

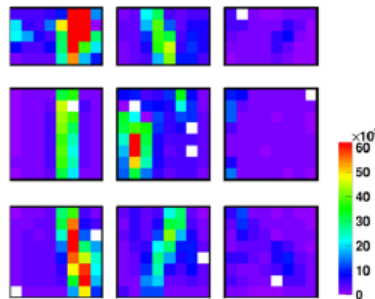
Technical Design Report for the:

\bar{P} ANDA Barrel DIRC

(AntiProton Annihilations at Darmstadt)

Strong Interaction Studies with Antiprotons

\bar{P} ANDA Collaboration March 17, 2015



- **Timeline**
- **Content**
- **Responsibilities**
- **Repository**

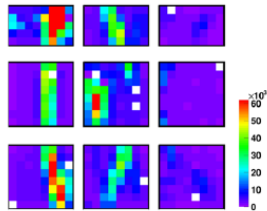
Technical Design Report for the:

\bar{P} ANDA
Barrel DIRC

(AntiProton Annihilations at Darmstadt)

Strong Interaction Studies with
Antiprotons

\bar{P} ANDA Collaboration March 17, 2015



- **TDR accepted** **Q2 / 2016**
- **accepted by PANDA** **March 2016**
- **int. or ext. reviewers** **Dec 2015**
 - all tests done
- **Results of beamtimes** **Oct 2015**
- **First full document** **Sept. 2015**
- **First draft to Ch-Group** **June 2015**
- **SVN repository** **April 2015**
- **Collection of input** **March 2015**

Successful Beamtime CERN

R. Dzhygadlo¹, A. Gerhardt¹, K. Götzen¹, G. Kalicy¹, M. Krebs¹, H. Kumawat¹, D. Lehmann¹,
M. Patsyuk¹, K. Peters¹, G. Schepers¹, L. Schmitt¹, C. Schwarz¹, J. Schwiening¹, M. Traxler¹,
M. Zühlsdorf¹, V. Kh. Dodokhov², A. Britting³, W. Eyrich³, A. Lehmann³, F. Uhlig³,
M. Düren⁴, E. Etzelmüller⁴, K. Föhl⁴, A. Hayrapetyan⁴, B. Kröck⁴, O. Merle⁴, J. Rieke⁴,
E. Cowie⁵, T. Keri⁵, R. Montgomery⁵, P. Achenbach⁶, M. Cardinali⁶, M. Hoek⁶, W. Lauth⁶,
S. Schlimme⁶, C. Sfienti⁶, M. Thiel⁶, P. Bühler⁷, L. Gruber⁷, J. Marton⁷, K. Suzuki⁷

¹GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

²Joint Institute for Nuclear Research, Dubna, Russia

³Friedrich Alexander-University of Erlangen-Nuremberg, Erlangen, Germany

⁴II. Physikalisches Institut, Justus Liebig-University of Giessen, Giessen, Germany

⁵University of Glasgow, Glasgow, United Kingdom

⁶Institut für Kernphysik, Johannes Gutenberg-University of Mainz, Mainz, Germany

⁷Stefan Meyer Institut für subatomare Physik, Austrian Academy of Sciences, Vienna, Austria

Editors:	Georg Schepers	Email: g.schepers@gsi.de
	Jochen Schwiening	Email: j.schwiening@gsi.de
	Carsten Schwarz	Email: c.schwarz@gsi.de
	Matthias Hoek	Email: hoek@uni-mainz.de
	Albert Lehmann	Email: albert.lehmann@physik.uni-erlangen.de
Technical Coordinator:	Lars Schmitt	Email: l.schmitt@gsi.de
Spokesperson:	James Ritman	Email: j.ritman@fz-juelich.de
Deputy:	Diego Bettoni	Email: bettoni@fe.infn.it

preface

1 Executive Summary

2 The PANDA Experiment and its PID Concept

2.1	The PANDA Experiment	.....
2.1.1	The Scientific Program	.....
2.1.2	High Energy Storage Ring	.....
2.1.3	Targets	.....
2.1.4	Luminosity Considerations	.....
2.2	The PANDA Detector	.....
2.2.1	Target Spectrometer	.....
2.2.2	Forward Spectrometer	.....
2.2.3	Data Acquisition	.....
2.2.4	Infrastructure	.....
2.3	The Particle Identification System	.....
2.3.1	Tracking Detectors	.....
2.3.2	EM Calorimeter	.....
2.3.3	Cherenkov Detectors	.....
2.3.4	Time-Of-Flight Detectors	.....
2.3.5	Muon Detection	.....
2.3.6	Combined PID	.....

Common with the
Endcap Disc DIRC

3 Design of the Barrel DIRC

3.1 Goals and Requirements of the DIRC	
3.1.1 Interferences with Neighbouring Detectors	
3.2 Image reconstruction	
3.3 Mechanical design	xi
3.4 Optical design	
3.5 Readout electronics	

4 Components

4.1 Radiators	
4.1.1 Materials	
4.1.2 Barrel DIRC	
4.1.3 Focussing Issues	
4.2 Photon Sensors	
4.2.1 Requirements	
4.2.2 Multichannel-plate PMTs	
4.2.3 Procedure of Quality Assessment	
4.2.4 Mounting Procedure	
4.3 Electronics	
4.3.1 Signal readout	
4.3.2 LV and HV	
4.3.3 slow control, monitoring	
4.3.4 Calibration	
4.4 Mechanical	
4.4.1 Radiator containers	
4.4.2 Mechanical support	
4.4.3 Cabling and Supplies	
4.4.4 Integration	

