JRA1 – Next Steps towards the Final Telescope

Ingrid-Maria Gregor, DESY

EUDET Annual Meeting

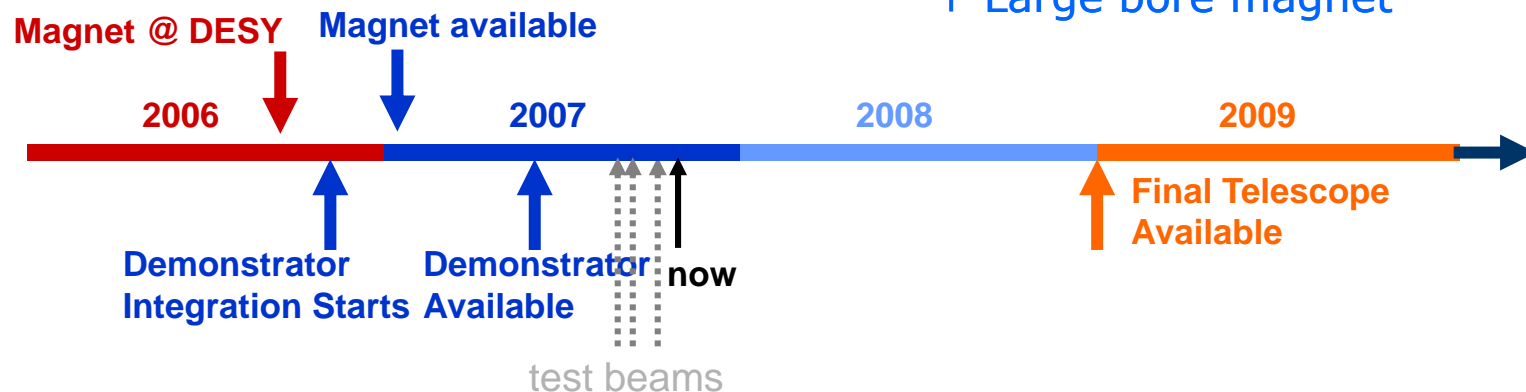Paris, October 2007

JRA1 Schedule

Phase1: "Demonstrator"

- First test facility will be available quickly for the groups developing pixels
- Use established pixel technology with analogue readout and no data reduction

