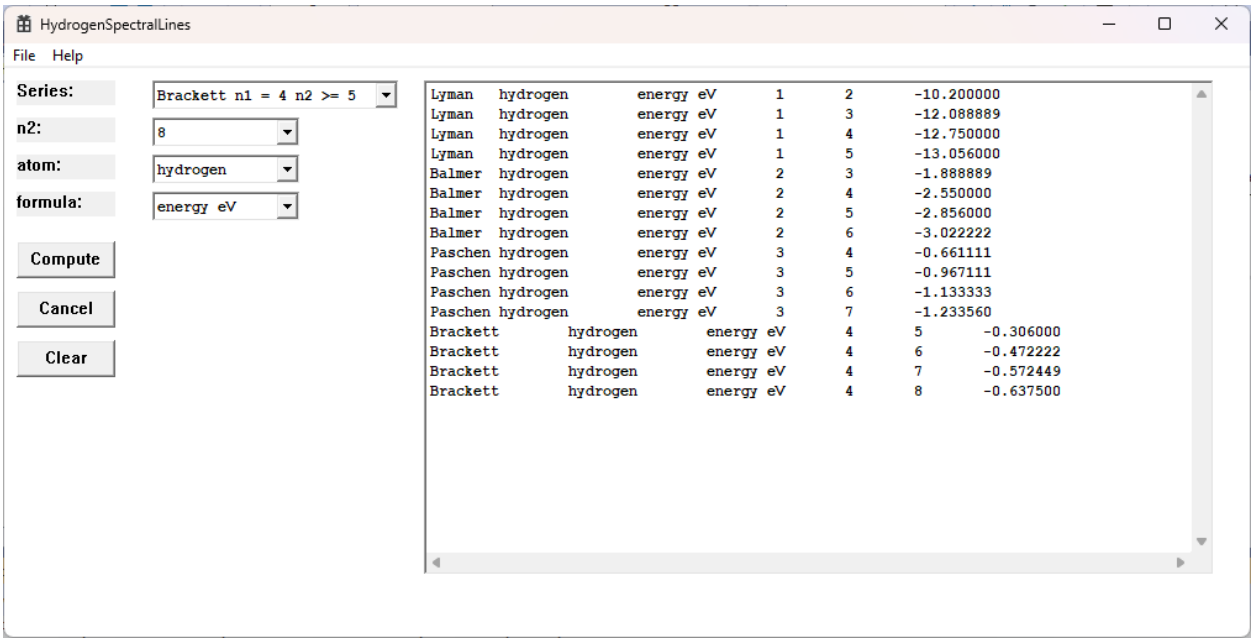
Blog Entry © Wednesday, October 29, 2025, by James Pate Williams, Jr. Hydrogenic Atomic Spectral Lines

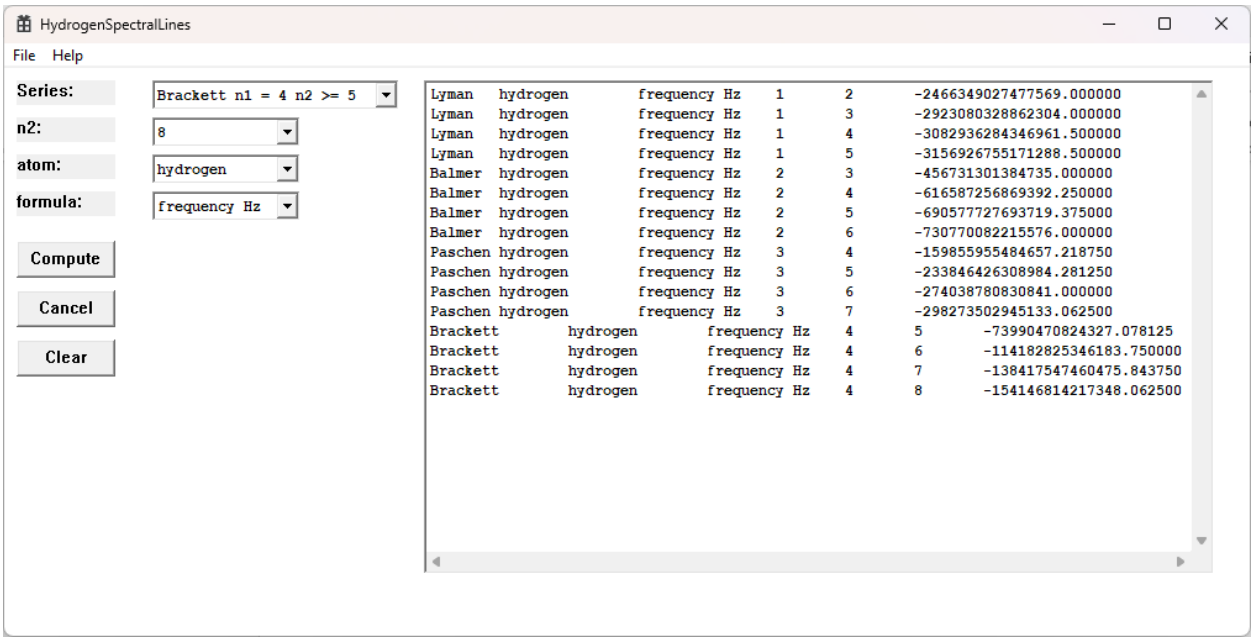
Formulas:

$$E = h\nu = -13.6Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)(units: eV)$$

$$\nu = \frac{E}{h}(units: Hz)$$

$$\lambda = \frac{c}{\nu}(units: 10^{-10}m = Angstrom)$$




HydrogenSpectralLines
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atom:
hydrogen
formula:
frequency Hz
Compute
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Lyman hydrogen frequency Hz 1 3 -2923080328862304.000000
Lyman hydrogen frequency Hz 1 4 -3082936284346961.500000
Lyman hydrogen frequency Hz 1 5 -3156926755171288.500000
Balmer hydrogen frequency Hz 2 3 -456731301384735.000000
