

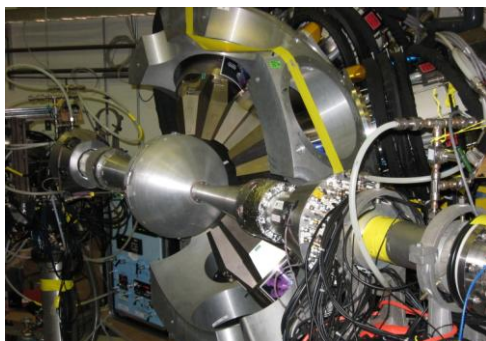
CHICO2 – A pixelated parallel-plate avalanche counter

CHICO2 is an upgrade version of CHICO (Compact Heavy Ion COunter) with improved position resolution. CHICO was designed specifically for Gammasphere as auxiliary detector for the charged-particle detection. The design and fabrication work were carried out at University of Rochester under NSF funding. A total of 26 Gammasphere/CHICO experiments were successfully fielded between 1996 and 2008 using various experimental techniques such as the sub-barrier Coulomb excitation, quasi-elastic or deep-inelastic reactions, and fission. It addressed issues related to the evolution of nuclear collectivity, such as the shape transition and shape coexisting phenomenon in nuclei.

CHICO consists of two mirror-image hemispheres with solid-angle coverage of 69% of 4π and each hemisphere holds 10 individual parallel-plate position-sensitive avalanche counters (PPAC). CHICO has a minimum mass for the construction material and can be operated stably at high counting rates without significant radiation damage. The position is read out in spherical coordinates; the polar angle, θ , is determined from the pixelation on the cathode plate using the delay-line readout technique and the azimuth angle, ϕ , is determined from the geometric location of segmented anode plates. For a given experiment, the event is uniquely identified by the measured quasi-two-body kinematics. It has two advantages; one is to allow precision Doppler-shift corrections for the coincident γ rays observed by Gammasphere. The resulting γ -ray energy resolution is about 1%, which is limited by the Ge detector size of Gammasphere. Secondly, it provides a signature to distinguish contaminants from the primary beam species. This is important for experiments with the radioactive beams where contaminants sometime are the dominant components of the delivered beam.

With the advent of the modern gamma-ray energy tracking arrays such as GRETINA, the γ -ray energy resolution can be improved by a factor 2 to 3 by developing an auxiliary detector system with matching position resolution. A proposal to upgrade CHICO to CHICO2 by improving the position resolution, in particular the ϕ resolution from $\sim 9^\circ$ to $\sim 1^\circ$, was submitted to DOE and approved in FY10. This improvement was made possible by adding pixels in the ϕ coordinate to the existing ones in θ coordinate on the cathode plate, resulting in a total of 1,478 pixels for each PPAC. The position determination is not from the location of each pixel, instead, it relies on the delay-line readout technique which lowers the output channels from 1,478 to 4.

In addition to the improved position resolution in this upgrade, a new generation fast amplifier, as well as a new VME based data acquisition system, were developed. CHICO2 was successfully integrated into Gammasphere in FY13 and GRETINA in FY14 with an achieved position resolution of 0.7° (σ) in θ and 1.4° in ϕ . It is ready for experiments.



GRETINA/CHICO2 setup

