AGATA

Advanced Gamma Tracking Array

Memorandum of Understanding

1. Introduction

The "*Advanced GAmma Tracking Array*" (AGATA) is a collaborative European project (hereafter referred to as the "Project" or the "AGATA project") to construct and operate a gamma-ray tracking spectrometer. It is based on the successful research & development project started in 2003 which demonstrated the feasibility of achieving the ultimate goal of a 4π spectrometer through the technique of gamma-ray energy tracking in electrically segmented Ge detectors. The resulting AGATA spectrometer will have an unparalleled level of detection sensitivity to nuclear electromagnetic radiation. AGATA will allow the pursuit of a very rich science programme using both radioactive and stable ion beams as described in the AGATA Physics Case. To maximize the science output of AGATA, campaigns of experiments with complementary research programmes will be pursued at research facilities within Europe.

The full 4π AGATA system comprises 60 triple Cluster Ge detectors, the associated electronics, data acquisition and related equipment. The system will be built up and operated in phases. The aim of the first phase is to build up and operate 1/3 of the full AGATA system in four years from the date on when this MOU comes into effect. It is the intention to pursue the construction and operation of 2/3 and 3/3 of the full system in subsequent phases.

2. Parties of this MoU

This memorandum of understanding (hereinafter "MoU") is between the Parties to this MoU (hereinafter "the Parties"). These Parties are listed in annexe A.1. The institutes or institutions forming the AGATA Collaboration are listed in annexe A.2 (hereinafter "the Collaborating Institutions").

3. Purpose of this MoU

The purpose of this MoU is to specify what the Parties intend with respect to planning, funding, constructing and operating the AGATA project.

This MoU is the non-binding expression of the current intentions of the Parties. None of the Parties will be bound by any legal obligation to the other Parties or incur any associated expense.

The intention of the Parties and/or the Collaborating Institutions as appropriate is to provide the necessary capital and human resources to successfully carry out this project.

The first phase of the project is to operate an AGATA system that is currently planned to consist of twenty AGATA units of which five have already been funded in the R&D phase. Any changes in the scope of the detector system will be agreed at the AGATA steering committee, as described in Annex D.

The items forming the 20 unit AGATA system, their costing, the sharing of the required capital investment and human resources, and the construction schedule and the milestones for the first phase of the Project are given in Annexe B.

Annexe C gives the operation costs for the first four years of the Project. The Parties agree to operate the AGATA system in campaigns of experiments as the units become available.

For the duration of this MoU the AGATA system is expected to be sited for at least 25% of its total operation time each at GANIL/SPIRAL2 (Caen, France), GSI/FAIR (Darmstadt, Germany), LNL/SPES (Legnaro, Italy). The host collaborating institutions GANIL, GSI and LNL (hereinafter "Host" or "AGATA Host") have agreed to host AGATA. AGATA will be an essential instrument for the future facilities FAIR, SPES and SPIRAL2.

Campaigns at any other host laboratory, in particular outside of the Collaborating Institutions, are subject to negotiations within the AGATA Steering Committee.

Formal letters of agreement between each Host and the AGATA Steering Committee, which represents the Parties as defined in Annexe D, will detail the commitment of the Host and the obligations of the Collaborating Institutions for each campaign.

4. Commencement, Duration, Withdrawal and Extension of the MoU

This MoU will become effective when at least three Parties have signed including at least one Party from a country with a host collaborating institution.

This MoU shall continue in force until 31 December 2015. This MoU may be extended only by an amendment to the MoU.

Any Party may withdraw from the AGATA MoU by giving not less than twelve months notice in writing to the AGATA Steering Committee. It is expected that equipment provided by the Party will remain with AGATA for the period of this MoU.

5. Organisation and Management

The AGATA organisation and the governance bodies for the construction and operation of AGATA are described in Annexe D.

AGATA is an open collaboration. New members may accede to this MoU through a written procedure defined by the AGATA Steering Committee.

