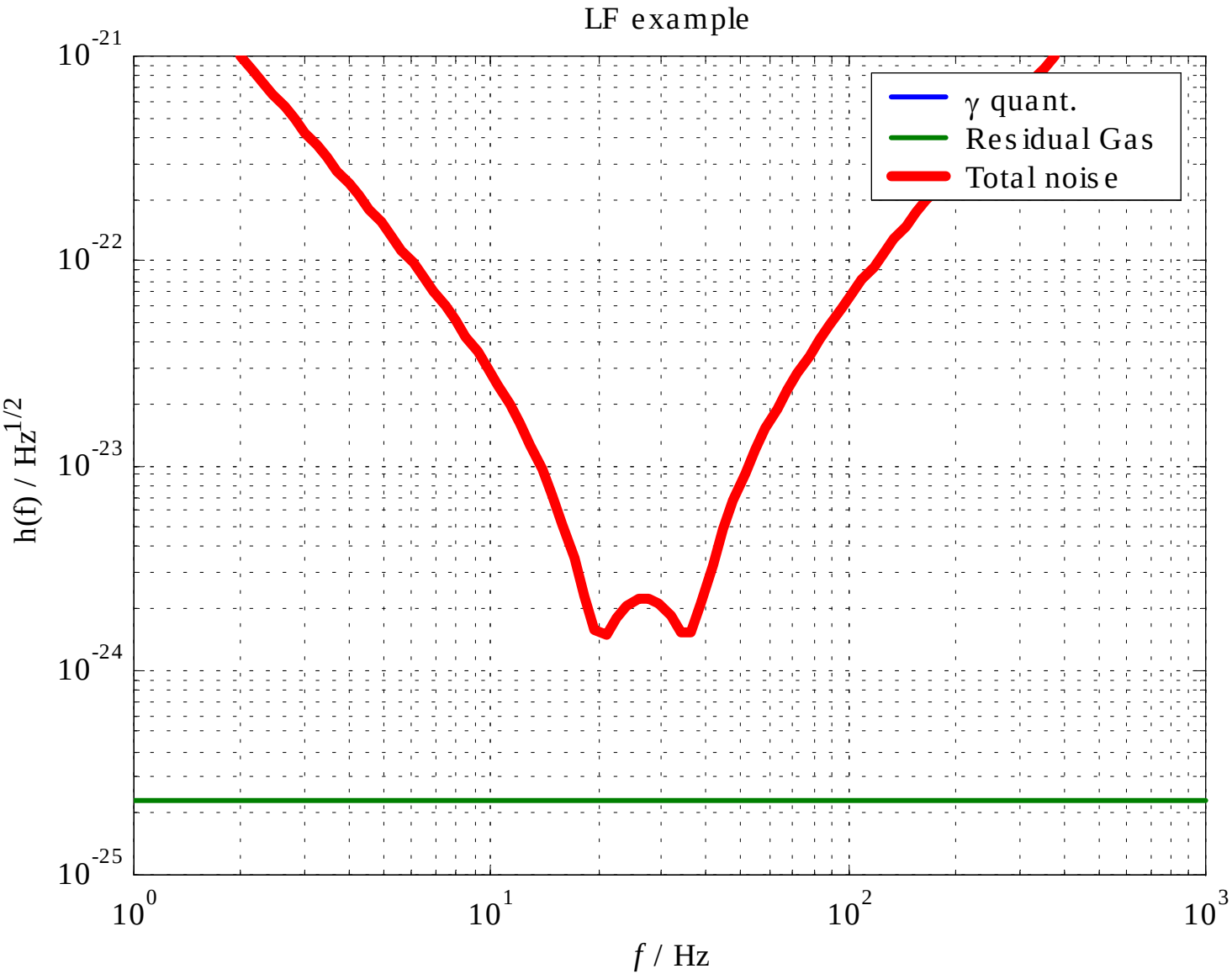
- AdLIGO close to “Quantum limited” at low frequency with 40 kg TMs.
- Facility limits permit significant improvements at mid/high frequency
  - Simply increasing stored light energy would make low frequency performance worse.
- We should recognize that early detection of signals is likely to change our perspective ...

