

# Laser Digital Cinema™

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- **Digital Cinema Benefits**
  - **Laser Digital Cinema™ Goals**
  - **Laser**
  - **Digital**
  - **Cinema**
  - **Summary**
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- **Movie makers**
    - » **Picture quality invariance between screening and theater**
    - » **All-electronic production**
  - **Distributors**
    - » **Costs of duplication and delivery**
    - » **Speed of distribution (overnight delivery, anti-pirating)**
    - » **Digital encryption (anti-pirating)**
  - **Exhibitors**
    - » **No splicing for trailers, advertisements**
    - » **Increased usage (education, town hall, pay-per-view, etc.)**
    - » **Schedule flexibility**
    - » **Equipment reduction (platters, racks, trailers)**
  - **Audiences**
    - » **Exceptional image quality (improved color, absent of artifacts)**
    - » **Pristine showing over time (no degradation)**
    - » **Flexible schedules allow convenience**
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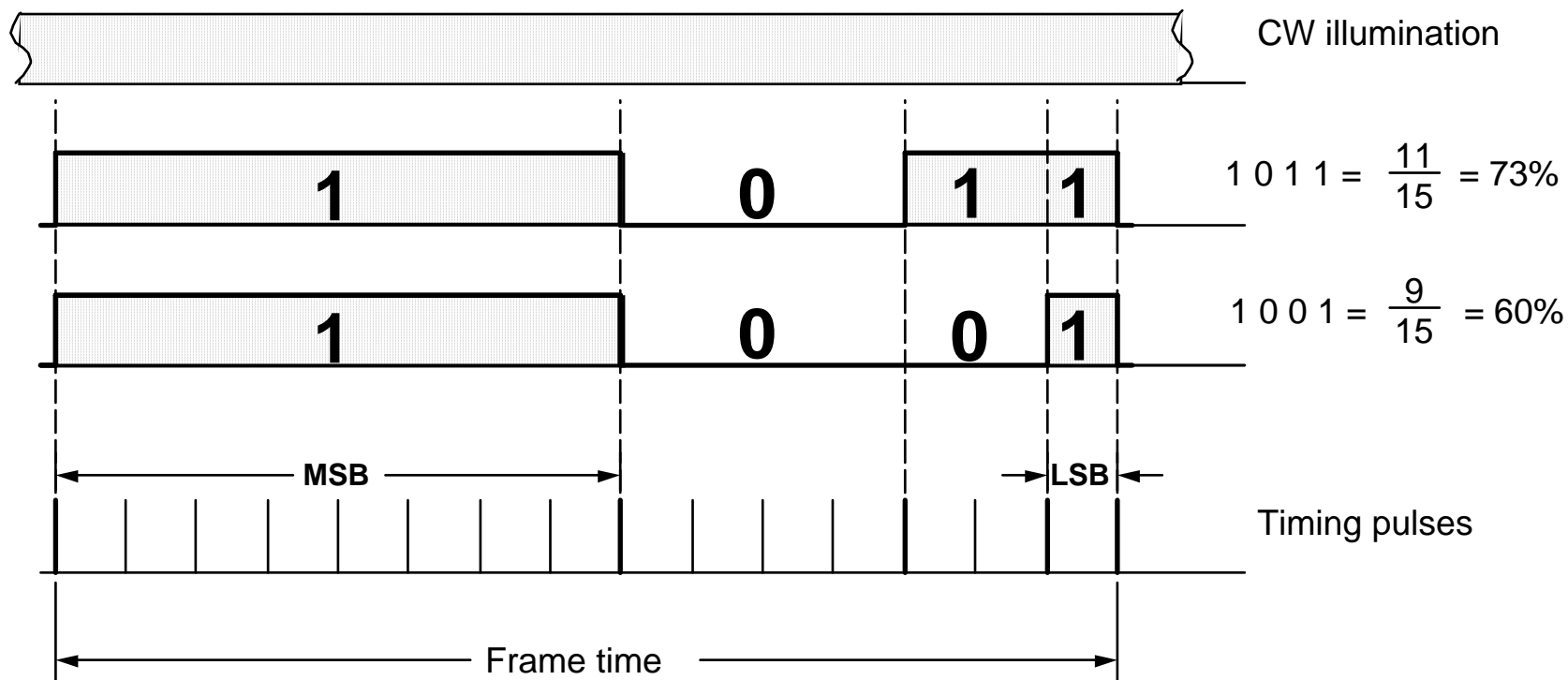
- **Provide absolute digital color accuracy**
    - » 24-bit (27, 30-bit potential)
    - » Take advantage of digital SLM switching
    - » Use laser sources for primary spectral invariance
    - » Use pulsed sources for true digital color
  
