DENIS
a DEep Near Infrared Survey of the Southern Sky
(…and beyond)

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On behalf of the DENIS team

overview

- DENIS brief history (1990-2005)
- The great achievements of DENIS/(& 2MASS!)
- The DENIS legacy
- Beyond DENIS/2MASS

Main Partners of DENIS

- Observatoire de Paris (France)
- Leiden Observatory (Netherlands)
- Institut d'Astrophysique de Paris (France)
- Universität Innsbruck (Austria)
- Centre de Données Astronomiques de Strasbourg (France)

- Instituto de Astrofisica de Canarias (Spain)
- Observatoire de la Côte d'Azur (France)
- Observatoire de Grenoble (France)
- Université de Montpellier, GRAAL (France)
- Istituto di Astrofisica Spaziale (Italy)
- Observatoire de Lyon (France)
- Konkoly Observatory Budapest (Hungary)
- Landessternwarte, Heidelberg (Germany)

- Observatoire de Besançon (France)
- Observatoire de Haute Provence (France)
- Universität Wien (Austria)
- Universidade de Sao Paulo (Brazil)
- DAPNIA/SAp, Saclay (France)
- Institut d'Astrophysique Spatiale (Orsay, France)

DENIS co-investigators

- **N. Epchtein, Observatoire de Paris (now at Université de Nice Sophia-Antipolis) , PI**
- **G. Simon, GEPI, Observatoire de Paris , CO-PI**
- C. Alard, IAP/GEPI, Observatoire de Paris
- **J. Borsenberger, SIO, Observatoire de Paris**
- L. Cambrésy, CDS, Observatoire de Strasbourg
- B. de Batz, GEPI, Observatoire de Paris
- F. Crifo, GEPI, Observatoire de Paris
- X. Delfosse, Observatoire de Grenoble
- M. Dennefeld, IAP
- S. Derriere, CDS, Observatoire de Strasbourg
- **E. Deul, Leiden Observatory**
- D. Egret, CDS et Observatoire de Paris
- T. Forveille, Observatoire de Grenoble, et CFHT
- **P. Fouqué, Observatoire de Toulouse**
- F. Garzón, Instituto de Astrofisica de Canarias, Tenerife, Spain
- H. J. Habing, Leiden Observatory
- J. Hron, Vienna Observatory
- **S. Kimeswenger, Innsbruck University**
- **F. Lacombe, LESIA, Observatoire de Paris**
- T. Le Bertre, LERMA, Observatoire de Paris
- C. Loup, IAP
- G. Mamon, IAP and GEPI, Observatoire de Paris
- M.-O. Mennessier (†) , U. Montpellier,
- A. Omont, IAP. Paris
- G. Paturel, Observatoire de Lyon
- P. Persi, Istituto Astrofisica Spaziale, Roma
- A. Robin, Observatoire de Besançon
- **D. Rouan, LESIA, Observatoire de Paris**
- **D. Tiphène, LESIA, Observatoire de Paris**
- I. Vauglin, Observatoire de Lyon
- S. Wagner, Landessternwarte Heidelberg

DENIS: brief history & status

- At the end of 80's; need for an all sky 2 micron survey
- DENIS and 2MASS
- instrument and data processing center implementation(1990-1994)
- DENIS routinely operated 1996 → 2001 (ESO 1 m tel. La Silla)
- DENIS Sky Coverage
  - goal ($-88^\circ < \delta < +2^\circ$)
  - 97 % covered
  - ~ 90% good quality
  - ~ 7% average or bad quality → eventually 91 % of goal
- Images processed at *Paris Data Analysis Center* (IAP/obs. Paris).
- Point Sources extraction
  - Leiden (Deul/Bertin @ *Leiden Data Analysis Center*)→ 2001
  - Paris Meudon Observatory (Borsenberger @ IAP/SIO) (2001→2005)

Main science objectives

- Discover new populations
  - Intrinsically red objects (dwarfs M, L, RGB,…)
  - Dusty objects (AGB, T Tau, YSOs, compact HII ..)
  - Hidden objects and structures (GC, dark clouds, ZoA …)
- Collect data on large unbiased samples of objects
  - Numerical Density of VLMS, IMF in solar neighbourhood
  - IMF of low mass young stars in SFR
  - Census of Magellanic Clouds, Galactic Bulge (ISOGAL) AGB/RGB populations
  - Galactic Structure (scale Height, cut-off, *warp*, ..) extinction (star counts, fractal structure of molecular clouds….)
  - Local Structure of the Universe (galaxy counts, e.g. in ZOA)
- Provide catalogues for VLT, and space missions

	DENIS			2MASS		
Photometric bands Wavelength	Gunn-I 0.8	J 1.25	K_s 2.15	J 1.25	H 1.65	K_s 2.15
Site	ESO, La Silla, Chile			Mt Hopkins USA/ C. Tololo, Chile		
Telescope	1 meter (pre existing)			2 x dedicated 1.3 m		
Arrays	1 x Tektronix 1024 x 1024 2 x NICMOS3 256x 256			3 X NICMOS3 (256x256)		
Pixel size	I: 24 µm; 1''/ JK: 40 µm; 3''			JHK: 40 µm ; 2''		
Image size/ IT	12' x 12' / 10 sec.			10' x 10'		
Sensitivity point s. 3 σ	I = 18.5, J = 16.5; K = 14			J = 17.5; H = 16.5; K = 15.5		
Saturation limit	I = 9.5; J = 7.5; K = 6			K = 5		
Camera	3 separate			1 compact		
Cooling	LN_2 + thermalisation of optical box (+5°C)			Single LN_2 dewar		
Survey strategy & Dithering	Strips of 30° in declination focal microscanning			Tiles of 6° x 6 ° « Ratcheting » secondary		
Coverage objective	Southern sky: -88° < δ < +2°			All sky		
Status	97% achieved 1996-2001			achieved 1997-2000		
Data processing/access	Paris DAC/Leiden DAC / CDS			IPAC/CDS		
Funding	EC/ESO/INSU/CNRS			NSF/NASA		
Cost	2.5 M€					

