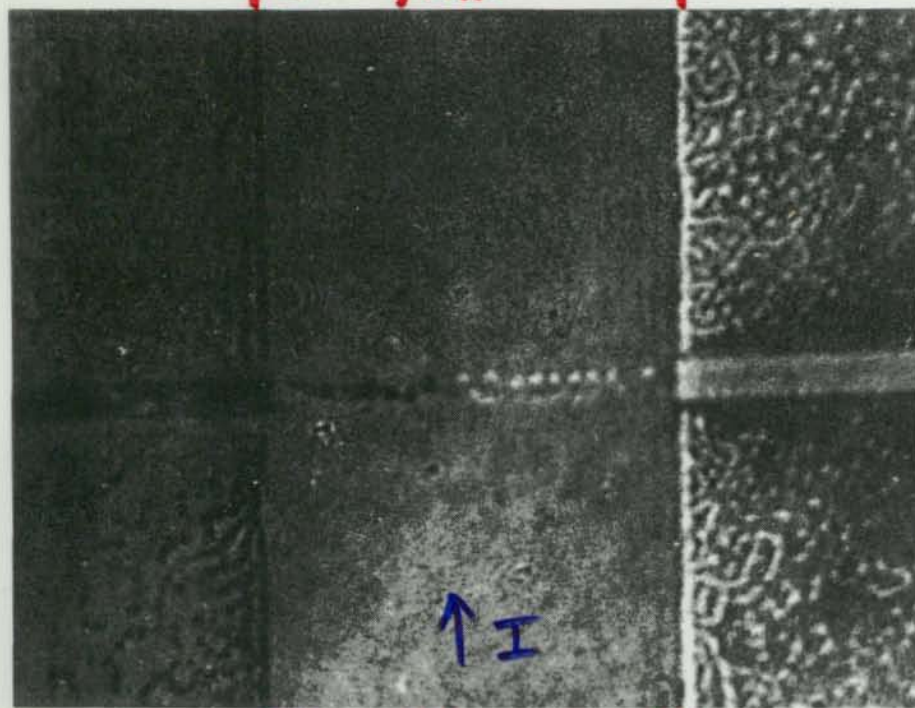


Pb 24c  
 ← film →



← film →

100  $\mu\text{m}$  500 kHz

Fig. 14.7. Current-induced resistive state of a constricted Pb film of  $6.2 \mu\text{m}$  thickness at 4.2 K. Current direction is vertical. Magneto-optic flux detection with stroboscopic illumination at 500 kHz. The horizontal array of black and bright flux tubes in the center represents the equivalent of a single "channel" such as shown in Fig. 14.4 observed under high time resolution (courtesy of D.E. Chimenti)

The constricted geometry has proved to be very useful in combination with the magneto-resistive field probe discussed in Sect. 8.6 and shown schematically in Fig. 8.6. With such an arrangement the regularity of the flux-tube nucleation process in the current-induced resistive state and its dependence upon the geometrical dimensions and the metallurgical microstructure of the sample can be studied in a *strictly passive* way. Figure 14.9 shows the spectrum of the flux-tube nucleation frequency in an indium constriction at 1.88 K as obtained from the signal amplitude of the field probe.

