Improving Searches for Gravitational Waves using Signal Isolation Tests

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August 18 2005

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LIGO-G050488-00-R

Overview

- Method of Detecting Gravitational Waves (GWs) from Binary Inspiral Sources

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- Characteristics of True and Noise-Induced Signals

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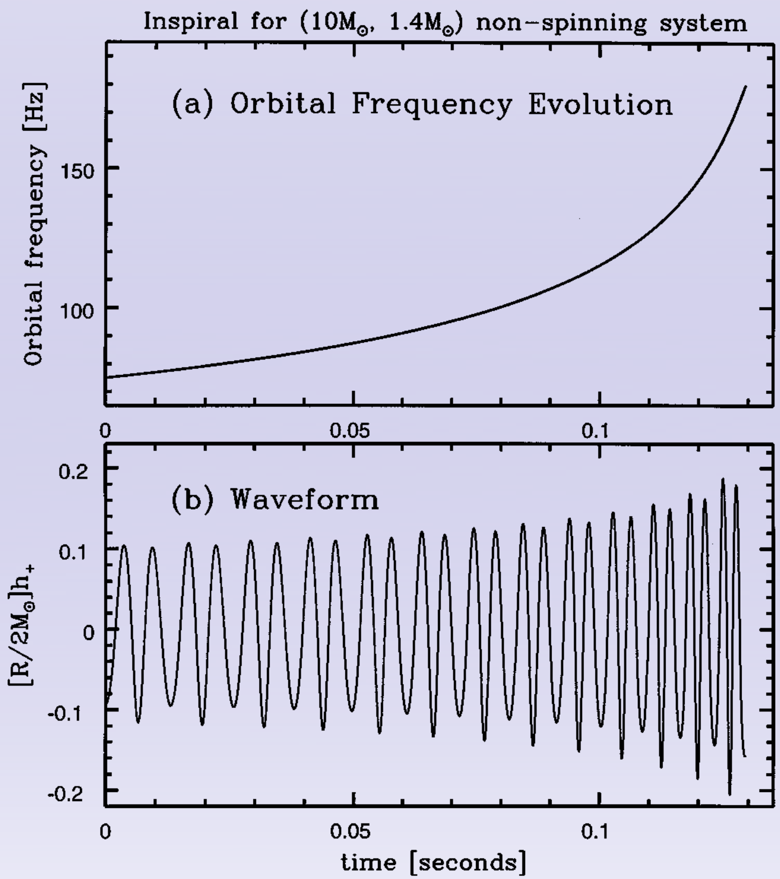
Method of Detecting GWs from Binary Inspiral Sources

- Knowledge of Waveform



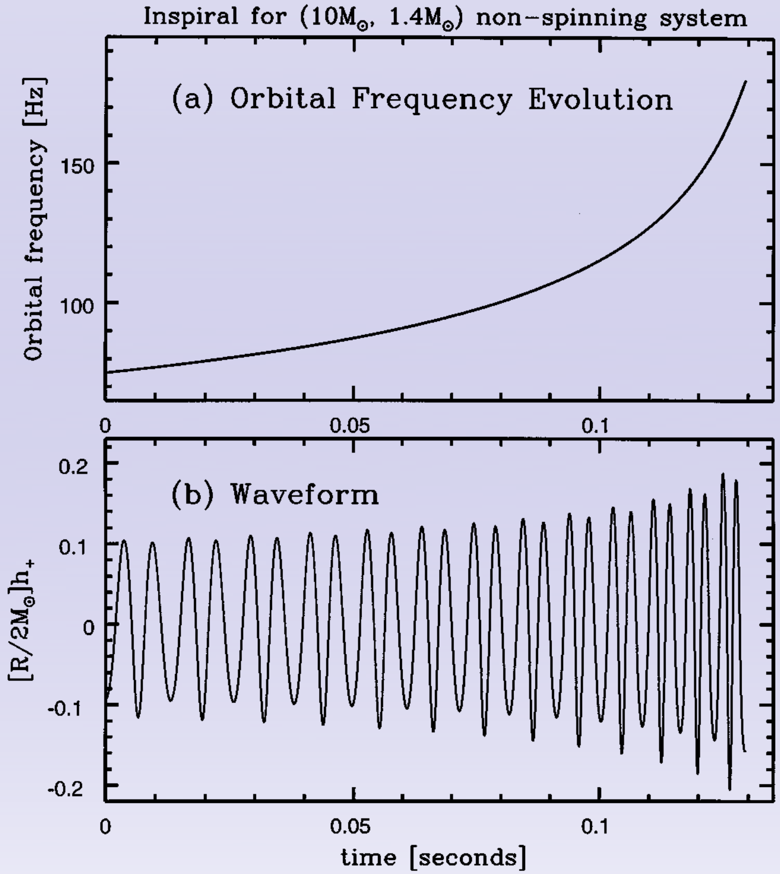
1. B. Allen, Phys Rev **D71**, 62001 (2005)   2. C. M. Will, A. G. Wiseman, Phys Rev **D54**, 4813 (1996)

Method of Detecting GWs from Binary Inspiral Sources

- Knowledge of Waveform
- Matched Filtering

$$\tilde{s}(f) \equiv \int e^{-2\pi i f t}\, s(t)\, dt$$

$$z(t) \equiv \int \tilde{s}(f) . \frac{\tilde{Q}^*(f)}{S_n(f)}\, df$$



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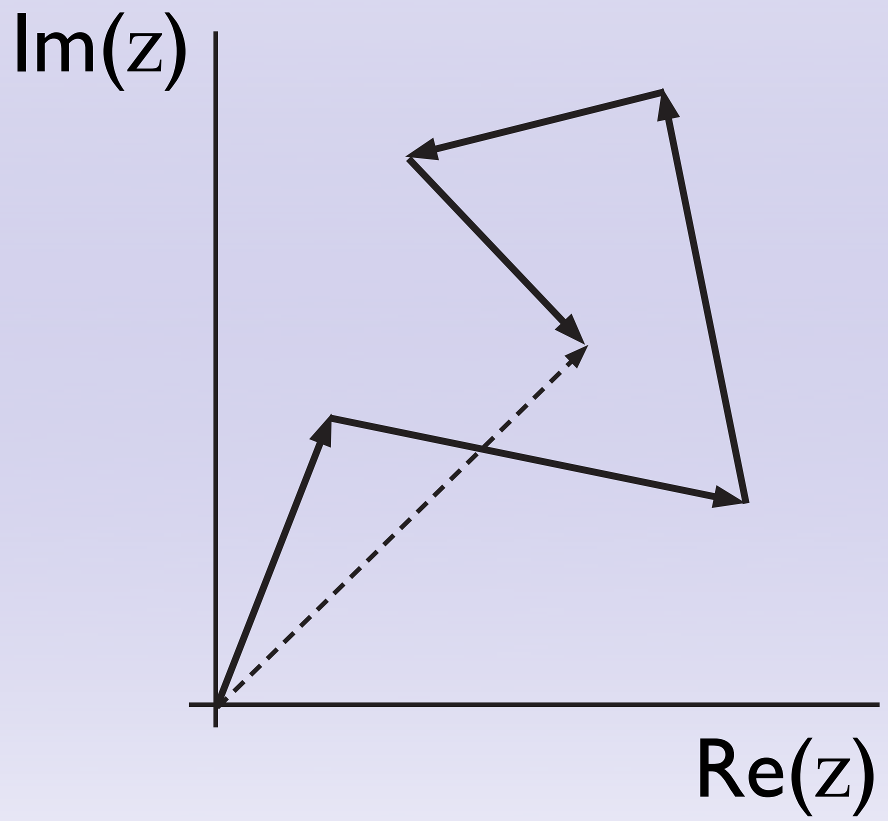
Method of Detecting GWs from Binary Inspiral Sources

- r^2 Veto



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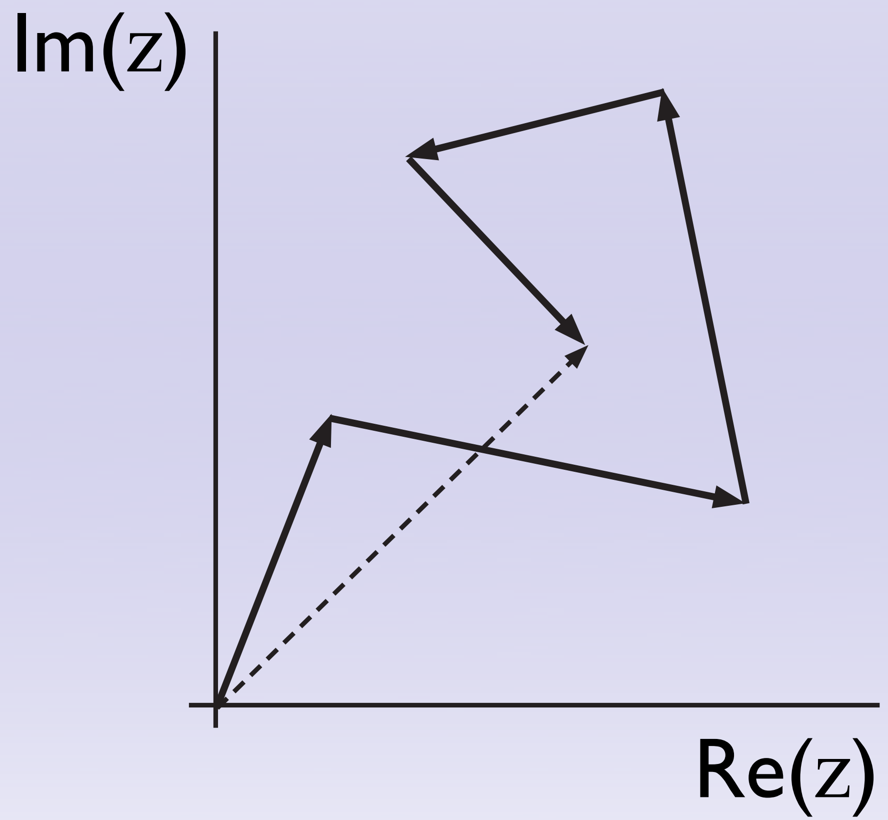
Method of Detecting GWs from Binary Inspiral Sources

