

Meteor spectra 2021

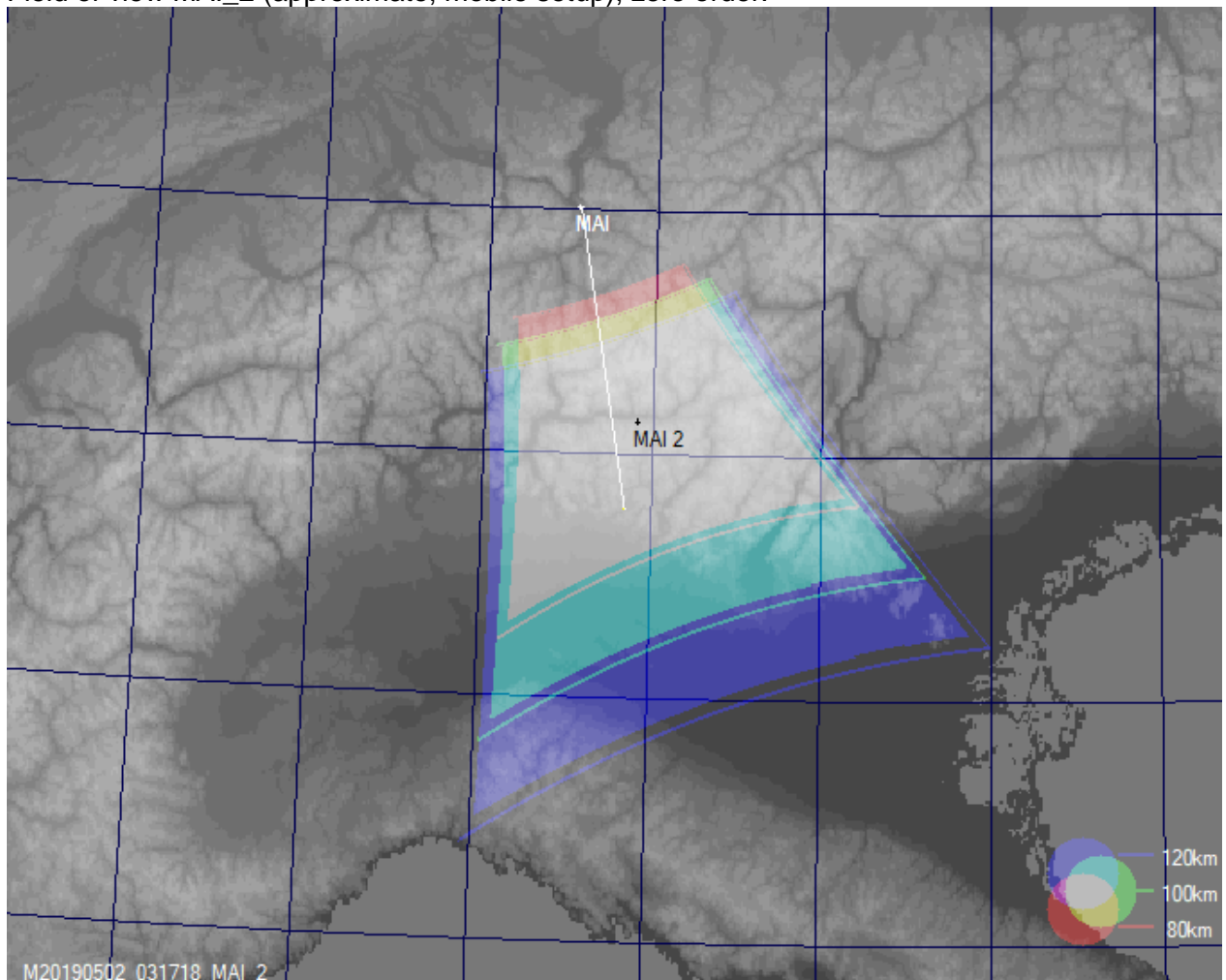
Overview

This is a collection of meteor spectra obtained at Maienfeld (MAI_2). Last year spectra were recorded with a Watec 902H2 ultimate

MAI_2 lens Tamron VG412 ASIR at $f \cong 7\text{mm}$, grating Thorlabs, 300l/mm

MAI_1 lens Tamron VG412 ASIR at $f \cong 4\text{mm}$

Field of view MAI_2 (approximate, mobile setup), zero order:



This was changed this year to

DMK 33GX249

Resolution 1920x1200

Frame Rate: 25 Hz

Sensor Type Sony IMX249LLJ-C

Sensor Format 1/1.2 inch

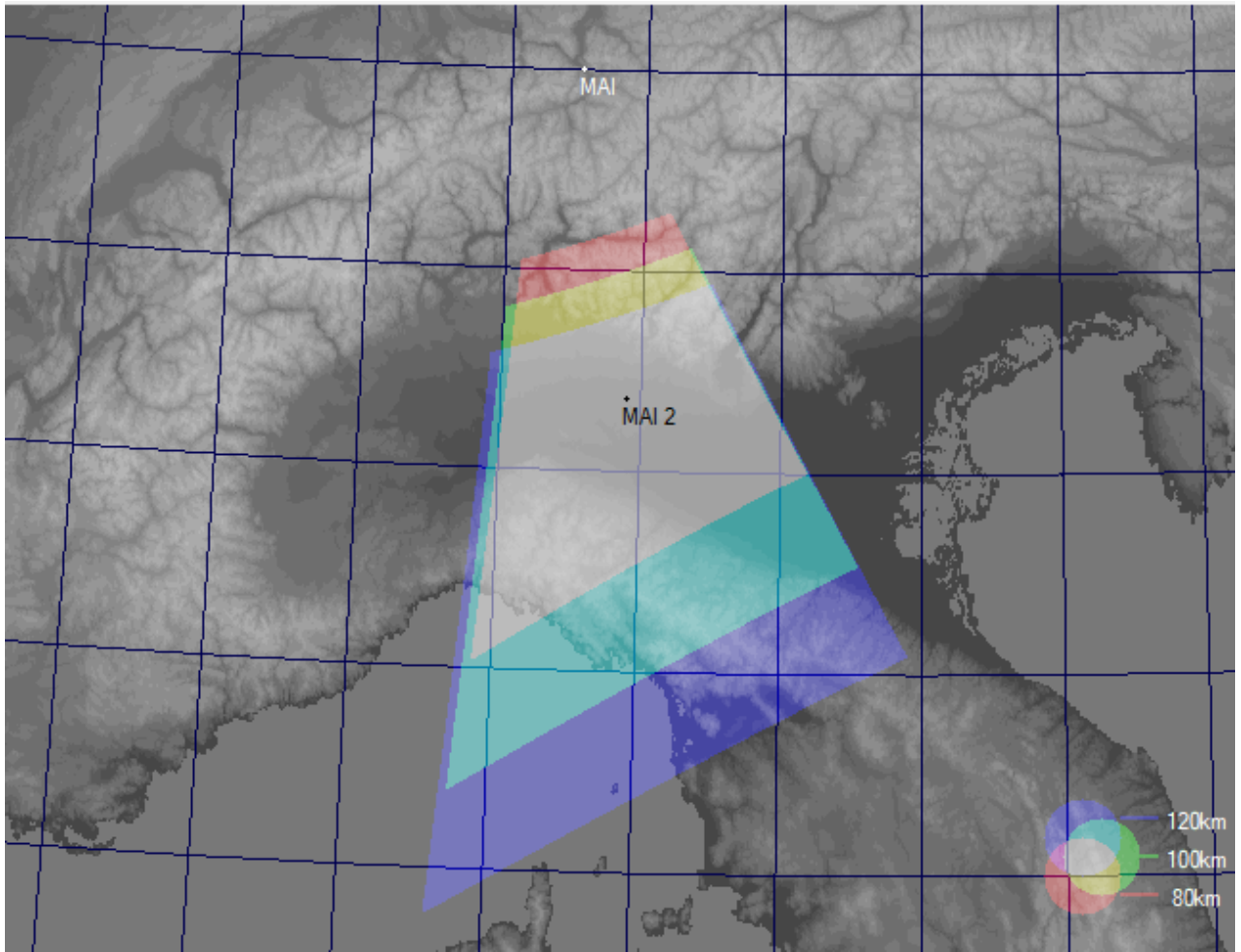
Pixel Size **5.86 μm**

Lens

Kowa LM16HC f: 16mm F/1.4

Field of view horizontal: 39°

Approximate sky coverage (mobile setup, may change) for elevation 37°, Azimuth 170°



Grating: Thorlabs 600l/mm, dispersion: 0.598 nm/pixel
Spectra analyzed with Python M_SPEC.py

M20210423_024820_MAI_2, LYR, -2.2m

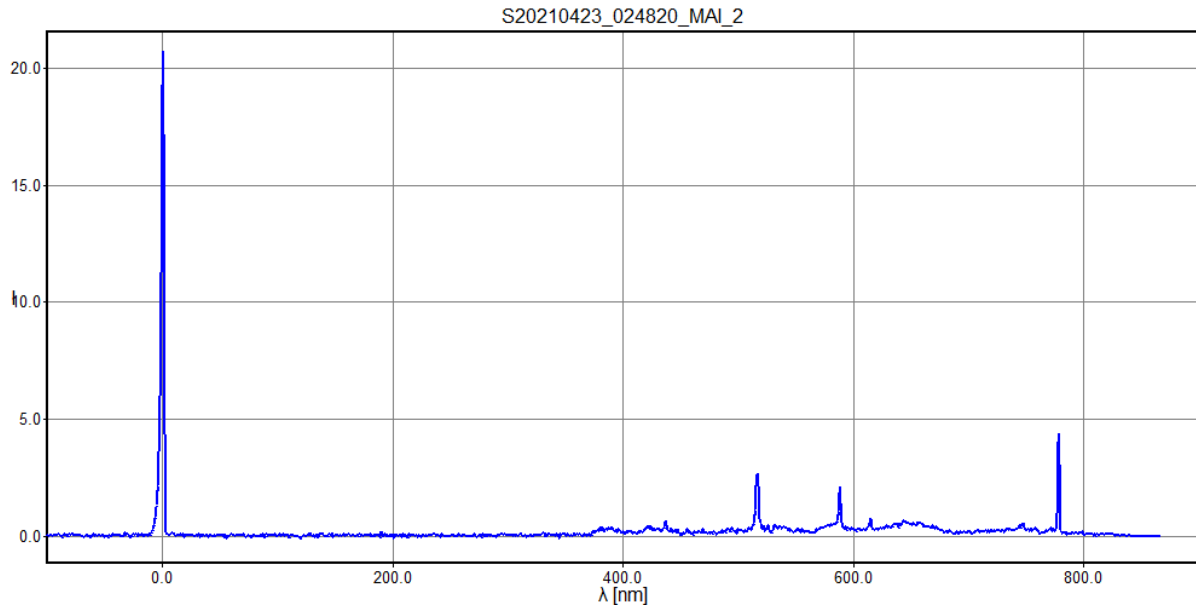


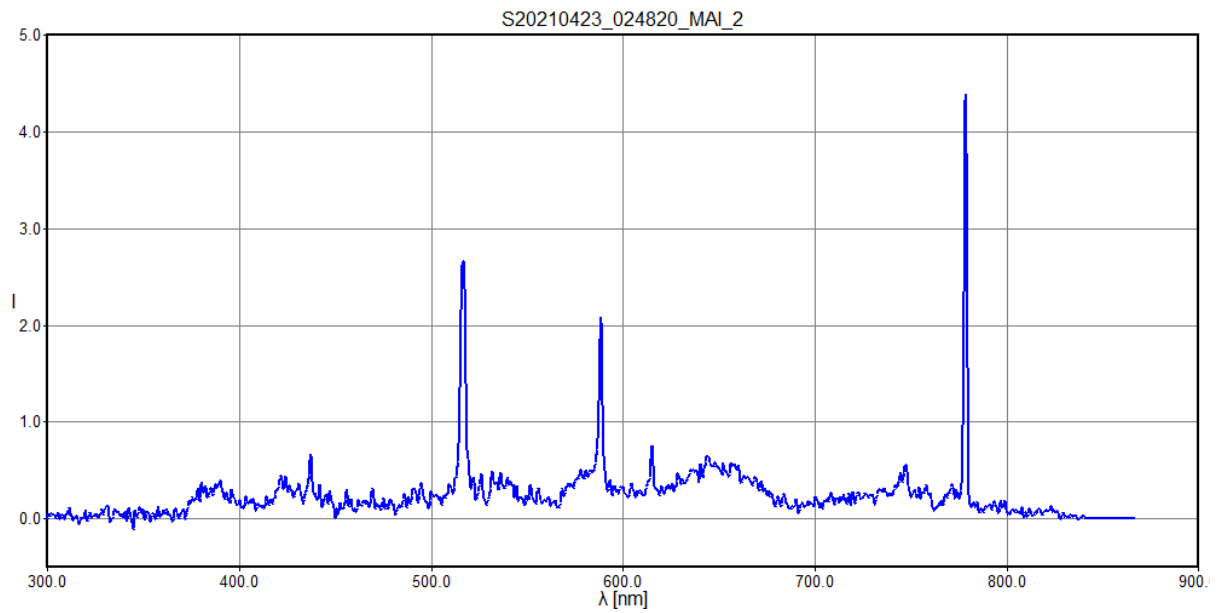
polynom for fit lambda c: [0.5977 -278.4499]

pixel	lambda	fit	error
466.58,	0.00,	0.44,	0.4418
1330.20,	517.50,	516.66,	-0.8415
1450.14,	589.00,	588.35,	-0.6491
1768.17,	777.40,	778.45,	1.0489

rms_x = 0.7786

spectrum 210423\r_add14cal.dat saved





M20210423_030622_MAI_2, satellite flash, -0.2m

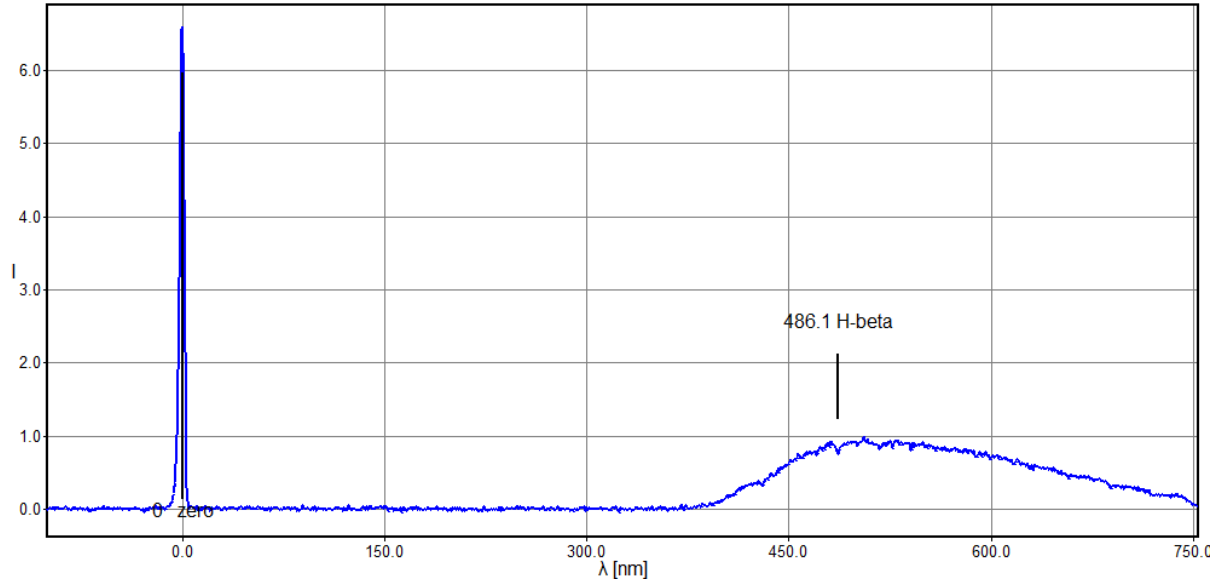


Zero order fit with dispersion from previous spectrum, disp0 = 0.5977 nm/pixel
 polynomial for fit lambda c: [0.5977, -391.099018]

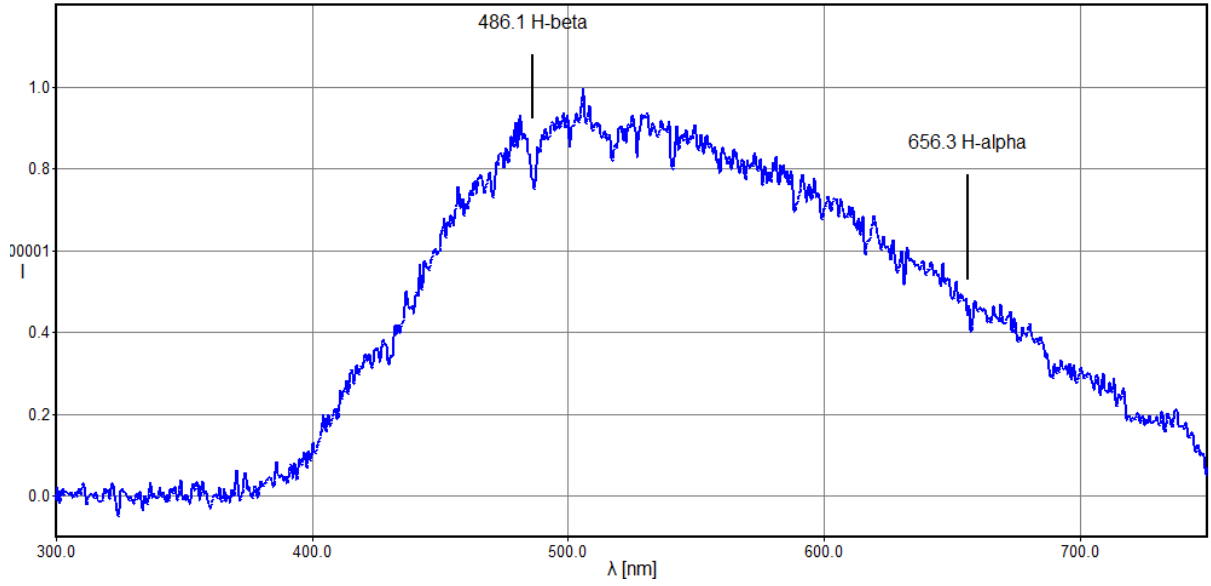
pixel	lambda	fit	error
654.34,	0.00,	0.00,	0.0000
1468.37,	486.10,	486.55,	0.4457 H-beta

 rms_x = 0.3152
 spectrum 210423\rs_add37cal.dat saved

S20210423_030622_MAI_2



S20210423_030622_MAI_2



M20210503_214758_MAI_2, spo, 1.4m



Test calibration, strongest line as zero order

polynom for fit lambda c: [0.5989822149276733, -565.792610398531]

pixel	lambda	fit	error
944.59	0.00	0.00	0.0000

rms_x = 0.0000

get line separations: 142 nm → 2xdelta (Na 1, Mg I)

line at right must be 2nd order Mg I

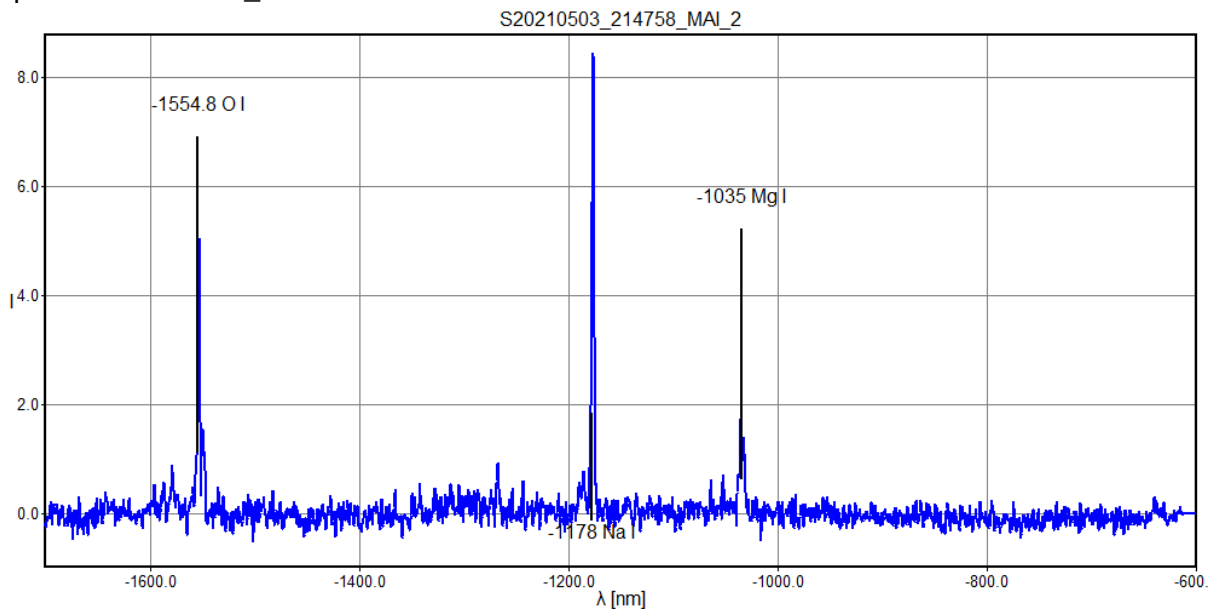
new calibration:

polynom for fit lambda c: [0.5989822149276733, -1742.3440874302387]

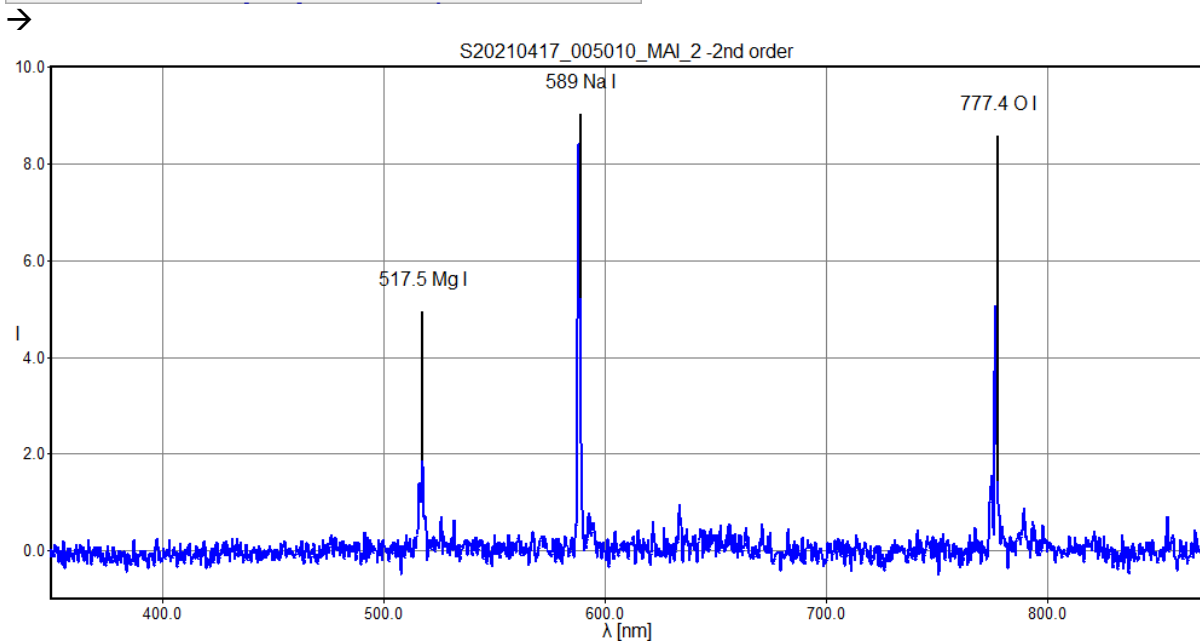
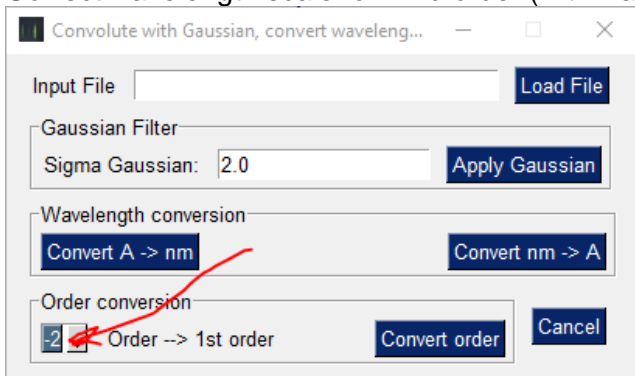
pixel	lambda	fit	error
1180.91	-1035.00	-1035.00	0.0000

rms_x = 0.0000

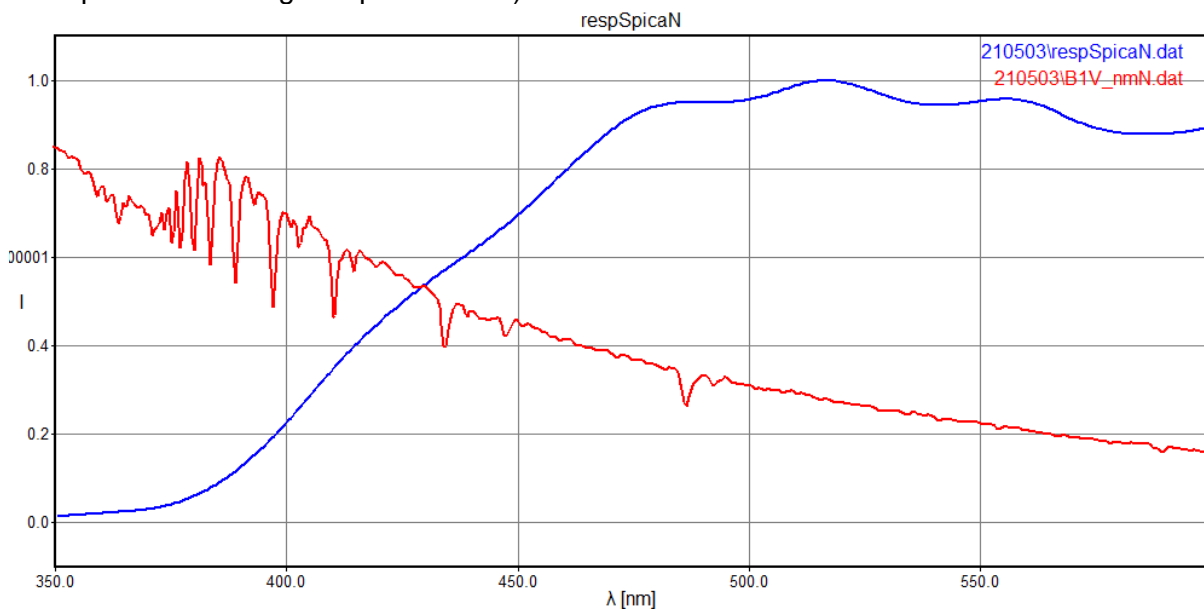
spectrum 210503\r_add9cal.dat saved



Correct wavelength scale for -2nd order (with wavelength tools – convert order)

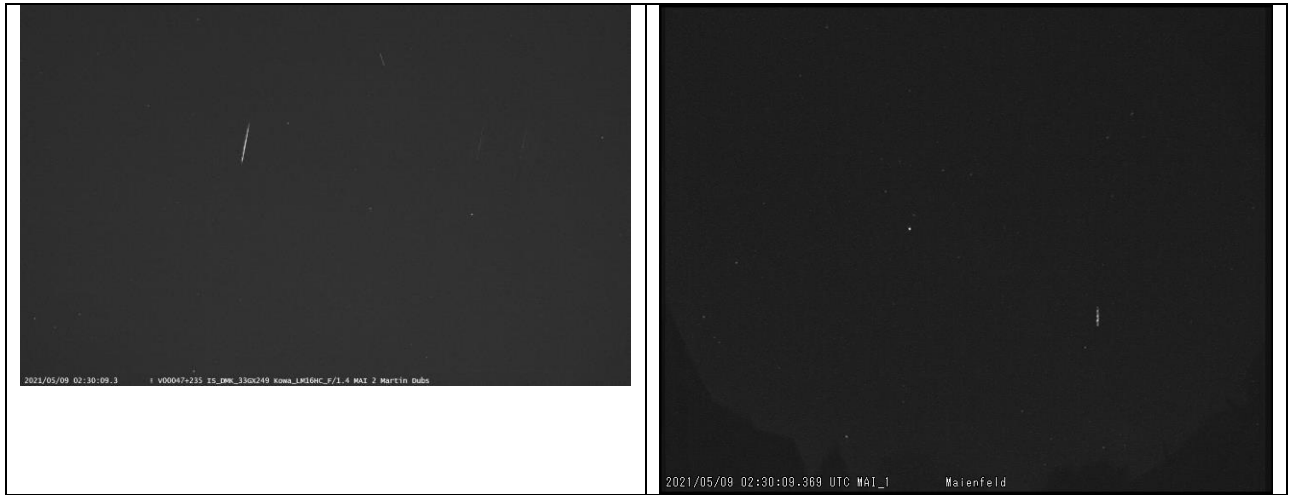


The bright star is Spica (spectral class B1V), it can be used to create an instrument response function (valid in the blue part of the spectrum, in the red the intensity is not sufficient (could be improved with longer exposure time)):



For details, see <https://github.com/meteorspectroscopy/meteor-spectrum-calibration/blob/response/doc/instrument%20response.pdf>

M20210509_023009_MAI_2, spo, -0.8m

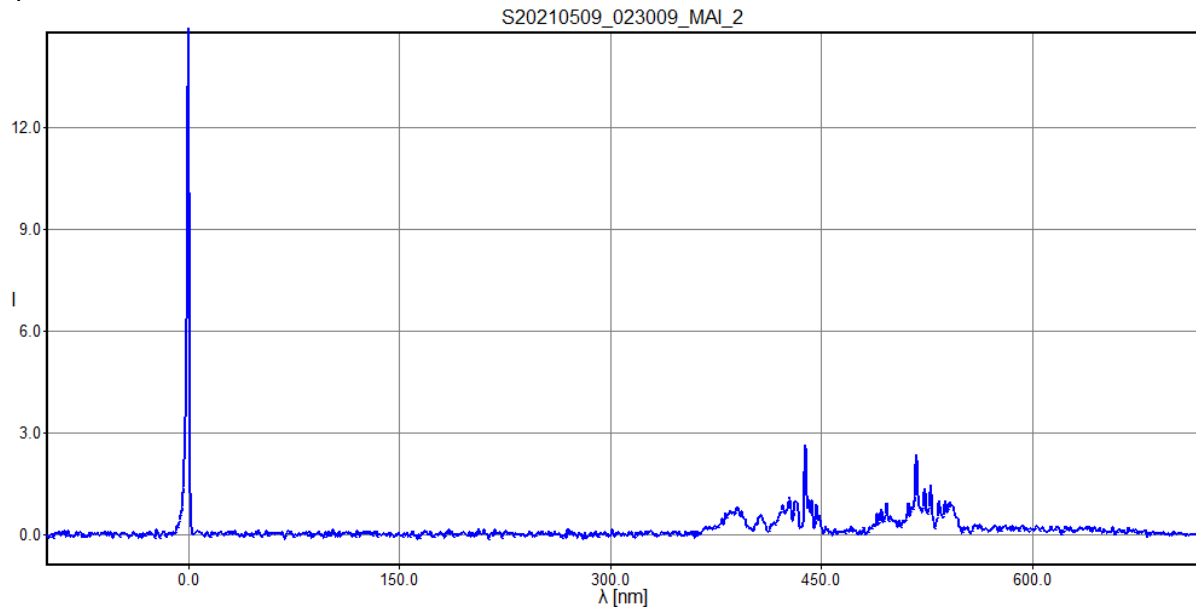


polynom for fit lambda c: [0.5993 -430.9973]

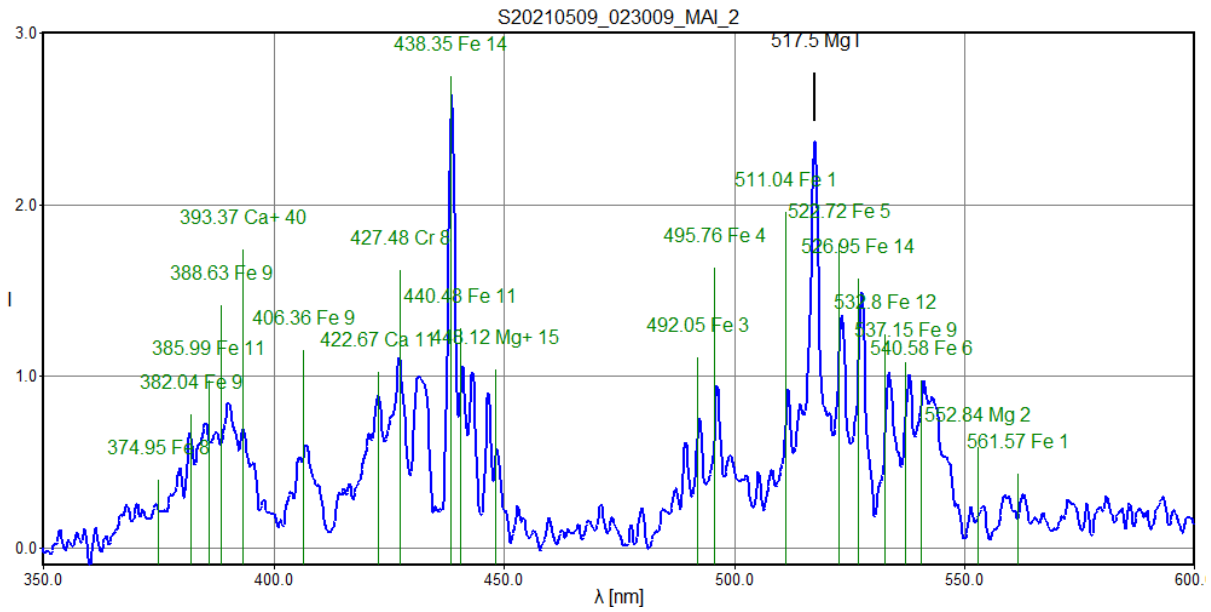
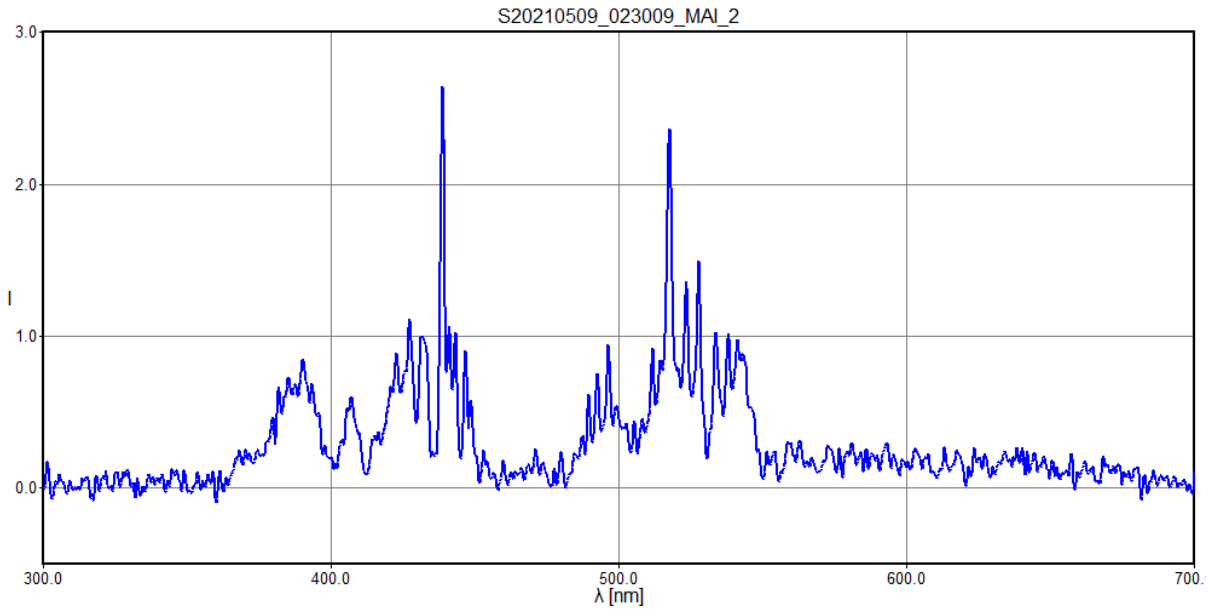
pixel	lambda	fit	error
719.12,	0.00,	0.00,	0.0000
1582.57,	517.50,	517.50,	0.0000

rms_x = 0.0000

spectrum 210509\r_add8cal.dat saved



Typical iron spectrum



With line identification from the following line list of meteor spectral lines.