Phase2: Final telescope

- Use pixel sensor with fully digital readout, integrated Correlated Double Sampling (CDS), and data sparsification
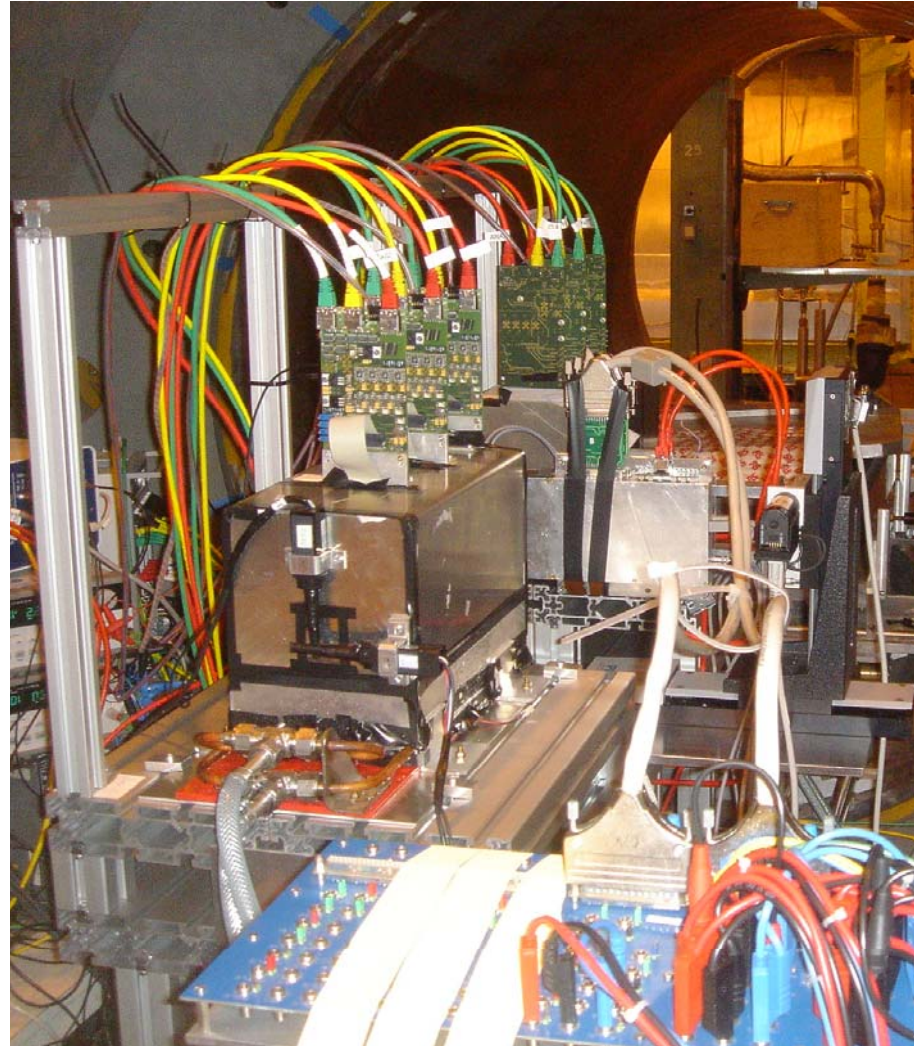- The beam telescope ready at the end of 2008

+ Large bore magnet

Magnet @ DESY   Magnet available

2006   2007   2008   2009

Demonstrator Integration Starts   Demonstrator Available   now

Final Telescope Available

test beams

Outline

- ❑ Introduction

- ❑ Immediate steps

- ❑ Milestones for final telescope

- ❑ Next steps for the PMAG

- ❑ Summary

Next Steps for Demonstrator

- TA2 user SiLC uses demonstrator at CERN H6 Testbeam (this week!)
- Afterwards:
    - Send most of hardware back to Hamburg
    - Keep 7-slot VME and 2 EUDRBs to Geneva
    - Put EUDRBs in new VME crate at DESY

- Work on improvements:
    - Follow up DAQ improvements as mentioned by Emlyn and Concezio
    - VME library: Julia Fourletova wants to help -> hardware to Bonn?
    - Test EUDRBs in different VME crate and see if "noise" changes

- Before end of year:
    - Testbeam with thinned sensors (1-2) plus Mimosa 18 at DESY?
    - (no testbeam available at DESY from January – August!!!)
    - Done by DESY team with offline support from JRA1

JRA1 Milestones

Milestone	Description	Date	Task	Status
JRA1-1	SDC Prototype 1 ready	9	C	completed
JRA1-2	Magnet available	12	A	completed
JRA1-3	SDC Prototype 2 ready	18	C	completed
JRA1-4	Field map available	18	A	soon available*
JRA1-5	Analog Telescope integration in beam	18	B	completed
JRA1-6	Readout for prototype available	18	D	completed
JRA1-7	IDC prototype ready	27	C	
JRA1-8	Final pixel telescope integrated in beam	36	B	
JRA1-9	TC ready	36	C	
JRA1-10	Final readout ready	36	D	
JRA1-11	Tracking software available	36	D	
JRA1-12	Test report analog telescope available	36	E	
JRA1-13	Final project reports	48	A,B,C,D,E	

