gaseous component has developed, concentric with the galaxy. The assumed magnetic field in the gaseous bulge is poloidal and is approximated by a dipole; the latter is centrally placed with its axis perpendicular to that of rotation.

This bulge, say a spheroid, rotates as a rigid body while condensing gradually. Magnetic lines of force and gas are carried along together (infinite conductivity). At the polar regions of the dipole matter can leak out radially. This matter stays behind the shrinking nucleus and forms, through differential rotation, spiral arms.

It is shown, as an example, that using numerical parameters taken from our galaxy and a reasonable rate for the shrinkage of the gaseous bulge, a galaxy like ours, in a time of the order of 10^9 years, will have formed spiral arms with 1.5 turns each, between 13 and 4 kpc from the center. It appears, therefore, that differential rotation, far from being destructive, is probably the very agent that produces spiral structure.

Studies of Flares Associated with Polar Cap Absorption. HELEN DODSON PRINCE AND E. RUTH HEDEMAN, *McMath-Hulbert Observatory*.—The 51 known cases of polar cap absorption during the five-year interval 1957–1961 have been ranked on the basis of reported maximum absorption. The 18 greatest PCA events were associated primarily with flares of importance 3 and 3+, all within 60° of the central meridian of the sun. However, in the five years here studied, there were 104 flares of importance 3 and 3+, but only 1/3 of these were followed by PCA.

The occurrence of type-IV radio frequency emission is one of the most general characteristics of PCA flares. Such radiation may be necessary for the occurrence of PCA, but is not sufficient. In the five years studied, there were 123 flares with type-IV continuum emission but less than 1/3 of these were followed by PCA.

Although strong emission at 10 cm is another general characteristic of PCA flares, only 1/3 of the flares with 10-cm bursts $>500 \times 10^{-22}$ W m $^{-2}$ cps $^{-1}$ were followed by PCA. For most PCA flares, the 10-cm maximum follows $H\alpha$ maximum, and this relationship can be used successfully to separate PCA from non-PCA flares. Ninety percent of the flares with 10-cm flux $>500 \times 10^{-22}$ W M $^{-2}$ cps $^{-1}$ and with maximum following $H\alpha$ maximum were PCA flares.

Optical records continue to provide evidence that PCA flares occur over major spot umbrae. The flare does not necessarily start over an umbra but usually spreads to it as the flare progresses. Records for 21 of the 51 PCA flares have been seen, and indicate umbra coverage in each case.

The only sufficient condition that we have yet found for PCA is the simultaneous occurrence of all of the major characteristics of PCA flares—i.e., importance 3+, large umbra covered, great type-IV radio emission, and great 10-cm burst with maximum after $H\alpha$ maximum.

Pre-Flare Filament Characteristics. H. E. RAMSEY AND S. F. SMITH, *Solar Physics Laboratory, Lockheed-California Company*.—A consistent picture of a pre-flare filament action has been drawn from a study of all flares of importance 2 or greater, cinematographically recorded by the Lockheed Observatories, from January 1959 to January 1963. Extensive observations in the wings of $H\alpha$ ($H\alpha - .5 \text{ \AA}$ and $H\alpha + .5 \text{ \AA}$) allow the detection and interpretation of a precursory filament action to the type of flare associated filament disappearance described by Bruzek and others.

The entire filament action, both prior and concurrent with a flare, is observed with seven overlapping phases: (1) increased opacity (darkening), (2) arch-like expansion, (3) breakup of the filament, (4) transition from absorption to emission, (5) sudden disappearance, (6) ejection of matter, (7) appearance of absorption matter during a flare. Although the order of the phases is consistent for every observation, not all phases are observable in any one wavelength on any one location on the solar disk. The first phase is uniformly observed in the blue wing of $H\alpha$, and has begun as early as 53 min before a flare. The flare appears during or any time after the third phase. The most generally observed phase of the action is the sudden disappearance of the filament within minutes before or during the rise of the flare.

Of 71 major flares studied, 32% are associated with one or more phases, always including the sudden disappearance. Twenty-five percent are classed as indeterminate, because of lack of pre-flare observations. Six percent are ambiguous. Thirty-seven percent show no association with filaments within or proximate to the flare area.

The various phases of the filament action should be useful in interpreting some observations of rare events reported by other observatories. The frequent occurrence of the filament action suggests it is intimately linked with the flare mechanism.

Velocity Field of O-B5 Stars in the Vicinity of the Sun. VERA C. RUBIN, *Georgetown College Observatory*, AND JAYLEE BURLEY, *Goddard Space Flight Center*.—The classical equations of Milne (*Monthly Notices Roy. Astron. Soc.* **95**, 560, 1935) are used to study the stellar velocity field in the vicinity of the sun, and to evaluate Θ/R , $\partial\Theta/\partial R$, Π/R , $\partial\Pi/\partial R$, and additional terms involving circular asymmetry