

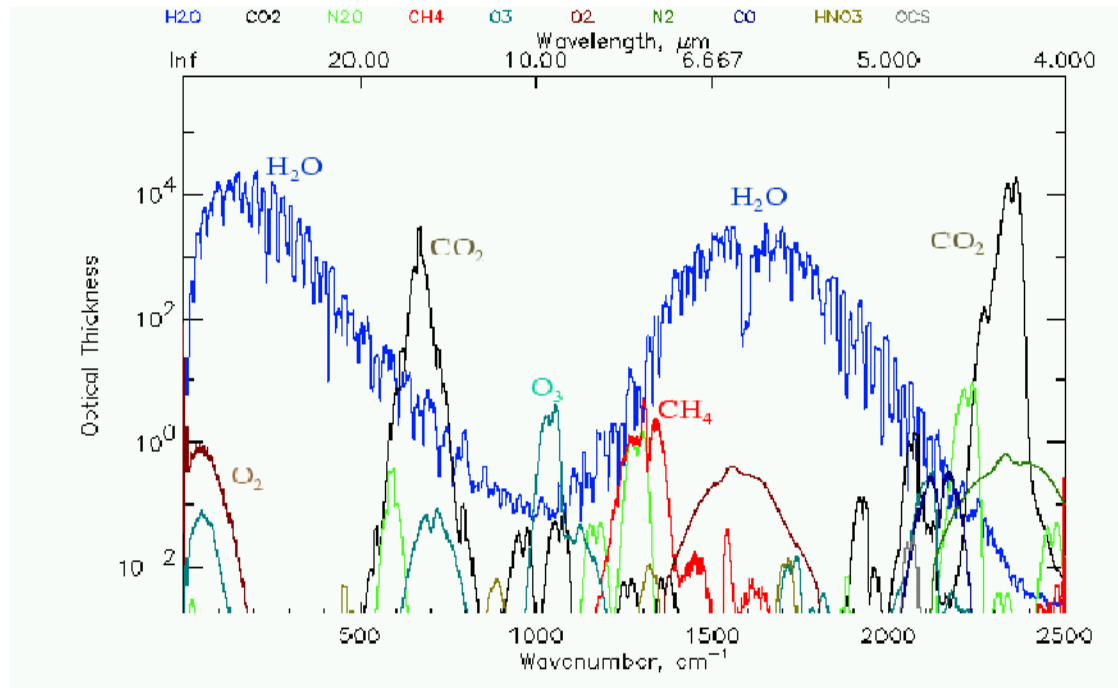
(thermal) IR instruments from Antarctica: what can be gained

Ralf Siebenmorgen

- ❑ Why? pwv, T, aerosols
- ❑ IR projects: DomeC and elsewhere
- ❑ Science cases
- ❑ Conclusion: my favoured modes

