New Herbig-Haro objects and outflows in Mon R1

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BAO NAS RA, SAO RAS

Instrumentation: Telescope

Telescope mirror :

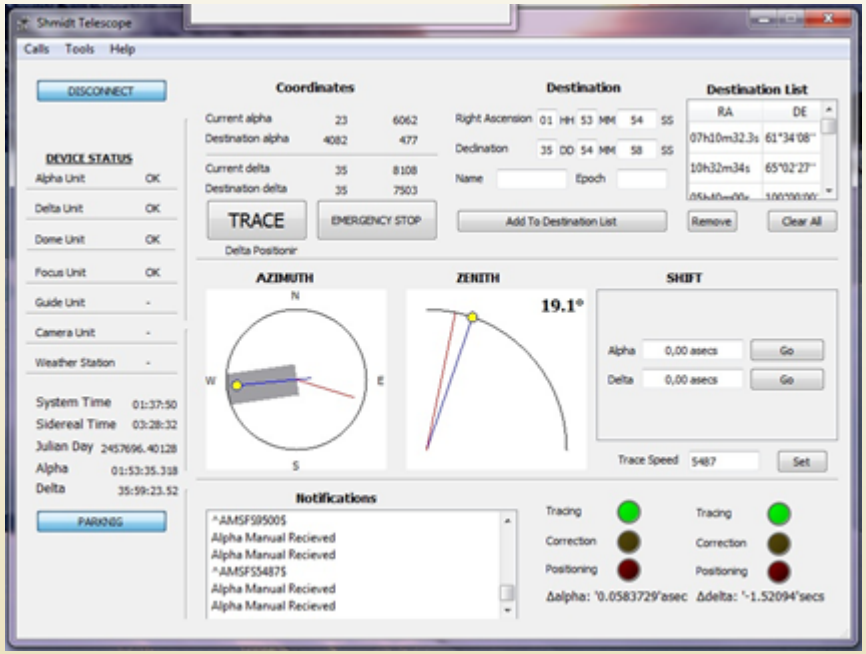
Diameter	1320 mm
Focal Length	2130 mm
Image Scale	96.7 “/mm
Field of View	~16 sq. deg.

Corrector Lens 1020 mm

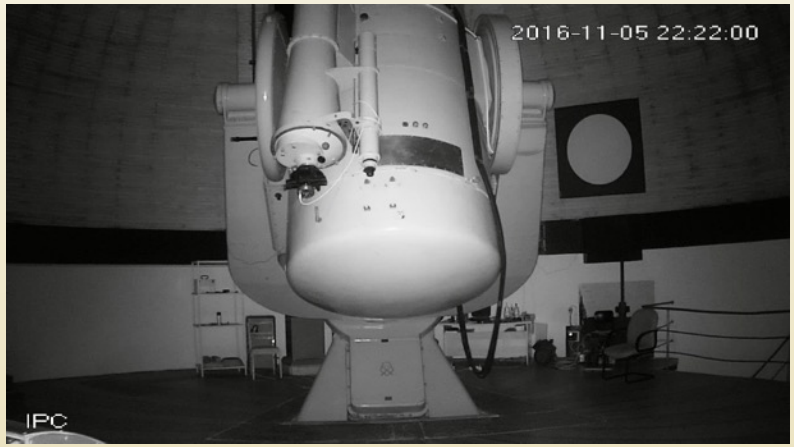
Objective Prisms :

Diameter	1000 mm
1.5 deg	1800 A/mm
3.0 deg	900 A/mm
4.0 deg	280 A/mm

Telescope control system



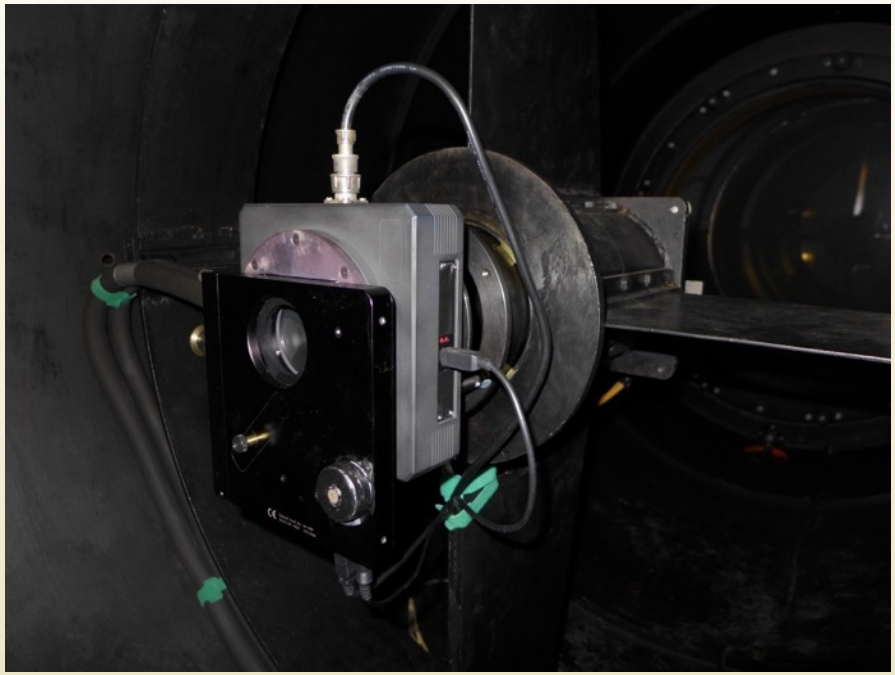
Dome camera

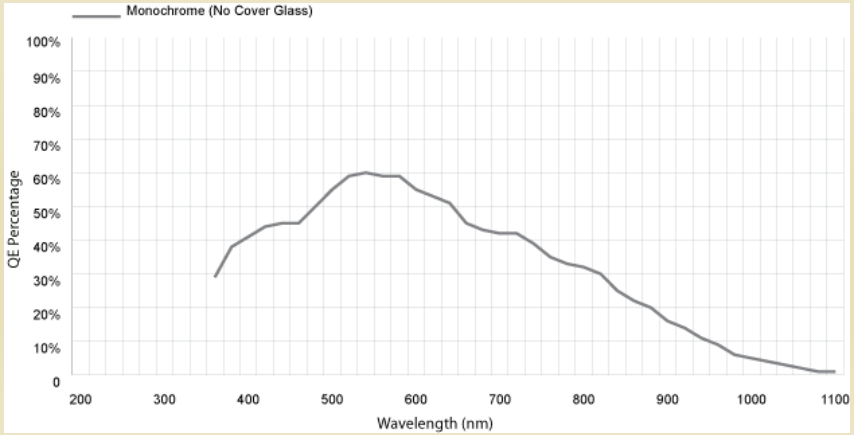


Detector

Apogee Alta U16M

Kodak KAF-16803	4k x 4k
Pixel Size	9 µk x 9 µk
Readout Noise	<11 e
Dark Current	< 0.01 e/sec
Q.E.	60 % (5500 A)
	35 % (3500 A)
	18 % (9000 A)
Field of View	~ 1 sq. deg
Image Scale	0.868 arcsec/pix
Liquid Cooling	± 0.1°C





