

## **Update of the**

## **HADES Memorandum Of Understanding**

## **for the execution of the HADES experiment during FAIR Phase-0**

Between

GSI Helmholtzzentrum für Schwerionenforschung GmbH (GSI) Darmstadt, GERMANY

hereafter referred to as the „Host“,

on the one hand,

and

- Laboratório de Instrumentação e Física Experimental de Partículas (LIP), Coimbra, PORTUGAL
- Consortium HADES-PL-FAIR consisting of Jagiellonian University (JU), Institute of Nuclear Physics (INP-Kraków), University of Warsaw (UW), POLAND
- GSI Helmholtzzentrum für Schwerionenforschung GmbH (GSI) Darmstadt, GERMANY
- Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, GERMANY
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Inst. für Strahlenphysik, Dresden, GERMANY
- Joint Institute of Nuclear Research (JINR), LHEP, Dubna, RUSSIA
- Johann-Wolfgang Goethe Universität, Institut für Kernphysik, Frankfurt, GERMANY
- Technische Universität München, Excellence Cluster Universe, Garching, GERMANY
- Justus-Liebig Universität, II Phys. Inst., Giessen, GERMANY
- Forschungszentrum Jülich (FZJ), Jülich, GERMANY
- Institute of Theoretical and Experimental Physics (ITEP), Moscow, RUSSIA
- Institute for Nuclear Research (INR), Russian Academy of Science, Moscow, RUSSIA
- Moscow Engineering Physics Institute (MEPhI), Moscow, RUSSIA
- University of Cyprus, Department of Physics, Nicosia, CYPRUS
- Institut National de Physique Nucléaire et de Physique des Particules du Centre National de la Recherche Scientifique (IN2P3/CNRS) acting for and on behalf of Institut de Physique Nucléaire d'Orsay (IPNO), Orsay, FRANCE
- Nuclear Physics Institute (NPI), Czech Academy of Sciences, Rez, CZECH REPUBLIC
- Universidade de Santiago de Compostela, Dep. de Física de Partículas, Santiago de Compostela, SPAIN  
Department of Physics, Bergische Universität Wuppertal (BUW), Wuppertal, GERMANY

on the other hand,

hereafter individually and collectively referred to as the “Party” or the “Parties” respectively, including the “Host”.

# 1 Regulatory framework of the agreement

## 1.1 Introduction

HADES has the aim of studying the properties of hadrons in nuclear matter at normal and elevated densities and temperatures. The experimental program includes reactions induced by heavy ions, up to Au+Au as well as pion, proton or deuteron beams. The HADES detector is installed at GSI.

## 1.2 Purpose of the agreement

The purpose of this agreement is to define the distribution of tasks and responsibilities between the groups. It also defines the financial contribution of each group as agreed upon by the different institutes. The present agreement is an update of the MoU for the Execution of the Experiment HADES dating 29.9.1999 and its subsequent modifications (most recent one on 9.12.2012), which become integral parts of the present agreement. The present version of the MoU reflects in particular aspects of the upgrade and operation of the detector during FAIR Phase-0. It will be replaced as soon as FAIR will request common MoU's from all FAIR collaborations based on General Conditions for Experiments at FAIR.

## 1.3 Physics programme

The main objective of HADES is to investigate the microscopic properties of resonance matter formed in heavy-ion collisions in the 1-2 AGeV energy regime. Various probes are used for these studies, such as  $e^+e^-$  pairs, strangeness, photon and meson production. The program also comprises experiments with proton, deuteron and pion beams to study either cold matter or elementary mechanisms. Analysis activities are organized in the Physics Working Groups (PWG), as described in section 2. The priority for upcoming experiments at SIS18 is decided by the Collaboration Board, after public discussion in HADES collaboration meetings.

## 1.4 Participants

The Parties of this agreement are listed on the front page of this document. A party is either an institute or a consortium of institutes. The Parties, except for the Host, shall provide the necessary financial support for the participation to the experimental runs including their contribution to the common funds. The amount of these contributions is listed in the institute or consortium pages collected in section 4, where each party also indicates its interest towards the different aspects of the physics program.

HADES can grant associated membership to individuals in cases where her/his host institution is not member of the HADES collaboration. Associate membership is granted upon a positive vote of the Collaboration Board (two-third majority of votes cast). Partial membership provides access to the HADES data and authorship of selected HADES papers, in agreement with the spokesperson.

Access of new parties to the collaboration is welcome, provided it brings new resources in terms of technical contributions or analysis manpower. The formal procedure to be followed, in such a case, shall go through the submission of a detailed request of membership to the HADES Collaboration Board. Membership is granted upon positive vote (two-third majority of CB members entitled to vote).

## 1.5 Organization of the collaboration

### 1.5.1 Collaboration Board

This body decides about matters that concern the general policy of the collaboration. It is formed by duly authorized representatives of the Parties. The representatives are decided upon by the member institutions. Only representatives of full members have voting right and each of them possess one vote. Decisions of the CB shall be taken by reaching a consensus. In case a consensus cannot be reached, the decision shall be taken by voting. 2/3 (two third) of the Parties entitled to vote, present in person or by proxy, shall constitute a quorum. Usual decisions shall require a 2/3 (two third) majority of the votes cast. Decisions concerning the access of new Parties shall be taken by 2/3 majority of the CB members entitled to vote. All documents (reports, list of candidates, etc.) related to decisions should be filed to the CB at least 5 working days in advance. The CB meets regularly at each collaboration meeting. CB board meetings can also be organized on a short notice in cases where important decisions have to be taken urgently, for example, concerning data taking.

The Chairperson is elected among the members of the CB by simple majority. The duration of the mandate is 3 years, with no limitation in the number of recurring nominations.

The CB appoints, in consultation with the GSI management for a period of 3 years, with no limitation of recurring nominations, a Spokesperson (SP), a Deputy (DE), a Technical Coordinator (TC) and a Software Coordinator (SC) with duties as defined below. These persons are ex-officio members of the Collaboration Board without voting right. The same goes for the Deputy Technical Coordinator and the Resource Coordinator.

### 1.5.2 Spokesperson and Deputy

The spokesperson (SP) and the deputy spokesperson (DSP) are elected by the Collaboration Board (CB) by simple majority of votes and for a period of 3 years. They are appointed after consultation with the GSI management. Re-election is possible. The DSP will not be from an institution of the same country as the spokesperson. The SP is responsible for the representation of the collaboration in scientific, technical and managerial concerns and coordinates all efforts of the collaboration. He reports to the CB on all items and prepares all major decisions to be made by the CB. The SP is responsible for the assignment of invited talks at conferences.

The DSP provides support to the SP in the management of the collaboration. In case the SP is not available, the DSP takes over his responsibilities. After consultation of and together with the members of corresponding committees they may take over all relevant decisions which do not allow further delay. Any decision is immediately forwarded to the CB. In particular, SP and DSP will be concerned with all preparations required to have an operating setup according to scheduled time scale. All management decisions are taken in understanding with the Executive Board (XB).

