Glow Starter RELCO SC480
Atlas of Emission Lines

Recorded by the Spectrographs
SQUES Echelle and DADOS

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1 Calibration Light Sources for Echelle Spectrographs

Due to the split-up of the highly resolved broadband-spectrum to numerous overlapping orders, Echelle spectrographs require calibration light sources, producing a huge number of evaluable emission lines, which are more or less evenly distributed over the entire wavelength range, reaching from blue to red. In the professional sector, but partly also in the amateur field, mostly hollow cathode lamps with eg iron, argon or thorium are used. Such are usually quite expensive and some of these substances, released by a possible lamp break, not really harmless. In addition, a specific high voltage supply is required.

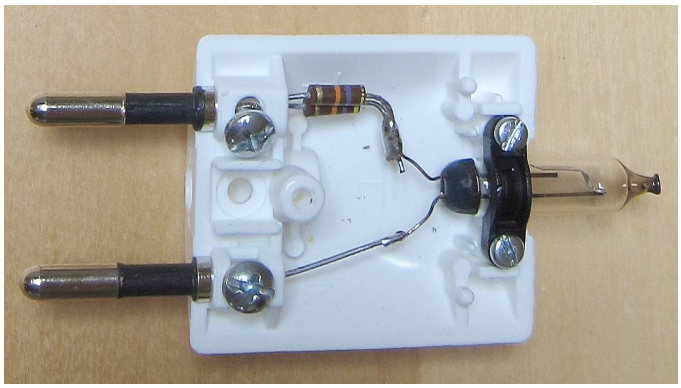
2 Low Cost Alternative

The popular neon glow lamp, particularly used in amateur circles, produces the main part of the useable emission lines in the red- or long wavelength range of the spectrum. Here it can possibly be used for the calibration of some individual orders, but it is useless for the overall calibration of an entire Echelle spectrum.

The glass bulb of the glow starter RELCO SC480, produced by the Italian lighting manufacturer RELCO, houses a bimetal switch and contains also strongly different portions of the noble gases *He, Ne* and *Ar*, as well as H (probably generated by dissociation of remaining water vapour within the bulb). By a simple modification of the starter these gases can be excited to produce several hundreds of evaluable emission lines. There exist also professional calibration lamps, using this gas mixture [71].

3 Modification of the Glow Starter

With minimal electrical knowledge this unit can be modified to a calibration light source by supplying it with 230V via a series resistor of about 24 kΩ. The following illustration shows my modified version with 2x47 kΩ connected in parallel. For our purposes, the capacitor, applied to prevent radio interference, can be removed. Before soldering, the oxide layer must be grinded from the connecting wires. If the switch opens and closes periodically, the value of the series resistor must be increased (up to >30kΩ). The glass bulb of the RELCO starter is so small that it may be mounted even in to the spectrograph as a fixed calibration light source. Anyway all such modifications remain of course at your own risk!



Modified in such a way, the excited gases in the bulb generate some 240 evaluable emission lines. Counting also those on all overlapped Echelle orders, this number increases even to approximately 370. Between the individual starters, the intensity of the hydrogen Balmer series can vary very strongly. Numerous additional lines, which are not listed here, are generated by alloying elements, coatings and dopants, such as tungsten (W), lanthanum (La), cerium (Ce), hafnium (Hf), thorium (Th), and Fe, Cr, Sn, Ni, Mn [72]. Their identification is difficult and highly speculative, since for a given line, almost always *several* plausible determination options exist in the immediate vicinity.

4 Application for the Echelle Calibration (R ≈ 20'000)

Within the entire range of λλ 3888 - 8136 [Å], and distributed to 30 SQUES Echelle orders, all usable emission lines are documented in the following tables. As an absolute exception, within the order 29 (λλ 7600-7900), only two evaluable emission lines are generated by noble gases, which however are supplemented here by a striking oxygen triplet. In addition, there are still other calibration options eg with known H_2O and/or O_2 lines of the daylight spectrum, during the night reflected by the moon and planets.

The SQUES Echelle spectrograph produces nearly straight running orders which can be simply processed also individually and applying conventional methods, eg the Vspec or RSpec Software [51, [52]. This way the modified RELCO starter allows the quick and easy wavelength calibration for the analysis of individual, highly resolved lines. Also possible is the somewhat demanding processing and calibration of the entire spectrum with ISIS or corresponding MIDAS routines, because significantly more than the minimum required three emission lines are available here. Line pairs which appear scarcely resolved here and therefore can hardly be selectively marked with the cursor are referred with "Blend" in the tables. Lines which, due to overlapping orders, appear twice, are labelled in colour. As a supplement and with relatively high probability, in the rather sparsely populated orders 39, 40 and 43, Ti- emissions could be identified. These lines are additionally labelled with "?".

5 Application for the Broadband-Calibration (R ≈ 900/4'000)

Since here neon as well as argon generate numerous and strong emission lines, the formation of many blends, particularly in the red part of *low-resolution spectra,* is inevitable. Nevertheless within the entire wideband spectrum still more than sufficient isolated lines are available for a reliable calibration of the wavelength axis. The corresponding commented DADOS profiles, recorded with 200- and 900L mm^{-1}, are attached at the end of this document in sect. 8.

6 Hα Analysis with Conventional Grating Spectrographs

The Hα line is located within the Echelle order No 34. Here also the calibration lines, located adjacent to Hα, can be found. For the users of Lhires III and ISIS, directly adjacent to the well known neon triple λλλ 6506/6532/6598, two additional argon lines at λλ 6538.112 and 6604.853, as well as the Hα emission itself are available.

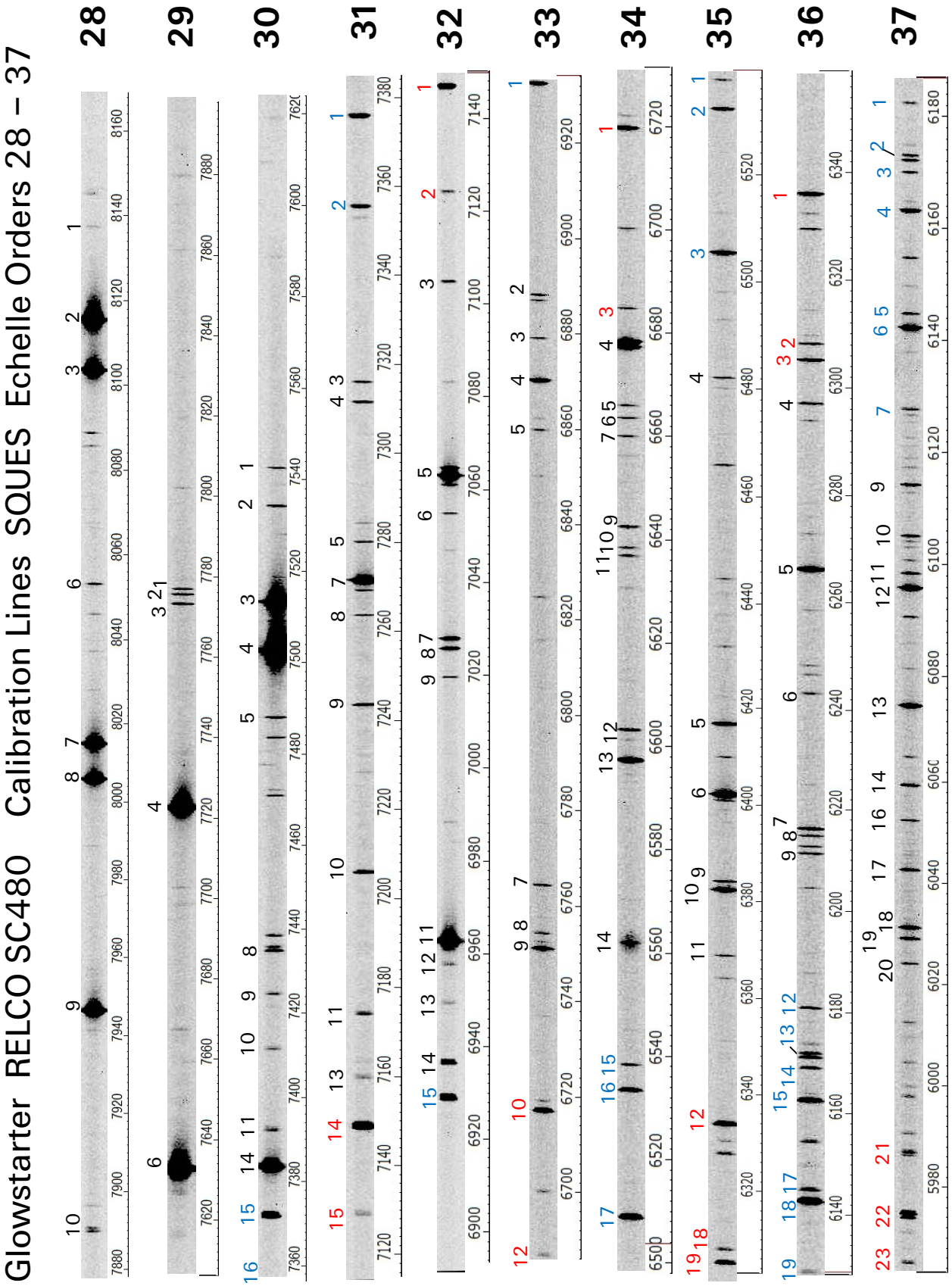
7 RELCO Calibration Lines and SQUES Echelle Orders (R ≈ 20'000)

The following charts and tables show the positions of the individual emission lines, distributed to the orders of the SQUES Echelle spectrograph (R ≈ 20'000). These can be used eg for the calibration of the entire spectrum with ISIS or MIDAS. The appropriate wavelengths have been copied in to these tables from the *"Elements"* tool of *Vspec*. For the calibration, limited to only one individual Echelle order, the labelled profiles are applicable.

