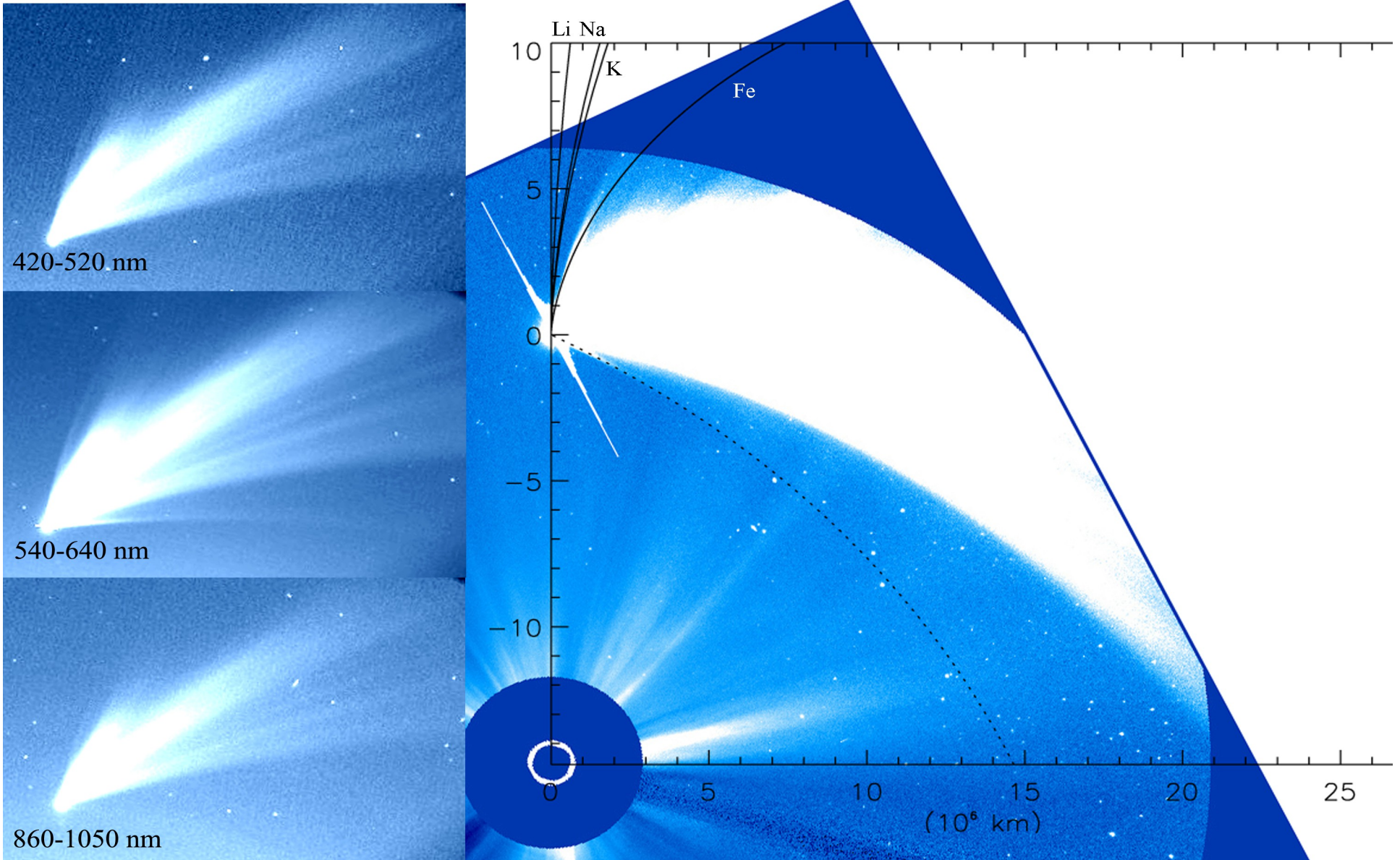
