transfer to the nucleus, $F_{e.m.}(Q)$ is the nuclear electromagnetic form factor, corrected for absorption of the outgoing pion.

As the Primakoff effect is not the only mechanism for pion photoproduction at high energies, some care must be taken to isolate it from competing processes. In particular, the total cross section is given by:

$$\frac{d^3\sigma}{d\Omega_\pi} = \frac{d\sigma_P}{d\Omega} + \frac{d\sigma_C}{d\Omega} + \frac{d\sigma_I}{d\Omega} + 2 \cdot \sqrt{\frac{d\sigma_P}{d\Omega} \cdot \frac{d\sigma_C}{d\Omega}} cos(\phi_1 + \phi_2) \tag{4}$$

where the Primakoff cross section, $\frac{d\sigma_P}{d\Omega}$, is given by equation (3). The nuclear coherent cross section is given by:

$$\frac{d\sigma_C}{d\Omega} = C \cdot A^2 |F_N(Q)|^2 sin^2\theta_\pi \tag{5}$$

and the incoherent cross section is:

$$\frac{d\sigma_I}{d\Omega} = \xi A(1 - G(Q)) \frac{d\sigma_H}{d\Omega} \tag{6}$$

where A is the nucleon number, $C sin^2\theta_\pi$ is the square of the isospin and spin independent part of the neutral meson photoproduction amplitude on a single nucleon, $|F_N(Q)|$ is the form factor for the nuclear matter distribution in the nucleus, corrected for absorption of the outgoing pion, ξ is the absorption factor of the incoherently produced pions, $1 - G(Q)$ is a factor which reduces the cross section at small momentum transfer due to the Pauli exclusion principle, and $\frac{d\sigma_H}{d\Omega}$ is the π^o photoproduction cross section on a single nucleon. The relative phase between the Primakoff and nuclear coherent amplitudes without absorption is given by ϕ_1 and the phase shift of the outgoing pion due to absorption in the final state is given by ϕ_2.

Kinematical considerations enable one to separate Primakoff from other photopion production mechanisms. The Primakoff cross section is zero for pions emitted along the incident photon direction, has a sharp maximum at an angle $\theta_\pi \sim m_\pi^2/2E_\pi^2$, and falls rapidly to zero at larger angles. It is proportional to Z^2, and its peak value is roughly proportional to E^4. The nuclear coherent cross section is also zero in the forward direction, has a broad maximum outside the angular region of the Primakoff effect, and falls at larger angles as shown in figure 3, where the amplitudes are taken from reference [15] and distortion effects are not included. It is expected to vary little with energy [16]. Consequently, this experiment requires a π^o detector with good angular resolution to eliminate nuclear coherent production, and good energy resolution in the decay photon detection will enable an invariant mass cut to suppress multiphoton backgrounds.

4 Experimental setup

The primary experimental equipment required in the proposed experiment includes: (1) the Hall B photon tagger; (2) a sweeping magnet located after the tagging dipole; (3) 5% r.l. solid π^o production targets (Pb and Cu); (4) a 1m × 1m highly segmented lead glass photon detector for π^o decay photons, with a high resolution insertion in the central region near the