Doppler Shift Calculations

Name:

Date:

**Given information:**

Speed of light = c = 3x105 km/s

NaD line 1 (λ1) = 5889.96 Angstroms

NaD line 2 (λ2) = 5895.93 Angstroms

ΔλLine 1-2 = λ2 - λ1 = 5.97 Angstroms (used for conversion)

In the Excel template, determine the line minimums for the two lines (i.e. Left and Right or TopLeft and BottomLeft, etc.) with the largest shift. Below we call the two lines P1 (stands for “position 1 (on the solar disk)”) and P2.

**Measurements from Excel Template:**

PixNaD\_Line1@P1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

PixNaD\_Line1@P2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

PixNaD\_Line2@P1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

PixNaD\_Line2@P2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

PixWaterLine@P1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

PixWaterLine@P2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

**Calculations:**

Conversion factor from pixel to wavelength

Calculate the pixel separation between NaD line 1 and NaD line 2 for each solar disk positions. These should be the same value.

Position 1: ΔpixelLine 1-2  = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Position 2: ΔpixelLine 1-2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Δλconversion = ΔλLine 1-2 /ΔpixelLine 1-2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Doppler Shift

Apparent pixel shift in sodium lines:

ΔPixLine1, apparent = PixNaD\_Line1@P1 – PixNaD\_Line1@P2  = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

ΔPixLine2, apparent = PixNaD\_Line2@P1 – PixNaD\_Line2@P2  = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

Correction factor determined from apparent water line offset:

ΔPixcorrection = PixWaterLine@P1 – PixWaterLine@P2  = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

True pixel shift in sodium lines:

ΔPixLine1, true = ΔPixLine1, apparent – ΔPixcorrection = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

ΔPixLine2, true = ΔPixLine2, apparent – ΔPixcorrection = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in pixels)

True wavelength shift in sodium lines:

ΔλLine1 = ΔPixLine1, true (in pixels) \* Δλconversion = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in Angstroms)

ΔλLine2 = ΔPixLine2, true (in pixels) \* Δλconversion = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (in Angstroms)

Rotational Velocity

Solve for ΔV, which is the difference of velocities at positions 1 and 2, using ΔV/c = Δλ/λLine 1. The solar rotational velocity itself would then be the absolute value of (ΔV/2). Fill in the table below with actual numbers:

|  |  |  |  |
| --- | --- | --- | --- |
| Na D Line number | Δλ (in Angstroms) | ΔV (in km/s) | Vrotation (in km/s) |
| 1 | ΔλLine1 |  |  |
| 2 | ΔλLine2 |  |  |
| *Average* |  |  |  |