



First Einstein@Home all-sky search for continuous gravitational waves in advanced LIGO data

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Columbia University,
10-15 July 2016
LIGO DCC: G1600983



Continuous Gravitational Waves

Non-axisymmetric rotating neutron stars

Continuous signal with $h \propto \varepsilon$ $f_{GW} = 2f_{NS}$

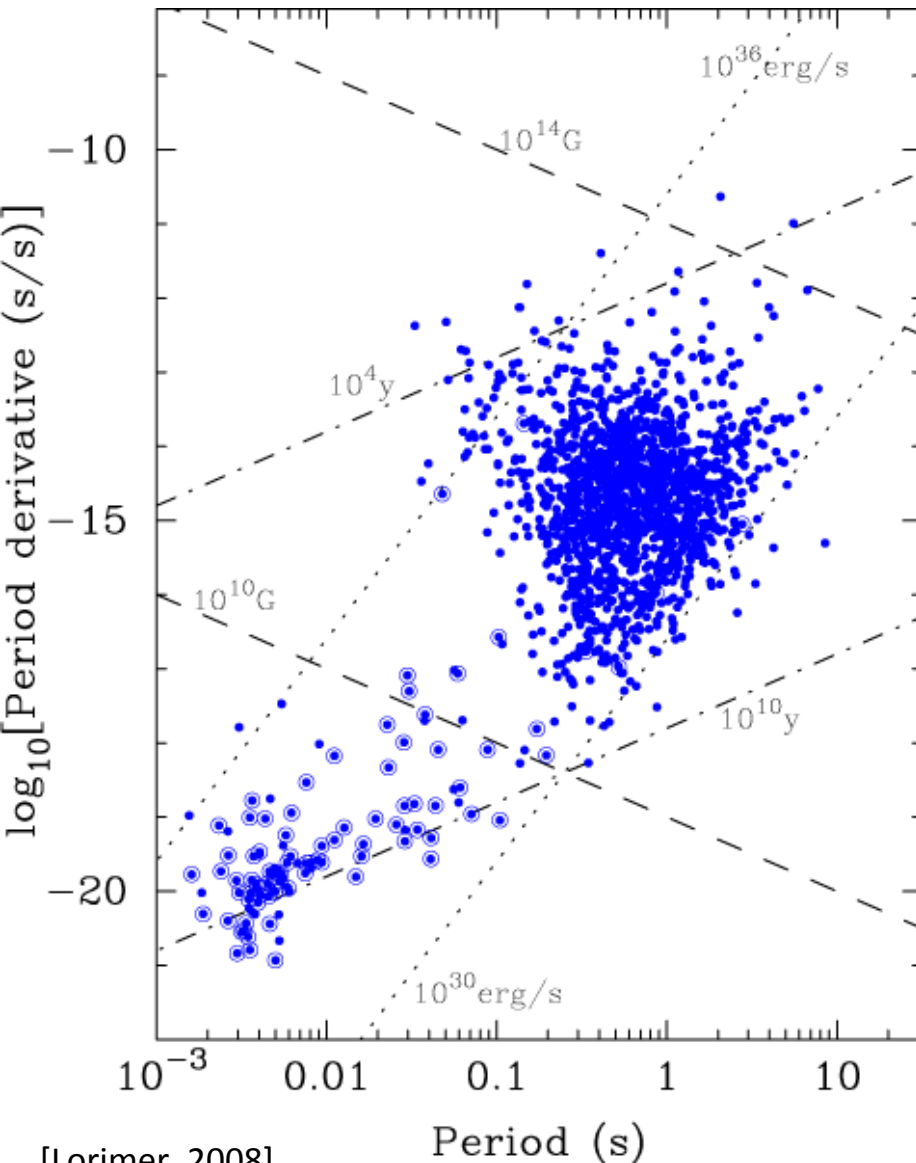
Maximum deformations

Normal NS: $\varepsilon \leq 10^{-5}$ [Johnson-McDaniel & Owen, 2013]

Hybrid: $\varepsilon \leq 10^{-3}$

Extreme quark stars: $\varepsilon \leq 10^{-1}$

Blind All sky Searches



[Lorimer, 2008]