Balmer hydrogen frequency Hz 2 4 -616587256869392.250000
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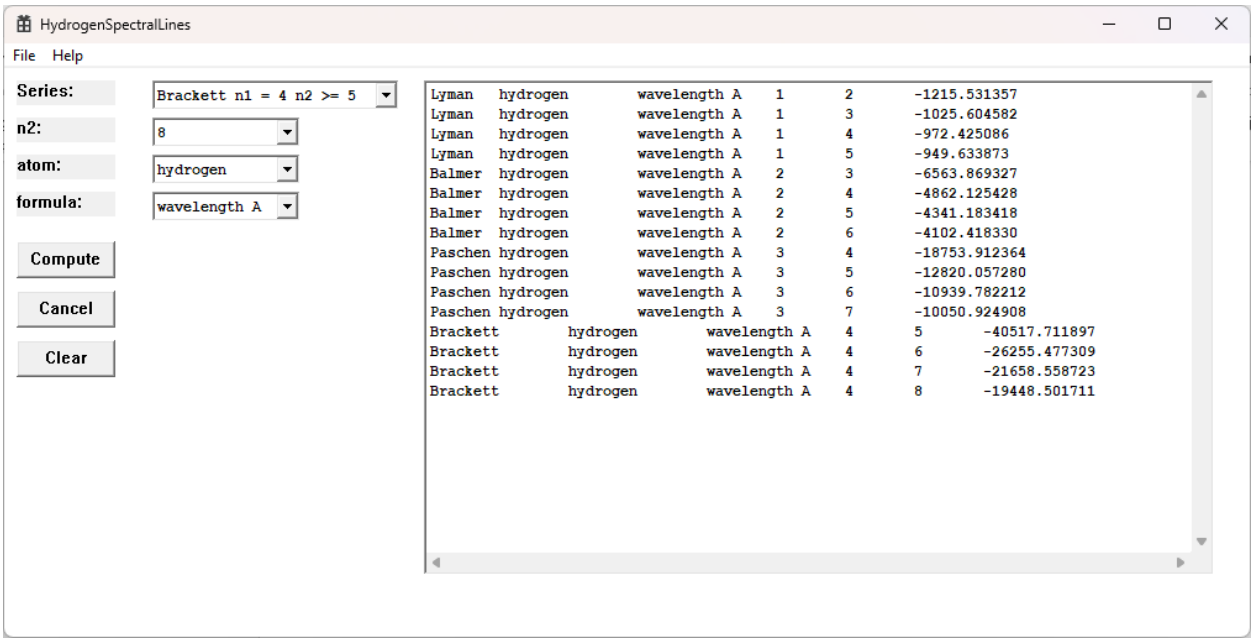
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n2:
8
atom:
hydrogen
formula:
wavelength A
Compute
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Lyman hydrogen wavelength A 1 3 -1025.604582
Lyman hydrogen wavelength A 1 4 -972.425086
Lyman hydrogen wavelength A 1 5 -949.633873
Balmer hydrogen wavelength A 2 3 -6563.869327
Balmer hydrogen wavelength A 2 4 -4862.125428
Balmer hydrogen wavelength A 2 5 -4341.183418
Balmer hydrogen wavelength A 2 6 -4102.418330
Paschen hydrogen wavelength A 3 4 -18753.912364
Paschen hydrogen wavelength A 3 5 -12820.057280
Paschen hydrogen wavelength A 3 6 -10939.782212
Paschen hydrogen wavelength A 3 7 -10050.924908
