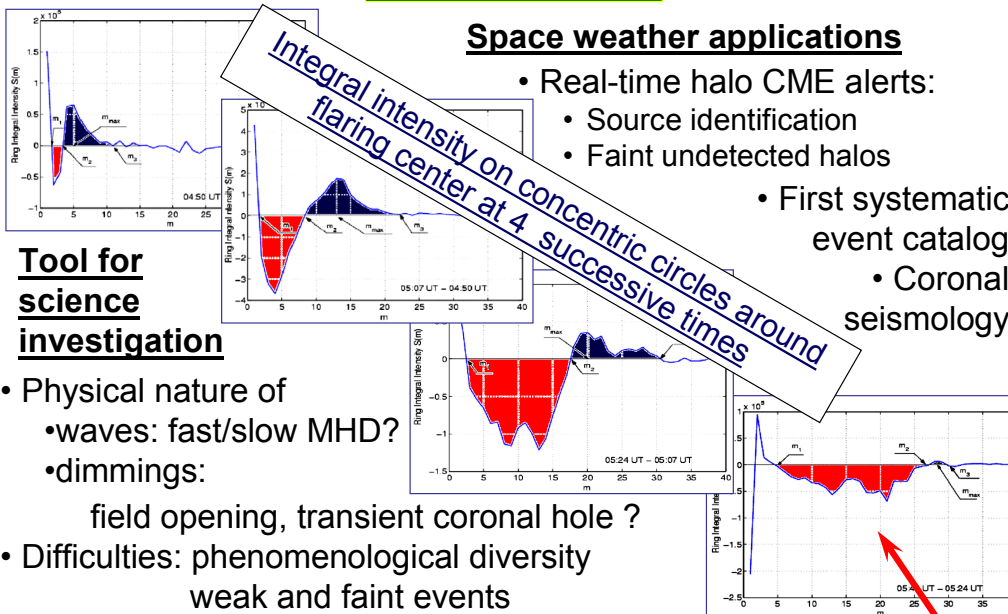
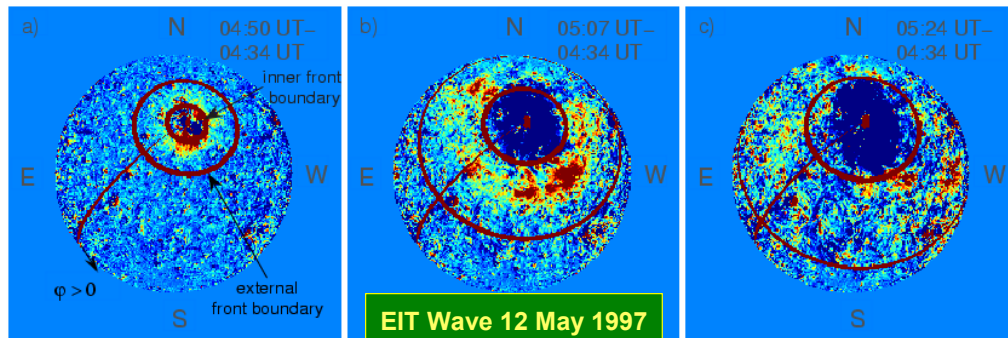


NEMO: an EIT waves and dimming detector for EUV imagers

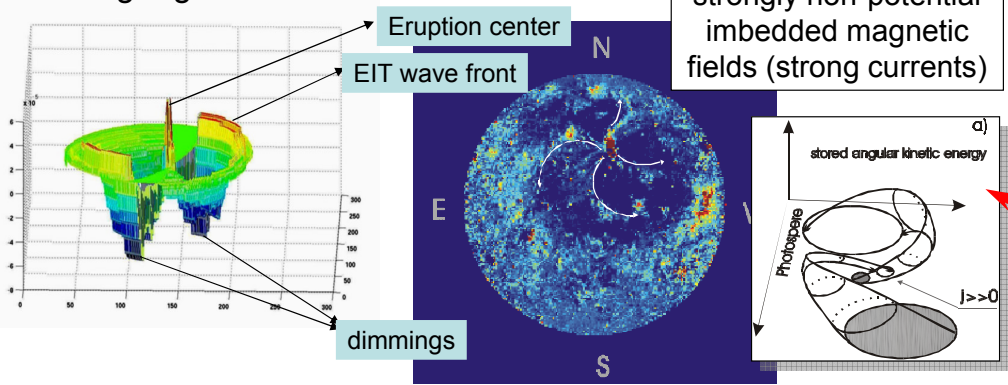
sidc.be/nemo

NEMO "Novel EIT wave Machine Observing" is a method that allows the automated detection of EIT waves and dimmings. Still in an experimental phase, this software package is developed at the SIDC (ROB) in view of a new generation of high-cadence EUV full-disk imagers, including STEREO/SECCHI and PROBA2/SWAP. In this section, we illustrate its principles and we show that preliminary applications on EIT images yield new insights about the geometrical shape of dimmings and the connection with the EIT wave front properties. In particular, we show an apparent angular rotation of the EIT wave during its expansion.



