Karlsruhe Institute of Technology

Version 4.0

CO_2 Cooling of PXD Endflange: Results from Karlsruhe

T. Barvich, S. Heindl, Th. Müller, H.J. Simonis and Th. Weiler

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Institut für Experimentelle Kernphysik

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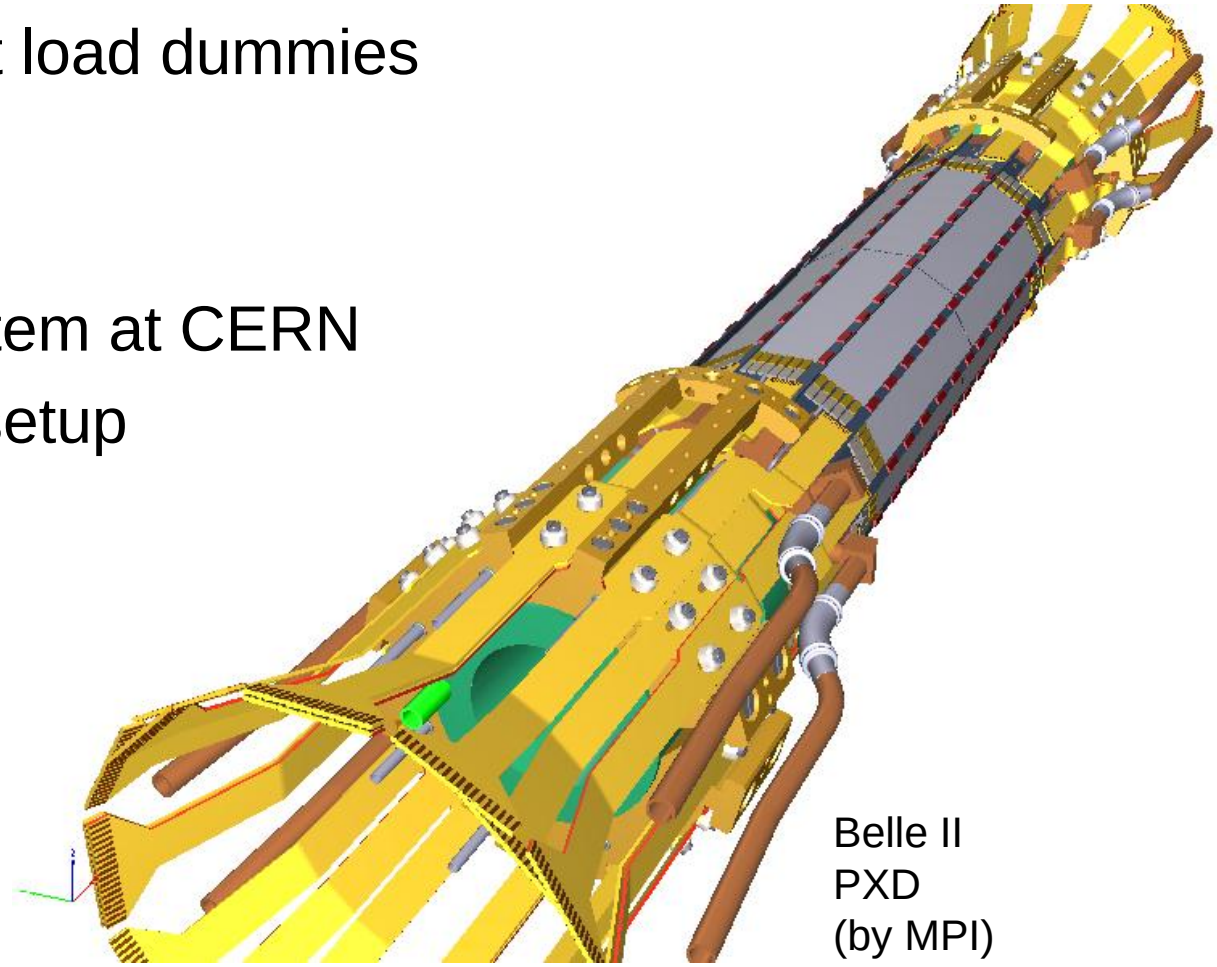
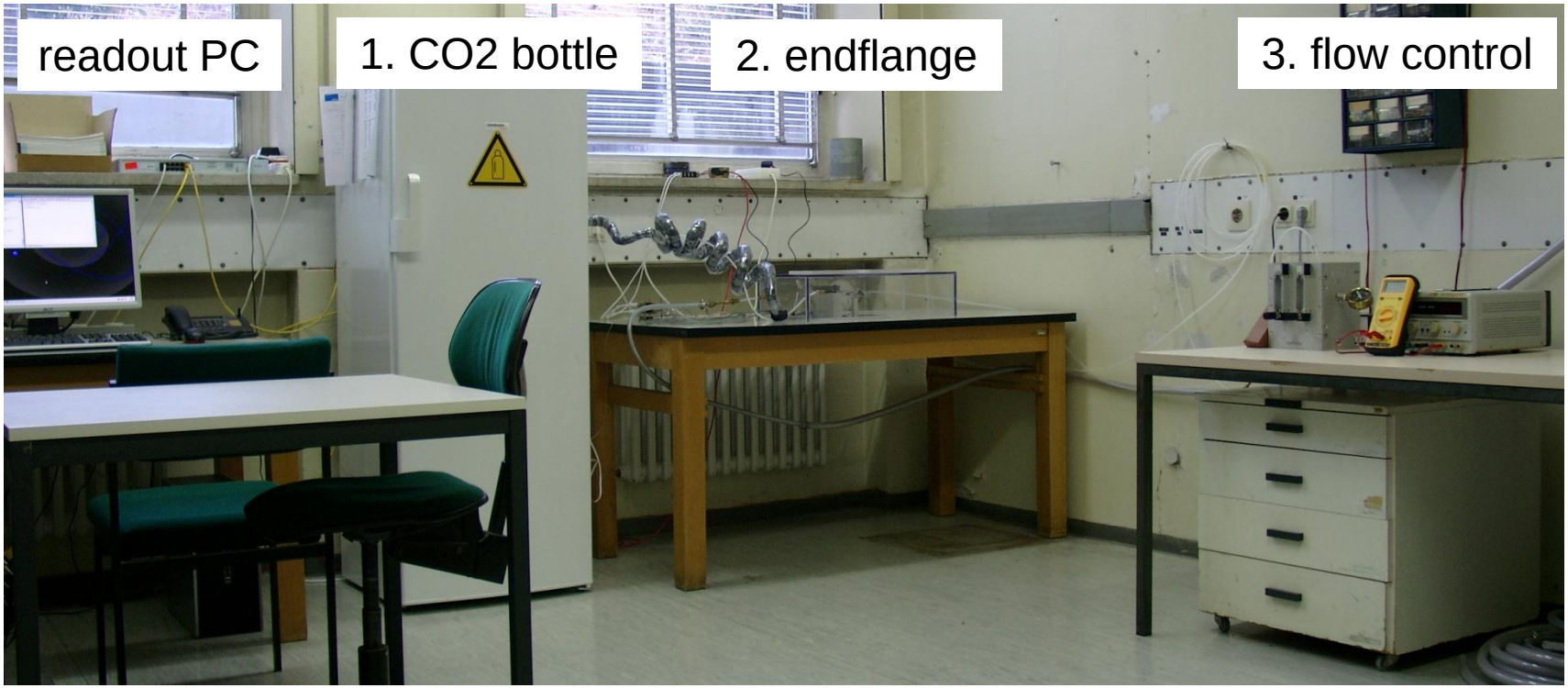


