The evolution of individual and groups of flux tubes as seen by IMaX/Sunrise

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**Introduction**

- Conventional picture for flux tube formation
  - Theory: flux expulsion (Parker 1963; Weiss 1964, 66) + convective collapse (Parker 1978; Spruit 1979) + oscillations (Hasan 1985), rebound shocks (Takeuchi 1999), jets in the periphery (Steiner et al. 1998),?


- Evolution of groups and chains of flux tubes
  - Bright points (Berger & Title 1996, Berger et al. 1998, Vittichié et al. 2009): fragmentation and coalescence
PHASE I: FLUX CONCENTRATION (Requerey et al. 2014)

- A small loop appears over a granule
- Granules drag it (flux expulsion) as the $\Omega$ loop ascends
- The negative foot disappears. Flux cancellation (Borrero et al. 2010)
- Merging and splitting ($4 \times 10^{16} < \phi < 5 \times 10^{17}$ Mx; $300 < B < 600$ G)
**PHASE II: CONVECTIVE COLLAPSE** *(Requerey et al. 2014)*

- Typical equipartition $B$
- Area decreases while $0.9 < v_{LOS} < 1.6$ km/s and $600 < B < 1600$ G
- BPs appear. That in the periphery: small granule
- Petal-like granules *(Muller et al. 1989, Muller & Roudier 1992)* (observed in the lab.)
**PHASE III: THE MATURE TUBE** (Requerey et al. 2014)

- $B$ drops below 1 kG to increase later (Martínez González et al. 2011)
- $v_{\text{LOS}}$ in phase with $B$ (0 km/s when 700 G and 2.8 km/s when 1500 G)
- $I_c$ remains constant. Upflow decreases while BP fades out
- Second upflow when the tube is compressed by granules (simultaneous with a downflow) (rings by Narayan & Scharmer 2010)
Multi-cored flux structures

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BPs and magnetic structures

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Dynamics of multi-core m.s.

- BPs: fragmentation and coalescence. We provide $B$
- Different cores are recognized in the p.q. maps
- All cores seem to belong to a single structure
- Magnetic flux remains constant (resolved structures)
- Fragmentation and coalescence are governed by convection. Interchange instability (Bünte 1993)
- Strong flows appear within and in the periphery
- Magnetic cores coincide with CN (line-core) BPs and not that much with Ca II
- Magnetic cores do not coincide with continuum BPs
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