

PANDA-Kollaboration

TOMASZ FIUTOWSKI¹, MAREK IDZIK¹, KRZYSZTOF SWIENTEK¹, PRZEMYSŁAW TERLECKI¹, P.N. DEEPAR², ARUN KULKARNI², EVGENY ANTOKHIN³, ALEXANDER YU. BARNYAKOV³, KONSTANTIN BELOBORODOV³, VLADIMIR E. BLINOV³, IVAN A. KUYANOV³, SERGEY PIVOVAROV³, EVGENIY PYATA³, YURY TIKHONOV³, MICHAEL FINGER⁴, MIROSLAV FINGER⁴, ANTONIN KVETON⁴, MICHAEL PESEK⁴, MARKETA PESKOVA⁴, IVAN PROCHAZKA⁴, MILOSLAV SLUNECKA⁴, XU CAO⁵, QIANG HU⁵, ZHANKUI LI⁵, HAI-XIA LI⁵, XINWEN MA⁵, PETR GALLUS⁶, VLADIMIR JARY⁶, JOSEF NOVY⁶, MICHAL TOMASEK⁶, LUKAS TOMASEK⁶, MIROSLAV VIRIUS⁶, VACLAV VRBA⁶, GIANANGELO BRACCO⁷, GIANLUIGI BOCA⁸, HELMUT SOHLBACH⁹, INGO AUGUSTIN¹⁰, RALPH BÖHM¹⁰, INTI LEHMANN¹⁰, DIANA NICMORUS MARINESCU¹⁰, LARS SCHMITT¹⁰, VICTOR VARENTSOV¹⁰, LUDOVICO BIANCHI¹¹, ARTUR DERIGHS¹¹, RENE DOSDALL¹¹, ANDREAS ERVEN¹¹, WALEED ESMAIL¹¹, ALBRECHT GILLITZER¹¹, FRANK GOLDENBAUM¹¹, DIRK GRUNWALD¹¹, LIUBOV JOKHOVETS¹¹, ALESSANDRA LAI¹¹, SERGEY ORFANITSKI¹¹, DIETER PRASUHN¹¹, ELISABETTA PRENCIPE¹¹, JENNIFER PÜTZ¹¹, JAMES RITMAN¹¹, EBERHARD ROSENTHAL¹¹, SUSAN SCHAIDMAND¹¹, RALF SCHMITZ¹¹, THOMAS SEFZICK¹¹, VALERIY SERDYUK¹¹, GÜNTER STERZENBACH¹¹, TOBIAS STOCKMANN¹¹, PETER WINTZ¹¹, PETER WÜSTNER¹¹, HUAGEN XU¹¹, YONG ZHOU¹¹, ARTEMIIY BELOUSOV¹², IVAN KISEL¹², GRIGORY KOZLOV¹², MYKHAILO PUGACH¹², MAKSYM ZYZAK¹², MERLIN BÖHM¹³, WOLFGANG EYRICH¹³, ALBERT LEHMANN¹³, DANIEL MIEHLING¹³, MARKUS PFFAFFINGER¹³, SAMUEL STELTER¹³, KAMAL DUTTA¹⁴, KUSHAL KALITA¹⁴, AHMED ALI¹⁵, ABDENNACER HAMDJ¹⁵, MARVIN KREBS¹⁵, FRANK NERLING¹⁵, MOHAMMAD AL-TURANY¹⁶, ANASTASIOS BELIAS¹⁶, HARALD DEPPE¹⁶, ROMAN DZHYGADLO¹⁶, HOLGER FLEMMING¹⁶, ANDREAS GERHARDT¹⁶, KLAUS GÖTZEN¹⁶, ANDREAS HEINZ¹⁶, RADOSŁAW KARABOWICZ¹⁶, UDO KURILLA¹⁶, DOROTHEE LEHMANN¹⁶, JOST LÜHNING¹⁶, ULI LYNEN¹⁶, SIMON NAKHOUL¹⁶, HERBERT ORTH¹⁶, KLAUS PETERS¹⁶, TAKEHIKO SAITO¹⁶, GEORG SCHEPERS¹⁶, CHRISTIAN JOACHIM SCHMIDT¹⁶, CARSTEN SCHWARZ¹⁶, JOCHEN SCHWIENING¹⁶, ALEXANDER TÄSCHNER¹⁶, MICHAEL TRAXLER¹⁶, BERND VOSS¹⁶, PETER WIECZOREK¹⁶, HEYBAT AHMADI¹⁷, SAMER AHMED¹⁷, SEBASTIAN BLESER¹⁷, MICHAEL BÖLTING¹⁷, LUIGI CAPOZZA¹⁷, ALAA DBEYSSI¹⁷, PHILLIP GRASEMANN¹⁷, ROMAN KLASEN¹⁷, RALF KLIENT¹⁷, HANS HEINRICH LEITHOFF¹⁷, FRANK MAAS¹⁷, STEPHAN