Magnetic flux losses from an active region and related coronal activity

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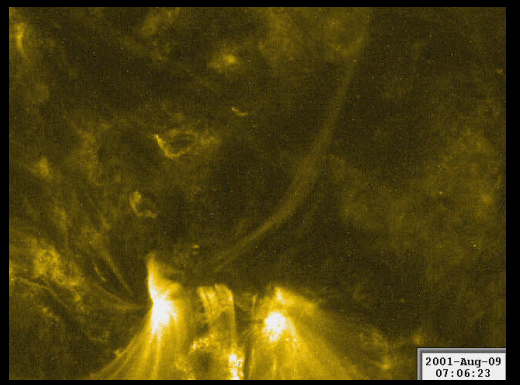
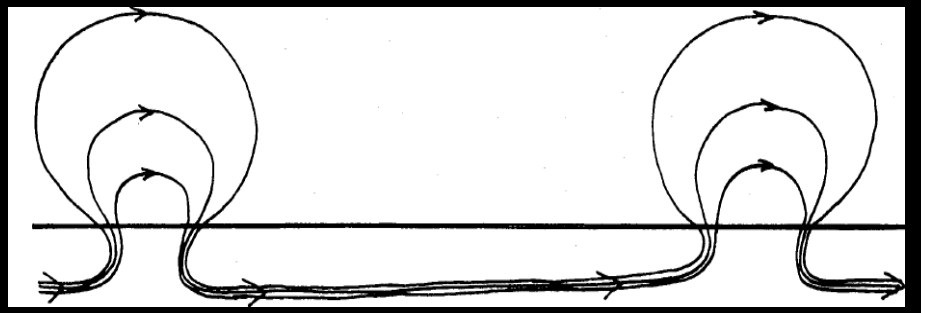
1. Context and Caveats

- AR Magnetic flux losses + Sunspot Decay

- Spectacular emergence
- Ω-loop rooted at the bottom of c.z.
- Active Regions must disappear
- Compatible with flux transport models
- Missing spectacular submergence !
- Reconnection+subtle submergence+ CME ?
- Toroidal flux repaired??
- Toroidal flux must go away too



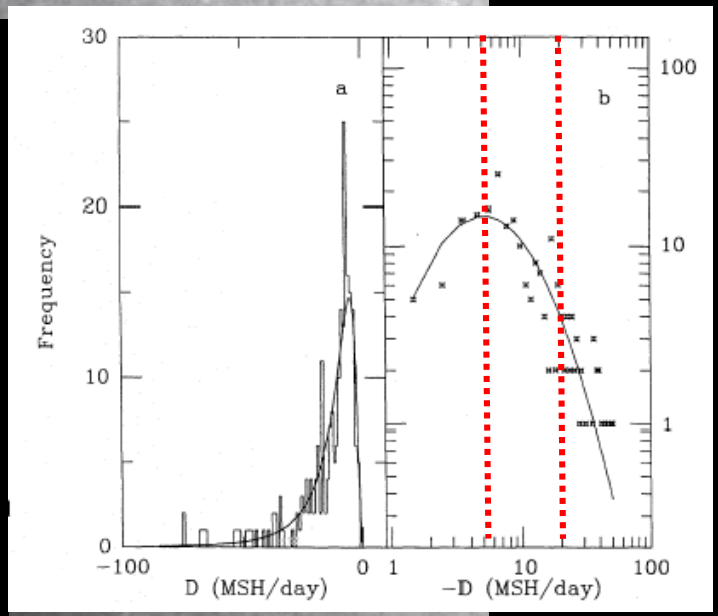


2. Sunspot decay: photosphere

- Sunspot decay as seen by TRACE:
  - Most of the sunspot decays in-place
  - A few small fragments break apart
  - Remnant facular regions
  - Decay rate is fast (-20 MSH/day)
  - Sunspot is unipolar
  - How about the other polarity ?
  - What happens in upper layers ?