* see presentation JRA1 parallel session
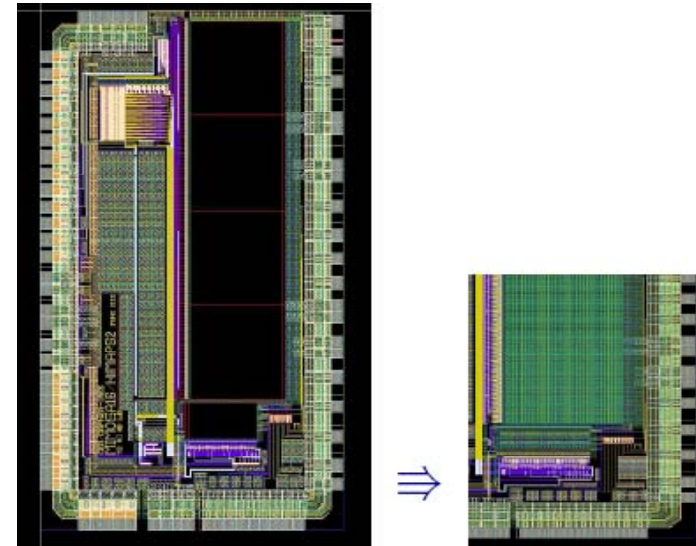
JRA1-7 IDC Prototype Ready

IDC = Intermediate Digital Chip

Spring 2008

MIMOSA-16 design features:

- ❑ AMS-0.35 OPTO translation of MIMOSA-8:
  11–15 μm epitaxy instead of <7 μm
  - ❑ 32 // columns of 128 pixels (pitch: 25 μm)
  - ❑ on-pixel CDS (DS at end of each column)
  - ❑ 24 columns ended with discriminator
- ❑ 4 sub-arrays :
  - ❑ S1 : like MIMOSA-8 (1.7x1.7 μm^2 diode)
  - ❑ S2 : like MIMOSA-8 (2.4x2.4 μm^2 diode)
  - ❑ S3 : S2 with ionising radiation tol. Pixels
  - ❑ S4 : with enhanced in-pixel amplification
    (against noise of read-out chain)

- ❑ MIMOSA-16 tests at the SPSvery preliminary analysis results:
  - ❑ The column architecture works very well
  - ❑ There is at least one pixel architecture which works fine (SNR>16, ε=99.9 %)
    (Complementary info expected from the analysis of the other pixel architectures)

See also: Marc Winter JRA1 Parallel Session

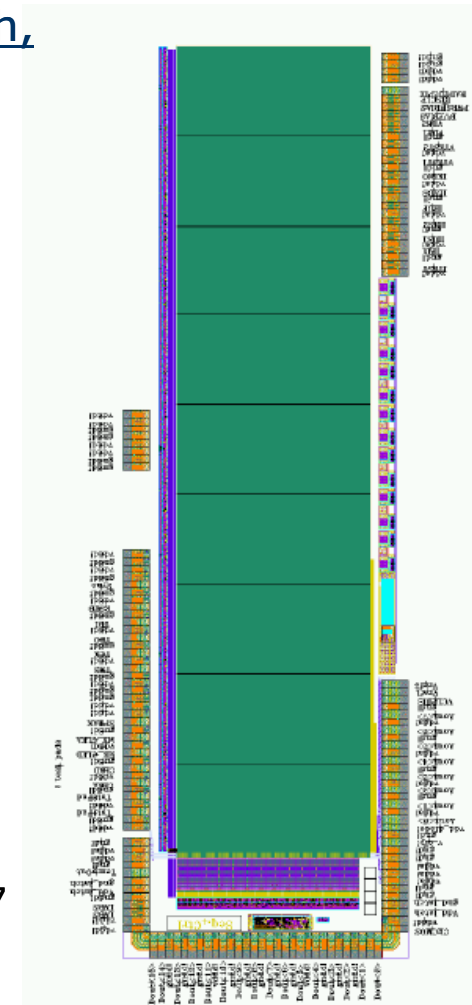# JRA1-7 IDC Prototype Ready

IDC = Intermediate Digital Chip

Extension of MIMOSA-16: larger surface, smaller pitch, optimised pixel, JTAG, more testability