~ 2000 known pulsars

40,000 millisecond pulsars in
our galaxy [Lorimer, Living Rev. Relativity, 11
2008]

$O(10^6 - 10^7)$ undiscovered EM
quiet NS within 5kpc [Narayan. *ApJ*,
1987]

Potential to discover off-axis
pulsars or gravitars

Semi-coherent methods

$$\text{SNR} \propto \frac{h_o}{\sqrt{S_n}} T_{\text{coh}}^{1/2} N_{\text{seg}}^{1/4 w},$$

$w(N_{\text{seg}}, p_{\text{FA}})$ range $[1, \approx 3.5]$

[Prix & Shaltev, PRD85, 2012]

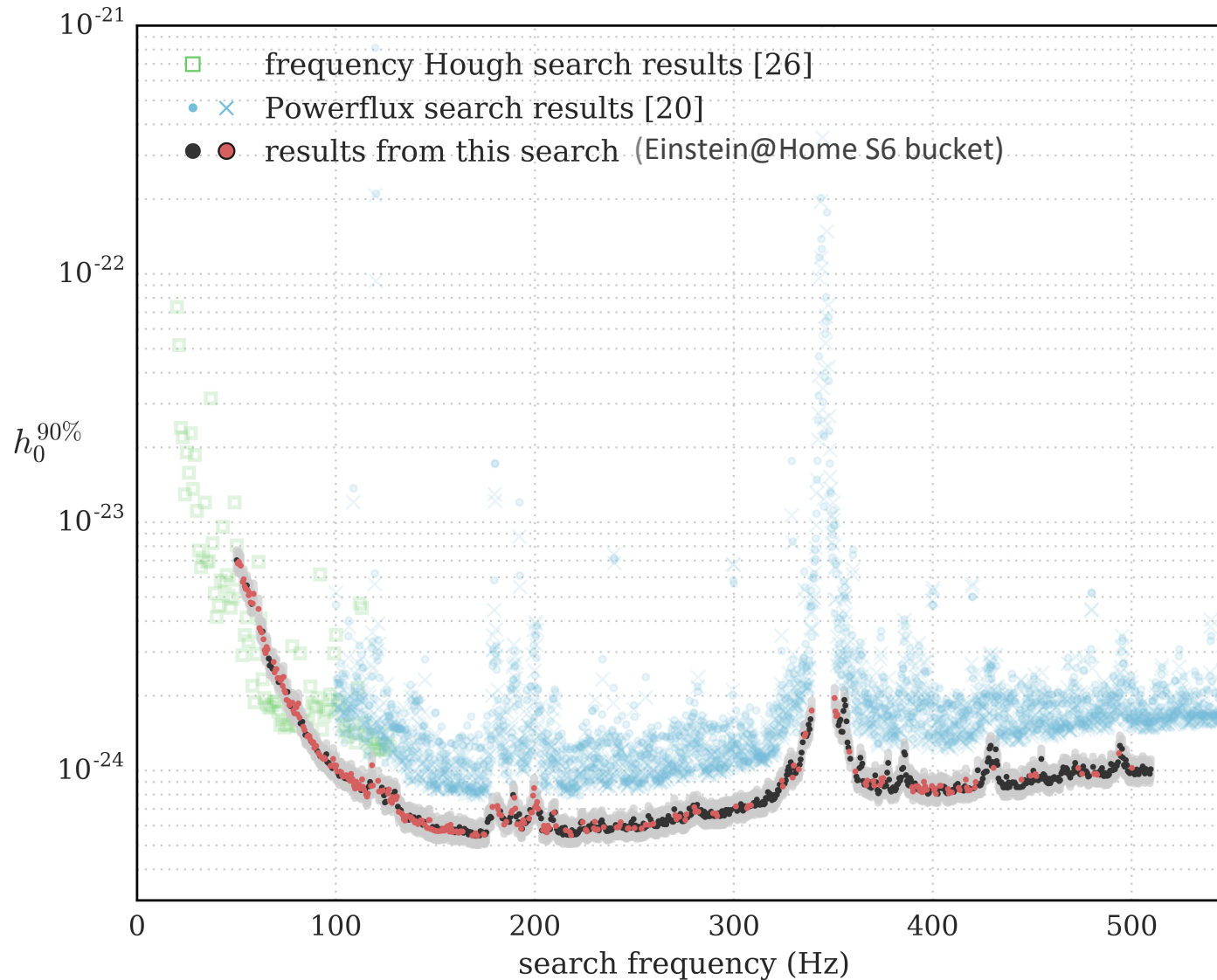
Computationally limited



- Volunteer distributed computing project, started 2005
- > 350k volunteers, order of 1 PetaFLOPS
- Enables most sensitive all-sky searches for isolated neutron stars [Walsh et al., arXiv:1606:00660 (2016)]