(thermal) IR := 2-24 μ m = K,L,M,N,Q

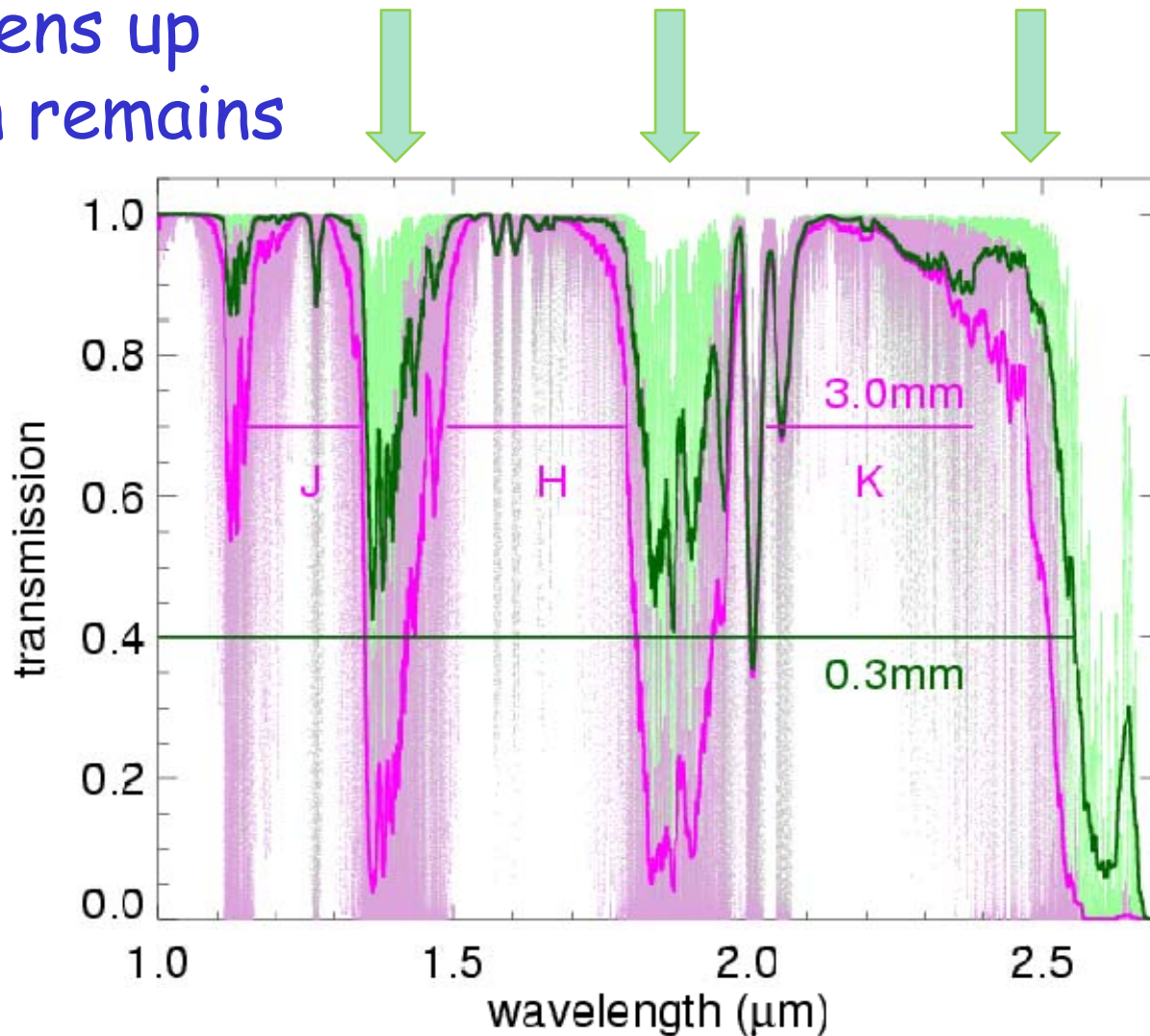
Atmospheric optical thickness spectrum



Atmospheric transmission

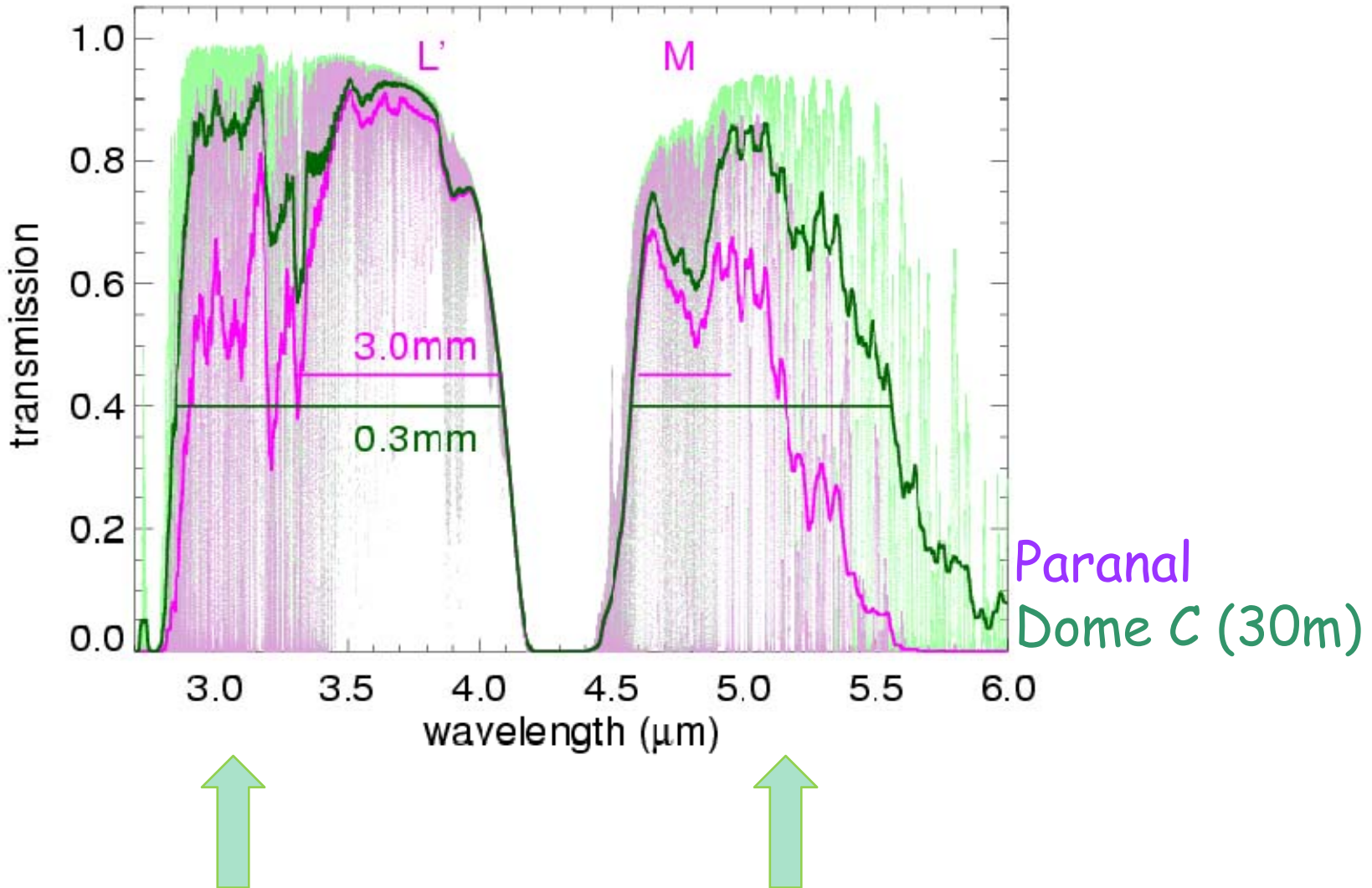


- 1 - 2.5 μm opens up
- OH emission remains
- K_{dark} filter



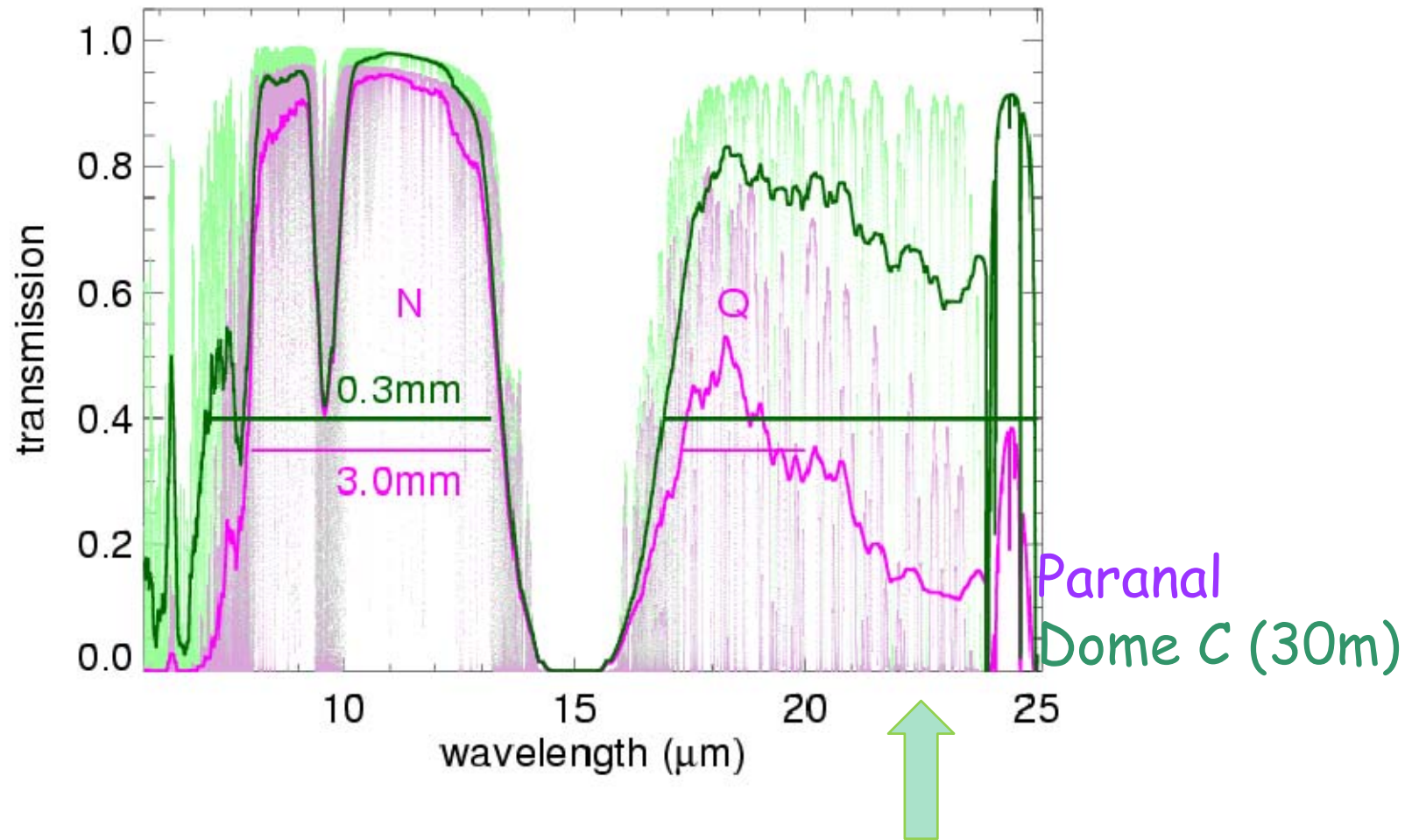
Paranal
Dome C (30m)

Atmospheric transmission



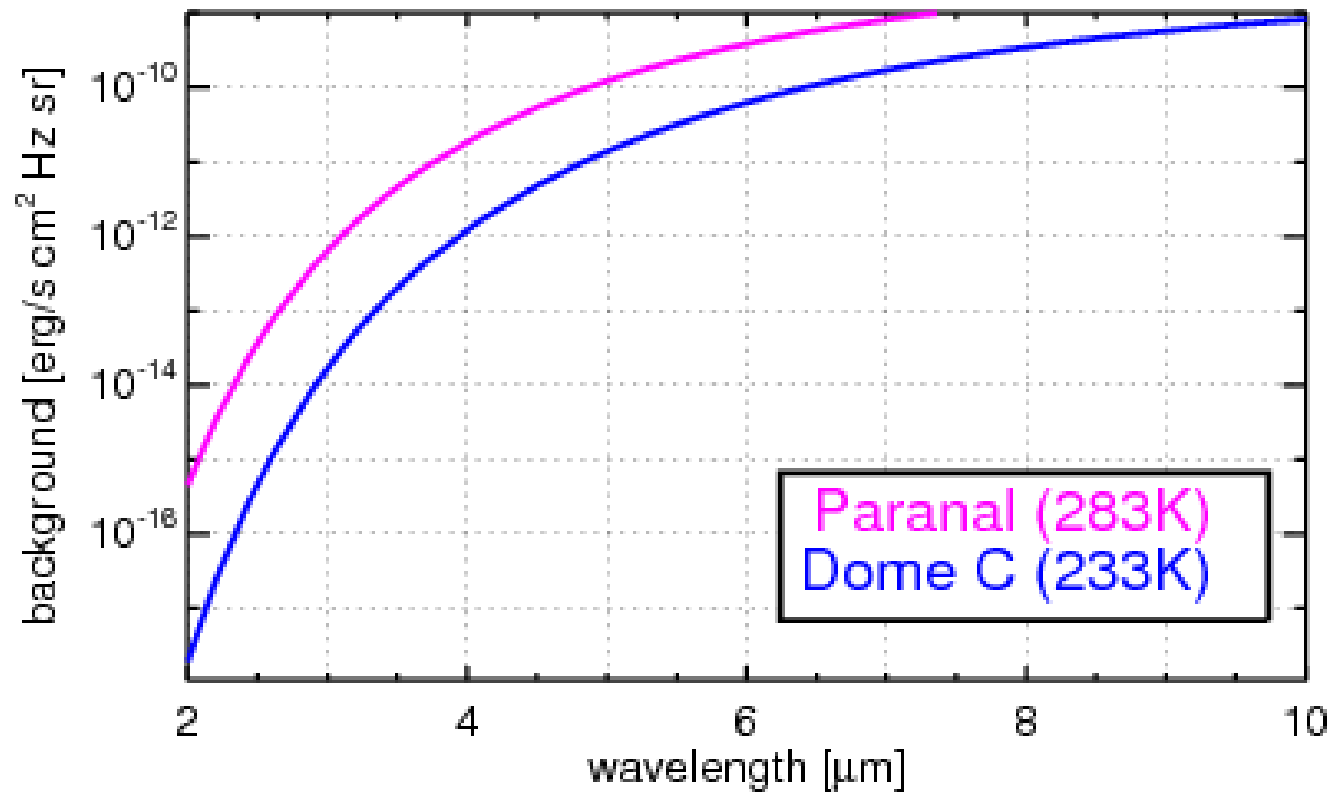
Paranal
Dome C (30m)