- Pixel characteristics (optimal charge coll. diode size ?) :
    - pitch : 18.4 µm(compromise resolution/pixel layout)
    - diode surface : 10–15 µm
    - 2 to optimise charge coll. & gain
    - 128 columns ended with discriminator
    - 8 columns with analog output for test purposes
    - 9 sub-matrices of 64 rows : various pixel designs w/o ionising rad. tol. Diode
    - active digital area : 128(+ 8) x 576 pixels (25 mm2)
- Testability :
    - JTAG + bias DACprogrammable chip steering
    - 2 additionnal DC voltages to emulate pixel's output for independent discriminator performance assessment
    - output frequency 40 MHz
- Status :
    - Design close to completionsubmission by end of Oct. '07
    - Funding (50 mm2): 40 keurosEUDET (27 keuros) & DAPNIA resources

on track

See also: Marc Winter JRA1 Parallel Session

JRA1-9 TC (Telescope Chip) ready

End 2008

<u>Roadmap towards the Final Chip</u>

❏ Autumn 2008 : MIMOSA-22+ = Final Sensor
  - ❏ MIMOSA-22 complemented with Ø (SUZE-01)
  - ❏ 1 or 2 sub-arrays (best pixel architectures of MIMOSA-22)
  - ❏ Active surface : 1088 columns of 544/576 pixels (20.0 x 10/10.5 mm2)
  - ❏ Read-out time 100 μs
  - ❏ Chip dimensions : 20 x 12 mm2

❏ Engineering run : 120 keuros for 6 diced and thinned wafers

❏ funding : EUDET (70 keuros) & STAR/CBM/DAPNIA (50 keuros)

❏ Open Question: how to distribute the work: testing and read out ?
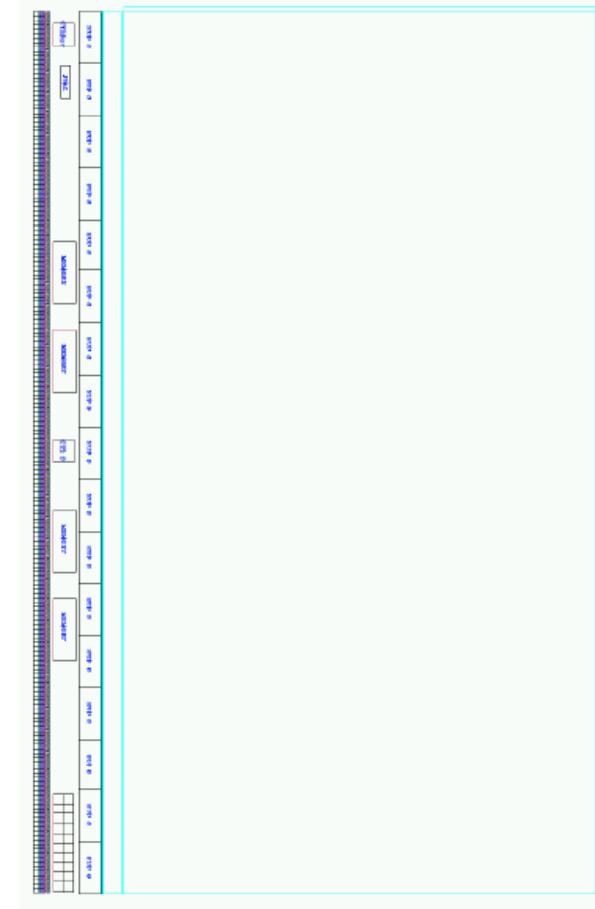
on track

See also: Marc Winter JRA1 Parallel Session

JRA1-10 Final readout ready

End 2008

❑ Readout = from AUX boards to hard disk (EUDRB + EUDAQ)

❑ EUDRB completely tested and runs well with MimoTel chip

❑ Next step: readout speed needs to be improved
  ❑ Mainly software side such as VME libraries need to be improved
  ❑ Implement MBLT for initial pedestals and noise