- r^2 Veto

$$r^2 \equiv \sum_{i=1}^{p} \left| z_i - \frac{z}{p} \right|^2$$

$$r^2 < r^2_{\text{crit}} \left(1 + \frac{\delta^2 \rho^2}{p} \right)$$



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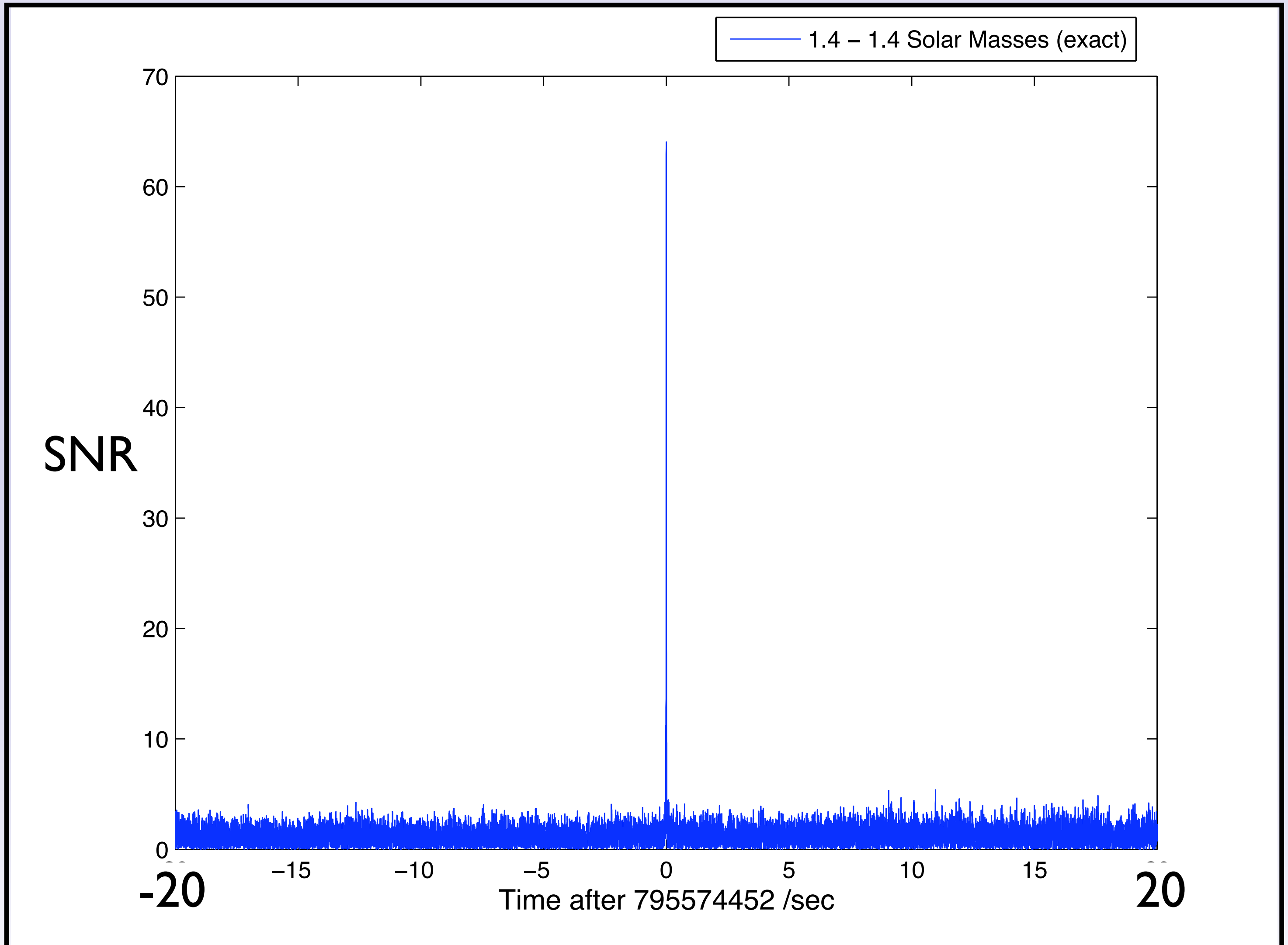
Signal-to-Noise Ratio Time Series for Injected Signal (True GW)



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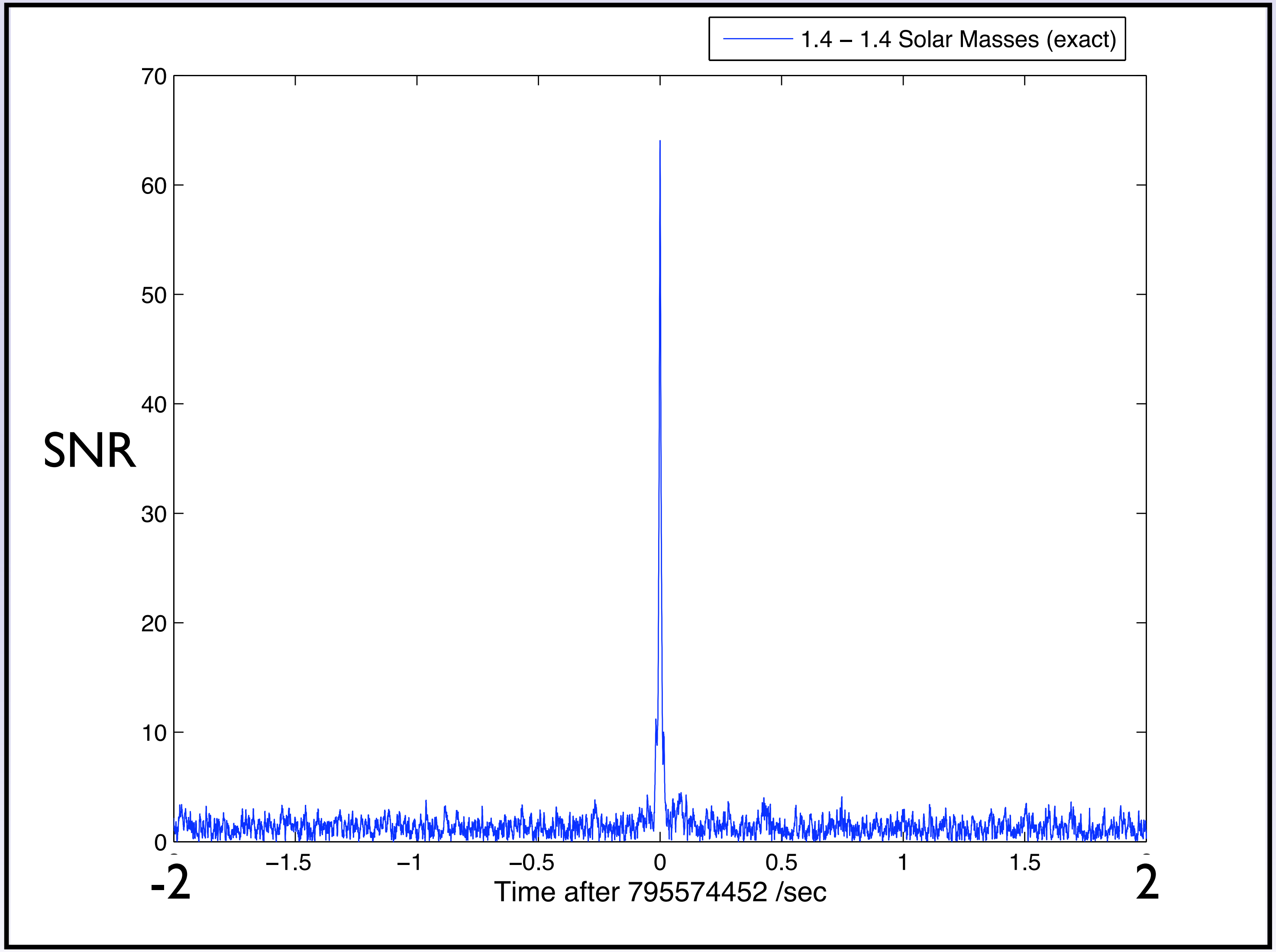