Atmospheric transmission

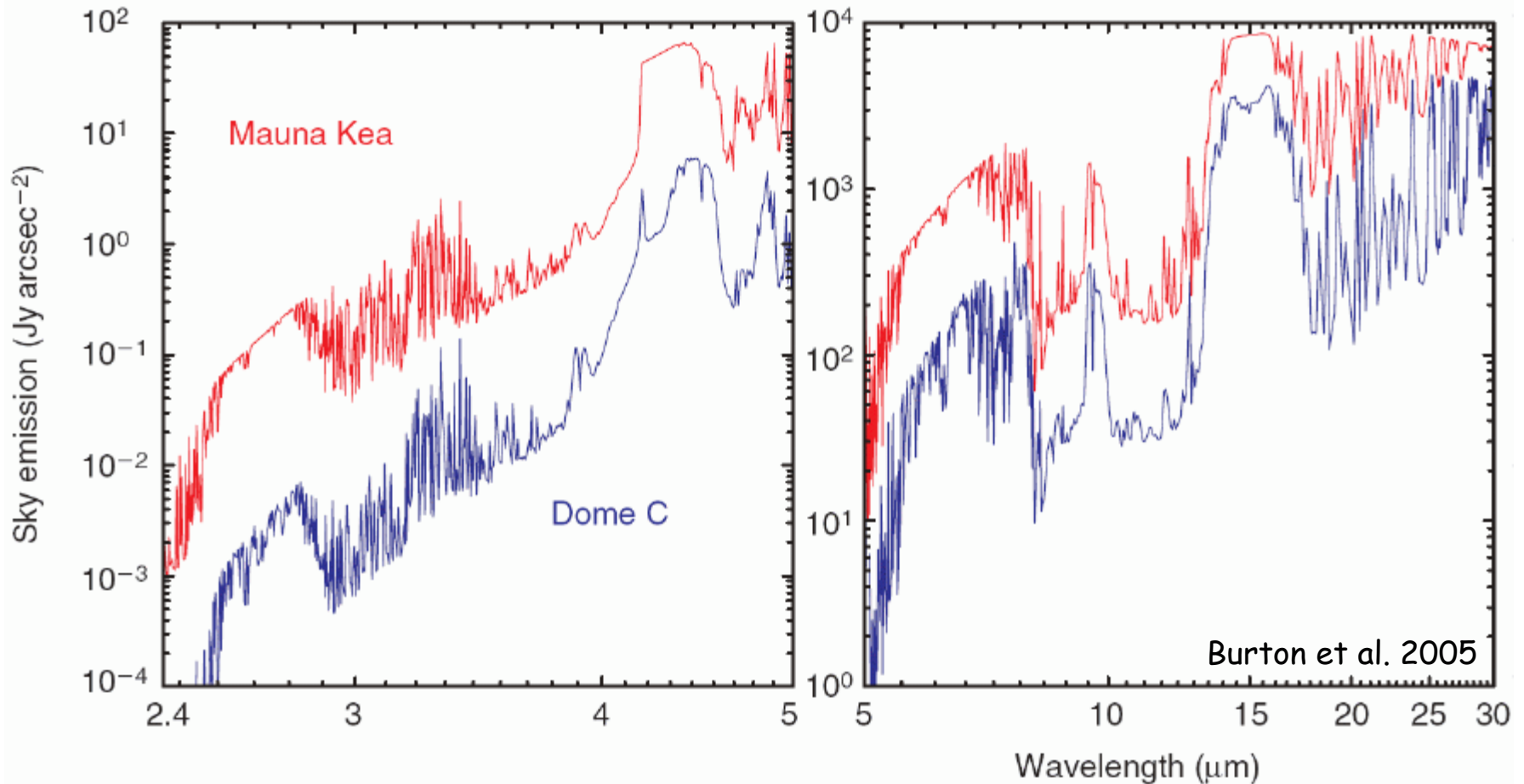
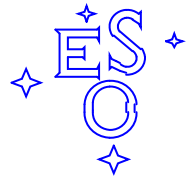


Paranal
Dome C (30m)

Sky background: temperature



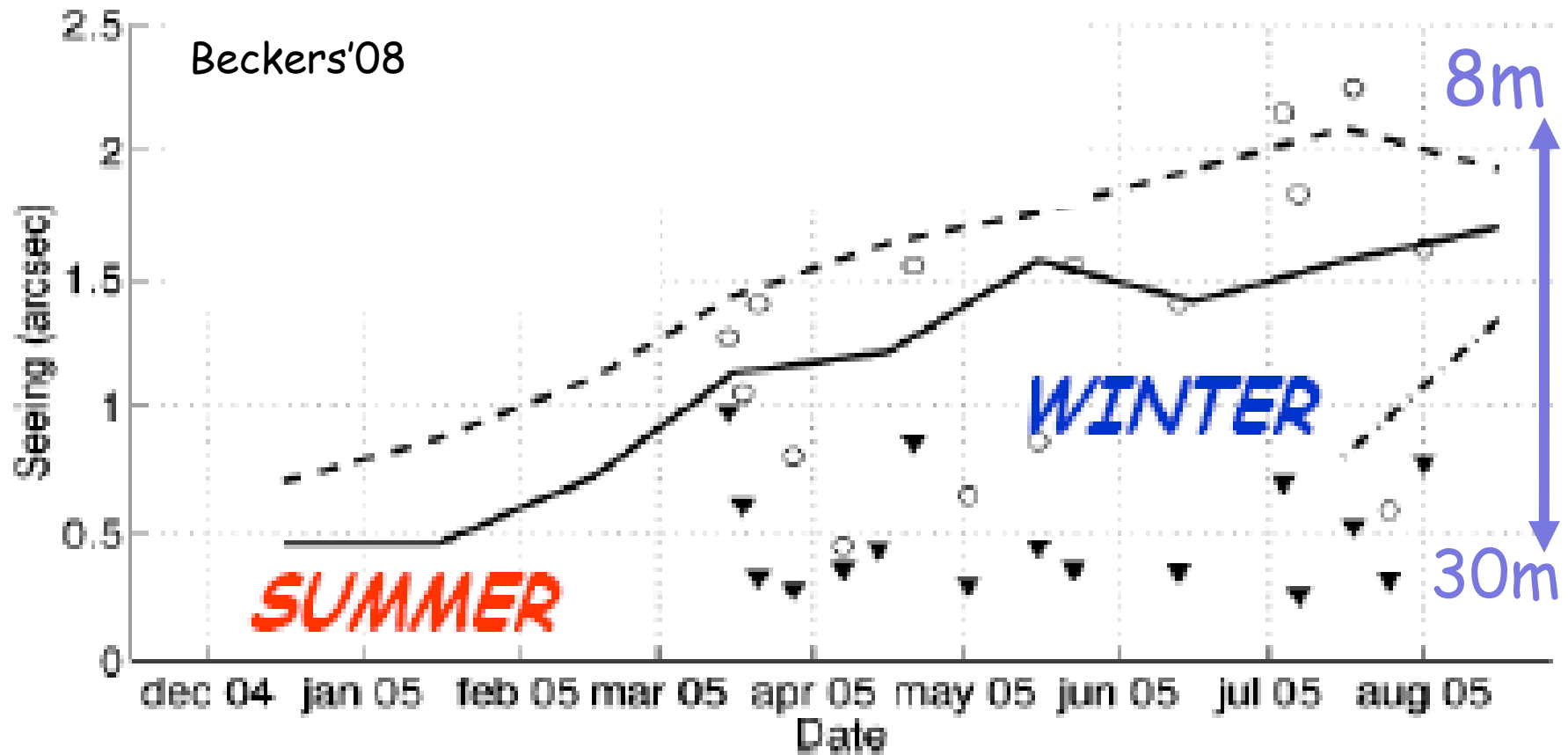
Sky background:



- PWV

Low: - temperature
- aerosol

Seeing at Dome C



AO at Dome C - what is done at E-ELT ?