$I \rightarrow$

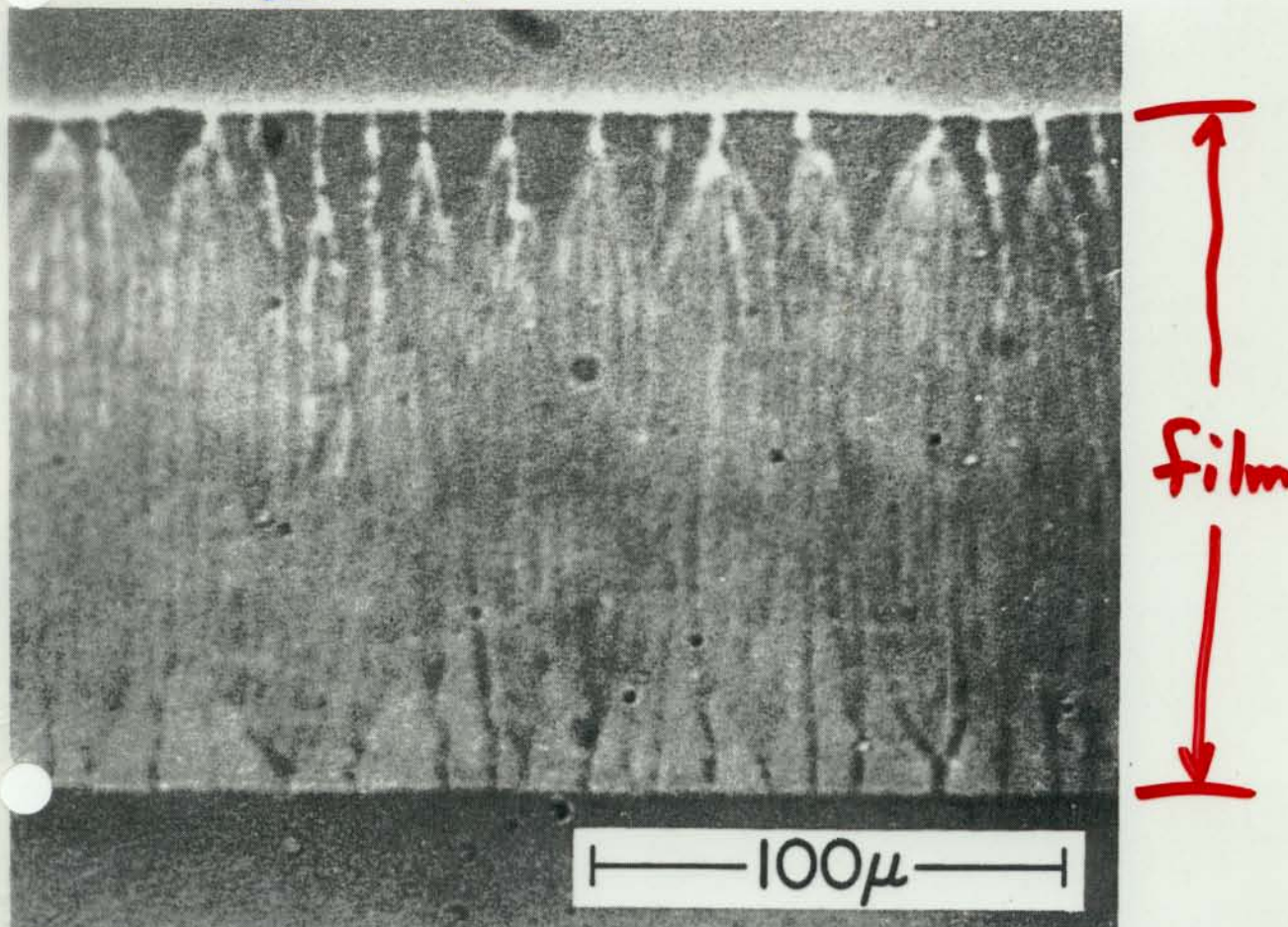


Fig.14.4. Magnetic flux structure in a Pb strip of  $4.0 \mu\text{m}$  thickness and  $160 \mu\text{m}$  width at  $4.2 \text{ K}$  carrying a transport current of  $3.8 \text{ A}$  (average current density =  $5.9 \times 10^5 \text{ A/cm}^2$ ). The current flows from left to right. At the top and the bottom the sample edges are clearly visible. The bright and dark "channels" indicate the current-induced flux structure as detected magneto-optically [14.31]

voltage associated with the nucleation of a single "channel" [14.28]. A more direct prove of the dynamic model is provided by photographs of the individual flux tubes in the moving train taken magneto-optically with highly increased time resolution (see Sect.14.2.3).

The abrupt nucleation of the individual flux-tube trains at distinct levels of the transport current leads to structure in the voltage-current characteristic [14.28,32]. Figure 14.6 shows typical voltage steps observed in a Pb strip at the onset of the resistive state. The nucleation of the flux-tube trains and the detail of the voltage-current characteristics are