### 1.5.3 Executive Board (XB)

It shall administrate on a short-term basis (weekly) all actions resulting from decisions taken by the CB. Its role is also to prepare important decisions to be taken by the CB. It is composed of the following office holders: the Spokesperson, the Deputy, the Technical Coordinator, his/her deputy and the CB chairperson.

### 1.5.4 Technical Coordinator and deputy

The technical coordinator (TC) is elected by the CB by simple majority of votes and appointed after consultation of the GSI management. The TC monitors the activities of the various project groups to ensure a coherent design of HADES and to resolve potential conflicts arising from incompatible design decisions within parts of HADES. The TC *only* can authorize any update of the HADES

detector. The TC receives and evaluates status reports from each project coordinator. He delivers summary reports to the CB. The TC is assisted by the technical coordinator of HADES at SIS100 who acts as a deputy. The deputy is proposed by the Technical Coordinator and endorsed by the Collaboration Board.

#### 1.5.5 Technical Project Coordinators

The different tasks within the collaboration are supervised by technical project coordinators (TPC). TPCs are nominated for the work related to detectors, computing, and infrastructure. The TPCs carry responsibility for all technical decisions concerning their project. Each TPC has sole responsibility for the assignment of task to manpower within the project. Design considerations, which have (or potentially might have) impact to other parts of HADES, have to be discussed with the corresponding TPC and with the TC. No such decision may be taken against the veto of the TC. In case of a "decision making deadlock", the spokesperson should be informed. The TPC is obliged to deliver a freeze-out of the project design upon request by the TC.

#### 1.5.6 Technical Board (TB)

The Technical Board is chaired by the Technical Coordinator. It consists of the Technical Project Coordinators and the deputy Technical Coordinator. Its aim is to coordinate the different projects and to assist the Technical Coordinator in the decision-making procedure. The Technical Board meets at least at each Collaboration Meeting and on a shorter notice when necessary.

#### 1.5.7 Task Forces

SP and the CB can install task forces for addressing and solving special issues, as e.g. future extensions of the present setup. Technical solutions are prepared in consultation with the TC and with corresponding project coordinators.

#### 1.5.8 Publication and Documentation Committee (PDC)

The board is composed of five ex officio members, i.e. the members of the XB. Additional six members are elected by the CB by simple majority of the votes cast. The PDC committee prepares collaboration documents (design report, status reports) and is responsible for the HADES WWW pages. The committee reviews all contributions to conferences and journals prior to submission. Details are laid out in section 2 (Hades Analysis and Publication Policies).

#### 1.5.9 Software Coordinator (SC)

The Software Coordinator (SC) is elected by the CB by simple majority of votes and appointed after consultation of the GSI management. He/she shall deal with the simulation and the data analysis tasks. He/she organizes the development and implementation of the standard analysis and simulation packages and ensures the quality of the package. He/she shall report regularly to the CB.

#### 1.5.10 Resource coordinator:

The Resource Coordinator is appointed by the GSI/FAIR management. He/she represents the HADES collaboration at the Resource Review Board where financial issues concerning future experiments at FAIR are discussed.

## 1.6 General conditions

The general terms of this agreement between GSI and the Parties are described in the document "General Conditions for Experiments at GSI". By signing the agreement, the Parties agree with the conditions defined in this document.

## 1.7 Data and intellectual properties

The rules laid down in the original MoU shall apply accordingly. New and associated members which did not sign the original agreement confirm by signing the present agreement that they consent and conform to these rules.

## 1.8 GSI and collaborating institutions obligations

The details of responsibilities and obligations of each Party are defined in sections 6 to 8.

## 1.9 Effective date

The addendum shall become effective for each party according to chapter 7.1. It shall remain in effect until the 31st of December 2022. The deadline of involvement of each party is the 31st of December 2022, unless differently stated and expressed in chapter 6 which defines the commitment of each institution. A further extension of the agreement is, however, possible.

## 1.10 Common funds

The participation to the common funds is mandatory. Every Party, except for the Host, contributes at least a sum of 1000€ per annum, which shall be used to cover the running costs of the experiment (consumables, small repairs or maintenance). As an exception lower contributions can be discussed and unanimously agreed upon, after a formal request by the Party to the CB and an agreement by the CB majority, but shall never be lower than 500 € per Party. Other ways to contribute to the HADES running costs may also be envisaged. The decision to use common funds for any expense shall be taken by the Executive Board. The contributions of the Party are transferred to GSI and booked to the HADES Common Fund Account. The authorized signatory of this account is the HADES department leader at GSI who will spend the money in accordance with decisions of the Executive Board.

## 1.11 Confidentiality

- (1) Confidential Information within the meaning of this agreement shall be all information either arising from documents (including in electronic form) provided by the Disclosing Party to the Recipient in connection with this agreement and which has been explicitly marked as "confidential", or when disclosed orally, has been identified as confidential at the time of disclosure and has been confirmed and designated in writing within 15 days from oral disclosure at the latest as confidential information by the Disclosing Party.
- (2) The Recipient undertakes to maintain strict confidentiality and to treat with the same degree of protection with which they treat their own Confidential Information and not to disclose such information to third parties. Moreover, the Recipient undertakes to use Confidential Information exclusively for the purpose of fulfillment of the agreement.
- (3) The Recipient shall be entitled to disclose Confidential Information to its employees, however, only to the extent necessary to fulfill the agreement. The Recipients shall be responsible for the fulfillment of the above obligations on the part of their employees and shall ensure that their

employees remain so obliged, as far as legally possible, during and two years after the end of the agreement and/or after the termination of employment.

- (4) In order to achieve the object of this agreement, Confidential Information may also be disclosed to third parties provided that the Disclosing Party has given its prior written consent. In the event of disclosure of Confidential Information, the Recipient shall impose, in written form, the confidentiality obligation undertaken by it upon such individuals or companies whom the Parties entrust with Confidential Information or work under this Contract. The imposition of the confidentiality obligation upon such third party by the Recipient shall constitute an agreement for the benefit of the Disclosing Party with recourse. In addition, the Recipient shall be jointly and severally liable for compliance by the third party with this Confidentiality Agreement.

