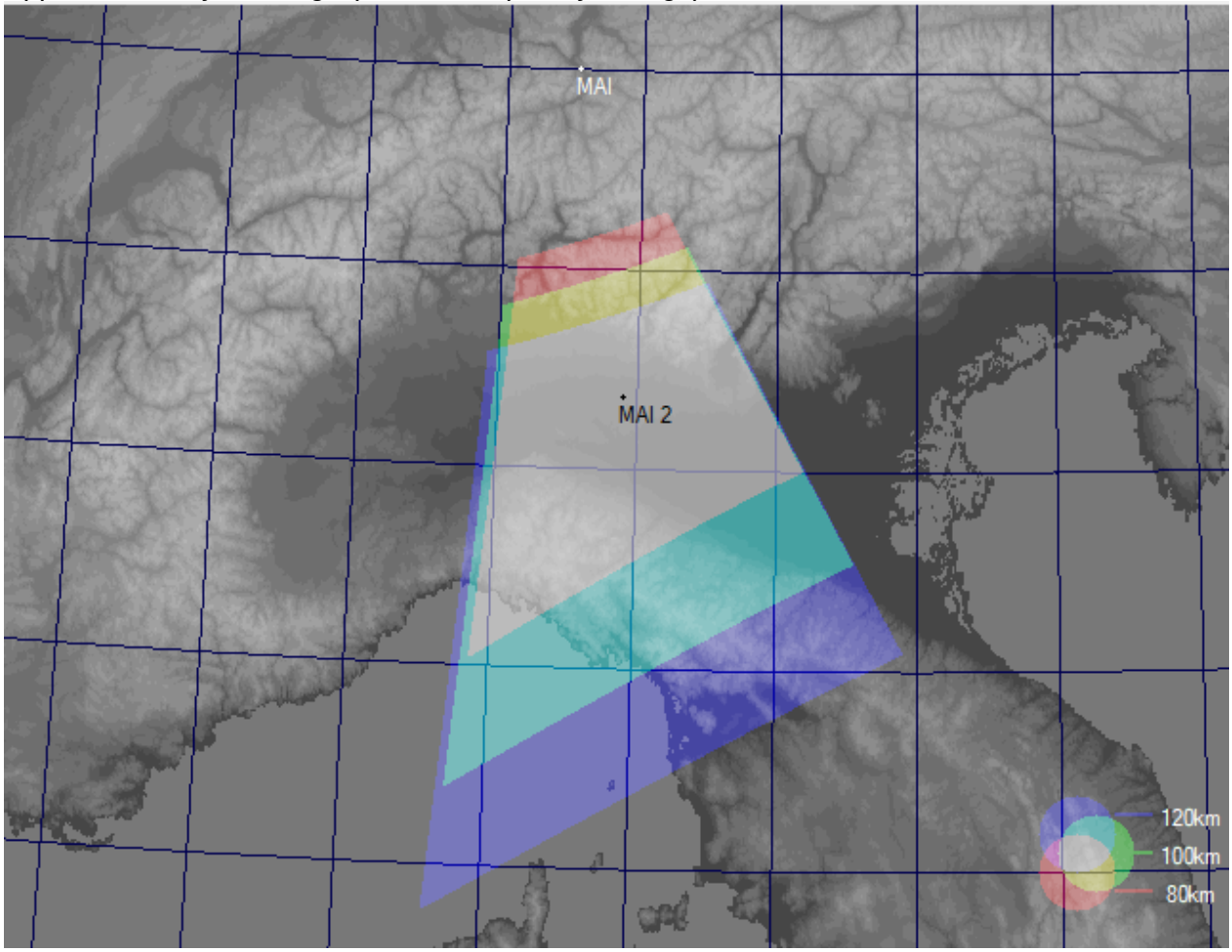
Meteor spectra 2024

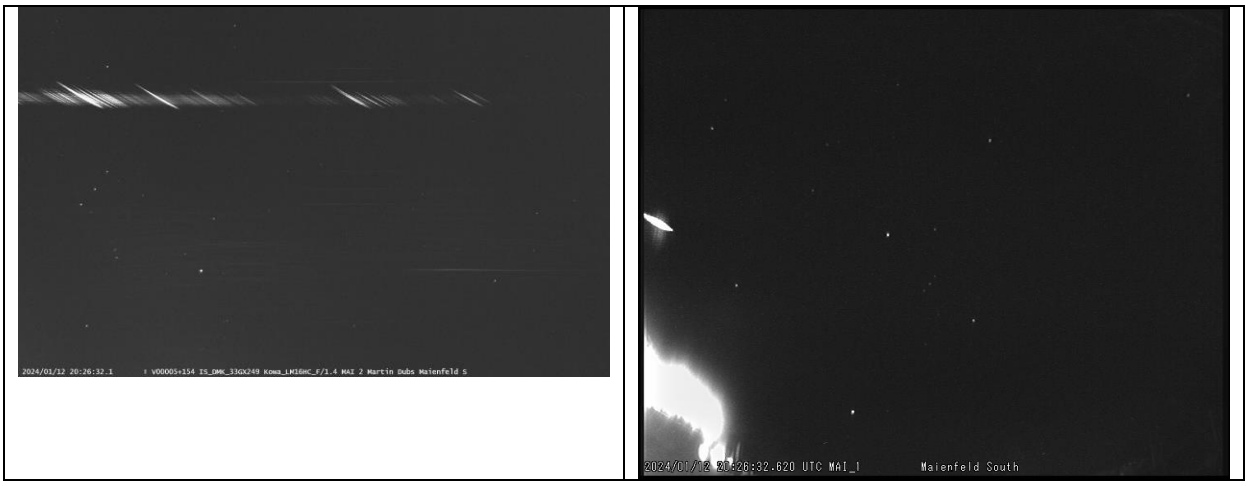
Overview

This is a collection of meteor spectra obtained at Maienfeld (station MAI_2, http://www.meteorastronomie.ch/stationen.html)
Setup:
Camera: **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 analysed with Python M_SPEC.py.
1st order spectra were further analysed by fitting synthetic meteor spectra to the observed spectra
(https://meteorspectroscopy.org/2022/03/08/synthetic-meteor-spectra/).
In addition, meteors were recorded with a Watec 902H2 ultimate, equipped with a wide angle lens: Tamron VG412 ASIR at f ≅ 4mm, MAI_1.

M20240112_202632_MAI_2, spo, -2.9m

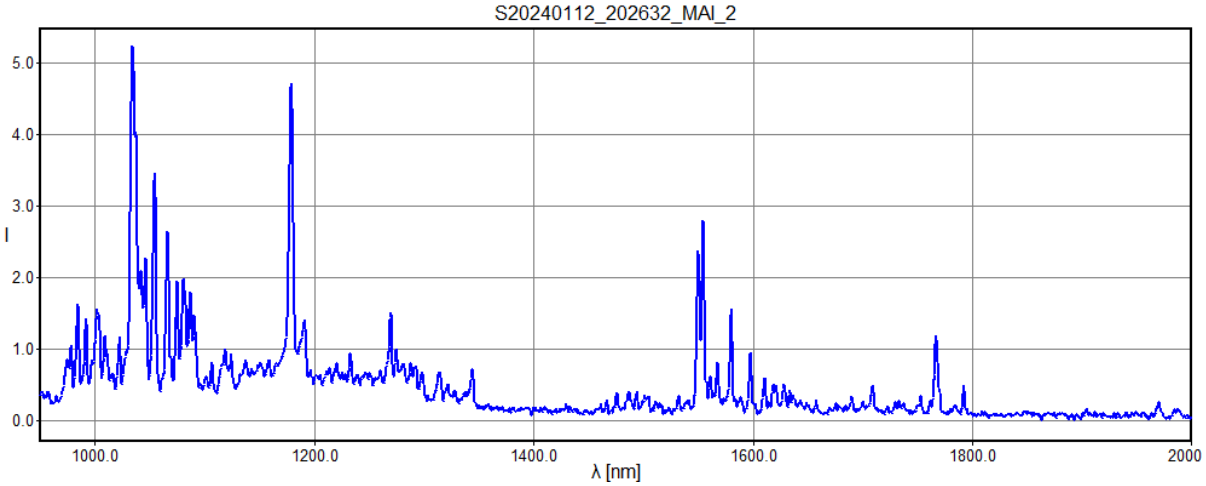


polynom for fit lambda c: [5.9786e-01 9.3960e+02]

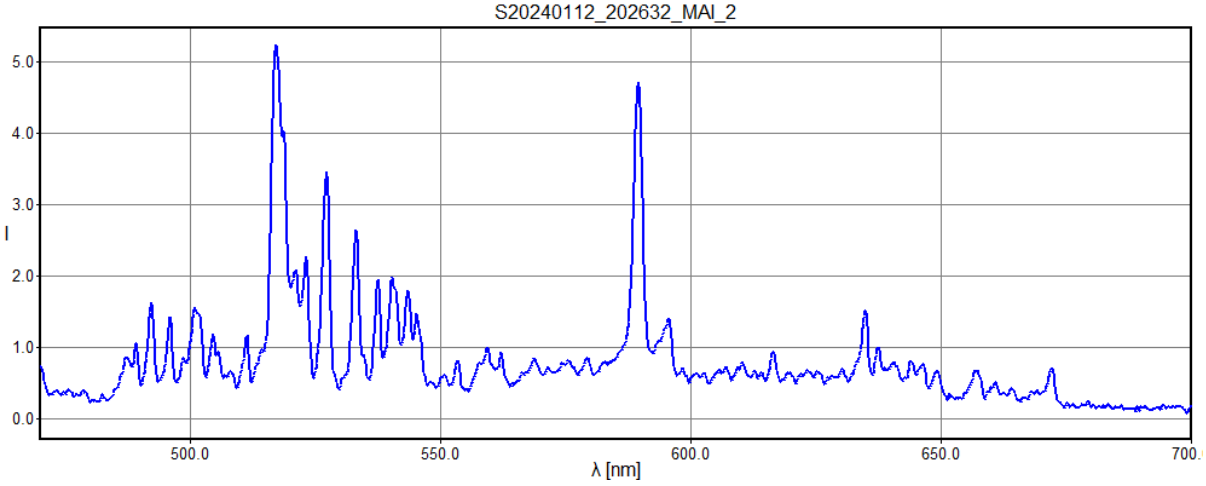
pixel	lambda	fit	error
158.42,	1035.00,	1034.32,	-0.6829
400.17,	1178.00,	1178.85,	0.8508
1383.64,	1767.00,	1766.83,	-0.1679

rms_x = 0.6373

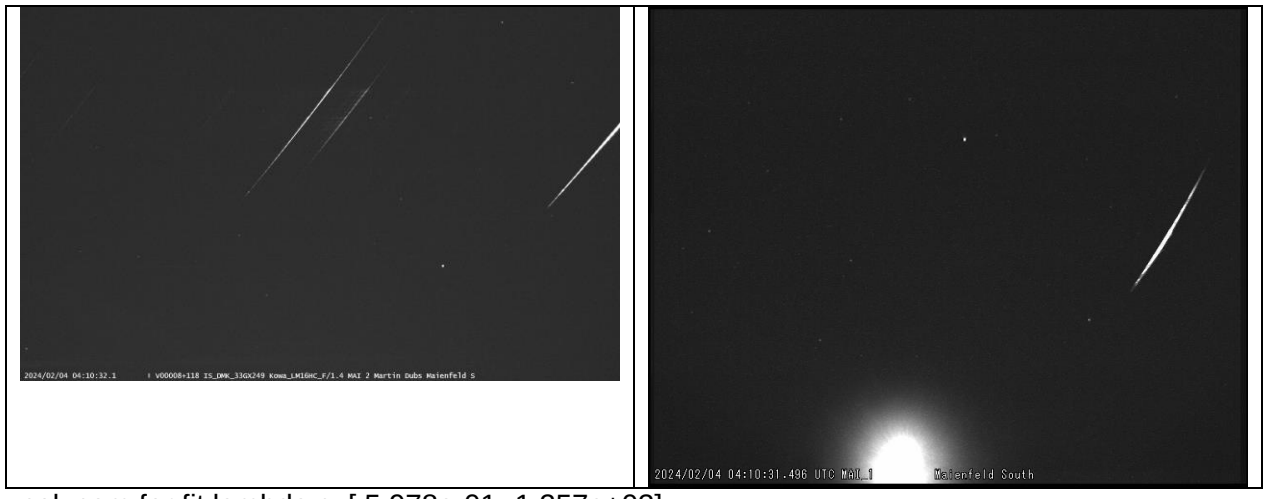
spectrum 240112\r_add52cal.dat saved



2nd order converted to wavelength:



M20240204_041032_MAI_2, spo, -2.9m

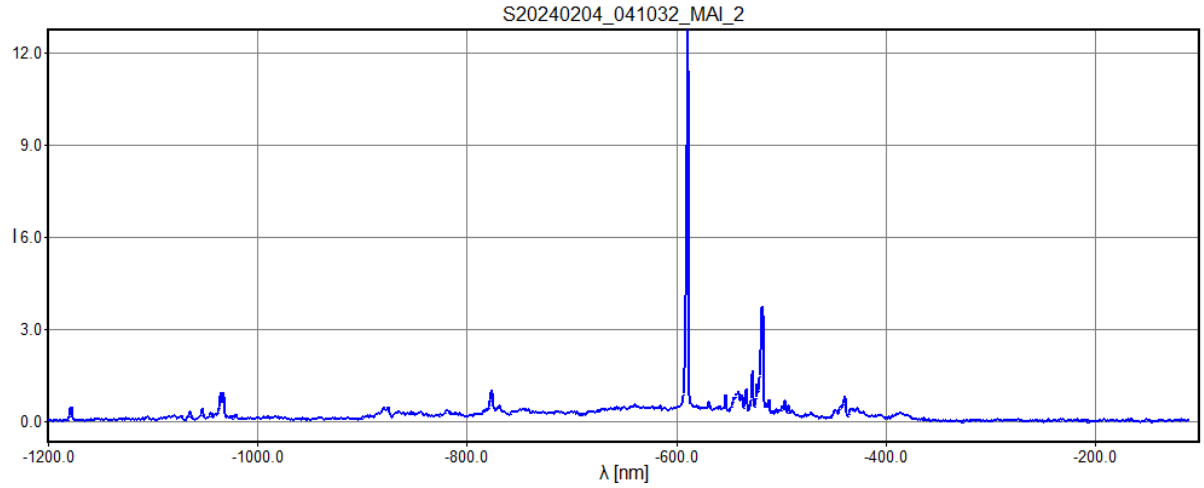


polynom for fit lambda c: [5.978e-01 -1.257e+03]

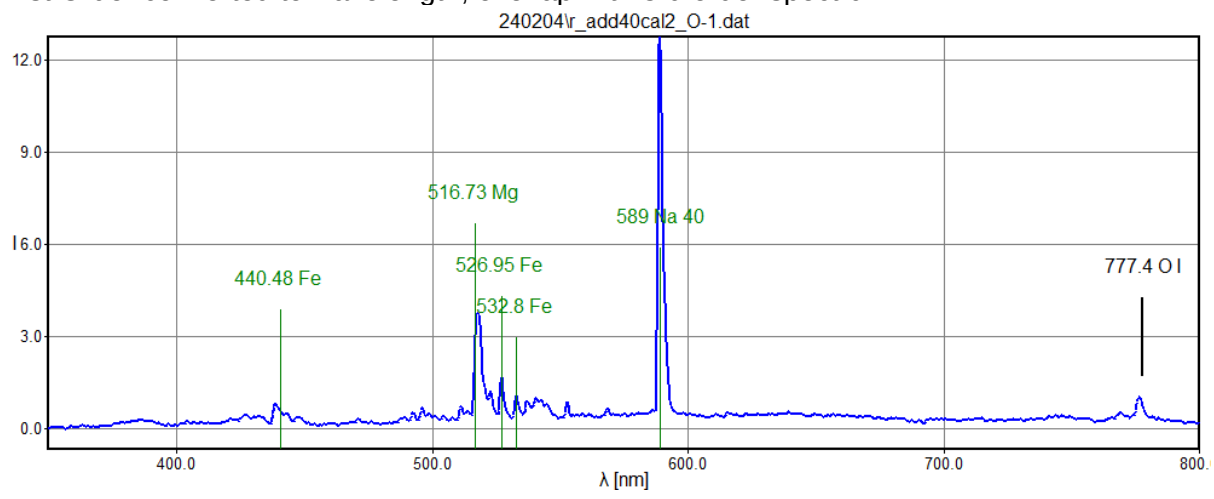
pixel	lambda	fit	error
1236.45,	-517.50,	-517.85,	-0.3545
1117.11,	-589.00,	-589.20,	-0.1965
803.83,	-777.40,	-776.48,	0.9232
371.13,	-1035.00,	-1035.15,	-0.1468
131.79,	-1178.00,	-1178.23,	-0.2253

rms_x = 0.4667

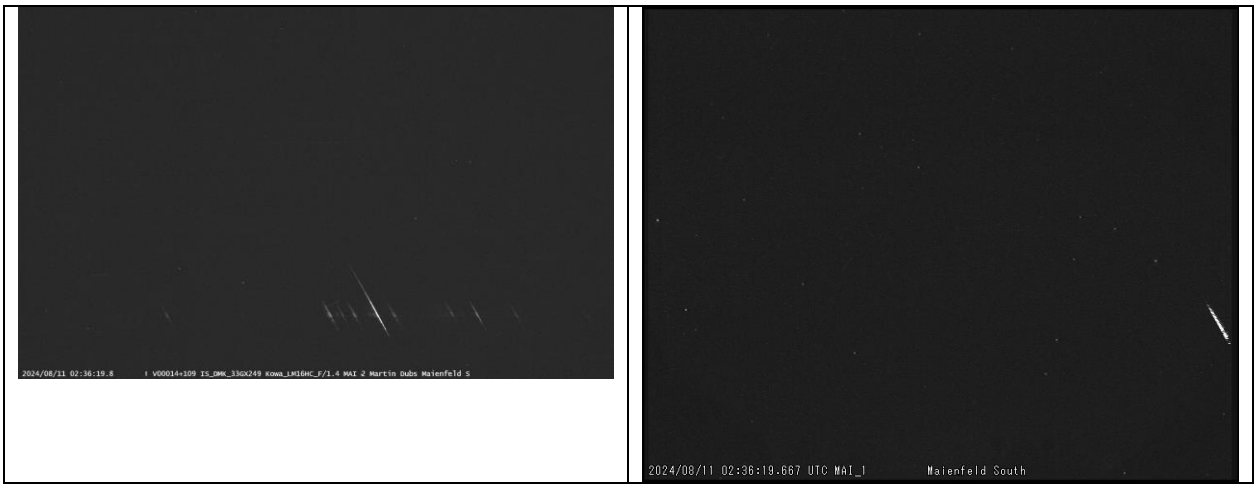
spectrum 240204\r_add40cal.dat saved



-1st Order converted to wavelength, overlap with 3rd order spectrum:



M20240811_023619_MAI_2, PER, -1.6m

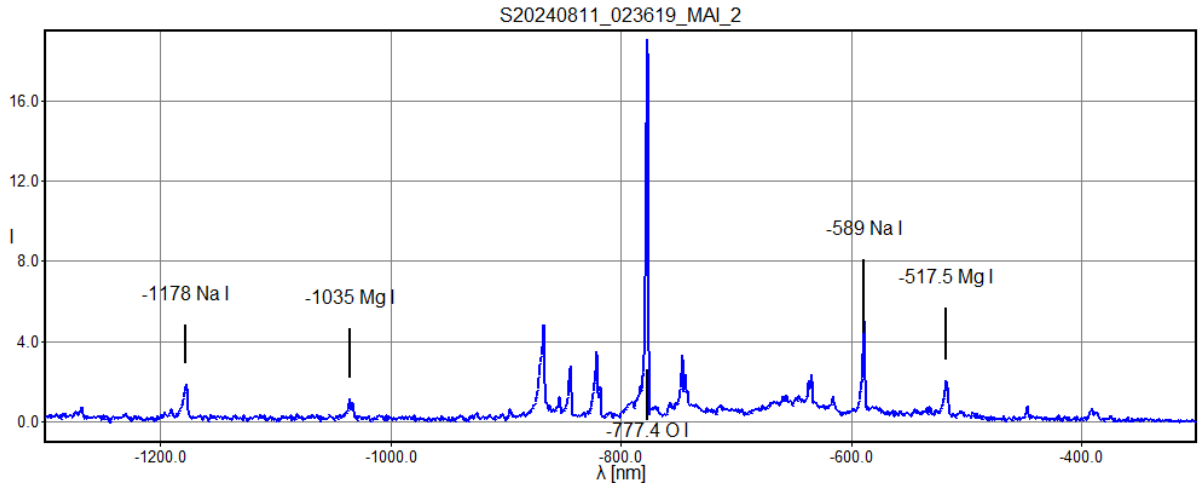


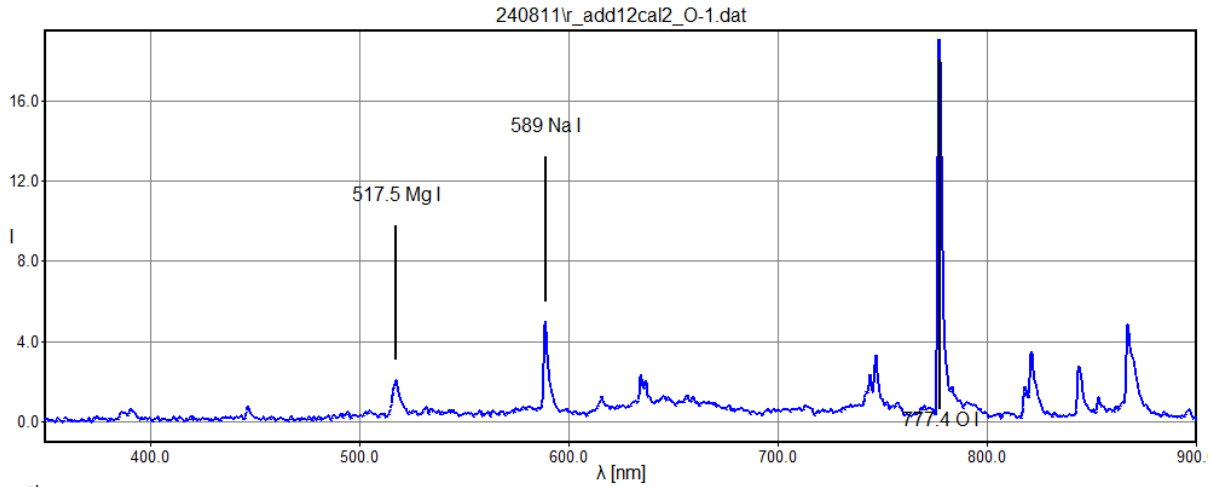
polynom for fit lambda c: [5.9641e-01 -1.4166e+03]

pixel	lambda	fit	error
1507.60,	-517.50,	-517.47,	0.0271
1387.72,	-589.00,	-588.97,	0.0293
1071.97,	-777.40,	-777.29,	0.1123
638.92,	-1035.00,	-1035.56,	-0.5637
400.76,	-1178.00,	-1177.61,	0.3950