6. Amendments and Modification of the MoU

This MoU may be amended or modified at any time in writing if agreed by at least two thirds of the Parties.

7. General Provisions

The Parties will conduct the collaboration in terms of this MoU in compliance with the

applicable laws and regulations. The obligations of each Party and/or Collaborating Institution are subject to the availability of appropriate funds and human resources.

Nothing in this MoU will affect any other agreements concerning cooperation between the Parties (applicable from the date on when this MoU comes into effect).

All questions regarding the interpretation of this MoU will be resolved consensually by the Parties. Any dispute as may arise between the Parties hereto in connection with this MoU, which cannot be resolved amicably between the Parties, shall be finally settled by the Rules of Conciliation and Arbitration of the International Chamber of Commerce by three arbitrators appointed in accordance with the said Rules unless the Parties agree on a single arbitrator. The award of the arbitrator will be final and binding upon the Parties concerned. Proceedings shall be conducted in English.

Information provided by any Party under this MoU and implementing agreements shall be accurate to the best of that Party's knowledge and belief but no warranty, expressed or implied, is given by that Party to such information.

Each Party and/or Collaborating Institution as appropriate takes charge of the insurance coverage for its own staff in accordance with applicable legal requirements for occupational injuries and occupational diseases. Consequently, each party and/or Collaborating Institution as appropriate must fulfil the required formalities and sustain all the costs, if any, involved in the insurances underwritten to cover its own staff against the risks.

Each Party and/or Collaborating Institution as appropriate is liable, in accordance with the applicable law, for damages caused by its staff to the staff of any other Party and/or Collaborating Institution as appropriate.

Each Party and/or Collaborating Institution as appropriate will bear the liability without any right of claim against any other Party and/or Collaborating Institution as appropriate, except in cases of gross negligence or wilful misconduct, for any damage to its own properties resulting from or in the course of fulfilment of this MoU.

Each Party and/or Collaborating Institution as appropriate remains liable, in accordance with the applicable legal regulations, for damages caused by itself or its staff to third Parties occurring under this MoU.

The following documents and annexes are an integral part of this MoU:

Annexe A:	List of Parties and Collaborating Institutions
Annexe B:	AGATA Equipment, Capital Investment and Installation
Annexe C:	AGATA Operation
Annexe D:	AGATA Management Structure

This MoU is drawn up and executed in English, in one original document.

Annexe A: List of Parties and Collaborating Institutions

Annexe A.1: List of Parties

Univ. Sofia, Bulgaria;

Bulgarian Academy of Sciences, Institute for Nuclear Research and Nuclear Energy, Bulgaria;

Univ. Jyväskylä, Department of Physics, Accelerator Laboratory, Finland;

Centre National de la Recherche Scientifique – Institut National de Physique Nucléaire et de Physique des Particules, France;

Commissariat a l'Energie Atomique – Direction des Sciences de la Matière, France;

Gesellschaft für Schwerionenforschung mbH, Germany;

Istituto Nazionale de Fisica Nucleare, Italy;

Polish Academy of Sciences – The Henryk Niewodniczanski Institute of Nuclear Physics, Poland;

University of Warsaw, Poland;

Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN/HH), Romania;

Royal Institute of Technology, Stockholm, Sweden;

Ankara University, Turkey;

Science and Technology Facilities Council, UK;

Each Party is representing their national institutions collaborating in the AGATA Project and takes the institutional responsibility for the Project with the exception of Bulgaria, France and Poland where each Party represents their own institutes or institutions.

