NUSTAR Newsletter 1 / 2013

Apr 12, 2013

Introduction

This newsletter is a summary of recent events and important information regarding the FAIR project and activities of the various NUSTAR Collaboration boards and committees.

Note that any information on highlights or upcoming meetings can be found on the NUSTAR@FAIR web page (see http://nustar.fair-center.eu). You can send your material to NUSTAR@fair-center.eu. Suggestions are always welcome.

News from the Boards and Committees

BR (NUSTAR Board of Representatives)

The NUSTAR Board of Representatives has discussed in several meetings the following main topics:

- Organization and scientific program of the NUSTAR Annual meeting 2013
- Situation of research and beam time at GSI and impact on ongoing experimental programs and tests (especially AGATA/PreSPEC)
- Composition of the Board of Representatives: The role and number of ex-officio members in the BR was discussed. It was decided to propose to the Council that the two NUSTAR Coordinators shall be permanent ex-officio members and the BR may invite colleagues from GSI (including FAIR@GSI) and FAIR depending on the topics on the agenda
- Super-FRS Collaboration and roadmap toward the LEB building

NC (NUSTAR Council)

The NUSTAR Council has met during the NUSTAR Annual meeting 2013 and discussed the following topics:

- New and outgoing BR members: Following the result from the on-line election in January 2013 (NUSTAR Council members, 87% participation) Ari Jokinen (University of Jyväskylä) and Thomas Aumann (TU Darmstadt) were elected as new members and Dolores Cortina-Gil was re-elected for a second 2-year term. The BR thanked the outgoing members, Patrick Regan and Christoph Scheidenberger, for their work in the past years.
- New composition of the NUSTAR Board of Representatives: The Council endorsed the proposal of the BR to have in addition to the five elected BR members the two NUSTAR Coordinators as ex-officio, only
- Situation of beam time and research at GSI
- Report on NUSTAR Common Fund
- Status of LEB building and LEB task force

CC (NUSTAR Collaboration Committee)

The NUSTAR Collaboration Committee has met after the plenary program of the NUSTAR

Annual meeting 2013 and discussed two main topics: The layout of the LEB building and the role of the Super-FRS Collaboration. The LEB task force was given a mandate from the CC to manage the activities toward the LEB building. The LEB shall report directly to the CC.
It was decided to meet more regularly in order to improve the activity and efficiency of the CC. The next meeting is scheduled for April 23, 2013.

LEB Task Force

In order to strengthen the activities toward the realization of the missing Low-Energy-Branch building, a task force was formed under the lead of Dieter Ackermann from GSI. Members are Hans Geissel, Jürgen Gerl, Alexander Herlert, Haik Simon, Helmut Weick, Martin Winkler, Christopher Geppert and Frank Herfurth. The LEB Task Force meets regularly and reports directly to the Collaboration Committee. A roadmap for the realization of the LEB building was defined and presently the layout of the LEB building is discussed with the experimental groups and with the architects.

TB (NUSTAR Technical Board)

The NUSTAR Technical Board has met during the NUSTAR Annual Meeting 2013 and the status of the various NUSTAR experiments was discussed. In addition, the implications of the FAIR@GSI project and the situation with the GSI beam time in 2013/14 with consequences for testing of equipment were looked into. It was decided to provide input for a document, which describes the requirements expected from the host-lab. The next meeting is planned during the NUSTAR Week 2013 in Helsinki.

BFC (Board of FAIR Collaborations)

The Board of FAIR Collaborations met on January 22 where Günther Rosner was invited to elucidate the process of unifying FAIR and GSI as well as the proposed FAIR Research Division. Oliver Kester was as well invited to give an update on the FAIR@GSI project structure. The resource and beam-time situation was discussed and actions towards the GSI Supervisory Board considered.

RB (NUSTAR Resource Board)

The NUSTAR Resource Board had its 3rd meeting during the NUSTAR Annual Meeting 2013. Besides the present financial status, a strategy toward the funding of the LEB building was discussed. It was also announced that UK joins FAIR as Associate Partner (signature on May 3, 2013). The main work of the RB will now focus on the upcoming FAIR Resources Review Boards and the preparation of documents like the NUSTAR Construction MoU.

