# Signal-based inspiral vetoes

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# Optimisation of vetoing statistic

Consider statistic which uses information about the signal we are looking for. Once statistic is chosen we need to optimise that statistic (if it has some parameters to optimise for) and set up the veto threshold.

Consider optimisation of $\chi^2$ with respect to the number of bins. The main idea is to use software injections of the chirps into the playground data and compare distribution of $\chi^2$ for the injected signals and spurious (noise-generated) events. "Spurious events" will be called those events which are not of astrophysical origin and have quite high SNR on the output of match filter.

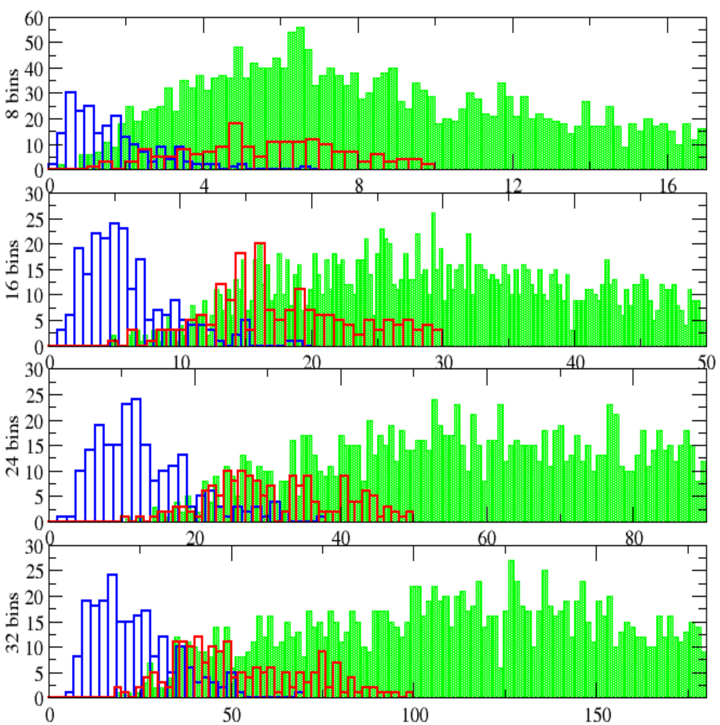
# Optimisation of vetoing statistic

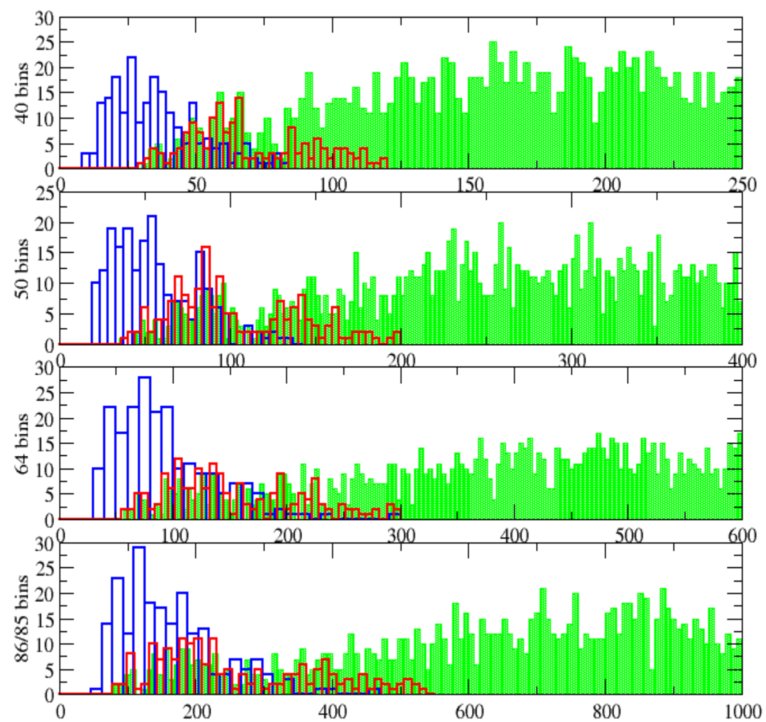
Injection parameters

m1=m2= 5.0 $M_\odot$
SNR = 13
with 80 sec interval
2.5$^h$ of GEO S1 data

Filtering parameters

m1=m2= 5.04 $M_\odot$
SNR threshold = 6.0
number of $\chi^2$ bins =
8,16,24,32,40,50,86



# Optimisation of vetoing statistic

Fix false alarm probability α.