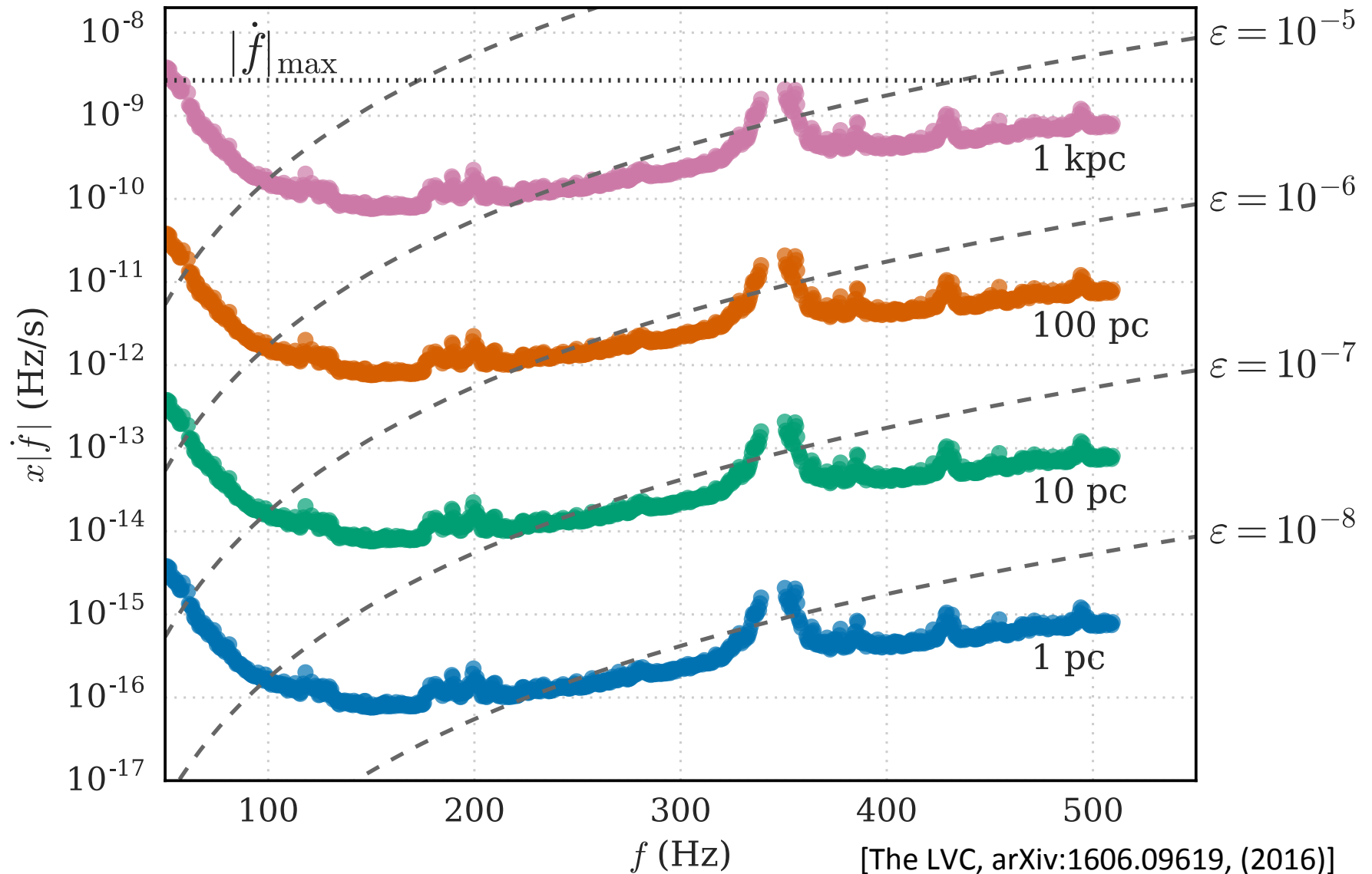
Results/Download instructions: <http://einstein.phys.uwm.edu>

