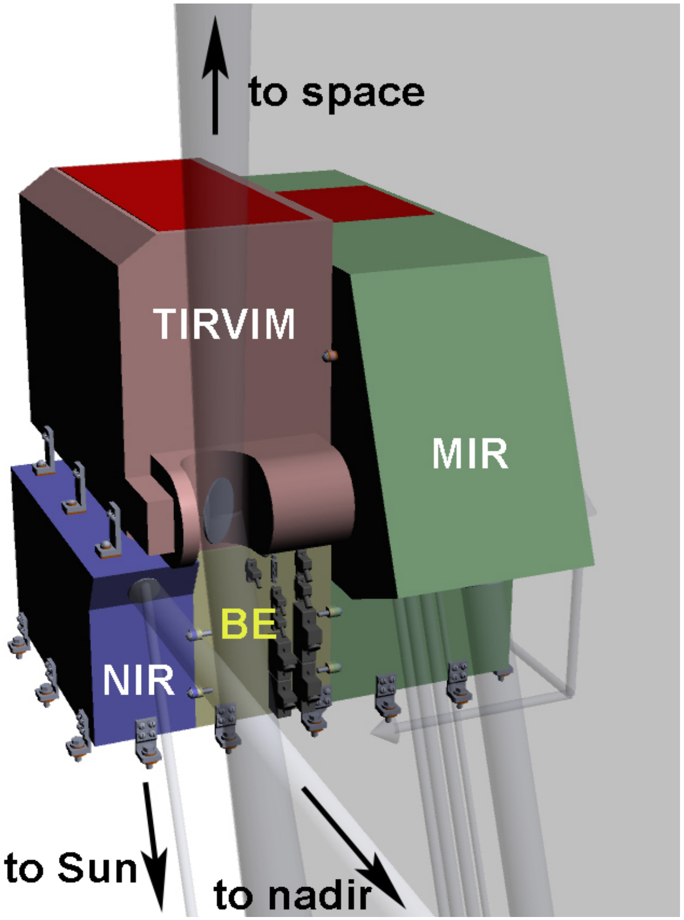
ACS NIR and MIR: technical status and expected parameters

Alexander Trokhimovskiy, Oleg Korablev,
Anna Fedorova and ACS Team
IKI Space Research Institute, Moscow

ACS Science working team , 14 October 2013, Moscow, Russia

Key questions of Mars science and ACS



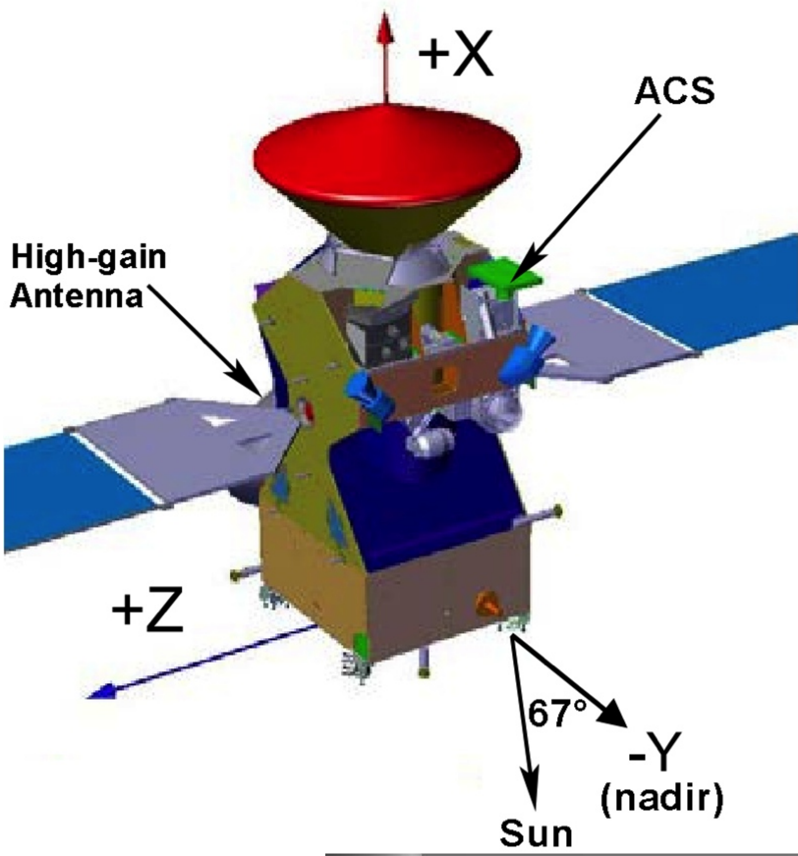
Three channels of ACS

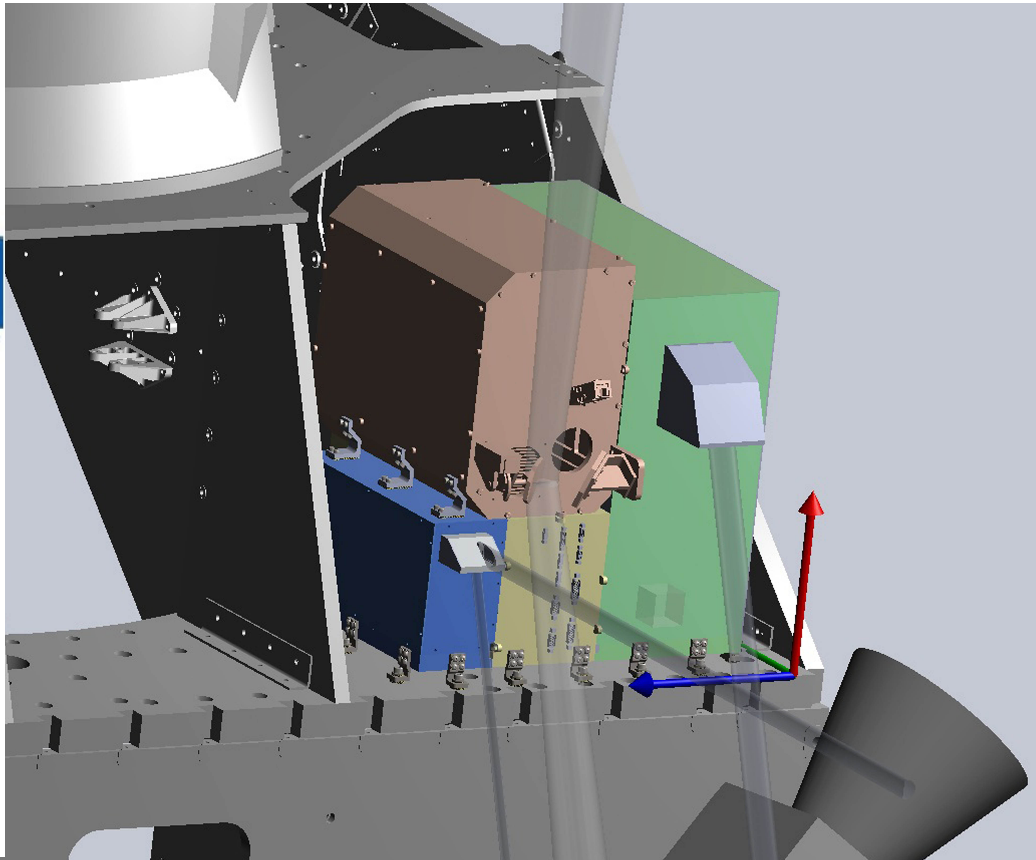
	Spectral range	Inst. range	resolution
ACS/MIR	2.4-4.2 µm	300 nm	50000
ACS/NIR	0.7-1.6 µm	~0.2 µm	20000
ACS/TIRVIM	490-4880 cm-1	full range	0.2cm-1 occ 0.2-1.6 cm-1 nadir

- Internal structure/Volcanism
  - By measuring minor gases of potential volcanic origin
- Climate: present and evolution
  - By characterizing atmospheric state, climate, and isotopic ratios (D/H in particular)
- Past and present habitability
  - By measuring minor gases of potential biological significance

ACS Accommodation at the Spacecraft

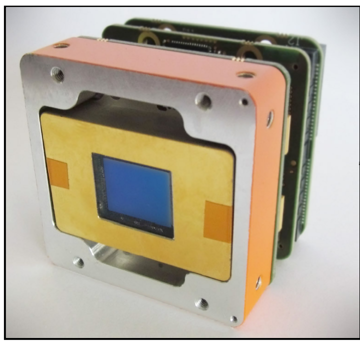
- occupies the MATMOS slot on the upper deck
- four separate blocks integrated into a single unit
- two solar occultation apertures (NIR and MIR)
- one nadir aperture (NIR)
- 1-D scanner in XY plane to observe open space, internal BB, nadir and sun (TIR)
- radiators



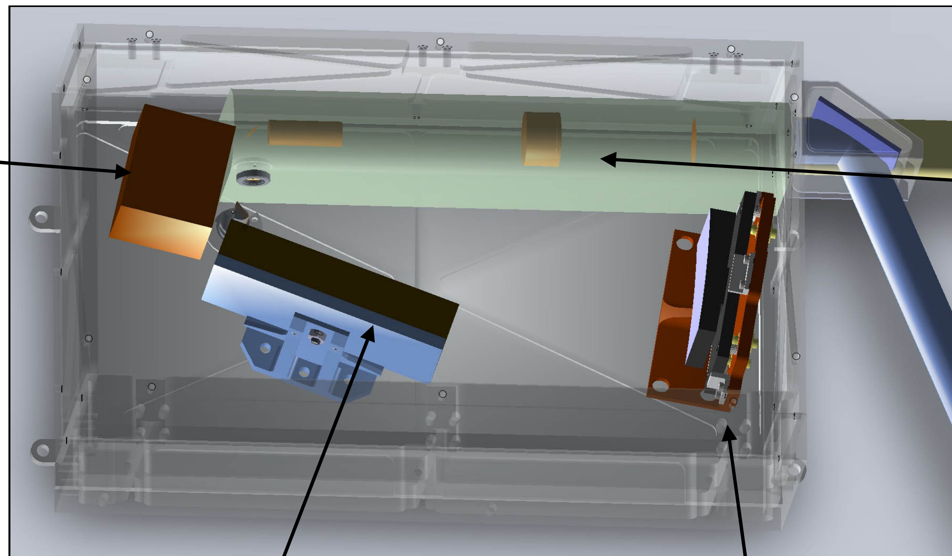


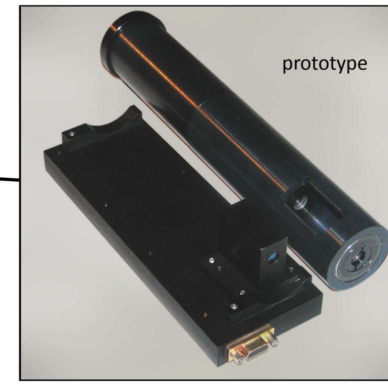
NIR: Near-IR Echelle/AOTF spectrometer

- Spectral range: 0.7 – 1.6 µm (not covered by NOMAD)
- Spectral resolving power: ~20 000
- Operation modes: Nadir, Solar Occultation
- FOV: 30 x 0.3 mrad
- Mass / Power / Data rate: 3.5 kg / 15 W / 0.5 Gbit/day

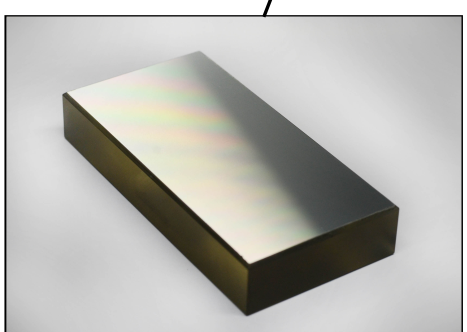


XSW-640: High resolution cooled shortwave infrared (SWIR) module
- TE1 cooled InGaAs array
- 640 x 512 pixels
- 0.4 to 1.7 µm bandwidth (extended)
- 20µm pixel pitch
- 50 Hz framerate