DENIS Optical lay-out

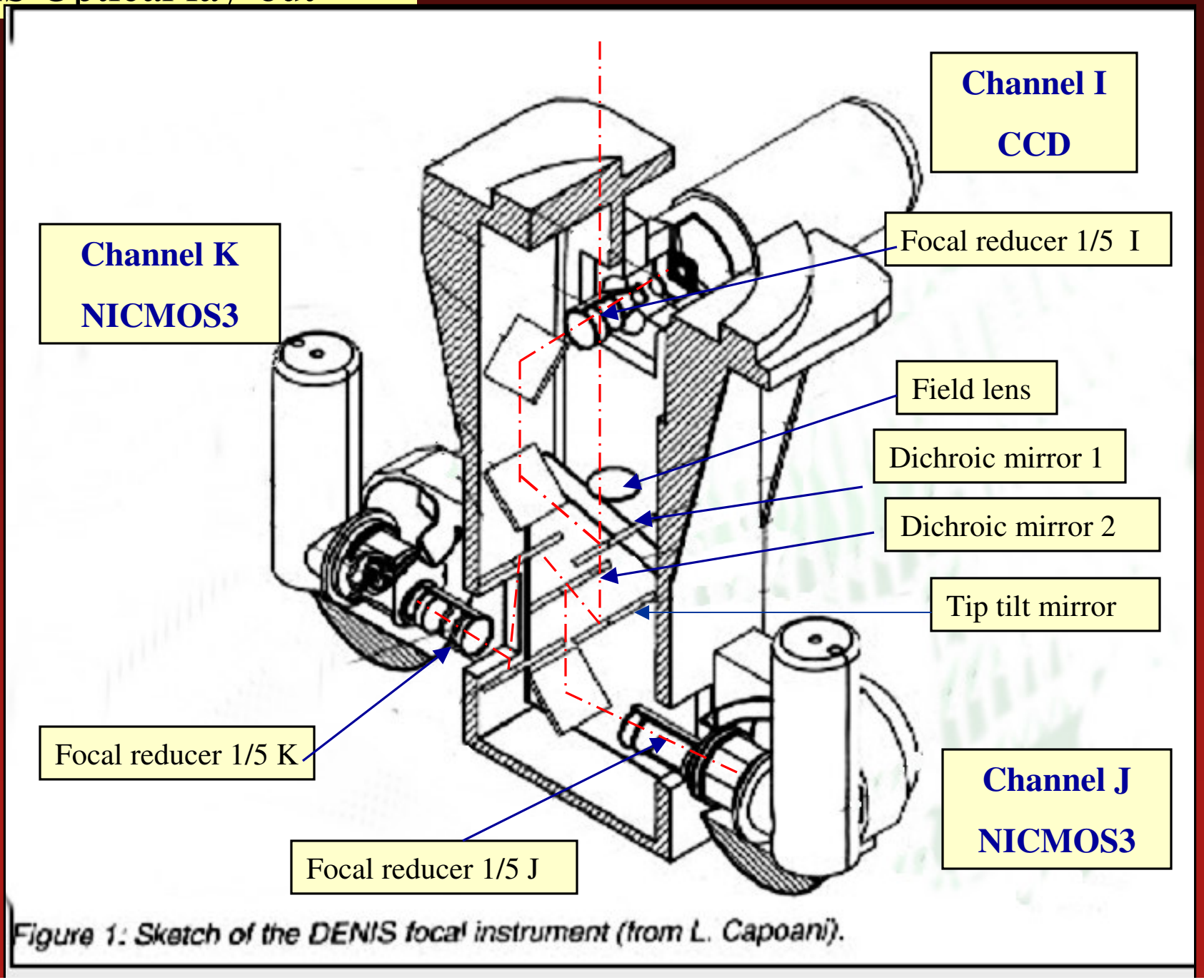
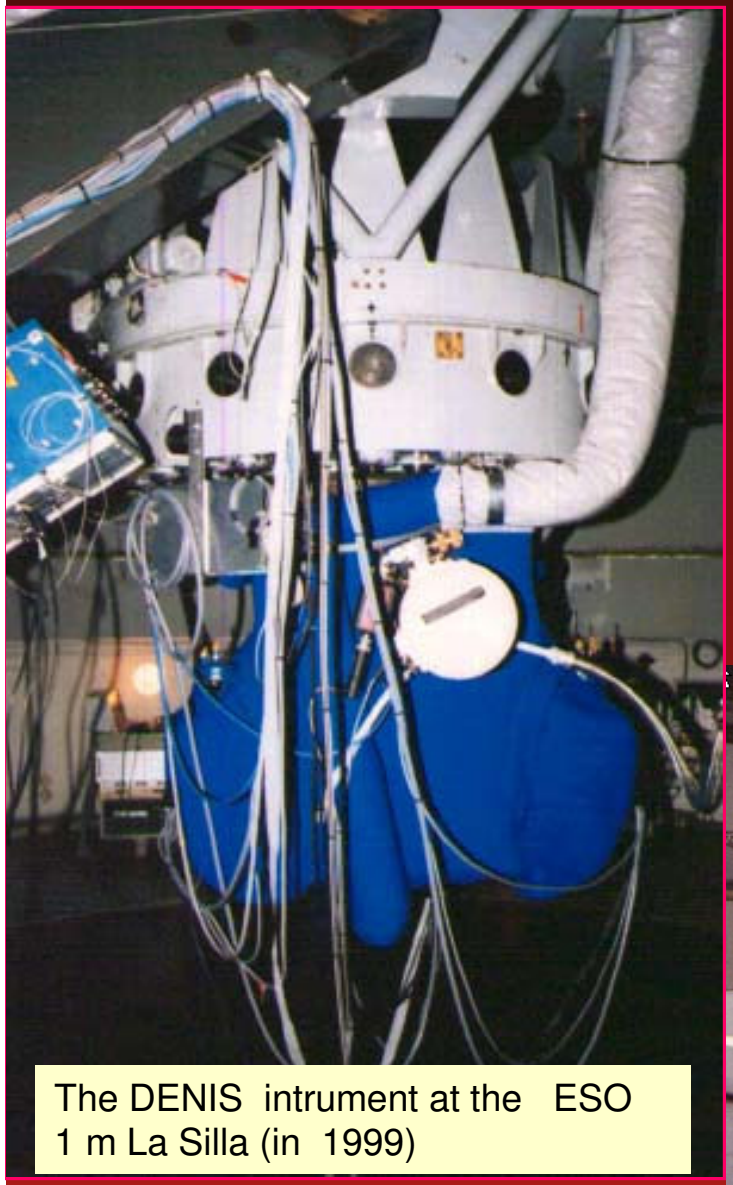
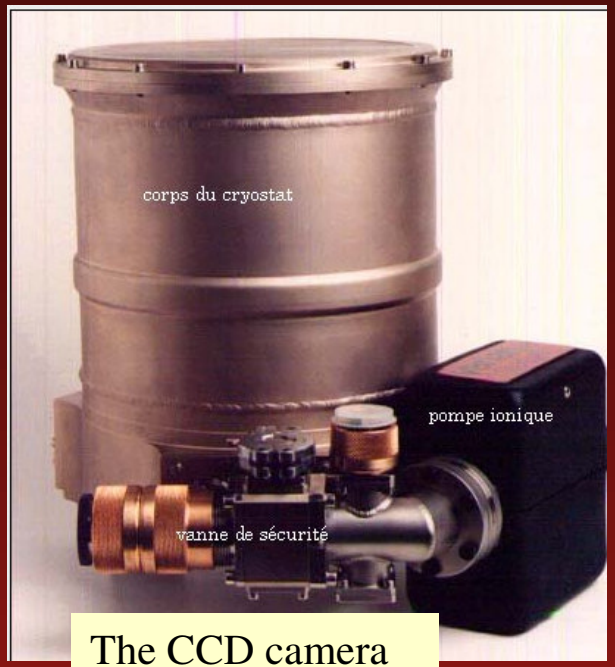


Figure 1: Sketch of the DENIS focal instrument (from L. Capoani).

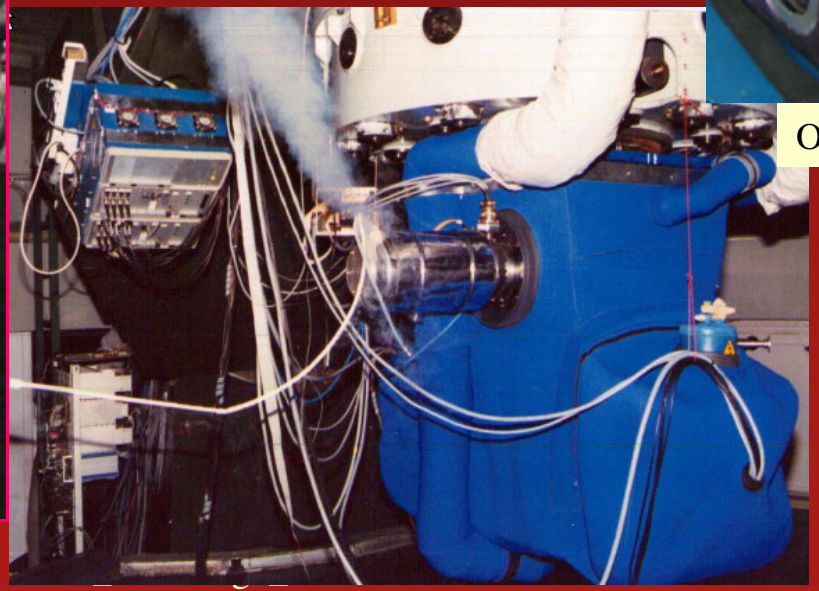


The DENIS intrument at the ESO 1 m La Silla (in 1999)