### 1.12 Exemptions from the undertaking of confidentiality

- (1) The obligations specified above shall not apply to the results of data analysis as well as of simulations even if they are marked as confidential. They are treated in accordance with rules given in chapter 2. "HADES Publication Policies".
- (2) The obligations specified above shall not also apply to the extent to which the Recipient can prove that such Confidential Information was lawfully:
  - available to the general public at the time of disclosure or became available to the general public thereafter,
  - disclosed to the Recipient without any obligation of confidence by a third party who is in lawful possession thereof and under no obligation of confidence to the Disclosing Party,
  - already in the possession of or known to the Receiving Party at the time of disclosure,
  - developed independently by the Receiving Party, and in good faith, by its employees who did not have access to the Confidential Information, or
  - required to be disclosed by the Receiving Party in a judicial or administrative proceeding

### 1.13 Return/destruction of documents

The Recipient shall return all documents and records containing Confidential Information within the meaning as defined above and all copies thereof to the Disclosing Party at the latter's request within one year after this agreement has been

executed. For this purpose, the term documents shall also include floppy disks and any other kind of data carriers. In the event of data stores incapable of being surrendered, such as hard disks etc., the Recipient shall delete or otherwise destroy the relevant data relating to Confidential Information at the request of the Disclosing Party. At the request of the Disclosing Party, the Recipient shall confirm in writing without undue delay that all documents and records have been returned or, as the case may be, deleted or destroyed in accordance with the obligation stipulated above. To prohibit the roaming of premature analysis results which have not been approved by the HADES Collaboration

## 2 HADES Analysis and Publication Policies

### 2.1 Data Analysis

- (1) Data from all HADES beam times is available for analysis to all members of the HADES Collaboration. The analysis has to be based on data summary tapes (DST) obtained with the official HYDRA analysis package.

- (2) All analysis projects carried out have to be announced to the Executive Board who will, in consultation with the group announcing the analysis, assign the proper Physics Working Group (PWG).
- (3) The progress of the analysis has to be regularly presented in open (to the collaboration) analysis meeting (see section PWG).
- (4) All analysis activities leading to HADES publications are carried out in one of the Physics Working Groups. The number of active PWG's can change depending on the evolution of the experimental programme.
- (5) The appointment or replacement of a coordinator is proposed by the XB and approved by the CB.
- (6) The PWG leaders in consultation with the XB define the computer infrastructure used for documentation and communication (tools). All PWG use the same tools.
- (7) Each PWG schedules regular meetings during fixed weekly time slots which are defined by the PWG leaders and validated by the XB. The meetings are open to the collaboration and organized as video conferences. The date of a given PWG meeting is chosen after consulting the other PWG leaders and is announced at least one week in advance. The PWG leaders are responsible for the organization of respective analysis sessions during regular collaboration meetings.
- (8) Data being ready for a public presentation or a publication are presented in a PWG meeting and validated by the PWG leader(s) and the spokesperson. The corresponding pictures are stored in a password-protected location.

## 2.2 Presentation of Analysis Results

- (1) The Spokesperson will distribute speaking invitations received by the Collaboration on the basis of suitability of the speaker to the topic, and an equitable distribution of talks to individuals and institutions. Members of the Collaboration who receive personal invitations to give talks must inform the Spokesperson.
- (2) All members of the Collaboration should exercise caution and good judgment when discussing experimental results with individuals outside the Collaboration before the results have been published (i.e., presented publicly in a seminar or conference or submitted for publication in a scientific journal). These results should clearly be labelled "Preliminary".
- (3) When individuals outside the Collaboration are consulted for advice on the analysis or interpretation of the data, those individuals should be asked to respect the confidentiality of the data.
- (4) Members of the Collaboration should not present unpublished analysis results outside the collaboration in seminars, conferences, or other public forum unless:
  - The plots to be publicly shown have been validated, as described above.
  - The presentation has been posted in the HADES forum and the collaboration notified with a response period of at least one week for comments.
  - In some specific cases (first presentation of new results, important conference, etc.) a rehearsal is made, after request of the Spokesperson, in front of at least two members of the collaboration and a PWG leader.
  - Final approval on the presentation content is obtained from the Spokesperson following the response period

## 2.3 Publication of Papers

### Papers of categories I

They present physics results which require extensive review and consultation of several collaboration members. The Publication and documentation Committee (PDC) will steer the publication process.

The submission of a category I paper proceeds along the following steps:

- (1) The leader of the PWG which guides the analysis process announces to the PDC the preparation of a paper and proposes the name of the chair of the writing committee and eventually other colleagues who will participate in preparing the draft.
- (2) The PDC approves the Paper Writing Committee (PWC) and adds a minimum of one colleague who did not take part in the respective analysis procedure as member of the writing committee. This person will take care that the general readability for non-experts is realized and acts as an unbiased writer.
- (3) Upon finalization of the draft, the PDC forms an internal Paper Review Committee (PRC), comprising a minimum of two colleagues, who will read and comment on the paper. The process of internal review is finished, when both the PRC and PWC agree on the quality of the paper draft.
- (4) The draft is placed on the Forum and the Collaboration is informed by email about the new paper draft. The discussion about the paper draft proceeds openly using the HADES Forum. The remarks are considered by the PWC. This review process lasts for a period of two weeks.
- (5) After this process, the PDC validates and submits the draft to a journal agreed about in consultation with the PWC. As corresponding email, the address [hades-info@gsi.de](mailto:hades-info@gsi.de) is used. Read access to [hades-info@gsi.de](mailto:hades-info@gsi.de) is granted to the whole Collaboration.
- (6) The iteration with the journal review team is steered by the PDC.

#### 2.3.1 Category II papers

A conference contribution requiring a proceeding is announced in time to the PDC. The PDC assigns a member who will iterate the paper with the conference attendee. This member will also take care that the talk and the paper draft are posted to the FORUM in due time before the conference/workshop and the proceedings submission deadline, respectively. The time period for discussion on the HADES Forum is one week and the paper is submitted by the conference attendee.

#### 2.3.2 Category III papers

This are publications concerned with instrumentation and simulations and reflect development work done mainly by a single local group and not using data obtained with the complete set-up. Such publications will be signed by members of this group and should be prepared in coordination with the respective PWG leader or member of the technical board. In addition, the PDC asks a qualified collaboration member (external to the submitting group) to review the manuscript and to communicate any objections both to the author(s) and to the PDC. Papers reflecting the work done by several subgroups might require the full approval procedure applicable to physics papers. Such a case is identified by the PDC.

## 2.4 Authors' lists

The Spokesperson and the CB Chairperson, based on the collaboration member database and following consultation of each Party's representative, shall set up the authors' lists for the publications of the collaboration with the following conditions:



- physicists, who participated during experiment, i.e. making shifts, contributing into preparation of the experiment etc. are included;
- physicists involved in the analysis of data related to the experiment are included;
- exception from above has to be approved by CB.

In particular the following lists should be maintained:

- active HADES members, that also show up on the HADES web site;
- authors for publications on physics journals;
- authors for conference proceedings, which only includes physicists;
- authors for other kinds of publications (like technical papers, annual reports, national meetings, etc.).

These lists shall be released by the CB chairperson, who shall update and make them available on a suitable location of the collaboration on-line document repository ([http://webdb.gsi.de/pls/hades\\_webdb/hades\\_webdb.home](http://webdb.gsi.de/pls/hades_webdb/hades_webdb.home)) at least once per annum.

Any publication resulting partly or totally from the work carried out in the framework of the HADES project shall mention ‘‘HADES collaboration’’.

