



DSS

Data & Storage Services

CERN IT
Department

Dust sensors for long term data preservation

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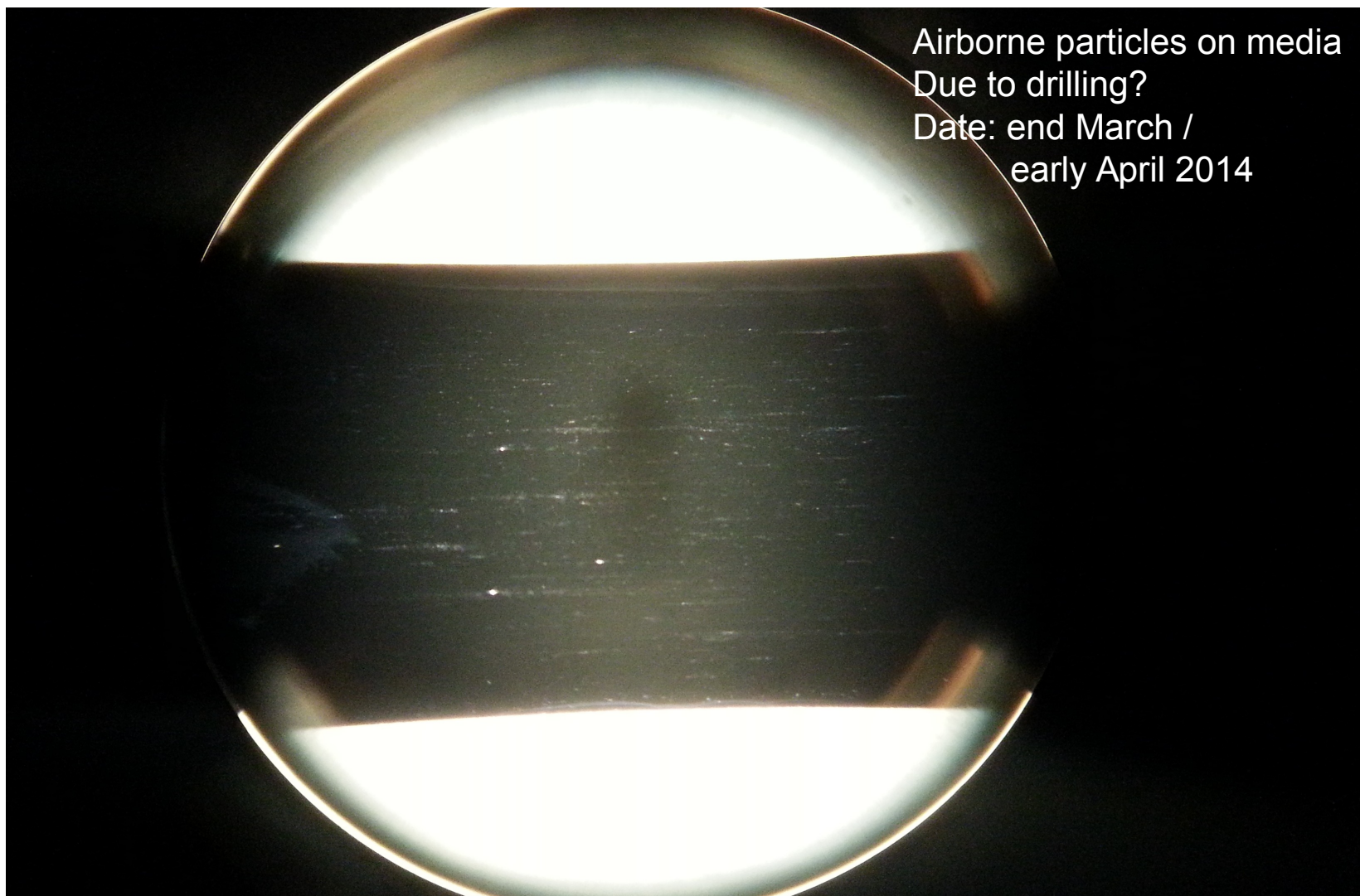
DSS Tape libraries





