Technische Universität Berlin

EINSTEIN CENTER Digital Future

Event-based Robot Vision

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Chair: Robotic Interactive Perception

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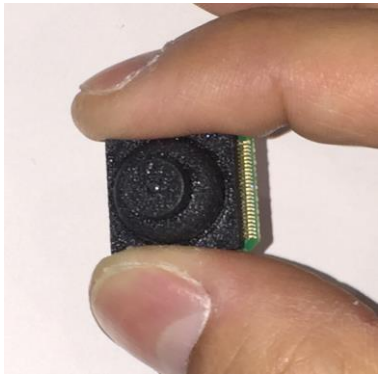
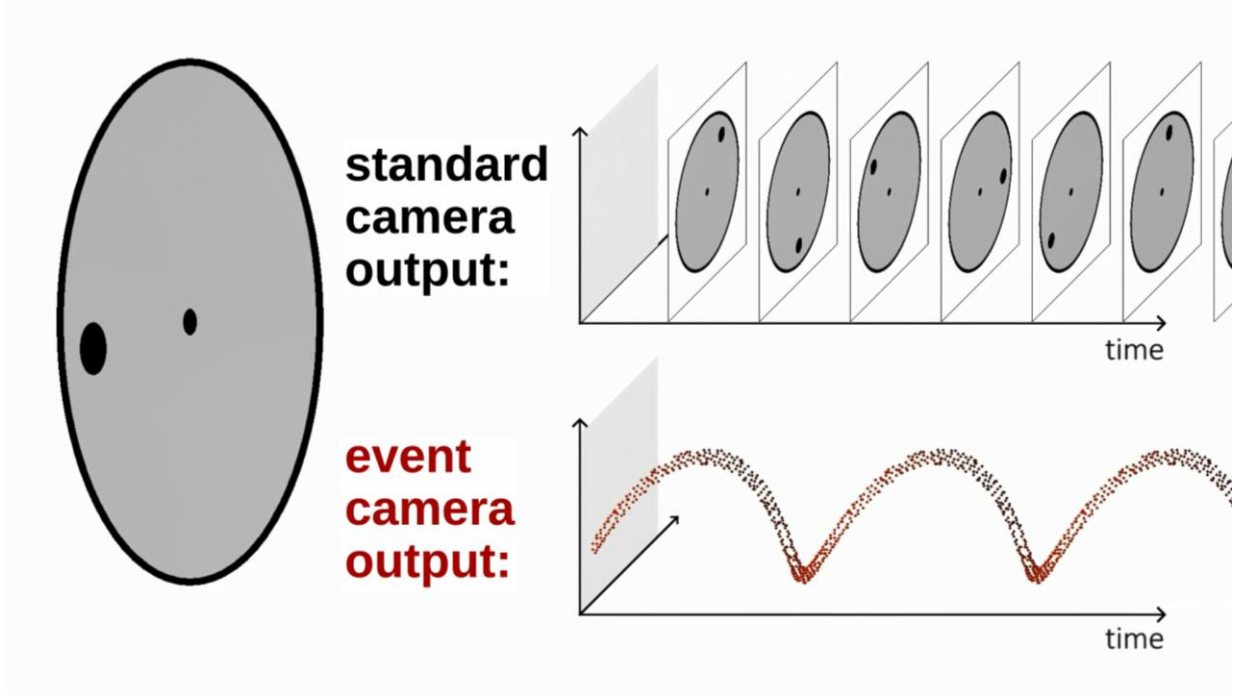
What is an Event Camera?

- A novel sensor that only outputs **intensity changes, asynchronously!**
- Output is a stream of **events** at **microsecond resolution**
- **Low-latency** (~ 1 µs)
- **Almost no motion blur**
- **High dynamic range** (140 dB instead of 60 dB)
- **Low power** (mW)
- **Traditional vision algorithms** cannot be directly used

