

MESS - Mass loss of Evolved StarS

Initial Results

Martin Groenewegen
marting@oma.be

on behalf of the MESS consortium

MESS

This GT KP aims at studying the circumstellar matter in evolved objects

- **AGB, Post-AGB, PNe, RSG, WR, LBV, SN**
 - Photometric mapping of nearby objects
 - Spectroscopy of nearby objects
 - SPIRE and PACS
- Mass-loss dominates the evolution
How? How much? Time evolution? Spherical?
Production of dust

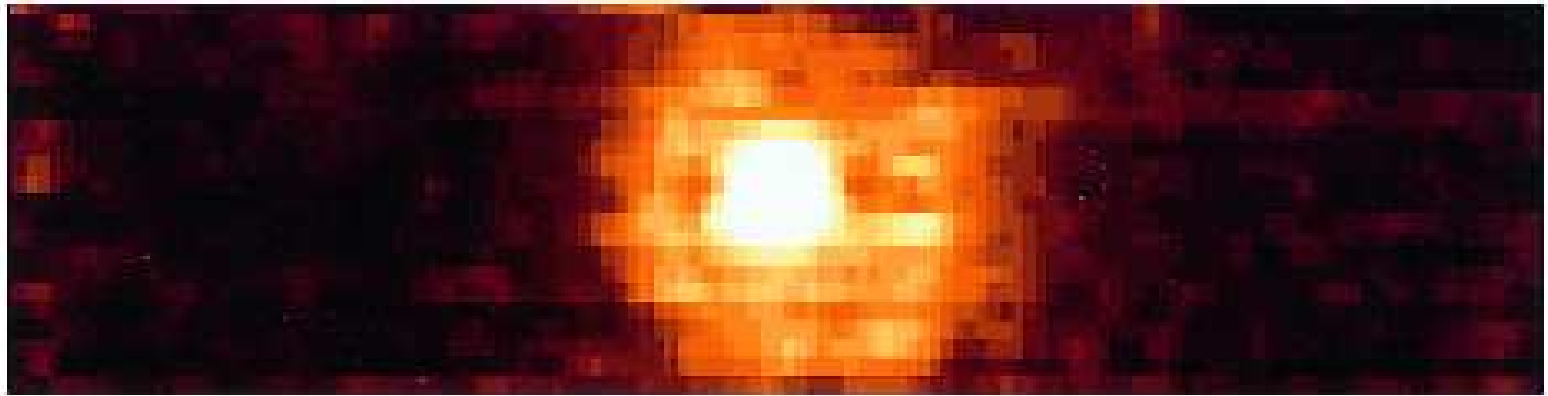


Fig. 1. 90 μm image of Y CVn taken with PHT-C100 array detector and C90 filter displayed in linear brightness scale.

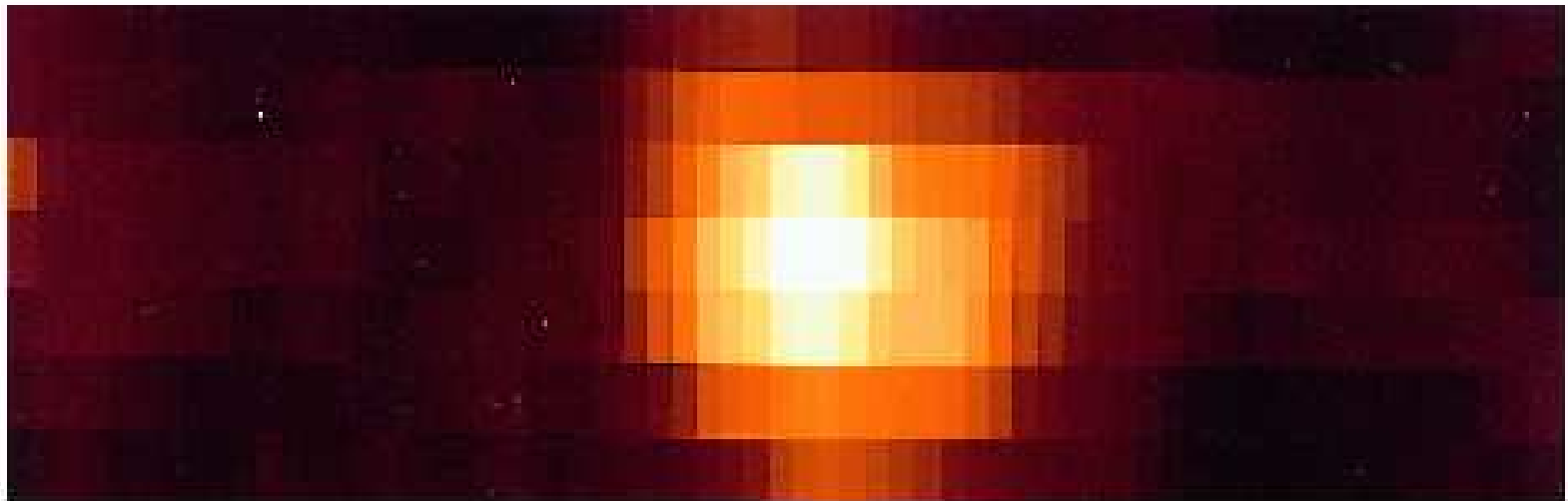


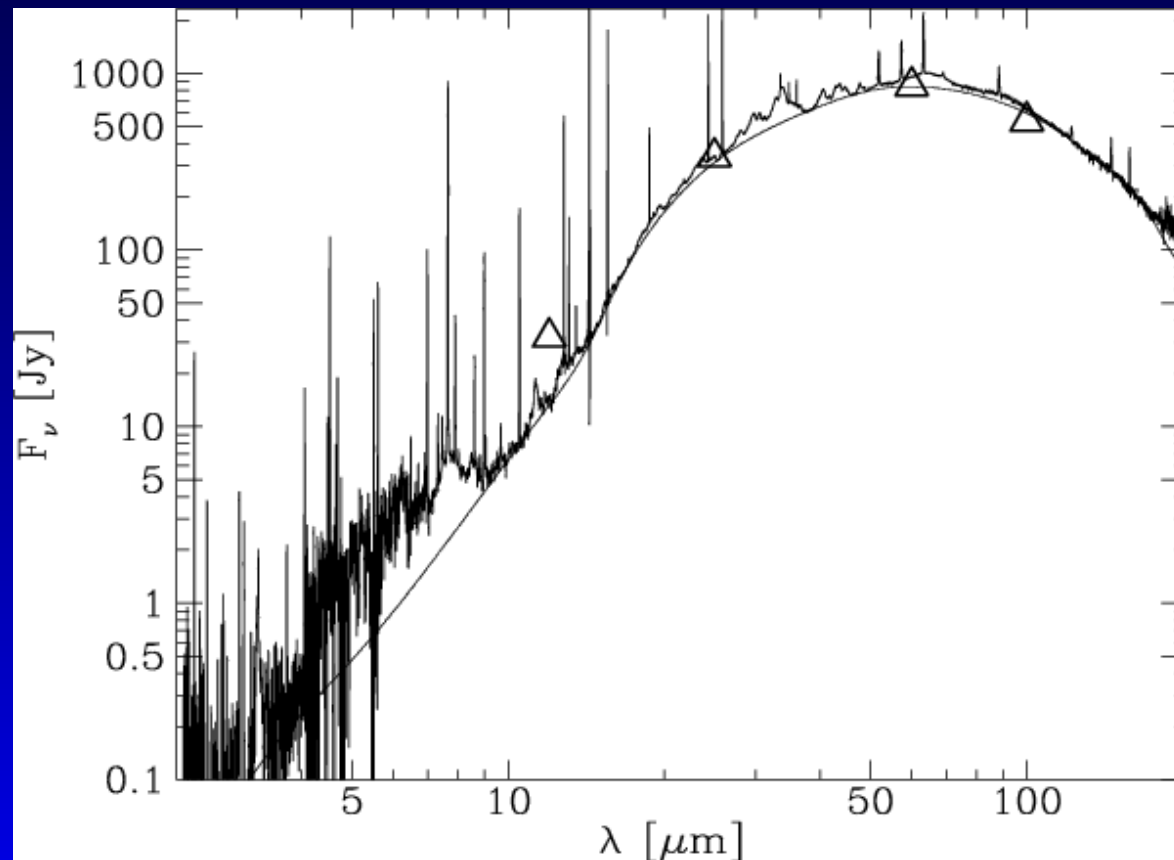
Fig. 2. 160 μm image of Y CVn taken with PHT-C200 array detector and C160 filter displayed in linear brightness scale.