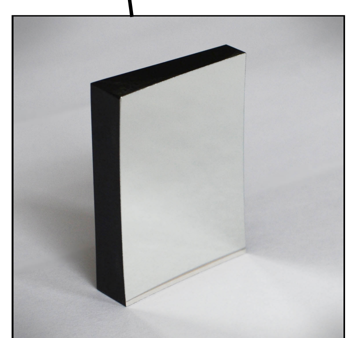




Telescope+AOTF block
- custom TeO_2 AOTF
- bandpass 70 cm-1



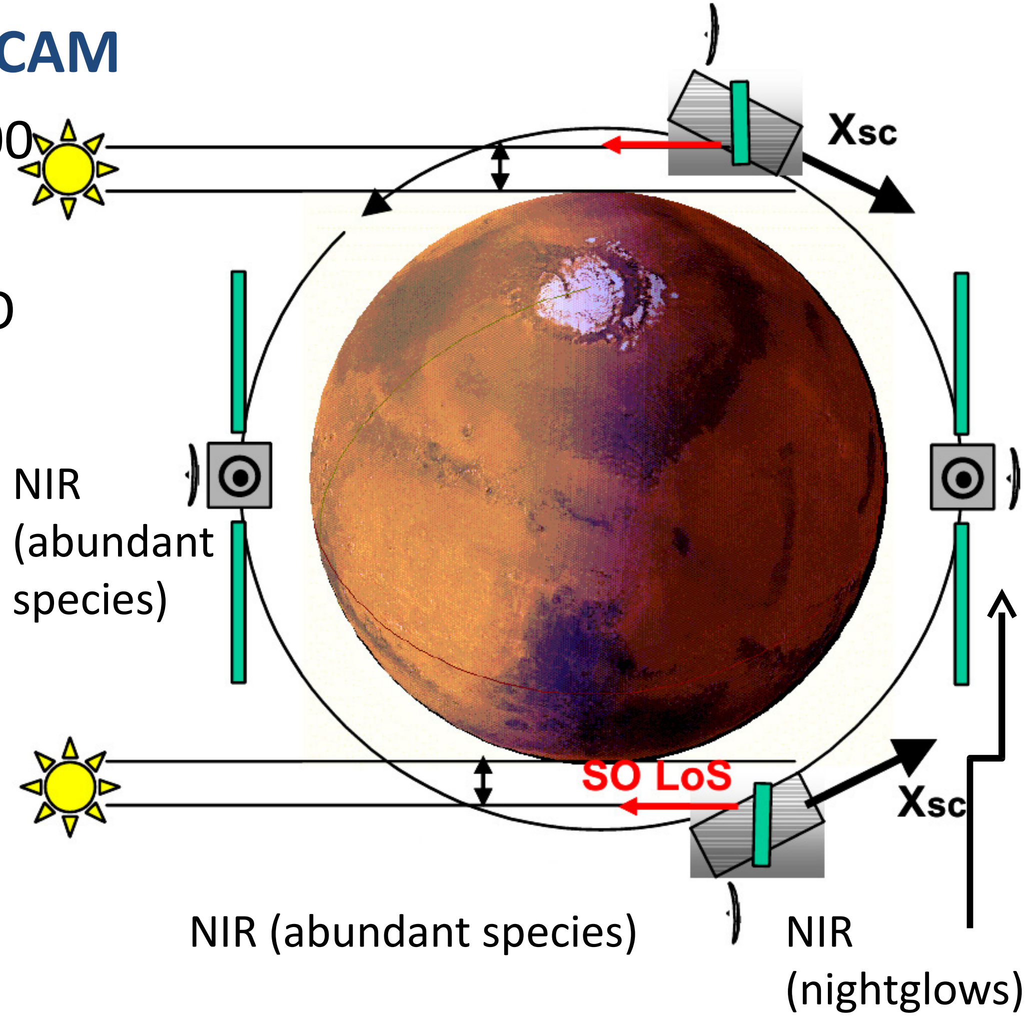
RGL/Newport catalogue echelle grating 24.35 gr/mm



Collimator: Diamond turned off-axis aluminum parabolic mirror F=200 mm on a stress-relief mount

NIR spectrometer

- ## Advantages compared to SPICAM
  - High spectral resolution 20000
  - Higher SNR
  - Better spatial resolution in SO

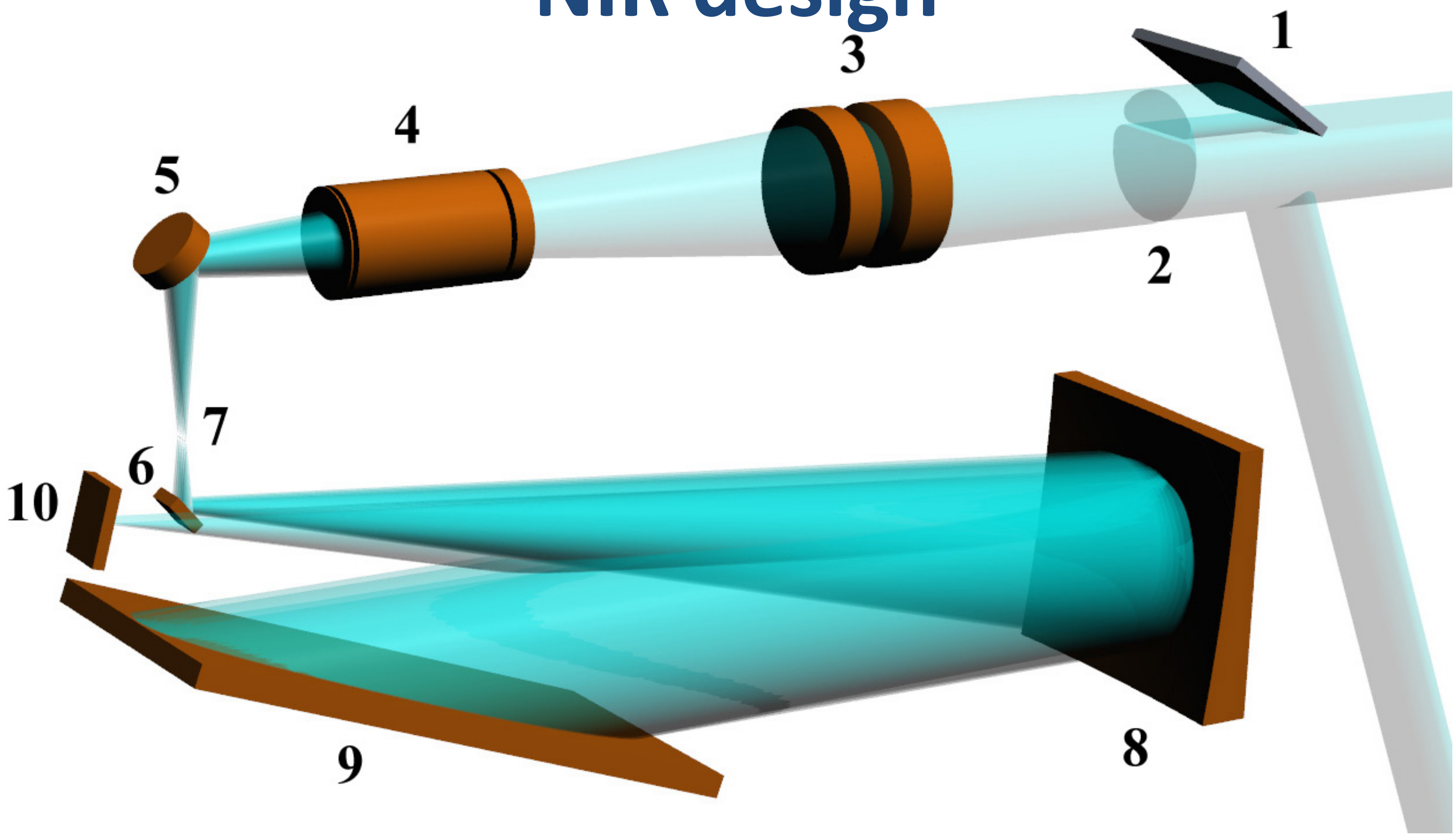


- ## Nadir viewing (day side)
  - H2O abundance at 1.38 μm
  - O2 dayglow – ozone tracer

- ## Solar occultation
  - CO2, H2O, **O2**, aerosols

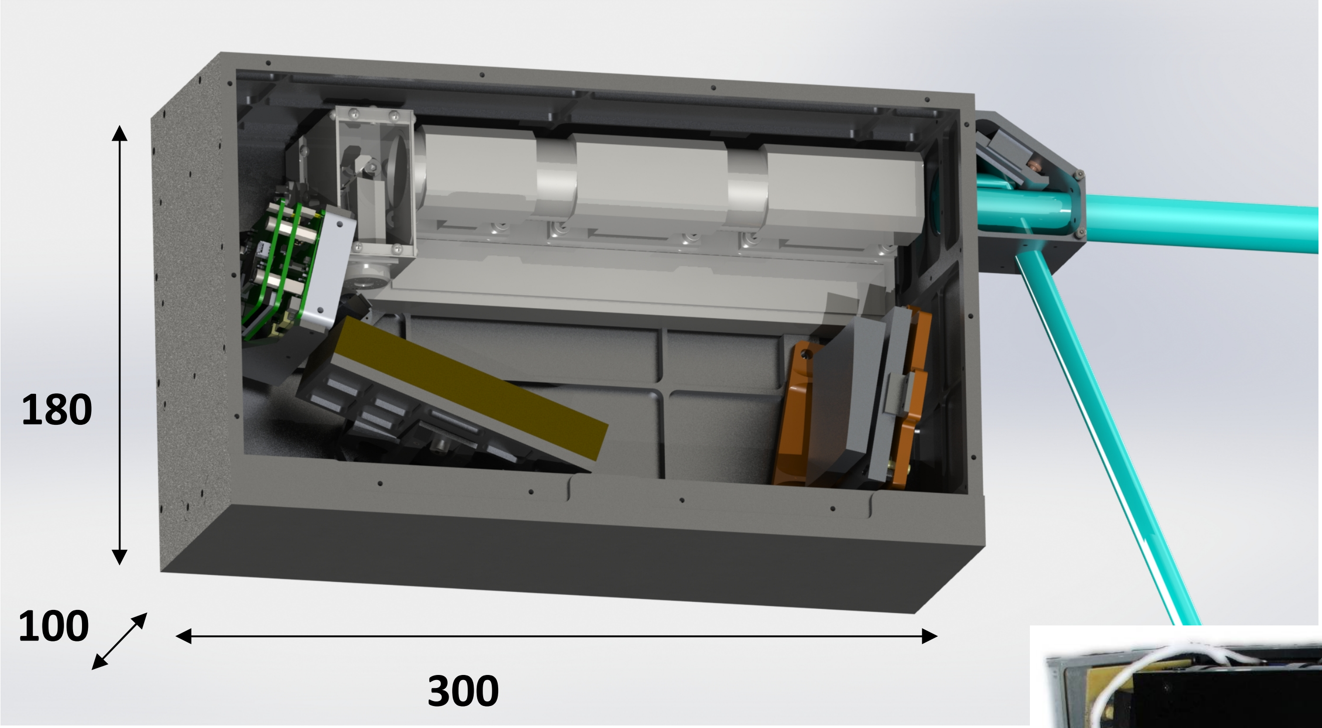
- ## Nadir viewing (night side)

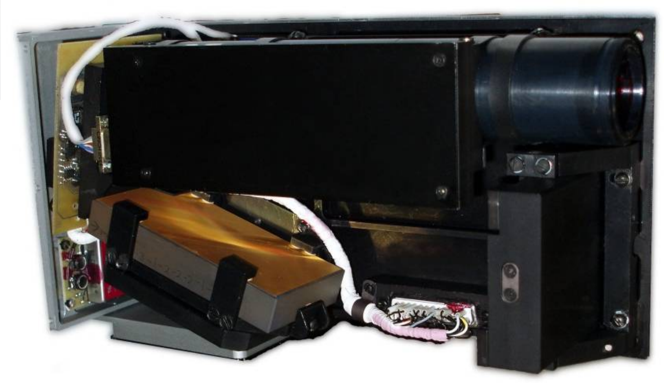
NIR design



A simplified optical scheme of the NIR channel. 1- solar FOV periscope; 2- blocking filter; 3- entry telescope; 4- AOTF in the converging beam, 5, 6- folding mirrors, 7- slit, 8-main collimating mirror of the spectrometer, 9- diffraction grating, 10- detector array

NIR design



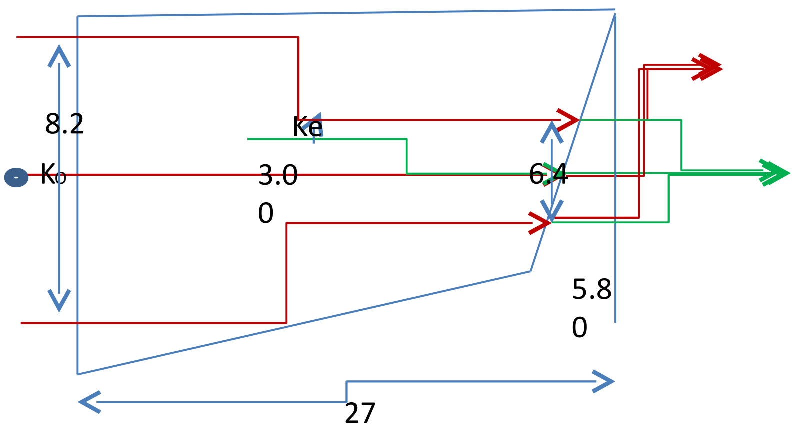


Prototype: RUSALKA/ISS spectrometer

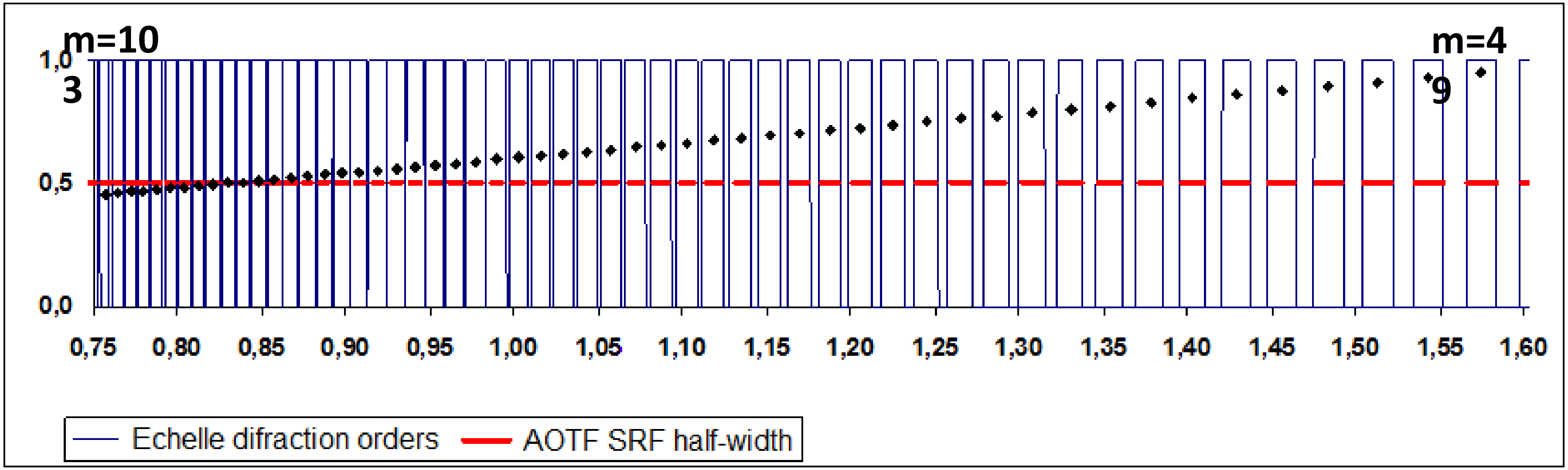
NIR major improvements

- Optical scheme thorough developmental work
- Detector array -> integration over slit's height
- AOTF design