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Impact of dust on tapes

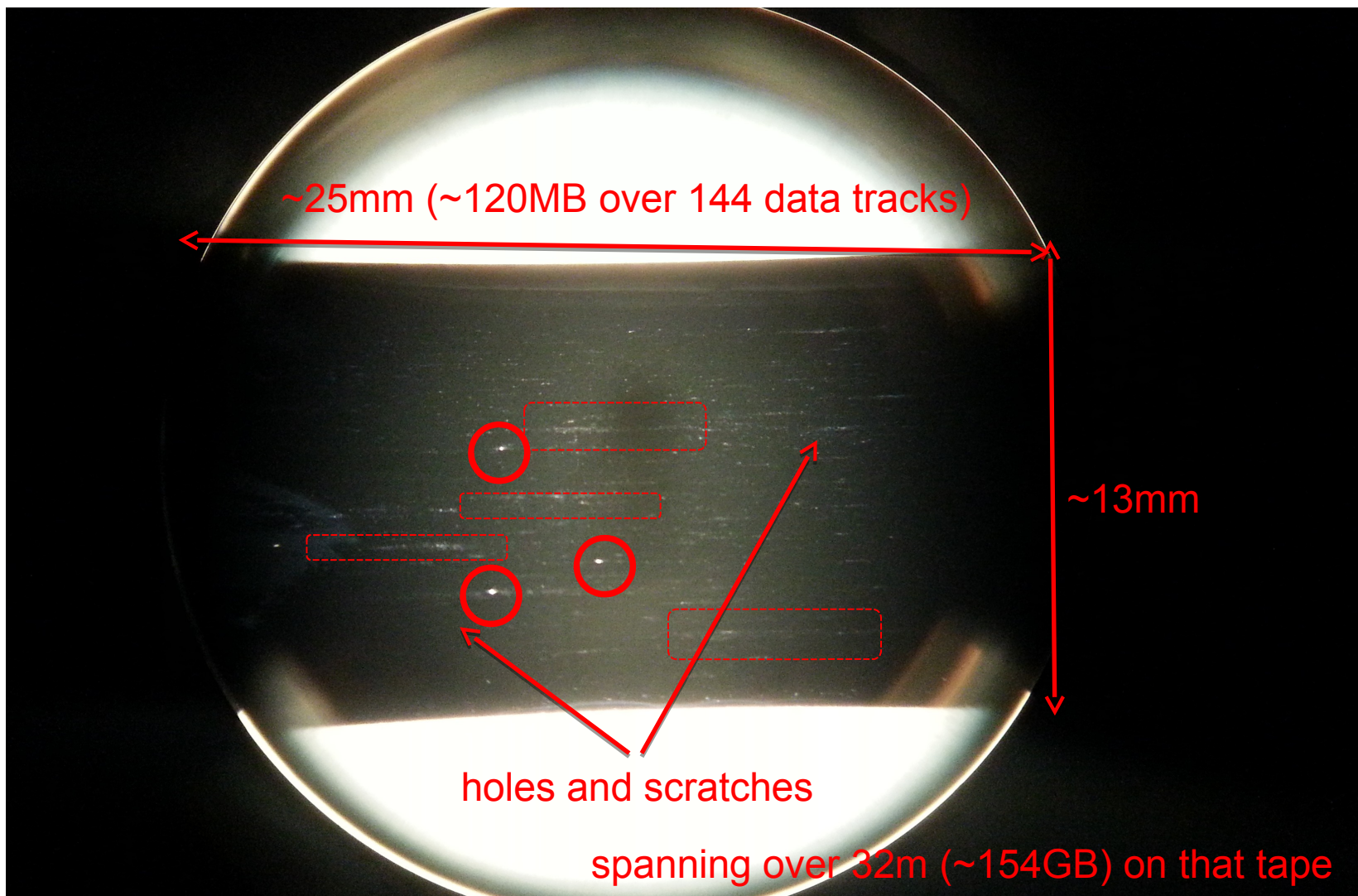


Airborne particles on media
Due to drilling?
Date: end March /
early April 2014



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Impact of dust on tapes





- 13 contaminated tapes :
 - 1868 files affected (786 GB)
 - 1715 files recovered by the vendor
-

113 files lost

All the tapes were verified in building 513 on both Oracle and IBM libraries.

➡ No further issue was found



DSS Tape libraries





Tape libraries are highways for airflows:

- Drive 0.57 m³/min
- DC PSU 0.71 m³/min
- Rack module 13.59 m³/min
- Electronics module 4.42 m³/min

Total per SL8500 library:

$$10 \times 0.57 + 14 \times 0.71 + 13.59 + 4.42 = \mathbf{33.65 \text{ m}^3/\text{min}}$$

Operating environment: **ISO 14644-1 Class 8**
environment (particles/m³)

Class	>0.5 um	>1 um	>5 um
8	3 520 000	832 000	29 300



Implement more restricted access to the tape library room

- To limit possible sources of contamination

Clean libraries to remove accumulated dust

- Going to take place soon

Monitor airborne particles around/inside tape libraries

- How ?
- Integration in libraries ?
- Integration in the monitoring infrastructure ?
- Cost ?