Y CVn

Izumiura et al. (1996), $8' \times 35'$ ISOPHOT map

Spectroscopy of nearby objects

Goal: Study of
dust properties, molecular lines, emission lines



NGC 6302; Molster et al., SWS + LWS spectrum

Partners involved

Partner	“origin”	hours	special interest
Belgium	PACS GT	145	KUL (AGB, post-AGB, PN, WR, LBV) ROB (AGB, PN) ULB (binary AGB) IAGL (WR, LBV)
Vienna	PACS GT	47	AGB
Heidelberg	PACS GT	10	SN remnants
SAG 6	SPIRE GT	80	SN, AGB, post-AGB, PN
HSC	HSC	26	special type of post-AGB
MS	MS	5	Molecules in specific stars
		—	
		313	

Implementation (Photo)

PACS:

“Scan Maps” at 70 + 160 μm

78 AGB/RSG, 16 post-AGB/PN, 8 WR/LBV, 5 SN

OBSERVED: 56

SPIRE:

“Large maps” at 250, 350, 500 μm

26 AGB/RSG, 8 post-AGB/PN, 5 SN

ALL but 4 OBSERVED

Implementation (Spectro)

PACS:

Concatenation of two AORs to cover entire
60-210 μm region

Spatial information: 5×5 pixels = $47'' \times 47''$

27 AGB/RSG, 26 post-AGB/PN, 2 WR/LBV, 4 SN

OBSERVED: 3 PV/SDP

SPIRE:

Full FTS scans

9 AGB/RSG, 10 post-AGB/PN, 2 WR/LBV, 1 SN

ALL but 3 OBSERVED

MESS - Spectroscopy

See:

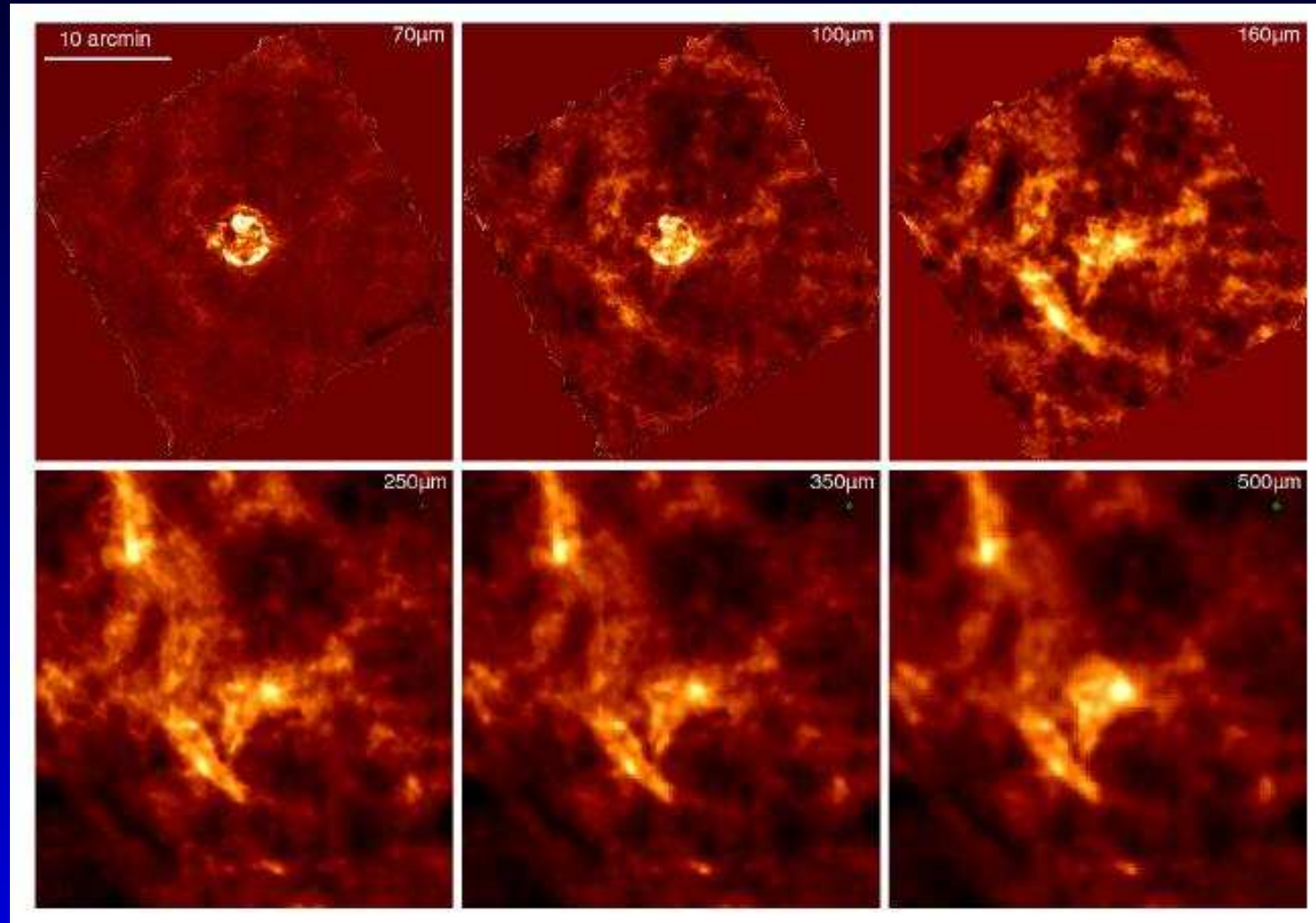
Plenary session 6, Friday: Decin et al.