NIR AOTF by Y. Kalinnikov

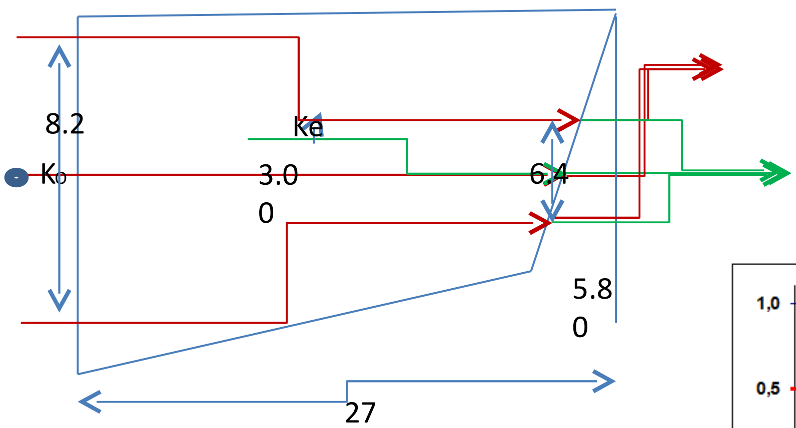


· Spectral range:	0.7 – 1.6 µm
·HW	70 cm-1
·Mass / Power	0.5 kg / 8 W



New productions facilities and team members!

NIR AOTF by Y. Kalinnikov



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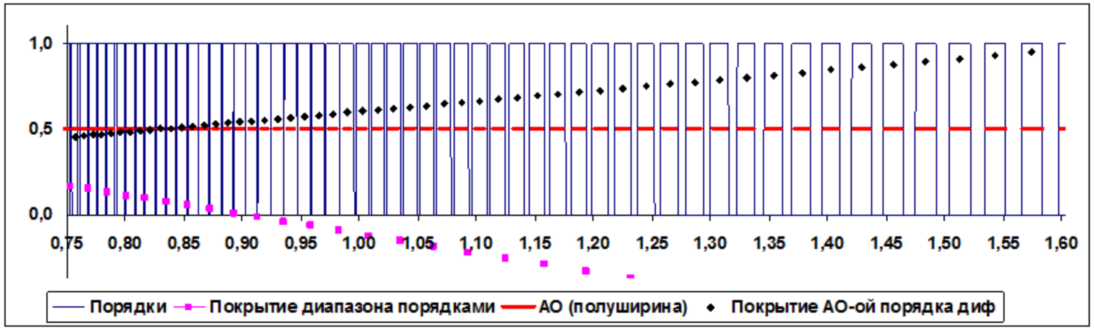
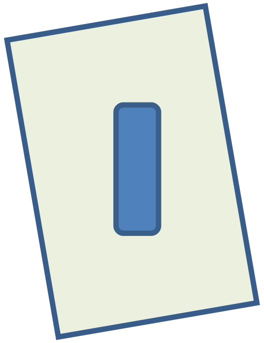
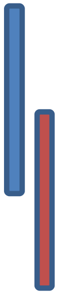


High slit (4 mm) illumination □ difficulties in orders separation

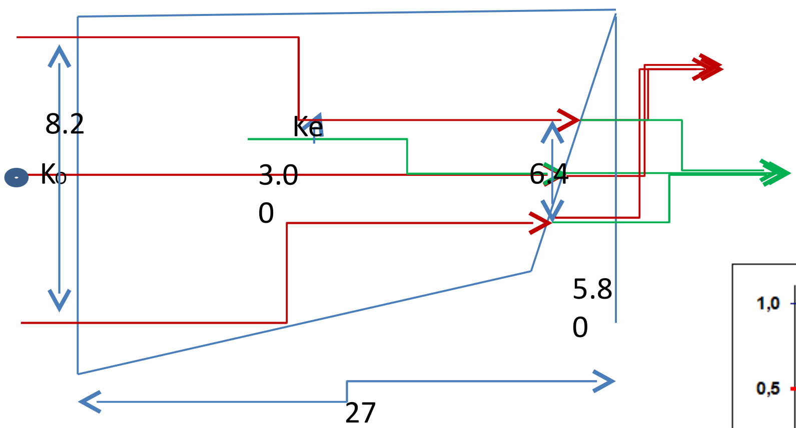


Crystal inclination □



Instead of □

NIR AOTF by Y. Kalinnikov



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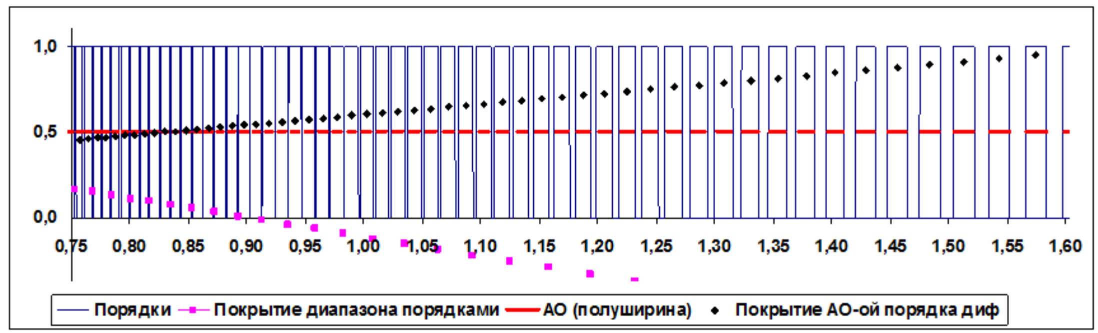
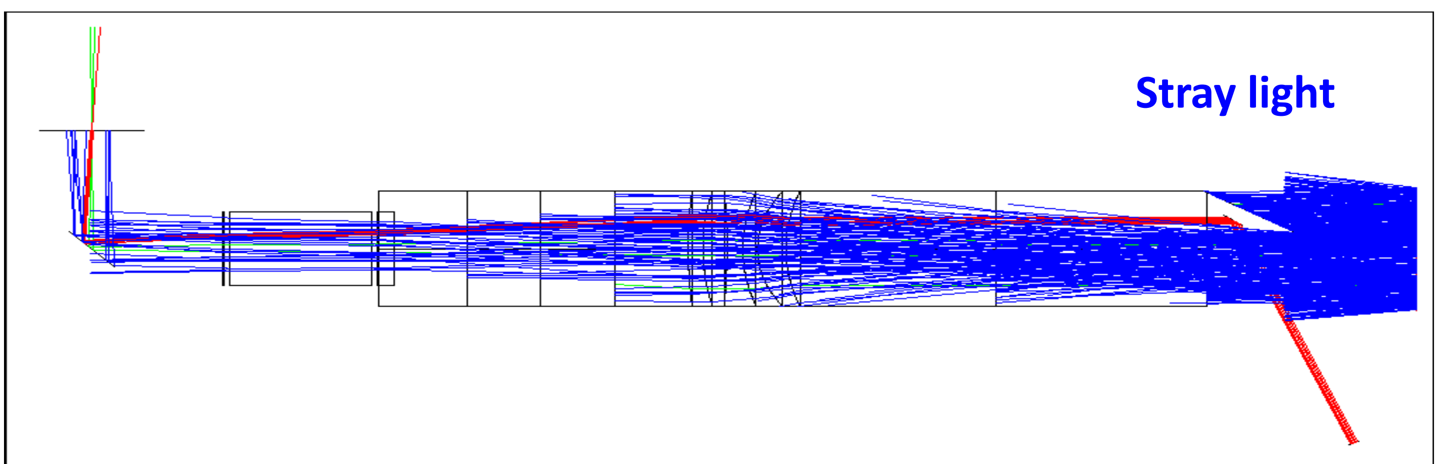
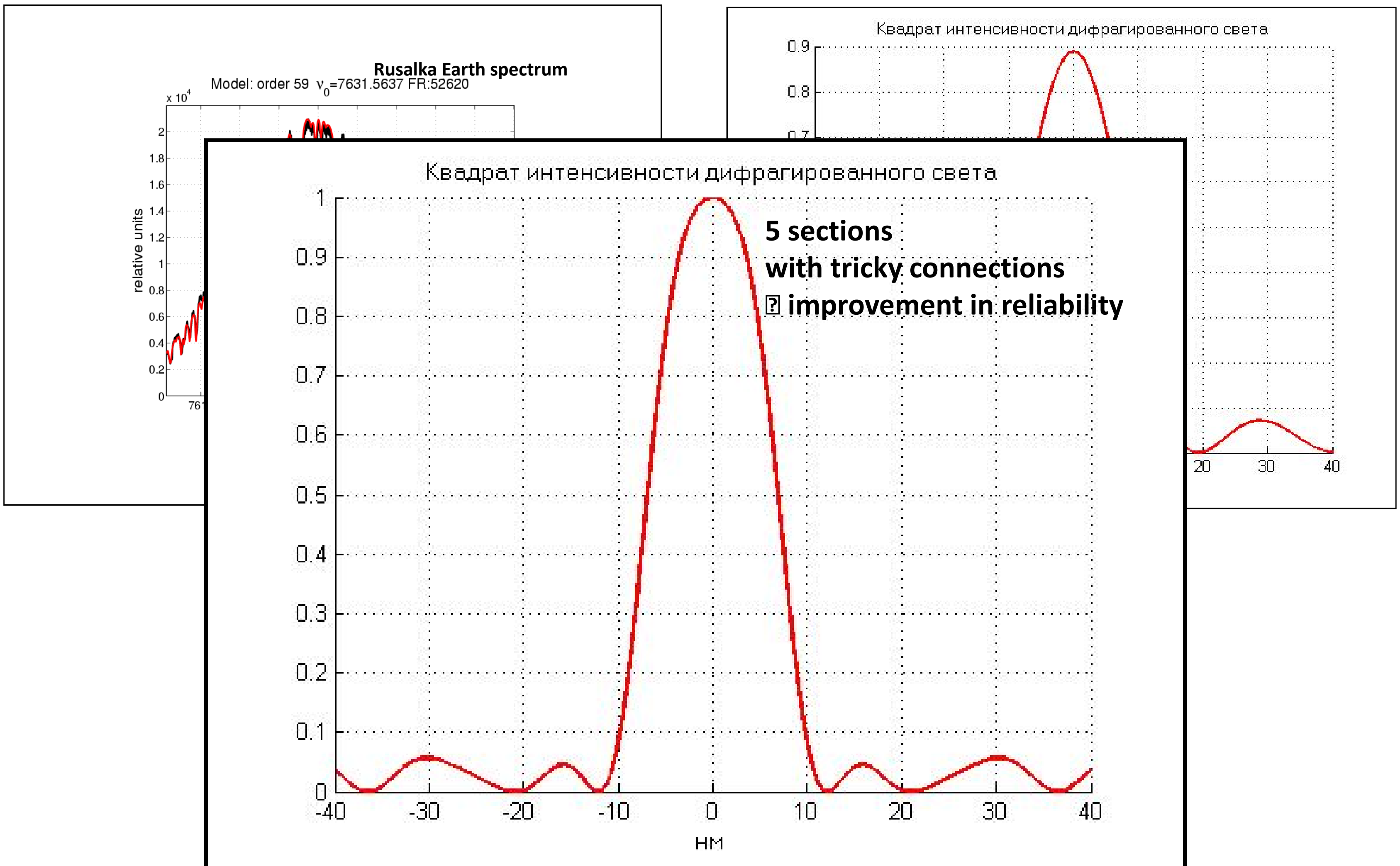


Zemax NSC model (non-sequential sources)