Practical Notes:

To improve the visibility of the weaker calibration lines a stronger zoom in the intensity axis is required. For the overall processing and calibration of the entire spectrum, eg with ISIS, it is recommended to select the more intense lines only. Applying different Echelle spectrographs with comparable or even the same grating configuration, some of the emission lines, located here at the outermost edges of the orders, may appear to be moved in the neighbouring orders. Further the line intensity, not only of the hydrogen Balmer series, is noticeably subjected to the manufacturing tolerance of the starter production.

Tip: To avoid transmission errors, the wavelength data can be copied with *ctrl c* from the pdf file and transferred to the Vspec calibration field with *shift insert*.


Glowstarter RELCO SC480 Calibration Lines SQUES Echelle Orders 28 – 37
28
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RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 28 – 34

28	1	8136.406	Ne
28	2	8115.311	Ar
28	3	8103.693	Ar
28	6	8053.308	Ar
28	7	8014.786	Ar
28	8	8006.157	Ar
28	9	7948.176	Ar
28	10	7891.075	Ar
29	1	7775.39	O
29	2	7774.17	O
29	3	7771.94	O
29	4	7723.761	Ar
29	6	7635.106	Ar
30	1	7544.044	Ne
30	2	7535.774	Ne
30	3	7514.652	Ar
30	4	7503.869	Ar
30	5	7488.871	Ne
30	8	BLEND	Ar
30	9	7425.294	Ar
30	10	7412.337	Ar
30	11	7392.98	Ar
30	14	7383.98	Ar
30	15	7372.118	Ar
30	16	7353.293	Ar

31	1	7372.118	Ar
31	2	7353.293	Ar
31	3	7316.005	Ar
31	4	7311.716	Ar
31	5	7281.35	He
31	7	7272.936	Ar
31	8	7265.172	Ar
31	9	7245.167	Ne
31	10	7206.98	Ar
31	11	7173.938	Ne
31	13	7158.839	Ar
31	14	7147.042	Ar
31	15	7125.82	Ar
32	1	7147.042	Ar
32	2	7125.82	Ar
32	3	7107.478	Ar
32	5	7067.218	Ar
32	6	7059.107	Ne
32	7	7032.413	Ne
32	8	7030.251	Ar
32	9	7024.05	Ne
32	11	6965.431	Ar
32	12	6960.25	Ar
32	13	6951.478	Ar
32	14	6937.664	Ar
32	15	6929.467	Ne

33	1	6929.467	Ne
33	2	6888.174	Ar
33	3	6879.582	Ar
33	4	6871.289	Ar
33	5	6861.269	Ar
33	7	6766.612	Ar
33	8	6756.163	Ar
33	9	6752.834	Ar
33	10	6717.043	Ne
33	12	6684.293	Ar
34	1	6717.043	Ne
34	3	6684.293	Ar
34	4	BLEND	Ar / Ne
34	5	6666.359	Ar
34	6	6664.051	Ar
34	7	6660.676	Ar
34	9	6643.698	Ar
34	10	6639.74	Ar
34	11	6638.221	Ar
34	12	6604.853	Ar
34	13	6598.953	Ne
34	14	6562.82	Hα
34	15	6538.112	Ar
34	16	6532.882	Ne
34	17	6506.528	Ne

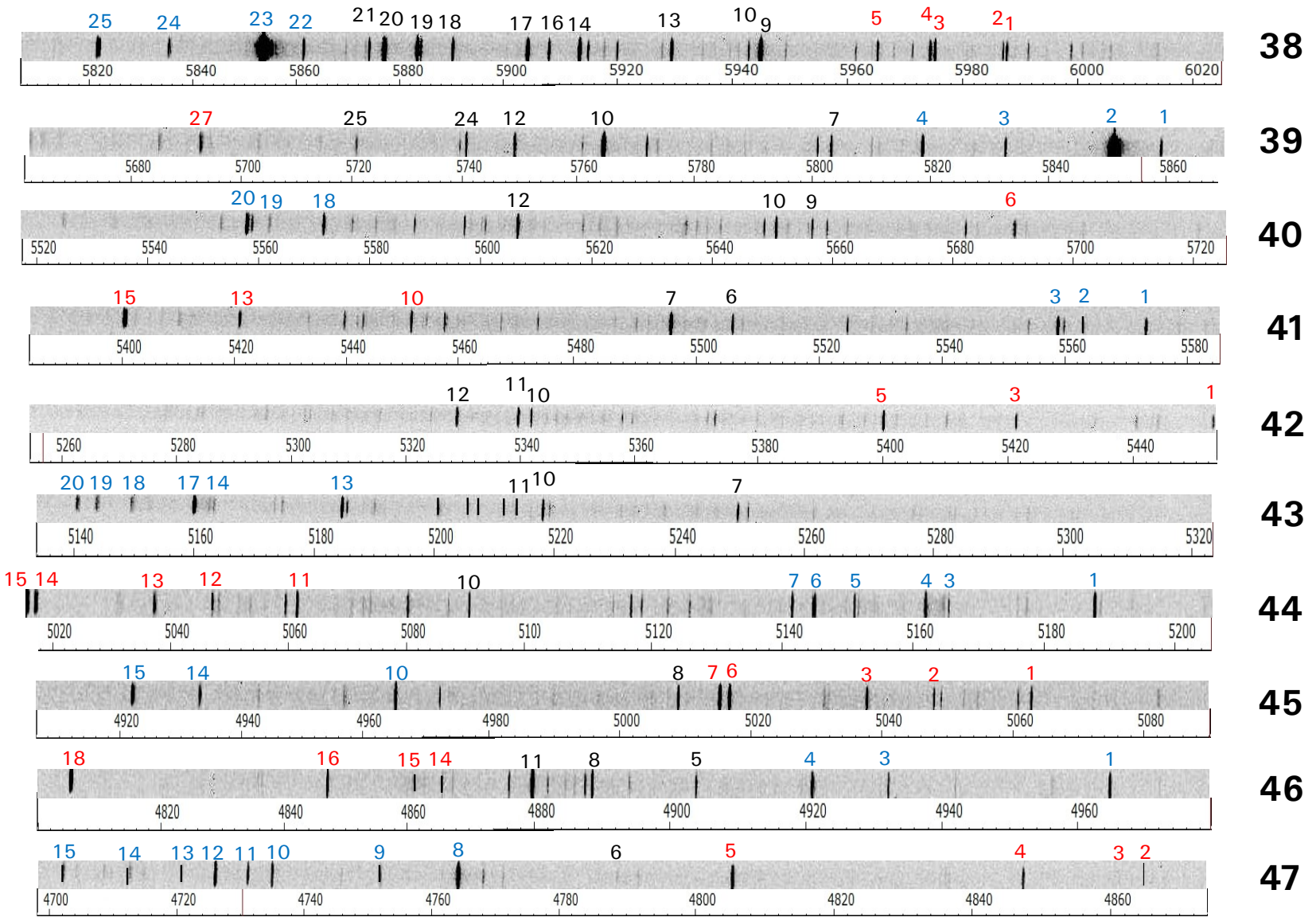
RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 35 – 37

35	1	6538.112	Ar
35	2	6532.882	Ne
35	3	6506.528	Ne
35	4	6483.082	Ar
35	5	6416.307	Ar
35	6	6402.246	Ar
35	9	6384.717	Ar
35	10	6382.992	Ne
35	11	6369.575	Ar
35	12	6334.428	Ne
35	18	6307.657	Ar
35	19	6304.789	Ne

36	1	6334.428	Ne
36	2	6307.657	Ar
36	3	6304.789	Ne
36	4	6296.872	Ar
36	5	6266.495	Ne
36	6	6243.12	Ar
36	7	6217.281	Ne
36	8	6215.938	Ar
36	9	6212.503	Ar
36	12	6182.146	Ne
36	13	BLEND	Ar
36	14	6170.174	Ar
36	15	6163.594	Ne
36	17	6145.441	Ar
36	18	6143.063	Ne
36	19	6128.45	Ne

37	1	6182.146	Ne
37	2	BLEND	Ar
37	3	6170.174	Ar
37	4	6163.594	Ne
37	5	6145.441	Ar
37	6	6143.063	Ne
37	7	6128.45	Ne
37	9	6114.923	Ar
37	10	6105.635	Ar
37	11	6098.803	Ar
37	12	6096.163	Ne
37	13	6074.338	Ne
37	14	6059.372	Ar
37	16	6052.723	Ar
37	17	6043.223	Ar
37	18	6032.127	Ar
37	19	6029.997	Ne
37	20	6025.15	Ar
37	21	BLEND	Ne/Ar
37	22	BLEND	Ne
37	23	5965.471	Ne

Glowstarter RELCO SC480 Calibration Lines SQUES Echelle Orders 38 – 47



RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 38 – 45

38	1	5987.907	Ne
38	2	5987.302	Ar
38	3	5975.534	Ne
38	4	5974.627	Ne
38	5	5965.471	Ne
38	9	5944.834	Ne
38	10	5942.669	Ar
38	13	5928.813	Ar
38	14	5912.085	Ar
38	16	5906.429	Ne
38	17	5902.462	Ne
38	18	5888.584	Ar
38	19	BLEND	Ne/Ar
38	20	5875.62	He
38	21	5872.828	Ne
38	22	5860.31	Ar
38	23	5852.488	Ne
38	24	5834.263	Ar
38	25	5820.156	Ne
39	1	5860.31	Ar
39	2	5852.488	Ne
39	3	5834.263	Ar
39	4	5820.156	Ne
39	7	5804.45	Ne
39	10	5764.419	Ne
39	12	5748.298	Ne
39	24	5739.52	Ar
39	25	5719.225	Ne
39	27	5689.47	Ti ?

