The relative momentum dependence of analyzing power for $pp \to pp\pi^0$ reaction.

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The axial charge density operator plays an important role in the nuclear s-wave pion production and absorption reactions[1]. This operator is derived from the extension of effective pion-nucleon interaction of Weinberg's model[2],

$$\mathcal{L} = \frac{1}{f_\pi} A^\mu \partial_\mu \phi, \tag{1}$$

where f_π is the pion decay constant and ϕ and A^μ is the pion field and the isovector axial current of nuclear system, respectively. The axial charge operator is given by the time component of axial current and is separated into single-nucleon and two-nucleons exchange current operators. The s-wave pion amplitude of pion production is in proportion to the total energy of emitted pion ω_q which is originated in the time-differentiation of pion field. As for the $pp \to pp\pi^0$ reaction, total cross section data near the pion production threshold was measured at IUCF[3] very precisely and it was indicated that the two nucleon's axial exchange charge operator of a short-range component gives large contributions to the s-wave pion-production amplitude in which final nucleon couples to S-state[4]. After that, this operator was established as the heavy meson exchange (σ,ω) on the basis of phenomenological meson exchange mechanisms[5] and these operators are in proportion to pion total energy ω_q and strongly couples to the S-wave final nucleons state due to the short range nature of it's wave function. As a result, the strong energy dependence of S-state wave function determines the momentum dependence of this s-wave pion amplitude. In this work, the relative momentum dependence of Ps amplitude, in which the final nucleons couple to P-state and pion is emitted by s-wave, is discussed from the analyzing power of $pp \to pp\pi^0$ reactions. It is expected that the final state interaction between P-state is not so strong and the dependence of pion total energy ω_q which may indicate the contribution of axial charge operator on Ps amplitude can be observed on it's momentum dependence. The experimental setup and the angular dependence of analyzing power are described in ref.[6]. Here the relative momentum dependence of analyzing power which is integrated by the emitted angle of pion is obtained. In this condition, the analyzing power is expressed by

$$Ay \frac{d\sigma}{dk} \sim Ps\ Pp\ d\rho(k), \tag{2}$$

where $d\sigma/dk$ is the relative momentum distribution and Pp is p-wave pion production amplitude in which final nucleons couple to P-state. $d\rho(k)$ is a phase space volume. The relative