Upper Limits from S6Bucket search

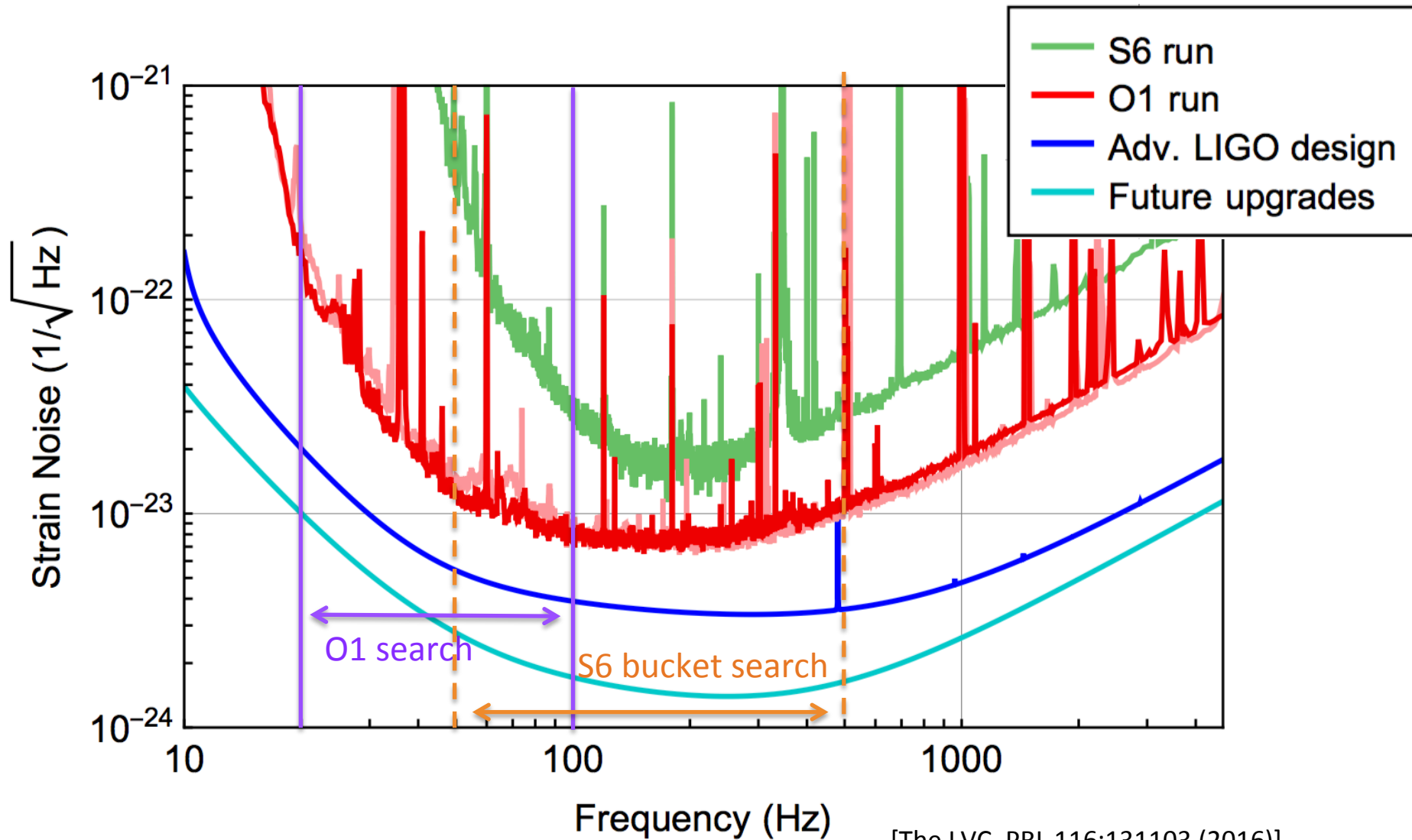


[The LVC, arXiv:1606.09619, (2016)]