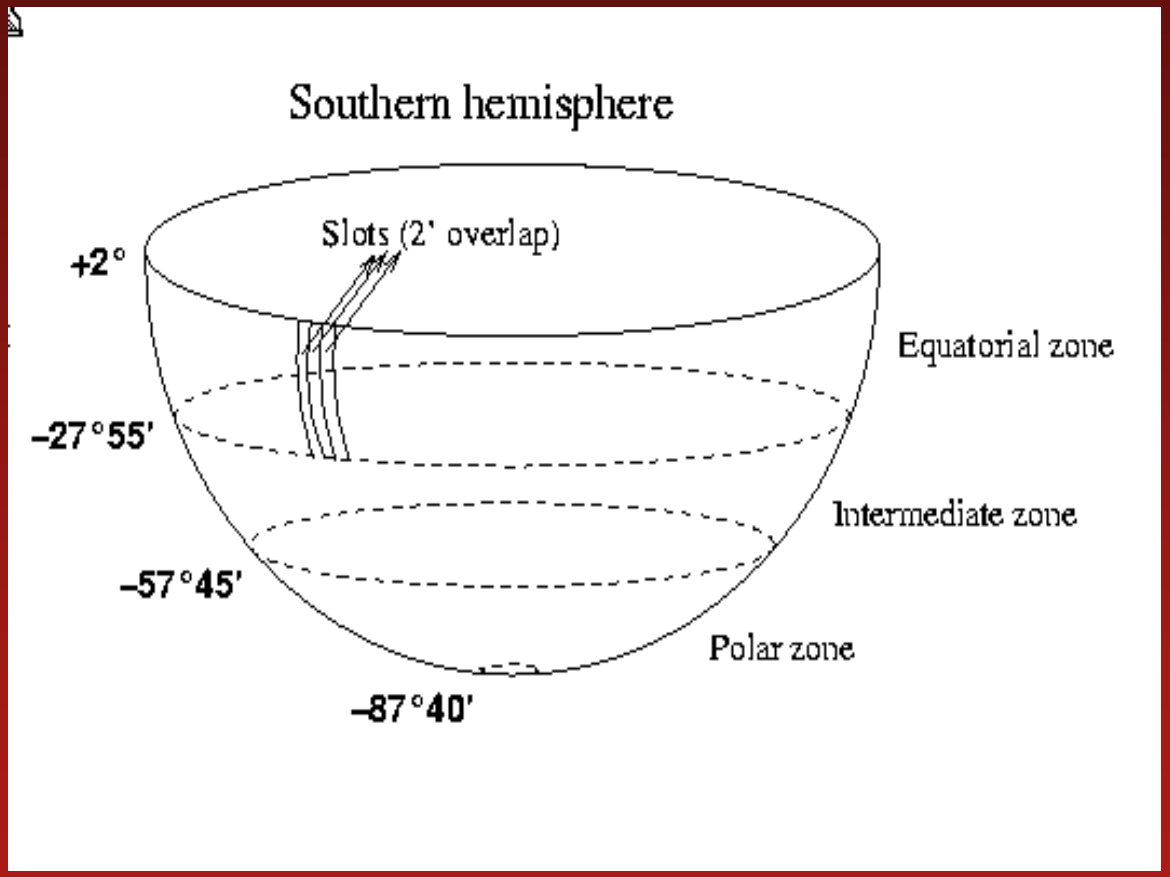


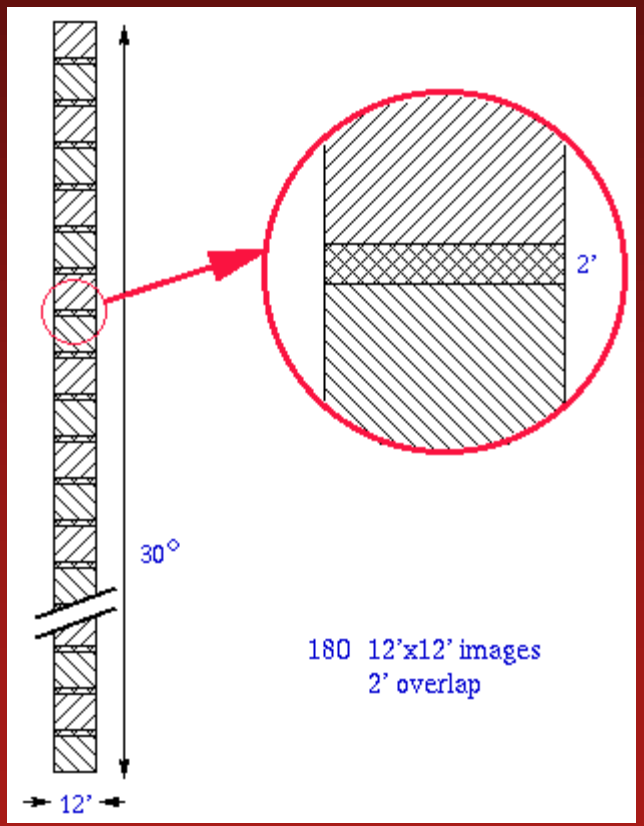
The CCD camera

One of the IR (K camera)

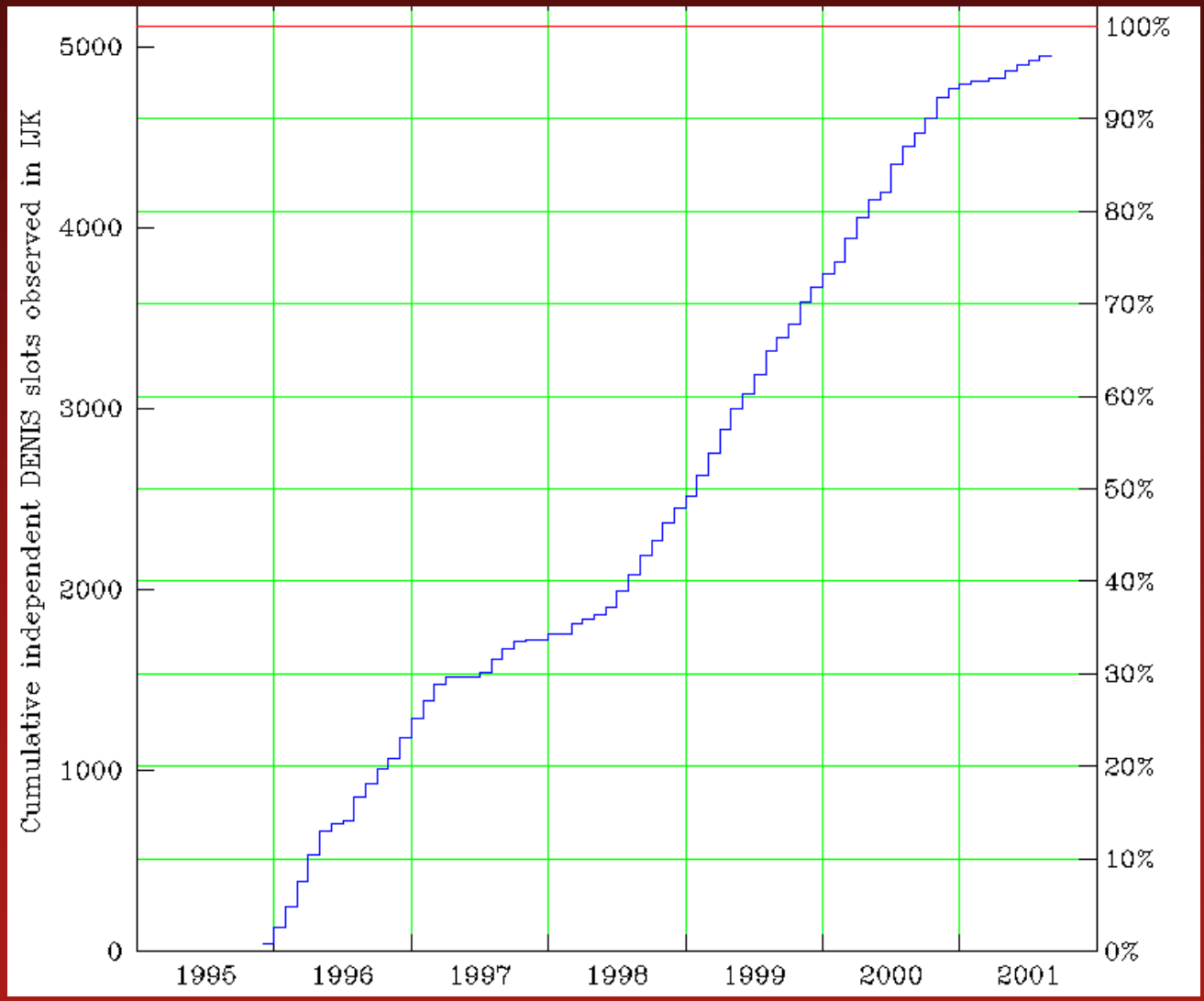


DENIS Observing strategy





DENIS Observation progress *(court. G. Mamon)*



Average point source photometry

	Saturation limit	complete to	Detection Limit (3 σ)	Accuracy (satur→comp)	Average Zero point
I	9.5	16.6	18.5	± 0.03	23.5
J	7.5	15.5	16.5	± 0.05	21.3
K	6.0	13.0	14.0	± 0.05	19.2

