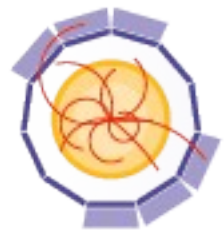


# PCMAG Solenoid Upgrade and DESY Testbeam Area T24/1

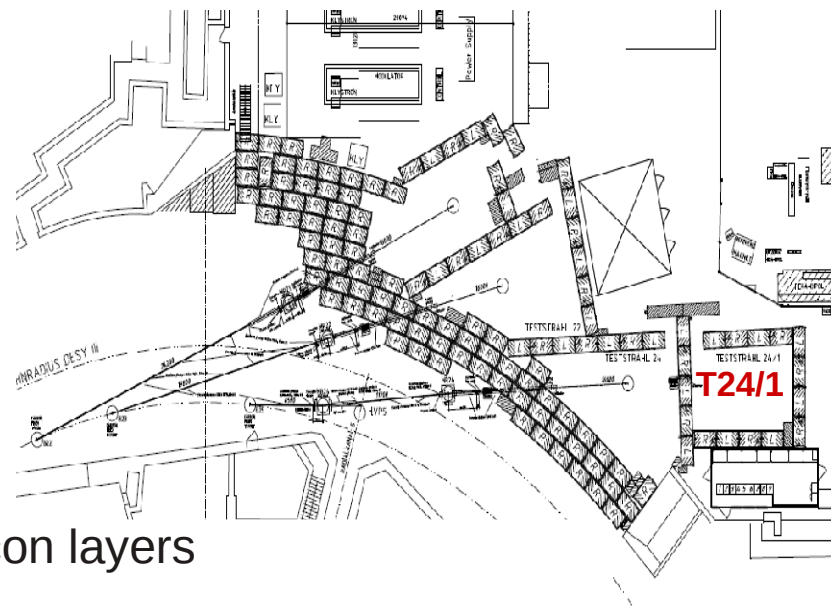
AIDA Annual Meeting, Apr. 10, 2013  
R. Diener, DESY



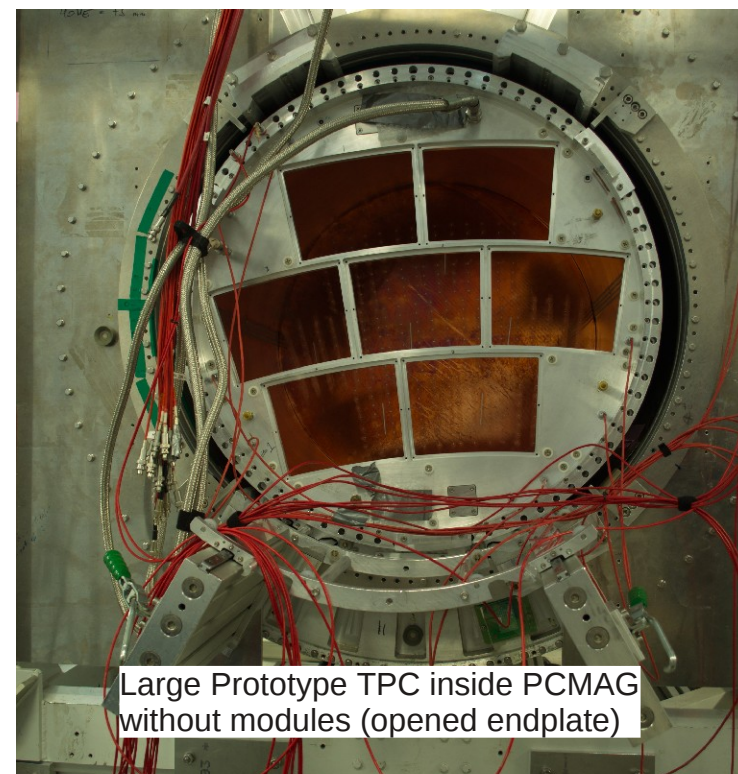
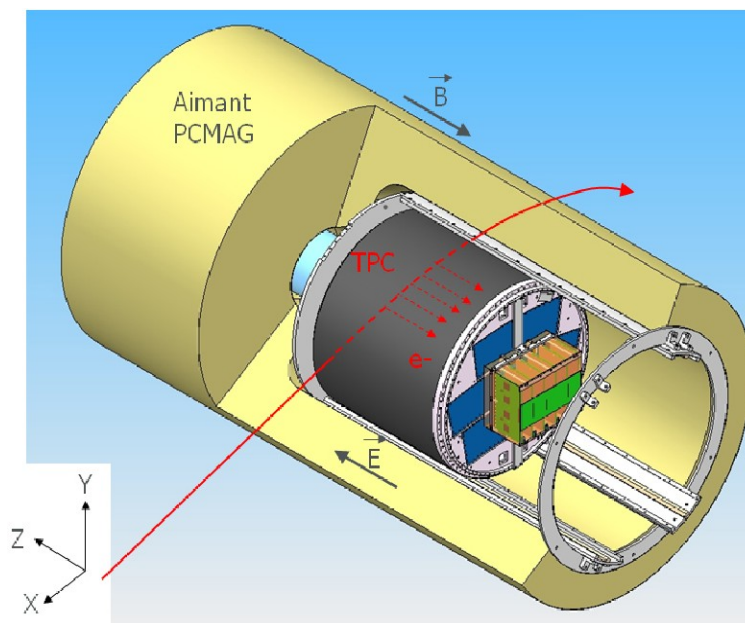
**AIDA**