Belle II
PXD
(by MPI)

1. Open CO2 system in Karlsruhe

- Built for CMS Tracker Upgrade
- Now used for Belle II PXD cooling tests
- Manual operation → limited runtime

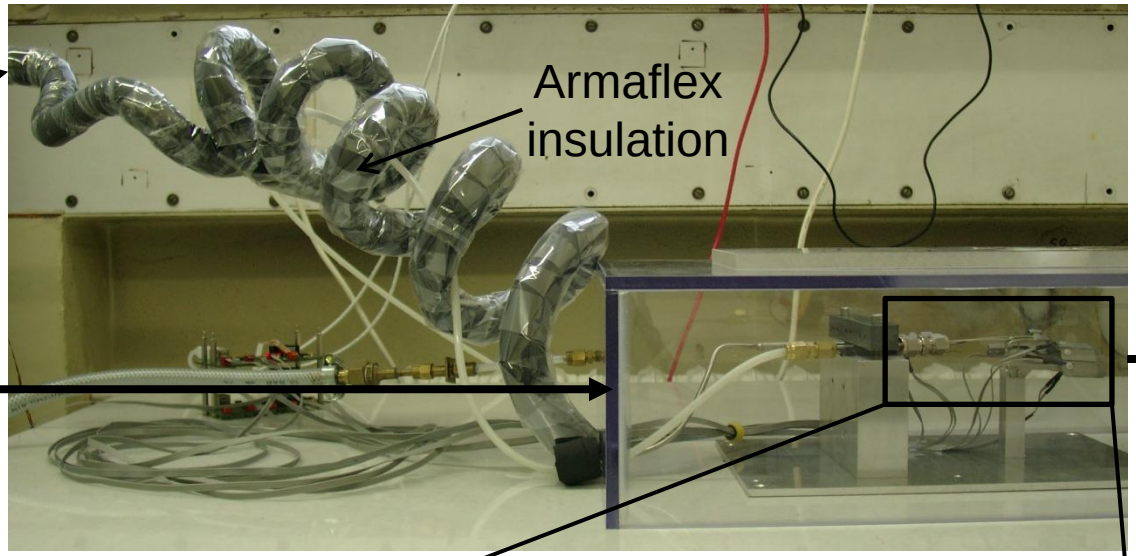


1. Open CO2 system in Karlsruhe

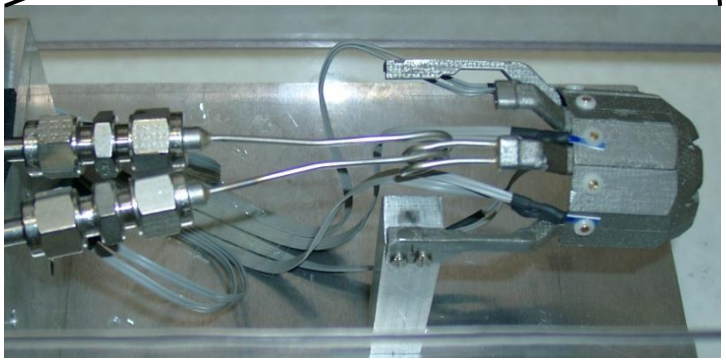
- Components of the system:

steel tube

dry air



1. CO2 bottle with pressure regulator, precooled to -32°C (saves CO2)

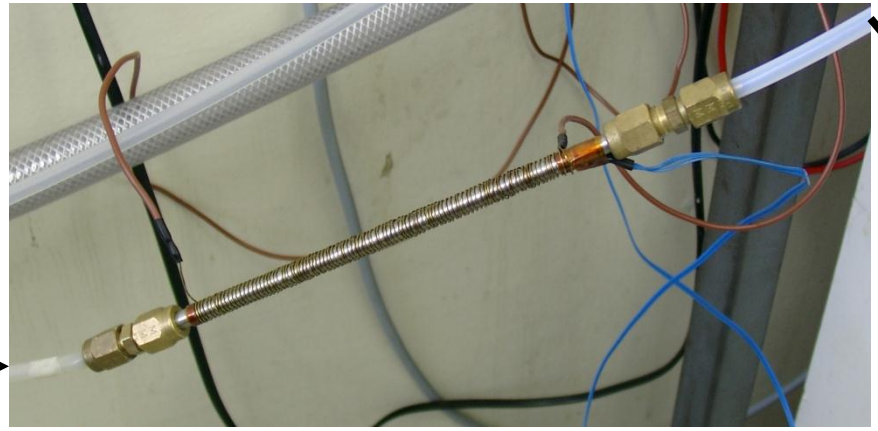


2. endflange prototype in air-flushed box to prevent condensation

1. Open CO2 system in Karlsruhe

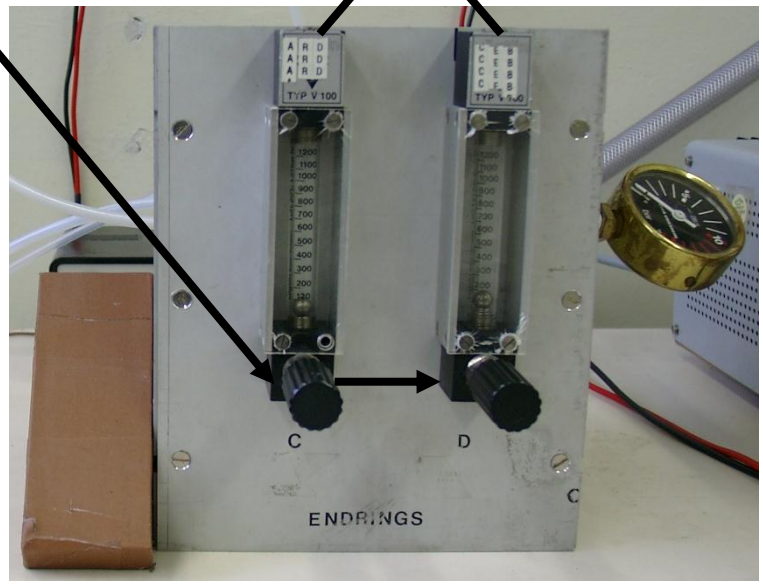
- Components of the system (cont‘d):

from flange



3. electric heater (temp. controlled) to prevent liquid CO2 from reaching the gas flow meters

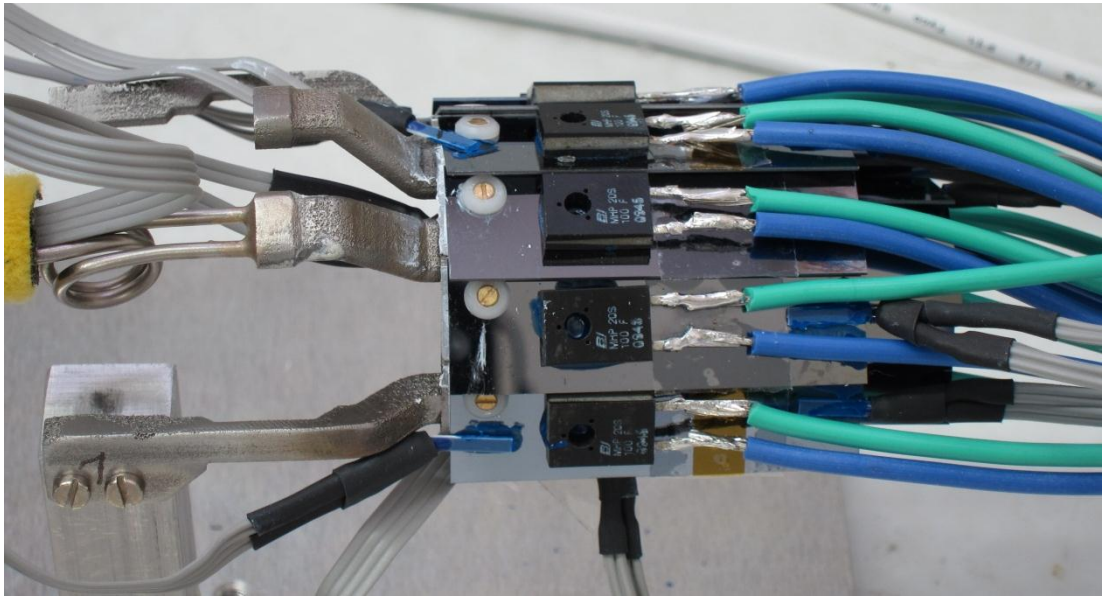
outlet (window)



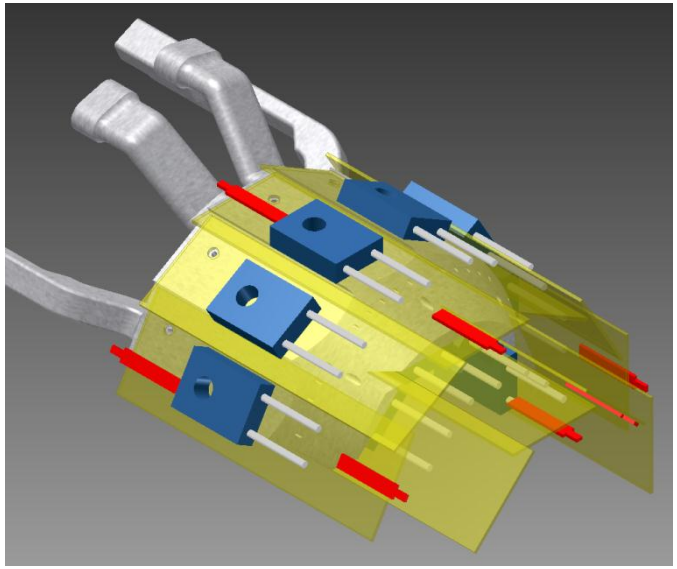
3. gas flow meters (combined) and pressure gauge for controlling operating values

2. Flange with heat load dummies

- Endflange prototype from MPI
- Silicon pieces made by HLL, with resistors (20 W each)
- Screwed to flange (heat transfer compound necessary)
- Pt1000 for temperature monitoring