Filters

5 SDSS filters

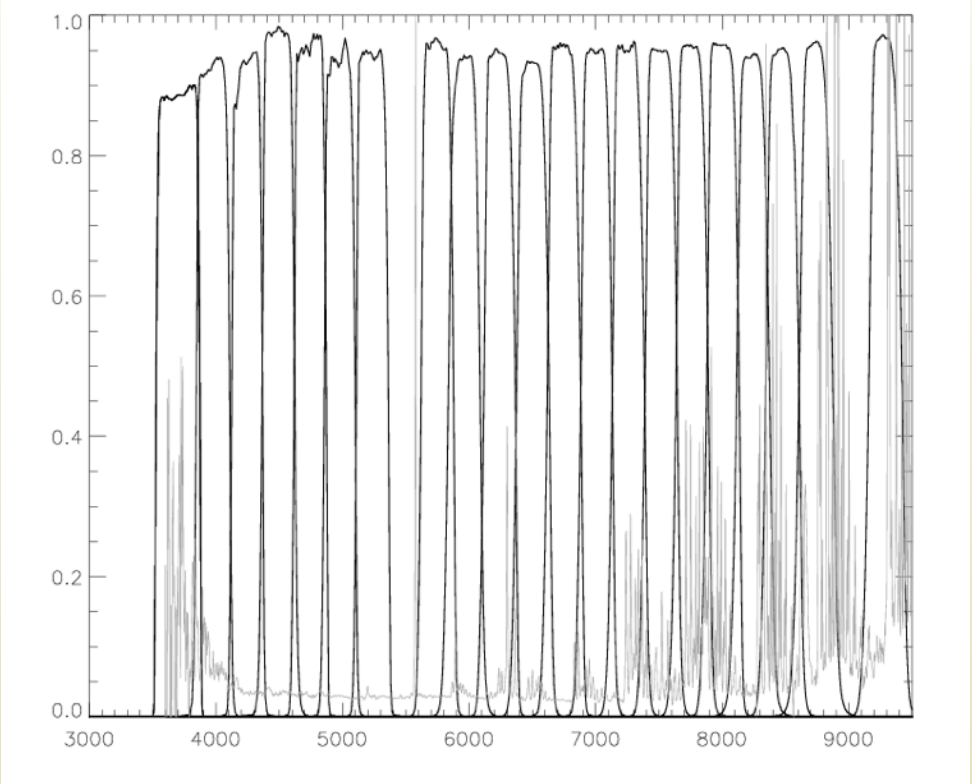
21 Medium Band Filters with FWHM ~ 250 A

3 Filters with FWHM ~100 A at 5000 A, 6560 A and 6760 A.

Filter Wheel Driver

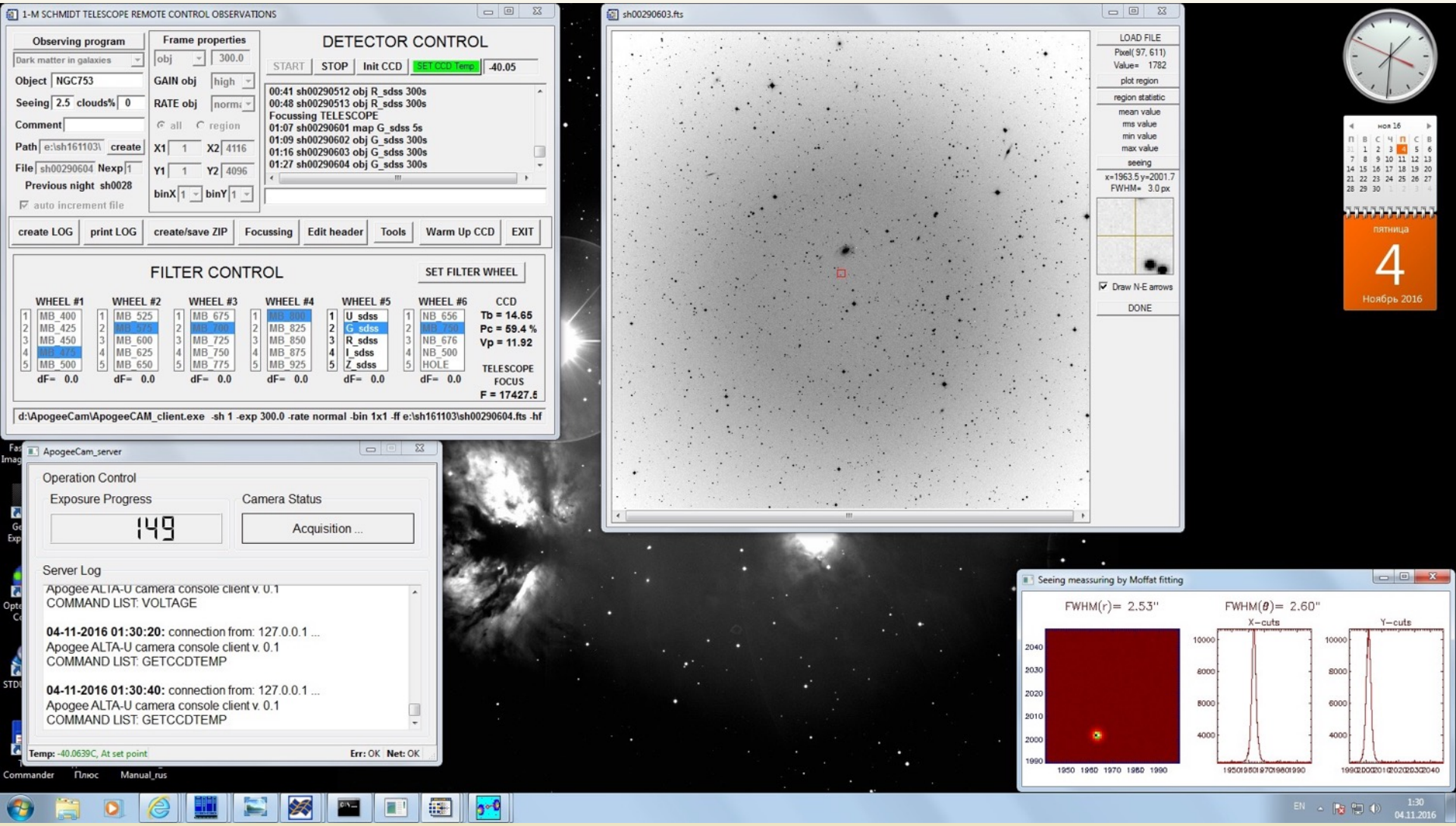
6 Filter Wheels with 5 Filter Positions in each Filter Wheel.

