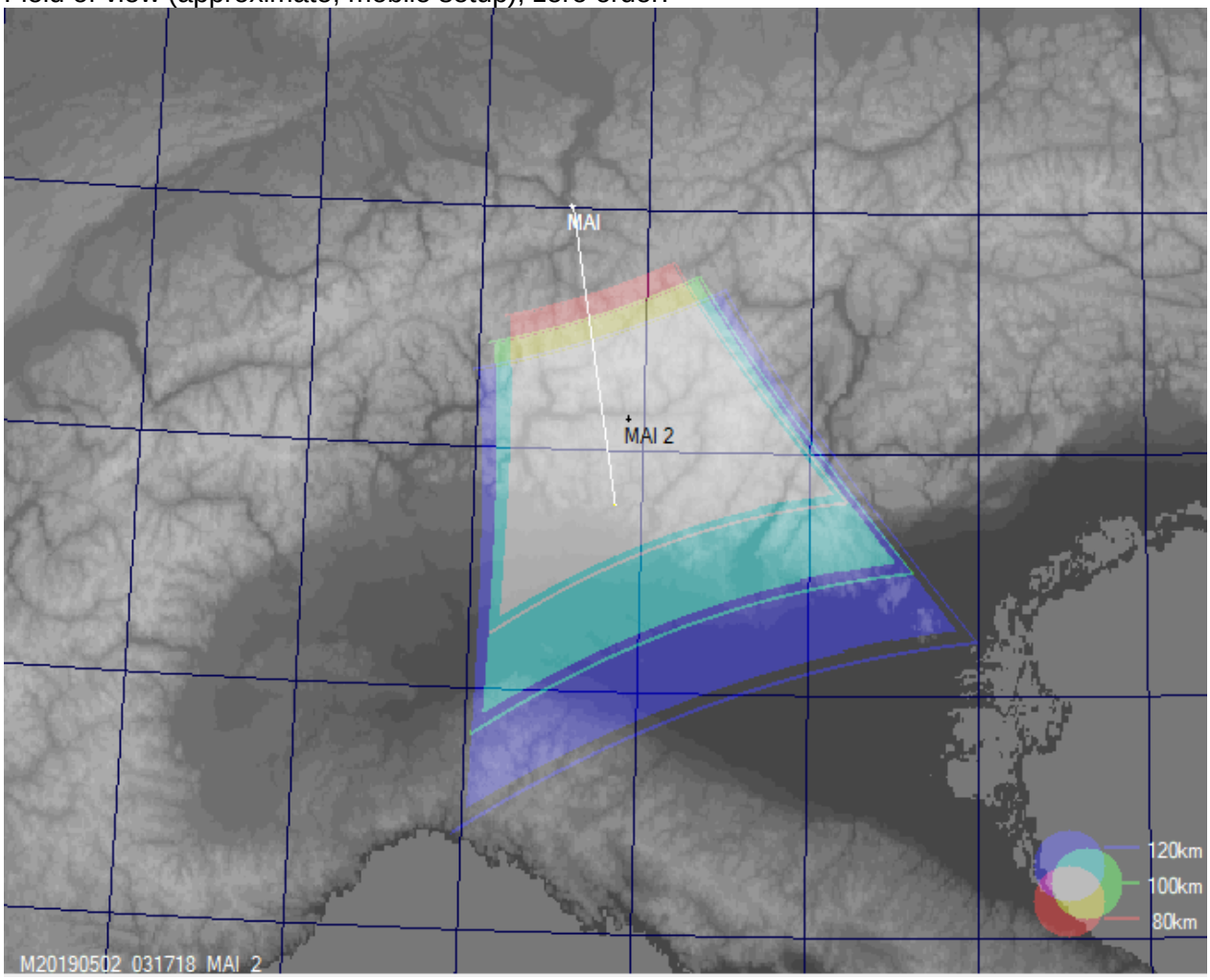
Meteor spectra 2021

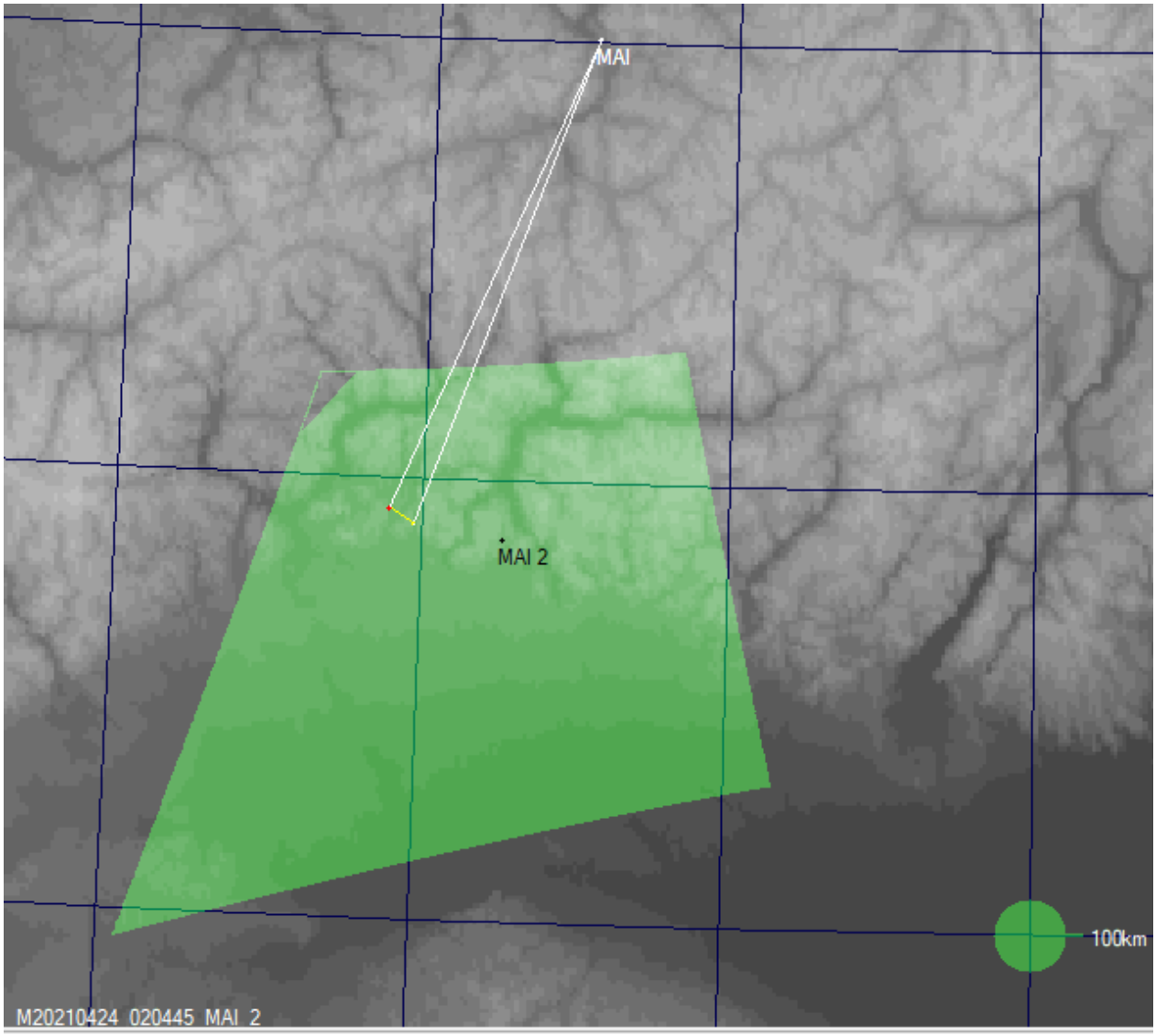
Overview

This is a collection of meteor spectra obtained at Maienfeld (MAI_2), with a Watec 902H2 ultimate
20.3.2019
MAI_2 lens Tamron VG412 ASIR at f ≅ 7mm, grating Thorlabs, 300l/mm
MAI_1 lens Tamron VG412 ASIR at f ≅ 4mm
Field of view (approximate, mobile setup), zero order:



Changed 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 190°

Grating: Thorlabs 600l/mm, dispersion: 0.598 nm/pixel



Spectra analyzed with Python M_SPEC.py

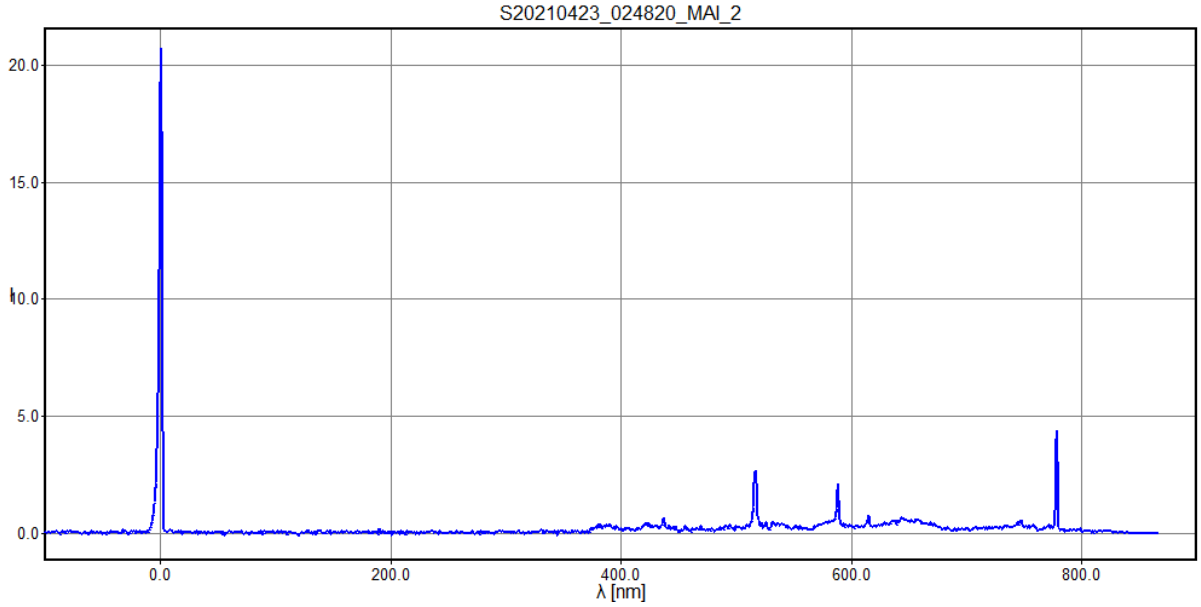
M20210423_030622_MAI_2, LYR, -2.2m

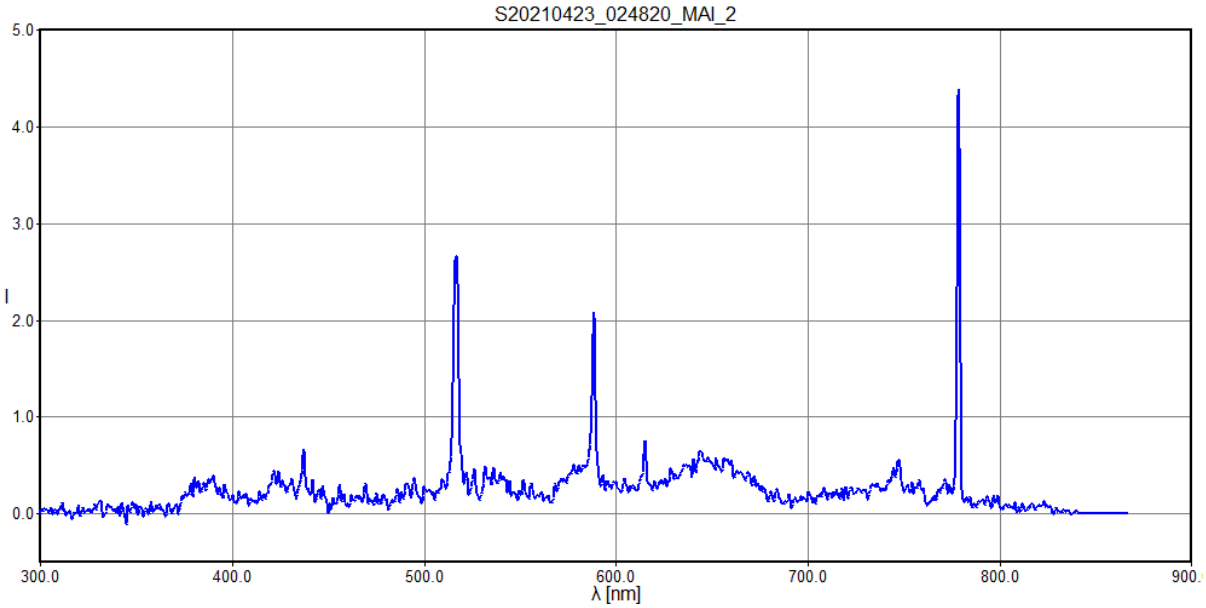
polynom for fit lambda c: [0.5977 -278.4499]