S6Bucket search



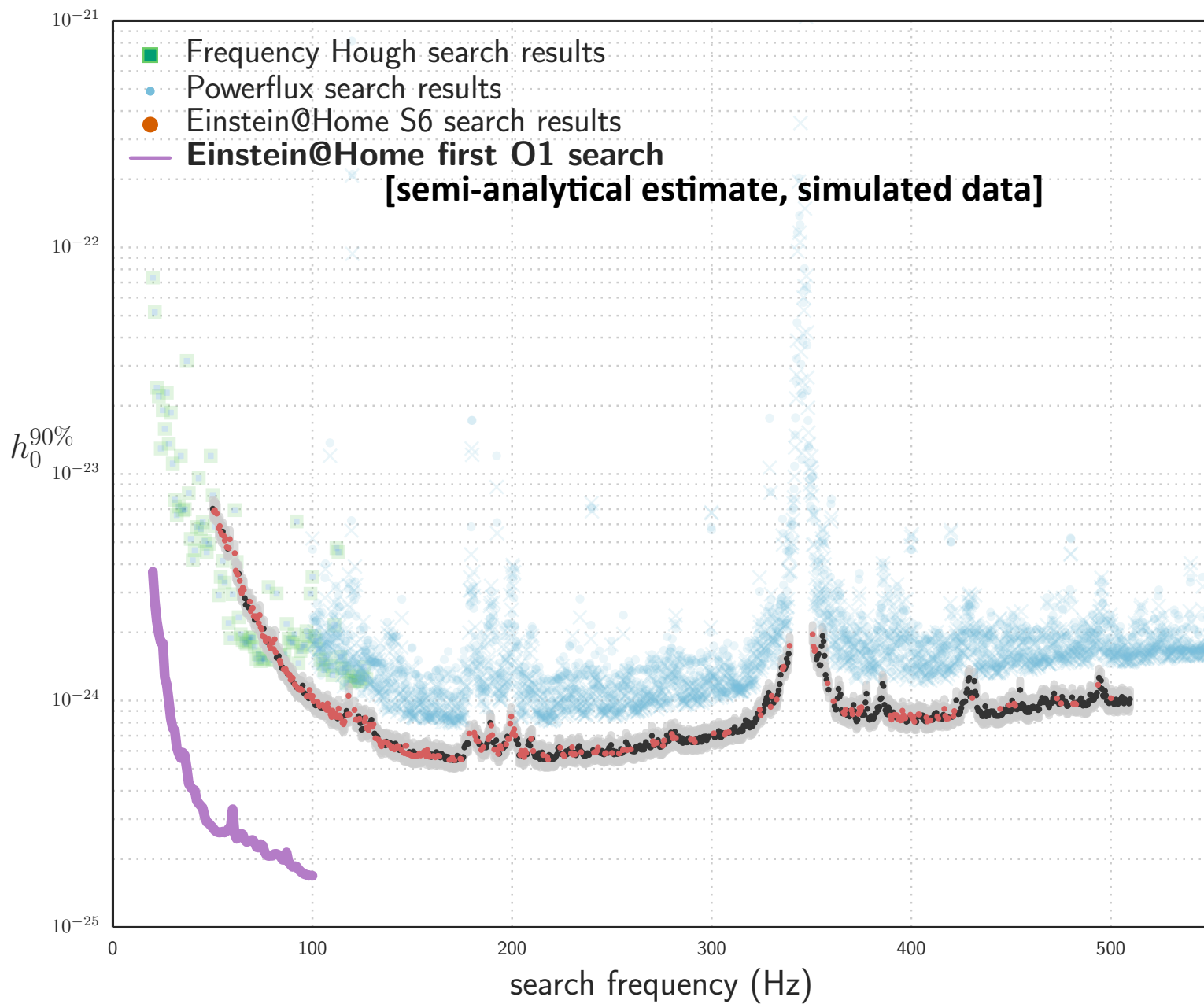
Detector Sensitivity