P1.34: Cernicharo et al.
Hydrides in IRC+10216

P2.30: Royer et al. + P2.32: Matsuura et al.
PACS and SPIRE Spectroscopy of the RSG VY CMa

P2.35: Wesson et al.
SPIRE FTS Spectra of Carbon-Rich Evolved Objects

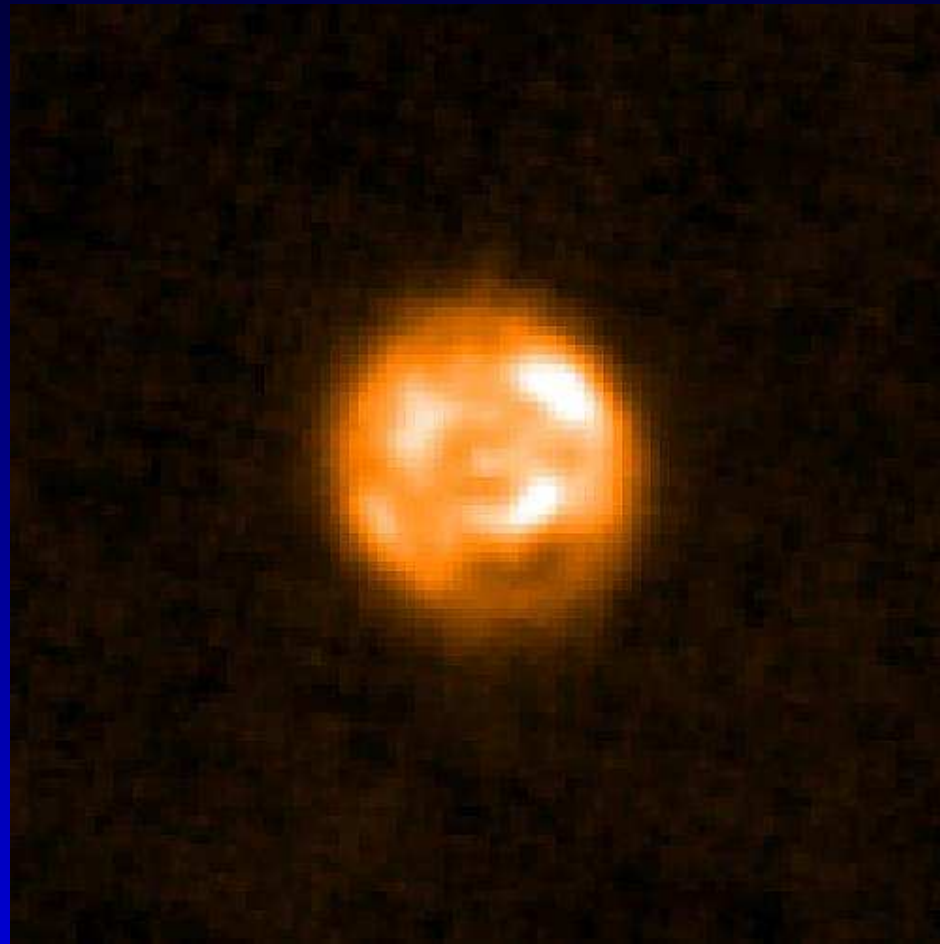
SN remnant: Cas A



Barlow et al. (2010)

Presentation by Krause et al. yesterday

Massive stars

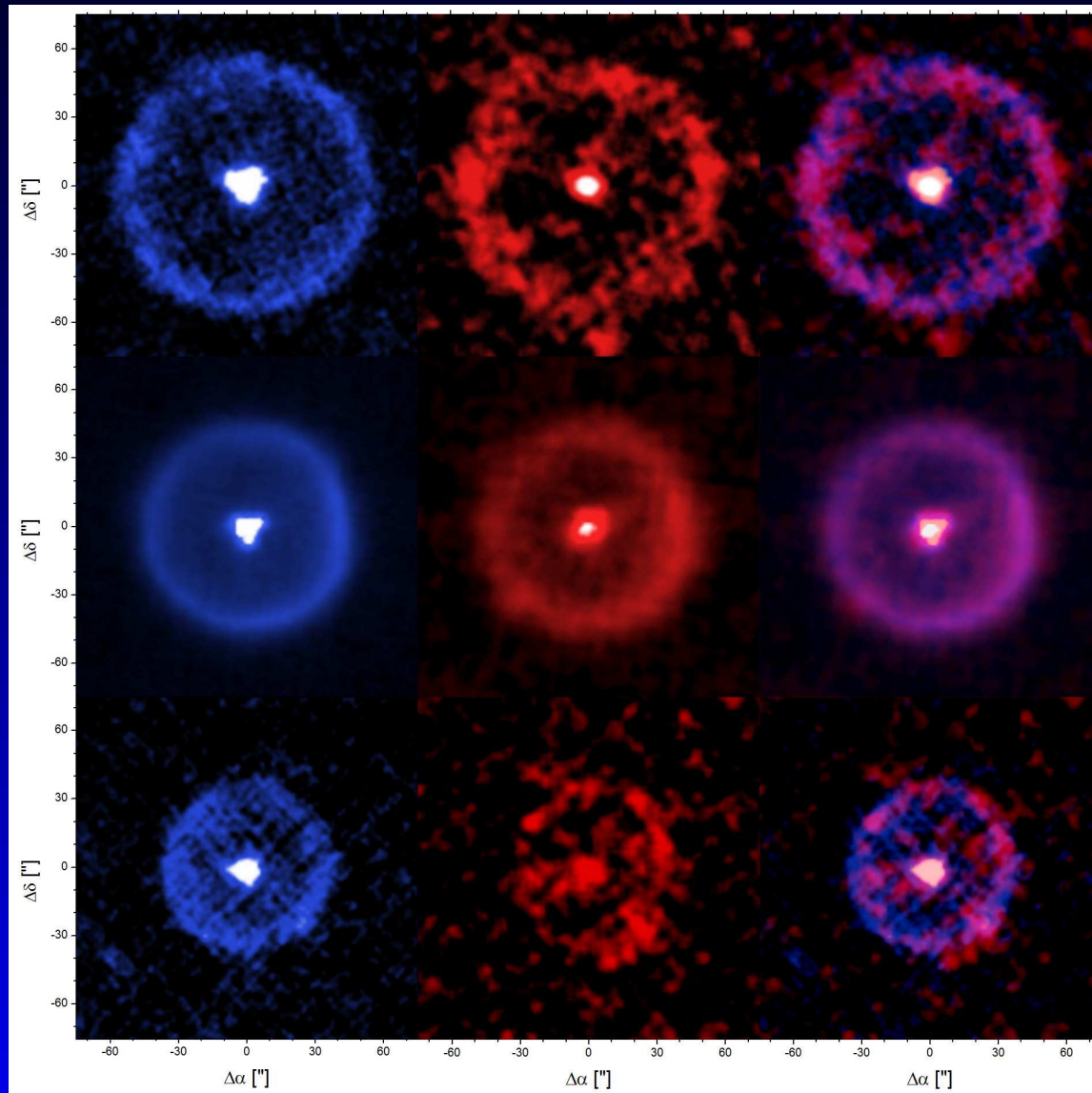


Vamvatira-Nakou et al.