MALDANER¹⁷, MATHIAS MICHEL¹⁷, CRISTINA MORALES MORALES¹⁷, CHRISTOF MOTZKO¹⁷, OLIVER NOLL¹⁷, STEFAN PFLÜGER¹⁷, DAVID RODRÍGUEZ PIÑEIRO¹⁷, FALK SCHUPP¹⁷, MARCELL STEINEN¹⁷, SAHRA WOLFF¹⁷, IRIS ZIMMERMANN¹⁷, KRZYSZTOF KORCYL¹⁸, ADAM KOZELA¹⁸, PAWEŁ KULESSA¹⁸, PIOTR LEBIEDOWICZ¹⁸, KRZYSZTOF PYSZ¹⁸, WOLFGANG SCHÄFER¹⁸, ANTONI SZCZUREK¹⁸, NICOLA BIANCHI¹⁹, PAOLA GIANOTTI¹⁹, VINCENZO LUCHERINI¹⁹, VALENTINO RIGATO²⁰, DANIELA CALVO²¹, PAOLO DE REMIGIS²¹, ALESSANDRA FILIPPI²¹, GIOVANNI MAZZA²¹, ANGELO RIVETTI²¹, RICHARD WHEADON²¹, RONALD KUNNE²², BEATRICE RAMSTEIN²², VICTOR ABRAMOV²³, SOFIA BUKREVA²³, SERGEI CHERNICHENKO²³, ANATOLY DEREVSCHIKOV²³, VALERI FERAPONTOV²³, YURY GONCHARENKO²³, ANDREI LEVIN²³, ESENIYA MASLOVA²³, YURY MELNIK²³, ALEXEI MESCHANIN²³, NIKOLAY MINAEV²³, VASILIIY MOCHALOV²³, VYACHESLAV MOISEEV²³, DMITRY MOROZOV²³, LARISA NOGACH²³, STANISLAV POSLAVSKIY²³, ANDREY RYAZANTSEV²³, SERGEY RYZHIKOV²³, PAVEL SEMENOV²³, IGOR SHEIN²³, ANDREY UZUNIAN²³, ALEXANDER VASILIEV²³, ALEXANDER YAKUTIN²³, PAVEL BALANUTSA²⁴, VIACHESLAV CHERNETSKY²⁴, ALEXEY DEMEKHIN²⁴, ANATOLY DOLGOLENKO²⁴, PAVEL FEDORETS²⁴, ALEXANDER GERASIMOV²⁴, ALEXANDER GOLUBEV²⁴, VLADIMIR GORYACHEV²⁴, ALEXEY KANTSYREV²⁴, DMITRIY YURIEVICH KIRIN²⁴, ANDREY KOTOV²⁴, NIKOLAI KRISTI²⁴, ELENA LADYGINA²⁴, ELENA LUSCHEVSKAYA²⁴, VLADIMIR A. MATVEEV²⁴, VSEVOLOD PANJUSHKIN²⁴, ALEXEY VALENTINOVICH STAVINSKIY²⁴, NING CAO²⁵, ZHENAN LIU²⁵, CHUNXIU LIU²⁵, BEIJIANG LIU²⁵, XIAOYAN SHEN²⁵, SHENGSEN SUN²⁵, JIA TAO²⁵, GUANG ZHAO²⁵, JINGZHOU ZHAO²⁵, JOSE DIAZ²⁶, MARIO BRAGADIREANU²⁷, DAN PANTEA²⁷, GRZEGORZ KORCYL²⁸, RAFAL LALIK²⁸, AKSHAY MALIGE²⁸, PAWEŁ MOSKAL²⁸, KRZYSZTOF NOWAKOWSKI²⁸, WITOLD PRZYGODA²⁸, NARENDRA RATHOD²⁸, ZBIGNIEW RUDY²⁸, PIOTR SALABURA²⁸, JERZY SMYRSKI²⁸, EGLE TOMASI-GUSTAFSSON²⁹, PATRICK ACHENBACH³⁰, ALEXANDER AYCOCK³⁰, OLIVER CORELL³⁰, ACHIM DENIG³⁰, MICHAEL DISTLER³⁰, MATTHIAS HOEK³⁰, WERNER LAUTH³⁰, ZHIQING LIU³⁰, HARALD MERKEL³⁰, ULRICH MÜLLER³⁰, JOSEF POCHODZALLA³⁰, SOEREN SCHLIMME³⁰, CONCETTINA SFIENTI³⁰, MICHAELA THIEL³⁰, MANUEL ZAMBRANA³⁰, VIKTOR