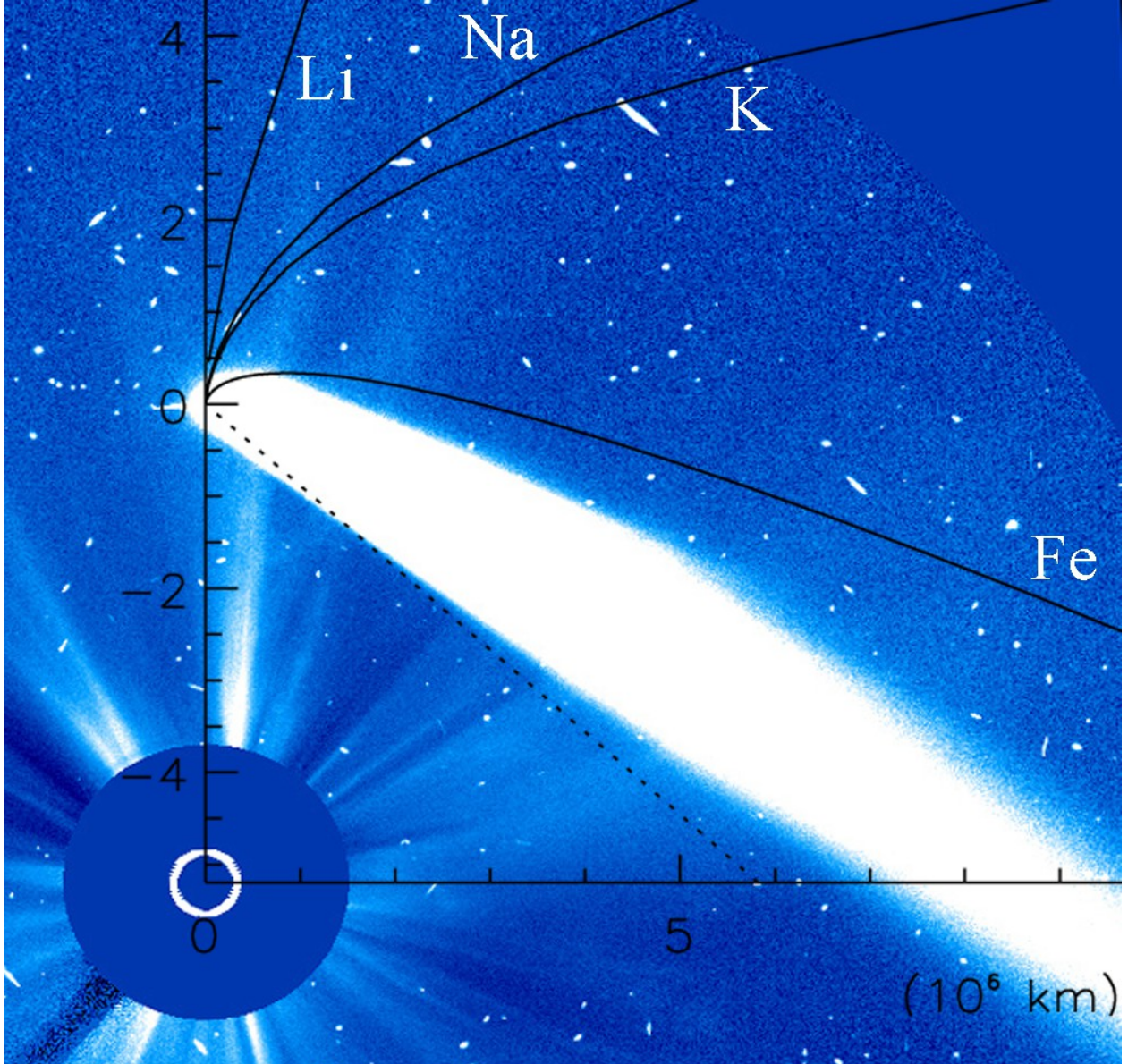
Aspirina 2 la Vendetta