Hen 3-519

Poster 2.29

Detached shells

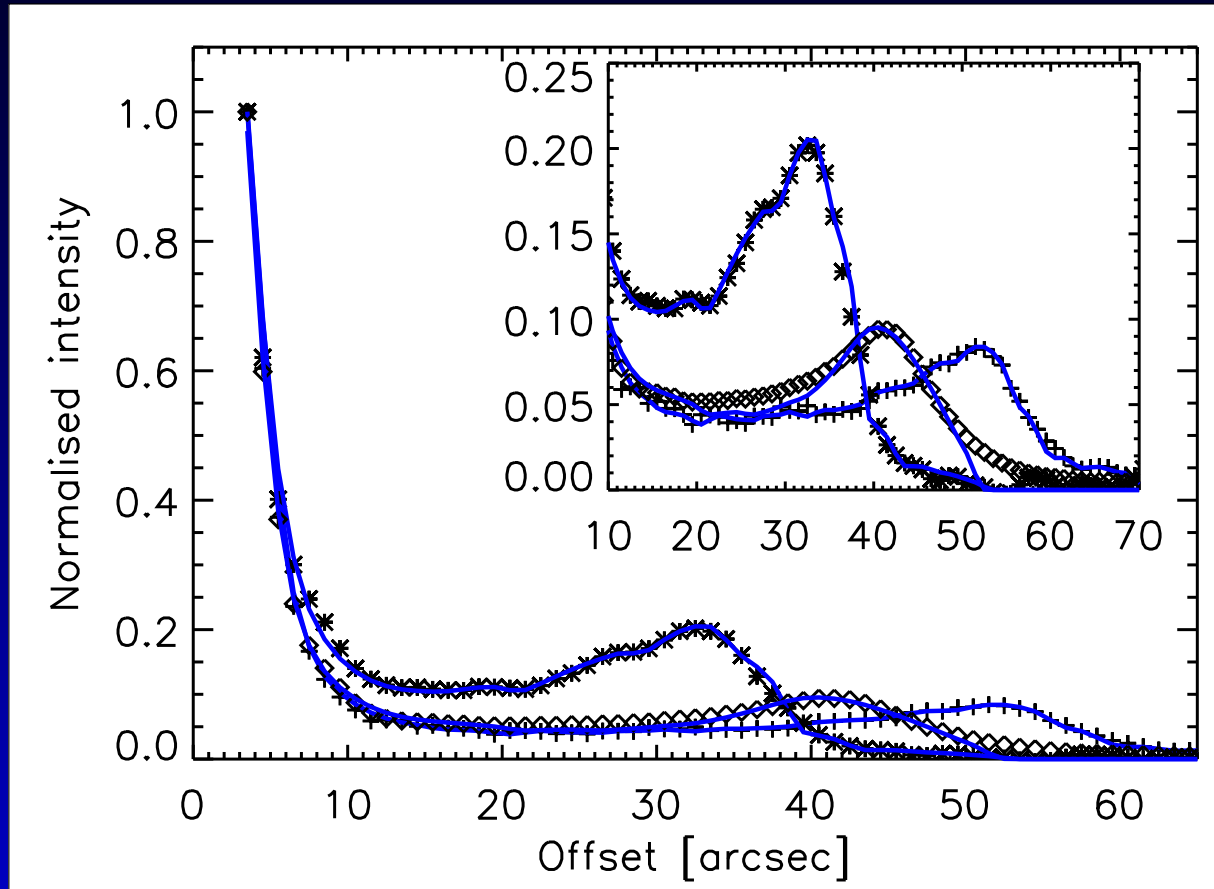


PACS:
blue / red /
combined

AQ And, U Ant,
TT Cyg

Kerschbaum et al. (2010)

Detached shells



AQ And = +
U Ant = ◇
TT Cyg = ×

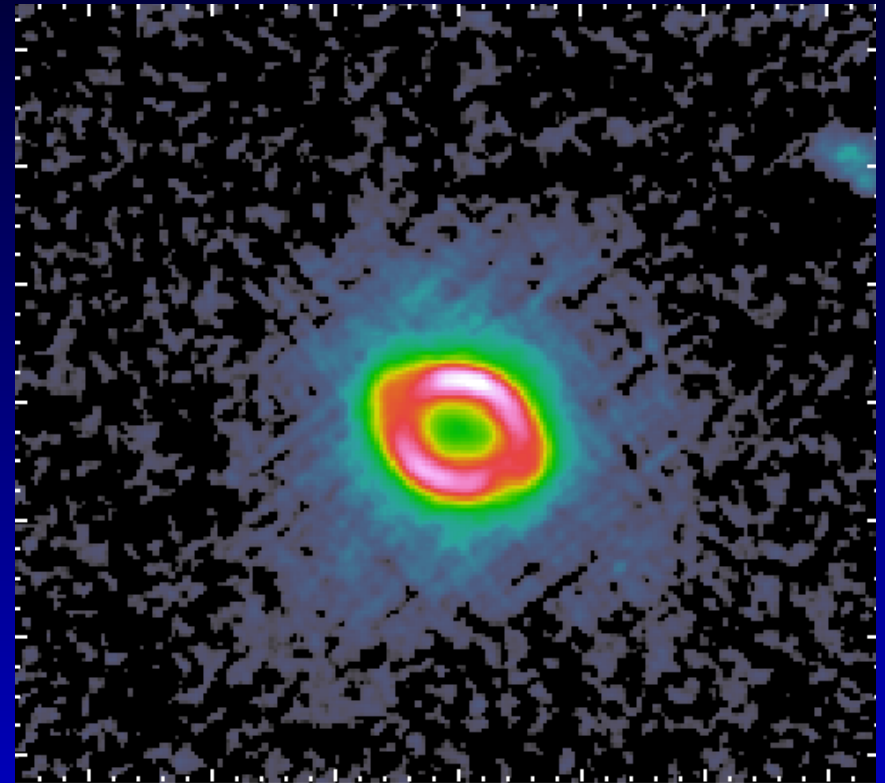
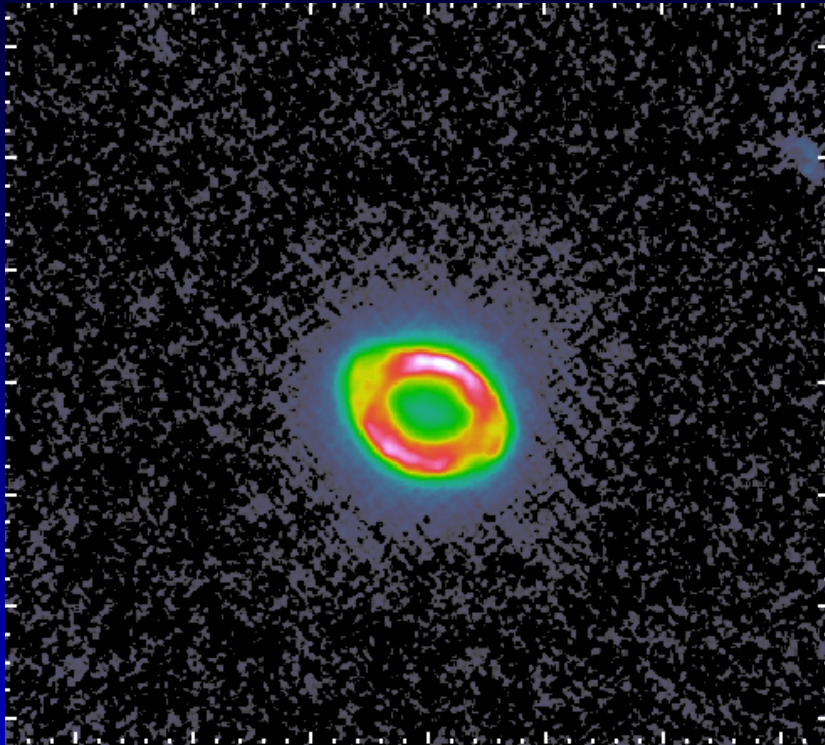
DUSTY
multiple-
shells

$T_{\text{dust}} =$
25-50 K

Kerschbaum et al. (2010)