Annexe A.2

List of Collaborating Institutions:

Bulgaria:	Univ. Sofia, INRNE Sofia
Finland:	Univ. Jyväskylä
France:	GANIL Caen, LPSC Grenoble, IPN Lyon, CSNSM Orsay, IPN Orsay, CEA/DSM/IRFU Saclay, IPHC Strasbourg
Germany:	GSI Darmstadt, TU Darmstadt, Univ. zu Köln, TU München
Italy:	INFN Firenze, INFN Genova, INFN Legnaro, INFN Milano, INFN Napoli, INFN Padova, INFN Perugia (Camerino)
Poland:	IFJ PAN Krakow, University of Warsaw (HIL)
Romania:	IFIN/HH Bucharest
Sweden:	Chalmers Univ. of Technology Göteborg, Lund Univ., Royal Institute of Technology Stockholm, Uppsala Univ.
Turkey:	Univ. Ankara, Univ. Istanbul, Technical Univ. Istanbul
UK:	Univ. Brighton, STFC Daresbury Laboratory, Univ. Edinburgh, Univ. Liverpool, Univ. Manchester, Univ. Surrey, Univ. West of Scotland, Univ. York

Annexe B: AGATA Equipment, Capital Investment and Installation

Annexe B.1: AGATA Equipment and Capital Investment

Each AGATA unit comprises a triple-cluster Ge detector with its associated electronics, data acquisition and storage system and related equipment. Specifications of all items will be produced by the AGATA management prior to production. All cost estimates are based on 2007 prices in Euro without tax.

Definition of AGATA equipment:

Germanium crystals:	encapsulated, 36-fold segmented HPGe diode
Triple-Cluster Cryostat (TCC):	cryostat for three HPGe diodes incl. 111 preamplifiers
Detector support system (DSS):	high- and low-voltage supplies, auto-fill control system detector cabling, etc.
Mechanics:	mechanical support structure, individual frames etc.
Digitiser module:	stand-alone module for 36+1 high resolution Ge channels
Pre-processing card:	twin Carrier cards in ATCA standard with mezzanines
Computer farm:	PC farm and shared infrastructure
General Trigger System (GTS):	GTS cards
Electronics infrastructure:	ATCA crates etc.
DAQ system:	PC farm for DAQ including data storage

Capital cost for the AGATA units:

Item	Cost/unit [k€]	N^{o}	Cost [k€]
Ge crystals	160	3	480
Triple-Cluster Cryostat	80	1	80
Detector Support System	25	1	25
Digitiser modules	30	3	90
Pre-processing cards	30	3	90
General Trigger System	8	1	8
Computer farm	20	1	20
Cost per AGATA unit			***793***
Cost for 15 new AGATA units			***11895***

Capital costs for common items

Item	Cost [k€]
Mechanics	150
Electronics infrastructure	150
DAQ system	100
Cost for common items	***400***
Total capital costs for 15 AGATA units	***12295***

Annexe B.2 Sharing of Capital investment and Human resources

The Parties and/or Collaborating Institutions as appropriate are planning to make bids to contribute with the capital given in table B.2.1 for 15 new AGATA units and common items as given in annexe B.1. In-kind contributions will be made, whenever possible, allowing to make best use of the expertise and experience acquired during the R&D phase.

The participating collaborating institutions are planning to make human resources (physicists, engineers and technicians) as given in table B.2.1 available to the AGATA project (personnel in person-months during the period for construction, installation and commissioning of the 20 unit AGATA system).

Table B.2.1 Capital investment and human resources for construction, installation and commissioning of 15 new AGATA units, and planned sharing between the participating collaborating institutions of each country.

Country	Planned new capital investment in k€	Planned personnel in person months
Bulgaria	25	50
Finland	25	50
France	2460	450
Germany	2460	400
Italy	2460	500
Poland	25	50
Romania	180	50
Sweden	1640	200
Turkey	820	70
UK*	2460	550
Total	**12555**	**2400**

* In July 2008 the UK approved an investment of 893 k€ and a Personnel investment of 470 person months.

Capital investment and human resource commitments for prototyping and 5 AGATA units have been recorded since the start of the project. The information is reproduced in table B.2.2.

Table B.2.2 Capital investment and human resources committed for the AGATA R&D phase and the 5 unit AGATA system. The capital investment beyond 2007 is estimated.

