Infrared Image Restoration

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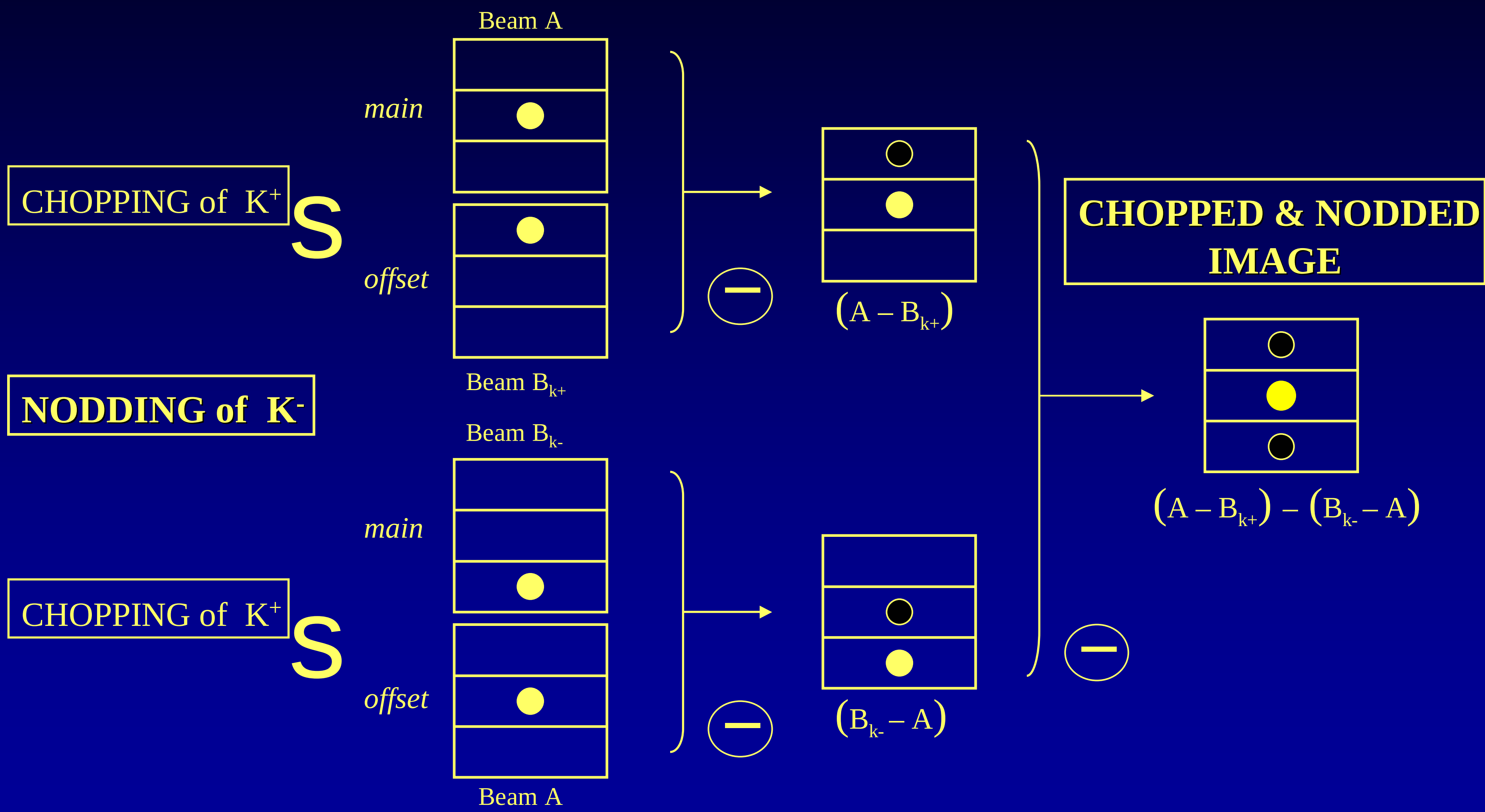
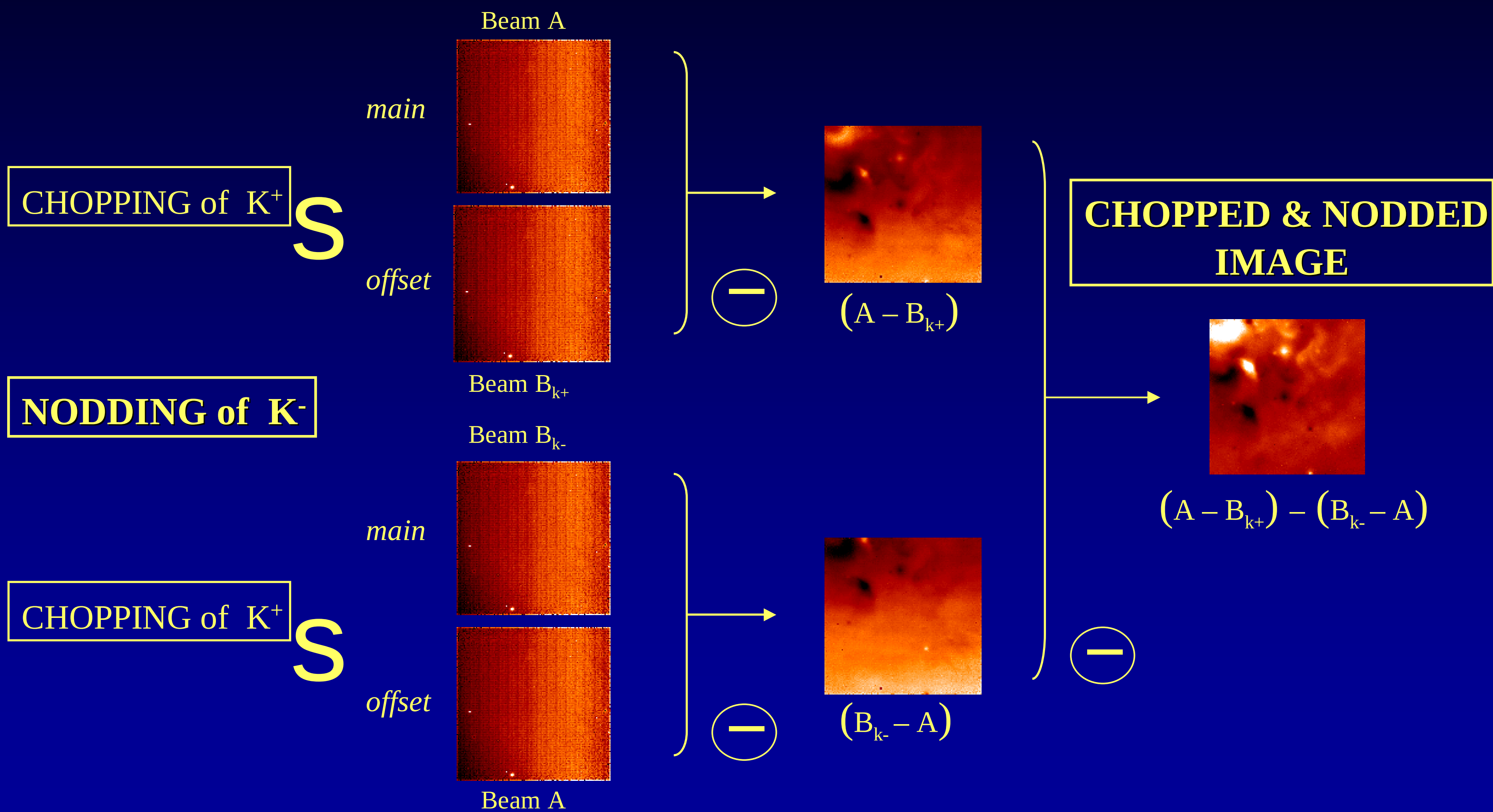
Outline