M20210531_000718_MAI_2. Spo, 0.0m

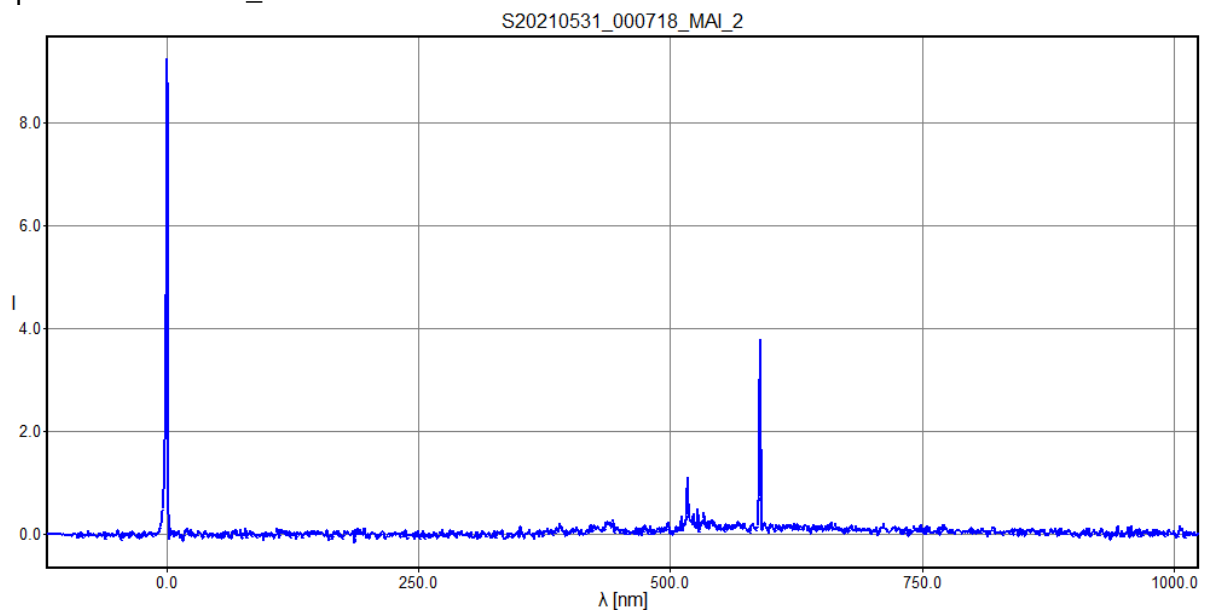


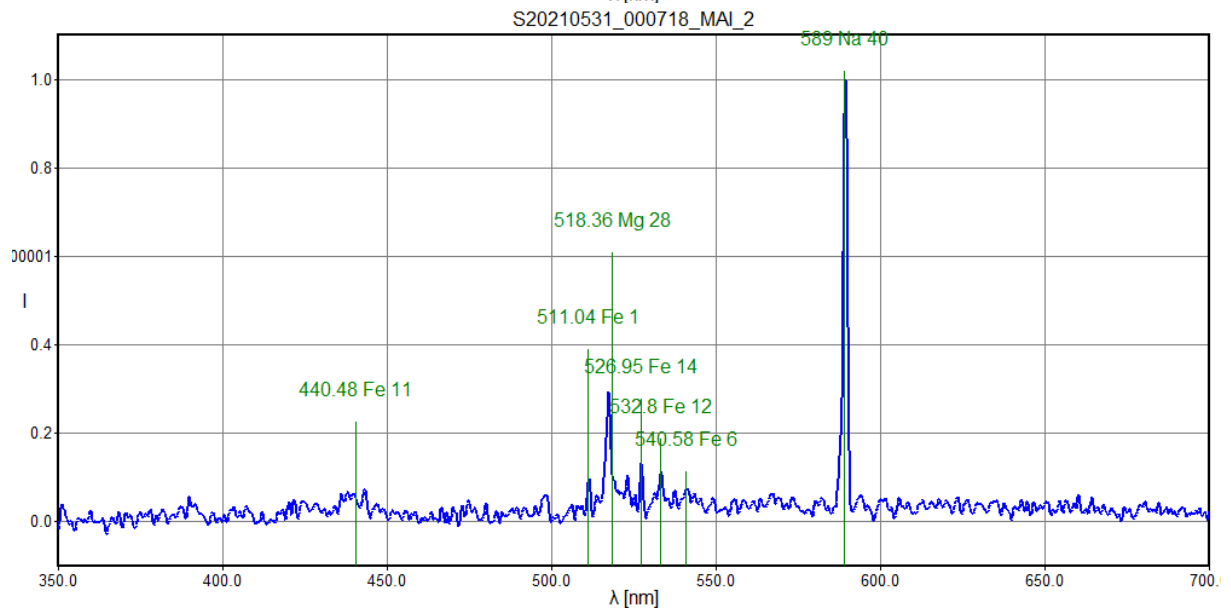
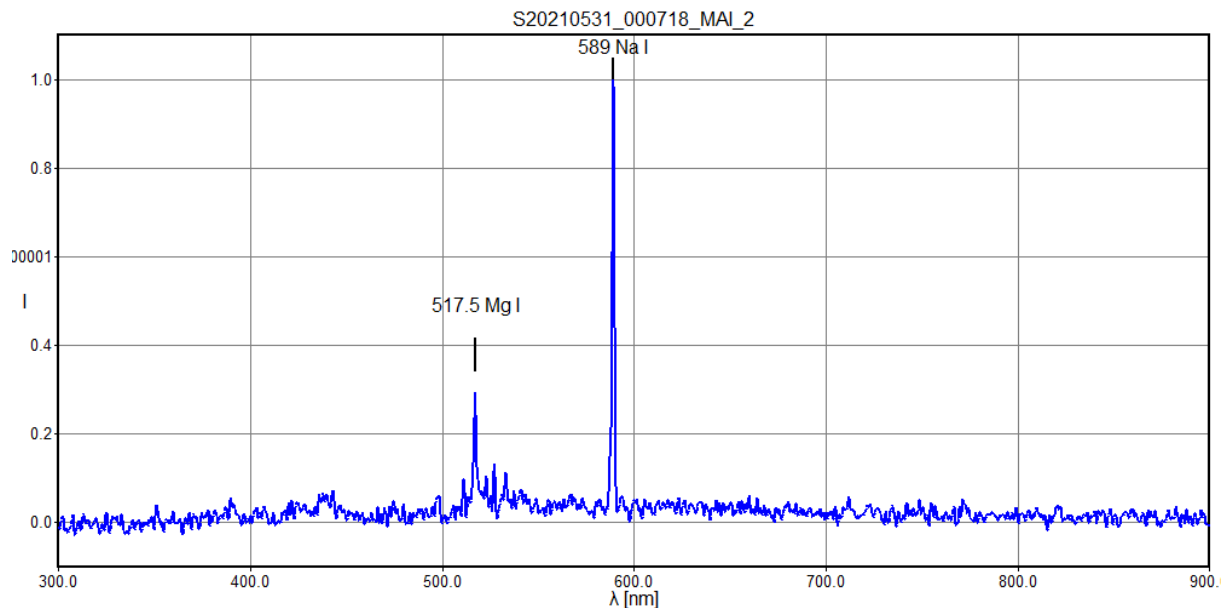
polynom for fit lambda c: [0.5977 -120.0619]

pixel	lambda	fit	error
200.93,	0.00,	0.04,	0.0410
1066.07,	517.50,	517.17,	-0.3348
1186.74,	589.00,	589.29,	0.2938

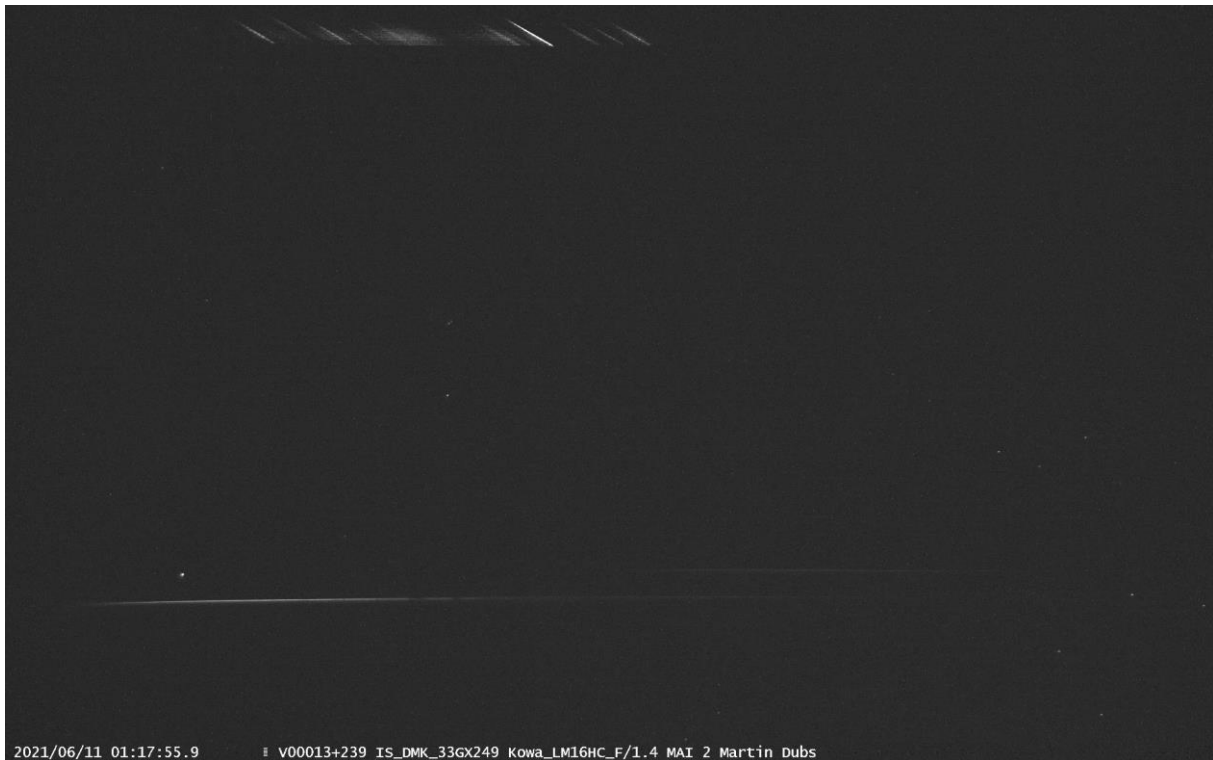
rms_x = 0.2583

spectrum 210531\r_add25cal.dat saved





M20210611_011755_MAI_2, spo, ?



No zero order, no MAI_1

Line at 777.4 nm identified, single fit → Mg, Na identified

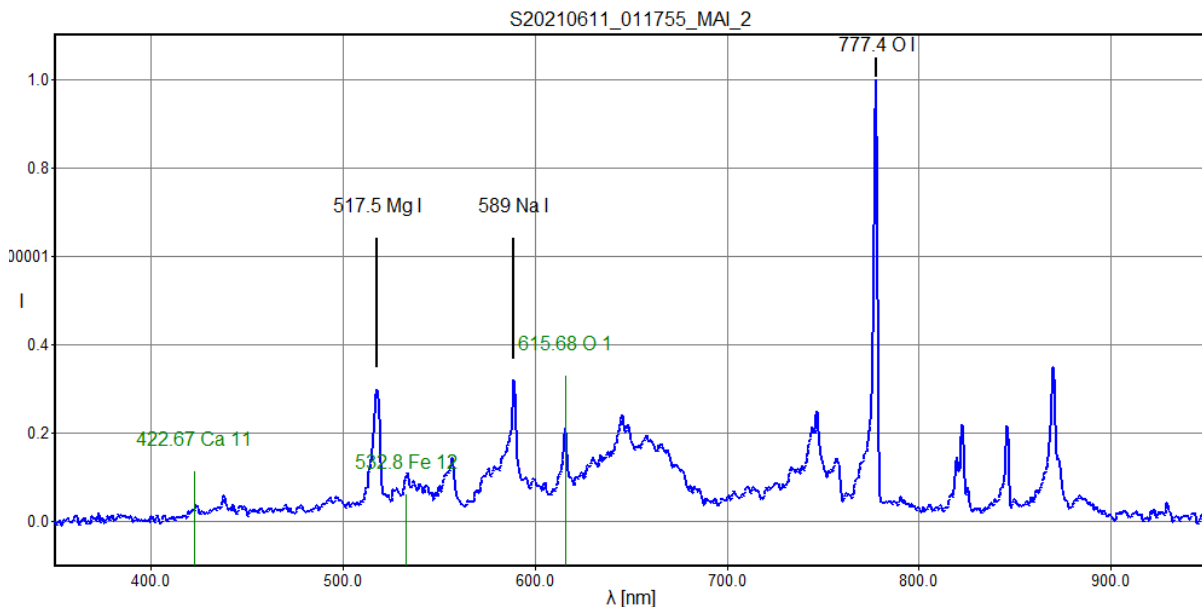
Pixel	lambda	fit error
374.26	517.50	517.51 0.01
492.71	589.00	588.99 -0.01
804.95	777.40	777.40 0.00

polynom degree: 1

polynom for fit lambda c: [0.6034 291.6676]

rms_x = 0.0097

spectrum D:\DatenD\meteor-spectrum-calibration-0.9.24\210611r_add12cal.dat saved



M20210612_022526_MAI_2, spo, -1.9m



Pixel	lambda	fit	error
1598.93	0.00	0.23	0.23
732.24	-517.50	-518.20	-0.70
299.71	-777.40	-776.93	0.47

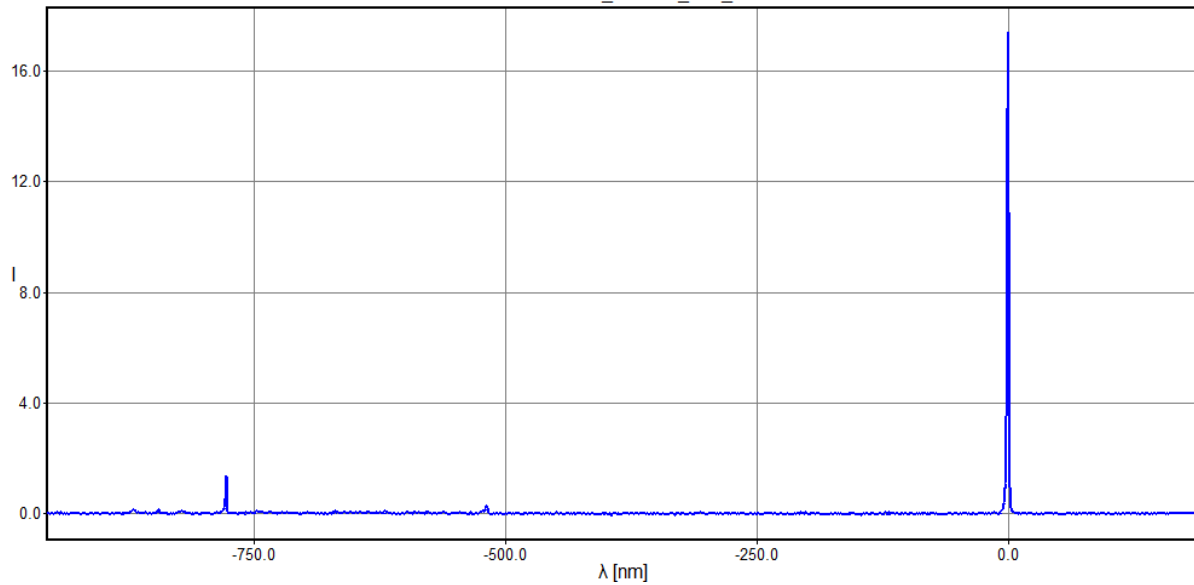
polynom degree: 1

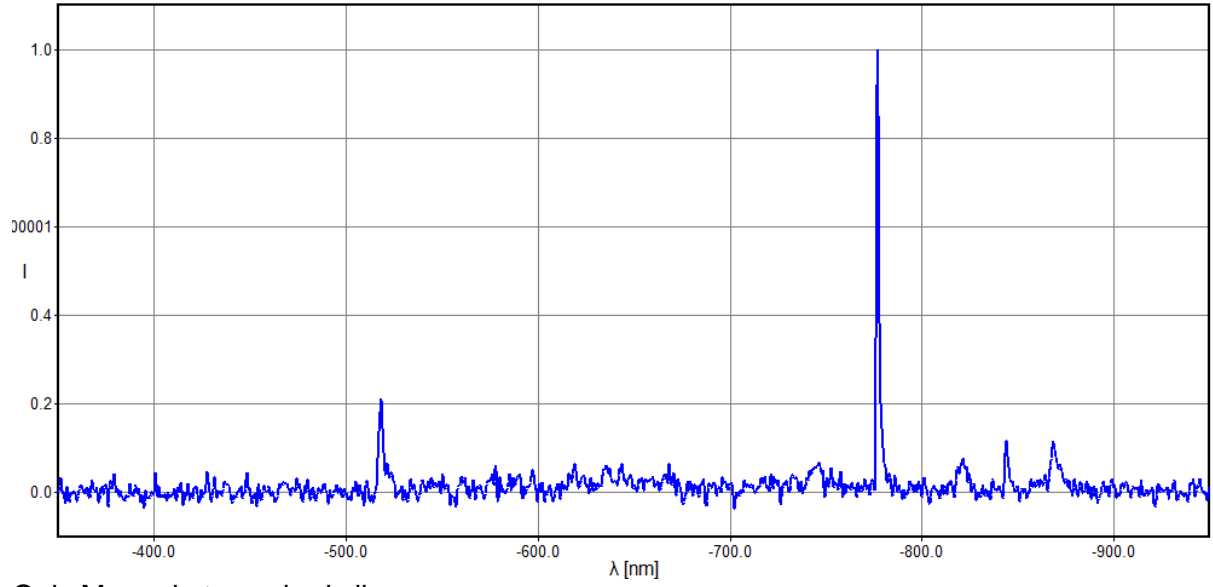
polynom for fit lambda c: [5.9818e-01 -9.5621e+02]

rms_x = 0.5053

spectrum D:\DatenD\meteor-spectrum-calibration-0.9.24\210611\rr_add10cal.dat saved

S20210612_022526_MAI_2





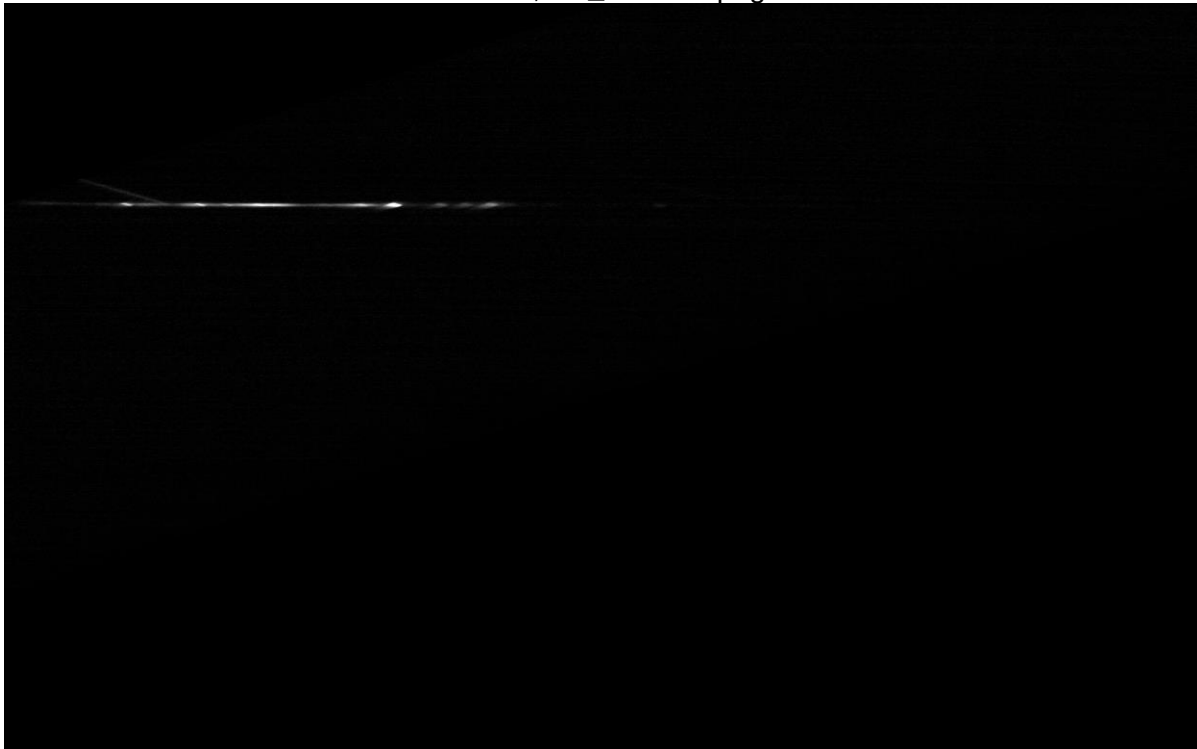
Only Mg and atmospheric lines

M20210616_232056_MAI_2, spo, -3.0m



Problem with registering frames

Use new cross correlation method works, rcc_add24st.png:

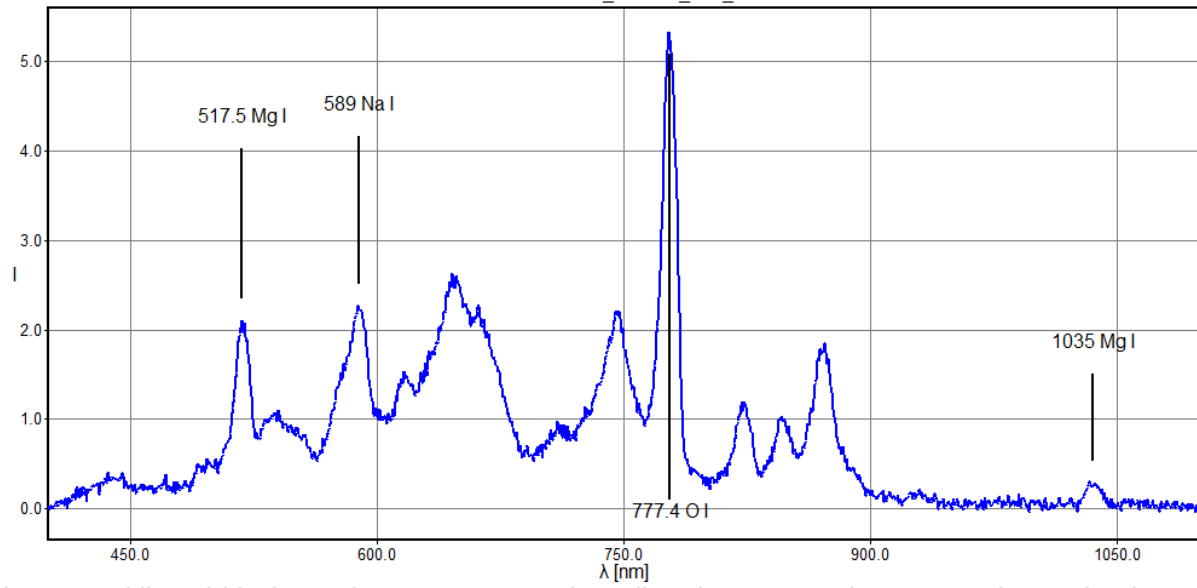


polynom for fit lambda c: [0.6037 399.6511]

pixel	lambda	fit	error
195.35,	517.50,	517.59,	0.0851
313.45,	589.00,	588.88,	-0.1173
625.77,	777.40,	777.43,	0.0322

rms_x = 0.0857

spectrum D:\DatenD\meteor-spectrum-calibration-0.9.24\210616\rcc_add24cal.dat saved



Increased linewidth due to large movement in x-direction, cannot be removed completely with tilt correction

M20210617_020608_MAI_2, spo, -2.6m



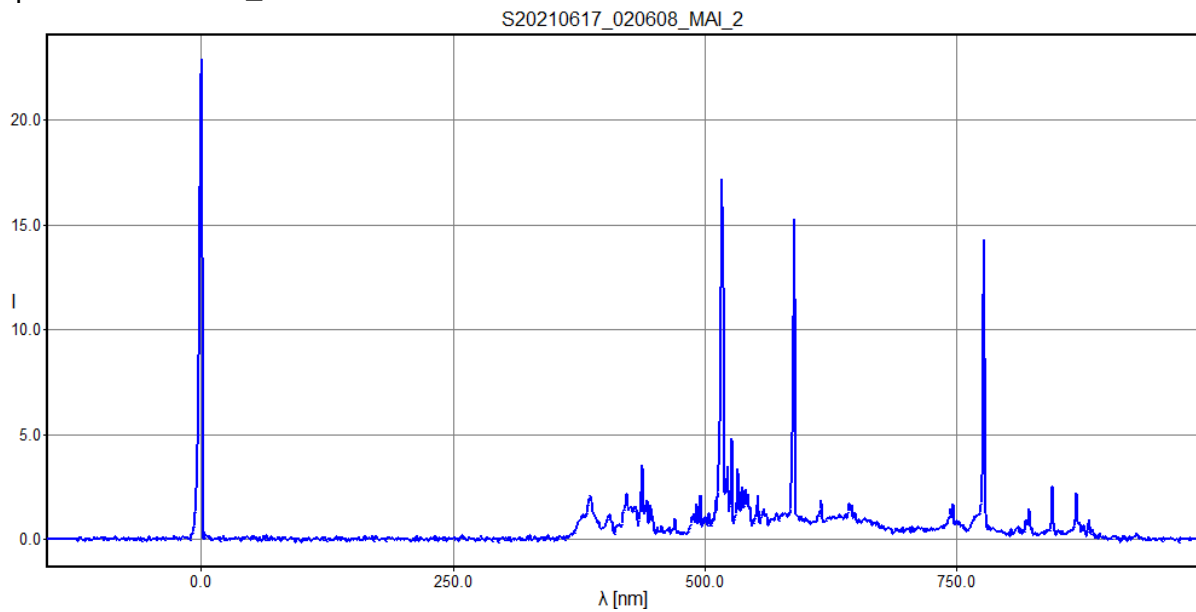
Pixel	lambda	fit	error
258.41	0.00	0.03	0.03
1123.82	517.50	517.49	-0.01
1243.20	589.00	588.88	-0.12
1558.65	777.40	777.50	0.10

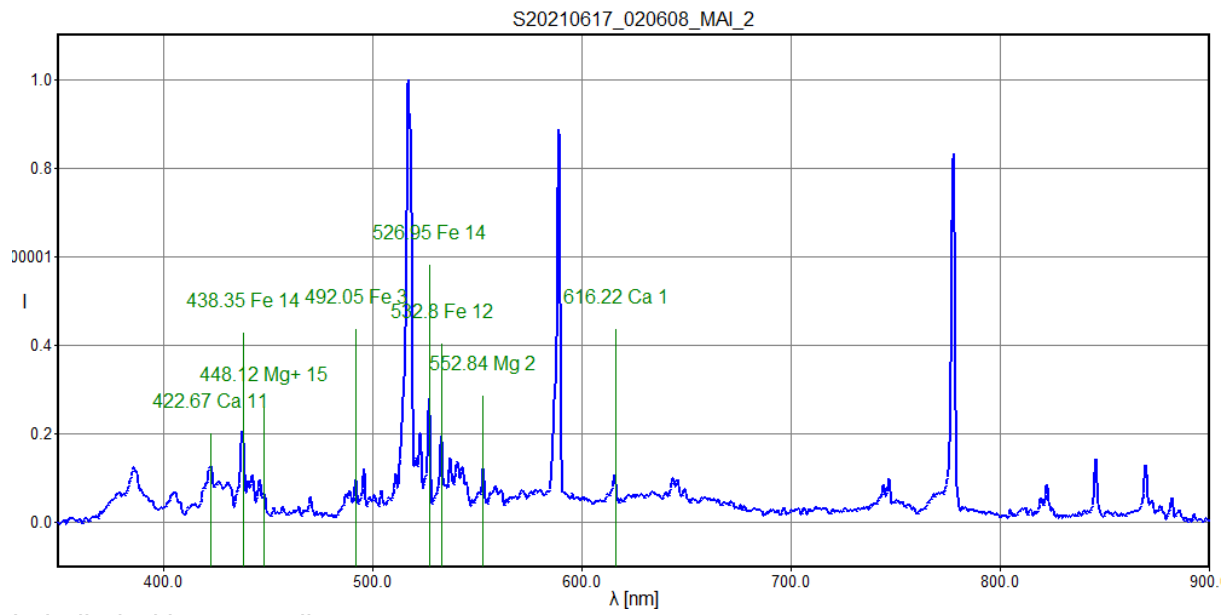
polynom degree: 1

polynom for fit lambda c: [0.5979 -154.4819]

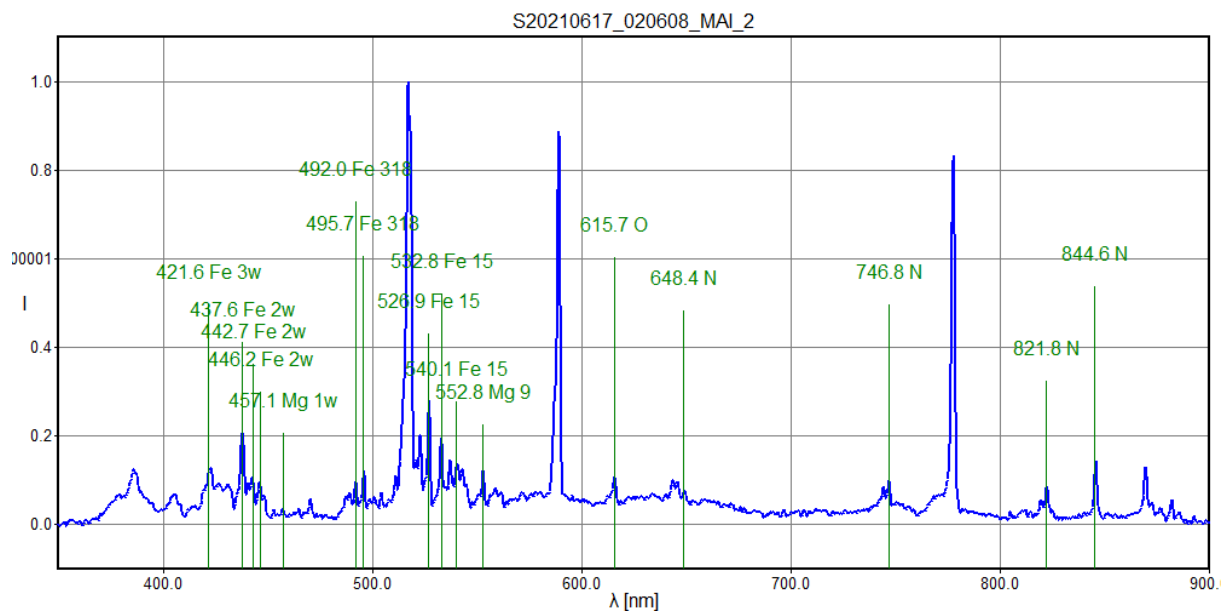
rms_x = 0.0800

spectrum 210617\r_add10cal.dat saved



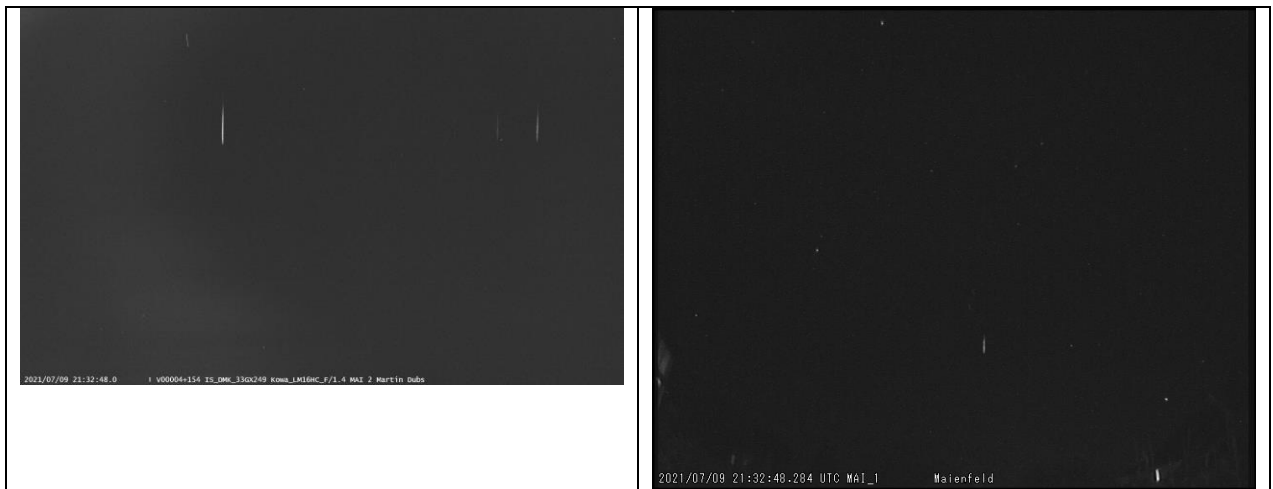


Labelled with meteor_lines.txt



Labelled with meteor_lines_Borovicka.txt

M20210709_213248_MAI_2, spo 0.0m

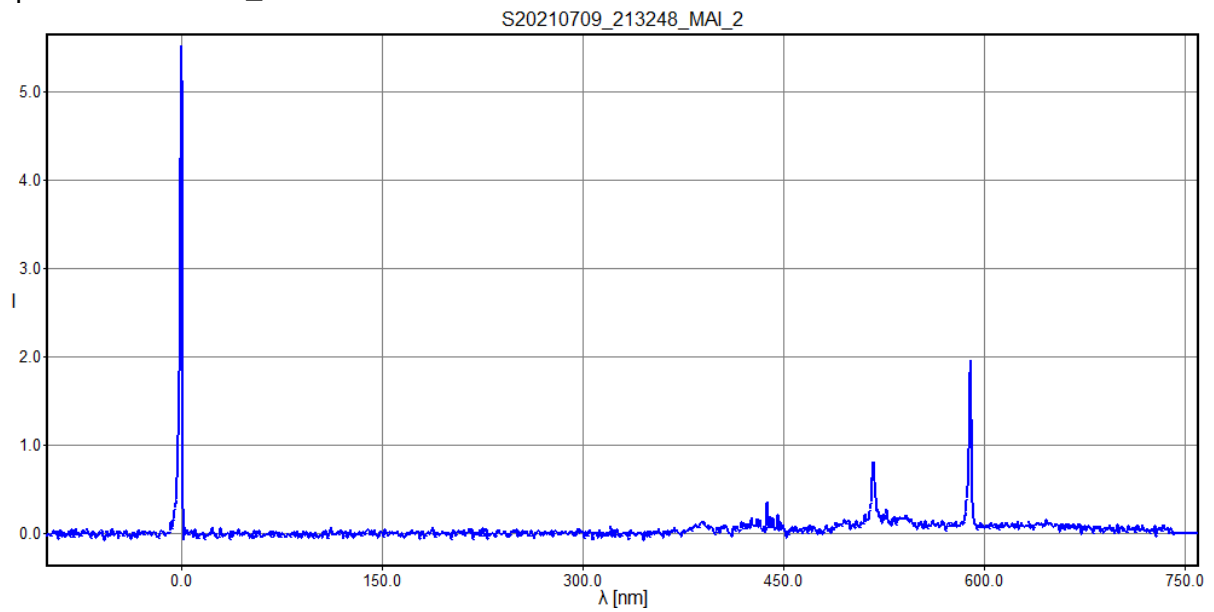


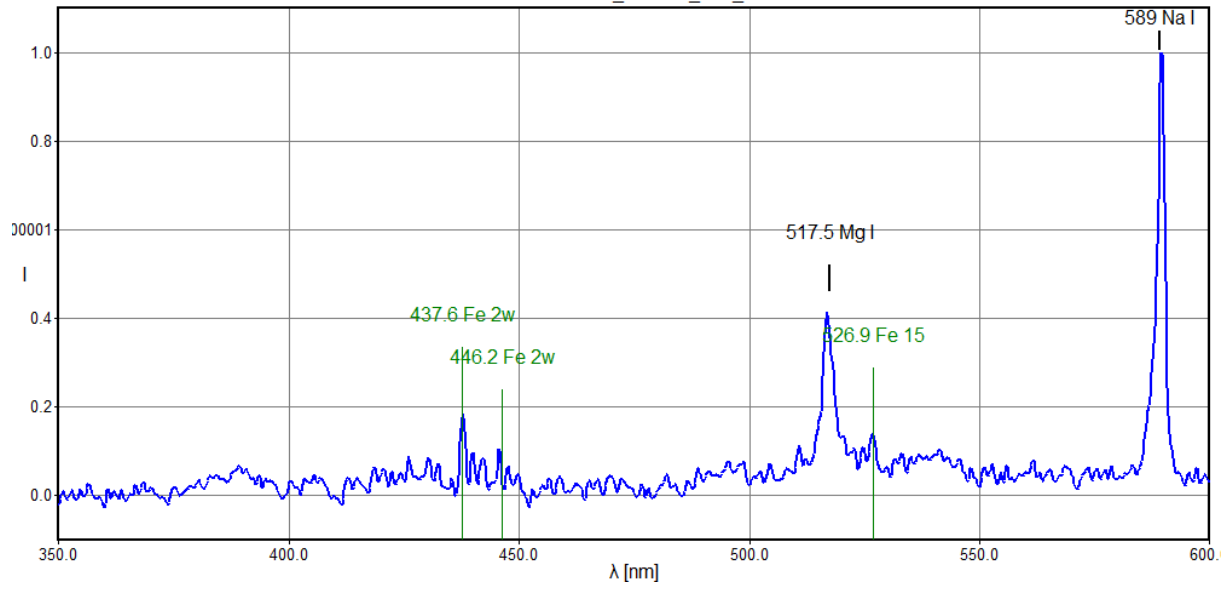
polynom for fit lambda c: [0.5986 -387.5982]

pixel	lambda	fit	error
647.56,	0.00,	0.05,	0.0541
1511.20,	517.50,	517.06,	-0.4406
1632.02,	589.00,	589.39,	0.3865

rms_x = 0.3398

spectrum 210709\r_add32cal.dat saved





M20210810_021002_MAI_2, PER, -2.9m

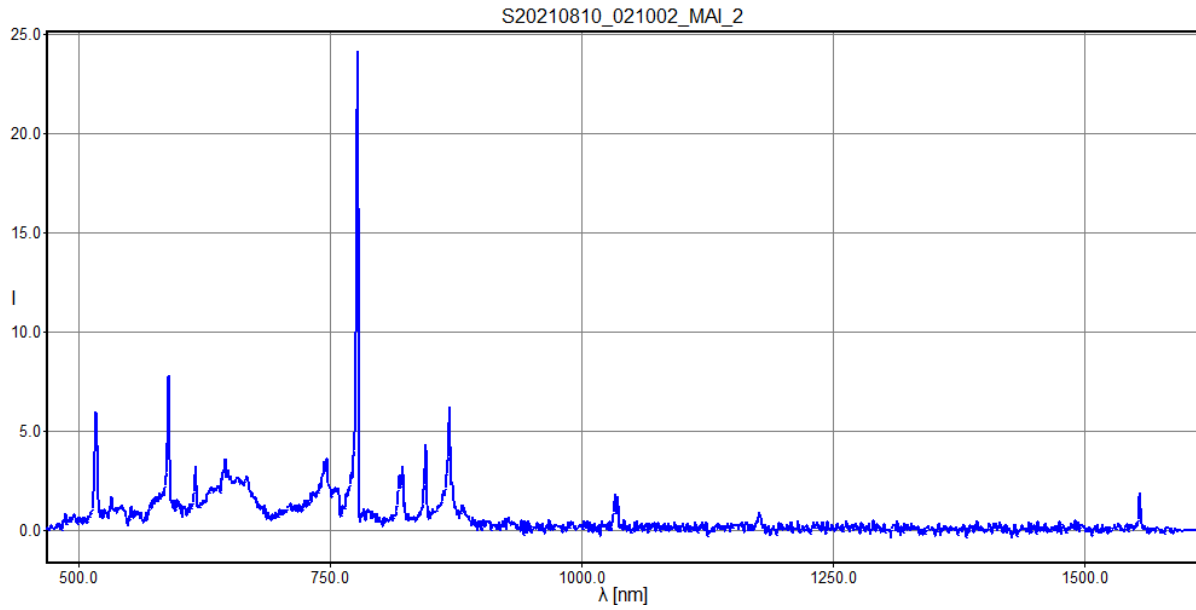


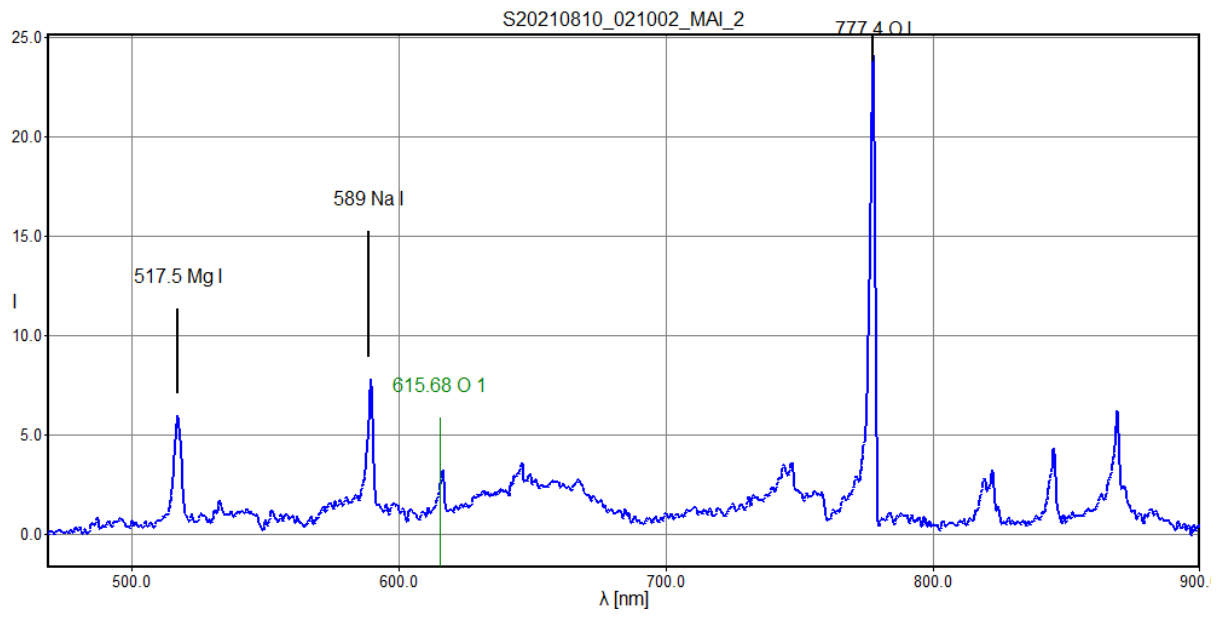
polynom for fit lambda c: [0.5976 468.9026]

pixel	lambda	fit	error
81.25	517.50	517.46	-0.0434
201.95	589.00	589.59	0.5854
516.57	777.40	777.60	0.1985
945.14	1035.00	1033.71	-1.2934
1818.06	1554.80	1555.35	0.5529