  - **DPSS laser technology advantages**
    - » Color saturation
    - » Brightness
    - » Contrast
    - » Life-cycle cost
  
  - **Fiber-optic distribution**
    - » Efficient time sequential color
    - » Allows single backup system for entire theater
    - » Other promotional usage (e.g. lobby laser light show)
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**RGB OPO-based system\* (4294-10)**

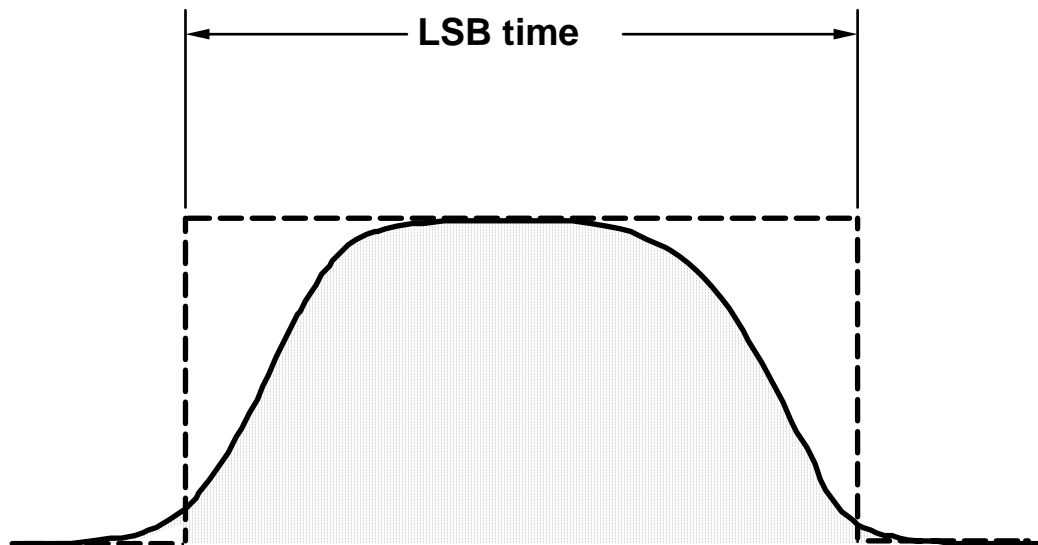
- **Primaries at 628 nm, 524 nm, 449 nm**
- **PRF ~16 kHz (for 24-bit system)**
- **$M^2 < 1.2$  for red, blue;  
~ 2 for green**
- **Wall-plug efficiency 11 lm/W**

