FINE STRUCTURE OF THE RADIO SOURCE CYGNUS A

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The present note describes briefly the fine structure of Cygnus A, as deduced from interferometric observations. The National Radio Astronomy Observatory interferometer has been described previously.[1] Data were obtained on each of the six available base-line lengths, which range from 10 800 to 24 280 λ at the operating wavelength of 11.1 cm. Since the hour-angle tracking range of the instrument is nearly 12^{h}, a considerable part of the two-dimensional Fourier transform of a radio-source brightness distribution is accessible to observation on each base line. In the present case, the data are distributed in a very asymmetrical way on the Fourier transform plane. This precludes recovery of the source brightness distribution by a straightforward Fourier inversion. Therefore, an iterative model-fitting procedure was used to develop a brightness distribution consistent with the data. The result is shown in Fig. 1. The solution is not unique, but it should represent the major features of the source reasonably well. Since the map is the result of model fitting, the effective angular resolution depends on surface brightness. It is about 8 sec of arc for the fainter regions and about 3 sec for the brightest.

The Fourier transform of the brightness distribution shown in Fig. 1 is in excellent accord with the observed complex fringe-visibility amplitudes and phases. The stippled areas indicate regions considered in the analysis, but which do not contribute radiation that can influence the data appreciably. The intensity in the blank area was assumed to be zero. The centroid of the distribution is within 10 sec of arc of the center of the Cygnus-A galaxy, at $19^{h}57^{m}44.4^{s}$, $+40°35'46''$ (1950).[2] The centroid is the origin of the relative coordinate system used in the figure.

This distribution agrees with earlier work at lower angular resolution[3] in that it possesses two well-separated major components, approximately two minutes of arc apart at position angle 109°. It shows further, however, that each of these components has a complicated structure. The salient new results are the following: (i) The brightness gradients within the source are very steep. For this reason,

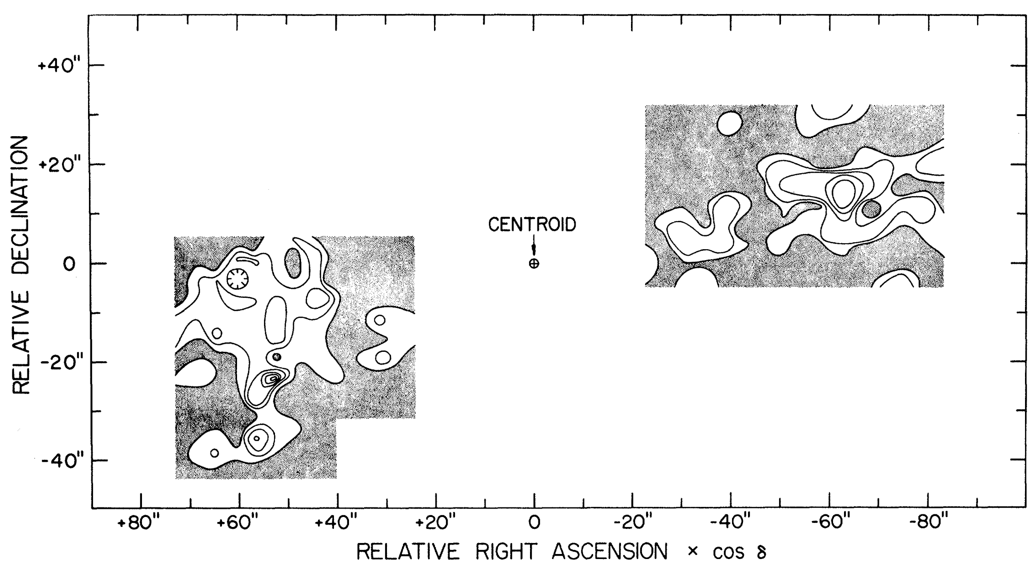

FIG. 1. Derived map of Cygnus A at λ 11.1 cm. Contours are drawn at intervals of a factor of 2 in surface brightness; the lowest contour is at brightness temperature 20 000°K. The contours are not labeled, owing to space restriction. Coordinates are in seconds of arc relative to the centroid. The distribution shown here accounts for 80% of the integrated flux density.

the contours are drawn at intervals of a factor of 2 in surface brightness. (ii) There are numerous local maxima or "hot spots." (iii) In each of the two major components, there is one strongly dominant maximum or "core." These are at (+53″, −24″) and (−62″, +13″). They have peak brightness temperatures of at least 900 000 and 530 000°K, respectively; together they account for about 20% of the total radiation of the source at λ 11.1 cm. A full report of this investigation is in preparation.

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K-MESON NONLEPTONIC DECAYS*

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The purpose of this Letter is to re-examine the predictions of a current×current Hamiltonian in the nonleptonic decays of K mesons.

It is still not clear whether the weak Hamiltonian for nonleptonic decays is of the current ×current form (universality)[1] with "dynamical" octet dominance[2] or if one has to make the extra assumption[3] that it belongs to an SU(3) octet.

For s-wave hyperon decays, Sugawara[4] and Suzuki[5] showed recently that, in the current ×current picture, partial conservation of axial-vector current (PCAC) and the SU(3)⊗SU(3) algebra lead to all predictions of the $\Delta I=\frac{1}{2}$ rule, up to a sign.[6]

With respect to p waves, the situation is much more ambiguous.[7] In the simplest model, namely the "strict pole approximation,"[8] it can be shown that one gets the $\Delta I=\frac{1}{2}$ predictions for Λ and Ξ decays, and that the Σ and Lee-Sugawara triangles do not close although the deviations are very small.[9]

Several authors[10] have shown that in the limit $m_\pi \to 0$ where all pions are off the mass shell, one finds the $\Delta I=\frac{1}{2}$ rule. This result is of course easy to understand: If all pions are reduced, one must evaluate matrix elements between the vacuum and a one-meson state; therefore, only the octet part can contribute.

In this Letter we try to improve this result by reducing only one or two pions in the $K\to 3\pi$. Our assumptions will be the following:

(1) The weak Hamiltonian for nonleptonic decays

$$H_W^{NL}=(G/2\sqrt{2})[(J_\mu^{\,c})^+J_\mu^{\,c}+J_\mu^{\,c}(J_\mu^{\,c})^+].$$

$J_\mu^{\,c}$ is the usual Cabibbo[11] current, i.e.,

$$J_\mu^{\,c}=\cos\theta(j_\mu^{\,1}+ij_\mu^{\,2}+j_{5\mu}^{\,1}+ij_{5\mu}^{\,2})$$
$$+\sin\theta(j_\mu^{\,4}+ij_\mu^{\,5}+j_{5\mu}^{\,4}+ij_{5\mu}^{\,5}).$$

Superscripts are unitary spin indices, and $j_\mu^{\,i}$ and $j_{5\mu}^{\,i}$ are, respectively, the vector and axial-vector parts of the current.

(2) Partial conservation of axial-vector current,[12] i.e.,

$$\partial_\mu j_{5\mu}^{\,i}=C\varphi^i \quad (i=1,2,3)$$