Particularly, the authors of conference proceedings should always make an effort to use the full actual author list by asking the editor of conference proceedings for an extra page. Only in case that it is refused, single author name and ‘‘for the HADES collaboration’’ could be used instead. Also in case of several HADES contributions to the same conference proceedings it is recommended to make only one contribution with the full author list and the other with single author and ‘‘for the HADES collaboration’’.

### 3 General conditions for experiments with HADES at GSI

GSI is the Host for the collaboration. GSI shall provide full support to conduct experiments at the HADES experimental site, according to the rules for approved experiments. Beam time shall be provided by GSI according to the standard application scheme. It shall be free of charge.

GSI provides and maintains the following infrastructure required for operating HADES for the time the HADES collaborations formally exists and at minimum for the period this agreement is signed. This includes:

- Basic cave infrastructure like cranes, counting houses, detector preparation container, gas inventory and security installations.
- Supply lines for electricity, cooling water, liquid nitrogen, high bandwidth computer network.
- Beam line installation including beam diagnostic elements, vacuum pumps and gauges, magnets and power supplies.
- Basic database infrastructure in the ORACLE framework.
- Permanent storage place for experimental data and analysis results on the GSI archive.

Typical consumables required to operate the spectrometer (detector gas, liquid Helium/Nitrogen, archiving media etc.) are subject to the common fund. GSI shall provide full access to the central computing farm and provides upgrades matching the computing needs of 50.000 cores·days and 200TByte distributed disc space per experimental run in accordance to the annual IT budget of GSI. GSI shall provide also access to the available lodging facilities and office space for the members of the HADES collaboration during the time needed to prepare and perform the experiments.

## 4 Resources and responsibilities

The following table summarizes the current situation with respect to resources and responsibilities among the different institutions, along with some extrapolation concerning the expected funding and manpower profiles.

Group	Manpower (physicists)	Comm on funds (k€/year)	funds and total effective manpower	Physics Analysis	New hardware construction (+tests)	Hardware maintenance	Software development and maintenance
LIP Coimbra	3 perm. 2 postdocs	2	100 k€ 2.5 FTE	medium (dielectrons)	TOF-FW	RPC, MDC	RPC
HADES-PL-FAIR consortium	6 perm. 3 postdocs 4 students	1	440k€ 6 FTE	elementary + medium (hadrons and dielectrons)	ECAL (main frame) + FD (2nd tracking station)	FD+FW	FD (tracking)
GSI Darmstadt	6 perm. 1 postdoc		660 k€ 13 FTE	elementary + medium (dielectrons, hadrons and light nuclei)	Beam line upgrade, MDC FEE	Magnet , beam detectors, cave, infrastructure,	Slow control, run control, tracking, alignment
TU Darmstadt	1 perm. 2 postdocs 5 students	2	92 k€ 6 FTE	elementary + medium (dielectrons, hadrons and light nuclei )	ECAL (read-out electronics), START		RPC, ECAL
HZDR Dresden	t.b.c.	t.b.c.	t.b.c.	Medium (hadrons, strangeness)		MDC	
JINR Dubna	6 perm. 2 postdocs 1 student	1	72 k€ 2.7 FTE	elementary (hadrons), SRC	FD (electronics)	MDC-II	FD (tracking)
IKF Frankfurt	3 perm. 4 postdocs 9 students	8	150 k€ 6.2 FTE	medium (dielectrons strangeness)	MDC (analogue electronics)	MDC (analogue electronics)	Tracking, alignment, acquisition
JLU Giessen	1 perm. 3 postdocs 3 students	8	103 k€ 3.5 FTE	medium (hadrons, dielectrons)	RICH (slow control)	RICH (slow control)	RICH reconstruction, slow control
FZ Jülich	3 perm. 1 postdoc	4	145 k€ 1.5 FTE	elementary (dielectrons, strangeness)	Forward Detector		FD (straws)
ITEP Moscow	3 perm.	In-kind	10 k€ 0.2 FTE	elementary (dielectrons, hadrons)	FW, ECAL	FW, ECAL	
INR Moscow	6 perm. 1 postdoc 2 students	In-kind	30 k€ 0.3 FTE	medium (flow)	FW, ECAL	FW, ECAL	FW
MEPhI Moscow	4 perm. 1 postdoc 3 students	2	20k€ 3 FTE	medium (flow)			
Excellence Cluster Universe München	2 perm 4 students	6	2 FTE	cold matter (strangeness)	Pion beam tracker	Pion beam tracker	
UCY Nicosia	2 perm. 1 postdoc	1	30 k€ 1.5 FTE	medium (dielectrons)			HPC cluster
IPN Orsay	2 perm. 2 students	3	40.5 k€ 3.2 FTE	elementary (dielectrons, hadrons)	FD (2 <sup>nd</sup> station +support)	MDC	Pion beam optics
NPI Rez	5 perm. 3 students	1	334 k€ 3.2 FTE	medium (dielectrons+ strangeness)	ECAL (PMTs, HV system, LED calibr., construction of modules)	TOF, FW, ECAL	TOF, ECAL, FW
USC Santiago	1 perm.	1	0.5 FTE				Reconstruction for Forward Wall and RPC
BUW Wuppertal	3 perm. 2 students	4	460 k€ 3 FTE	medium+ elementary (dielectrons)	RICH (electr. for photodetector)	RICH	

## 5 List of tasks versus Parties

The situation of the collaborating Parties with respect to their tasks within the collaboration is updated on a regular basis in an on-line table accessible at [http://jspc29.x-matter.uni-frankfurt.de/ethercalc/hades\\_mou\\_tasks](http://jspc29.x-matter.uni-frankfurt.de/ethercalc/hades_mou_tasks).

## 6 Final Provisions

This Memorandum of Understanding shall become effective for each Party when all the signed agreements are lodged at the Host. This agreement shall remain in force until the 31<sup>st</sup> of December 2022. It may be terminated by extraordinary dismissal with not less than 6 month prior written notice. A further extension of the agreement is however possible.

The MoU for the execution of the experiment HADES dating 29.9.1999, the General conditions for experiments at GSI and Annex A are an integral part of this agreement. This agreement shall be governed by the law of the country where the Host is based. Each Party shall ensure that the students and scientists taking part in the Project are fully informed of the terms of this agreement and personally undertake to comply with such terms.

Annulment or invalidity of one or more articles in this agreement shall not affect the legal validity of the remaining articles

## 7 Disputes

The parties shall endeavour to resolve their differences amicably. Should they fail to do so, any disputes shall be settled in accordance with the rules of conciliation and arbitration of the international Chamber of Commerce under the aegis of one or more arbitrators appointed pursuant to these rules

## 8 Commitments and signatures of each party

IN WITNESS hereof, the undersigned Parties describe their contribution, both in terms of manpower and funds and execute this Agreement

## LIP, Laboratório de Instrumentação e Física experimental de Partículas, Coimbra

Members of the group:

Alberto Blanco (perm.), Paulo Fonte (perm.), Celso Franco (PostDoc), Luis Lopes (perm.), Luis Silva (PostDoc)

The institute will contribute to all types of experiments performed with HADES.

