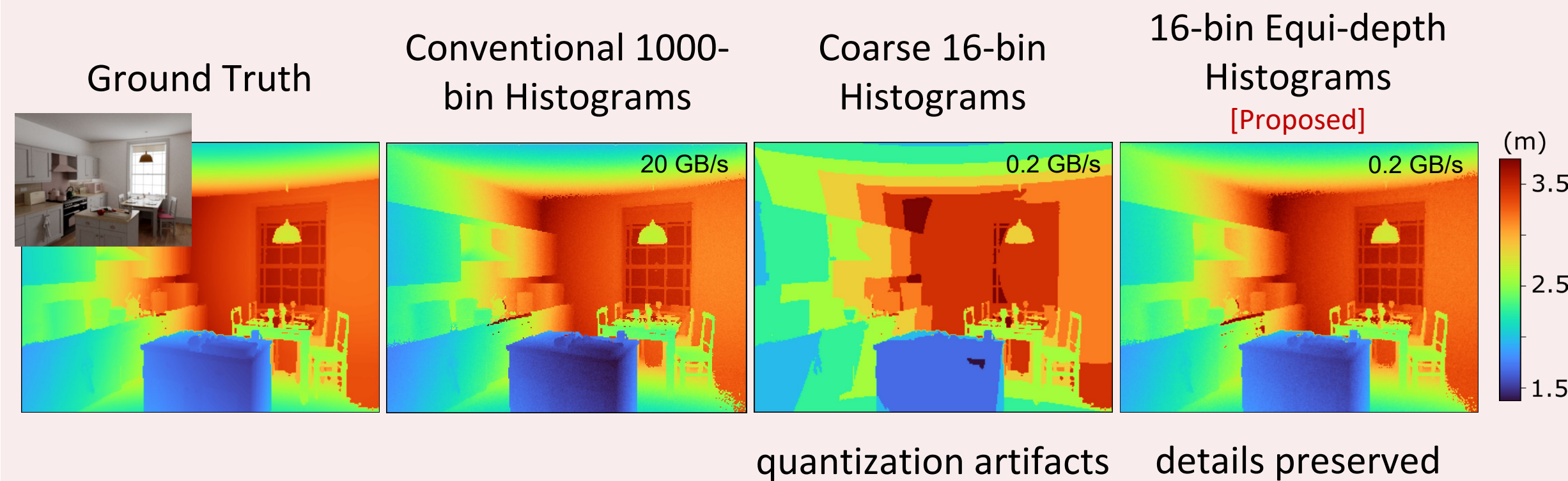
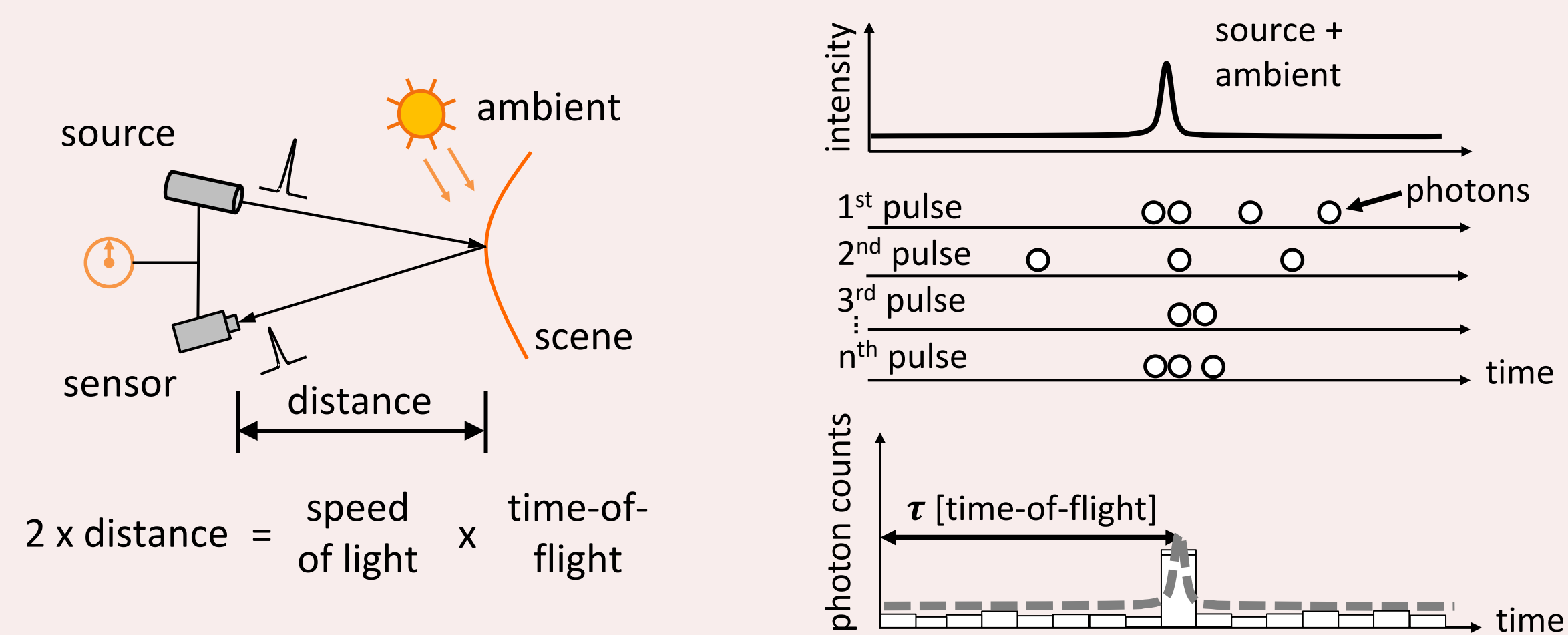