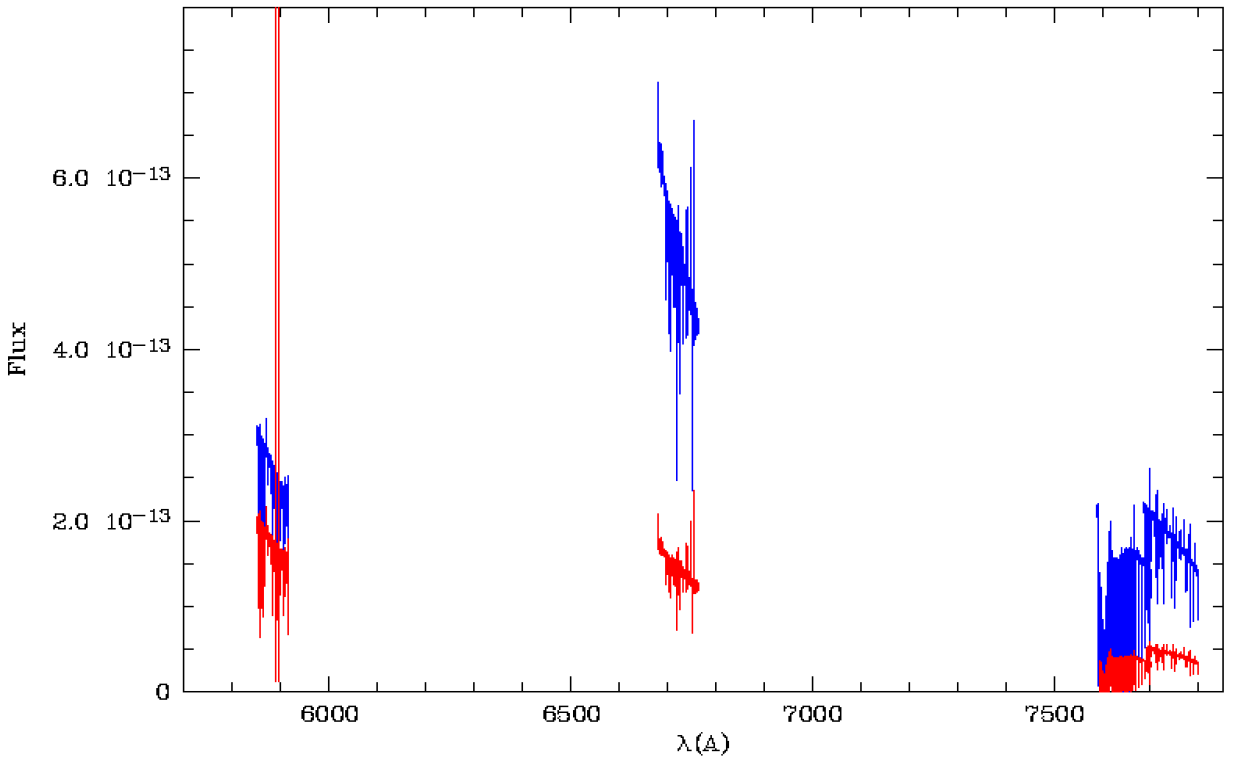
Marco Fulle, Paolo Molaro – INAF Trieste
Ilya Ilyin – PEPSI Large Binocular Telescope