ABAZOV³¹, GENNADY ALEXEEV³¹, VALENTIN A. AREFIEV³¹, VALERY ASTAKHOV³¹, MIKAIL YU. BARABANOV³¹, BORIS V. BATYUNYA³¹, VALERY KH. DODOKHOV³¹, ALEXANDER FECHTCHENKO³¹, AIDA GALOYAN³¹, GEORGY GOLOVANOV³¹, EVGENY K. KOSHURNIKOV³¹, YURI YU. LOBANOV³¹, ALEXANDER G. OLSHEVSKIY³¹, ALEXEY A. PISKUN³¹, ALEXANDER SAMARTEV³¹, STEPAN SHIMANSKI³¹, ANNA N. SKACHKOVA³¹, EVGENY A. STROKOVSKY³¹, VALERY TOKMENIN³¹, VLADIMIR UZHINSKY³¹, ALEXANDER VERKHEEV³¹, ALEXANDER VODOPIANOV³¹, NIKOLAI I. ZHURAVLEV³¹, SIMON BODENSCHATZ³², KAI-THOMAS BRINKMANN³², STEFAN DIEHL³², VALERY DORMENEV³², MICHAEL DÜREN³², ERIK ETZELMÜLLER³², KLAUS FÖHL³², MARTIN GALUSKA³², THOMAS GESSLER³², ERIC GUTZ³², CHRISTOPHER HAHN³², AVETIK HAYRAPETYAN³², MARTIN KESSELKAUL³², WOLFGANG KÜHN³², JENS SÖREN LANGE³², YUTIE LIANG³², VOLKER METAG³², MARKUS MORITZ³², MARIANA NANOVA³², RAINER NOVOTNY³², MATTHIAS SACHS³², MURSTAF SCHMIDT³², HASKO STENZEL³², MARC STRICKERT³², ULRICH THÖRING³², THOMAS WASEM³², CHRISTIAN WILLI³², BENJAMIN WOHLFAHRT³², HANS-GEORG ZAUNICK³², AYSE ATAC³³, TORBJÖRN BÄCK³³, BO CEDERWALL³³, ROSA KAPPERT³⁴, MYROSLAV KAVATSYUK³⁴, HERBERT LOEHNER³⁴, JOHAN MESSCHENDORP³⁴, VIKTOR RODIN³⁴, PETER SCHAKEL³⁴, SOLMAZ VEJGANI³⁴, LENNART ISAKSSON³⁵, ALEXANDER BALASHOFF³⁶, ALEXANDER BOUKHAROV³⁶, OLEG MALYSHEV³⁶, GRAZINA KESIK³⁷, DMYTRO MELNYCHUK³⁷, ANDRZEJ TRZCINSKI³⁷, MARCIN WOJCIECHOWSKI³⁷, SŁAWOMIR WRONKA³⁷, BOGUSŁAW ZWIEGLINSKI³⁷, STANISLAV BELOSTOTSKI³⁸, GENNADIY GAVRILOV³⁸, ANTONI IZOTOV³⁸, SERGEY MANAENOV³⁸, OLEG MIKLUKHO³⁸, DENIS VERETENNIKOV³⁸, ANDREY ZHDANOV³⁸, NIAN QUIN³⁹, LUKE ROBISON³⁹, KAM SETH³⁹, TING XIAO³⁹, ALEXANDER E. BLINOV⁴⁰, SERGEY KONONOV⁴⁰, EVGENIY A. KRAVCHENKO⁴⁰, K. NAYAK BASANT⁴¹, HARPHOOL KUMAWAT⁴¹, BIDYUT ROY⁴¹, ALOK SAXENA⁴¹, SAWANT YOGESH⁴¹, CLAUDE AMSLER⁴², PAUL BÜHLER⁴², NICOLAUS KRATOCHWIL⁴², JOHANN MARTON⁴², WILLIAM NALTI⁴², DOMINIK STEINSCHADEN⁴², KEN SUZUKI⁴², EBERHARD WIDMANN⁴², SEBASTIAN ZIMMERMANN⁴², JOHANN ZMESKAL⁴², FELICE IAZZI⁴³, ANDREA LAVAGNO⁴³, ANDREI FEDOROV⁴⁴, MIKHAIL KORZHIK⁴⁴, OLEG MISSEVITCH⁴⁴, REINHARD BECK⁴⁵, CHRISTIAN HAMMANN⁴⁵, JAN HARTMANN⁴⁵, BERNHARD KETZER⁴⁵, JOHANNES MÜLLERS⁴⁵, MERLIN ROSSBACH⁴⁵, BEN SALISBURY⁴⁵, CHRISTOPH SCHMIDT⁴⁵, ULRIKE THOMA⁴⁵, MARTIN URBAN⁴⁵, MALTE ALBRECHT⁴⁶, STEPHAN BÖKELMANN⁴⁶, THORSTEN ERLÉN⁴⁶, FLORIAN FELDBAUER⁴⁶, MARIO FINK⁴⁶, JENS