Position accuracy (average) : 0.03 arcsec rms (PPM)

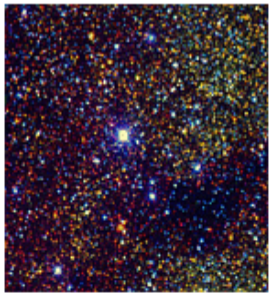
DENIS data Access

- **Public access through CDS (Strasbourg)** (D. Egret, S. Derriere, F. Ochsenbein) http://cdsweb.u-strasbg.fr/denis.html
  - First release: Dec. 1998 (17 million sources)
  - Second release: May 2003 (195 million sources)
  - Third and last (incremental) release: September 2005 (355 million point sources) . Now ~ 80% on line
  - !! Overlaps of adjacent strips → ~ 20 % sources are duplicate
- Special catalogues
  - Catalogue towards Magellanic Clouds (2000)
  - Catalogue of galaxies (2003-2005)
  - ISOGAL catalogues (merging DENIS & ISOCAM 7-15 μm)

How to access DENIS data
http://cdsweb.u-strasbg.fr/denis.html

DENIS

Deep Near Infrared Survey of the Southern Sky



DENIS is a deep astronomical survey of the Southern Sky in two near-infrared bands (J at 1.25 µm and K at 2.16 µm) and one optical band (I at 0.8 µm) simultaneously, conducted by a European consortium, using a one meter telescope (ESO, La Silla). The survey started in 1996 and operations at La Silla have been completed on 9 Sept. 2001.

NEW Third DENIS data release (355 million sources): VizieR access.

The DENIS project

- Overview of the project
- The DENIS team
- Acknowledgements
- Observing strategy

Access to released data

NEW Third DENIS Release (sep 2005)
- Access the 355 million point sources via VizieR
- Contents of this second release: ReadMe file.

VizieR Search Page

CDS · Simbad · VizieR · Aladin · Catalogues · Nomenclature · Biblio · Tutorial · Developer's corner

Tokyo, Japan · IUCAA, India · CADC, Canada · Cambridge, UK · CFA/Harvard, USA · UKIRT-Hawaii, USA · INASAN, Russia · Bejing Obs., China [Help]

	B/denis	The DENIS database (DENIS Consortium, 2005) (ReadMe) [Similar Catalogues]
1.	B/denis/denis	NEW 3rd release of DENIS (2005Sep) *(355220325 rows)*
		See also the DENIS home page

Query Setup *(usage)*

Maximum Entries per table: 50 | Output layout: HTML Table | Output Order: (+) (-) | Reset All

Query by Position on the Sky *(Adapt Form to use a List of targets)*

Target Name (resolved by SIMBAD) or **Position**: Clear | 05 51 46.0 -44 34 12.0 | J2000

Position in (•) Sexagesimal or ( ) Decimal °

Target dimension: 10 | arcmin

(•) Radius or ( ) Box size

Submit Query

Output preferences for Position:

	r	x,y	Position	Galactic	J2000	B1950
Compute	☑	☐	☑	☐	☐	☐
Sort by	(•)	( )	( )	( )	( )	( )

r and **x,y** are the distance to the Target;
Position is in the same coordinate system as **Target**.

Query by Constraints applied on Columns *(Not all columns present in the form!)*

Show	*Sort*	*Column*	Clear *Constraint*		*Explain*
☑	( )	Strip			DENIS strip number
☑	( )	RAJ2000		deg	Right ascension (J2000)

VizieR Result Page

CDS · Simbad · VizieR · Aladin · Catalogues · Nomenclature · Biblio · Tutorial · Developer's corner

Result of VizieR Search within **1'** of **05 51 46.0 -44 34 12.0**(J2000) (no other constraint specified)
ordered by increasing _r

Modify the Query

Max. Entries: 50 | Output layout: HTML Table | **ALL** columns | ReSubmit | B

B/denis/denis

The DENIS database (DENIS Consortium, 2005) (ReadMe)
NEW 3rd release of DENIS (2005Sep)

To get all details for a row, just click on the row number in the leftmost `Full' column.
The 3 columns in ***color*** are computed by VizieR, and are ***not part of the original data.***

Note: *See also the DENIS home page*

Binary brown dwarf

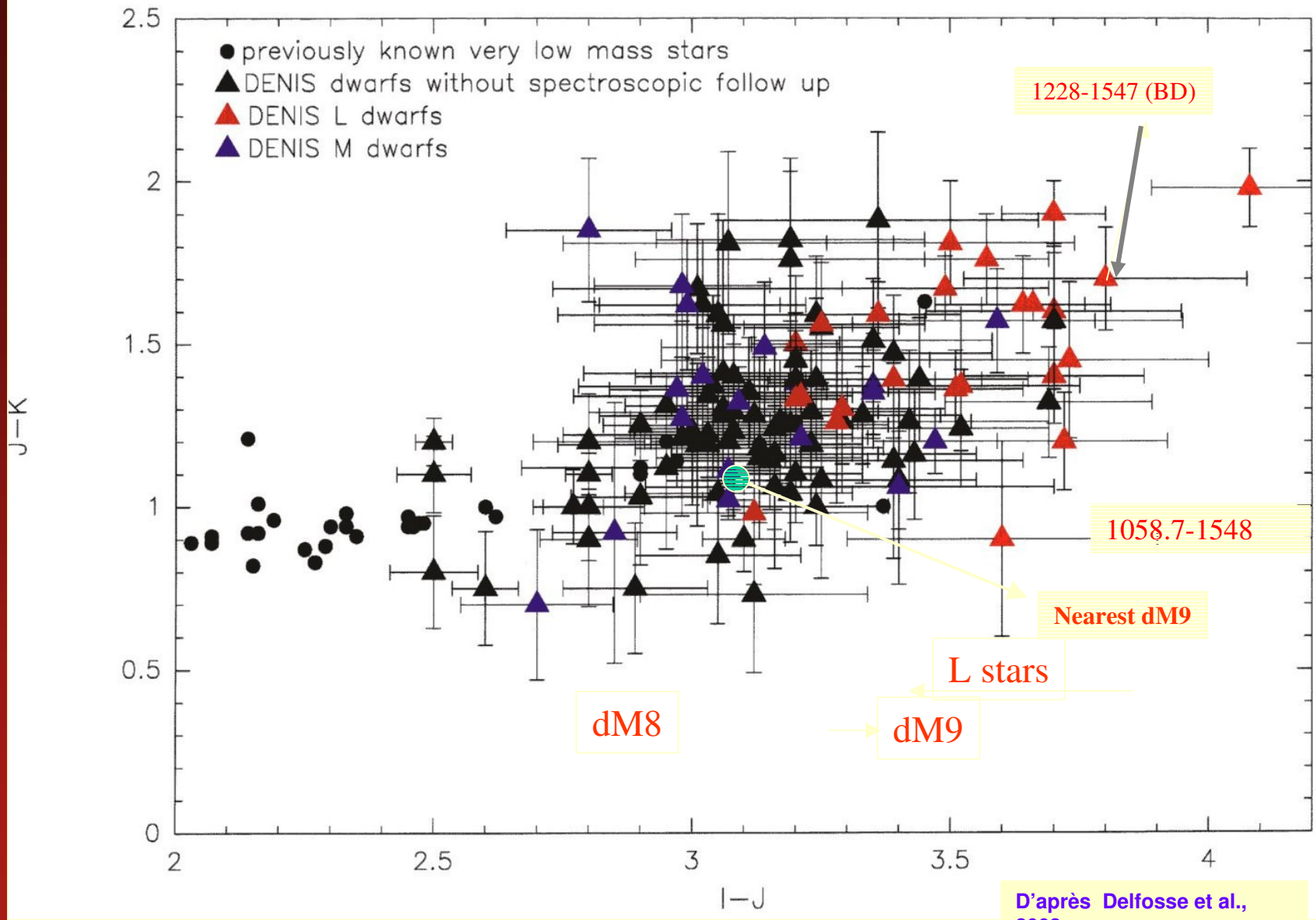
Full	_r	_RAJ2000	_DEJ2000	Strip	RAJ2000	DEJ2000	Imag	e_Imag	Jmag	e_Jmag	Kmag	e_Kmag	Rmag	Bmag	Ipsf	Jpsf	Kpsf
	arcmin	"h:m:s"	"d:m:s"		deg	deg	mag	mag	mag	mag	mag	mag	mag	mag			
1	0.0095	05 51 46.00	-44 34 12.6	9032	087.941686	-44.570157	18.434	0.26	15.541	0.19					49	81	
2	0.2017	05 51 46.50	-44 34 01.1	9032	087.943734	-44.566978	17.993	0.21					17.7	18.9	83		
3	0.2128	05 51 46.59	-44 34 00.9	8702	087.944134	-44.566920	17.888	0.19					17.7	18.9	88		
4	0.3119	05 51 45.62	-44 33 53.7	8702	087.940099	-44.564923			15.781	0.20						85	
5	0.4474	05 51 44.98	-44 33 47.5	9032	087.937417	-44.563186					13.736	0.28					75
6	0.5163	05 51 47.98	-44 33 49.4	9032	087.949924	-44.563719	12.905	0.03	12.319	0.08	11.907	0.11	13.5	14.4	99	99	96
7	0.5164	05 51 47.98	-44 33 49.3	8702	087.949896	-44.563700	12.916	0.04	12.428	0.08	11.969	0.10	13.5	14.4	99	97	95