Country	Funds committed in k€ (2003-2008)	Personnel in person months (2003 - 2007)
Bulgaria	0	45
Finland	2	8
France	1400	1145
Germany	1228	336
Italy	1400	737
Poland	0	60
Romania	57	40
Sweden	850	175
Turkey	750	70
UK	950	455
Total	**6637**	**3031**

The Hosts will incur costs directly related to the installation and operation of the AGATA system. Estimates of these costs and the required human resources are given in table B.2.3.

Table B.2.3 Capital investment without general infrastructure costs and human resources planned to be provided by the Hosts for the installation, commissioning and operation of AGATA assuming an 18 months operation period at each site.

Country	Host	Planned capital investment [k€]	Personnel in person months
Italy	LNL	230	150
France	GANIL	190	101
Germany	GSI	200	171

The total capital investment needed for the construction, installation and commissioning of the 20 unit AGATA system is summarised in table B.2.4.

Table B.2.4 Summary table of the capital investment for the 20 unit AGATA system and the planned sharing between the participating collaborating institutions of each country, which comprises the planned investment for 15 new AGATA units, the funds committed until 2008 for the R&D phase, prototyping and 5 units, and the planned capital investment by the Hosts.

Country	Planned new capital investment [k€]	Funds committed (until 2008) [k€]	Planned capital investment by the Hosts [k€]	Total capital investment [k€]
Bulgaria	25	0	0	25
Finland	25	2	0	27
France	2,460	1,400	190	4,050
Germany	2,460	1,228	200	3,888
Italy	2,460	1,400	230	4,090
Poland	25	0	0	25
Romania	180	57	0	237
Sweden	1,640	850	0	2,490
Turkey	820	750	0	1,570
UK	2,460	950	0	3,410
Total	12,555	6,637	620	19,812

Annexe B.3: Construction schedule and Milestones

Provisional planning and milestones for the construction of a 20 unit AGATA system in 4 years. The final planning will depend on the detailed funding profile and the delivery schedule of the Ge detectors which is to be negotiated with the manufacturer.

Month	Item
01	Start ordering of new AGATA Ge detectors and cryostats
07	Start production of new AGATA front-end electronics
12	AGATA system with 5 Triple-Cluster detectors completed
13	Begin delivery of AGATA Ge detectors and cryostats (at least 3 crystals every 2 months)
16	Begin integration of AGATA triple-cluster detectors (at least 1 cluster every 2 months)
30	Start upgrading AGATA DAQ system for 20 Triple-Cluster detectors
42	End delivery of new AGATA Ge detectors and cryostats
47	Integration of AGATA triple-cluster detectors completed
48	Installation of 20 unit AGATA system completed

Annexe C: AGATA Operation

Annexe C.1: AGATA operation costs

Table C.1: Estimate of the yearly operation costs for AGATA systems of 5 and 20 units. The running and maintenance costs are given separately from the personnel costs.

Item	**Unit costs [€]**	**Failure rate**	**Costs for N units [€]**	
			5	**20**
Detectors & Infrastructure				
LN_2	2,000	-	10,000	40,000
Capsule repair/exchange	50,000	0.05	37,500	150,000
Crystal exchange	150,000	0.01	22,500	90,000
Preamplifier exchange (incl. FETs and motherboard)	4,000	0.03	1,800	7,200
Other repairs (cabling etc.)	8,000	0.01	400	1,600
HV/LV system, infrastructure			5,000	20,000
Detector laboratory (consumables etc.)	20,000		20,000	40,000
Electronics and DAQ				
Electronics maintenance/repair	60,000	0.03	27,000	108,000
DAQ computer upgrade	30,000	0.01	4,500	18,000
Other Costs				
Shipping costs			20,000	40,000
Mechanics etc.			4,000	12,000
Total operation & maintenance costs (excl. personnel)			**153,000**	**527,000**