5 Assembly

- 5.1 Mounting Procedure
- 5.2 Operating Procedures
- 5.3 Maintenance

6 Expected Performance

- 6.1 Simulation
- 6.2 Reconstruction
- 6.3 Detector Resolution
- 6.4 PID results on benchmark channels

7 Prototyping, Tests and Qualification

- 7.1 Optical Elements
 - 7.1.1 Radiation Hardness of Optical Elements
 - 7.1.2 Qualification of Optical Surfaces
- 7.2 Sensors
 - 7.2.1 Evaluation of MCP-PMTs
- 7.3 System tests at test-beam facilities
- 7.4 Component tests
- 7.5 Photon Sensors
 - 7.5.1 Requirements
 - 7.5.2 Radiator materials
- 7.6 Test experiments
- 7.7 (GSI, CERN)

8 Organisation and Cost

- 8.1 Quality assurance
- 8.2 Safety
- 8.3 Assembly and Installation
- 8.4 Collaboration Structure
- 8.5 Schedule and Cost

Responsibilities I



Directory	File	Responsible Person / Author
executive	executive/executive_summary.tex	Georg
executive	executive/executive_summary.tex	Georg
introduction	introduction.tex	Georg
	introduction_physics_case.tex	Georg
	introduction_benchmark_channels.tex	Maria, Roman
	introduction_hesr.tex	Georg
	introduction_panda_detector.tex	Georg
	introduction_pid_in_panda.tex	Georg
goals and requirements	goalsandreqs.tex	Georg
	goalsandreqs_goals.tex	Georg
	goalsandreqs_requirements.tex	Georg
	goalsandreqs_barrel_dirc.tex	Georg
	goalsandreqs_interferences.tex	Georg
design	design.tex	Georg
	designbarrel.tex	Georg
	designbarrel_mechanical.tex	Georg
	designbarrel_optical.tex	Georg
	designbarrel_image_reconstruction.tex	Georg
	designbarrel_readout_electronics.tex	Georg

Responsibilities II



components	components.tex	Georg
components radiators	componentsradiators.tex	Georg
	componentsradiators_materials.tex	Georg
	componentsradiators_barrel_dirc.tex	Georg
	componentsradiators_focussing_issues.tex	Carsten
components photonsensors	componentsphotonsensors.tex	Albert
	componentsphotonsensors_requirements.tex	Albert
	componentsphotonsensors_multi_anode_pmts.tex	Albert
	to be continued here	
components electronics	componentselectronics.tex	Carsten
	componentselectronics_signal_readout.tex	Carsten
	componentselectronics_lv_hv.tex	Carsten
	componentselectronics_slowcontrol_monitoring.tex	Carsten
	componentselectronics_calibration.tex	Carsten
components mechanical	componentsmechanical.tex	
	componentsmechanical_radiator_containers.tex	Carsten
	componentsmechanical_mechanical_support.tex	Carsten
	componentsmechanical_cabling_and_supplies.tex	Carsten
	componentsmechanical_integration.tex	Carsten
prototyping	prototyping.tex	Marco
	prototypingprototypingcomponents.tex	Marco
	prototypingprototypingcomponents_photon_detectors.tex	Marco
	prototypingprototypingcomponents_radiator_materials.tex	Matthias
	prototypingtestexps/prototypingtestexps.tex	Marco

assembly	assembly.tex	Carsten
	assembly_mounting_procedure.tex	Carsten
	assembly_operating_procedures.tex	Carsten
	assembly_maintenance.tex	Carsten
performance	performance.tex	Roman, Maria
	performance_simulation.tex	Roman, Maria
	performance_reconstruction.tex	Roman, Maria
	performance_detector_resolution.tex	Roman, Maria
	performance_pid_benchmark_channels.tex	Roman, Maria
organization	organisation.tex	Georg
	organisation_quality_assurance.tex	Georg
	organisation_safety.tex	Georg
	organisation_assembly_and_installation.tex	Georg
	organisation_collaboration_structure.tex	Georg
	organisation_schedule_and_cost.tex	Georg

•First Steps: Only the first time: checkout with

- `svn checkout svn+ssh://charme@lx-pool.gsi.de/u/charme/svn/tdr-cherenkov`
- You find two directories
 - trunk (working directory)
 - tags (holds later named snapshots)
- Work is done in trunk
 - editing files
 - adding files (later do a `svn add filename`)
 - removing files by `svn remove filename`
 - at end
 - `svn commit -m "what I have done string"`

•Normal working cycle:

- in directory `pid-tag/trunk`
- `svn update` (get changes from other people)
- work
- `svn commit` (upload changes to repository)

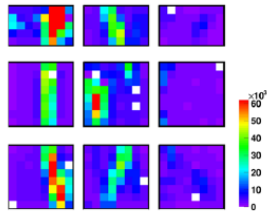
Technical Design Report for the:

\bar{P} ANDA
Barrel DIRC

(AntiProton Annihilations at Darmstadt)

Strong Interaction Studies with
Antiprotons

\bar{P} ANDA Collaboration March 17, 2015



Thank you for your attention
and
your contribution to the TDR

TDR accepted	Q2 / 2016
accepted by PANDA	March 2016
int. or ext. reviewers - all tests done	Dec 2015
Results of beamtimes	Oct 2015
First full document	Sept. 2015
First draft to Ch-Group	June 2015
Collection of input	April 2015
Successful Beamtime CERN	