40	6	5689.47	Ti ?
40	9	5656.659	Ne
40	10	5650.704	Ar
40	12	5606.733	Ar
40	18	5572.541	Ar
40	19	5562.766	Ne
40	20	5558.702	Ar
41	1	5572.541	Ar
41	2	5562.766	Ne
41	3	5558.702	Ar
41	6	5506.113	Ar
41	7	5495.874	Ar
41	10	5451.652	Ar
41	13	5421.352	Ar
41	15	5400.562	Ne
42	1	5451.652	Ar
42	3	5421.352	Ar
42	5	5400.562	Ne
42	10	5343.283	Ne
42	11	5341.094	Ne
42	12	5330.778	Ne
43	7	5252.11	Ti ?
43	10	5221.271	Ar
43	11	5216.814	Ar
43	13	5187.746	Ar
43	14	BLEND	Ar
43	17	5162.285	Ar
43	18	5151.391	Ar
43	19	BLEND	Ne/Ar
43	20	5141.783	Ar

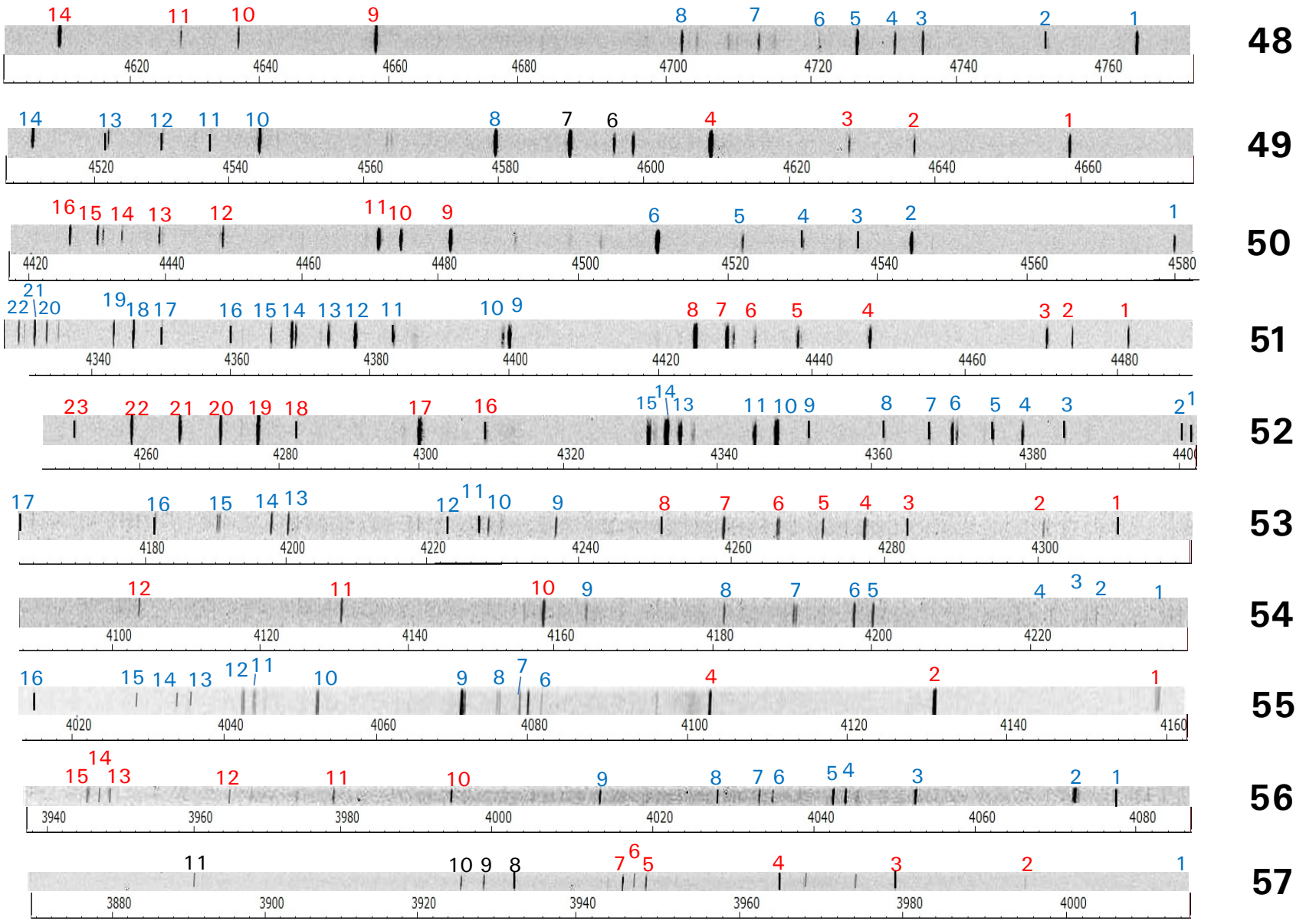
44	1	5187.746	Ar
44	3	5165.773	Ar
44	4	5162.285	Ar
44	5	5151.391	Ar
44	6	BLEND	Ne/Ar
44	7	5141.783	Ar
44	10	5090.495	Ar
44	11	5062.037	Ar
44	12	5047.74	He
44	13	5037.751	Ne
44	14	5017.163	Ar
44	15	5015.678	He
45	1	5062.037	Ar
45	2	5047.74	He
45	3	5037.751	Ne
45	6	5017.163	Ar
45	7	5015.678	He
45	8	5009.334	Ar
45	10	4965.08	Ar
45	14	4933.209	Ar
45	15	4921.931	He

RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 46 – 47

46	1	4965.08	Ar
46	3	4933.209	Ar
46	4	4921.931	He
46	5	4904.752	Ar
46	8	4889.042	Ar
46	11	4879.864	Ar
46	14	4865.91	Ar
46	15	4861.33	Hβ
46	16	4847.81	Ar
46	18	4806.02	Ar

47	2	4865.91	Ar
47	3	4861.33	Hβ
47	4	4847.81	Ar
47	5	4806.02	Ar
47	6	4788.927	Ne
47	8	4764.865	Ar
47	9	4752.732	Ne
47	10	4735.906	Ar
47	11	4732.053	Ar
47	12	4726.868	Ar
47	13	4721.591	Ar
47	14	4713.146	He
47	15	4702.316	Ar

Glowstarter RELCO SC480 Calibration Lines SQUES Echelle Orders 48 – 57



RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 48 – 51

48	1	4764.865	Ar
48	2	4752.732	Ne
48	3	4735.906	Ar
48	4	4732.053	Ar
48	5	4726.868	Ar
48	6	4721.591	Ar
48	7	4713.146	He
48	8	4702.316	Ar
48	9	4657.901	Ar
48	10	4637.233	Ar
48	11	4628.441	Ar
48	14	4609.567	Ar
49	1	4657.901	Ar
49	2	4637.233	Ar
49	3	4628.441	Ar
49	4	4609.567	Ar
49	6	4596.097	Ar
49	7	4589.898	Ar
49	8	4579.35	Ar
49	10	4545.052	Ar
49	11	4537.754	Ne
49	12	4530.552	Ar
49	13	4522.323	Ar
49	14	4510.733	Ar

50	1	4579.35	Ar
50	2	4545.052	Ar
50	3	4537.754	Ne
50	4	4530.552	Ar
50	5	4522.323	Ar
50	6	4510.733	Ar
50	9	4481.811	Ar
50	10	4474.759	Ar
50	11	4471.479	He
50	12	4448.879	Ar
50	13	4439.461	Ar
50	14	4433.838	Ar
50	15	4430.189	Ar
50	16	4426.001	Ar

51	1	4481.811	Ar
51	2	4474.759	Ar
51	3	4471.479	He
51	4	4448.879	Ar
51	5	4439.461	Ar
51	6	4433.838	Ar
51	7	4430.189	Ar
51	8	4426.001	Ar
51	9	4400.986	Ar
51	10	4400.097	Ar
51	11	4385.057	Ar
51	12	4379.667	Ar
51	13	4375.954	Ar
51	14	BLEND	Ar
51	15	4367.832	Ar
51	16	4362.066	Ar
51	17	4352.205	Ar
51	18	4348.064	Ar
51	19	4345.168	Ar
51	20	4335.338	Ar
51	21	4333.561	Ar
51	22	4331.2	Ar

RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 52 – 55

52	1	4400.986	Ar
52	2	4400.097	Ar
52	3	4385.057	Ar
52	4	4379.667	Ar
52	5	4375.954	Ar
52	6	BLEND	Ar
52	7	4367.832	Ar
52	8	4362.066	Ar
52	9	4352.205	Ar
52	10	4348.064	Ar
52	11	4345.168	Ar
52	13	4335.338	Ar
52	14	4333.561	Ar
52	15	4331.2	Ar
52	16	4309.239	Ar
52	17	4300.101	Ar
52	18	4282.898	Ar
52	19	4277.528	Ar
52	20	4272.169	Ar
52	21	4266.286	Ar
52	22	4259.362	Ar
52	23	4251.185	Ar

