ERC Advanced Grant
Research proposal (Part B2)

Section 2: *The Project proposal* (max 15 pages)

i. State-of-the-art and objectives

WHAT? First ever production of a beam of polarized antiprotons

For more than two decades, physicists have tried to produce beams of polarized antiprotons, generally without success. Conventional methods like atomic beam sources (ABS), appropriate for the production of polarized protons and heavy ions cannot be applied, since antiprotons annihilate with matter. Polarized antiprotons have been produced from the decay in flight of hyperons at Fermilab [D.P. Grosnki et al., Nucl. Instrum. and Meth. A 290, 269 (1990)]. The intensities achieved with antiproton polarizations P>0.35 never exceeded $1.5 \cdot 10^5$ s^{-1}. Scattering of antiprotons off a liquid hydrogen target could yield polarizations of P~0.2, with beam intensities of up to $2 \cdot 10^3$ s^{-1} [H. Spinka et al. Proc. of the 8th Symp. on Polarization Phenomena in Nuclear Physics, Bloomington, Indiana, 1994. Eds. E.J. Stephenson and S.E. Vigdor, AIP Conf. Proc. 339 (AIP, Woodbury, NY, 1995) p. 713]. Unfortunately, both approaches do not allow efficient accumulation in a storage ring, which would greatly enhance the luminosity. Spin splitting using the Stern-Gerlach separation of the given magnetic sub states in a stored antiproton beam was proposed in 1985 [T.O. Niinikosi and R. Rossmanith, Nucl. Instrum. Meth. A 255, 460 (1987)]. Although the theoretical understanding has much improved since then, spin splitting using a stored beam has yet to be observed experimentally [P. Cameron et al., Proc. of the 15th Int. Spin Physics Symp., Upton, New York, 2002, Eds. Y.I. Makdisi, A. U. Luccio and W.W. MacKay, AIP Conf. Proc. 675 (AIP, Melville, NY, 2003), p. 781].

In contrast to that, a convincing proof of the spin-filtering principle has been produced by the FILTEX experiment at the TSR ring in Heidelberg. Spin-filtering exploits the spin dependence of the interaction between a stored proton (antiproton) beam and a polarized internal proton target; this spin dependence induces a difference in the lifetimes for spin-up and spin-down states of the stored beam, which leads to a polarization build-up in the stored beam. In 1992, the FILTEX Collaboration performed a test experiment at the Test Storage Ring in Heidelberg by injecting a 23 MeV proton beam into the ring and leaving it interacting with a polarized internal hydrogen target. After two hours of spin-filtering a beam polarization of about 2% was observed. By reversing the sign of the magnetic holding field the sign of the induced polarization in the beam was reversed as well. The estimated polarization build-up cross-section derived from the analysis of the experimental data amounted to 72 mbarn.

Although the FILTEX experiment clearly demonstrated that the spin-filtering technique works, a unique interpretation of the result is not available yet. In order to make spin filtering a practicable method for polarizing antiprotons, preparatory experiments with protons and antiprotons are required. The measurements proposed in this project will extend the present level of understanding of the spin-filtering mechanism towards the production of the first ever beam of polarized antiprotons. The main goals are:

- A complete understanding of the mechanism underlying the spin-filtering process with protons; At the same time, the measurement with protons will aim to demonstrate that with a proper setting of the ring parameters a high level of polarization can be reached with the spin-filtering method;
- Dedicated and unprecedented measurements of polarized proton-antiproton interactions which will serve as a basis for the exploitation of the spin-filtering with antiprotons.