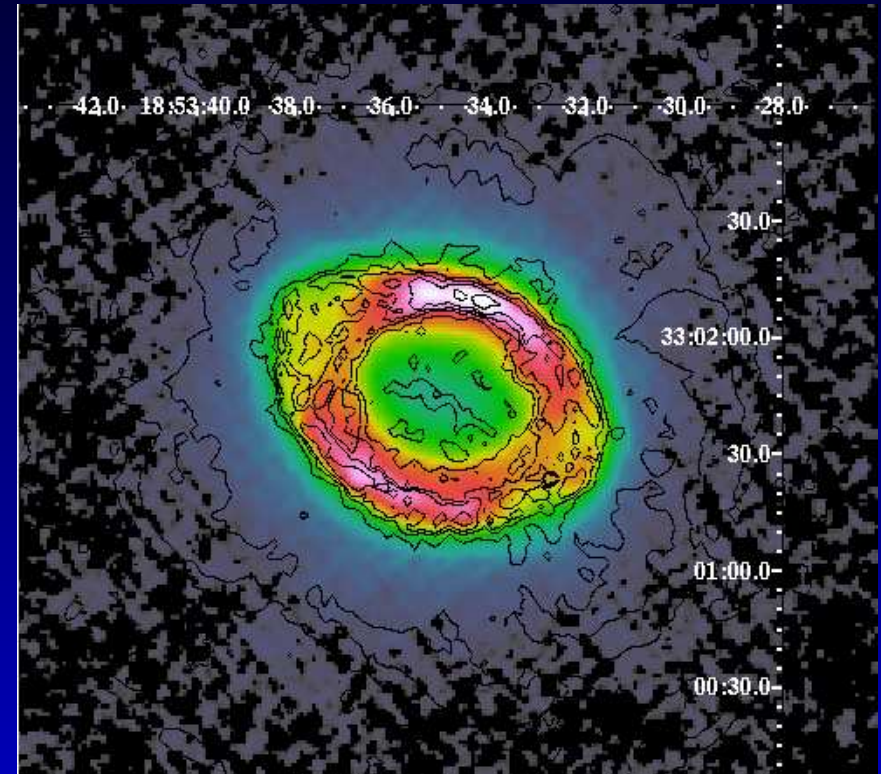
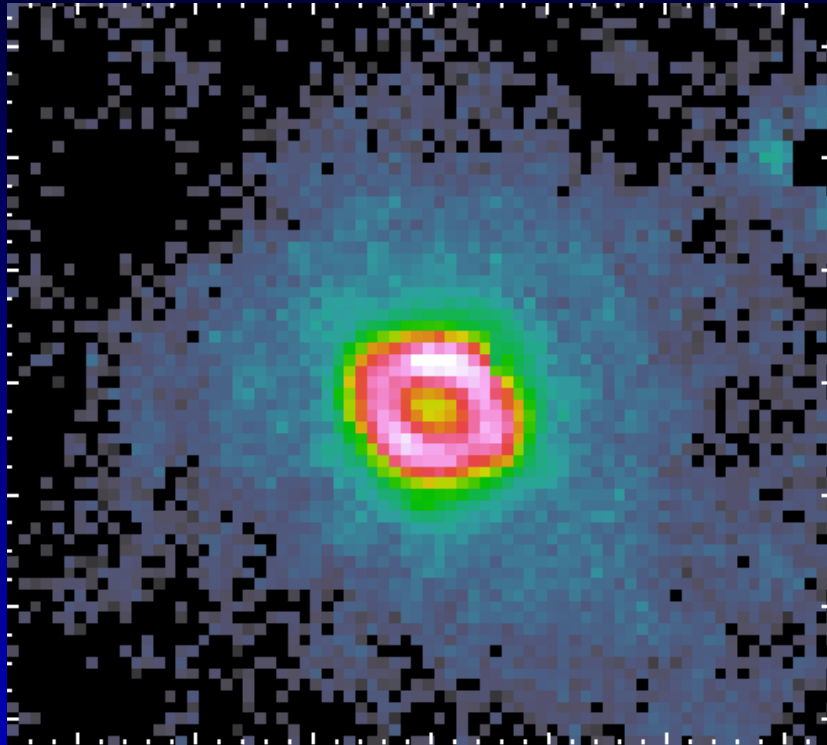
Poster 1.33

NGC 6720



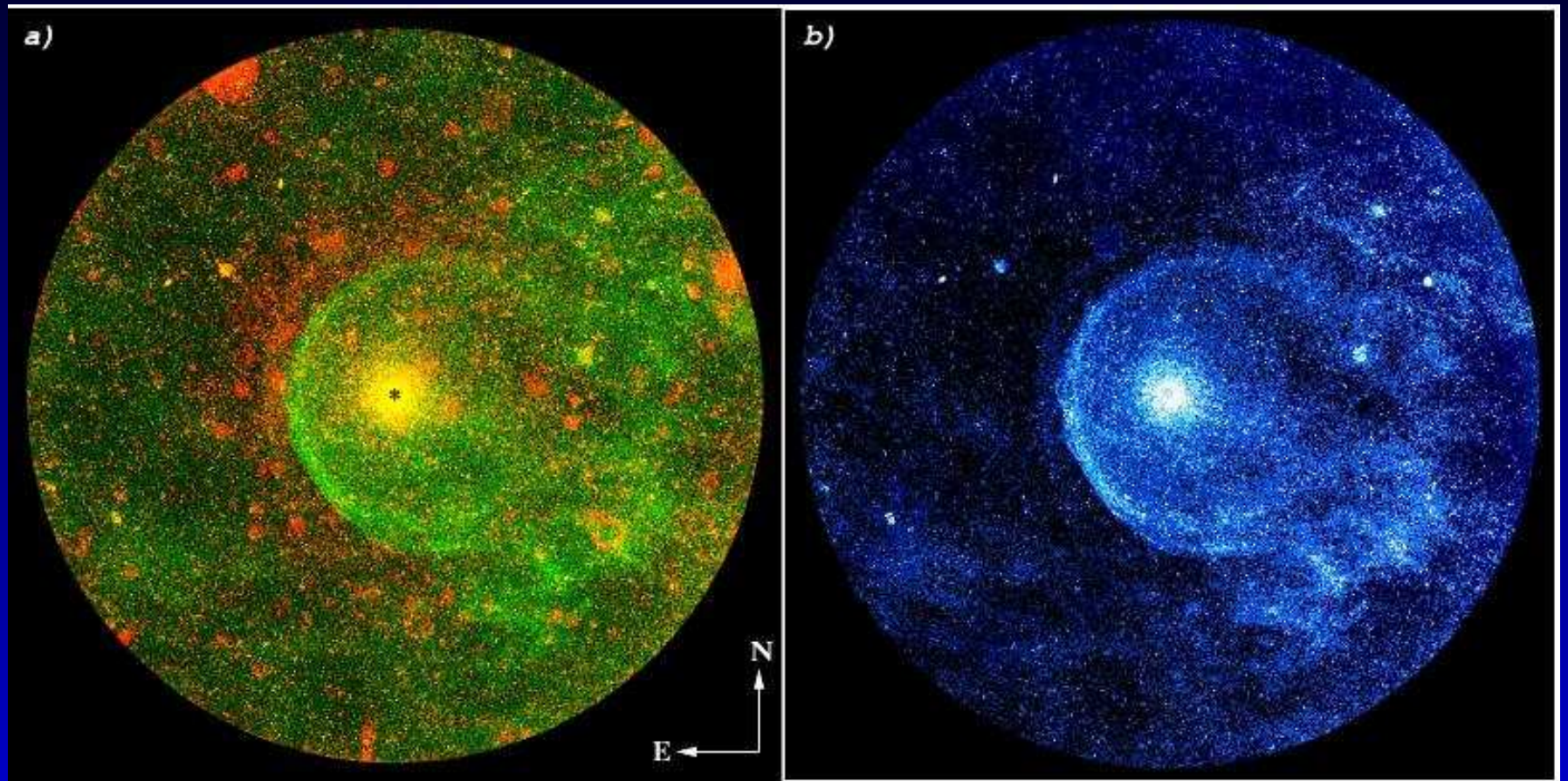
van Hoof et al. (2010)
PACS 60 and 160 micron