420-520 nm
540-640 nm
860-1050 nm
Li Na
K
Fe
10
5
0
−5
−10
0
5
10
15
20
25
(10⁶ km)


Li
Na
K
Fe
4
2
0
−2
−4
0
5
(10⁶ km)

UT Oct 2024	exposure sec	air mass	r au	Δ au	$\dot{r}$ km/s	$\dot{\Delta}$ km/s	α deg	PA_r deg	PA_v deg	PA_o deg	ρ_o km	a_{Na} m/s^2	a_K m/s^2
26.09-26.11	3×720	1.9-2.4	0.812	0.774	+33.64	+58.02	77.6	71.6	239.8	225.1	5600	0.65	0.48
27.06-27.12	3×1800	1.6-2.9	0.831	0.808	+33.61	+58.80	74.6	71.4	238.3	225.2	5800	0.62	0.46

r and Δ: heliocentric and geocentric distances. α: phase angle. PA_r and PA_v: Position Angles of the antisolar and trailing orbit directions. PA_o and ρ_o: Position Angle and distance from the nucleus of the trail observation. a_{Na} and a_K: alkali antisunward acceleration due to solar radiation pressure.



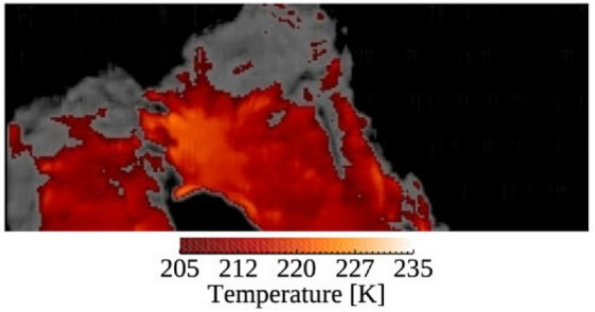
Red: C/2023 A3 on 26 October
Blue: C/2023 A3 on 27 October

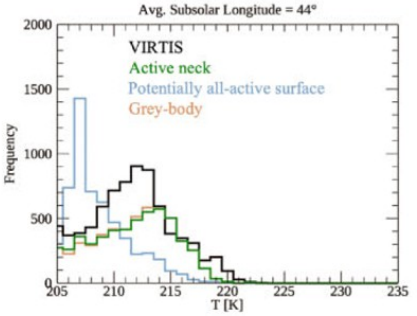
NaI, LiI and KI at 3 different CDs

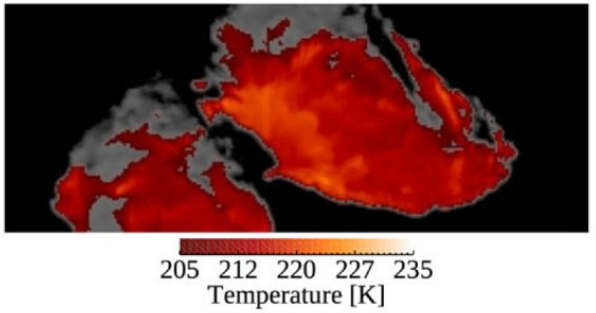
Expected continuum slope:
Solar Planckian: -18%/100nm
Dust color: +(11-14)%/100nm

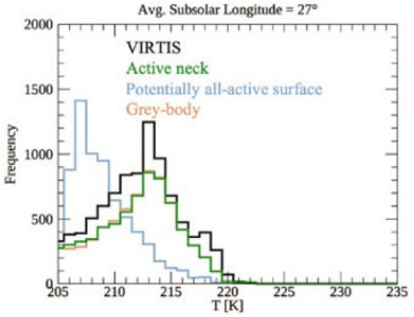
From NaI to KI lines:
Dust continuum flat within 15%

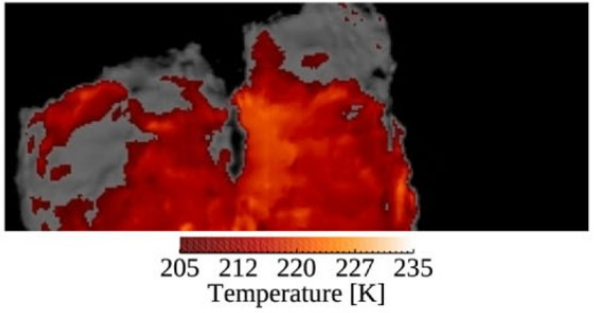
Grey body T = 440 K @ 0.83 au inconsistent with potassium phenoxilation

