

contain hundreds of circles, squares, octagons, ellipses, etc. and are understood to have been built by Hopewell people between 400 B.C. and 400 C.E. From these data it is evident that these people were able to lay out such figures, some of which are more than a mile across, accurately on the ground; to compute areas; to lay out straight lines 4 and possibly 11 miles long; to determine true north by the stars and to lay out right triangles on such lines. They used the 3,4,5 right triangle and a dozen other simple right triangles including the Golden triangle and other Fibonacci ratios. There is no consistent orientation to critical solar, lunar, stellar or planetary risings or settings. Evidence that they knew the Pythagorean theorem remains weak. The unit of measure I have found in Ohio is the same as that found by Millon at Teotihuacan. There also seems to be an affinity with contemporary Florida earthworks. Apparently some of this knowledge persisted into historic times. The stereotype that prehistoric eastern North Americans lacked such skills is due for major re-evaluation.

**Session 24: Extragalactic Radio Astronomy  
0930-1630 (Aspen Room)  
(Display Presentation)**

24.01 Nova-Like H $\alpha$  Sources in the Center of M31, R. Ciardullo and H. Ford, UCLA and G. Jacoby, KPNO - H $\alpha$  on-band/off-band photographs of M31 taken 26 Sept. 81 with the KPNO 0.9-m telescope revealed four relatively bright stellar H $\alpha$  sources within 1000 pc of M31's center. Spectra obtained with the Lick 3-m telescope 4 and 5 Oct. 81 show that the objects had steep Balmer decrements and H $\alpha$  line widths which range from 1900 k/s to 2880 k/s (FWHM). The H $\alpha$  luminosities were  $\sim 10^{35}$  ergs/s. The three brightest stars had broad weak lines at  $\sim 4633$ ,  $\sim 5018$ , and  $\sim 5166$ . There were no other emission lines with a strength of more than half H $\alpha$ . The frequency of these objects and their relationship to classical novae will be discussed.

24.02 VLA Scaled-Array Observations of the Radio Galaxy 3C166, S. R. SPANGLER, NRAO, A. H. BRIDLE, Queen's U. We have observed the radio galaxy 3C166 (0642+214) at 1.4 and 4.9 GHz using the "scaled-array" capability of the Very Large Array (VLA). The 1.4 GHz observations were made in the "A array", and the 4.9 GHz observations were made in the "B array", resulting in nearly identical (u,v) coverage at the two frequencies. This mode of observation is ideal for studies of spectral index and polarization distributions. Our observations show a double source of approximately 40" total angular extent, aligned in a nearly North-South direction. The southern lobe shows pronounced brightening along the extreme edge and a bright, off-axis hot spot. The northern lobe is more diffuse, with feeble

hot spots in the interior of the lobe. Polarization observations show substantial Faraday depolarization in the southern lobe, but no apparent depolarization in the northern lobe. The spectral index is relatively constant in the extended parts of the source, except for regions near the central component where a pronounced spectral index break is observed. The data have been used to calculate values of equipartition magnetic field and thermal electron density in the southern lobe. We have also made a comparison between our observations and models for energetic electron transport in double radio sources.

24.03 The Kiloparsec Structures of Six Superluminal Radio Sources, R. A. PERLEY, NRAO, E. B. FOMALONT, NRAO, and K. J. JOHNSTON, NRL. Six compact radio sources have known or suspected superluminal motion of components on the milliarcsecond scale. All of these contain structure on the arcsecond ( $\sim$ Kiloparsec) scale which consists of a single, detached, steep-spectrum component located on the same side of the core as the superluminal components. In all sources, the position angles of the milliarcsecond and arcsecond structure agree to better than 20 degrees. For most sources (but excluding 3C273), a bridge joins the arcsecond component to the core. The asymmetry in the arcsecond structures is very marked: in all six sources, the asymmetry exceeds 5:1, and exceeds 500:1 for 3C273. Two of the sources (3C120 and 3C345) contain considerable diffuse emission, two others (3C273 and 3C454.3) contain no diffuse emission to  $\sim 1\%$  of the total flux.

The continuity between milliarcsecond and arcsecond structures indicates a physical association between these components. In particular, given that the superluminal motion is due to a relativistic jet aligned near to the line of sight, the arcsecond component is then most easily explained as the end of, or perhaps a bend in, the jet, and the asymmetry in the arcsecond structure is due to relativistic motion of these components.

24.04 Superluminal Behavior in BL Lacertae, R. B. PHILLIPS, U. Kansas, R. L. MUTEL, U. Iowa.

New VLBI hybrid maps have confirmed our earlier reports that the compact radio structure of BL Lac has evolved rapidly during 1980 and 1981, following a great flux outburst at 1980.0. The changes observed are complex, and not as systematic as those seen at some times in previously detected superluminal sources, but reflect extremely rapid variations and apparent component motions. The very short time scale for structure variations is strong evidence that small viewing-angle, relativistic "beaming" effects are responsible for observed variations in both the structure and the brightness.

24.05 Galaxies in the Region around NGC 5846, M.P. HAYNES, R. GIOVANELLI, NRAO. The elliptical galaxy NGC 5846 lies at the center of a nearby concen-