## Linear PWM (simple 4-bit case)

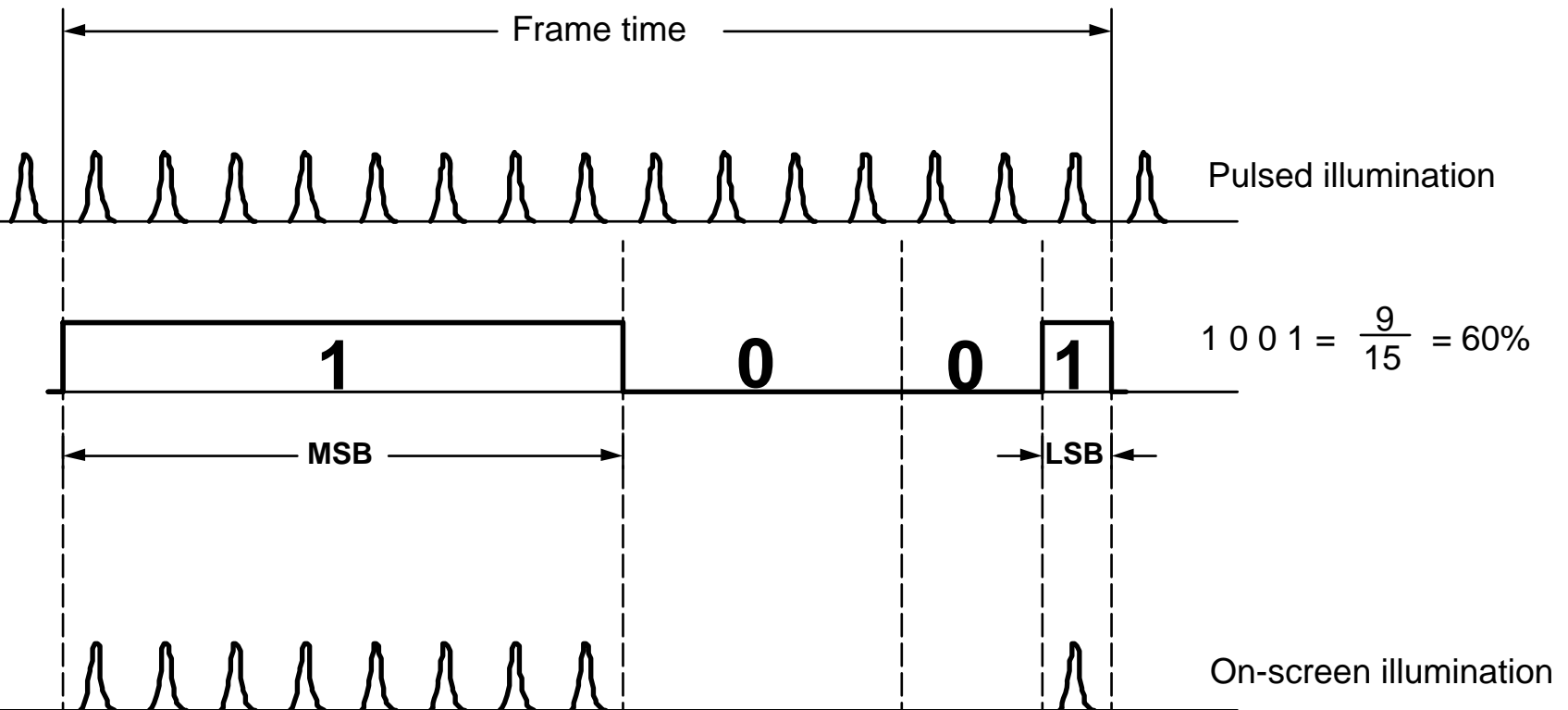
- Frame time divided into time-weighted bits
- CW illumination provides time-integrated gray scale