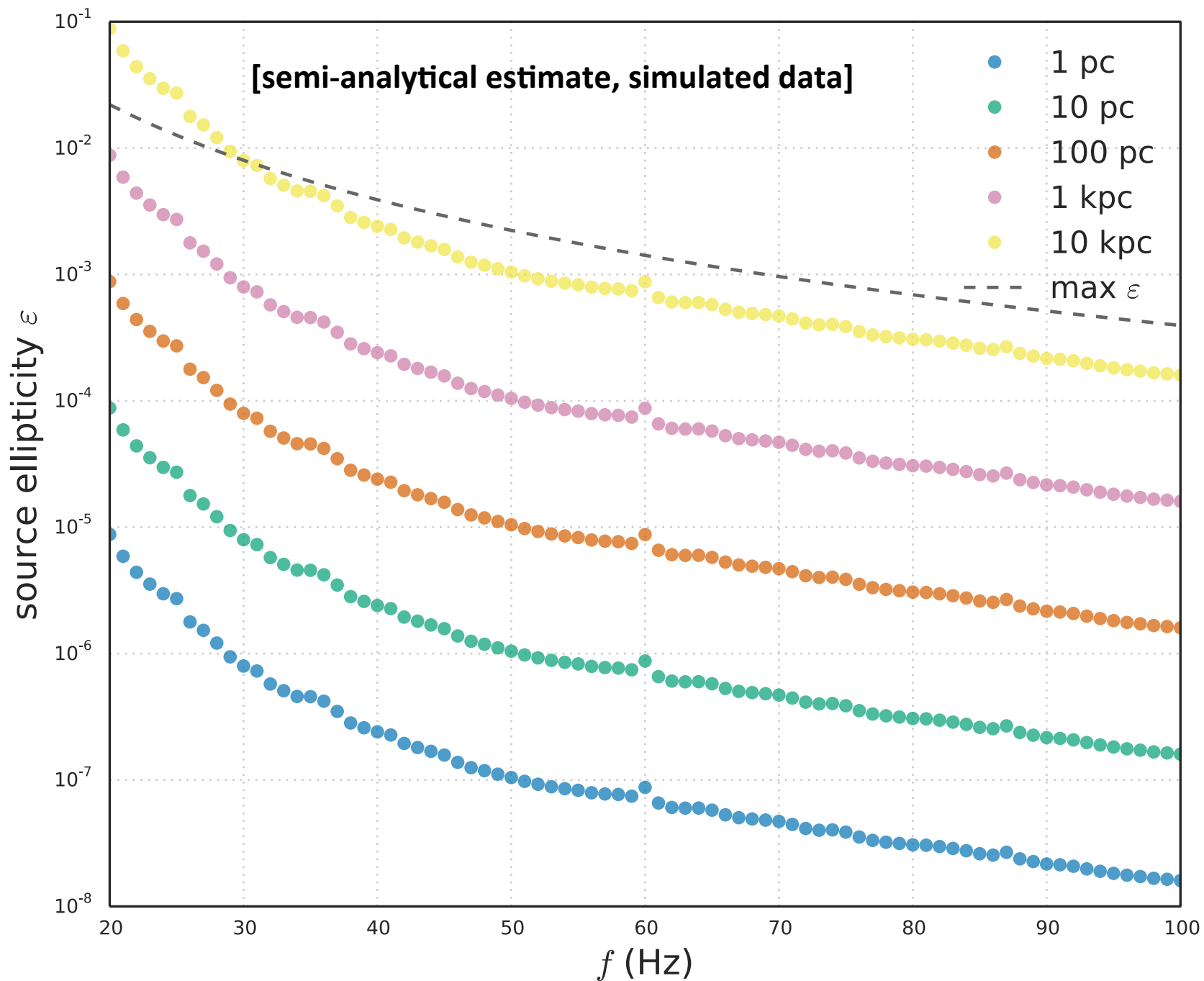


[The LVC, PRL 116:131103 (2016)]