Personnel	**FTE costs [€]**	**Number of FTE**	**Costs for N units [€]**	
			5	**20**
On-site support personnel				
2 physicists	75,000	2	150,000	150,000
1-2 engineers	75,000	N/30	13,000	50,000
2-3 technicians/students	45,000	N/20	11,000	45,000
Off-site support personnel				
2-4 physicists/engineers	75,000	N/15	25,000	100,000
2-5 technicians/students	45,000	N/10	23,000	90,000
Total personnel costs			**221,000**	**435,000**

Annexe C.2: Sharing of AGATA operation costs

As laid out in annexe C.1 the AGATA operation costs can be divided into running and maintenance costs and personnel costs. The running and maintenance costs will be shared by the whole AGATA Collaboration based on potential usage as given in table C.2. The costs and percentage shares will be reviewed annually by the ASC.

The operation of AGATA will start in 2009 with the 5 unit system; from 2012 the 20 unit system should be operational. The expected costs per year are given in table C.2. The actual cost, depending on the number of operational AGATA units, will be reviewed annually by the ASC. It is planned that AGATA systems operate first at Legnaro National Laboratory, Italy, then at GANIL, France and then at GSI, Germany. Due to the varying Host contribution the actual share of the countries may differ from the yearly distribution given in table C.2.

Table C.2: Sharing of running and maintenance costs (in Euro, excluding personnel) between the collaborating institutions of the countries forming the AGATA Collaboration. These are estimated costs which will be reviewed annually along with the percentage shares by the ASC.

Year/ Country	2009	2010	2011	2012	Total	*Percentage*
Bulgaria	3,000	5,500	8,000	10,500	27,000	*2*
Finland	3,000	5,500	8,000	10,500	27,000	*2*
France	26,250	48,125	70,000	91,875	236,250	*17,5*
Germany	26,250	48,125	70,000	91,875	236,250	*17,5*
Italy	26,250	48,125	70,000	91,875	236,250	*17,5*
Poland	3,000	5,500	8,000	10,500	27,000	*2*
Romania	3,000	5,500	8,000	10,500	27,000	*2*
Sweden	7,500	13,750	18,000	26,250	67,500	*5*
Turkey	3,000	5,500	8,000	10,500	27,000	*2*
UK	26,250	48,125	70,000	91,875	236,250	*17,5*
EU	22,500	41,250	60,000	78,750	202,500	*15*
Total	**150,000**	**275,000**	**400,000**	**525,000**	**1,350,000**	***100***

The personnel costs as given in table C.1 can be divided into a Host contribution (covering on-site personnel directly attributable to hosting AGATA systems) and personnel which will be contributed by the Collaborating Institutions. An additional contribution to the personnel costs has been requested from the EU through the FP7-I3 project ENSAR. The sharing of the personnel will be defined in a letter of agreement between the AGATA Steering Committee and each Host.

Annexe D:

AGATA Management Structure

The organisation for the construction and the operation of the AGATA project comprises the following bodies:

- The AGATA Steering Committee (ASC), acting on behalf of the Parties, is responsible for the Project coordination and the science policy of the collaboration.

- The AGATA Collaboration Council (ACC), representing all the institutions collaborating under the AGATA project, advises the ASC on scientific matters.

- The AGATA Project Manager (PM) and the AGATA Management Board (AMB) are responsible for the execution of the Project along the lines defined by the ASC.

The terms of reference of each of these bodies is given in more detail below.

AGATA Steering Committee (ASC)

Membership:
Members are nominated by the Parties of the MoU. Contributing Parties of a country which represent more than 10% of the total capital investment will have two members, all other contributing Parties of a country will have one member.

The AGATA Project Manager and the AGATA Spokesperson attend meetings for consultation only and therefore without voting rights. The ASC can invite others to attend as needed for consultation only, for example the Campaign Spokespersons and Local Campaign Managers.