FRECH⁴⁶, VINCENT FREUDENREICH⁴⁶, MIRIAM FRITSCH⁴⁶, REINE HAGDORN⁴⁶, FRITZ-HERBERT HEINSIUS⁴⁶, THOMAS HELD⁴⁶, TOBIAS HOLTSMANN⁴⁶, IMAN KESHK⁴⁶, HELMUT KOCH⁴⁶, BERTRAM KOPF⁴⁶, MARKUS KUHLMANN⁴⁶, MIRIAM KÜMMEL⁴⁶, MEIKE KÜSSNER⁴⁶, STEPHAN LEIBER⁴⁶, PATRICK MUSIOL⁴⁶, ARBER MUSTAFA⁴⁶, MARC PELIZÄUS⁴⁶, ANDREAS PITKA⁴⁶, JAN REHER⁴⁶, GERHARD REICHERZ⁴⁶, MARVIN RICHTER⁴⁶, CLAUDIUS SCHNIER⁴⁶, SIBEL SERSIN⁴⁶, LUKAS SOHL⁴⁶, CATHRINA SOWA⁴⁶, MATTHIAS STEINKE⁴⁶, TOBIAS TRIFFTERER⁴⁶, TOBIAS WEBER⁴⁶, CHRISTOPHER WENZEL⁴⁶, ULRICH WIEDNER⁴⁶, VINODKUMAR POTHODI CHACKARA⁴⁷, KEVAL GANDHI⁴⁸, AJAY KUMAR RAI⁴⁸, UTPAL ROY⁴⁹, KAROLY MAKONYI⁵⁰, MARKUS PRESTON⁵⁰, PER-ERIK TEGNER⁵⁰, DIRK WÖLBING⁵⁰, CHRISTOPH HEROLD⁵¹, KHANCHAI KHOSONTHONGKEE⁵¹, CHINORAT KOBDJAJ⁵¹, AYUT LIMPHIRAT⁵¹, THANACHOT NASAWAD⁵¹, TAWANCHAT SIMANTATHAMMAKUL⁵¹, PORN-RAD SRISAWAD⁵¹, YUPENG YAN⁵¹, ANDREA BIANCONI⁵², DIEGO BETTONI⁵³, MARIA PIA BUSSA⁵⁴, STEFANO SPATARO⁵⁴, ANNA MARTIN⁵⁵, GIANNI BARUCCA⁵⁶, FABRIZIO DAVI⁵⁶, GIOVANNI LANCIONI⁵⁶, PAOLO MENGUCCI⁵⁶, LUIGI MONTALTO⁵⁶, PIER PAOLO NATALI⁵⁶, NICOLA PAONE⁵⁶, DANIELE RINALDI⁵⁶, LORENZO SCALISE⁵⁶, WERNER ERNI⁵⁷, BERND KRUSCHE⁵⁷, MICHAEL STEINACHER⁵⁷, NATALIE WALFORD⁵⁷, DEREK BRANFORD⁵⁸, DEREK GLAZIER⁵⁸, DANIEL WATTS⁵⁸, DAVID IRELAND⁵⁹, BJORN SEITZ⁵⁹, BRUCE YABSLEY⁶⁰, MARIUSZ DOMAGALA⁶¹, GRZEGORZ FILO⁶¹, EDWARD LISOWSKI⁶¹, FILIP LISOWSKI⁶¹, JOANNA PŁAZEK⁶¹, DANIEL DUDA⁶², ADEEL AKRAM⁶³, HANS CALEN⁶³, WALTER IKGAMI ANDERSSON⁶³, TORD JOHANSSON⁶³, ANDRZEJ KUPC⁶³, PAWEŁ MARCINIOWSKI⁶³, MICHAEL PAPPENBROCK⁶³, JENNY REGINA⁶³, KARIN SCHÖNNING⁶³, MAGNUS WOLKE⁶³, SUBODH GODRE⁶⁴, DANIEL BONAVENTURA⁶⁵, CHRISTOPHER FRITZSCH⁶⁵, SILKE GRIESER⁶⁵, CATHARINA HARGENS⁶⁵, ANN-KATRIN HERGEMÖLLER⁶⁵, BENJAMIN HETZ⁶⁵, NILS HÜSKEN⁶⁵ und ALFONS KHOUKAZ⁶⁵ — ¹AGH, University of Science and Technology, **Cracow**, Poland — ²Birla Institute of Technology and Science, Pilani, K K Birla Goa Campus, **Goa**, India — ³Budker Institute of Nuclear Physics, **Novosibirsk**, Russia

