The OPTIMus* survey of massive star-forming regions: science goals and prospects for UV follow-up

M. S. Kirsanova[1], A. V. Moiseev[2], A. M. Tatarnikov[3], A. S. Gusev[3], A. D. Yarovova[3], D. S. Wiebe[1], S. V. Salii[4], P. A. Tanatova[4]

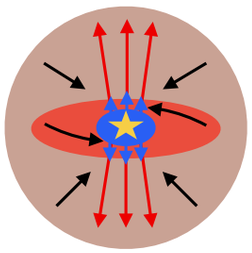
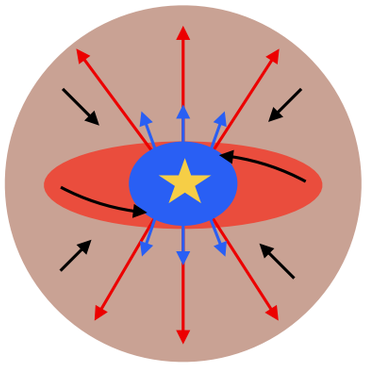
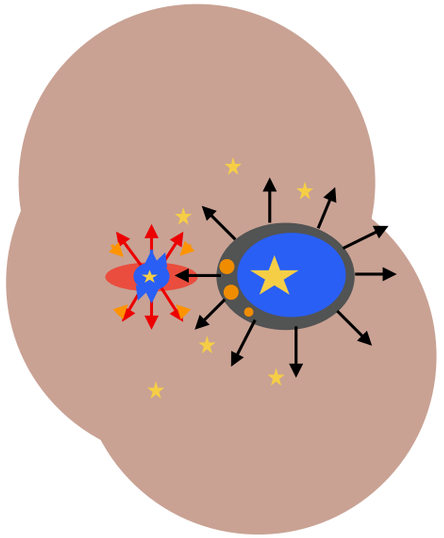
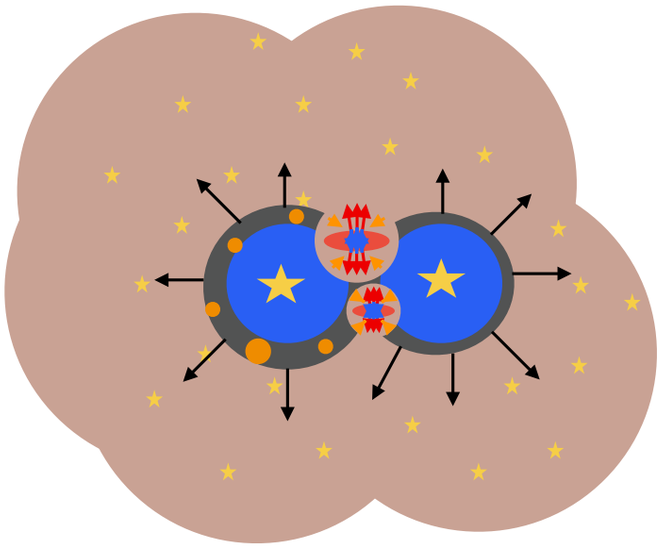
[1]Institute of Astronomy, RAS
[2]Special Astrophysical Observatory, RAS
[3]Moscow State University
[4]Ural Federal University

*optical
infrared
millimeter

08/10/2026, NUVA e-meeting 2026

Intro

Structure of massive star-forming regions and the morphology of ionized regions

hypercompact	ultracompact	compact	extended
nearest vicinity of young star is ionized	ionized disk and outflow	HII region	HII region
			
Molecular disk and jet	Molecular disk and outflow	Compressed molecular gas and embedded protostars	Second generation of protostars in the compressed gas

Kirsanova et al., 2026, Astrophysical Bulletin, 81, 2, 317

Aims and objectives of the survey

AIMS:

- **Estimate the efficiency of feedback from young massive stars**

- Develop a comprehensive observational and theoretical description of the complex, multicomponent interstellar medium surrounding young massive stars of different spectral types

OBJECTIVES:

- reconstruct the spatial structure of the surveyed regions

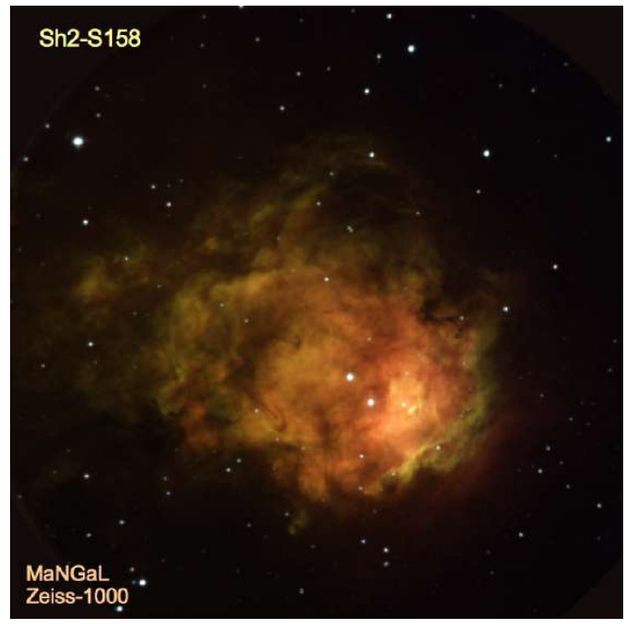
- Determine the physical conditions in HII regions, photodissociation regions, and the surrounding molecular clouds using multiwavelength data

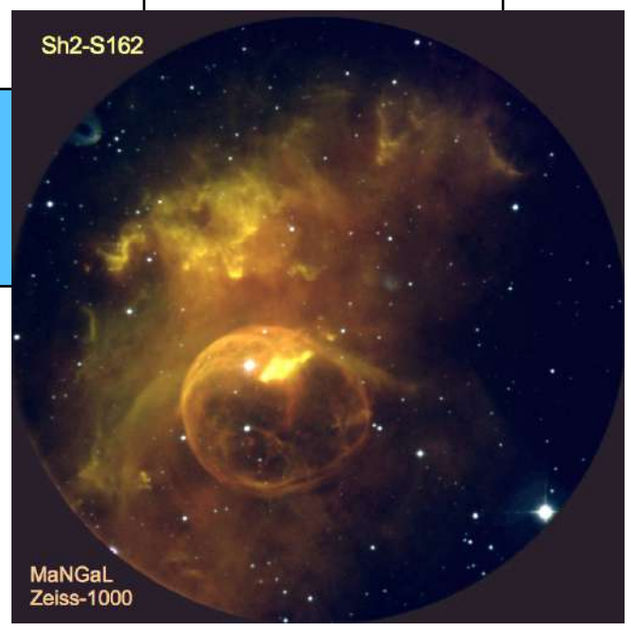
Optical	Infrared	Millimeter
1m Zeiss-1000 + 6m BTA Special Astrophysical Observatory	2.5m telescope Caucasian Mountain Observatory Moscow State University	20m telescope Onsala observatory
imaging		
Mapper of Narrow Galaxy Lines (MaNGaL)	ASTROnomical Near InfraRed CAMera	
spectroscopy		
SCORPIO-2	The AstroNIRCam camera with a grism	receiver at 3-4 мм
Afanasiev & Moiseev, 2011 Moiseev et al., 2020	Nadjip et al., 2017 Zheltoukhov et al., 2020 Gusev et al., 2026	Belitsky et al., 2015