All Filters **50 mm** in Diameter.

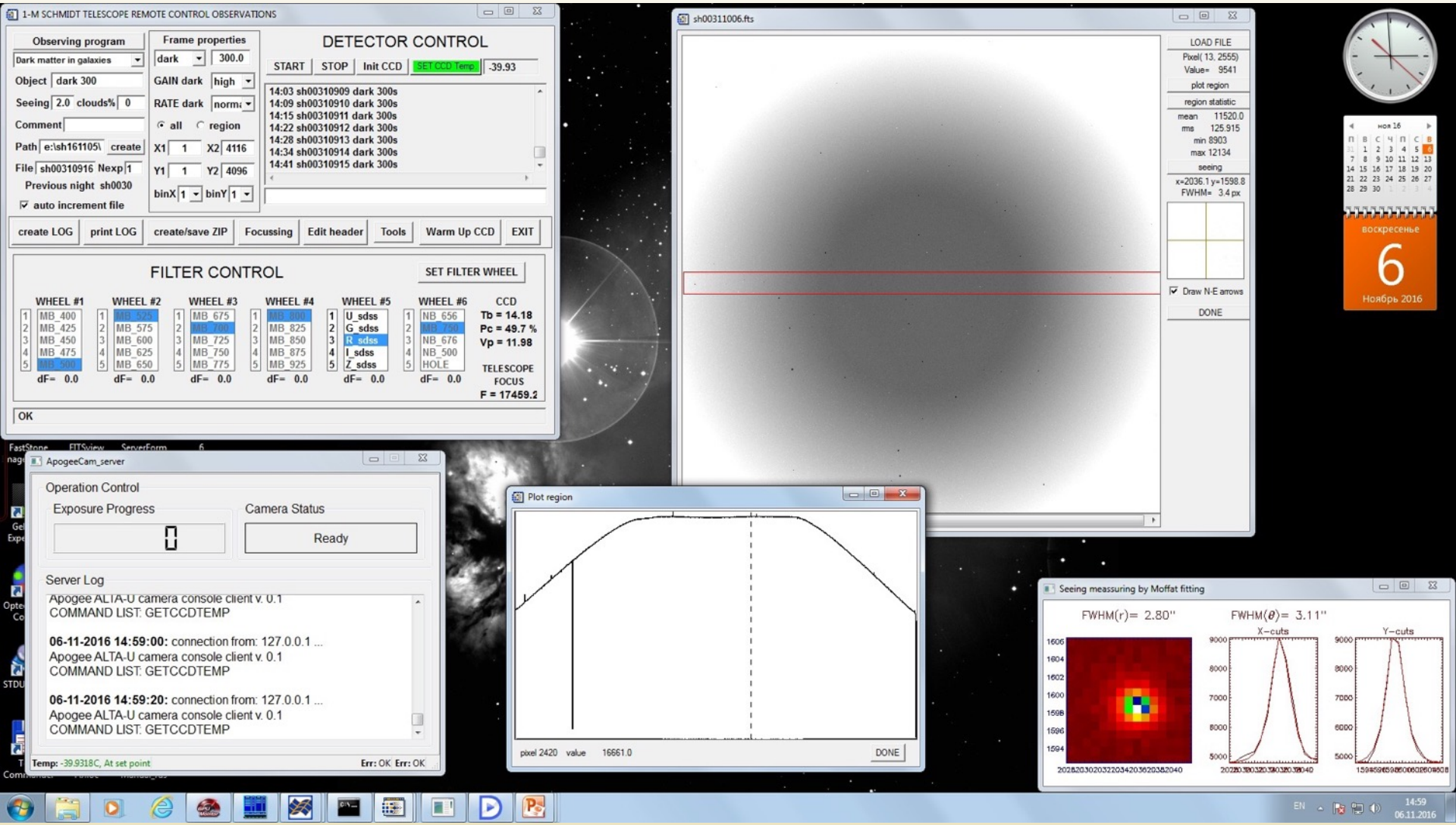


Medium Band Filter Set.
Filter Transmissions measured at F/2.