- Set up in DESY II test beam area T24/1 (e<sup>+</sup>/e<sup>-</sup> from 1 to 6 GeV/c):
  - Large field cage with modular end plate
  - PCMAG magnet mounted on movable lifting stage (3 axis)
  - HV, gas and slow control systems
  - Cosmic and beam trigger
  - Laser calibration system, planned: external silicon layers



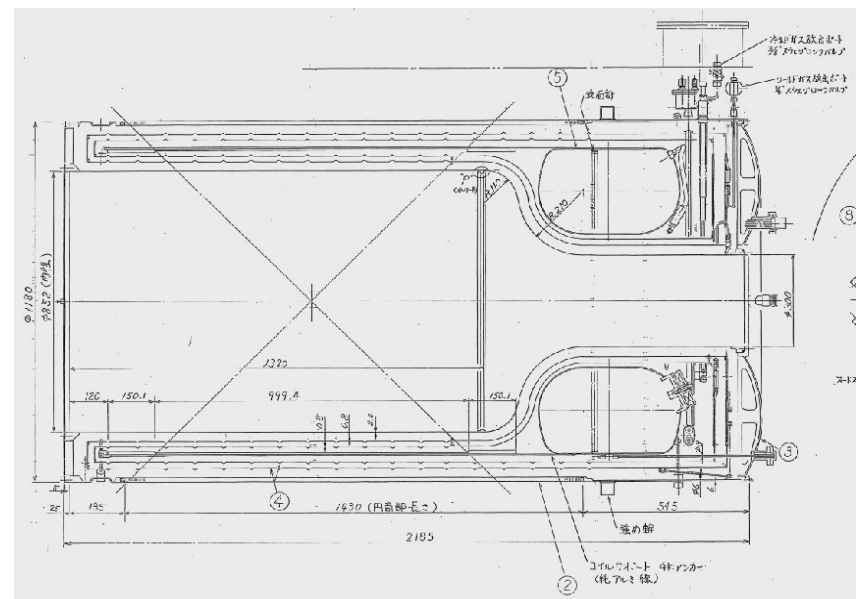
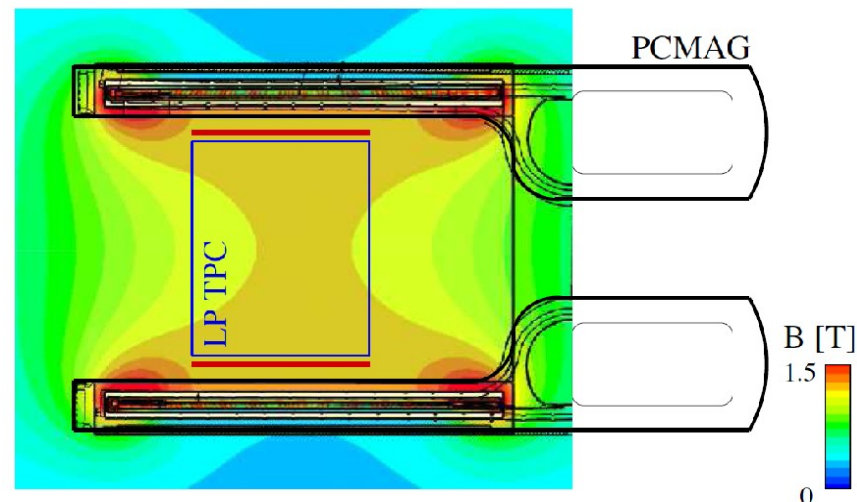
- Goal: study in practice the design and fabrication of all components of a MPGD TPC in larger scale
- Large TPC Prototype:
  - Light weight; made of composite materials
  - Sensitive Volume:  $\varnothing$  72cm, L= ~58cm
- Modular end plate
  - Up to 7 read-out modules
  - Size/shape similar as foreseen for the final detector



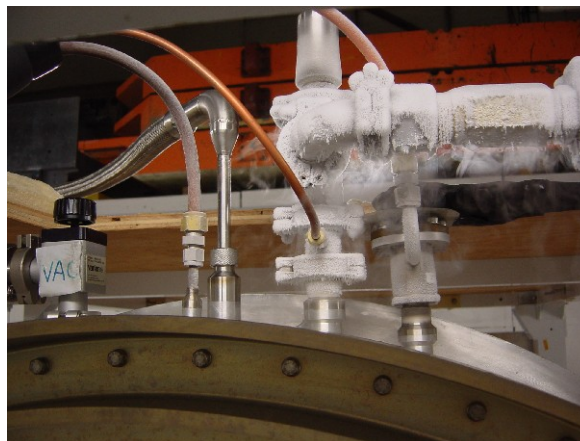
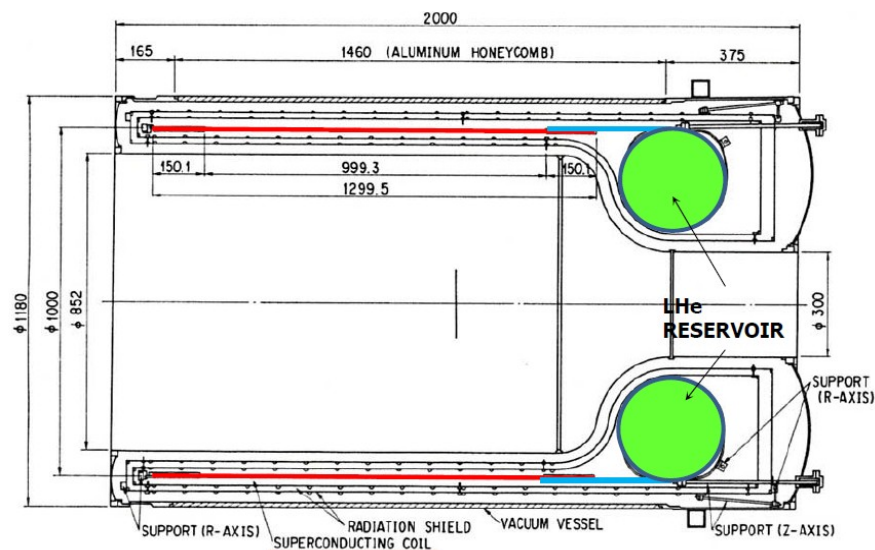
Large Prototype TPC inside PCMAG without modules (opened endplate)