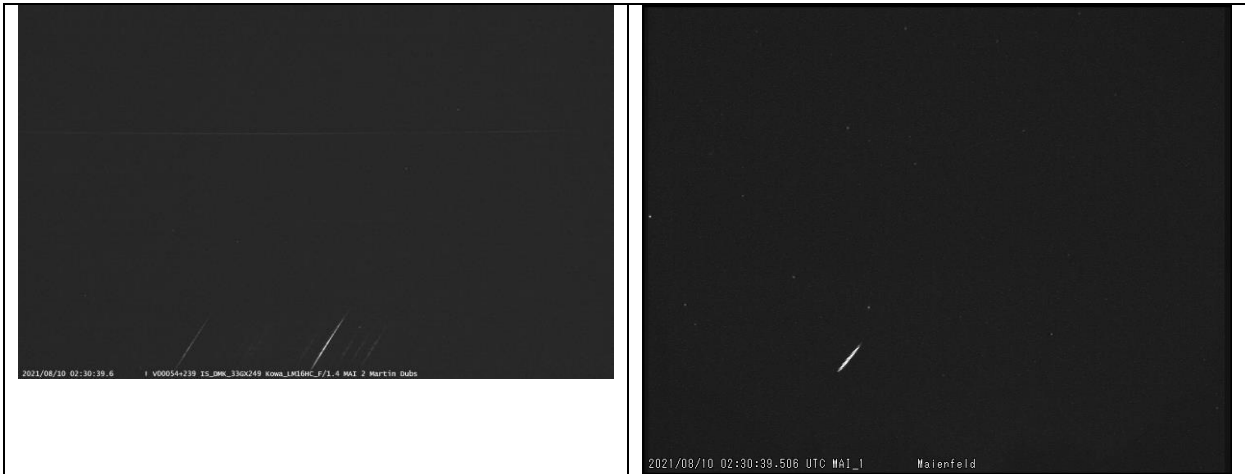
rms_x = 0.6874

spectrum 210810\ra_add6cal.dat saved





M20210810_023039_MAI_2, spo, -2.1m

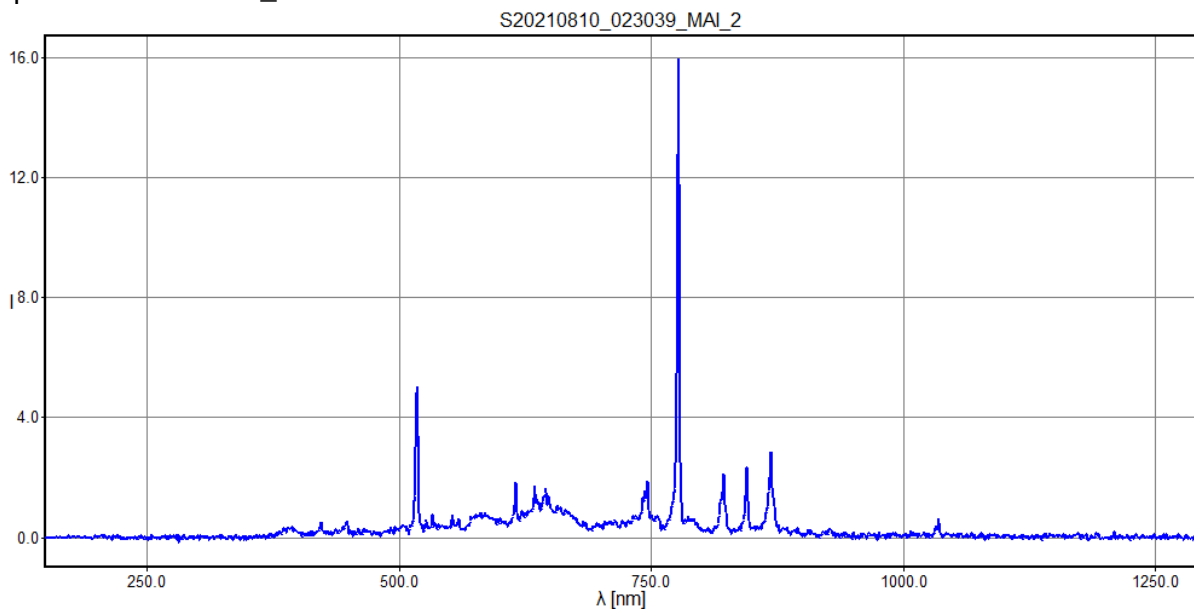


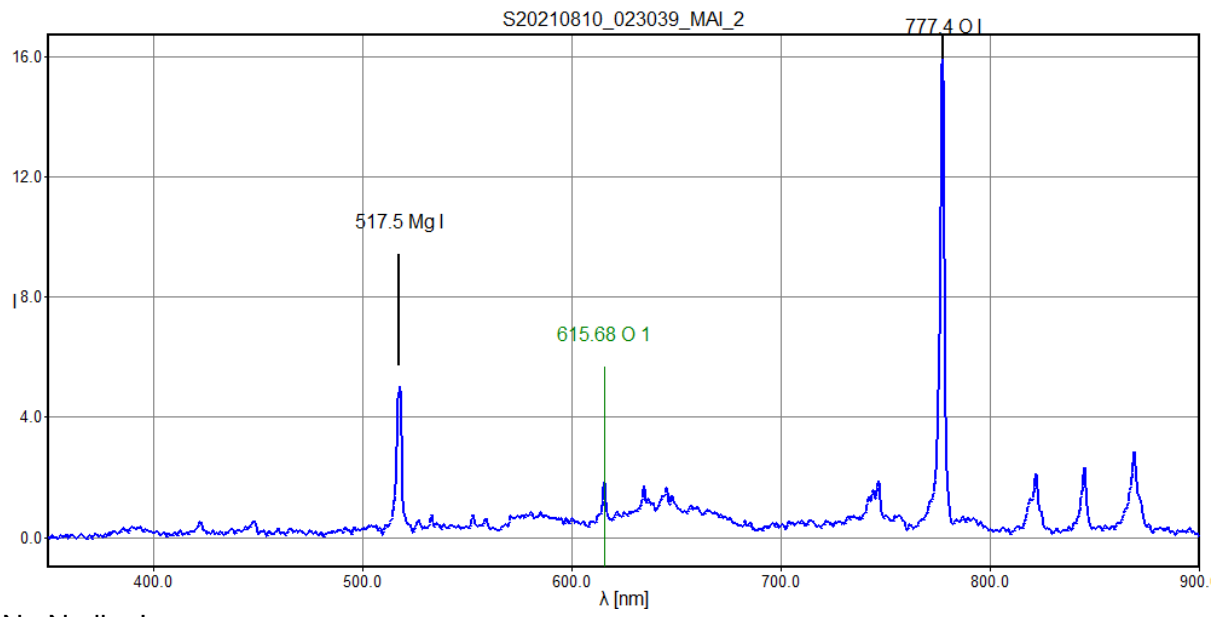
polynom for fit lambda c: [0.5964 148.3943]

pixel	lambda	fit	error
619.12,	517.50,	517.67,	0.1662
1054.03,	777.40,	777.07,	-0.3332
1486.76,	1035.00,	1035.17,	0.1670

rms_x = 0.2356

spectrum 210810\rb_add9cal.dat saved





M20210810_025859_MAI_2, PER, -2.9m

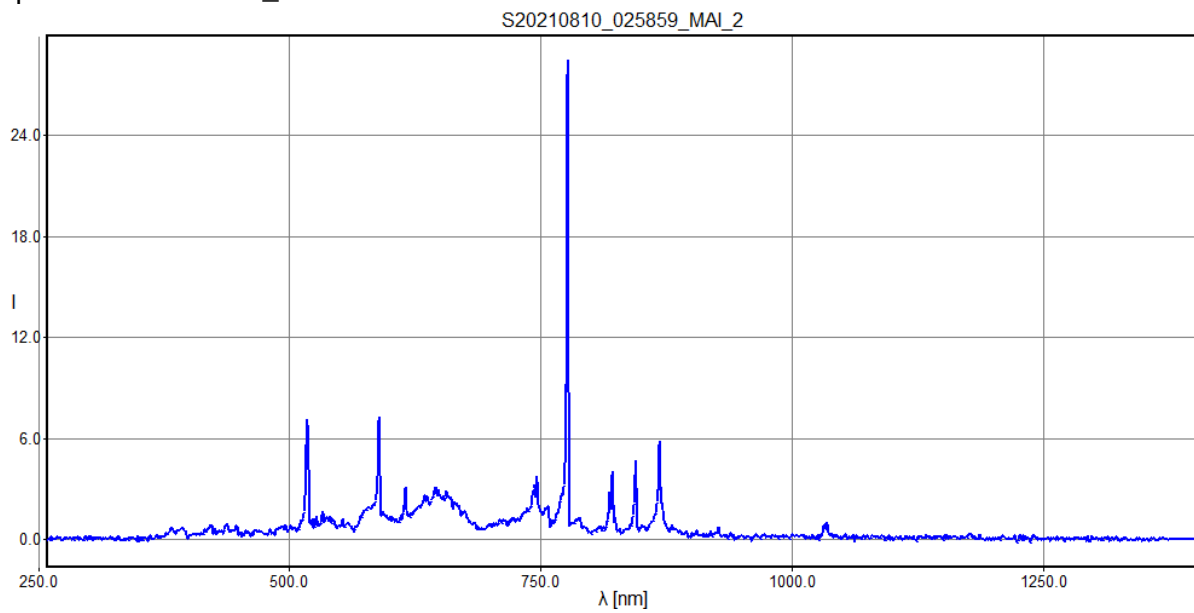


polynom for fit lambda c: [0.5982 258.2843]

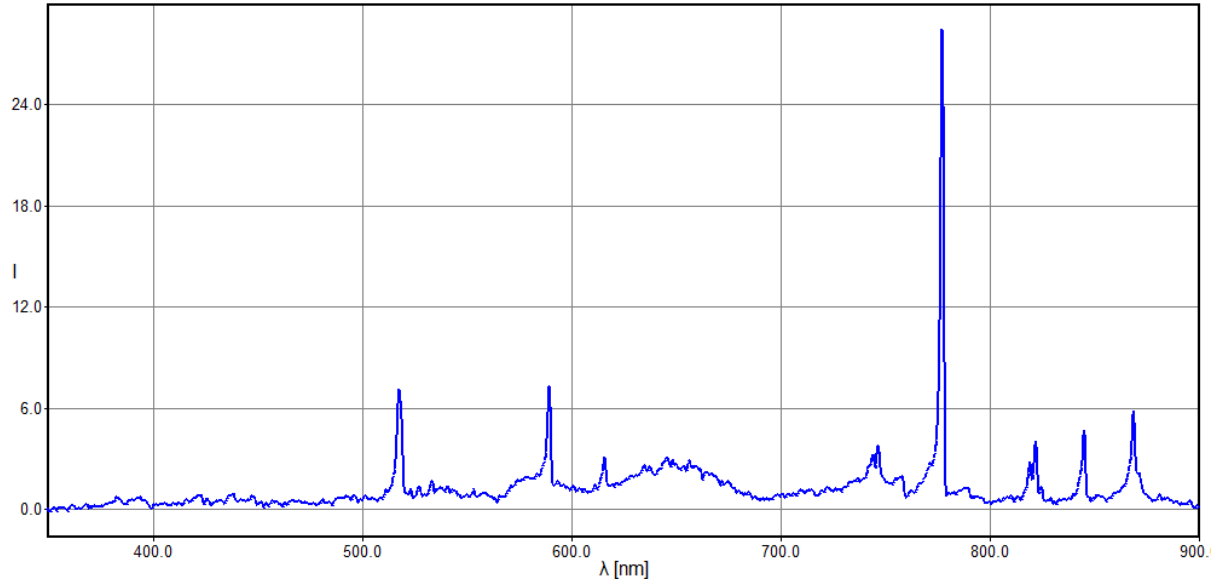
pixel	lambda	fit	error
433.60,	517.50,	517.67,	0.1733
552.99,	589.00,	589.09,	0.0950
866.91,	777.40,	776.89,	-0.5112
1298.78,	1035.00,	1035.24,	0.2429

rms_x = 0.2997

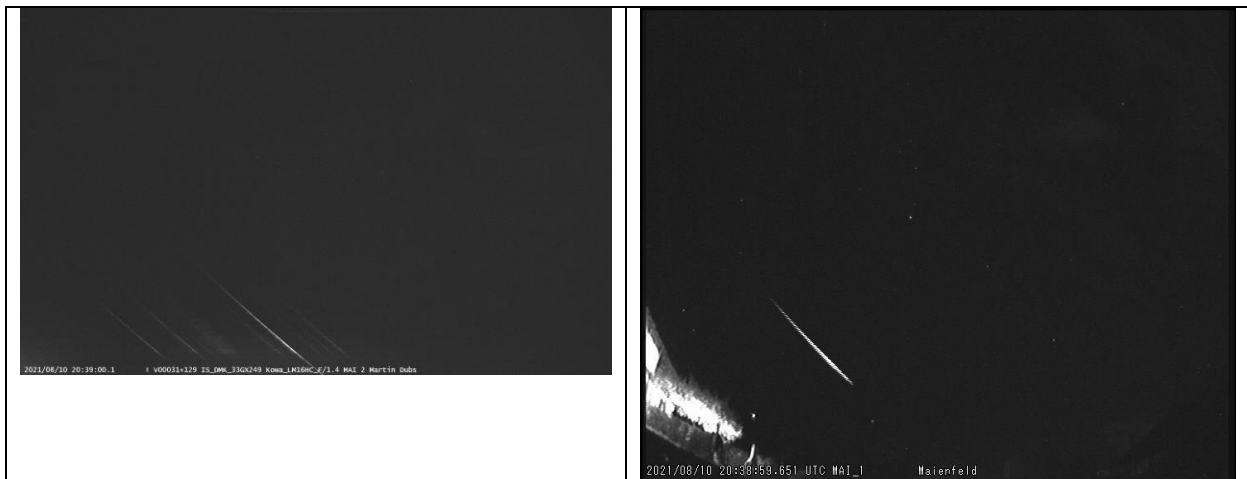
spectrum 210810\rb_add8cal.dat saved



S20210810_025859_MAI_2



M20210810_203900_MAI_2, PER, -2.9m

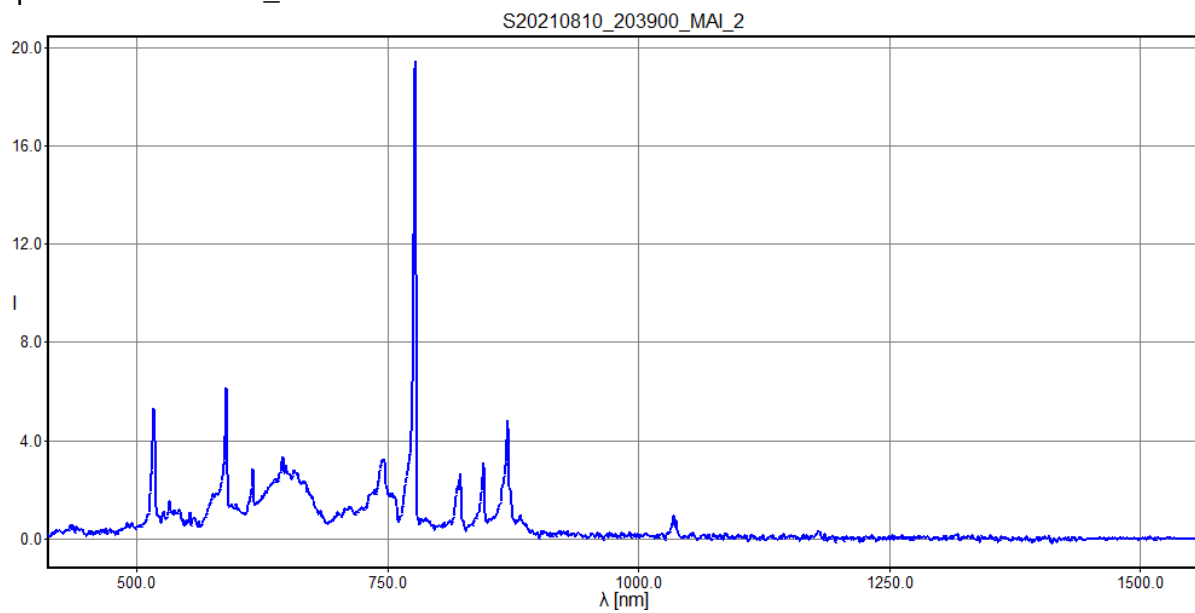


polynom for fit lambda c: [0.5985 411.9769]

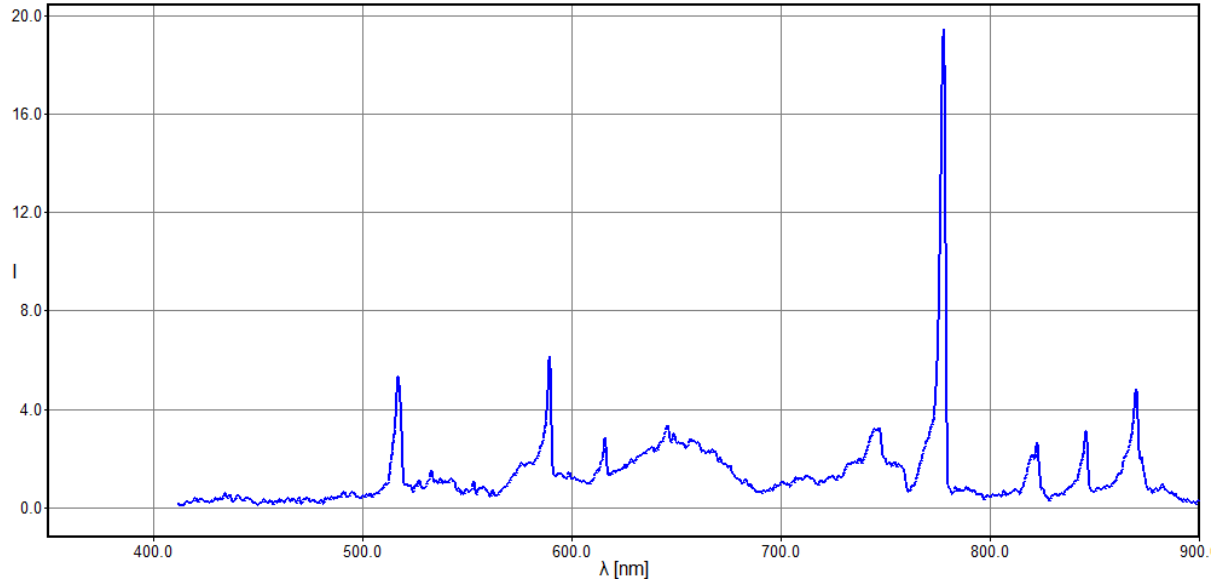
pixel	lambda	fit	error
175.82,	517.50,	517.20,	-0.3023
296.35,	589.00,	589.33,	0.3298
610.67,	777.40,	777.44,	0.0370
1040.94,	1035.00,	1034.94,	-0.0646

rms_x = 0.2268

spectrum 210810\rb_add13cal.dat saved



S20210810_203900_MAI_2



M20210811_003843_MAI_2, spo, -1.3m



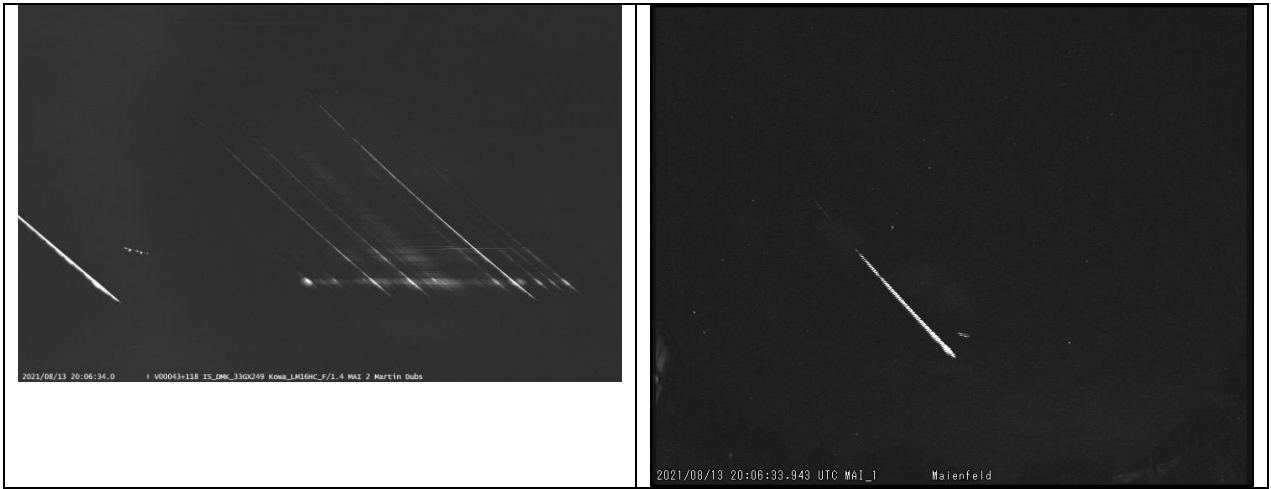
polynom for fit lambda c: [0.5994 221.1771]

pixel	lambda	fit	error
494.25,	517.50,	517.45,	-0.0543
613.65,	589.00,	589.02,	0.0177
928.05,	777.40,	777.48,	0.0786
1357.59,	1035.00,	1034.96,	-0.0420

rms_x = 0.0529

spectrum 210811\r_add9cal.dat saved

M20210813_200634_MAI_2, PER, -3.5m

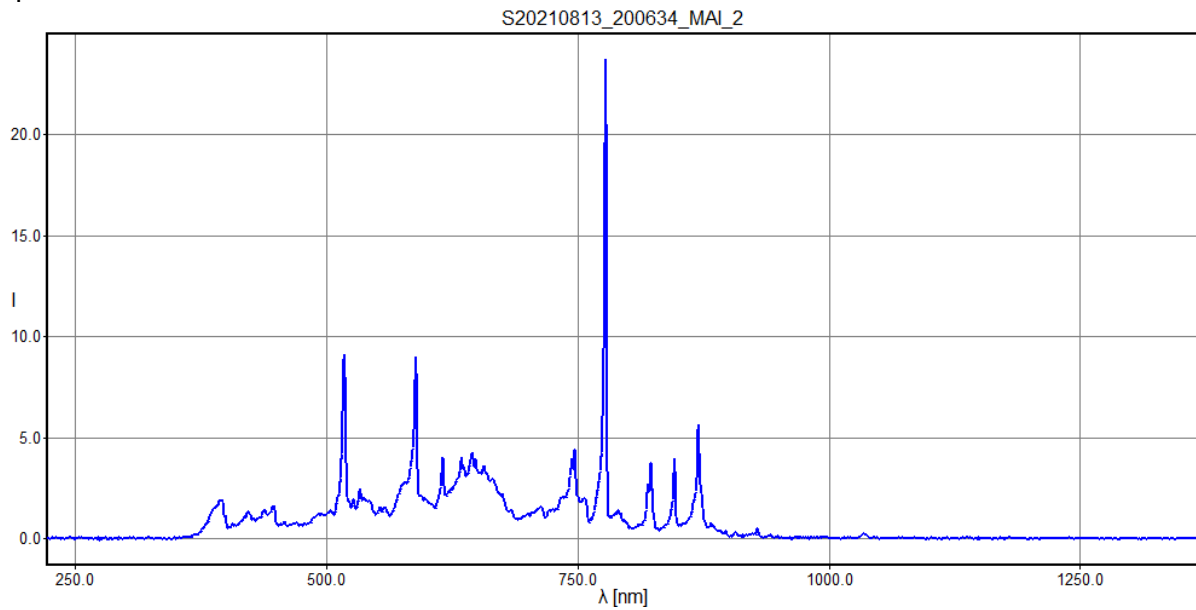


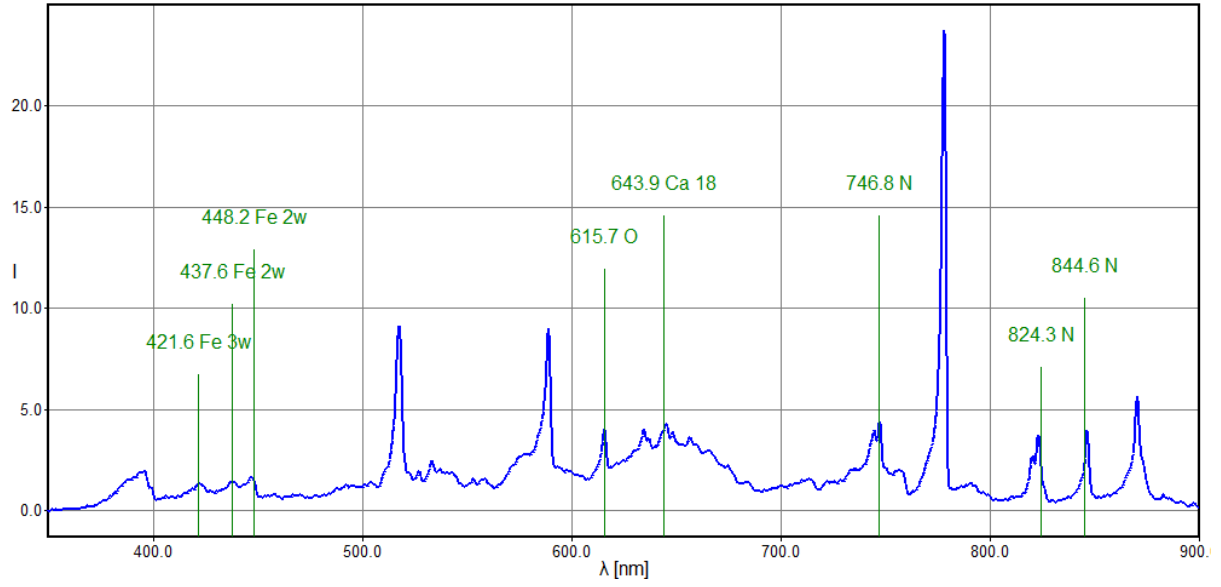
polynom for fit lambda c: [0.5984 221.4456]

pixel	lambda	fit	error
494.78	517.50	517.51	0.0115
613.86	589.00	588.77	-0.2336
929.74	777.40	777.78	0.3823
1359.33	1035.00	1034.84	-0.1602

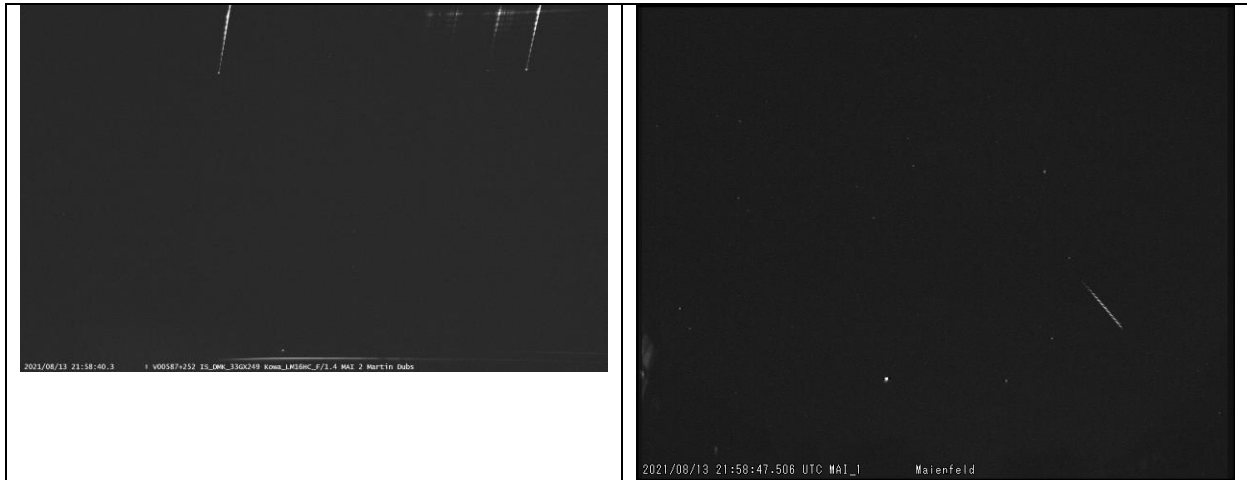
rms_x = 0.2380

spectrum 210813\r_add25cal.dat saved





M20210813_215840_MAI_2, KCG, -2.3m

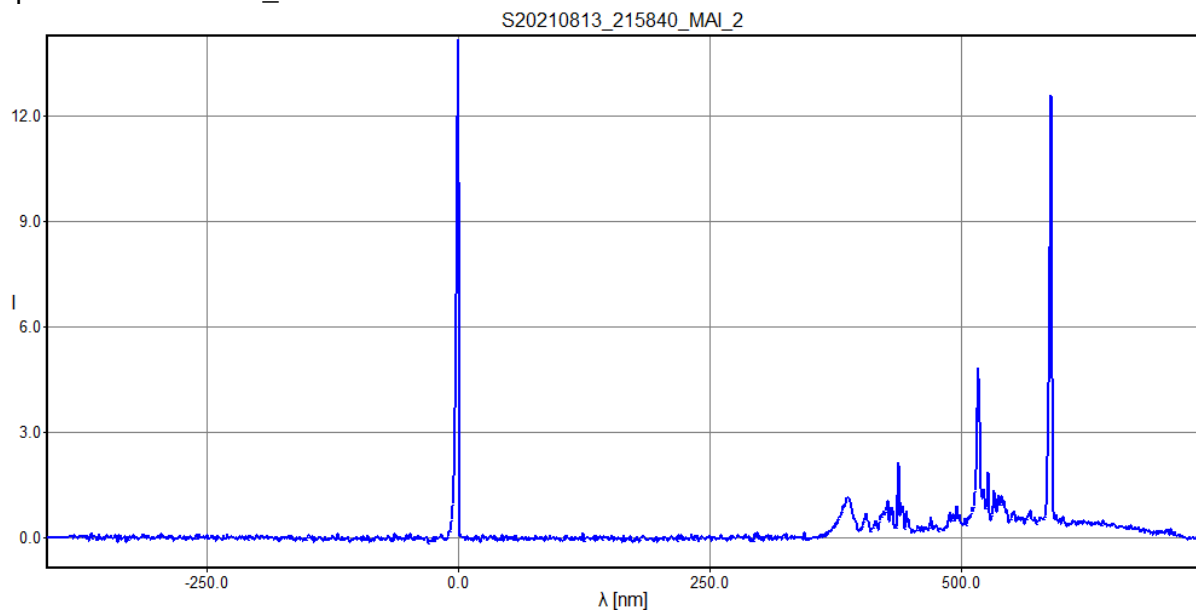


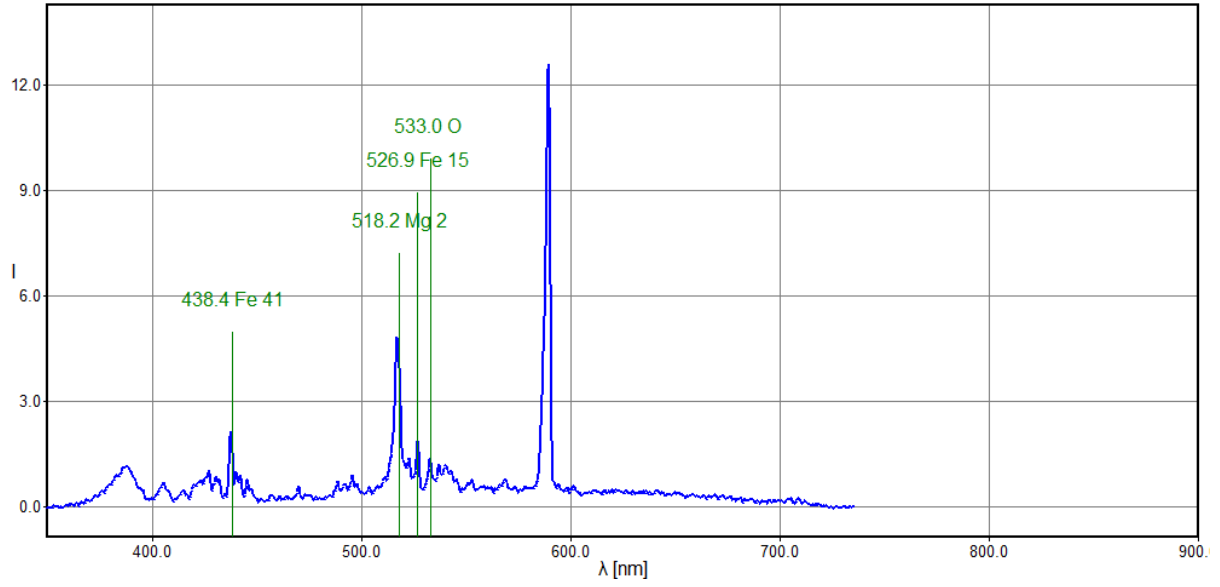
polynom for fit lambda c: [0.5979 -409.6793]

pixel	lambda	fit	error
685.27,	0.00,	0.03,	0.0316
1550.34,	517.50,	517.24,	-0.2583
1670.74,	589.00,	589.23,	0.2267

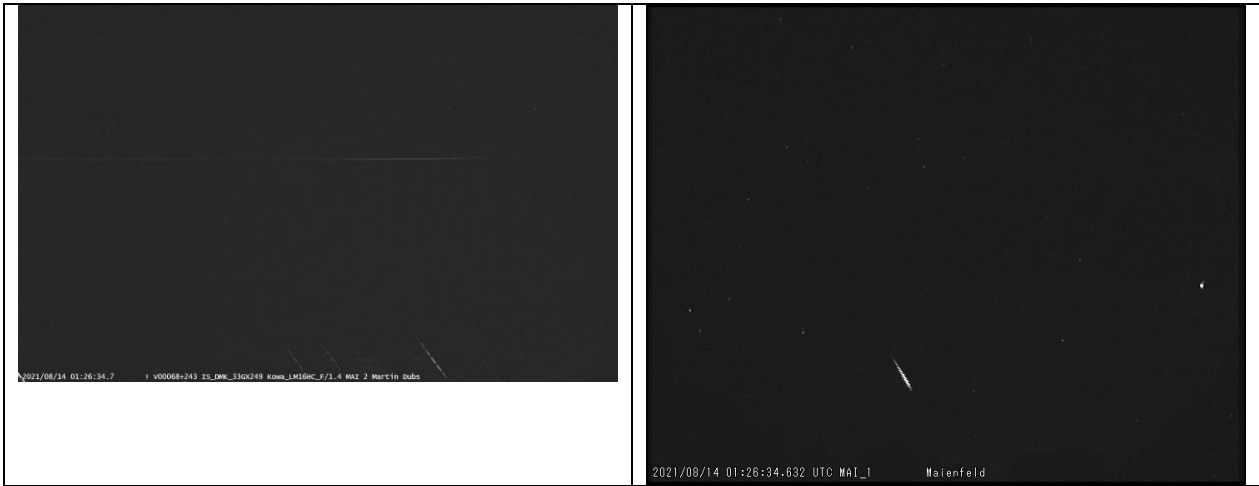
rms_x = 0.1993

spectrum 210813\ra_add12cal.dat saved





M20210814_012634_MAI_2, PER, -2.4m

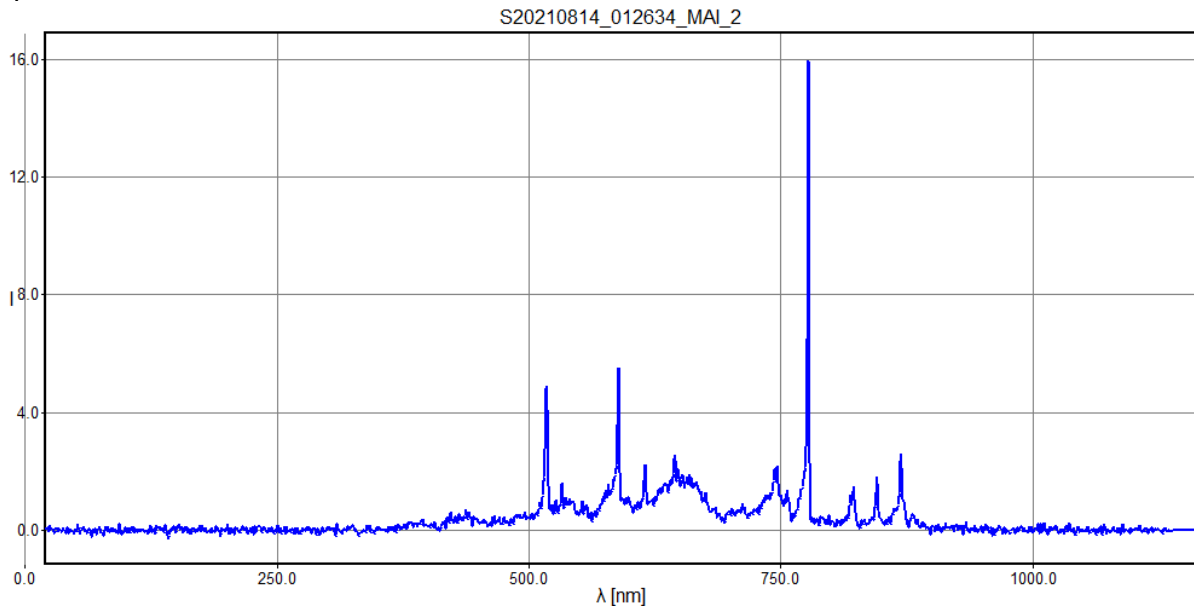


polynom for fit lambda c: [0.5967 19.6955]

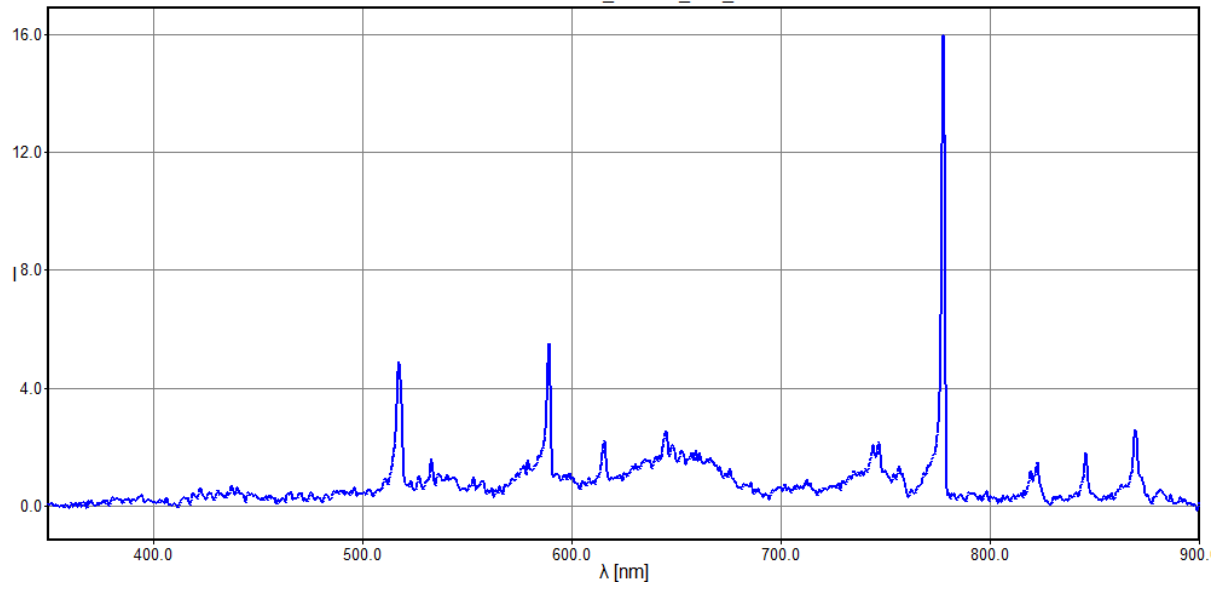
pixel	lambda	fit	error
834.41	517.50	517.55	0.0466
954.06	589.00	588.94	-0.0642
1269.96	777.40	777.42	0.0176

rms_x = 0.0469

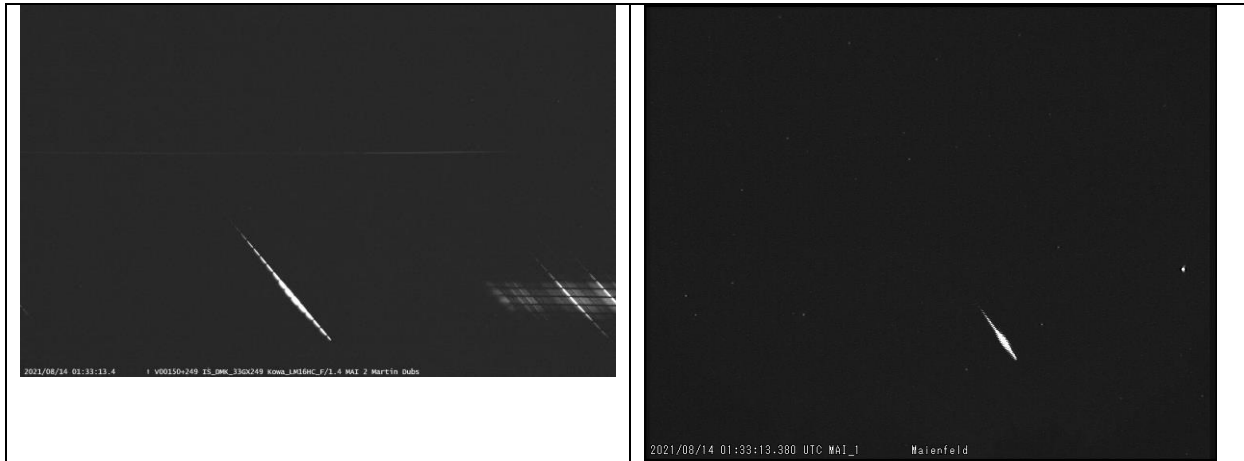
spectrum 210814\r_add5cal.dat saved



S20210814_012634_MAI_2



M20210814_013313_MAI_2, PER, -3.7m

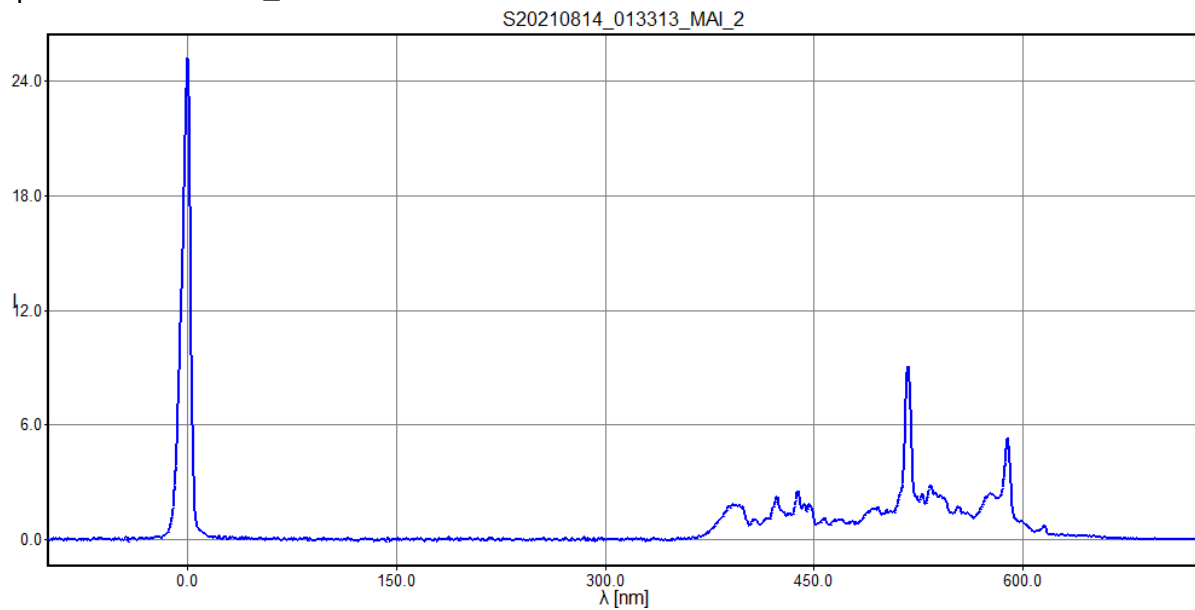


polynom for fit lambda c: [0.5956 -414.5104]