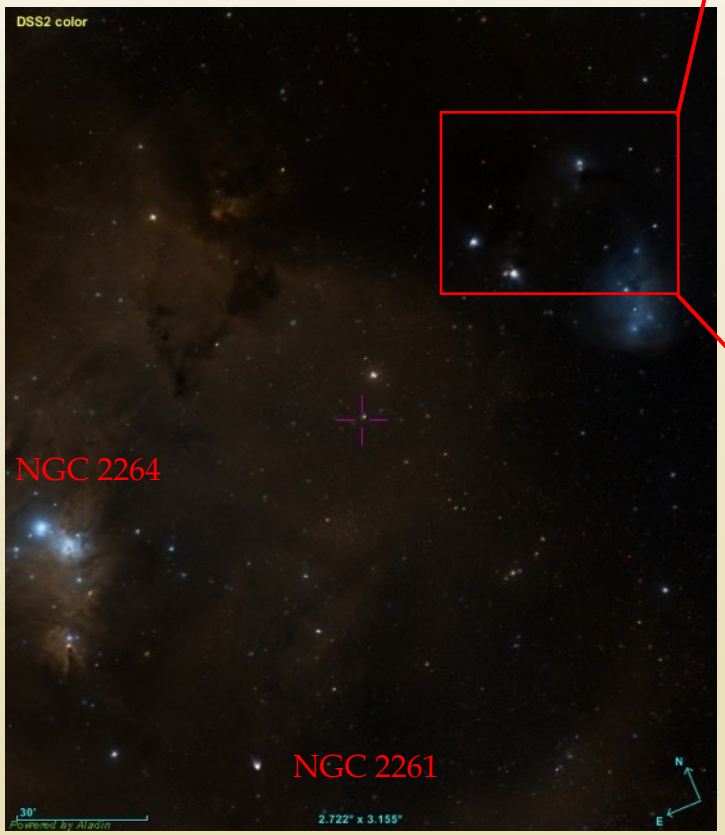
Data acquisition

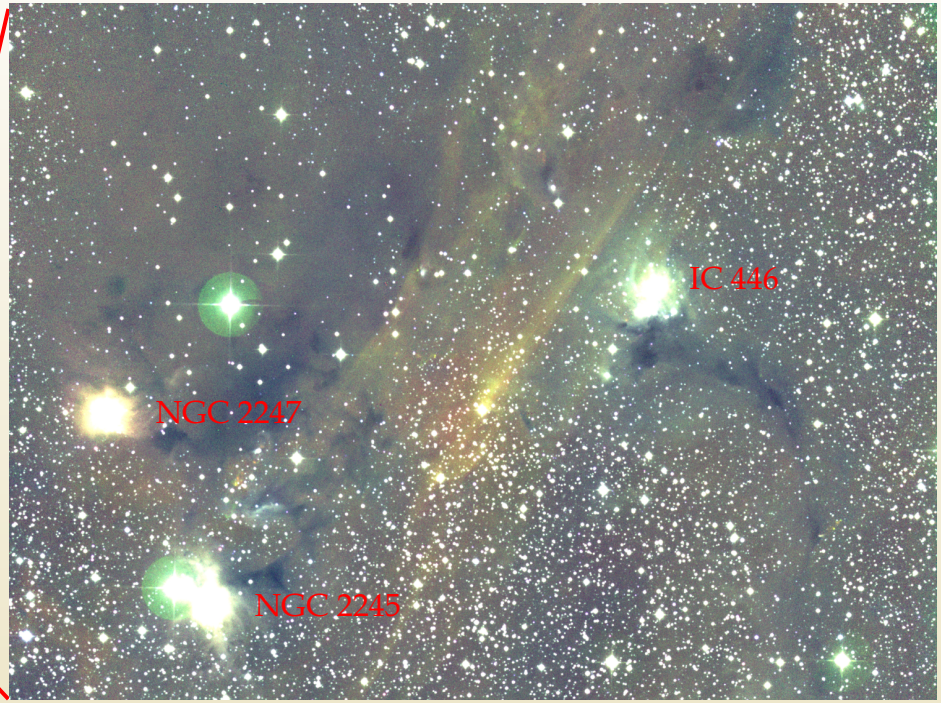


Flat field

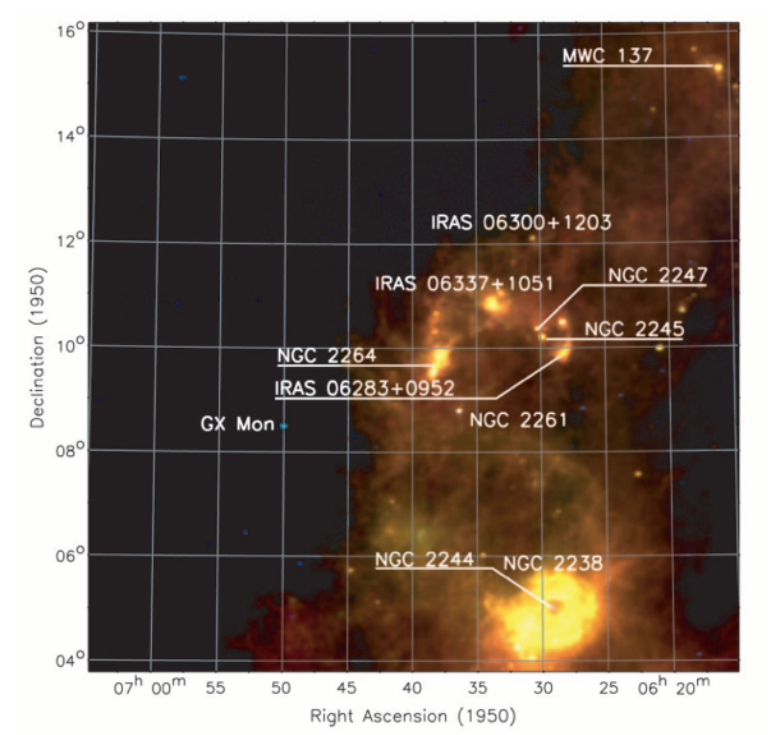

1-M SCHMIDT TELESCOPE REMOTE CONTROL OBSERVATIONS
Observing program
Dark matter in galaxies
Object dark 300
Seeing 2.0 clouds% 0
Comment
Path e:\sh161105\ create
File sh00310916 Nexp 1
Previous night sh0030
auto increment file
Frame properties
dark 300.0
GAIN dark high
RATE dark norma
all region
X1 1 X2 4116
Y1 1 Y2 4096
binX 1 binY 1
DETECTOR CONTROL
START STOP Init CCD SET CCD Temp -39.93
14:03 sh00310909 dark 300s
14:09 sh00310910 dark 300s
14:15 sh00310911 dark 300s
14:22 sh00310912 dark 300s
14:28 sh00310913 dark 300s
14:34 sh00310914 dark 300s
14:41 sh00310915 dark 300s
create LOG
print LOG
create/save ZIP
Focussing
Edit header
Tools
Warm Up CCD
EXIT
FILTER CONTROL
SET FILTER WHEEL
WHEEL #1
MB_400
MB_425
MB_450
MB_475
MB_500
dF= 0.0
WHEEL #2
MB_525
MB_575
MB_600
MB_625
MB_650
dF= 0.0
WHEEL #3
MB_675
MB_700
MB_725
MB_750
MB_775
dF= 0.0
WHEEL #4
MB_800
MB_825
MB_850
MB_875
MB_925
dF= 0.0
WHEEL #5
U_sdss
G_sdss
R_sdss
I_sdss
Z_sdss
dF= 0.0
WHEEL #6
NB_656
MB_750
NB_676
NB_500
HOLE
dF= 0.0
CCD
Tb = 14.18
Pc = 49.7 %
Vp = 11.98
TELESCOPE FOCUS
F = 17459.2
OK
sh00311006.fts
LOAD FILE
Pixel(13, 2555)
Value= 9541
plot region
region statistic
mean 11520.0
rms 125.915
min 8903
max 12134
seeing
x=2036.1 y=1598.8
FWHM= 3.4 px
Draw N-E arrows
DONE
воскресенье
6
Ноябрь 2016
ApogeeCam_server
Operation Control
Exposure Progress
Camera Status
Ready
Server Log
Apogee ALTA-U camera console client v. 0.1
COMMAND LIST: GETCCDTEMP
06-11-2016 14:59:00: connection from: 127.0.0.1 ...
Apogee ALTA-U camera console client v. 0.1
COMMAND LIST: GETCCDTEMP
06-11-2016 14:59:20: connection from: 127.0.0.1 ...
Apogee ALTA-U camera console client v. 0.1
COMMAND LIST: GETCCDTEMP
Temp: -39.9318C, At set point
Err: OK Err: OK
Plot region
pixel 2420 value 16661.0
DONE
Seeing meassuring by Moffat fitting
FWHM(r)= 2.80''
FWHM(θ)= 3.11''
X-cuts
Y-cuts