— ⁴Charles University, Faculty of Mathematics and Physics, **Prague**, Czech Republic — ⁵Chinese Academy of Science, Institute of Modern Physics, **Lanzhou**, China — ⁶Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering, **Prague**, Czech Republic — ⁷Dept of Physics, University of Genova and INFN-Genova, **Genova**, Italy — ⁸Dipartimento di Fisica, Università di Pavia, INFN Sezione di Pavia, **Pavia**, Italy — ⁹Fachhochschule Südwestfalen, **Iserlohn**, Germany — ¹⁰FAIR, Facility for Antiproton and Ion Research in Europe, **Darmstadt**, Germany — ¹¹Forschungszentrum Jülich, Institut für Kernphysik, **Jülich**, Germany — ¹²Frankfurt Institute for Advanced Studies, **Frankfurt**, Germany — ¹³Friedrich Alexander Universität Erlangen-Nürnberg, **Erlangen**, Germany — ¹⁴Gauhati University, Physics Department, **Guwahati**, India — ¹⁵Goethe Universität, Institut für Kernphysik, **Frankfurt**, Germany — ¹⁶GSF Helmholtz-Zentrum für Schwerionenforschung GmbH, **Darmstadt**, Germany — ¹⁷Helmholtz-Institut Mainz, **Mainz**, Germany — ¹⁸IFJ, Institute of Nuclear Physics PAN, **Cracow**, Poland — ¹⁹INFN Laboratori Nazionali di Frascati, **Frascati**, Italy — ²⁰INFN Laboratori Nazionali di Legnaro, **Legnaro**, Italy — ²¹INFN Sezione di Torino, **Torino**, Italy — ²²Institut de Physique Nucléaire, CNRS-IN2P3, Univ. Paris-Sud, Université Paris-Saclay, 91406, **Orsay cedex**, France — ²³Institute for High Energy Physics, **Protvino**, Russia — ²⁴Institute for Theoretical and Experimental Physics, **Moscow**, Russia — ²⁵Institute of High Energy Physics, Chinese Academy of Sciences, **Beijing**, China — ²⁶Instituto de Física Corpuscular, Universidad de Valencia-CSIC, **Valencia**, Spain — ²⁷Institutul National de C&D pentru Fizica si Inginerie Nucleara "Horia Hulubei", **Bukarest-Magurele**, Romania — ²⁸Instytut Fizyki, Uniwersytet Jagielloński, **Cracow**, Poland — ²⁹IRFU, CEA, Université Paris-Saclay, **Gif-sur-Yvette Cedex**, France — ³⁰Johannes Gutenberg-Universität, Institut für Kernphysik, **Mainz**, Germany — ³¹Joint Institute for Nuclear Research, **Dubna**, Russia — ³²Justus Liebig-Universität Gießen II. Physikalisches Institut, **Gießen**, Germany — ³³Kungliga Tekniska Högskolan, **Stockholm**, Sweden — ³⁴KVI-Center for Advanced Ra-