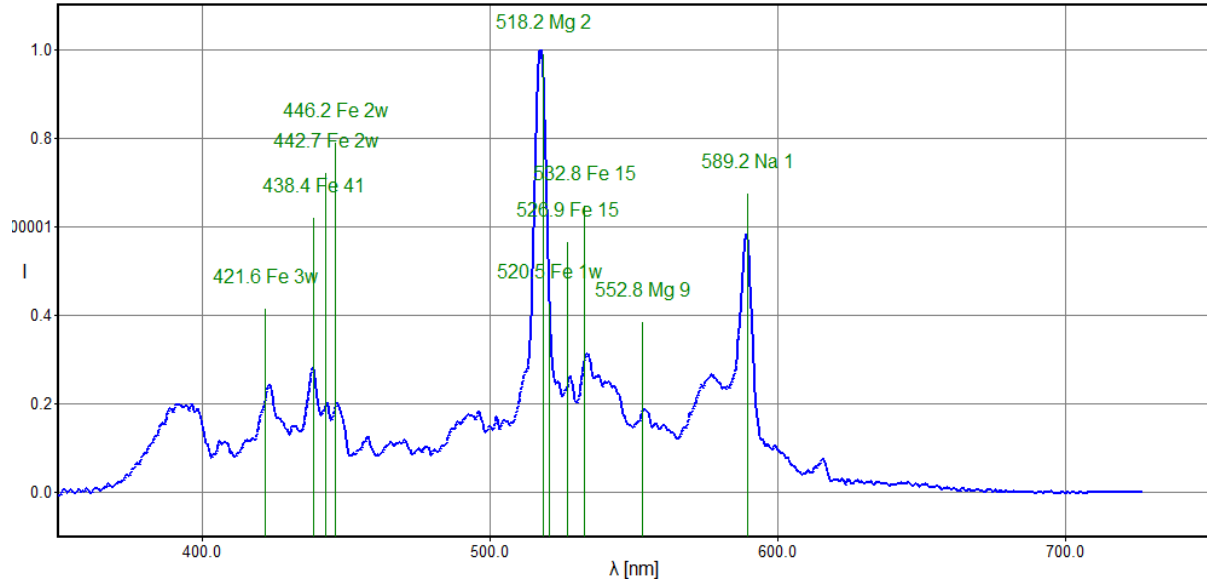
pixel	lambda	fit	error
696.00,	0.00,	-0.00,	-0.0029
1564.98,	517.50,	517.52,	0.0240
1684.96,	589.00,	588.98,	-0.0211

rms_x = 0.0185

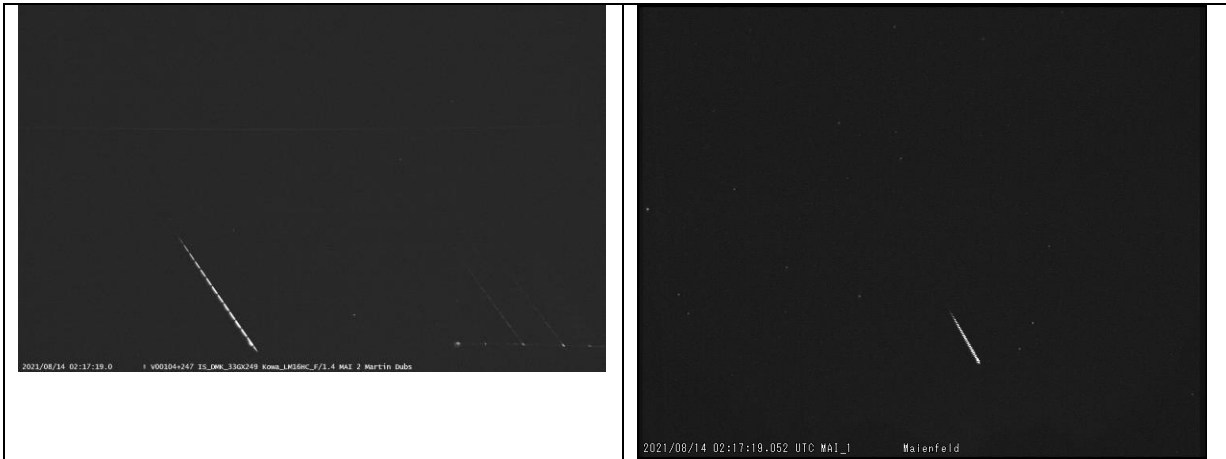
spectrum 210814\ra_add15cal.dat saved



S20210814_013313_MAI_2



M20210814_021719_MAI_2, PER, -2.8m

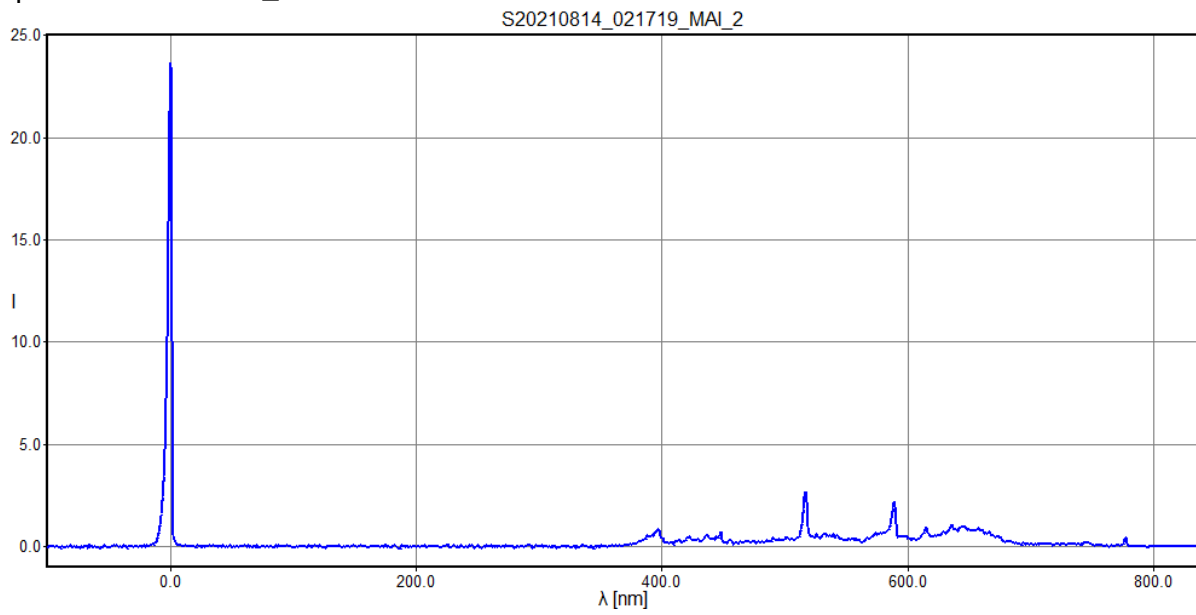


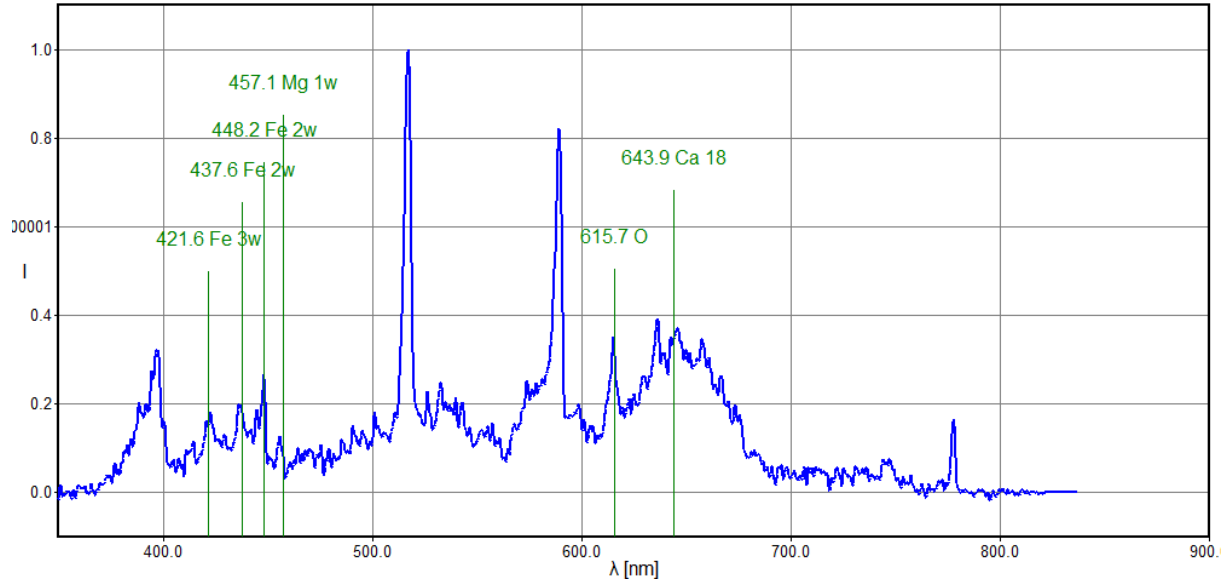
polynom for fit lambda c: [0.5962 -306.0928]

pixel	lambda	fit	error
513.58,	0.00,	0.13,	0.1260
1380.47,	517.50,	517.00,	-0.4965
1501.50,	589.00,	589.17,	0.1669
1817.54,	777.40,	777.60,	0.2037

rms_x = 0.2880

spectrum 210814\rb_add15cal.dat saved





M20210814_232134_MAI_2, PER, -2.3m

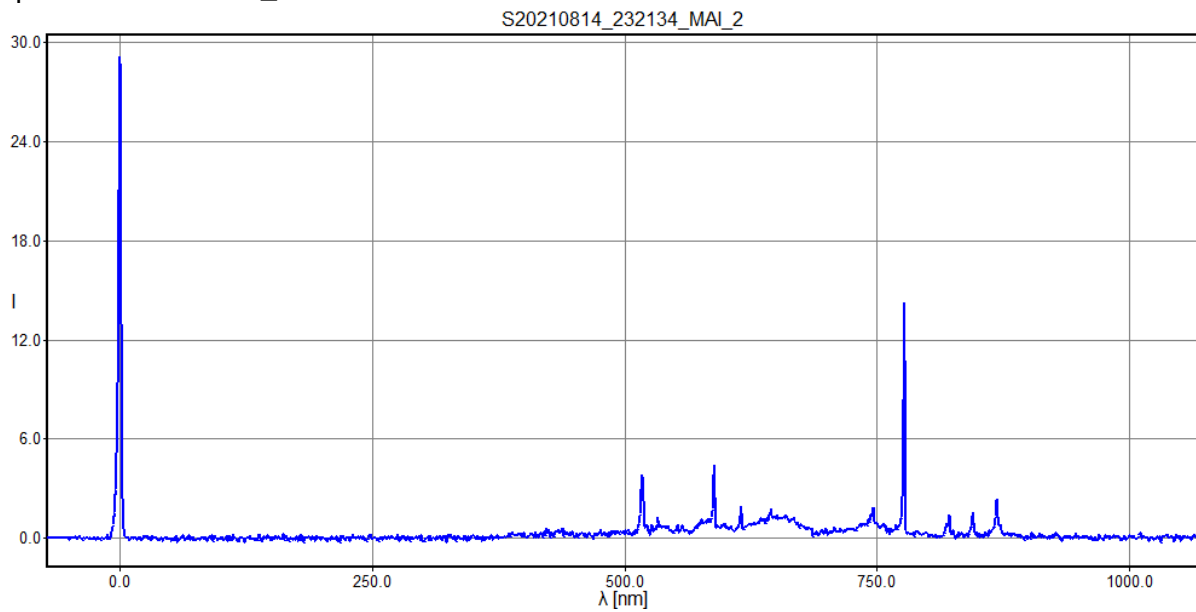


polynom for fit lambda c: [0.5962 -73.1988]

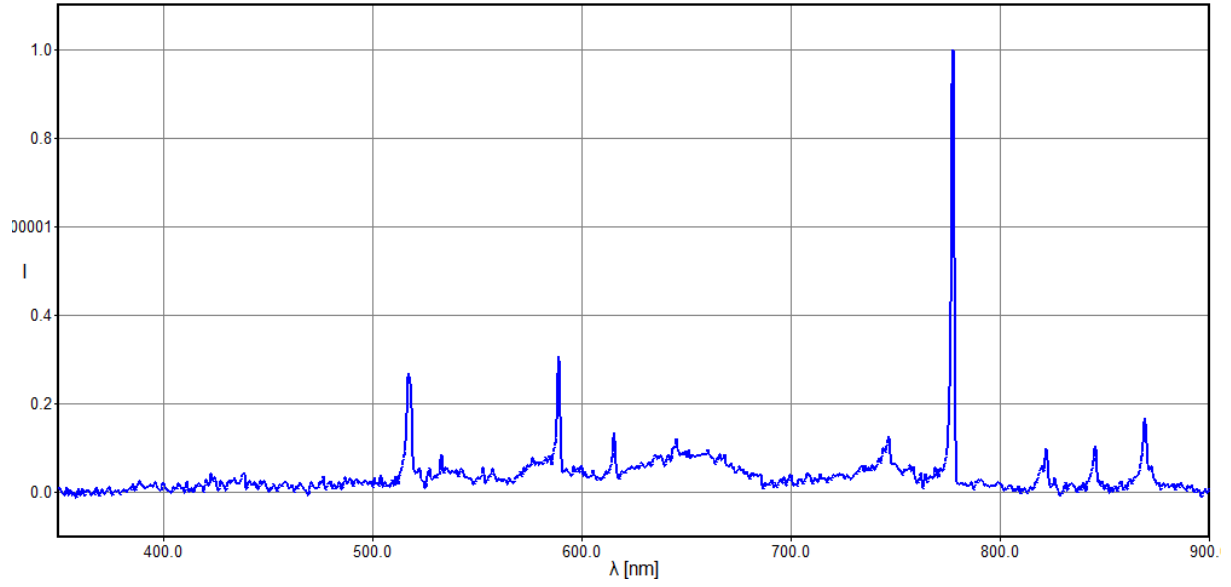
pixel	lambda	fit	error
122.72,	0.00,	-0.03,	-0.0318
990.92,	517.50,	517.60,	0.0987
1110.67,	589.00,	588.99,	-0.0050
1426.57,	777.40,	777.34,	-0.0619

rms_x = 0.0604

spectrum 210814\rc_add14cal.dat saved



S20210814_232134_MAI_2



M20210820_214528_MAI_2, KCG, -2.1m

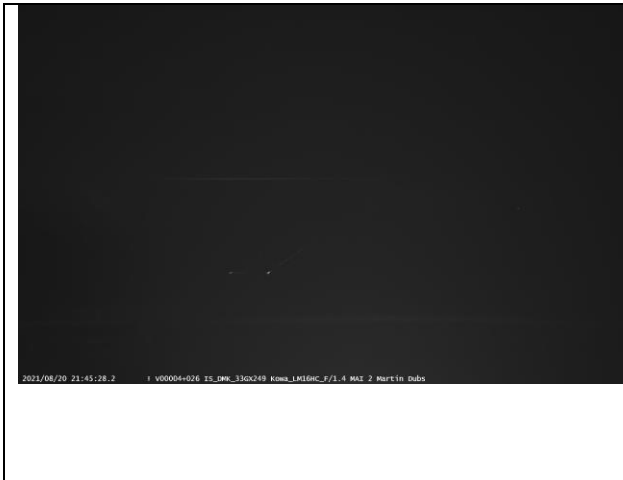
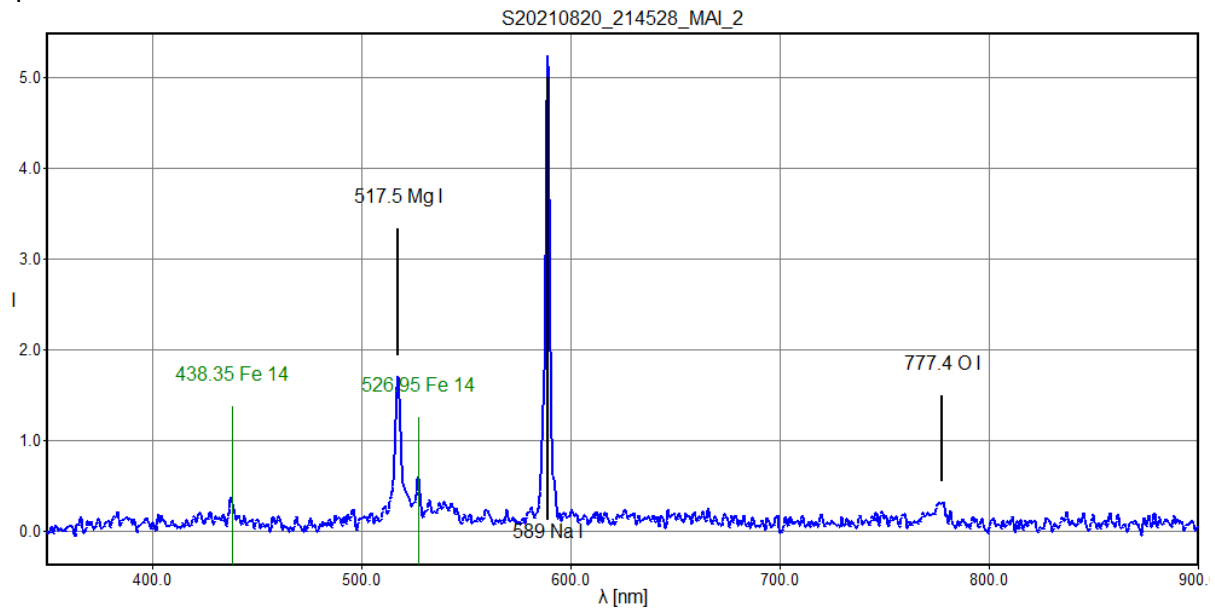


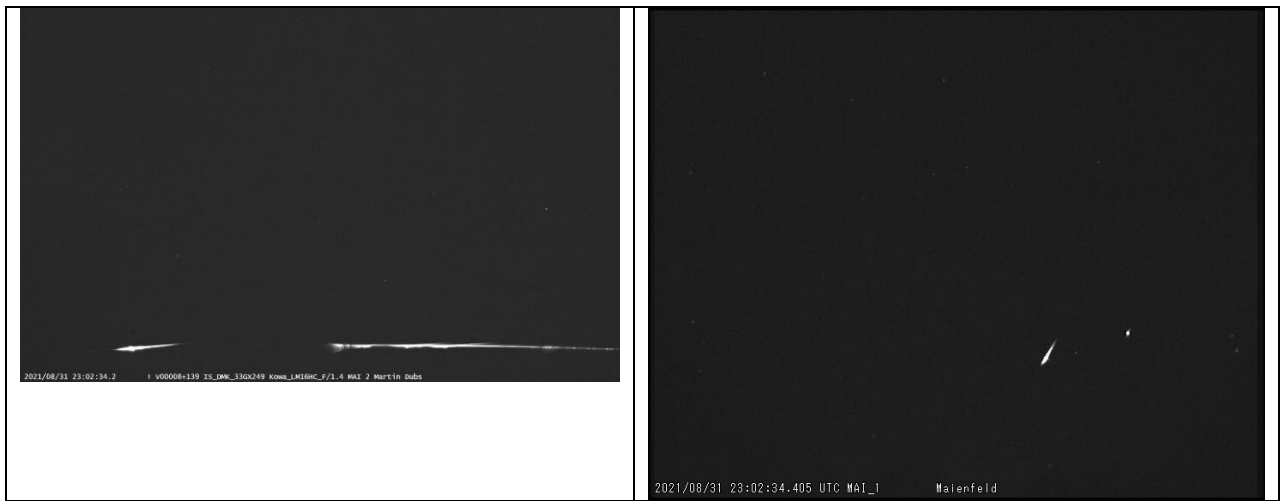
table saved as 210820\r_add11.txt
 polynom for fit lambda c: [0.5974 47.2841]

pixel	lambda	fit	error
787.10,	517.50,	517.48,	-0.0154
906.85,	589.00,	589.02,	0.0213
1222.18,	777.40,	777.39,	-0.0058

 rms_x = 0.0155
 spectrum 210820\r_add11cal.dat saved



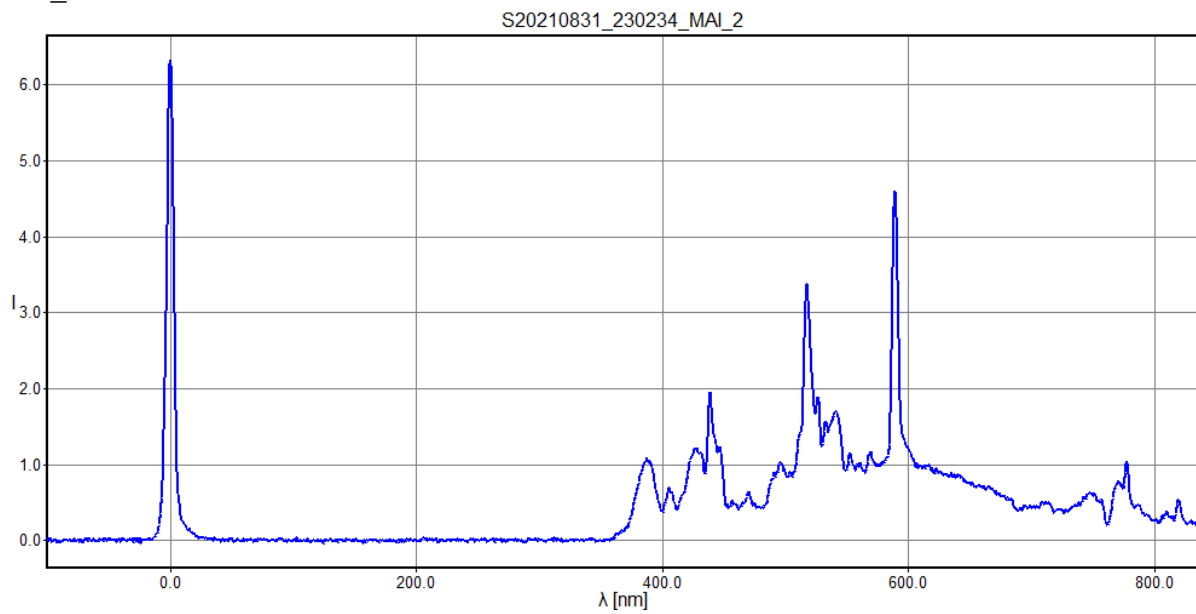
M20210831_230234_MAI_2, spo, -2.1m

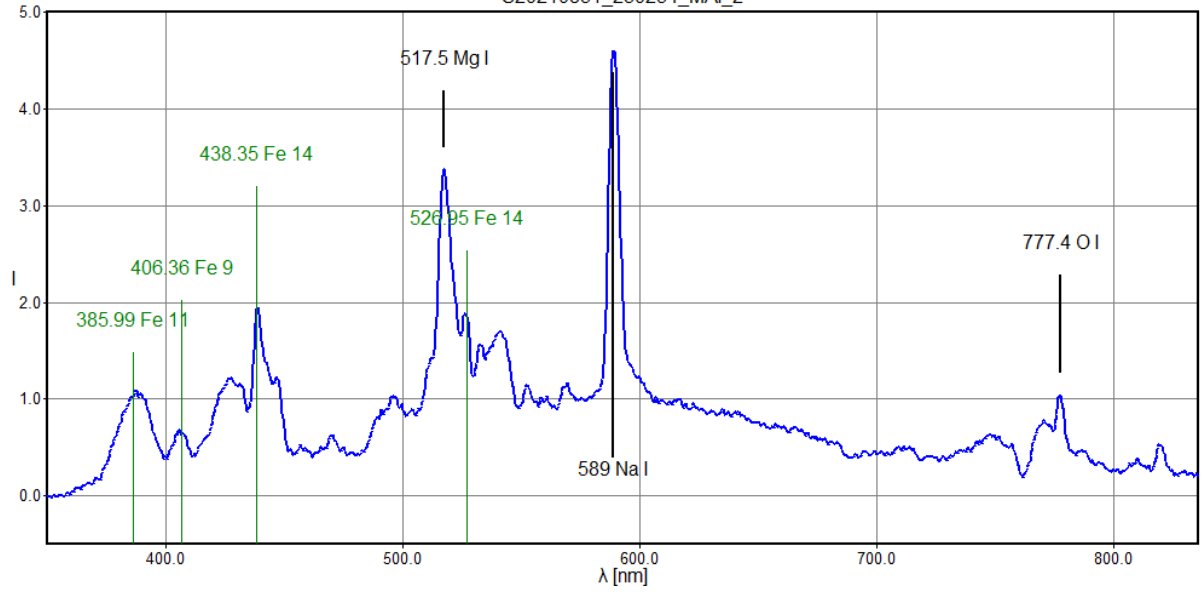


polynom for fit lambda c: [-3.2749e-06 6.0389e-01 -3.0976e+02]

pixel	lambda	fit	error
514.37,	0.00,	0.00,	0.0009
1380.17,	517.50,	517.48,	-0.0221
1500.53,	589.00,	589.03,	0.0267
1818.17,	777.40,	777.39,	-0.0056

rms_x = 0.0176





M20210904_224017_MAI_2, spo, -2.8m

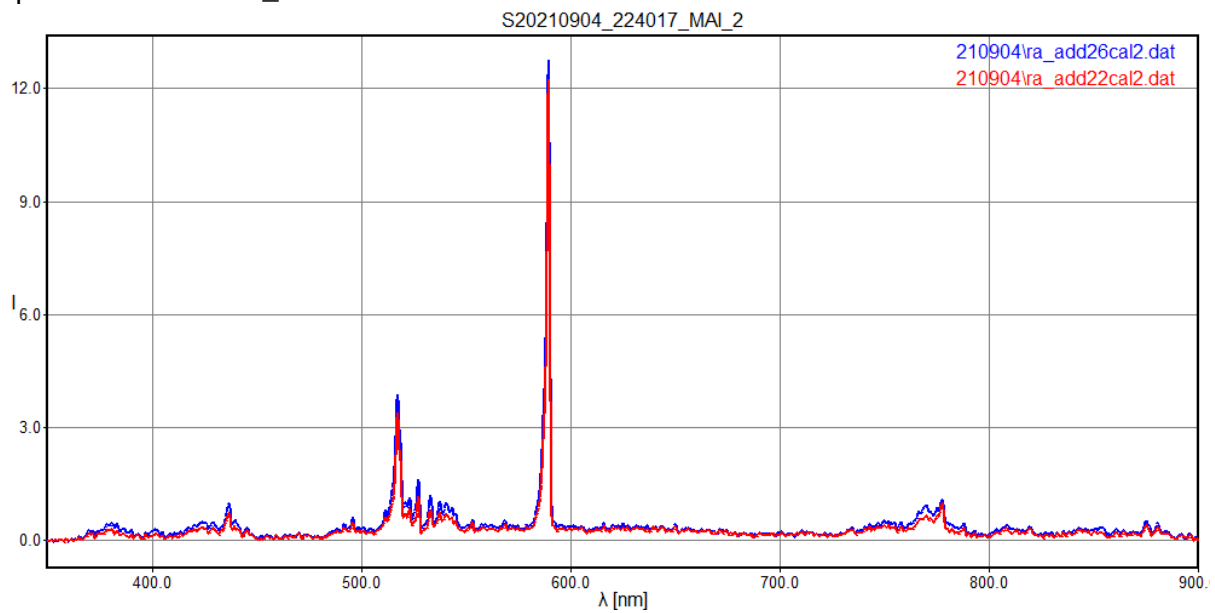


polynom for fit lambda c: [0.5977 153.0967]

pixel	lambda	fit	error
609.37,	517.50,	517.30,	-0.2031
729.81,	589.00,	589.28,	0.2799
1044.44,	777.40,	777.32,	-0.0763
1714.84,	1178.00,	1178.00,	-0.0005

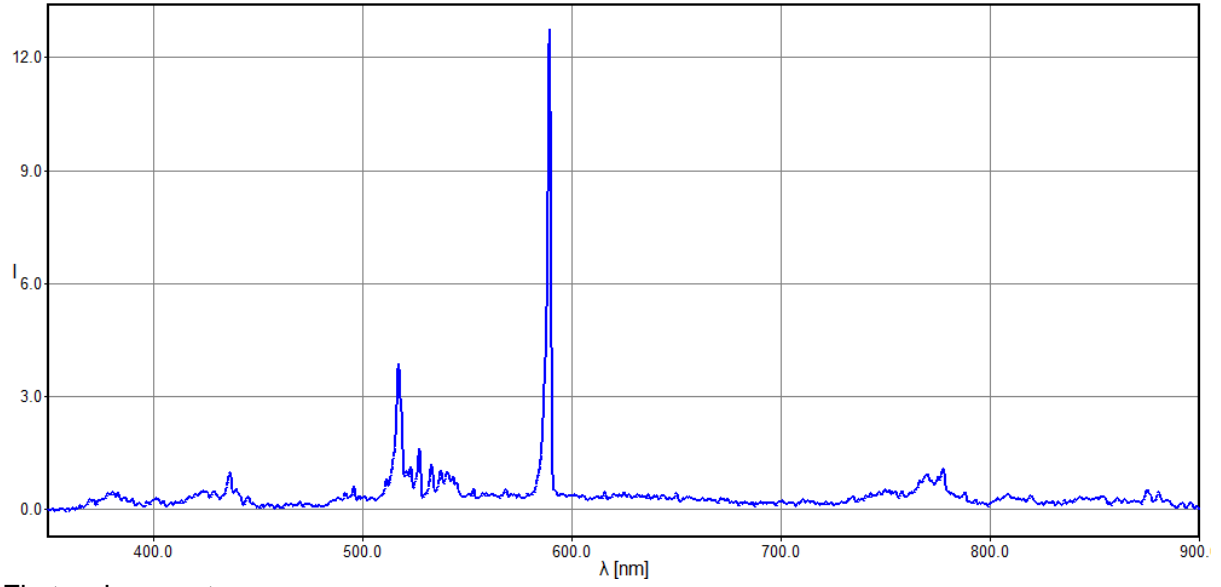
rms_x = 0.1771

spectrum 210904\ra_add22cal.dat saved



Comparison of adding 22 frames and 26 frames (including bright flashes)

S20210904_224017_MAI_2



First order spectrum

M20210904_225107_MAI_2, SPE, -2.6m

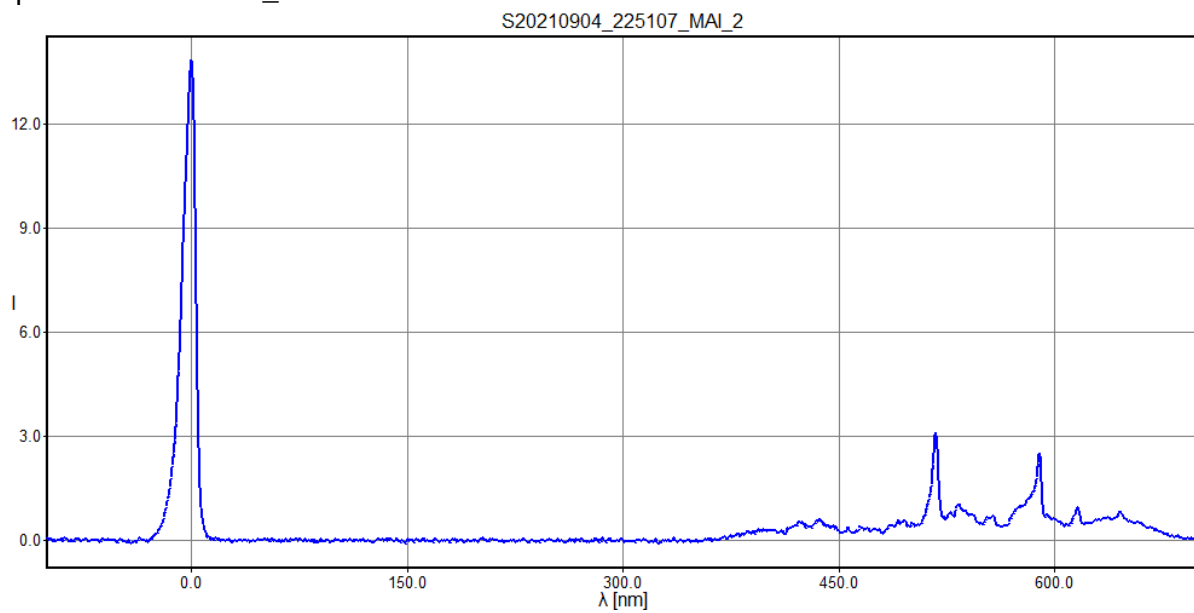


polynom for fit lambda c: [0.5974 -350.22]

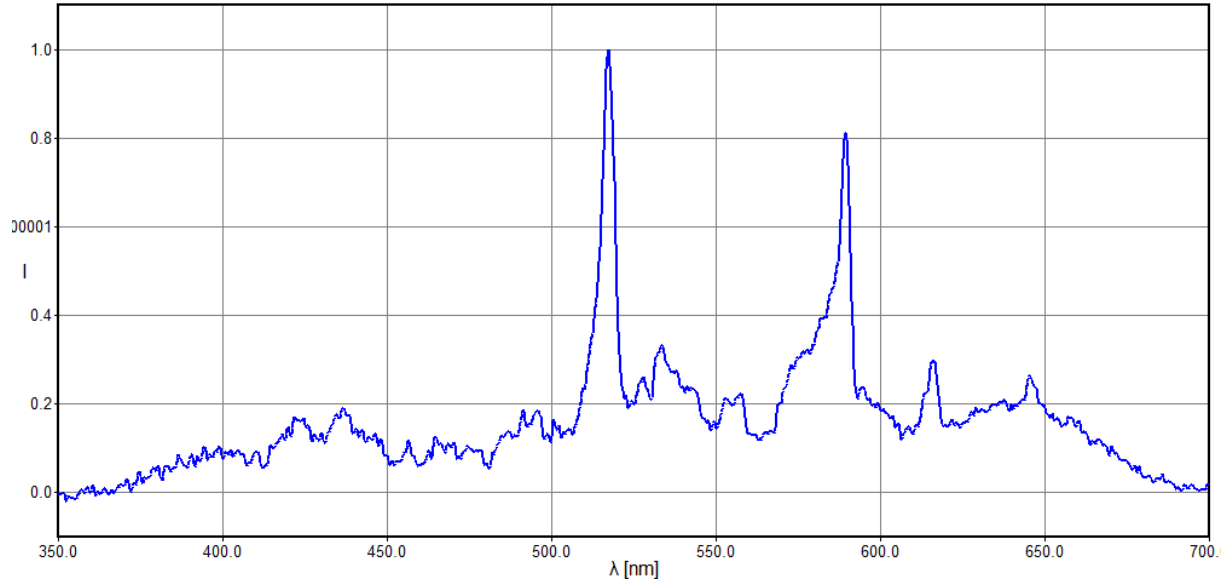
pixel	lambda	fit	error
586.33,	0.00,	0.03,	0.0345
1452.10,	517.50,	517.22,	-0.2826
1572.68,	589.00,	589.25,	0.2480

rms_x = 0.2180

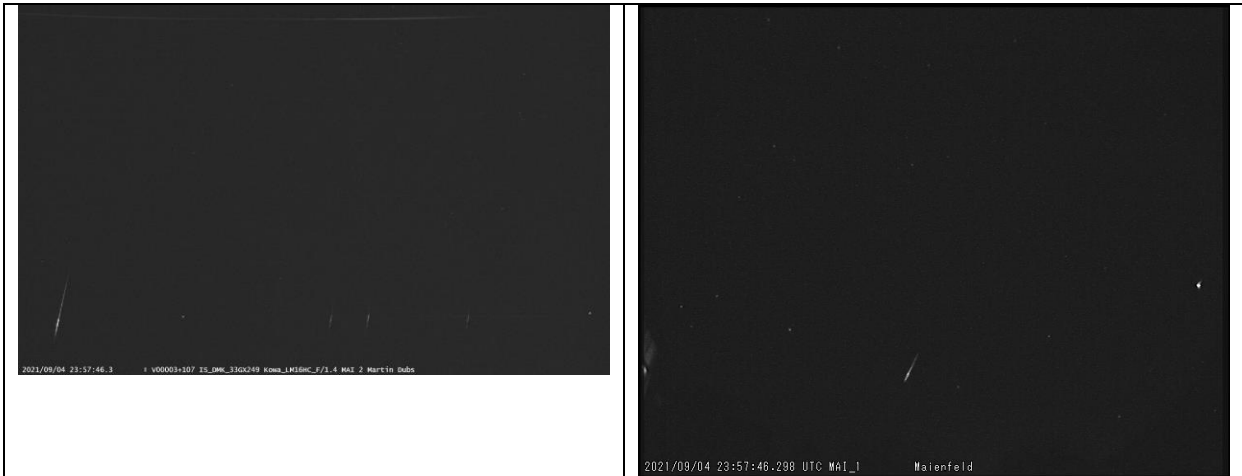
spectrum 210904\rb_add14cal.dat saved



S20210904_225107_MAI_2



M20210904_235746_MAI_2, spo, -0.7m

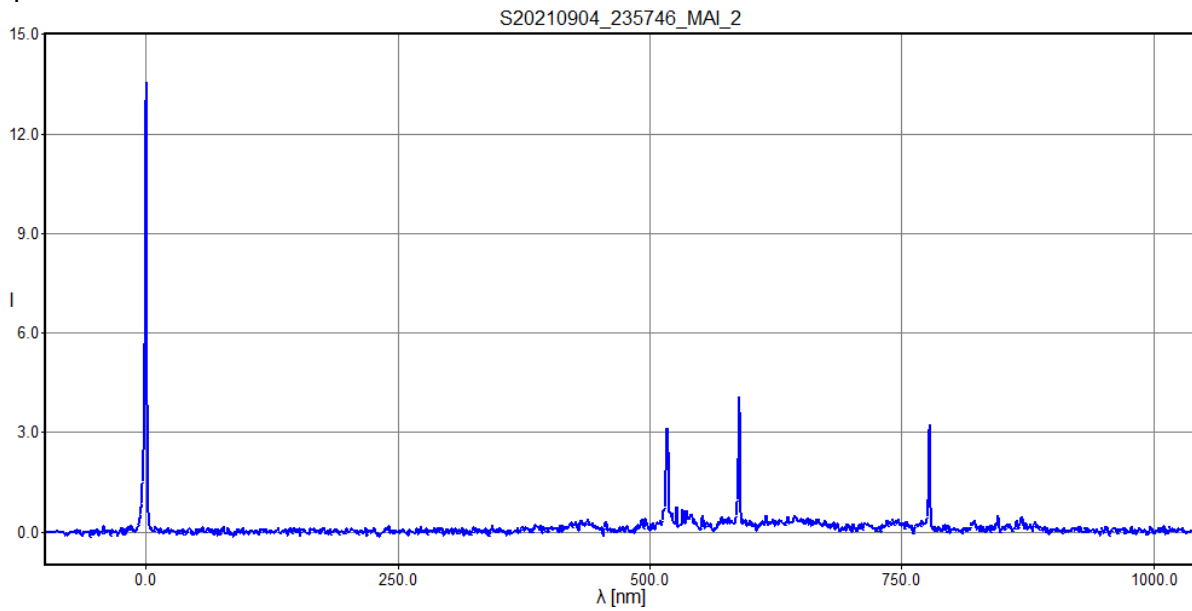


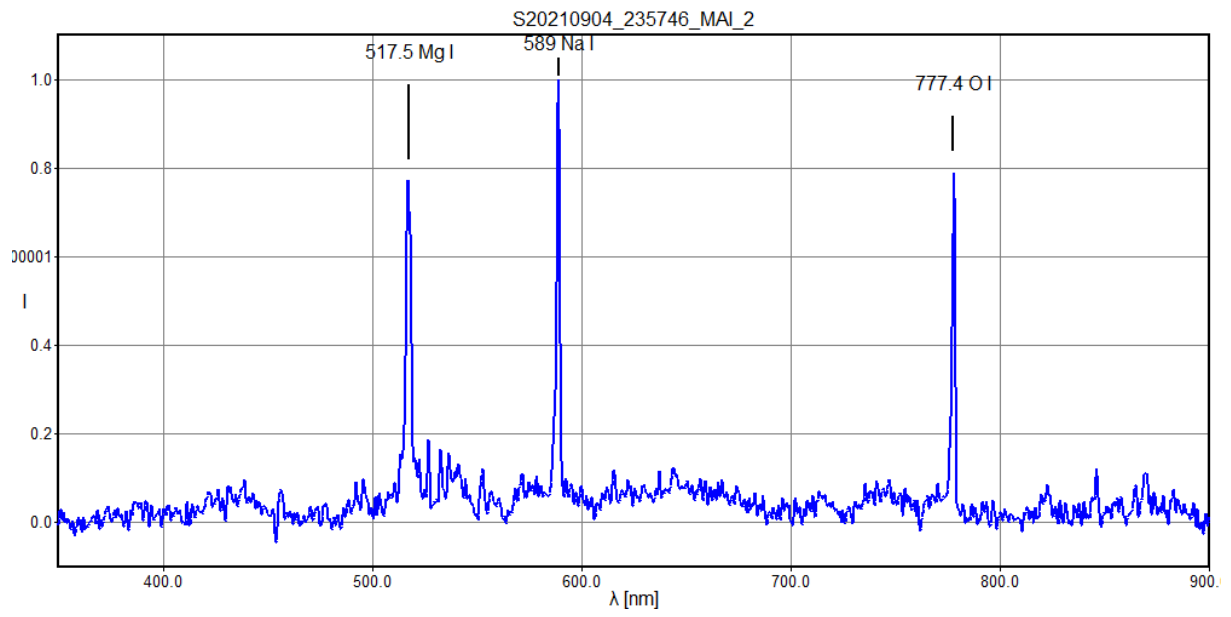
polynom for fit lambda c: [0.5966 -100.3522]

pixel	lambda	fit	error
168.41,	0.00,	0.12,	0.1206
1035.32,	517.50,	517.32,	-0.1844
1155.07,	589.00,	588.76,	-0.2420
1471.78,	777.40,	777.71,	0.3059

rms_x = 0.2240

spectrum 210904\rc_add12cal.dat saved





M20210906_024711_MAI_2, spo, -3.0m

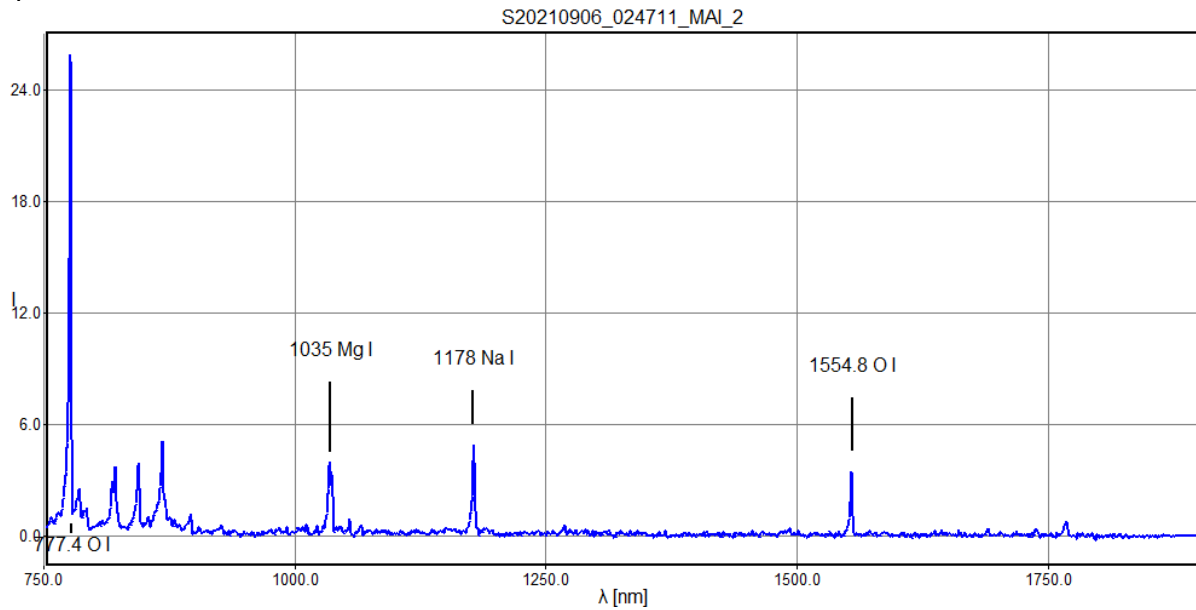


polynom for fit lambda c: [5.9827e-01 7.5323e+02]