Some science highlights of DENIS

Low Mass stars and brown dwarfs discovery

- **T. Forveille, X. Delfosse, E. Martin, F Crifo**
- **X. Delfosse**, PhD, Grenoble 1997, sup. T. Forveille
- **Phan Bao**, PhD, Paris 6, 2002 , sup. F. Crifo/J. Guibert

- Sample of 300 cool dwarfs I-J >3.0
- 1/3 L dwarfs, and 2/3 M > M8
- Reject artefacts
- Complete to I =18
- The I-J selection selects all the L type stars
- No contamination by other red objects (giants, galaxies..)



D'après Delfosse et al., 2003,

search of BD

- Selection criteria
  - I - J > 3 (redder than M8)
  - |b| > 20 °
  - Main Problem : **reject artefact**
- Mini survey (1997-98) (230 sq. deg.)➔ 3 very red objects first confirmed BD

(DENIS PJ 1228.2-1547) (Li test)

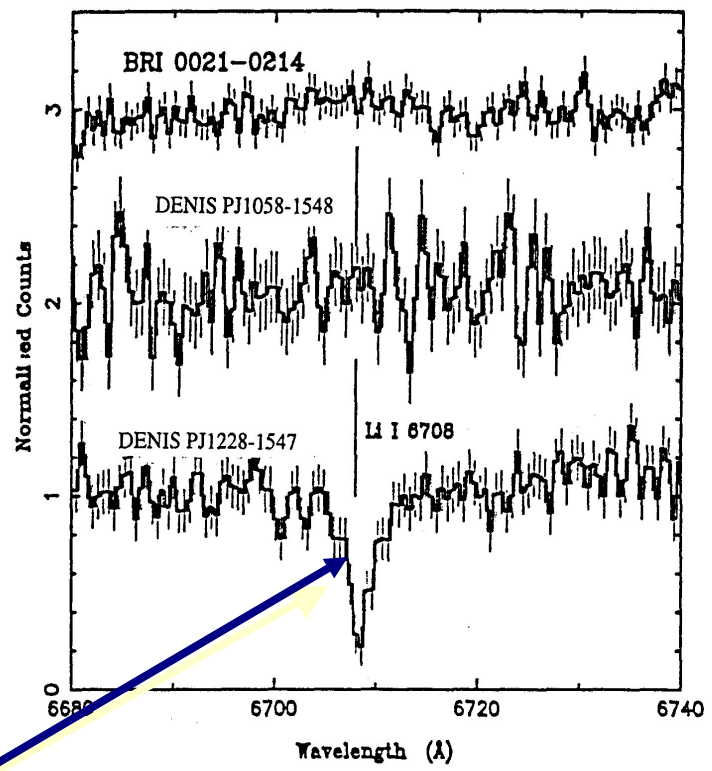
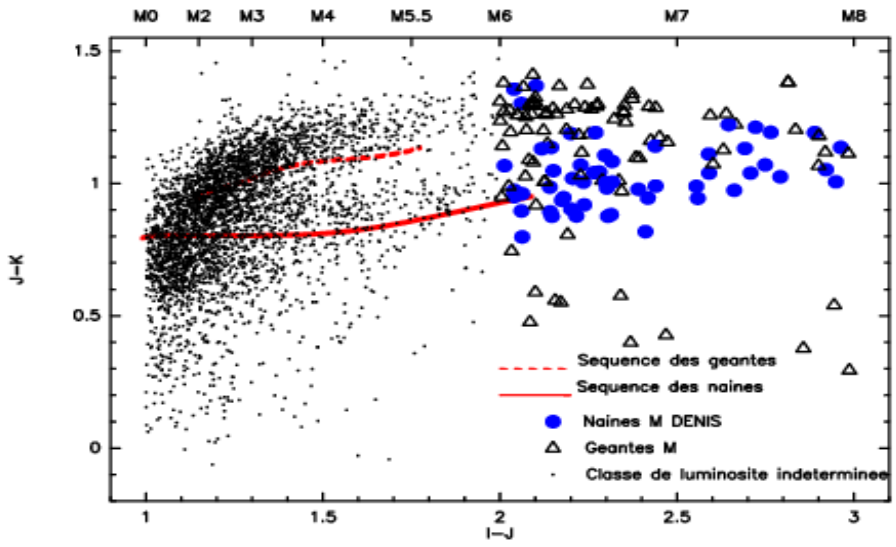


Fig. 2.— High resolution (1 Å) AAT spectra in the region of the Li I 6708 Å line. Each spectrum has been normalised to unity at 6660-6680 Å, and offset in unit steps for clarity. Error bars show the propogated photon-counting uncertainties.

Dwarfs in the solar neighbourhood

- Stellar content of the Solar neighbourhood still not completely known
- Mainly late dwarfs >M6

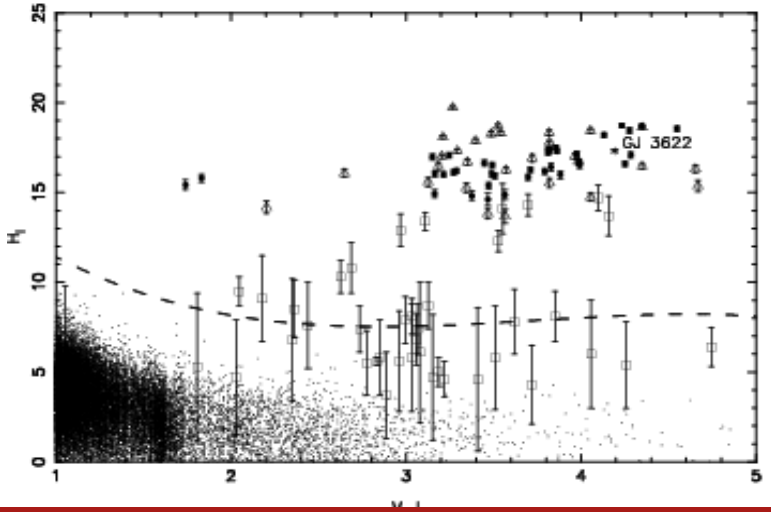


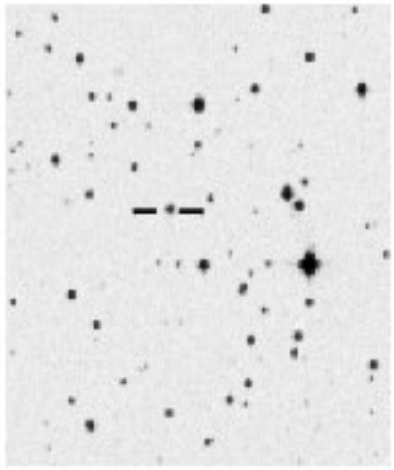
D'après Delfosse et al., 2003,

From Delfosse et al., 2003,

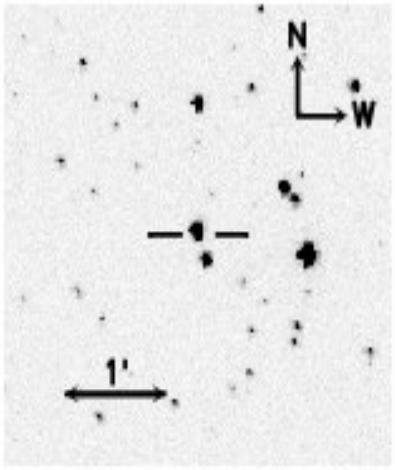
- •search of M6-M8 dwarfs at d <30 pc
- •Colour criteria (2.0<I-J<3.0) and photometric distances
- •Giant rejected (proper motions)
- •About 65 M dwarfs discovered between 5 and 30 pc (Phan Bao et al., 2001, A&A 280, 590; 2003, A&A 401, 959)
- •Spectroscopic follow-up (Crifo et al., A&A, 441,653)