rms_x = 0.3124

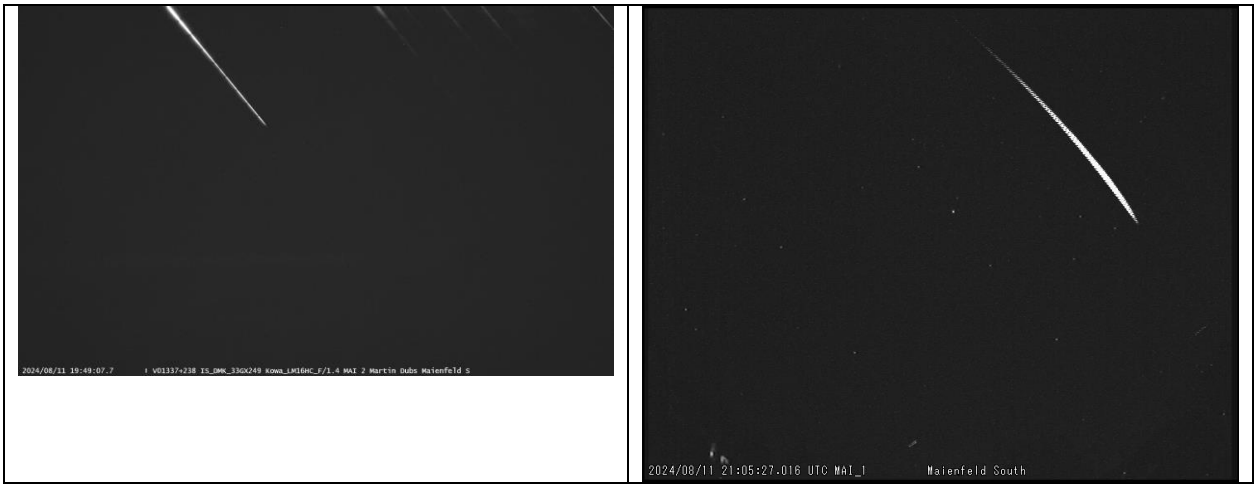
spectrum 240811\r_add12cal.dat saved





-1st order converted to wavelength

M20240811_194907_MAI_2. PER, -3.6m

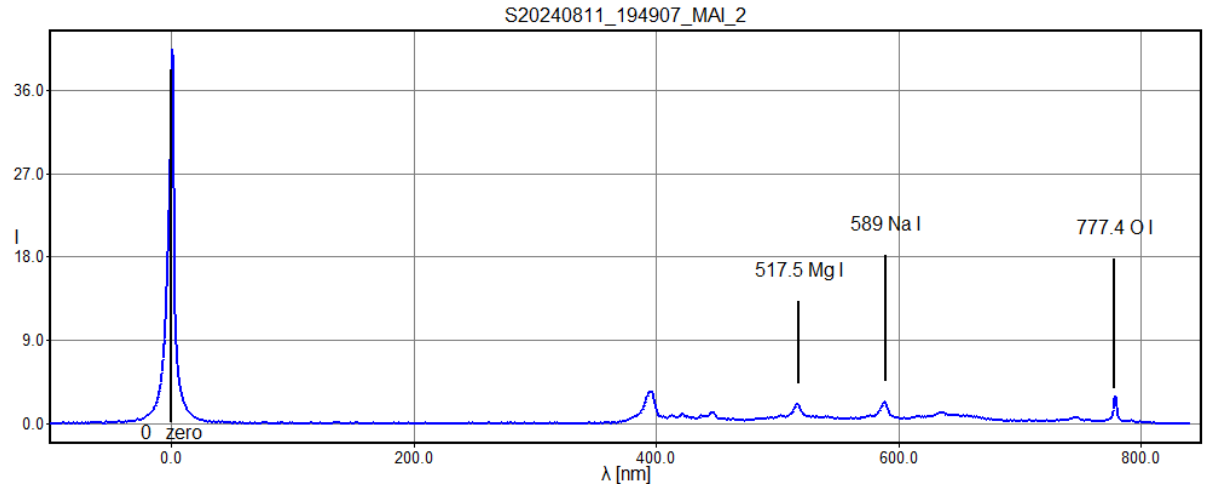


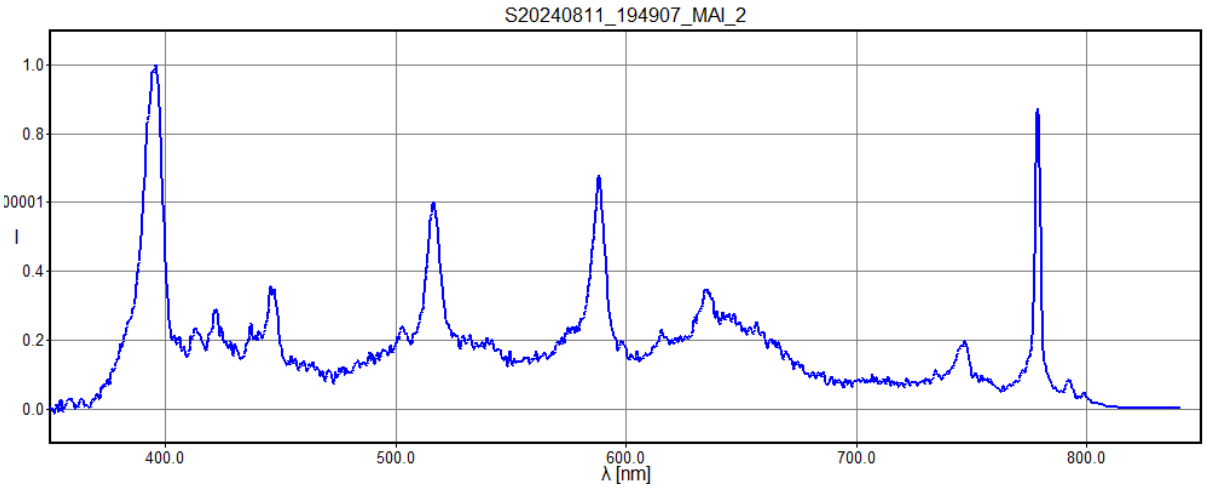
polynom for fit lambda c: [0.598 -305.4541]

pixel	lambda	fit	error
511.78,	0.00,	0.60,	0.5983
1374.10,	517.50,	516.28,	-1.2208
1494.43,	589.00,	588.24,	-0.7616
1813.06,	777.40,	778.78,	1.3841

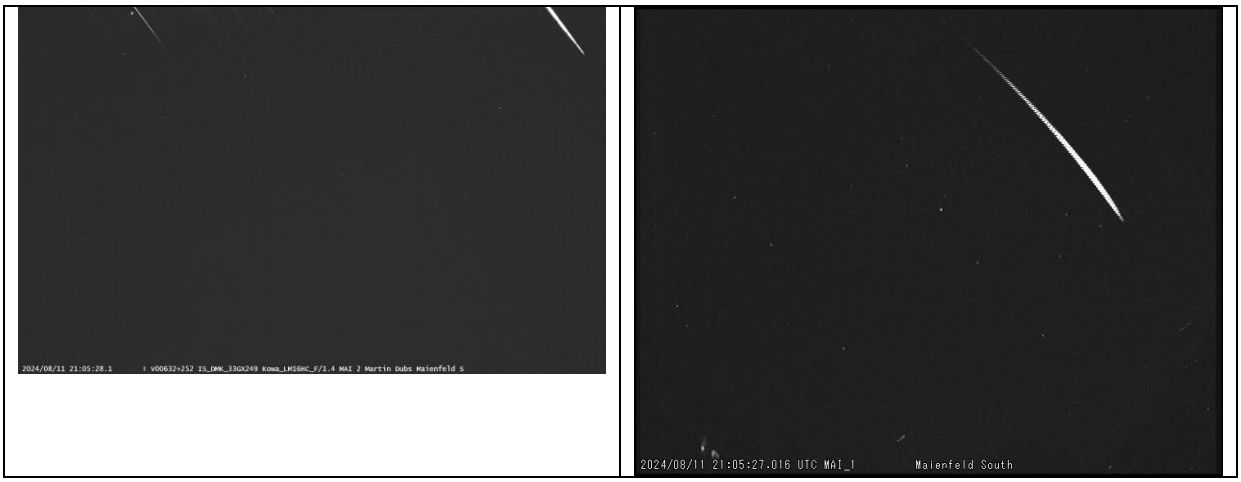
rms_x = 1.0421

spectrum 240811\ra_add9cal.dat saved





M20240811_210528_MAI_2, PER, -4.2m

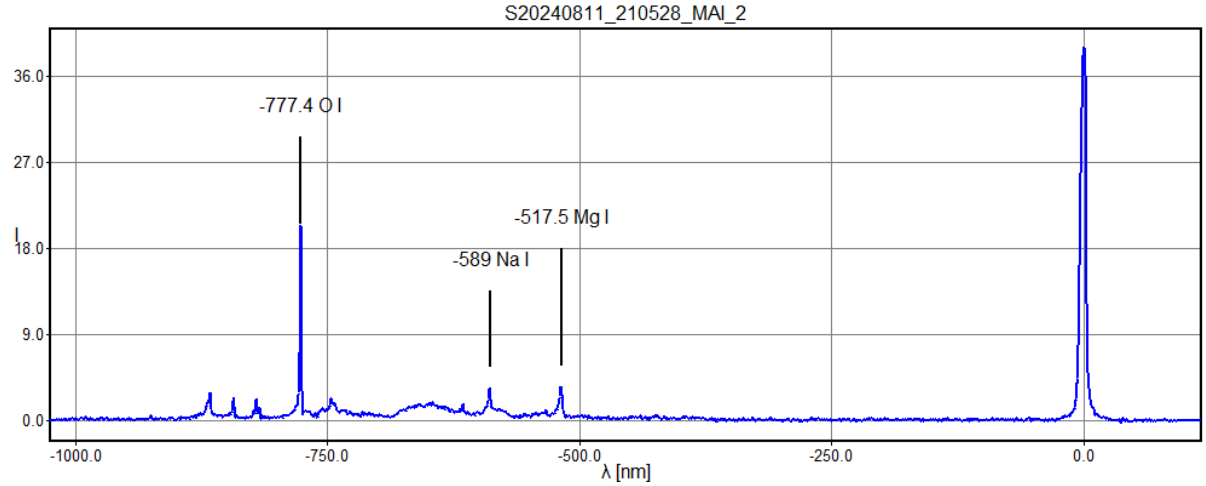


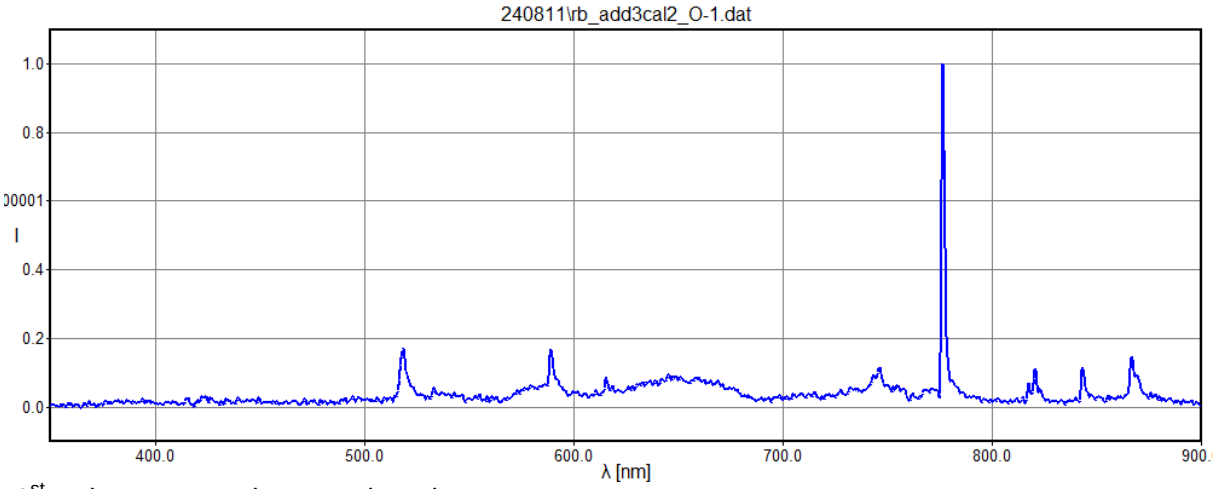
polynom for fit lambda c: [5.9732e-01 -1.0263e+03]

pixel	lambda	fit	error
1718.86,	0.00,	0.38,	0.3841
850.19,	-517.50,	-518.49,	-0.9871
731.75,	-589.00,	-589.23,	-0.2333
418.13,	-777.40,	-776.56,	0.8362