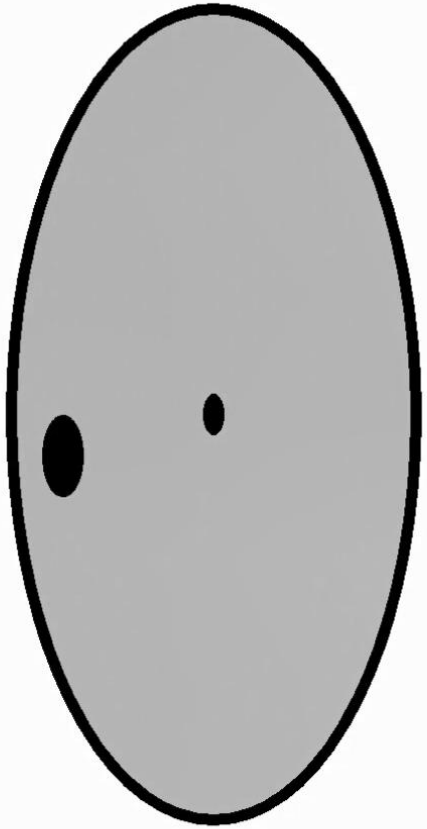


Mini DVS sensor from iniVation.com

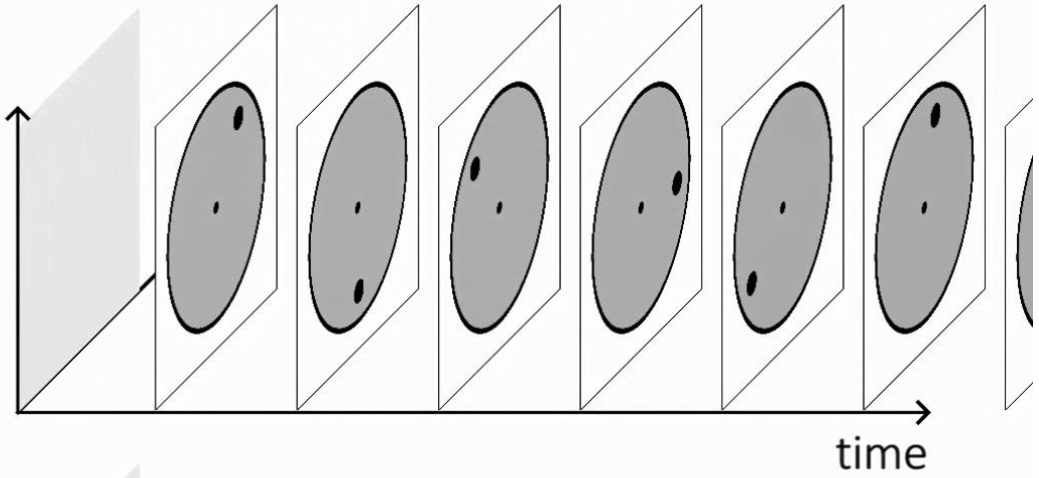
https://youtu.be/LauQ6LWTkxM?t=24



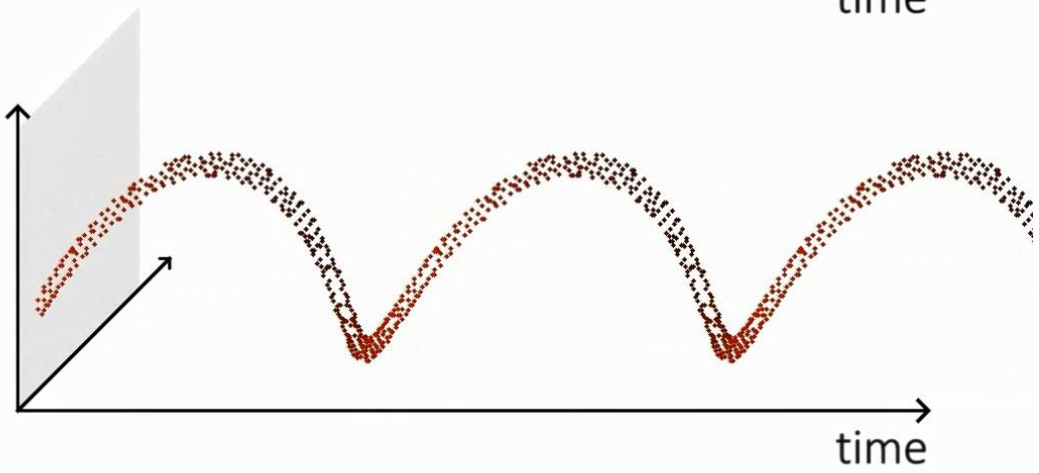
What is an Event Camera?



standard camera output:

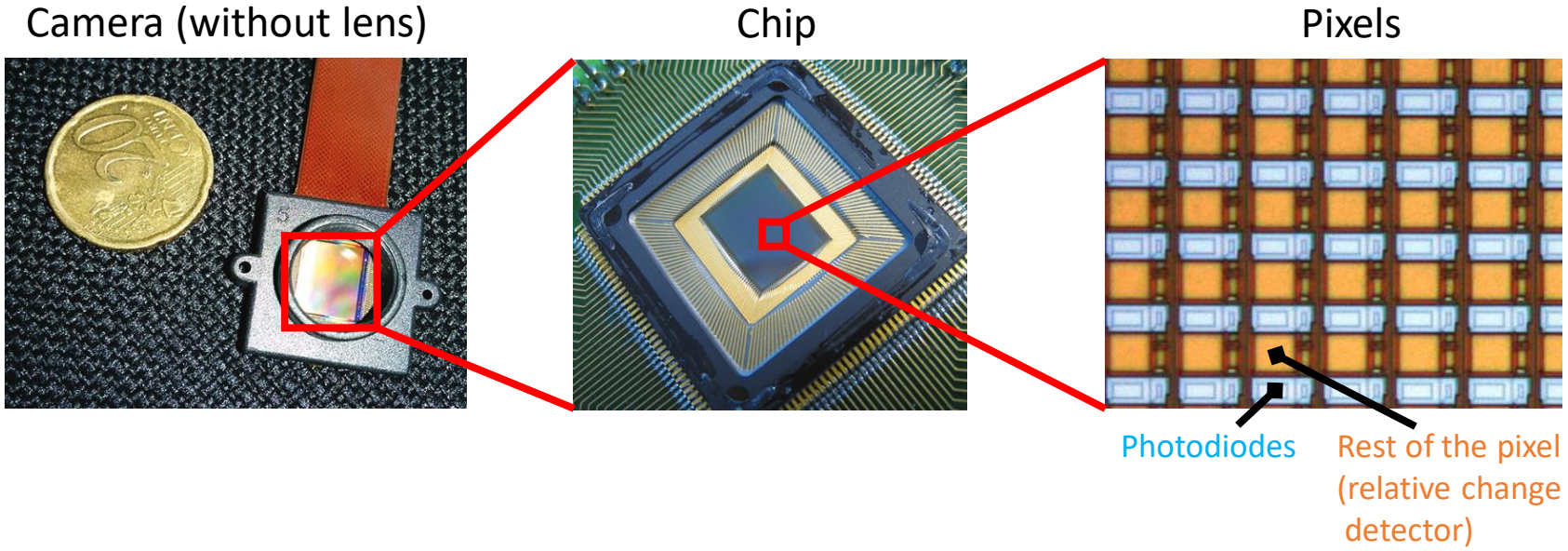


event camera output:



https://youtu.be/LauQ6LWTkxM?t=24

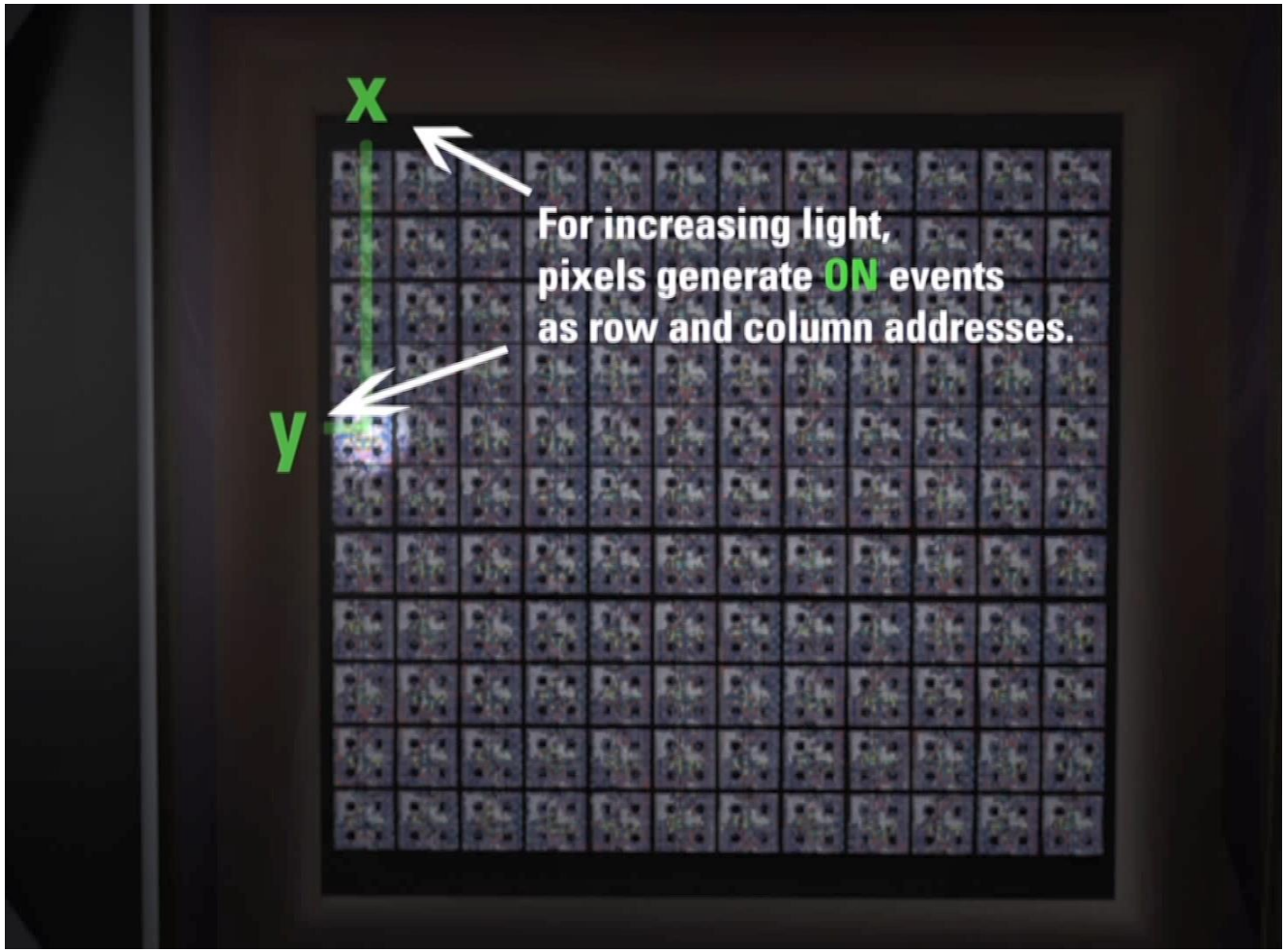
From the camera to the pixels



Posch et al. *Giving Machines Humanlike Eyes*, IEEE Spectrum, 52(12):44-49, 2015. PDF