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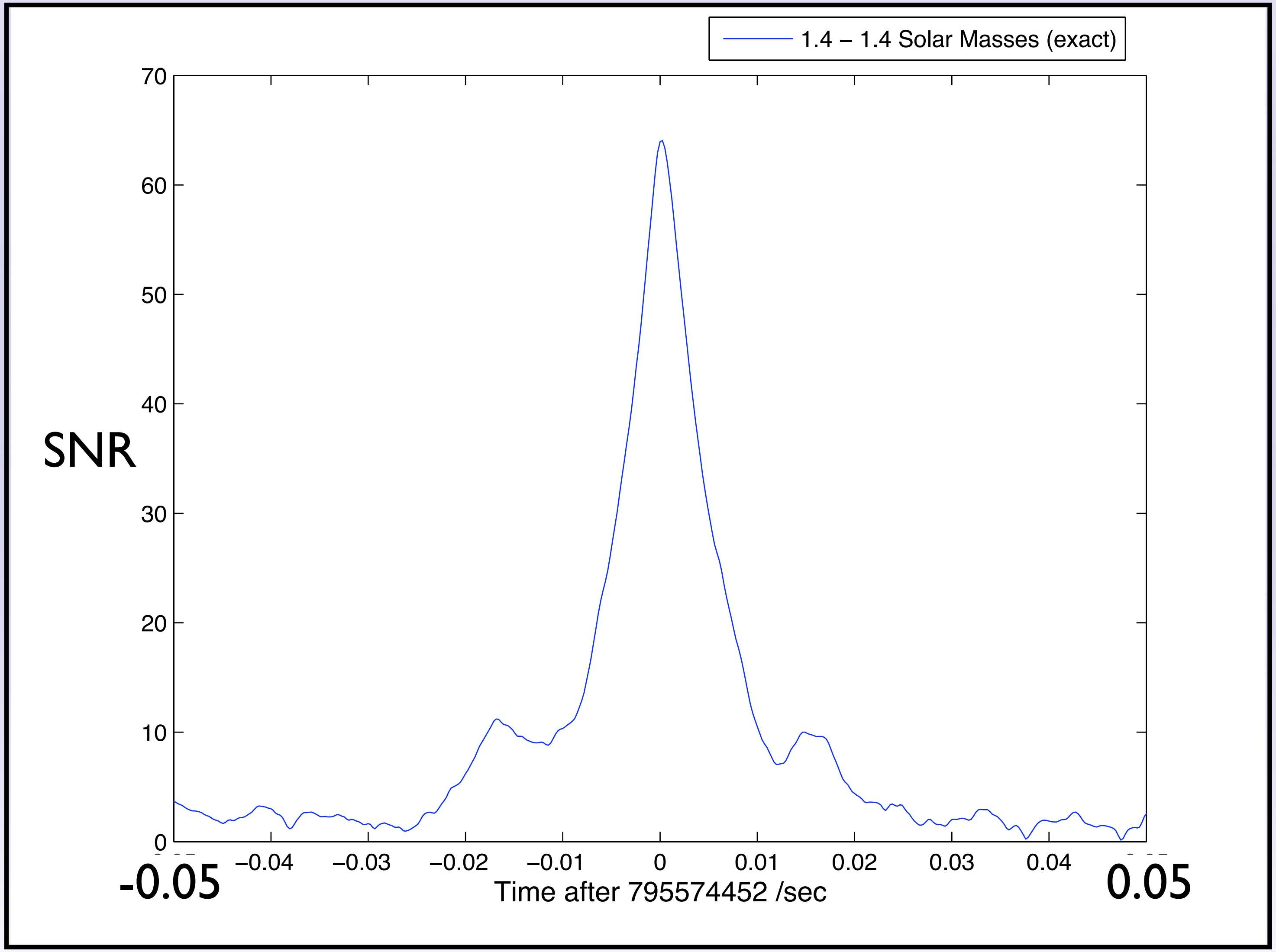
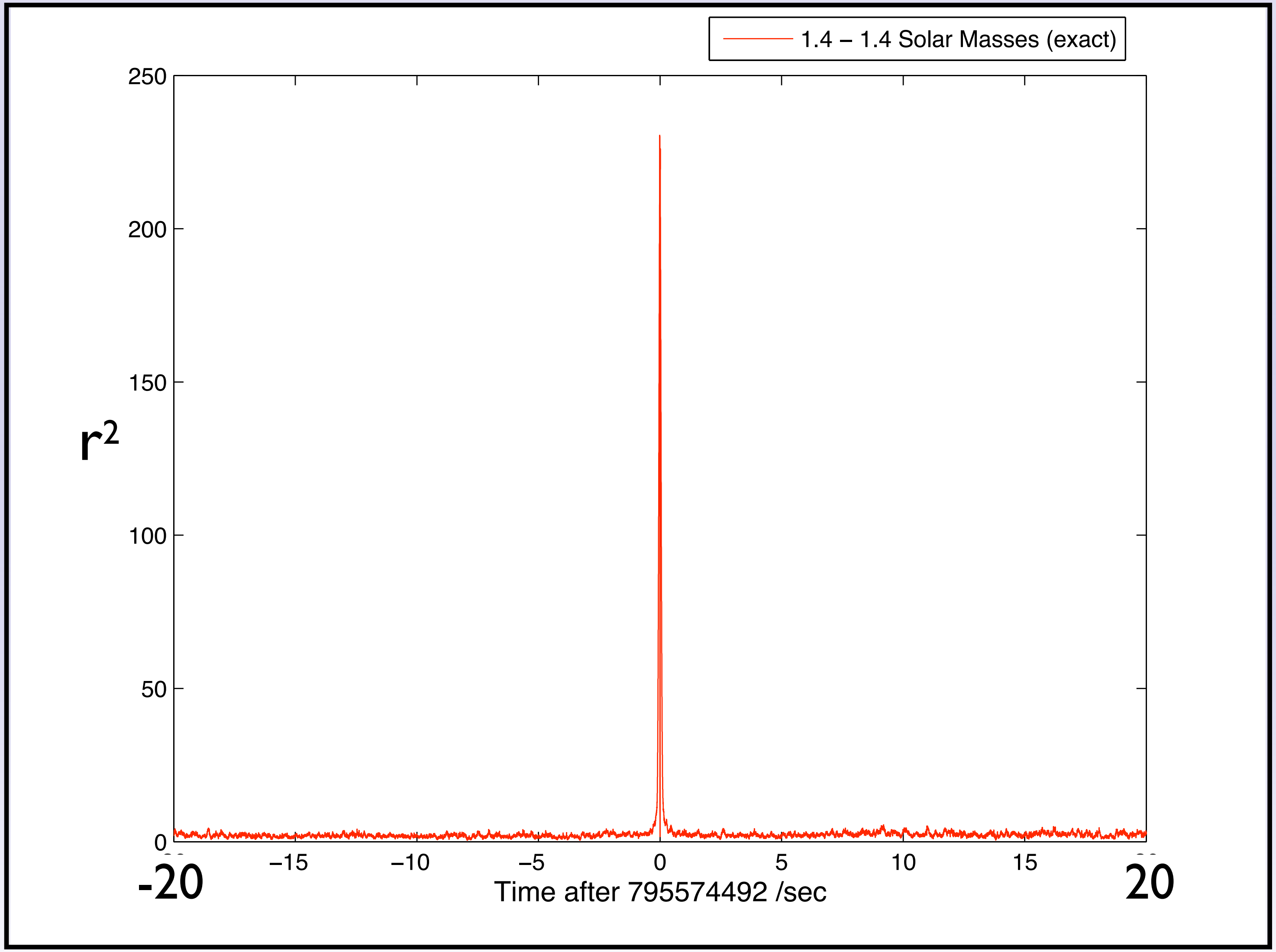


r^2 Time Series for Injected Signal (True GW)



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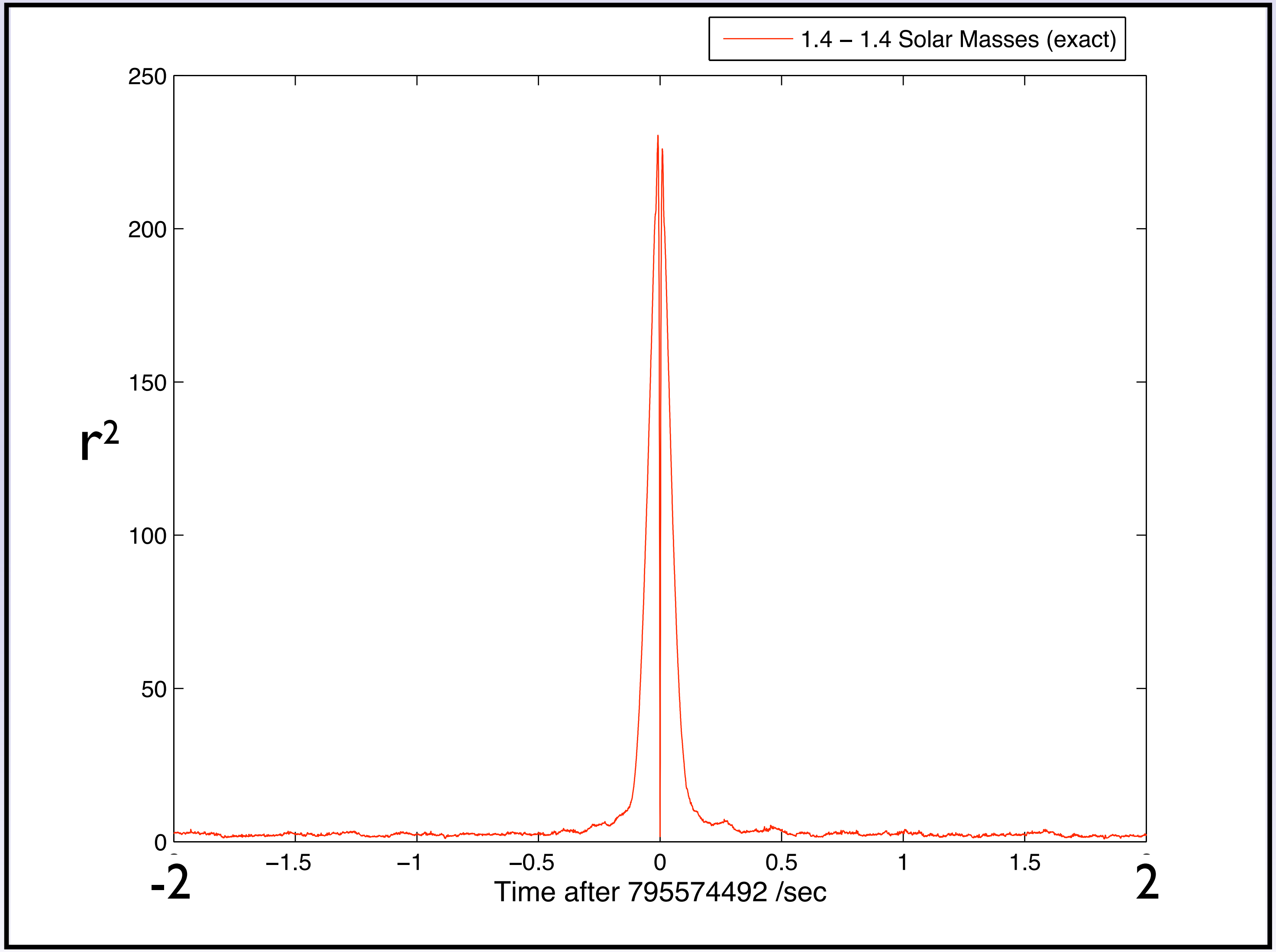