WHY? Double polarized proton-antiproton interactions will open a new era in hadron physics

If a beam of polarized antiproton will be obtained, the polarized antiproton–proton interactions (e.g. at the High Energy Storage Ring (HESR) at the future Facility for Antiproton and Ion Research (FAIR)) will provide unique access to a number of new fundamental physics observables. The physics program of such a facility would extend to a new domain the exceptionally fruitful studies of the nucleon structure performed in unpolarized and polarized deep inelastic scattering (DIS), which have been at the centre of high energy physics during the past four decades.
The physics case for experiments with polarized antiprotons is outstanding and concerns

- First ever direct measurement of transversity, the missing piece in the description of the spin structure of the proton. Double polarized antiproton-proton Drell-Yan reactions are entirely dominated by the annihilation of valence quarks in the proton with the valence antiquarks in the antiproton. The measured double spin-asymmetry A_{TT} gives direct and unique access first to transversity. No other existing or future facility will be ever able to directly measure the transversity in a competitive way. This measurement is for the understanding of the spin structure of the nucleon as fundamental as the wave function of the hydrogen atom in atomic physics.
- First measurements of the moduli and absolute phases of the electromagnetic form-factors in the time-like region, providing an independent way to test the Rosenbluth separation in the time-like region.
- Measurements of double-polarized proton-antiproton hard scattering to be compared to the analogue pp measurement, the asymmetry of which represents the largest ever measured asymmetry in hadron physics, and for which a theoretical interpretation is still missing.
- Hadron spectroscopy studies and searches for exotic new states like glueballs or hybrids will definitely benefit from polarization of beam and/or target particles, because the initial spin state of the system can be prepared at will.

Highest ratings have been repeatedly given by various scientific committees to the experiments proposed by PAX (see news section of the PAX website, where also all proposals of the PAX collaboration can be found: http://www.fz-juelich.de/ikp/pax.) Different theory groups are providing the basis and help to further develop the physics programme.

ii. Methodology

HOW? Implementation of a polarized target in two different storage rings to perform spin-filtering tests with protons (COSY-Jülich) and antiprotons (AD-CERN)

Aim of the Proposal

It is the aim of the present Proposal to perform dedicated measurement aimed to produce of the first ever intense beam of polarized antiprotons. In order to accomplish this goal, a proper experimental setup and a theoretical structure have to be implemented to support a series of dedicated experimental investigations.

Two sets of measurements are foreseen. One at the COSY-ring in Jülich and the other at AD ring at CERN.

Spin-filtering tests with the proton beam of COSY-Jülich
The depolarization experiments with protons at COSY rules also out the practical use of polarized leptons to polarize a beam of antiprotons with present-day technologies. This leaves us with the only proven method to polarize a stored beam in situ, namely *spin filtering*, exploiting the spin-dependence of the strong interaction using a polarized internal target. The measurements at COSY

will aim at a complete understanding of the spin-filtering process and to demonstrate that a consistent polarization build-up can be achieved in a storage ring.

Spin-filtering tests with the antiproton beam of AD-CERN,
Since polarized antiproton beams have never been available in the past, our present knowledge about the spin dependence of the antiproton-proton interaction is marginal. It is at present impossible to obtain a robust theoretical estimation of the polarization build-up of a stored antiproton beam. Therefore, it is mandatory to carry out spin-filtering experiments using stored antiprotons impinging on an internal polarized Hydrogen target at CERN. The Antiproton-Decelerator (AD) of CERN is currently the only machine worldwide which provides the required experimental conditions to perform such spin-filtering experiments with antiprotons.

Logistics and organization

The commissioning of a spin-filtering experiment in a storage ring requires the design, production and installation of five major dedicated components:

- i) a Polarized Internal Target using a Storage cell and a target polarimeter,
- ii) a polarimeter for the beam polarization,
- iii) a low-beta section,
- iv) an upgrade of the electron cooler at the AD for higher energies, and
- v) a Siberian-snake for the measurements with longitudinal polarization.

For the operation of the experimental setup, the implementation of a Data Acquisition System and Slow Control System will be required. The design of the elements has to take into account their utilization both in the COSY ring environment for the experiment with proton and in the AD-ring for the subsequent experiment with antiprotons. For this particular case dedicated modifications of the ring have also to be foreseen. The finalization of the detector geometry and the analysis of the acquired data will require the development of dedicated software for the experiment.