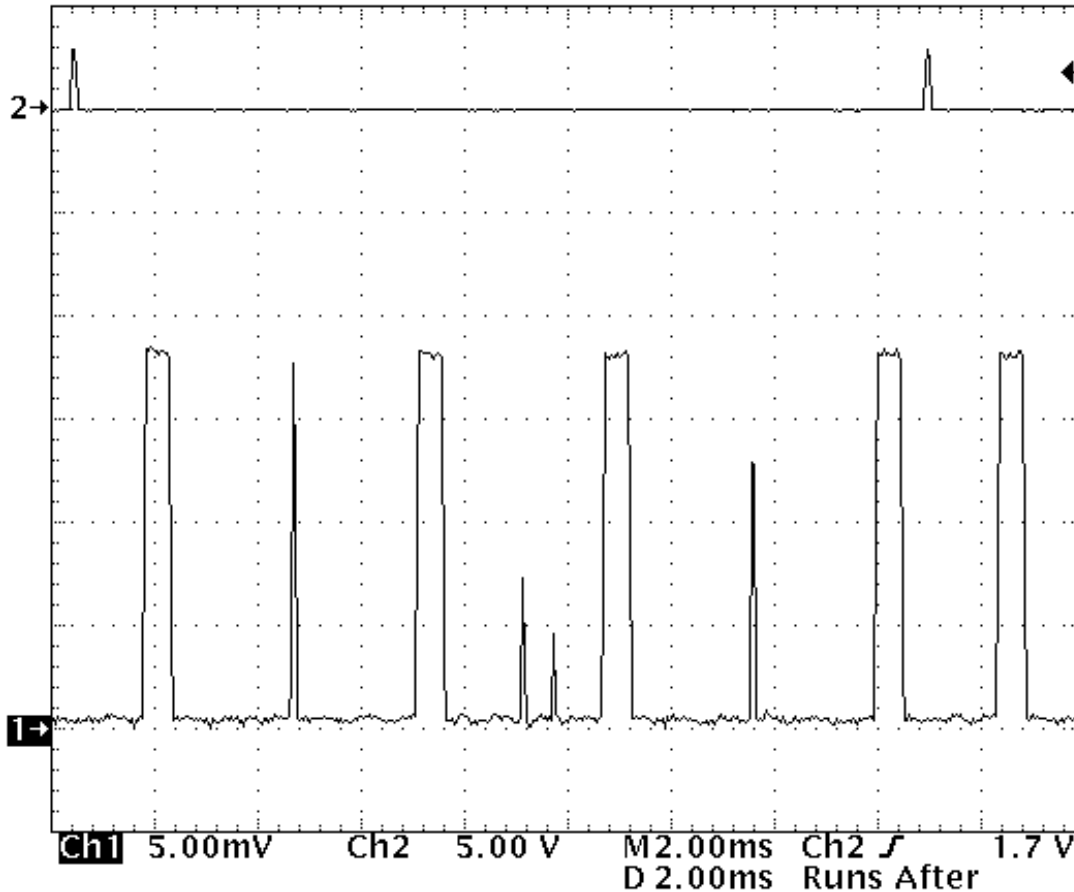


- Finite switching time of mirror affects low gray levels
- Integrated illumination becomes non-linear



- Use DMD as a gate for each laser pulse
- Provides true gray level reproduction at low levels