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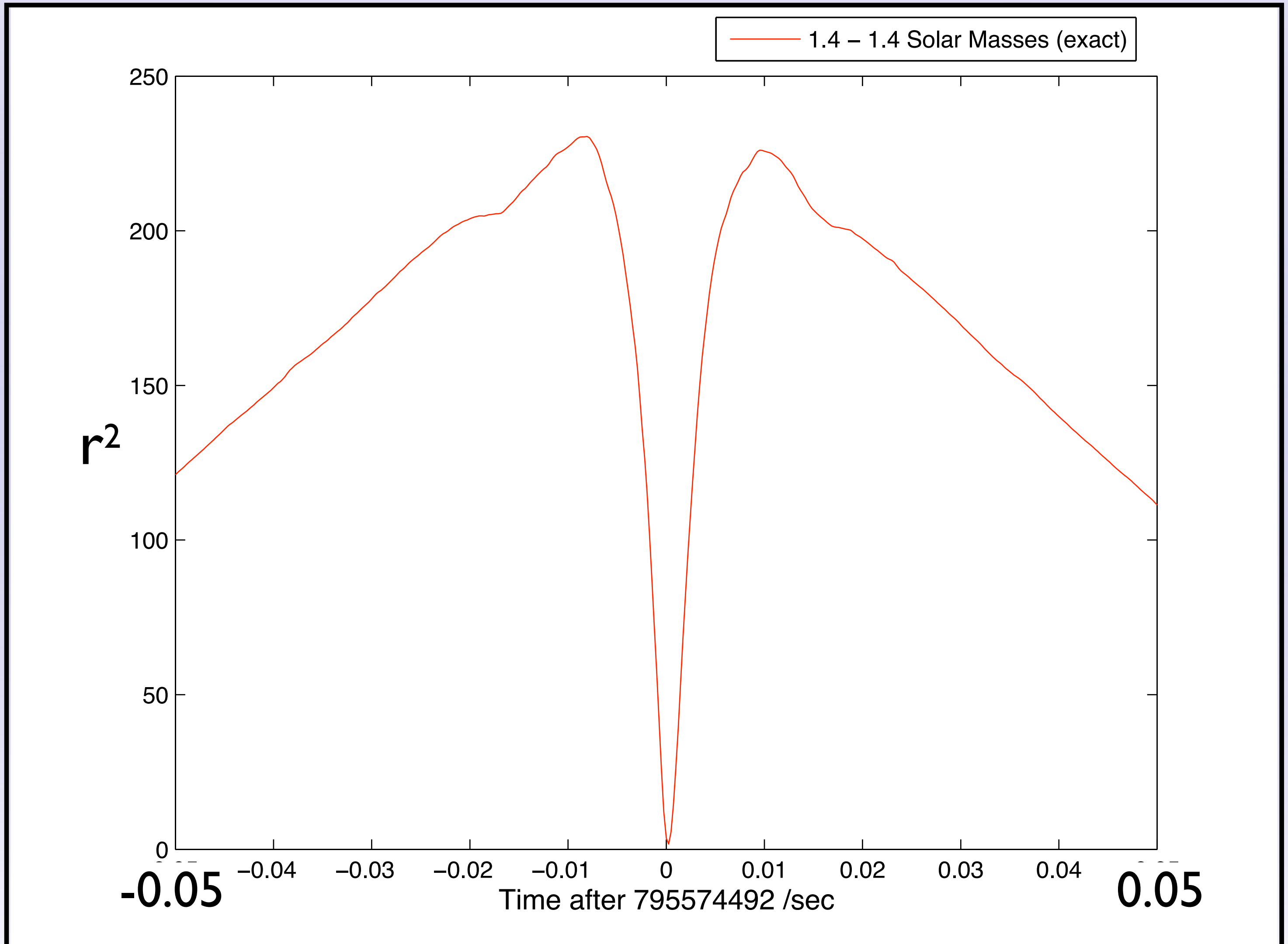
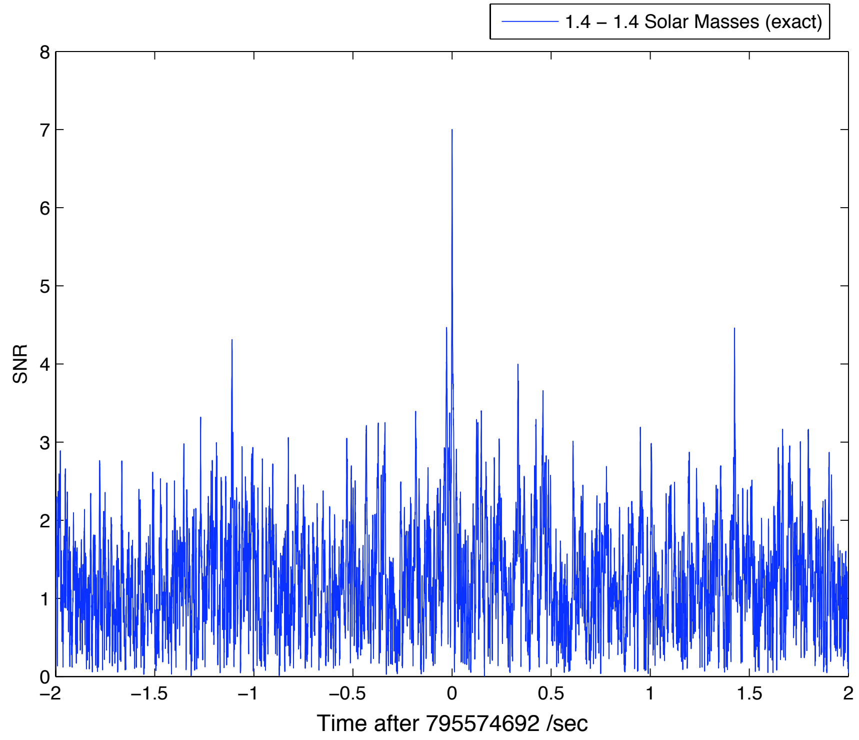
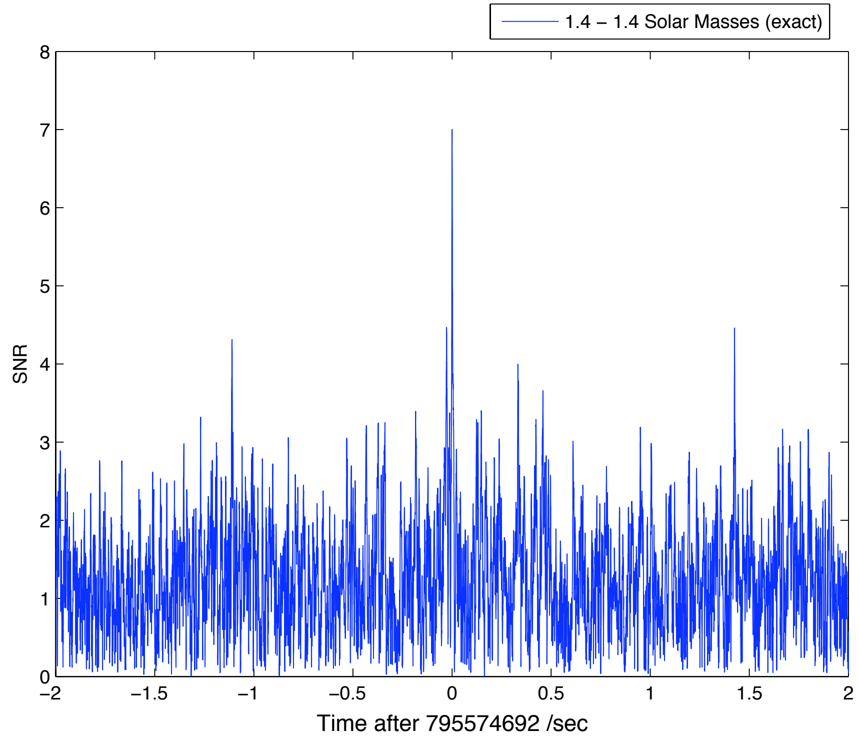



1.4 – 1.4 Solar Masses (exact)
SNR
Time after 795574692 /sec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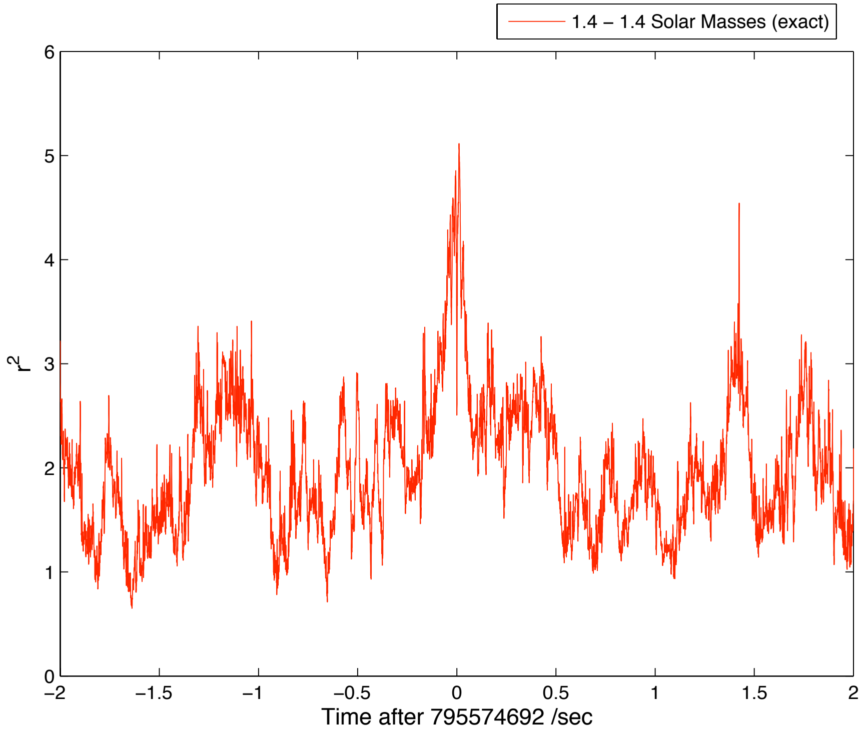
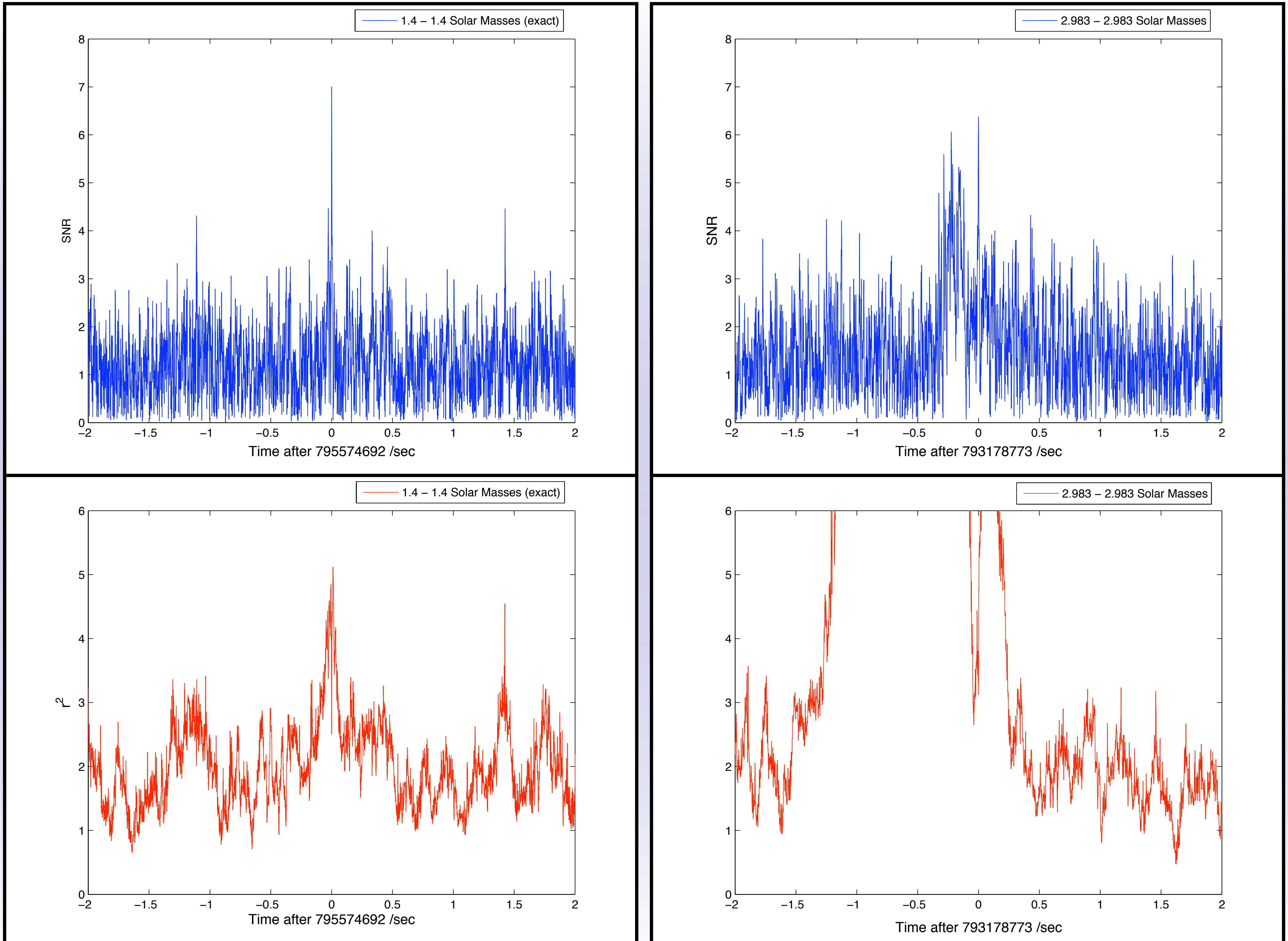