The present theoretical understanding of the spin-filtering process is unsatisfactory and it is the goal of the proposed measurements to experimentally solve this issue. Additional theoretical investigation will be required both as predictions and for the interpretation of the results of the measurements.

A working team is formed and the different activities related to the implementation of the experiment are structured into Tasks. The key-persons of the team, presented in the next sections, are responsible for the accomplishment of the tasks. Task 0 concerns the management of the experiment.

I) Experimental setup:

Task 1: Target
Task 2: Detector
Task 3: Data acquisition
Task 4: Slow control
Task 5: Design, construction and installation of the low-beta section
Task 6: Instrumentation for AD: design, construction and installation of Siberian – snake, electron cooler upgrade

II) Data analysis and theoretical investigations:

Task 7: Simulations and data analysis for COSY and AD
Task 8: Theoretical investigations

III) Measurements:
Task 9: Polarization build-up studies at COSY
Task 10: Polarization build-up studies at AD

A short description of the foreseen activity in each of the Tasks is given below:

I) Experimental setup

Task 1: Target
The Spin Filtering method is based on spin-selective scattering of a circulating proton or antiproton beam off a polarized internal gas target. The aim of this Task is to set up the polarized target consisting of:
- An Atomic Beam Source (ABS) to produce the polarized atomic beam;
- A so-called Breit-Rabi Polarimeter (BRP) to measure the polarization of the target gas;
- An openable storage cell implemented into a target chamber.

Task 2: Detector System
The detector for the spin-filtering experiments constitutes a multipurpose device which should work as beam polarimeter and recoil detector for the measurement of the spin-dependent cross-section, cope with a broad range of beam energies and fit into the lattices of the different accelerators (COSY at Jülich, and AD at CERN).

Task 3: Data Acquisition
The objective of this Task is the development of dedicated software for the Silicon Tracking Telescope (STT) tests, calibration and read-out procedures. It includes the development of the software needed to control front-end, trigger and read-out electronics of the STTs and a Graphical User Interface (GUI) to control run status and front-end, read-out and trigger electronics.

Task 4: Slow Control
The objective of this Task is the implementation of a control system for the experiment. In addition to the readout of the detector signals, also subsystems belonging to the detector environment like vacuum, target and high voltage have to be monitored and controlled. The signals coming from the sensors or the actuators of these subsystems have a typical response time of the order of milliseconds and all the electronics and software related to these signals is typically called “slow control system”.

Task 5: Design, Construction and Installation of the Low-β Section
The objective of this Task is the implementation of low-β sections into the lattices of the COSY and AD rings. In order to achieve this objective, a preliminary study of the optics and operation scheme of the rings with low-β sections, using a system of up to six normal conducting quadrupole magnets for the realization of the low-β section to be used at COSY and AD has to be carried out. In order to perform experiments with a longitudinal polarized beam, the operation of the rings with spin rotators (Siberian snakes) has to be investigated. At the COSY ring the use of a Siberian snake might be foreseen consisting of already existing solenoids. At the AD, the existing solenoids are not strong enough and new solenoids need to be incorporated into the ring lattice and their operation together with all existing elements needs to be studied and optimized.

Task 6: Instrumentation of AD ring: Design Construction and Installation of Siberian snake
Objectives of this Task are the necessary implementations on the AD – ring to perform the spin filtering experiments. In particular in order to perform experiments with longitudinal polarized beam and target the design, construction and installation of a Siberian snake has to be foreseen. The present AD electron cooler is limited to beam energies below 70 MeV. An upgrade is necessary in

order to explore the spin-dependence of the antiproton - proton interaction in the energy range up to about 500 MeV.

II) Data analysis and theoretical investigations

Task 7: Simulations and Data Analysis for COSY and AD

The objective of this task is to perform dedicated simulations of the detector design and its optimization to efficiently detect proton-proton elastic scattering events at the COSY ring. At the same time the possibility has to be foreseen to use the same detector (probably with minor modifications) with the antiproton beam of the AD ring. The objective of this task is also the development of dedicated simulation and analysis codes for the experiments at AD.