The analysis activities will be focused on channels involving di-leptons.

The institute will contribute with the maintenance of the RPC-TOF and takes the responsibility for the construction of the Time of Flight Forward Wall.

Detector upgrades	Resources	
-Conceptual design and construction of TOF-FW.	1 x FTE 40 k€	
Participation in hardware and analysis activities		
- Operation of the RPC detector system, calibration and physics analysis.	1.5 x FTE	To be requested to the National Funding Agency
- Possible collaboration in MDC-related activities.	10k€/year	
Contribution to common fund	2k€/year	
<b>HADES at SIS100</b>		
Interest in heavy-ion experiments		



Alberto Blanco Castro  
Collaboration Board Member



Prof. Doutor Paulo Manuel Cadete Ferrão  
The President of Fundação para a Ciência e Tecnologia

**Consortium HADES-PL-FAIR consisting of Jagiellonian University (JU), Institute of Nuclear Physics (INP-Kraków), University of Warsaw (UW)**

*Members of the group JU*

Piotr Salabura, Jerzy Smyrski (permanent); Witold Przygoda, Grzegorz Korcyl, (PostDocs); Szymon Harabasz (joint position with TU), Krzysztof Nowakowski (PhDs) + one new PhD position and 3 engineers involved in construction of the straw detectors

*Members of the group INP-Kraków*

Adam Kozela, Izabela Ciepał (permanent) + one new PhD position

*Members of the group UW*

Krzysztof Piasecki, Tomasz Matulewicz (permanent) + one new PhD position

HADES-PL-FAIR will contribute to physics analysis related to strangeness and dielectron production in heavy ion, proton and pion induced reactions. In future experiments it will contribute to development of new physics programme and detector infrastructure related to studies of production and decay of hyperons. It will also contribute to the analysis of experiments of other physics collaborations vital for the interpretation of results of the HADES data.

The Jagiellonian University a member of the consortium is responsible for the construction of the ECAL main frame. Construction and maintenance of the forward tracking based on the straw detectors developed for PANDA experiment (activity of Polish groups - JU and INP-Kraków - involved in PANDA).

**Consortium HADES-PL-FAIR consisting of Jagiellonian University (JU),  
Institute of Nuclear Physics (INP-Kraków), University of Warsaw (UW)**

*Members of the group JU*

Piotr Salabura, Jerzy Smyrski (permanent); Witold Przygoda, Grzegorz Korcyl, (PostDocs); Szymon Harabasz (joint position with TU), Krzysztof Nowakowski (PhDs) + one new PhD position and 3 engineers involved in construction of the straw detectors

*Members of the group INP-Kraków*

Adam Kozela, Izabela Ciepał (permanent) + one new PhD position

*Members of the group UW*

Krzysztof Piasecki, Tomasz Matulewicz (permanent) + one new PhD position

HADES-PL-FAIR will contribute to physics analysis related to strangeness and dielectron production in heavy ion, proton and pion induced reactions. In future experiments it will contribute to development of new physics programme and detector infrastructure related to studies of production and decay of hyperons. It will also contribute to the analysis of experiments of other physics collaborations vital for the interpretation of results of the HADES data.

The Jagiellonian University a member of the consortium is responsible for the construction of the ECAL main frame. Construction and maintenance of the forward tracking based on the straw detectors developed for PANDA experiment (activity of Polish groups - JU and INP-Kraków - involved in PANDA).

<b>Participation in analysis activities</b>	<b>Resources</b>
Detector maintenance and commissioning (Straws detectors)	3 x FTE (shared with PANDA)
Physics analysis:	3 x FTE
Common funds	3 k€/year (to be asked for in upcoming applications to national funding agencies)
<b>Detector upgrade</b>	<b>Resources</b>
ECAL (main frame, design, production)	240 k€ from Polish in-kind contribution to FAIR (contract between JU and FAIR under realization)
Forward Tracking (second tracking station)	140 k€ UJ grant from National Centrum of Science for development of forward tracking (shared with PANDA)
	10 k€/year - maintenance of the Forward Tracking system (to be asked for in upcoming applications to national funding agencies)
<b>SIS100</b>	Interest in dilepton and strangeness production in heavy and nucleon-nucleon interactions

Prof. dr hab. Piotr Salabura  
 Leader of Consortium  
 Collaboration Board Member

Prof. dr hab. Ewa Gudowska-Nowak  
 Dean of Faculty of Physics, Astronomy  
 and Applied Computer Science of  
 Jagiellonian University

Prof. dr. hab Marek Jeżabek  
 Director of Institute of Nuclear Physics  
 PAN

Prof. dr hab. Paweł Kowalczyk  
 Director of Institute of Experimental  
 Physics, Faculty of Physics,  
 University of Warsaw



## GSI Helmholtzzentrum für Schwerionenforschung GmbH (GSI) Darmstadt

**Current members:** T. Heinz, R. Holzmann, I. Koenig , J. Markert, V. Pechenov, J. Pietraszko, E. Schwab, J. Stroth, C. Wendisch (PostDoc), HADES department, J. Hener, (Detector Laboratory) J. Adamczewski-Musch, S. Linev, M. Traxler, P. Zumbruch (Experiment Electronics), W. Schön (High Performance Computing)

GSI is also a member institution and agrees to meet the obligations defined below **as a Member of the Collaboration**. The interest of the GSI HADES group is to develop further the spectrometer and to participate in the analysis, presentation and publication of the physics results. GSI will also be fully committed to the physics program with HADES at SIS-100. The HADES group at GSI has/takes over responsibility for the following activities/projects:

- Development, M&O of beam-line detectors,
- Design, M&O of the HADES LVL1 trigger,
- Design, installation, M&O of the IT infrastructure for event building and mass storage,
- Development, M&O and management of the HADES experiment database,
- Development, M&O and management of the analysis and simulation frame work,
- Event reconstruction,
- Management of the slow-control platform EPICS.

The group also participates in:

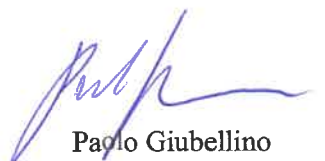
- Upgrade of the MDC read-out hardware,
- FEE and Read-out of new detector systems (RICH, FW detectors, ECAL),
- Installation of new detector systems (ECAL, RICH-UV, FW detectors),
- M&O of installed detector systems at HADES not mentioned explicitly above.