1.4 – 1.4 Solar Masses (exact)
r2
Time after 795574692 /sec


1.4 – 1.4 Solar Masses (exact)
SNR
Time after 795574692 /sec
2.983 – 2.983 Solar Masses
SNR
Time after 793178773 /sec
1.4 – 1.4 Solar Masses (exact)
r^2
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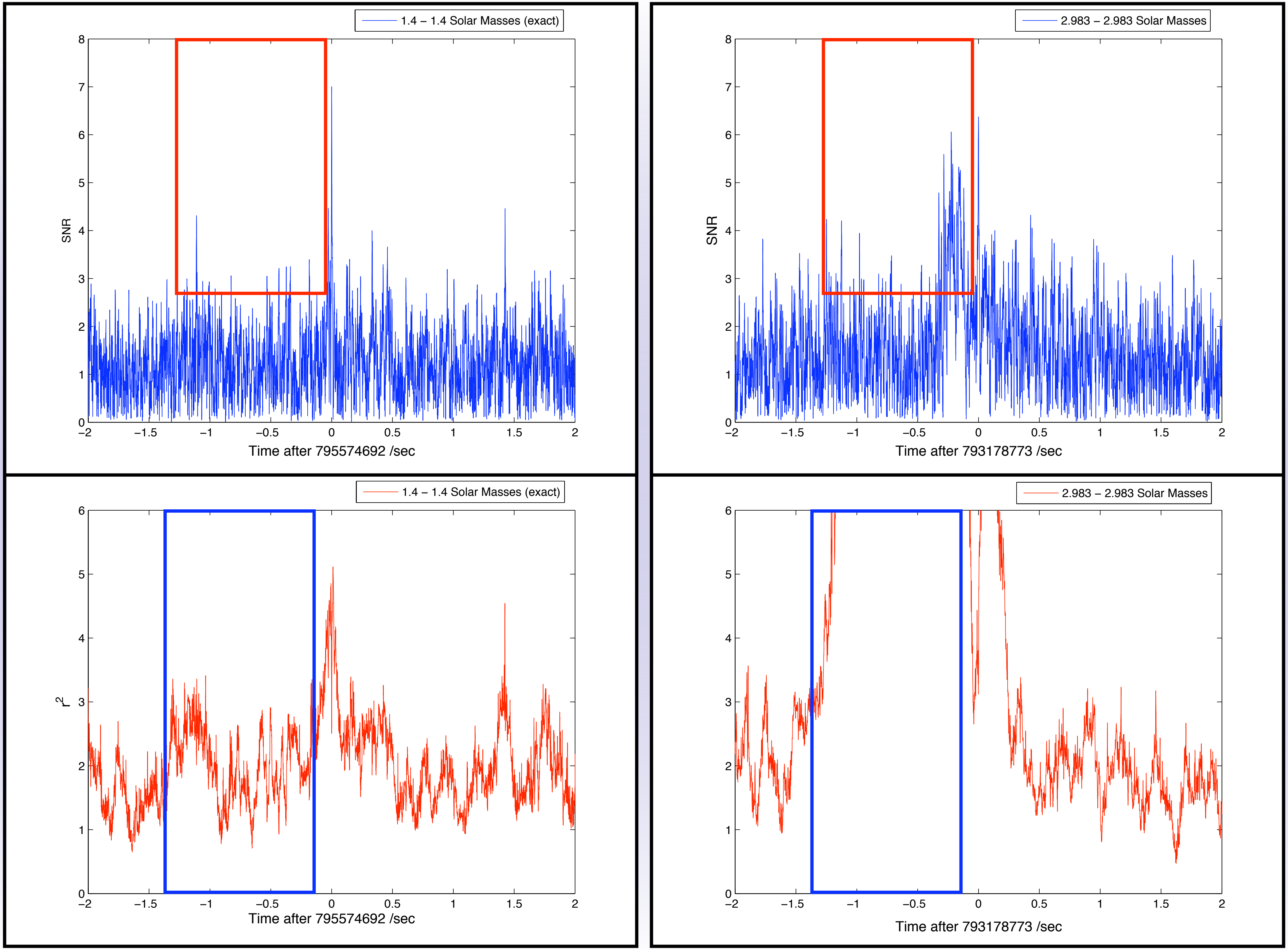

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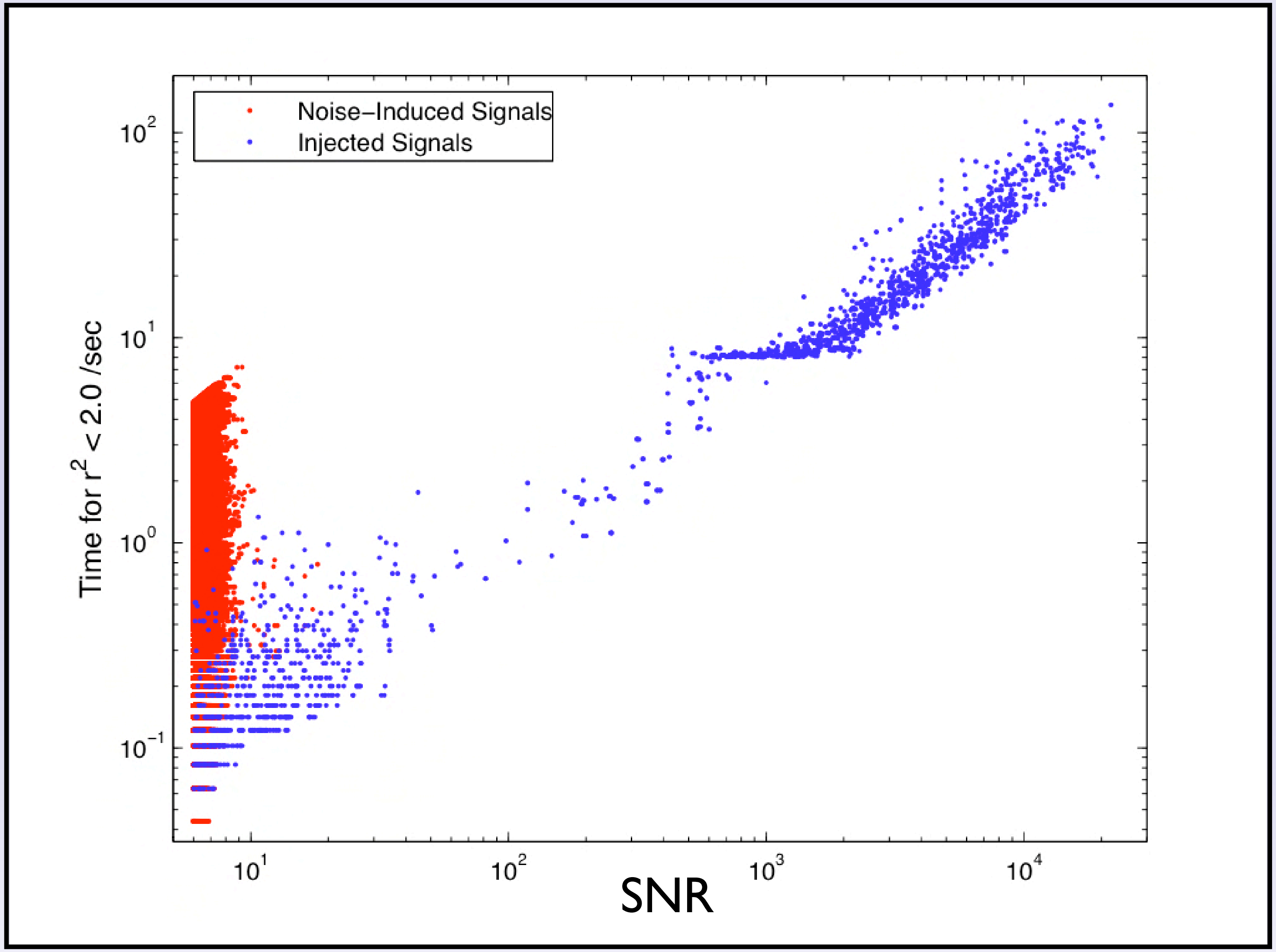
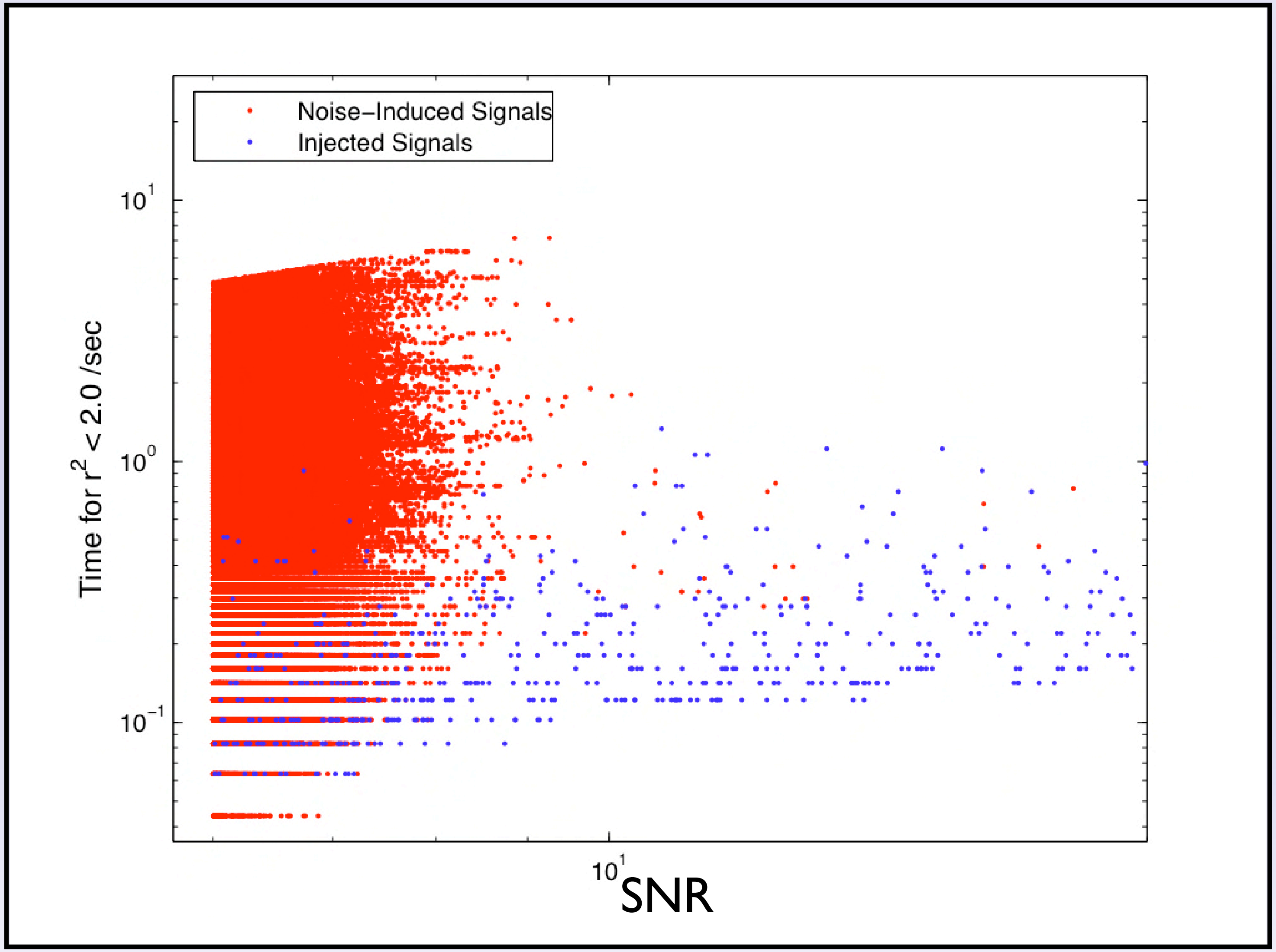
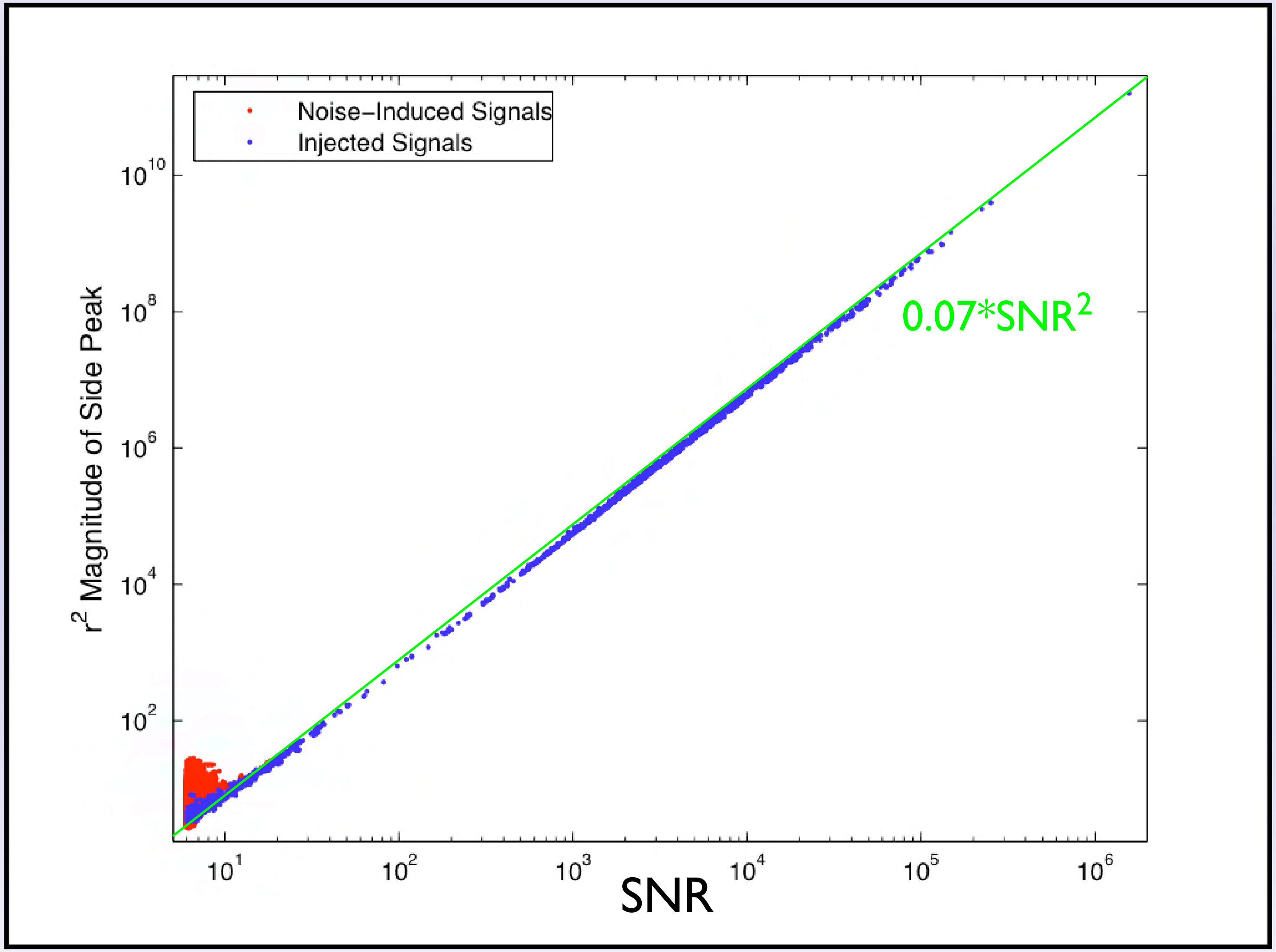
Determining the r^2 Offset