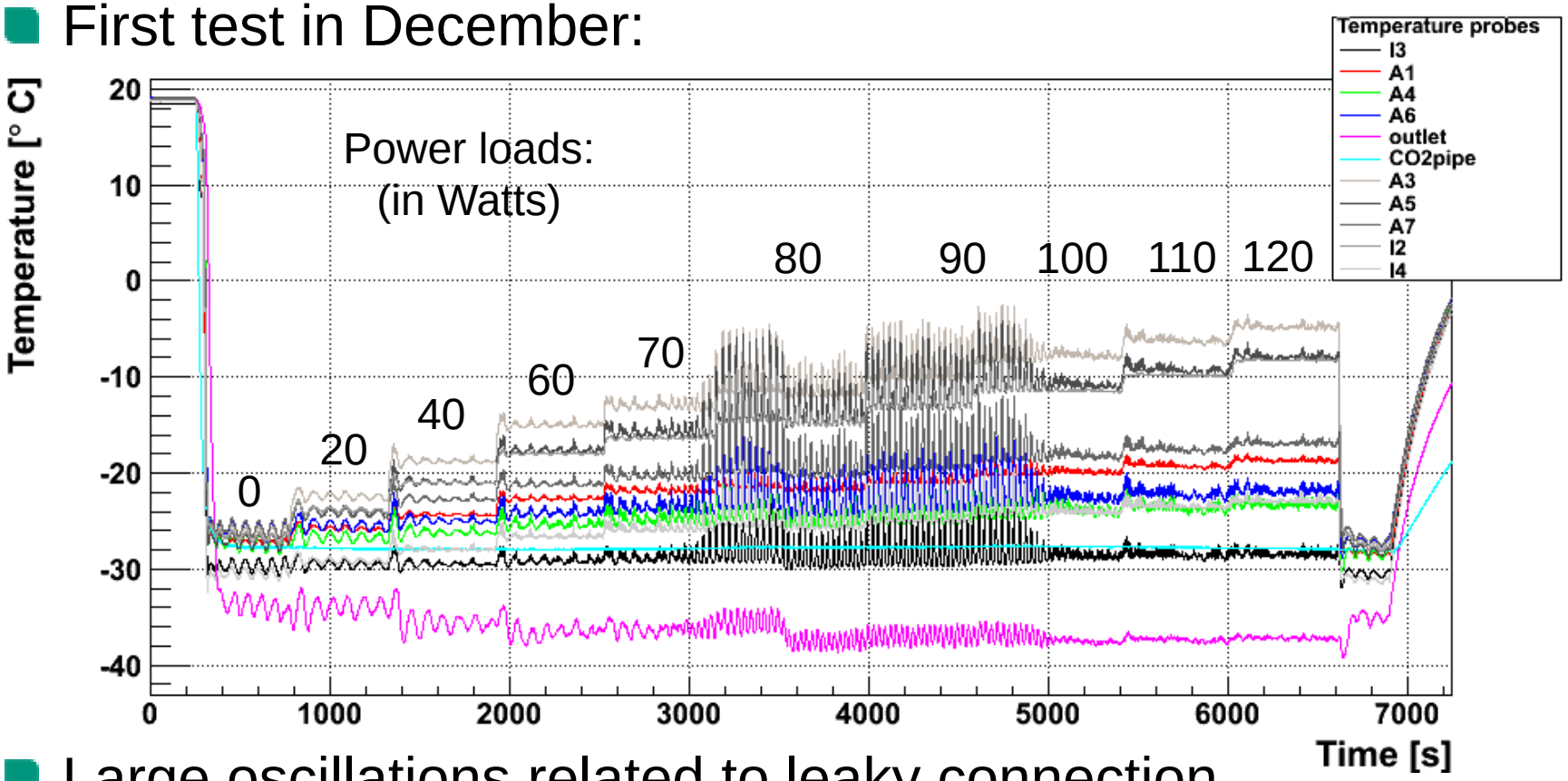
fully equipped flange in test setup



drawing of the fully equipped flange (Pt1000 shown in red)

3. Results with heat load

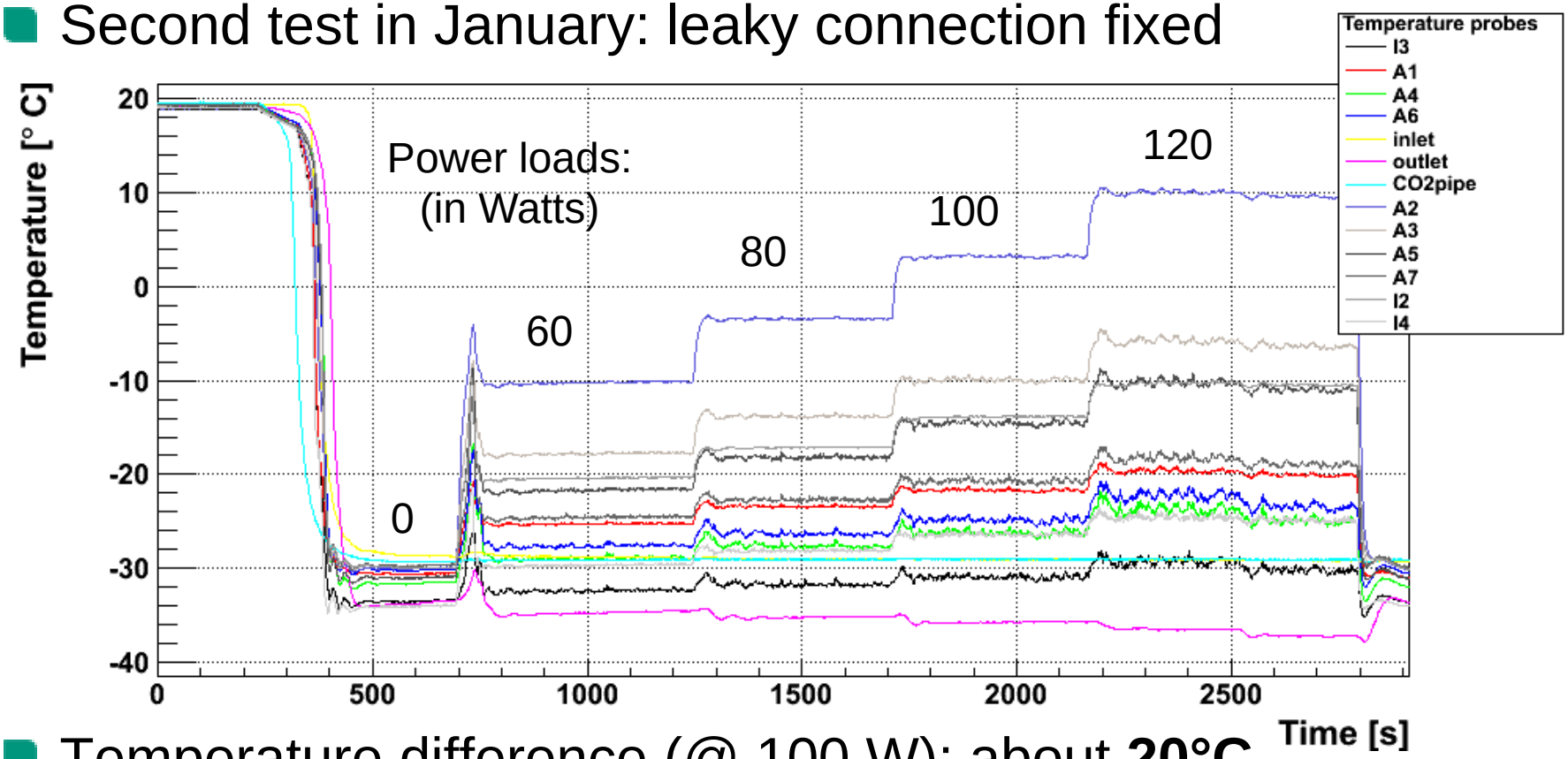
- First test in December:



- Large oscillations related to leaky connection
- Temperature difference (@ 100 W): about **19°C**

3. Results with heat load

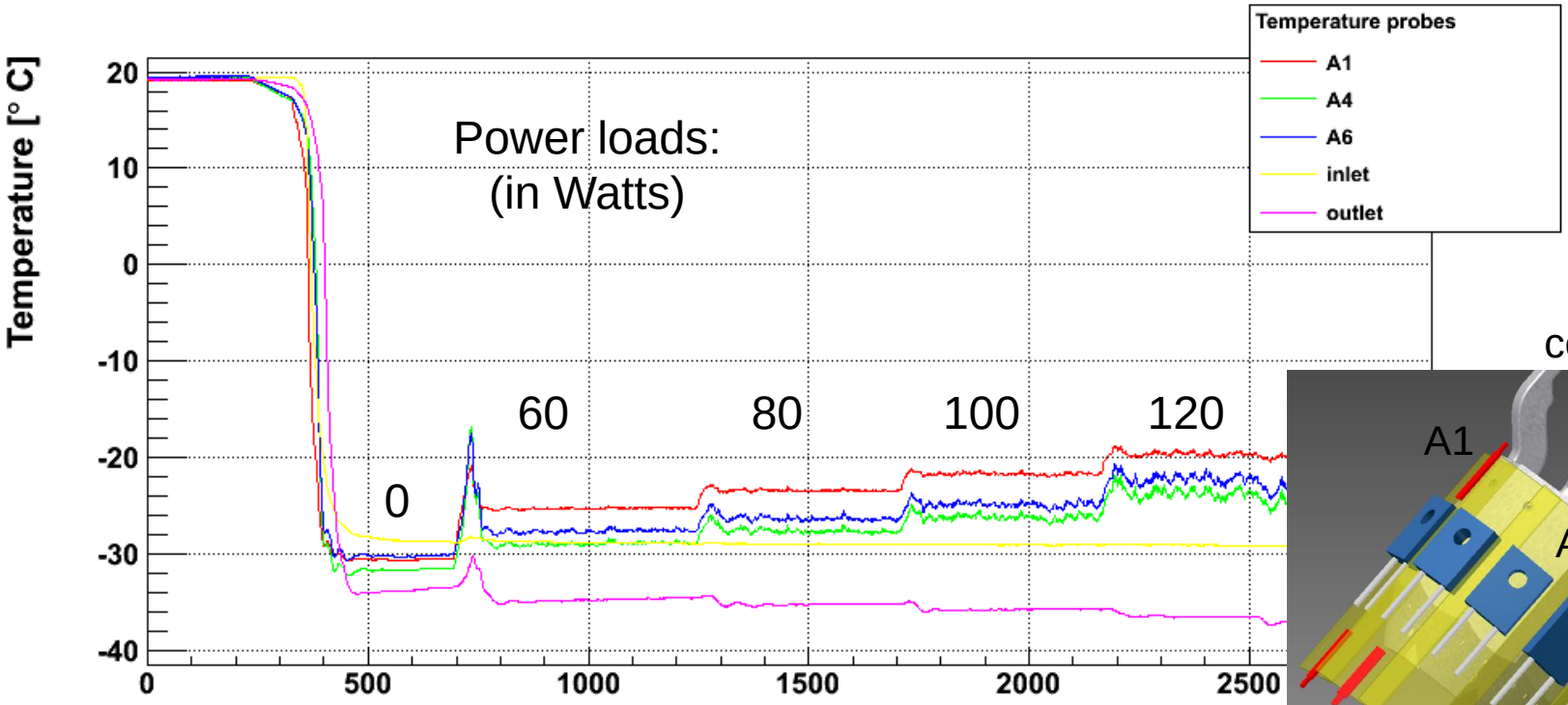
- Second test in January: leaky connection fixed

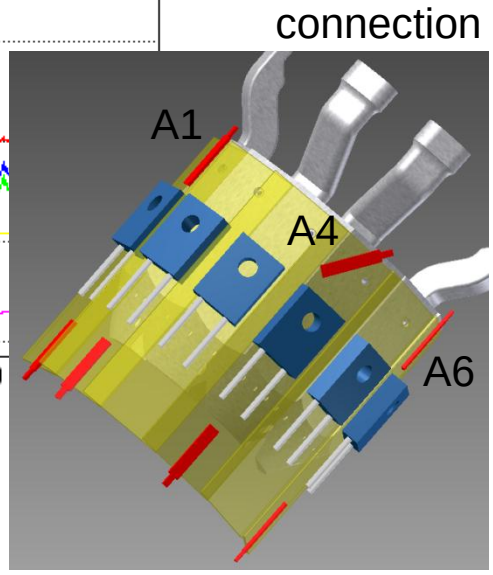


- Temperature difference (@ 100 W): about **20°C**
- Remaining oscillations common to open CO2 systems

3. Results with heat load

- now: closer look at different areas of flange
- 1. connection side:

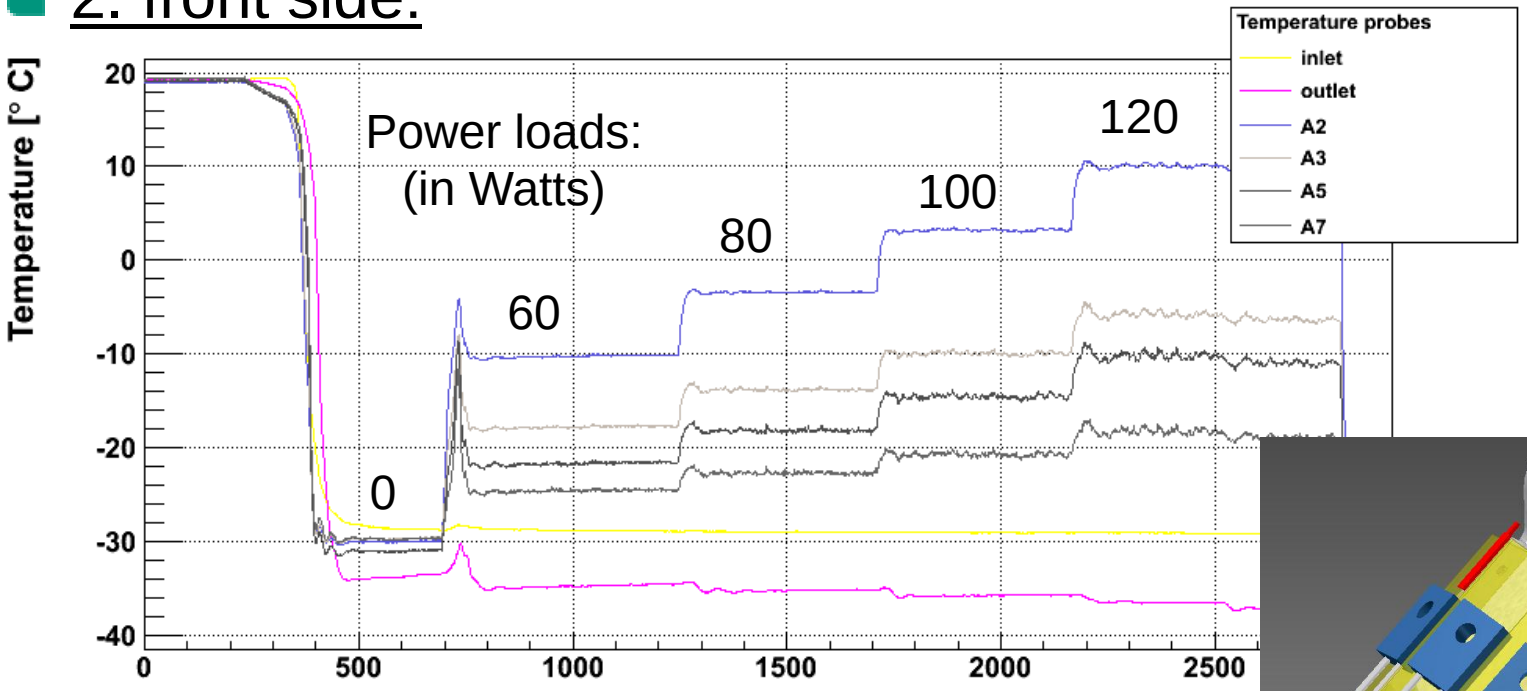




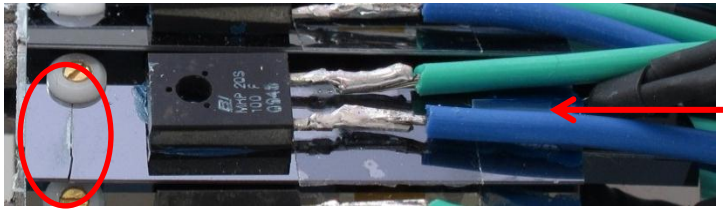
- all probes within a range of 5°C

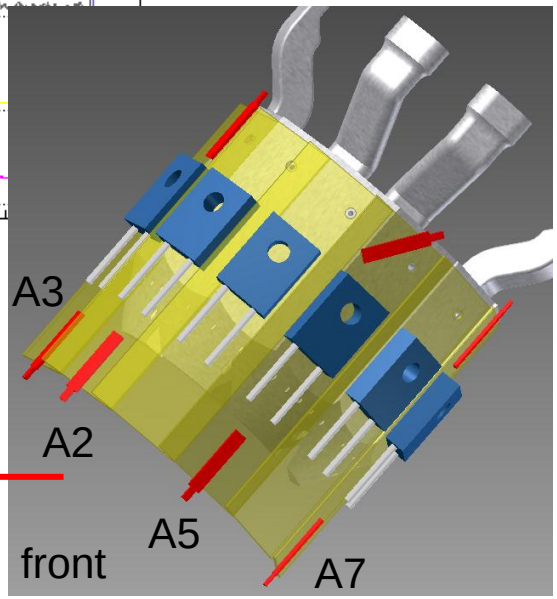
3. Results with heat load

- 2. front side:



- much larger deviation of 24°C
- probe A2:
  bad contact
  (without: 11°C)





4. Conclusion

- Cooling and Mechanics workpackages have passed a **milestone**:
  first proof of working cooling solution for Belle II PXD!

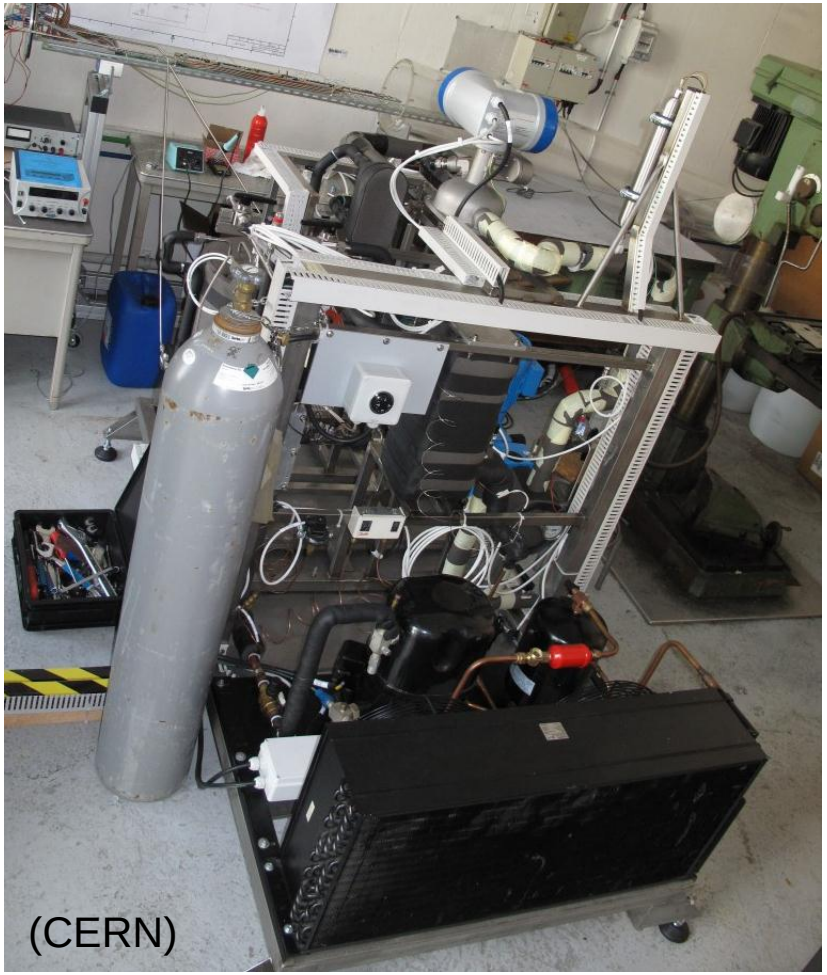
- Minor problems identified:
  quality of flange surfaces and threads needs to be improved in next iteration → even better results expected

- Next steps:
  - test with closed CO2 system
  - how to get a working system for Belle II?