## Single-Photon LiDAR at 100x Lower Bandwidth?



Equi-depth photon histograms: 100x lower bandwidth while maintaining distance resolution

## Single-Photon LiDAR: Data Bottleneck

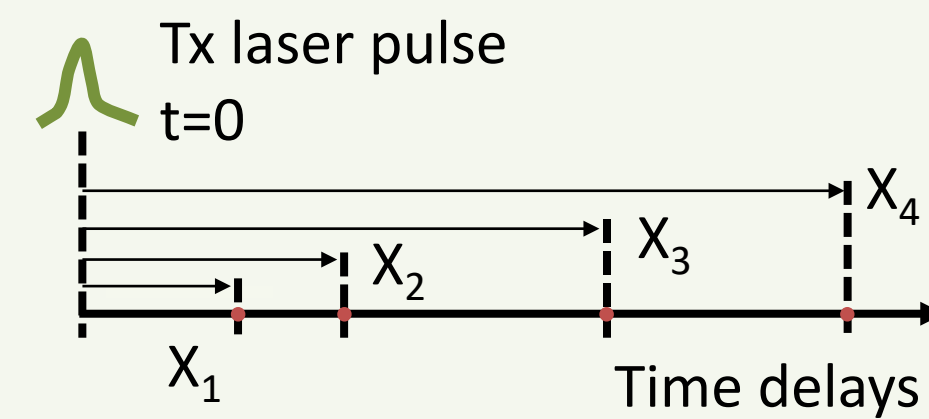


$$30 \text{ frames/s} \times 10^6 \text{ pixels/frame} \times 1 \text{ histogram/pixel} \times 1000 \text{ bins/histogram} \times 1 \text{ byte/bin}$$