Determining the r^2 Offset



Height of r^2 Side Peaks



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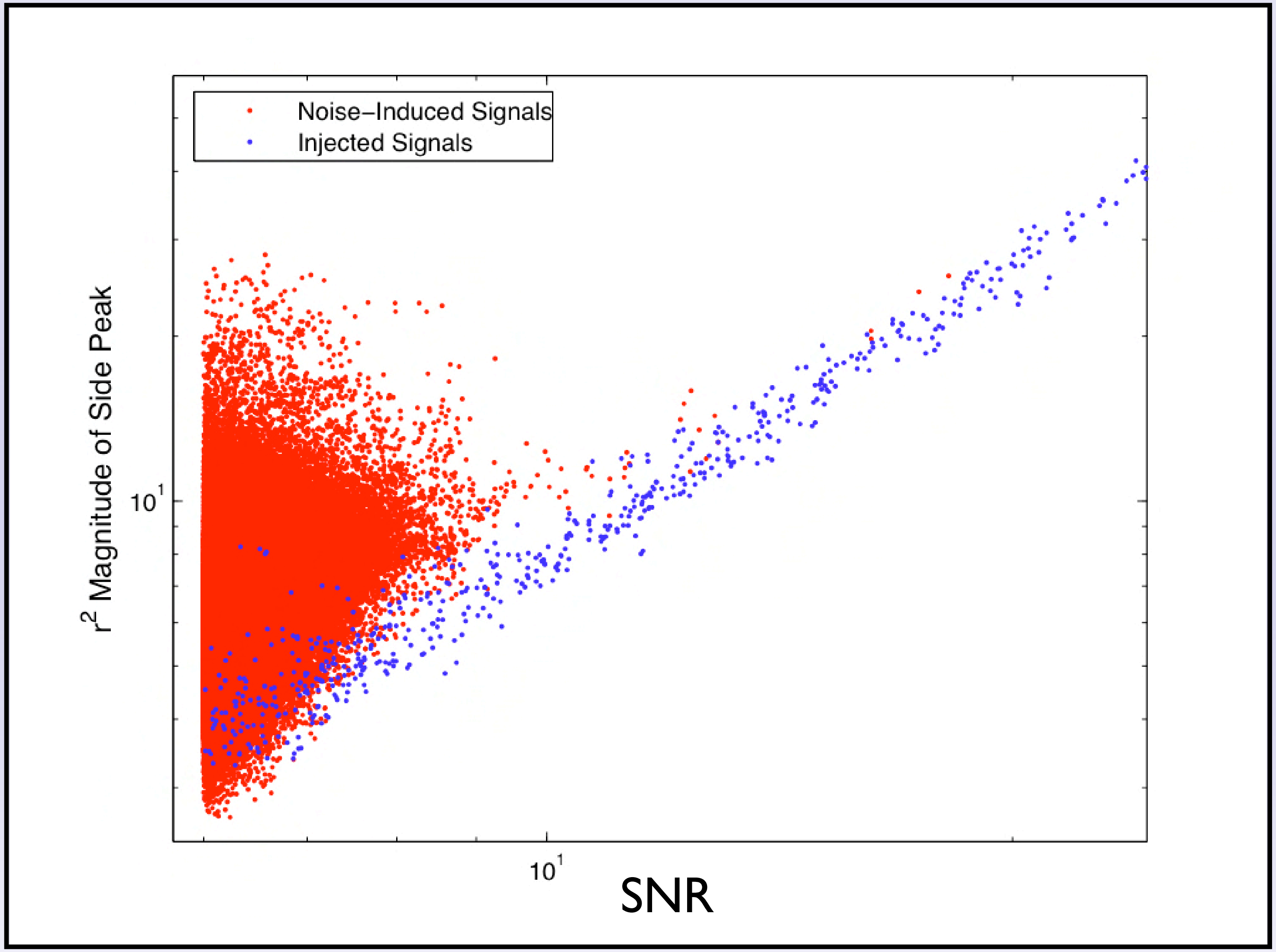
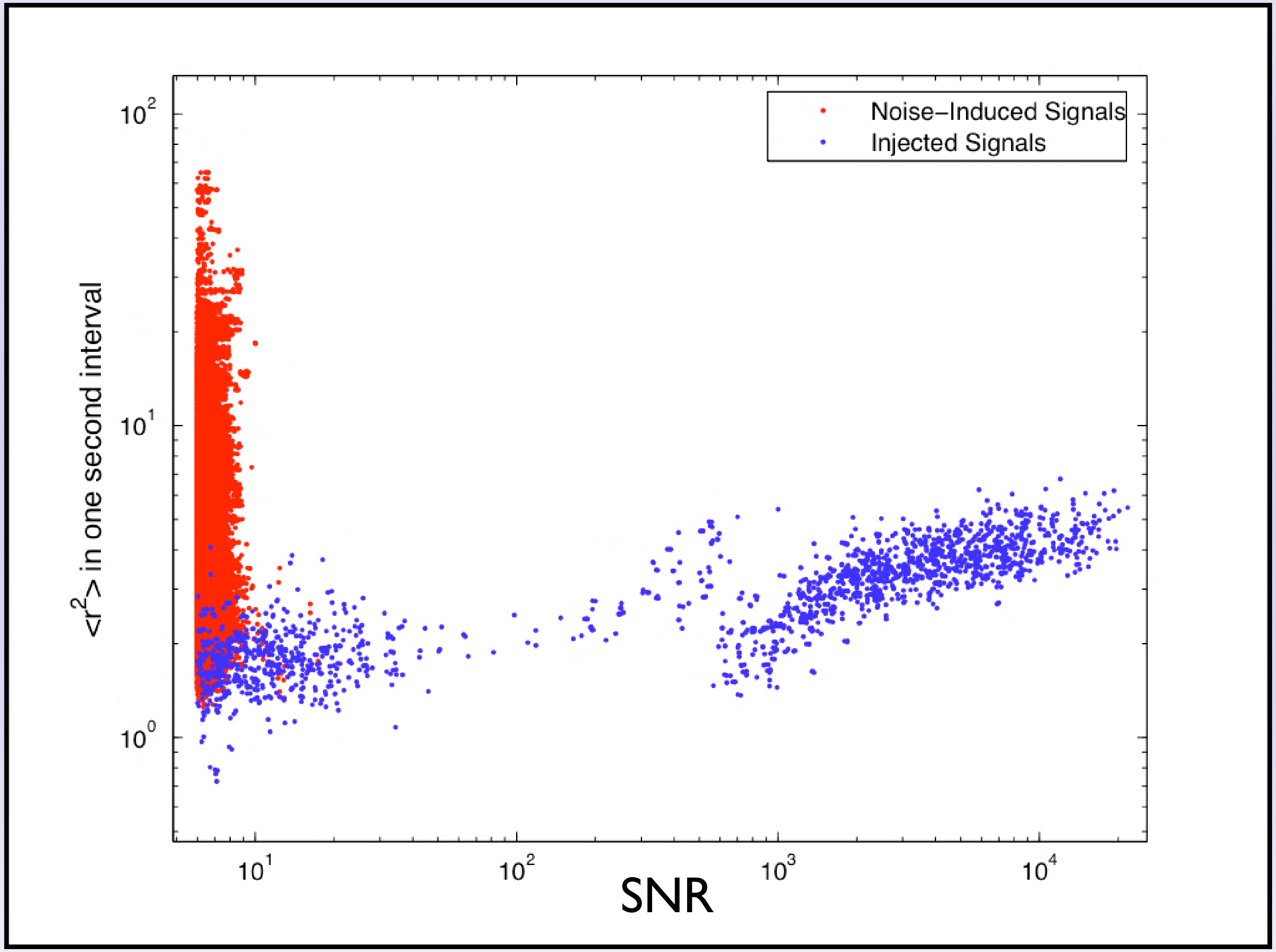
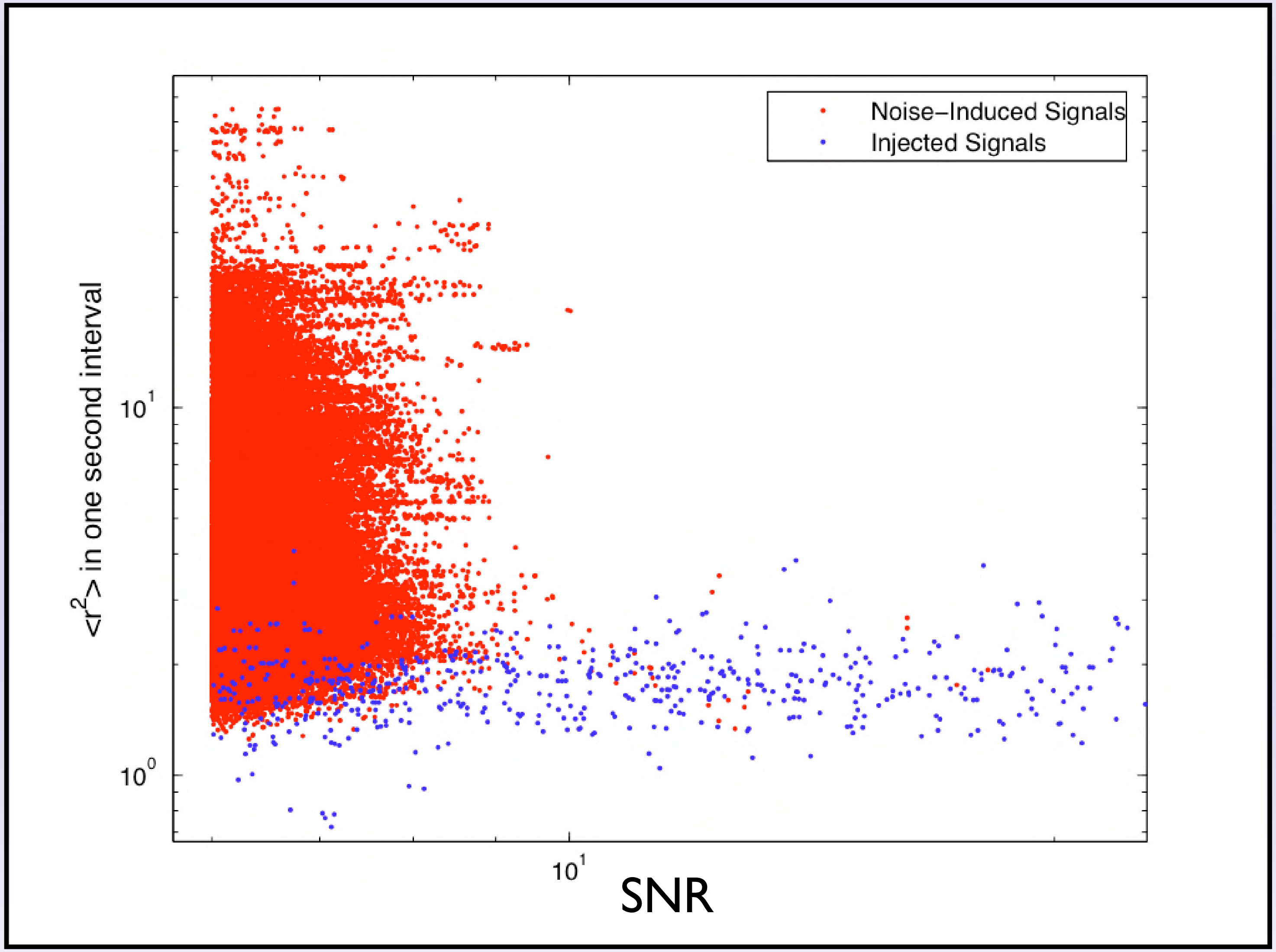


