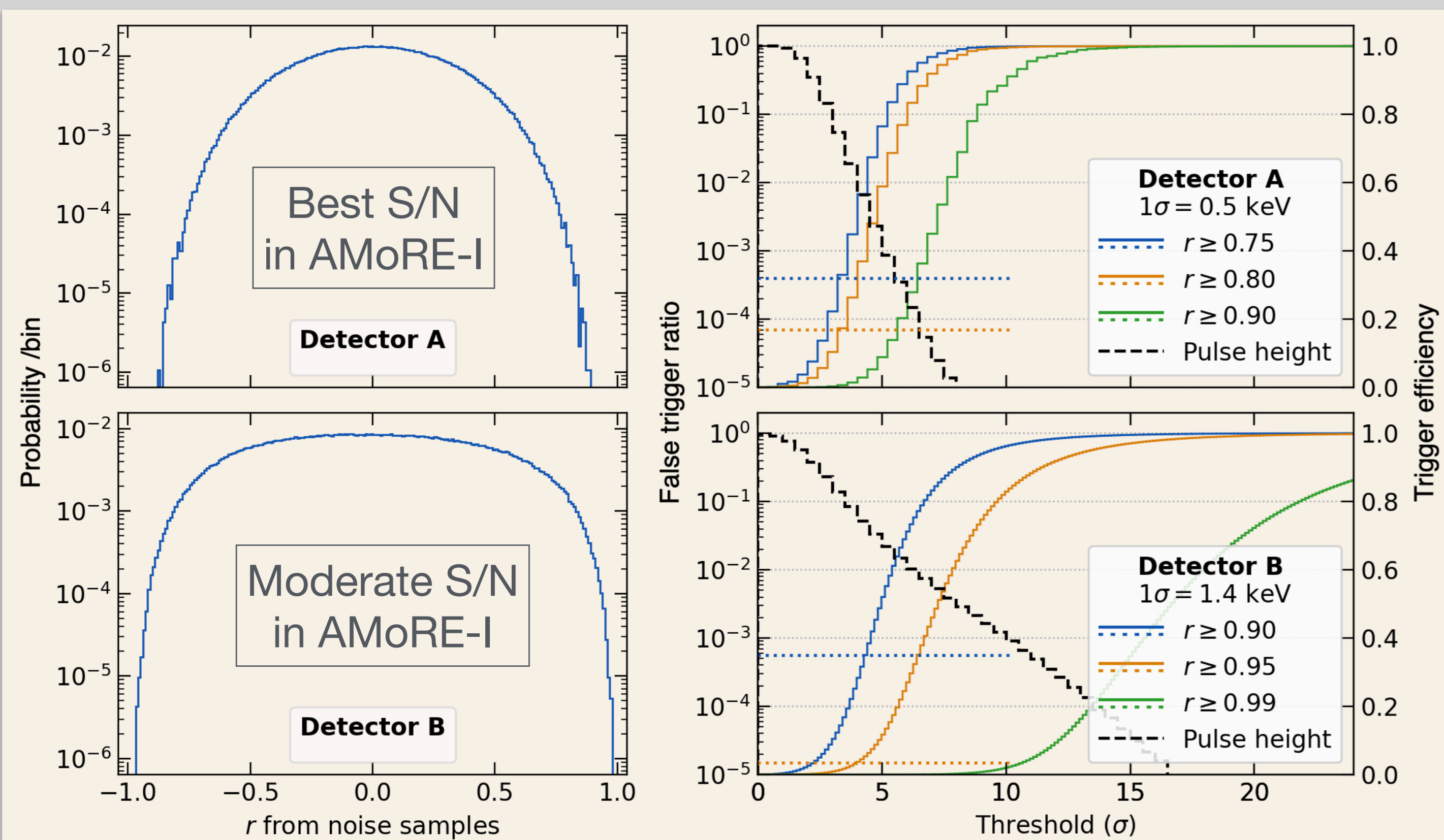


Why do we need to lower energy threshold for $0\nu\beta\beta$ decay search experiment?

- Better understanding of background:
 - E.g., better efficiency for tagging multi-site hit events caused by external background source
- Enriching physics program:
 - Other possible neutrino-involved processes such as $2\nu 2K$, $0\nu 2EC$ of ^{40}Ca in AMoRE.
 - Dark matter search

Threshold setting and trigger efficiency

- Signal acceptance $\sim 100\%$ for wide energy range
- Acceptable false trigger rate by looking at the r distribution for random noise samples.



- Best case: $5 \times$ noise r.m.s threshold achievable at 50% efficiency.
- Much lower false trigger rate than the pulse height trigger.