Global AR Decay

2001-Jul-27
00:30:56

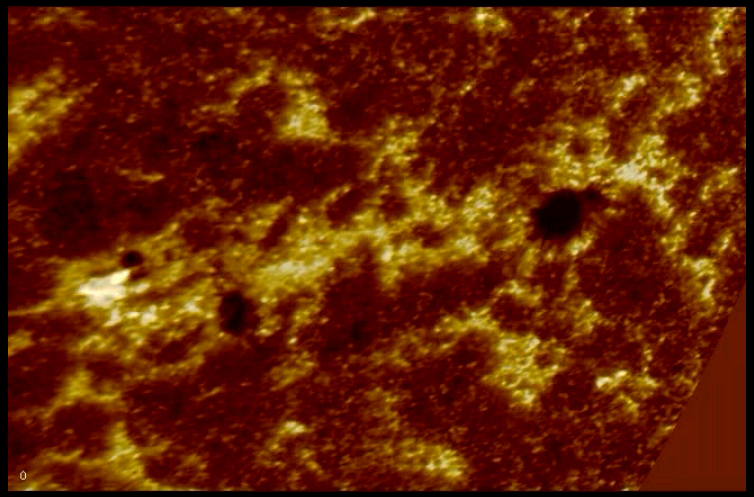


Sunspot Set[1]	N	Mean (MSH/day)	Stan. Deviation (MSH/day)	Median (MSH/day)	Mode[2] (MSH/day)
RT	157	-12.1	12.4	-8.2	-9.3/-7.0
nRT	59	-19.7	15.1	-17.1	-16.7/-18.4
T	216	-14.2	13.6	-9.3	-9.3/-7.0
RU	157	-2.0	1.7	-1.7	-1.6/-1.0
nRU	59	-3.7	2.0	-3.3	-1.8/-1.9
U	216	-2.50	1.95	-2.0	-1.6/-1.0

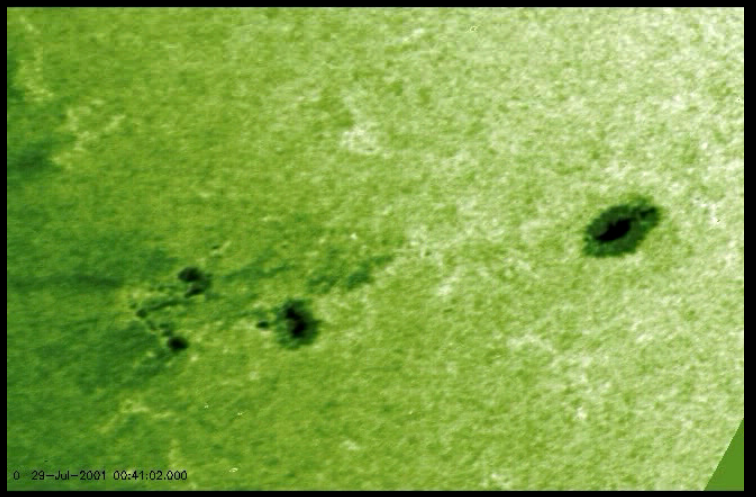
[1] R=recurrent, nR=non-recurrent, T=total decay, U=umbral decay
[2] Binning independent value/binning dependent value

3. Sunspot Decay: Chromosphere & Corona

- Other TRACE wavelengths:



1600 Å



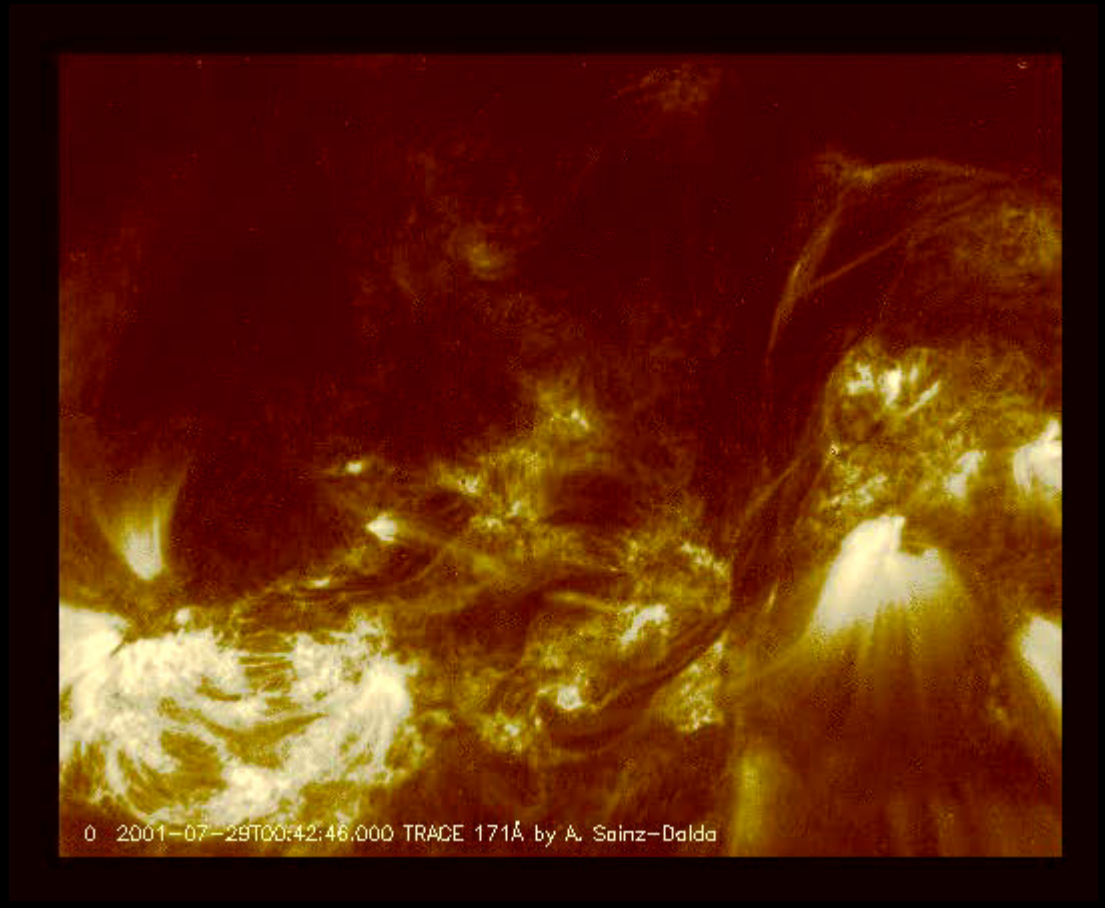
171 Å+WL

<u>5 coronal events including:</u>

- 1 global flare
- 1(3) filament eruptions (CMEs)
- post-flare loop

3. Sunspot Decay: Chromosphere & Corona

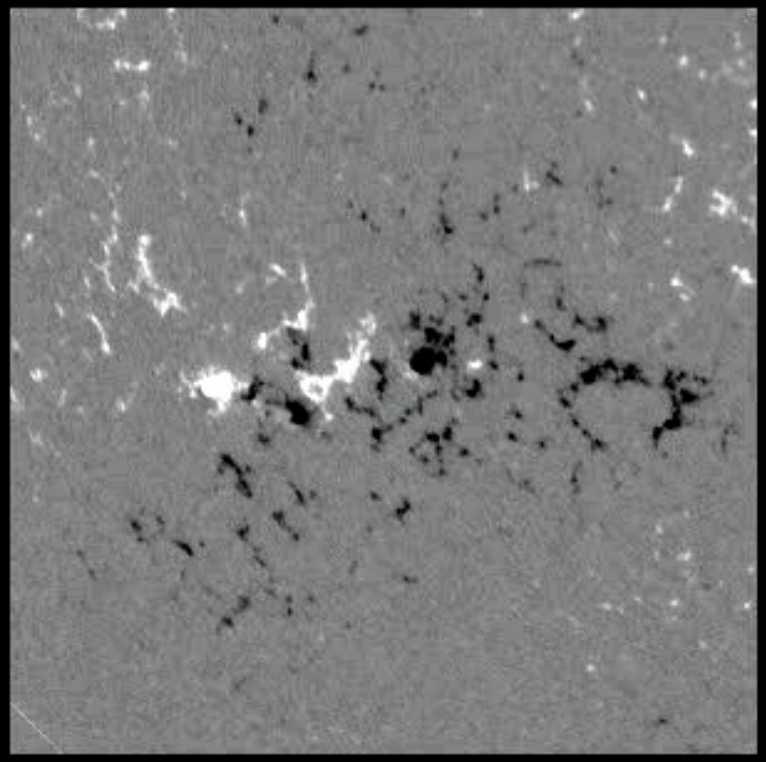
- Other TRACE wavelengths:



171 Å

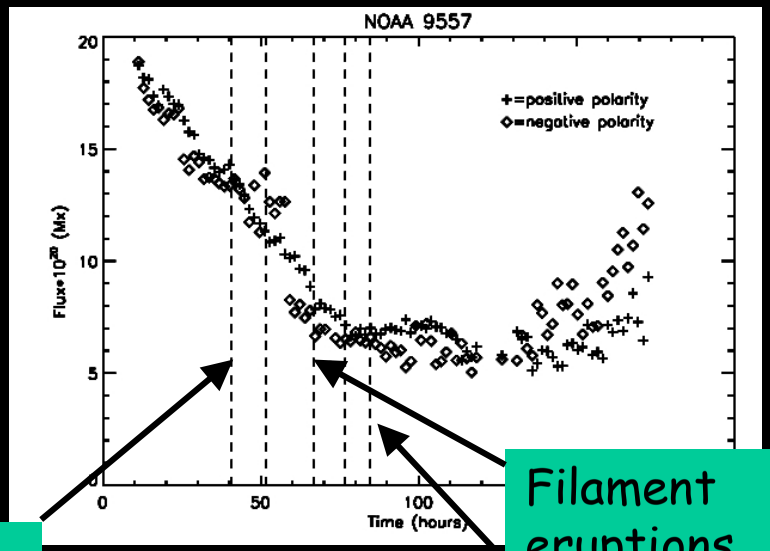
4. AR magnetic flux losses

- But, what happened to the magentic flux?



SOHO/MDI

- Linear flux decay (69 %!)
- Reaches a plateau
- Coronal events localized right & before the plateau