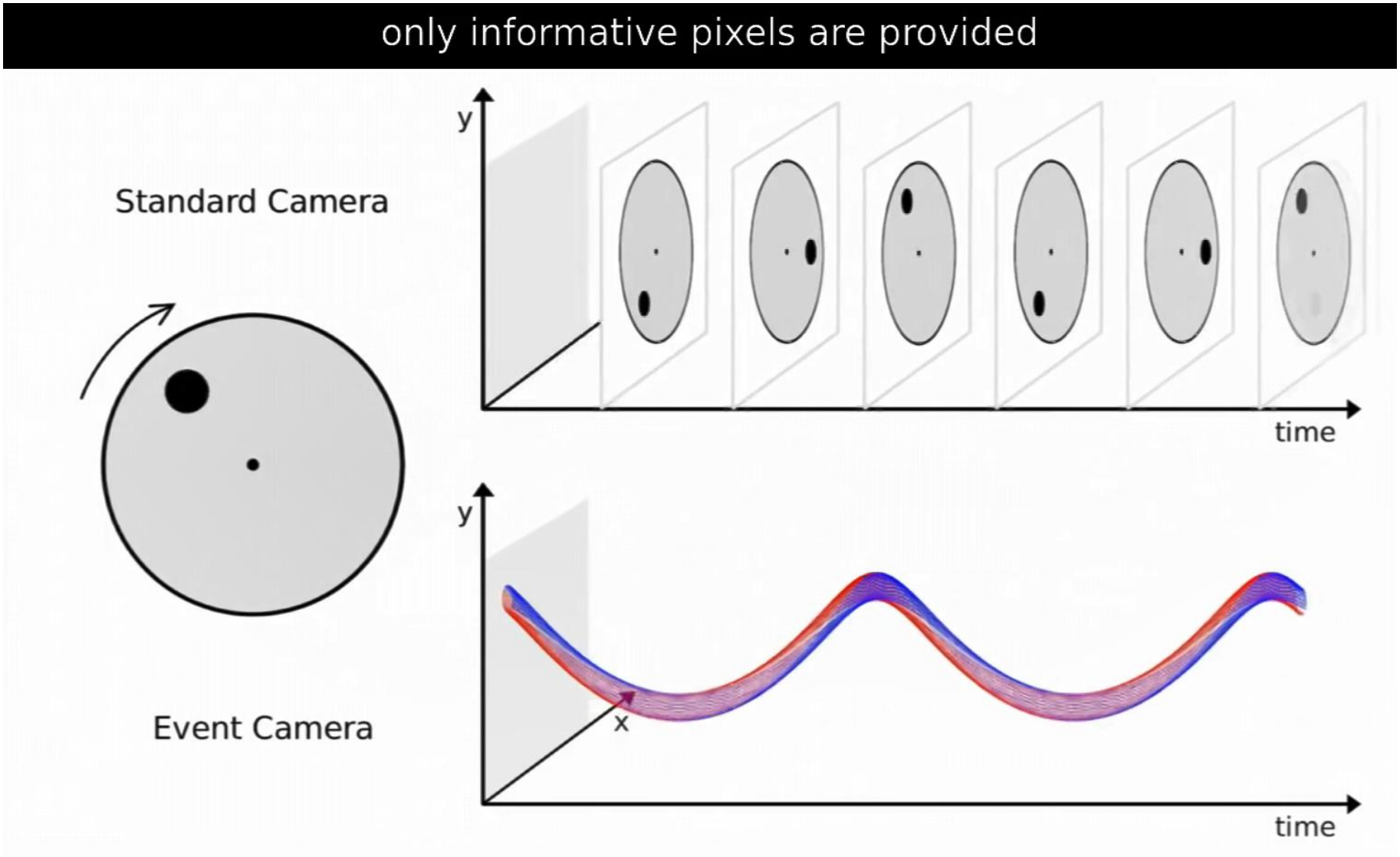
Illustration with a light beam

- Event camera pixels respond **independently** and **asynchronously** to light intensity **changes**.



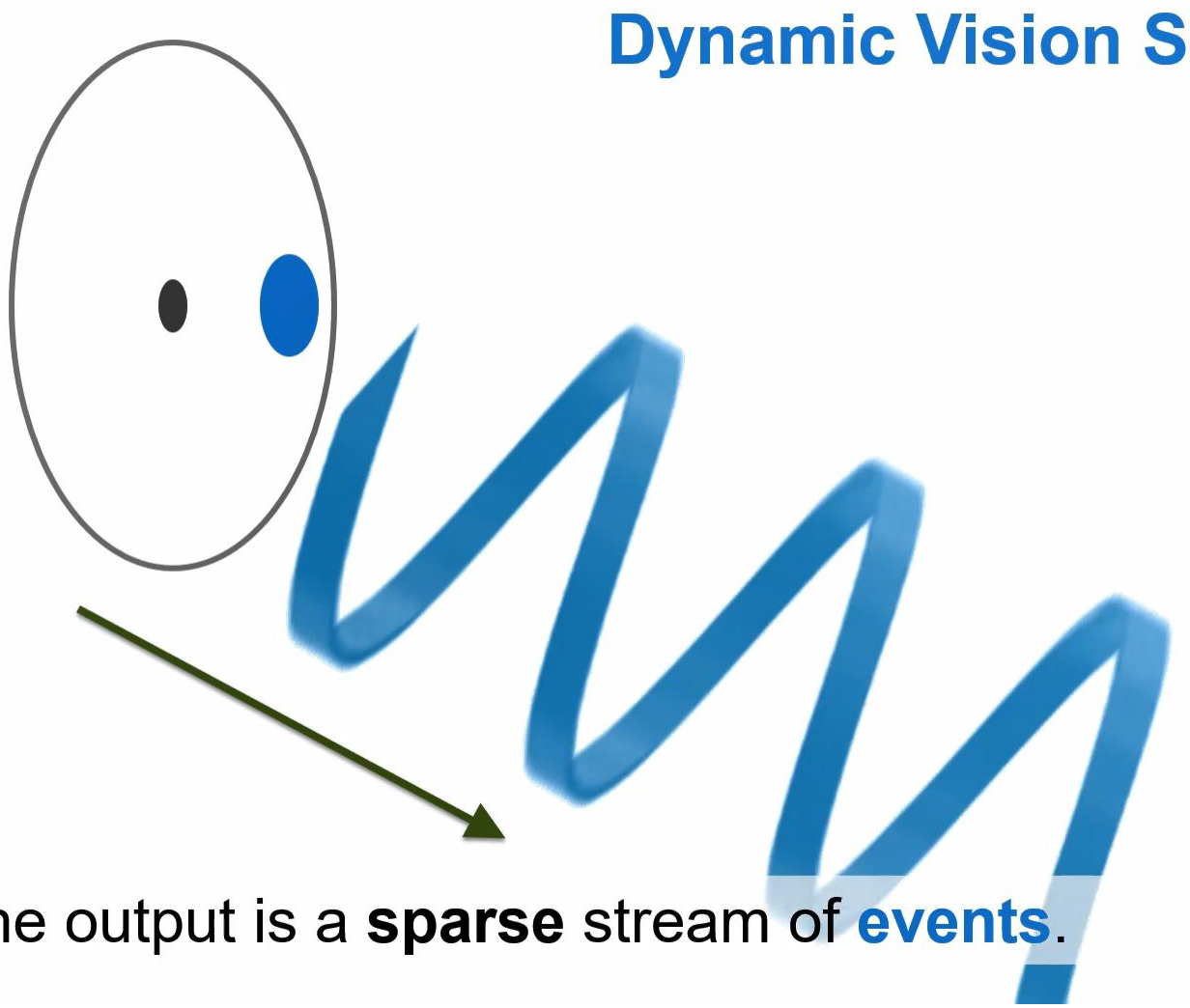
Video: Dynamic Vision Sensor https://youtu.be/QxJ-RTbpNXw