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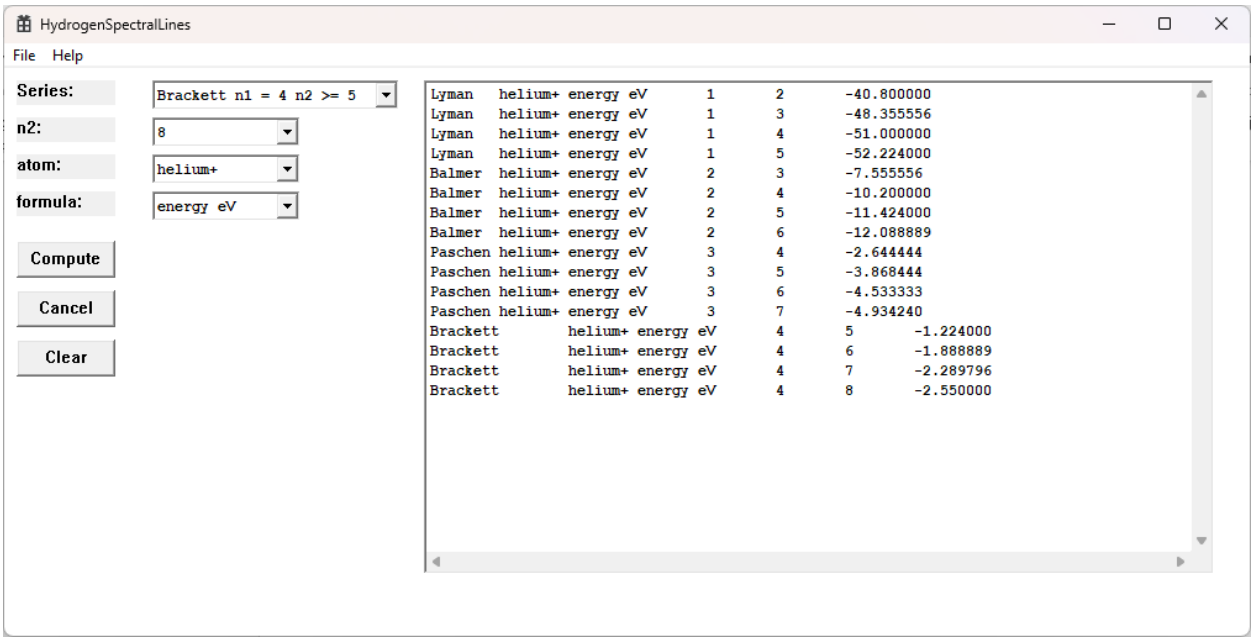
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n2:
8
atom:
helium+
formula:
energy eV
Compute
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Lyman helium+ energy eV 1 4 -51.000000
Lyman helium+ energy eV 1 5 -52.224000
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Balmer helium+ energy eV 2 4 -10.200000
Balmer helium+ energy eV 2 5 -11.424000
Balmer helium+ energy eV 2 6 -12.088889
Paschen helium+ energy eV 3 4 -2.644444
Paschen helium+ energy eV 3 5 -3.868444
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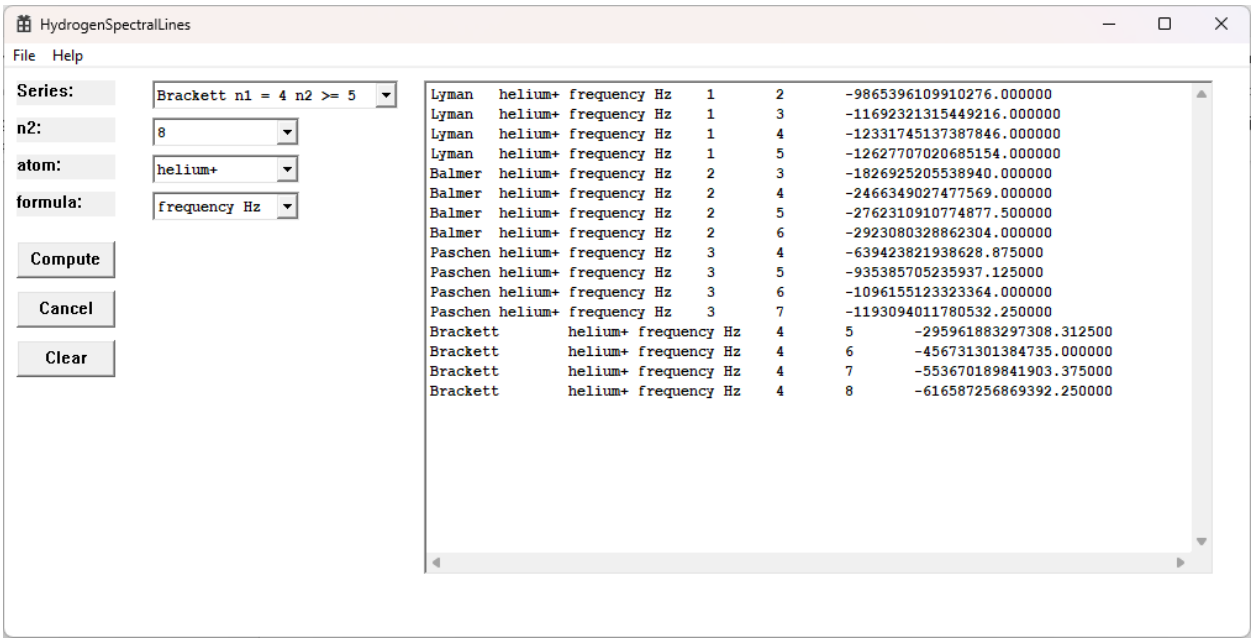
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File Help
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n2:
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atom:
helium+
formula:
frequency Hz
Compute
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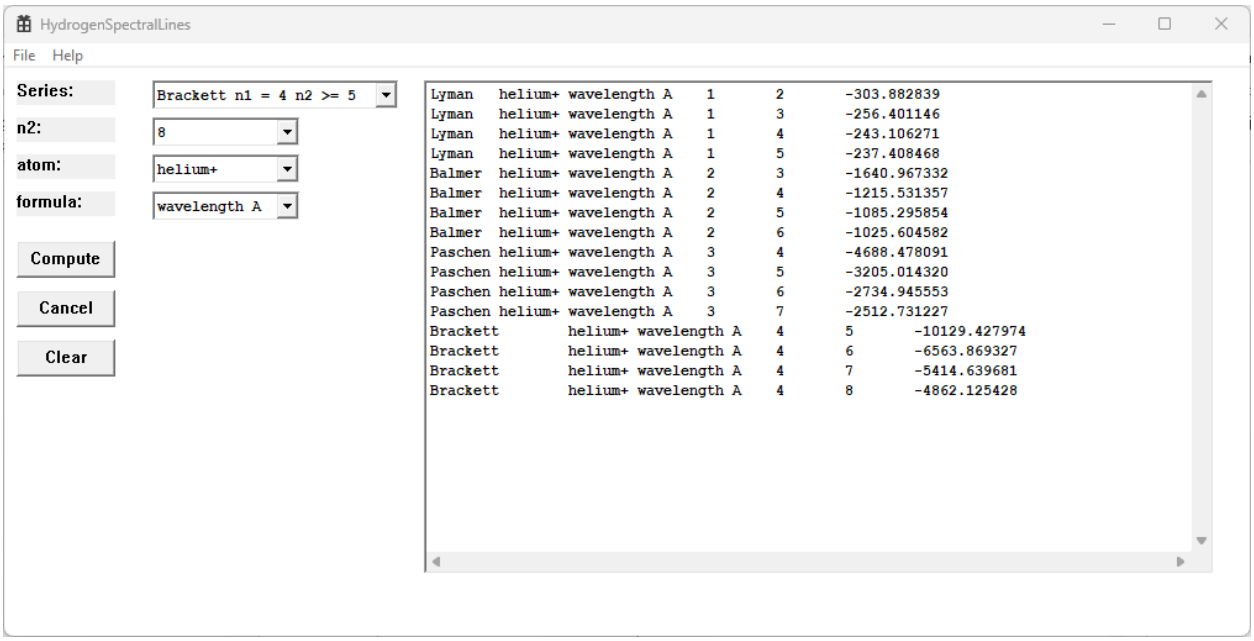
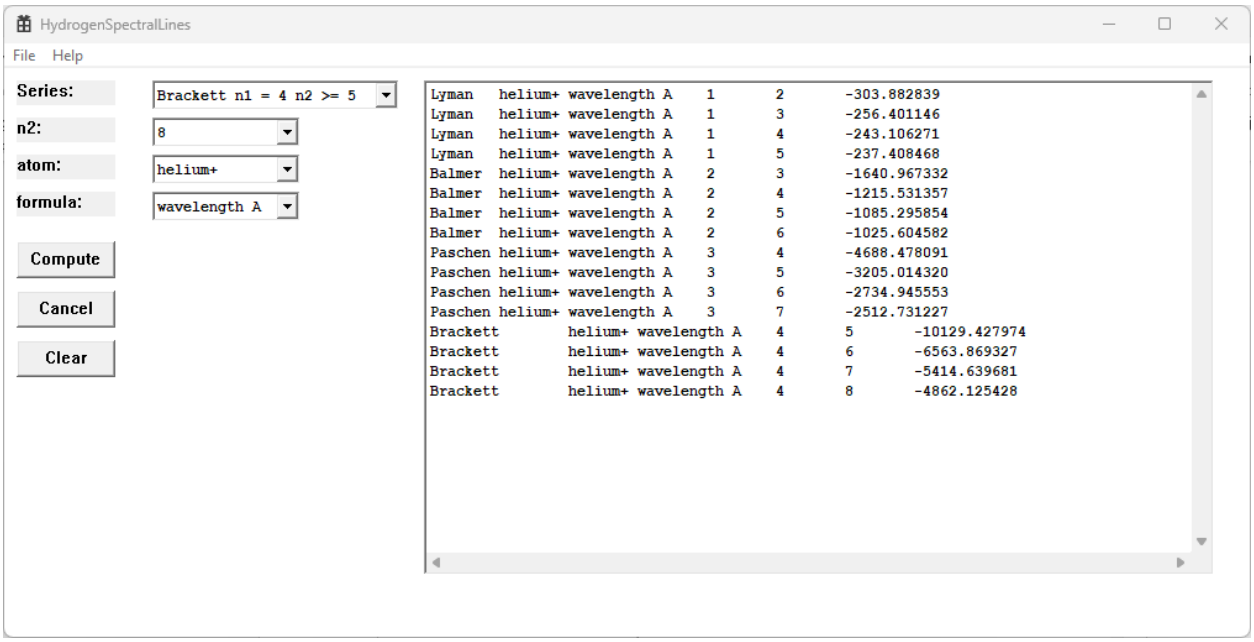

HydrogenSpectralLines
File Help
Series:
Brackett n1 = 4 n2 >= 5
n2:
8
atom:
helium+
formula:
wavelength A
Compute
Cancel
Clear
Lyman helium+ wavelength A 1 2 -303.882839
Lyman helium+ wavelength A 1 3 -256.401146
Lyman helium+ wavelength A 1 4 -243.106271
Lyman helium+ wavelength A 1 5 -237.408468
Balmer helium+ wavelength A 2 3 -1640.967332
Balmer helium+ wavelength A 2 4 -1215.531357
Balmer helium+ wavelength A 2 5 -1085.295854
Balmer helium+ wavelength A 2 6 -1025.604582
Paschen helium+ wavelength A 3 4 -4688.478091
Paschen helium+ wavelength A 3 5 -3205.014320