❑ Final Telescope: modify the EUDRBs to be able to read out Mimosa22
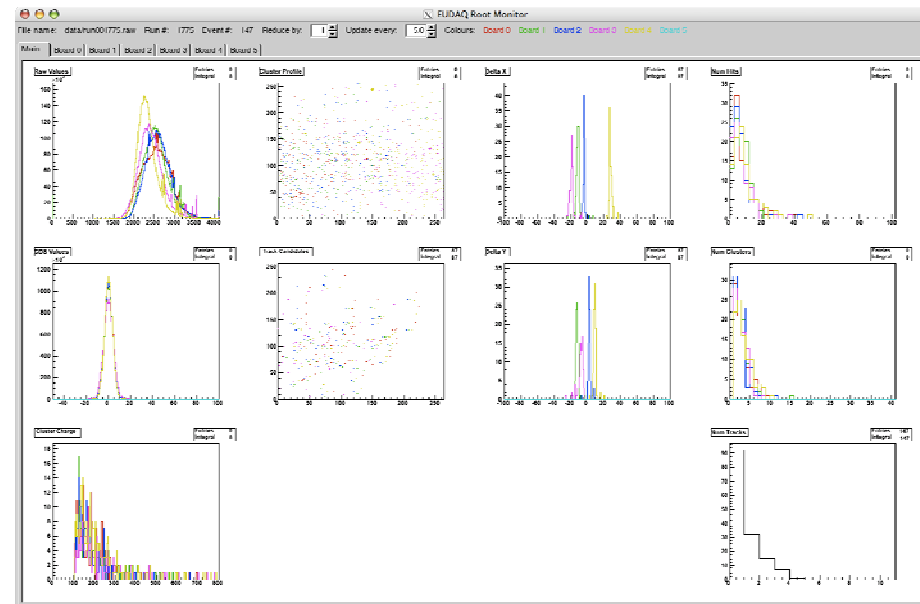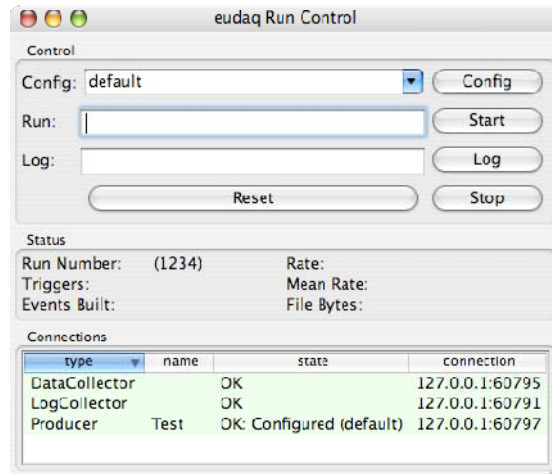 ❑ Design new daughter card?