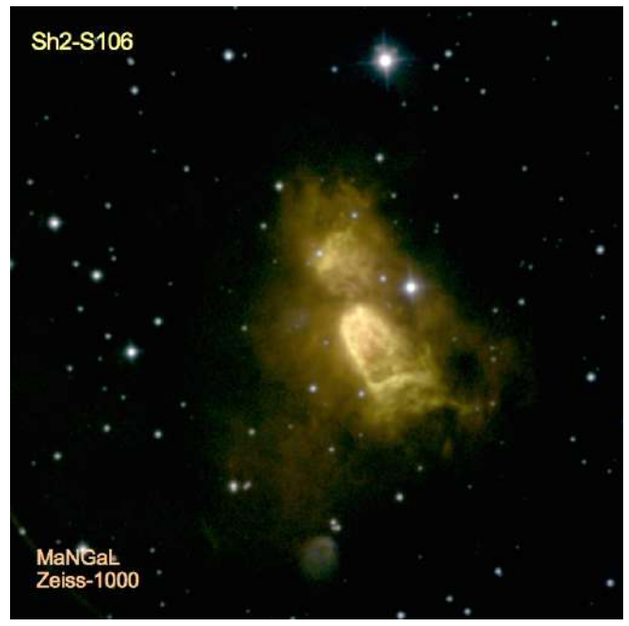
OPTIMus Observations: the sample

16 bright HII regions in the northern sky
+ star-forming regions along the ionization fronts

S106	S146	S152	S156
S162	S158	S165	S187
S201	S209	S228	
S235+S237			
S255+S257+S258			

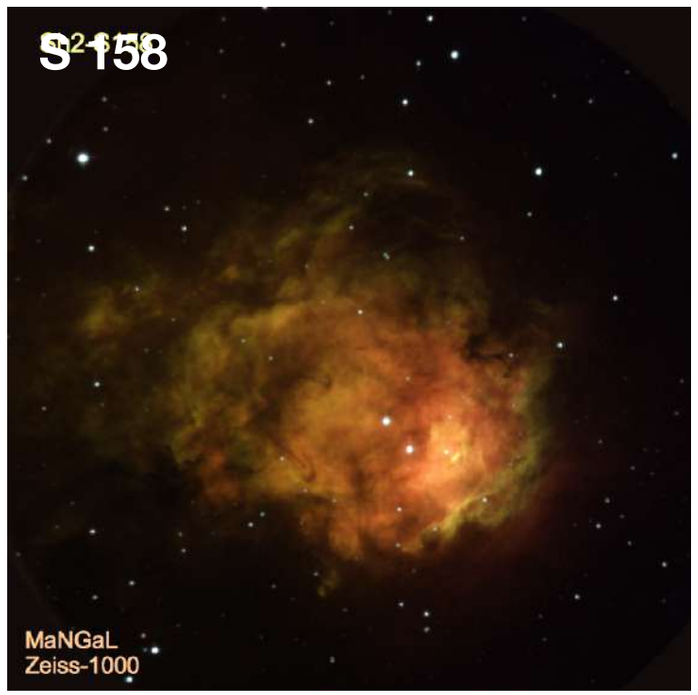






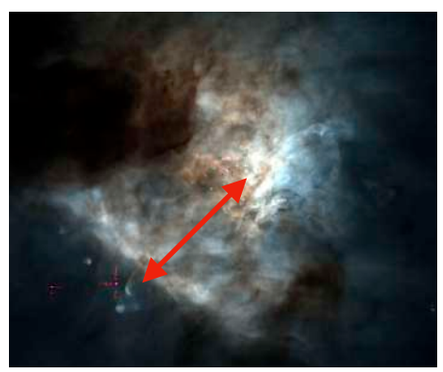
https://www.sao.ru/hq/lsfvo/devices/mangal/gallery_sky.html

OPTIMus Observations: optical comparison



https://www.sao.ru/hq/lsfvo/devices/mangal/gallery_sky.html

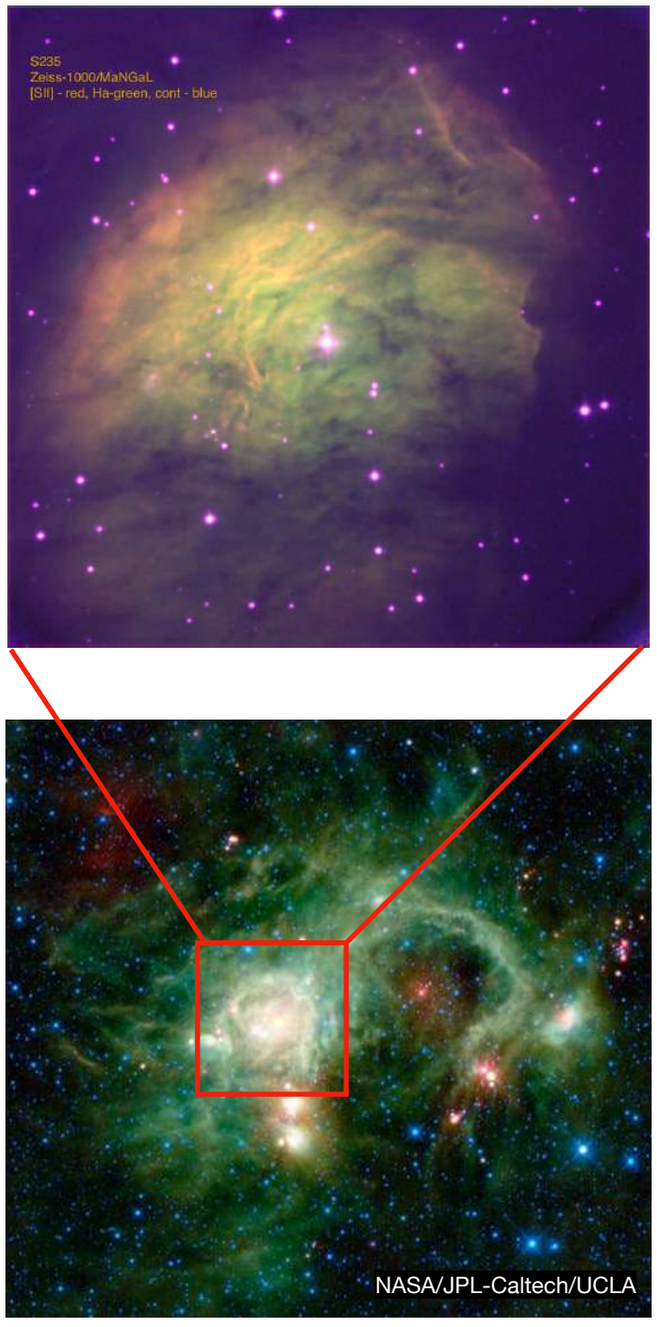
	S235	S255-257	S158	*Central Orion Nebula*
ionizing star	O9.5	B0-B0.5	O5-O6	*O6.5-O7*
distance	1.6-1.8 kpc	2-2.5 kpc	2.5 kpc	*414 pc*
size	5 pc	2 pc	2 pc	*< 0.5 pc*