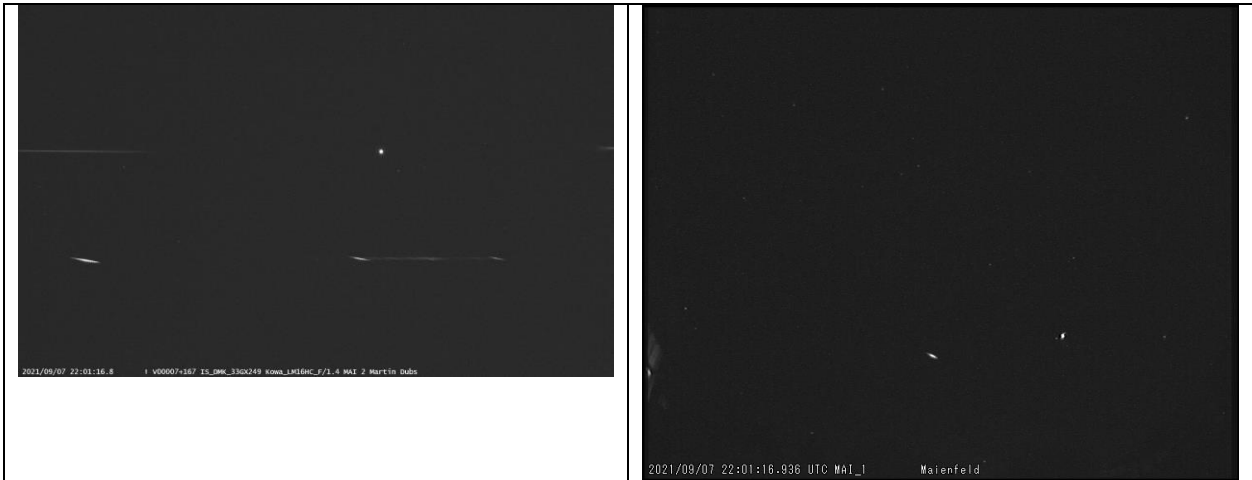
pixel	lambda	fit	error
39.70,	777.40,	776.98,	-0.4204
471.34,	1035.00,	1035.22,	0.2154
710.96,	1178.00,	1178.57,	0.5720
1339.21,	1554.80,	1554.43,	-0.3670

rms_x = 0.4138

spectrum 210906\r_add11cal.dat saved



M20210907_220116_MAI_2, spo, -1.0m

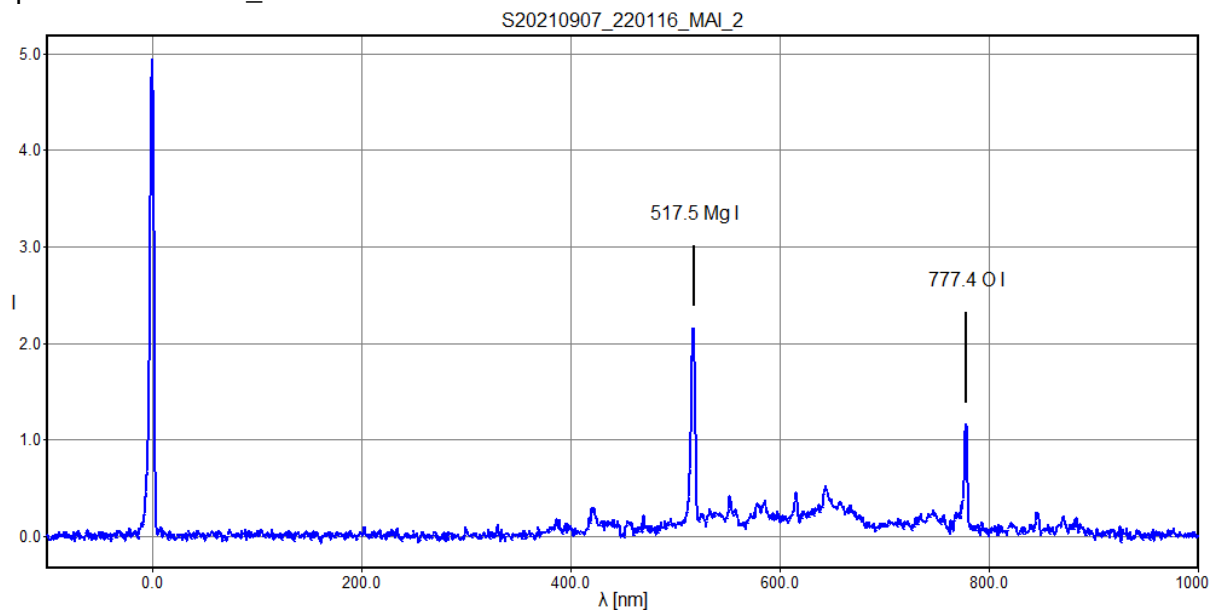


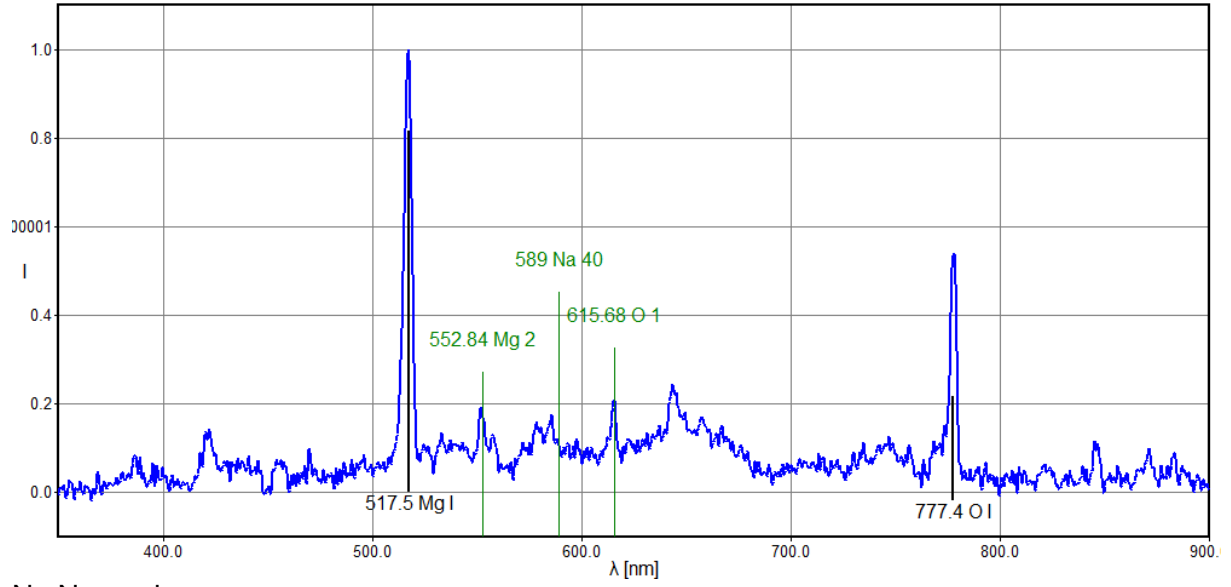
polynom for fit lambda c: [0.5969 -108.6555]

pixel	lambda	fit	error
182.25,	0.00,	0.13,	0.1285
1048.38,	517.50,	517.12,	-0.3834
1484.87,	777.40,	777.65,	0.2550

rms_x = 0.2760

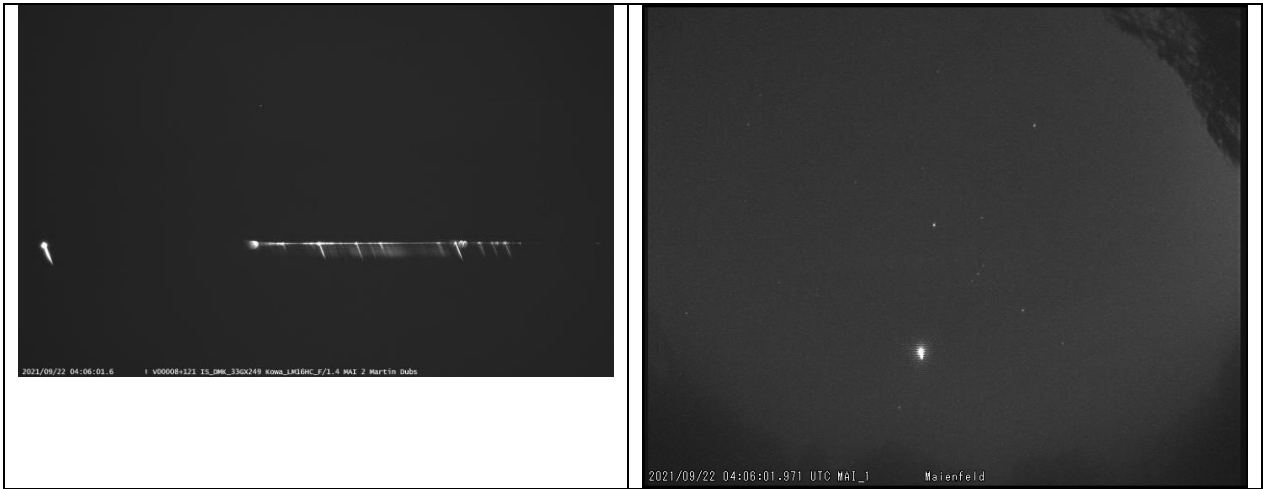
spectrum 210907\r_add17cal.dat saved





No Na-peak

M20210922_040601_MAI_2, spo, -5.1m

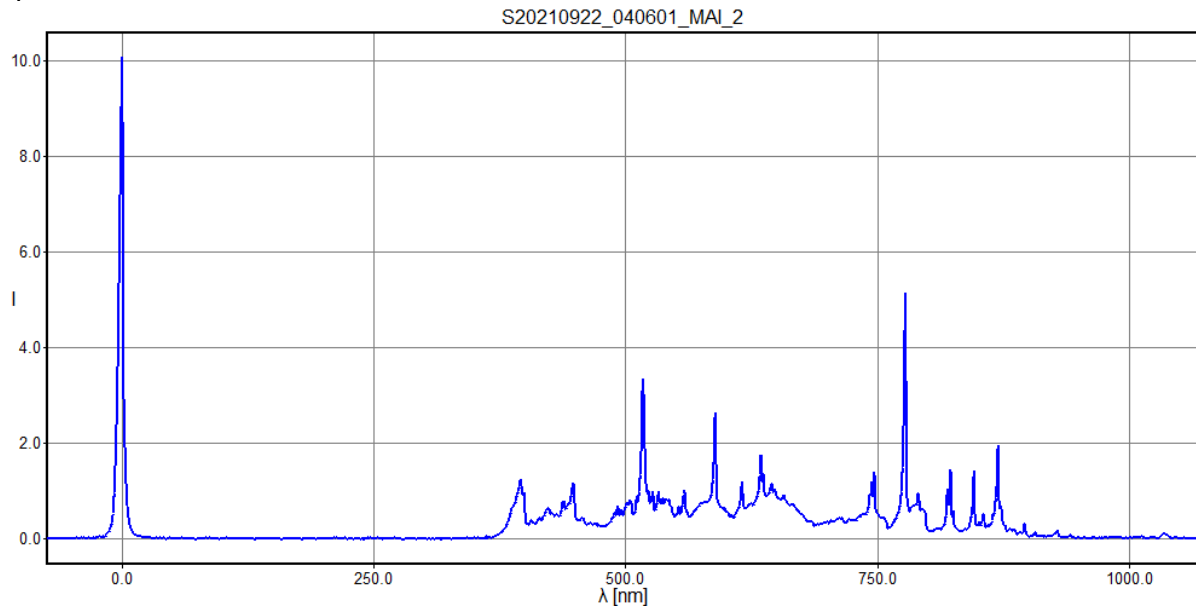


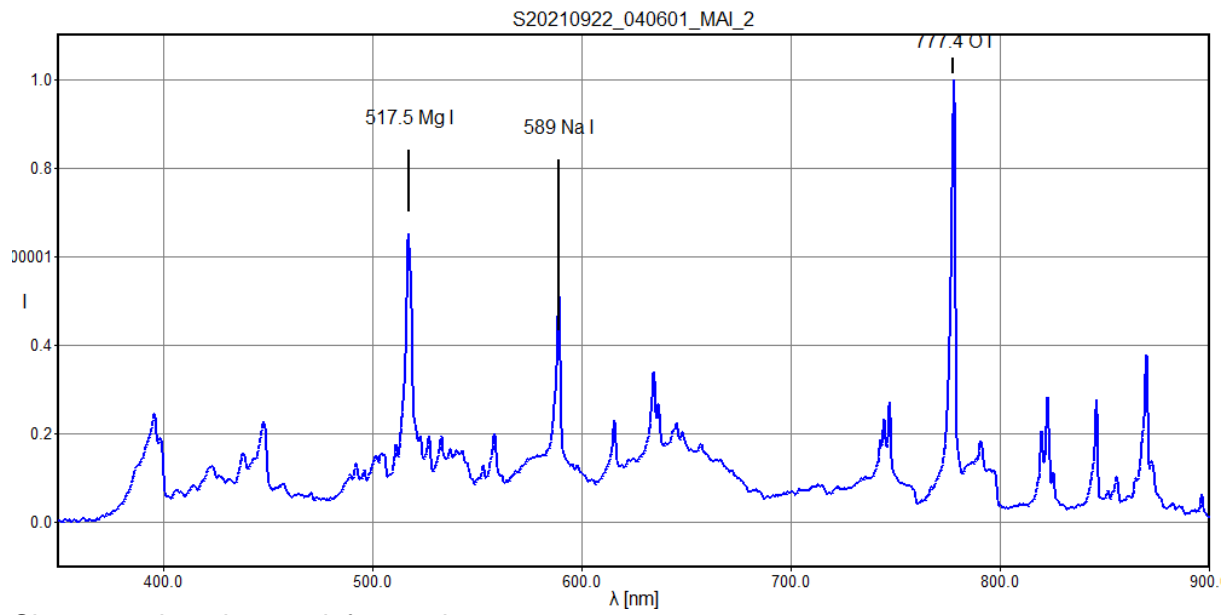
polynom for fit lambda c: [0.5969 -75.0297]

pixel	lambda	fit	error
125.65,	0.00,	-0.03,	-0.0259
992.52,	517.50,	517.43,	-0.0684
1112.43,	589.00,	589.01,	0.0091
1428.41,	777.40,	777.63,	0.2258
1859.34,	1035.00,	1034.86,	-0.1407

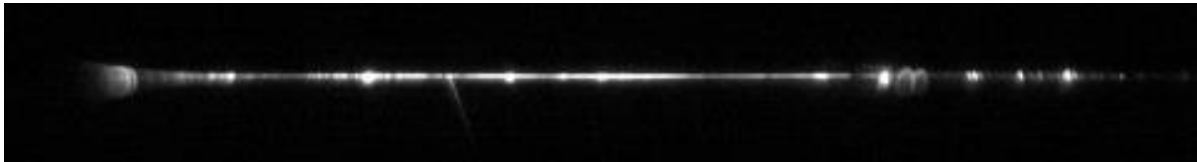
rms_x = 0.1235

spectrum 210922\r_add29cal.dat saved





Short wavelengths are defocused:



Note Ca-lines in 1st and 2nd order

M20210924_225645_MAI_2, STA, -2.3m

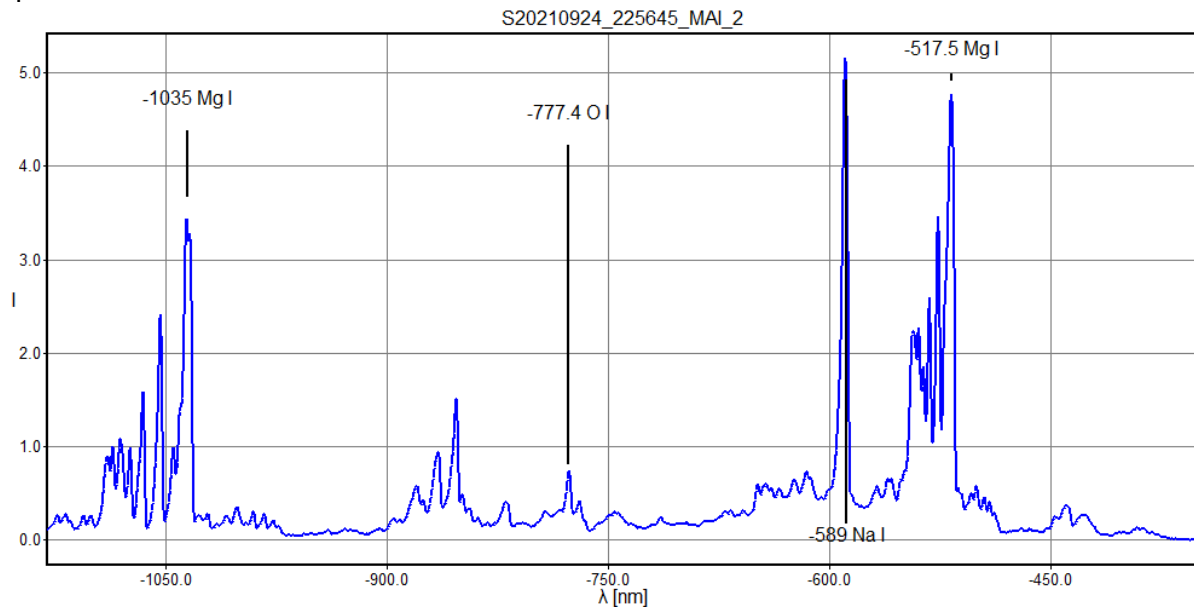


29 frames analysed starting from frame 34 (+24 = 58 in original video)
 polynom for fit lambda c: [5.9777e-01 -1.1318e+03]

pixel	lambda	fit	error
1027.55,	-517.50,	-517.59,	-0.0913
907.43,	-589.00,	-589.40,	-0.3959
594.37,	-777.40,	-776.54,	0.8648
161.36,	-1035.00,	-1035.38,	-0.3776

rms_x = 0.5137

spectrum 210924\ra_add29cal.dat saved



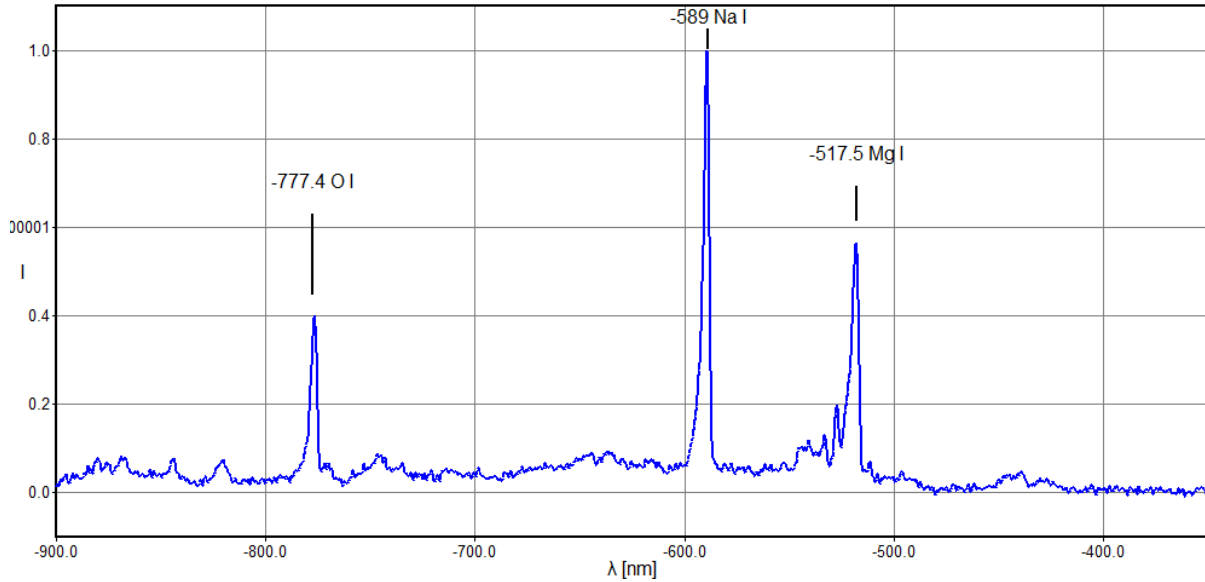
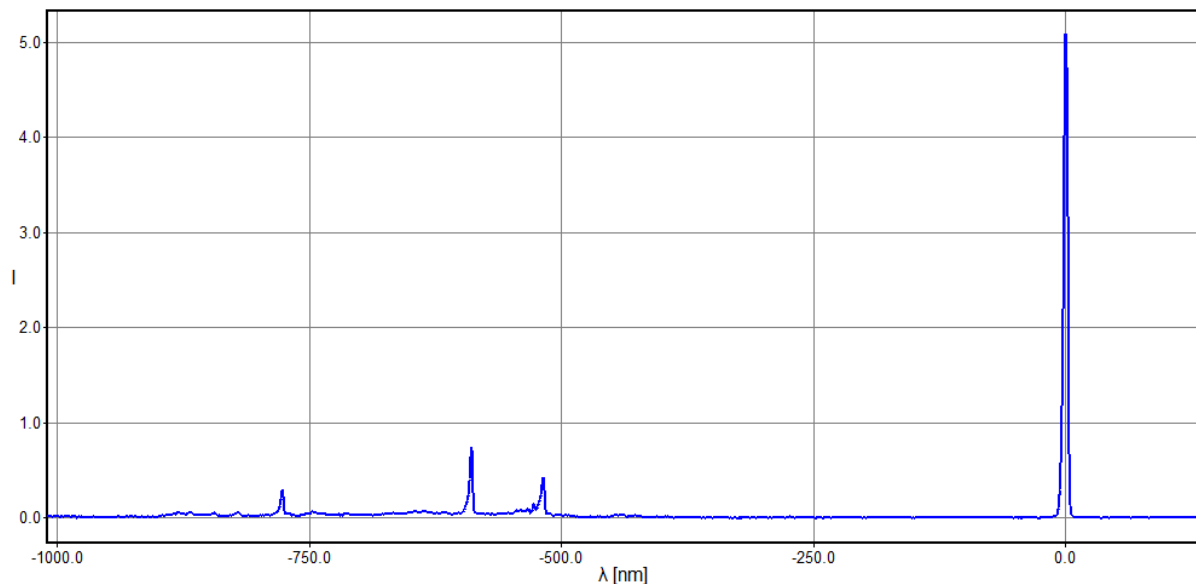
First 31 frames analysed:

polynom for fit lambda c: [5.9688e-01 -1.0115e+03]

pixel	lambda	fit	error
1695.14,	0.00,	0.29,	0.2911
826.59,	-517.50,	-518.13,	-0.6252
707.27,	-589.00,	-589.34,	-0.3444
393.34,	-777.40,	-776.72,	0.6785

rms_x = 0.5134

spectrum 210924\r_add31cal.dat saved



M20210925_033625_MAI_2, spo, -2.1m



polynom for fit lambda c: [0.5996 -529.347]

pixel lambda fit error

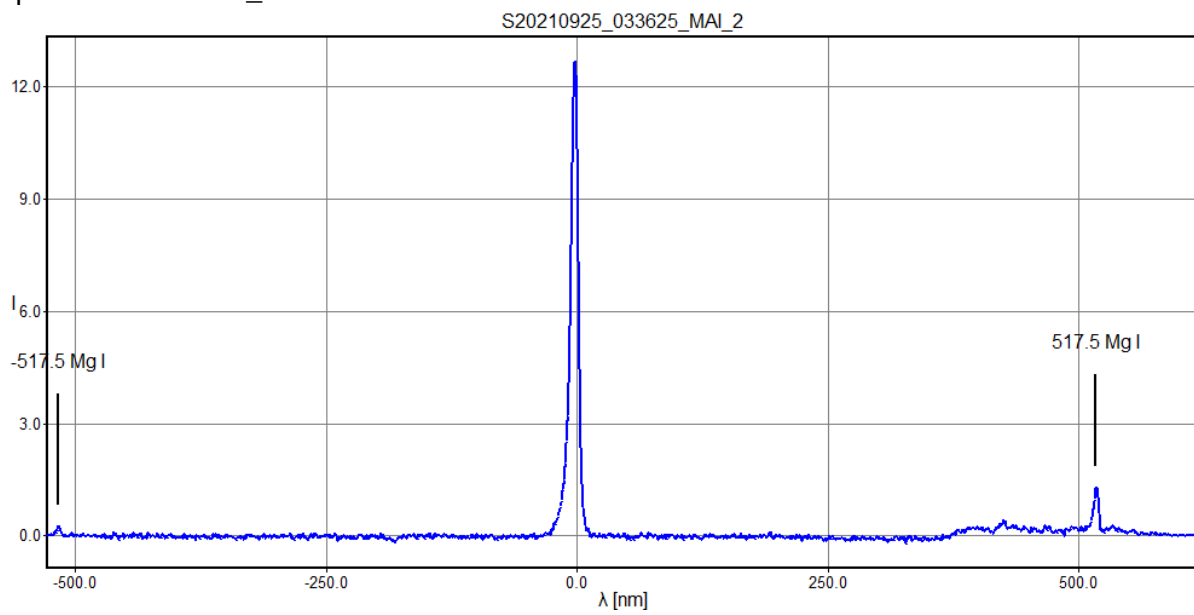
21.22, -517.50, -516.62, 0.8758

879.98, 0.00, -1.74, -1.7427

1747.46, 517.50, 518.37, 0.8670

rms_x = 1.2323

spectrum 210925\r_add7cal.dat saved



M20211001_012126_MAI_2, spo, -2.3m

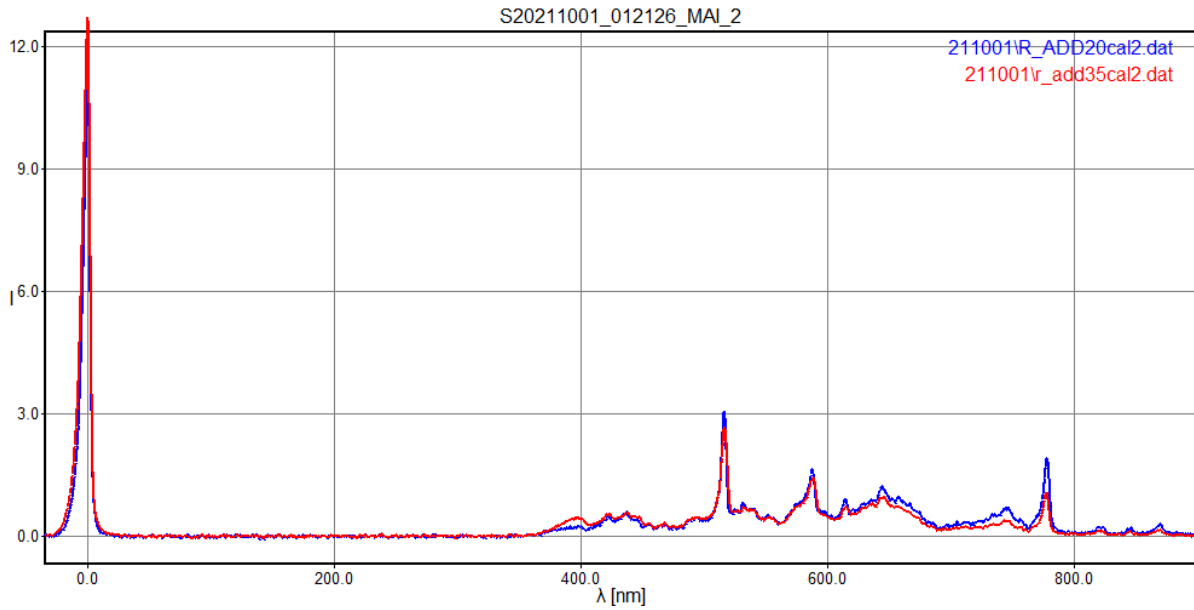


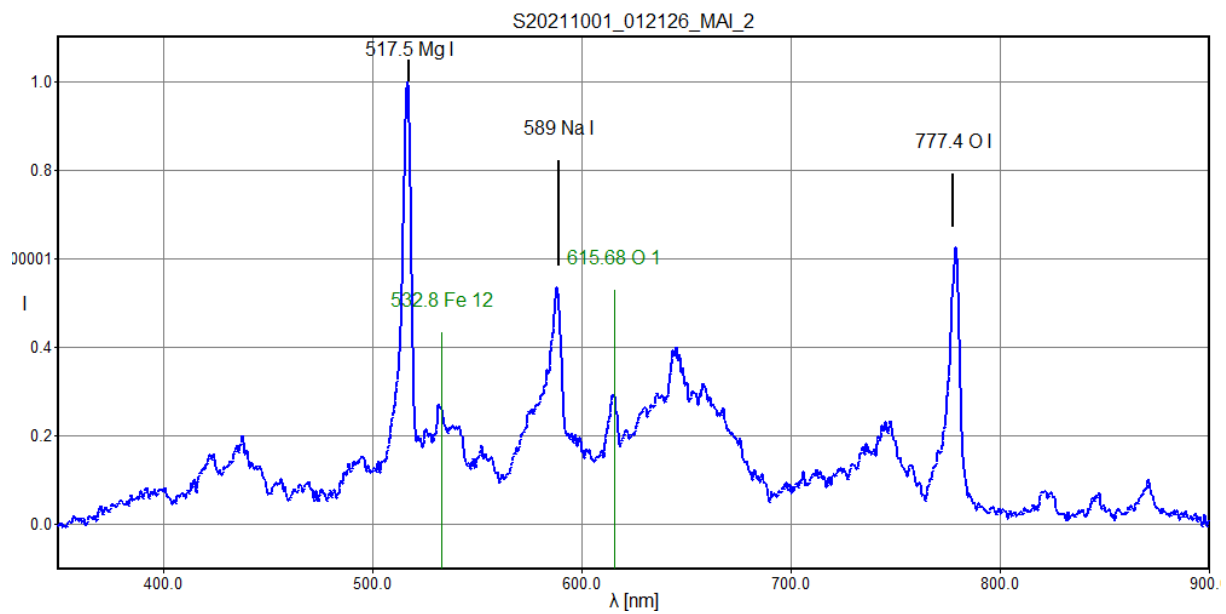
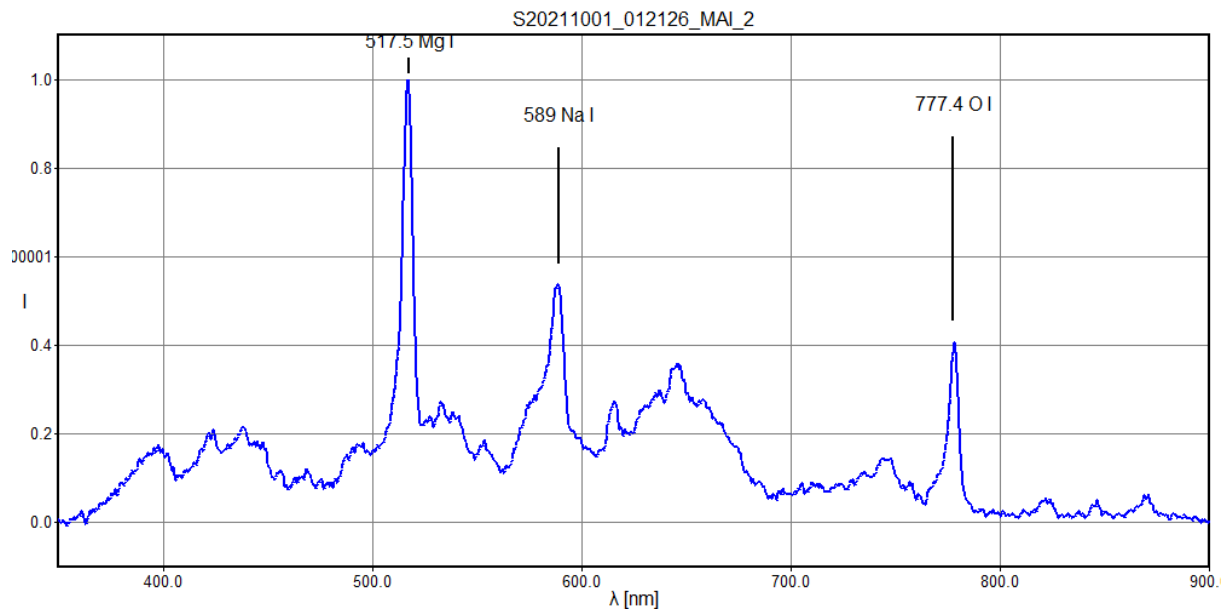
polynomial for fit lambda c: [0.5982 -35.3603]

pixel	lambda	fit	error
59.53,	0.00,	0.25,	0.2480
923.42,	517.50,	516.99,	-0.5103
1043.28,	589.00,	588.68,	-0.3152
1359.74,	777.40,	777.98,	0.5775

rms_x = 0.4344

spectrum 211001\r_add35cal.dat saved





First 20 images added, higher intensity at right hand side of spectrum (cut off in later frames)