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

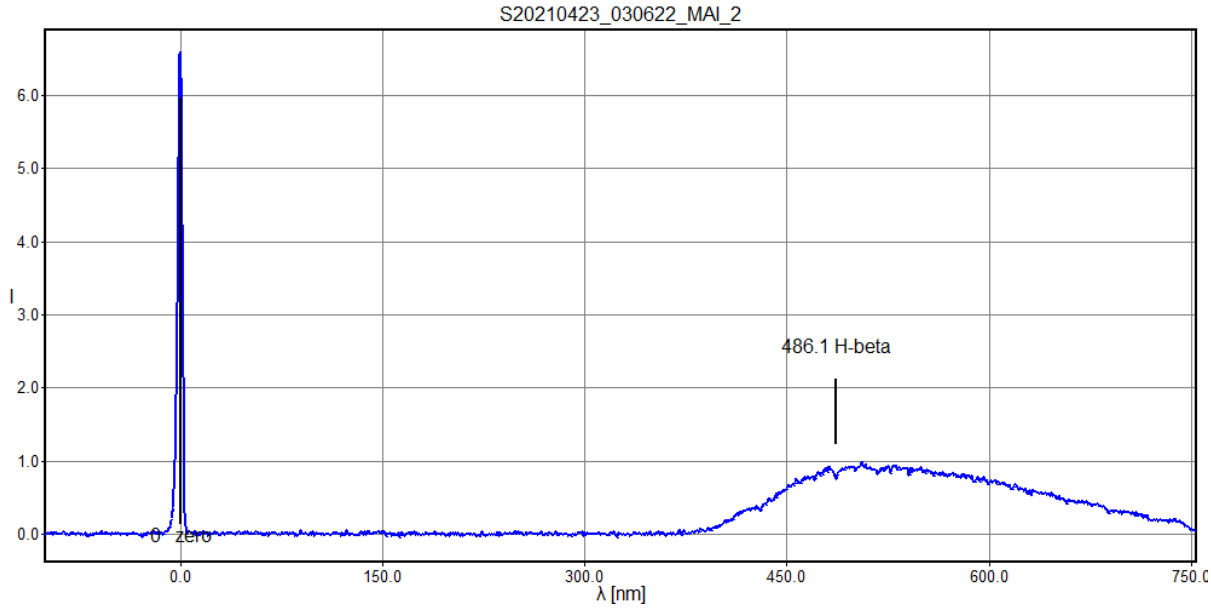
spectrum 210423\r_add14cal.dat saved

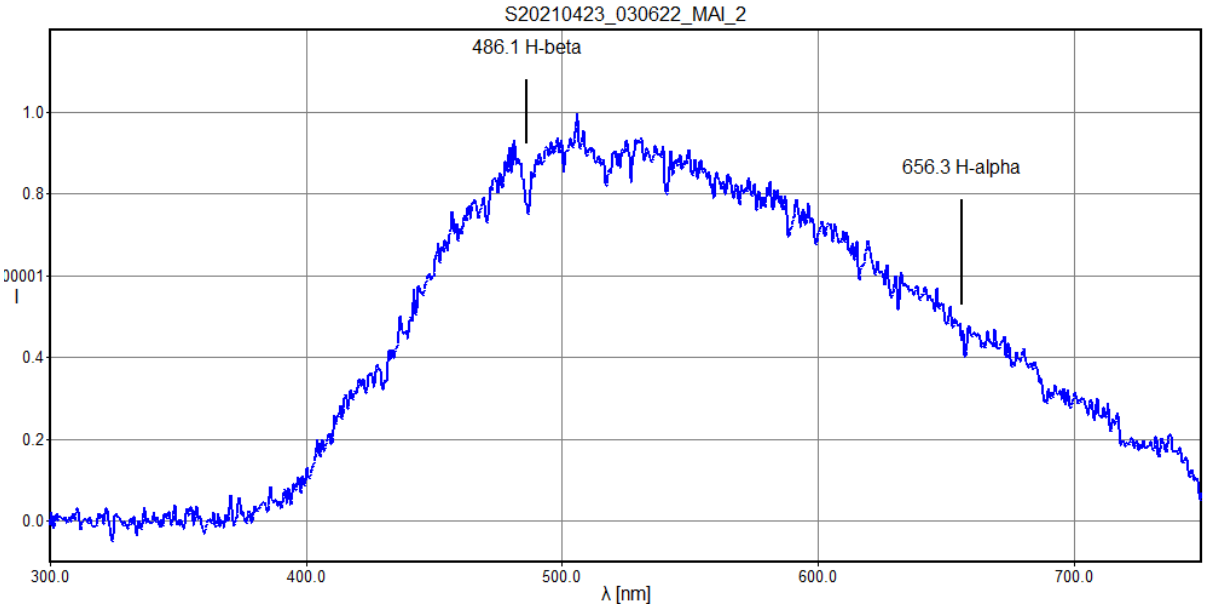




M20210423_030622_MAI_2, satellite flash, -0.2m

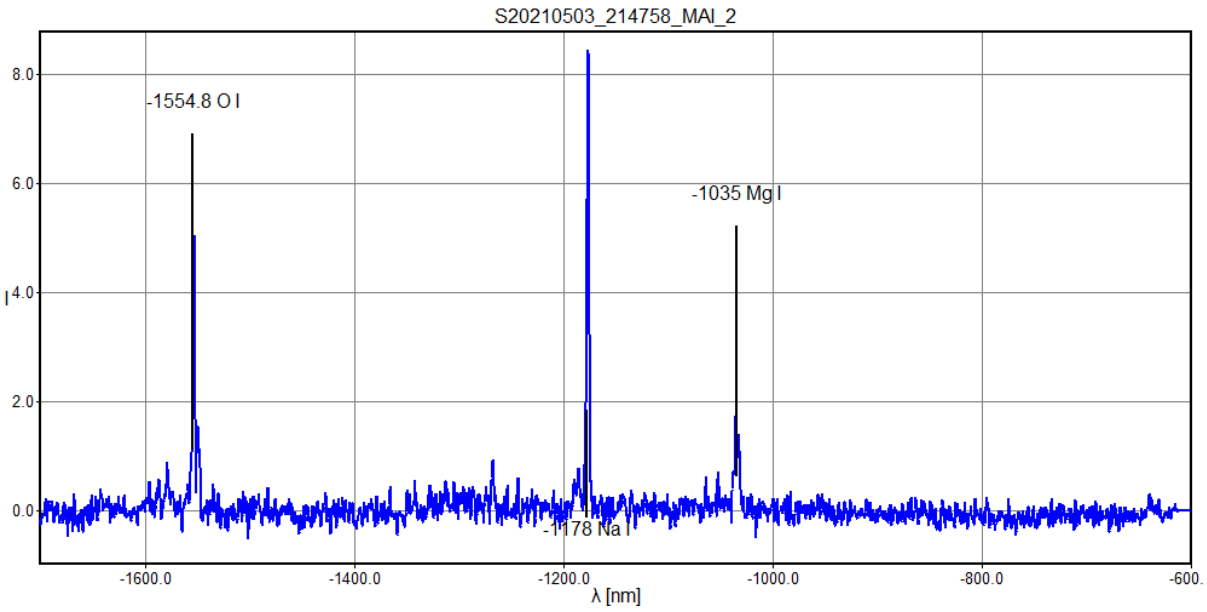
Zero order fit with dispersion from previous spectrum, disp0 = 0.5977 nm/pixel
polynom for fit lambda c: [0.5977, -391.099018]