Reduced proper motions of our objects: giants and dwarfs. Dots represents 28022 giants from Hipparcos. The curve shows the reduced maximum proper motions of a giant having the escape velocity of the Galaxy





ESO R: 1986.118



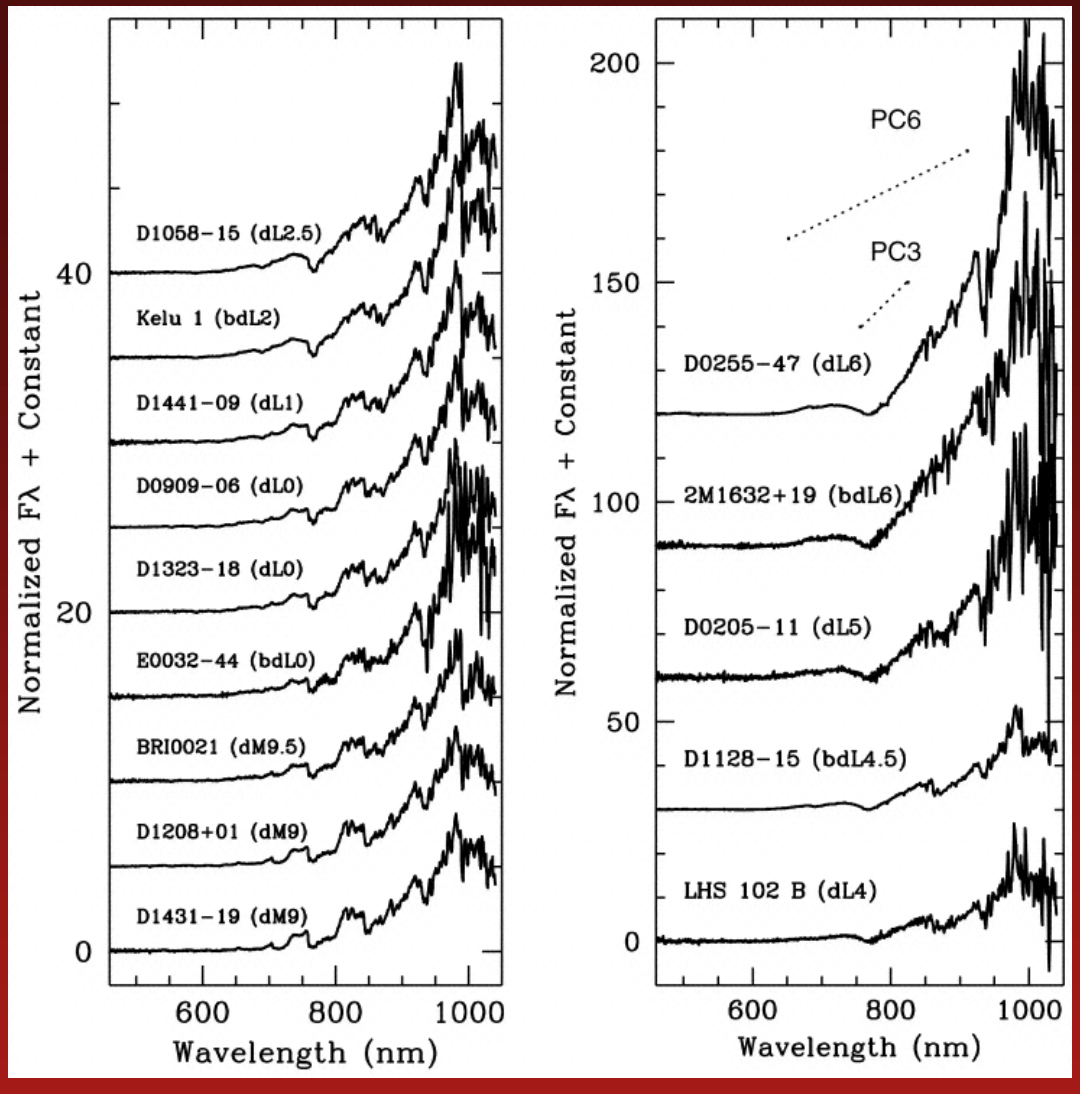
DENIS I: 1999.113

An example of a nearby M9.5 star found by DENIS:

PJ 1048-3946 (distance: 4pc)

From Delfosse et al., 2003,

From Delfosse et al., 2003,



- Stellar classification proposed by Martin et al. 1999, AJ 118, 2466 upon DENIS observations
- Based on pseudo continuum PC3
- Each sub type represents a jump of 100 K of Effective temperature

A few interesting dwarfs discovered by DENIS

- Three first isolated BDs (Delfosse et al. A&A., 1997, 327, L25)
  - **DENIS- J1228.2-1547** binary (Brandner et al 2004, A&A, 428, 205)
  - **DENIS- J1058.7-1548**
  - **DENIS- J0205.4-1159** binary and possibly 3 components L dwarf (Bouy et al., 2005, AJ 129, 511)
- **DENIS -J104814.7−395606: most nearby dM9 (4~pc)** (Delfosse et al., 2001, A&A, 366, L13)
- **DENIS -J055146.0-443412AB** : a large separation BD binary (M8.5/L0) (Billière et al., 2005; astro-Ph/0508130)
- **DENIS -J033411−495333** another nearby M9 (d ~7pc) (Phan et al, 2005, MNRAS in press, astro-Ph/0510639)

Interstellar Extinction & stellar Formation

- E. **Copet**, PhD. Paris 7, 1996 , supervisor. D. Rouan
- L. **Cambrésy**, PhD. Paris 7 1999, supervisor N. Epchtein
- R. **Vavrek**, PhD. Paris7/ U. de Budapest , 2001, co-supervisors . L. Balazs et N. Epchtein
- **Myha Vuong,** PhD. UNSA/CEA supervisors N. Epchtein, T. Montmerle

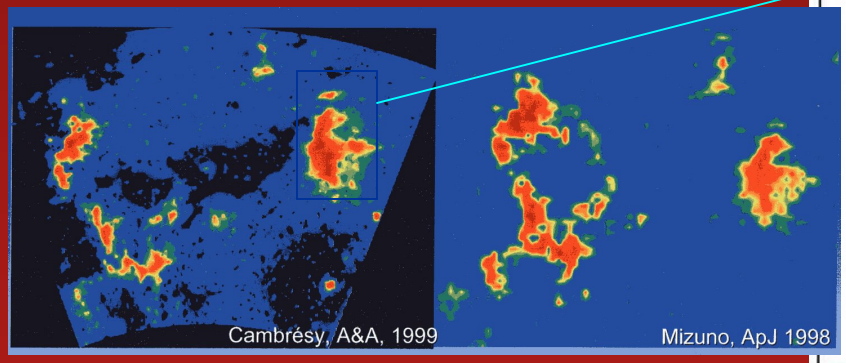
Dark cloud extinction studies and identification of young low mass stars

