

# Interim Memorandum of Understanding

## For the Execution of the Initial Phase of the Nuclear Structure, Astrophysics, and Reactions (NuSTAR) Experiments at FAIR

between

The Facility for Antiproton and Ion Research, represented by the Joint Core Team, hereinafter referred to as FAIR, Darmstadt, as the Host Laboratory on the one hand,

and

the Institutions forming the NuSTAR Collaboration

### Preamble

- (a) A group of Institutes from FAIR Member and non-Member States as well as FAIR, has agreed to collaborate to form the NuSTAR Collaboration (**Annex 1**). This Collaboration has proposed to FAIR several experiments to study fundamental aspects of *nuclear structure physics, nuclear astrophysics, and nuclear reaction physics*. For each experiment, Sub-Collaborations have been formed (**Annex 3**) which have submitted individual proposals to FAIR describing in detail the physics programme as well as the technical details for the realisation of the respective experiments.
- (b) On the basis of the NuSTAR Technical Proposals submitted in December 2005 (FAIR/AIC, FAIR/ELISe, FAIR/EXL, FAIR/HISPEC/DESPEC, FAIR/ILIMA, FAIR/LASPEC, FAIR/MATS, FAIR/R3B) and a detailed review of their scientific merits, technological feasibility and estimates of the resources needed, the STI (Scientific and Technical Issues) Committee of FAIR recommended approval of the experiments to the FAIR ISC (International Steering Committee), subject to a set of milestones to be met by the experiments in the initial phase of FAIR (STI\_Recomm-2.2).
- (c) Based on the recommendations of the STI, the ISC approved the NuSTAR experiments AIC, ELISe, EXL, HISPEC/DESPEC, ILIMA, LASPEC, MATS, and R3B, together with plans, including milestones, leading to the Technical Design Reports for the individual NuSTAR experiments and their sub-systems. The EXO-PBAR collaboration was encouraged by the ISC to further develop the technical implementation of the challenging physics goals and to join the NUSTAR MoU at a latter stage.
- (d) The Super-FRS, a high-resolution, multi-stage magnetic spectrometer, provides and analyses the rare isotope beams for the different NUSTAR experiments and represents a versatile nuclear research instrument. It is a central part of all NuSTAR experiments. All costs for the design and construction of the Super-FRS are listed in the FBTR cost-book.

- (e) As a step towards the final Memorandum of Understanding, an Interim Memorandum of Understanding (IMoU) is concluded for the initial phase of the experiments up to the presentation of the Technical Design Reports for the individual NuSTAR experiments.

#### **Article 1: Parties to this IMoU**

- 1.1 All institutes and institutions of FAIR Member and non-Member States forming the NuSTAR Collaboration will take part in this initial phase.
- 1.2 Parties shall be the institutes and institutions of the NuSTAR Collaboration listed in **Annex 1**. The involvement of the Parties in the individual NuSTAR experiments and in the Super-FRS is given in **Annex 6**.
- 1.3 The collaborating institutes and institutions and the NuSTAR Collaboration will hereinafter be referred to as “Institute(s)” and “Collaboration”, respectively. The different NuSTAR experiments including the Super-FRS covered by this IMoU are listed in **Annex 3**. For each NuSTAR Experiment and the Super-FRS a Sub-Collaboration has been formed. These Sub-Collaborations are described in **Annex 3**.

#### **Article 2: Purpose of this IMoU**

- 2.1 The purpose of this IMoU is to define the initial phase for each NuSTAR experiment, the programme of work to be carried out during this phase and the distribution of charges and responsibilities among the Parties for the execution of this work. It further sets out organisational, managerial and financial guidelines to be followed by the Parties. It defines the integration of the Sub-Collaborations into NuSTAR as well as NuSTAR common projects.
- 2.2 The initial phase encompasses the remaining research and development (R&D) work, engineering design and prototyping required for the submission of Technical Design Reports for the NuSTAR Experiments at the - low-energy, high energy, and ring branches of the Super-FRS.
- 2.3 While all Parties have the firm intention to adhere to the terms of this IMoU, it is understood that this document is not legally binding.

#### **Article 3: NuSTAR Technical Design Reports**

- 3.1 The membership of the Collaboration and the construction schedule of the NuSTAR experiments will be updated after the submission of the Technical Design Reports of the individual NuSTAR experiments, and again prior to the signing of the MoU for the construction phase of FAIR.
- 3.2 After the submission of the Technical Design Reports of the individual NuSTAR experiments, the responsibilities for the construction of the NuSTAR experiments will be laid down in a final Memorandum of Understanding covering the full period of construction of the NuSTAR experiments and their installation in the experimental areas at FAIR.