pixel lambda fit error
654.34, 0.00, 0.00, 0.0000
1468.37, 486.10, 486.55, 0.4457 H-beta
rms_x = 0.3152
spectrum 210423\rs_add37cal.dat saved


S20210423_030622_MAI_2
6.0
5.0
4.0
3.0
2.0
1.0
0.0
I
0 zero
486.1 H-beta
0.0
150.0
300.0
450.0
600.0
750.0
λ [nm]

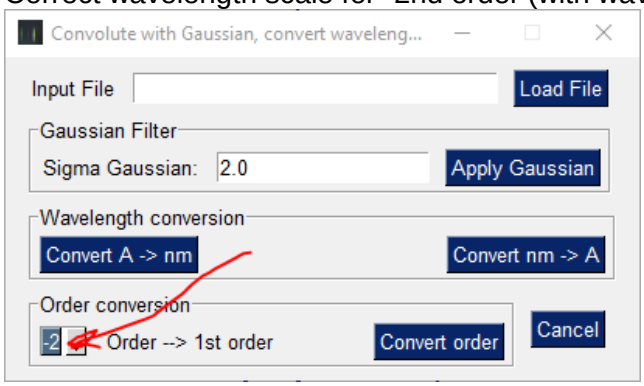

S20210423_030622_MAI_2
486.1 H-beta
656.3 H-alpha
1.0
0.8
0.4
0.2
0.0
300.0
400.0
500.0
600.0
700.0
λ [nm]