Location


DSS2 color
NGC 2264
NGC 2261
30'
2.722° x 3.155°
N
E


IC 446
NGC 2247
NGC 2245

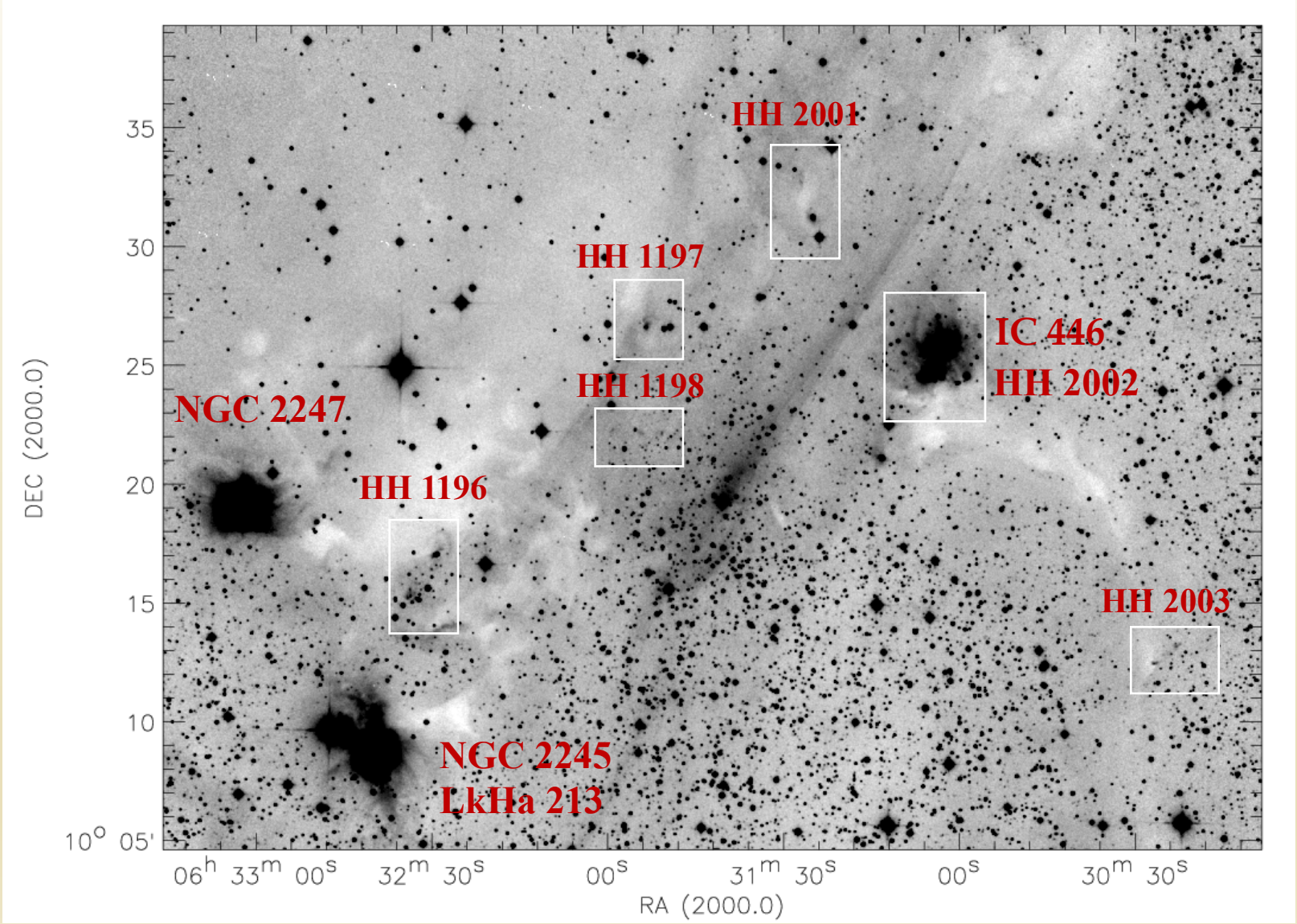
Monoceros OB1 and R1 associations



False-color IRAS image (100, 60, and 25 m) of the Mon OB1 and Mon R1 associations

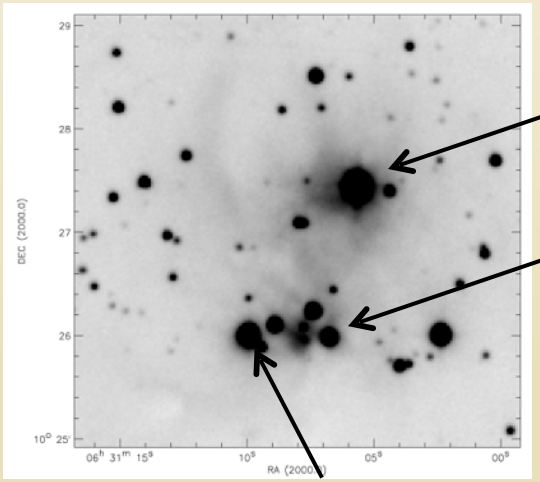
- **THE T TAU STELLAR POPULATION**
  S. E. Dahm and T. Simon, 2005, AJ, 129,829
- **CO survey**
  Oliver R.J., Masheder M.R.W. & Thaddeus P., 1996, A, 315, 578
- **Infrared**
  Gutermuth R.A., Megeath S.T., Myers P.C., Allen L.E., Pipher J.L. & Fazio G.G., 2009, ApJS, 184, 18
- **Submillimeter mapping**
  Sandell G., Weintraub D.A. & Hamidouche M. 2011, ApJ, 727, 26

Mon R1 association

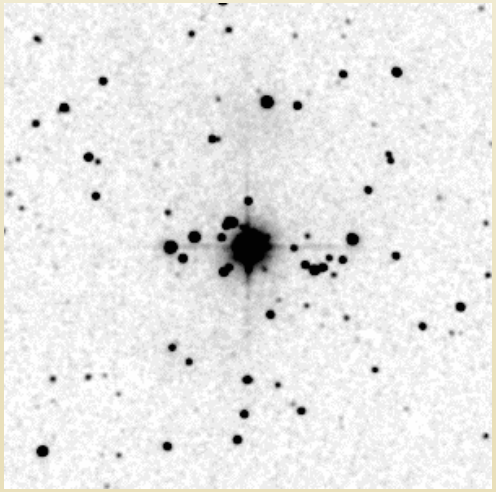


VY Mon group

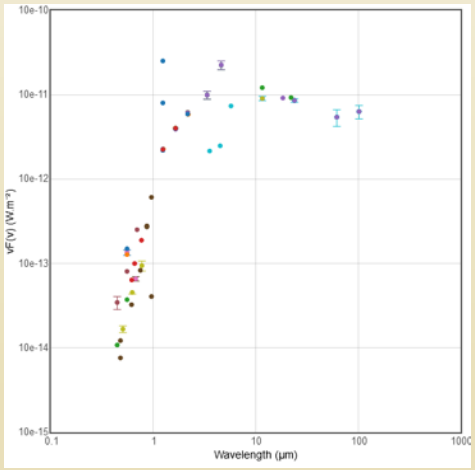
- Distance 800pc
- VY Mon - sp. B0, $L_{tot} = 870L_o$