- Infrared vision technique: *chopping and nodding*
- Work description
  - Input data
  - Pre-processing
  - Mosaicing
  - Results
- Conclusions
- Future work

Chopped and nodded imaging

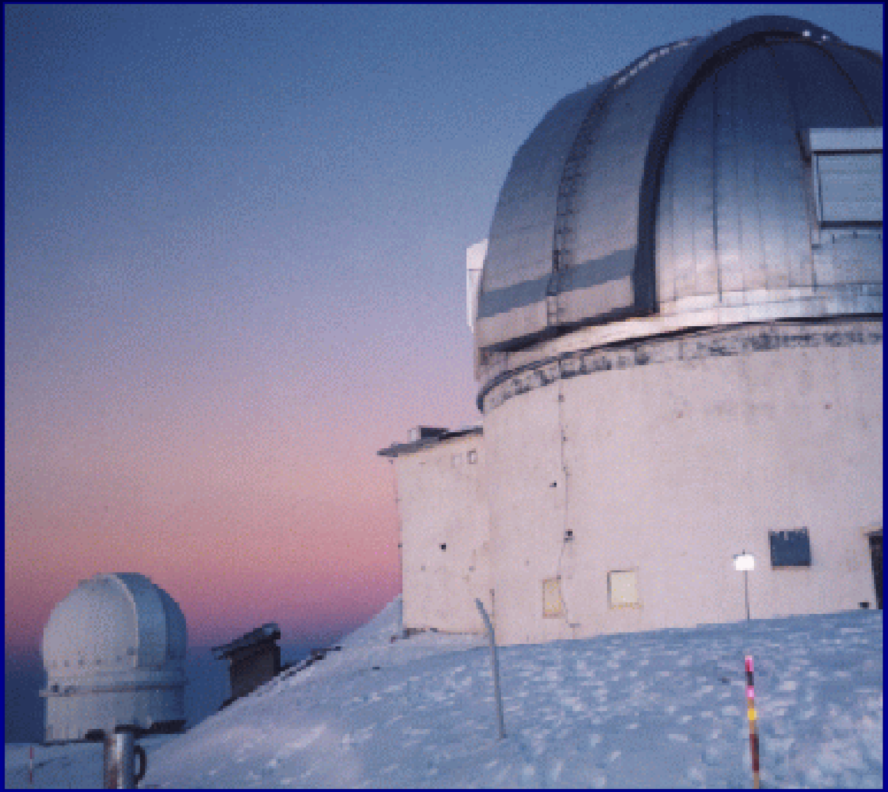


Chopped and nodded imaging II

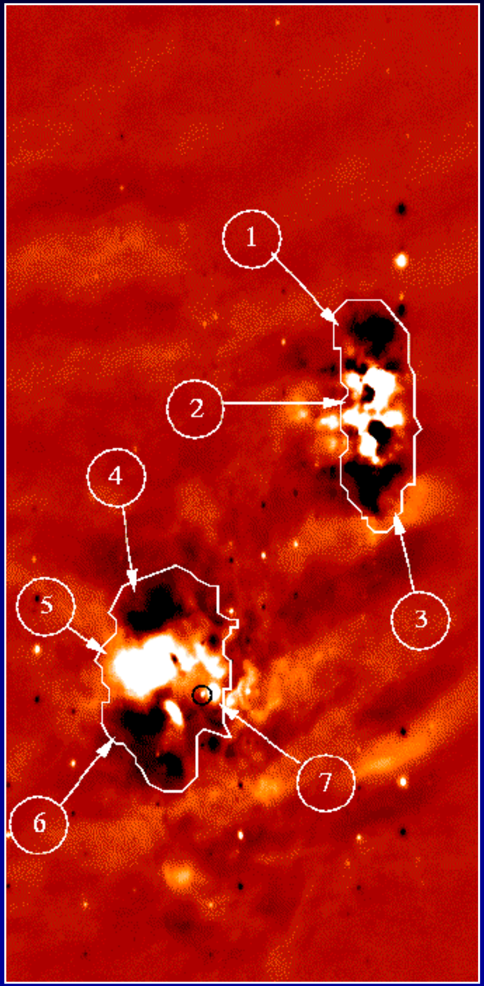


Input data

- The Orion nebula
- The observations
- Data features
- The environment



The Orion nebula



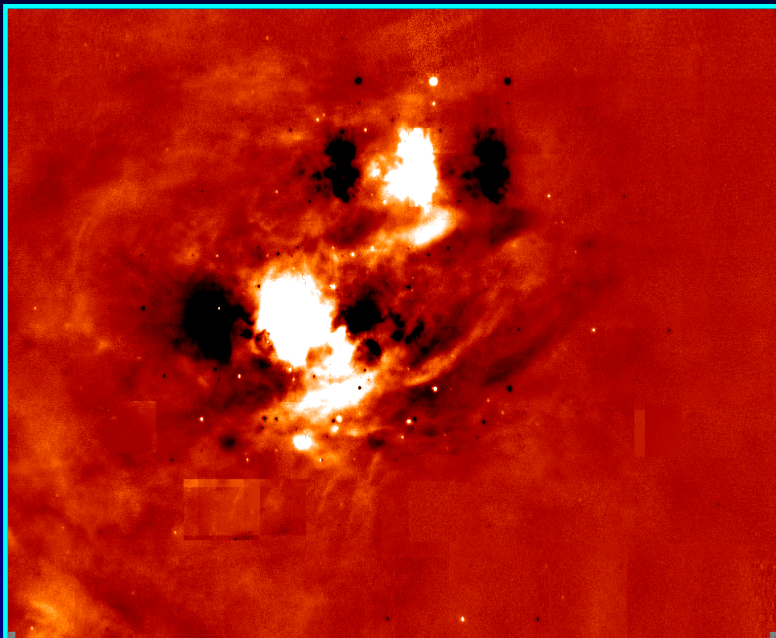
Our data parameters:

wavelenght: 10μm and 20μm

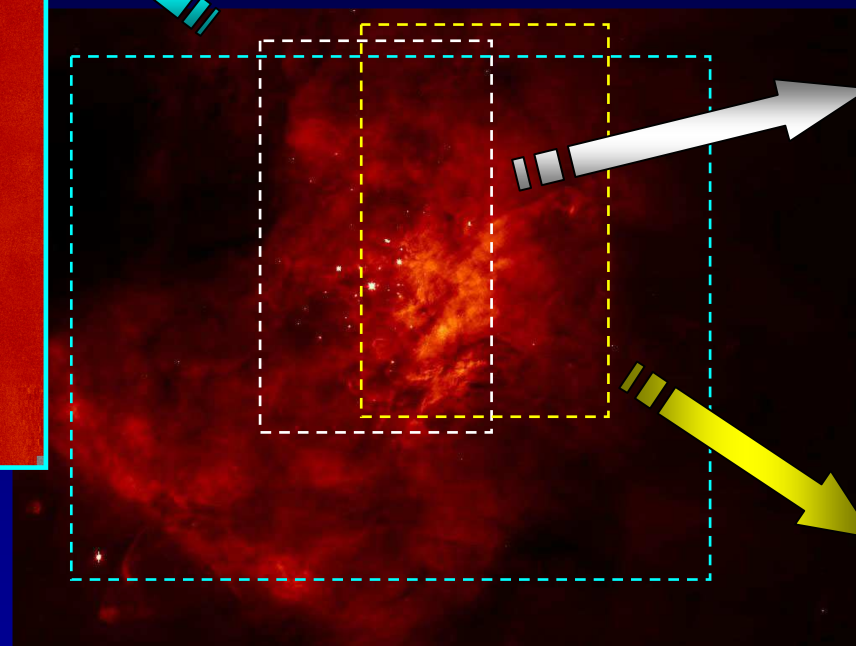
27th and 28th of November 1998 images
18th and 19th of December 2000 images

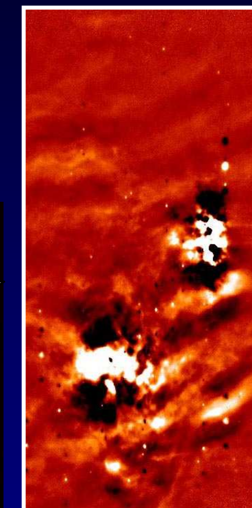
(1)-(2)-(3): Becklin-Neugebauer
(4)-(5)-(6): Trapezium
(7): θ1C

