STATUS REPORT ON THE RADPHI EXPERIMENT

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We report on Jefferson Laboratory Experiment 94-016 (RadPhi), a search for rare, radiative decays of the $\phi(1020)$ meson. We provide a motivation, description of the detector, and summary of status. With regard to the latter, the experiment is in the midst of its data run, expected to end 31 July, 2000, having collected an event sample equivalent to that at Novosibirsk and Frascati (1999 run), but with substantially different backgrounds and systematics.

1 Motivation

High energy photon beams are in some ways equivalent to vector meson factories. The tagged photon beam in Hall B at Thomas Jefferson National Accelerator Facility, with its continuous wave acceleration of electrons to an end-point energy of nearly 6 GeV, thus provides an excellent means for precision studies of ρ, ω, and ϕ mesons. At the time of the proposal for Experiment 94-016 (RadPhi)[a], very little was known about radiative decays of the ϕ. Of its seven two-body radiative channels, only two had been observed. The two-body radiative rate of vector meson to (pseudo)scalar is damped as E_γ^3 .

Measuring the remaining undetected channels would not only determine the radiative width of the ϕ—an important consideration for ϕ-factories intending to study kaon CP-violation—but also provide insights into a number of outstanding spectroscopic questions and examples of symmetry violations. In particular, such measurements might illuminate the nature of the $a_0(980)$ and $f_0(980)$ mesons (assigned originally to the scalar nonet but perhaps four-quark or molecular ($K\overline{K}$) rather than $q\overline{q}$ states)[1,2,3] as well as the gluonic and strangeness content of the η' versus the η.

Two energetically allowed decays, $\phi \to \rho\gamma$ and $\phi \to \omega\gamma$ are C-violating; experimental limits on the branching ratios are quite high. In addition, RadPhi is capable of investigating ρ and ω decays as well as looking for exotics.

[a] The RadPhi collaboration includes the following institutions: Catholic University of America, University of Connecticut, Indiana University, Thomas Jefferson National Accelerator Facility, University of Notre Dame, Rensselaer Polytechnic Institute, University of Richmond, University of Virginia, and College of William and Mary.

2 RadPhi Detector

The bachelor photon in ϕ radiative decay is low in energy and so difficult to detect. When the ϕ is formed in a tagged photon beam with 6 GeV endpoint electrons, this photon is boosted by as much as a factor of 12.

To detect all-neutral final states, RadPhi's primary component is a 650-channel lead-glass wall assembled octogonally around the beamline. In front of the wall sits a 30-channel scintillator array, which will identify offline charged particles in the final state. The original JETSET barrel array surrounds a 2.5cm beryllium target, providing nearly full angular coverage. Its lead-scintillating fiber calorimeter should reconstruct η's. It readily detects wide-angle photons which miss the lead-glass. Such "broken" events comprise RadPhi's primary background. A steel wall and veto-counter system upstream of the target block beamline-related backgrounds.

The first-level trigger consists of a coincidence (from the recoil proton) in the barrel's three scintillator planes with a signal in the high-energy portion of the photon tagger. A feature of the custom-built ADCs used in the experiment provides fast analog descrimination for large energy deposition in any given lead-glass block, and this feature is employed as a second-level trigger. A custom-built memory look-up unit computes total energy in the glass from ADC readouts and serves as the third-level trigger.

3 Status

Radphi is presently collecting data at approximately the rate requested in its proposal. By the end of its run (31 July 2000), it expects statistics comparable to those of Novosibirsk and KLOE (1999). With analysis already underway, first results shoulld be announced before Spring, 2001.

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