M20211010_214627_MAI_1, OCT, -1.9m

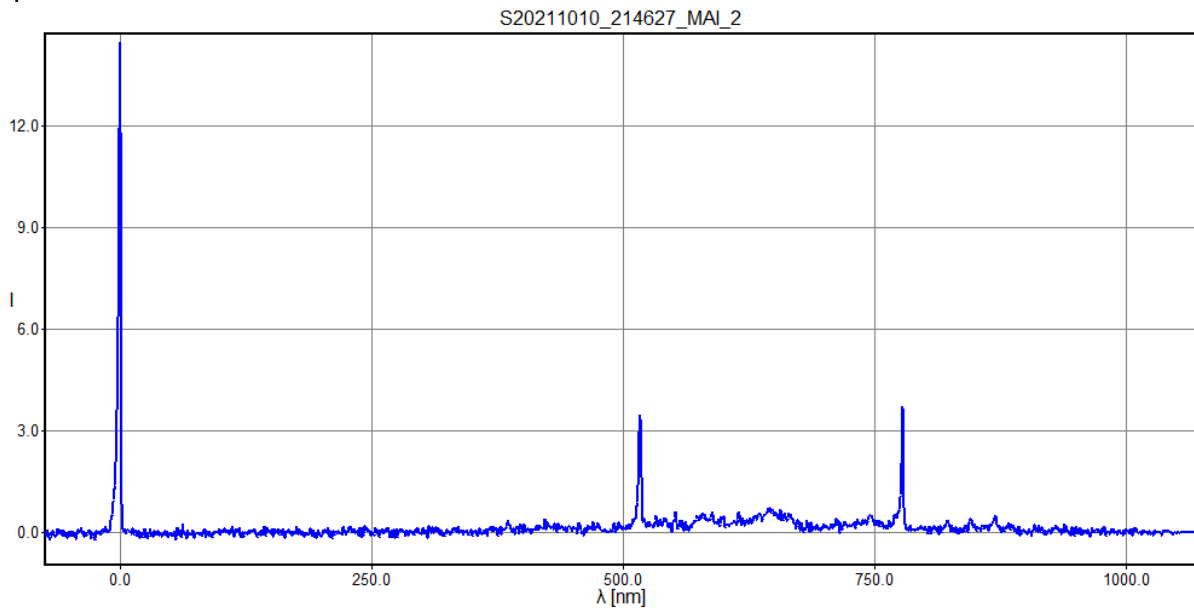


polynom for fit lambda c: [0.5977 -75.9798]

pixel	lambda	fit	error
127.37,	0.00,	0.15,	0.1517
992.15,	517.50,	517.05,	-0.4526
1428.23,	777.40,	777.70,	0.3009

rms_x = 0.3258

spectrum test\r_add8cal.dat saved



M20211011_023110_MAI_2, spo, -0.8m

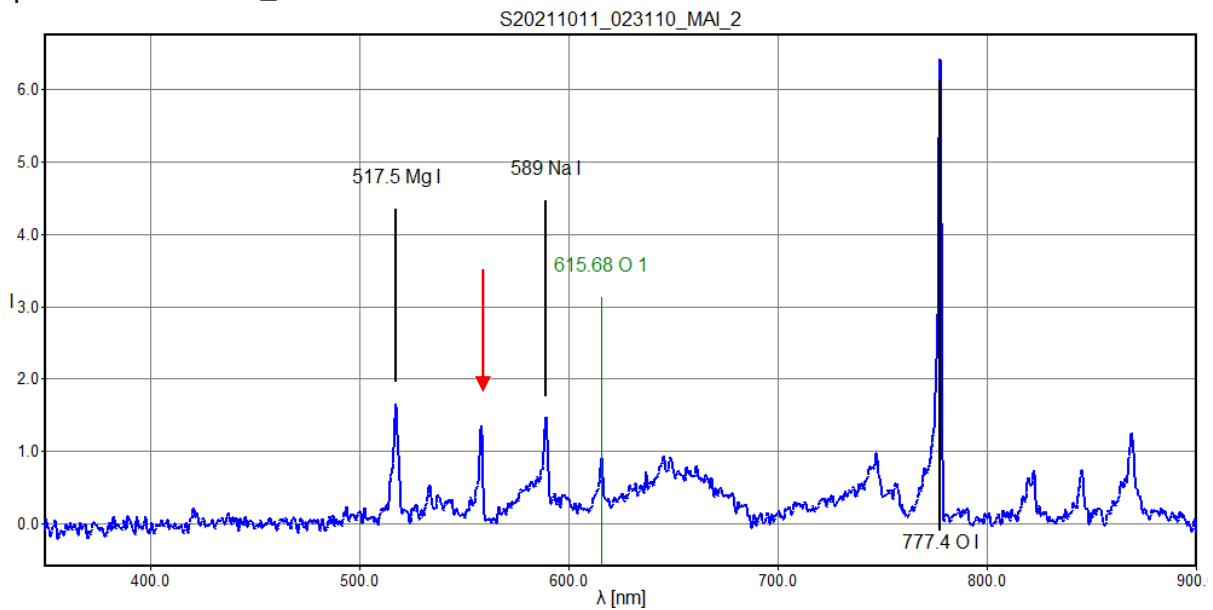


polynom for fit lambda c: [0.5982 306.2561]

pixel	lambda	fit	error
353.07,	517.50,	517.45,	-0.0475
472.79,	589.00,	589.07,	0.0656
787.61,	777.40,	777.38,	-0.0181

rms_x = 0.0479

spectrum 211011\ra_add14cal.dat saved



Notice [O I] train line at 557.7nm

M20211011_222545_MAI_2, OCT, -3.8m

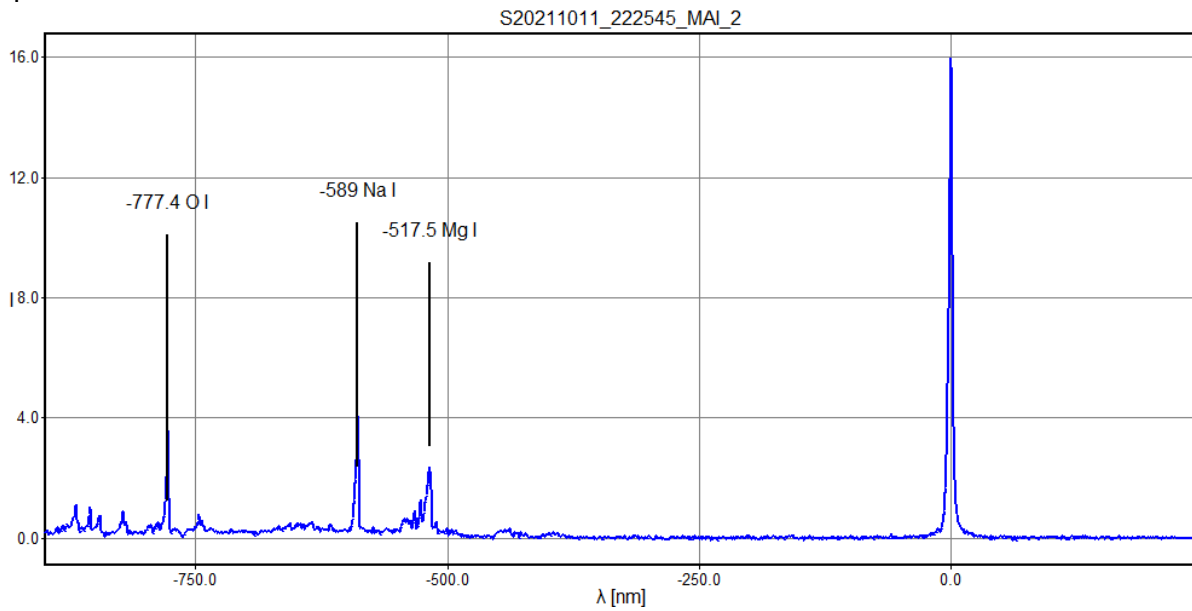


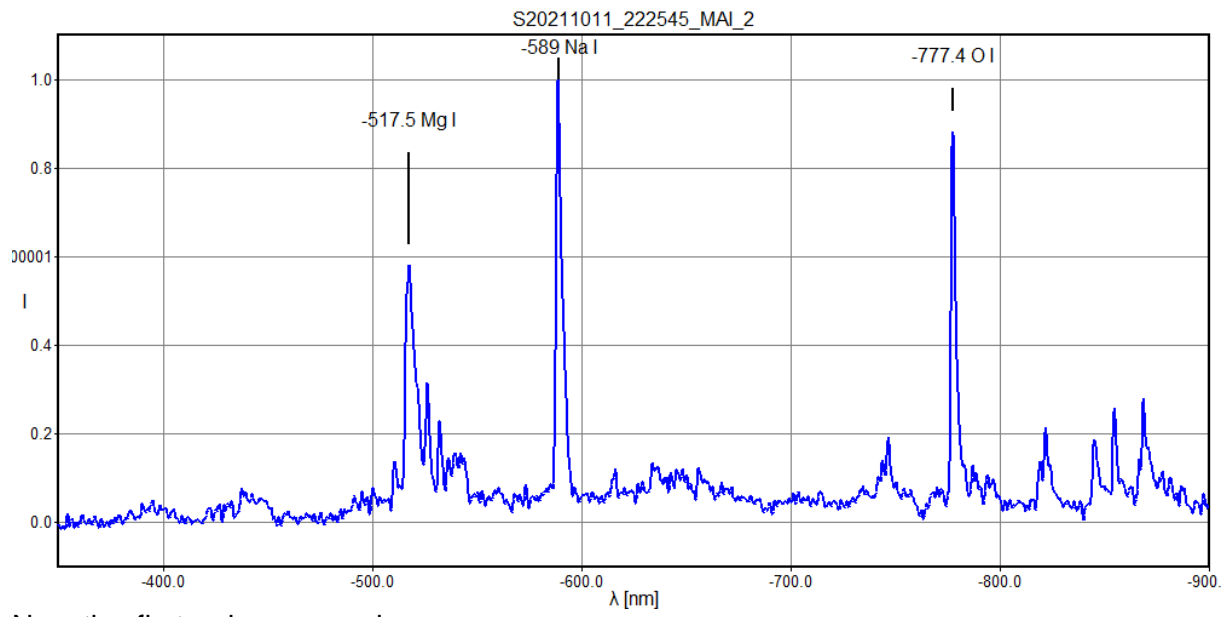
polynom for fit lambda c: [5.9708e-01 -9.0045e+02]

pixel	lambda	fit	error
1508.06,	0.00,	-0.03,	-0.0272
641.38,	-517.50,	-517.50,	-0.0006
521.82,	-589.00,	-588.89,	0.1130
205.95,	-777.40,	-777.49,	-0.0852

rms_x = 0.0721

spectrum 211011\rb_add14cal.dat saved





Negative first order reversed

M20211025_213339_MAI_2, ORI, -4.4m

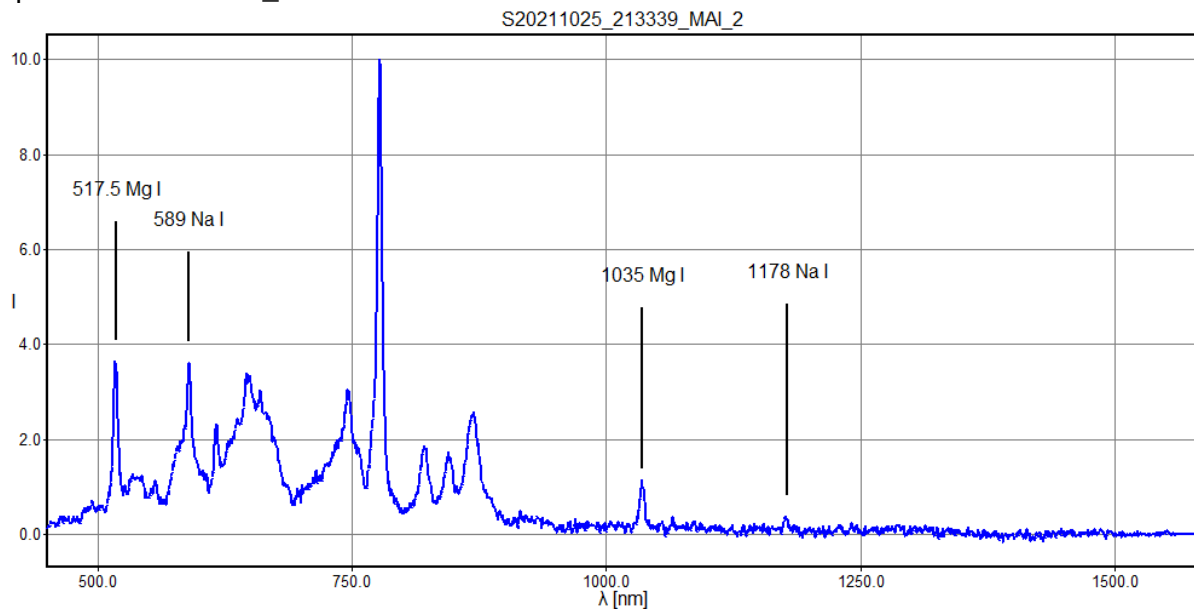


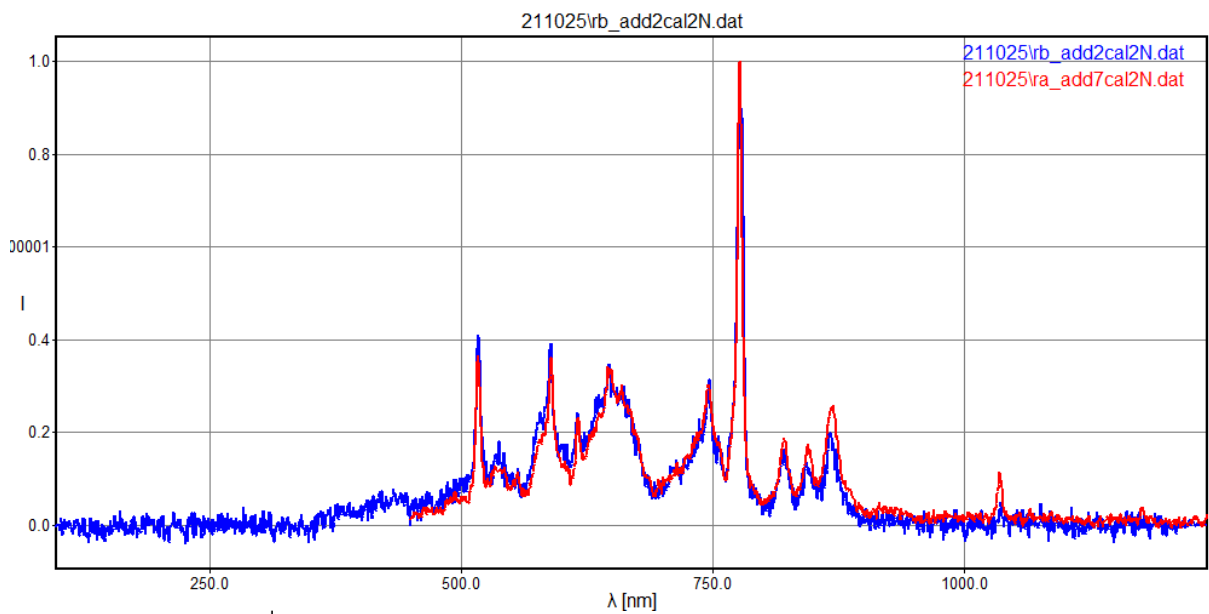
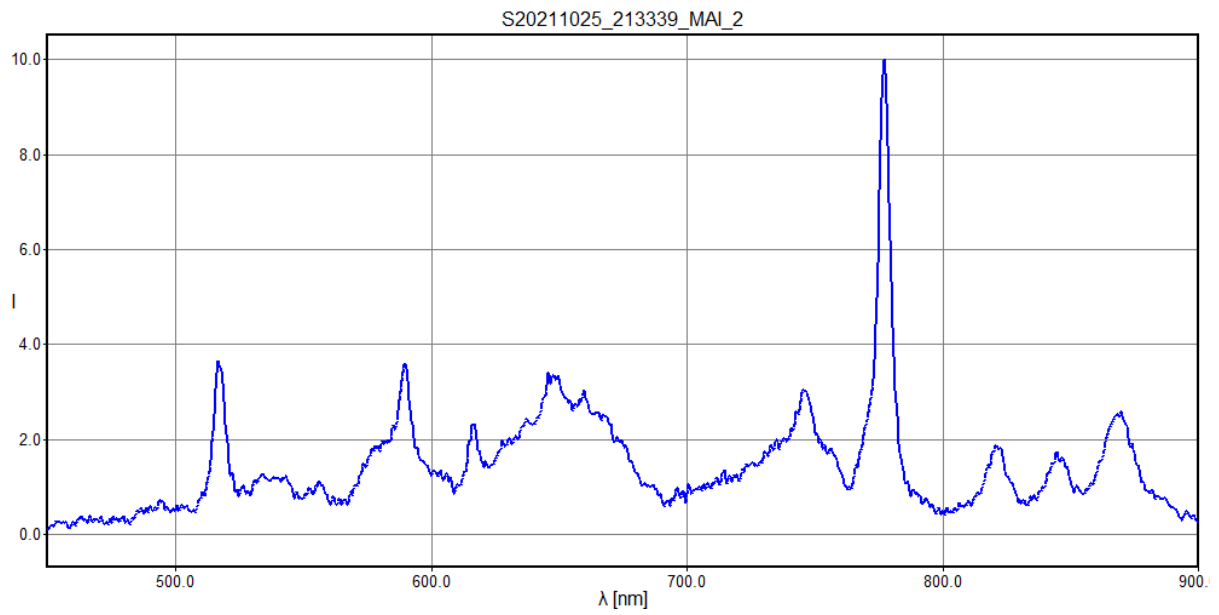
polynom for fit lambda c: [0.5915 449.7379]

pixel	lambda	fit	error
113.79	517.50	517.05	-0.4512
236.67	589.00	589.74	0.7366
553.30	777.40	777.03	-0.3655
989.53	1035.00	1035.08	0.0801

rms_x = 0.4707

spectrum 211025\ra_add7cal.dat saved





Comparison with 2nd part of spectrum (only two frames), in blue

M20211027_234907_MAI_2, ORI, -1.9m

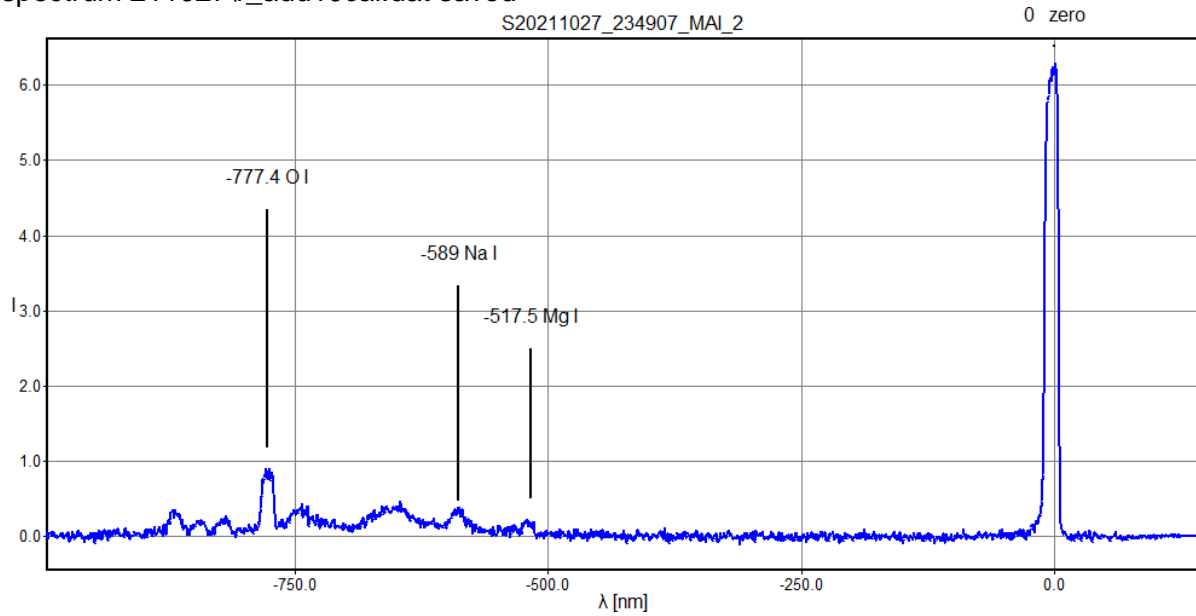


polynom for fit lambda c: [5.9480e-01 -9.9674e+02]

pixel	lambda	fit	error
1677.48,	0.00,	1.04,	1.0364
799.75,	-517.50,	-521.04,	-3.5412
686.36,	-589.00,	-588.49,	0.5140
372.10,	-777.40,	-775.41,	1.9908

rms_x = 2.1120

spectrum 211027\r_add10cal.dat saved



Movement parallel dispersion axis, cannot remove slant

M20211107_175856_MAI_2, spo, -0.9m

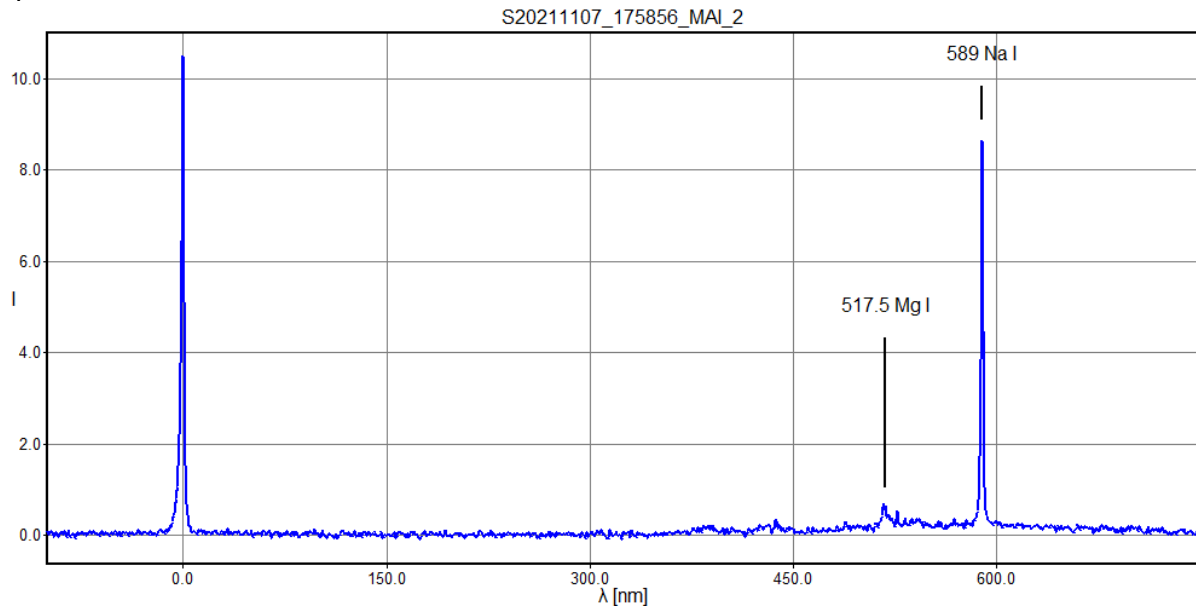


polynom for fit lambda c: [0.5986 -397.8492]

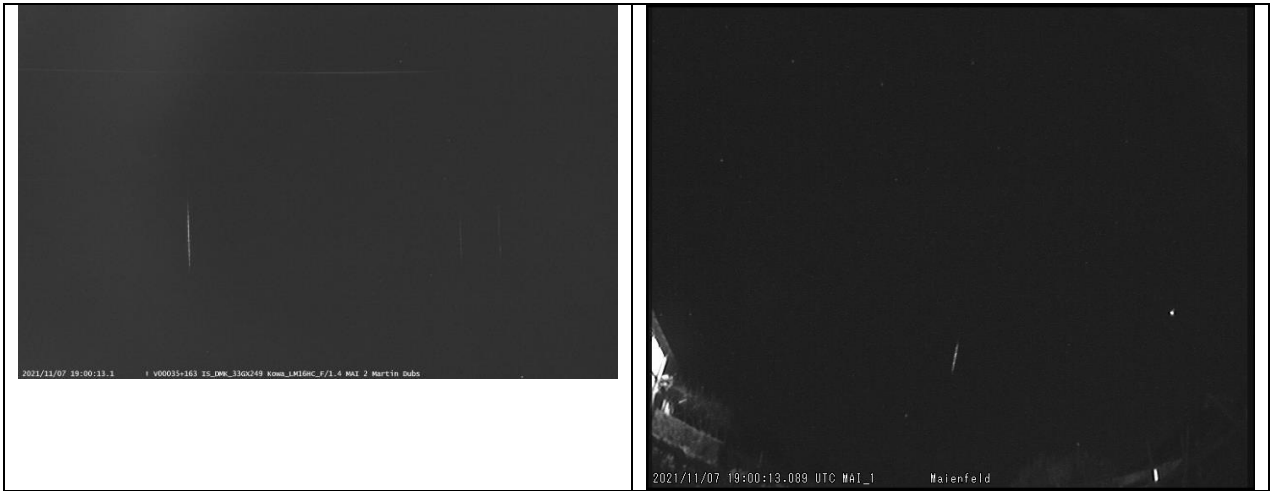
pixel	lambda	fit	error
664.70,	0.00,	0.04,	0.0432
1528.55,	517.50,	517.15,	-0.3525
1649.10,	589.00,	589.31,	0.3093

rms_x = 0.2719

spectrum 211107\r_add39cal.dat saved



M20211107_190013_MAI_2, spo, -0.9m

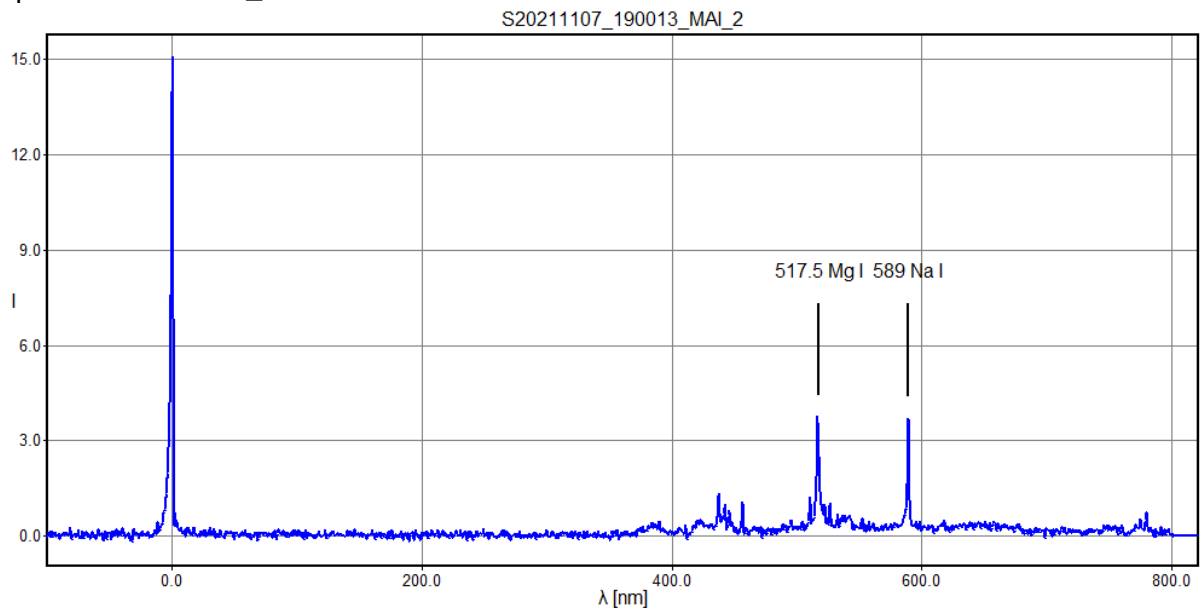


polynom for fit lambda c: [0.5989 -326.088]

pixel	lambda	fit	error
544.60,	0.00,	0.08,	0.0765
1407.51,	517.50,	516.88,	-0.6209
1528.84,	589.00,	589.54,	0.5444

rms_x = 0.4788

spectrum 211107\r_add14cal.dat saved



M20211109_032453_MAI_2, spo, -1.2m

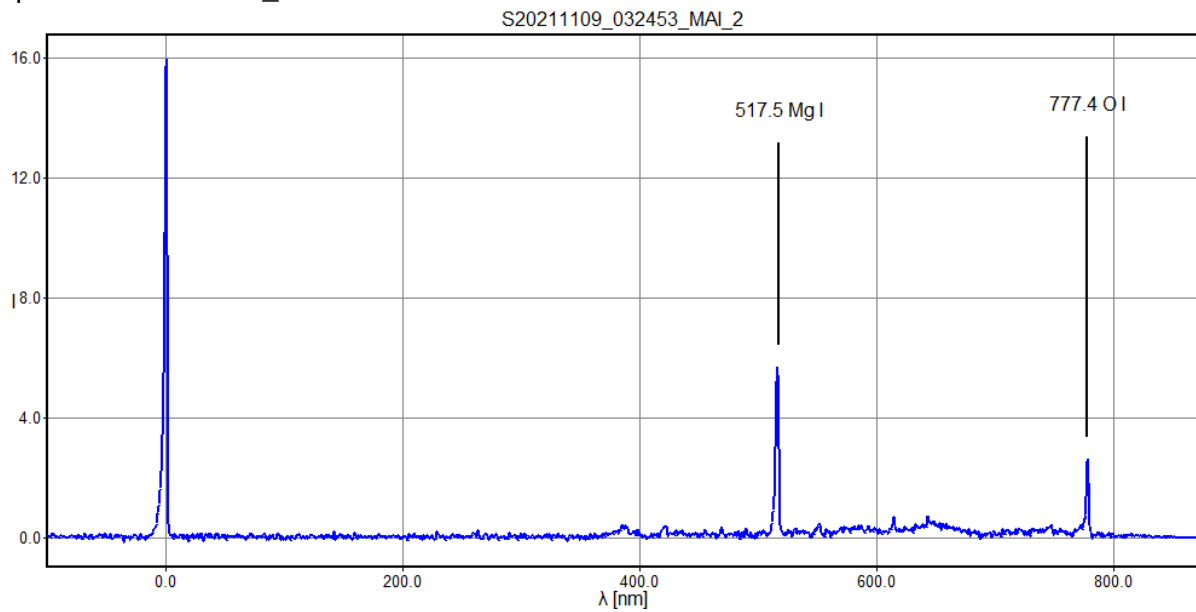


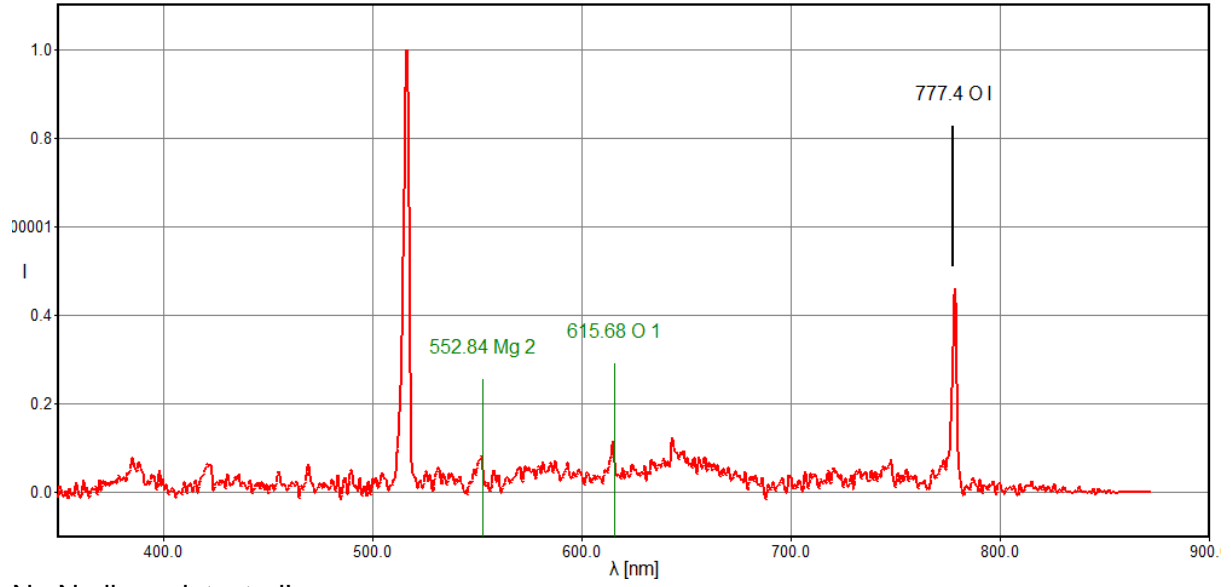
polynom for fit lambda c: [0.5964 -271.4454]

pixel	lambda	fit	error
455.79	0.00	0.38	0.3811
1320.98	517.50	516.37	-1.1322
1759.93	777.40	778.15	0.7511

rms_x = 0.8147

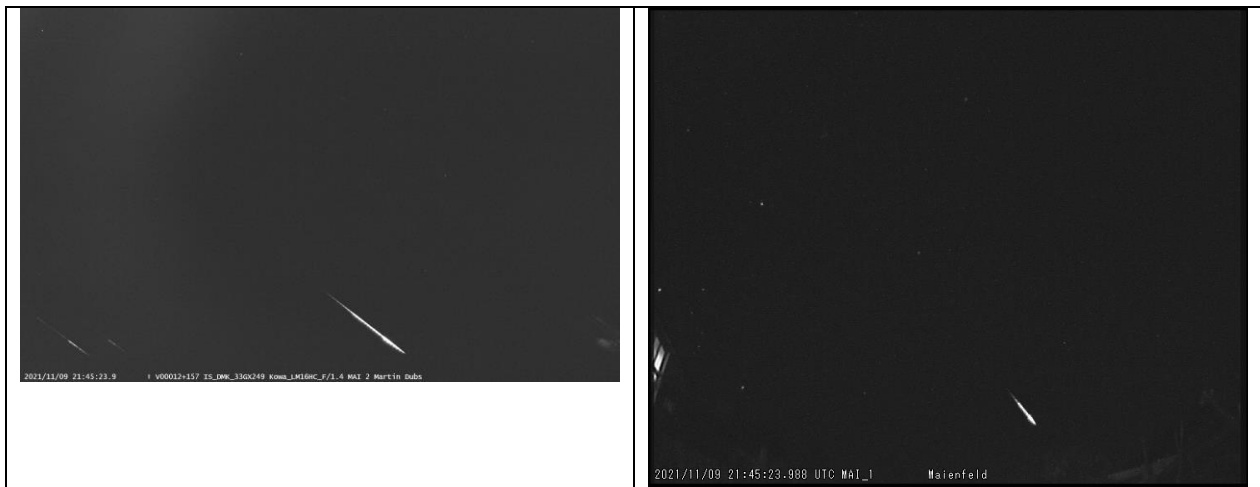
spectrum 211109\ra_add9cal.dat saved





No Na lines detected!

M20211109_214523_MAI_2, NTA, -2.9m

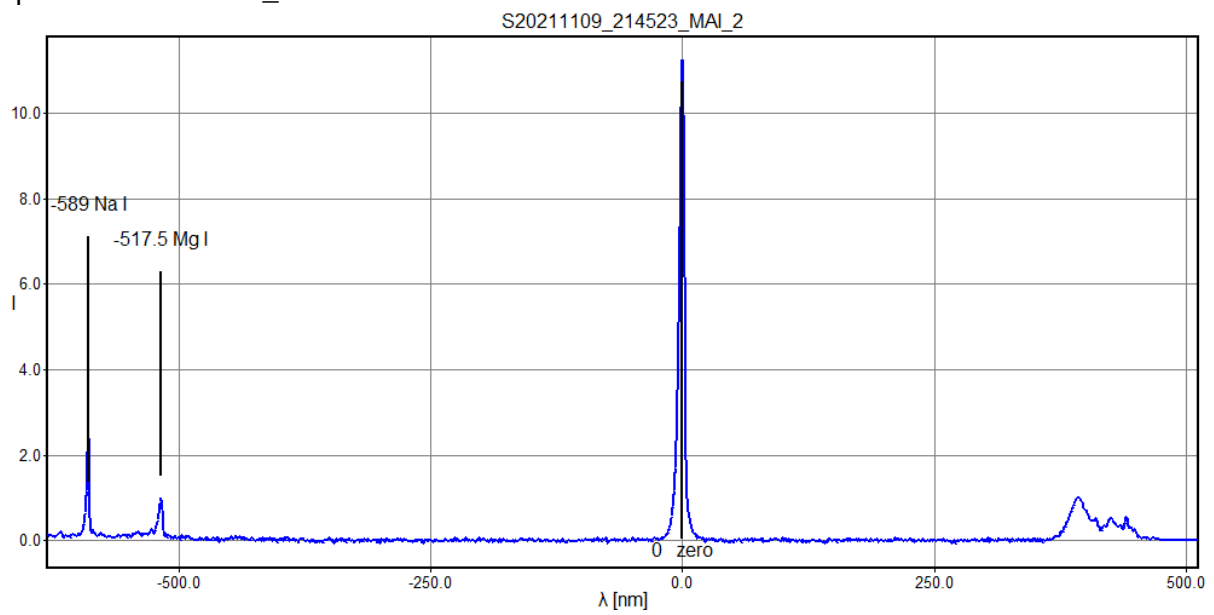


polynom for fit lambda c: [5.9645e-01 -6.3144e+02]

pixel	lambda	fit	error
1058.59,	0.00,	-0.04,	-0.0402
191.58,	-517.50,	-517.17,	0.3287
70.67,	-589.00,	-589.29,	-0.2885

rms_x = 0.2536

spectrum 211109\rb_add19cal.dat saved



M20211112_035220_MAI_2, NOO, -1.4m

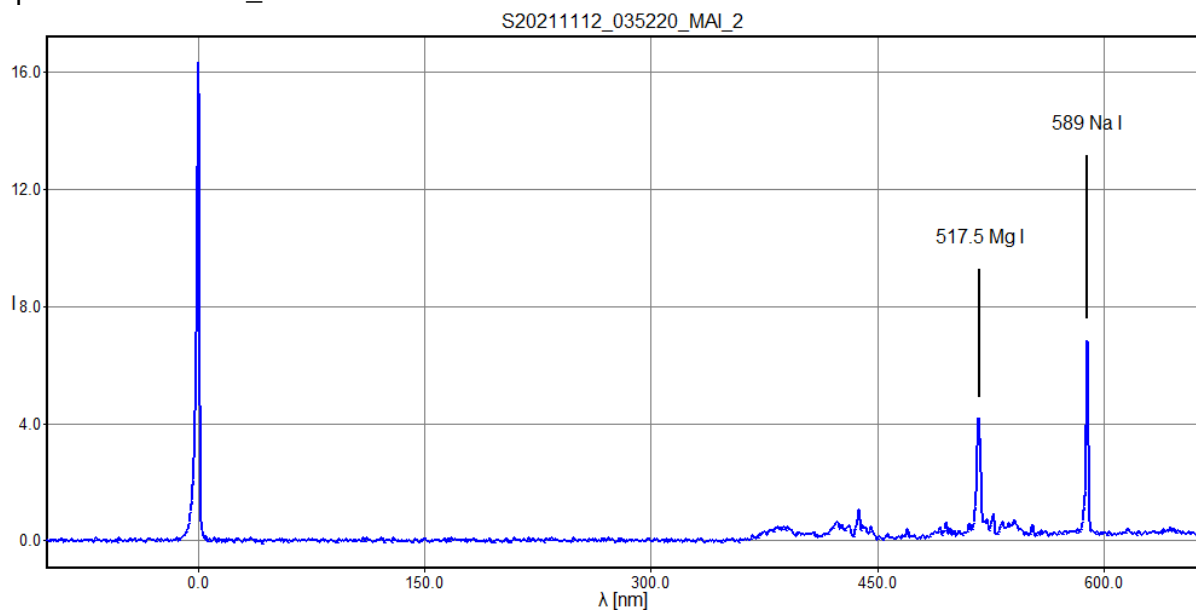


polynom for fit lambda c: [0.5975 -481.98]

pixel	lambda	fit	error
806.74,	0.00,	0.03,	0.0264
1672.48,	517.50,	517.28,	-0.2162
1792.83,	589.00,	589.19,	0.1898

rms_x = 0.1668

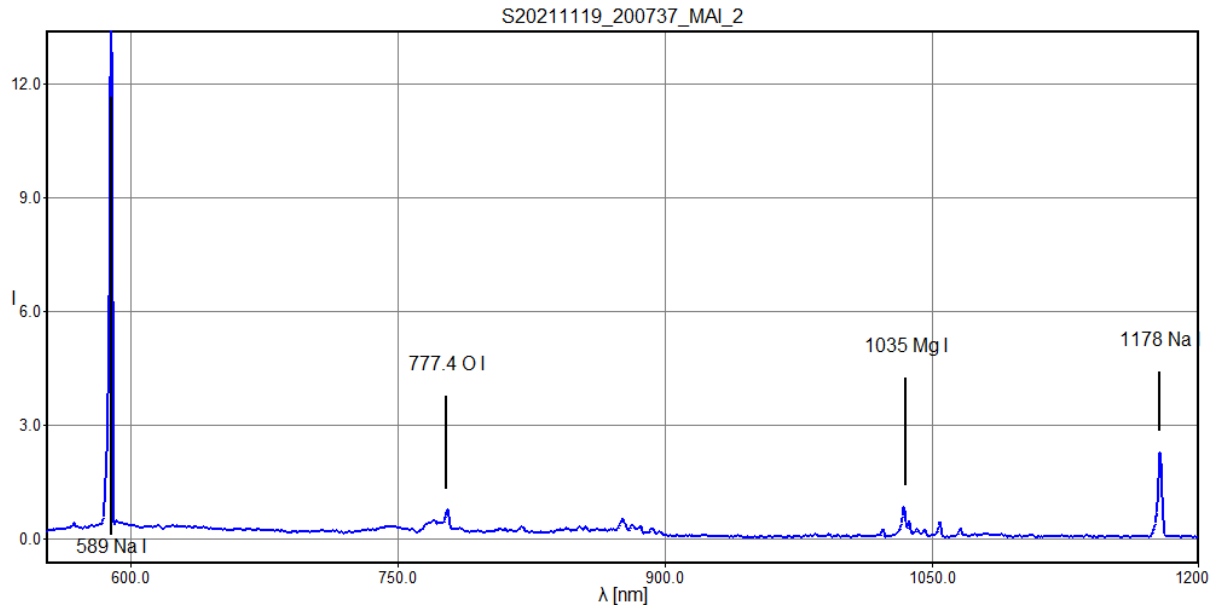
spectrum 211112\r_add22cal.dat saved



M20211119_200737_MAI_2, spo, -2.7m



polynom for fit lambda c: [0.597 552.804]
pixel lambda fit error
60.46, 589.00, 588.90, -0.1013
376.80, 777.40, 777.75, 0.3542
806.74, 1035.00, 1034.43, -0.5711
1047.76, 1178.00, 1178.32, 0.3182
rms_x = 0.3752
spectrum 211119\r_add29cal.dat saved