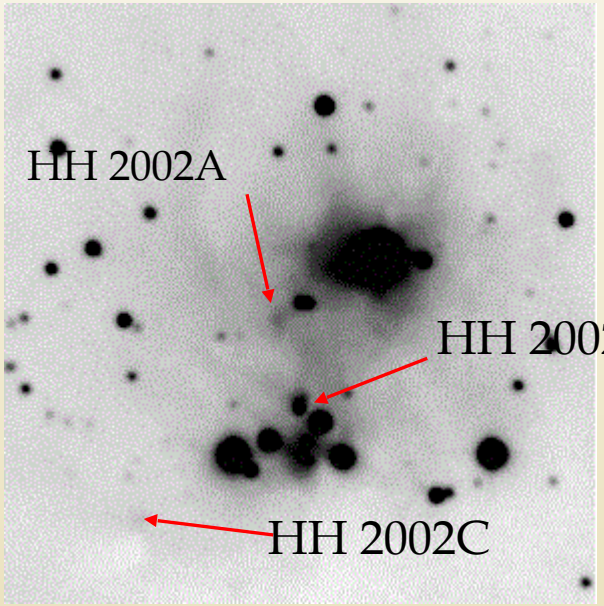
LkHα 274



2MASSK



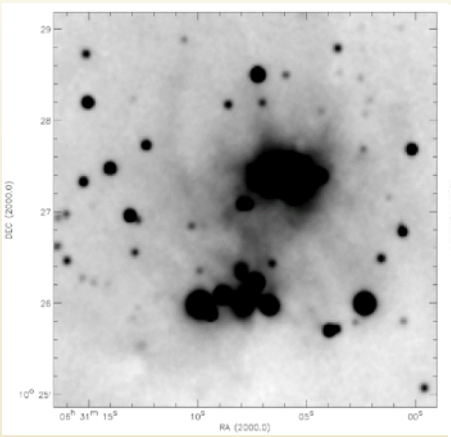
VY Mon group



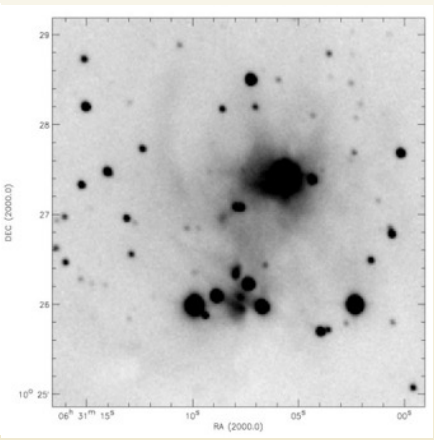
Blink of Hα + [SII] and continual images of VY Mon group.
Herbig-Haro objects marked by arrows.

VY Mon group

Hα

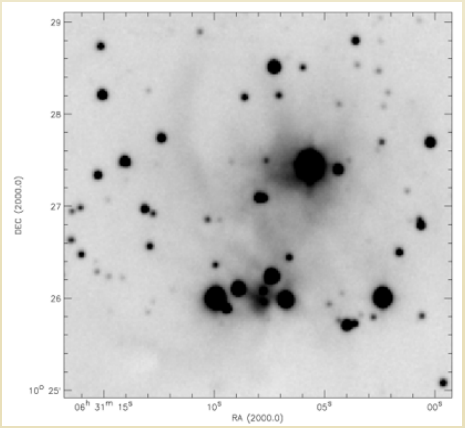


[SII]

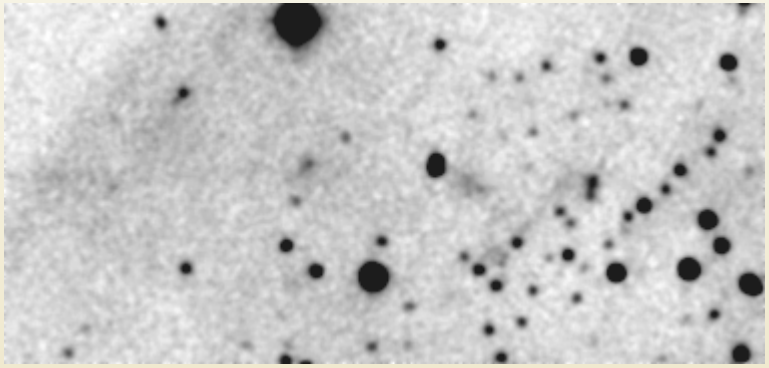


Narrow band images of the region around VY Mon (gray scale panels) and the composite color image of Hα (red), [SII] (green) and continuum (blue).

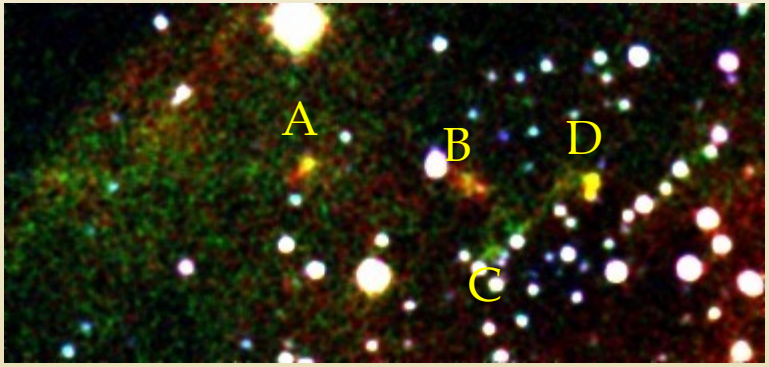
Cont. 7500A



HH 1198

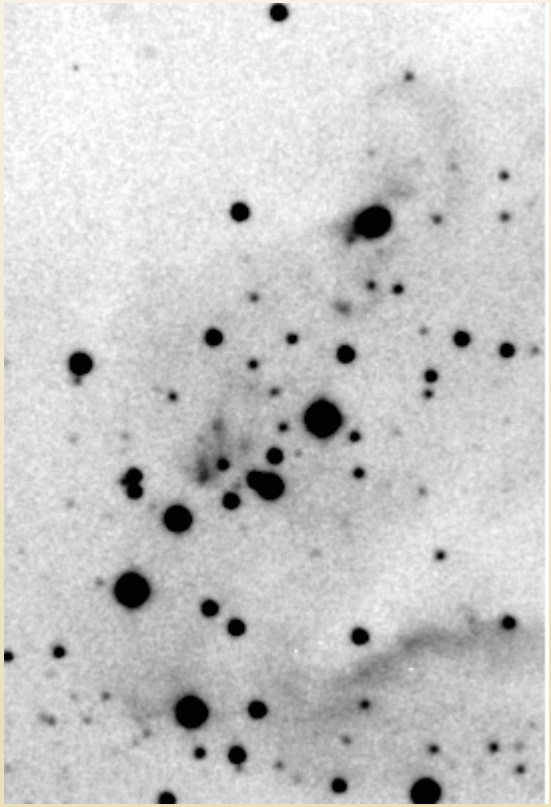


Blink of Hα + [SII] and continual images



Composite color image of Hα (red), [SII] (green) and continuum (blue).