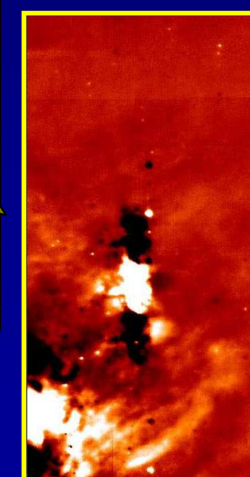
Our observations at 10μm



The Hubble Image





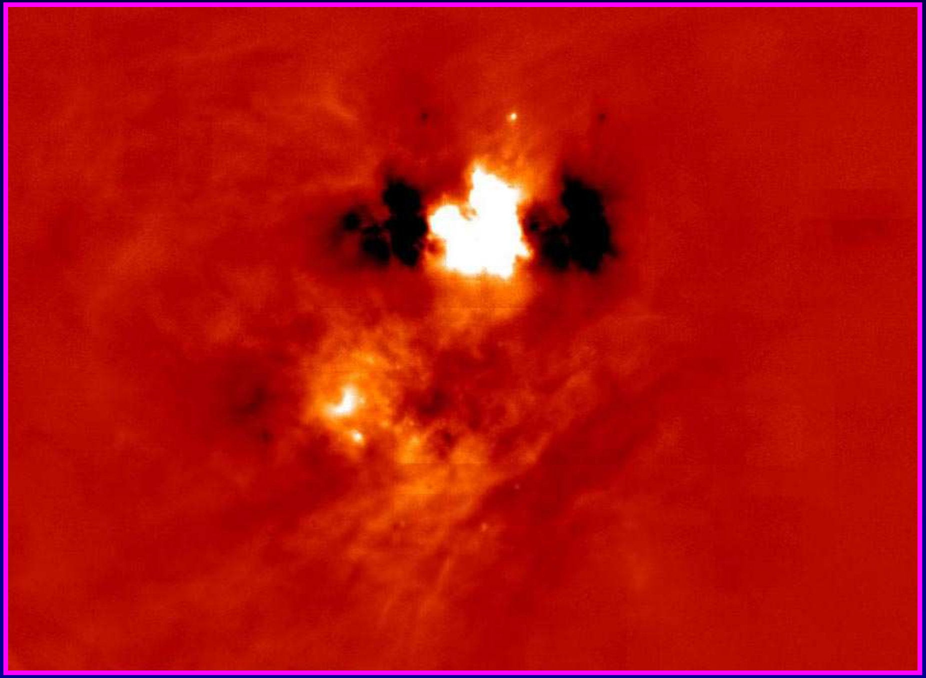


UKIRT December 2000

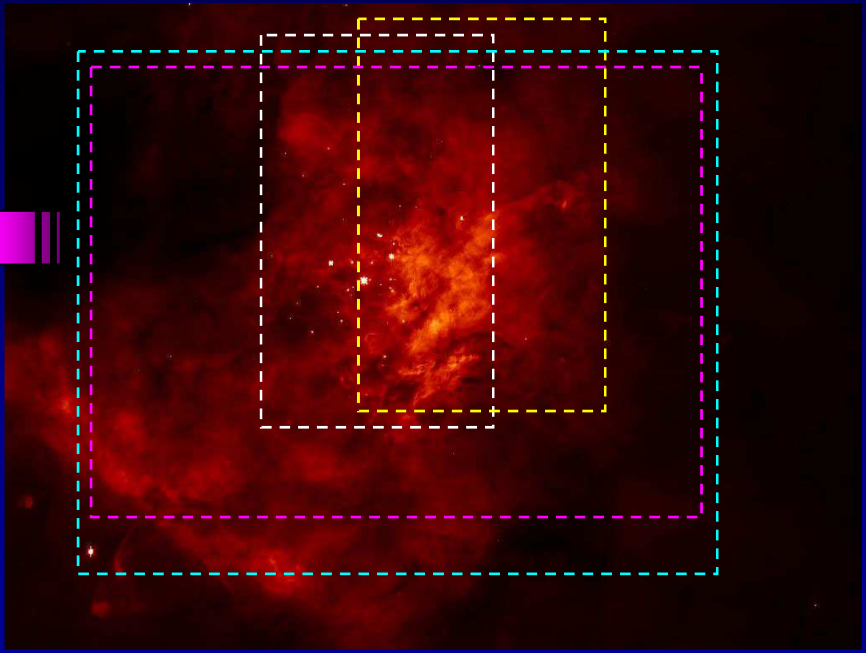
UKIRT November 1998

Our observations at 20μm

UKIRT December 2000



The Hubble Image



Pre-processing

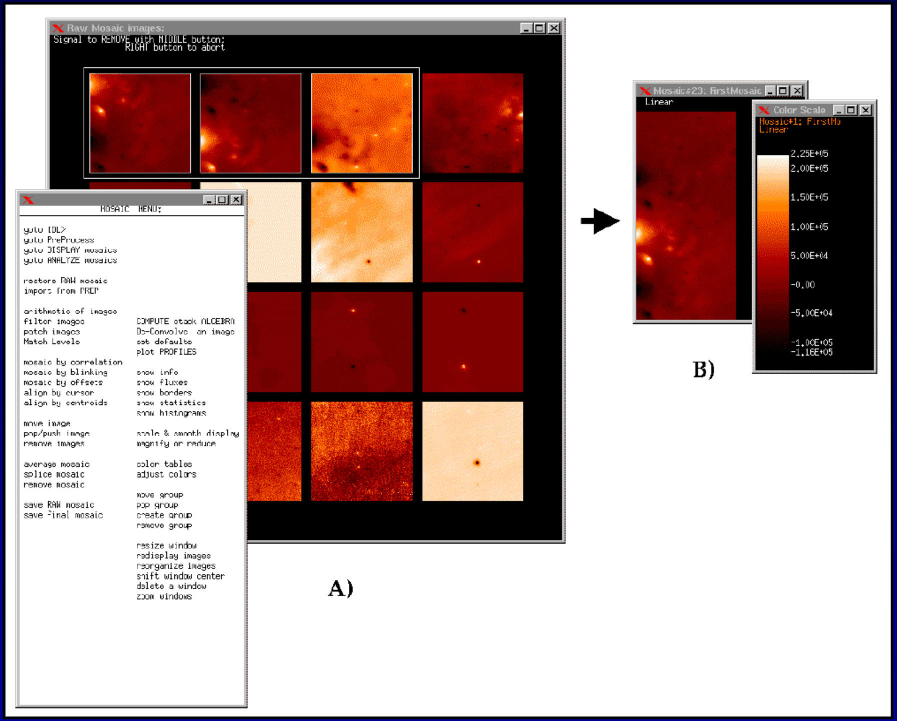
Microsoft Excel - inf10mic_comm.xls

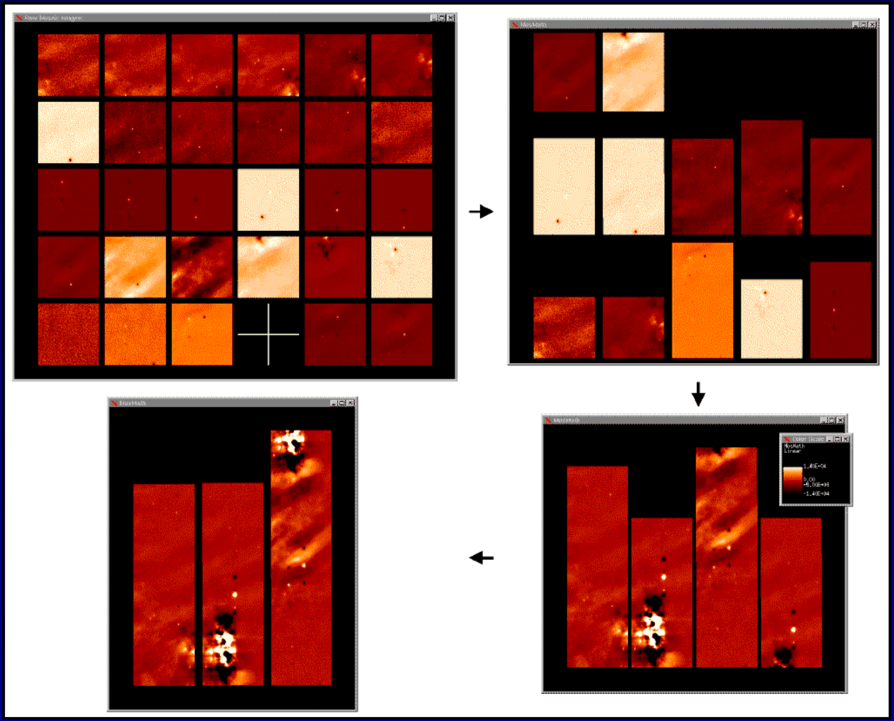
	NAME	POS	RA	DEC	OFSTx pxl	OFSTy pxl	OFSTx arc	OFSTy arc	dx	dy
2	ab1514	main	5:35:21.8	-5:22:11.3	180.36578	479.38156	48.698764	124.6392	0	0
3	ab1516	main	5:35:23.4	-5:22:11.1	87.395783	480.14309	23.596862	124.8372	0	0
4	ab1518	main	5:35:21.8	-5:22:11.3	180.36578	479.38156	48.698764	124.6392	0	0
5	ab1520	main	5:35:23.4	-5:22:11.1	87.395783	480.14309	23.596862	124.8372	0	0
6	ab1522	main	5:35:25.1	-5:22:10.9	-5.3751392	480.90463	-1.4512877	125.0352	0	0
7	ab1524	main	5:35:25.1	-5:21:45.9	-5.3751392	577.06618	-1.4512877	150.0372	0	0
8	;ab1526	main	5:35:23.4	-5:21:46.1	87.395783	576.30464	23.596862	149.8392	0	0
9	ab1528	main	5:35:21.8	-5:21:46.3	180.36578	575.5431	48.698764	149.6412	0	0
10	;ab1530	main	5:35:20.1	-5:21:46.5	273.33578	574.78156	73.800665	149.4432	0	0
11	;ab1532	main	5:35:18.4	-5:21:46.7	366.30579	574.02002	98.902566	149.2452	0	0
12	ab1534	main	5:35:16.7	-5:21:46.9	459.27579	573.25848	124.00447	149.0472	0	0
13	ab1536	main	5:35:15.0	-5:21:47.1	552.24579	572.49694	149.10637	148.8492	0	0
14	ab1538	main	5:35:13.3	-5:21:47.3	645.21579	571.74925	174.20827	148.6548	0	0
15	ab1540	main	5:35:11.5	-5:21:47.5	745.55172	570.98771	201.29897	148.4568	0	0
16	ab1542	main	5:35:09.9	-5:21:47.7	838.32264	570.22617	226.34712	148.2588	0	0
17	ab1544	main	5:35:13.2	-5:21:47.3	652.58172	571.74925	176.19707	148.6548	0	0
18	ab1546	main	5:35:14.9	-5:21:47.1	559.61172	572.51079	151.09517	148.8528	0	0