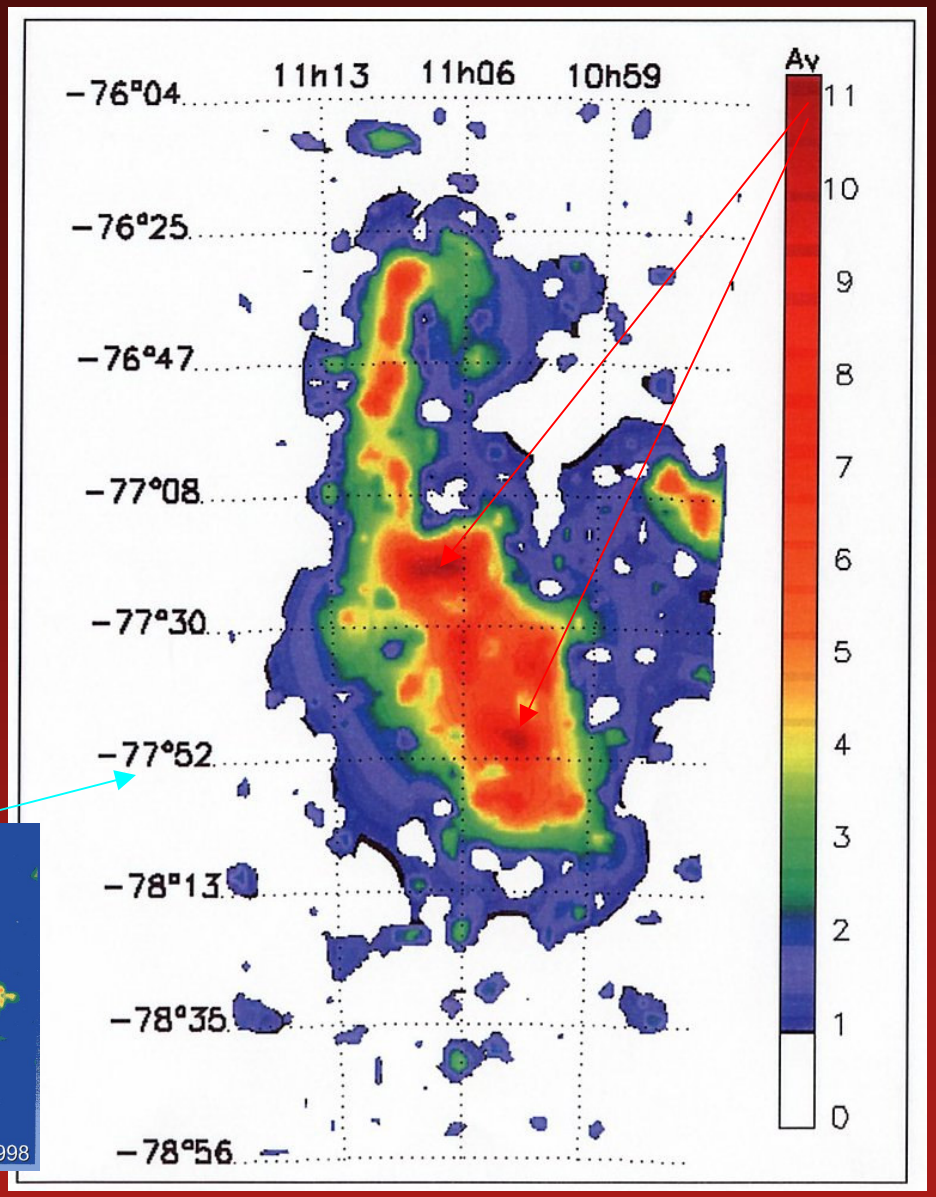
- Source counts to estimate dust extinction (Wolf diagrams)
- Adaptive counts + wavelet analysis (Cambrésy, PhD., 1999, Cambrésy *et al*. 1997 A&A 324, 5)
- (multi) fractal Structure of clouds (PhD Vavrek, 2001)
- Extinction mapped at 1 arcmin. resolution up to A_V= 10 in Cham I cloud
- Dereddening of DENIS sources → Extract young low luminosity objects (T Tau)(Cambrésy et al. 1998, A&A 338, 977; Vuong et al. , 2001, A&A 379, 208)
  - Identification with X ray & ISOCAM sources
  - Search of young BDs

Chameleon I cloud:

extinction map derived from DENIS J counts (Cambrésy et al. 1997)

•Next step : full coverage of the clouds (Vuong et al., 2001) and other clouds (Lupus, Rho oph, Serpens, coal sack) in progress





Galactic Structure

- **S. Ruphy**, PhD. Paris 6, 1996, supervisor, N. Epchtein
- **S. Derriere**, PhD. Strasbourg . 2001, supervisor, D. Egret
- **M. Schultheis**, PhD Vienna Austria, 1999, supervisor, J. Hron
- **S. Picaud,** PhD, Besançon, 2003, supervisor A. Robin
- **F. Schuller** PhD, Paris, 2004, supervisor A. Omont

Galactic Structure

(Ruphy et al., 1996 A&A 313, 21)

Comparison between DENIS star counts with synthetic models of the Galaxy lead to estimate the scale height and cut off limit of the disk of the Galaxy.

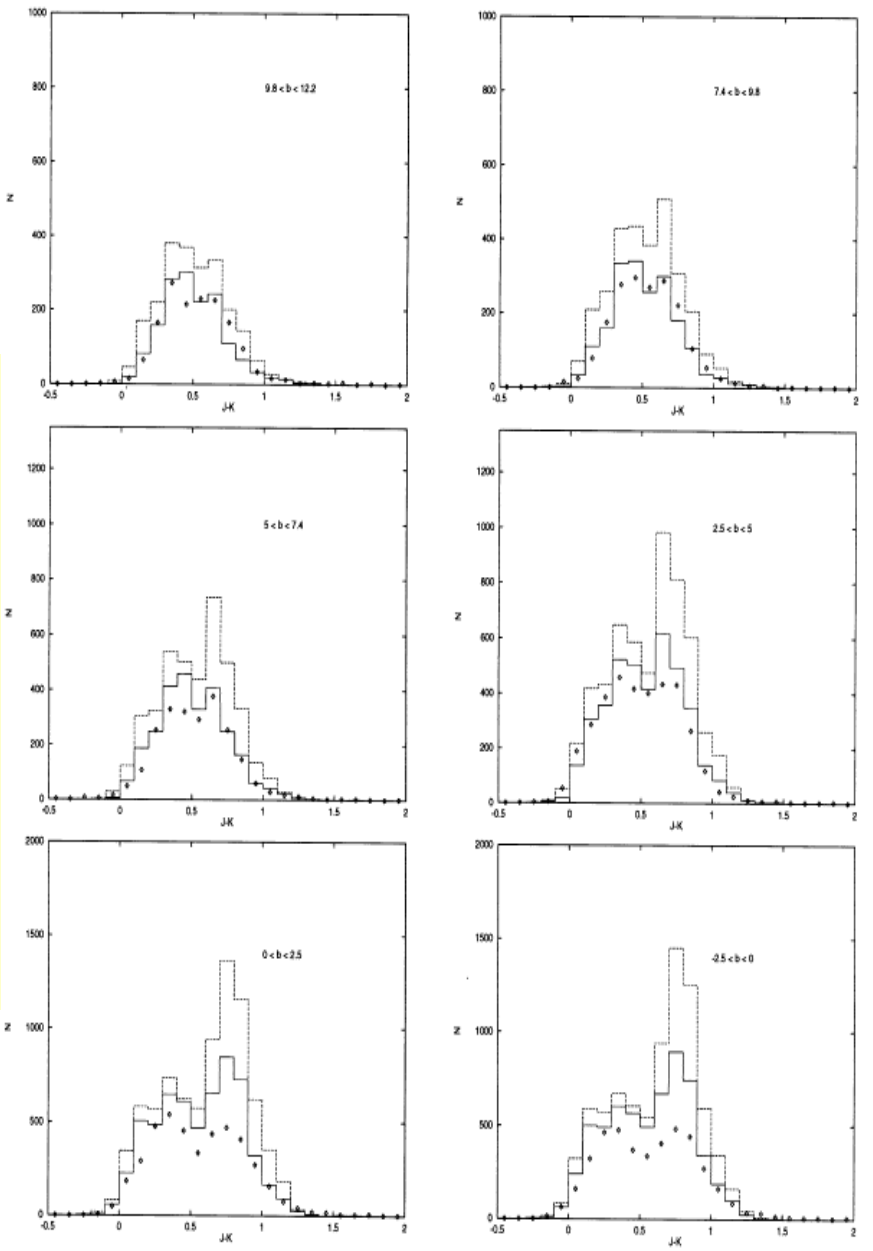
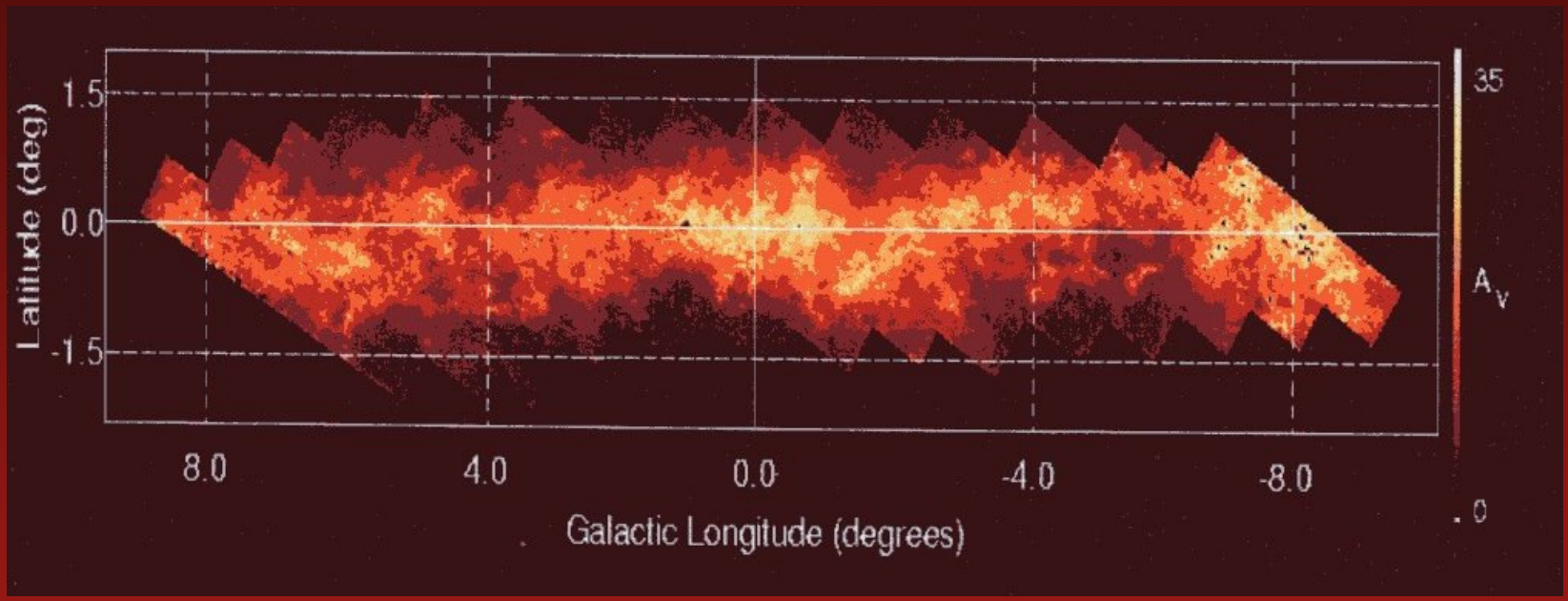