Task 8: Theoretical Investigations

The main task of the theory team is to provide theoretical support for the spin-filtering experiments with protons at COSY, and antiprotons at AD.

III) Measurements

Task 9: Polarization Build-up Studies at COSY

The objective of this task is the polarization build-up experiments at the COSY ring. The build-up measurements will contribute to the complete understanding of the spin-filtering mechanism. At the same time an important goal will be the demonstration that a high-degree of polarization can be achieved in a storage ring by means of the spin-filtering technique. This will be a fundamental step beyond the feasibility test experiment at TSR (FILTEX). The measurements at COSY will also serve as a commissioning experiment of the experimental apparatus for the subsequent measurements at the AD ring.

Task 10: Polarization build-up studies at AD

Objective of this task is the measurements of the spin-dependence of the p-pbar cross section at the AD ring at CERN. The experimental basis for predicting the polarization build-up in a stored antiproton beam is practically non–existent. The AD–ring at CERN is a unique facility at which stored antiprotons in the appropriate energy range are available and whose characteristics meet the requirements for the first ever antiproton polarization build-up studies.

The two double–spin observables, which can be measured by the spin–filtering technique, are the spin–dependent cross sections σ_1 and σ_2 in the parameterization of the total hadronic cross section σ_{tot}, written as

$$\sigma_{tot} = \sigma_0 + \sigma_1 (\mathbf{P} \cdot \mathbf{Q}) + \sigma_2 (\mathbf{P} \cdot \mathbf{k})(\mathbf{Q} \cdot \mathbf{k}) ,$$

where σ_0 denotes the total spin–independent hadronic cross section, σ_1 the total spin– dependent cross section for transverse orientation of beam polarization **P** and target polarization **Q**, σ_2 denotes the total spin–dependent cross section for longitudinal orientation of beam and target polarizations, **k** points along the beam direction.) Such observables would improve substantially the modern phenomenology of proton–antiproton interactions based on the experimental data gathered at LEAR. The spin–filtering experiment at the AD of CERN aims at measuring for the first time these observables in the energy range of 50–500 MeV. The measurements of σ_1 and σ_2 will be carried out in transmission mode.

iii. Resources (incl. project costs)

Presentation of the Team

Task 0: Management

H. Ströher (FZJ – Jülich, staff)
F. Rathmann (FZJ – Jülich, staff)

Task 1: Target.

Responsible: P. Lenisa (Università di Ferrara and INFN, staff)
Other members: G. Giullo (Università di Ferrara and INFN, staff)
A. Nass (FZJ – Jülich, PostDoc)
B.

Task 2 : Detector System

Responsible: R. Schleichert (FZJ – Jülich, staff)
Other members: S. Merzliakov (JINR – Dubna, Guest Scientist)
M. Contalbrigo (INFN – Ferrara, Staff)
D. Oellers (FZJ – Jülich, PostDoc)

Task 3: Data Acquisition

Responsible: S. Trusov (JINR – Dubna, Guest Scientist)
Other members: P. Wüstner (FZJ – Jülich, staff)
S. Merzliakov (JINR – Dubna, Guest Scientist)

Task 4: Slow Control

Responsible: H. Kleines (FZJ, staff)
Other members A. Cotta Ramusino (INFN – Ferrara, Staff)

Task 5: Design, Construction and Installation of a Low-β Section

Responsible: B. Lorentz (FZJ – Jülich, staff)
Other members: A. Lehrach (FZJ – Jülich, staff)
M. Statera (Università di Ferrara and INFN, staff)
A. Garishvili (FZJ – Jülich, PostDoc)

Task 6: Instrumentation of AD: Design, Construction and Installation of a Siberian snake

Responsible: A. Lehrach (FZJ – Jülich, staff)
Other members: B. Lorentz (FZJ – Jülich, staff)
A. Garishvili (FZJ – Jülich, PhD – Student)