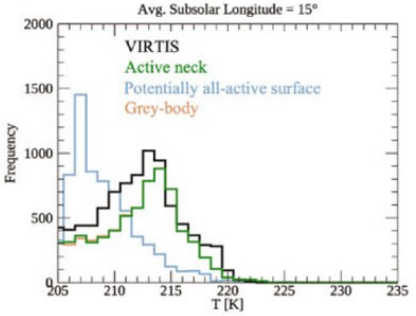


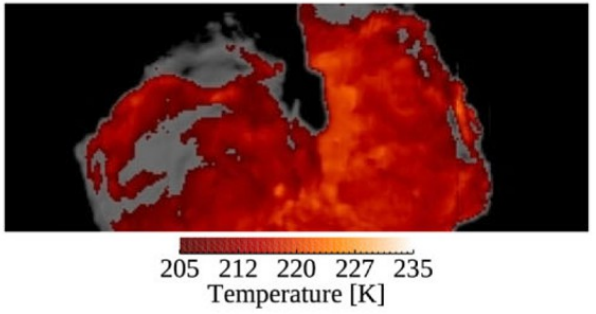


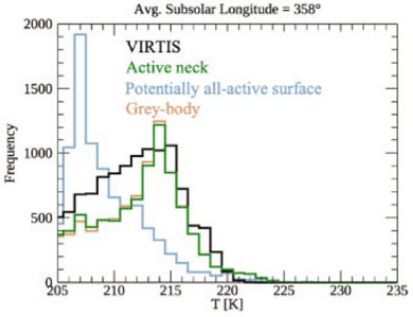


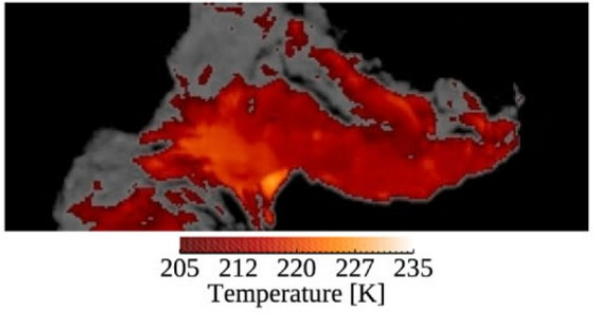


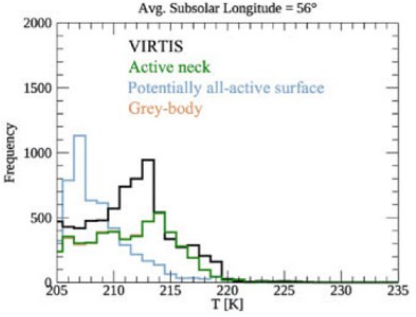