on track

See also: Concezio Bozzi JRA1 Parallel Session

JRA1-10 Final readout ready

End 2008

- ❏ **EUDAQ:** Already have a reasonable usable DAQ system, but a few remaining issues
  - ❏ Improve speed and stability
  - ❏ Run Control: GUI for configuration
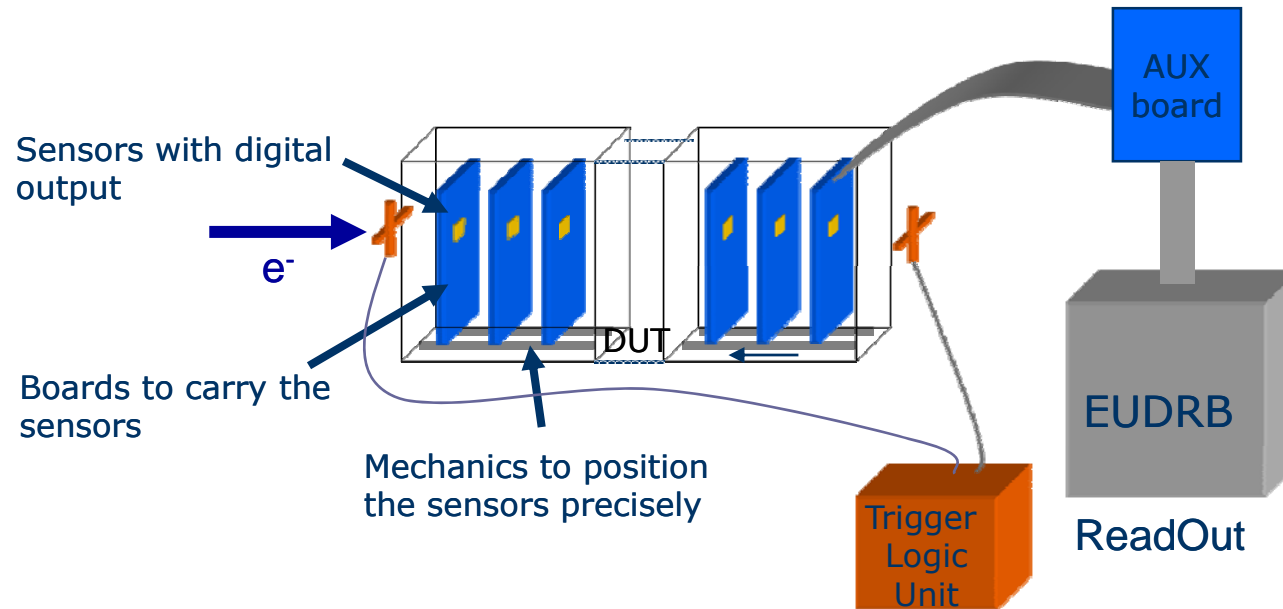 - ❏ Data Collector: Processing - what/where?
  - ❏ Documentation
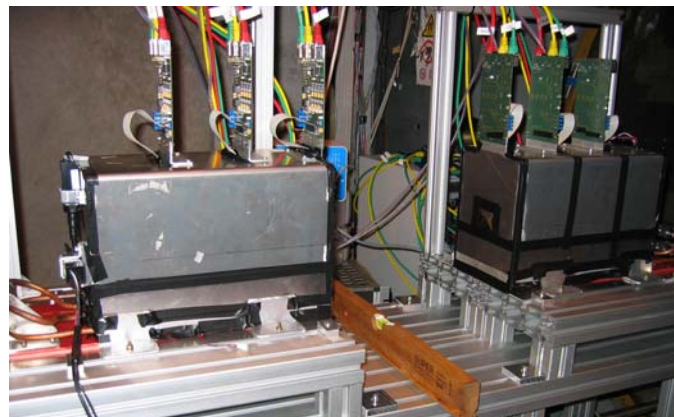
on track