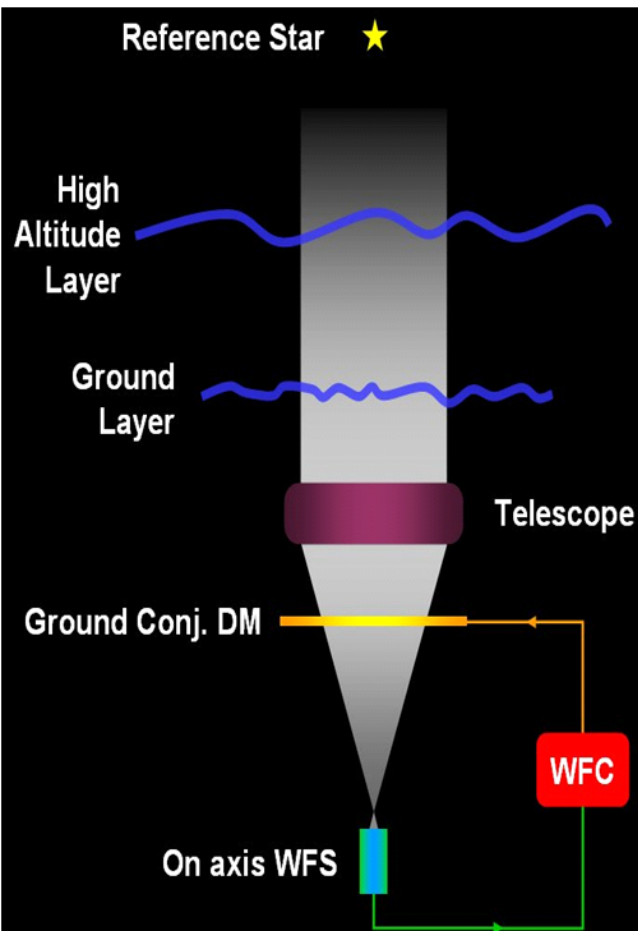


NGS Single Conjugate AO

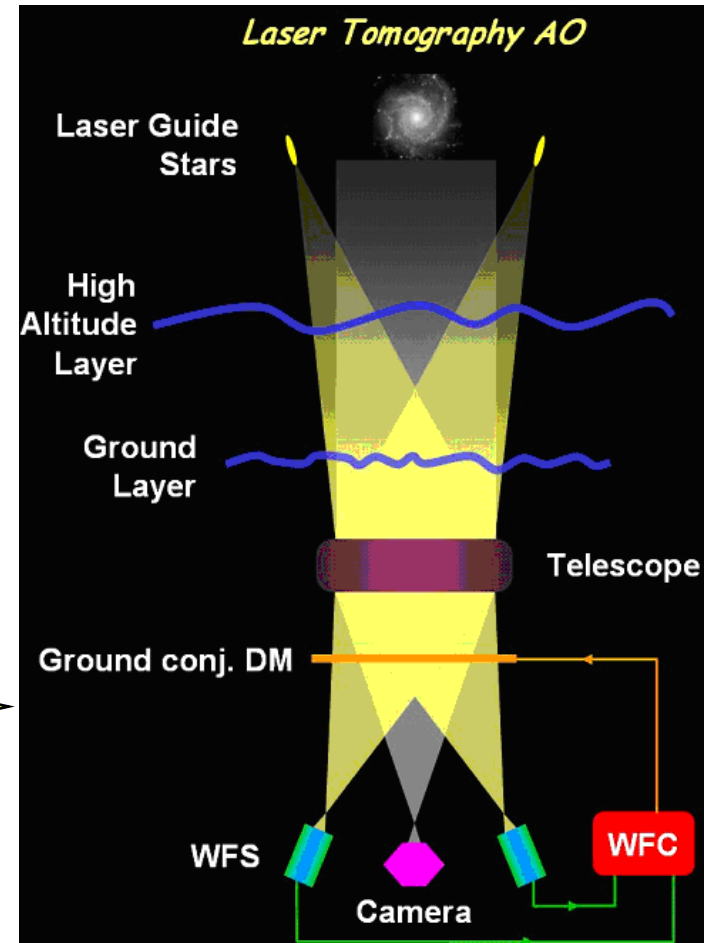
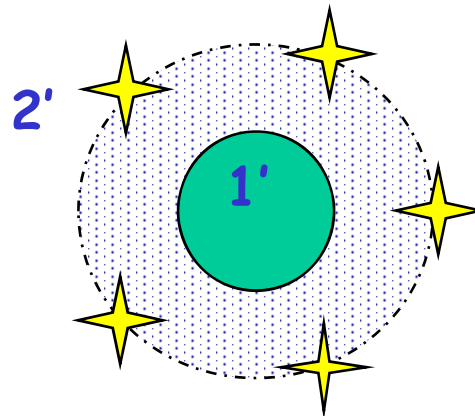


LTAO

sky coverage



- 4-6 LGSs (cone effect)
- Correction on axis
- 1 deformable mirror



AO at Dome C - what is done at E-ELT ?

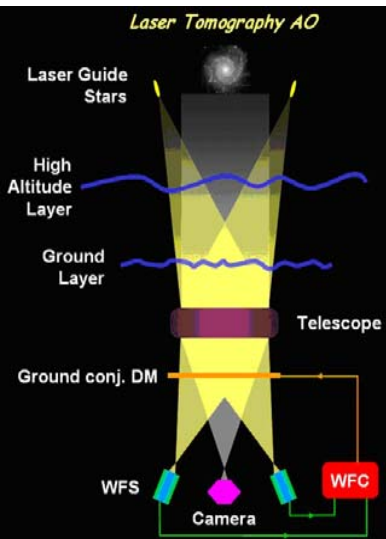


LTAO

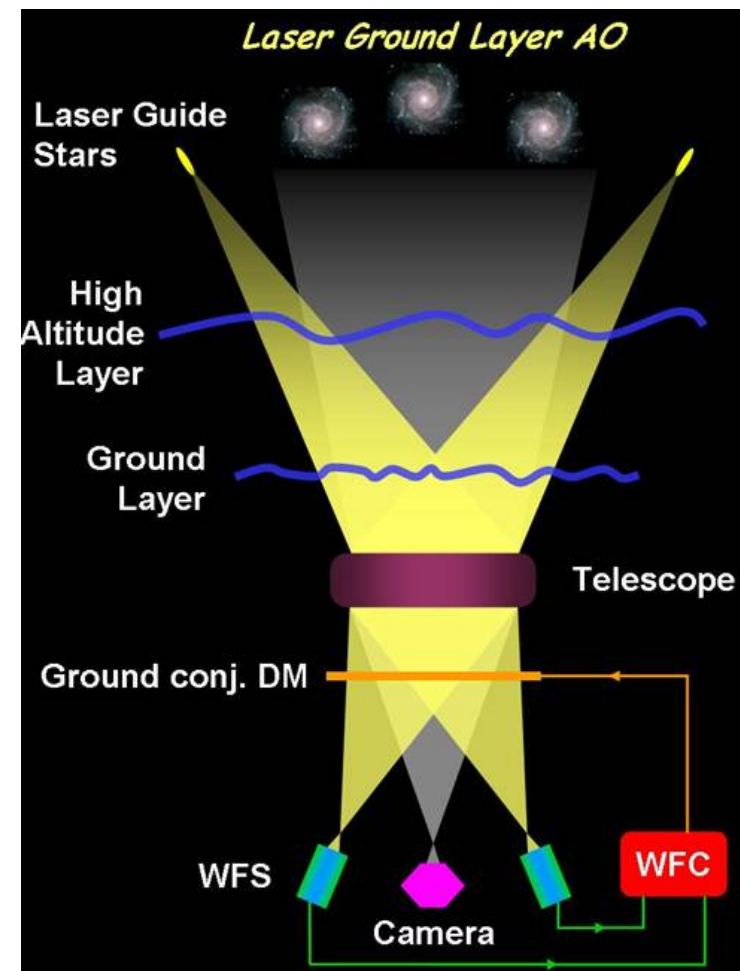
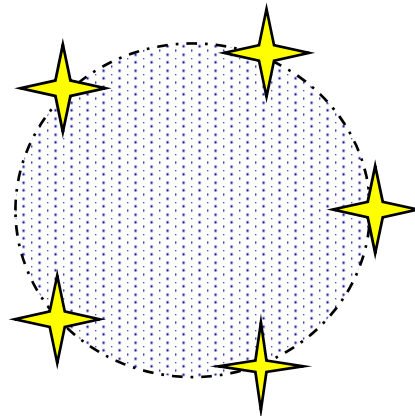


GLAO

Wide corrected FoV



- 5 LGSs/ WFSs
- 1 DM
- FoV ~ 6'



AO at Dome C - what is done at E-ELT ?

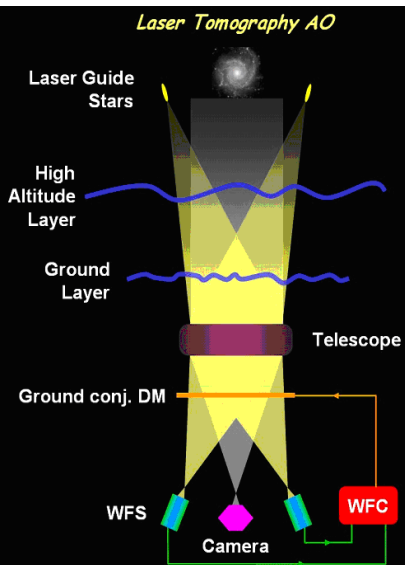


GLAO

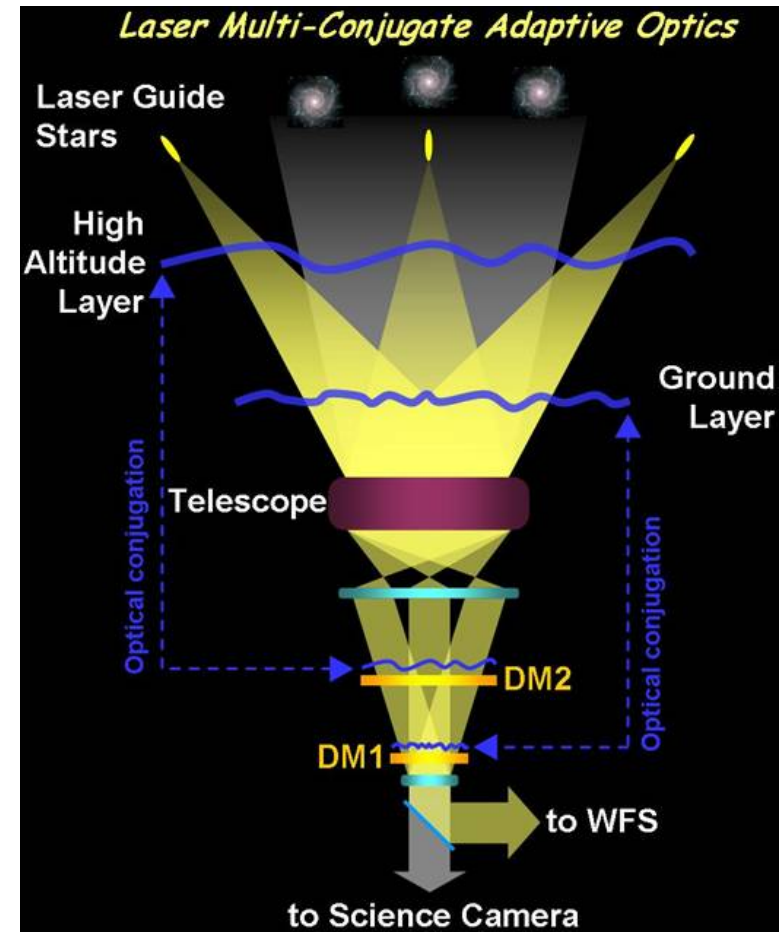
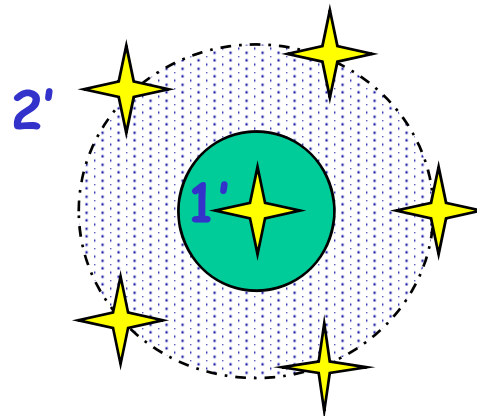


PSF uniformity

MCAO



- >6 LGSs/ WFSs
- >3 NGS
- >2 DM
- improve corrected FoV



AO at Dome C ?