- **2008:**
  - Nov-Dec Micromegas module w/ resistive anode (T2K electronics)
- **2009:**
  - Feb-Apr 3 Asian GEM Modules w/o Gating GEM (3,000ch ALTRO electronics)
  - Apr TDC electronics with an Asian GEM Module
  - Apr-May Maintenance of PCMAG
  - May-Jun Micromegas w/ two different resistive anodes (New T2K electronics)  
Setup and test of laser-cathode calibration
  - Jun GEM+Timepix (Bonn)
  - Jun Installation of PCMAG moving stage and SiTR support
  - Jul TDC electronics with an Asian GEM module  
ALTRO electronics study w/ Asian GEM
  - Jul-Aug Full installation of PCMAG moving stage
  - Aug Micromegas w/o resistive anode with laser-cathode calibration
  - Sep Bonn GEM module (small area GEM with ALTRO electronics)
  - Nov Micromegas with SiTR
- **2010:**
  - Mar Micromegas using PCMAG movable table.
  - Mar+Sep Three Asian GEM modules w ALTRO electronics
  - Dec Octopuce test in LP with (Saclay/Nikhef)
- **2011:**
  - Apr First test of DESY GridGEM module (B=0T)
  - May Integrated AFTER electronics for Micromegas  
Installation of new cosmic trigger logic
  - Jun/Jul DESY GridGEM module with ALTRO read-out
  - Jul PCMAG shipped to Japan
- **2012:**
  - Mar-Jun Return & installation of upgraded PCMAG
  - Jul 6 Micromegas modules (integrated electronics)
  - Sep DESY GEM module test with 3 modules
  - Nov/Dec Japanese three GEM module test
- **2013**
  - Jan/Feb: Micromegas 7 module test
  - Feb/Mar: DESY three GridGEM module with ALTRO
  - Mar/Apr: U Bonn Octoboard TimePix (GEM) + 8 Ingrid

- PCMAG (designed for airborne experiments)
  - **Persistent Current**, superconducting **MAG**net
  - Thin coil and wall ( $0.2X_0$ ), no return yoke
  - Liquid Helium reservoir
- Moved to DESY in Dec 2006
- Tested and mapped in 2006-2007 (cooperation of DESY, KEK and CERN)  
Accuracy of  $10^{-4}$
- Dimensions and data:
  - Coil:  $\varnothing$  1.0 m,  $\leftrightarrow$  1.3 m, weight:  $\sim$ 460 kg
  - Central magnetic field: up to 1.2T
  - Liquid He capacity: 240L (max. 10 days)
  - Operational current:  $\sim$ 430A (1T)

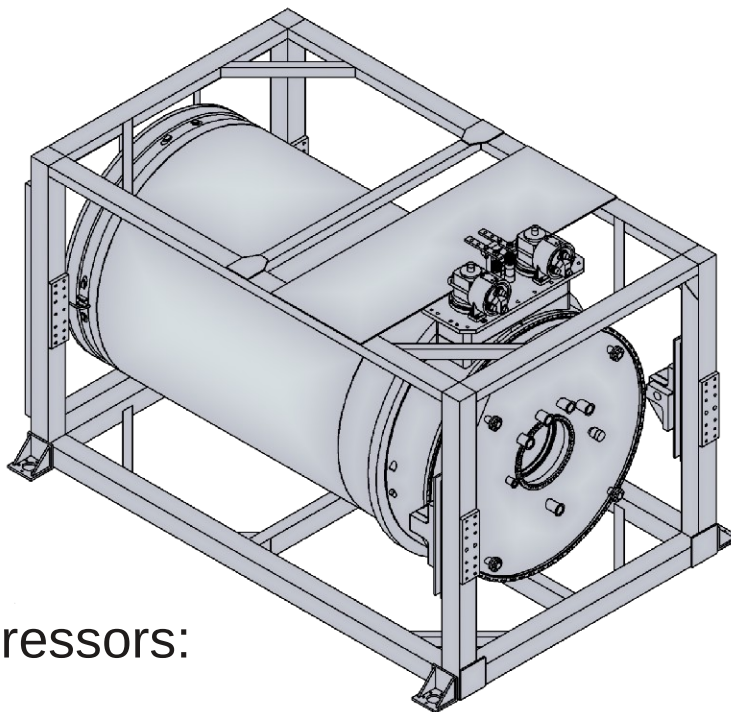
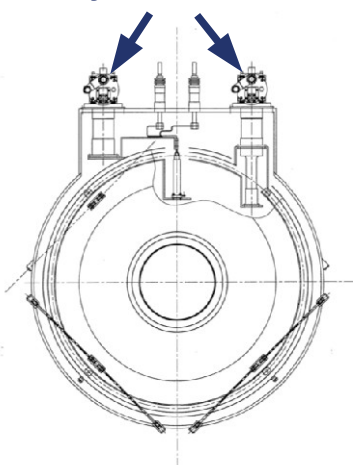