<i>Task, component</i>	<i>Allocated funds or personnel</i>	<i>Comments</i>
<b>Integration/maintenance/operation of detector system</b>	1.5 FTE	New detector systems incl.
<b>DAQ/FEE upgrade for high rates</b>	1.5 FTE	Mainly MDC and DAQ
<b>Trigger electronics, beam detectors, target assemblies, magnet, gas systems, etc.</b>	3 FTE, 60 k€/a	
<b>Management and maintenance of the DAQ, Slow Control and Analysis environment</b>	3 FTE, 50 k€/a	Event building, HPC, Database
<b>Data analysis</b>	3 FTE	w/o PhD students
<b>HADES management</b>	1 FTE	Technical coordination

GSI as the host is not participating to the common funds. The annual expenses for maintaining the basic infrastructure as detailed in paragraph 4, not included in the table above, amount to approximately 50 k€ w/o personnel. This commitment might be subject to changes only in case of unexpected reductions in allocated funding resources or severe rises in costs. Any change will be communicated to the Collaboration Board.



Joachim Stroth  
Collaboration Board member



Paolo Giubellino  
Scientific Director of GSI



Ursula Weyrich  
Administrative Director of GSI

## Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt

Members of the group

Tetyana Galatyuk (HYIG leader, JProf.), Malgorzata Gumberidze (PostDoc), Georgy Kornakov (PostDoc), Szymon Harabasz (co-directed PhD with JU Cracow), Adrian Rost (PhD), Federico Scozzi (co-directed PhD with Orsay), Florian Seck (PhD), Frederic Kornas (M. Sc.).

The institute will contribute to all experiments performed with HADES. The analysis activities will focus on heavy-ion, proton- and pion induced reactions addressing dileptons, hadrons (strangeness and short-lived baryons) as well as light nuclei production. The institute will contribute to the RPC, ECAL detector calibration/digitizer and reconstruction software, as well as perform performance studies for pA and AA collisions at SIS18 and SIS100 energies.

The institute takes the responsibility for the design, installation and commissioning of the read-out electronics for the ECAL, commissioning of the diamond detectors for heavy-ions and minimum-ionizing particle beams.

Participation in analysis activities	Resources
<b>Physics analysis:</b> <b>Low-Mass Dileptons in AuAu</b> <b>Intermediate Mass Dileptons in pA, AA</b> <b>Hadrons and light nuclei in pionA, pA, AA</b>	1 FTE 1 FTE 2 FTE
<b>Common funds</b>	2000 €/year
Detector upgrade	Resources
<b>ECAL read-out electronics:</b> <b>Installation, Commissioning</b> <b>START detector:</b> <b>Commissioning</b>	0,5 FTE / 92 k€ IOI  0,5 FTE
HADES at SIS100	Resources
<b>Interest in experiments with proton and heavy-ions</b> <b>Simulations</b>	1 FTE

Juniorprofessorin Dr. T. Galatyuk

Prof. Dr. Tetyana Galatyuk  
Collaboration Board Member

Prof. Dr. Dr.h.c. Norbert Pietralla  
Director IKF

**Institut für Kernphysik**  
Technische Universität Darmstadt  
64289 Darmstadt, Schloßgartenstraße 9

**Institut für Strahlenphysik, Helmholtz-Zentrum Dresden-Rossendorf (HZDR)**

*Members of the group*

Burkhard Kämpfer, Roland Kotte, Lothar Naumann, Andreas Wagner (perm. scientist); Robert Greifenhagen (PhD student)

The HADES group in the institute will contribute to experiments performed with HADES. The analysis activities focus on heavy-ion and cold-matter physics addressing collective effects, hadron (strangeness) production and femtoscopy.

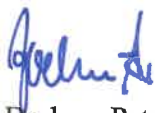
<b>Participation in analysis activities</b>	<b>Resources</b>
Physics analysis: identical-hadron intensity interferometry (HBT)	1.5 FTE
Common funds	2 k€/year
<b>Detector physics</b>	<b>Resources</b>
Investigation of drift parameters in realistic HADES drift chamber cells at the HZDR Laser test facility	0.5 FTE
<b>HADES at SIS100</b>	



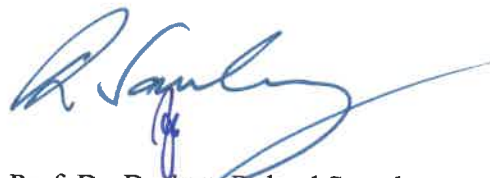
Prof. Dr. Burkhard Kämpfer  
Collaboration Board Member



Prof. Dr. Thomas E. Cowan  
Director Institute of Radiation Physics



Prof. Dr. Dr. h. c. Peter Joehnk  
Administrative Director HZDR



Prof. Dr. Dr. h. c. Roland Sauerbrey  
Scientific Director HZDR

## Joint Institute for Nuclear Research (JINR), LHEP, Dubna

### *Members of the group*

Vladimir Ladygin, Oleg Fateev, Alexander Ierusalimov, Alexander Belyaev, Alexander Malakhov, Alexander Troyan (perm.); Pavel Kurilkin, Alexei Kurilkin (PostDocs); Yaroslav Skhomenko (Student)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on the baryonic resonance studies in hadronic and electromagnetic channels and short range correlations in proton/deuteron induced reactions.

The institute will contribute in the R&D for MCD plane-II and for Forward Detector.

<b>Participation in analysis activities</b>	<b>Resources</b>
Detector maintenance and commissioning (MDC)	0.7x FTE
Physics analysis:	2.0x FTE
Common funds	1 k€/year
<b>Detector upgrade</b>	<b>Resources</b>
R&D for MDC and Forward Detector	12 k€/year (from JINR-BMBF grant)
<b>HADES at SIS100</b>	
Interest in pp and dp program : baryonic resonances studies, SRC	



Vladimir Ladygin  
Collaboration Board Member



Vladimir Kekelidze  
Director LHEP JINR

## Institut für Kernphysik, Goethe-Universität, Frankfurt am Main

### Members of the group

Christoph Blume, Christian Müntz, Ingo Fröhlich (perm.); Jan Michel, Manuel Lorenz, Heidi Schuldes, Olga Pechenova (PostDocs); Timo Scheib, Claudia Behnke, Patrick Sellheim, Michael Wiebusch, Behruz Kardan (PhDs) Melanie Szala, Mathilde Himmelreich, Max Zuschke, Giuseppe Cantarella (Students)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on heavy-ion and cold-matter physics addressing collective effects, hadron (strangeness) production and dileptons.

The institute takes the responsibility for the up-grade of the MDC analogue electronics.