Task 7: Simulation and Data Analysis for COSY and AD

Responsible: G. Macharashvili (JINR – Dubna, staff)
Other members: S. Barsov (JINR – Dubna, staff)
M. Nekipelov (FZJ – Jülich, PostDoc)

Task 8: Theoretical Investigations

Responsible: N.N. Nikolaev (FZJ – Jülich, staff)
Other members: J. Haidenbauer (FZJ – Jülich, staff)

Task 9: Polarization build-up studies at COSY

Responsible: Management
Other members: Complete team

Task 10: Polarization build-up studies at AD

Responsible: Management
Other members: Complete team

Presentation of the status of the resources for the single tasks

Task 1: Target
The Atomic Beam Source and Breit-Rabi polarimeter of the HERMES experiment which has been decommissioned in 2005 has been moved to Jülich and put back into operation under the responsibility of FZJ and the Ferrara group. The whole setup has an estimated value about 0.8 M€. Maintenance and running costs can be estimated to be of about 200 k€ and will be supported by FZJ and Ferrara. For this task, a two year PostDoc position shall be financed through this grant.

Task 2: Detector System
Partial use will be made of Silicon-layers of the HERMES recoil detector which geometry fits the needing of the experiments. The estimated value of these Silicon detectors is of about 0.2 M€. The present grant will guarantee the 0.7 M€ necessary for additional silicon detector to increase the acceptance and for the readout electronics. In the European grant a three year contract for a senior scientist is foreseen for the FZJ. The person will be involved in the development and commissioning of the detector

Task 3: Data Acquisition
The measurements at the COSY ring will be supported by the existing Data Acquisition system of the ANKE experiment. A stand alone Data Acquisition system will be also developed for the Silicon detector for the following experiments at AD. The estimated cost of this system is about 200 k€ and will be supported by FZJ and the Dubna group. For this demanding task, we have foreseen a two year postdoctoral position for Jülich and Ferrara, and a three year postdoctoral position for the Dubna group.

Task 4: Slow Control
The ZEL (Zentrallabor Elektronik) of the FZJ will take over the design and implementation of the slow control system. Investment costs around 200 k€ are foreseen and will be supported by the FZJ.

Task 5: Design, Construction and Installation of a low-β Section
The accelerator group of FZJ will study the quadrupole magnet system for the low-β target section. Four quadrupoles have to be foreseen for the COSY ring, while six will be necessary for the experiments at AD. The estimated investment costs are about 0.6 M€, which will be guaranteed by the present application. A three year contract for a senior physicist with experience in accelerator physics will be financed for the Ferrara group, and a two year postdoctoral position for an accelerator expert in Jülich.

Task 6: Instrumentation of AD: Design, Construction and Installation of a Siberian snake; Upgrade of the AD electron cooler
Besides additional beam diagnostics a crucial point of the AD experiment will be the measurement of the p-pbar cross section for longitudinally polarized beam. This will require the installation in the ring of a Siberian snake. The snake design will be finalized the FZJ accelerator group. The cost of a Siberian snake with the proper characteristics for the experiment is around 0.6 M€. The cost of the electron cooler upgrade is estimated to amount ~1 M€. These expenses will be financed through third party funding. For Jülich, our application foresees a two year contract for a PostDoc with experience in electron cooler operation.

Task 7: Simulation and Data Analysis for COSY and AD
Simulation and data analysis will be performed by a joint team from all the participating institutions which have long experience in polarized physics experiments. Two three year contracts for physicists for the Dubna group are foreseen to be financed from the EU contribution to the present project. In order to support this effort, the Ferrara group requires a two year contract for an

experienced person. The personnel will develop and utilize the analysis codes necessary for the experiment.

Task 8: Theoretical Investigations
The theoretical group of FZJ has long proven experience in the field of low-energy polarized physics and will provide the proper theoretical support to the experimental investigations.

Task 9 and 10: Polarization build-up studies at COSY and AD
The management of the experiment will be responsible for the preparation and organization of the measurements. The responsible persons have acknowledged experience in leading international groups.