Pearson correlation coefficient (r) for signal recognition

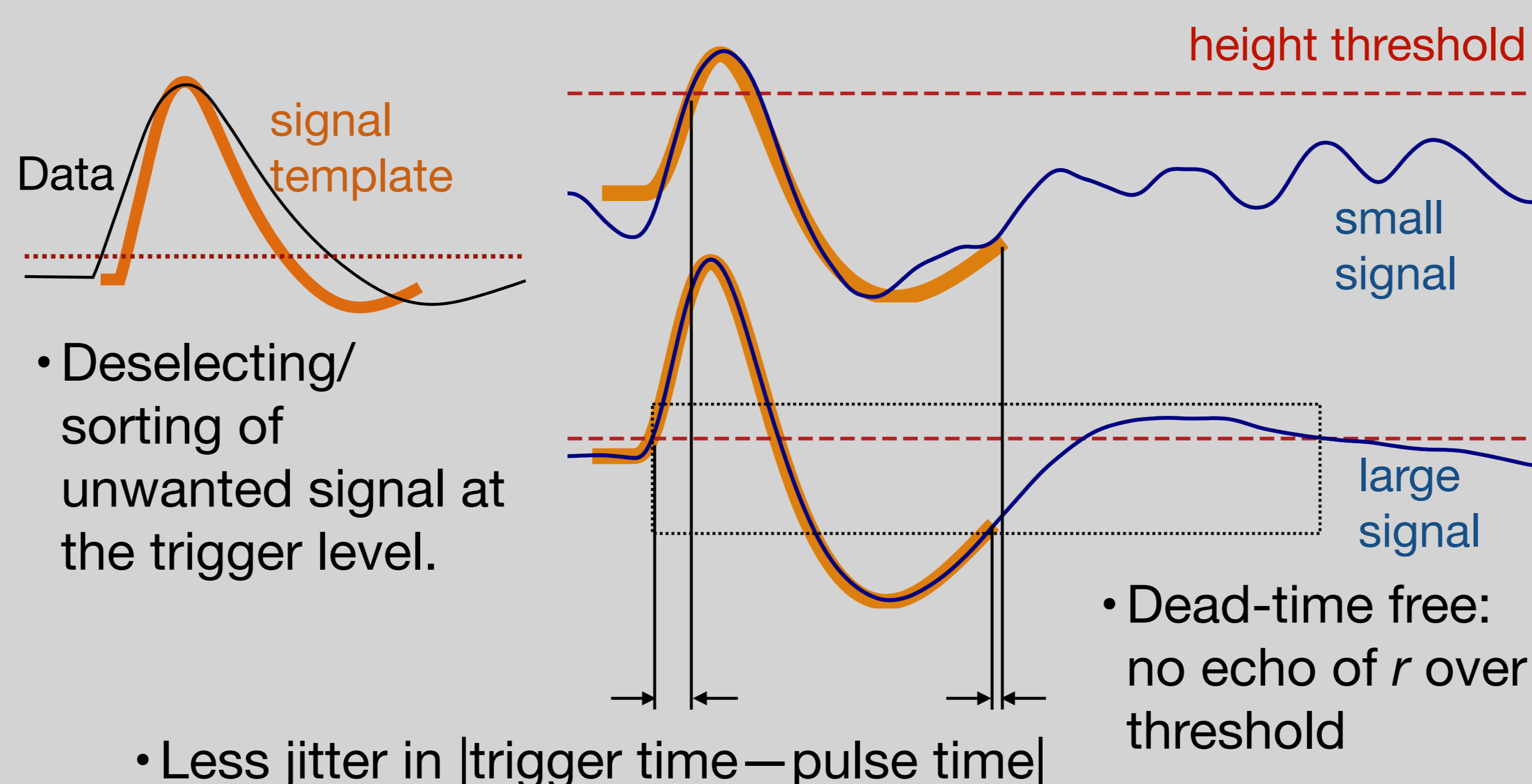
$$r(t) = \frac{\sum_{i=1}^N (x_{t-N+i} - \bar{x}) \cdot (s_i - \bar{s})}{\sqrt{\sum_{i=1}^N (x_{t-N+i} - \bar{x})^2} \sqrt{\sum_{i=1}^N (s_i - \bar{s})^2}}$$

x : data, s : signal template, \bar{x} , \bar{s} : mean values.

- Useful when the signal shape changes little with amplitude.
 - Cryogenic bolometer signal such as in AMoRE.
 - Phonic signal, gravitational wave, etc.
- Expecting better noise suppression and lower energy threshold.
 - Further improvement along with a noise suppression filter.
- A quick estimation of the signal amplitude at the trigger time:

$$A(t) = \sqrt{\sum_{i=1}^N (x_{t-N+i} - \bar{x})^2} / \sqrt{\sum_{i=1}^N (s_i - \bar{s})^2}$$

Advantages (vs pulse height trigger)



- Deselecting/sorting of unwanted signal at the trigger level.
- Dead-time free: no echo of r over threshold
- Less jitter in |trigger time - pulse time|

Applications and practical considerations

- Real-time online trigger—computing efficiency
- Minimal N with downsampling: e.g. $N = N_{\text{Raw}}/N_{\text{DS}} = 1600/8$.
- Simpler noise suppression filter: Butterworth filter (BF) instead of an optimal filter (OF)
- Two+ level trigger
 - First level with down-sampling and a simple condition.
 - Second level with a larger N and a more sophisticated condition.
- Together with pulse height trigger not to miss a large signal.