M20210503_214758_MAI_2, spo, 1.4m

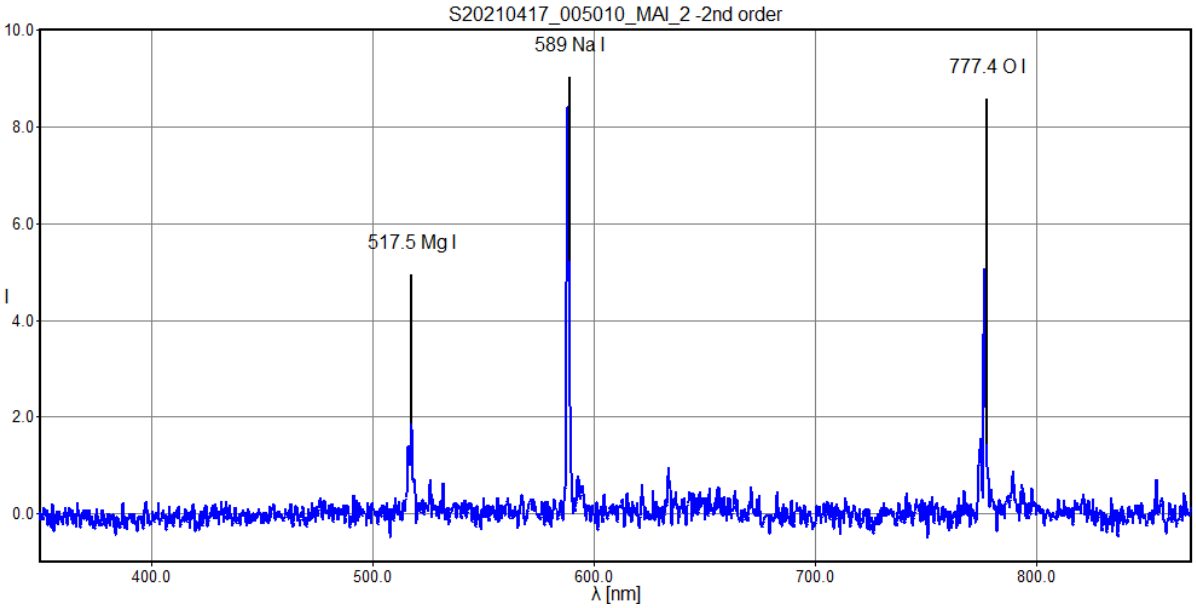
Test calibration, strongest line as zero order
polynom for fit lambda c: [0.5989822149276733, -565.792610398531]
pixel lambda fit error
944.59, 0.00, 0.00, 0.0000
rms_x = 0.0000
get line separations: 142 nm → 2xdelta (Na 1, Mg I)
line at right must be 2nd order Mg I
new calibration:
polynom for fit lambda 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



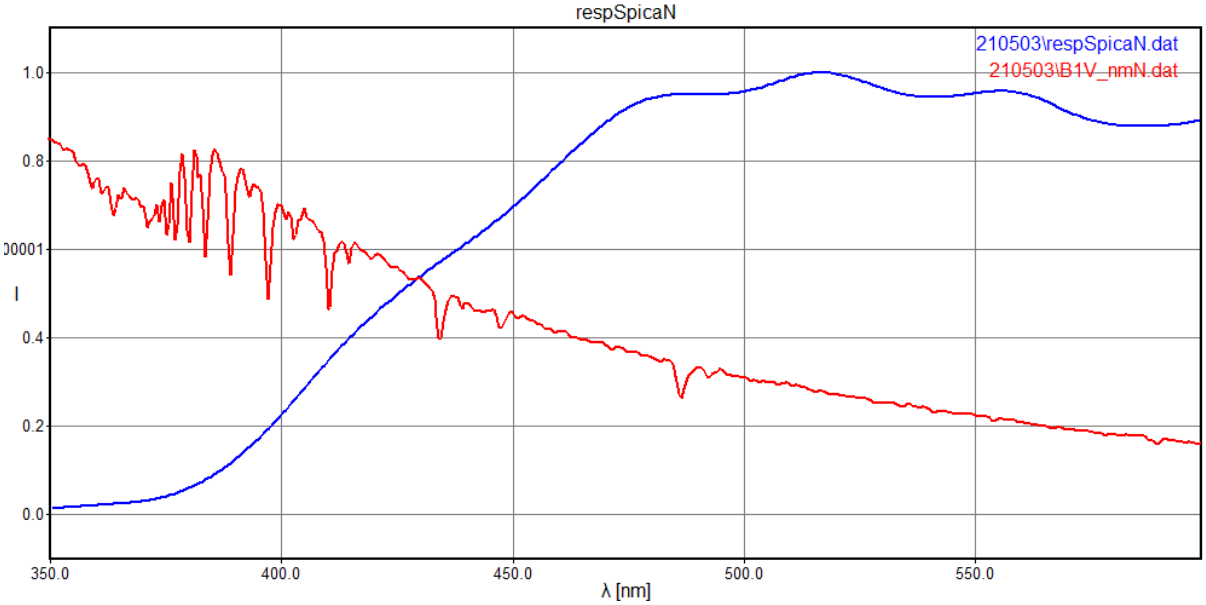
Correct wavelength scale for -2nd order (with wavelength tools – convert order)