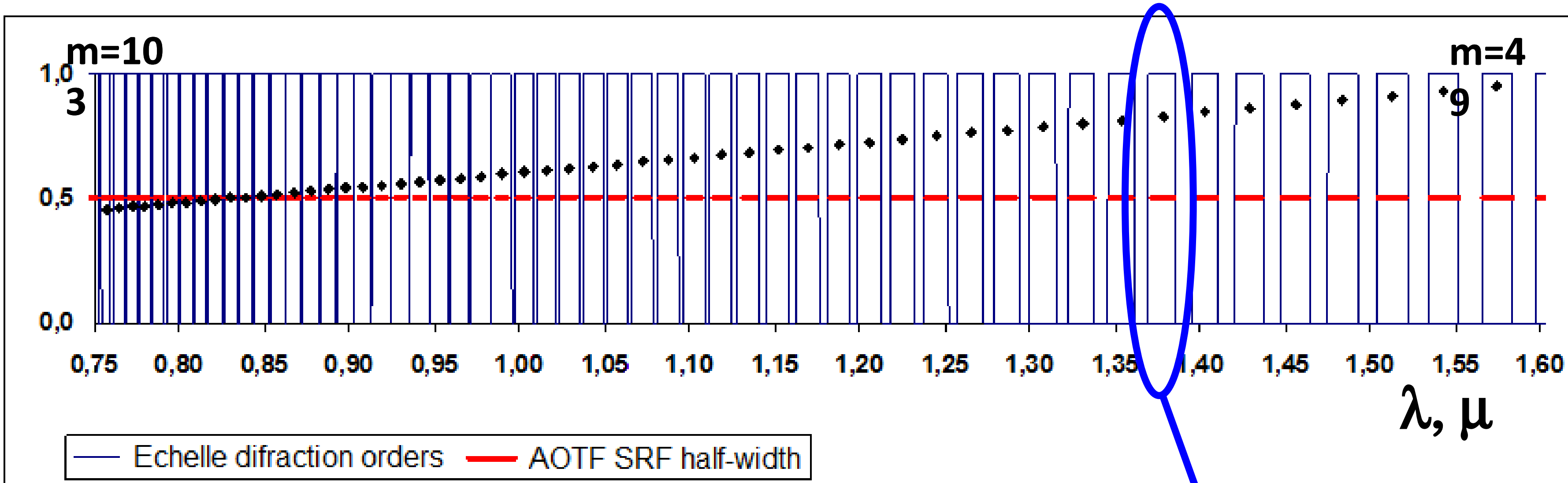
NIR AOTF by Y. Kalinnikov

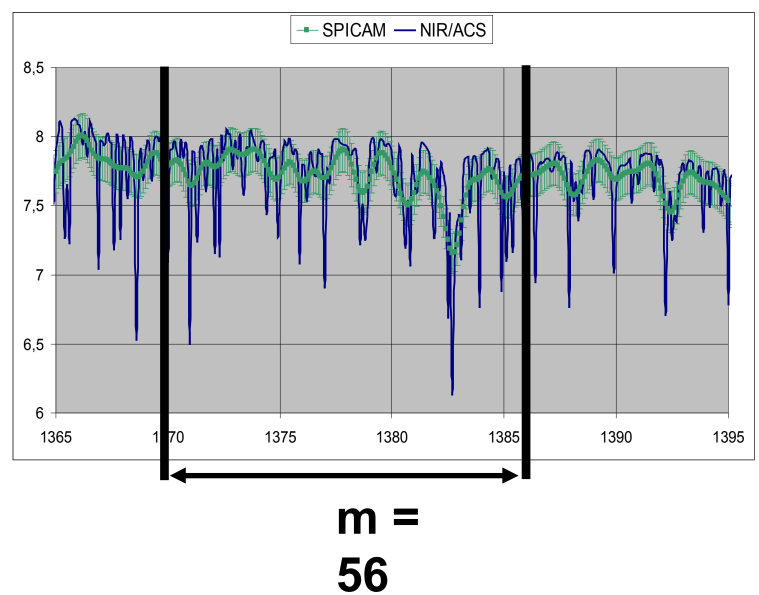
Advanced sinc-shape



Species	Scientific Objective	Current Knowledge	Wavelengths, µm	Detection limit Solar Occultation	Detection limit Nadir
Abundant species					
CO2	Profiles, pressure, temperature field	0.965	**1.43, 1.58, 1.60, 2.7, 3.8, 4.3, 15 etc**	5-140 km	Temperature field
CO2 isotopes	Profile isotopes	13C/12C=0.967 18O/16O=1.018 Ratios wrt Earth	**1.47, 1.45, 2.6, 2.9, 3.0, 4.0 etc**		
H2O	Profile. abundance	1-500 ppm (variable with season)	**1.13, 1.38, 2.56**	10-80 km	0.5 ppm
CO	Profile. abundance	300-1000 ppm	**1.57**	4 ppm	100 ppm
Aerosol	Properties, extinction profiles	opacities, integrated and limb profiles, particle sizes	**0.65-1.65, 2-25**	0.1 µm <reff <10 µm Distinguish H2O/dust	Mapping of dust and ice cloud opacity
O2	Profile	0.13%	**0.76**	Profiling up to 50-60 km with abundance 0.13%	0.02-0.05%
O2(a1Δg)	Dayglow (ozone)+ Nightglow	0-30MR (dayglow) 0-0.3MR (nightglow)	**1.27**		0.1MR (in nadir) and 10kR column in limb
Trace species					
CH4	Detection, profiles	10-50 ppb	**3.3**	0.02 ppb	
C2H2	Detection	<2 ppb	**3**	0.1 ppb	
C2H4	Detection	<4 ppb	**3.2**	0.5 ppb	
C2H6	Detection	<0.2 ppb	**3.3**	0.05 ppb	
H2S	Detection	<20 ppb	**2.6**	5 ppb	
OCS	Detection	<10	**2.44, 3.4**	0.3 ppb	
HDO	Detection	0.1-1 ppm	**3.7**	0.2 ppb	
H2CO	Detection	<3 ppb	**3.6**	0.03 ppb	
HO2	Detection	200	**2.94**	1 ppb	
NO2	Detection	<10	**3.43, 6.25**	0.1 ppb	
	Detection	<0.3	**3.42**	0.04 ppb	

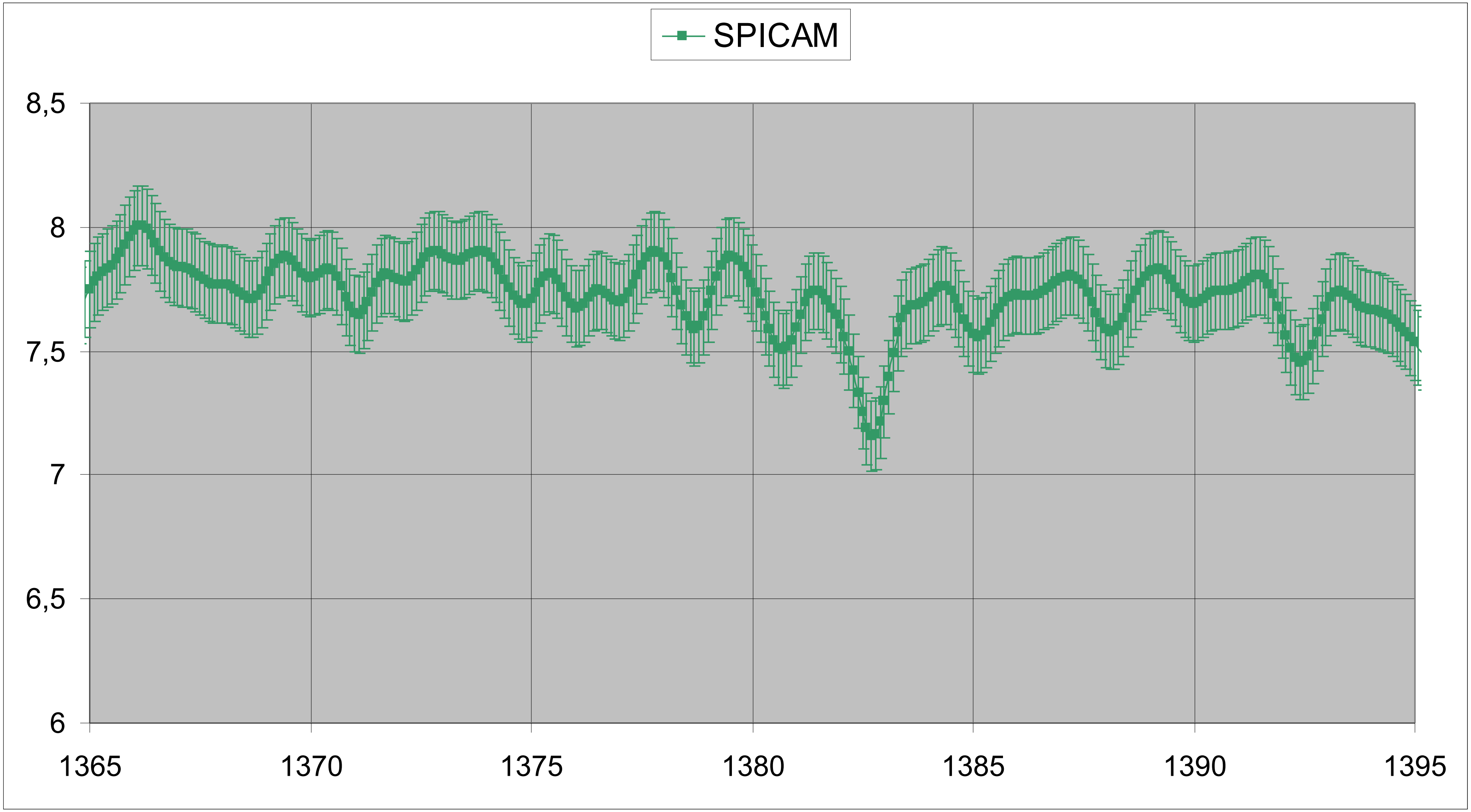
Talk by Anna Fedorova after the coffee break



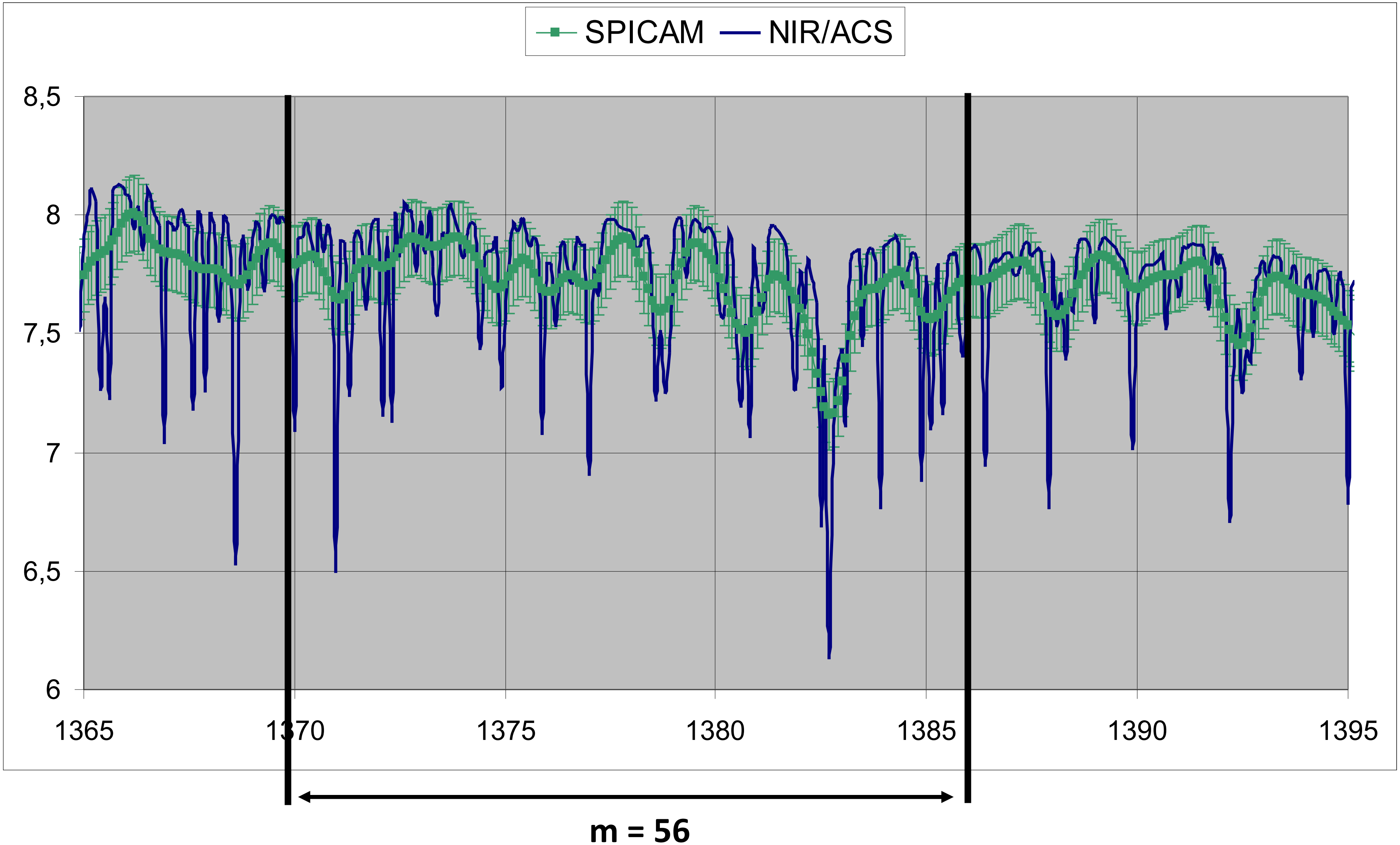


- Up to 10 orders per measuring sequence;
- Exposure 1ms – 1s;
- Onboard image averaging 1..256;
- Averaged into 5 frame stripes;

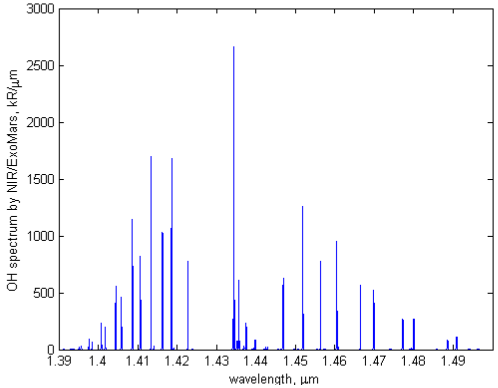
NIR nadir measurements (H2O)



NIR nadir measurements (H2O)



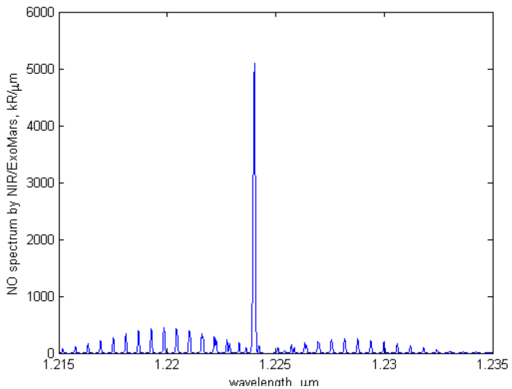
Nightglow O2(1.27μm), OH(1.43 μm) и NO(1.224 μm)



$$H + O_3 \rightarrow OH\ (v \leqslant 9) + O_2$$

OH at 1.43 μm for nadir NIR, 16kR

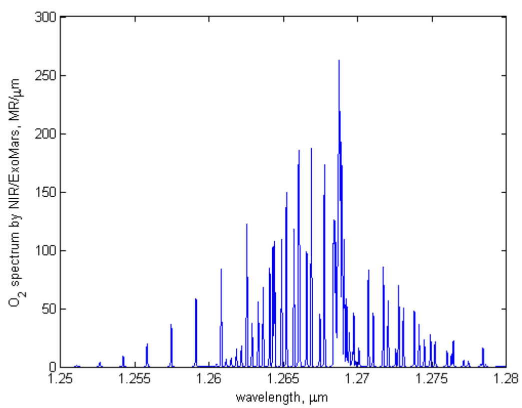
S/N ~ 5



N+O = NO+hv

NO, 1.2 kR.