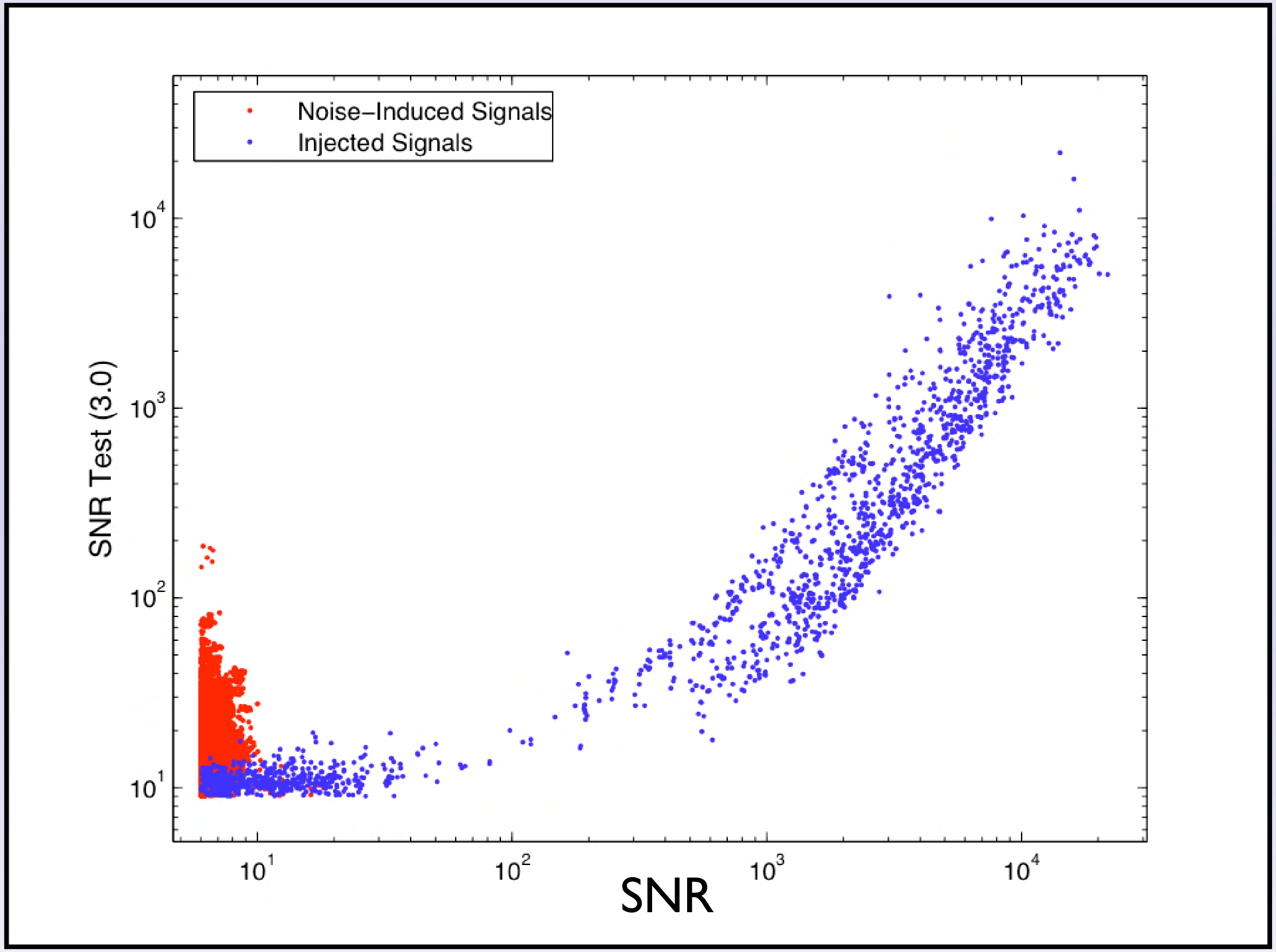
Average r^2 during one sec Interval



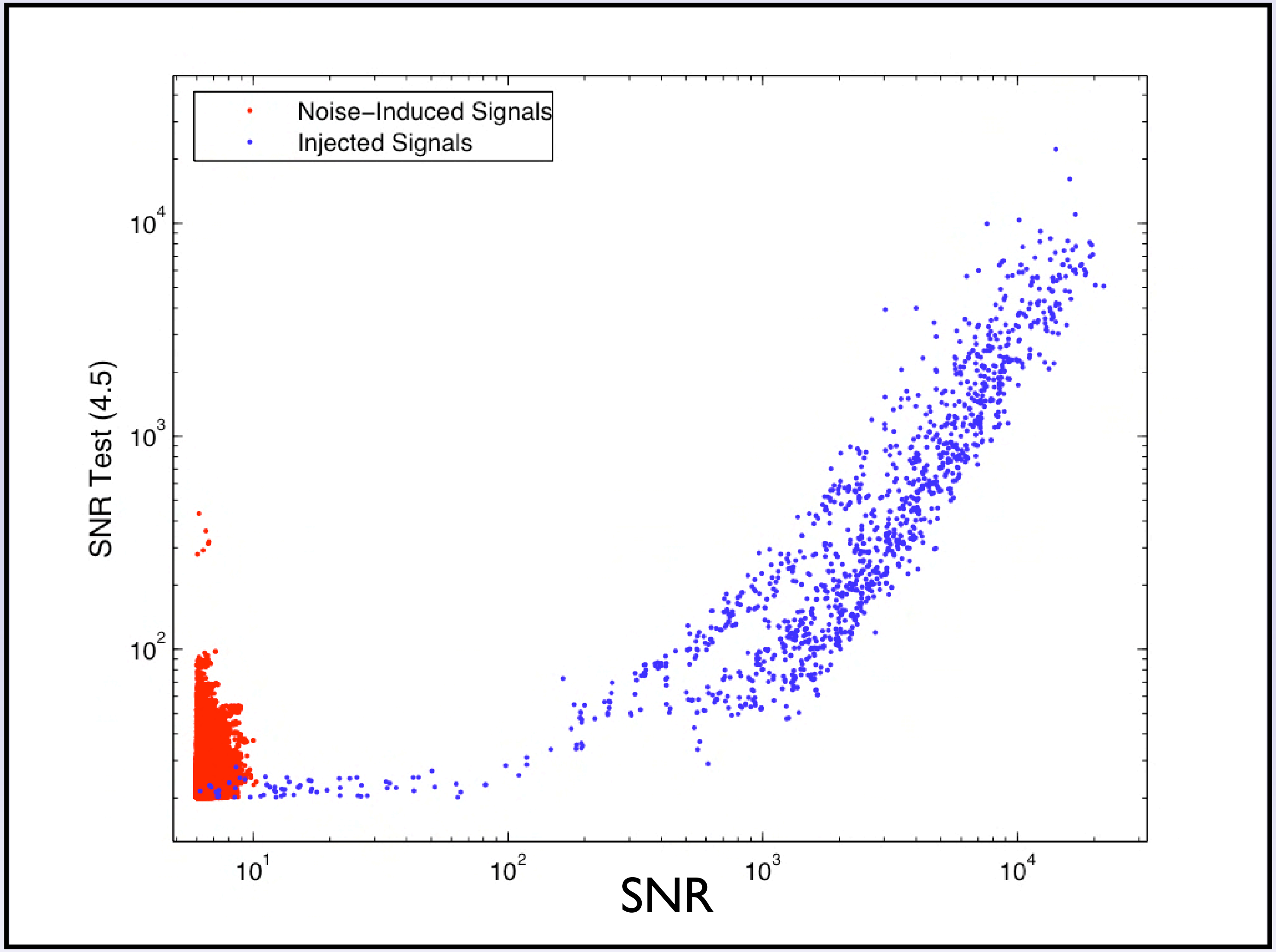
Average r² during one sec Interval



SNR Test (threshold = 3.0)



SNR Test (threshold = 4.5)



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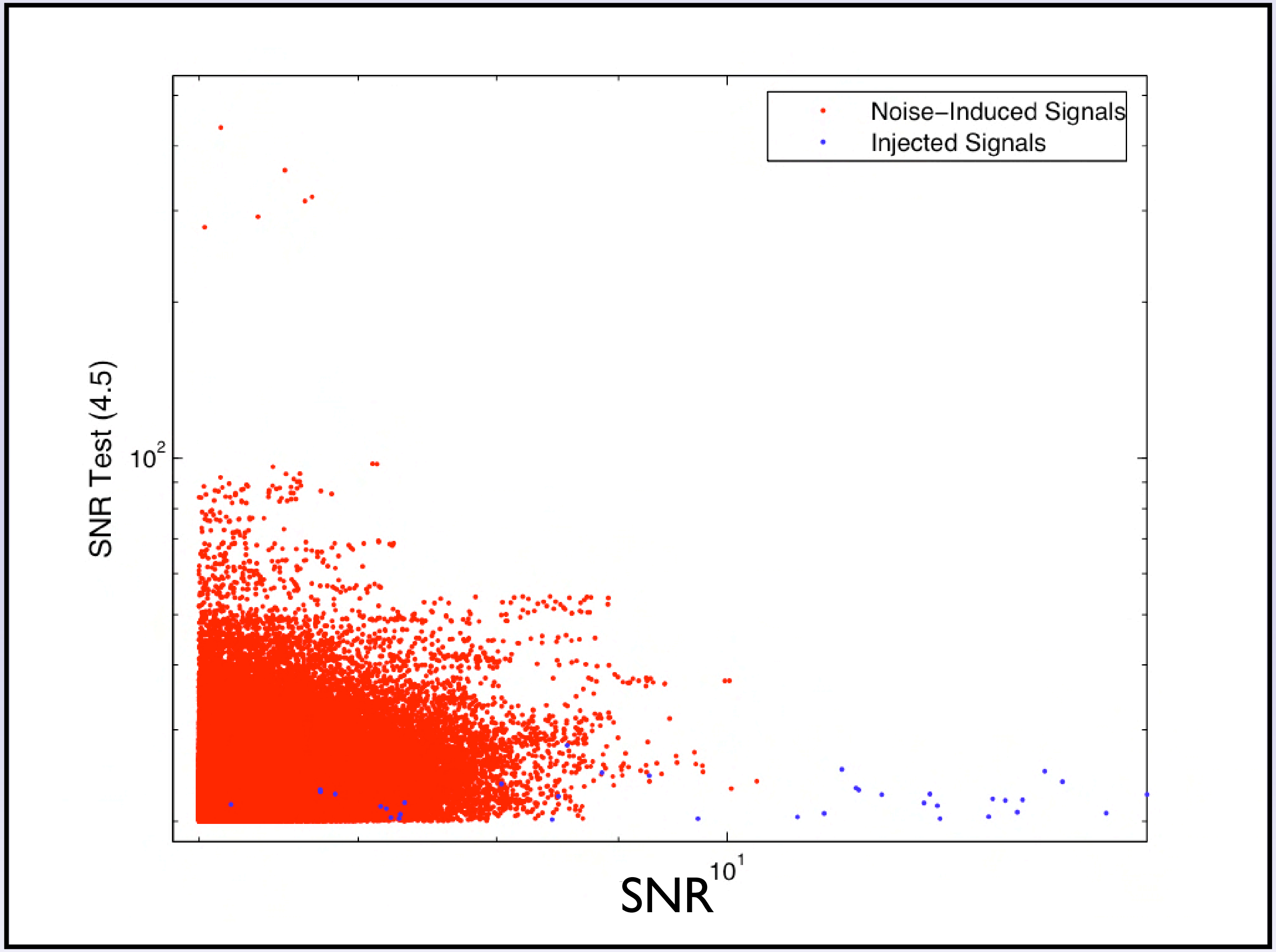
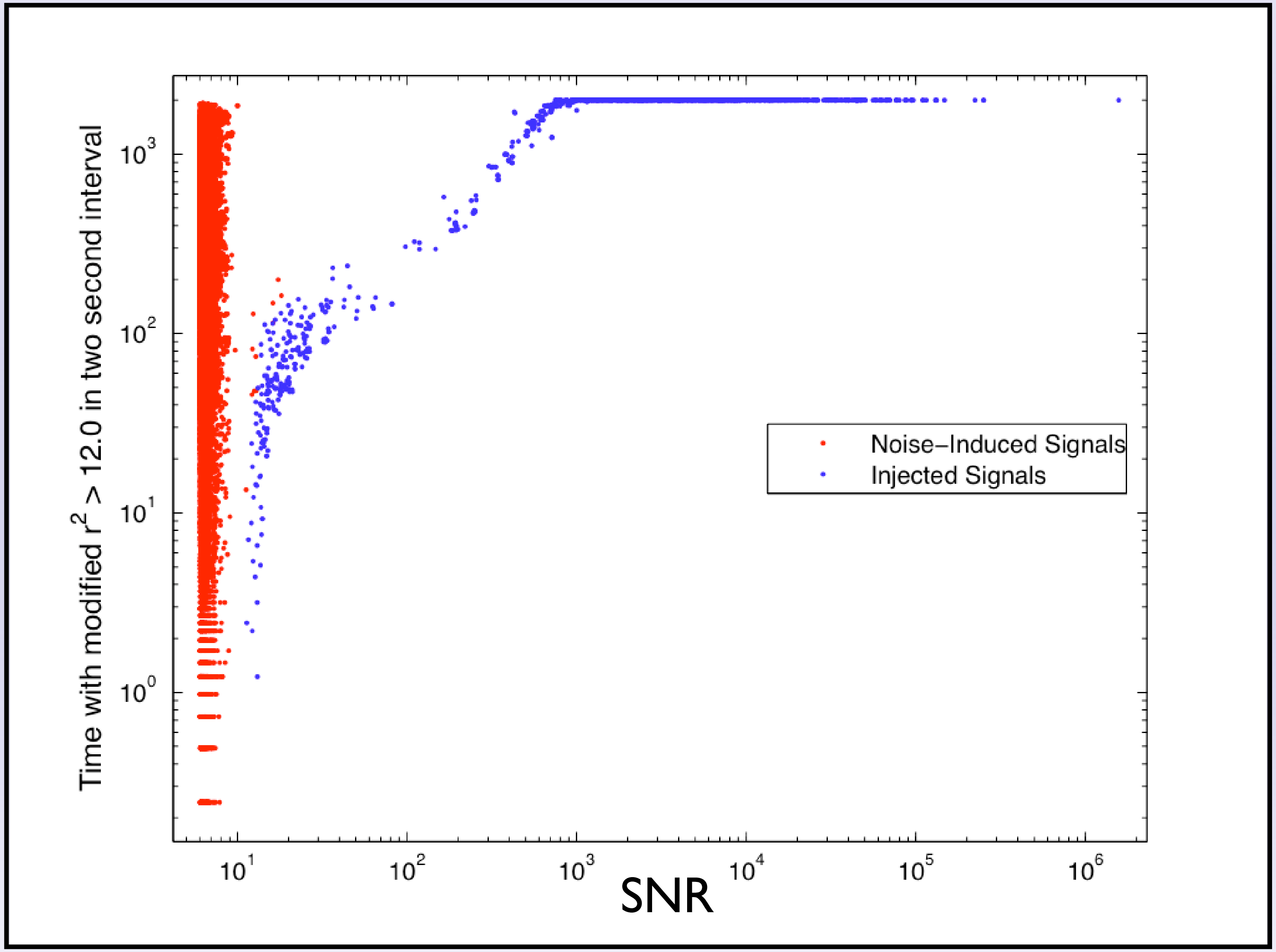


Modified r^2 Test *



*Andres Rodriguez, Louisiana State University

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