Clean room monitoring systems :

- Used by semiconductor industry for fabs...
- Heavy equipment (samplers, vacuum pumps, sensors...)
- Huge initial cost (and maintenance cost)

Portable devices

- Do not fit inside inside libraries
- ~10kCHF/sensor
- Cheap models are precise but too slow





I proposed a homemade solution :



- Conceive a dust sensor around a raw HVAC sensor component (cheap) and commodity microcontrollers (arduino/Rpi)



- Calibrate it and test it against one cheap calibrated portable dust sensor (500 CHF)
- Integrate with monitoring/libraries
- Multiply



DSS Prototype 1



Using components lying around in my office

Raw sensor in serie with Dylos laser particule counter (same airflow)

Rpi collecting/logging data on SD card.
Automatically connects on CERN WIFI when powered



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Prototype 2



2 Channels RAW sensor
Arduino mega 2560 upgrade



DSS Prototype 3

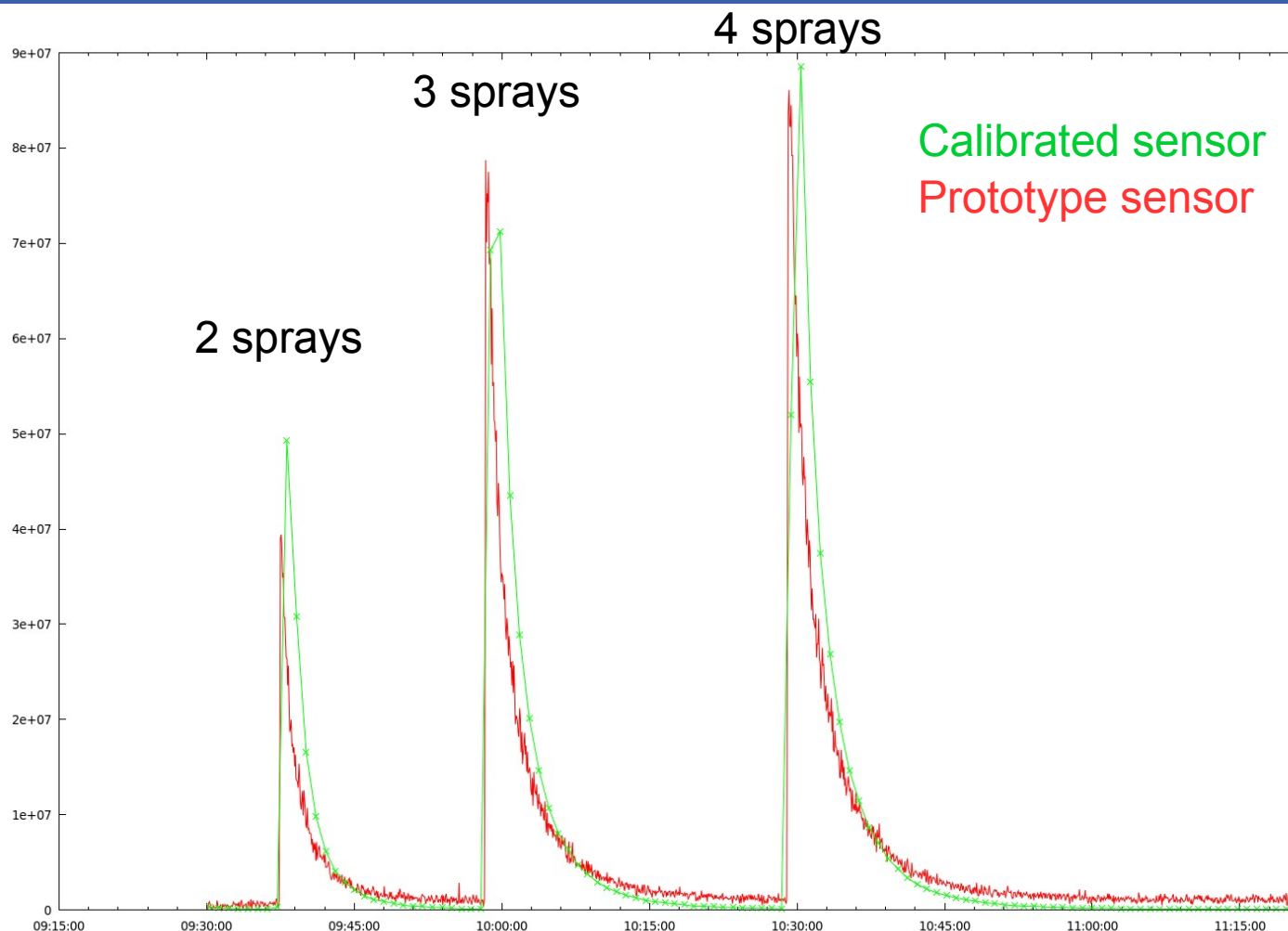


Soldered components
on an arduino shield

Everything nicely
packaged for rough
environments



DSS Calibration



> 0.5 μm particles per m^3



According to several calibration measurements the developed prototype is :