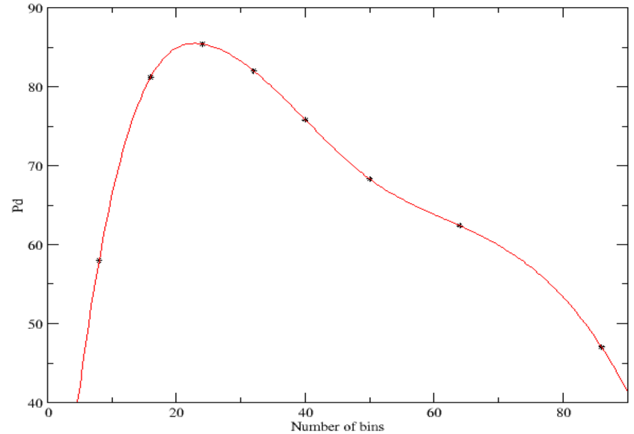
$$\int_0^{+\infty} P_1(r)dr = 1, \qquad \int_0^{+\infty} P_2(r)dr = 1. \qquad\qquad \int_0^{\eta(N)} P_2(r,N)dr = \alpha.$$

*We will call number of bins optimal if for a given α it maximizes detection probability Pd*

$$N_{opt} = max_N \left( \int_0^{\eta(N,\alpha)} P_1(r,N) \right).$$

| N bins | 8 | 16 | 24 | 32 | 40 | 50 | 64 | 86 |
|---|---|---|---|---|---|---|---|---|
| $P_d$ | 58% | 81.2% | 85.4% | 82% | 75.8% | 68.3% | 62.4% | 47% |
| threshold | 1.59 | 8.985 | 20.8 | 34.54 | 47.46 | 65.97 | 95.11 | 143 |

α=1%

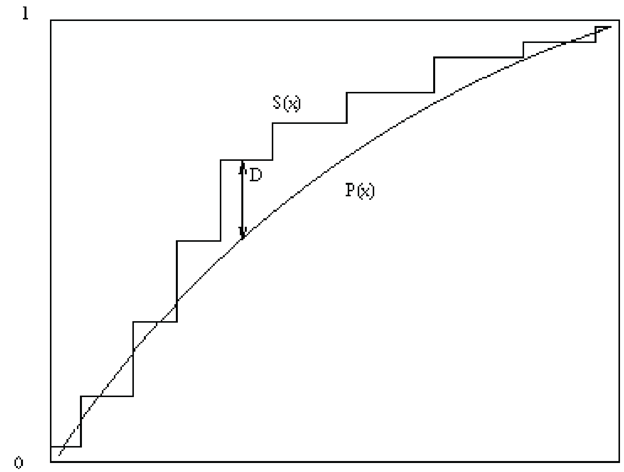


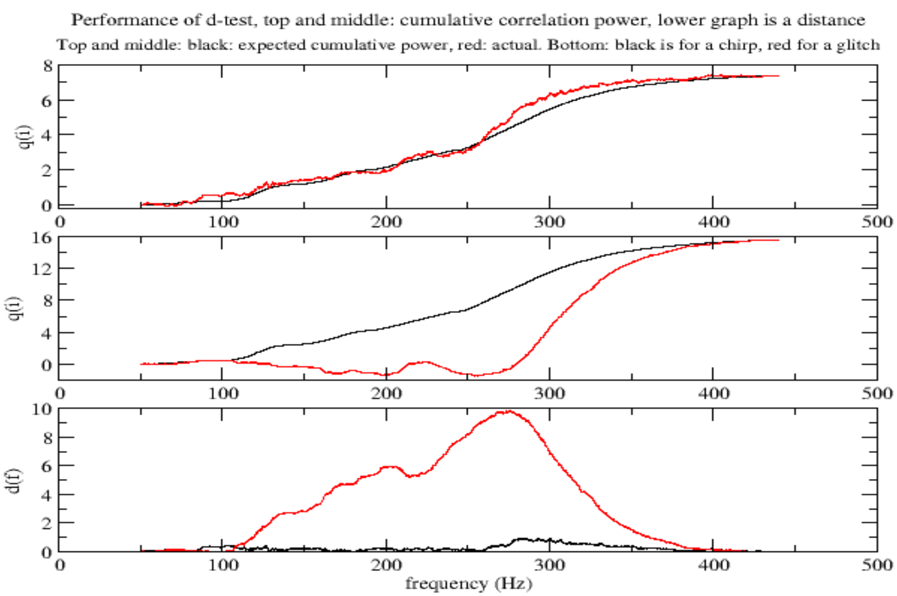
# Other signal-based veto statistics

Kolmogorov-Smirnov based statistic

$$\psi_i = \sum_{f_k=F_0}^{F_i} \frac{\tilde{s}(f_k)\tilde{s}^*(f_k)}{S_n(f_k)}; \quad i=\overline{1,M}, \quad F_M = f_{lso}, \quad \psi_M = 1.$$