- Before modification:
  - filling manually with liquid Helium
  - Expert work: many steps that have to be followed carefully
  - Longer running times (many fillings): probability of pipe blocking due to small amounts of air in the system
  - Persistent current mode: complicated ramping procedure
- Upgrade in AIDA (with contributions from KEK & DESY): PCMAG without liquid Helium using cryo coolers (closed circuit system):
  - Save liquid Helium (1000l for initial cooling and ~250l/week)
  - Simple *switch-on* procedure
  - Standard way of operation (no persistent current mode) → increased safety
  - No pipe blocking  
Longer, continuous running periods possible



- Two cryo coolers (*Gifford McMahon cycle*) have been added to vacuum vessel:
  - One two-stage cooler for the coil and the radiation shield (4 resp. 50 K)
  - One one-stage cooler for the current leads (50 K)

cryo coolers



- 2 Helium gas compressors:
  - Water cooled: 7-28 °C water, minimum 7 l/min @ 28°C
  - Power: 6.5-7.2 W (380 V, 13 A)

Screenshots from <http://www.shicryogenics.com>

SRDK-408D2 Specification Chart

	Model	SRDK-408D2-A71A	SRDK-408D2-F50L	SRDK-408D2-F50H	SRDK-408D2-F50I
1 <sup>st</sup> Stage	Watts @ 50 Hz			34 W @ 40 K	
	Capacity			4.1 W @ 4.0 K	
2 <sup>nd</sup> Stage	Watts @ 50 Hz			1.0 W @ 4.2 K	
	Capacity			1.0 W @ 4.2 K	
Lowest Temperature 2 <sup>nd</sup> Stage †				<3.5 K	
Cooldown Time 2 <sup>nd</sup> Stage †				<60 Min. (4.2 K)	
Coldhead	Ambient Temperature			5-35 °C ‡	
	Weight			18.0 kg (39.7 lbs.)	
	Maintenance Interval			10,000 Hours	

