

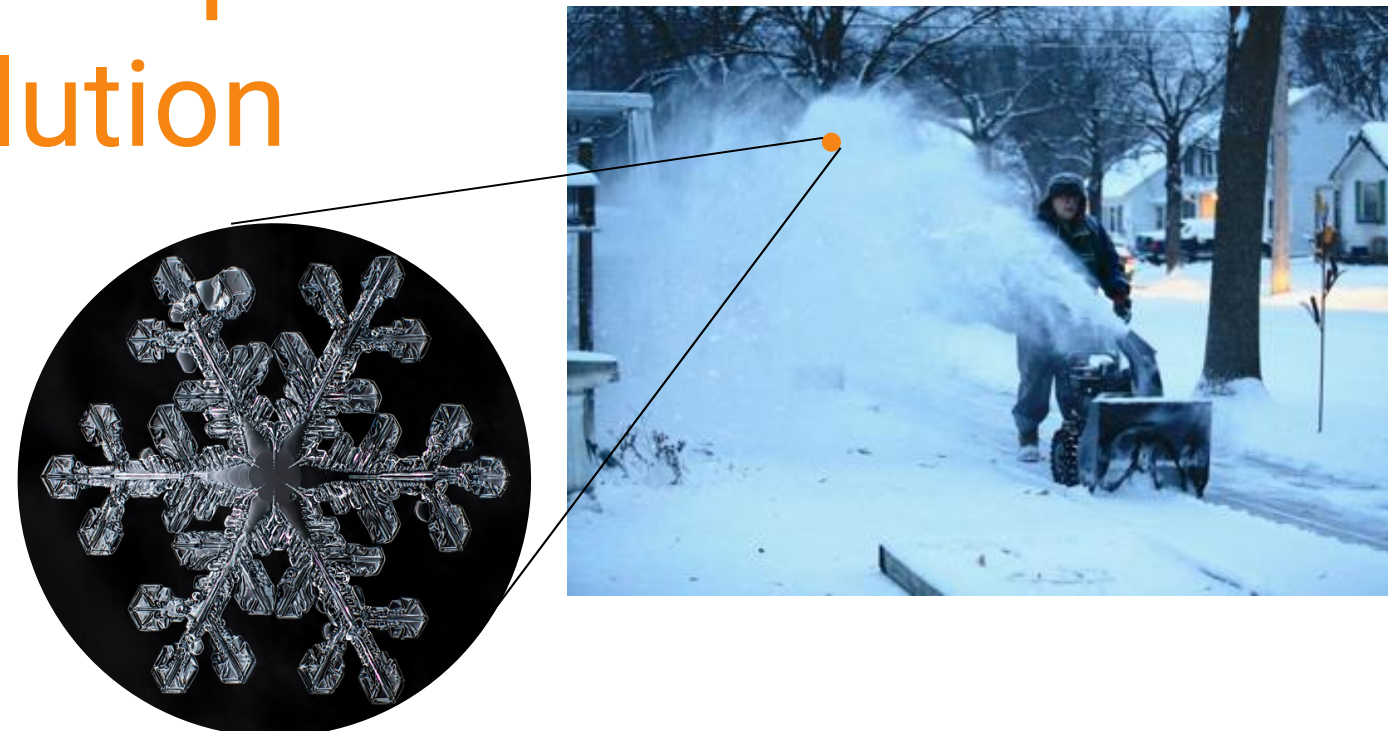
# The DESY Telescopes



The perfect R&D vehicle: Chasing particles at test beams to understand novel detectors

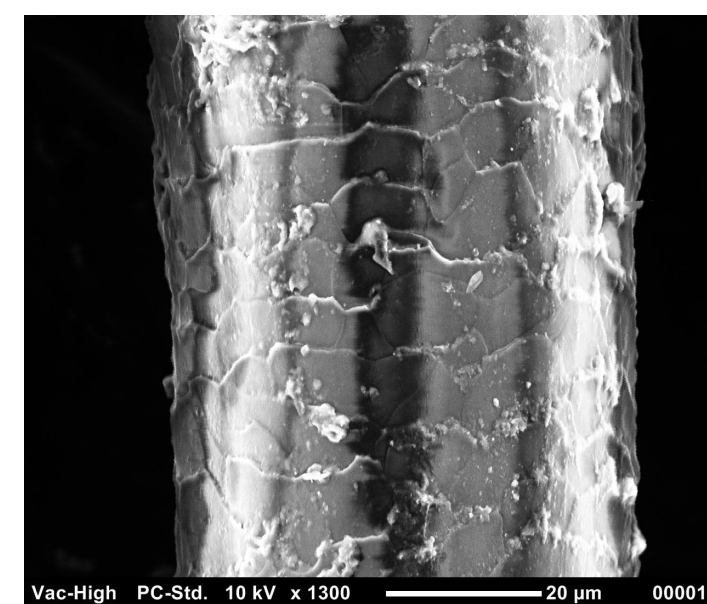
**Introduction:** Particle physicists are using telescopes not only to look into the sky, but also to follow the trajectory of elementary particles. DESY is pioneering and pushing telescope developments since 20 years, as they are not only crucial to test novel detectors, but also an optimal test-bench for feasibility and integration studies of new concepts.