Same explanation (including event polarity)



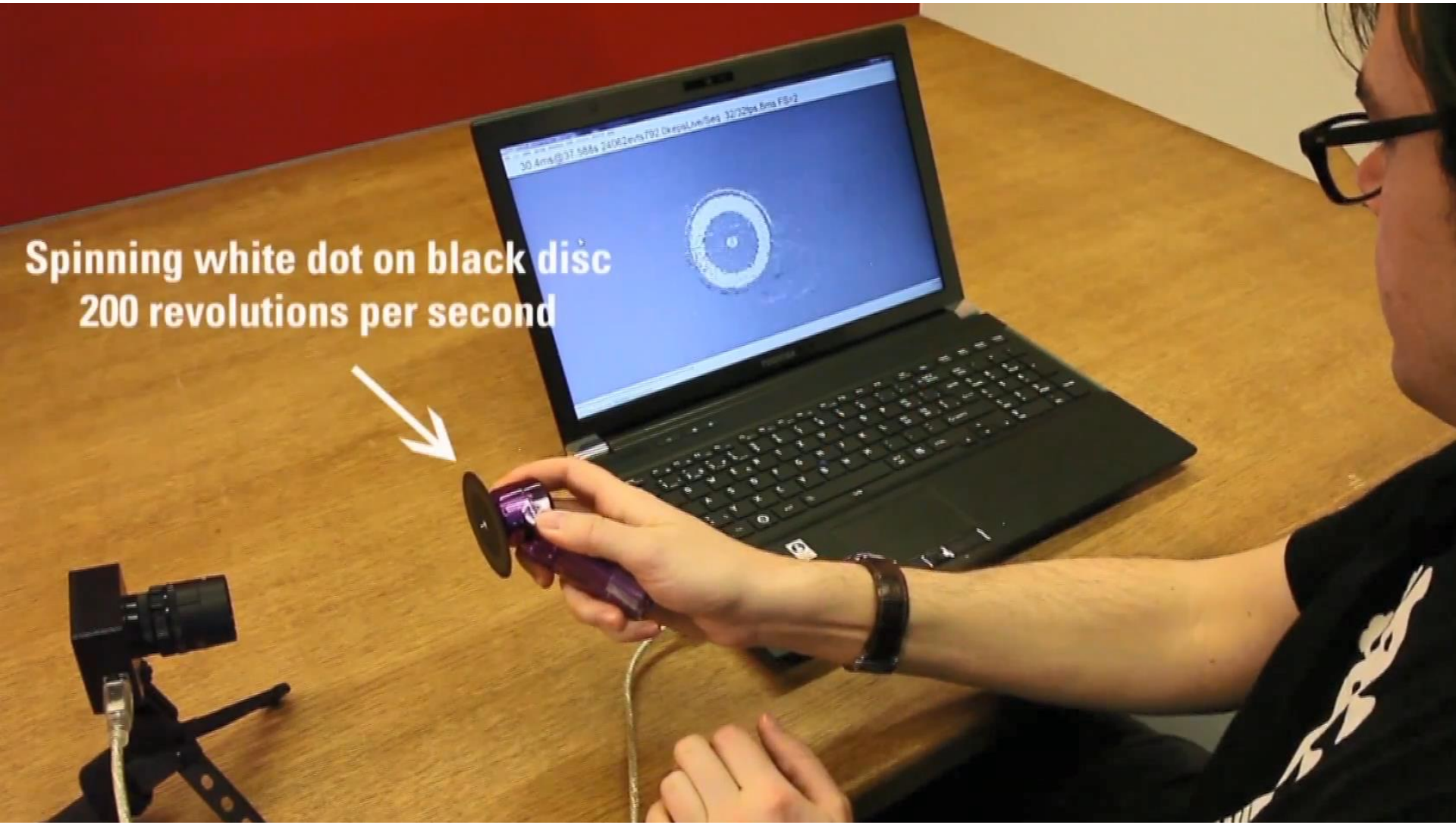
Video by Kim et al, ECCV 2016. https://youtu.be/yHLyhdMSw7w