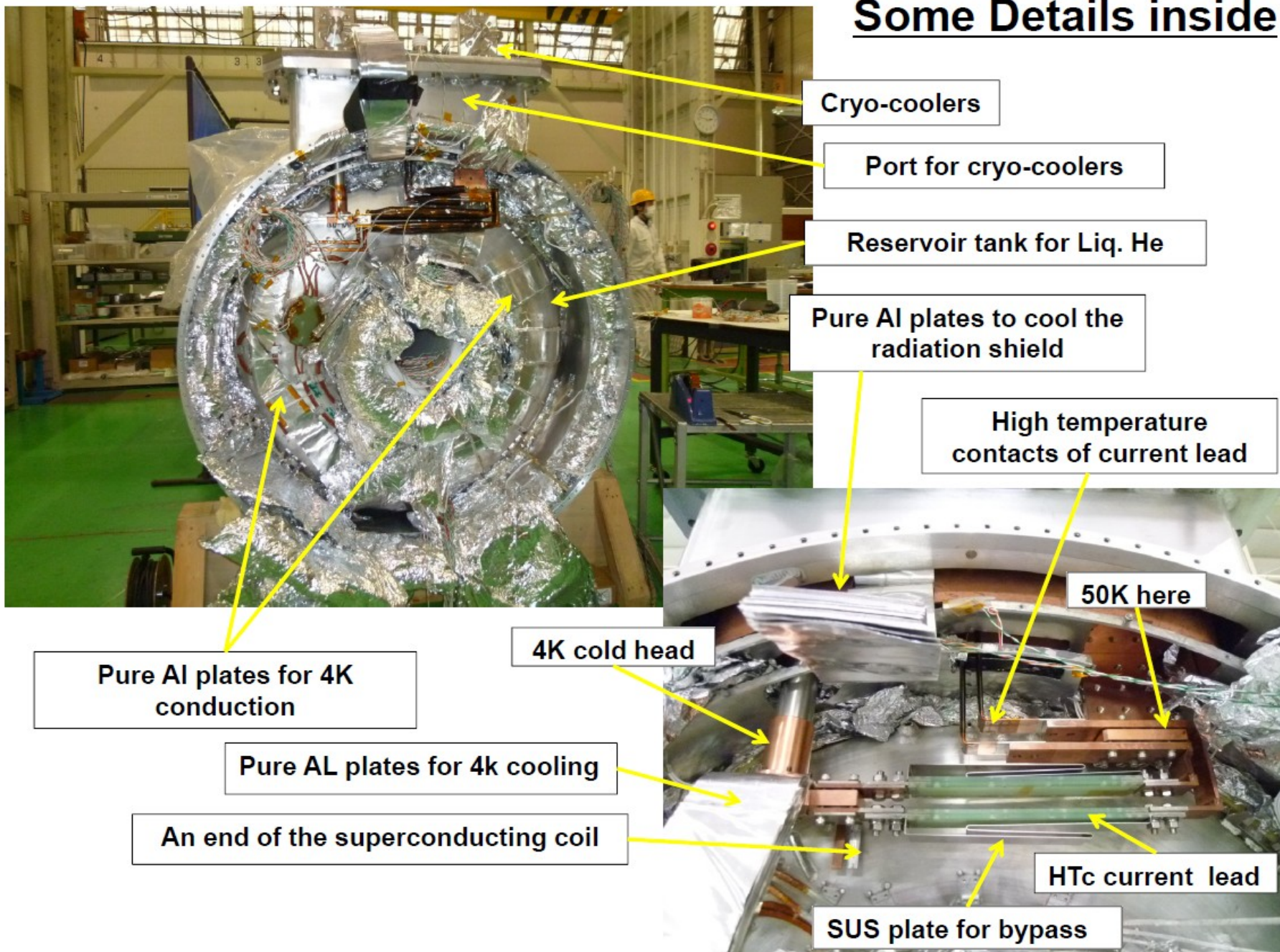


F-50 Indoor Water-Cooled Compressor

F-50	
Electrical Power†	3 Phase 200 V, 50/60 Hz [Low Volt] 380, 400, 415 V, 50 Hz or 460-480 V, 60 Hz [High Volt]
Ambient Temperature‡	5-35 °C (41-95 °F)
Minimum Cooling Water Requirement and Temperature Range*	4-28 °C (39-82 °F)‡ Min. 7 L/min (1.9 gal/min) at 28 °C
Weight and Dimensions	120 kg (265 lbs.) 591 mm x 450 mm x 588 mm (23.3" x 17.7" x 23.2") HxWxD
Maintenance Interval/ Adsorber Exchange	30,000 Hours



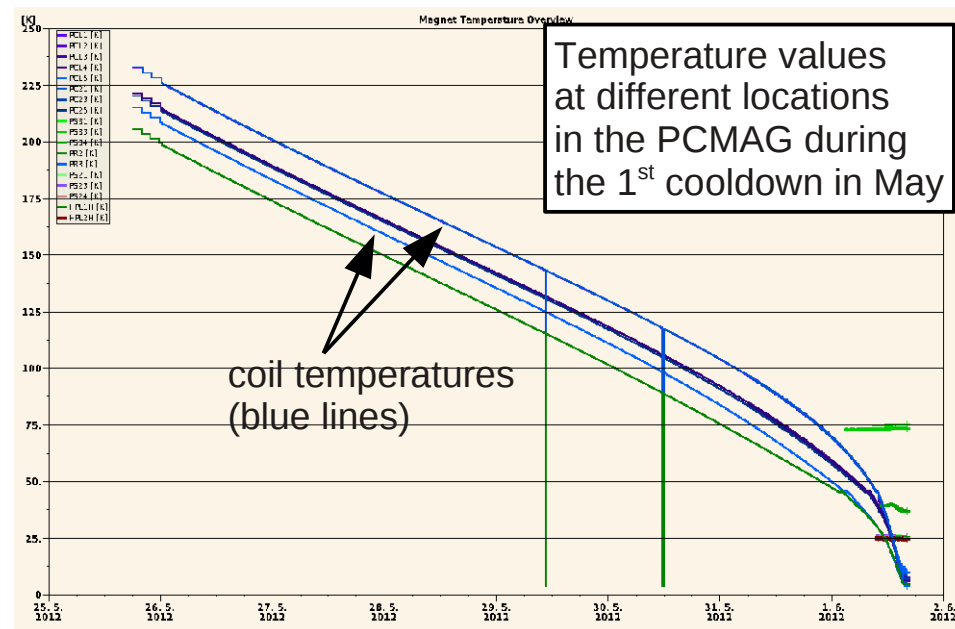
## Some Details inside





- July, 2011 : PCMAG shipped to Japan
- 2011/12 : Modification of PCMAG (Toshiba)
- March, 2012 : PCMAG back at DESY
- April, 2012 : Visit of Japanese experts  
Unpacking and mounting
- May, 2012 :
  - Infrastructure installation at test beam area finished
  - 1<sup>st</sup> Cool-down of magnet at DESY started on May, 23<sup>rd</sup> 2012  
Cool-down takes about 10 days
- June, 2012 : First excitation test @DESY
- Reliably working since:
  - Continuously cooled from 1.6.-29.9.2012 without problems
  - Cool-down on 15.-24.Nov. without problems
  - 2013: cold since January, vacuum still good