**= 30 GB/second**

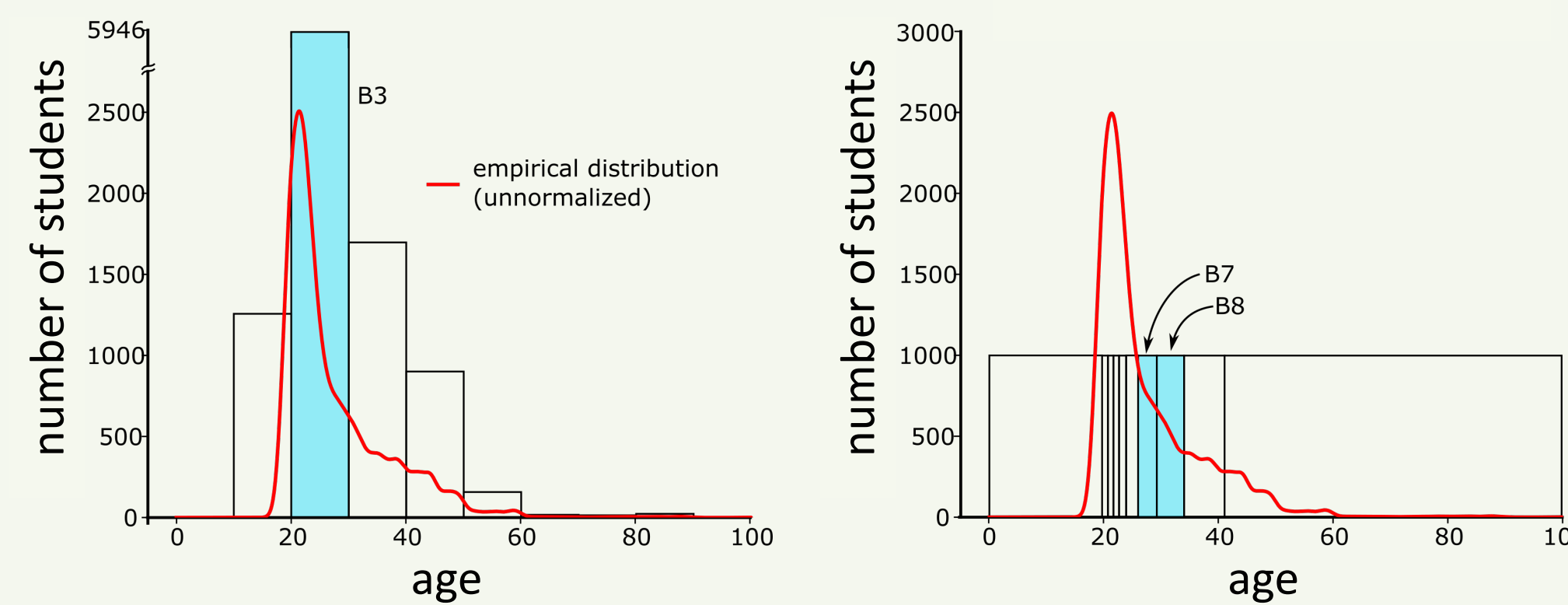
Raw photon data far exceeds available bandwidth!