NGC 6720



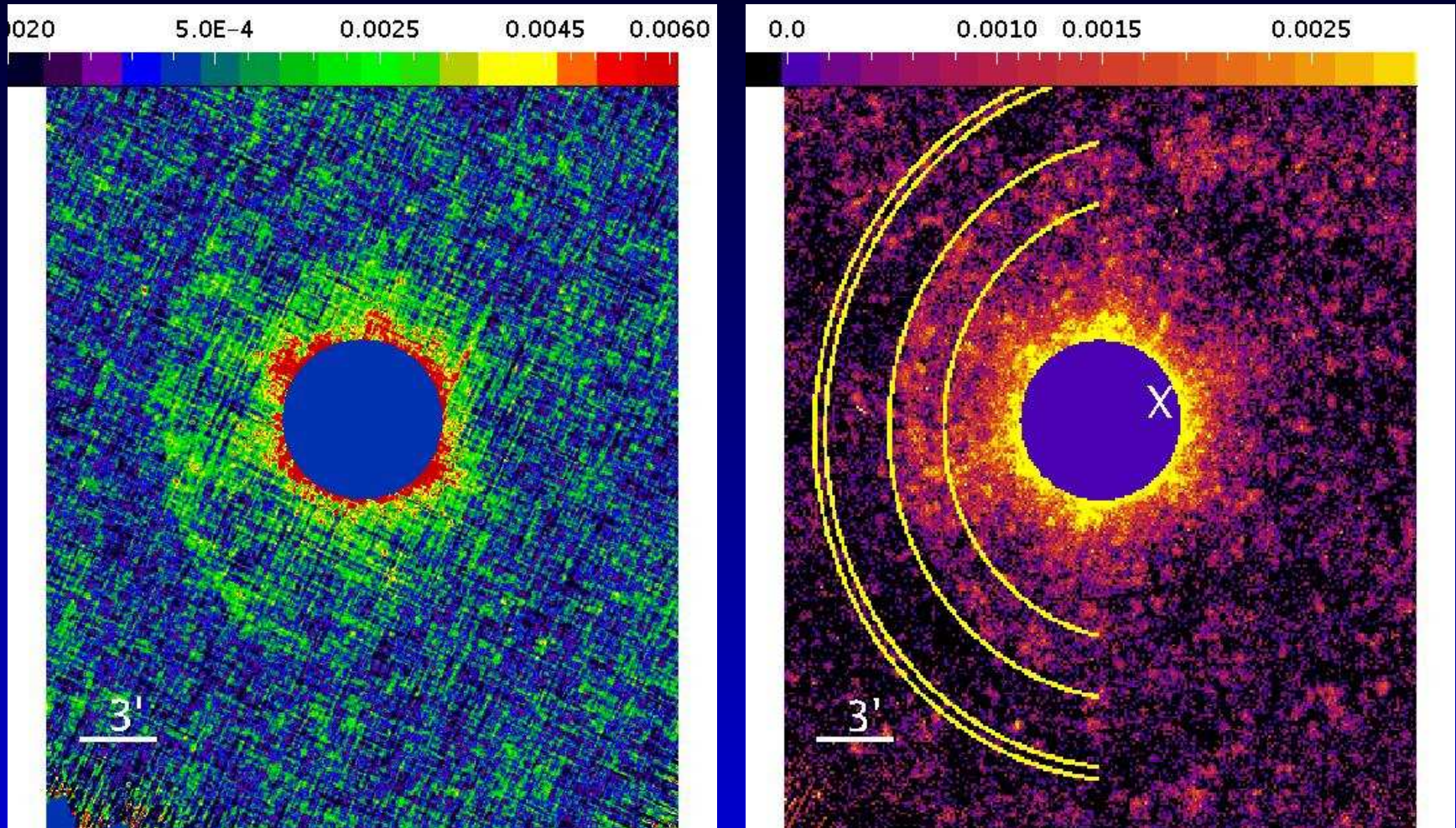
van Hoof et al. (2010)
SPIRE 250, and PACS 70 micron with H₂ contours
⇒ H₂ formation on dust grains, in high density knots.
Poster 2.33

CW Leo



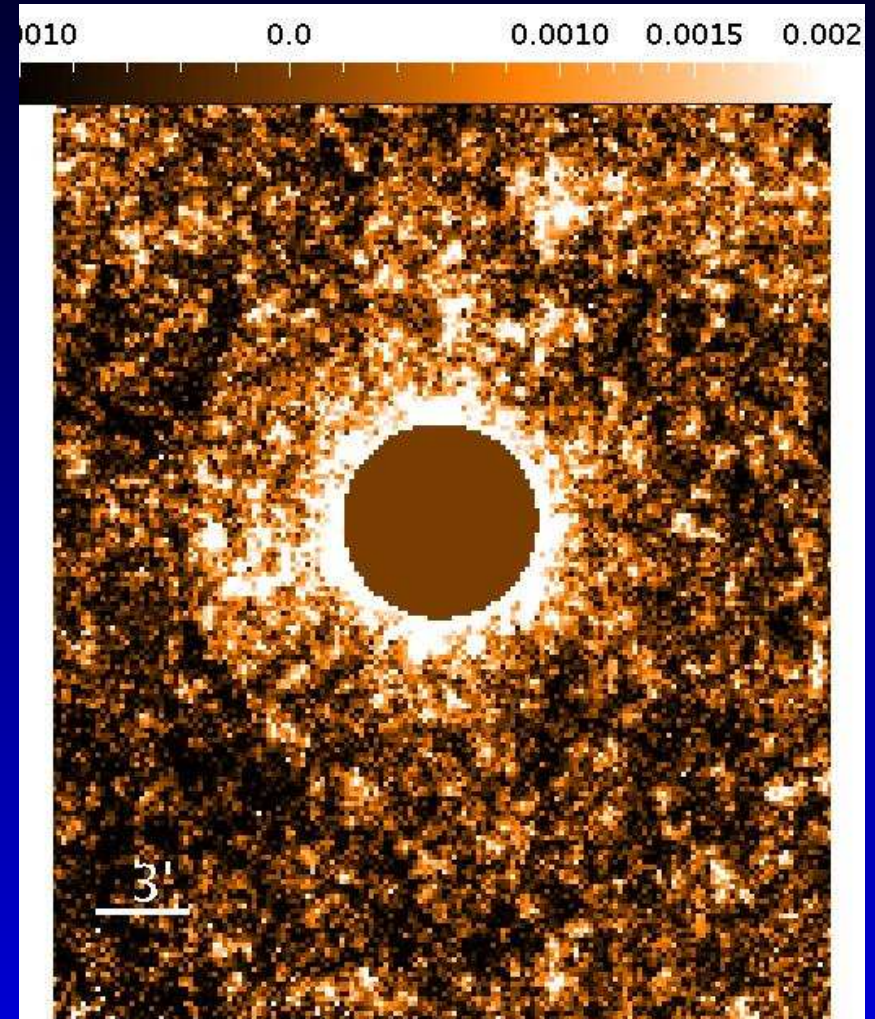
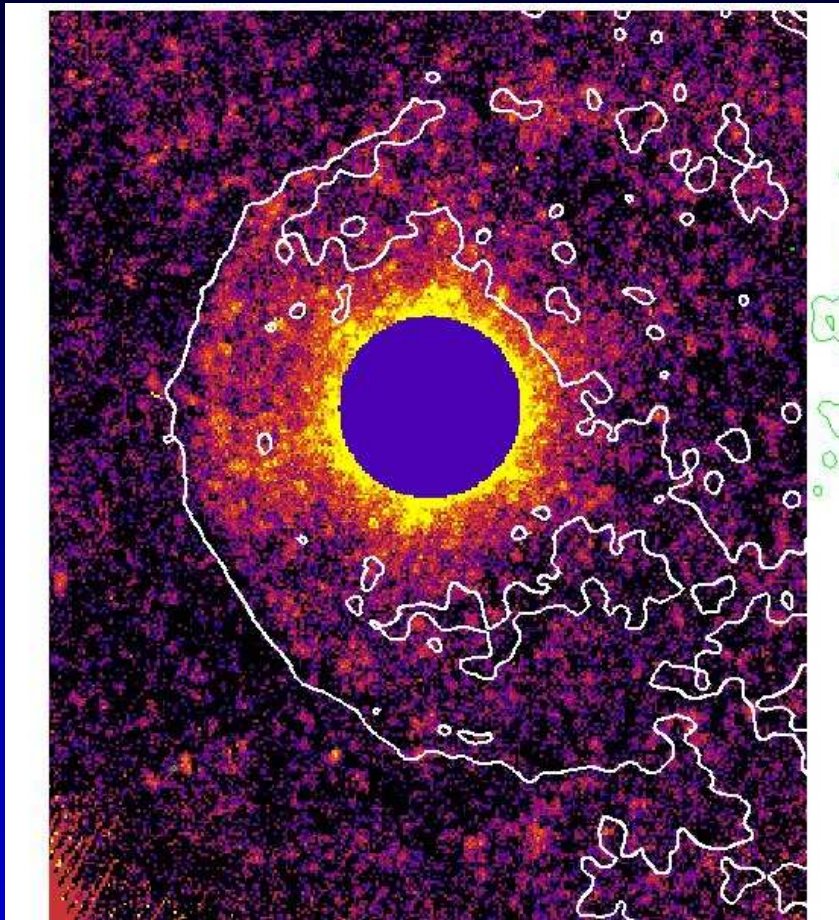
GALEX NUV/FUV composite (left), FUV (right).
Sahai & Chronopoulos (2010)