Frame-based camera vs Event-based camera



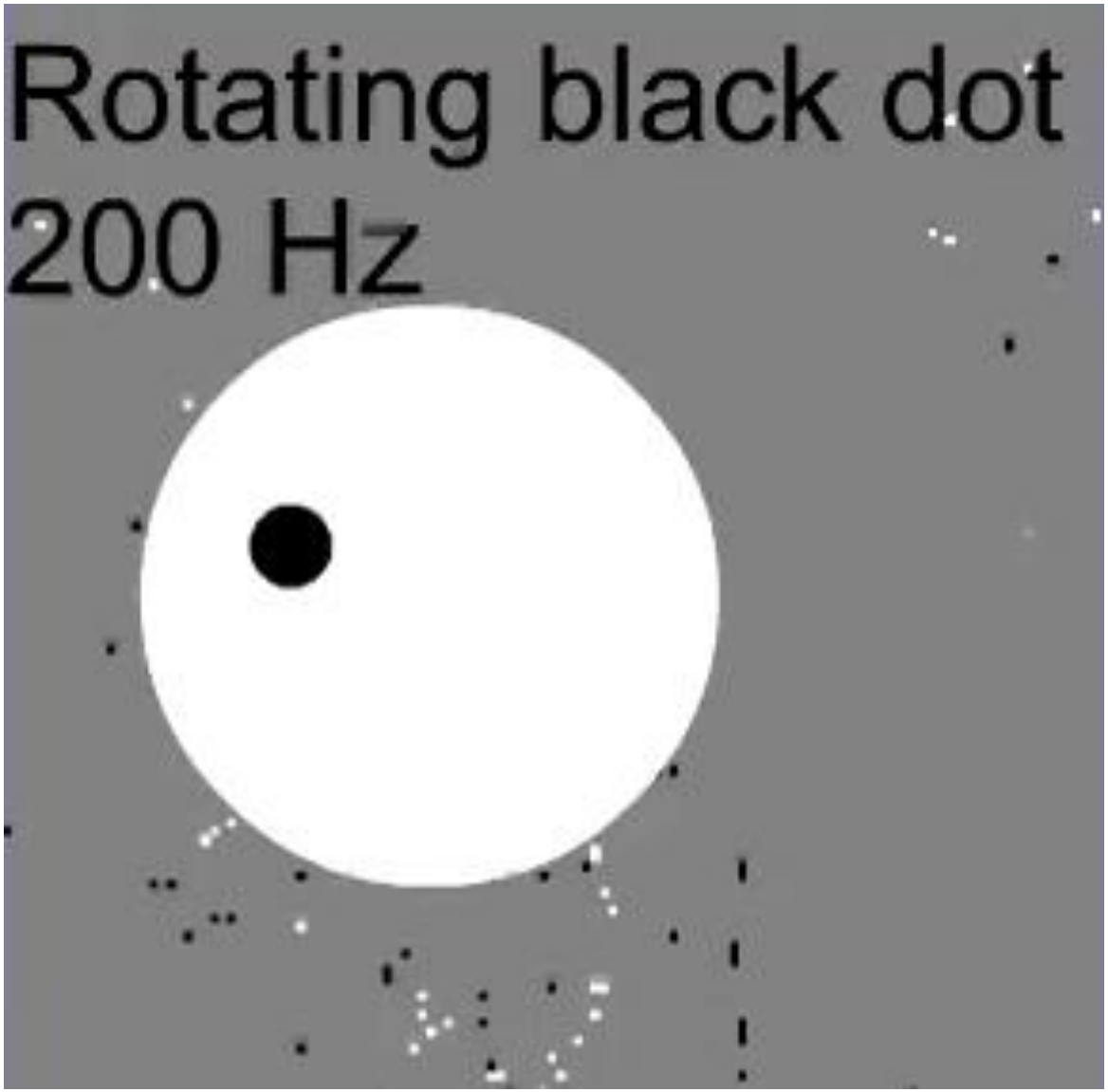
Video by iniVation https://www.facebook.com/inivation/videos/176121543038362/