## Key Ingredient #1: Race Logic



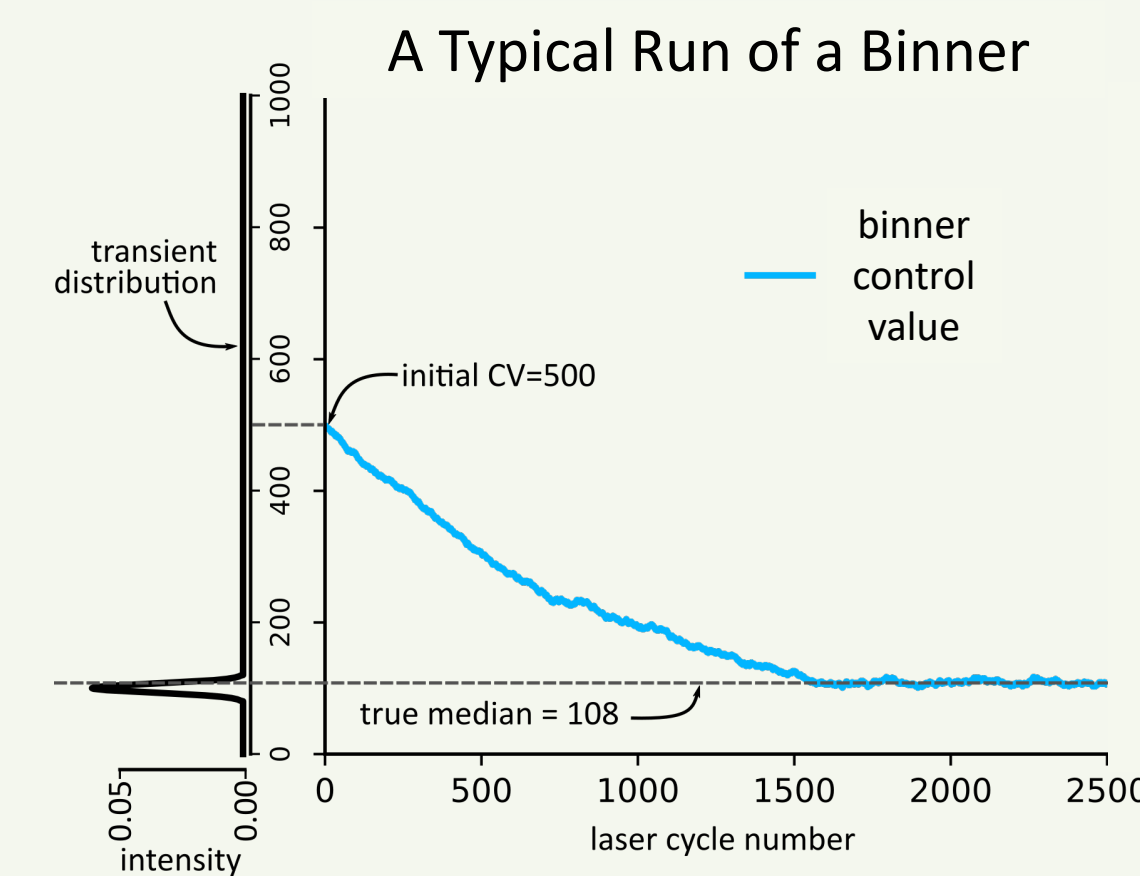
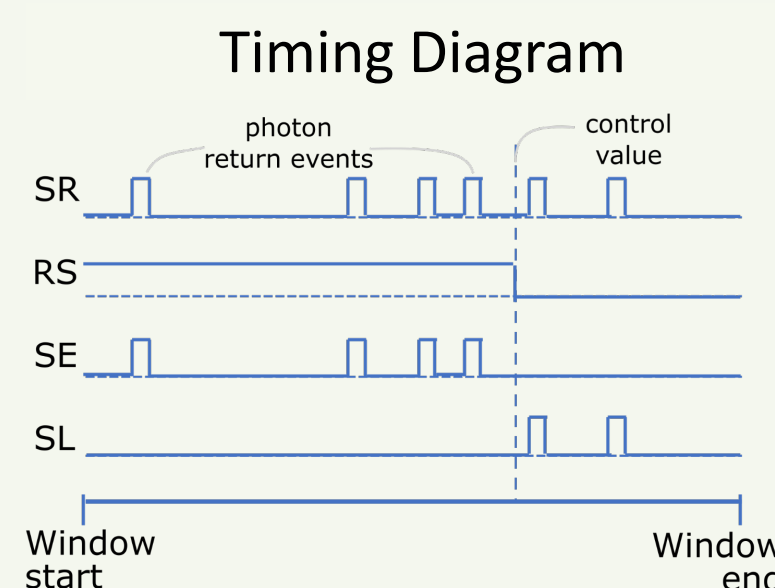
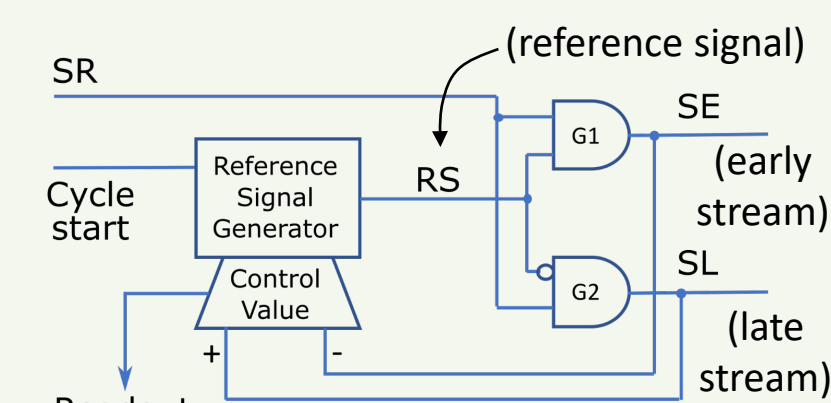
Encode signal values in terms of time delays.  
Avoid time-to-digital conversion.  
Naturally suited to single-photon 3D imaging.