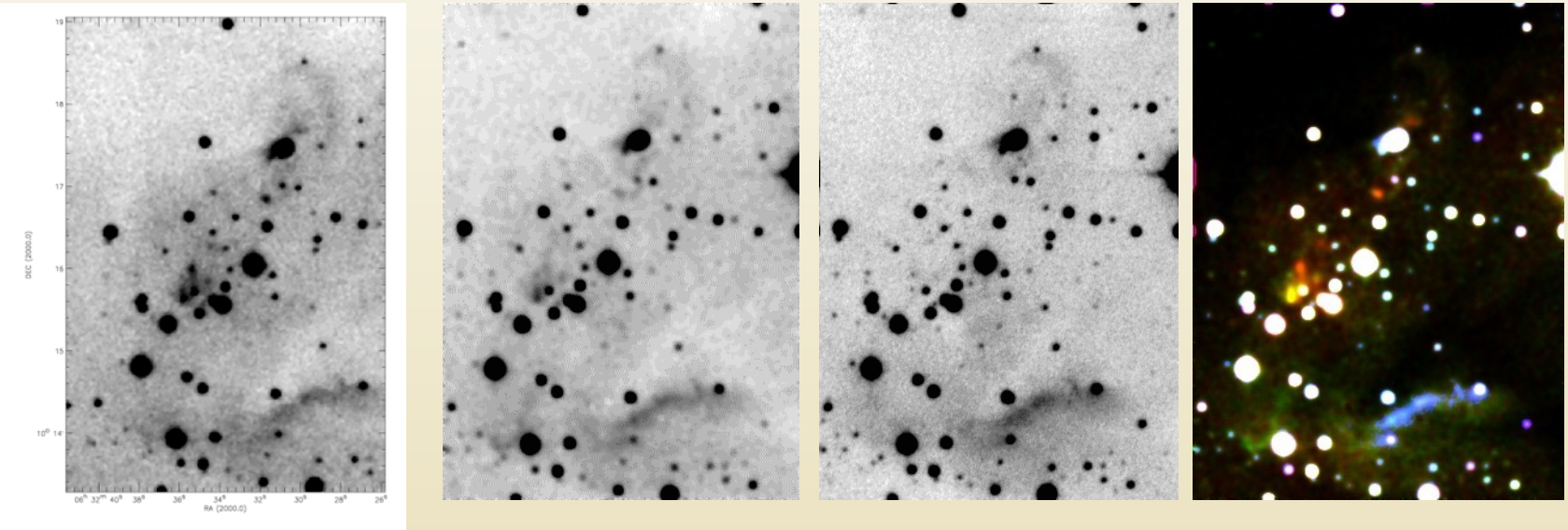
HH 1196 – outflow system



Blink of Hα + [SII] and cont. images of CN1 outflow system.
Total length of outflow – 1.1pc
Kinematic age more than 1000yr

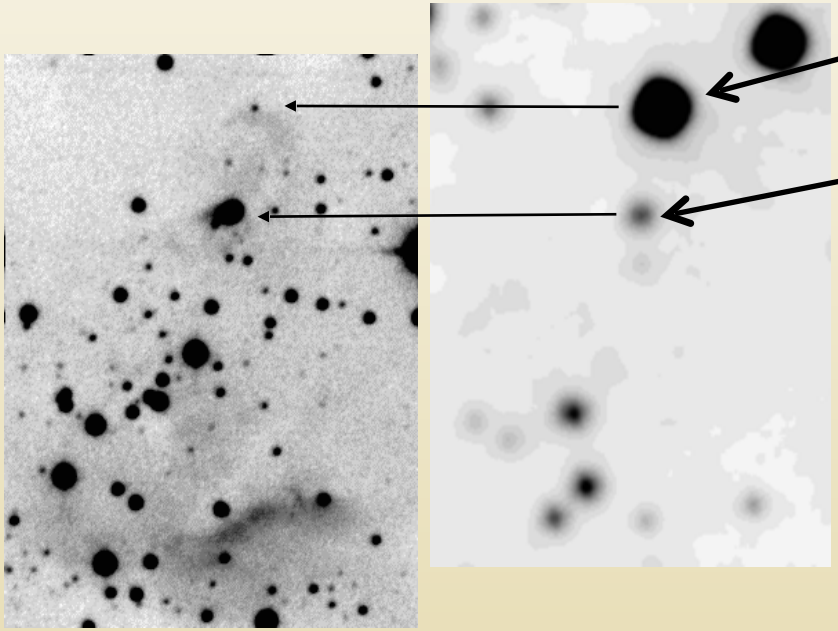
HH 1196 – outflow system

Hα [SII] Cont. 7500A



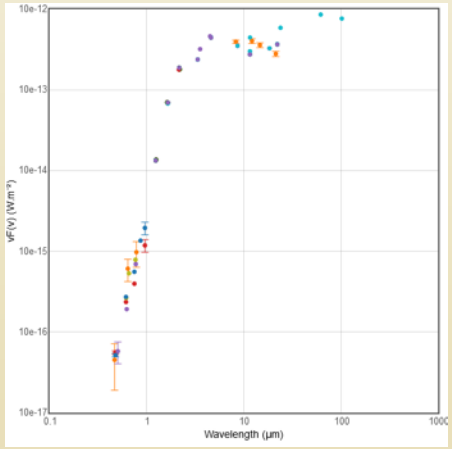
Narrow band images of HH 1196 outflow system (gray scale panels) and
The composite color image of Hα (red), [SII] (green) and continuum (blue).

Source of HH 1196 outflow

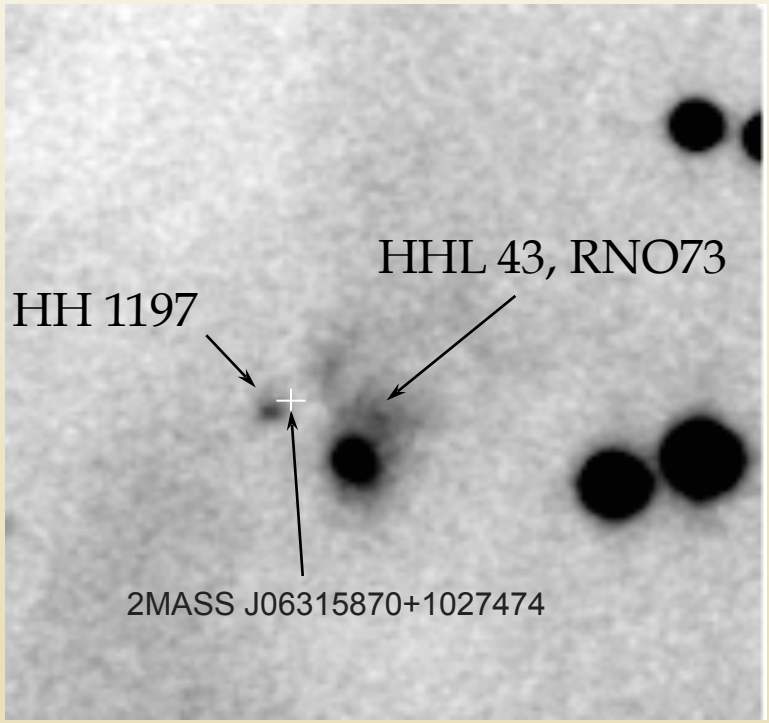


2MASS J06323082+1018396
IRAS 06297+1021(E)