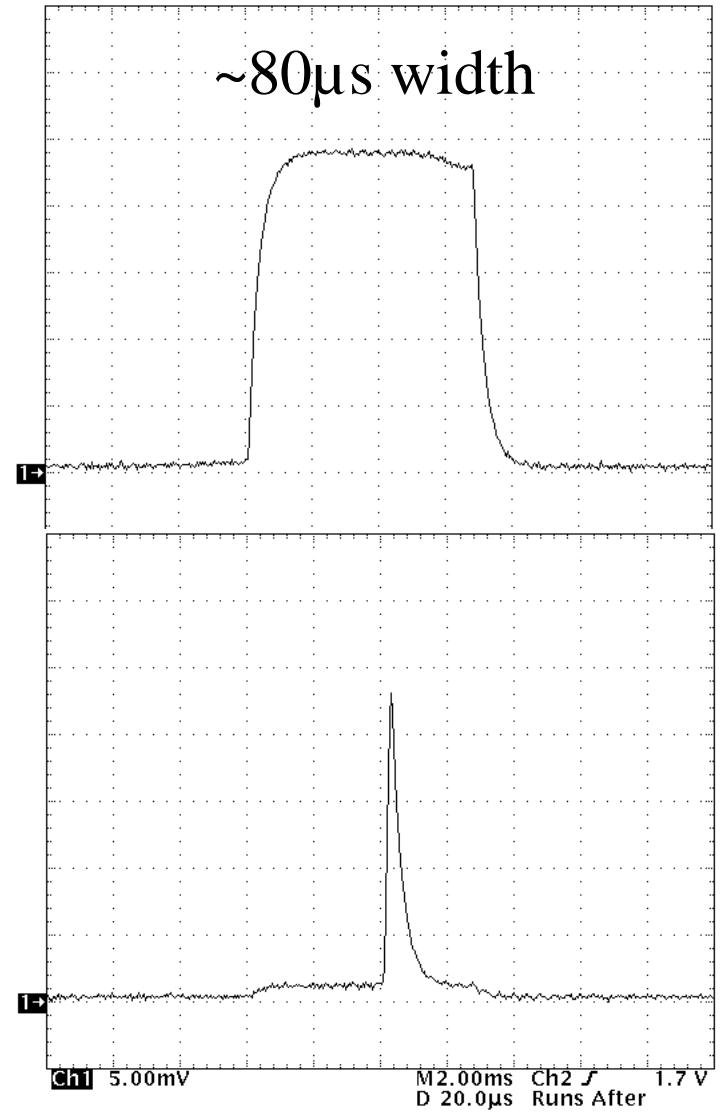
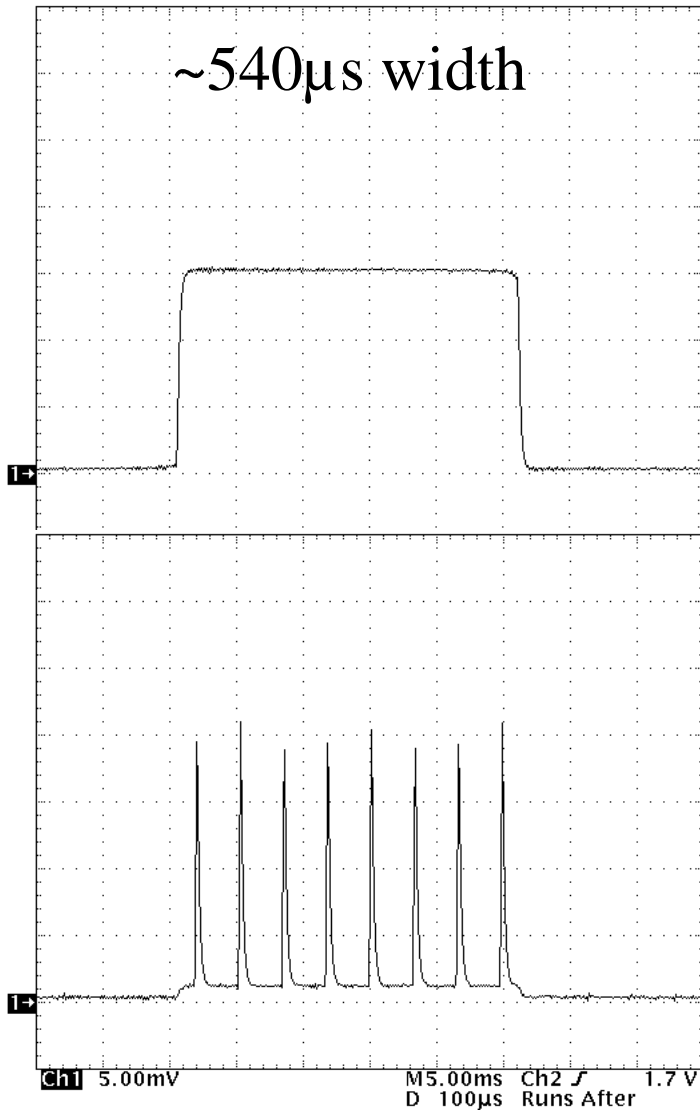