rms_x = 0.6848

spectrum 240811\rb_add3cal.dat saved





-1st order converted to wavelength

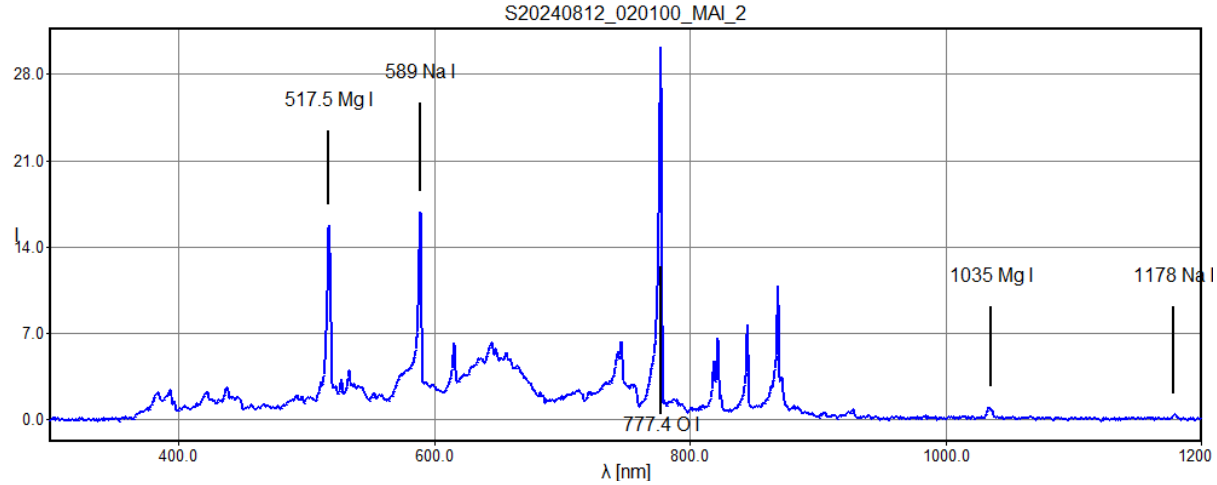
M20240812_020100_MAI_2, PER, -3.0m

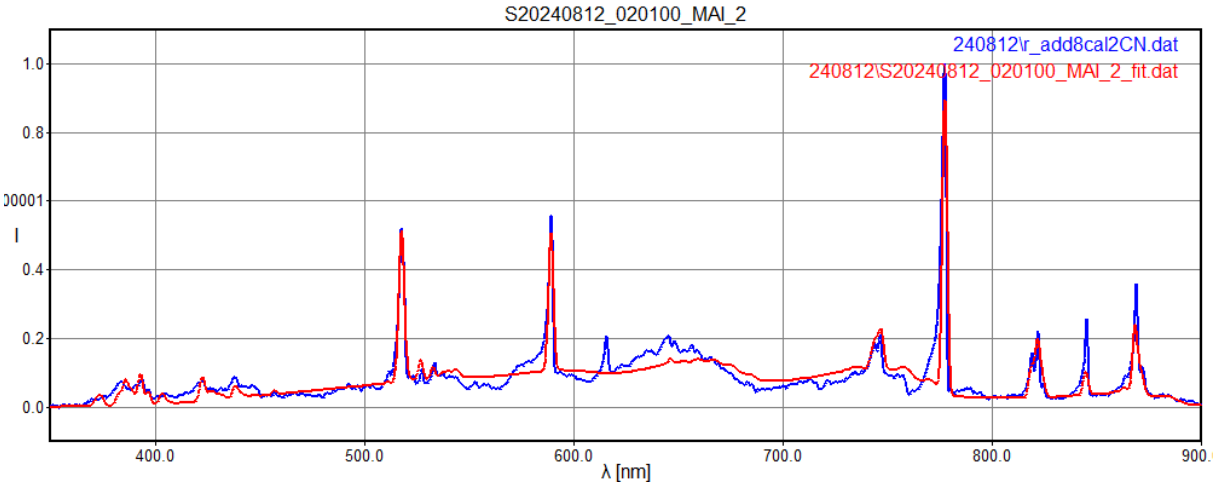
polynom for fit lambda c: [0.597 166.6224]

pixel	lambda	fit	error
588.40,	517.50,	517.87,	0.3729
707.76,	589.00,	589.13,	0.1259
1022.52,	777.40,	777.02,	-0.3754
1452.71,	1035.00,	1033.83,	-1.1698
1695.97,	1178.00,	1179.05,	1.0464

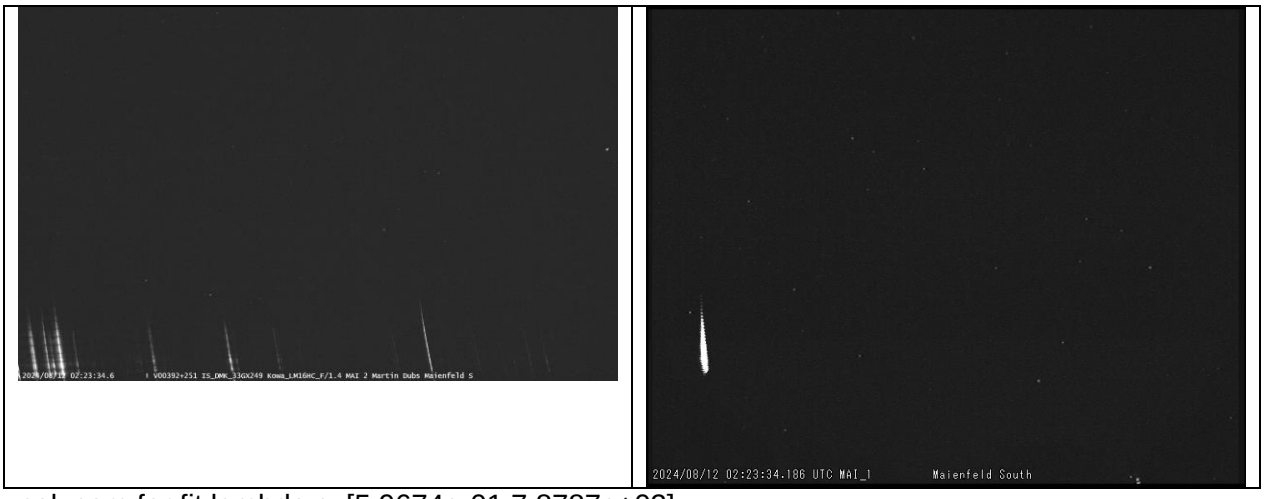
rms_x = 0.7429

spectrum 240812\r_add8cal.dat saved





M20240812_022334_MAI_2, PER, -3.4m

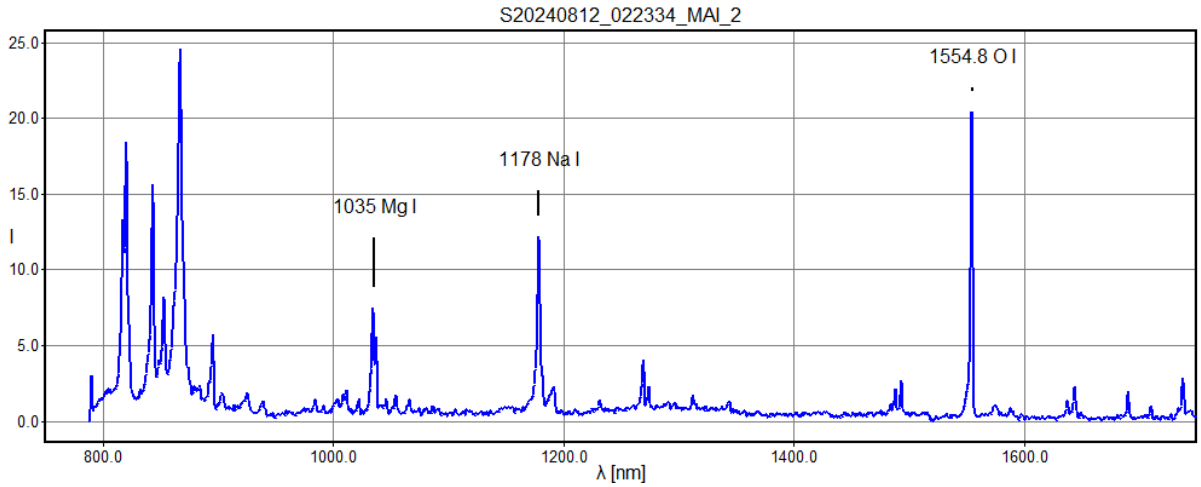


polynom for fit lambda c: [5.9674e-01 7.8787e+02]

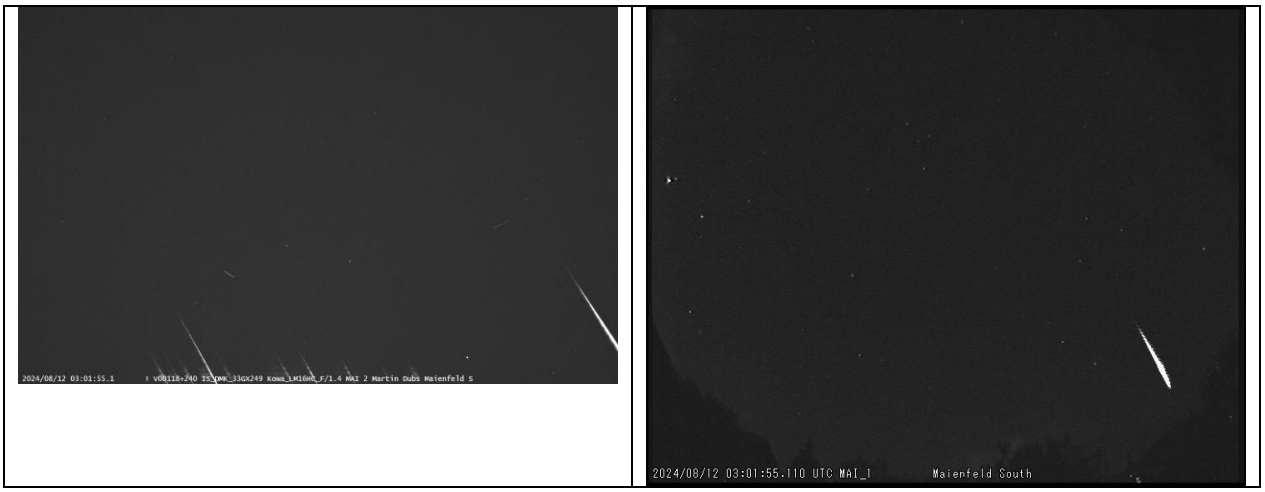
pixel	lambda	fit	error
413.35,	1035.00,	1034.53,	-0.4668
654.85,	1178.00,	1178.65,	0.6457
1284.90,	1554.80,	1554.62,	-0.1789