inf10mic_comm

Mosaicing

Mosaic by offset: the old technique





Raw Mosaic data structure

Math Mosaic data structure

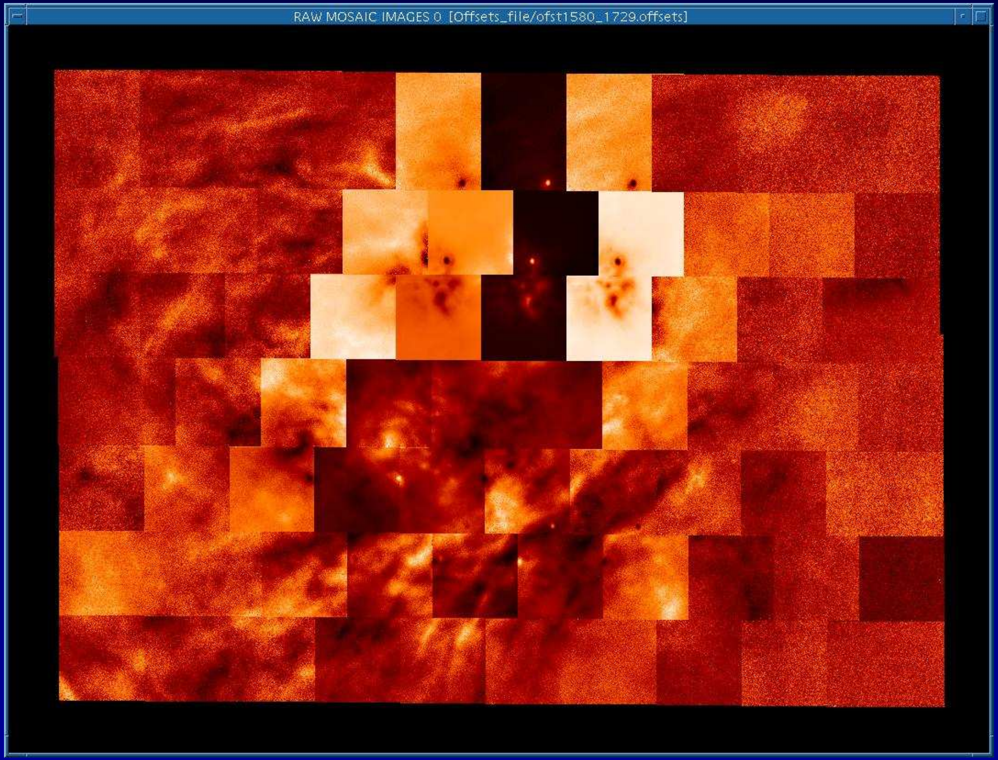
Mosaicing II

Mosaic by offset: the new automatic technique

Data set

(set of fits files 128x128 px)

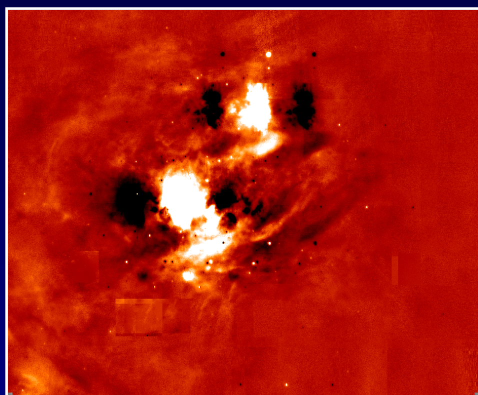
→ *MkOfst_by_info.pro*



Restoration

The Landweber loop and the median filter

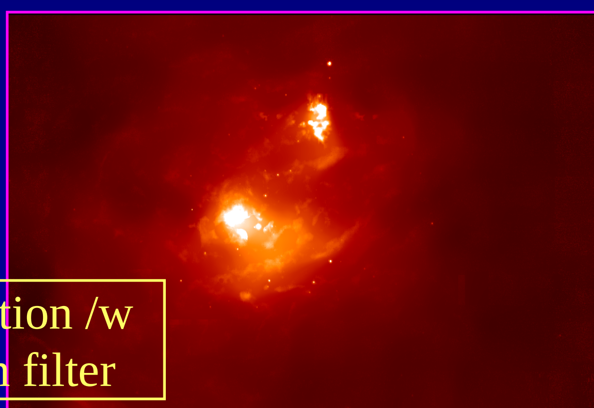
The Original Image



1)

2b)

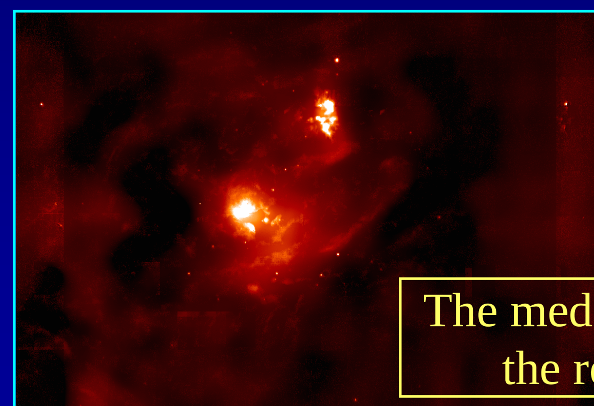
The original restoration



2a)

The restoration /w the median filter

3)