Rotation of EIT waves

Progressive rotation of the azimuth of maximum/minimum intensity sectors in the expanding ring and dimming region



Wave detection principle:

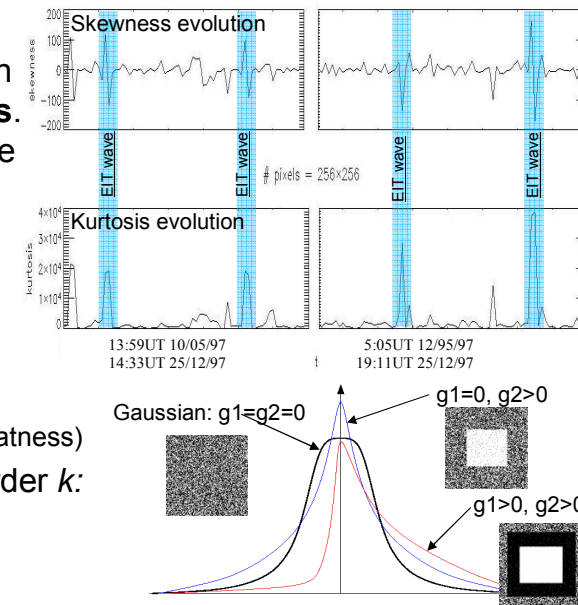
Analysis of the intensity distribution (histogram) in **difference images**.

- Undisturbed case: gaussian noise
- **Event signature: distorted distribution.** The measure is given by the higher-order moments:

$$\gamma_1 = \frac{\mu_3}{\mu_2^{3/2}} \quad \gamma_2 = \frac{\mu_4}{\mu_2^2} - 3$$

Skewness (asymmetry) Kurtosis (flatness)
where the centered moment of order k :

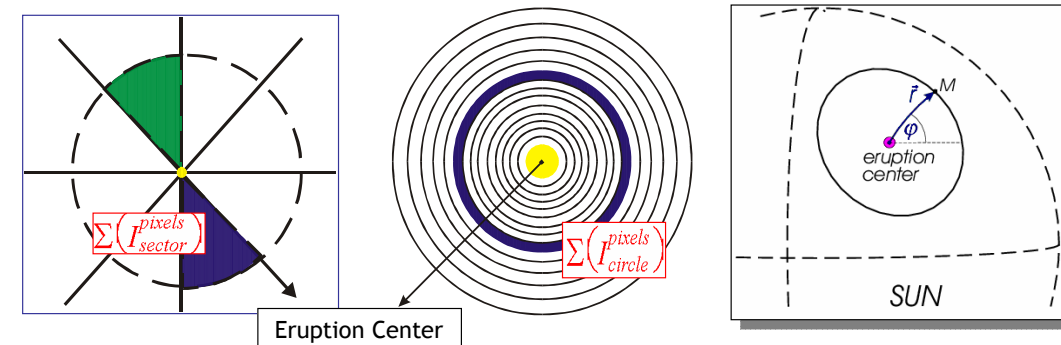
$$\mu_k = \frac{1}{n} \sum_{i=1}^n (x_i - \langle x \rangle)^k$$



Measurement principle: ring analysis

- Assumption: free expansion, i.e. quasi circular properties.
>>> surface polar coordinates centered on the source flare:
 - distance r to the eruption center
 - azimuthal angle around it (radius vector m).
- Step 1: localisation of eruption center (brightest point of solar flare)
- Step 2: localisation of wave front (radial brightness peak)
- Step 3: **velocity profile, wavefront width, integrated differential intensity in wavefront and inside wavefront (dimming)**

Angular-Ring Analysis Ring Analysis



Observed properties:

- Width of the wavefront grows quasi quadratically in time
- Dimming boundary contiguous to inner wavefront edge
- Integrated intensity of wave front grows for more than 1/2 hr (The front intensity of linear magnetosonic waves would decrease)
- In the first few minutes, the integrated excess intensity of the wavefront balances the integrated deficit in the dimming.
- Correlation of wave structure with associated dimming
- Anisotropy even without obstacles.
- Some events show a rotation of the EIT wave, maybe suggesting the presence of strongly twisted magnetic fields.

Podladchikova & Berghmans, Automated Detection of EIT waves and dimmings, 2005, Sol.Phys, 228, 267
Podladchikova & Berghmans, Energetic dynamics of EIT Wave structure analyzed by EIT Wave Detector, 2005a, ESA-592, SOHO 16/SW 11.
Podladchikova & Berghmans, Interaction of EIT wave with AR on the Sun, 2005b, ESA-592, SOHO 16/SW 11.