Highest possible resolution



Requirements on telescopes

As thin as a human hair



Fast readout - high speed

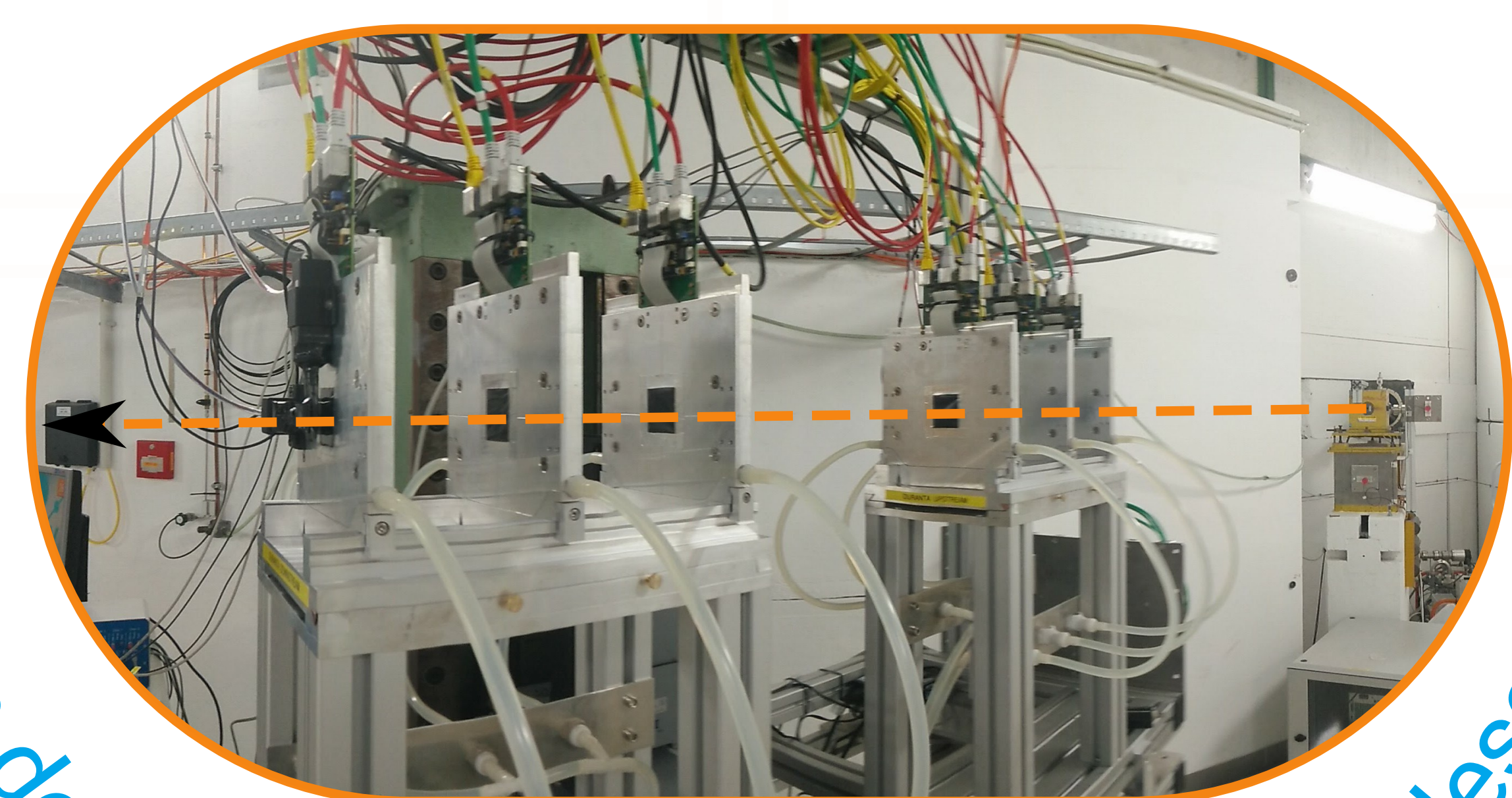
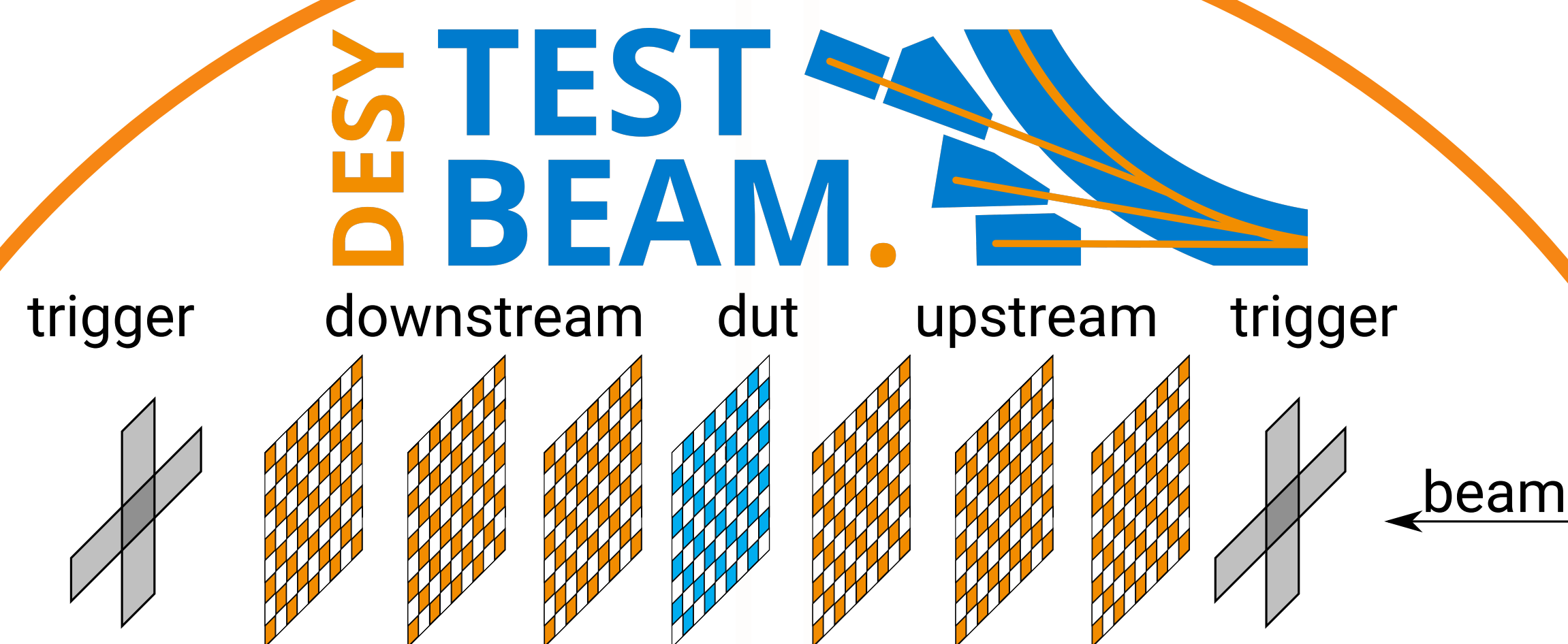