Voting rights:
Members have voting rights if they represent a Party having contributed at least one AGATA unit or the equivalent monetary value to the Project. Groups of Parties contributing together the equivalent of an AGATA unit can also have a vote by agreeing to join together. Additional voting rights will be attributed by ASC for each future commitment to the Project of one AGATA unit or the equivalent monetary value.

Terms of reference:
The ASC is the decision-making body of the AGATA Collaboration and responsible for the allocation of resources supplied by the Parties and the collaborating institutions. The ASC will ensure that the primary criterion for deployment of any equipment is based on scientific merit.

The tasks of the Steering Committee are as follows:

1. define the scientific policy of the AGATA Collaboration taking advice from the AGATA Collaboration Council.
2. elect a chair and vice-chair among its members who will each serve for a period of two years.
3. appoint a project manager and members of the AGATA Management Board.

4. monitor the Project based on reports received from the Project Manager.
5. decide on any modification of the Project proposed by the Project Manager.
6. decide on the experiment campaigns for AGATA and the timetable for the deployment of AGATA systems at various facilities.
7. appoint the Campaign Spokesperson for each experiment campaign.
8. review the scientific progress of each experimental campaign based on reports received from the Campaign Spokesperson.
9. review the running cost statements and allocations

Decisions in the ASC shall be taken by consensus.

The ASC shall not make any decision unless a quorum of two thirds of the votes are represented.

Minutes of each meeting shall be drafted by the chairperson to the other members without delay. The minutes of each meeting shall be considered as accepted by the other members if, within thirty calendar days from receipt, the other members have not objected in writing to the chairperson.

The ASC chair signs on behalf of the ASC all written agreements.

AGATA Project Manager (PM)

The AGATA Project Manager is appointed by the ASC to coordinate the execution and implementation of the project. For this purpose the PM can create and dissolve working groups as needed and after acceptance of the ASC. The PM will nominate the chairpersons of these working groups.

AGATA Management Board (AMB)

Membership of the AMB:
The AGATA Project Manager; Chairpersons of the working groups; Chairperson of ASC (ex-officio). The AGATA Project Manager will chair the AMB.

The Local Campaign Manager(s) nominated by each Host are invited to attend.

Voting rights:
All members have equal voting rights.

Terms of Reference:
The AMB executes and implements the project. The AMB shall report to and be accountable to the ASC through the AGATA Project Manager.

The tasks of the AMB are as follows:

1. supervise the effective and efficient implementation of the Project.
2. collect information on the progress of the Project, examine that information to assess the compliance of the Project with the programme decided by the ASC and, if necessary, propose modifications of the programme to the ASC.
3. provide reports of the progress of the Project to the ASC including an annular planning and resource report.
4. advise the ASC on technical issues.
5. work with the Local Campaign Manager of each Host to ensure the successful operation of AGATA.
6. organise AGATA working group meetings as needed.

AGATA Collaborating Council (ACC) and AGATA Spokesperson

Membership:
One representative from each collaborating institution and the AGATA Spokesperson.
The AGATA Spokesperson chairs meetings of the ACC.

The Campaign Spokespersons are invited to attend.

Voting:
All members have equal voting rights. The AGATA Spokesperson is excluded from any vote concerning the Spokesperson role.

Terms of Reference:
The ACC is the advisory body of the ASC on scientific matters concerning the AGATA project.

The tasks of the ACC are as follows:

1. elect the AGATA spokesperson who will serve for a period of two years.
2. advise the ASC on scientific matters concerning the AGATA project and the research programme through the AGATA Spokesperson.
3. nominate the Campaign Spokesperson for each experiment campaign to the ASC.
4. hold meetings, at least annually, to receive reports from the ASC and AMB on the progress of the Project and from the Campaign Spokespersons on the progress of the research programme.
5. hold an annual open meeting of the AGATA Collaboration to present the status of the Project and to discuss future experiment campaigns.