Project costs:
The proposed experiment requires substantial investments in the five main parts of the apparatus: the polarized target, the detector, the low-β section, the upgrade of the AD electron cooler, and the Siberian snake. The polarized target and part of the detector system have been recovered from the previous HERMES experiment, the investment costs from the present application are solely used for the completion of the detector and the readout electronics. The magnets for the low-β section, the electron cooler upgrade, and the Siberian snake will come from contributions of the collaborating institutions to this project. A summary of the total investment costs over the five year duration of the project is presented in the following table:

Table: **Summary of total investment costs (in k€)**

		2010	2011	2012	2013	2014	Sum
Task 1	**All**	840	40	40	40	40	1000
	Own	840	40	40	40	40	1000
	EC	0	0	0	0	0	0
Task 2	**All**	900	15	15	15	15	960
	Own	200	15	15	15	15	260
	EC	700	0	0	0	0	700
Task 3	**All**	0	200	10	10	10	230
	Own	0	200	10	10	10	230
	EC	0	0	0	0	0	0
Task 4	**All**	200	5	5	5	5	220
	Own	200	5	5	5	5	220
	EC	0	0	0	0	0	0
Task 5	**All**	415	15	215	15	15	675
	Own	415	15	215	15	15	675
	EC	0	0	0	0	0	0
Task 6	**All**	0	1000	600	15	15	1630
	Own	0	1000	600	15	15	1630
	EC	0	0	0	0	0	0
Task 7	**All**	0	0	0	0	0	0
	Own	0	0	0	0	0	0
	EC	0	0	0	0	0	0
Task 8	**All**	0	0	0	0	0	0
	Own	0	0	0	0	0	0

	EC	0	0	0	0	0	0
Task 9	**All**	0	0	0	0	0	0
	Own	0	0	0	0	0	0
	EC	0	0	0	0	0	0
Task 10	**All**	0	0	0	0	0	0
	Own	0	0	0	0	0	0
	EC	0	0	0	0	0	0
Sum	**All**	2355	1275	885	100	100	4715
	Own	1655	1275	885	100	100	4015
	EC	700	0	0	0	0	700

The personal costs of the project will be mainly covered by the involved institutions. The contribution from the European Union will be used to finance postdoctoral positions at each of the participating institutions. The requested personnel will be focusing on the four tasks, Detector System (Task 2), Data Acquisition (Task 3), Low-beta Section (Task 5), Instrumentation of AD (Task 6), and Data Analysis (Task 7). In the following table we summarize the total staff effort to the best of our knowledge.

Table: **Summary of total staff effort (in person months)**

Part. No.		**Tasks**											**Sum**
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
1 FZJ	**All**	96	60	156	90	36	120	60	36	36	24	24	738
	Staff	96	60	120	66	36	96	36	36	36	24	24	630
	EC	0	0	36	24	0	24	24	0	0	0	0	108
2 FER	**All**	0	90	60	36	12	60	0	36	0	12	12	318
	Staff	0	66	60	12	12	24	0	12	0	12	12	210
	EC	0	24	0	24	0	36	0	24	0	0	0	108
3 JINR	**All**	0	0	60	96	0	0	0	132	0	12	12	312
	Staff	0	0	60	60	0	0	0	60	0	12	12	204
	EC	0	0	0	36	0	0	0	72	0	0	0	108
Sum	**All**	96	150	276	222	48	180	60	204	36	48	48	1368
	Staff	96	126	240	138	48	120	36	108	36	48	48	1044
	EC	0	24	36	84	0	60	24	96	0	0	0	324

The following table gives an account of how the funds requested through the ERC Advanced Grant money shall be spent will be spent during the five year project. The bulk of the funds are used to finance postdoctoral position at the different institutions. For travel we used an ansatz of 200€ per requested person month, equally distributed for the three involved institutions and the five year duration of the project. The specified cost for subcontracting involves the auditing process which is carried out by external firms.