- as sensitive as the calibrated sensor
- 20 times faster than the calibrated sensor:
1(stable) measurement every 1.5 seconds
- More accurate : faster measurements means more data that allow to remove more false positives.
- More reactive : 1.5 seconds is 500MB of data per drive... 30 seconds is 10GB/drive
- BoM ~ 100CHF/sensor

Feasability is proven at that point

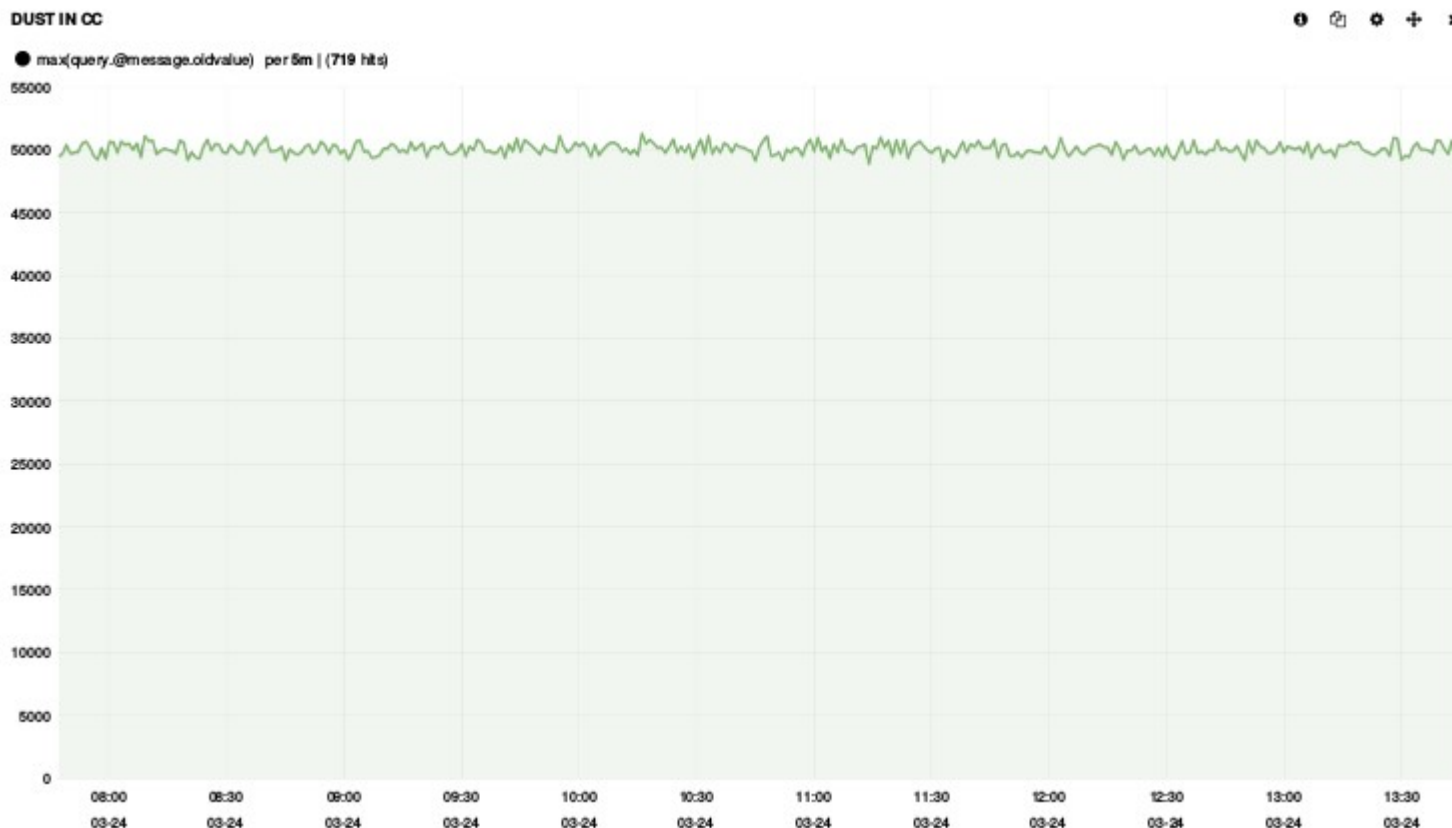


I chosed to implement an **SNMP agent** on the Rpi to integrate the sensor measurements in the **monitoring infrastructure** using the standard SNMP sensor and my own metric.
Allow to send **alarms** if dust peak detected.
Need to implement **SNMP traps** and correctly specify **my own private MIB**.