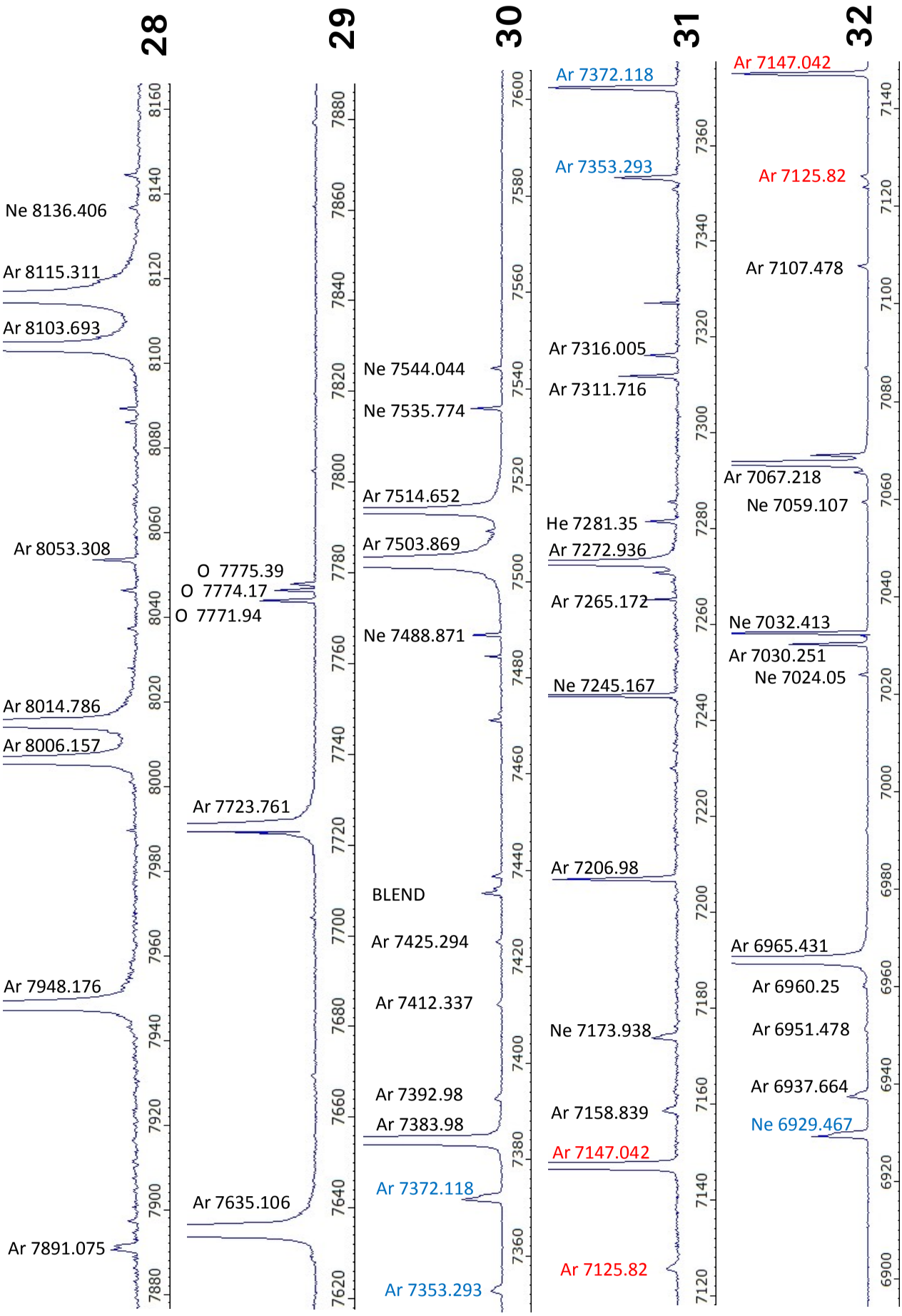
53	1	4309.239	Ar
53	2	4300.101	Ar
53	3	4282.898	Ar
53	4	4277.528	Ar
53	5	4272.169	Ar
53	6	4266.286	Ar
53	7	4259.362	Ar
53	8	4251.185	Ar
53	9	4237.22	Ar
53	10	4228.158	Ar
53	11	4226.988	Ar
53	12	4222.637	Ar
53	13	4200.674	Ar
53	14	4198.317	Ar
53	15	BLEND	Ar/Hf
53	16	4181.884	Ar
53	17	4164.18	Ar
54	1	4237.22	Ar
54	2	4228.158	Ar
54	3	4226.988	Ar
54	4	4222.637	Ar
54	5	4200.674	Ar
54	6	4198.317	Ar
54	7	BLEND	Ar/Hf
54	8	4181.884	Ar
54	9	4164.18	Ar
54	10	4158.59	Ar
54	11	4131.724	Ar
54	12	4103.912	Ar

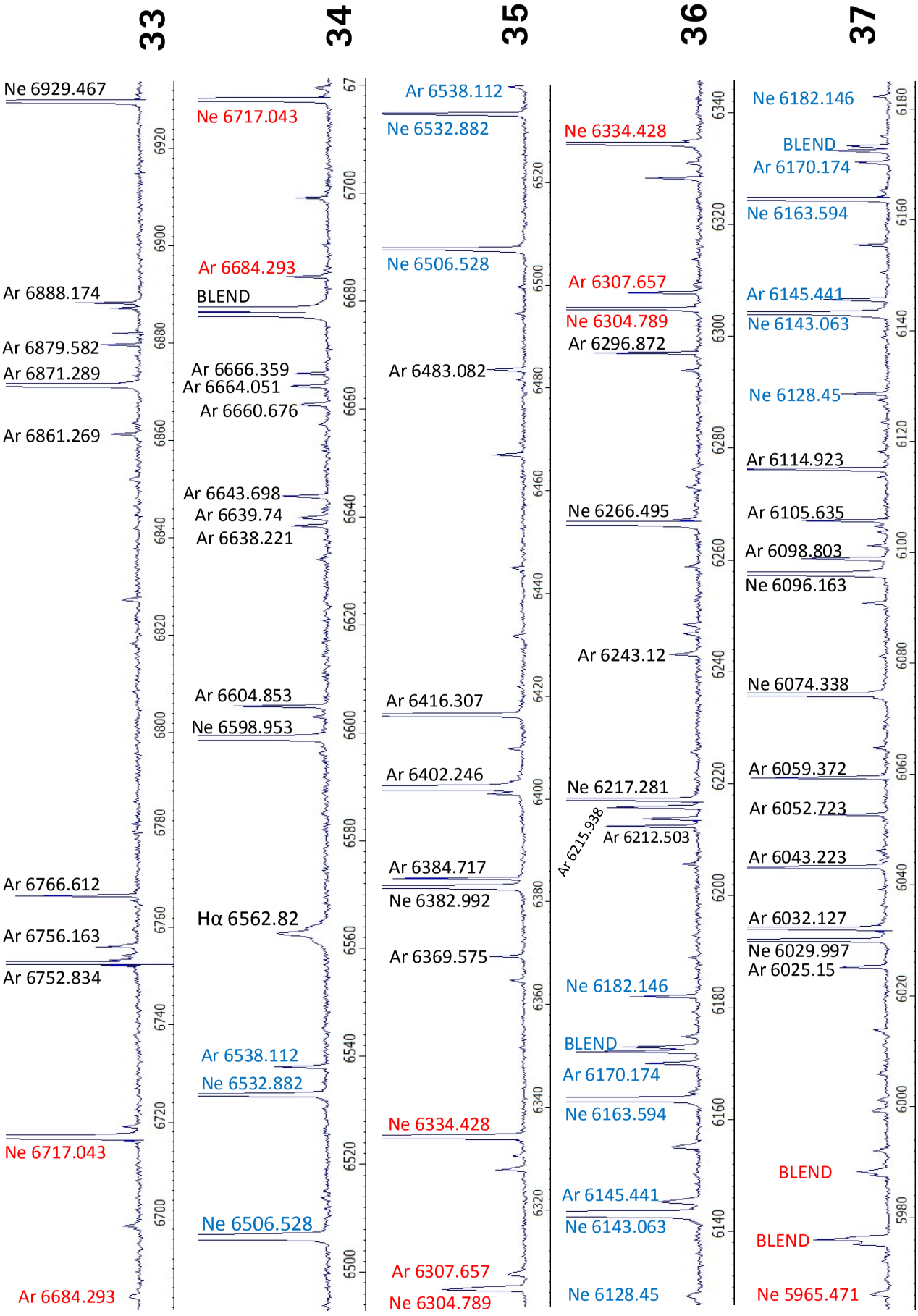
55	1	4158.59	Ar
55	2	4131.724	Ar
55	4	4103.912	Ar
55	6	4082.387	Ar
55	7	4079.574	Ar
55	8	BLEND	Ar/?
55	9	BLEND	Ar/Ar
55	10	4052.921	Ar
55	11	4044.418	Ar
55	12	4042.894	Ar
55	13	4035.46	Ar
55	14	4033.809	Ar
55	15	4026.36	He
55	16	4013.857	Ar

RELCO SC480 Glowstarter Emissionlines SQUES Echelle Orders 56 – 57

56	1	BLEND	Ar/?
56	2	BLEND	Ar/Ar
56	3	4052.921	Ar
56	4	4044.418	Ar
56	5	4042.894	Ar
56	6	4035.46	Ar
56	7	4033.809	Ar
56	8	4026.36	He
56	9	4013.857	Ar
56	10	3994.792	Ar
56	11	3979.356	Ar
56	12	3964.729	He
56	13	3948.979	Ar
56	14	3947.505	Ar
56	15	3946.097	Ar

57	1	4013.857	Ar
57	2	3994.792	Ar
57	3	3979.356	Ar
57	4	3964.729	He
57	5	3948.979	Ar
57	6	3947.505	Ar
57	7	3946.097	Ar
57	8	3932.547	Ar
57	9	3928.623	Ar
57	10	3925.719	Ar
57	11	3888.65	He