ECE (FAIR Expert Committee Experiments)

The Expert Committee Experiments will meet in May/June to continue the evaluation of submitted TDRs. In the case of NUSTAR, the TDR of MONSTER has been submitted for evaluation. Recently, the FAIR Research Director approved the TDR of AIDA (as part of HISPEC/DESPEC).

RRB (FAIR Resources Review Boards)

Present planning aims at a first meeting of the FAIR RRBs in July 2013. It will be announced in due time once the date is fixed. Invitations to the funding agencies and ministries will be sent in April.

MATS

A "phase clock" as high-precision atomic scale – Imaging of rotating ions increases the precision of mass measurements of unstable nuclei.

Over the last years, precision mass measurements of atomic nuclei gained considerable importance for many fundamental questions in physics. An important issue is the stability of the nuclei determined by the binding energy. A particular challenge is the mass measurement of radioactive nuclides, which often decay within a blink of an eye after their production.

An established technique is the trapping of radioactive nuclides as single ions in Penning traps, as they will be used in the future MATS experiment at NUSTAR/FAIR. In principle, an ion is confined in a strong magnetic field, performing a cyclotron motion, and by a positive voltage applied to two opposite electrodes (Fig. 1). From a measurement of the rotation frequency the mass is obtained with high precision.

In case of short-lived nuclides there is only little time left to measure the rotation frequency. To this end, a novel method was recently developed: The radial motion of the ion is amplified by a radio-frequency field before the ion is imaged on a position sensitive detector. Depending on the time the ion rotates in the trap after a radio frequency pulse (start), typically some tenths of seconds, the position of the ion on the detector changes (stop) describing a circle like the hand of a clock.

The frequency of a clock is determined by the revolution time of its hand, for example one full revolution of the minute hand corresponds to one minute. More precise clocks have a second hand. In this experiment, this part in taken by the rotating ion itself – one only has to image the clock hand position, i.e., the phase of its radial motion. Fig. 2 shows the "clock face" on the detector for different stopping times.

This idea was now realized by members of the MATS collaboration at the SHIPTRAP facility at GSI (S. Eliseev *et al.*, Phys. Rev. Lett. 110, 082501 (2013)). It leads to a 40-fold increase in the resolving power and a fivefold gain for the precision – a major breakthrough in precision

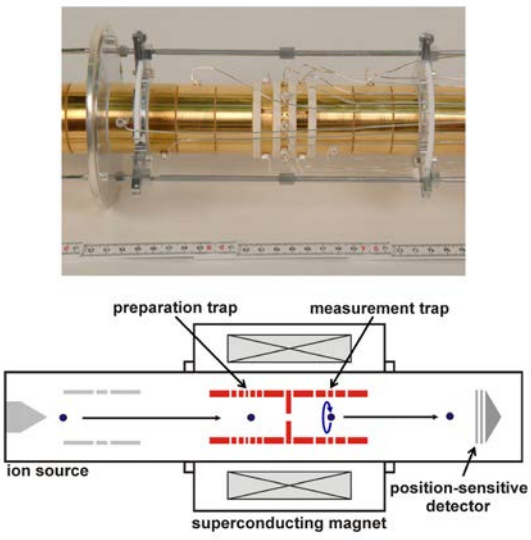

Fig. 1. Schematic of the setup of the SHIPTRAP trap with a space resolving detector for imaging the radial motion of the ion.