$$q_i = \sum_{f_k=F_0}^{F_i} \frac{\tilde{x}(f_k)\tilde{s}^*(f_k)}{S_n(f_k)}; \quad q_M = Q \quad y_k = \frac{\tilde{x}(f_k)\tilde{s}^*(f_k)}{S_n(f_k)}$$




$$d = max_i \left| q_i - \psi_i Q \right| ,$$

$$d = max_i \left| \frac{q_i}{Q} - \psi_i \right| .$$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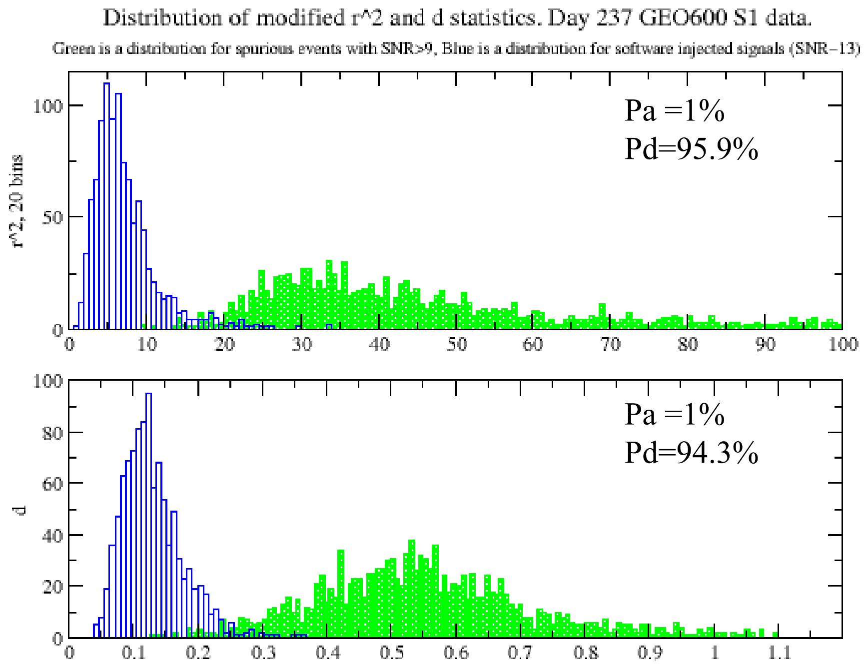
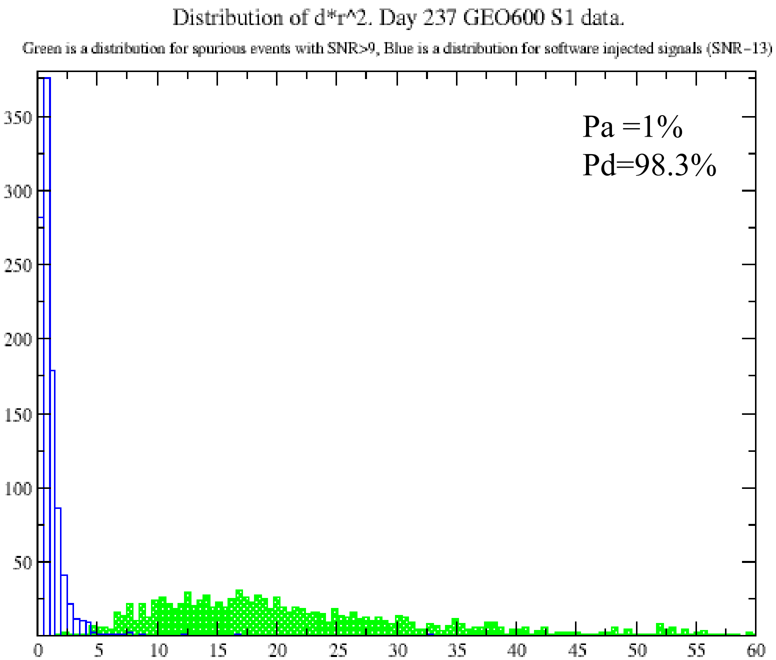
# Other signal-based veto statistics




## Optimisation (?) of $d\chi^2$ statistic for the number of bins

| N bins | 16 | 24 | 32 | 40 |
|---|---|---|---|---|
| $P_d$ | 79% | 85.6% | 84.8% | 85% |
| threshold | 1.55 | 4.13 | 7.38 | 10.84 |

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