CW Leo



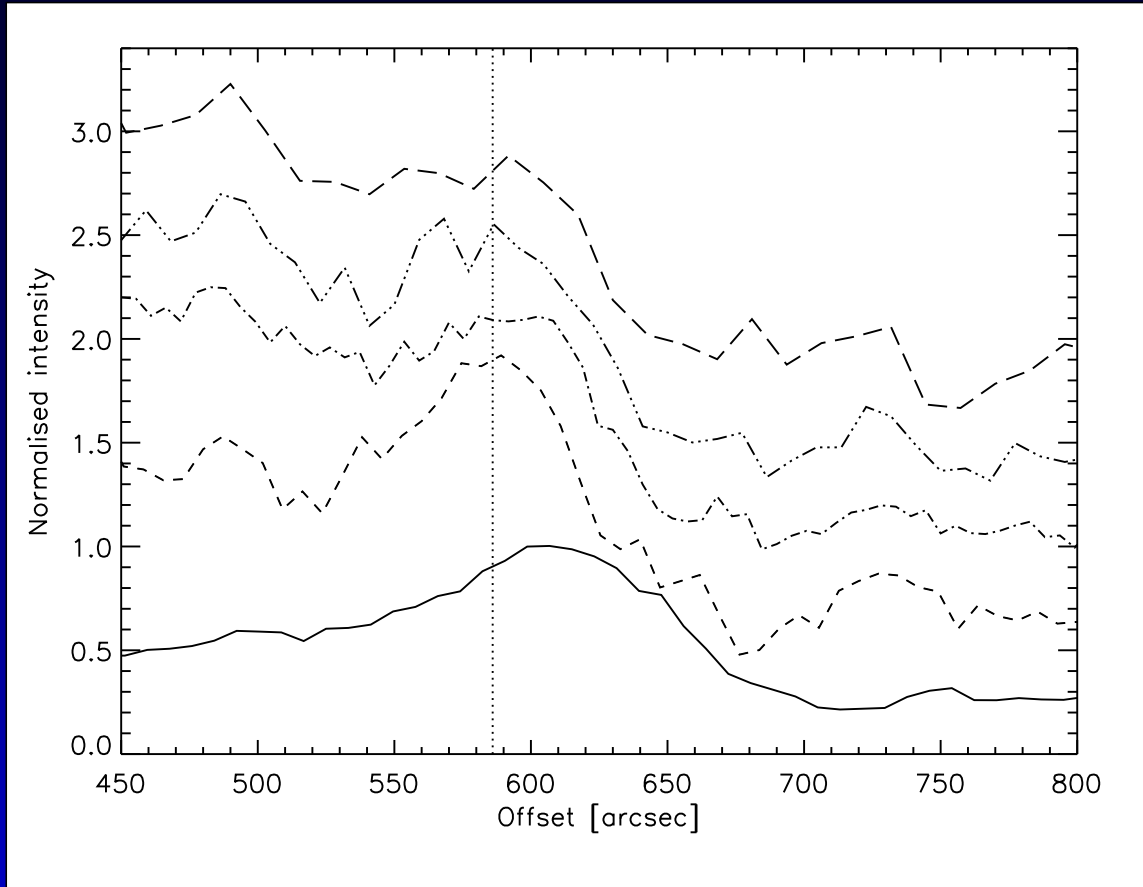
PACS 160 and SPIRE 250 micron
 $23' \times 27'$ (Ladjal et al. 2010)

CW Leo



SPIRE 250 micron with GaleX FUV contours (left),
SPIRE 350 micron (Ladjal et al. 2010)