Table: **Summary of Costs requested to be financed by the ERC Advanced Grant (in €):**

		2010	2011	2012	2013	2014	Total
Direct Costs:	*Personnel:*						
	PI	0	0	0	0	0	0
	Senior Staff	0	0	0	0	0	0
	Post docs	252851	252851	252851	252851	252851	1264254
	Students	0	0	0	0	0	0
	Other	0	0	0	0	0	0
	Total Personnel:	252851	252851	252851	252851	252851	1264254
	Other Direct Costs:						
	Equipment	700000	0	0	0	0	700000
	Consumables	0	0	0	0	0	0
	Travel	12960	12960	12960	12960	12960	64800
	Publications, etc	0	0	0	0	0	0
	Other	0	0	0	0	0	0
	Total Other Direct Costs:	712960	12960	12960	12960	12960	764800
	Total Direct Costs:	965811	265811	265811	265811	265811	2029054
Indirect Costs (overheads):	Max 20% of Direct Costs	193162	53162	53162	53162	53162	405811
Subcontracting Costs:	(No overheads)	2700	2700	2700	2700	2700	13500
Total Costs of project:	(by year and total)	1161673	321673	321673	321673	321673	2448365
Requested Grant:	(by year and total)	1161673	321673	321673	321673	321673	2448365

iv. Ethical Issues

Ethical issues Table:

	Research on Human Embryo/ Foetus	**YES**	**NO**
	Does the proposed research involve human Embryos?		**X**
	Does the proposed research involve human Foetal Tissues/ Cells?		**X**
	Does the proposed research involve human Embryonic Stem Cells (hESCs)?		**X**
	Does the proposed research on human Embryonic Stem Cells involve cells in culture?		**X**
	Does the proposed research on Human Embryonic Stem Cells involve the derivation of cells from Embryos?		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

	Research on Humans	YES	NO
	Does the proposed research involve children?		**X**
	Does the proposed research involve patients?		**X**
	Does the proposed research involve persons not able to give consent?		**X**
	Does the proposed research involve adult healthy volunteers?		**X**
	Does the proposed research involve Human genetic material?		**X**
	Does the proposed research involve Human biological samples?		**X**
	Does the proposed research involve Human data collection?		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

	Privacy	YES	NO
	Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?		**X**
	Does the proposed research involve tracking the location or observation of people?		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

	Research on Animals	YES	NO
	Does the proposed research involve research on animals?		**X**
	Are those animals transgenic small laboratory animals?		**X**
	Are those animals transgenic farm animals?		**X**
	Are those animals non-human primates?		**X**
	Are those animals cloned farm animals?		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

	Research Involving Developing Countries	YES	NO
	Does the proposed research involve the use of local resources (genetic, animal, plant, etc)?		**X**
	Is the proposed research of benefit to local communities (e.g. capacity building, access to healthcare, education, etc)?		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

	Dual Use	YES	NO
	Research having direct military use		**X**
	Research having the potential for terrorist abuse		**X**
	DO ANY OF THE ABOVE ISSUES APPLY TO MY PROPOSAL?		**X**

Other Ethical Issues	YES	NO
Are there **OTHER** activities that may raise **Ethical Issues**?		**x**
If **YES** please specify:		

Section 3: *Research Environment* (max 2 pages)

i. PI's Host institution FZJ-Jülich

Expertise in:

- Operation of the Cooler Synchrotron COSY
- Spin physics experiments in storage rings, accelerator design; production of polarized proton and deuteron beams; stochastic and electron cooling; design of superconducting magnets and other accelerator equipment; beam dynamics calculations; design of spin manipulators for stored beams.
- Design, construction and operation of internal targets for storage ring experiments, including polarized gas targets.
- Design, construction, simulation and data analysis of spin physics experiments, including in particular the design, construction, and operation of Silicon-based detection systems.
- The infrastructure divisions FZJ-ZAT (mechanical engineering) and FZJ-ZEL (electronic engineering) provide excellent engineering and workshop capabilities to build and operate large-scale scientific equipment.

