UNCERTAINTY ON THE MEAN FREQUENCY OF A SUB-BURST

$$\bar{\nu} = \frac{\sum_{\nu} \nu I_\nu^2}{\sum_{\nu'} I_{\nu'}^2}$$

$$\delta\bar{\nu} = \frac{\sum_{\nu}(\delta\nu\, I_\nu^2 + \nu\, 2 I_\nu\, \delta I_\nu)}{\sum_{\nu'} I_{\nu'}^2} + \frac{\sum_{\nu} \nu I_\nu^2 \cdot (-1) \sum_{\nu'} 2 I_{\nu'} \delta I_{\nu'}}{(\sum_{\nu'} I_{\nu'}^2)^2}$$

$$= \frac{\sum_{\nu} \delta\nu\, I_\nu^2}{\sum_{\nu'} I_{\nu'}^2} + 2\frac{\sum_{\nu} \nu I_\nu \delta I_\nu}{\sum_{\nu'} I_{\nu'}^2} - 2\underbrace{\left(\frac{\sum_{\nu} \nu I_\nu^2}{\sum_{\nu'} I_{\nu'}^2}\right)}_{=\bar{\nu}}\left(\frac{\sum_{\nu'} I_{\nu'} \delta I_{\nu'}}{\sum_{\nu'} I_{\nu'}^2}\right)$$

<u>Assumptions</u>

1º $\delta\nu$ is constant ; independent of ν

2º δI_ν is constant ; independent of ν (this is debatable because of RFI but we still use it ...)

3º $\langle \delta\nu\, \delta I_\nu \rangle = \underbrace{\langle \delta\nu \rangle \langle \delta I_\nu \rangle}_{\text{this is also debatable because of RFI ...}} = 0$ since we assume $\langle \delta\nu \rangle = \langle \delta I_\nu \rangle = 0$

We thus have

$$\delta\bar{\nu} = \delta\nu + 2\delta I_\nu \cdot \frac{\sum_{\nu} (\nu - \bar{\nu}) I_\nu}{\sum_{\nu'} I_{\nu'}^2}$$

$$\langle (\delta\bar{\nu})^2 \rangle = \langle (\delta\nu)^2 \rangle + 4 \langle (\delta I_\nu)^2 \rangle \left(\frac{\sum_\nu (\nu - \bar{\nu}) I_\nu}{\sum_{\nu'} I_{\nu'}^2} \right)^2$$

or

$$\sigma_{\bar{\nu}}^2 = \sigma_\nu^2 + 4\, \sigma_{I_\nu}^2 \left(\frac{\sum_\nu (\nu - \bar{\nu}) I_\nu}{\sum_{\nu'} I_{\nu'}^2} \right)^2$$

Note that for a symmetric intensity profile about $\bar{\nu}$ (e.g., a Gaussian function) the last term goes to zero.

For a flat-top sample of width $\Delta\nu$, we have

$$\sigma_\nu^2 = \frac{\Delta\nu^2}{12}$$

The sensitivity σ_{I_ν} is given by the amount of noise on the waterfall.