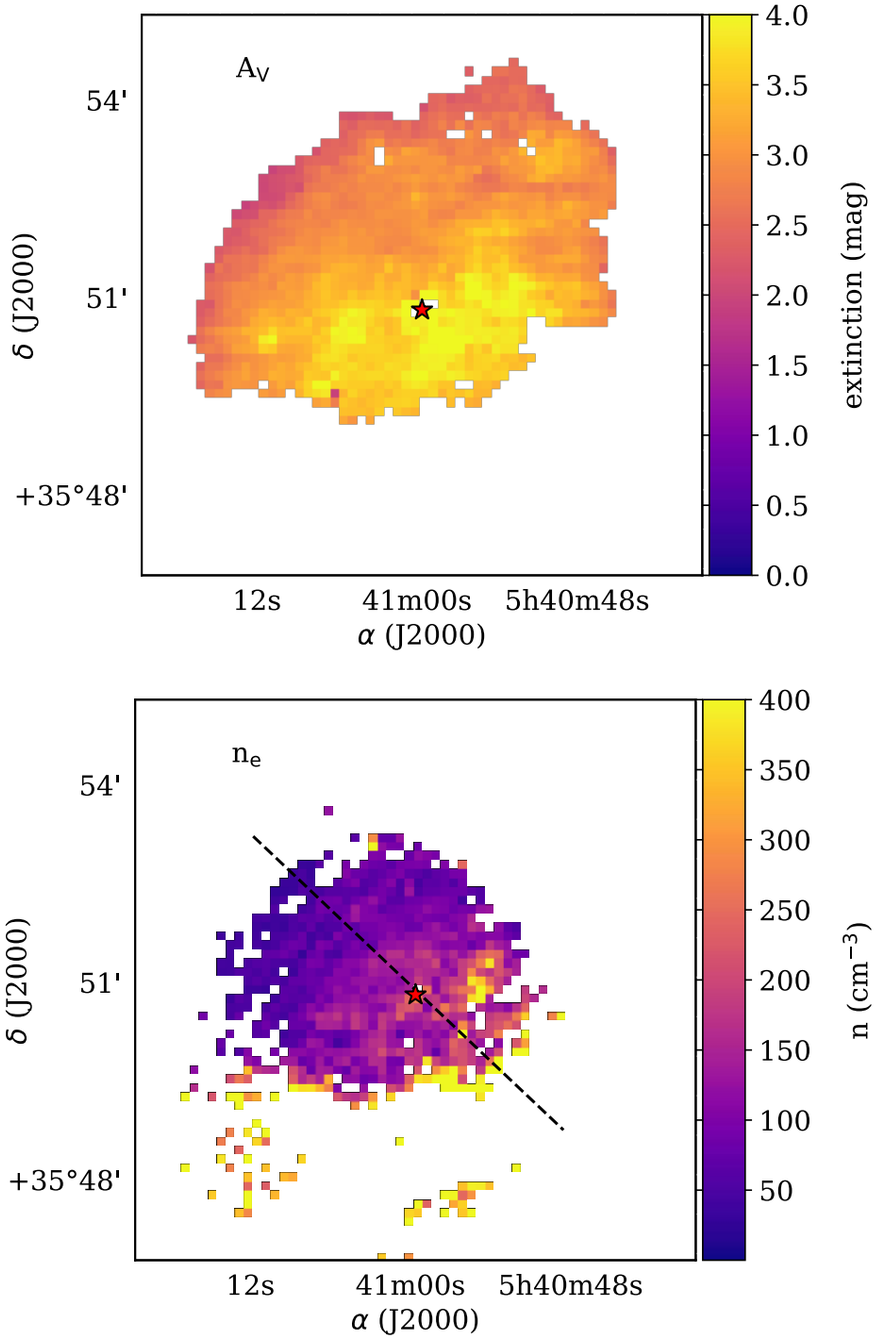


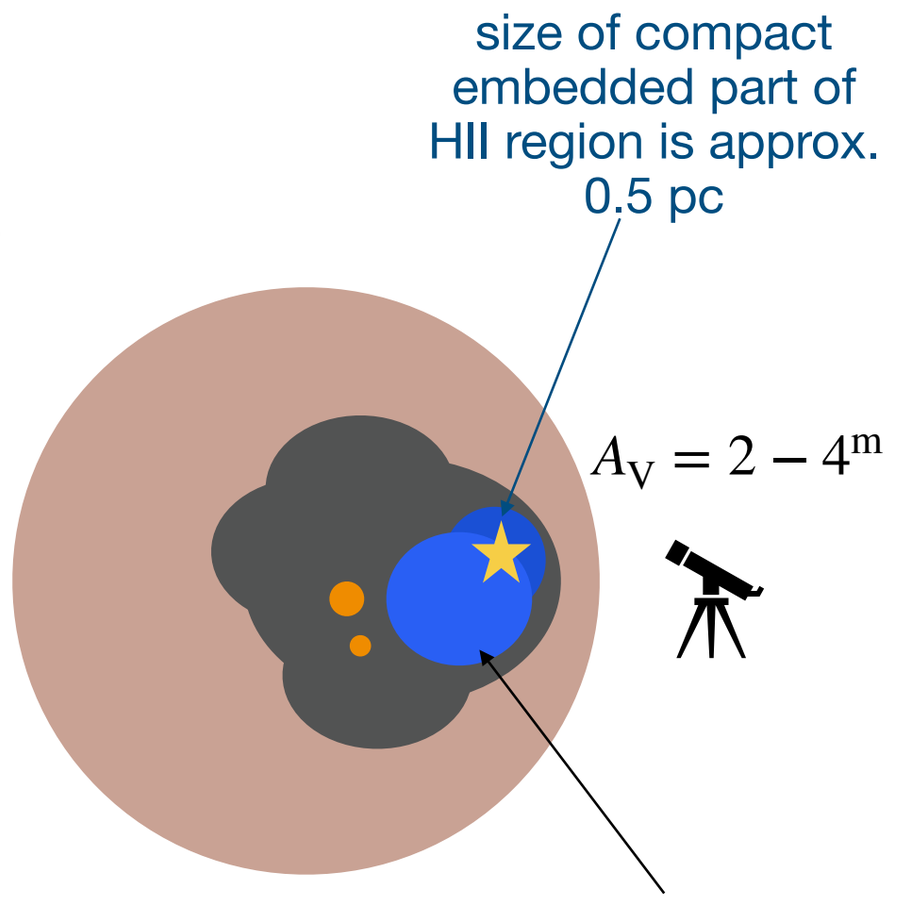
Weilbacher et al., 2015

OPTIMus Observations: structure of S235

Ha, Hb, [SII], [NII] images + long-slit spectra

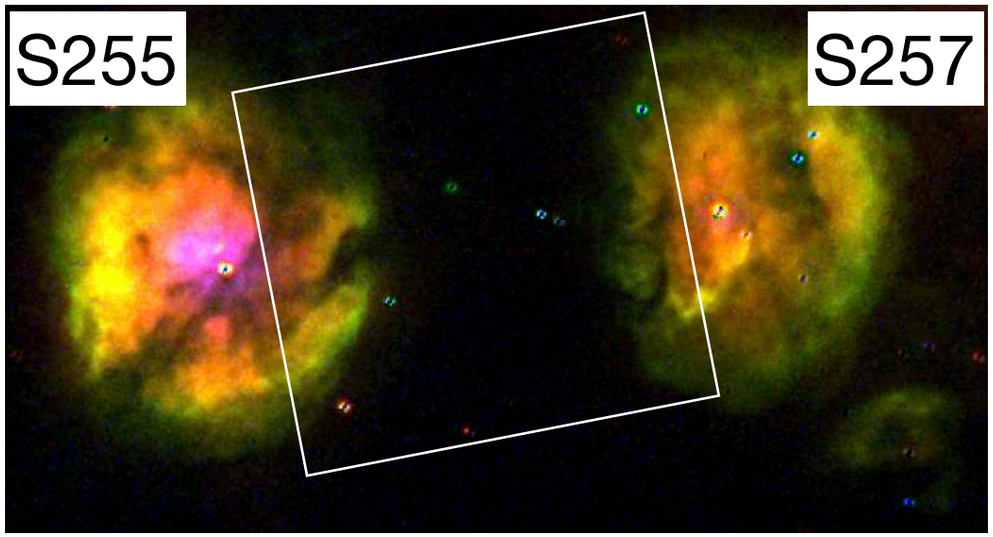


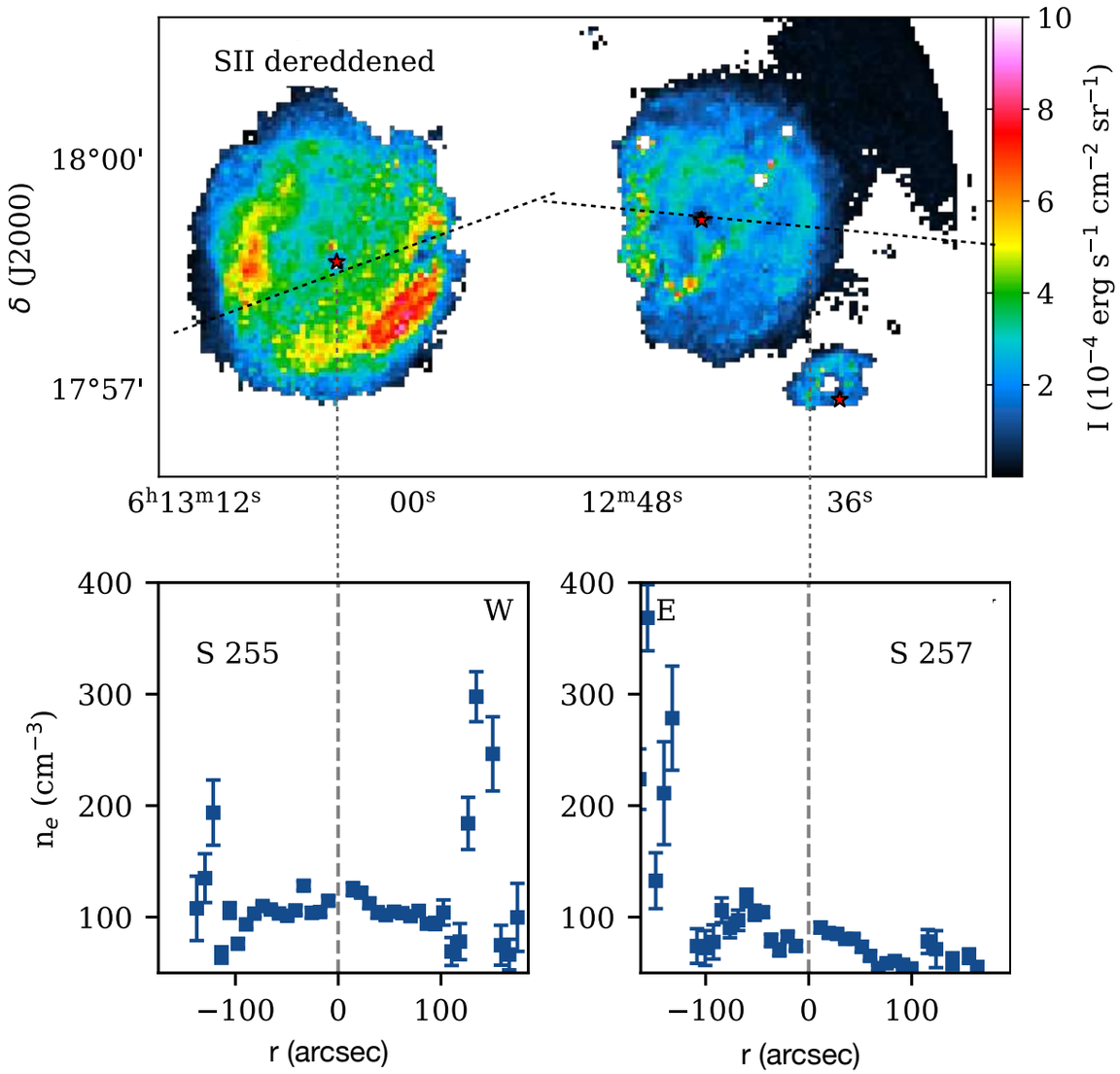