FZJ is involved in the following tasks:

Task 0: The project will be managed by a management team under the leadership of the PI.

Task 2: The silicon based detector systems presently utilized at the ANKE experiment at COSY constitute a completed recent development from scratch at IKP of FZJ, with strong support by ZAT-FZJ. The required detector system to perform the proposed project will be based upon these developments.

Task 4: The slow control experts from IKP and ZEL of FZJ involved in the proposed project possess an outstanding experience in automation of scientific equipment.

Task 5: Physicists of the COSY accelerator group together with experts in magnet design are responsible for the low-β section.

Task 6: Physicists of the COSY accelerator group will supervise the process of building the additional instrumentation needed to carry out the experimental investigations at the AD of CERN. They will also design, and supervise the construction of the upgrade of the AD electron cooler, together with experts from CERN.

Task 8: The Theory group of FZJ-IKP possesses an outstanding record of scientific achievement in the medium energy nuclear physics sector, In particular their expertise in antinucleon-nucleon scattering.

ii. Additional institutions (additional participants)

Università di Ferrara and INFN – Ferrara Italy

Expertise in:

- Experiments with both electromagnetic (HERMES) and hadronic probes (LEAR, E835).
- Polarized targets. The group was responsible for the running of the Internal Polarized Target of the HERMES experiment. A laboratory for the development of high-intensity sources has been equipped in Ferrara.
- Storage cells. The mechanical workshop has been responsible for the design and production of the storage cells of the HERMES experiment.
- Analysis of polarized data (HERMES).
- DAQ. The electronic workshop has worked to the design and realization of the DAQs system for different high-energy physics experiments (NA 48 – CERN, E835-Fermilab, and Babar-SLAC).
- Superconductivity. Prototype construction, characterization, and precise mapping.
- Coordination activities in international collaborations.

The Ferrara group is involved in the following tasks:

Task 0: The project will be managed by a management team under the leadership of the PI.

Task 1: After its successful running in the HERMES experiment, the target has been transferred to Jülich and it will be put back into operation with the proper modifications. An openable storage cell has to be designed and produced in Ferrara.

Task 5: The Ferrara laboratory is equipped with a complete system for mapping of magnets at working conditions.

JINR – Dubna – Russia

SIS100 related: JINR operates the Nuclotron synchrotron with fast ramped superconducting magnets at 4 T/s and has a long term experience in magnet design. The Nuclotron type of superferric magnets is the basis for the development of the SIS100 magnets. Expertise in high-energy particle physics and relativistic nuclear physics; in the development of the simulation and analysis software at JINR, IHEP, FNAL and CERN; the design and construction of the position-sensitive detectors (proportional and drift chambers, Iarocci tubes, muon detectors) at JINR, IHEP, FNAL and CERN; time-of-flight systems at CERN; electromagnetic and hadronic calorimeters at ITEP and CERN; design and construction of the conventional and superconducting magnets for spectrometers and accelerators at JINR and CERN, design and construction of advanced computerised multi-channel high voltage systems at CERN, Uppsala and BNL, front-end electronics and data acquisition systems. PANDA specific tasks: Event generators for pbar-p and pbar-A annihilations, software development for tracking, event reconstruction and simulation, GRID computing, magnet design (TOSCA magnetic field calculations, stress analysis, engineering, cryogenics) and prototype development, avalanche photo detectors and hybrid PMT's. PANDA related facilities: Electronics laboratory, clean room facility and mechanical workshops, access to the existing Nuclotron accelerator and computer centre.

JINR group is involved in the following tasks:

Task 3: The expertise called upon here is available through a number of world leading experts in the field of data acquisition, and control and development of detection systems. Within the ANKE and HERMES, and DIRAC collaborations, many of the scientists involved are already well-known as strong contributing partners in international collaborations.

Task 7: JINR is a very crucial participant in the proposed project, in particular in this Task, and the working group leader has a proven record of excellence in the field, as participant in many international collaborations.