→

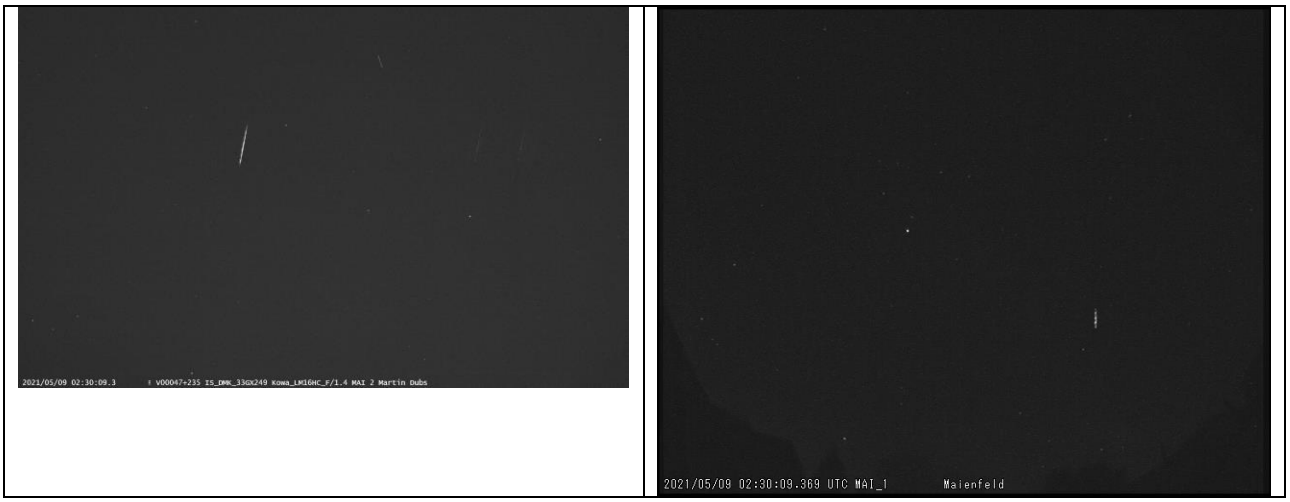


The bright star is Spica (spectral class B1V), it can be used to create an instrument response function (valid in the blue part of the spectrum, in the red the intensity is not sufficient (could be improved with longer exposure time):



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

M20210509_023009_MAI_2, spo, -0.8m

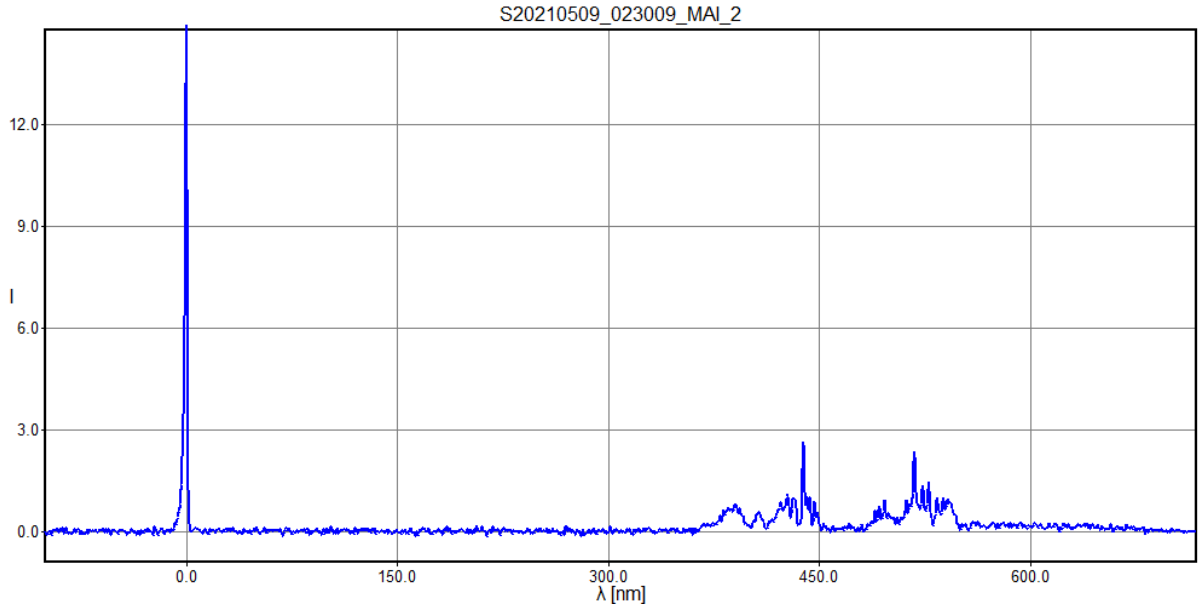


polynom for fit lambda c: [0.5993 -430.9973]