Integration is OK



DSS Kibana



Collecting raw sensor data since 16/02/2015
50000 is around 200000 >0.5 μm particles/ m^3

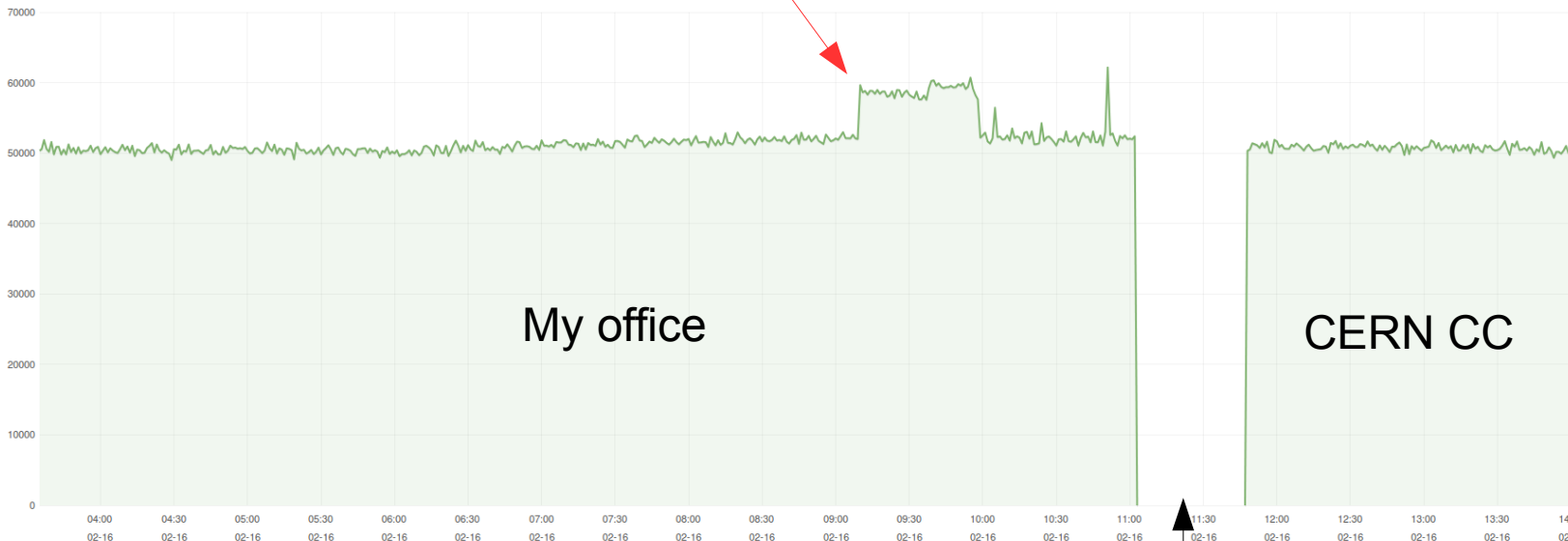


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Kibana

DUST IN CC

● max(query@message.oidvalue) per 1m | (1440 hits)



CERN CC is OK but has
similar dust levels as my office.



Integration work in the tape library

- Integrate the sensor in drive trays using onboard connectivity



Integration in collaboration with Oracle:

- **Do not want to void warranty**
- Regular technical meetings with Oracle hardware designers

Internship starting on April 1st for 2.5 month (student in applied industrial electronics)



Interesting project, lot of personal involvement

- **Easy to source raw sensors** and interface those with popular microcontrollers
 - Farnell, RS components available in CERN store
- Implement raw microcontroller firmware and then **direct integration**
 - No useless and **buggy vendor integration layer** (LDAP, HTTP, telnet...)
 - `Easier` to integrate
- Real OS is running on the Rpi
 - Regular **security** upgrades
 - Ipv6 support
 - **Puppetized network of sensors is not far...**



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Q&A

?