GLAO -> next talk by Marcell Carbillet

GLAO



Tower solution

- Technical issues
- maintenance

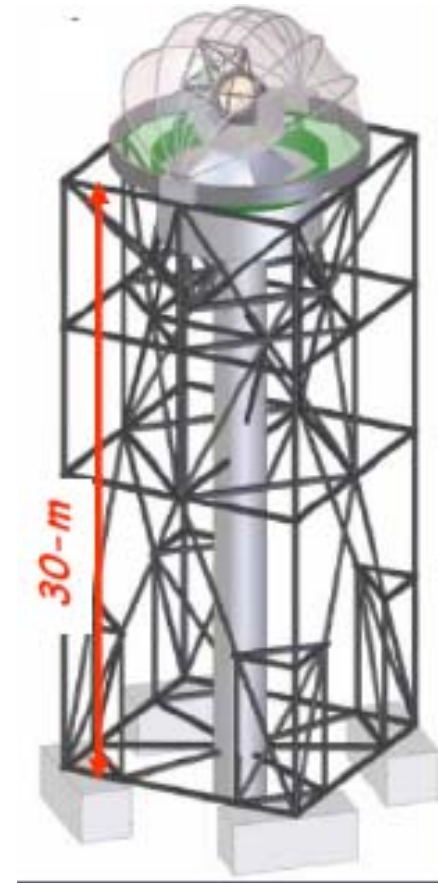
GLAO



maintenance

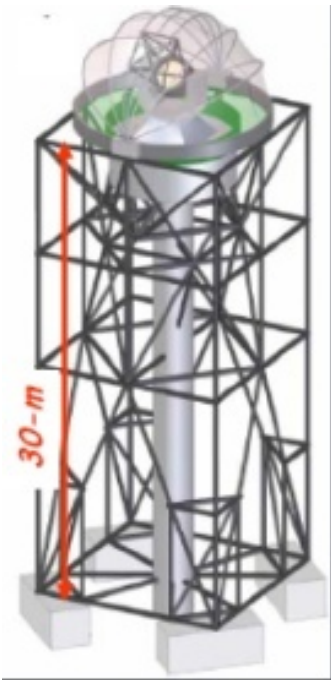
Tower solution

- Vibration
- Footing
- Thermal bending
- Icing

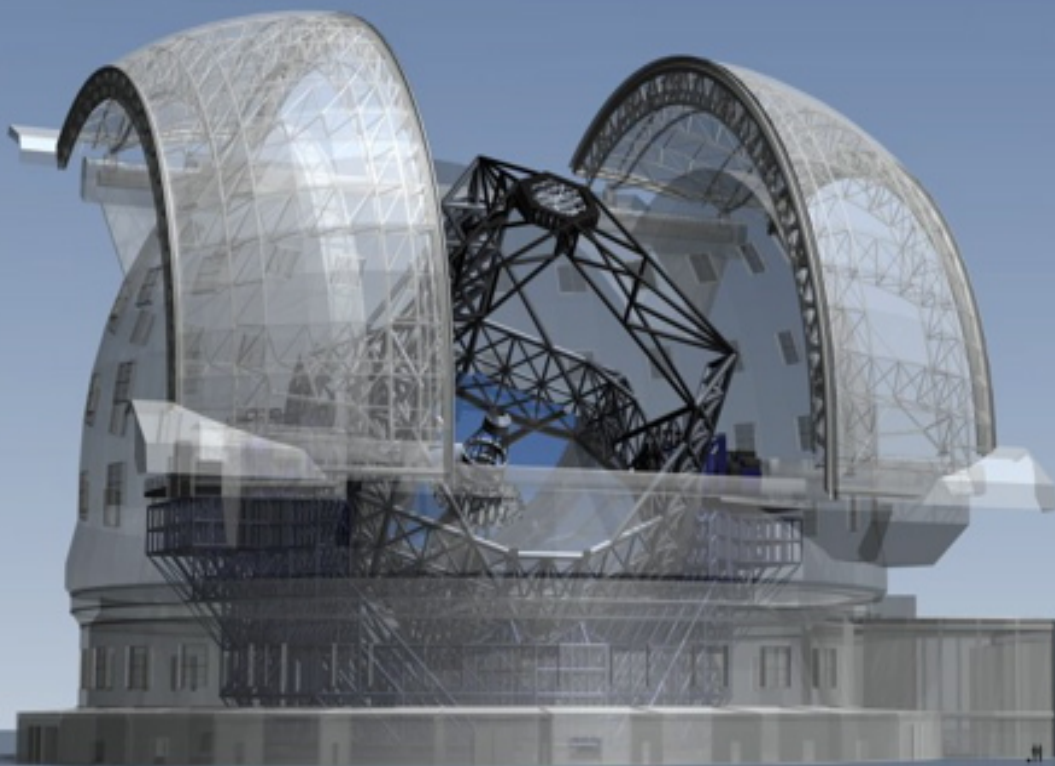
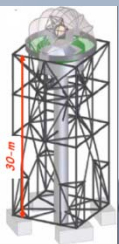


Beckers'08

Dome sizes



Dome sizes



IR projects at Dome C



This session :

- **IRAIT** (International Robotic Antarctic IR Tel.) Maurizio Busso
- **AMICA** (Antarctic Multiband IR Camera) Mauro Dolci

IR projects at Dome C



WHITE

**A WIDE-FIELD HIGH-RESOLUTION
INFRARED TELESCOPE
FOR DOME C, ANTARCTICA**



WHITE

- 2.4m tel.
- 0.3" resolution
- 0.7deg² fov
- 1-5 μ m ?

Surveys

- LMC
- weak lensing
- SN($z < 0.2$)

PI: Denis Burgarella

IR projects at Dome C



PILOT – a 2.4 metre optical/infrared telescope for Dome C, Antarctica

John Storey
Will Saunders
Michael Burton
and
the PILOT Team

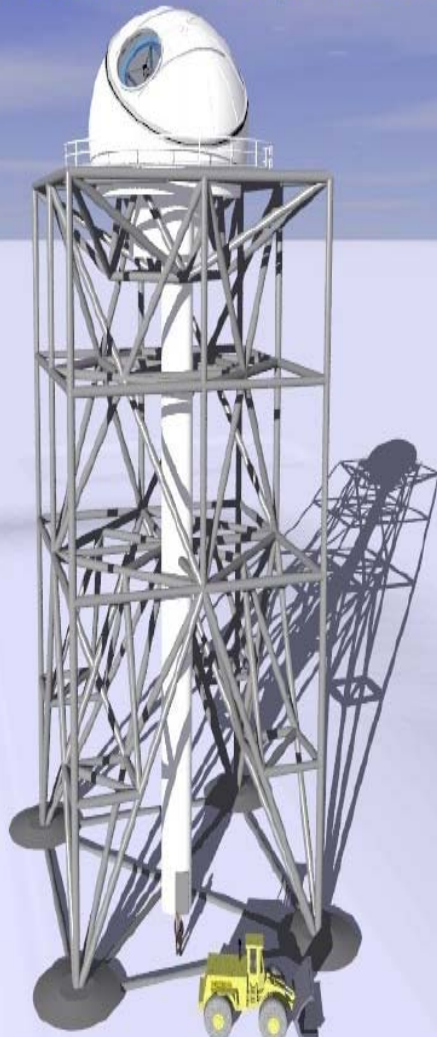


Image: A

IR projects at Dome C



PILOT – a 2.4 metre optical/infrared telescope for Dome C, Antarctica

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www.publish.csiro.au/journals/pasa

Publications of the Astronomical Society of Australia, 2005, 22, 199–235

Science Programs for a 2-m Class Telescope at Dome C, Antarctica: PILOT, the Pathfinder for an International Large Optical Telescope

M. G. Burton^{A,M}, J. S. Lawrence^A, M. C. B. Ashley^A, J. A. Bailey^{B,C}, C. Blake^A,
T. R. Bedding^D, J. Bland-Hawthorn^B, I. A. Bond^E, K. Glazebrook^F, M. G. Hidas^A,
G. Lewis^D, S. N. Longmore^A, S. T. Maddison^G, S. Mattila^H, V. Minier^I, S. D. Ryder^B,
R. Sharp^B, C. H. Smith^J, J. W. V. Storey^A, C. G. Tinney^B, P. Tuthill^D, A. J. Walsh^A,
W. Walsh^A, M. Whiting^A, T. Wong^{A,K}, D. Woods^A, and P. C. M. Yock^L



Image: A

MIR instrument at Dome C



Point source sensitivity

	$10\sigma/1h$
K	$2\mu Jy$
L	$80\mu Jy$
M	$200\mu Jy$
N	$8mJy$
Q	$200mJy$

Burton et al '05

N band:

pfov $0.5''$;

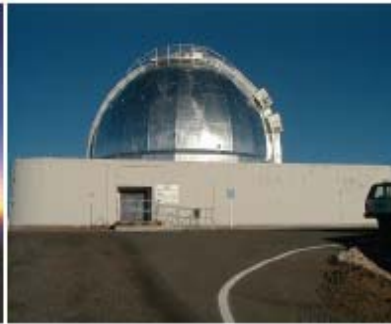
1kx1k detector

Mora et al. (this session)

