Available online at www.sciencedirect.com

ScienceDirect

Nuclear Physics A 931 (2014) 267–276

NUCLEAR PHYSICS A

www.elsevier.com/locate/nuclphysa

Physics at FAIR

Subhasis Chattopadhyay

Variable Energy Cyclotron Centre, 1/AF, Salt Lake, Kolkata 700064, W.B., India

Received 3 August 2014; received in revised form 26 September 2014; accepted 27 September 2014

Available online 2 October 2014

Abstract

The Facility for Antiproton and Ion Research (FAIR) is under construction at Darmstadt, Germany. It will deliver high intensity beams of ions and antiprotons for experiments in the fields of atomic physics, plasma physics, nuclear physics, hadron physics, nuclear matter physics, material physics and biophysics. One of the scientific pillars of FAIR is the Compressed Baryonic Matter (CBM) experiment which is designed for the study of high density nuclear matter as it exists in the core of neutron stars. In this article the scientific program of FAIR will be reviewed with emphasis on the CBM experiment.

Keywords: QGP; Neutron star; CBM; APPA; NUSTAR; PANDA

1. Introduction

A new accelerator facility for fundamental research is being built at Darmstadt, Germany. The facility known as the Facility for Antiproton and Ion Research (FAIR) will use some of the accelerator components of GSI as injector systems. High intensity beams of ions and antiprotons will be used by different communities to perform experiments probing from quarks to atoms. Broadly, the research communities at FAIR have been divided into four different categories i.e., (a) atomic, plasma physics and applications (APPA), (b) nuclear structure, astrophysics and reactions (NUSTAR), (c) hadron physics using antiproton beams (PANDA) and (d) the compressed baryonic matter (CBM) experiment to create and study the strongly interacting matter under very high net-baryon density. The facility to be built in phases is scheduled to deliver its first beam in 2019. The start-up phase known as the modularized start version (MSV) is planned in such a way that all four communities can start their experiments in the respective start-up phases from the beginning of operation of FAIR. In this document we discuss in brief different physics programmes

http://dx.doi.org/10.1016/j.nuclphysa.2014.09.099

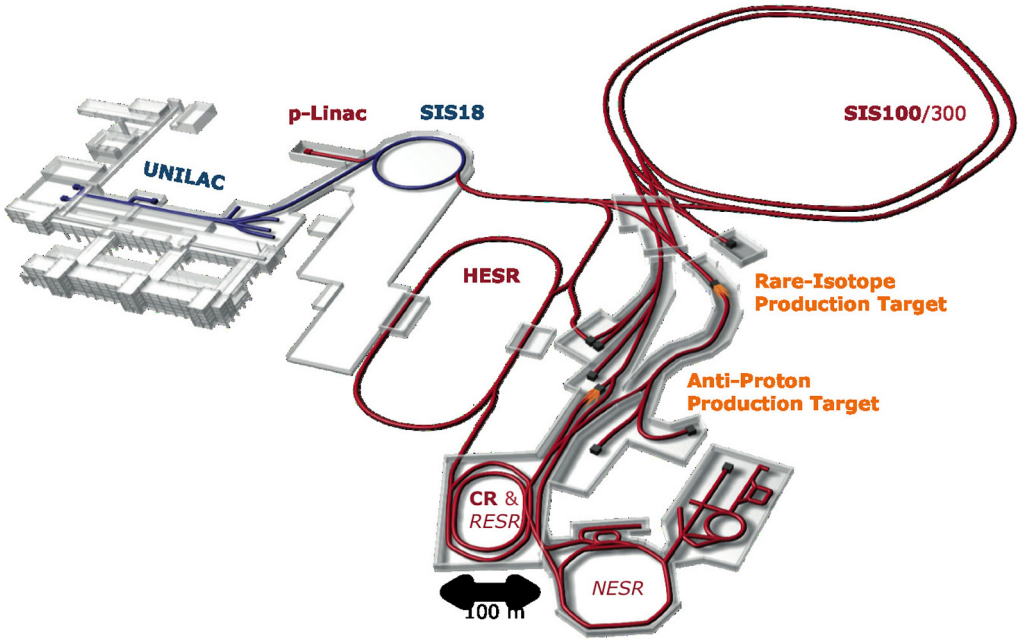

Fig. 1. Layout of the FAIR facility.

Table 1
Main beam parameters of FAIR for the full version including SIS-300.

Species	Beam energy	Intensity
U^{28+}	1.5 A GeV	10^{12}/s
U^{92+}	upto 35 A GeV	10^{10}/s
Protons	90 GeV	3×10^{13}/s
Radioactive ion beams	upto 1.5–2 A GeV	$< 10^{9}$
Stored and cooled antiproton	1.5–15 GeV	10^{11}

to be undertaken at FAIR with somewhat detailed view of the CBM experiment. The article is organized as follows: in the next section we discuss about the properties of FAIR beams with a broad sketch of the facility. Sections 3, 4 and 5 discuss the activities of APPA, NUSTAR and PANDA respectively. We discuss CBM in Section 6 with a summary in Section 7.

2. FAIR facility

The layout of FAIR is illustrated in Fig. 1. The new facility and the existing GSI complex are shown in red and grey, respectively. At the heart of FAIR is a tunnel housing two accelerator rings with a bending power of 100 Tm and 300 Tm, called SIS-100 and SIS-300. The MSV of FAIR includes the SIS-100 ring, production targets for anti-proton and secondary beams (stable and short-lived), the high energy storage ring (HESR) for storing the antiproton beams and the superconducting fragment separator (super-FRS) for secondary ion beams. The full version of the facility will include the SIS-300 ring which will provide parallel operation of experiments along with higher beam energy. In Table 1, we give a list of main beam parameters of the facility.