S/N ~ 10



O + O + M→ O2* + M

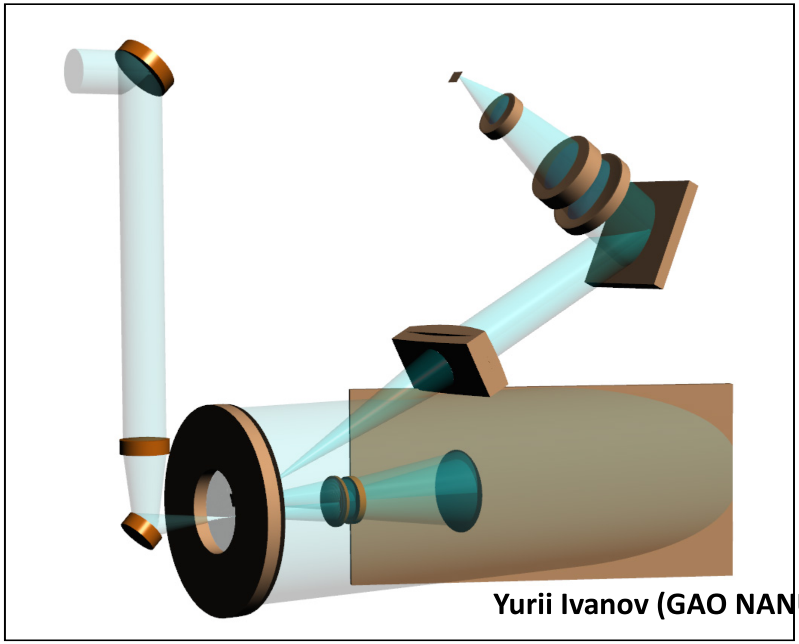
O2 at 1.27 μm for nadir, 240kR

S/N ~ 500

In detail by Anna

MIR: Mid-IR Echelle/cross-dispersion

Spectral range:	2.4 – 4.2 µm
Instantaneous coverage:	230-300 nm ranges per measurement
Spectral resolving power:	>50 000
FOV:	0.1 x 2.9 mrad
Aperture ratio	1:3
Mass/ Power / Data:	12 kg / 20 W / 1.2 Gbit per day
Size	460 x 200 x 440 mm
Operation modes:	Solar Occultation
Operation rate	1-2 images/s
S/N	>500



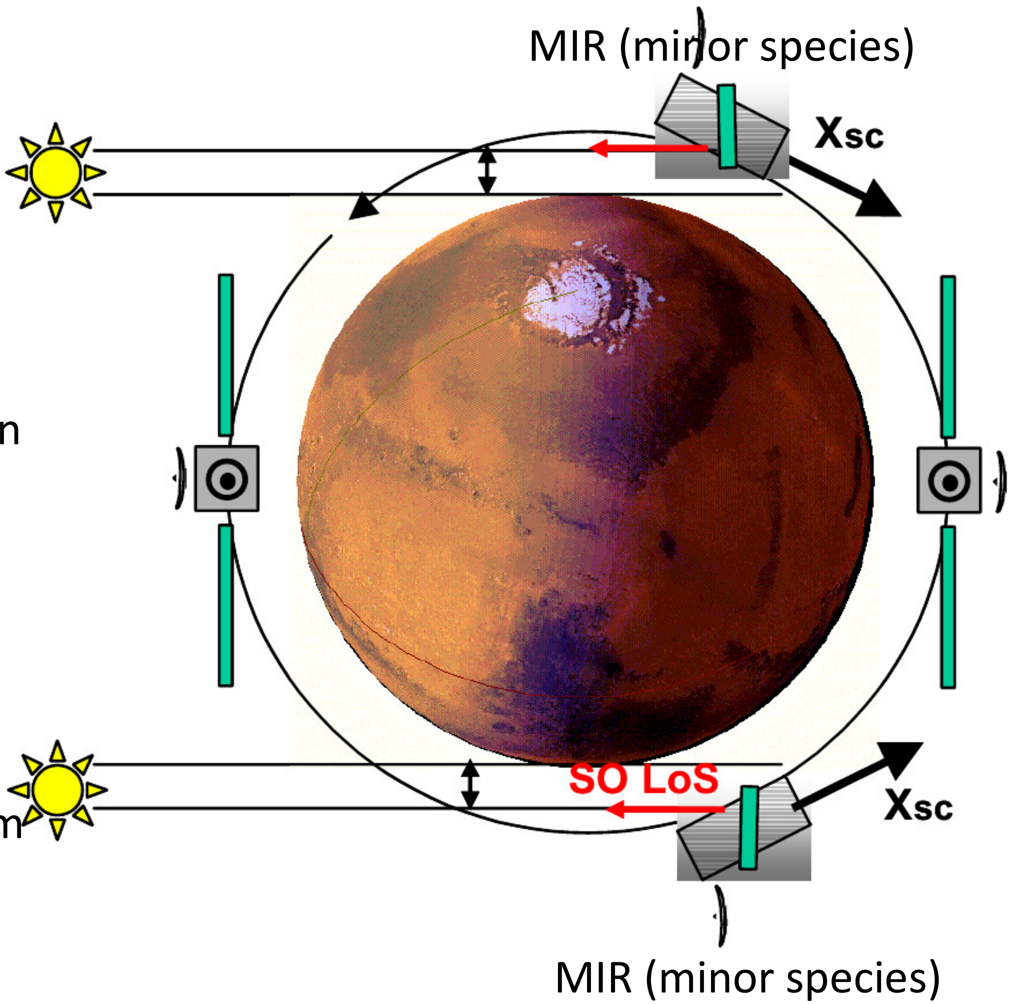
Yurii Ivanov (GAO NANU)

Concept of the cross-dispersion

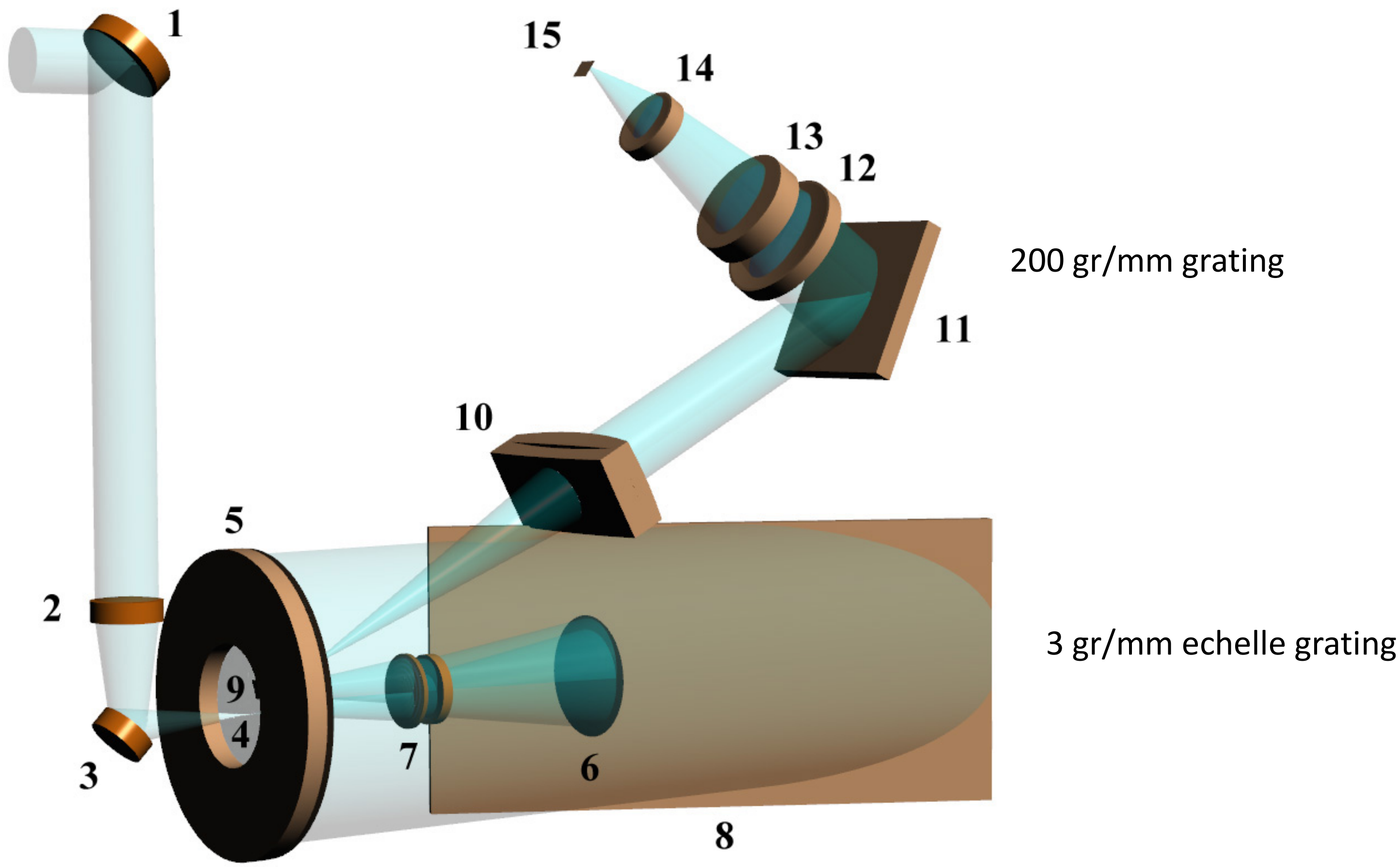
MIR spectrometer

Solar occultation

- High spectral resolution ~ 50000
- SNR ~500 (current estimation)
- Spatial resolution in SO ~5 km
- 0.5-1 sec for measurements – 1-2 position of secondary grating angle
- 72 sec for occultation 0-100 km in the atmosphere
- **CO_2** measurements for density and temperature from 10 to at least 140 km
- Known species **CH_4 , H_2O, CO** at 10-80 km
- Isotopic ratios **HDO/H_2O, $^{13}CO_2/CO_2$, $CO^{18}O/CO_2$** etc.
- Search of minor gaseous species **C_2H_2, C_2H_4, C_2H_6 и, SO_2, HO_2, H_2O_2, H_2CO, HCl, OCS etc.**