Paschen helium+ wavelength A 3 6 -2734.945553
Paschen helium+ wavelength A 3 7 -2512.731227
Brackett helium+ wavelength A 4 5 -10129.427974
Brackett helium+ wavelength A 4 6 -6563.869327
Brackett helium+ wavelength A 4 7 -5414.639681
Brackett helium+ wavelength A 4 8 -4862.125428


HydrogenSpectralLines
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Series:
Brackett n1 = 4 n2 >= 5
n2:
8
atom:
helium+
formula:
wavelength A
Compute
Cancel
Clear
Lyman helium+ wavelength A 1 2 -303.882839
Lyman helium+ wavelength A 1 3 -256.401146
Lyman helium+ wavelength A 1 4 -243.106271
Lyman helium+ wavelength A 1 5 -237.408468
Balmer helium+ wavelength A 2 3 -1640.967332
Balmer helium+ wavelength A 2 4 -1215.531357
Balmer helium+ wavelength A 2 5 -1085.295854
Balmer helium+ wavelength A 2 6 -1025.604582
Paschen helium+ wavelength A 3 4 -4688.478091
Paschen helium+ wavelength A 3 5 -3205.014320
Paschen helium+ wavelength A 3 6 -2734.945553
Paschen helium+ wavelength A 3 7 -2512.731227
Brackett helium+ wavelength A 4 5 -10129.427974
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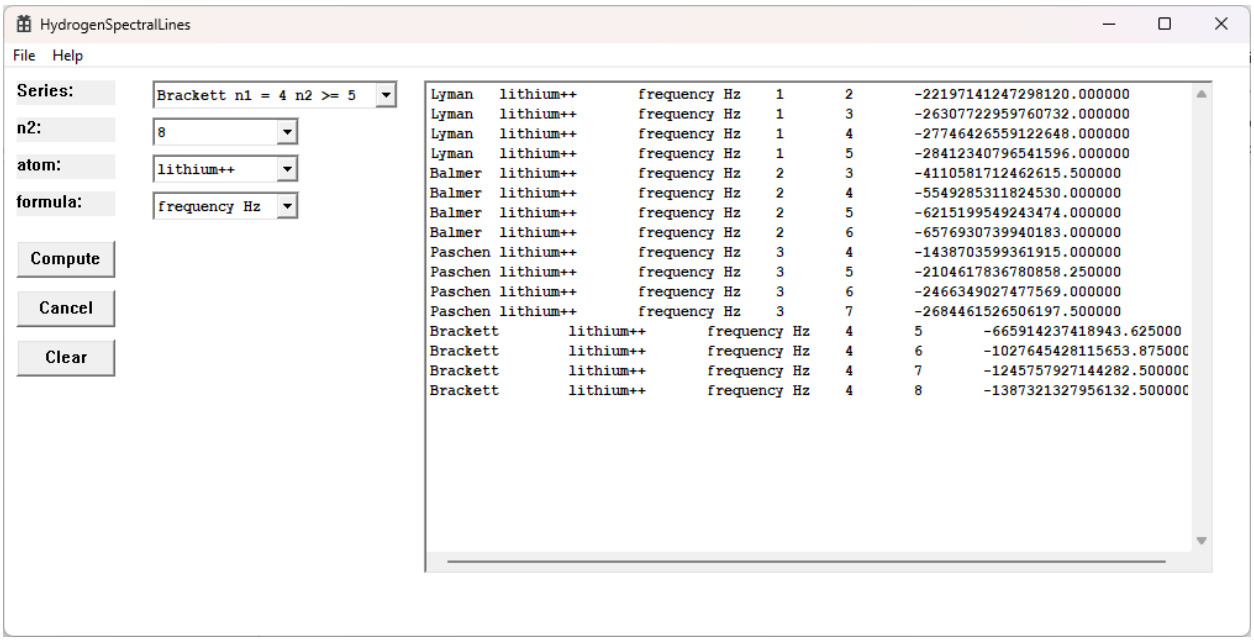
Brackett helium+ wavelength A 4 7 -5414.639681
Brackett helium+ wavelength A 4 8 -4862.125428


HydrogenSpectralLines
File Help
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n2:
8
atom:
lithium++
formula:
frequency Hz
Compute
Cancel
Clear
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Balmer lithium++ frequency Hz 2 6 -6576930739940183.000000
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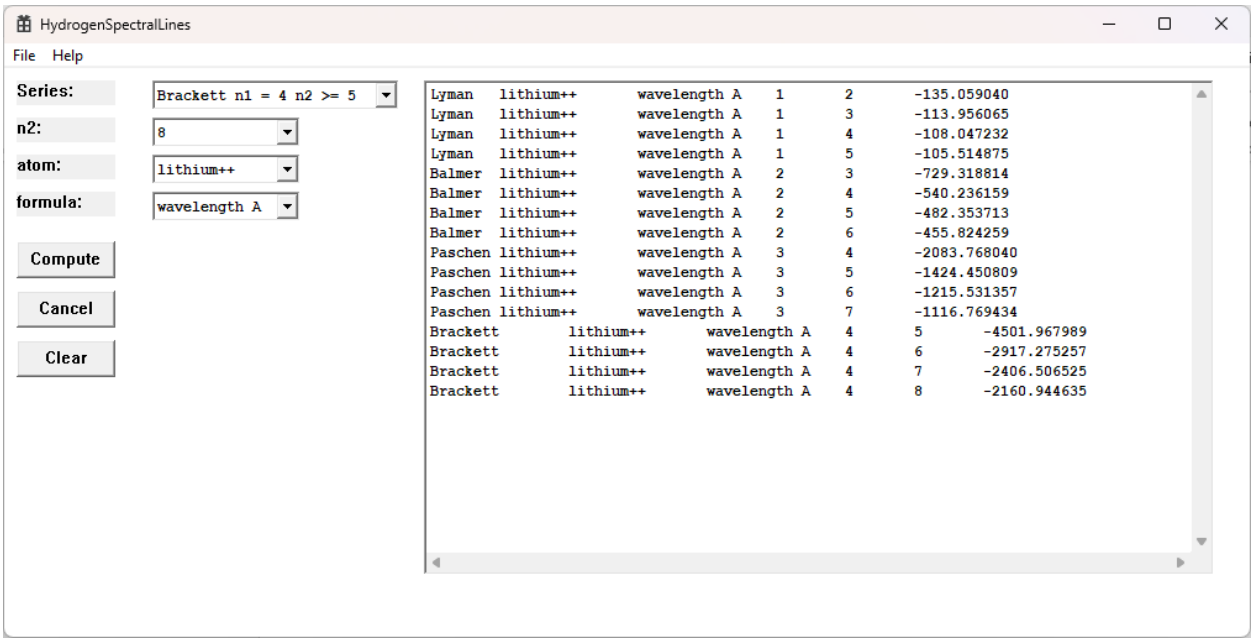
HydrogenSpectralLines
File Help
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n2:
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atom:
lithium++
formula:
wavelength A
Compute
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Balmer lithium++ wavelength A 2 3 -729.318814
Balmer lithium++ wavelength A 2 4 -540.236159
Balmer lithium++ wavelength A 2 5 -482.353713
Balmer lithium++ wavelength A 2 6 -455.824259
Paschen lithium++ wavelength A 3 4 -2083.768040
Paschen lithium++ wavelength A 3 5 -1424.450809
Paschen lithium++ wavelength A 3 6 -1215.531357
Paschen lithium++ wavelength A 3 7 -1116.769434
Brackett lithium++ wavelength A 4 5 -4501.967989
Brackett lithium++ wavelength A 4 6 -2917.275257
Brackett lithium++ wavelength A 4 7 -2406.506525
Brackett lithium++ wavelength A 4 8 -2160.944635