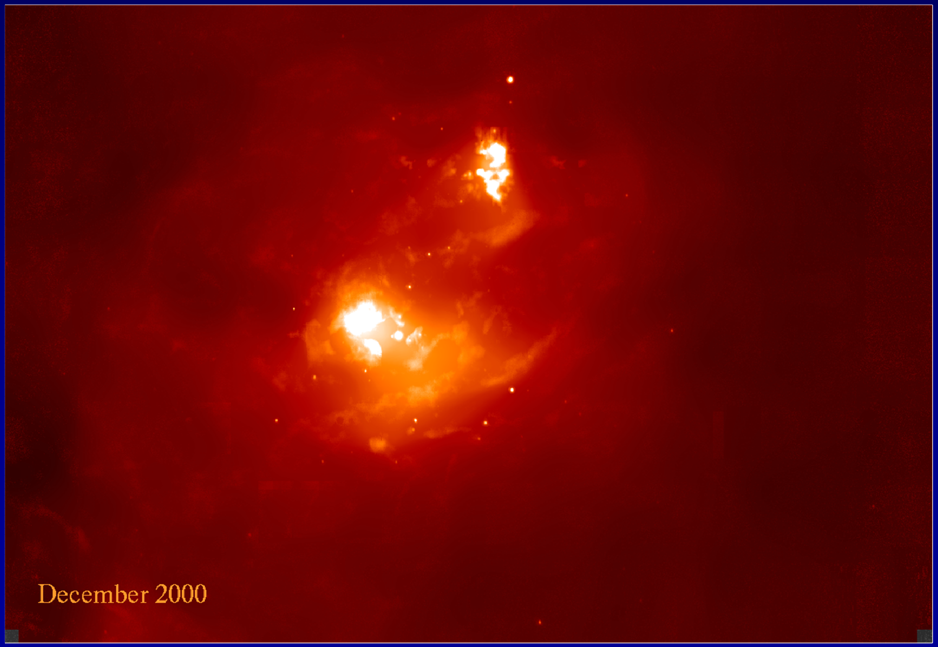


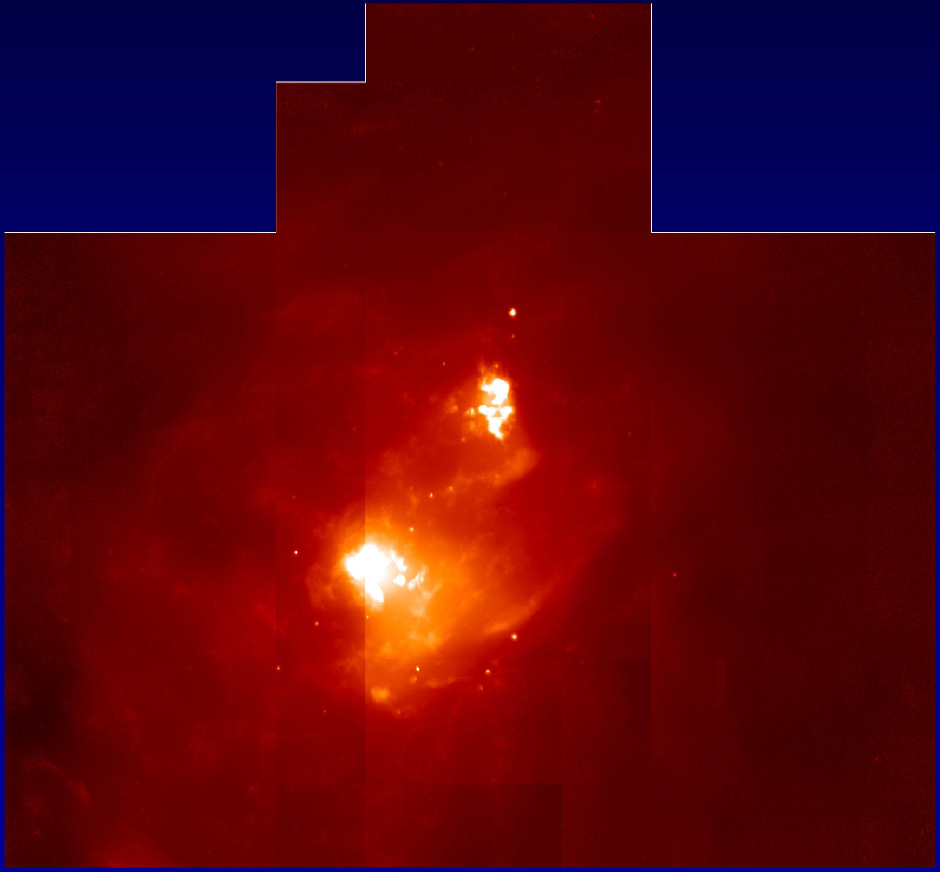
The median filter after the restoration

Restoration II

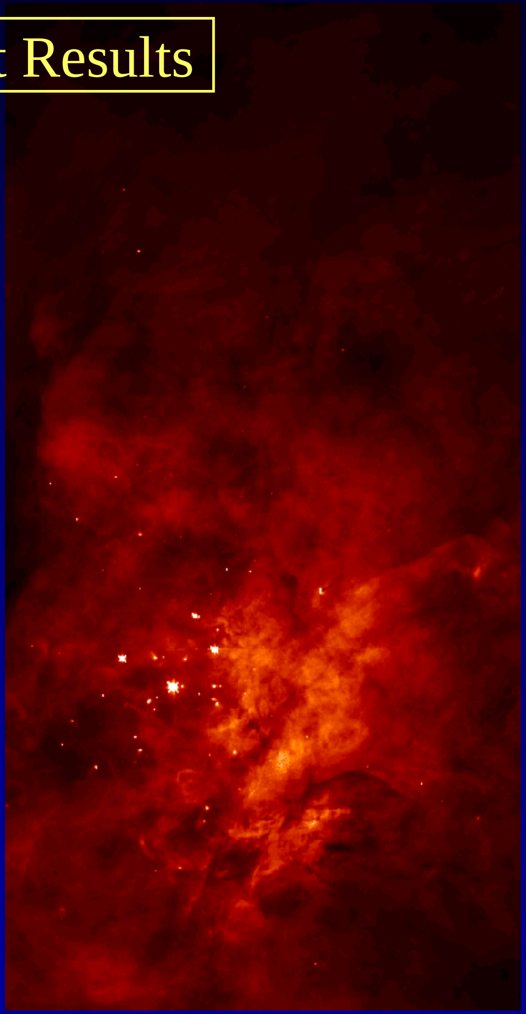
The three layers → Their composition

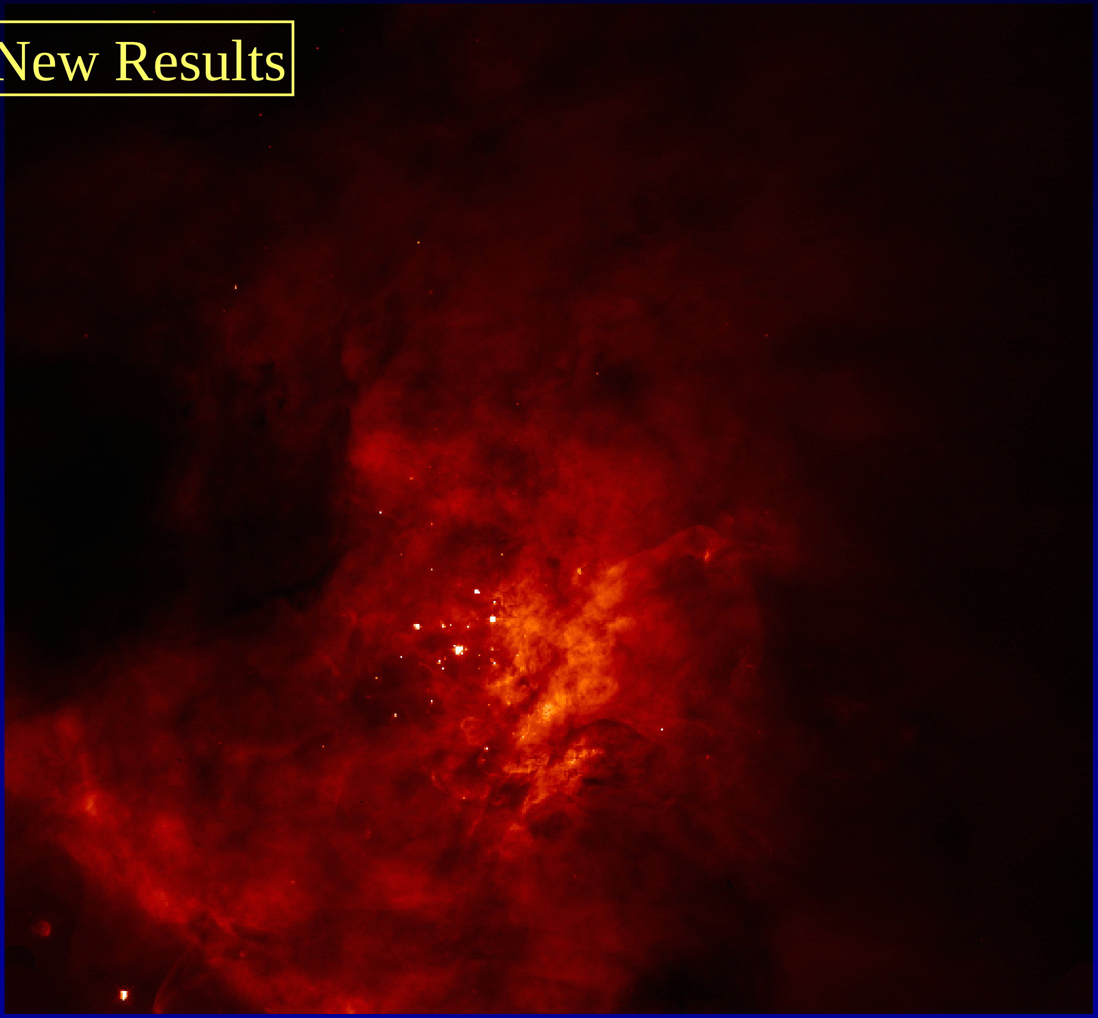
MkBest.pro





Our results

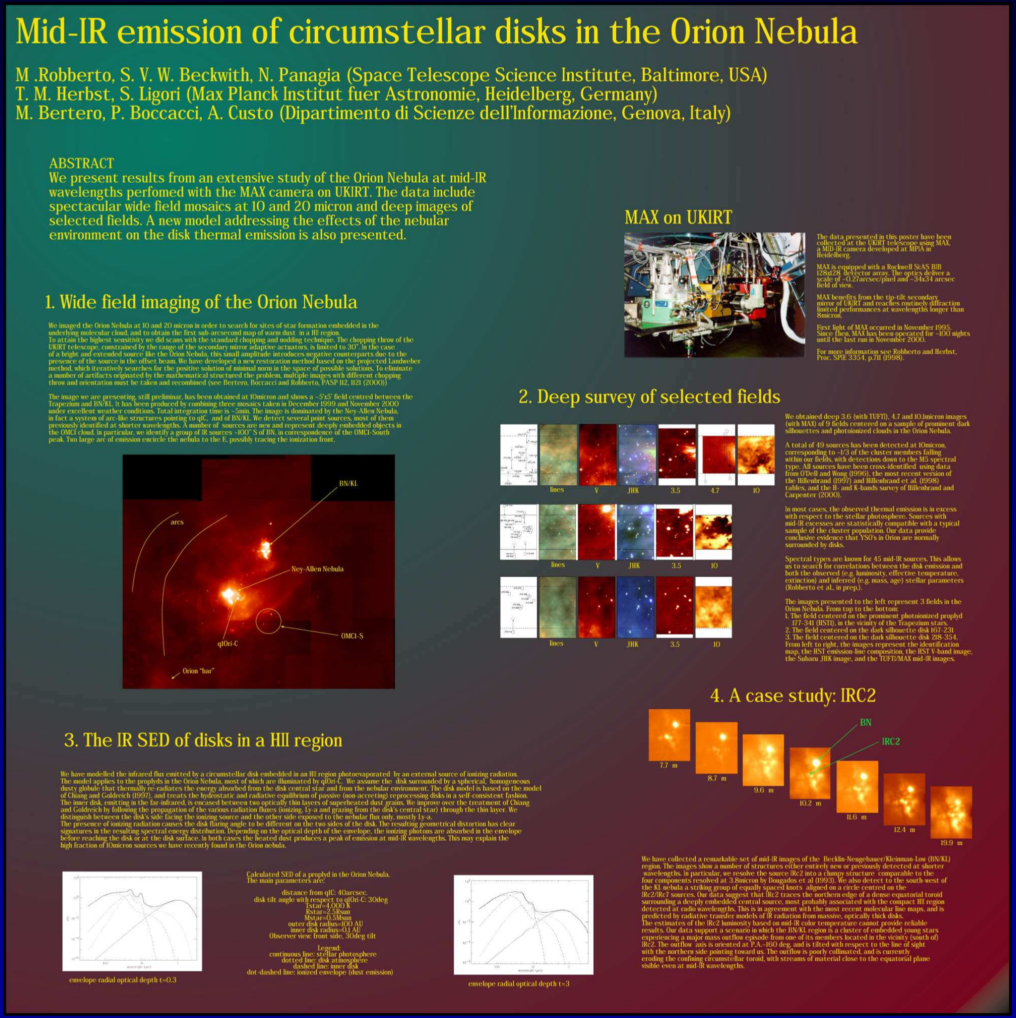




Conclusions

- Main astronomical goals achieved
- What we learned:
  - Basic rules for future observations (alignment)
  - Parameters of interest (K, IT, Right Ascension, Declination)
  - Critical aspects (different K)
- Problems to be solved:
  - Better filter technique
  - More accuracy in the combination methods
  - Portability of the new procedures
  - More automation