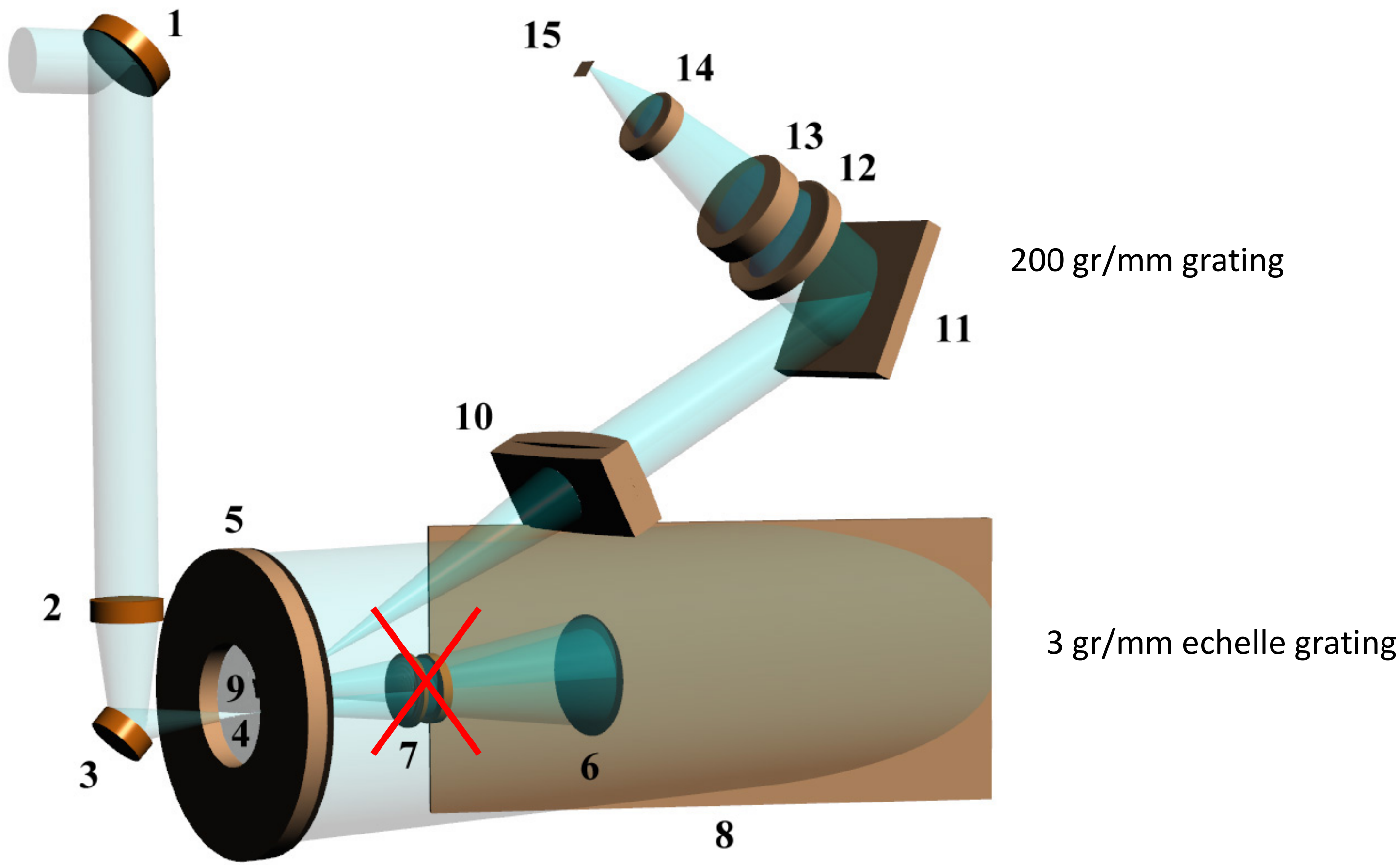


MIR design



A simplified optical scheme of the MIR channel. 1, 3, 9- folding mirrors; 2- entry telescope; 4- slit; collimator of the main spectrometer: 5- primary mirror, 6- secondary mirror, 7- corrector; 8- echelle diffraction grating, 10- collimator of the secondary grating; 11- steerable secondary grating; 12-14 detector's focusing lenses; 15- detector array

MIR design



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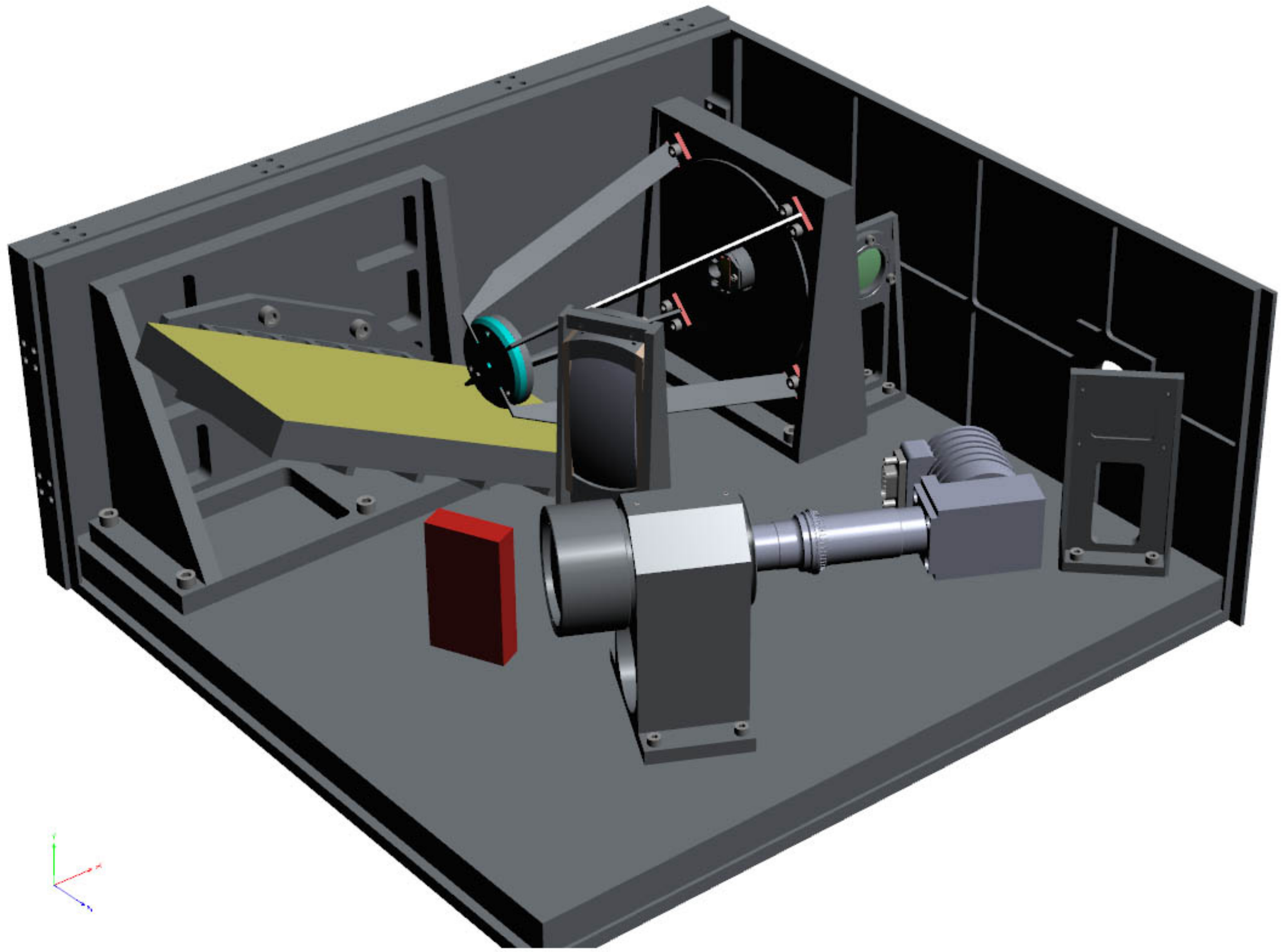
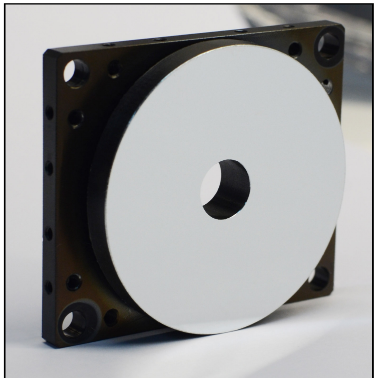
MIR design



MIR key components

AMOS custom echelle grating
· 3 gr/mm
·Blaze angle 63.43°
·Dimensions 107 x 240 mm
·Gold coating

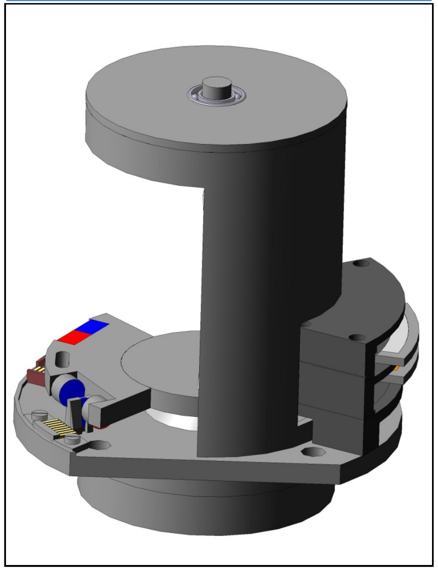
Diamond turning aspherical mirrors collimator



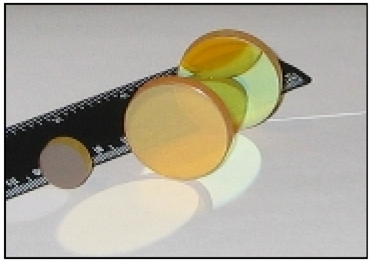
Sofradir Scorpio MW detector
·640 x 512 HgCdTe MWIR (15 µm PITCH)
·Mechanical cooler RICOR K508 adapted for operation in space
·custom band-pass filter 2.4-4.2 µm

Late delivery…

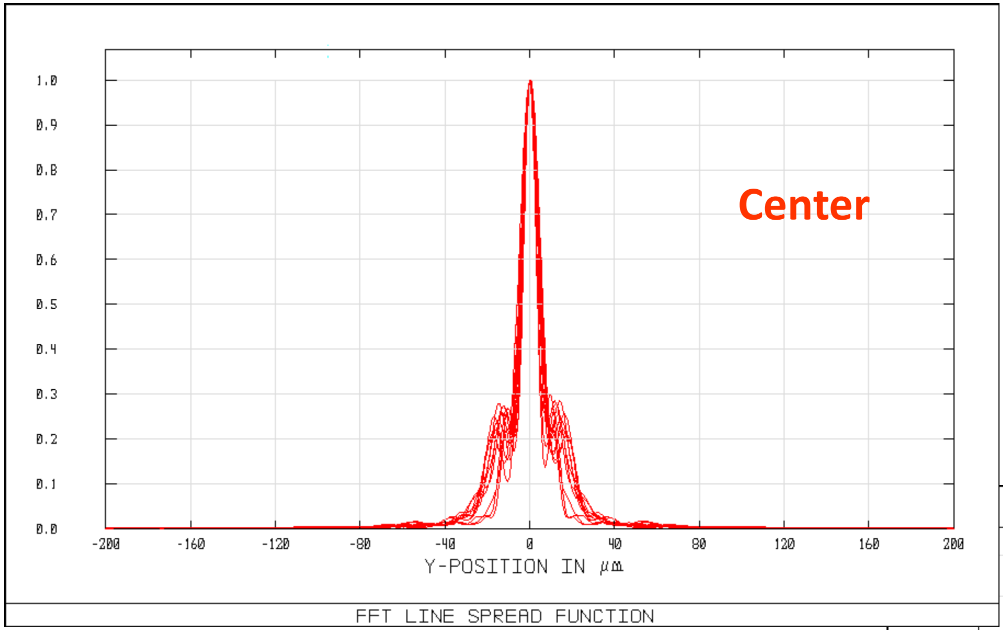
Rotating unit
·Range ±6 degree
·Accuracy 30 arcsec



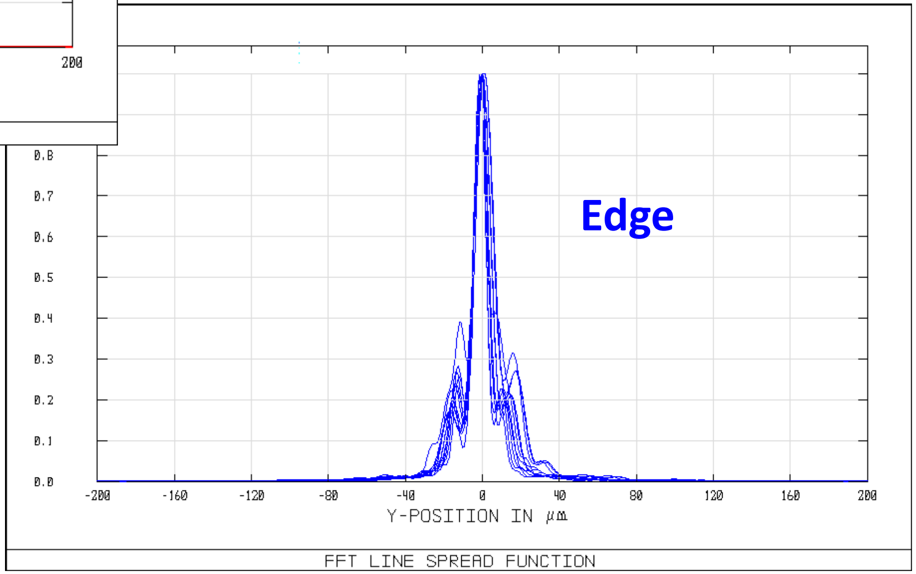
ZnSe and CaF2 optics



MIR point spread function



·Close to the diffraction limit (5-6 mkm)



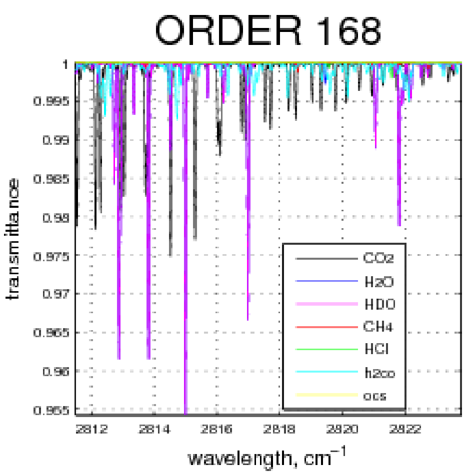
·R = 50000 even with reserve for manufacture and alignment