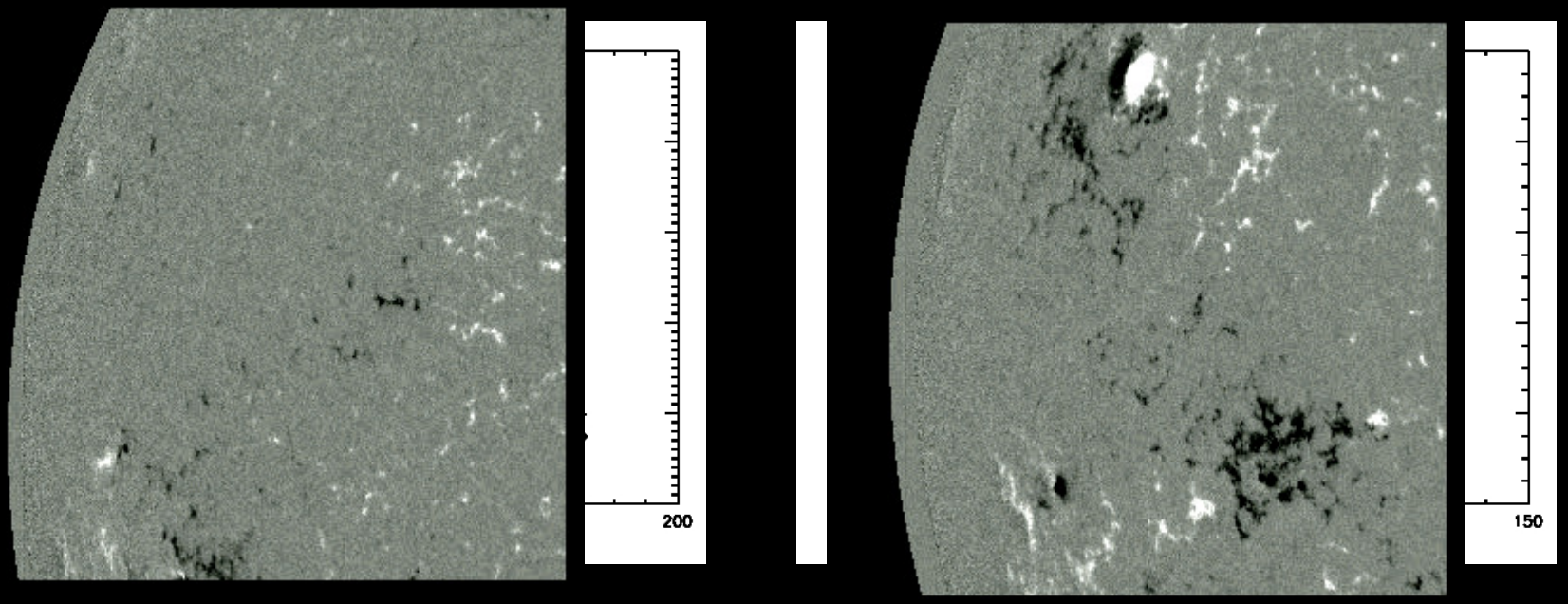


Flare

Filament eruptions

4. AR magnetic flux losses

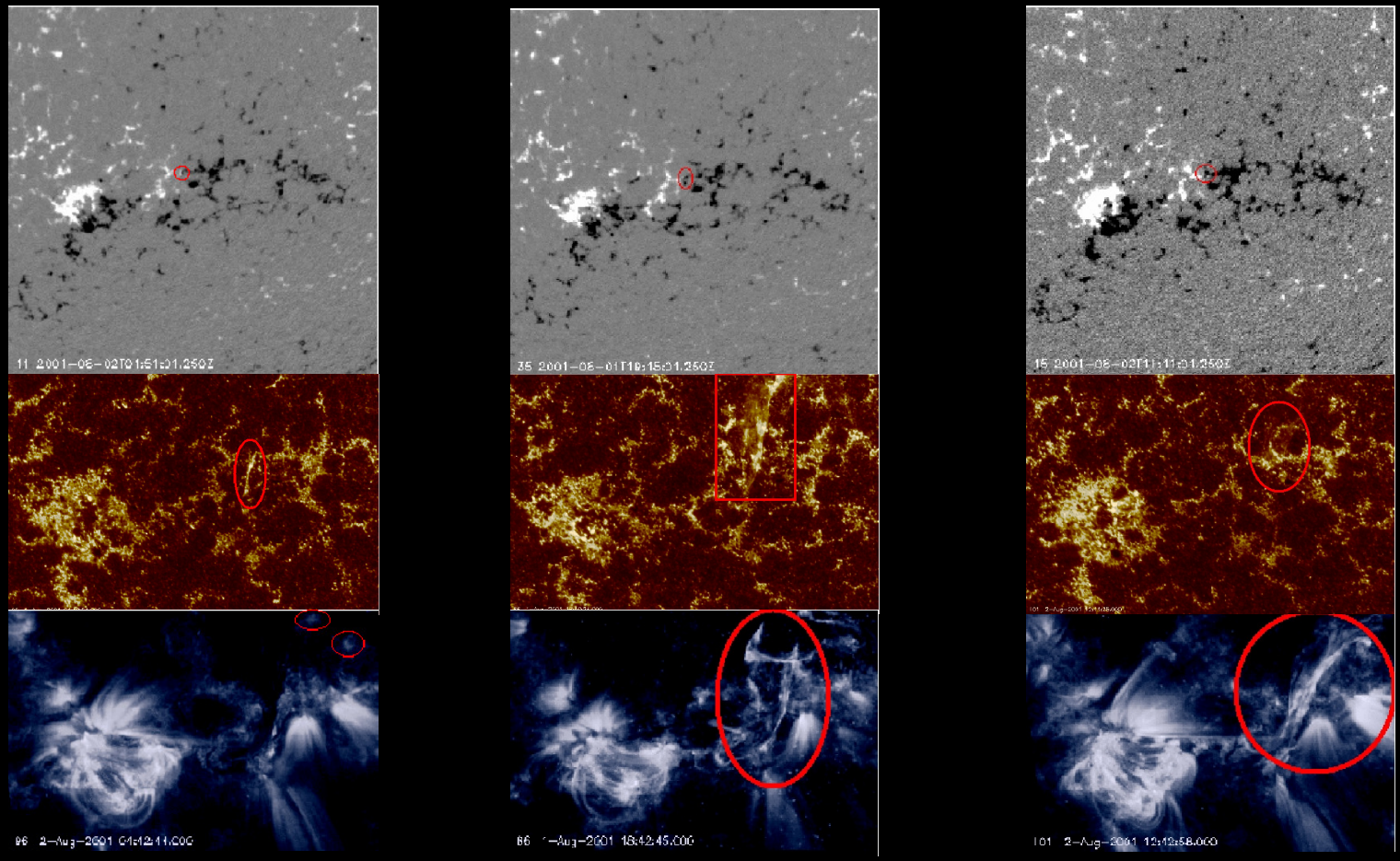
- Other cases



3 out of 3 show the linear decay+plateau

4. AR magnetic flux losses

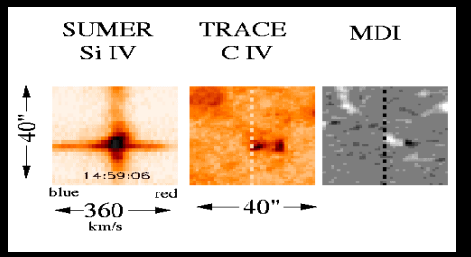
- What physical process makes the flux disappear?



