# Manufacturing cross-correlation masks

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# Cross-correlation techniques
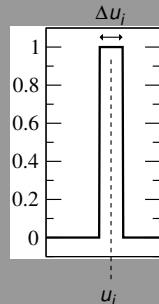
- using a synthetic template $M$:

$$C(\epsilon) = \int_D S(v) \, M(v - \epsilon) \, \mathrm{d}v \qquad (1)$$

- using a binary mask $M$:

$$C(\epsilon) = \sum_i \int_{-\epsilon + u_i - \Delta u_i/2}^{-\epsilon + u_i + \Delta u_i/2} S(v) \, \mathrm{d}v, \qquad (2)$$

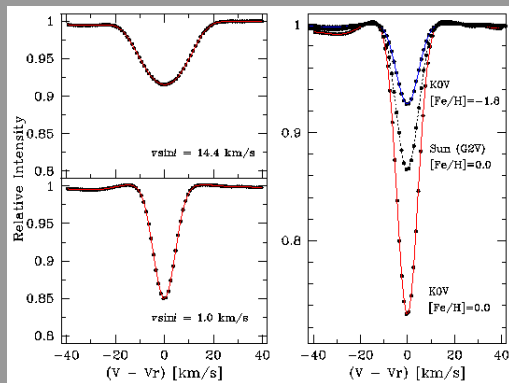where $\Delta u_i$ is the width of the $i$-th line, centered on $u_i$.

- advantages of binary masks
  - use only parts of the spectrum (i.e. less computational time)
  - CCF $\approx$ average line profile (degraded by a boxed profile)

# CORAVEL-type CCF

- position ⇒ radial velocity
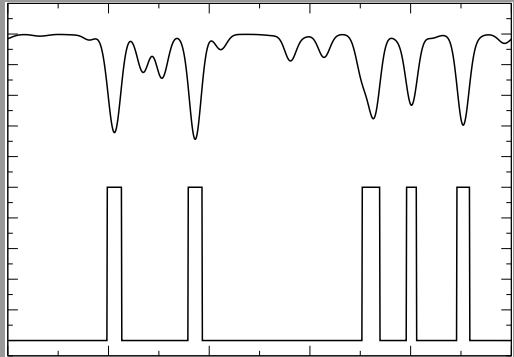- width ⇒ $v \sin i$
- surface ⇒ [Fe/H]



(Santos et al. 2002)

# Manufacturing masks

(see Baranne et al. 1979)

- "cutting" the lines on the level of the mean value
- tuning the tolerance on the box width
- optimizing the mask:
  - ▶ transparency
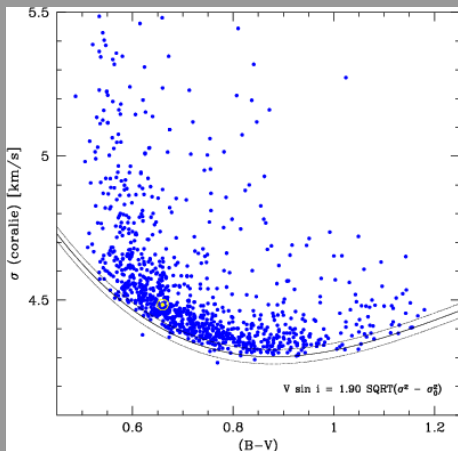  - ▶ contrast of the resulting CCF

# Calibrating masks

Rotational velocities

$$v \sin i = A \sqrt{\sigma^2 - \sigma_0^2} \quad (3)$$

- $\sigma$: observed CCF width
- $\sigma_0$: zero-rotation width
- $A$: scale constant
  - ▸ $\sigma_0$, $A$ to be calibrated
  - ▸ variation of $\sigma_0$ with $B - V$



(Santos et al. 2002)

# Workpackage GWP-S-650-05000

| Start: Jan 2007 | End: Jun 2012 | FTE: 0.2 |
| --- | --- | --- |

| Input: Synthetic and observed (high S/N) spectra at $R = 11500$ |
| --- |

| Output: Grid of binary masks |
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- Input
  - Synthetic spectra (noiseless, good sampling, $R = 11500$) to create the binary masks
  - Synthetic spectra (noise, GAIA sampling, $R = 11500$) *and* observed spectra (GAIA sampling, $R = 11500$) to test and calibrate the masks

# Workplan

- Specific correlation algorithm !
  - coordination with Y. Viala and C. Delle Luche (GWP-S-650-07000)
- Synthetic and observed spectra
  - interface with CU8
- First masks for ≈March 2007