5. Closed CO2 system at CERN

- Closed CO2 system built by the group of B. Verlaat and H. Postema
- Based on experience with AMS and LHCb systems
- Available to IEKP Karlsruhe for tests, slot booked for **March 2011**

- Visited CERN last week:
  - preparation of test
  - cooling plant for Belle II?


(CERN)

6. Air cooling test setup

- Purpose-built cooling plant for CMS Tracker petal testing:
  - made by University of Louvain, Belgium
  - mono-phase, using FC-77
  - over pressure system, P_{max} = 2.8 bar
  - 350 W @ -20°C
- Heat exchanger: designed to our specifications

Anlagenbau Böhmer

Technische Daten		08.09.10	Seite A	Seite B
Wärmemenge	<1 KW			
			Trockene Luft	Wasser/Gly.50%
Menge		m³/h	0,6	0,1
Einlasstemperatur		℃	20	-25
Auslasstemperatur		℃	-20	-20
Druckverlust		kPa	5 (0,05 bar)	1 (0,01 bar)

(PXD+SVD air volume: ~60 litres)

6. Air cooling test setup

- Components now connected and working

- Preliminary results:
  -5°C air temperature at flange outlets (with chiller @ -25°C)
- Output temperature of heat exchanger seems lower
- Good insulation is crucial → setup needs to be refined

- Proposal by H. Postema and B. Verlaat (CERN):
  simply use cold endflanges to cool down the air,
  they are confident that it will work
- Possible problems: temperature control, not independent from CO2 cooling

7. Schedule

- Air cooling:
  - refine current test setup
  - but: delivering cold air through long tubes is difficult
  - new proposal: cool down air within the endflanges

  → combination of CO2 and air cooling test setup needed

- Closed CO2 system:
  - time slot booked for March 2011
  - acquisition of parts has started
  - measurement program still to be defined

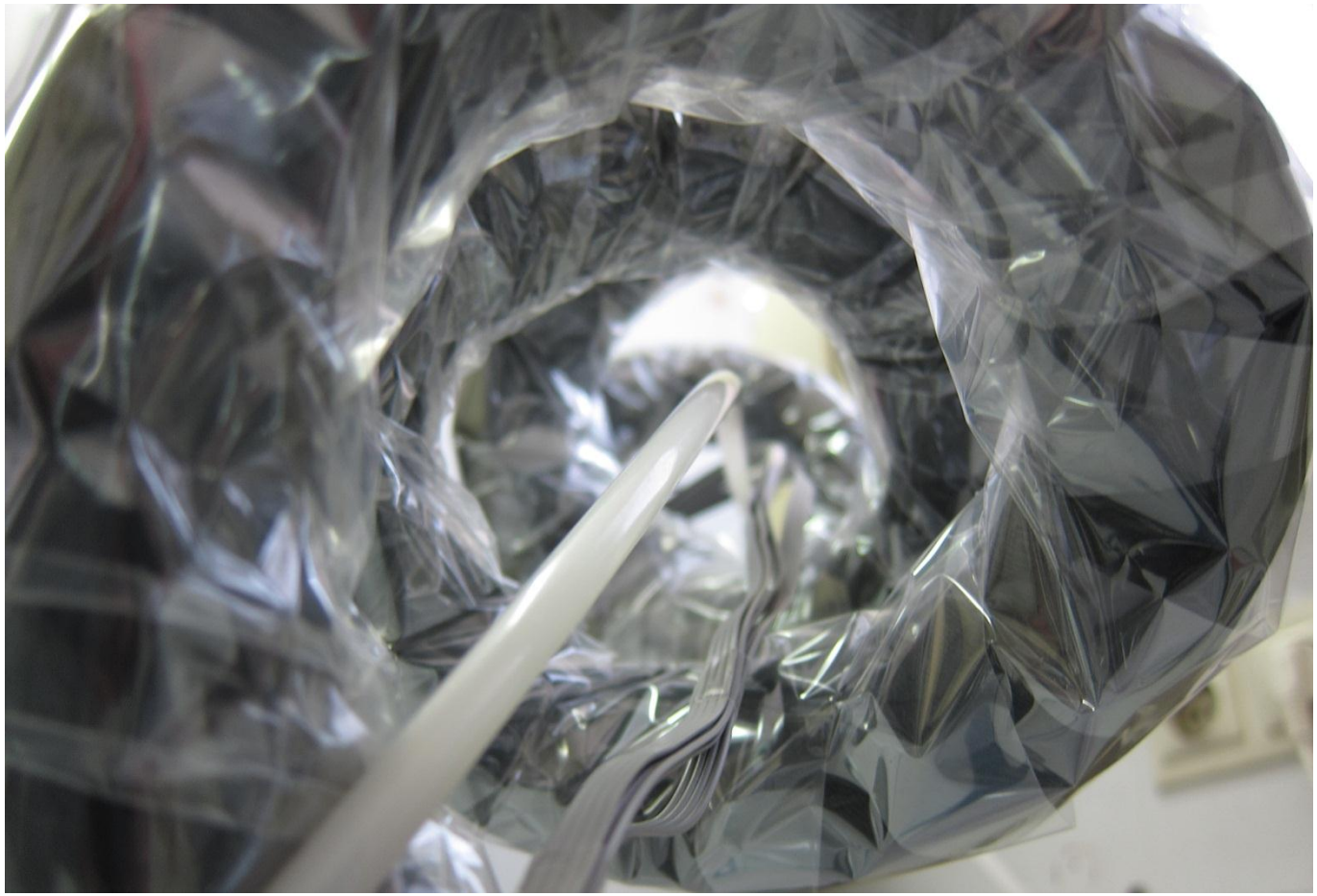
8. Summary

- Results with heat load promising
- First **milestone** passed: cooling concept is working!
- Next iteration of endflanges will give even better results

- Visit CERN in March to test with closed system

- Discussion held with CERN CO2 Cooling Group last week on how to get a working cooling plant for Belle II
  → Summary following…

Thank you…



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CO_2 Cooling Plant for Belle II: How to proceed?