Vsync trigger

CW illumination

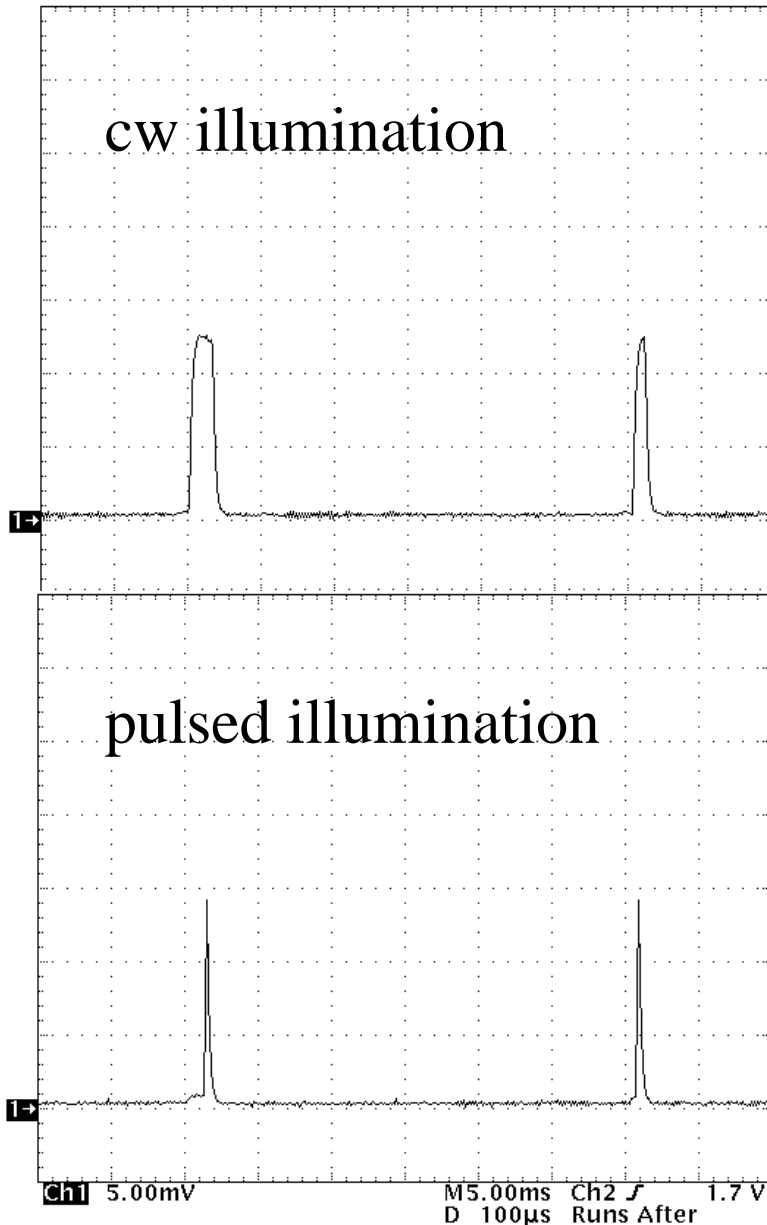
Data taken using Roadster X4\*

\* Courtesy Christie Digital Systems



Data taken using Roadster X4\*

\* Courtesy Christie Digital Systems

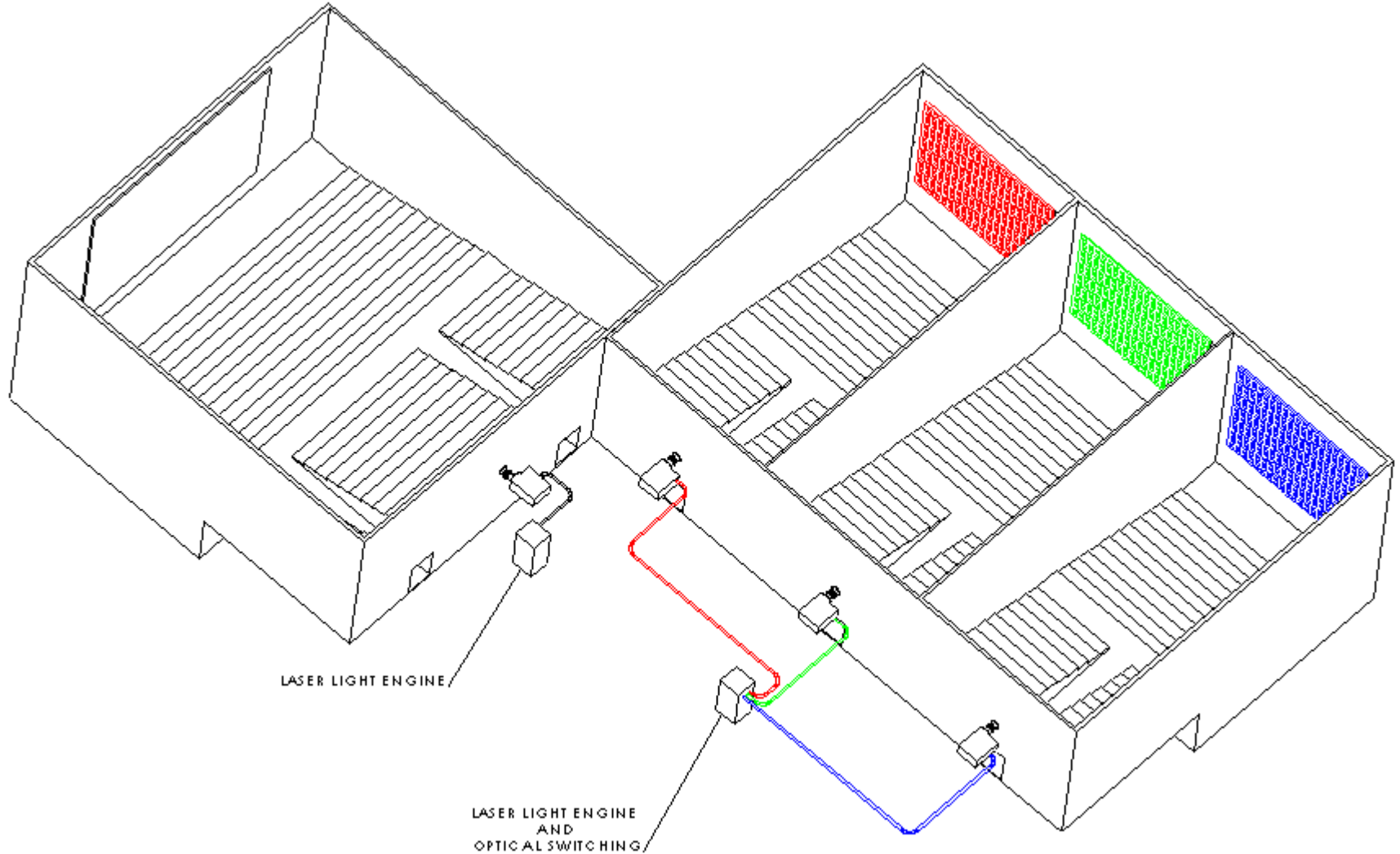


- **Lowest bits can be faithfully represented**
- **Total energy per pulse falls within “on” time**

Data taken using Roadster X4\*

\* Courtesy Christie Digital Systems

- **Use video trigger to synchronize Q-switch driver**
  - **Increase rep rate to 64 kHz**
    - » **Provides  $2^{10}$ -bit per color**
    - » **Allows increased frame rate (180 Hz)**
    - » **Enables laser engine sharing among three single-chip projectors**
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- **Single laser engine feeds three single-chip projectors**

- **Digital Cinema is coming!**
  - **Use of pulsed laser system enables many additional advantages in performance**
  - **Laser Digital Cinema™**
    - » **True digital color accuracy**
    - » **Allows scalability for increased bit depth**
    - » **Enables increased functionality in projection system and theater design**
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