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A PROPOSAL FOR A DETERMINATION OF THE γ-RAY SPECTRUM IN THE FORWARD DIRECTION ($5^{o} \div 20^{o}$) AT THE ISR

A PRECISION TEST FOR SCALING

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ABSTRACT

We propose a simple measurement of the γ-ray angle and energy distribution in the forward direction ($<20^{o}$) which can be performed immediately in I6, in parallel with the elastic scattering experiment R601 and essentially at no cost using the 61 blocks of the Aachen-CERN-Torino lead glass spectrometer. The acceptance of the spectrometer is at least 100,000 times larger than for instance the one for charged particles of the Argonne-Bologna-Michigan collaboration[(1)] in I2.

Since the 61 blocks are read out independently, γ-ray multiplicities and correlations can be studied.

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1. A number of traditional features of multiparticle process in very high energy collisions are now opened for significant precision tests at the ISR. The experiment we propose is intended to provide to a high statistics (10^6) tests of two main questions

i) the existence of "limiting" distributions in the frame of reference of the incoming projectiles.

ii) the possible existence of anomalously large values for the transverse component of the moments.

The first of the two assumptions, usually known as hypothesis of a limiting fragmentation[2], states that at sufficiently high energies any configuration of n particles will tend to a limiting probability in the frame of reference of one of the incoming particles. It is evident that the same has to apply also to the γ-ray distributions from decays of any (hadronic) state. Lorentz transformation from the frame of reference of the projectile P to the center of mass implies that the energy distribution in units of the incident energy is an invariant[3].

The second question we would like to investigate is about the existence of anomalous high transverse momentum tail. The distribution of transverse momenta $K_\perp$ of γ-rays from decays of a π^o of transverse momentum $p_\perp >> m\pi/2$, has a flat probability distribution from zero to $p_\perp$. Integrating over the $p_\perp$ distribution gives the resultant $K_\perp$ distribution:

$$\frac{dn}{dK_\perp}(K_\perp) \simeq 2 \int_{K_\perp}^{\infty} \frac{\perp}{p_\perp} \frac{dn}{dp_\perp} dp_\perp \qquad K_\perp >> m\pi/2 \qquad (1)$$

Assuming for instance that the distribution of $p_\perp$ for π^o distribution of the form $\frac{dn}{dp_\perp} \sim e^{-3,5p_\perp^2}$, postulated by the charged pion production[1], predictions can be compared with experiment. Deviations from such a dependence cannot however be uniquely related to the π^o spectrum, since it is possible that other sources of γ-rays contribute to the recorded counts. However since the smalliness of the transverse momentum is expected to be a general property for all hadronic states, the presence of high $K_\perp$ events would be of great interest, even if additional investigations

would then be necessary in order to specify the origin of the effect.

2. The Aachen-CERN-Torino lead-glass spectrometer consists of 61 exagonal blocks of lead-glass each one viewed by its separate phototube and arranged in a honey comb structure, so to form approximately a large exagon. The energy resolution is $8\times10^{-2}/\sqrt{E}$ FWHM, where E is the γ-ray energy in GeV. We propose to locate such a counter hodoscope at one side of the elastic scattering set-up in I6 (R601) in order to cover angles approximately from 6^{o} to 25^{o}. A 10x10 matrix of horizontal and vertical counters, which have been used in the $K_L \to \pi^o \pi^o$ experiment with the lead-glass hodoscope, is located in front of the lead-glass hodoscope, in order to identify the events in which a neutral particle is entering the counter. Additional charged particles are permitted, unless they hit accidentally both the horizontal and vertical counters covering the lead-glass block in which a count is recorded.

The 61 pulse-heights and the pattern of the anticoincidence counters are recorded onto tape by our on-line computer IBM 1800. The triggering of the event requires at total energy threshold in the lead-glass hodoscope, in coincidence with two large forward telescope one on each arm detecting charged particles emitted to angles less than 0.5 rad. These two telescopes presently used in the elastic scattering experiment R601, give a trigger for at least 90% of the beam-beam events and effectively remove beam-gas background events.

At 2.5 Ax2.5A currents, we estimate an event rate of ~100 ev/second.

We could start data taking immediately after authorization. We would like to run ~20 hrs at 2.5Ax2.5A at each of the 3 energies 15+15 GeV, 22+22 GeV and 26+26 GeV. We expect to collect in excess of 10^7 γ-ray events at each of the three energies.

REFERENCES

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