Present MIR instruments: <8m



Sub-
8-meter-
class



INSTRUMENT		BLINC-MIRAC4	MIRSI	MIRLIN	SPECTROCAM-10
Facility		MMT (6.5 m)	IRTF (3.0 m)	Palomar Observatory (5.08 m)	Palomar Observatory (5.08 m)
MODES	Imaging FOV	11.5" to 44" square	85" x 64"	20" square	15" square
	LR N		R~200		R~100
	MR N				R~2000
	HR N				
	Other	Nulling interferometry	LR Q (R~100)		
SENSITIVITY [mJy] 10σ, 1h obs. time	N imaging			30	
	Q imaging			300	
	LR N			375	
	MR N				
	HR N				

None in the South

Present MIR instruments: $\geq 8\text{m}$

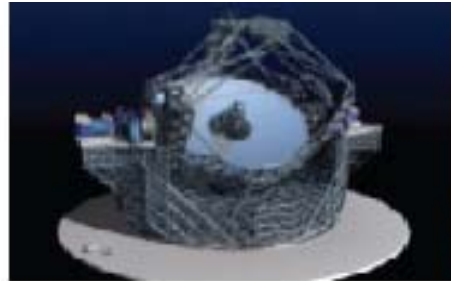


Current
8-meter-
class



INSTRUMENT	VISIR	MIDI/VLTI	MICHELLE	T-RECS	COMICS	TEXES	CANARICAM
Facility	VLT (8.2 m)	VLT UTs (8.2 m) VLT ATs (1.8 m)	Gemini North (8.1 m)	Gemini South (8.1 m)	Subaru (8.3 m)	Gemini (8.1 m)	Gran Telescopio Canarias (10.4 m segmented)
Imaging FOV	19.2" or 32.3" square	1-2"	32" x 24"	21" x 28"	42" x 32"		18" x 26"
MODES	LR N	R~350	R~200	R~100	R~250		R~175
	MR N	R~3200	R~1000-3000	R~1000	R~2500		R~1300
	HR N	R~25,000	R~10,000-30,000		R~8500		
	Other	Interferometry	LR Q (R~110), N polarimetry	LR Q (R~80)	MR Q (R~2500), HR Q (R~5300)	HR (R~100,000)	LR Q (R~120), MR Q (R~890), dual-beam N polarimetry, coronagraphy
SENSITIVITY [mJy] 10 σ , 1h obs. time	N imaging	4	>1000	9	4	8	4
	Q imaging	50		36	60	110	
	LR N	50	>3000	60	80	630	
	MR N	300		210			
	HR N	6000		1200		906	

Future ELT- class



INSTRUMENT		METIS	MIRES	MIISE
Facility		ELT (42 m segmented)	TMT (30 m segmented)	GMT (24.5 m segmented)
MODES	Imaging FOV	18" square	15" square	
	LR N	R~900		R~1500
	MR N	R~3000		
	HR N	R~50,000	R~60,000-120,000	
	Other	HR L/M (R~100,000), N polarimetry, coronagraphy		
SENSITIVITY [mJy] 10 σ , 1h obs. time	L imaging	0.001		0.001
	M imaging	0.018		0.01
	N imaging	0.035	0.001	0.04
	Q Imaging		0.15	0.2
	LR N	0.3		

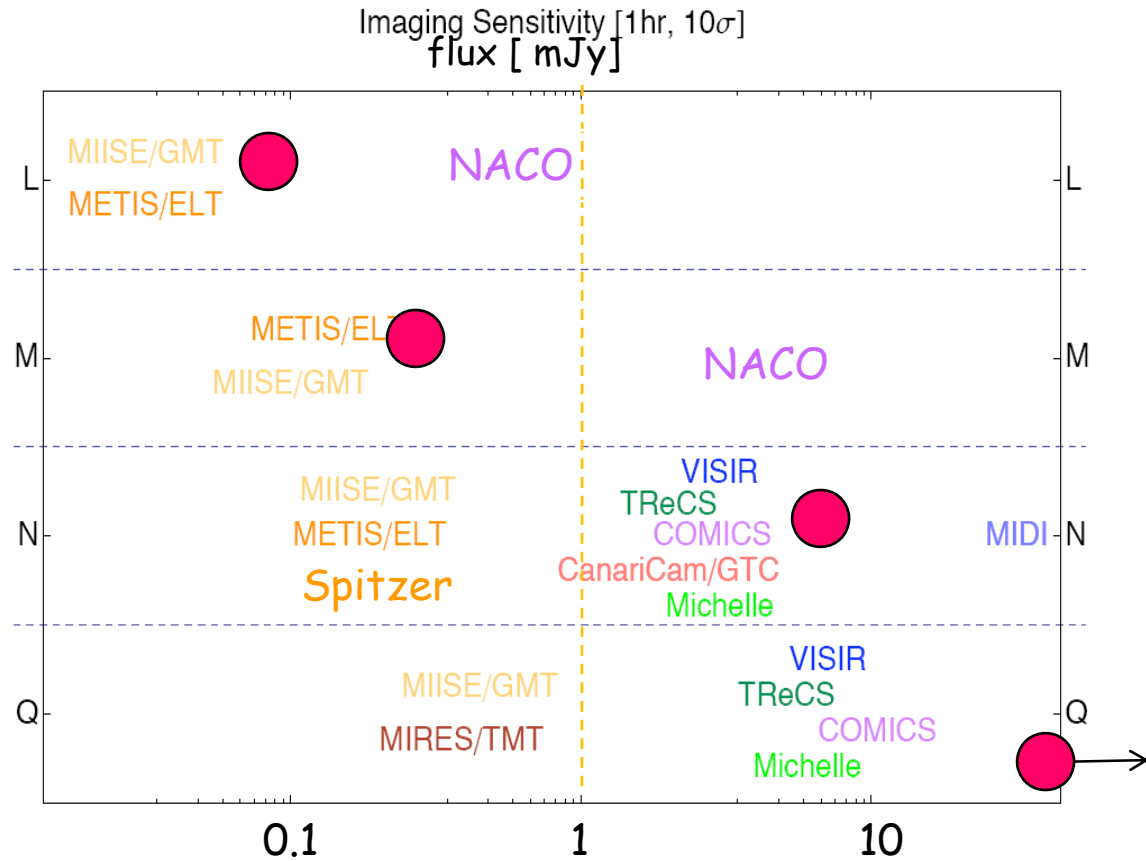
Space & Airborne



INSTRUMENT		IRAC	IRS	MIPS	EXES	FORCAST	MIRI
Facility		Spitzer Space Telescope (0.85 m)	Spitzer Space Telescope (0.85 m)	Spitzer Space Telescope (0.85 m)	SOFIA (2.7 m)	SOFIA (2.7 m)	James Webb Space Tel. (8.5 m segmented)
MODES	Imaging FOV	5.12' square		5.4' square		8.2' square	79" x 113"
	LR N		R-60-120		R-2000		
	MR N				R-10,000		
	HR N		R-600		R-100,000		
	Other		LR N (R-60-120), LR Q (R-600)		range extends beyond N; same R		IFU, coronagraphy

Dome C: IR sensitivities in context

● Dome C
~VLT

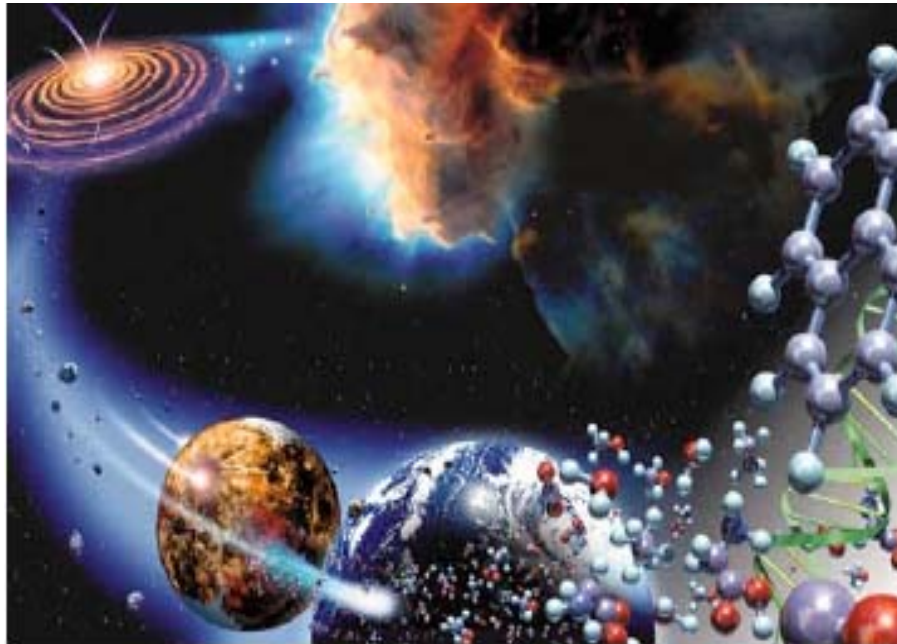


Science in the Galaxy



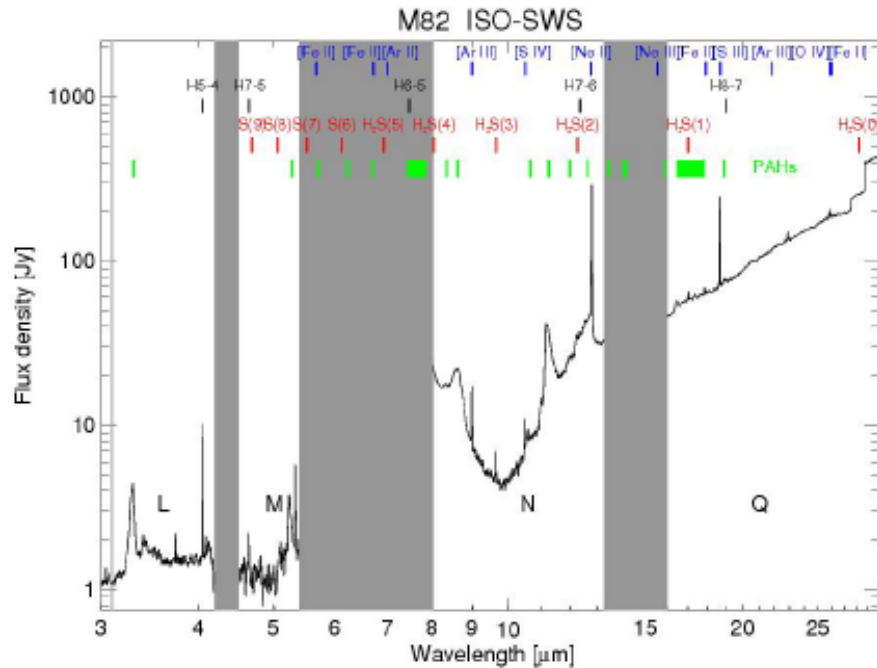
Evolution of
proto-planetary &
debris disks:
spectral index
 $3-10\mu\text{m}$