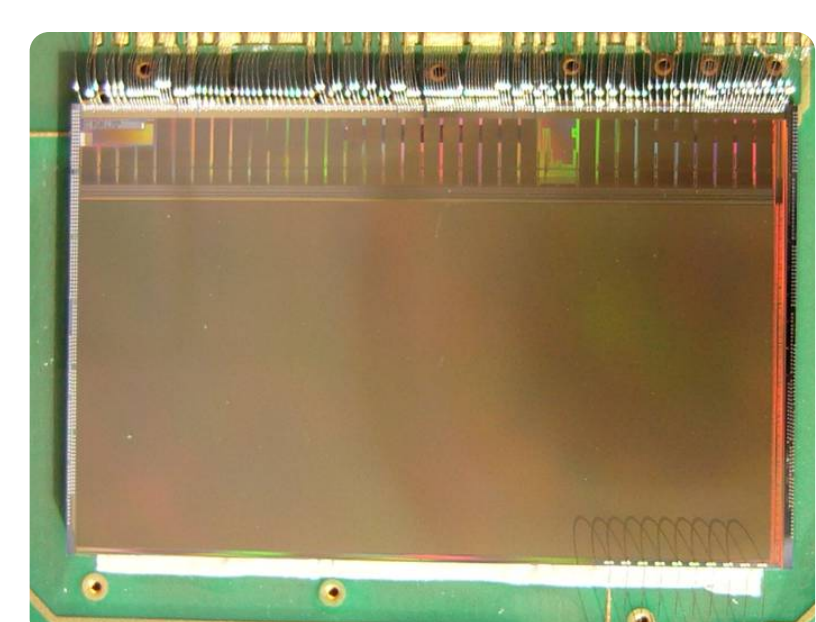
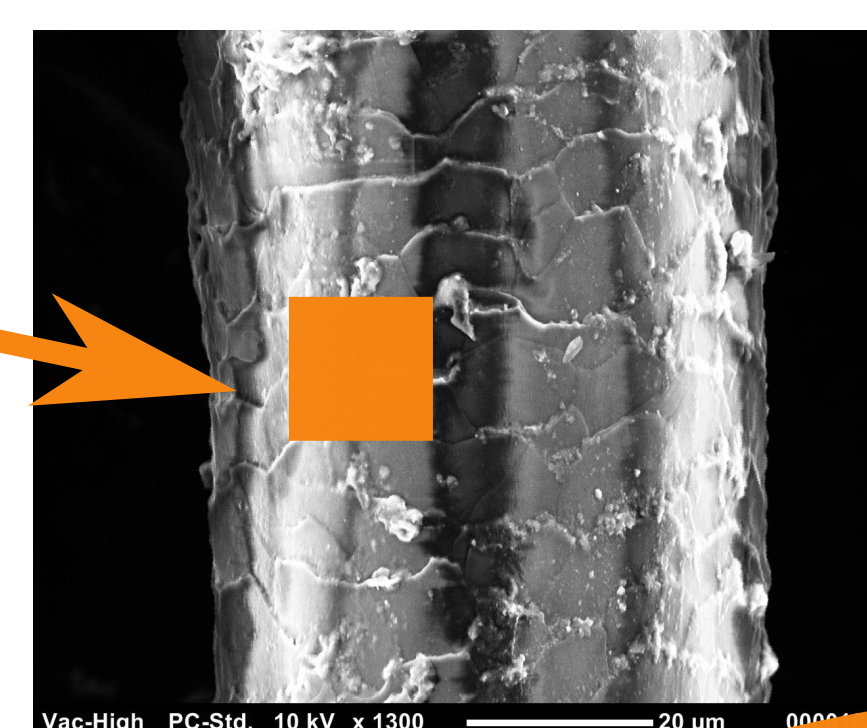