CW Leo



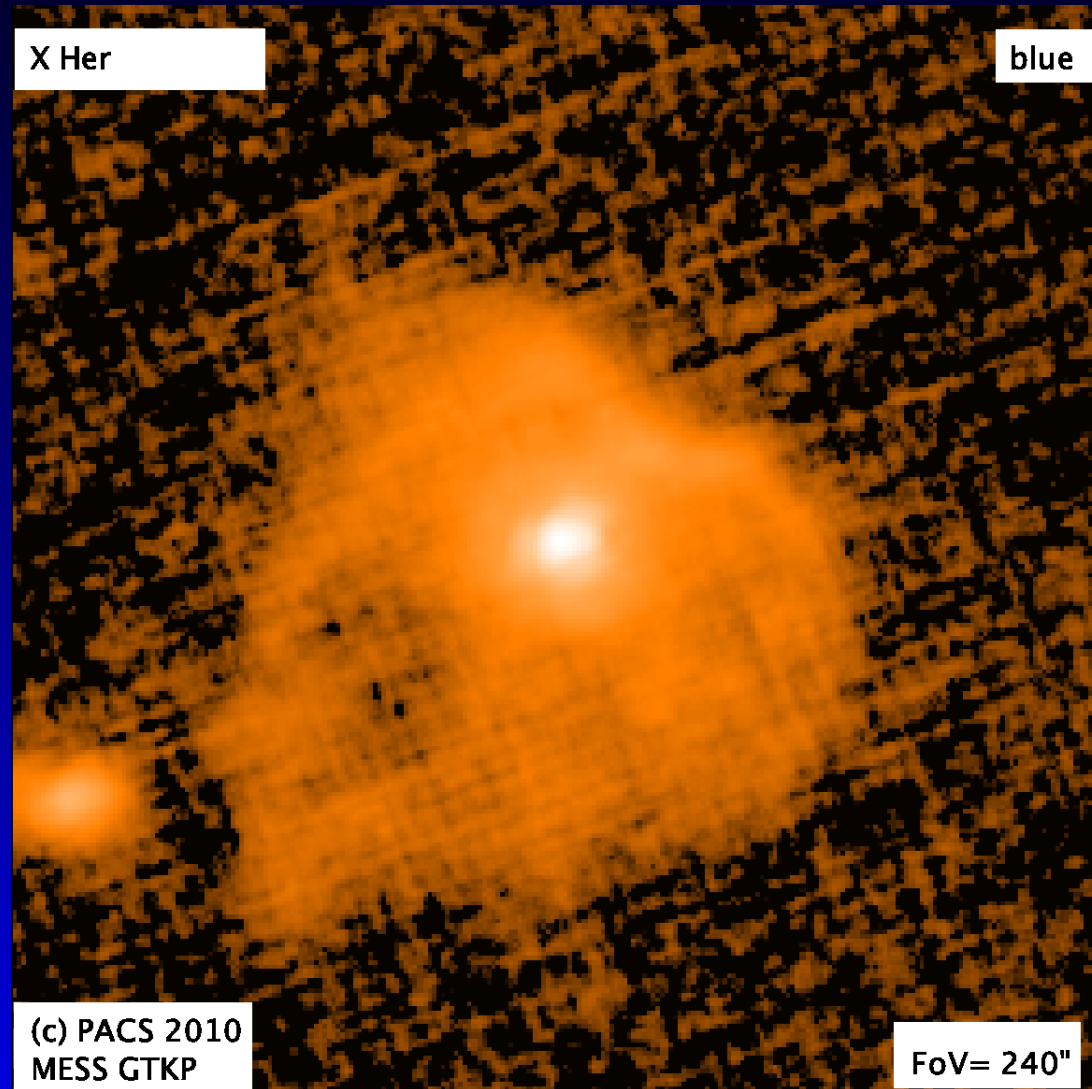
Intensity profiles FUV, 160, 250,350,550 micron

$$T_{\text{dust}} = 25 \text{ K}$$

$$V_{\star\text{relativeISM}} = 107 / \sqrt{n_{\text{ISM}}} \text{ km s}^{-1}$$

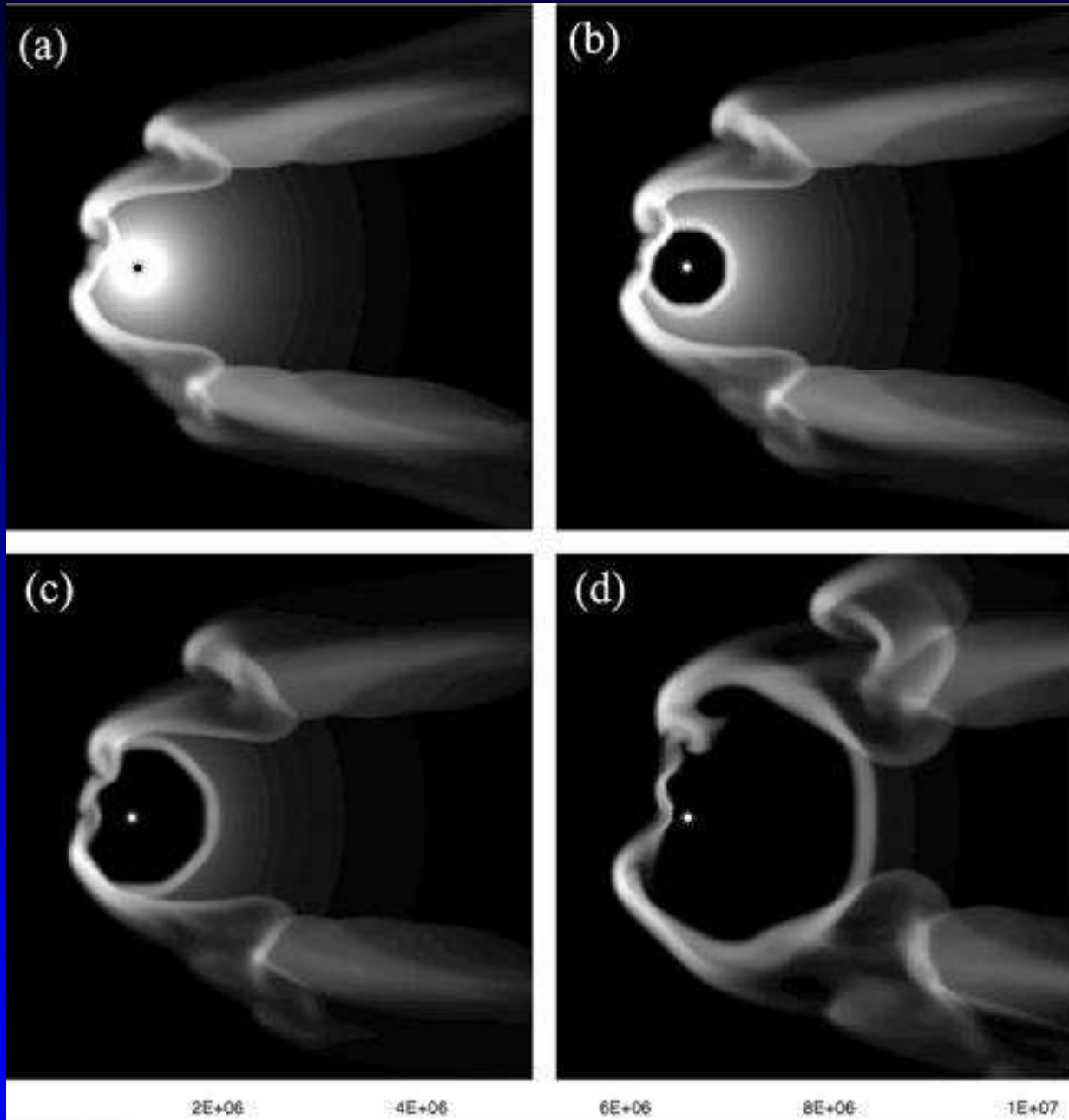
Poster 1.31

Interaction ISM



Jorissen, Kerschbaum, Van Eck, et al. (in prep.)

Models



Wareing et al.
(2007)

Conclusions

- Detected "old" dust mass loss in AGB stars !
- Interaction with the ISM is common
- Issues
 - Faint extended emission
PhotProject/NaiveMapper versus MADMap
 - Dust emission close to the star
PSF subtraction / deconvolution

MESS is produced by

A. Baier, M. Barlow, B. Baumann, J. Blommaert, J. Bouwman,
P. Cernicharo, M. Cohen, L. Decin, L. Dunne, K. Exter,
P. Garcia-Lario, H. Gomez, M.A.T. Groenewegen, P. Hargrave,
Th. Henning, D. Hutsemékers, R. Ivison, F. Kerschbaum,
O. Krause, D. Ladjal, T. Lim, M. Mecina, W. Novotny-Schipper,
G. Olofsson, R. Ottensamer, E. Polehampton, Th. Posch,
G. Rauw, P. Royer, B. Sibthorpe, B. Swinyard, T. Ueta,
B. Vandenbussche, G. Van de Steene, P. van Hoof, H. Van
Winckel, E. Verdugo, H. Walker, C. Waelkens, R. Wesson

FWF-projects: P18939-N16 & I163, P21988

FWO

STFC

ASAP-CO-016/03

PRODEX C90371

THE END