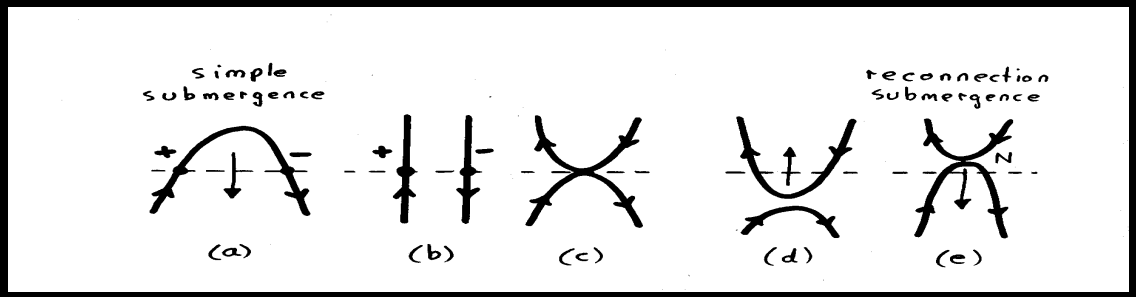
Filament eruptions+cancellation

4. AR magnetic flux losses

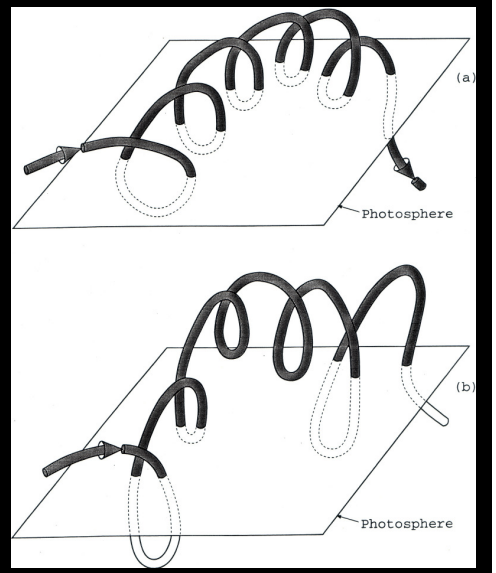
- Questions about magnetic field cancellation:
  - Found everywhere (QS, Network, ARs, Poles)
  - Related to coronal energetic phenomena
  - It happens at small scales (resistive)
  - Always reconnection?
  - Simple submergence/emergence ? (2D)
  - Flux rope expulsion (3D)



Innes, 97



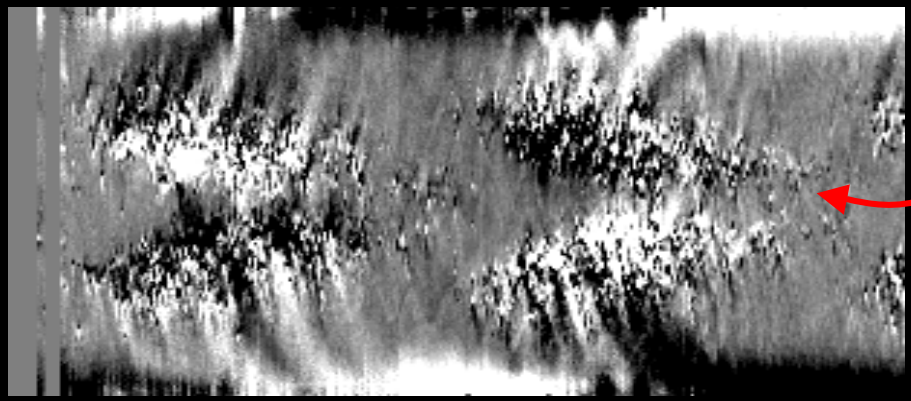
Priest, 87



Low, 01

4. AR magnetic flux losses

- Summary of AR decay:
  - ARs enter a linear flux decay shortly after emergence
  - 70 % of the original flux is wiped-out "in-situ"
  - 30 % (only !) available for transport to the poles
  - Coronal activity concentrated before flux plateau
  - Filament eruptions (CMEs) occur during flux decay
  - Cancellation (U-loop emergence?) as a key player



THANKS