Precise time resolution

## EUDET Type Telescopes

World wide distributed test beam workhorse

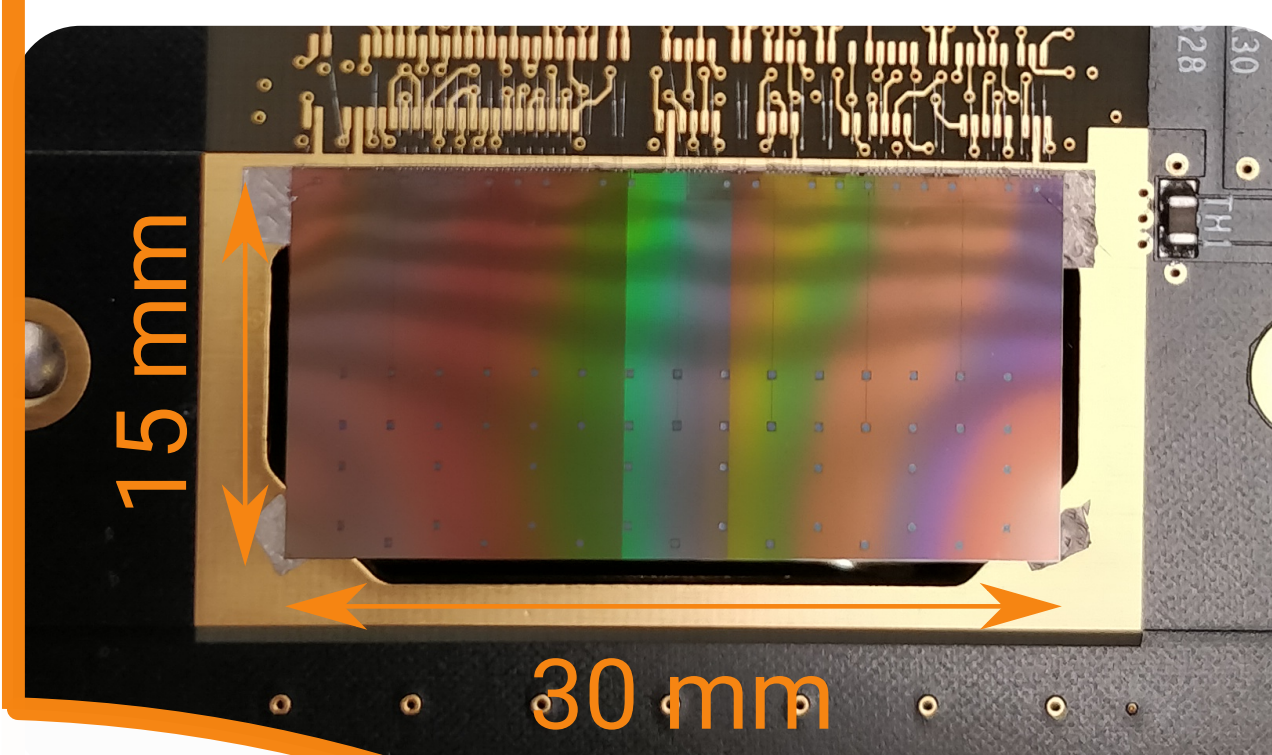
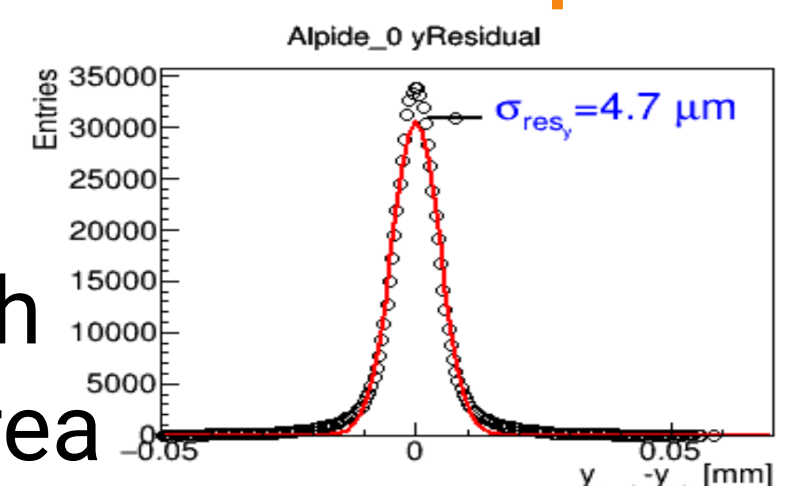
- 6 layers of pixel sensors
- $18.4 \times 18.4 \text{ } \mu\text{m}^2$  pixel pitch
- 650k-pixel
- 50  $\mu\text{m}$  thin
- Performing well since 10 years
- Best pointing resolution of all telescopes
- 1 kHz rate
- No timestamps