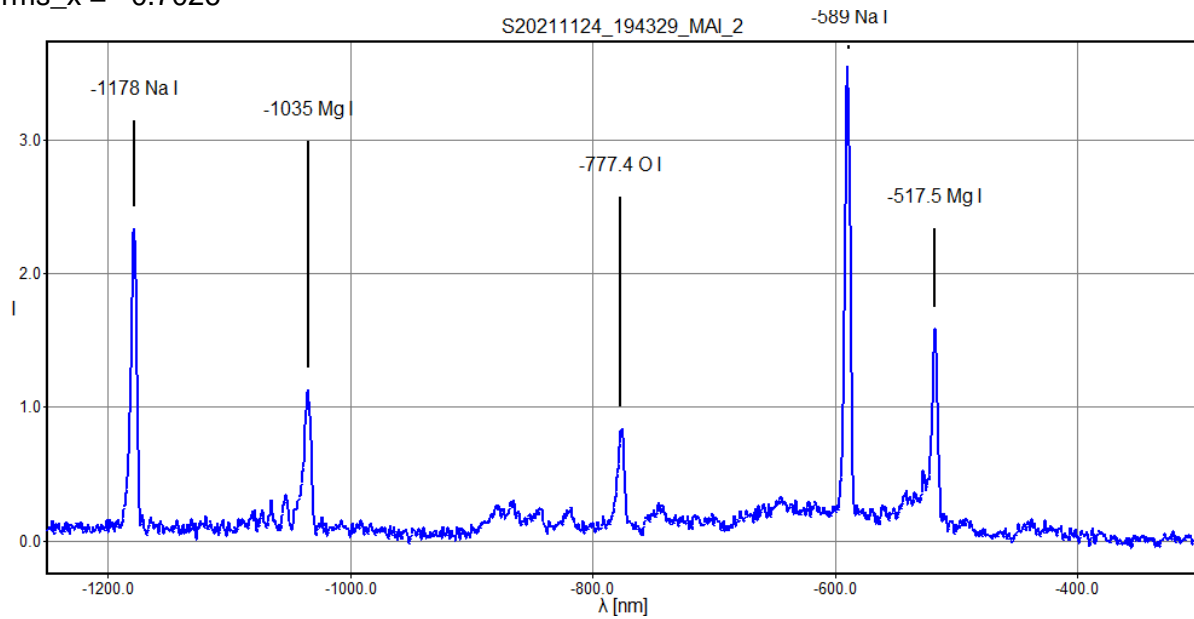
M20211124_194329_MAI_2, GEM, -1.9m



polynom for fit lambda c: [6.0053e-01 -1.2740e+03]

pixel	lambda	fit	error
1259.69,	-517.50,	-517.55,	-0.0516
1139.36,	-589.00,	-589.81,	-0.8133
829.13,	-777.40,	-776.12,	1.2845
397.99,	-1035.00,	-1035.03,	-0.0277
159.26,	-1178.00,	-1178.39,	-0.3920

rms_x = 0.7026



M20211124_233531_MAI_2, spo, -2.5m

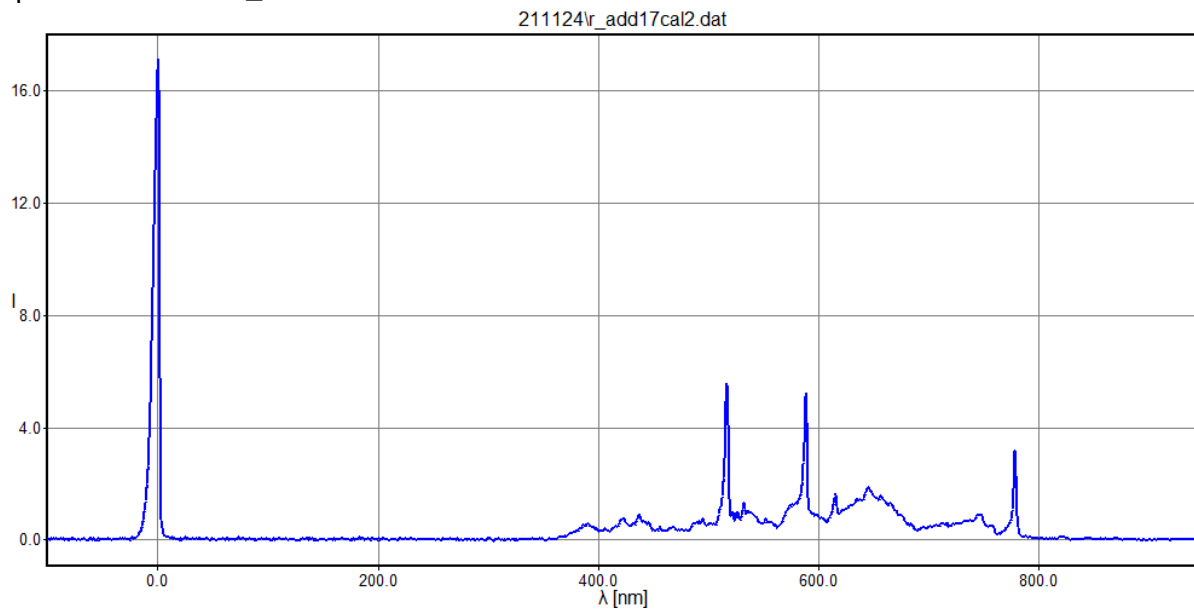


polynom for fit lambda c: [0.5967 -197.9822]

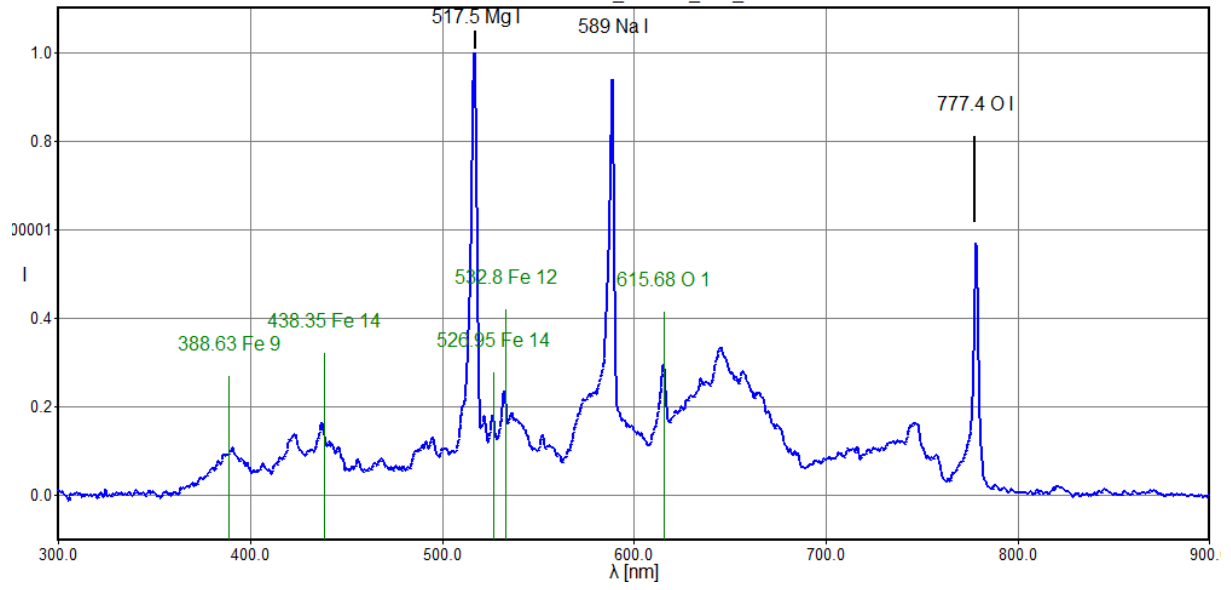
pixel	lambda	fit	error
332.43,	0.00,	0.37,	0.3655
1197.94,	517.50,	516.78,	-0.7194
1318.13,	589.00,	588.49,	-0.5069
1636.18,	777.40,	778.26,	0.8608

rms_x = 0.6421

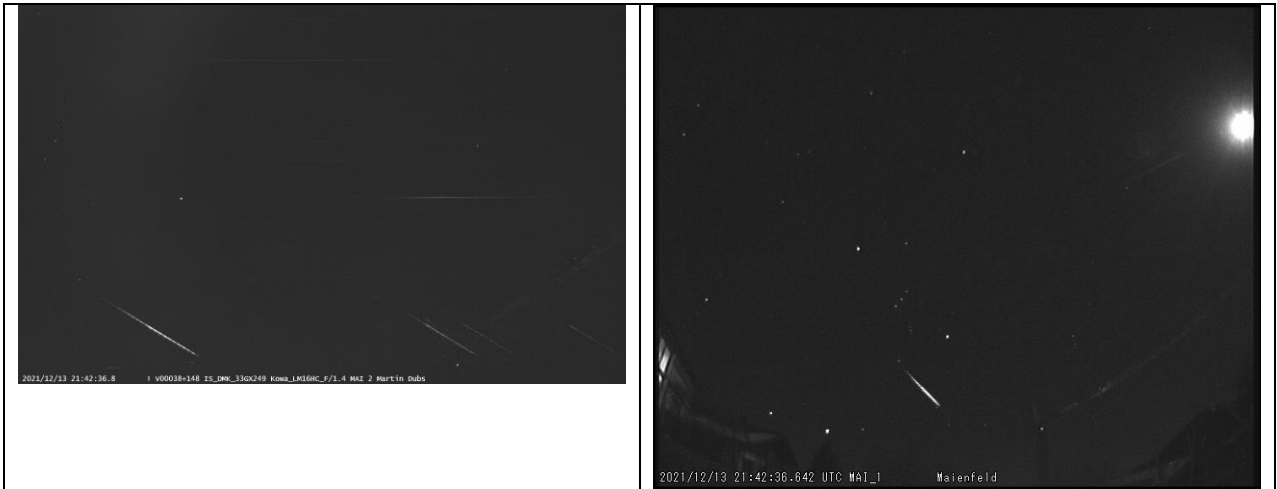
spectrum 211124\r_add17cal.dat saved



S20211124_233531_MAI_2



M20211213_214236_MAI_2, DAD, -1.5m

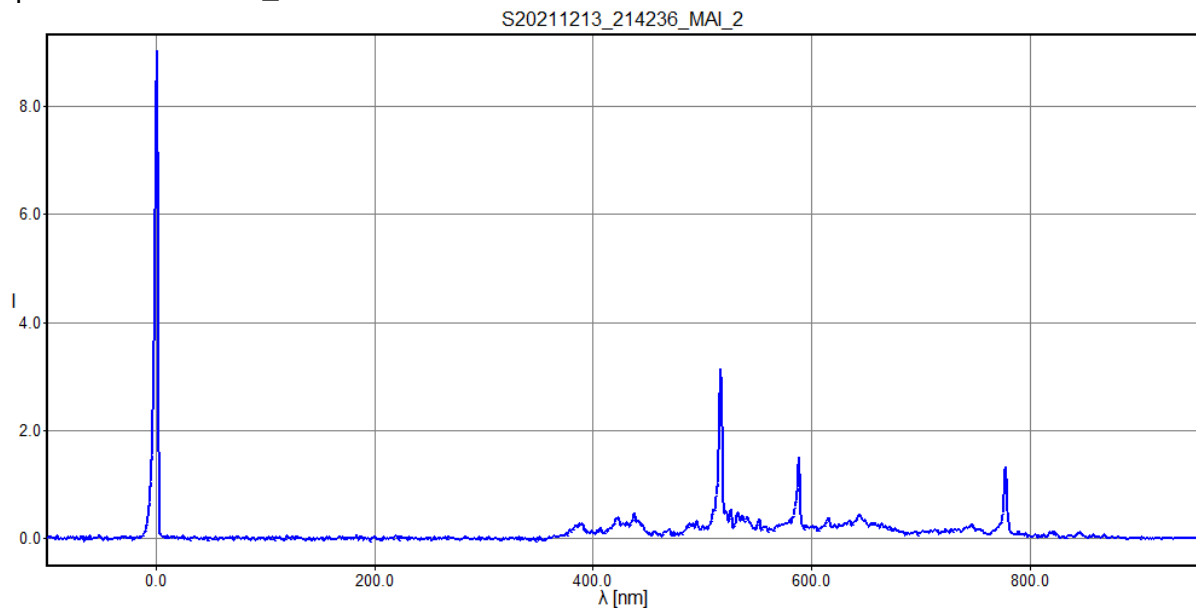


polynom for fit lambda c: [0.5957 -186.2217]

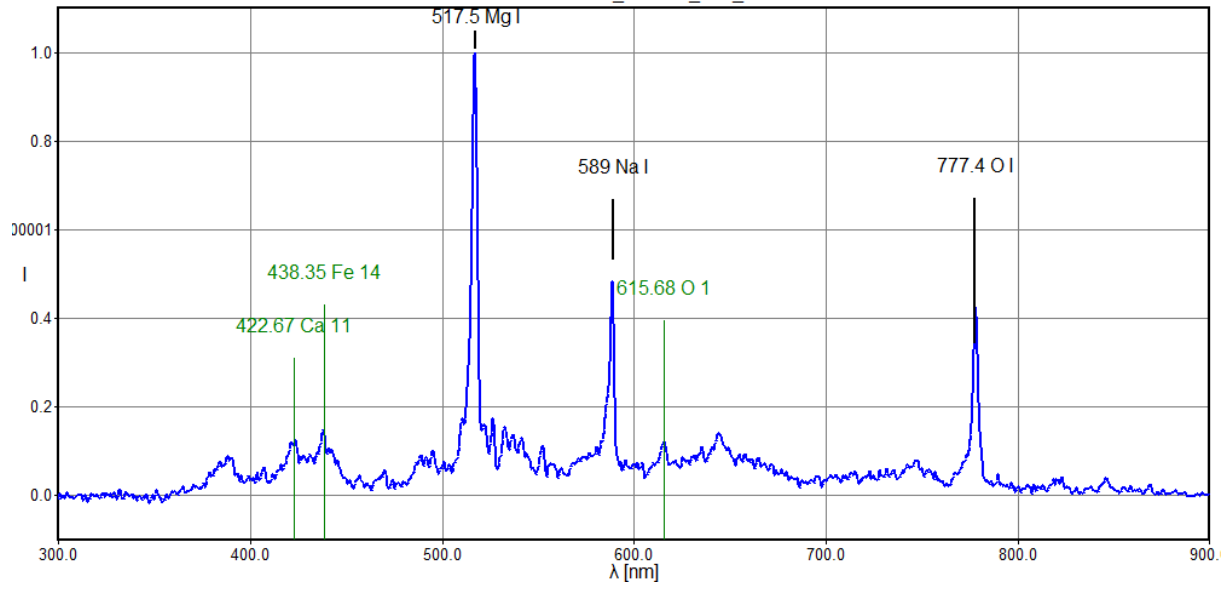
pixel	lambda	fit	error
313.02,	0.00,	0.25,	0.2543
1180.43,	517.50,	517.00,	-0.5017
1300.70,	589.00,	588.65,	-0.3530
1618.55,	777.40,	778.00,	0.6004

rms_x = 0.4476

spectrum 211213\ra_add19cal.dat saved



S20211213_214236_MAI_2



M20211213_222633_MAI_2, GEM, -1.7m

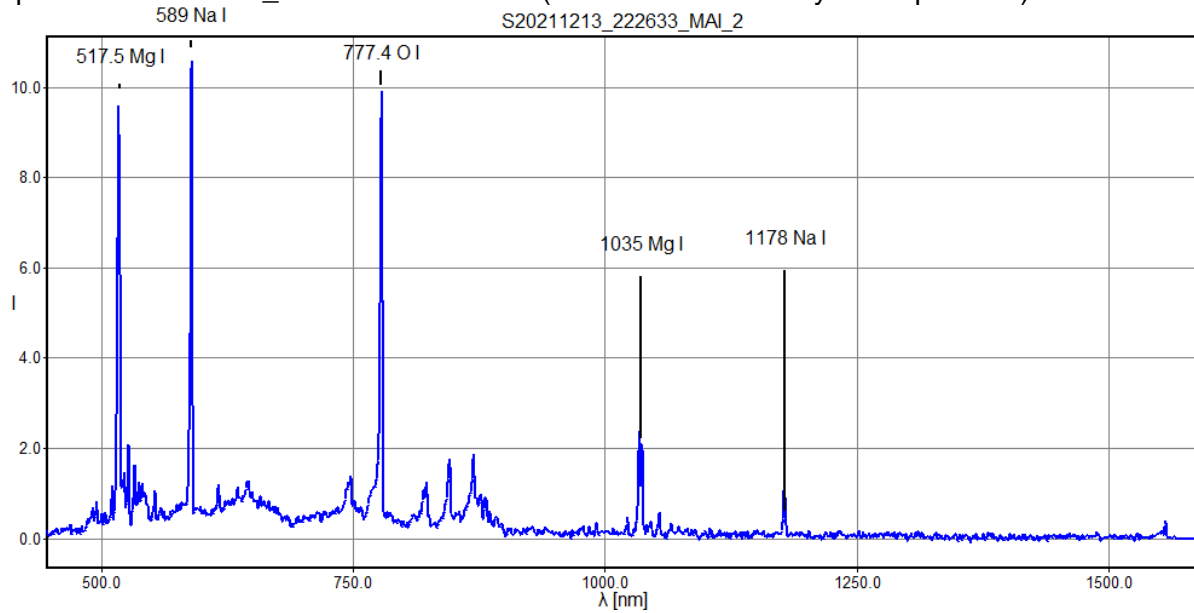


polynom for fit lambda c: [0.5976 445.0142]

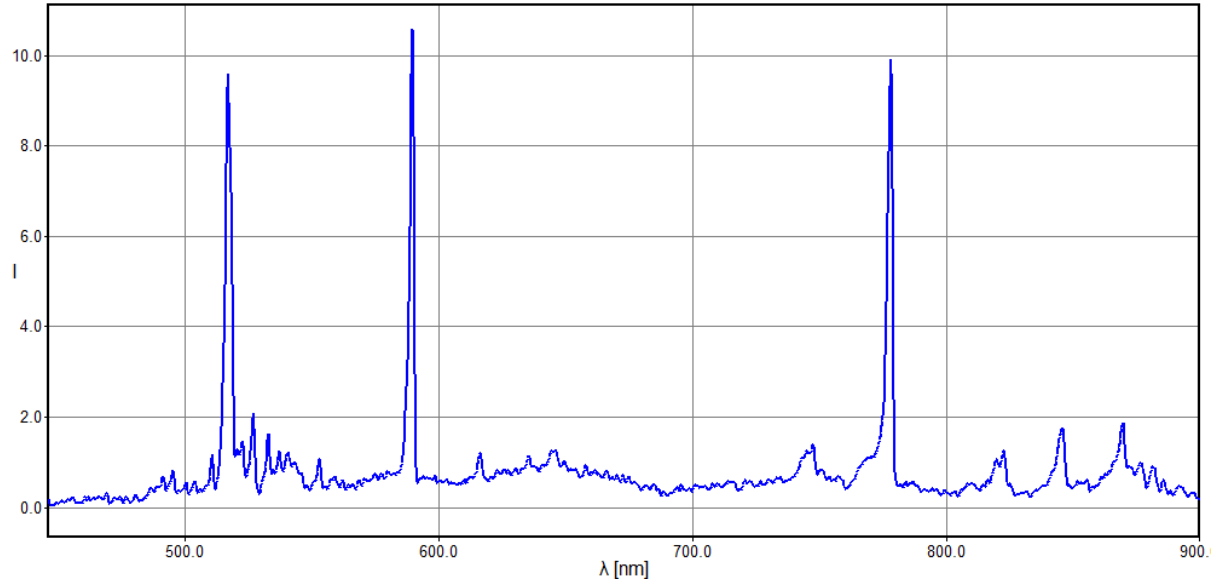
pixel	lambda	fit	error
120.39,	517.50,	516.96,	-0.5381
241.67,	589.00,	589.44,	0.4414
557.00,	777.40,	777.89,	0.4895
986.06,	1035.00,	1034.31,	-0.6949
1227.01,	1178.00,	1178.30,	0.3021

rms_x = 0.5095

spectrum 211213\rb_add19cal.dat saved (results overwritten by next spectrum)



S20211213_222633_MAI_2



M20211213_232534_MAI_2, GEM, -1.7m

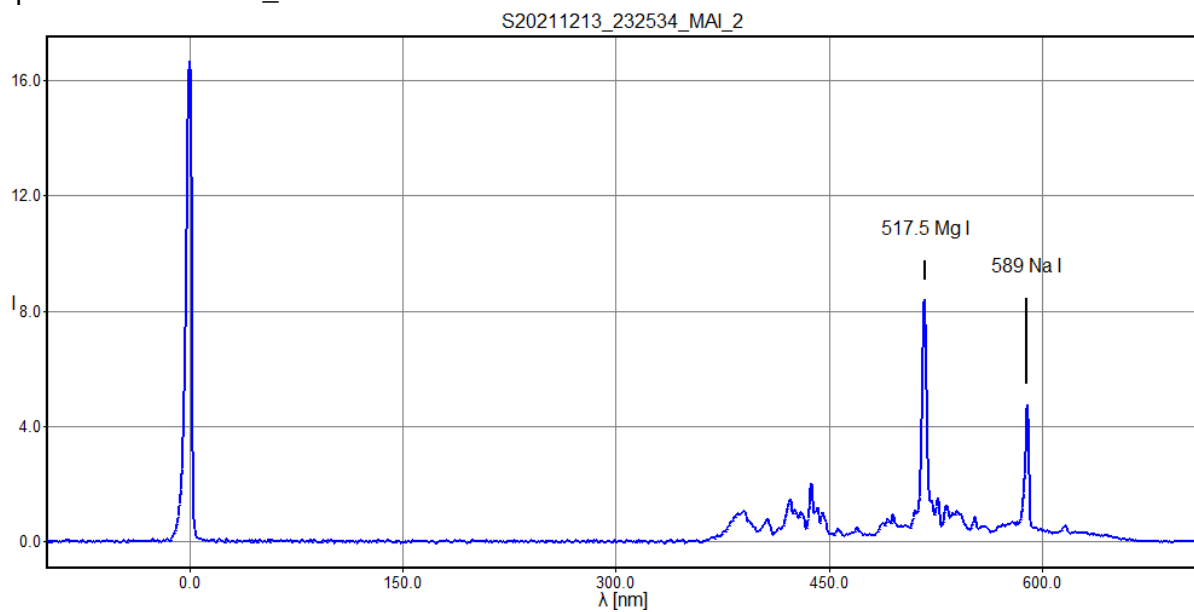


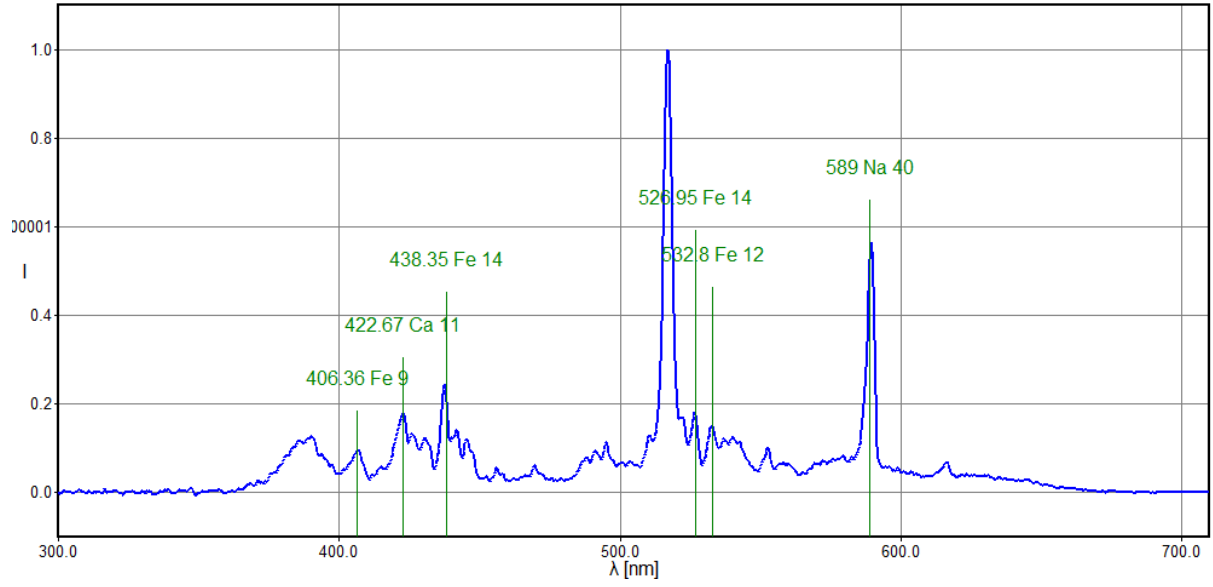
polynom for fit lambda c: [0.5971 -434.661]

pixel	lambda	fit	error
728.04,	0.00,	0.05,	0.0521
1593.93,	517.50,	517.08,	-0.4245
1715.01,	589.00,	589.37,	0.3724

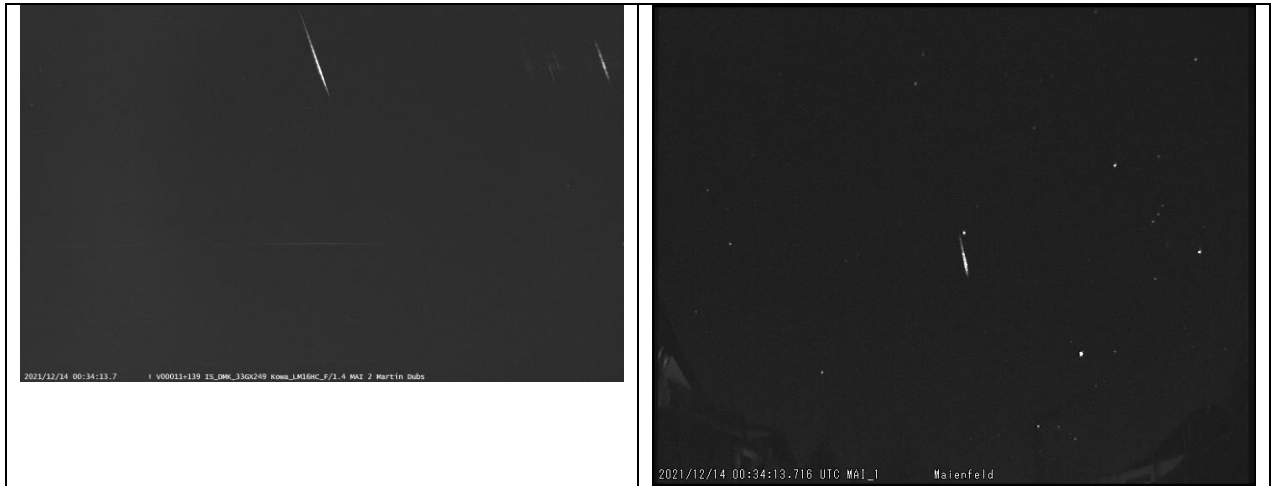
rms_x = 0.3274

spectrum 211213\rb_add19cal.dat saved





M20211214_003413_MAI_2, GEM, -1.8m

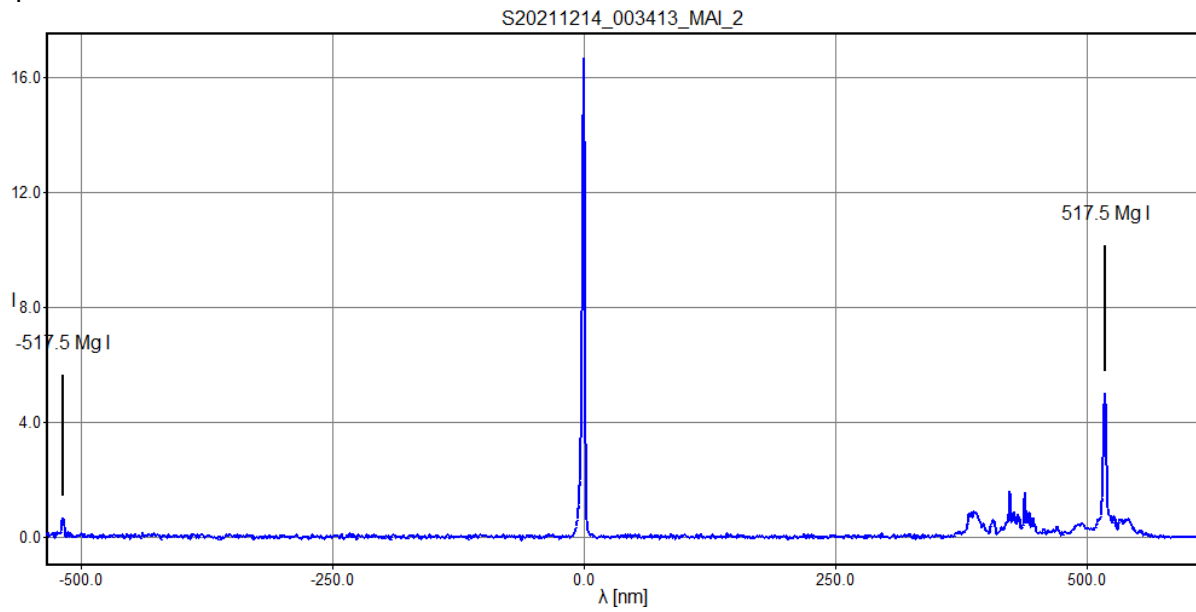


polynom for fit lambda c: [0.5977 -534.033]

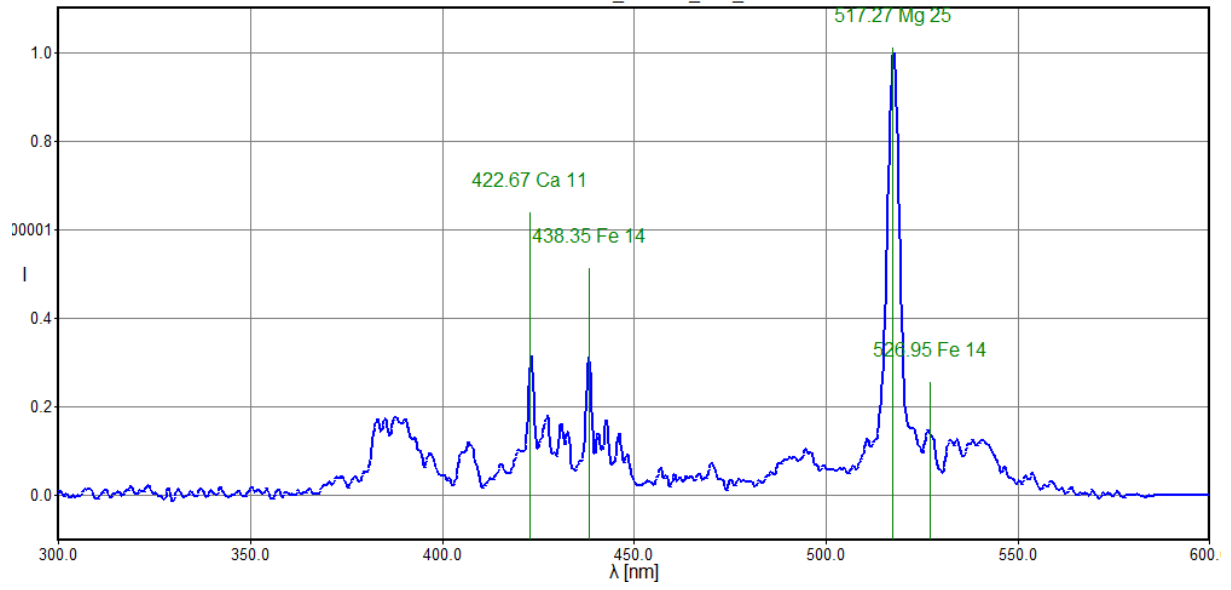
pixel	lambda	fit	error
27.81,	-517.50,	-517.41,	0.0887
893.20,	0.00,	-0.18,	-0.1773
1759.48,	517.50,	517.59,	0.0886

rms_x = 0.1254

spectrum 211214\ra_add17cal.dat saved



S20211214_003413_MAI_2



M20211214_011914_MAI_2, GEM, -1.2m

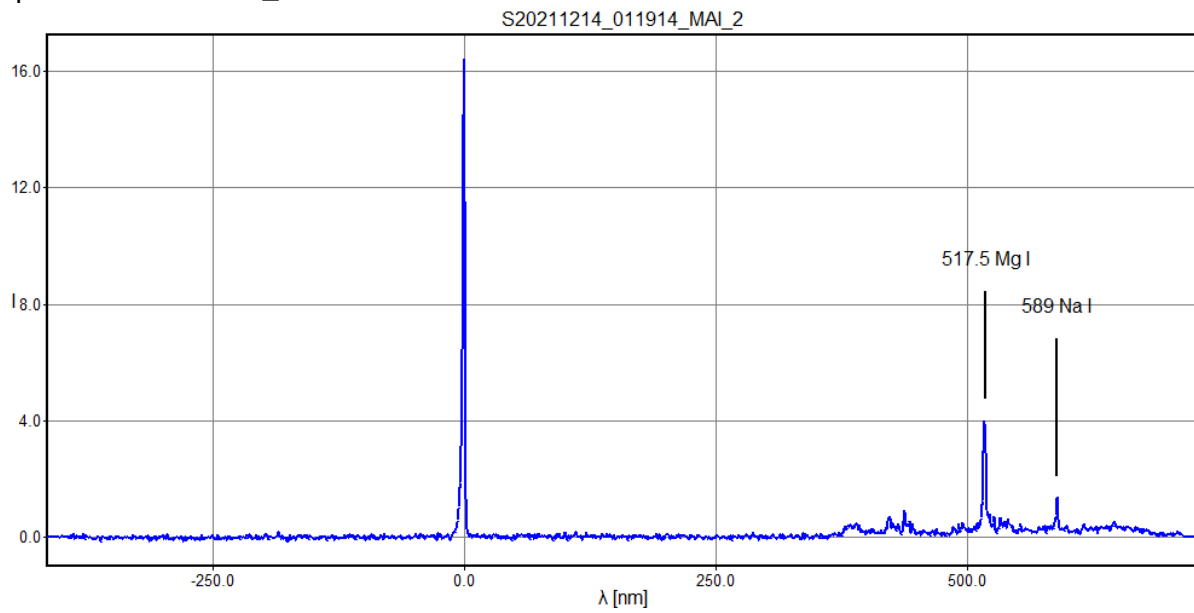


polynom for fit lambda c: [0.5981 -415.9233]

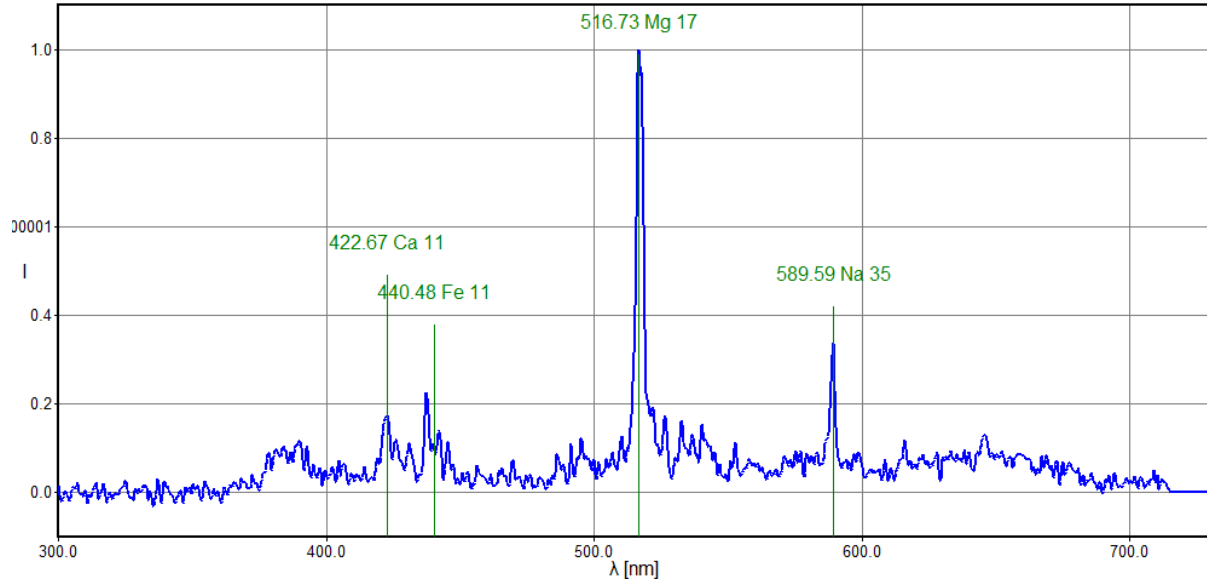
pixel	lambda	fit	error
695.43,	0.00,	0.04,	0.0407
1559.99,	517.50,	517.17,	-0.3321
1680.57,	589.00,	589.29,	0.2915

rms_x = 0.2562

spectrum 211214\rb_add13cal.dat saved



S20211214_011914_MAI_2



M20211214_012631_MAI_2, GEM, -1.8m

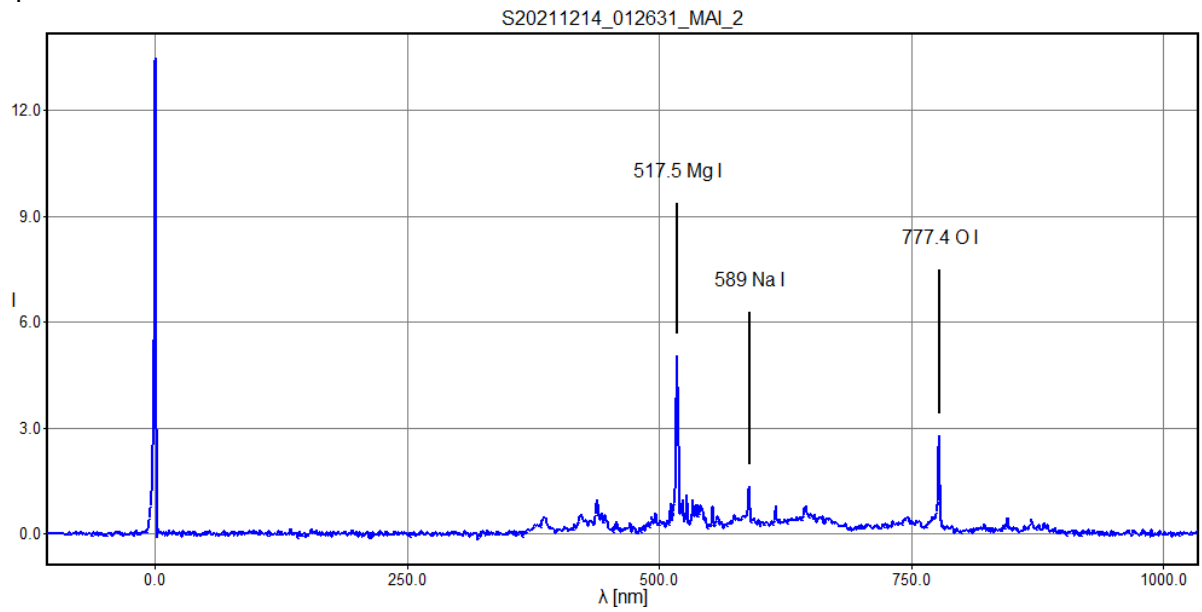


polynom for fit lambda c: [0.5965 -108.5806]