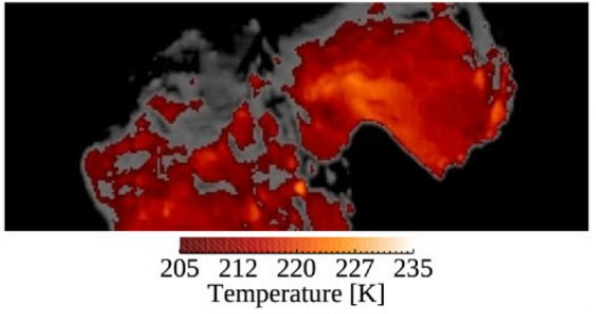


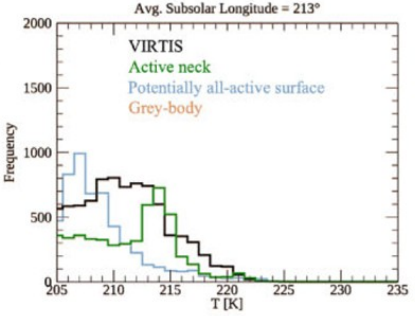






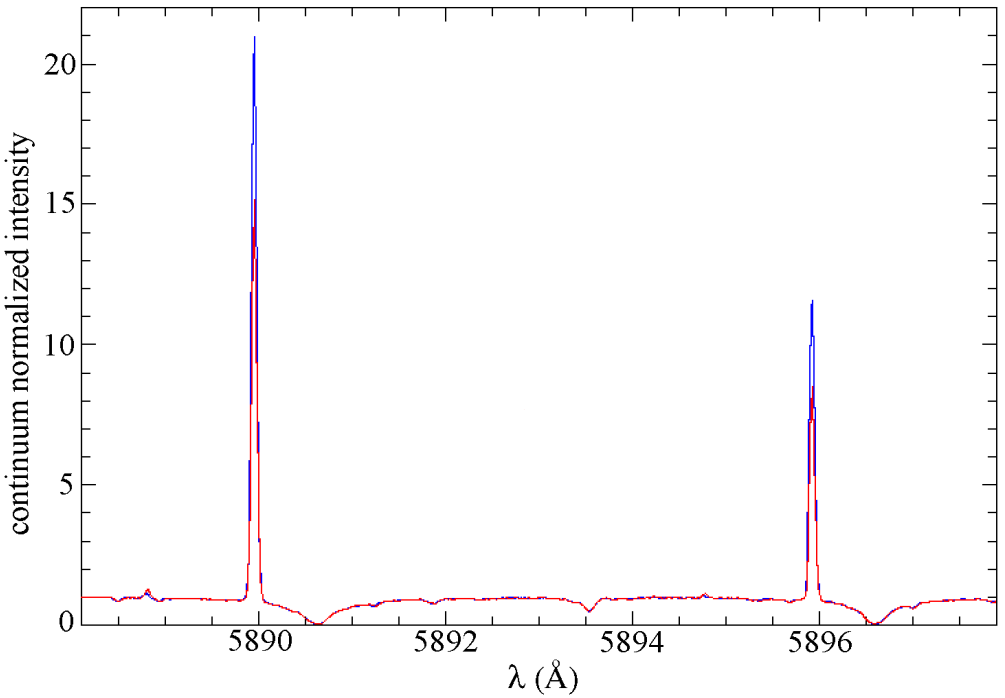




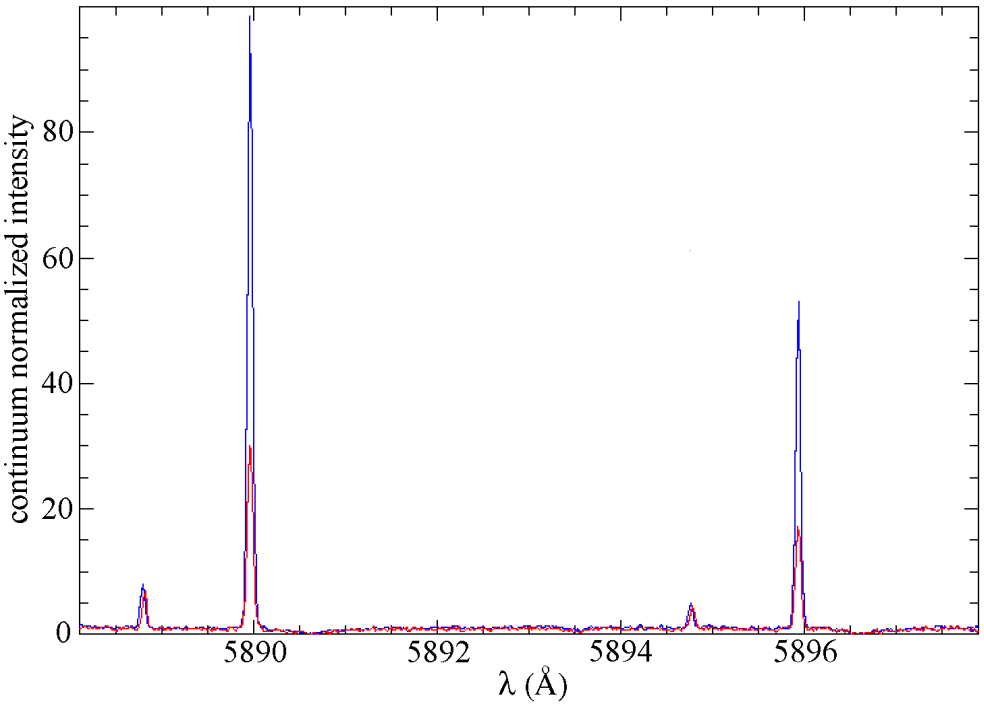


Sodium

Nucleus centered (1 = 1.4-1.9E-13 cgs)