See also: Emlyn Corrin JRA1 Parallel Session

JRA1-8 Final pixel telescope integrated in beam

End 2008

Sensors with digital output

e⁻

Boards to carry the sensors

Mechanics to position the sensors precisely
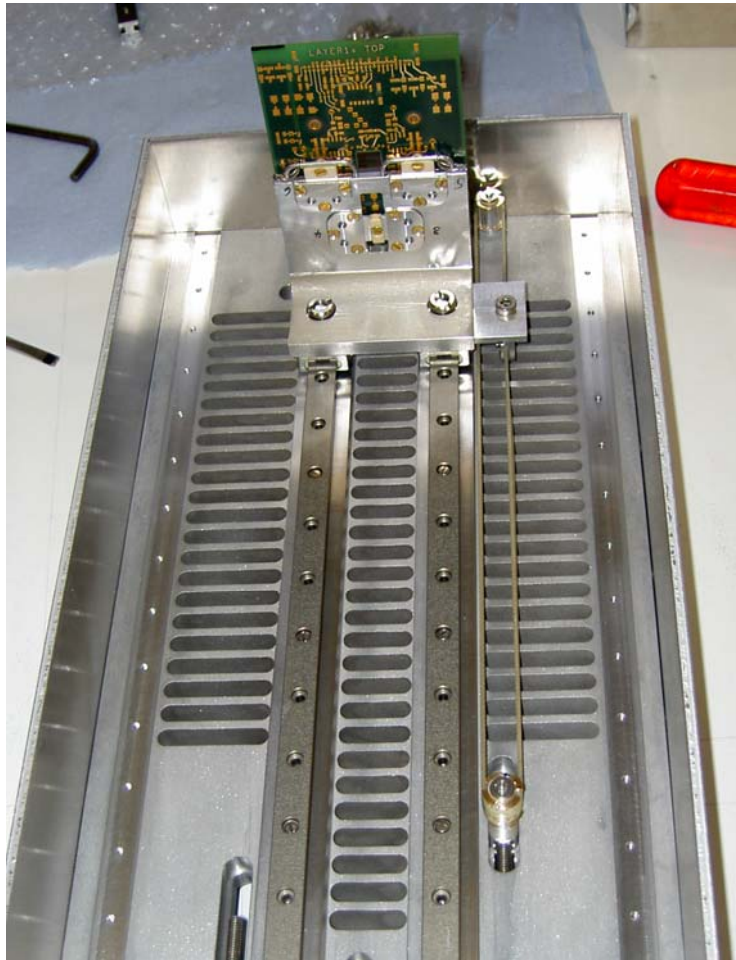
DUT

AUX board

EUDRB

ReadOut

Trigger Logic Unit

❑ All building blocks ready or on track, details were discussed in JRA1 parallel session

JRA1-8 Final pixel telescope integrated in beam

End 2008

- ❑ **Mechanics for final telescope:**
  - ❑ First version of mechanics used at CERN during testbeam
  - ❑ Problems with heat transport from sensor and precision of sensor placement

- ❑ New design of L-pieces (sensor board holding frame) under way

on track

See also: Ingrid Gregor JRA1 Parallel Session

JRA1-11 Tracking software available

End 2008

- ❑ EUTelescope is working!
    - ❑ The results obtained from the three data taking periods are proving that it is well behaving...
    - ❑ A lot of work has been done and the milestone foreseen for the end of 2008 will be easily achieved.

- ❑ include the LCIO format in the DAQ software to avoid the conversion step.
- ❑ improve the alignment processor:
    - ❑ implement Millipede as a Marlin processor and include it into MarlinUtil
- ❑ improve the integration with the DUT user. A good exercise will be the integration of the DEPFET sensor and will start with the next month.
- ❑ improve the currently available event display.
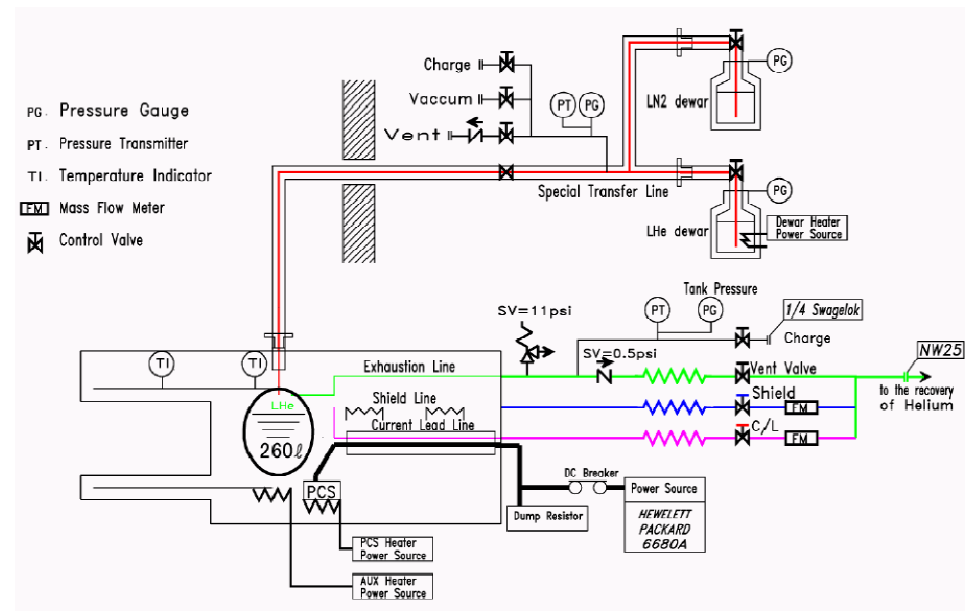   - ❑ In contact with other JRA members