28
Ne 8136.406
Ar 8115.311
Ar 8103.693
Ar 8053.308
Ar 8014.786
Ar 8006.157
Ar 7948.176
Ar 7891.075
29
O 7775.39
O 7774.17
O 7771.94
Ar 7723.761
Ar 7635.106
30
Ne 7544.044
Ne 7535.774
Ar 7514.652
Ar 7503.869
Ne 7488.871
BLEND
Ar 7425.294
Ar 7412.337
Ar 7392.98
Ar 7383.98
Ar 7372.118
Ar 7353.293
31
Ar 7372.118
Ar 7353.293
Ar 7316.005
Ar 7311.716
He 7281.35
Ar 7272.936
Ar 7265.172
Ne 7245.167
Ar 7206.98
Ne 7173.938
Ar 7158.839
Ar 7147.042
Ar 7125.82
32
Ar 7147.042
Ar 7125.82
Ar 7107.478
Ar 7067.218
Ne 7059.107
Ne 7032.413
Ar 7030.251
Ne 7024.05
Ar 6965.431
Ar 6960.25
Ar 6951.478
Ar 6937.664
Ne 6929.467


33
34
35
36
37
Ne 6929.467
Ar 6888.174
Ar 6879.582
Ar 6871.289
Ar 6861.269
Ar 6766.612
Ar 6756.163
Ar 6752.834
Ne 6717.043
Ar 6684.293
Ne 6717.043
Ar 6684.293
BLEND
Ar 6666.359
Ar 6664.051
Ar 6660.676
Ar 6643.698
Ar 6639.74
Ar 6638.221
Ar 6604.853
Ne 6598.953
Hα 6562.82
Ar 6538.112
Ne 6532.882
Ne 6506.528
Ar 6538.112
Ne 6532.882
Ne 6506.528
Ar 6483.082
Ar 6416.307
Ar 6402.246
Ar 6384.717
Ne 6382.992
Ar 6369.575
Ne 6334.428
Ar 6307.657
Ne 6304.789
Ne 6334.428
Ar 6307.657
Ne 6304.789
Ar 6296.872
Ne 6266.495
Ar 6243.12
Ne 6217.281
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BLEND
Ar 6170.174
Ne 6163.594
Ar 6145.441
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Ne 6128.45
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BLEND
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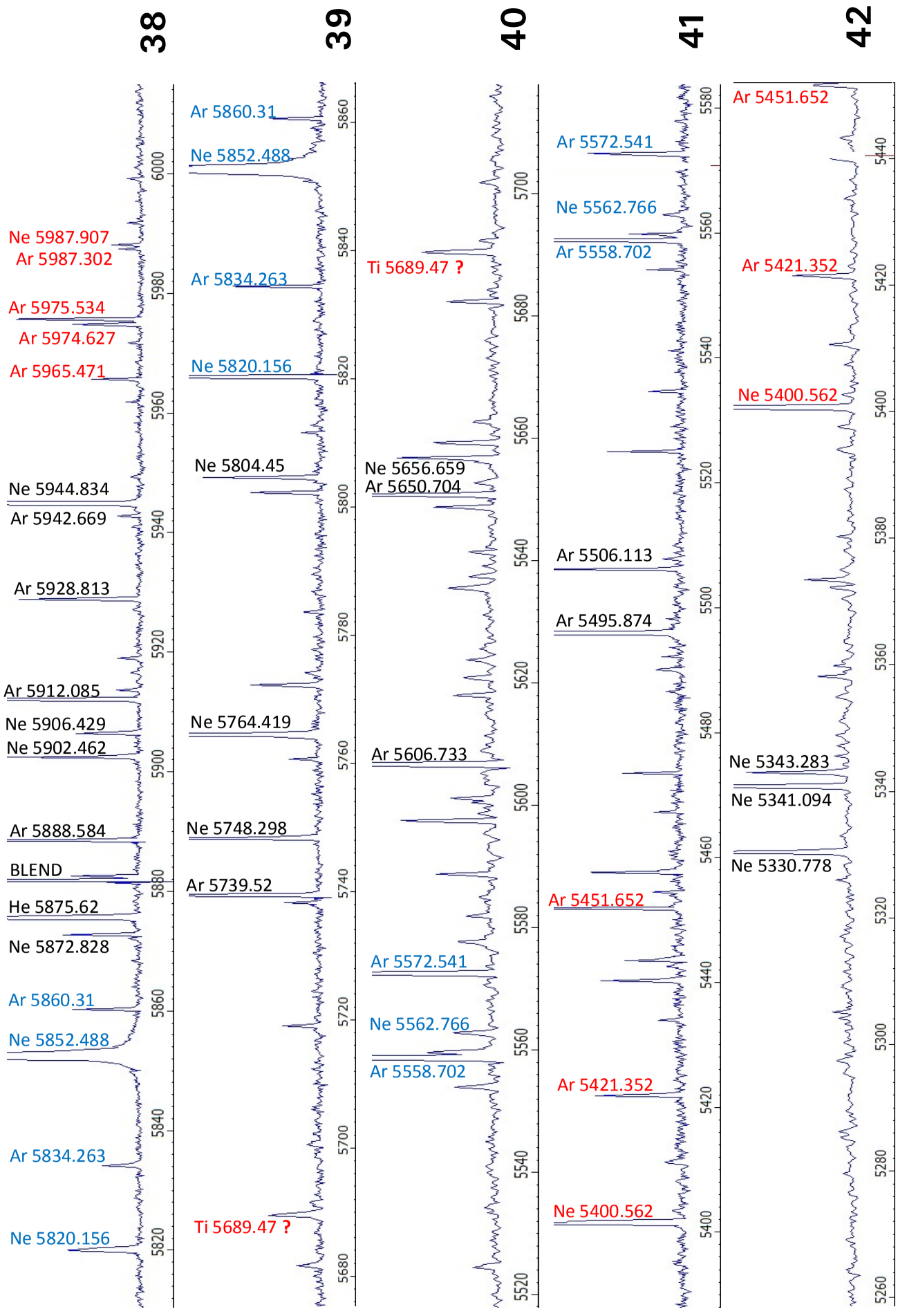
Ne 6128.45
Ar 6114.923
Ar 6105.635
Ar 6098.803
Ne 6096.163
Ne 6074.338
Ar 6059.372
Ar 6052.723
Ar 6043.223
Ar 6032.127
Ne 6029.997
Ar 6025.15
BLEND
BLEND
Ne 5965.471