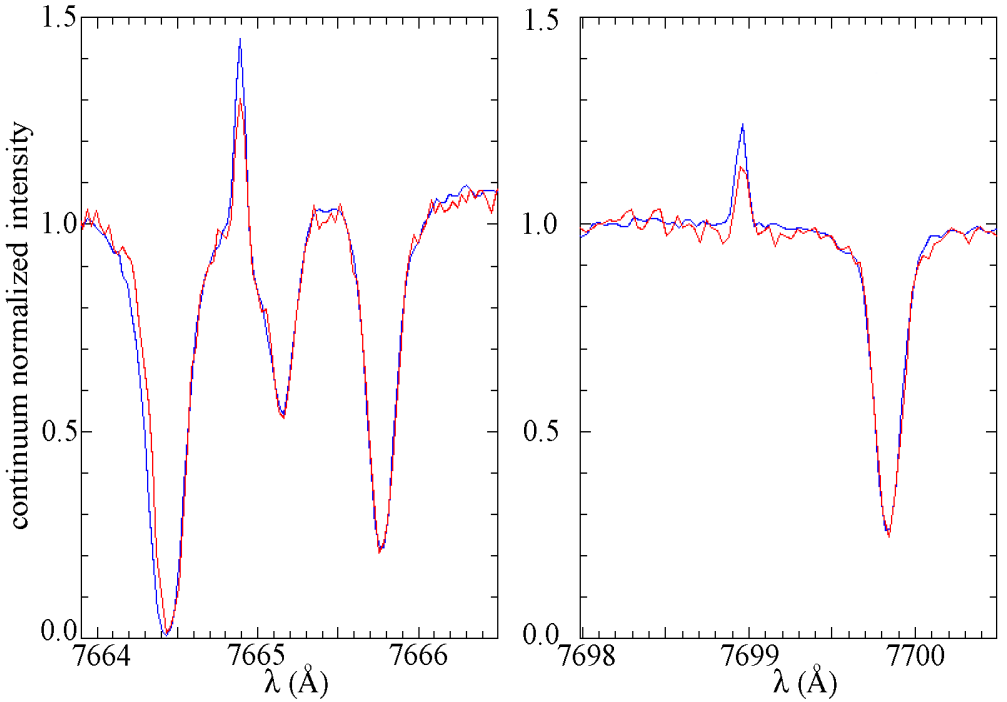
Trail centered (1 = 5-6E-15 cgs)