## Key Ingredient #2: Equi-Depth (ED) Histograms



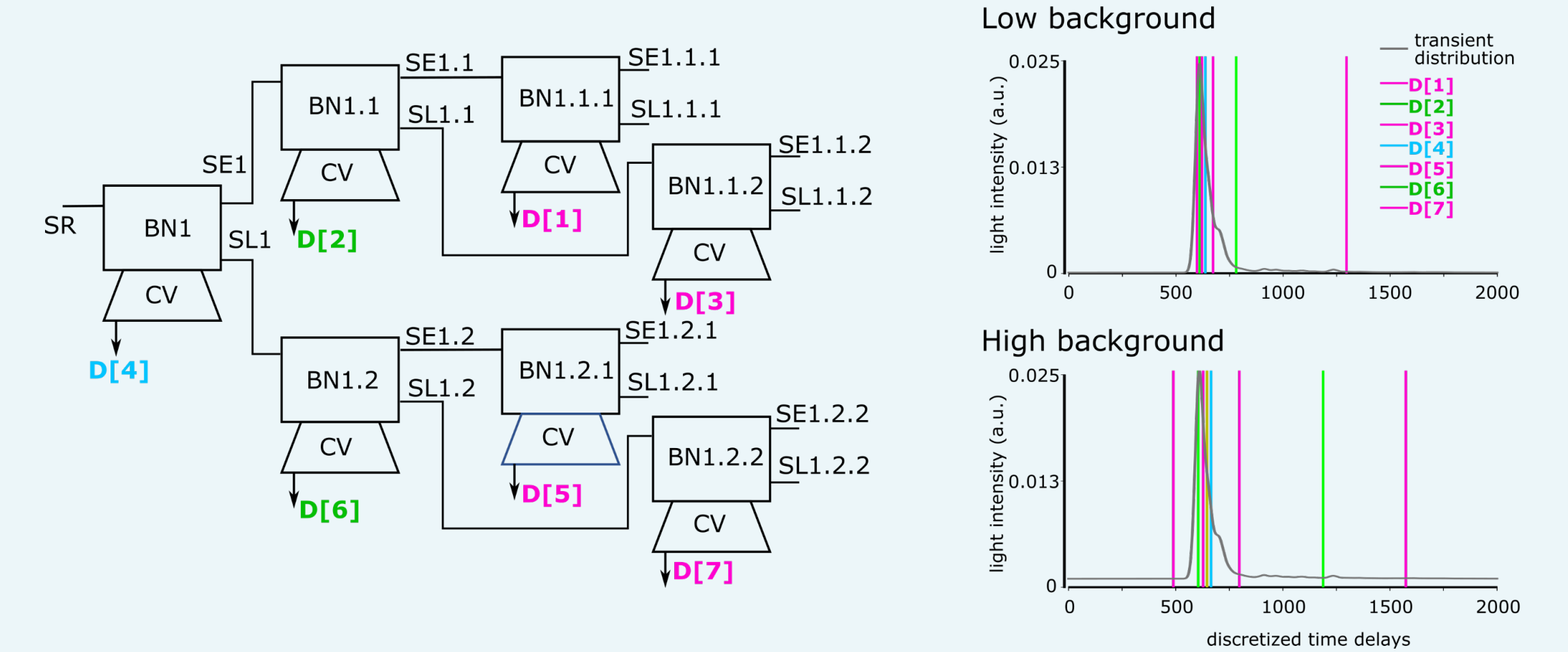
ED histograms adaptively capture “peaky” distributions.