38
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Ar 5987.302
Ar 5975.534
Ar 5974.627
Ar 5965.471
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Ar 5912.085
Ne 5906.429
Ne 5902.462
Ar 5888.584
BLEND
He 5875.62
Ne 5872.828
Ar 5860.31
Ne 5852.488
Ar 5834.263
Ne 5820.156
39
Ar 5860.31
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Ar 5834.263
Ne 5820.156
Ne 5804.45
Ne 5764.419
Ne 5748.298
Ar 5739.52
Ti 5689.47 ?
40
Ti 5689.47 ?
Ne 5656.659
Ar 5650.704
Ar 5606.733
Ar 5572.541
Ne 5562.766
Ar 5558.702
41
Ar 5572.541
Ne 5562.766
Ar 5558.702
Ar 5506.113
Ar 5495.874
Ar 5451.652
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Ne 5400.562
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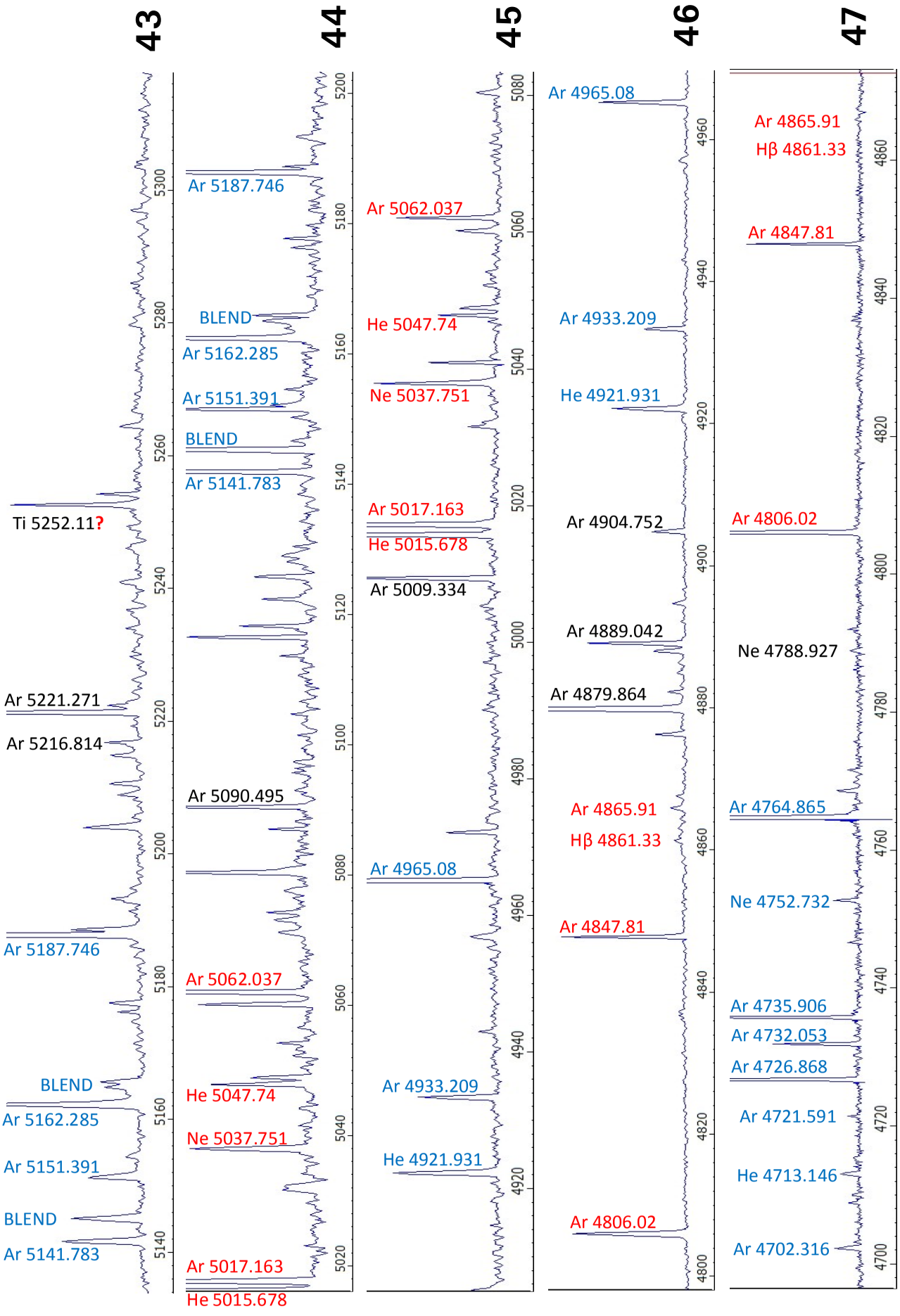
Ne 5341.094
Ne 5330.778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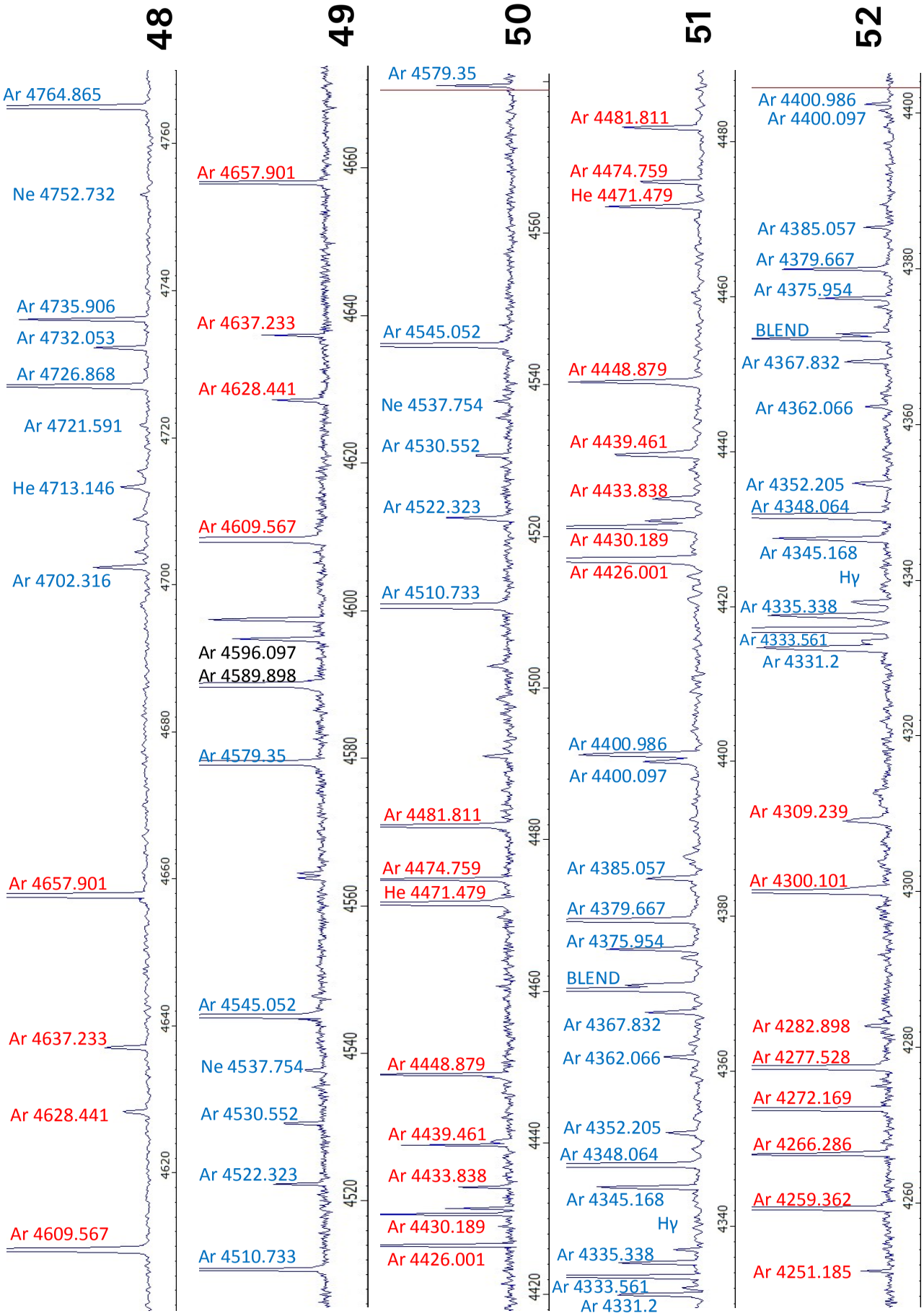
Ti 5252.11?
Ar 5221.271
Ar 5216.814
Ar 5187.746
BLEND
Ar 5162.285
Ar 5151.391
BLEND
Ar 5141.783
44
Ar 5187.746
BLEND
Ar 5162.285
Ar 5151.391
BLEND
Ar 5141.783
Ar 5090.495
Ar 5062.037
He 5047.74
Ne 5037.751
Ar 5017.163
He 5015.678
45
Ar 5062.037
He 5047.74
Ne 5037.751
Ar 5017.163
He 5015.678
Ar 5009.334
Ar 4965.08
Ar 4933.209
He 4921.931
46
Ar 4965.08
Ar 4933.209
He 4921.931
Ar 4904.752
Ar 4889.042
Ar 4879.864
Ar 4865.91
Hβ 4861.33
Ar 4847.81
Ar 4806.02
47
