Chapter 1

Introduction

The Broad RAnge Hadron Magnetic Spectrometers experiment (BRAHMS) is designed to measure charged hadrons over a wide range of rapidity and transverse momentum for all available beams and energies.

One of the physics goals is to study the reaction mechanisms of the relativistic heavy ion reactions at RHIC energies and the properties of the highly excited nuclear matter formed in these reactions. The amount of stopping will be studied through the net baryon distributions. The expansion and freeze-out characteristics of the hot nuclear system formed in the reaction will be established by studying the spectral shapes and particle abundances. At higher p_t values (1-2.5 GeV/c) the measurements will give insight into the earlier reaction phases through the properties of the hadron spectra. Some information concerning the space-time characteristics of the system will be obtained from interferometry measurements in a limited rapidity and p_t range.

Another goal is to look for evidence of the QGP phase transition as it may manifest itself in the final hadronic stages, e.g. through study of the $< p_t >$ dependence on centrality, and the strange particle production via K^+ and K^-, both in the relatively baryon free mid-rapidity region and in the baryon rich fragmentation region. These goals are achieved by using two small solid angle spectrometers which operate from $2^o - 20^o$ and $20^o - 90^o$, respectively. The rapidity range will be from 0 to 4 with p_t up to 2.5 GeV/c over most of this y range. A measure of the centrality of the collisions will be obtained from a multiplicity array.

This conceptual design report describes the BRAHMS detector and how it will be installed and operated at RHIC. Chapter 2 presents an overview of the physics program to be achieved with the BRAHMS Experiment. This is an extended text of what was given previously in Letter of Intent #8 from January 1992. This is followed in Chapter 3 by an overview of the detector systems, a description which is close to earlier designs but changed to reflect updates.

The magnet design is reviewed in Chapter 4. Considerable work has gone into a more detailed study of the magnets in the forward arm spectrometer. These studies have confirmed the design originally proposed in LOI8. A detailed first-design of all magnets has been completed.

Chapter 5 describes the requirements that the BRAHMS Experiment sets for the intersection region. The arguments for the proposed positioning of the two magnet arms are presented. The needed support buildings and their possible placements are discussed.

Chapter 6 examines the requirements on the elements of the forward arm, and demonstrates the feasibility of the proposed combination of magnets and tracking detectors. Most of the detectors are small TPC's, and several features of a prototype TPC and the testing thereof are described.

The particle identification in BRAHMS is achieved by time-of-flight techniques and Čerenkov counters. This is described in Chapter 7. It is shown that a RICH detector is well suited to and capable of handling the high momentum particle identification.

The global detectors, i.e., the beam-beam counters and the multiplicity detector, are described next in Chapter 8. The concept for a centrality detector based on silicon strips is presented; a backup scheme employs an array of proportional gas counters.

Considerations on data aquisition and triggers, as given next in Chapter 9, are fairly conventional and should not pose any major problems for development.

The cost estimate for the experiment is given last; the total budget for BRAHMS is within the original goal. Conservative cost estimates have been used throughout. The schedule for construction has yet to be worked out in detail. Attention is drawn to the need for the larger magnets to be procured in FY96 in order to be installed before RHIC commissioning in the fall of 1998.