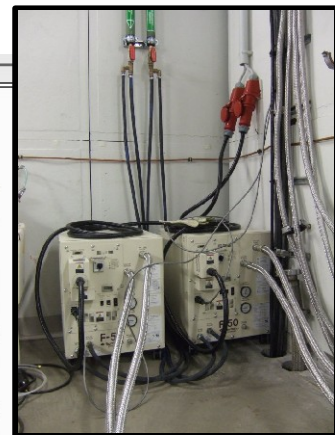
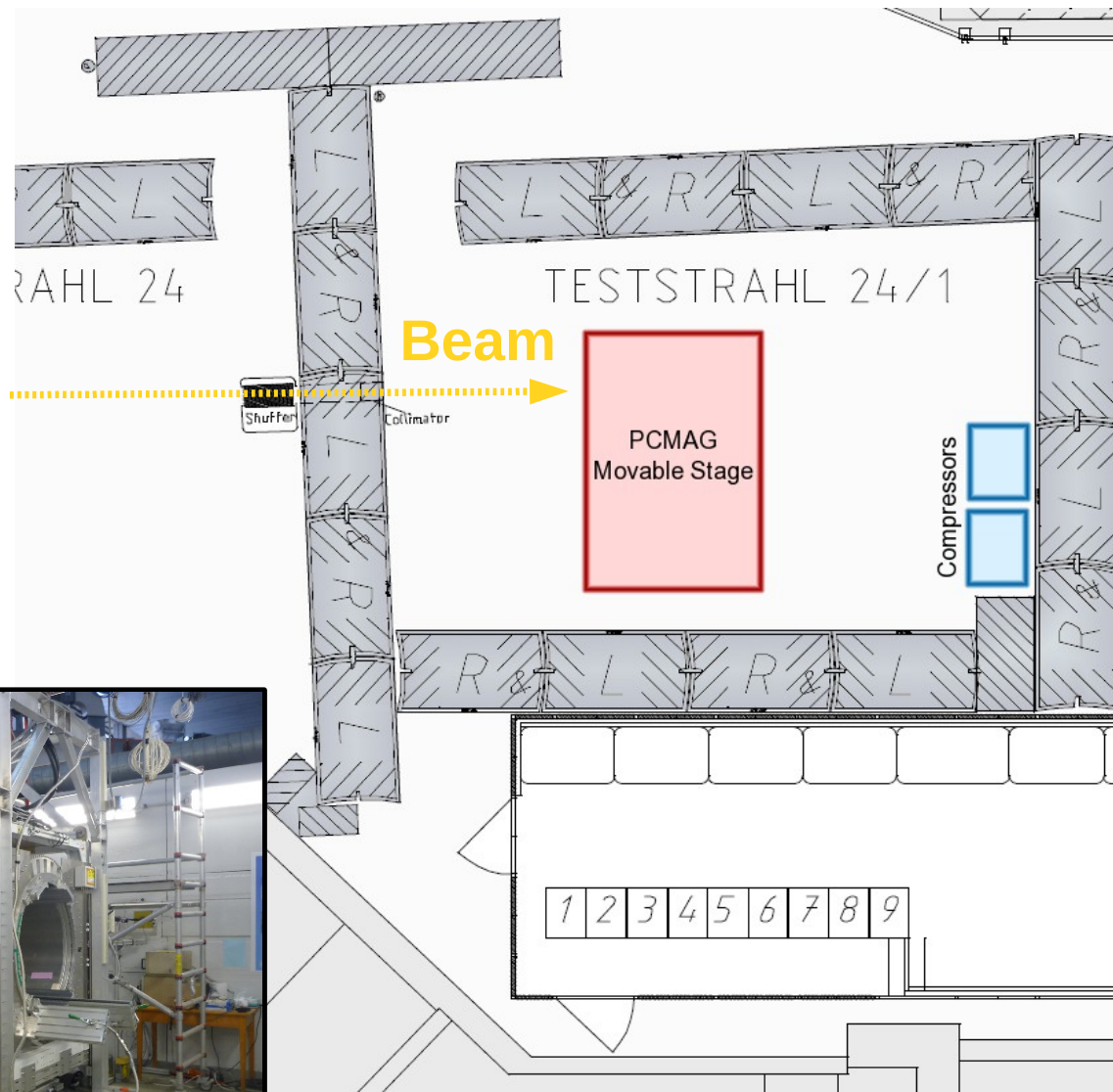
Mounting of PCMAG at DESY



Temperature values at different locations in the PCMAG during the 1<sup>st</sup> cooldown in May

coil temperatures (blue lines)

- Power:
  - improved cables to magnet up to 448A, 1kV
  - new power lines for compressors: 35A each
- Cooling water from central DESY lines at 7°C (now also available for testbeam users)



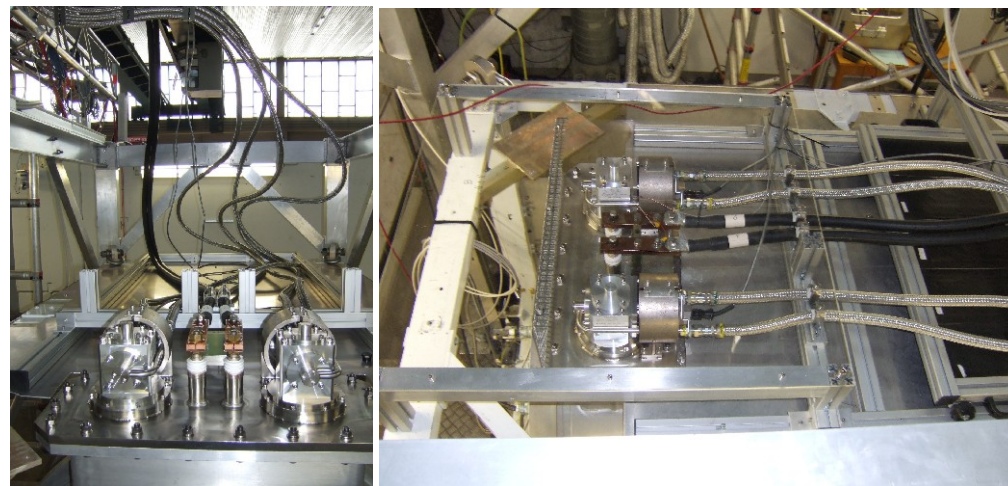
Water lines & He compressors



Power Distribution



- Adjustment to DESY safety rules:
  - Covering cold heads and currents leads
  - Covers at & grounding of power rack
  - Integration into interlock system
- Integration of PCMAG monitoring in the DOOCS slow control system