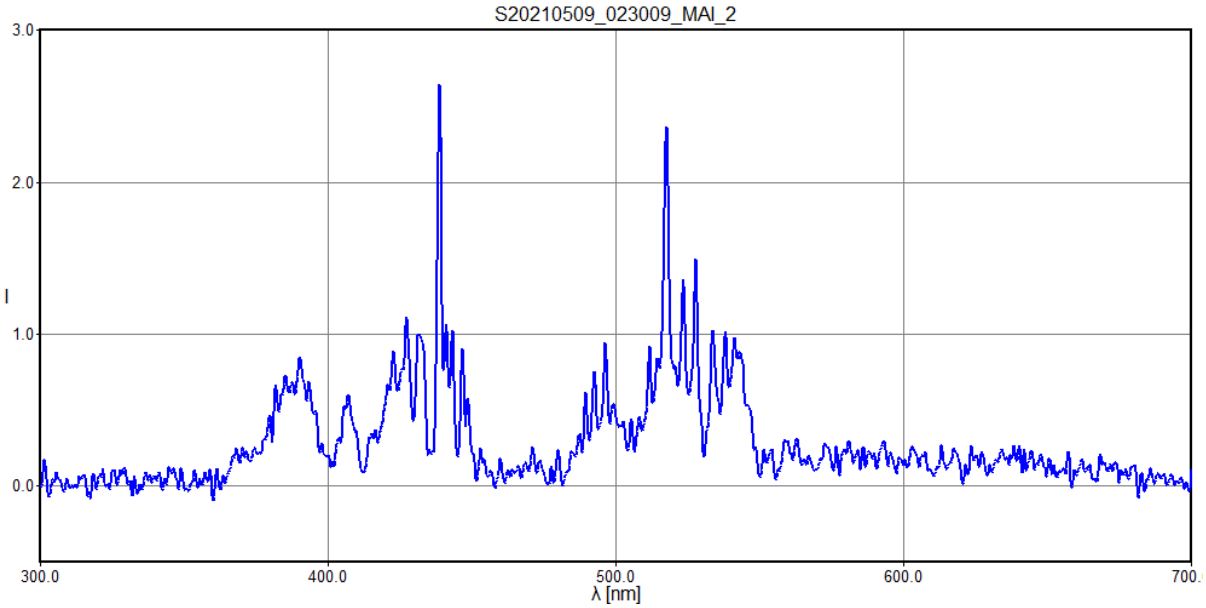
pixel	lambda	fit	error
719.12,	0.00,	0.00,	0.0000
1582.57,	517.50,	517.50,	0.0000

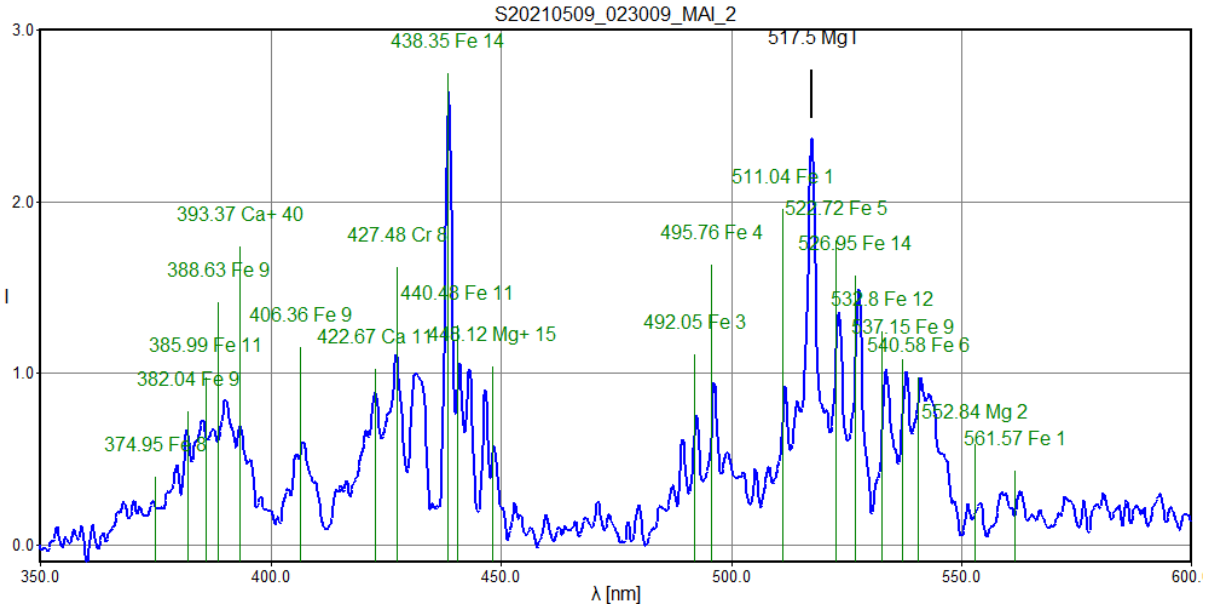
rms_x = 0.0000

spectrum 210509\r_add8cal.dat saved



Typical iron spectrum





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

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.
$\lambda_{lab}, [\AA]$	atom/ion	intensity	number	$\lambda_{lab}, [\AA]$	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.

Content