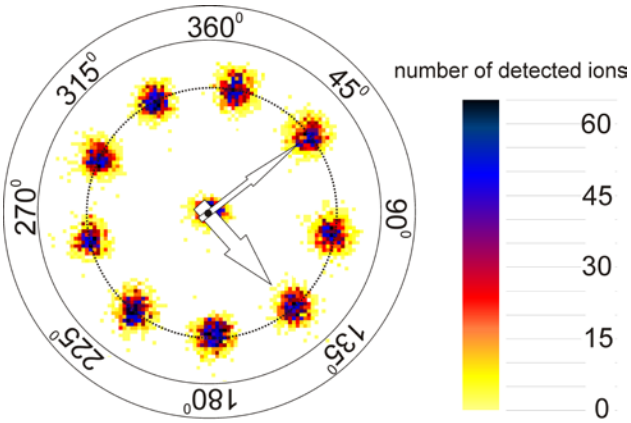

Fig. 2. Radial movement of the ion on the detector ("Phase watch") for different stopping times. The figure is composed of a great number of single measurements which could be taken within some minutes. The rotating moment of the ion is approximately 1 microsecond.

mass spectrometry. Thus, the new technique measures masses with the same accuracy but 25 times quicker. Investigating two xenon isotopes with the mass numbers 129 and 130 they obtained relative mass precisions up to the ninth digit after the decimal point within some minutes.

ILIMA

Nuclear energy trap unveiled at GSI – Direct observation of long-lived isomers in ^{212}Bi

Catching bismuth ions in a storage ring has revealed previously hidden features, thereby solving a scientific conundrum, and at the same time providing a possible test case for a type of "nuclear battery". Working at the GSI, an international team of scientists has studied a long-lived isomer, or energy trap, associated with the isotope Bi-212 (L. Chen et al., Phys. Rev. Lett. 110, 122502 (2013)). The bismuth ions were created by U-238 fragmentation and focused into the GSI experimental storage ring, where individual ions were observed as they circulated. The new half-life and excitation-energy information now fits well with shell-model calculations, which themselves show that the energy trap could be suitable for induced energy-release measurements. It is hoped that this may, in the longer term, lead to the ability to control the trapped nuclear energy, with wide-ranging applications.

This work opens new avenues for the ILIMA program at FAIR, where there will be dramatically enhanced capabilities for isomer manipulation – in addition to the much extended scope for nuclear mass measurements. Isomer studies with the CRYRING, for example, give for the first time the possibility to implant bare ions onto a solid surface at low kinetic energy. The subsequent “Coulomb implosion” of atomic electrons can be expected to reveal novel nuclear effects. For such studies, the Bi-212 isomer appears to be particularly attractive.

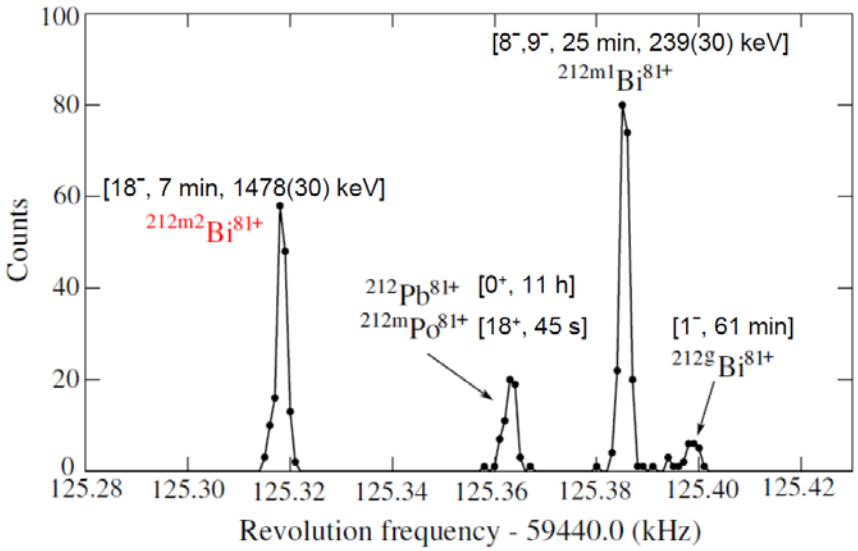

Fig. 1. New data for Bi-212, with events corresponding to the strongly produced second isomer (m2) on the left.