The Munich conference



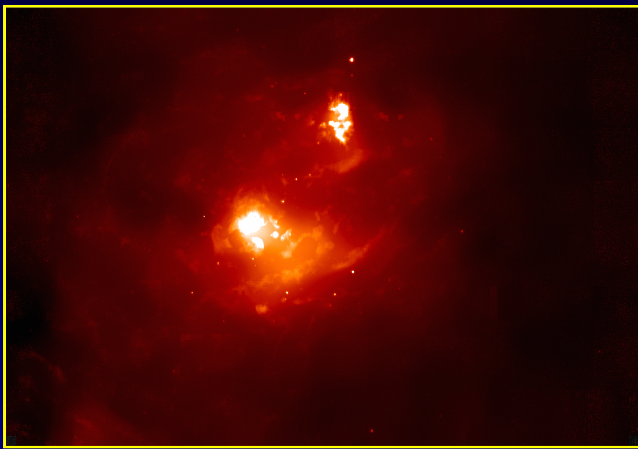
At the Munich conference (April 2001) we presented the restored image of the Orion nebula supporting the STScI group's thesis about the circumstellar disks

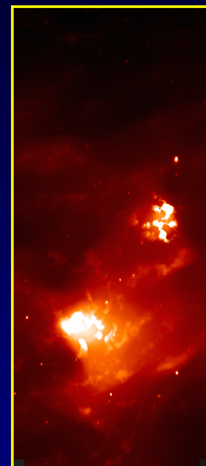
Future work: the simulator

- Goals
  - Automation
  - Pattern creation
  - New technique testing
- Description
- Features
- Advantages
  - Useful tool for astronomer
  - User-friendly interface
  - Easy testing

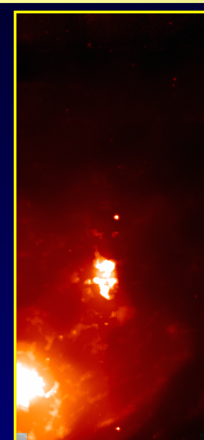
Appendix A: MkBest

Chop Distance K 93 px





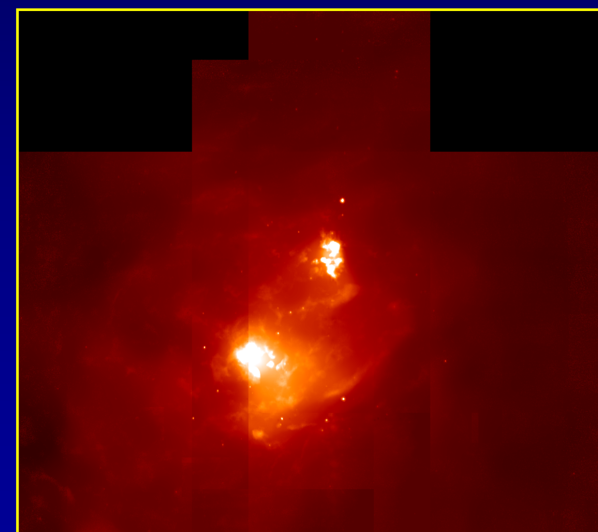
K 36 px



K 70 px

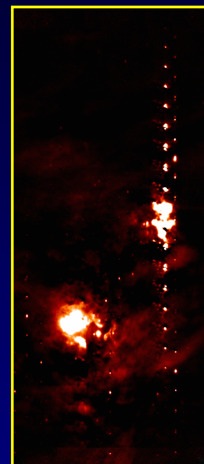
Create the masks in order to compute the right weights