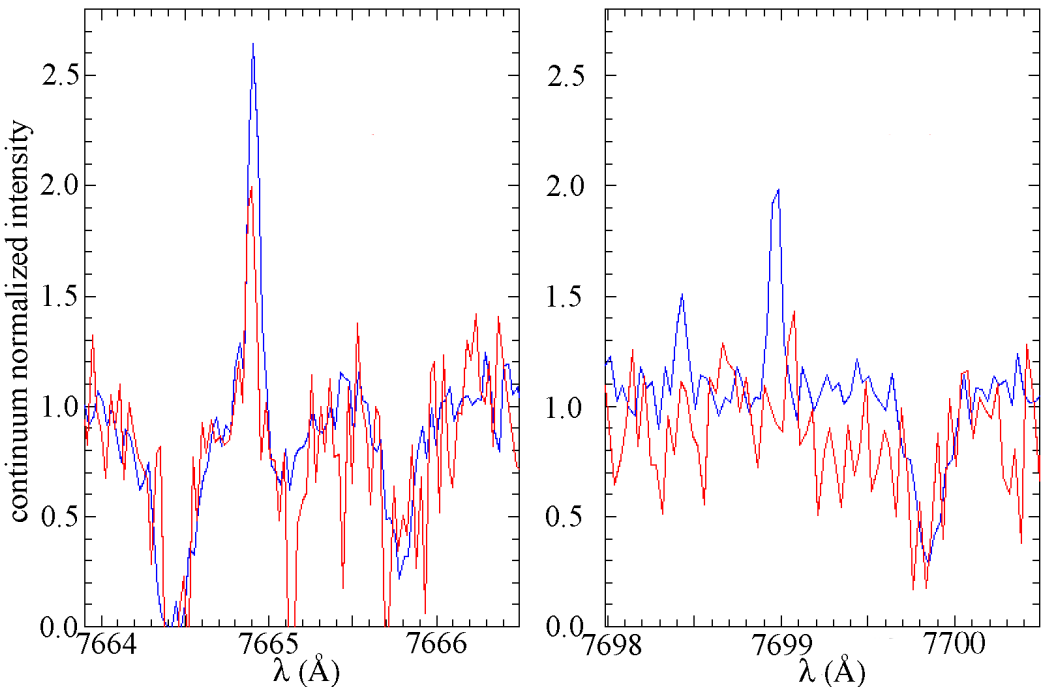
Spectrum blue-shifted of 58 km/s → comet emissions at laboratory wavelengths
Telluric sodium emission from cities pollution → blue-shifted of 58 km/s
Solar absorption in the comet dust continuum → red-shifted of 34 km/s

Potassium

Nucleus centered (1 = 1.4-1.9E-13 cgs)



Trail centered (1 = 5-6E-15 cgs)



Line intensities >300 times fainter than all other detections → photodesorption
Line intensities independent of dust continuum one → atom source is not dust
Trail source = trail mininuclei → trail mininuclei cross section = 20% of main nucleus

Atom	λ (Å)	I_{26N} (3σ)	I_{27N} (3σ)	I_{26T} (3σ)	I_{27T} (3σ)	$(Na/x)_{26N}$	$(Na/x)_{27N}$	$(Na/x)_{26T}$	$(Na/x)_{27T}$
Li	6707.78	< 2.3	< 1.9				> 4500		
Na	5889.95	1315 ± 15	2415 ± 20	109.5 ± 1.5	379.3 ± 1.5	1	1	1	1
Na	5895.92	720 ± 15	1370 ± 20	59.1 ± 1.5	205.5 ± 1.5	1	1	1	1
K	7664.90	32.9 ± 2.1	59.7 ± 1.4	3.3 ± 1.6	7.0 ± 1.6	53 ± 12	53 ± 10	61 ± 37	77 ± 30
K	7698.96	15.0 ± 3.1	32.6 ± 1.4	< 1.8	4.6 ± 1.8	70 ± 23	57 ± 10	> 38	75 ± 35

Intensities I are in 10^{-15} erg cm^{-2} s^{-1} Å^{-1} units. I_{ij} specifies the intensities measured on the October day $= i$ and on the nucleus ($j = N$) or on the trail ($j = T$). I_{Kij} specifies the average of the potassium intensities. $(Na/K)_N$ and $(Na/K)_T$ specify the averages of the nucleus and trail (Na/K) values, respectively.

Two sources of sodium at T = 440 K: photodesorption and phenoxilation

Na/K >> chondritic value → main sodium source is phenoxilation
→ trail sodium source must be trail mininuclei as well as for potassium

sodium phenoxilation >= six times more efficient than sodium photodesorption
→ Na/K in all nuclei of C/2023 A3 is chondritic
→ observed trail Na/K <= (6 + 1) * 15.6 = 110 = max(Na/K)$_{27T}$
→ Na/Li > six times chondritic value = 6000 consistent with observations