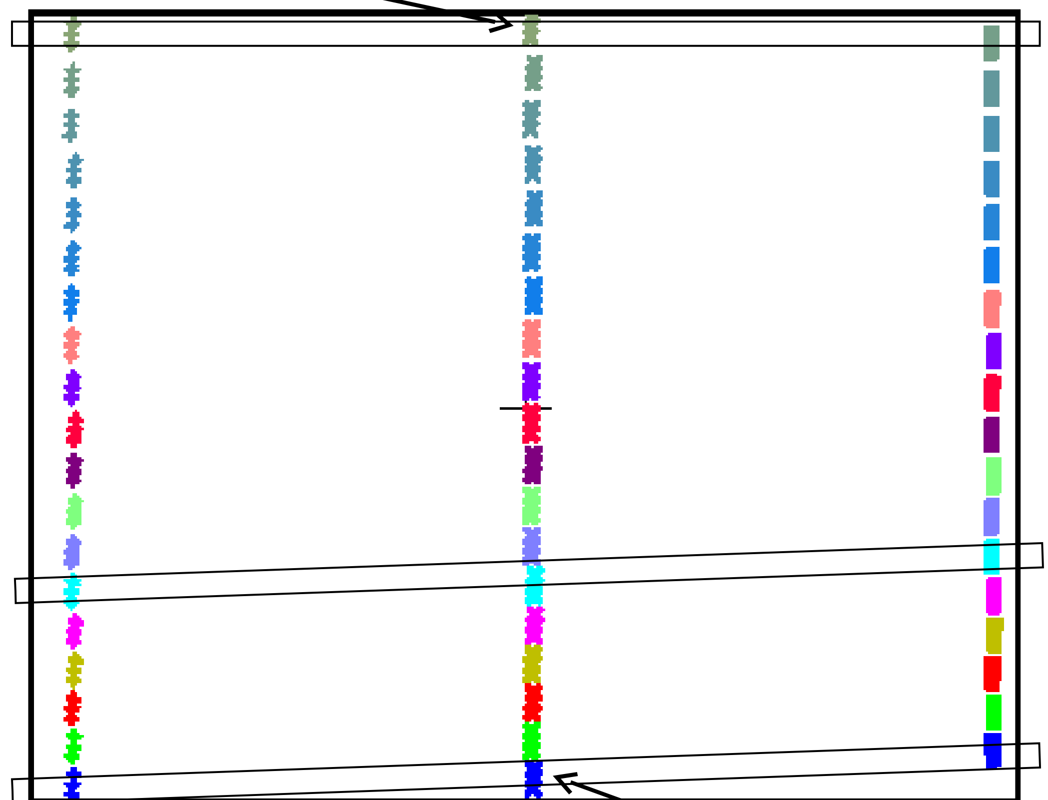
MIR/ACS single footprint

<u>Line height 150 - 200 mkm</u>

3.8468 mkm

Order 155





Order 173

3.4466 mkm

Stroke	M	λ min	λ mid-0,7	λ mid	λ mid+0,7	λ max	Δλ/2			Angle
1	142	4,184325	4,188730	4,199007	4,209285	4,213689	0,014682	Красный		59,0
2	143	4,155166	4,159509	4,169644	4,179778	4,184122	0,014478	Красный		59,0
3	144	4,126410	4,130693	4,140688	4,150683	4,154966	0,014278	Красный		59,0
4	145	4,098049	4,102273	4,112131	4,121989	4,126214	0,014083	Красный		59,0
5	146	4,070075	4,074242	4,083966	4,093690	4,097857	0,013891	Красный		59,0
6	147	4,042481	4,046592	4,056184	4,065776	4,069887	0,013703	Красный		59,0
7	148	4,015258	4,019314	4,028777	4,038241	4,042297	0,013519	Красный		59,0
8	149	3,988399	3,992401	4,001739	4,011076	4,015078	0,013339	Красный	Оранж	59,0
9	150	3,961898	3,965847	3,975060	3,984274	3,988223	0,013162	Красный	Оранж	59,0
10	151	3,935746	3,939643	3,948735	3,957828	3,961725	0,012989	Красный	Оранж	57,2
11	152	3,909937	3,913783	3,922757	3,931730	3,935576	0,012819		Оранж	57,2
12	153	3,884465	3,888261	3,897118	3,905975	3,909771	0,012653		Оранж	57,2
13	154	3,859322	3,863069	3,871812	3,880555	3,884302	0,012490		Оранж	57,2
14	155	3,834503	3,838202	3,846833	3,855463	3,859162	0,012330		Оранж	57,2
15	156	3,810001	3,813653	3,822173	3,830694	3,834346	0,012173		Оранж	57,2
16	157	3,785810	3,789415	3,797828	3,806241	3,809847	0,012018		Оранж	57,2
17	158	3,761924	3,765484	3,773791	3,782098	3,785659	0,011867		Оранж	57,2
18	159	3,738338	3,741854	3,750057	3,758260	3,761776	0,011719		Оранж	57,2
19	160	3,715046	3,718518	3,726619	3,734720	3,738192	0,011573	Желтый	Оранж	57,2
20	161	3,692042	3,695471	3,703472	3,711474	3,714903	0,011430	Желтый	Оранж	55,4
21	162	3,669321	3,672708	3,680611	3,688515	3,691902	0,011290	Желтый		55,4
22	163	3,646878	3,650224	3,658031	3,665838	3,669183	0,011153	Желтый		55,4
23	164	3,624709	3,628014	3,635726	3,643438	3,646743	0,011017	Желтый		55,4
24	165	3,602807	3,606072	3,613691	3,621310	3,624576	0,010885	Желтый		55,4
25	166	3,581168	3,584394	3,591922	3,599450	3,602676	0,010754	Желтый		55,4
26	167	3,559787	3,562975	3,570413	3,577852	3,581040	0,010626	Желтый		55,4
27	168	3,538660	3,541811	3,549161	3,556511	3,559661	0,010500	Желтый		55,4
28	169	3,517783	3,520896	3,528160	3,535424	3,538537	0,010377	Желтый		55,4
29	170	3,497151	3,500227	3,507406	3,514585	3,517662	0,010256	Желтый		55,4
30	171	3,476759	3,479800	3,486895	3,493990	3,497031	0,010136	Желтый		55,4
31	172	3,456603	3,459609	3,466622	3,473636	3,476641	0,010019	Желтый		55,4
32	173	3,436680	3,439651	3,446584	3,453517	3,456488	0,009904	Желтый	Зеленый	55,4
33	174	3,416985	3,419923	3,426776	3,433630	3,436567	0,009791	Желтый	Зеленый	53,6
34	175	3,397515	3,400419	3,407195	3,413970	3,416874	0,009680		Зеленый	53,6
35	176	3,378265	3,381136	3,387835	3,394535	3,397406	0,009570		Зеленый	53,6
36	177	3,359233	3,362071	3,368695	3,375319	3,378158	0,009463		Зеленый	53,6
37	178	3,340413	3,343220	3,349770	3,356320	3,359127	0,009357		Зеленый	53,6
38	179	3,321803	3,324579	3,331056	3,337533	3,340309	0,009253		Зеленый	53,6
39	180	3,303400	3,306145	3,312550	3,318956	3,321701	0,009151		Зеленый	53,6
40	181	3,285199	3,287914	3,294249	3,300584	3,303299	0,009050		Зеленый	53,6
41	182	3,267197	3,269883	3,276149	3,282414	3,285100	0,008951		Зеленый	53,6
42	183	3,249392	3,252048	3,258246	3,264444	3,267100	0,008854		Зеленый	53,6
43	184	3,231780	3,234408	3,240538	3,246669	3,249296	0,008758		Зеленый	53,6
44	185	3,214358	3,216957	3,223022	3,229087	3,231686	0,008664	Голубой	Зеленый	53,6
45	186	3,197122	3,199694	3,205694	3,211694	3,214265	0,008571	Голубой	Зеленый	51,8
46	187	3,180071	3,182615	3,188551	3,194487	3,197031	0,008480	Голубой	Зеленый	51,8
47	188	3,163200	3,165717	3,171591	3,177464	3,179981	0,008390	Голубой		51,8
48	189	3,146508	3,148998	3,154810	3,160621	3,163112	0,008302	Голубой		51,8
49	190	3,129990	3,132455	3,138205	3,143956	3,146421	0,008215	Голубой		51,8
50	191	3,113645	3,116084	3,121775	3,127466	3,129905	0,008130	Голубой		51,8
51	192	3,097470	3,099884	3,105516	3,111148	3,113561	0,008045	Голубой		51,8
52	193	3,081463	3,083851	3,089425	3,094999	3,097388	0,007962	Голубой		51,8
53	194	3,065619	3,067984	3,073500	3,079017	3,081381	0,007881	Голубой		51,8
54	195	3,049938	3,052278	3,057739	3,063199	3,065539	0,007800	Голубой		51,8
55	196	3,034417	3,036733	3,042138	3,047543	3,049859	0,007721	Голубой		51,8
56	197	3,019052	3,021345	3,026696	3,032046	3,034339	0,007643	Голубой		51,8
57	198	3,003843	3,006113	3,011409	3,016706	3,018976	0,007566	Голубой		51,8
58	199	2,988786	2,991033	2,996277	3,001520	3,003767	0,007491	Голубой		51,8
59	200	2,973879	2,976104	2,981295	2,986487	2,988711	0,007416	Голубой		51,8
60	201	2,959120	2,961323	2,966463	2,971603	2,973806	0,007343	Голубой	Синий	51,8
61	202	2,944507	2,946688	2,951777	2,956867	2,959048	0,007270	Голубой	Синий	51,8
62	203	2,930038	2,932197	2,937237	2,942276	2,944436	0,007199	Голубой	Синий	50,0
63	204	2,915710	2,917848	2,922838	2,927829	2,929967	0,007129		Синий	50,0
64	205	2,901521	2,903639	2,908581	2,913522	2,915640	0,007060		Синий	50,0
65	206	2,887470	2,889567	2,894461	2,899355	2,901453	0,006991		Синий	50,0
66	207	2,873554	2,875631	2,880478	2,885325	2,887403	0,006924		Синий	50,0
67	208	2,859772	2,861829	2,866630	2,871431	2,873488	0,006858		Синий	50,0
68	209	2,846121	2,848159	2,852914	2,857669	2,859707	0,006793		Синий	50,0
69	210	2,832600	2,834619	2,839329	2,844039	2,846057	0,006728		Синий	50,0
70	211	2,819207	2,821207	2,825872	2,830538	2,832537	0,006665		Синий	50,0
71	212	2,805940	2,807921	2,812543	2,817164	2,819145	0,006602		Синий	50,0
72	213	2,792798	2,794760	2,799338	2,803917	2,805879	0,006541		Синий	50,0
73	214	2,779778	2,781721	2,786257	2,790793	2,792737	0,006480		Синий	50,0
74	215	2,766878	2,768804	2,773298	2,777792	2,779718	0,006420		Синий	50,0
75	216	2,754098	2,756006	2,760459	2,764911	2,766819	0,006361		Синий	50,0
76	217	2,741435	2,743326	2,747738	2,752149	2,754040	0,006302		Синий	50,0
77	218	2,728889	2,730762	2,735133	2,739504	2,741378	0,006245		Синий	50,0
78	219	2,716456	2,718313	2,722644	2,726975	2,728832	0,006188	Фиолет	Синий	50,0
79	220	2,704137	2,705976	2,710268	2,714561	2,716400	0,006132	Фиолет	Синий	48,2
80	221	2,691928	2,693751	2,698005	2,702258	2,704081	0,006077	Фиолет	Синий	48,2
81	222	2,679829	2,681636	2,685852	2,690067	2,691874	0,006022	Фиолет		48,2
82	223	2,667839	2,669630	2,673807	2,677985	2,679776	0,005968	Фиолет		48,2
83	224	2,655955	2,657730	2,661871	2,666011	2,667786	0,005915	Фиолет		48,2
84	225	2,644177	2,645936	2,650040	2,654144	2,655903	0,005863	Фиолет		48,2
85	226	2,632503	2,634246	2,638314	2,642382	2,644126	0,005811	Фиолет		48,2
86	227	2,620932	2,622660	2,626692	2,630724	2,632452	0,005760	Фиолет		48,2
87	228	2,609461	2,611174	2,615171	2,619168	2,620881	0,005710	Фиолет		48,2
88	229	2,598091	2,599789	2,603751	2,607713	2,609412	0,005660	Фиолет		48,2
89	230	2,586819	2,588503	2,592431	2,596359	2,598042	0,005611	Фиолет		48,2
90	231	2,575645	2,577314	2,581208	2,585102	2,586771	0,005563	Фиолет		48,2
91	232	2,564567	2,566221	2,570082	2,573943	2,575597	0,005515	Фиолет		48,2
92	233	2,553584	2,555224	2,559052	2,562879	2,564520	0,005468	Фиолет		48,2
93	234	2,542694	2,544320	2,548116	2,551911	2,553537	0,005422	Фиолет		48,2
94	235	2,531897	2,533510	2,537273	2,541035	2,542648	0,005376	Фиолет		48,2
95	236	2,521191	2,522790	2,526521	2,530253	2,531852	0,005330	Фиолет		48,2
96	237	2,510576	2,512161	2,515861	2,519561	2,521146	0,005285	Фиолет		48,2
97	238	2,500049	2,501621	2,505290	2,508959	2,510531	0,005241	Фиолет		48,2
98	239	2,489610	2,491169	2,494808	2,498446	2,500005	0,005198	Фиолет		48,2
99	240	2,479258	2,480805	2,484413	2,488021	2,489567	0,005154	Фиолет		48,2
100	241	2,468992	2,470526	2,474104	2,477682	2,479216	0,005112	Фиолет		48,2
101	242	2,458811	2,460332	2,463880	2,467429	2,468950	0,005070	Фиолет		48,2
102	243	2,448713	2,450221	2,453741	2,457261	2,458769	0,005028	Фиолет		48,2
103	244	2,438697	2,440194	2,443685	2,447176	2,448672	0,004987	Фиолет		48,2
104	245	2,428764	2,430248	2,433710	2,437173	2,438657	0,004947	Фиолет		48,2
105	246	2,418911	2,420383	2,423817	2,427252	2,428724	0,004907	Фиолет		48,2
106	247	2,409137	2,410597	2,414004	2,417411	2,418871	0,004867	Фиолет		48,2
107	248	2,399443	2,400891	2,404270	2,407649	2,409097	0,004827	Фиолет		48,2