Ar 4865.91
Hβ 4861.33
Ar 4847.81
Ar 4806.02
Ne 4788.927
Ar 4764.865
Ne 4752.732
Ar 4735.906
Ar 4732.053
Ar 4726.868
Ar 4721.591
He 4713.146
Ar 4702.316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Ne 4752.732
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Ar 4732.053
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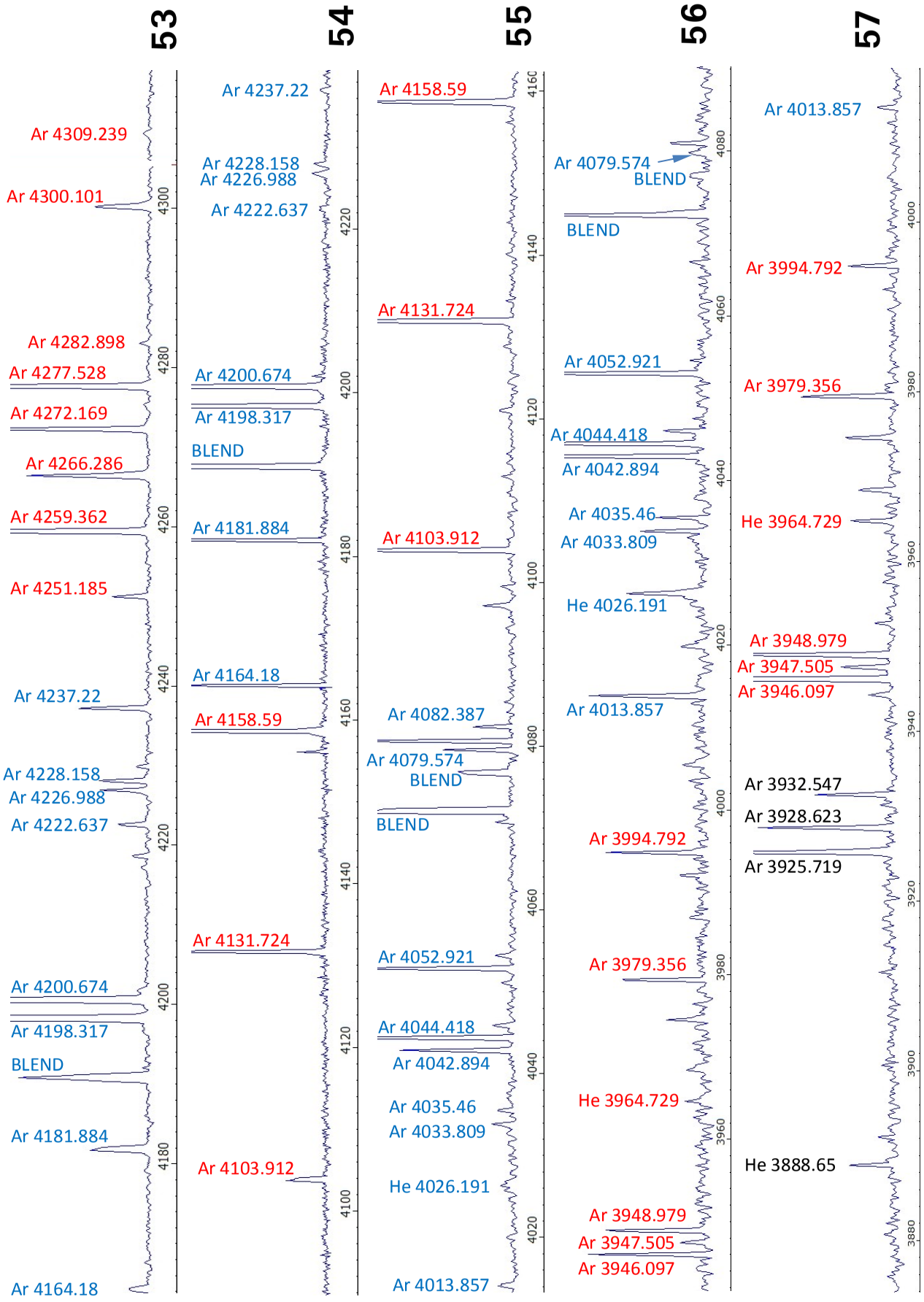
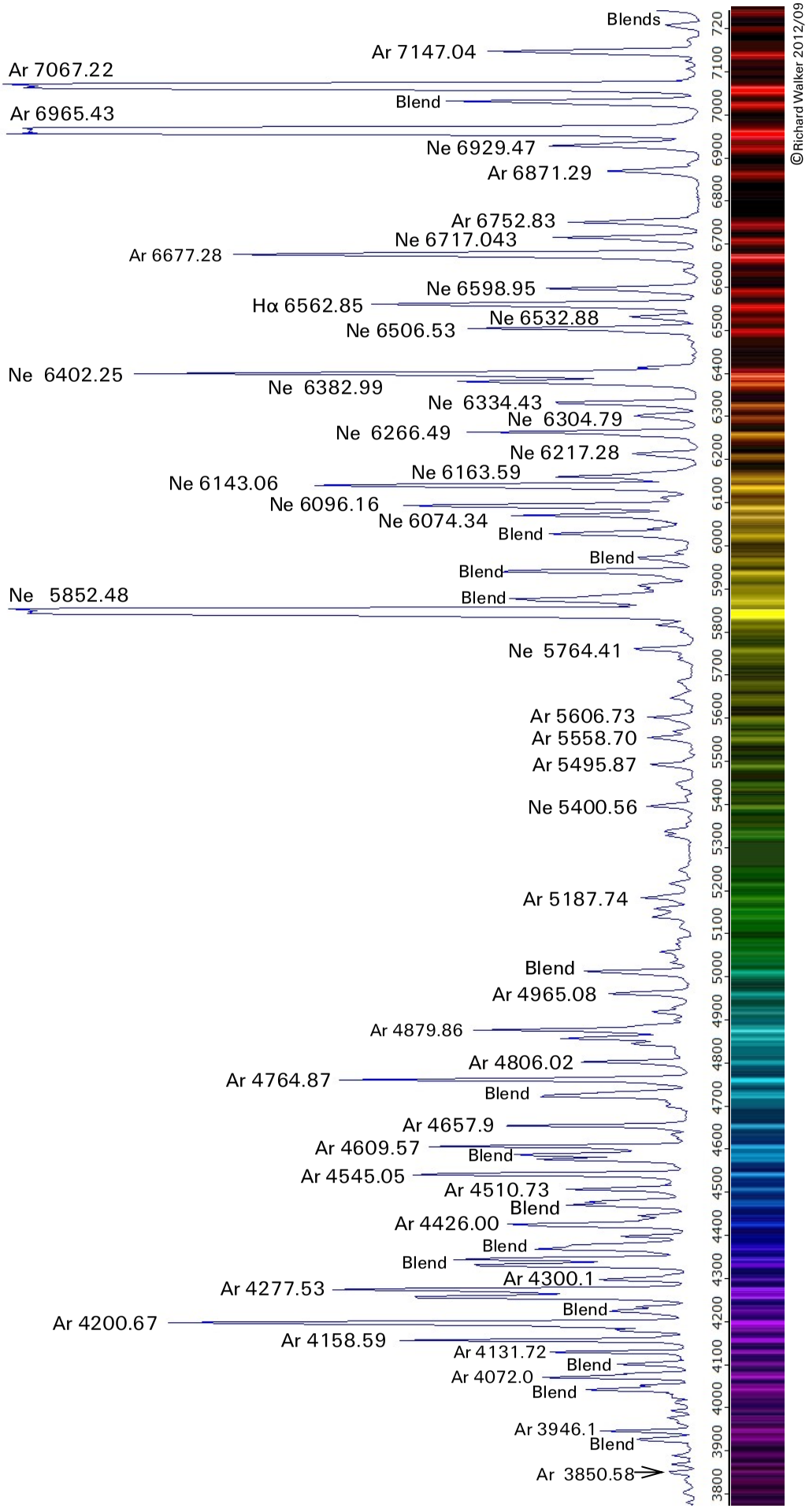
Ar 4721.591
He 4713.146
Ar 4702.316
Ar 4657.901
Ar 4637.233
Ar 4628.441
Ar 4609.567
49
Ar 4657.901
Ar 4637.233
Ar 4628.441
Ar 4609.567
Ar 4596.097
Ar 4589.898
Ar 4579.35
Ar 4545.052
Ne 4537.754
Ar 4530.552
Ar 4522.323
Ar 4510.733
50
Ar 4579.35
Ar 4545.052
Ne 4537.754
Ar 4530.552
Ar 4522.323
Ar 4510.733
Ar 4481.811
Ar 4474.759
He 4471.479
Ar 4448.879
Ar 4439.461
Ar 4433.838
Ar 4430.189
Ar 4426.001
51
Ar 4481.811
Ar 4474.759
He 4471.479
Ar 4448.879
Ar 4439.461
Ar 4433.838
Ar 4430.189
Ar 4426.001
Ar 4400.986
Ar 4400.097
Ar 4385.057
Ar 4379.667
Ar 4375.954
BLEND
Ar 4367.832
Ar 4362.066
Ar 4352.205
Ar 4348.064
Ar 4345.168
Hγ
Ar 4335.338
Ar 4333.561
Ar 4331.2
52
Ar 4400.986
Ar 4400.097
Ar 4385.057
Ar 4379.667
Ar 4375.954
BLEND
Ar 4367.832
Ar 4362.066
Ar 4352.205
Ar 4348.064
Ar 4345.168
Hγ
Ar 4335.338
Ar 4333.561
Ar 4331.2
Ar 4309.239
Ar 4300.101
Ar 4282.898
Ar 4277.528
Ar 4272.169
Ar 4266.286
Ar 4259.362
Ar 4251.185