Participation in analysis activities	Resources
Detector maintenance and commissioning (MDC):	0.75 x FTE
DAQ coordination (J. Michel):	0.75 x FTE
Physics analysis:	3.5 x FTE
<b>Common funds</b>	8 k€/year
<b>Detector upgrade</b>	Resources
<b>MDC analogue electronics:</b> Conceptual design study Mass production	1.2 FTE/ 50 k€ (approved money) 100 k€ (funds to be requested from BMBF)
<b>HADES at SIS100</b>	
Interest in experiments for heavy-ion and cold matter physics	



Christoph Blume  
Collaboration Board Member



Reinhard Dörner  
Director IKF

**Justus-Liebig Universität, II Phys. Inst., Giessen, GERMANY**

Members of the group

Prof. Dr. Claudia Höhne (perm.); Dr. Christina Deveaux, Dr. Semen Lebedev, Dr. Tariq Mahmoud (PostDocs); ... (PhD); Adrian Weber, Jan-Handrik Otto (master students); one shared technical FTE in the institute (perm.)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on heavy-ion and cold-matter physics (proton, pion beams) addressing collective effects, hadron production and dileptons.

The institute participates in the upgrade of the HADES RICH detector and takes responsibility for the reconstruction software and slow control.

Participation in analysis activities	Resources
<b>Detector maintenance and commissioning (RICH)</b>	1 FTE
<b>Physics analysis:</b>	1-2 FTE
<b>Common funds</b>	8 k€/year
<b>Detector upgrade</b>	Resources
<b>RICH software:</b> ring reconstruction, ring track matching, simulations	1 FTE/ 82 k€ (approved money)
<b>RICH slow control (in collaboration with GSI):</b> HV, LV control, temperature control etc.	21 k€ (funds to be requested from BMBF)
<b>HADES at SIS100</b>	
<b>Interest in experiments for heavy-ion and cold-matter physics, complementary to CBM</b>	



Prof. Dr. Claudia Höhne  
Collaboration Board member



Prof. Dr. Joybrato Mukherjee  
Präsident der Justus-Liebig-Universität  
Gießen

## Institut für Kernphysik – 1, Forschungszentrum Jülich (FZJ)

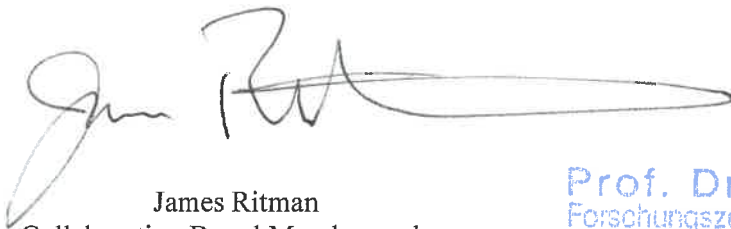
### *Members of the group*

Prof. Dr. James Ritman, Dr. habil Albrecht Gillitzer, Dr. Peter Wintz (perm.), Michael Kunkel (postdoc)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on reactions with pion and proton beams and will address the transition form factors of excited hyperon states.

The institute will build one of the two sets of straw tube chambers (STS1/2) as well as components of the electronic readout system for both straw chambers. This activity is part of the PANDA-Phase0 program and the detectors as well as readout electronics must be transferred back to PANDA by the time that its cave becomes available, currently predicted to be in 2022.

Participation in analysis activities	Resources
Physics analysis (dileptons from excited hyperons):	0.5 FTE
Common funds	4 k€/year
Detector upgrade	Resources
Assembly of STS1 including the straw series production. Production and test of the readout system for both straw chambers in collaboration with JU Krakow. Components of the gas and voltage supply systems. Development of calibration and tracking algorithms for STS1/2.	1 FTE / 145 k€ (approved money)



James Ritman  
Collaboration Board Member and  
Director of the Institut für Kernphysik-1

Prof. Dr. J. Ritman  
Forschungszentrum Jülich GmbH  
– Institut für Kernphysik –  
Briefpost: 52425 Jülich  
Fracht/Paketpost: 52423 Jülich

FSBI "Institute for Theoretical and Experimental Physics"

n. A.I.Alikhanov NIC "Kurchatov Institute"

Members of the group:

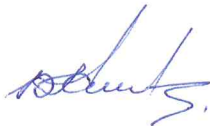
Yury Kiselev, Eduard Paryev, Vladimir Khomyakov, Alexander Lebedev (all perm.)

The Institute will participate in all types of experiments performed with HADES. The analysis activities will be focused on the strangeness production in pion-nucleus and nucleus-nucleus reactions addressing the production mechanisms, in-medium modification of the produced particles, the properties of the short-distance nuclear structure.

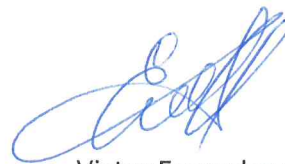
The Institute will contribute to the construction of new Forward Wall and ECAL.

Participation in data taking	Resources
Physics analysis	0.2xFTE
Common fund	0.1xFTE/year - (service activities for the HADES collaboration)
Detector upgrade	Resoueces
Developing, construction and maintenance of new FW and ECAL.	0.1xFTE/year - (participation for maintenance of new FW and ECAL.
HADES at SIS100	
Interest in pA and AA program: charm studies	

Yury Kiselev



HADES Collaboration Board Member



Victor Egorychev

Director NIC "Kurchatov Institute" - ITEP



## Institute for Nuclear Research of the Russian Academy of Science

### *Members of the group*

Fedor Guber, Marina Golubeva, Alexander Ivashkin, Sergey Morozov, Oleg Petukhov, Andrey Reshetin (all perm.), Alexander Sadovsky (0.3 FTE), Arseny Shabanov (PhD student), 1 -2 students.

The institute will participate in all types of experiments performed with HADES. The analysis activities will be focused on heavy ion reactions addressing flow and fluctuations studies.

The Institute will contribute to the construction of new Forward Wall and ECAL.

<b>Participation in data taking</b>	<b>Resources</b>
Physics analysis: flow	0.3 x FTE
Common funds	5 k€/year - in kind
<b>Detector upgrade</b>	<b>Resources</b>
Developing, construction and maintenance of new FW and ECAL.	30 k€ - in kind
<b>HADES at SIS100</b>	
Interest in AA program : flow and fluctuations	



Fedor Guber  
HADES Collaboration Board Member



Leonid Kravchuk  
Director INR

## National Research Nuclear University MEPhI, Moscow

### Members of the group

Arkadiy Taranenko (perm.), Ilya Selyuzhenkov (perm, associate), Nikolay Kargin (perm.), Mikhail Strikhanov (perm.), Sergey Morozov (PostDoc, associate), 1 (PhD), 2 (Master students)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on heavy-ion physics addressing collective effects, such as flow and azimuthal correlations with light and strange hadrons.

The institute takes part in the upgrade of the ECAL detector in collaboration with INR Moscow and NPI Rez groups.

Participation in analysis activities	Resources
<b>Detector upgrade and commissioning (ECAL):</b>	1.0 x FTE
<b>Physics analysis:</b>	2.0 x FTE
<b>Common funds</b>	2 k€/year
<b>Detector upgrade</b>	<b>Resources</b>
<b>ECAL detector system:</b> upgrade of the PMT's and development of the calibration system	20k€ - Upon availability of funding from "5/100 Russian academic excellence project"
<b>HADES at SIS100</b>	
<b>Interest in experiments with heavy-ions</b>	



Arkadiy Taranenko  
Collaboration Board Member

Mikhail Strikhanov  
MEPhI Rector



E62 Physic Department of the Technische Universität München, München (TUM)

*Members of the group*

Laura Fabbietti, Jürgen Friese (perm.), Tobias Kunz, Joana Wirth, Steffen Maurus (PhDs), Ulrike Fahrenholz (student).