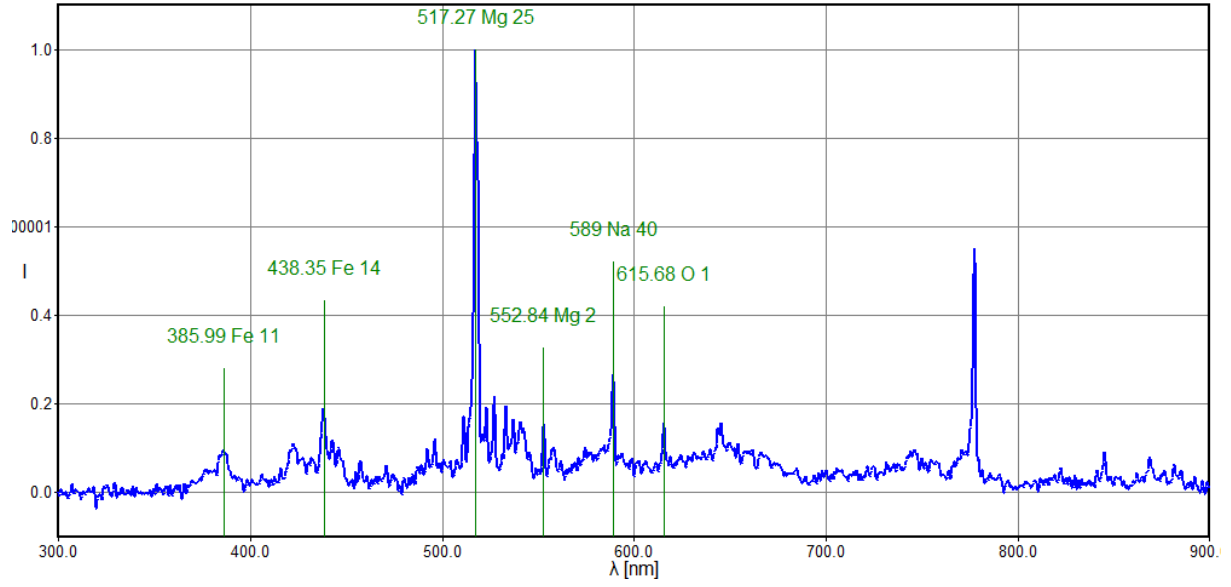
pixel	lambda	fit	error
181.94,	0.00,	-0.05,	-0.0471
1049.62,	517.50,	517.55,	0.0539
1169.59,	589.00,	589.12,	0.1201
1485.00,	777.40,	777.27,	-0.1269

rms_x = 0.0944

spectrum 211214\rc_add12cal.dat saved



S20211214_012631_MAI_2



M20211214_014450_MAI_2, HYD, -1.2m

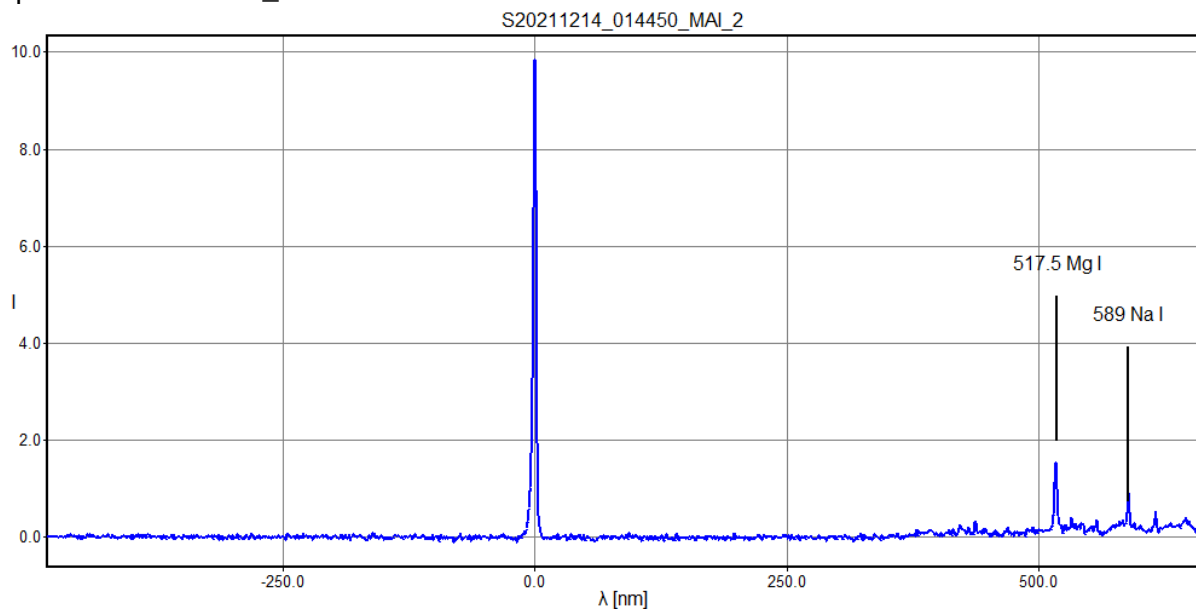


polynomial for fit lambda c: [0.5974 -485.868]

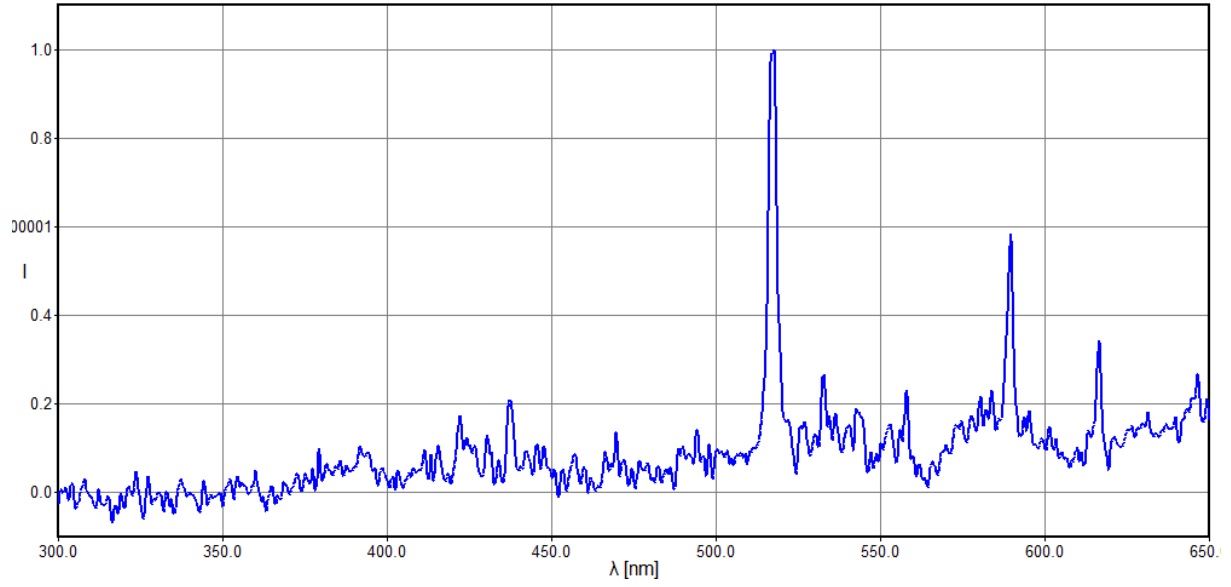
pixel	lambda	fit	error
813.40	0.00	0.05	0.0465
1678.96	517.50	517.12	-0.3793
1799.84	589.00	589.33	0.3328

rms_x = 0.2926

spectrum 211214\rd_add12cal.dat saved



S20211214_014450_MAI_2



M20211214_023328_MAI_2, GEM, -2.6m

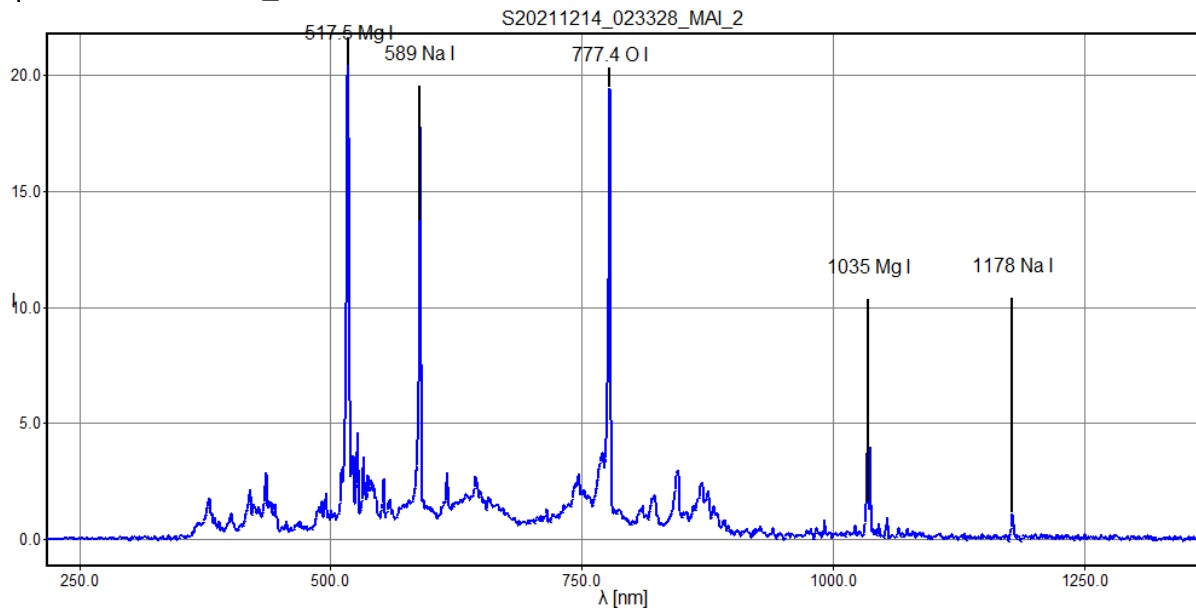


polynom for fit lambda c: [0.5984 217.2868]

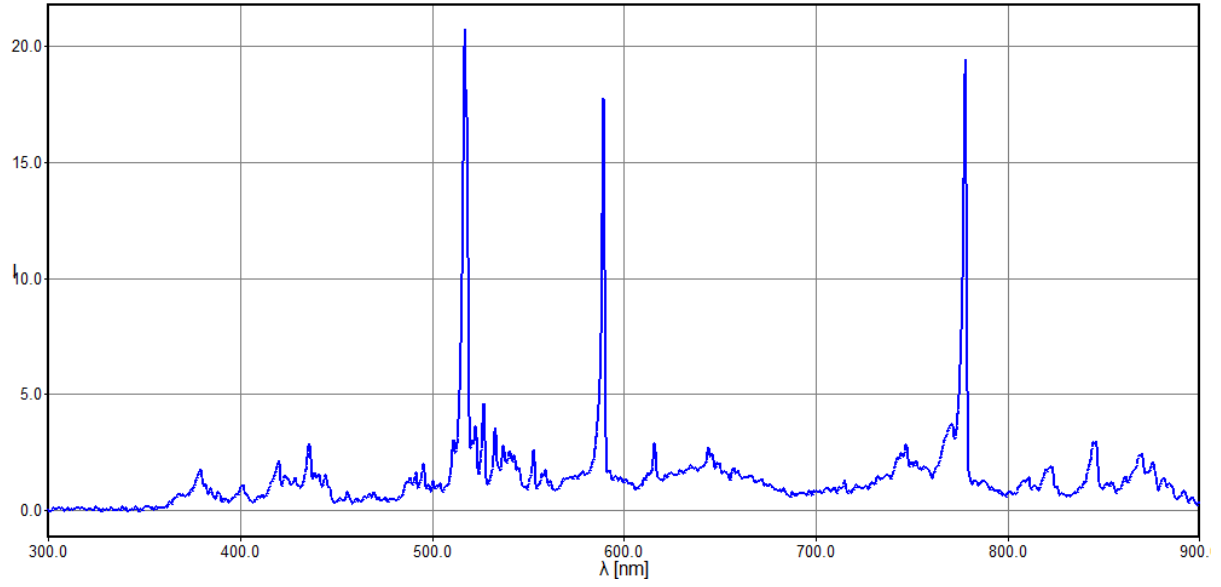
pixel	lambda	fit	error
501.31,	517.50,	517.27,	-0.2264
621.59,	589.00,	589.25,	0.2499
936.50,	777.40,	777.69,	0.2939
1365.15,	1035.00,	1034.20,	-0.7995
1606.26,	1178.00,	1178.48,	0.4821

rms_x = 0.4630

spectrum 211214\re_add12cal.dat saved



S20211214_023328_MAI_2



M20211214_024214_MAI_2, GEM, -1.4m

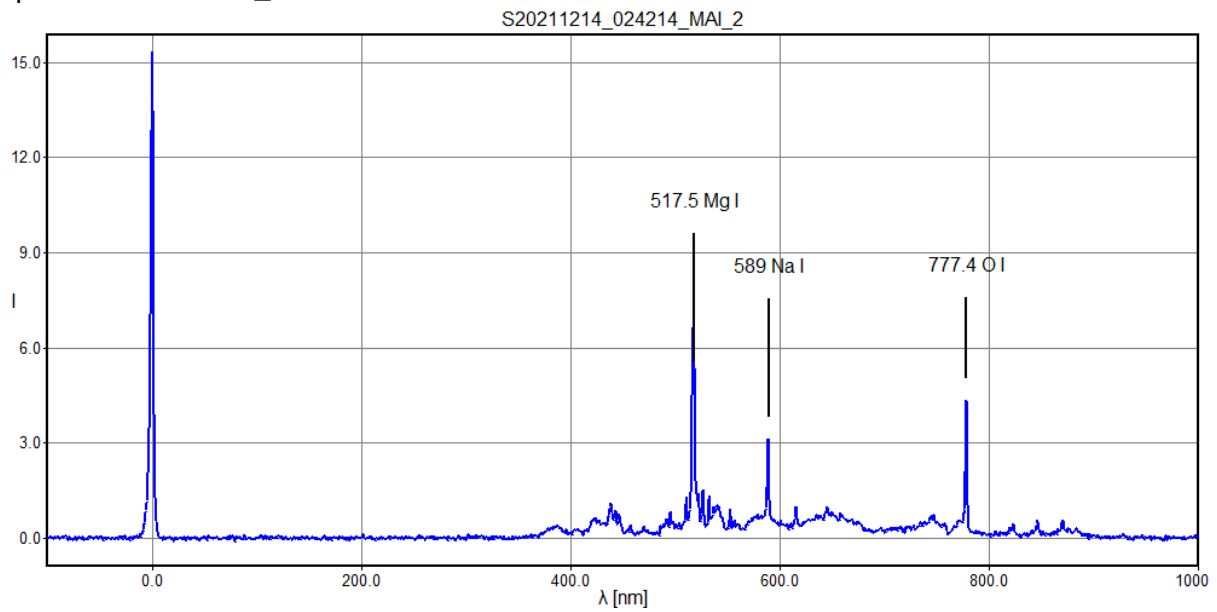


polynom for fit lambda c: [0.5965 -136.1042]

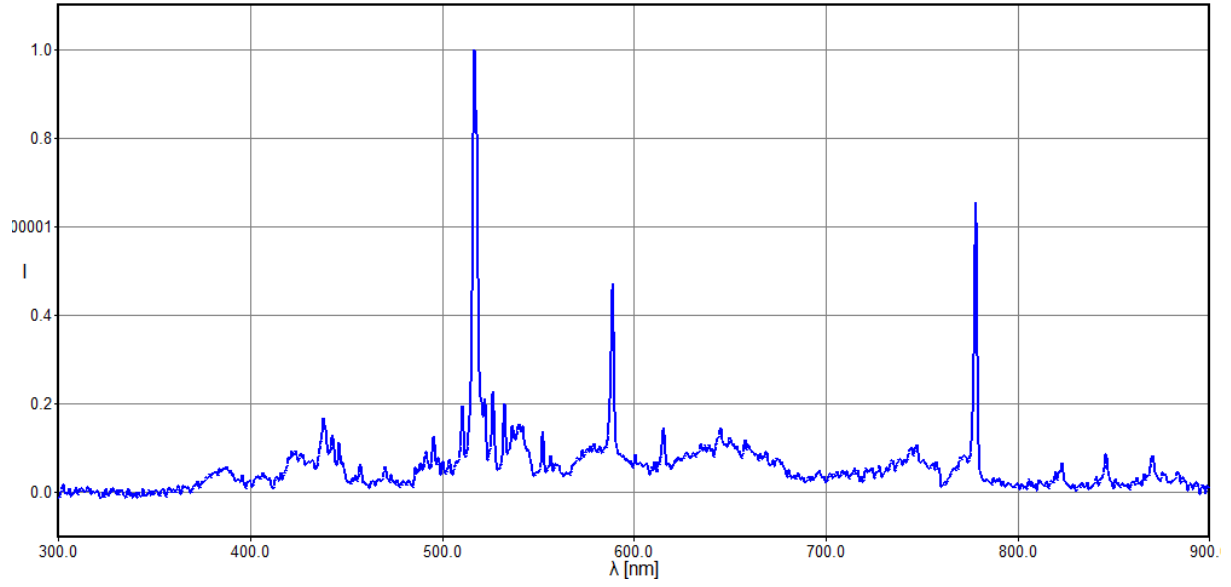
pixel	lambda	fit	error
228.55,	0.00,	0.24,	0.2366
1094.82,	517.50,	517.01,	-0.4924
1215.01,	589.00,	588.71,	-0.2934
1532.24,	777.40,	777.95,	0.5492

rms_x = 0.4142

spectrum 211214\rf_add11cal.dat saved



S20211214_024214_MAI_2



M20211214_024626_MAI_2, GEM, -1.6m



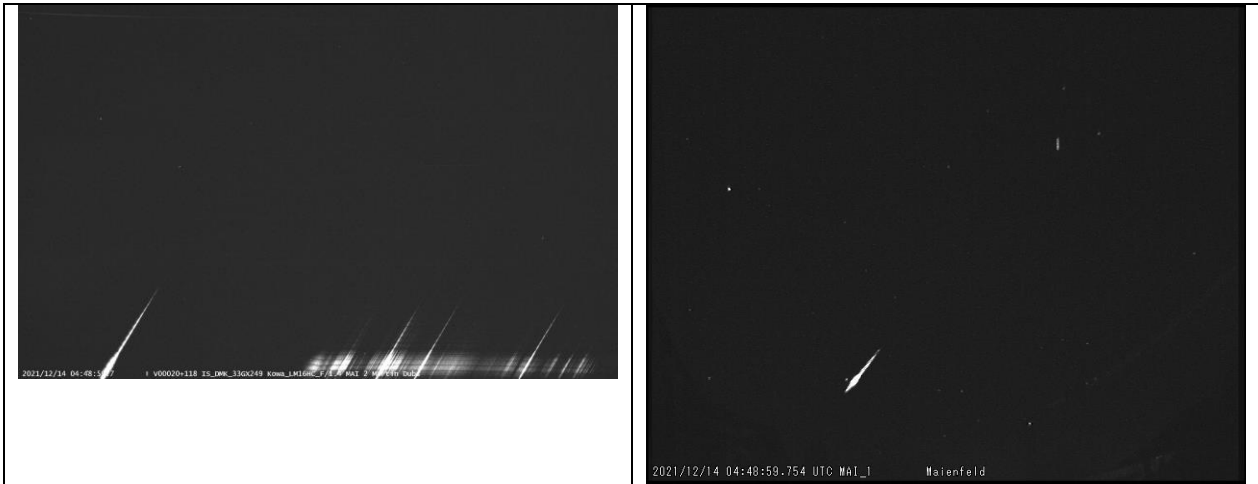
polynom for fit lambda c: [0.5975 -278.3178]

pixel	lambda	fit	error
466.33,	0.00,	0.33,	0.3252
1330.72,	517.50,	516.82,	-0.6815
1450.86,	589.00,	588.60,	-0.3951
1768.08,	777.40,	778.15,	0.7513

rms_x = 0.5681

spectrum 211214\rg_add12cal.dat saved

M20211214_044859_MAI_2, GEM, -2.8m

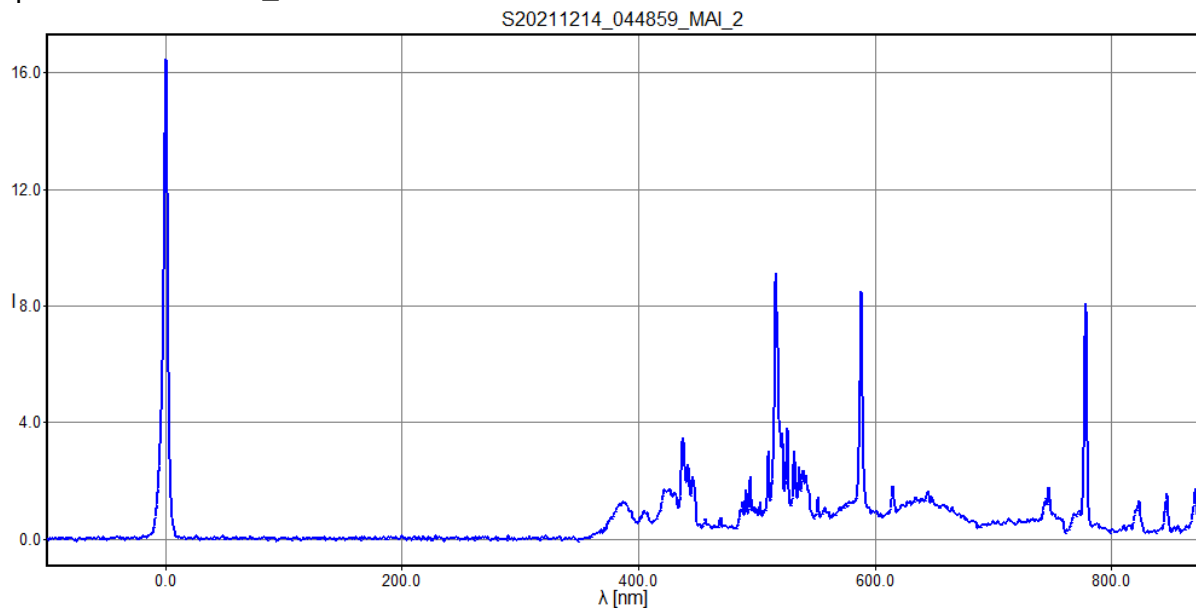


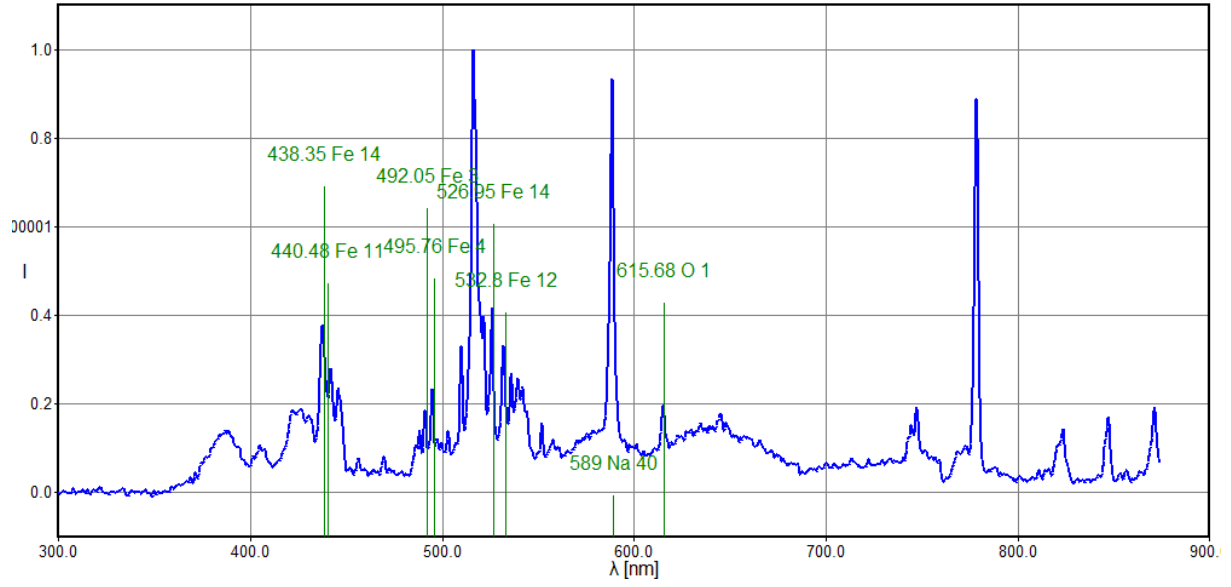
polynom for fit lambda c: [0.5969 -270.3765]

pixel	lambda	fit	error
453.72,	0.00,	0.43,	0.4338
1318.43,	517.50,	516.55,	-0.9498
1439.03,	589.00,	588.53,	-0.4677
1757.11,	777.40,	778.38,	0.9836

rms_x = 0.7544

spectrum 211214\rh_add14cal.dat saved





M20211214_230453_MAI_2, GEM, -3.5m



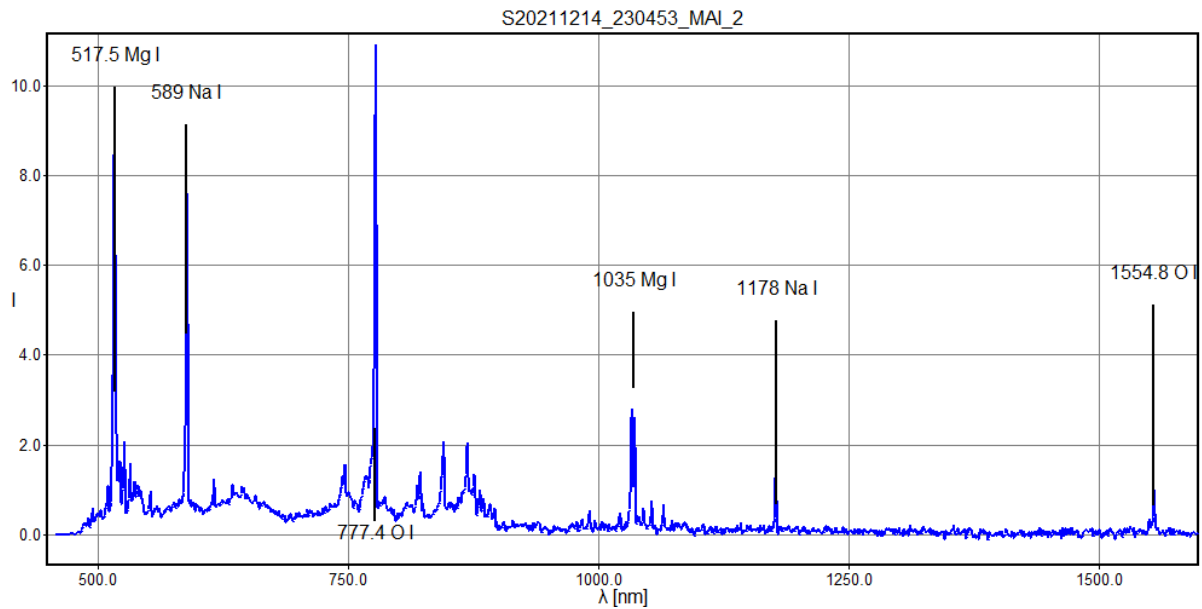
polynom for fit lambda c: [0.5972 457.2098]

pixel	lambda	fit	error
100.34,	517.50,	517.13,	-0.3709
221.81,	589.00,	589.67,	0.6665
537.04,	777.40,	777.91,	0.5103
965.92,	1035.00,	1034.02,	-0.9784
1206.38,	1178.00,	1177.62,	-0.3845
1838.94,	1554.80,	1555.36,	0.5570

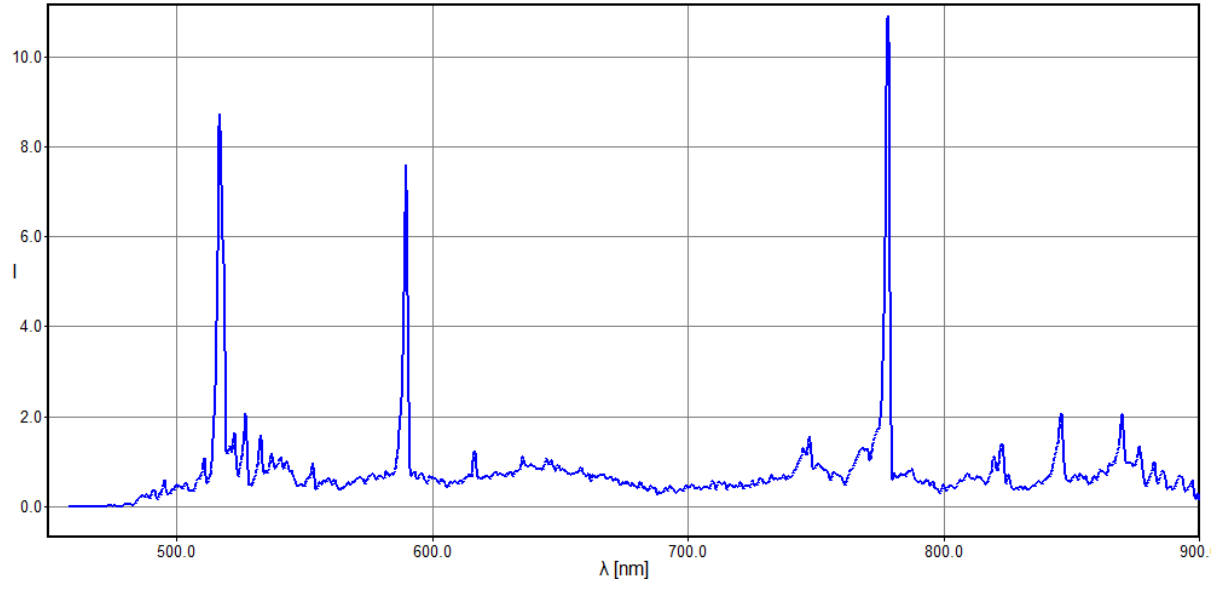
rms_x = 0.6134

spectrum 211214\ri_add15cal.dat

saved



S20211214_230453_MAI_2



M20211219_014729_MAI_2, NTA, -0.8m



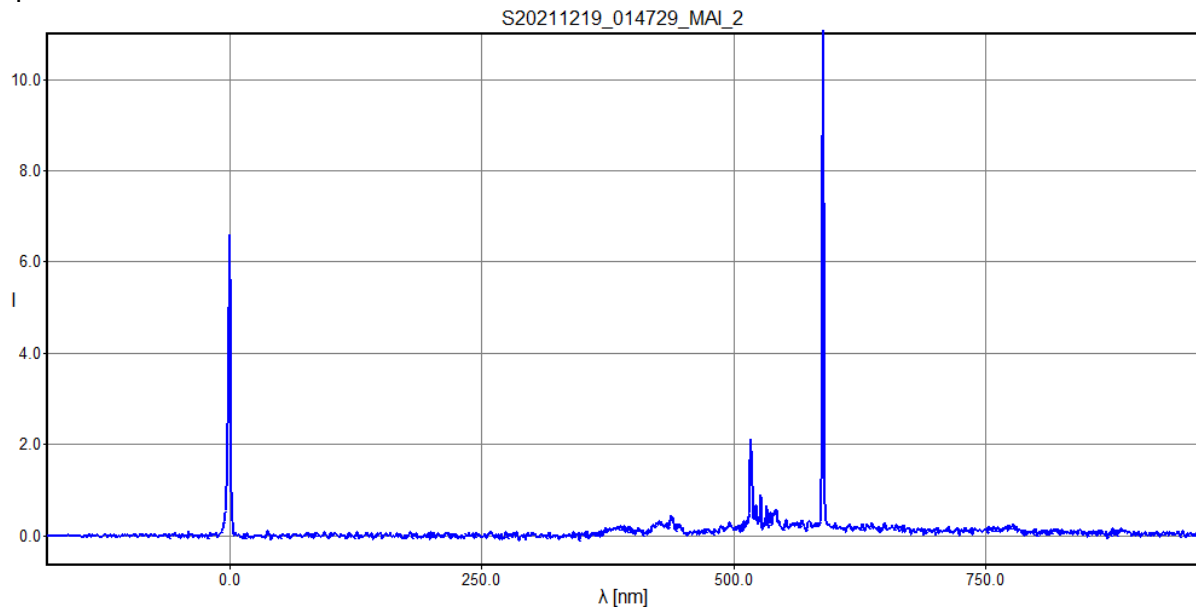
2021/12/19 01:47:29.0 # V00010+047 IS_DMK_33GX249 Kowa_LM16HC_F/1.4 MAI 2 Martin Dubs

polynom for fit lambda c: [0.5971 -182.6064]

pixel	lambda	fit	error
305.83,	0.00,	0.01,	0.0060
1172.42,	517.50,	517.45,	-0.0494
1292.32,	589.00,	589.04,	0.0434

rms_x = 0.0381

spectrum 111219\r_add25cal.dat saved



M20211219_023908_MAI_2, spo, -3.3m



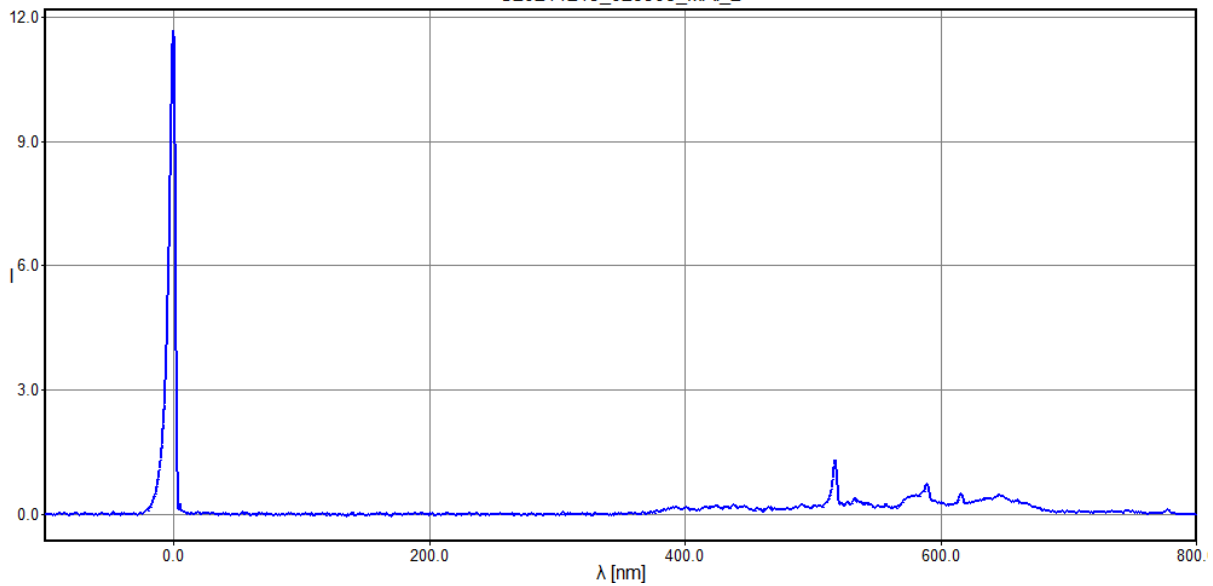
polynom for fit lambda c: [0.5959 -296.9504]

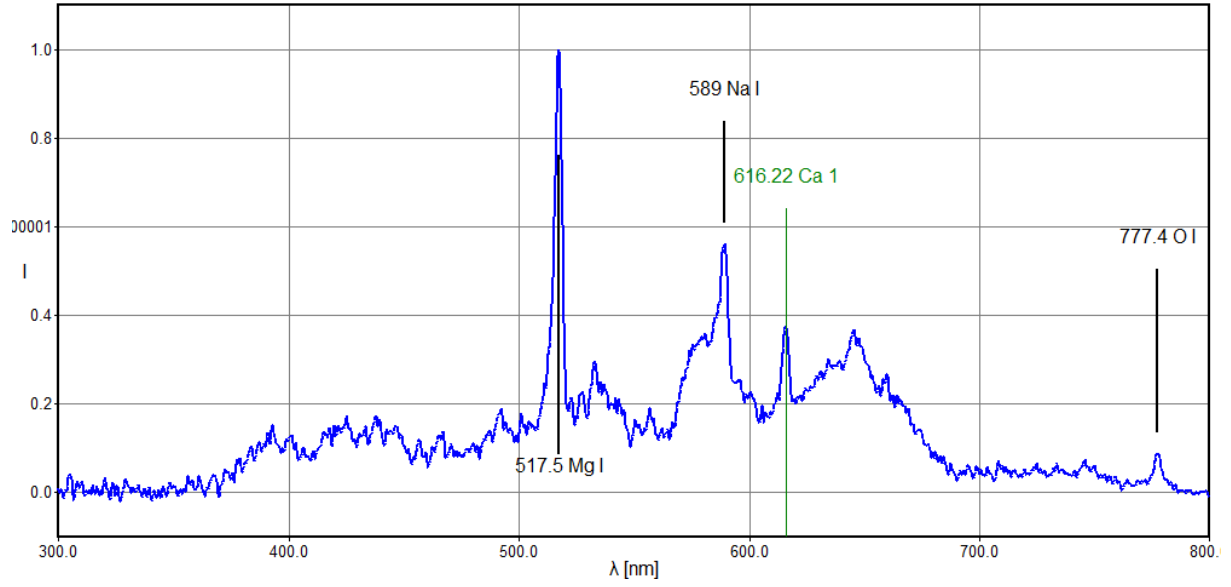
pixel	lambda	fit	error
498.39,	0.00,	0.03,	0.0262
1366.46,	517.50,	517.28,	-0.2151
1487.13,	589.00,	589.19,	0.1888

rms_x = 0.1659

spectrum 111219\ra_add14cal.dat saved

S20211219_023908_MAI_2





Meteor spectral lines

Table 3-7: List of spectral lines frequently found in meteor spectra and their relative intensities. The identification of the lines (numbers) in our example is also given. Lines marked with an asterisk appear in spectra of fast meteors, such as the Perseids, but much fainter in spectra of slow meteors.

Laboratory data			ident. number	Laboratory data			ident. number
λ_{lab} , [Å]	atom/ion	intensity		λ_{lab} , [Å]	atom/ion	intensity	
3719.9	Fe	10	2	4923.9	Fe ⁺	2*	
3734.9	Fe	8		4957.6	Fe	4	
3737.1	Fe	9	3	5012.1	Fe	1	
3745.6	Fe	8		5018.4	Fe ⁺	3*	
3749.5	Fe	8		5110.4	Fe	1	
3820.4	Fe	9		5167.3	Mg	17	
3825.9	Fe	8		5172.7	Mg	25	
3829.4	Mg	10		5183.6	Mg	28	
3832.3	Mg	11		5208.4	Cr	10	
3838.3	Mg	12		5227.2	Fe	5	
3859.9	Fe	11		5269.5	Fe	14	
3886.3	Fe	9		5328.0	Fe	12	
3933.7	Ca ⁺	40*	8	5371.5	Fe	9	
3968.5	Ca ⁺	35*	9	5397.1	Fe	5	
4030.8	Mn	10		5405.8	Fe	6	
4045.8	Fe	10		5429.7	Fe	6	
4063.6	Fe	9		5434.5	Fe	4	
4131.0	Si ⁺	1*		5446.9	Fe	4	
4226.7	Ca	11	12	5455.6	Fe	4	
4254.4	Cr	9		5528.4	Mg	2	
4271.8	Fe	10		5615.7	Fe	1	
4274.8	Cr	8		5890.0	Na	40	
4289.7	Cr	7		5895.9	Na	35	
4307.9	Fe	10		6156.8	O	1*	
4325.8	Fe	10		6162.2	Ca	1	
4383.5	Fe	14	15	6347.1	Si ⁺	6*	
4404.8	Fe	11		6371.4	Si ⁺	3*	
4481.2	Mg ⁺	15*		6495.0	Fe	1	
4920.5	Fe	3		6562.9	H	2*	

From: Spectral lines, (IMO Photographic Handbook 03 Spectra, p 47)

<http://www.imo.net/docs/03spectra.pdf>

Another list from Borovicka, 2005

<https://ui.adsabs.harvard.edu/abs/2005Icar..174...15B/abstract>

Free access from:

<https://sci-hub.st/https://doi.org/10.1016/j.icarus.2004.09.011>

Table 1

List of the most important atomic lines used to fit the spectra in the 4200–8500 Å range, ordered according to line groups

λ (Å)	Atom & multiplet	Typical intensity	λ (Å)	Atom & multiplet	Typical intensity
<i>Low temperature lines</i>			<i>Wake lines^a</i>		
4226	Ca I 2	80	4216	Fe I 3	16
4273	Fe I 42	30	4376	Fe I 2	26
4308	Fe I 42	25	4427	Fe I 2	21
4326	Fe I 42	25	4462	Fe I 2	12
4384	Fe I 41	45	4482	Fe I 2	7
4405	Fe I 41	25	4571	Mg I 1	17
4920	Fe I 318	11	5110	Fe I 1	9
4957	Fe I 318	16	5169	Fe I 1	8
5047	Fe I 114	13	5205	Fe I 1	5
5182	Mg I 2	200	<i>Atmospheric lines</i>		
5269	Fe I 15	23	5330	O I 12	47
5328	Fe I 15	19	5436	O I 11	34
5371	Fe I 15	17	6157	O I 10	150
5404	Fe I 15	15	6455	O I 9	17
5431	Fe I 15	13	6484	N I 21	27
5449	Fe I 15	11	7424	N I 3	60
5528	Mg I 9	22	7442	N I 3	120
5589	Ca I 21	5	7468	N I 3	150
5892	Na I 1	150	7774	O I 1	1400
6163	Ca I 3	4	8186	N I 2	400
6439	Ca I 18	3	8218	N I 2	700
6463	Ca I 18	2	8243	N I 2	280
8194	Na I 4	3	8446	O I 4	800
<i>High temperature line</i>			<i>Train line</i>		
4481	Mg II 4	36	5577	[O I] 3F	31

^a Wake lines are low excitation intercombination lines with a small transition probability. They are so named because they are prominent in meteor wakes, i.e., in the radiation forming a “tail” just behind the meteor head. They may be, nevertheless, present also in meteor heads, in particular when the collisional deexcitation rate is low.

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