Stefan Heindl and Thomas Weiler

6th International Workshop on DEPFET Detectors and Applications

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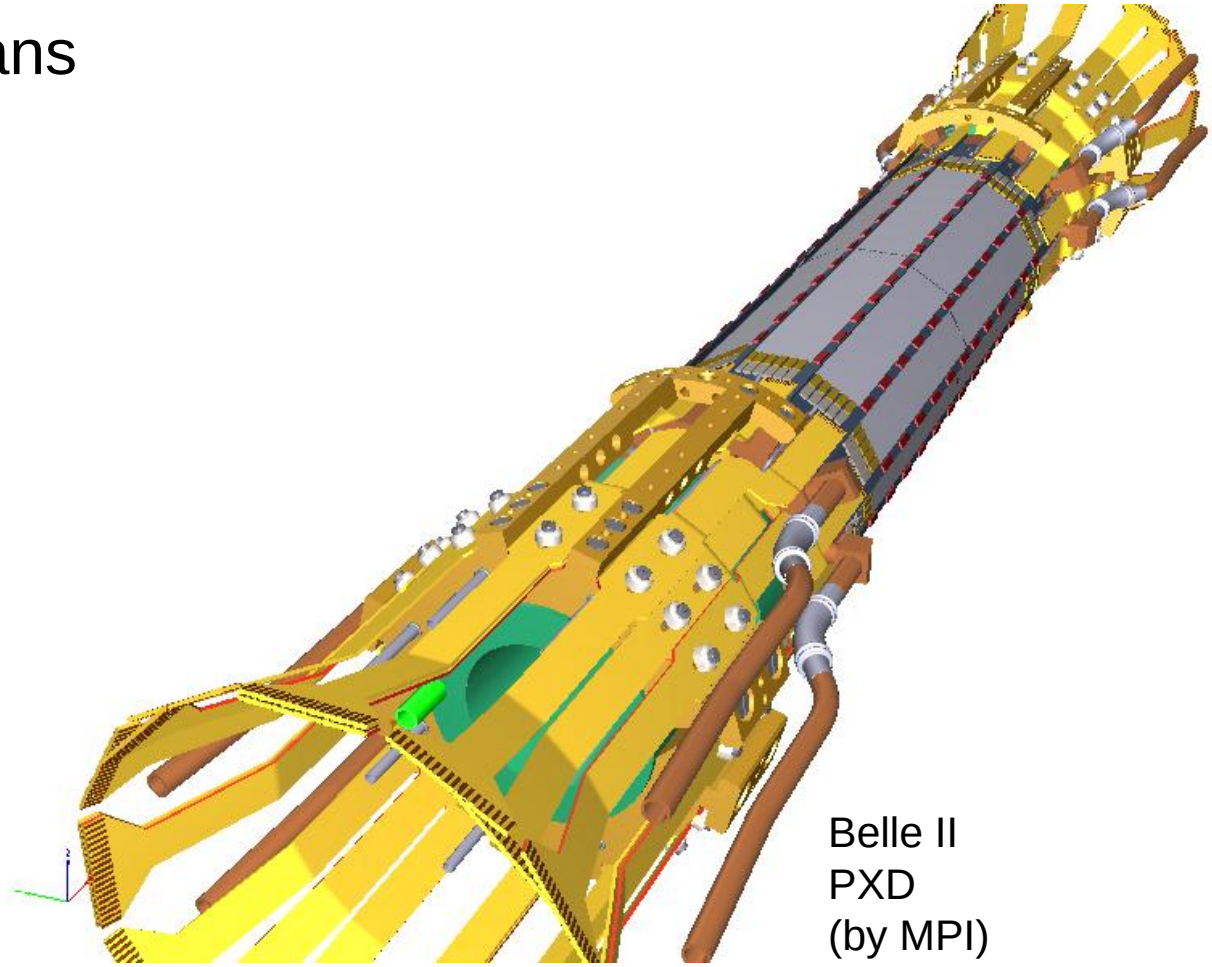
Overview

1. Introduction
2. Collaboration plans
3. CERN plans
4. Challenges
5. Summary



Belle II
PXD
(by MPI)

1. Introduction

- Visited CERN for 2 days last week
- Main purpose:
  prepare cooling test with closed CO2 system
- System is currently under repair
- Schedule has therefore moved forward to March 2011

- Second goal:
  talk to H. Postema and B. Verlaat about our plans and a CO2 cooling plant for Belle II

2. Collaboration plans

- Use current CERN CO2 cooling plant
- Have one system for cooling tests and final system test in Europe and one for detector operation at KEK
- Both systems should be identical
- Buy directly from CERN or get their plans and build it by ourselves
- European system ready for cooling tests in first half of 2012

3. CERN plans

- Current system only considered as test system
- **Not** for “production use” (too complex)
- Already started development of a new system
- New system has 1 kW of cooling power, but is easily upgradeable to more
- System will operate fully automated
- System will serve as baseline for future experiments:
  - CMS Pixel upgrade
  - ATLAS IBL
  - European XFEL
  - Belle II? (if we want it to…)

Additional information about system available from B. Verlaat: slides are uploaded to Indico!

4. Challenges (aka. Problems)

- CERN development will **not** be ready in our timeframe
- Project needs additional resources and especially manpower (technicians and engineers) to speed up
  → if we want the system to be ready in time for Belle II, we have **to join their effort!**

- Dividing the project into two subprojects (European system and KEK system) is not considered practical by CERN

5. Summary

- Current system not available for Belle II
- New system in development
- But: We cannot simply “buy” it!
- In addition to money also **manpower** needs to be invested: technicians and engineers (to stay at CERN for some time!)
- Major challenge for the collaboration:

Who will do it?

- Decision to be taken in **summer 2011**!

Thank you…