Formation of
stars in MC:
surveys

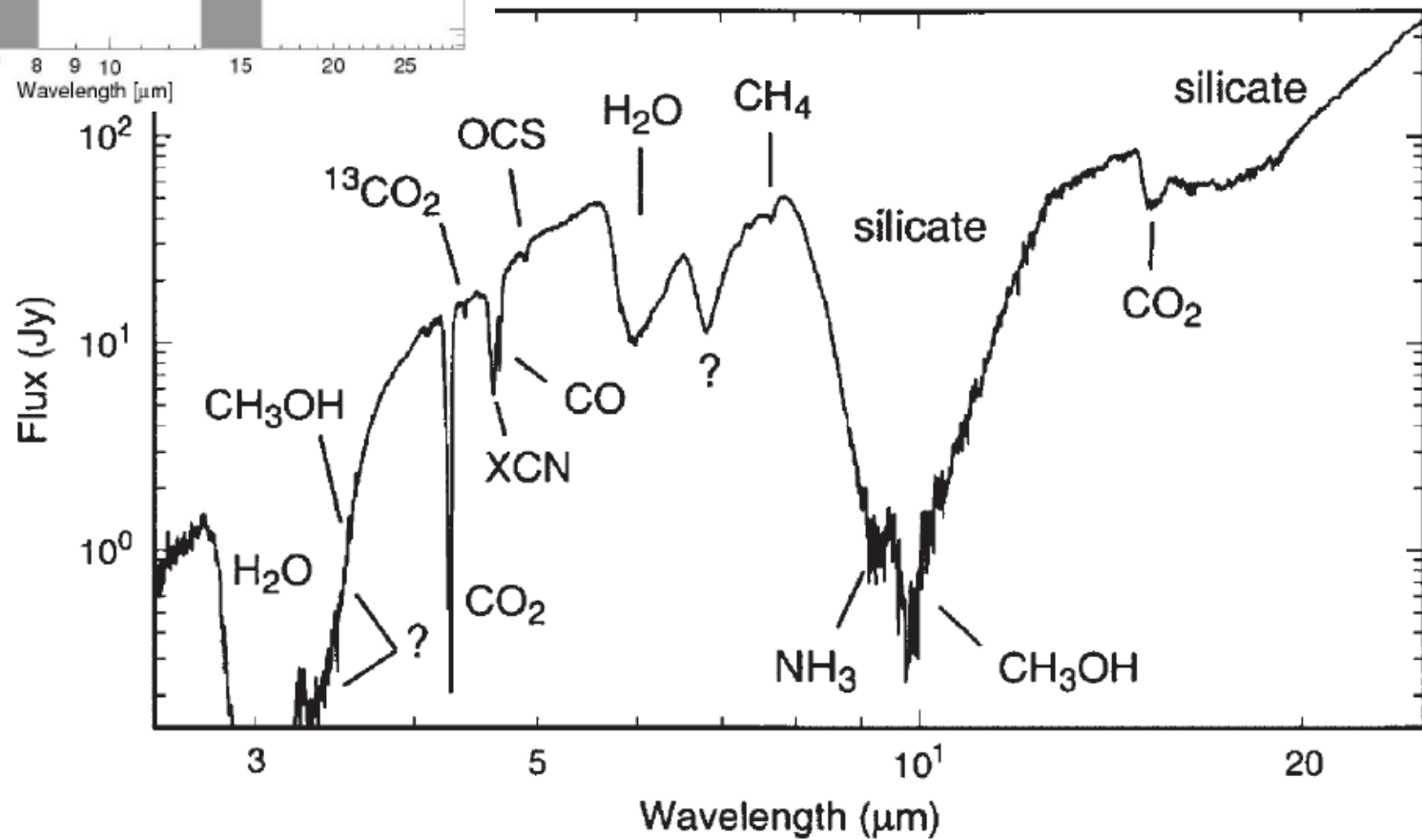


Planet: transits in K

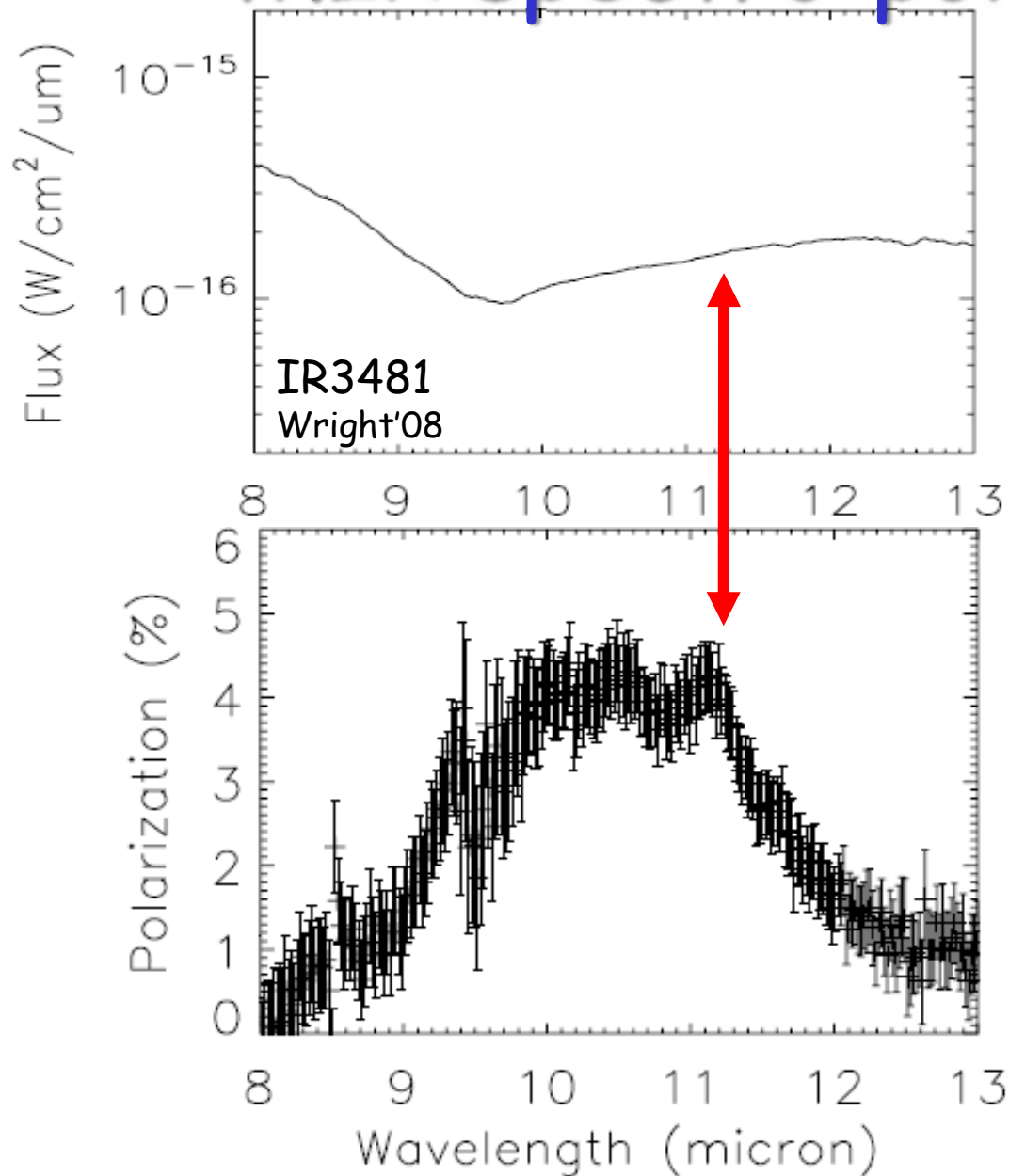
Life cycle of dust
MIR spectro-polarisation