## The “Binner” Circuit: Two-Bin ED Histogram



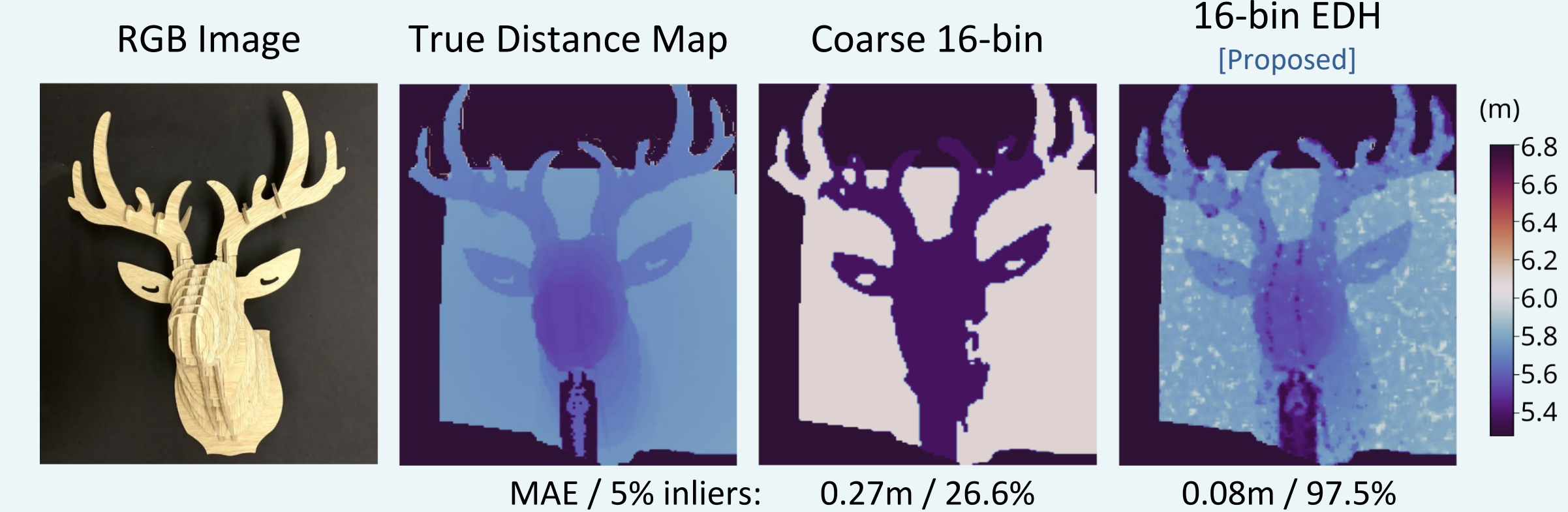
Return stream is split into early and late streams using the race logic “INHIBIT” operation.  
Control value tracks the overall median.

## Equi-Depth Histogrammer

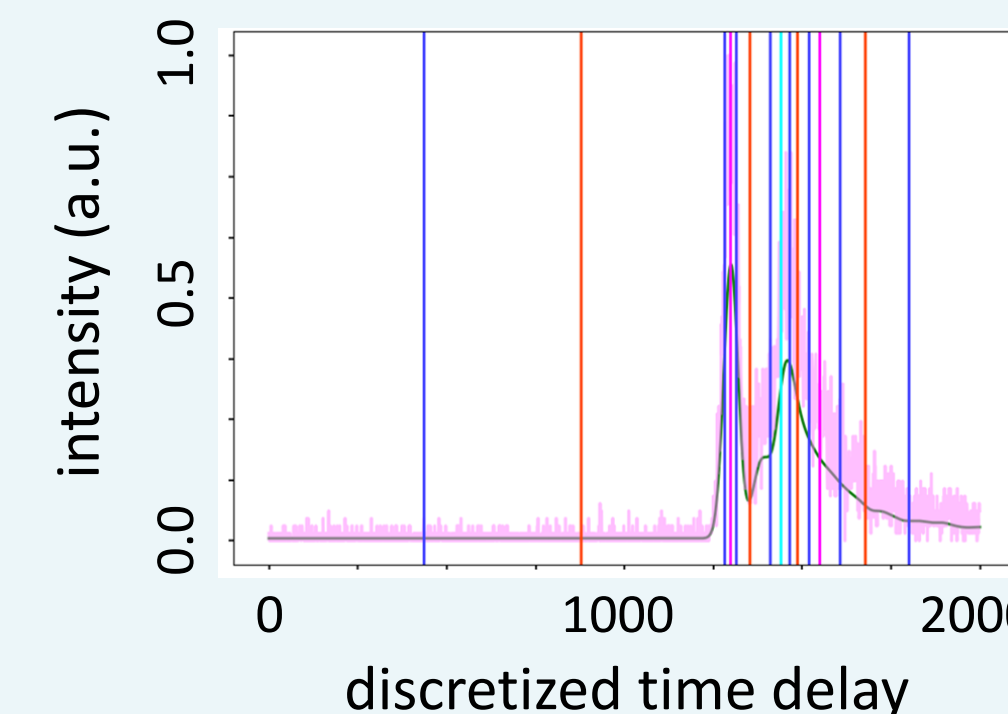


Recursive binner tree adaptively captures the signal peak.

## Hardware Emulation



## A Novel Scene Representation?



ED histogram can capture complex transient distributions (e.g., multiple returns, interreflections and multipath)