2MASS J06323159+1017352

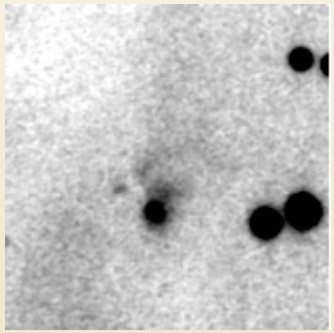


HH 1197

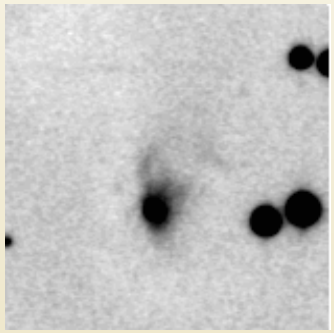


Blink of Hα + [SII] and cont. images

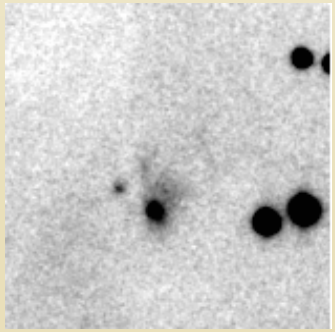
Hα



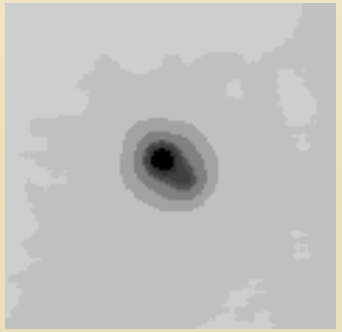
Cont.



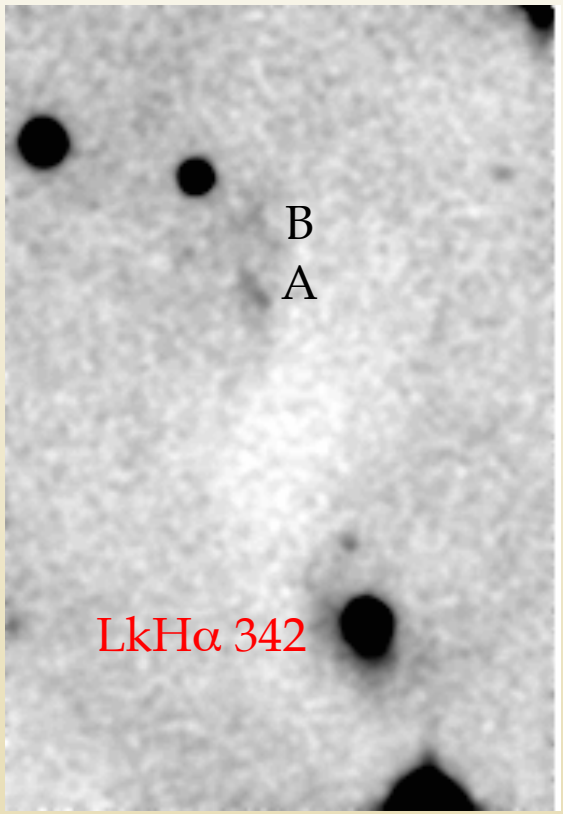
[SII]



WISE 22

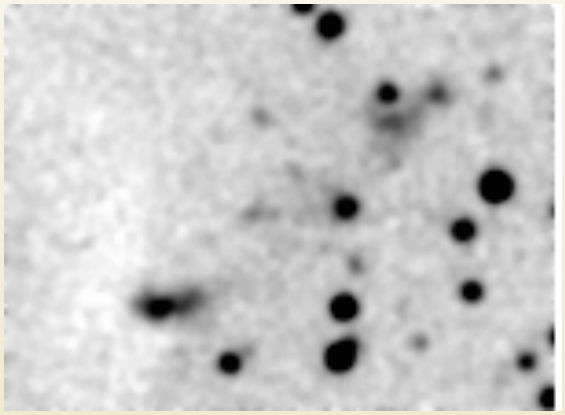


HH 2001

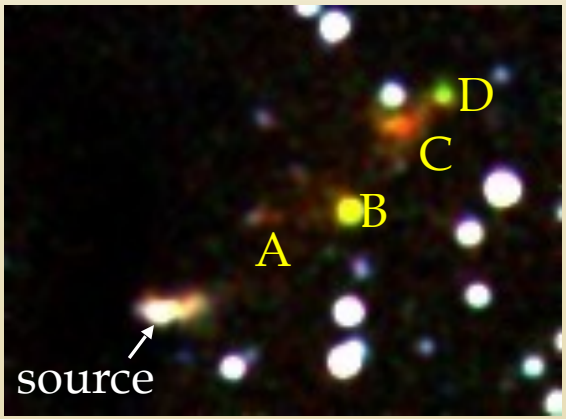


Blink of Hα + [SII] and cont. images of CN3

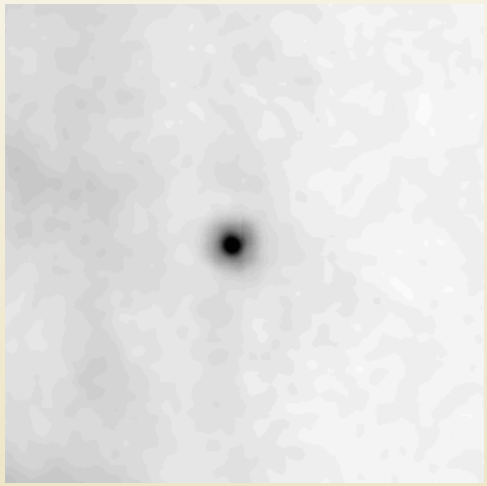
HH 2003



Blink of Hα + [SII] and cont. images



The composite color image of Hα (red), [SII] (green) and continuum (blue).



WISE 22 image of the source
2MASS J06302857+1014236
IRAS 06277+1016

Length of collimated flow is about 0.35pc

Заключение

- В ассоциации Mon R1 были найдены около 20-и новых объектов Хербига-Аро
- Три группы составляют направленные истечения из молодых звезд
- Направленное истечение HH 1196 представляет собой гигантский поток длиной около 1.3 пс
- Большое количество объектов Хербига-Аро в области Mon R1 свидетельствует об активном звездообразовании в этой ассоциации

Спасибо за внимание