## ALPIDE Telescope

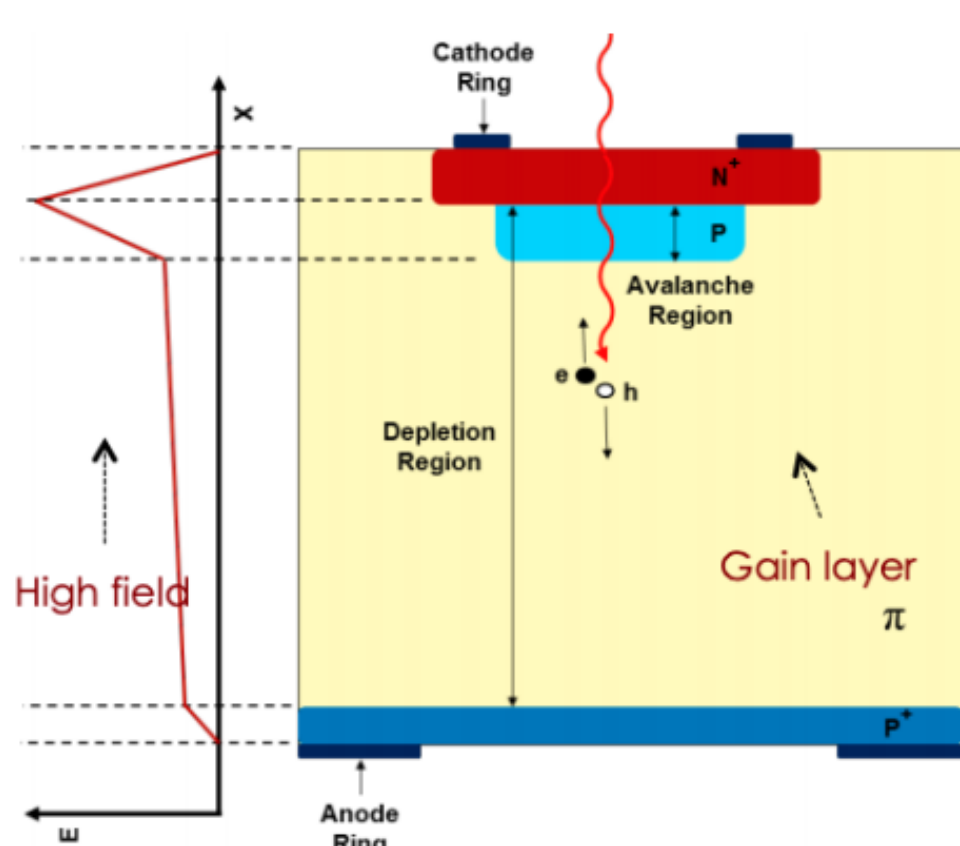
Mid-term upgrade of the EUDET telescopes

- 6 layers
- 99% efficiency
- $28 \times 26 \text{ } \mu\text{m}^2$  pixel pitch
- $30 \times 15 \text{ mm}^2$  active area
- Standalone running readout electronics
- Essentially noise-free
- Under commissioning with first users

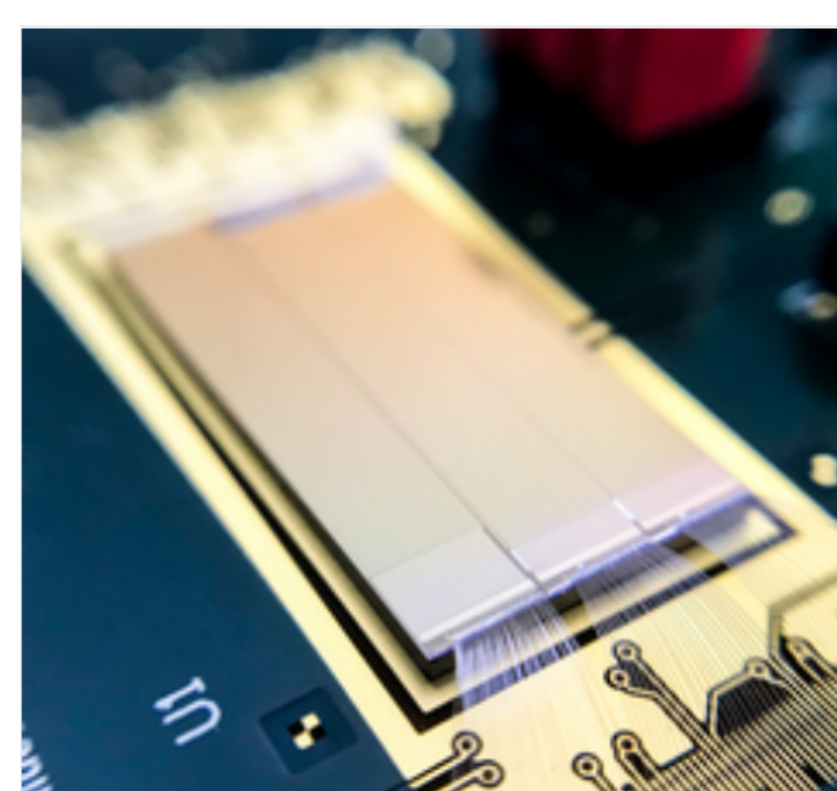


Ultimate silicon time resolution

LGADs



Monolithic active pixel sensors  
HV-CMOS, HR-CMOS, ...