Kirsanova et al., 2020

OPTIMus Observations: optical and infrared





Kirsanova et al., 2023

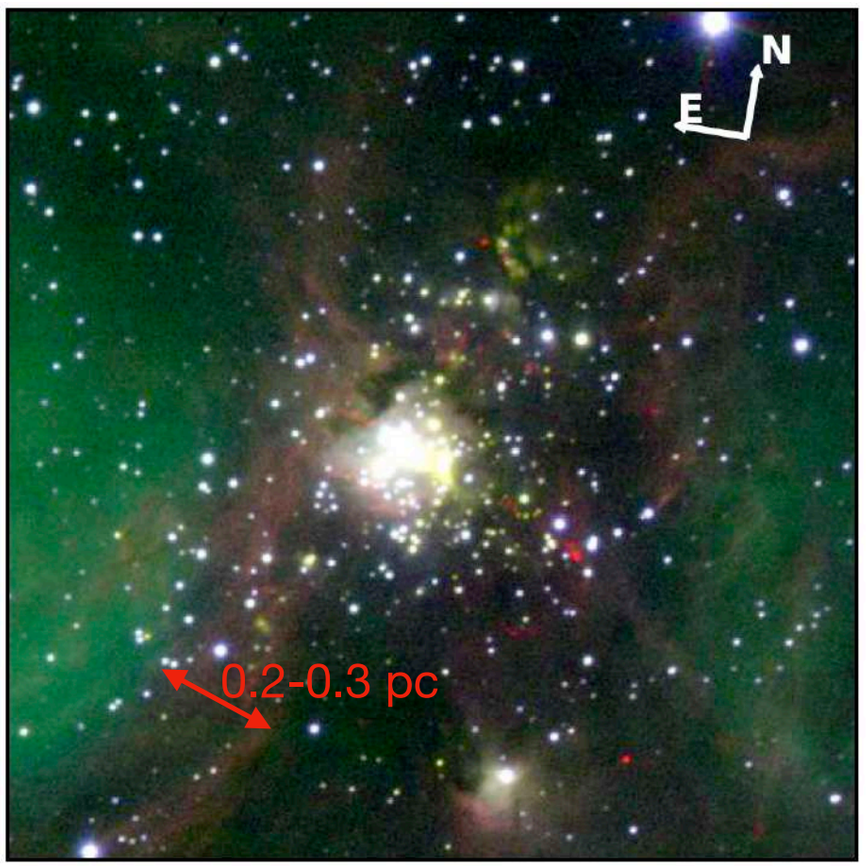
Electron density

Approximately 100 cm^{-3} in both regions, rising up to 200-400 cm^{-3} at their borders.

Possible explanations:

Diffuse UV photons penetrating an inhomogeneous ISM

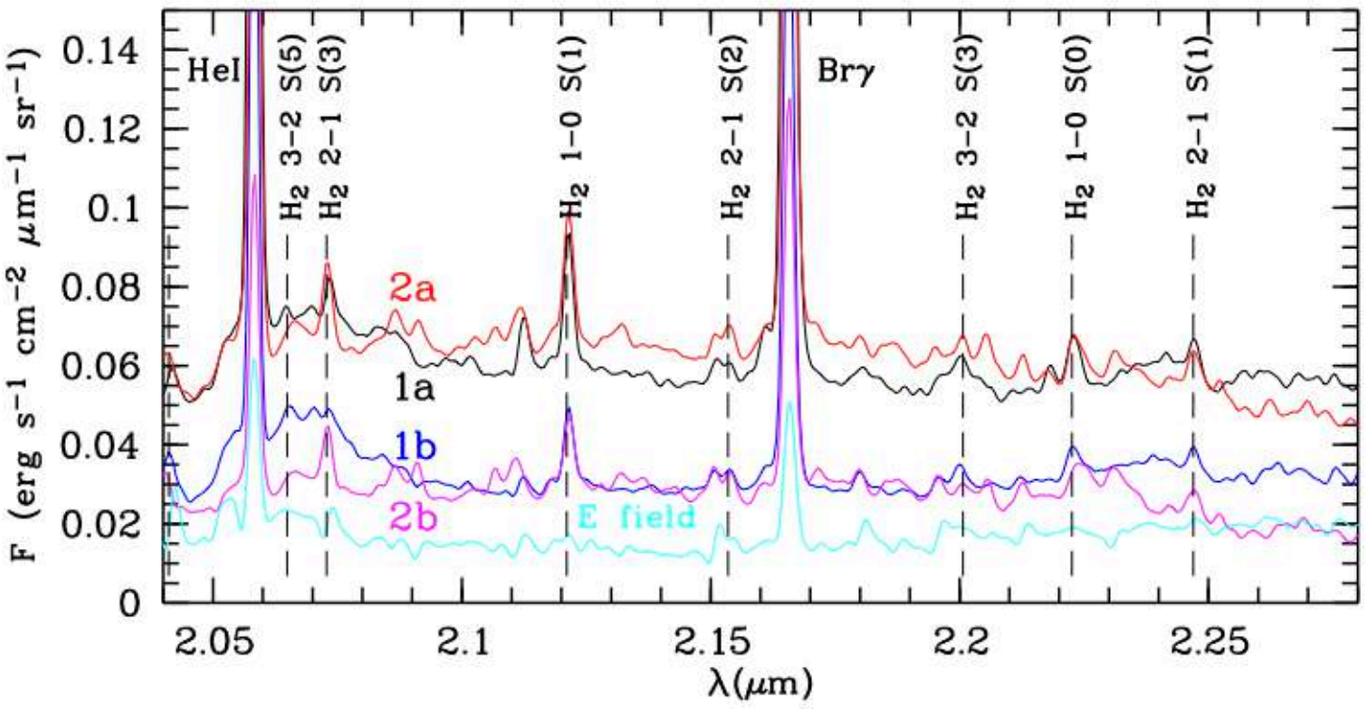
Stellar winds



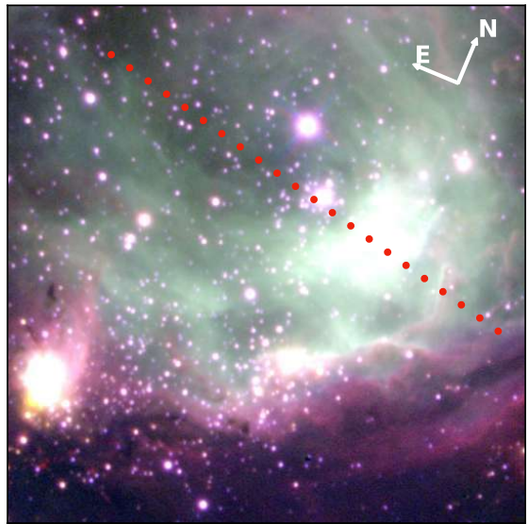
[FeII]
Br-gam
H_2

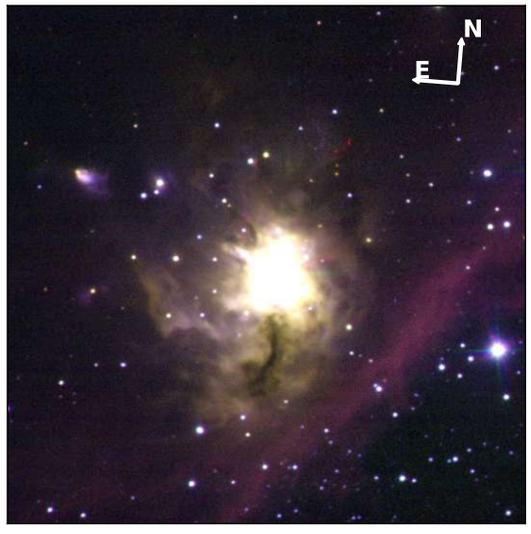