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on cold-matter physics with proton and pion beams addressing effects of hadron (strangeness) production, femtoscopy and Lambda(1405) measurements .

The institute takes the responsibility for the pion tracker and continues to take care of RICH detector operation and maintenance.

Participation in analysis activities	Resources
Detector maintenance and commissioning (RICH, CERBEROS pion tracker) Physics analysis: strangeness production in proton and pion induced reaction	1 FTE  1 FTE
Common funds	6000 €/year
<b>HADES at SIS100</b>	
Interest in experiments for cold matter physics	



Laura Fabbietti

Collaboration Board Member

## University of Cyprus, Department of Physics, Nicosia

Members of the group

H. Tsertos (perm.), Y. Parpottas (Perm.), V. Petousis (PostDoc)

The Party takes on the responsibility for the maintenance of a high performance Linux cluster, participates in the experiments, and contributes to the physics data analysis.

Participation in data taking	Resources
<b>Physics analysis:</b>	1.5 x FTE
<b>Maintenance of HPC Cluster.</b>	5 k€/year (local funds)
<b>Common funds</b>	1 k€/year
<b>HADES at SIS100</b>	
<b>Interest in experiments with heavy-ion and cold matter physics</b>	

The contribution to the common funds is 1 k€ per annum.

This commitment might be subject to changes only in case of unexpected reductions in allocated funding resources or severe rises in costs. Any change has to be approved by the Collaboration Board.

## Institut de Physique Nucléaire d'Orsay

Members of the group

Béatrice Ramstein (perm.), Ronald Kunne (perm.), Federico Scozzi (co-directed PhD with TU Darmstadt), Amel Belounnas (PhD student)

The institute will participate to all types of experiments performed with HADES. The analysis activities will be focused on elementary reactions (pion/proton/deuteron beams) addressing baryonic resonance studies in hadronic and electromagnetic channels.

The institute will contribute to the construction of the Forward Detector by mechanical realization and supply of material. IPNO is responsible for the pion beam optics calculation

Participation in data taking	Resources
<b>Physics analysis</b>	2.4 FTE
<b>Common funds</b>	3 k€/year
<b>Detector upgrade</b>	Resources
<b>Pion beam tracking Contribution to Forward Detector (construction of frames and support, supply of material for straw tube mounting)</b>	10 persons.months (0.8 FTE) 16.5 k€ (approved money 2017) - 24 k€ ( requested for 2018)
<b>HADES at SIS100</b>	
<b>Interest in pp program : baryonic resonances studies</b>	

VISA:

Date : 8.03.2018

Béatrice Ramstein  
Collaboration Board Member



SIGNATURE:

Date: 27.02.2018

Reynald Pain  
Director IN2P3



## Nuclear Physics Institute, Czech Academy of Sciences, Rez

Members of the group

Andrej Kugler, Vasilij Kushpil, Ondrej Svoboda, Pavel Tlusty, Vladimir Wagner (perm.); Lukas Chlad, Vasily Mikhaylov, Pablo Rodriguez Ramos.... (PhDs)

The party will contribute to all types of experiments performed with HADES. The analysis activities will be focused on heavy-ion and cold-matter physics addressing collective effects (flow), dilepton and hadron (strangeness) production with the aim to study hadron properties in medium.

The Party takes the responsibility of contributing to software implementation of analysis algorithms for the ECAL detector and corresponding data analysis, and to simulation of ECAL as well as simulation and design studies of whole HADES setup performance for heavy ion beam energies up to 8 AGeV.

The Party takes on the responsibility for following detectors:

- TOF scintillator wall maintenance and related analysis framework
- ECAL detector build up, maintenance and related analysis framework

The party will contribute to Forward Wall detector maintenance and related analysis framework

Participation in analysis activities	Resources
<b>Detector maintenance and commissioning (TOF, FW, ECAL) Physics analysis (Flow, dileptons, strangeness):</b>	1 FTE 1 FTE
<b>Common funds</b>	1 k€/year
<b>Detector upgrade</b>	Resources
<b>ECAL mass production</b>	1,2 FTE/ 50 k€ (approved money) 174 k€ (funds already spent before 2016 for HV system, LED system, mechanics) 334 k€ (funds to be requested from OP VVV)
<b>HADES at SIS100</b>	
<b>Interest in experiments for heavy-ion and cold matter physics</b>	

This commitment might be subject to changes only in case of unexpected reductions in allocated funding resources or severe rises in costs. Any change has to be approved by the Collaboration Board.

  
Andrej Kugler  
Collaboration Board Member

  
Petr Lukas  
Director NPI CAS

*Members of the group*

Juan A. Garzón

The Party takes over the responsibility for contributing to the development and maintenance of track reconstruction software in downstream detectors

<b>Participation in analysis activities</b>	<b>Resources</b>
Contribution to the development of tracking algorithm for downstream detectors and software support for the tRPC ToF wall	0.5 FTE
Common funds	1 k€/year
<b>Detector upgrade</b>	<b>Resources</b>
<b>HADES at SIS100</b>	
Interest in experiments for heavy-ion physics	



Juan A. Garzón  
Collaboration Board Member



Isabel Rodríguez-Moldes Rey  
Vicechancellor for Research and Innovation

## Department of Physics, Bergische Universität Wuppertal (BUW)

Members of the group

Prof. Dr. Karl-Heinz Kampert, Dr. Christian Pauly (perm.); Dennis Pfeifer (Engineer, perm.), Vivek Patel, Ievgenii Kres, Jörg Förtsch (PhDs)

The institute will contribute to all types of experiments performed with HADES. The analysis activities will be focused on reactions with pion, proton and ion beams and will address the production of di-leptons in particular.

The institute participates in the upgrade of the HADES RICH detector and takes responsibility for the development and construction of a new electronic readout chain for the HADES photon detector.

Participation in analysis activities	Resources
<b>Detector maintenance and commissioning (RICH)</b>	1 FTE
<b>Physics analysis (di-electrons):</b>	1 FTE
<b>Common funds</b>	4 k€/year
<b>Detector upgrade</b>	Resources
<b>RICH camera: MAPMTs, related mechanics, related readout electronics</b>	1 FTE/ 460 k€ (approved money)
<b>Acceptance tests of MAPMTs; design, production and tests of readout electronics in collaboration with GSI</b>	
<b>HADES at SIS100</b>	
<b>Interest in experiments complementary to CBM</b>	

  
 Christian Pauly  
 Collaboration Board Member

  
 Karl-Heinz Kampert  
 Chair of Department

o