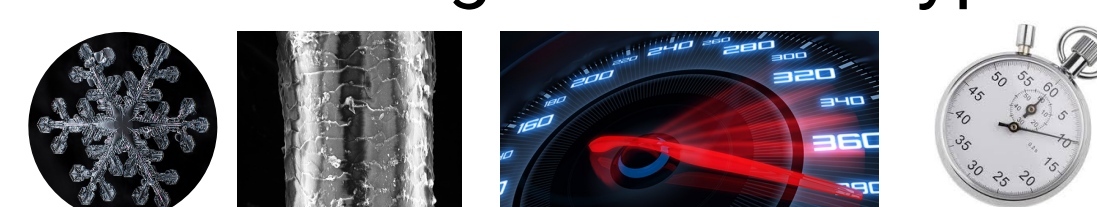
```

class TestClass
{
    int val1;
    int val2;
    TestClass(int x, int y)
    {
        val1 = x;
        val2 = y;
    }
}

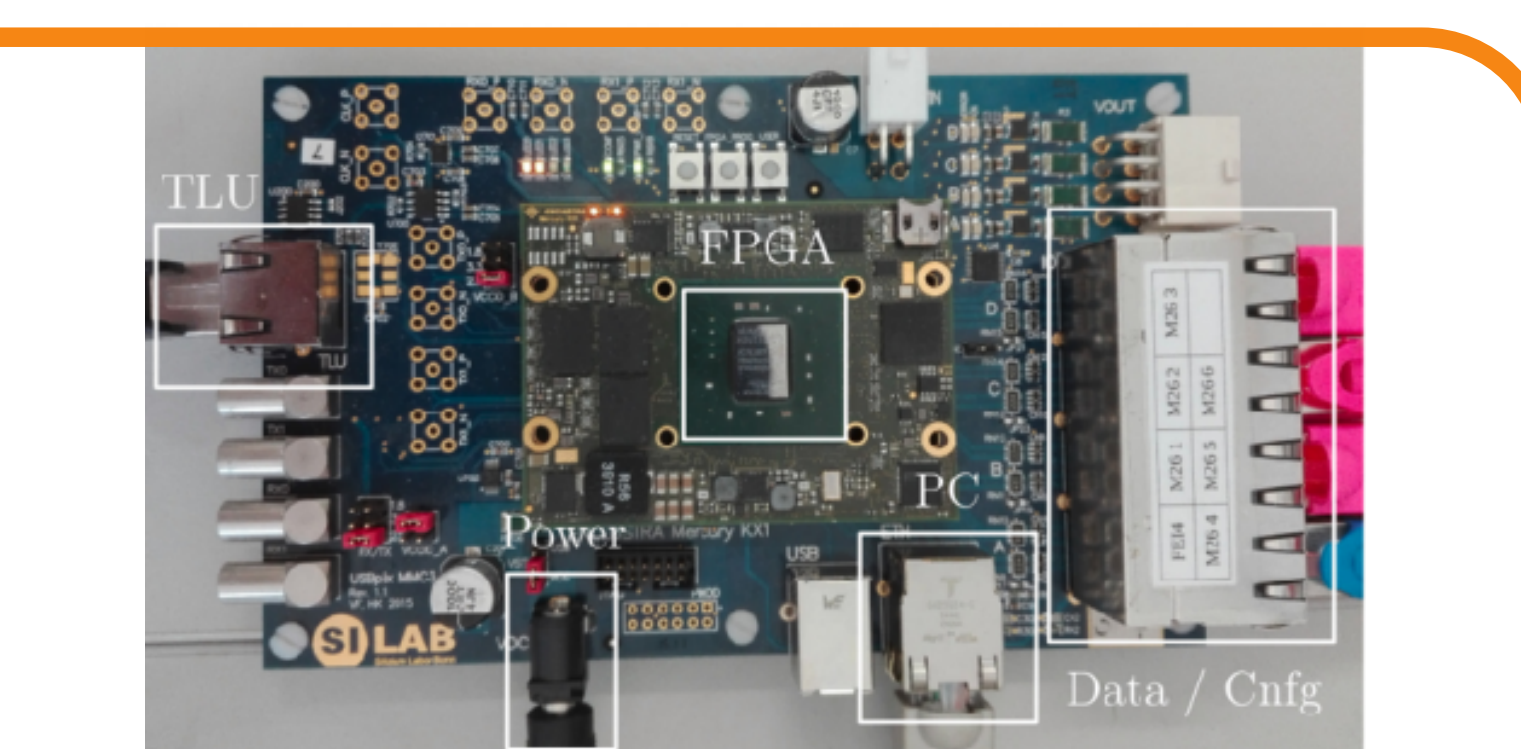
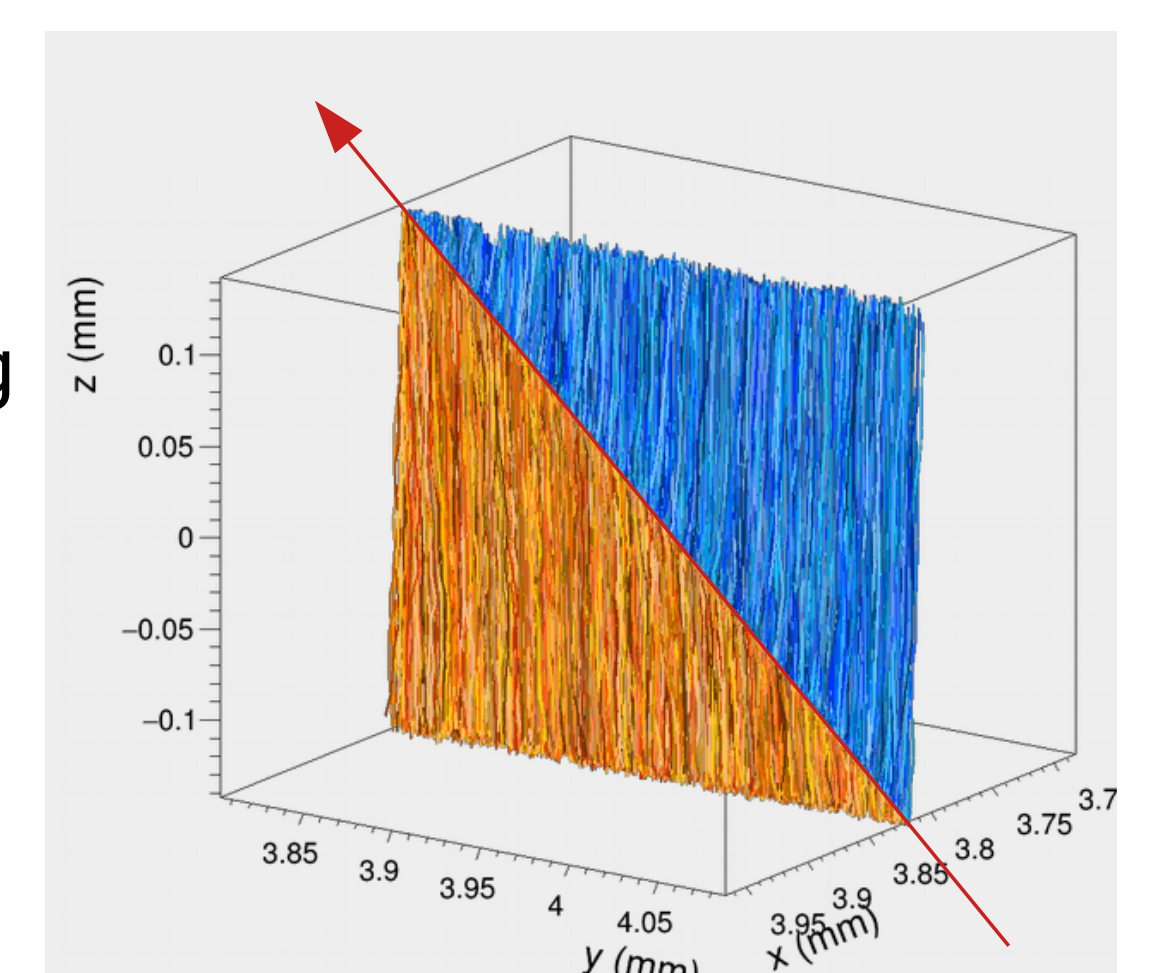
class Testing
{
    static public void main (String args[])
    {
        String string1 = new String("Hello world.");
        TestClass foo = new TestClass(2,4);
    }
}
    
```

Modern DAQ  
Systems

Ultimate Goal: **4D-tracking**  
Separate particles in time and space  
with a single detector type



**Simulation:** Understanding  
detectors and predict  
performance of  
new developments



Novel readout boards and architectures  
**FPGA/GPU tracking**  
**Fast readout software**  
**Optical readout**  
**multi sensors support**

Telescopes are an essential tool for successful sensor R&D and a perfect test-bench to study and integrate novel technologies. High spatial and time resolution, combined with minimal thickness and high speed readout are key features of modern telescopes. DESY has world-leading expertise in telescope developments with a bright future in sensor and telescope R&D