rms_x = 0.4715

spectrum 240812\ra_add8cal.dat saved



M20240812_030155_MAI_2, PER, -3.0m

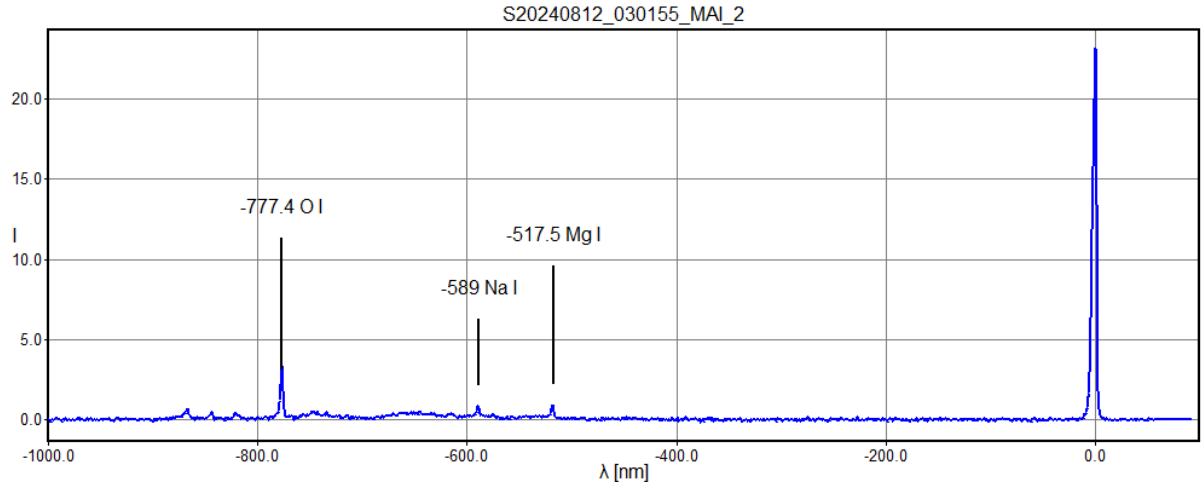


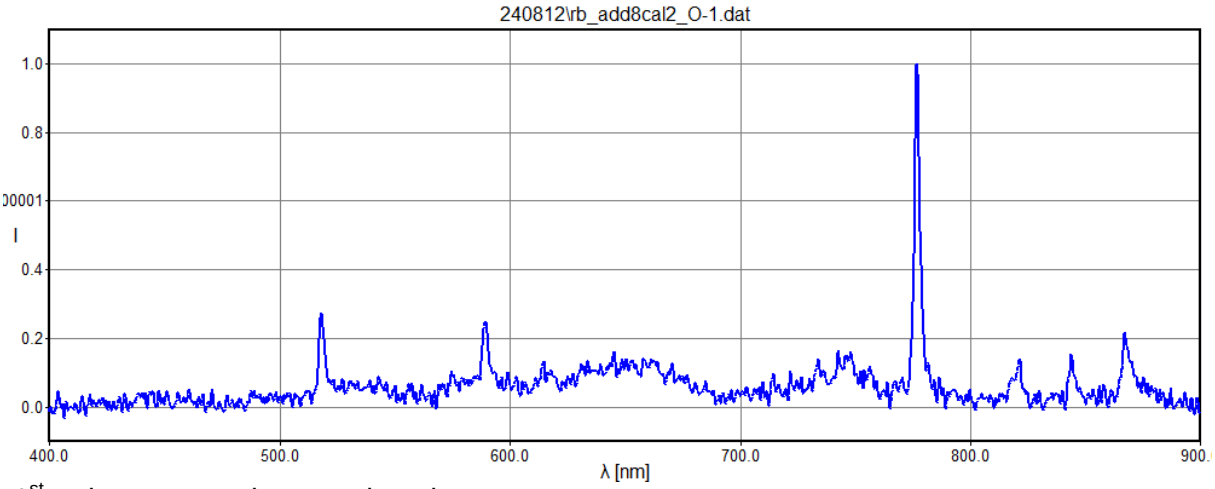
polynom for fit lambda c: [5.9404e-01 -1.0456e+03]

pixel	lambda	fit	error
1760.67,	0.00,	0.30,	0.2950
887.86,	-517.50,	-518.19,	-0.6893
768.20,	-589.00,	-589.27,	-0.2722
452.63,	-777.40,	-776.73,	0.6665

rms_x = 0.5197

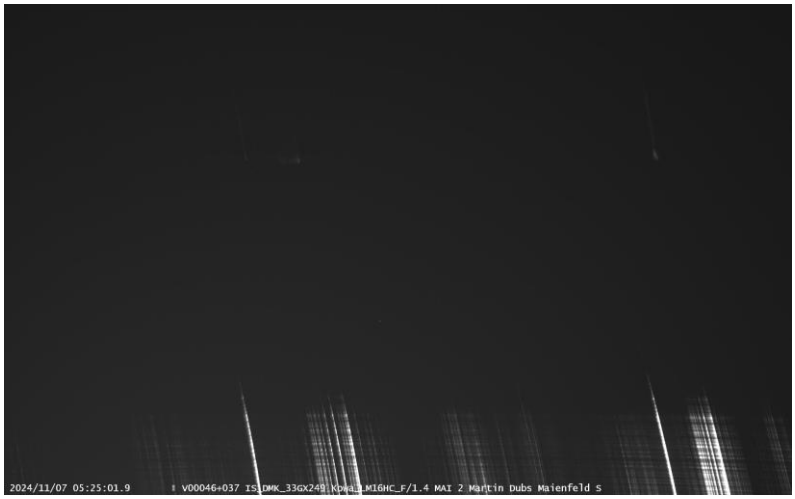
spectrum 240812\rb_add8cal.dat saved





-1st order converted to wavelength

M20241107_052501_MAI_2, spo, (-0.5m)

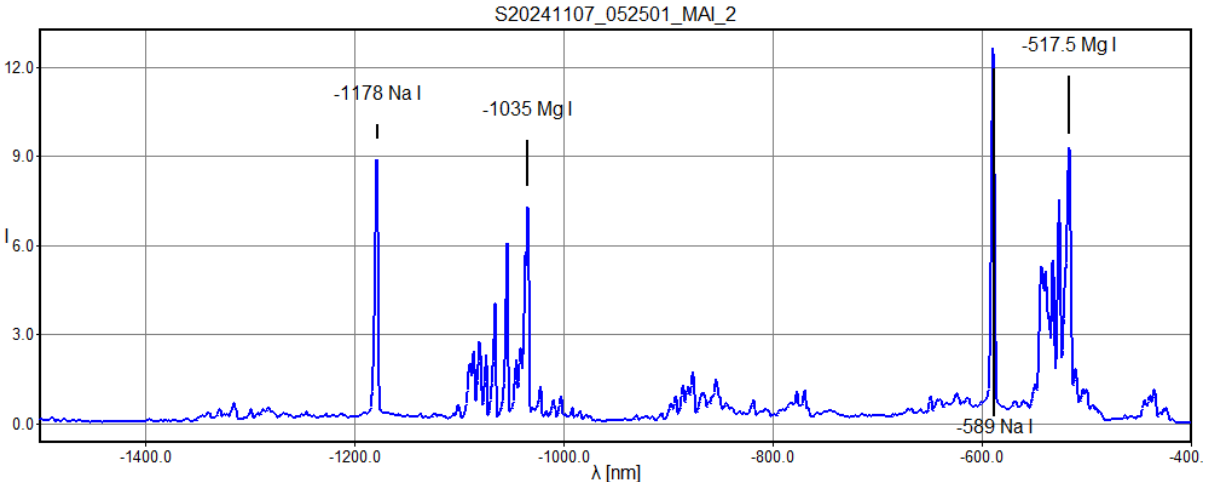


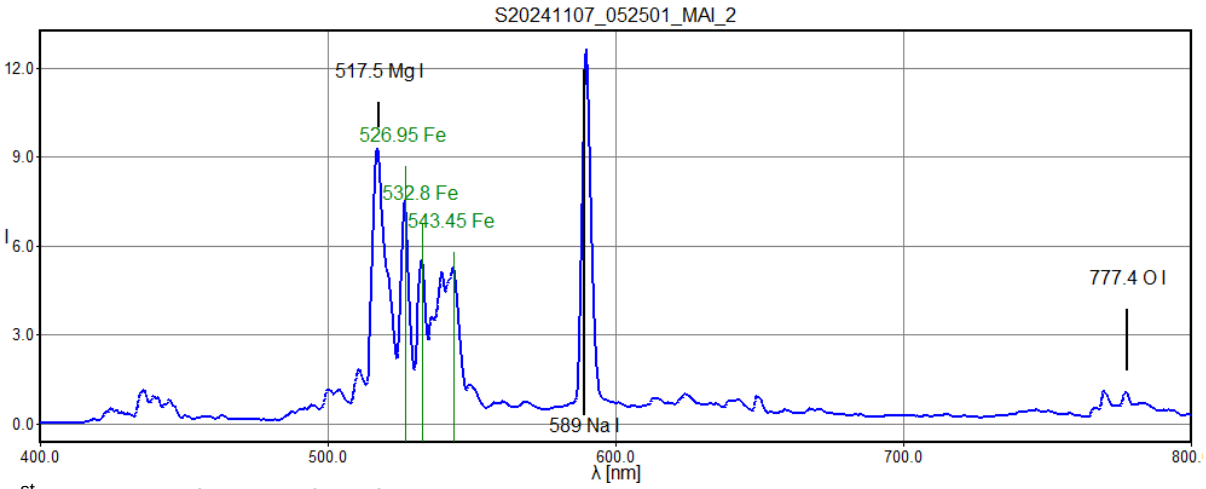
polynom for fit lambda c: [5.9672e-01 -1.5181e+03]

pixel	lambda	fit	error
1677.59,	-517.50,	-517.07,	0.4320
1555.92,	-589.00,	-589.67,	-0.6707
810.89,	-1035.00,	-1034.24,	0.7566
569.11,	-1178.00,	-1178.52,	-0.5179

rms_x = 0.6077

spectrum 241107\r_add29cal.dat saved





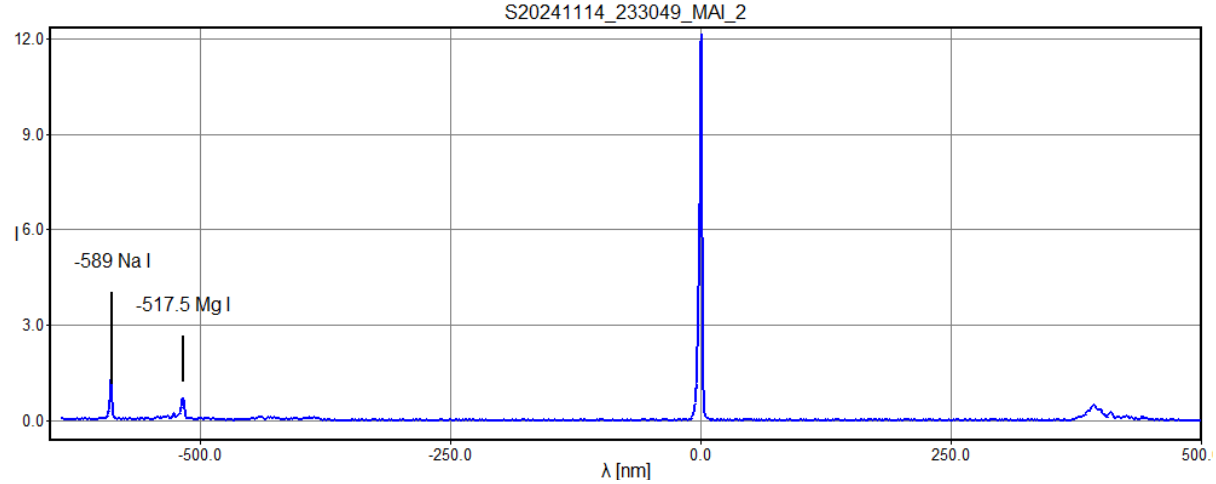
-1st O converted to wavelength

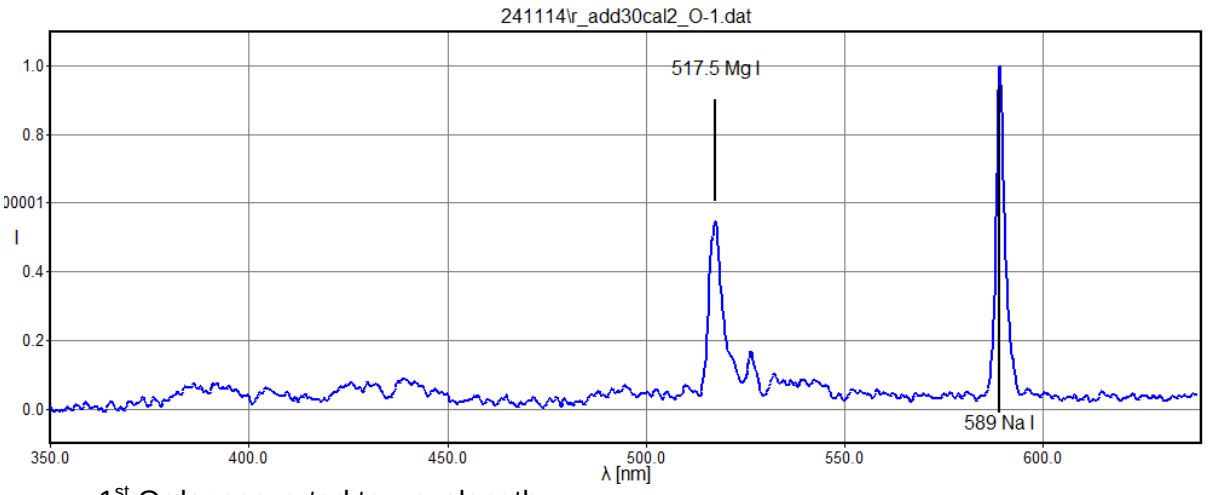
M20241114_233049_MAI_2, NTA, -2.3m

polynom for fit lambda c: [5.9672e-01 -6.4035e+02]

pixel	lambda	fit	error
1073.08,	0.00,	-0.02,	-0.0232
206.19,	-517.50,	-517.31,	0.1898
85.77,	-589.00,	-589.17,	-0.1667