Solutions

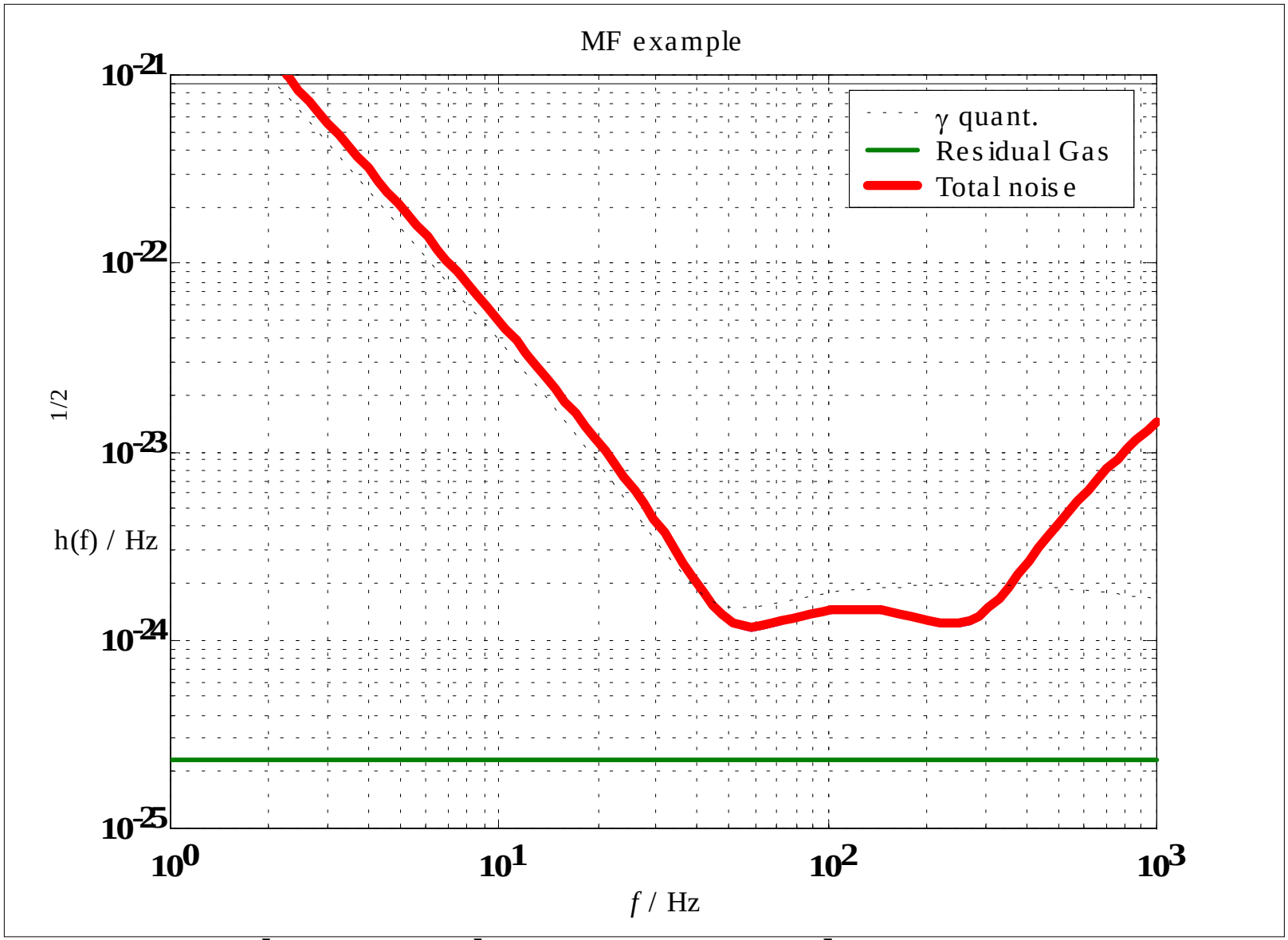
- Combining some of the following could provide a solution
  - Multiple interferometers for different frequency ranges.
  - More exotic QND than in AdLIGO.
  - Alternative interferometer configurations.
- These are discussed in no particular order ...

Multiple interferometers

- Two interferometers 1) High power 2) LF
  - Newtonian background (etc.) sets LF limit
  - Determine a balance between power/test mass/bandwidth, these determine the LF and HF limits for this interferometer.
  - Cover rest of the band with ifo(s) tuned to higher frequencies.
  - In each case QND could improve the performance



TM ~100 kg Pin ~ 5W conventional RSE



TM ~ 100 kg/Pin ~ 1kW/ conventional RSE or DR

QND solutions

- Several options all needing study
  - Signal recycling / multiple ifos
  - Output filter cavities to provide frequency dependent readout phase
  - Application of more “traditional” QND techniques (PR-Michelson squeezing at ANU), novel readout schemes (speed-meter systems).

Alternatives?

- Sagnacs for HF ifo? - need long delay lines.
- White-light interferometers
  - various means proposed to provide broad response with lower power than traditional designs
  - seem to break the Mizuno noise/power/ bandwidth theorem (according to some claims)
  - study required, including UF

Challenges

- How to get below ~1e-24?
- How best to apply QND?
- Can white-light schemes work?