Temperatures (PtCo)		Temperatures (CGR)	
Coil		Carbon Glass Resistors	
PC11	4.00 K	CG11	14.59340 mV
PC12	4.00 K	CG13	12.47655 mV
PC13	6.96 K	CG15	13.32994 mV
PC14	4.00 K		
PC15	8.10 K	Temperatures (Pt100)	
PC21	4.00 K	Refrigerator Port	
PC23	5.99 K	R11T	2.82873 mV
PC25	4.00 K	R21T	2.26374 mV
Inner Shield		R11E	2.91128 mV
PS21	25.32 K	R21E	2.38703 mV
PS23	25.75 K	Temperatures (Cernox)	
PS24	24.75 K	R12T	1.45496E2 mV
Outer Shield		R12E	1.21793E2 mV
PS81	74.45 K	Currents	
PS83	73.13 K	I-PtCo	0.0010 A
PS84	36.75 K	I-CGR	9.1661E-6 A
High Tc Current Lead		Power Supply	
HPL-HP	25.04 K	Coil Current	-6.9E-2 A
HPL-HN	24.70 K	Coil Voltage	1.27E-5 V
Reservoir		Hall Probe	
PR2	4.00 K	Hallprobe	-6.9337E-5 T
PR3	4.00 K		

Plot in V, without conversion!



- Schedule very tight this year and probably also next year
- T24/1 setup with magnet now also used by non-LCTPC groups:
  - ATLAS upgrade: measurement of Lorentz angle of silicon microstrip detectors
  - GEM tracker chambers for SBS (Super Bigbite Spectrometer) @ JLAB
  - GridPIX (Micromegas/GEM on TimePix chip)
  - Belle II Vertex detector

**DESY Testbeam Schedule 2013 - version12 of March 25th 2013**

Ingrid-Maria Gregor, Norbert Meyners, Marcel Stanitzki - DESY Test Beam Coordinators

	Week	TB21		TB22		TB24/1	PCMAG	TB24
		DATURA	none	ACONITE/ANEMONE	CAL	EUDET in PCMAG	PCMAG	none
	2	---	---	---	---	---	---	---
14-Jan-13	3	---	ITER	Tele setup				
21-Jan-13	4	X0			CALICE AHCAL			
28-Jan-13	5	CMS Pix-irrad	---	---	CALICE AHCAL		TPC MMG	ECAL
4-Feb-13	6	CMS Pix-fwd	---	---			TPC MMG	
11-Feb-13	7	CLICpix	---	---		LorAngle		
18-Feb-13	8	---	SIW ECAL	---		LorAngle		
25-Feb-13	9	---	Sc ECAL	---			DESY TPC	
4-Mar-13	10							
11-Mar-13	11	ALICE ITS	---	MuPix			DESY TPC	
18-Mar-13	12	CMS Pix-irrad	---	APIX PPS			DESY TPC	
25-Mar-13	13	CMS Pix-KA	---	APIX PPS			LCTPC Time	
1-Apr-13	14	CMS Pix-ro	---	APIX IBL			LCTPC Time	
8-Apr-13	15	X0	---	APIX DBM		LorAngle		
15-Apr-13	16	ITER		ILCPOL				
22-Apr-13	17			ILCPOL		SBS GEM		
29-Apr-13	18					SBS GEM		
6-May-13	19	DEPFET	---		RD50	LorAngle		
13-May-13	20	FE-14	---	COMPASS-II			GridPix	
20-May-13	21	CMS Pix-ro	---					Belle 2 PID
27-May-13	22	X0						
3-Jun-13	23	CLICpix	---				LCTPC Time	
10-Jun-13	24	CLICpix	---	MuPix	CALICE AHCAL			
17-Jun-13	25	ALICE ITS	---	APIX 3D				AIDA
24-Jun-13	26	CMS Trk II	---	DIA-SiGe				AIDA
1-Jul-13	27	---	SIW ECAL	---	CAL MMG		LCTPC Time	
8-Jul-13	28	---	SC ECAL	---	CAL MMG		LCTPC Time	
15-Jul-13	29	APD	---	APIX 3D			DESY TPC	
22-Jul-13	30	CMS Ph2	---	ALICE ITS			DESY TPC	
29-Jul-13	31	CMS high rate	---	ALICE ITS				GSI DIRC
5-Aug-13	32	LHCb VELO	---	APIX IBL		LorAngle		
12-Aug-13	33	LHCb VELO	---	APIX PPS				PLUME
19-Aug-13	34	CLICpix	---	APIX PPS				PICSEL
26-Aug-13	35	CLICpix	---	---	SC ECAL			PICSEL
<b>SHUTDOWN</b>	<b>36-52</b>							
6-Jan-14	2	FCAL	---		CALICE AHCAL	Belle II VXD		
13-Jan-14	3	FCAL	---		CALICE AHCAL	Belle II VXD		
20-Jan-14	4	SBS GEM	---	APIX 3D		Belle II VXD		
27-Jan-14	5	SBS GEM	---	DIAPIX		Belle II VXD		
3-Feb-14	6	LHCb VELO	---	MuPix		LorAngle		
10-Feb-14	7	LHCb VELO	---	ATLAS Strip				SIPM
17-Feb-14	8	ATLAS Lucid	---	ATLAS Strip				
	9							
	10							

- Latest schedule and more information about the DESY testbeam available on:

<http://testbeam.desy.de>

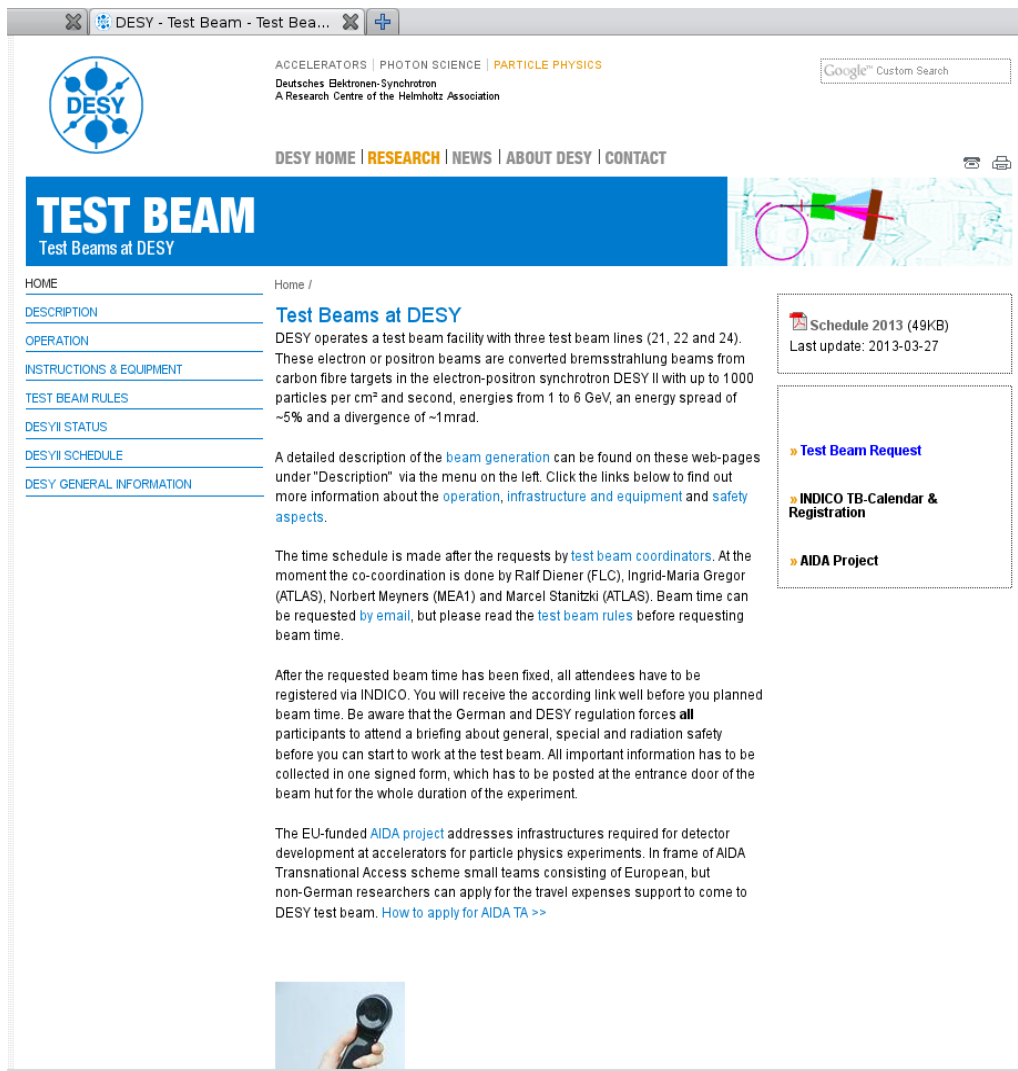
(recently completely overhauled)

- Planning for 2014 started Requests (even preliminary) very welcome
- Contact over web page link or via:

[testbeam-coor@DESY.de](mailto:testbeam-coor@DESY.de)

For beam time requests please include (to simplify and speed up the process):

- Project description
- Person responsible for the test
- Requested period
- Further participants
- Additional hardware or materials needed



The screenshot shows the DESY Test Beam website. The header includes the DESY logo, navigation links for ACCELERATORS, PHOTON SCIENCE, and PARTICLE PHYSICS, and a Google Custom Search box. The main content area features a blue banner for 'TEST BEAM' with the subtitle 'Test Beams at DESY'. A left sidebar contains a table of contents with links to HOME, DESCRIPTION, OPERATION, INSTRUCTIONS & EQUIPMENT, TEST BEAM RULES, DESYII STATUS, DESYII SCHEDULE, and DESY GENERAL INFORMATION. The main text area is titled 'Test Beams at DESY' and describes the facility's capabilities, including three test beam lines (21, 22, and 24) and the use of carbon fibre targets. It also provides information on how to request beam time, mentioning the need for a signed form and registration via INDICO. A right sidebar contains links to 'Schedule 2013 (49KB)', 'Test Beam Request', 'INDICO TB-Calendar & Registration', and 'AIDA Project'. At the bottom, there is a small image of a hand holding a device.

- PCMAG upgrade went without problems and according to schedule
- Collaboration between KEK and DESY very good
- A few smaller items to do:
  - Finishing magnet slow control panel (conversion tables)
  - Inclusion of compressor status into slow control system and interlock
- Modified PCMAG:
  - Runs without problems, much less servicing/maintenance work
  - Improves the usability of the setup
  - Increased safety in case of emergency shutdown
- Improved setup well requested and PCMAG upgrade happened at the right time:
  - Nearly continuous operation periods this year wouldn't have been possible with liquid Helium operation of PCMAG
- Thanks to everyone involved, especially to our colleagues from Japan