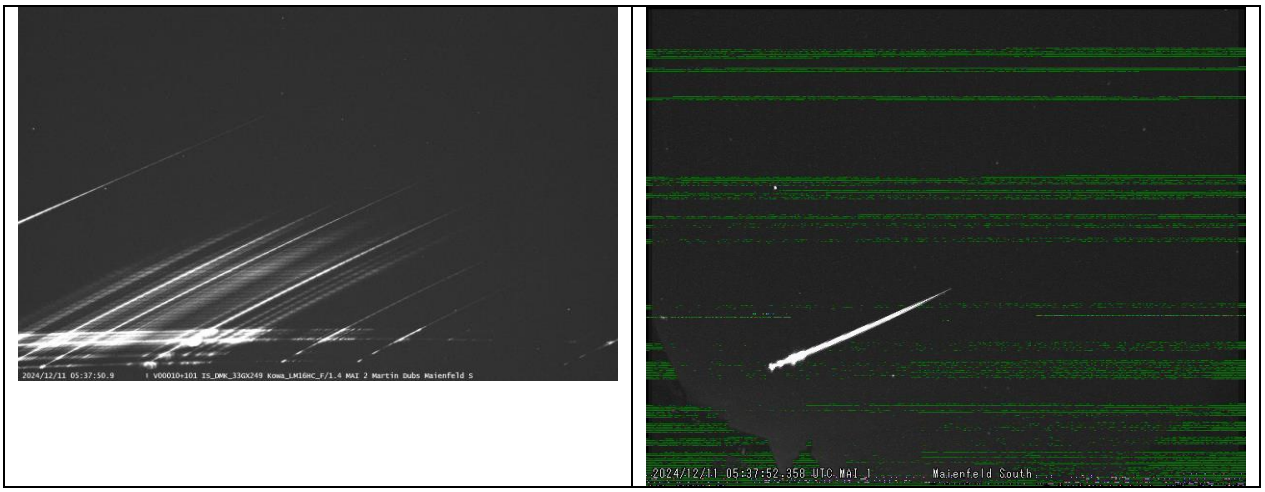
rms_x = 0.1465
spectrum 241114\r_add30cal.dat
saved





- 1st Order converted to wavelength

M20241211_053750_MAI_2, MON, -3.3m

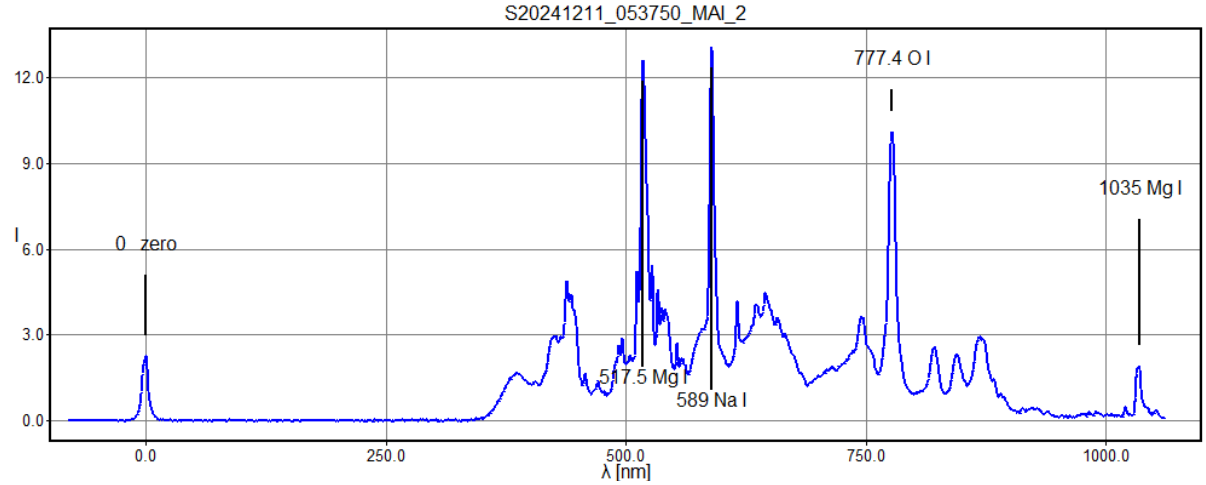


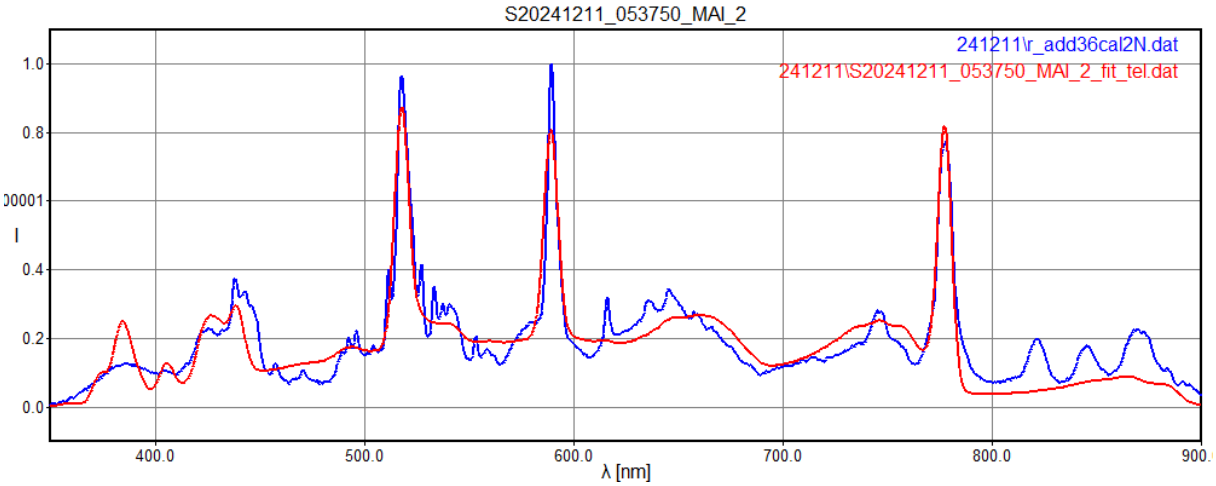
polynom for fit lambda c: [0.5973 -82.6455]

pixel	lambda	fit	error
137.71,	0.00,	-0.38,	-0.3847
1005.34,	517.50,	517.89,	0.3925
1125.08,	589.00,	589.42,	0.4190
1439.83,	777.40,	777.43,	0.0343
1870.24,	1035.00,	1034.54,	-0.4611

