Pulsar Radiometer Equation

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Integration Time Calculation

- **The observing time required to achieve a specific Signal to Noise ratio can be calculated using the radiometer equation (Dicke 1946).**

- ***Ignoring the effects of Radio Frequency Interference (RFI) on the noise floor (Tsys).***

$$T_{int} = \left(\frac{T_{sys}(S/N)}{G S_{psr} \sqrt{n_{pol} B_w}} \right)^2$$

Key Parameters for an observation

Target:

- **S_{psr}: Strength of the radio signal from the target in Janskys (Watts per m^2 per Hz)**

Telescope:

- **T_{sys}: System temperature, a measure of the background noise level of the telescope in degrees Kelvin (K)**
- **Gain: proportional to the size (collecting area) of the telescope dish and the performance of the amplifier (K per Jansky)**
- **n_{pol}: Number of polarisations observed (generally 2)**
- **B_w: Bandwidth of the receiver in MHz**

Variable parameters:

- **T_{int}: Integration time or duration of the observation in seconds**
- **S/N: Signal to Noise ratio, how much of a signal do we need for a detection?**

Key Parameters for a pulsar observation

Pulsar Target:

- ***S_{psr}: Strength of the radio signal from the pulsar in Janskys (Watts per m^2 per Hz)***
- **P: Pulse Period in seconds**
- **W: Pulse width in seconds**

Telescope:

- ***T_{sys}: System temperature, a measure of the background noise level of the telescope in degrees Kelvin (K)***
- ***Gain: proportional to the size (collecting area) of the telescope dish and the performance of the amplifier (K per Jansky)***
- ***n_{pol}: Number of polarisations observed (generally 2)***
- ***B_w: Bandwidth of the receiver in MHz***

Variable parameters:

- ***T_{int}: Integration time or duration of the observation in seconds***
- ***S/N: Signal to Noise ratio, how much of a signal do we need for a detection?***

Integration Time Calculation

- **The observing time required to achieve a specific Signal to Noise ratio can be calculated using the radiometer equation (Dicke 1946).**
- **As we do not receive radio emissions for the whole of the pulsar period a duty cycle correction, $\sqrt{(W/(P-W))}$, is used to adapt the basic radiometer equation for pulsar observations**
- ***Ignoring the effects of Radio Frequency Interference (RFI) on the noise floor (Tsys).***

$$T_{int} = \left(\frac{T_{sys}(S/N)}{G S_{psr} \sqrt{n_{pol} B_w}} \sqrt{\frac{W}{P-W}} \right)^2$$