Real data. High temporal resolution



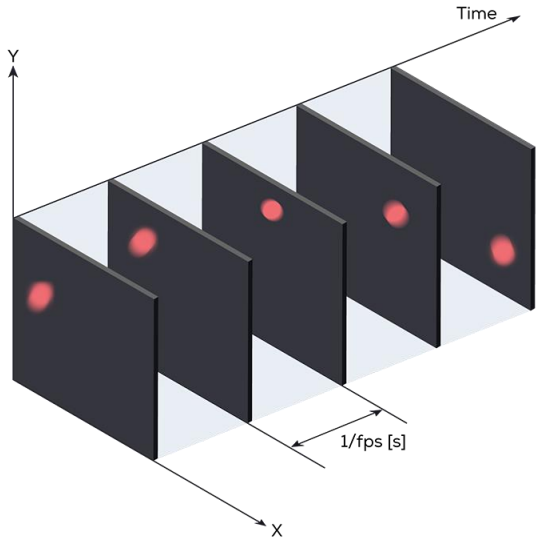
Video: Dynamic Vision Sensor https://youtu.be/QxJ-RTbpNXw

Real event data & Space-time display

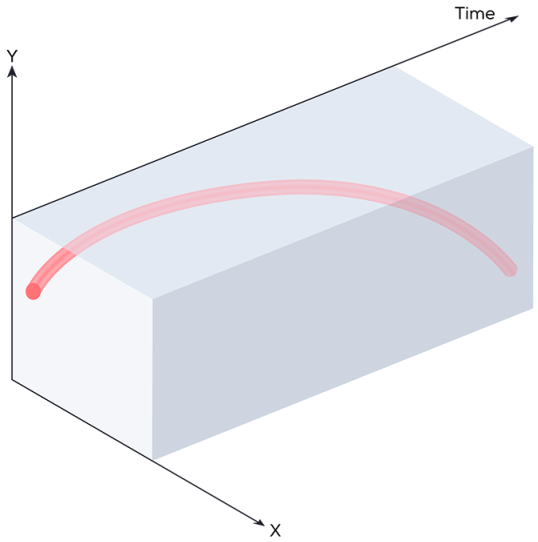


Video: T. Delbruck https://youtu.be/suqeFoYVWvs

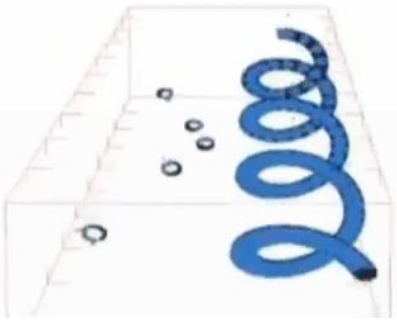
Frame-based camera vs Event-based camera



Frame-based



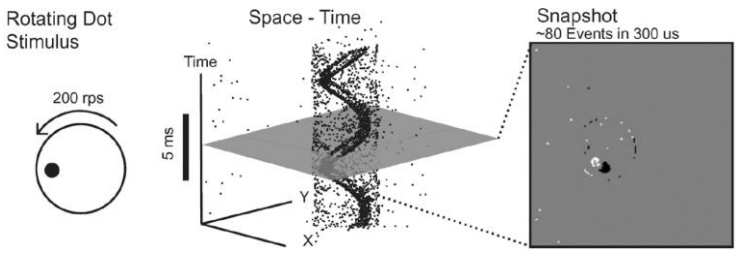
Event-based



Video: Prophesee https://www.prophesee.ai/event-based-sensor-packaged/

Why so many spinning-dot animations?

- It is on the seminal paper (2008)



- Every lab or company “has its own animation”.
- Event cameras work fundamentally different from standard cameras.
- Need to convey it in a simply way to your audience
  - Avoid getting your work rejected because there is a gap in understanding the context, the *novel sensing paradigm*
- It also shows the high-speed capabilities of the sensor.

Lichtsteiner et al., *A 128x128 120dB 15µs latency asynchronous temporal contrast vision sensor*, IEEE J. Solid-State Circuits, 2008.