on track

See also: Antonio Bulgheroni JRA1 Parallel Session

Next Steps for Magnet

❑ Improvement of the cryogenic system is necessary for safer and easy operation of the PCMAG in the DESY experimental area.

❑ The new safety regulations at DESY forbid any work higher than 2m without proper protection and training.

❑ a new transfer tube with a cold helium-gas vent to minimize the heat flow into the reservoir and minimize the work on the top of magnet.

❑ More important: new transfer line would eaze He filling of magnet

❑ No dewar exchange necessary

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Summary

❑ JRA1 group build and
tested in the recent months
the Demonstrator telescope
and is happy about the
status of the project

❑ Next steps will concentrate
on the final telescope, using
the final telescope chip
(intergrated discriminator),
final readout and newly
improved mechanics

❑ Softwarewise (DAQ,
Tracking Software) also
very well on track
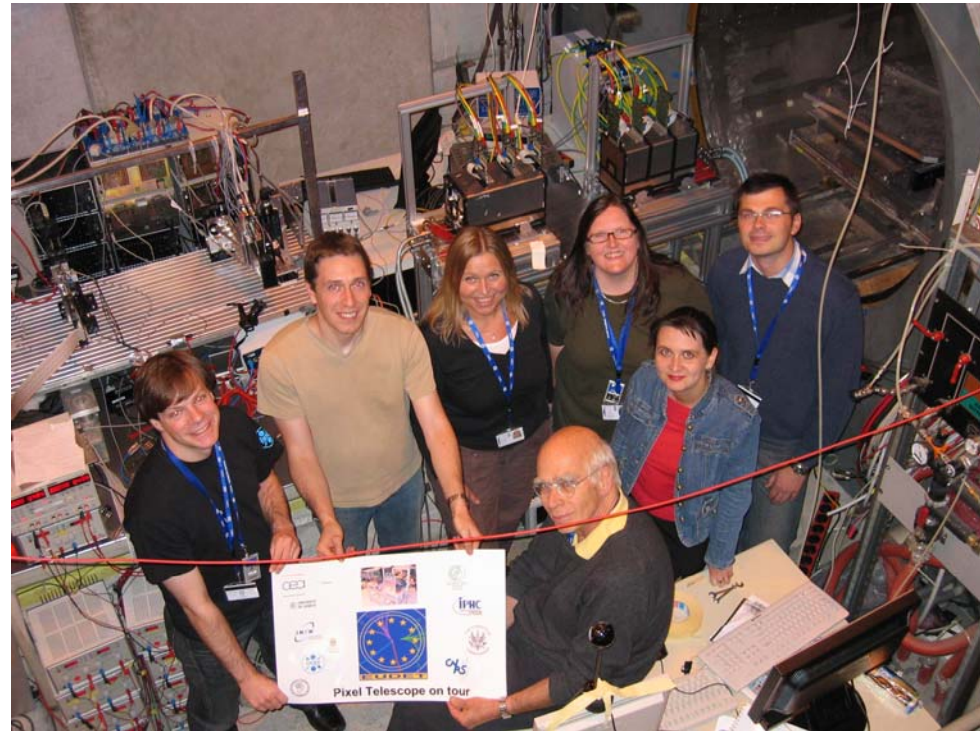
❑ Preparation to meet all the
milestones are well under
way and we are optimistic
that we will meet all future
milestone