OPTIMus Observations: infrared

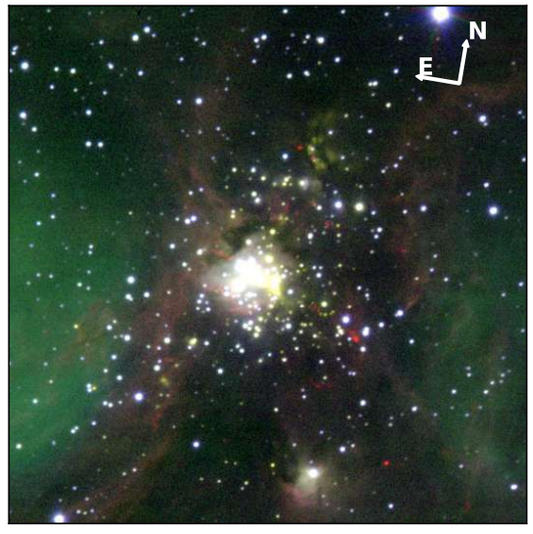
Near IR spectroscopy of extended objects



Brγ + H_2 + [FeII]







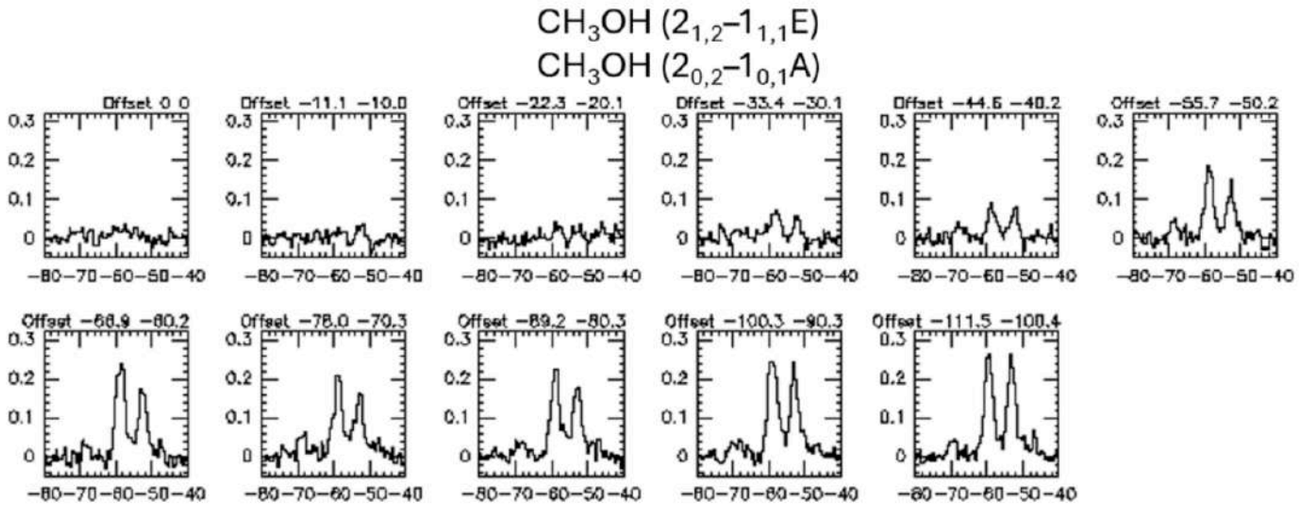
Physical diagnostics of PDRs:

H_2 excitation temperature
H_2 column density
ortho-to-para ratio

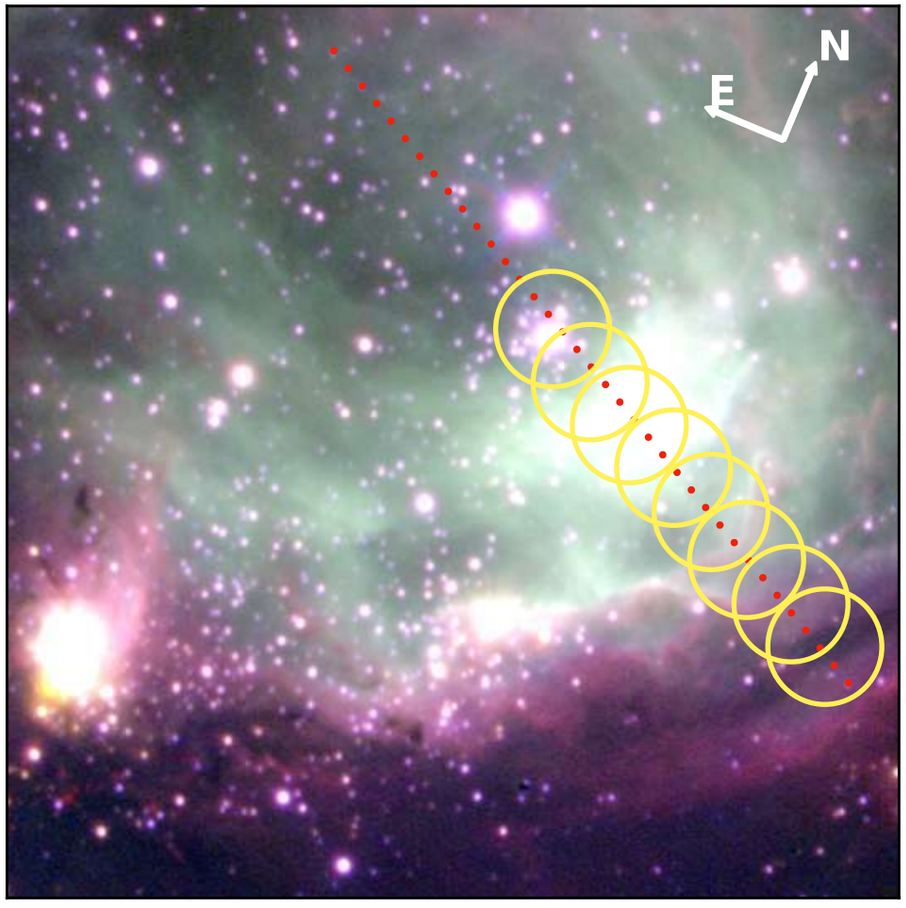
Gusev et al., 2026

OPTIMus Observations: millimeter

millimeter spectroscopy along selected lines of sight



NGC 7538



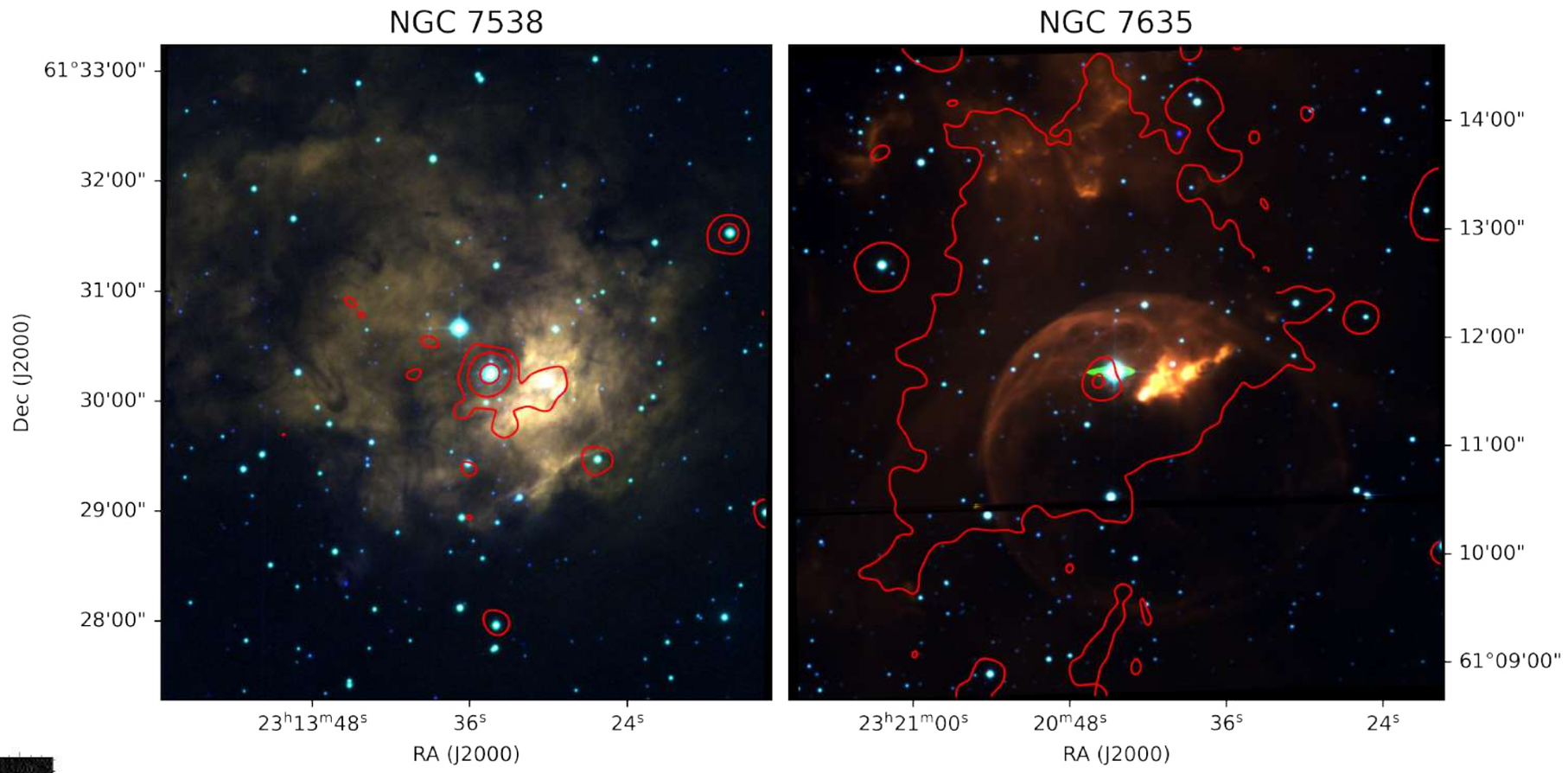
Molecular gas diagnostics:

temperature and density
chemical composition

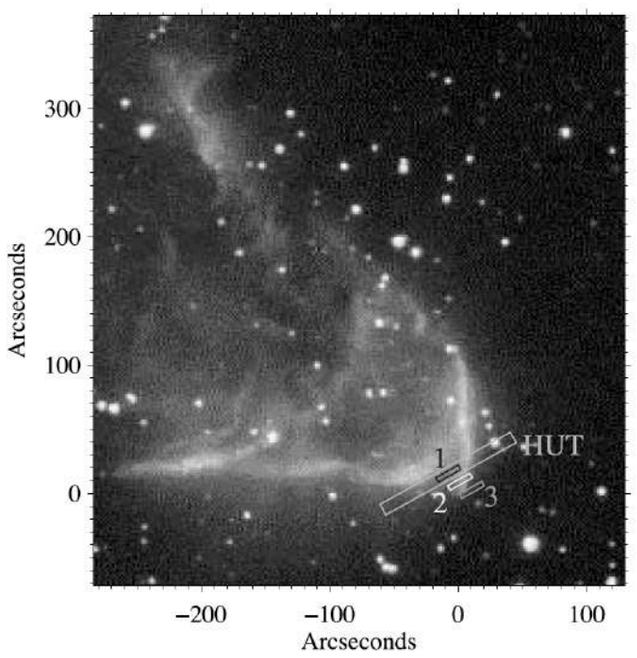
Tanatova et al., in preparation

OPTIMus Observations: UV follow-up

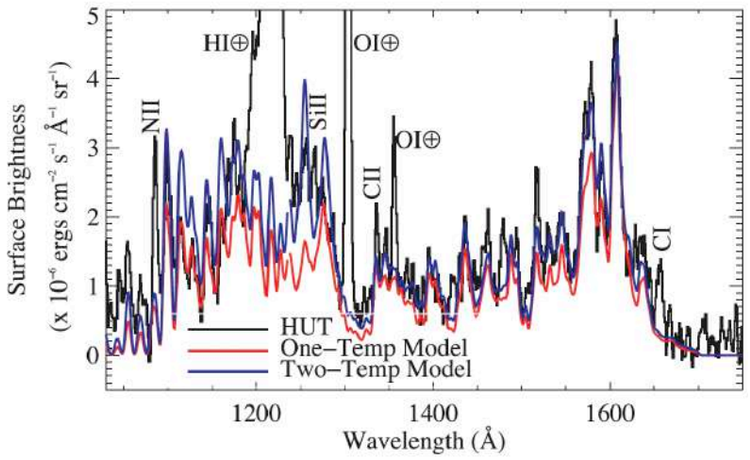
Diffuse UV emission: a possible signature of stellar winds?



contours: GALEX UV emission
color composite — r, i, H-alpha (IPHAS)



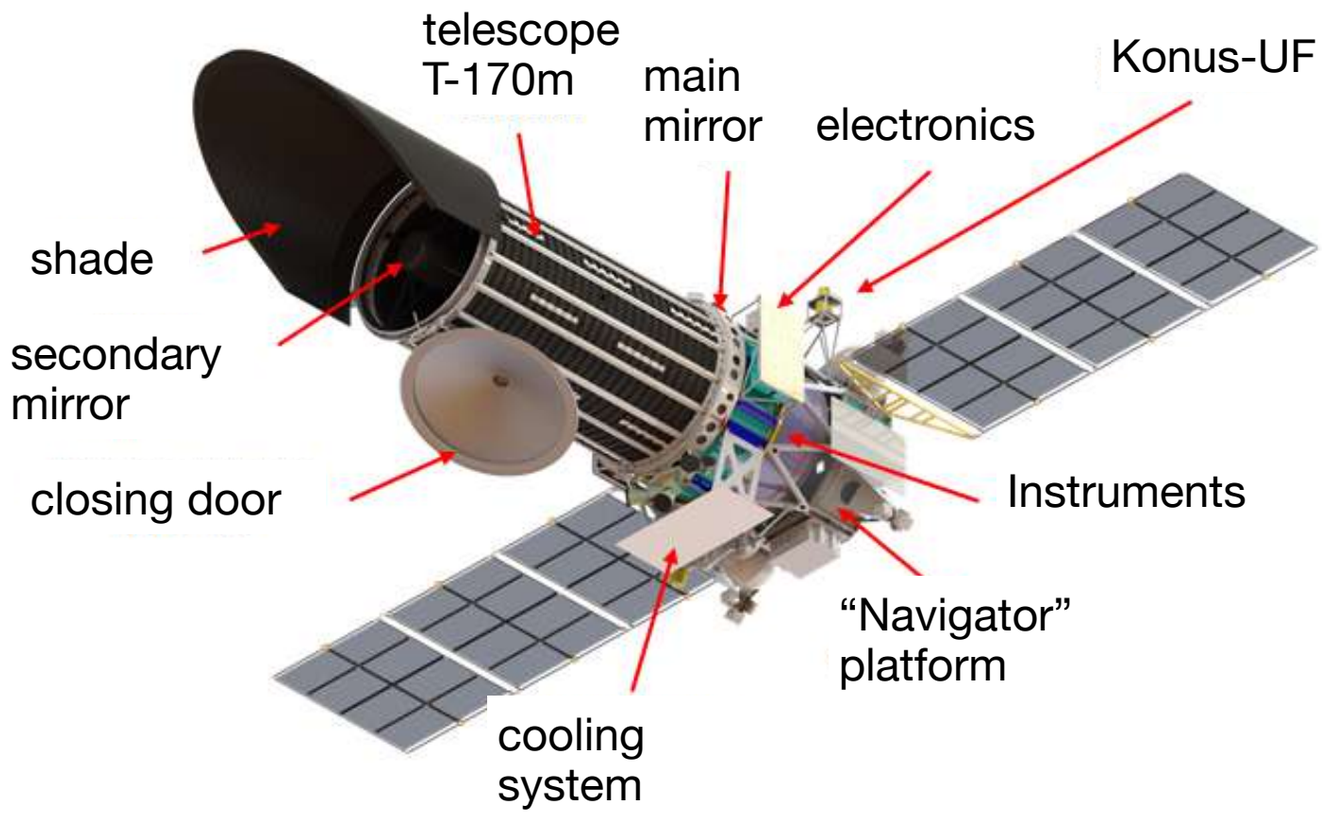
France et al., 2005



UV diagnostic

radiation field
stellar winds
ionization structure

Science with the Spektr-UF telescope



ASTRONOMY REPORTS, 2026, vol , pages, accepted

Interstellar and intergalactic medium in the ultraviolet band

M. S. Kirsanova,[1,*] S. A. Balashev,[2] M. V. Barkov,[1] E. O. Vasiliev,[3] D. S. Wiebe,[1,4,†] I. I. Zinchenko,[5] A. V. Moiseev,[6] M. S. Murga,[1] I. N. Nikonorov,[1] M. E. Sachkov,[1] I. S. Khrykin,[7] B. M. Shustov,[1] Yu. A. Schekinov,[8] A. D. Yarovova[9]

Study supported by BASIS foundation 25-1-2-88-1