**Article 4: The NuSTAR Collaborations and the NuSTAR experiments**

- 4.1 The NuSTAR Experiments have been described in detail in the Technical Proposals submitted to the STI in January 2005 and in the addenda submitted in December 2005 summarised in the FAIR Baseline Technical Report. The NuSTAR Experiments and their sub-systems are listed in **Annex 3**. The Super-FRS has been described in the FAIR Baseline Technical Report Vol.2.
- 4.2 The names of the scientists presently participating in the individual Sub-Collaborations are listed in **Annex 3** by Country and by Institute, and for the NuSTAR Collaboration in **Annex 4**. An overview of all the NuSTAR experiments is given in **Annex 6**.
- 4.3 The management structure of each Sub-Collaboration is described in the associated section in **Annex 3** including the list of persons currently holding management positions in each Sub-Collaboration. The overall structure of the NuSTAR Collaboration is described in the attached document 'NuSTAR Organisation' (**Annex 5.1**). Persons currently holding management positions in the NuSTAR Collaboration are given in **Annex 5.2**.
- 4.4 Following the recommendations of the FAIR Cost Review Committee (CORE), the manpower and financial resources needed for the NuSTAR Experiments are grouped under three headings:
  - 4.4.1 R&D work necessary to make final choices for the various detector elements;
  - 4.4.2 Costs for infrastructure, personnel, travel, etc. arising from participation in the Collaboration;
  - 4.4.3 Design, prototyping, construction, and installation costs for the complete experimental set-up.

The resources needed for work under the headings 4.4.1 and 4.4.2 is the responsibility of the Institutes supported by their respective Funding Agencies. These resources are neither accounted for in construction costs, nor monitored centrally by the Sub-Collaborations or the NuSTAR Collaboration.

The resources needed for work under the heading 4.4.3 cover the costs of the construction of individual sub-systems of each NuSTAR Experiment as listed in the FAIR Cost Book. Only these costs and ensuing expenditures are monitored centrally by the Sub-Collaboration of each NuSTAR experiment and the NuSTAR Collaboration.
- 4.5 The individual CORE costs for each NuSTAR Experiment, evaluated in Euro at 2005 prices, are contained in the Cost Book section of the FAIR Baseline Technical Report, dated March 2006, and are shown in **Annex 3**. The list of items in this document and their costs serve as a basis for the sharing of charges and responsibilities among the collaborating Institutes (Article 5).
- 4.6 The contributions from the Funding Agencies for the complete construction of the NuSTAR experiments, as initially assumed by the NuSTAR management, are presented in **Annex 6**. It is understood that this table is included for information only and does not, at this stage, commit any Funding Agency.

## **Article 5: Programme of Work and Milestones for the Initial Phase of the NuSTAR experiments and the Sharing of Responsibilities for its Execution**

- 5.1 Milestones have been set, defining for all NuSTAR Experiments and Common Projects the work necessary until the submission of the Technical Design Reports of the individual NuSTAR experiments.
- 5.2 The milestones and the sharing of responsibilities for the NuSTAR Experiments are presented in **Annex 3**. In addition, in **Annex 7** a summary table, indicating the level of involvement of each country, is supplied for the countries in the NuSTAR Experiments and the funds necessary during the initial phase for design and prototyping contained in the NuSTAR Technical Reports. The Institutes will try the best of their endeavours to raise third-party funding for the initial phase.

## **Article 6: Common Projects**

- 6.1 The NuSTAR Common Projects involve the shared development of subsystems used by all or several NuSTAR experiments. The investment costs for the construction of these sub-systems lies generally in the responsibility of the individual NuSTAR Sub-Collaborations.
- 6.2 **Annex 8.1** lists the NuSTAR Common Projects, the Sub-Collaborations involved and the institutions participating in the individual Common Projects. Procedures for the management of the NuSTAR Common Projects are outlined in **Annex 8.2**.
- 6.3 Contributions to the NuSTAR Common Projects will be made by taking responsibility for a NuSTAR Common Project item or parts of it, in agreement with the NuSTAR Collaboration Committee and the involved Sub-Collaboration Boards.
- 6.4 The Common Projects within the individual NuSTAR Experiments and their funding is described in the respective section of **Annex 3** for each Sub-Collaboration.
- 6.5 Contributions by Institutes to the NuSTAR Common Projects will be solicited by the individual Sub-Collaboration Boards in coordination with the NuSTAR Collaboration Committee.

## **Article 7: Obligations of FAIR as the Host Laboratory, and of the Institutes**

- 7.1 The general obligations of FAIR as Host Institution and of the Institutes will be contained in the document "General Conditions for Experiments Performed at FAIR". After submission of the Technical Design Reports of the individual NuSTAR experiments the general conditions for experiments to be performed at FAIR may be laid down in a new document which will form an integral part of the final Memorandum of Understanding.
- 7.2 All equipment brought to the FAIR site must comply with FAIR's safety regulations. If relevant, the design, test criteria and testing of equipment should be discussed well in advance with FAIR's safety officials. All equipment brought to FAIR must be accessible for inspection with regard to matters of safety.

**Article 8: Annexes**

- 9.1 All the Annexes are an integral part of this IMoU. They are understood to be the planning basis for the construction of the NuSTAR Experiments. Updates will be possible and must be agreed upon by the respective Parties by means of amendments to the appropriate annex or annexes.

**Article 9: Effective date**

- 10.1 This IMoU shall become effective when two thirds of the Institutes listed in the cost-matrices of the NuSTAR Experiments have signed the IMoU and will be effective until the final MoU for the NuSTAR experiments comes into effect.