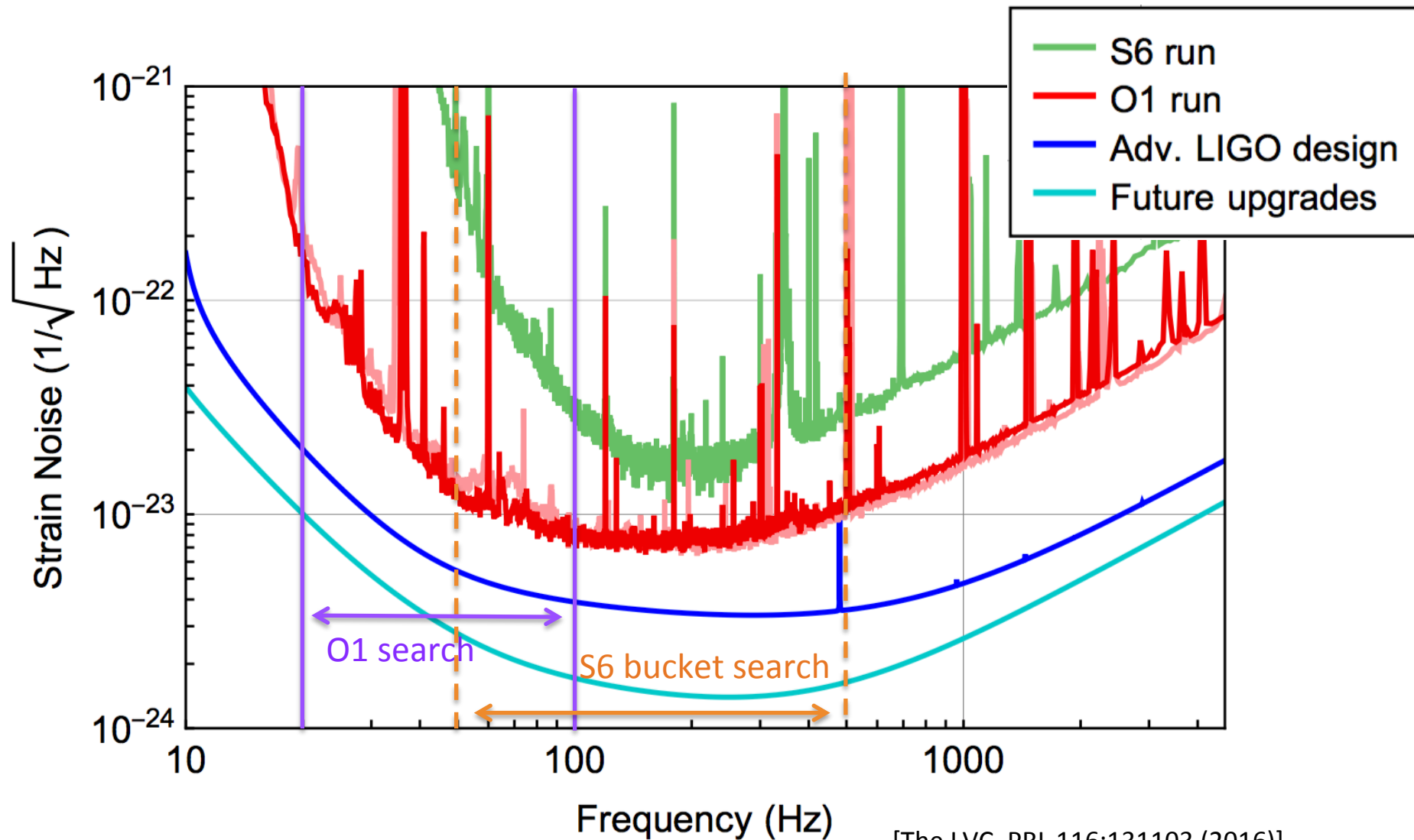
	S6Bucket search	First O1 search
Frequency	50-510 Hz	20-100 Hz
Spindown	-2.6e-9 to 3.1e+10 Hz/s	-2.6e-9 to 3.1e+10 Hz/s
Coherent segment length	60 hours	230 hours
Observation time	9 months	4 months

O1 Einstein@Home search to complete this month -> ready for postprocessing





Outlook: next frequency range



[The LVC, PRL 116:131103 (2016)]

Conclusion

Analysing first Einstein@Home search on O1 data

Expect significant improvement in astrophysical reach