rms_x = 0.3718

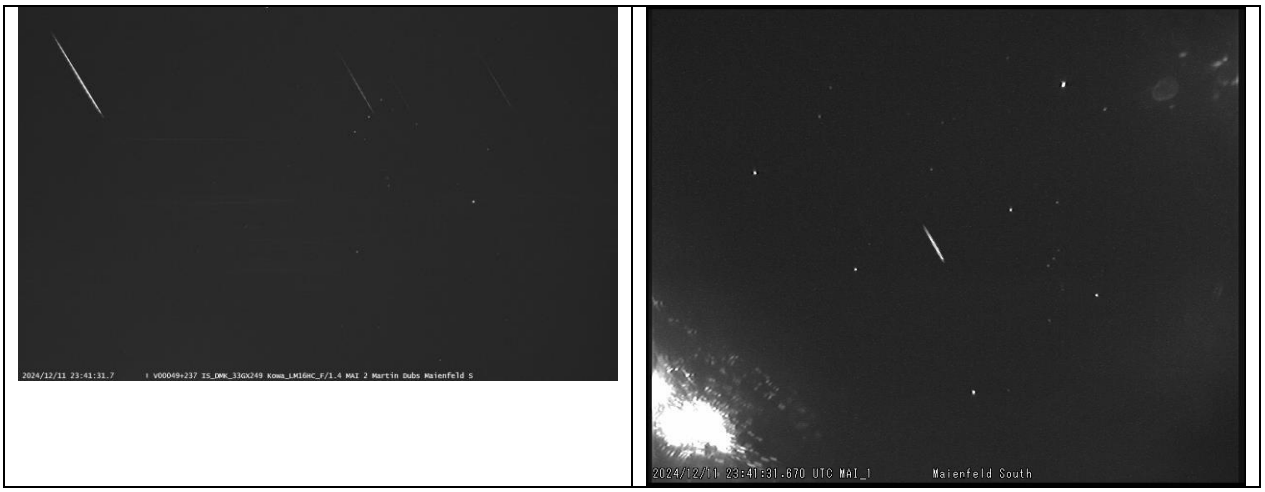
spectrum 241211\r_add36cal.dat saved





Fit T_el = 4500K

M20241211_234131_MAI_2, GEM, -1.6m

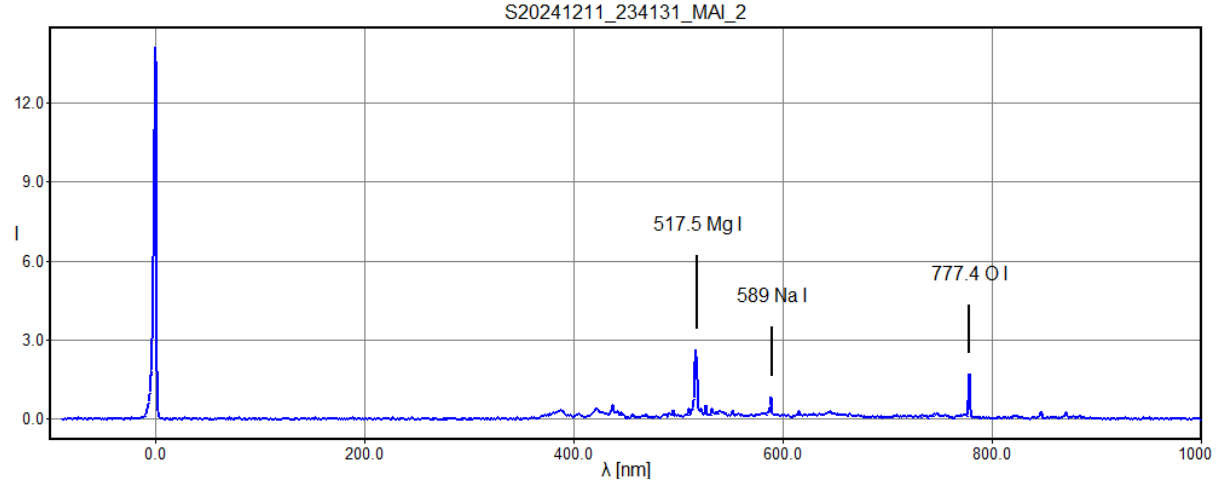


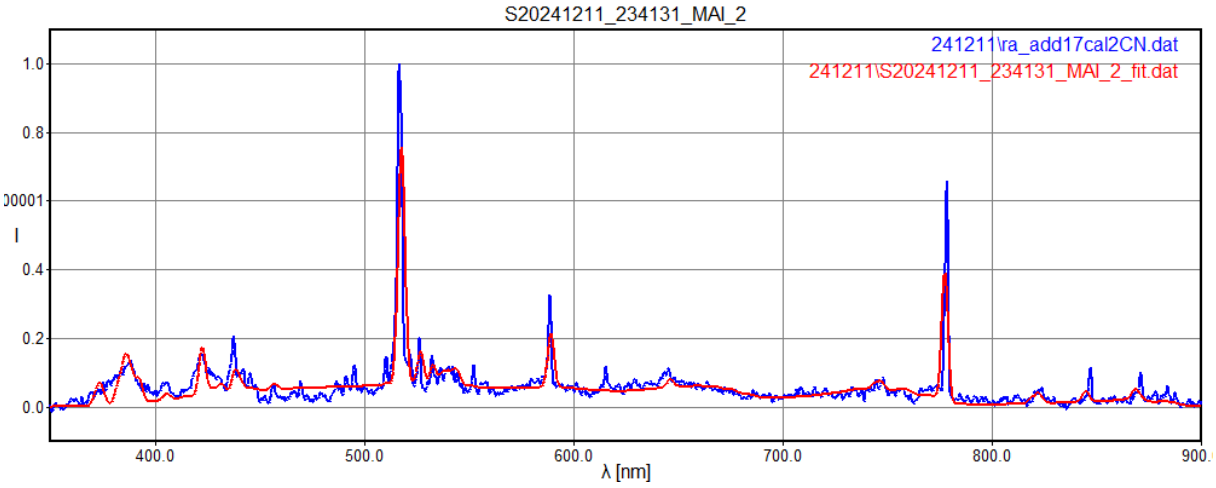
polynom for fit lambda c: [-3.3010e-06 6.0378e-01 -9.1495e+01]

pixel	lambda	fit	error
151.66,	0.00,	-0.00,	-0.0017
1014.33,	517.50,	517.54,	0.0426
1134.00,	589.00,	588.95,	-0.0515
1450.61,	777.40,	777.41,	0.0107

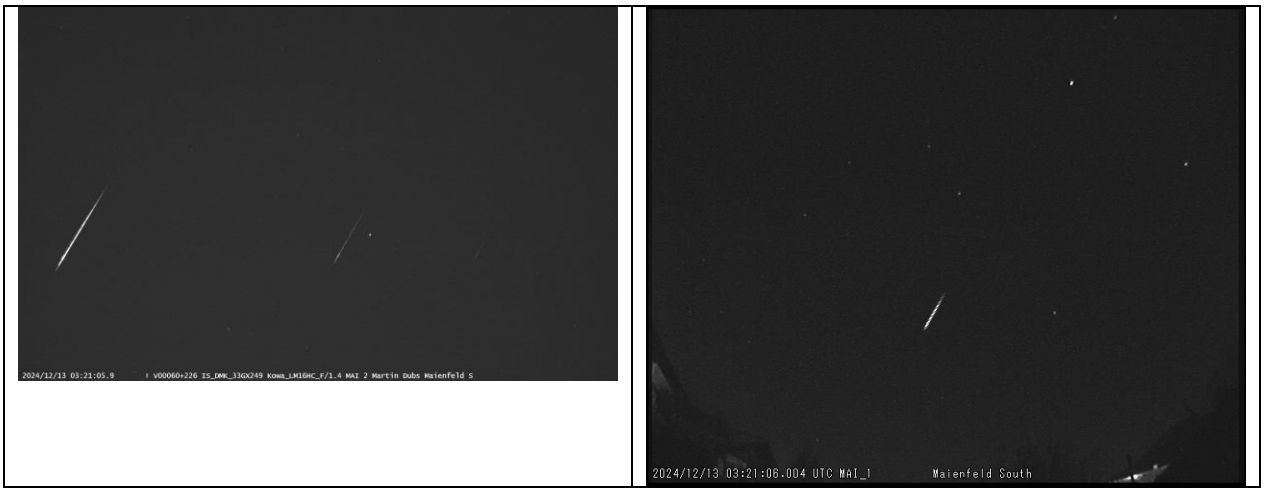
rms_x = 0.0338

spectrum 241211\ra_add17cal.dat saved





M20241213_032105_MAI_2, GEM, -2.2m

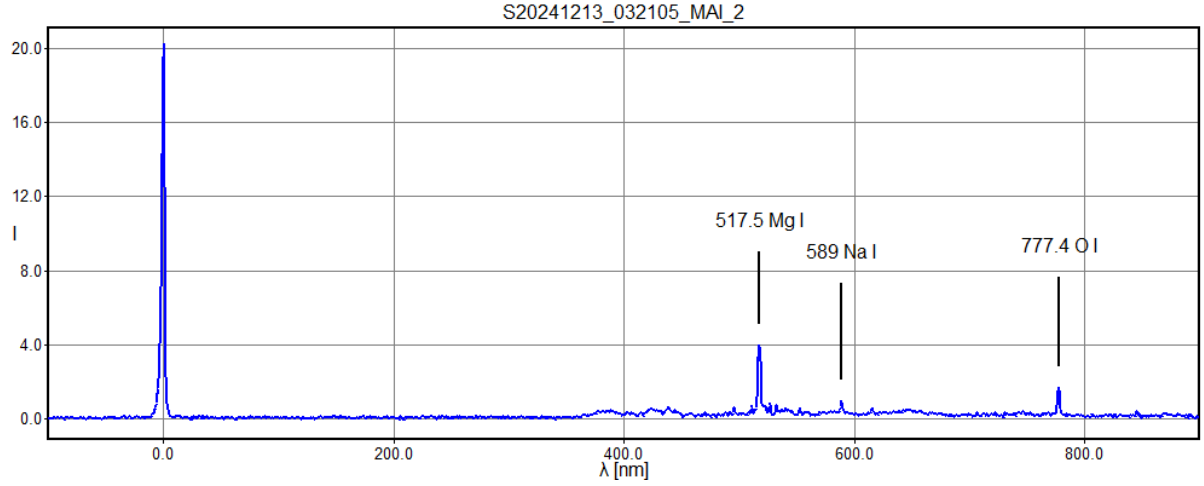


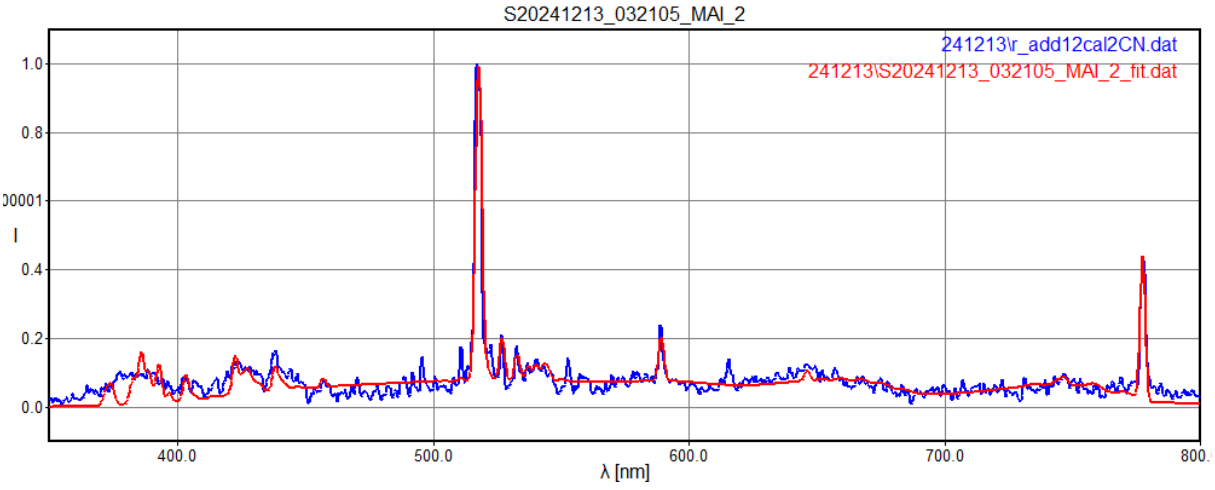
polynom for fit lambda c: [-1.5349e-06 6.0010e-01 -1.6120e+02]

pixel	lambda	fit	error
268.81,	0.00,	-0.00,	-0.0016
1134.34,	517.50,	517.54,	0.0402
1254.07,	589.00,	588.95,	-0.0486
1570.40,	777.40,	777.41,	0.0101

rms_x = 0.0319

spectrum 241213\r_add12cal.dat saved





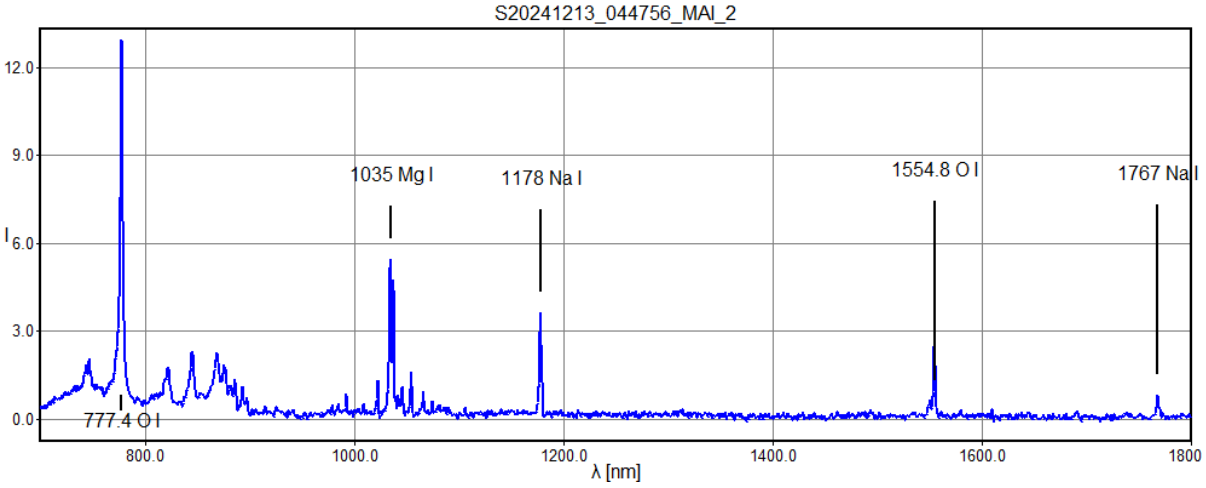
M20241213_044756_MAI_2, GEM, -3.2m

polynom for fit lambda c: [5.9560e-01 6.5941e+02]

pixel	lambda	fit	error
198.72,	777.40,	777.77,	0.3693
629.94,	1035.00,	1034.60,	-0.3954
870.82,	1178.00,	1178.07,	0.0731
1502.40,	1554.80,	1554.24,	-0.5570
1860.47,	1767.00,	1767.51,	0.5100