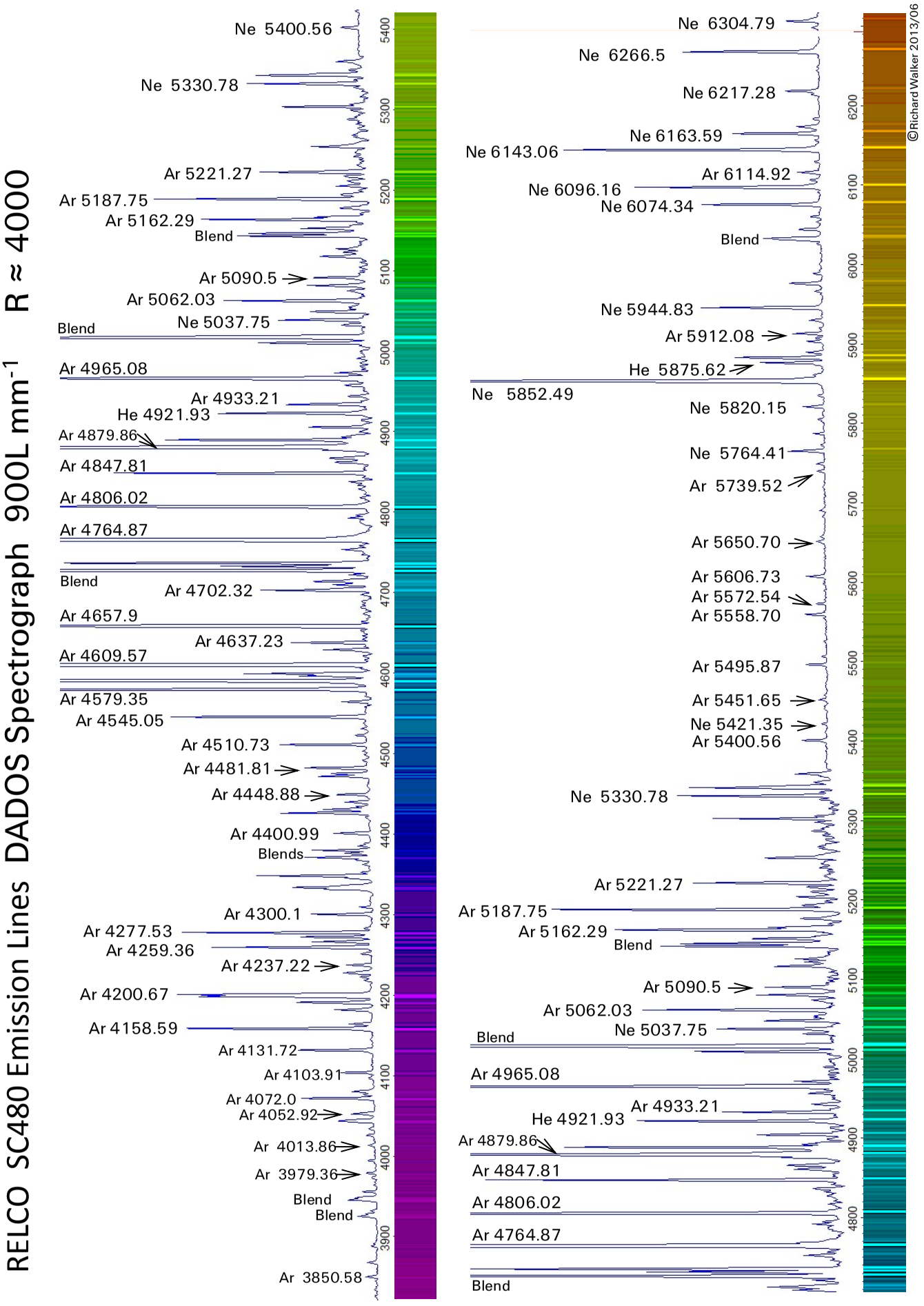

53
Ar 4309.239
Ar 4300.101
Ar 4282.898
Ar 4277.528
Ar 4272.169
Ar 4266.286
Ar 4259.362
Ar 4251.185
Ar 4237.22
Ar 4228.158
Ar 4226.988
Ar 4222.637
Ar 4200.674
Ar 4198.317
BLEND
Ar 4181.884
Ar 4164.18
54
Ar 4237.22
Ar 4228.158
Ar 4226.988
Ar 4222.637
Ar 4200.674
Ar 4198.317
BLEND
Ar 4181.884
Ar 4164.18
Ar 4158.59
Ar 4131.724
Ar 4103.912
55
Ar 4158.59
Ar 4131.724
Ar 4103.912
Ar 4082.387
Ar 4079.574
BLEND
BLEND
Ar 4052.921
Ar 4044.418
Ar 4042.894
Ar 4035.46
Ar 4033.809
He 4026.191
Ar 4013.857
56
Ar 4079.574
BLEND
BLEND
Ar 4052.921
Ar 4044.418
Ar 4042.894
Ar 4035.46
Ar 4033.809
He 4026.191
Ar 4013.857
Ar 3994.792
Ar 3979.356
He 3964.729
Ar 3948.979
Ar 3947.505
Ar 3946.097
57
Ar 4013.857
Ar 3994.792
Ar 3979.356
He 3964.729
Ar 3948.979
Ar 3947.505
Ar 3946.097
Ar 3932.547
Ar 3928.623
Ar 3925.719
He 3888.65

8 Relco Broadband-Calibration Lines (R ≈ 900 / 4'000)

The following tables show the Relco calibration lines for resolutions of R ≈ 900 and ≈ 4,000. Only those emissions are labelled here, which are suitable for the calibration of a spectral profile.

RELCO SC480 Emission Lines DADOS Spectrograph 200L mm^{-1} R ≈ 800




RELCO SC480 Emission Lines DADOS Spectrograph 900L mm-1 R ≈ 4000
Ne 5400.56
Ne 5330.78
Ar 5221.27
Ar 5187.75
Ar 5162.29
Blend
Ar 5090.5
Ar 5062.03
Ne 5037.75
Blend
Ar 4965.08
Ar 4933.21
He 4921.93
Ar 4879.86
Ar 4847.81
Ar 4806.02
Ar 4764.87
Blend
Ar 4702.32
Ar 4657.9
Ar 4637.23
Ar 4609.57
Ar 4579.35
Ar 4545.05
Ar 4510.73
Ar 4481.81
Ar 4448.88
Ar 4400.99
Blends
Ar 4300.1
Ar 4277.53
Ar 4259.36
Ar 4237.22
Ar 4200.67
Ar 4158.59
Ar 4131.72
Ar 4103.91
Ar 4072.0
Ar 4052.92
Ar 4013.86
Ar 3979.36
Blend
Blend
Ar 3850.58
5400
5300
5200
5100
5000
4900
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
Ne 6304.79
Ne 6266.5
Ne 6217.28
Ne 6163.59
Ne 6143.06
Ar 6114.92
Ne 6096.16
Ne 6074.34
Blend
Ne 5944.83
Ar 5912.08
He 5875.62
Ne 5852.49
Ne 5820.15
Ne 5764.41
Ar 5739.52
Ar 5650.70
Ar 5606.73
Ar 5572.54
Ar 5558.70
Ar 5495.87
Ar 5451.65
Ne 5421.35
Ar 5400.56
Ne 5330.78
Ar 5221.27
Ar 5187.75
Ar 5162.29
Blend
Ar 5090.5
Ar 5062.03
Ne 5037.75
Blend
Ar 4965.08
Ar 4933.21
He 4921.93
Ar 4879.86
Ar 4847.81
Ar 4806.02
Ar 4764.87
Blend
6200
6100
6000
5900
5800
5700
5600
5500
5400
5300
5200
5100
5000
4900
4800
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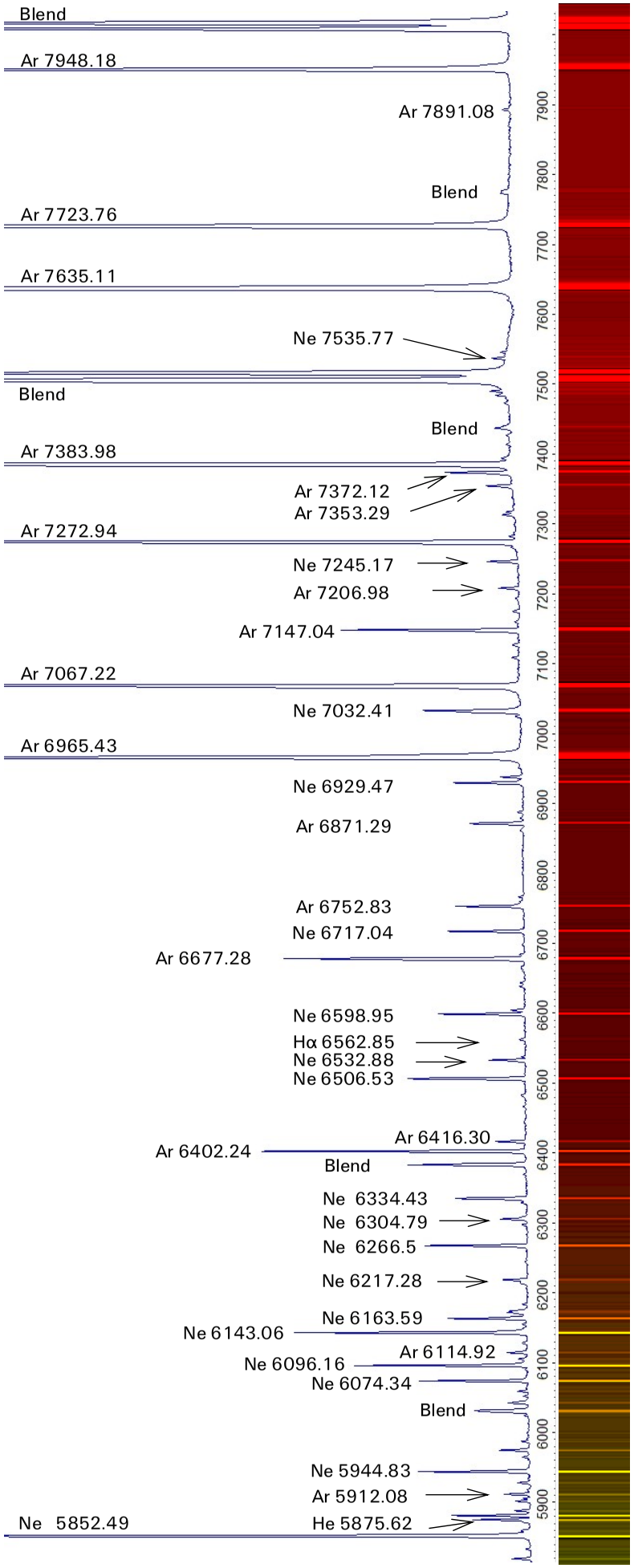
RELCO SC480 Emission Lines DADOS Spectrograph 900L mm^{-1} R ≈ 4000



9 Literature and Internet Links

Author:

The following scripts on the subject (some of them in German only) are downloadable under this link:
http://www.ursusmajor.ch/astrospektroskopie/richard-walkers-page/index.html

[1] *Spectroscopic Atlas for Amateur Astronomers*

[2] *Analysis and Interpretation of Astronomical Spectra, Theoretical Background and Practical Applications for Amateur Astronomers*

[3] *Das Aufbereiten und Auswerten von Spektralprofilen mit den wichtigsten IRIS und Vspec*

[4] *Kalibrierung von Spektren mit der Xenon Stroboskoplampe*

[5] *Atomic Emission Spectroscopy with Spark- or Arc Excitation, Experiments with the DADOS Spectrograph and Simple Makeshift Tools*

[6] *Kalibrierung von Spektren mit dem Glimmstarter ST 111 von OSRAM*

[7] *Quasar 3C2 73, Optical Spectrum and Determination of the Redshift*

Further Internet Links

Spectrographs:

[20] SQUES Echelle Spectrograph, Eagleowloptics Switzerland,
http://www.eagleowloptics.com/

[21] DADOS Spectrograph, Baader Planetarium, Germany:
http://www.baader-planetarium.com/pdf_download.htm

[22] Shelyak Instruments: http://www.shelyak.com/

[23] SBIG Spectrograph DSS-7, http://ftp.sbig.com/dss7/dss7.htm

Spectrographic software:

[50] IRIS / ISIS: Webpage of *Christian Buil*
http://www.astrosurf.com/buil/

[51] Vspec: Webpage of *Valerie Désnoux*
http://astrosurf.com/vdesnoux/

[52] RSpec: Webpage of *Tom Field*
http://www.rspec-astro.com/

[53] MIDAS, ESO
http://www.eso.org/sci/software/esomidas//

Database:

[70] *NIST Atomic Spectra Database*:
http://physics.nist.gov/PhysRefData/ASD/lines_form.html