MIR spectra



MIR spectro-pol



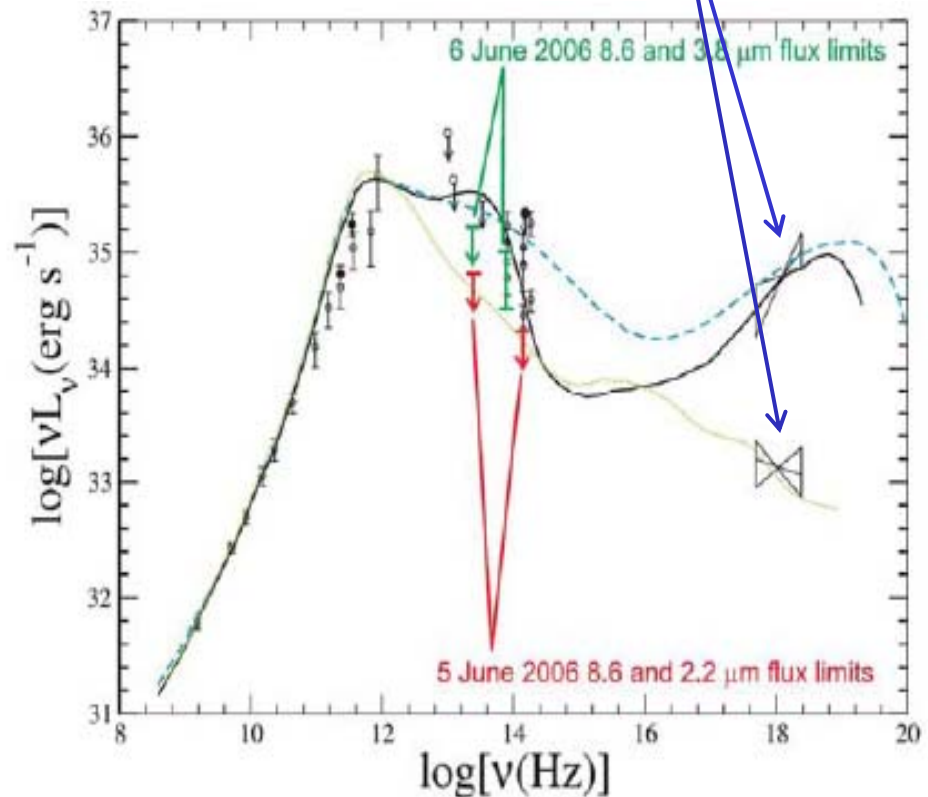
Monitoring of X-ray flares of the GC at $10\mu\text{m}$



Colour Composite of the Galactic Centre
(VLT Melipal + VISIR)

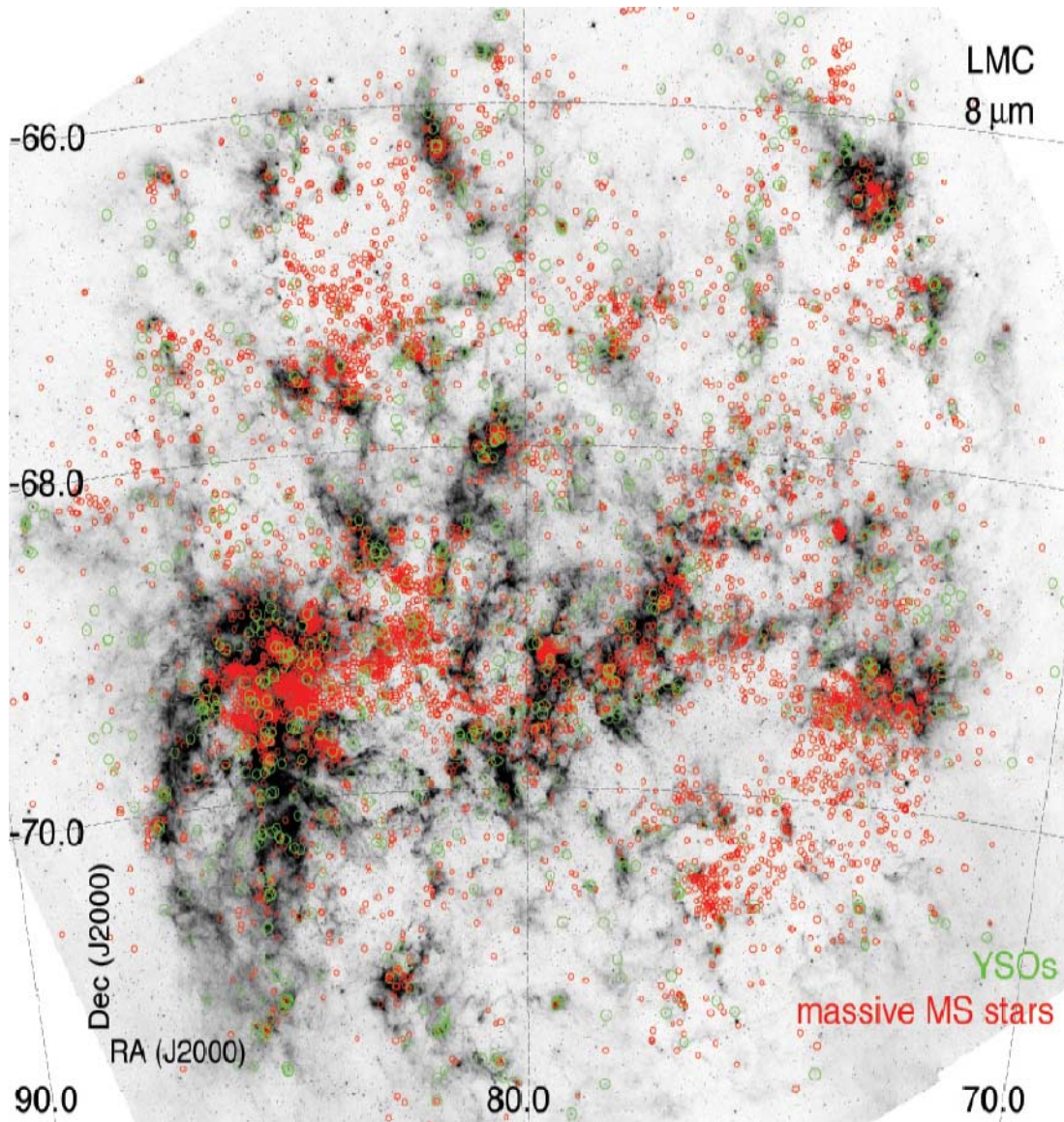
ESO PR Photo 16d04 (12 May 2004)

© European Southern Observatory



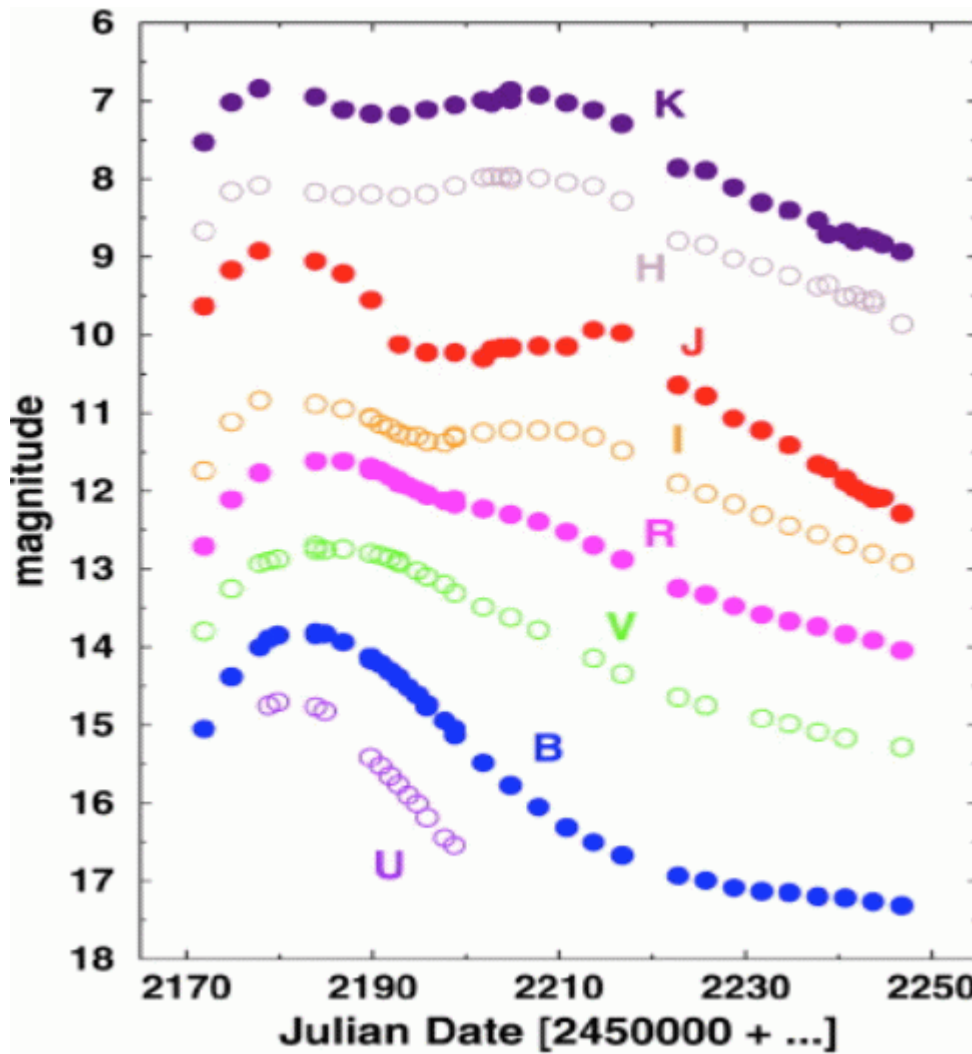
Emission models for Sgr A (Yuan et al. 2003, 2004).*

MIR surveys



Whitney '08

SN light curves in K



+ rapid monitoring
GRB at high z

Burgarella '08



IR instruments from Antarctica:

- 2m telescope (+ tower)

-Surveys

- wide field imaging: K,L band
- SED: K,L,M,N,Q
- low resolution spectro-polarisation in N

-Monitoring

- Sgr A*
- SN
- GRB