rms_x = 0.4168

spectrum 241213\ra_add10cal.dat saved



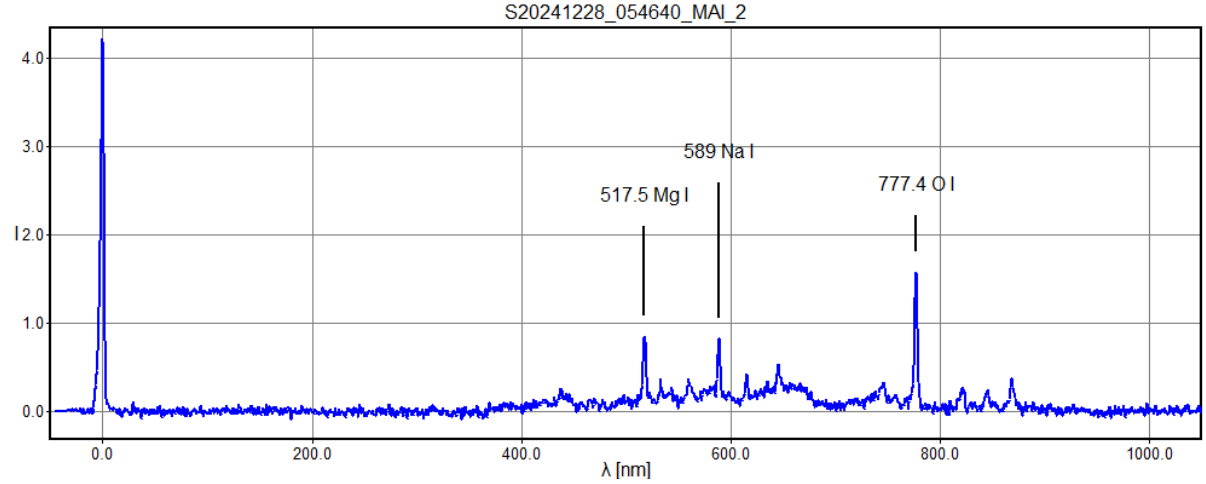
M20241228_054640_MAI_2, spo, -1.8m

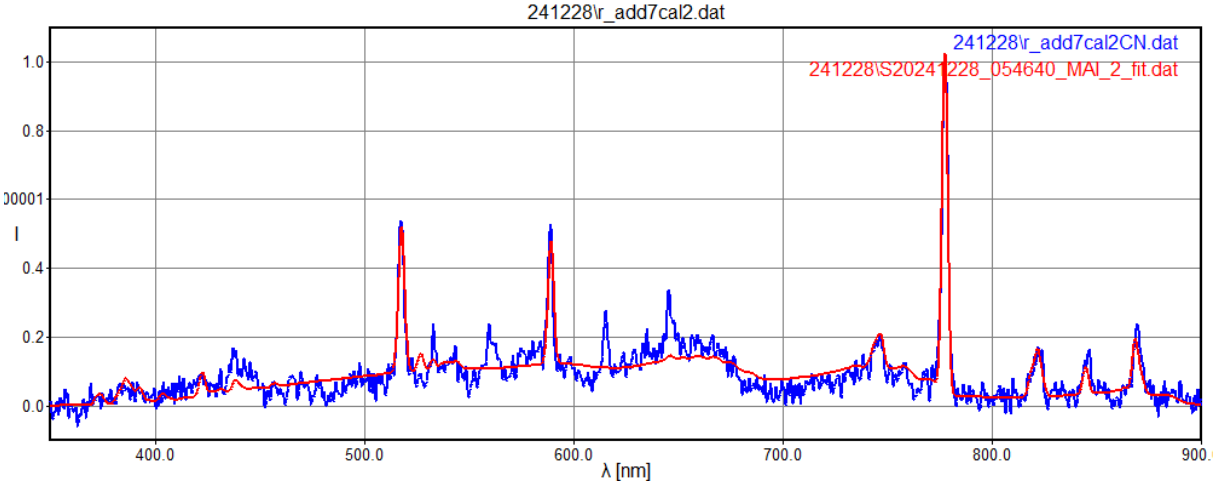
polynom for fit lambda c: [1.0570e-06 5.9468e-01 -4.7271e+01]

pixel	lambda	fit	error
79.47,	0.00,	-0.00,	-0.0047
948.30,	517.50,	517.62,	0.1168
1067.67,	589.00,	588.86,	-0.1416
1383.39,	777.40,	777.43,	0.0294

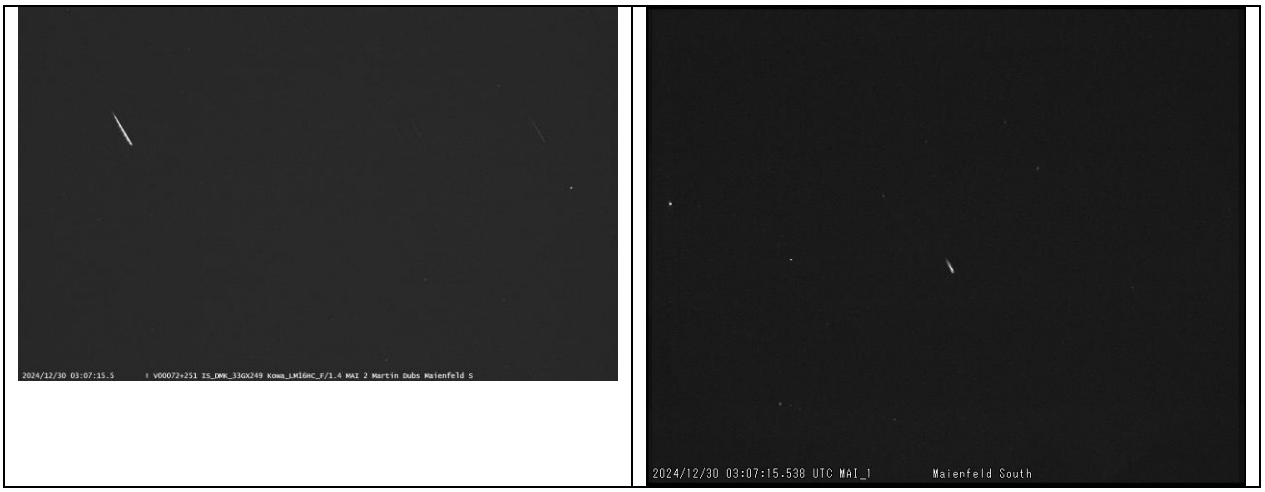
rms_x = 0.0930

spectrum 241228\r_add7cal.dat saved





M20241230_030715_MAI_2, COM, -1.8m

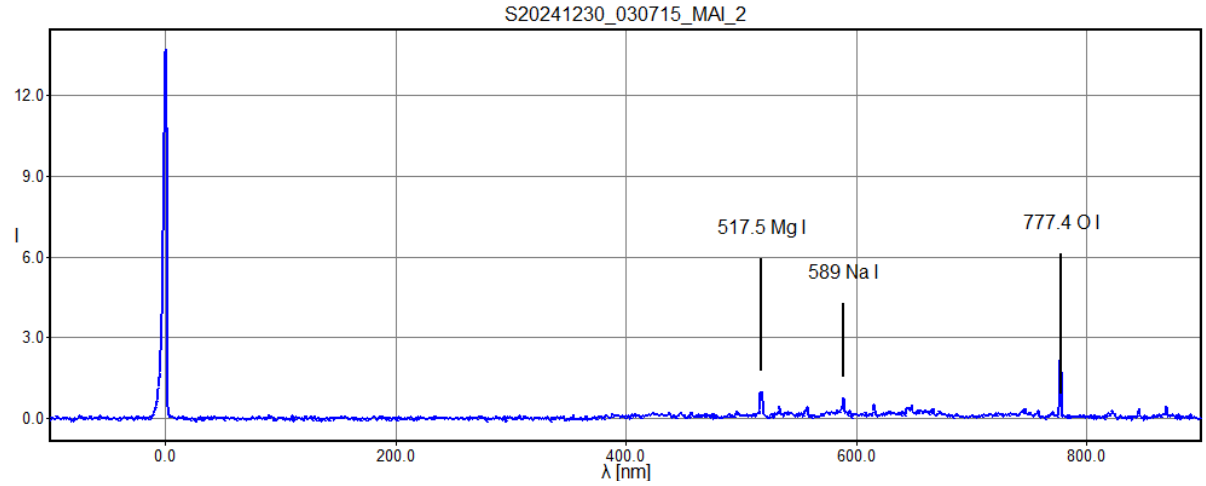


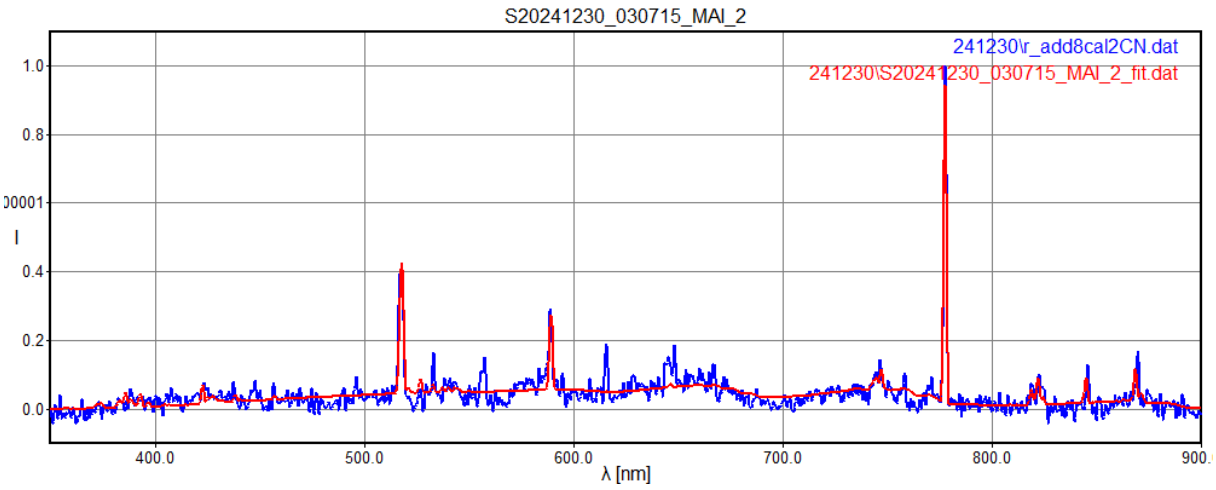
polynom for fit lambda c: [-4.0469e-06 6.0570e-01 -1.8950e+02]

pixel	lambda	fit	error
313.50,	0.00,	-0.01,	-0.0075
1176.79,	517.50,	517.68,	0.1828
1296.14,	589.00,	588.78,	-0.2210
1613.80,	777.40,	777.45,	0.0456

rms_x = 0.1453

spectrum 241230\r_add8cal.dat saved





Meteor spectral lines

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

Laboratory data			ident.	Laboratory data			ident.
λ_{lab}, [Å]	atom/ion	intensity	number	λ_{lab}, [Å]	atom/ion	intensity	number
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 PhotographicHandbook 03 Spectra, p 47)
http://www.imo.net/docs/03spectra.pdf

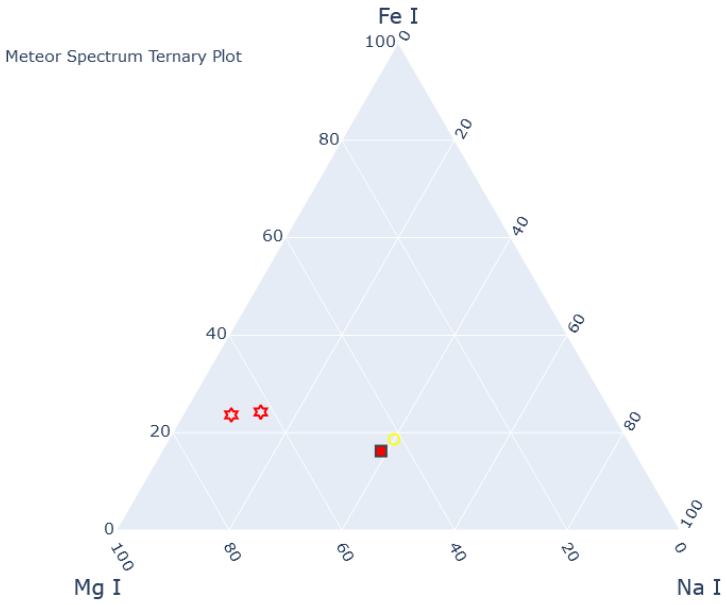
Another list from Borovicka, 2005
https://ui.adsabs.harvard.edu/abs/2005Icar..174...15B/abstract
Free access from:
https://sci-hub.st/https://doi.org/10.1016/j.icarus.2004.09.011

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
Low temperature lines				*Wake lines*[a]			
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	*Atmospheric lines*			
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
High temperature line				*Train line*			
4481	Mg II	4	36	5577	[O I]	3*F*	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.

Ternary plot 2024



GEM: red star
PER: red square
MON: yellow circle
[ternary Plot 2024 annotated.htm]

Content