diation Technology (CART), University of Groningen, **Groningen**, Netherlands — ³⁵Lunds Universitet, Department of Physics, **Lund**, Sweden — ³⁶Moscow Power Engineering Institute, **Moscow**, Russia — ³⁷National Centre for Nuclear Research, **Warsaw**, Poland — ³⁸National Research Centre "Kurchatov Institute" B. P. Konstantinov Petersburg Nuclear Physics Institute, Gatchina, **St. Petersburg**, Russia — ³⁹Northwestern University, **Evanston**, U.S.A. — ⁴⁰Novosibirsk State University, **Novosibirsk**, Russia — ⁴¹Nuclear Physics Division, Bhabha Atomic Research Centre, **Mumbai**, India — ⁴²Österreichische Akademie der Wissenschaften, Stefan Meyer Institut für Subatomare Physik, **Wien**, Austria — ⁴³Politecnico di Torino and INFN Sezione di Torino, **Torino**, Italy — ⁴⁴Research Institute for Nuclear Problems, Belarus State University, **Minsk**, Belarus — ⁴⁵Rheinische Friedrich-Wilhelms-Universität Bonn, **Bonn**, Germany — ⁴⁶Ruhr-Universität Bochum, Institut für Experimentalphysik I, **Bochum**, Germany — ⁴⁷Sardar Patel University, Physics Department, **Vallabh Vidyanagar**, India — ⁴⁸Sardar Vallabhbhai National Institute of Technology, Applied Physics Department, **Surat**, India — ⁴⁹Sikaha-Bhavana, Visva-Bharati, WB, **Santiniketan**, India — ⁵⁰Stockholms Universitet, **Stockholm**, Sweden — ⁵¹Suranaree University of Technology, **Nakhon Ratchasima**, Thailand — ⁵²Università di Brescia, **Brescia**, Italy — ⁵³Università di Ferrara and INFN Sezione di Ferrara, **Ferrara**, Italy — ⁵⁴Università di Torino and INFN Sezione di Torino, **Torino**, Italy — ⁵⁵Università di Trieste and INFN Sezione di Trieste, **Trieste**, Italy — ⁵⁶Università Politecnica delle Marche-Ancona, **Ancona**, Italy — ⁵⁷Universität Basel, **Basel**, Switzerland — ⁵⁸University of Edinburgh, **Edinburgh**, United Kingdom — ⁵⁹University of Glasgow, **Glasgow**, United Kingdom — ⁶⁰University of Sidney, School of Physics, **Sidney**, Australia — ⁶¹University of Technology, Institute of Applied Informatics, **Cracow**, Poland — ⁶²University of West Bohemia, **Pilsen**, Czech — ⁶³Uppsala Universitet, Institutionen för fysik och astronomi, **Uppsala**, Sweden — ⁶⁴Veer Narmad South Gujarat University, Department of Physics, **Surat**, India — ⁶⁵Westfälische Wilhelms-Universität Münster, **Münster**, Germany