HDO

NO_2

HCl

CH_4

CO_2

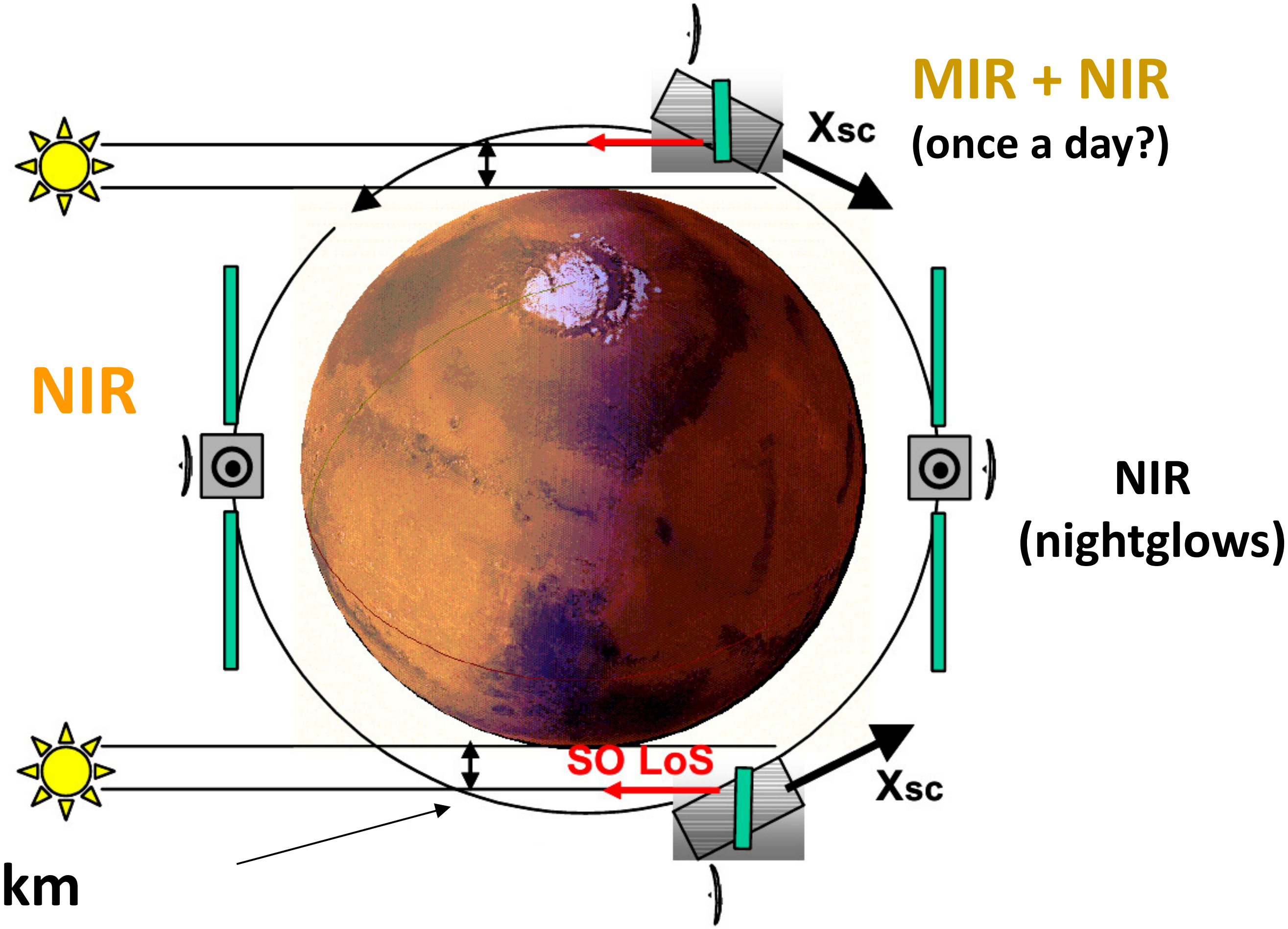
H_2O

<u>One or two positions per second</u>

EXPERIMENT OPERATION PLAN

TGO operational orbit T ~ 2 hr orbital period

 12 orbits per day, 12 sunrises and 12 sunsets – 24 occultation's per day



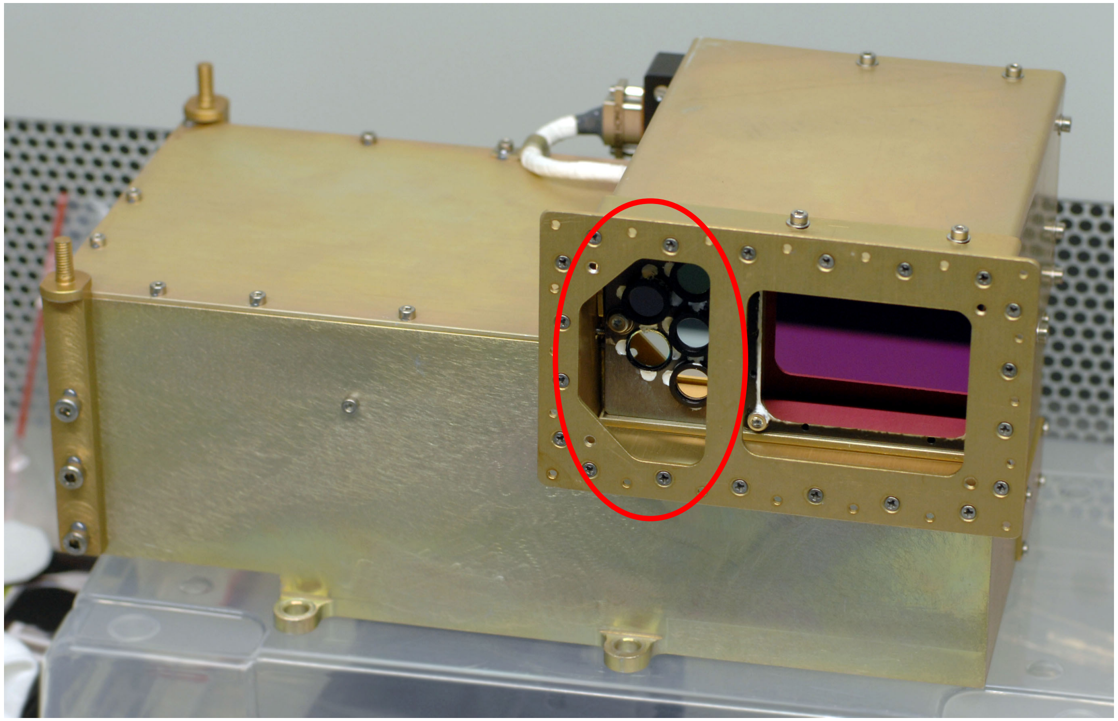
72 s 100 km

Species	Scientific Objective	Current Knowledge	Wavelengths, µm	Detection limit Solar Occultation	Detection limit Nadir
Abundant species					
CO_2	Profiles, pressure, temperature field	0.965	**1.43, 1.58, 1.60, 2.7, 3.8, 4.3, 15 etc**	5-140 km	Temperature field
CO_2 isotopes	Profile isotopes	13C/12C=0.967 18O/16O=1.018 Ratios wrt Earth	**1.47, 1.45, 2.6, 2.9, 3.0, 4.0 etc**		
H_2O	Profile. abundance	1-500 ppm (variable with season)	**1.13, 1.38, 2.56**	10-80 km	0.5 ppm
CO	Profile. abundance	300-1000 ppm	**1.57**	4 ppm	100 ppm
Aerosol	Properties, extinction profiles	opacities, integrated and limb profiles, particle sizes	**0.65-1.65, 2-25**	0.1 µm <reff <10 µm Distinguish H_2O/dust	Mapping of dust and ice cloud opacity
O_2	Profile	0.13%	**0.76**	Profiling up to 50-60 km with abundance 0.13%	0.02-0.05%
$O_2(a1\Delta g)$	Dayglow (ozone)+ Nightglow	0-30MR (dayglow) 0-0.3MR (nightglow)	**1.27**		0.1MR (in nadir) and 10kR column in limb
Trace species					
CH_4	Detection, profiles	10-50 ppb	**3.3**	0.02 ppb	
C_2H_2	Detection	<2 ppb	**3**	0.1 ppb	
C_2H_4	Detection	<4 ppb	**3.2**	0.5 ppb	
C_2H_6	Detection	<0.2 ppb	**3.3**	0.05 ppb	
H_2S	Detection	<20 ppb	**2.6**	5 ppb	
OCS	Detection	<10	**2.44, 3.4**	0.3 ppb	
HDO	Detection	0.1-1 ppm	**3.7**	0.2 ppb	
H_2CO	Detection	<3 ppb	**3.6**	0.03 ppb	
HO_2	Detection	200	**2.94**	1 ppb	
NO_2	Detection	<10	**3.43, 6.25**	0.1 ppb	
	Detection	<0.3	**3.42**	0.04 ppb	

Talk by Anna Fedorova after the coffee break

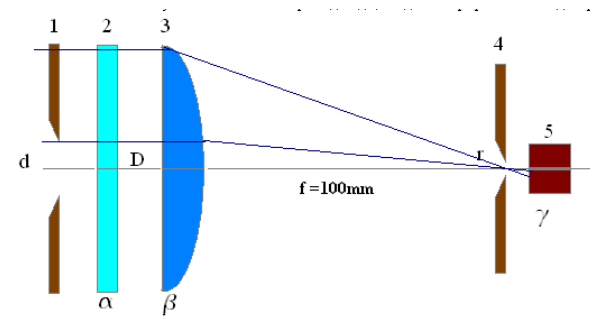
Photometric channels on TIMM2 (Phobos Grunt)

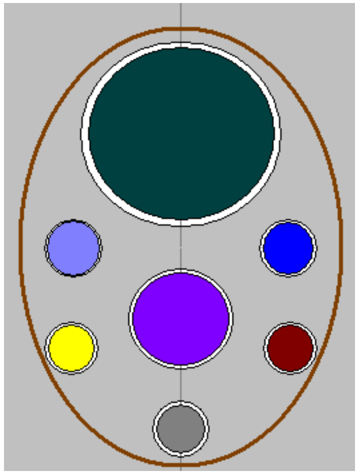
#q	Target	λ [nm]	Δλ [nm]	Aperture, Ø [mm]	Diaphragm Ø [μm]	Detector
6	Ozone	250	10	11	100	Si 2.4x2.4 mm Hamamatsu S1336-5BQ
8	Aerosol, ozone	340	10	8	100	-'-
5	Aerosol	990	10	3	100	-'-
7	Aerosol	1550	12	3	100	InGaAs Ø 1 mm Hamamatsu G8370-01
1-4	Pointing monitoring	550	1	3	-	Si 4x 1x1mm ФД19КК

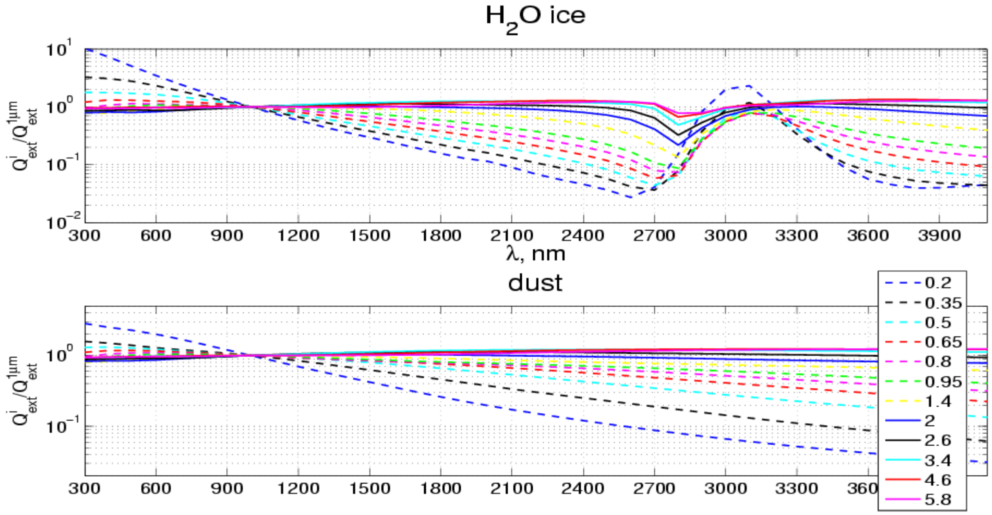


Photometric channels on ACS (TBC)

#q	λ [nm]	Δλ [nm]	Detector
1	200	10	Si 2.4x2.4 mm Hamamatsu S1336-5BQ x 7
2	310		
3	430		
4	580		
5	750		
6	900		
7	N		







The dust characterization in the width spectral range from the solar occultations. The refractive index of Martian dust was taking from Ockert-Bell model, refraction index of H2O was taking from Warren. Lig-normal distribution was used: for H2O veff=0.2 mum, for dust veff=0.4 mum. The color marks a reff

To-do list until 2014

NIR

- Optical and mechanical test with qualification model without flight electronics
- Production of flight hardware
- Accelerate electronics production

MIR

- Finalizing instrument design (best effort for S/N improvement)
- Partial production of flight hardware and tests
- Accelerate electronics production
- Final decision on photometric channels
- Accelerate electronics production