The result image of the merge algorithm



Appendix A: MkBest II

Mask with ghosts each 93 px

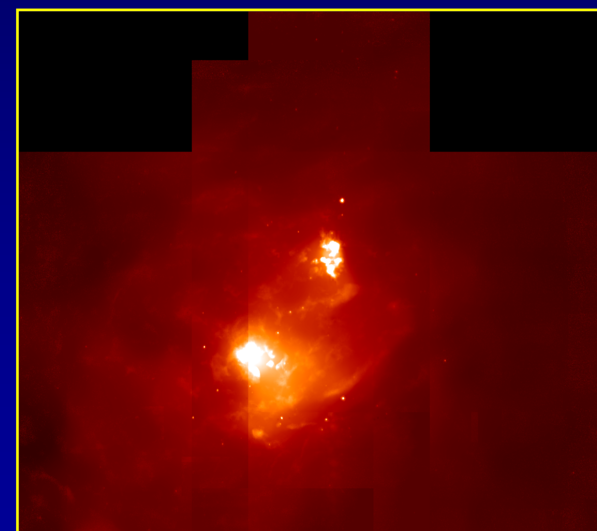


Mask (36 px)

Mask (70 px)

Merge with the right weights

The result image of the merge algorithm

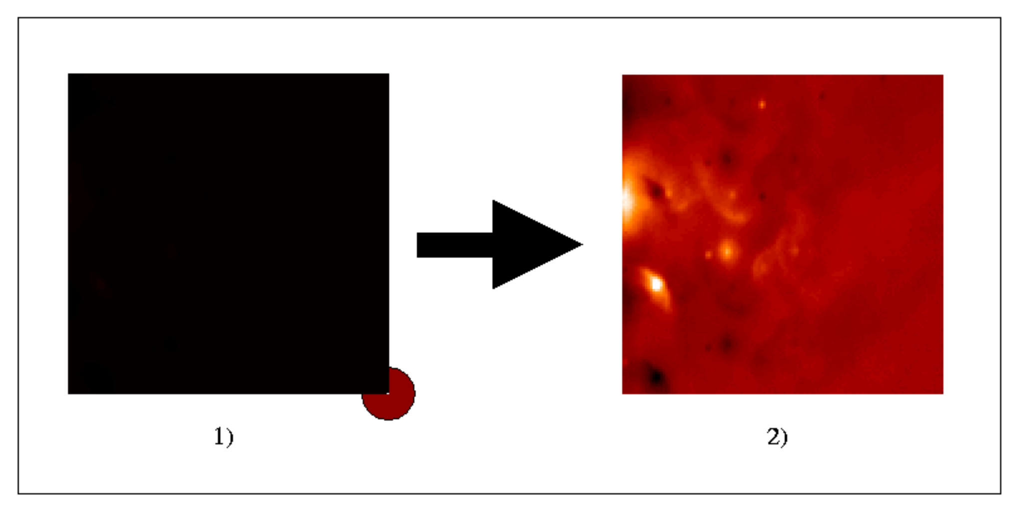


Appendix B: cleaning

- Image cleaning
  - cosmic ray (1)
  - bad columns and rows (2)
  - bad deep columns and rows (3)
  - bad channels (4)

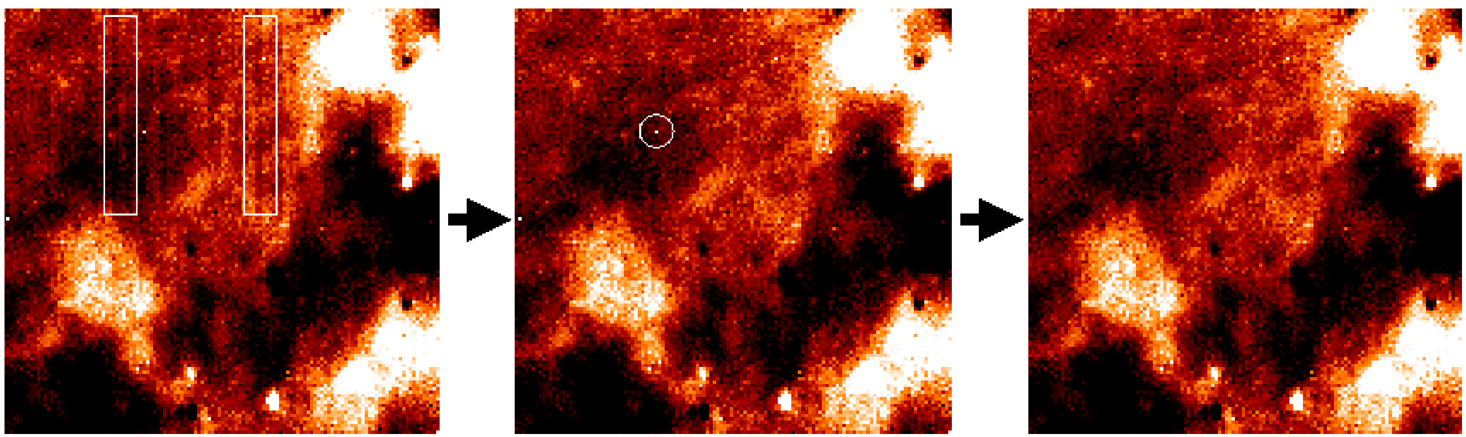
Appendix B: cleaning II

- Cosmic ray (1)



Appendix B: cleaning III

- Bad columns and rows (2)



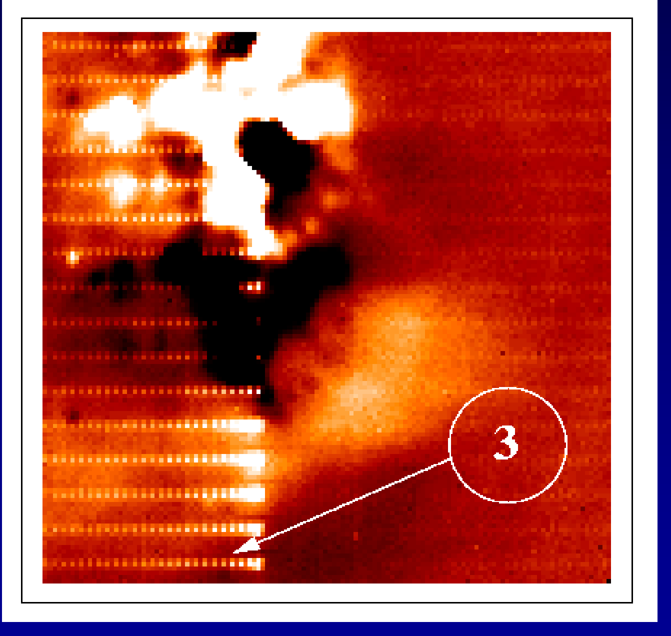
1) 2) 3)

In questo gruppo di immagini vediamo tre fasi della pulizia di un frame:

- nei rettangoli di fig.1: bad column
- nel cerchio di fig.2: bad pixel.

Appendix B: cleaning

- Bad columns and rows (3)



Appendix B: cleaning V

- Bad channels (4)