Fig. 1. J-K distributions of sources brighter than 13.5 in K, for different ranges of latitude in the strip II, as specified on the figures. Diamonds : DENIS data ; dashed line : model prediction for $h_R = 3.5$ kpc and $R_{max} = 15$ kpc ; solid line : model prediction for $h_R = 2.3$ kpc and $R_{max} = 15$ kpc.

Extinction map of the galactic center

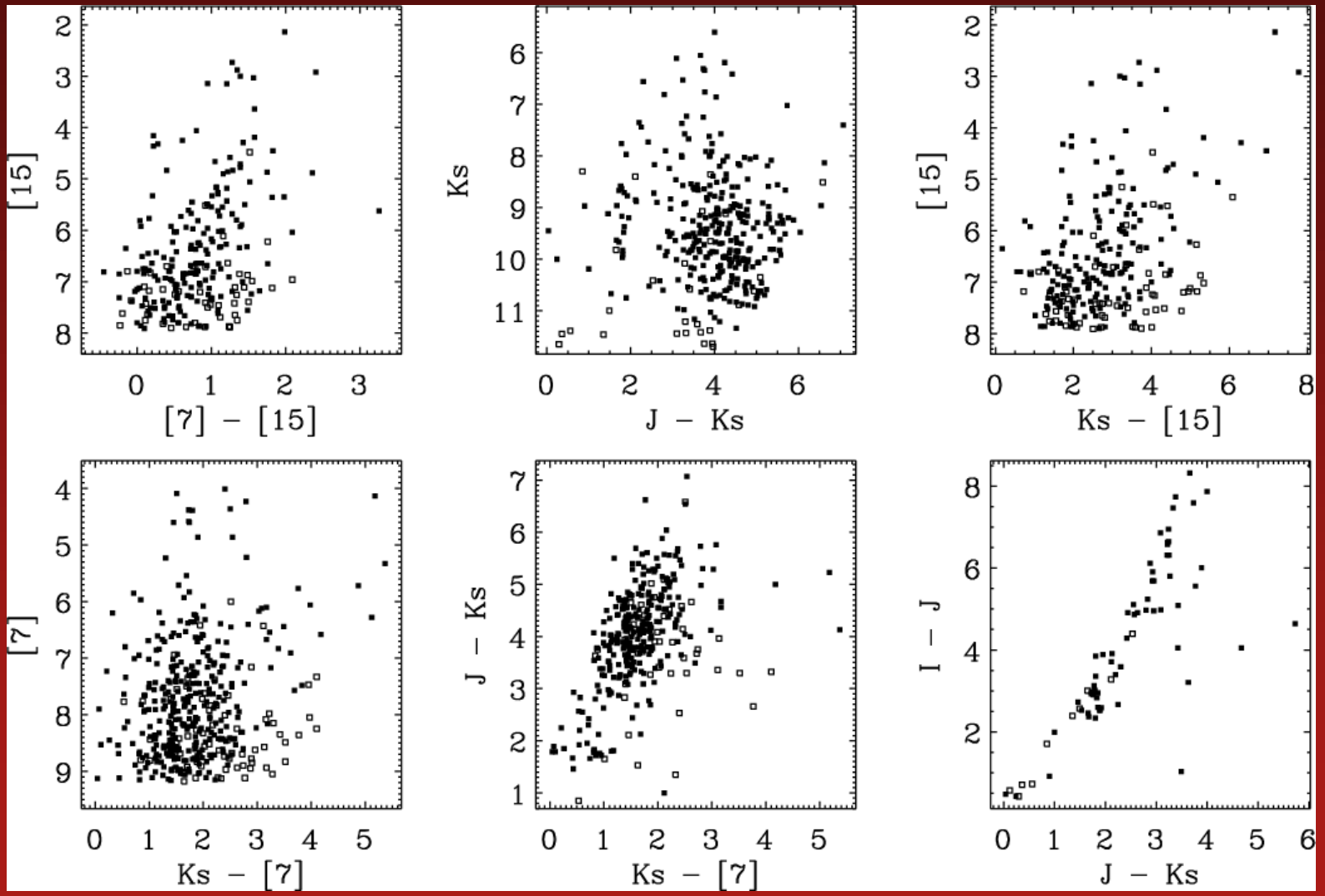


From Schultheis, et al., 1999 A&A. **349**, 69

DENIS+ ISO ➔ISOGAL
(PI A. Omont, IAP)

- sample of bulge and galactic disk fields totalizing 16 sq. degrees
- ISOCAM (7 & 15 μm) + DENIS IJK → catalogue in 5 colours **(Omont et al. A&A 403, 975)**
- 10^5 sources mainly AGB/ RG/ YSOs.
- Bulge populations, extinction maps,…
- Should be completed in L' M' bands
- Catalogue ISOGAL: http://www-isogal.iap.fr

Colour colour diagrams ISOGAL



- **1-** ***First ISOCAM images of the Milky Way*****,**
- **2-** ***Detection of Young Stellar Objects with ISO*****,**
- **3-** ***ISOGAL survey of Baade's windows in the mid-infrared*****,**
- **4-** ***ISOGAL-DENIS detection of red giants with weak mass-loss in the Galactic Bulge*****,**
- **5-** ***A survey of selected areas in the Galactic plane with ISOCAM*****,**
- **6-** ***OH/IR stars in the inner bulge detected by ISOGAL*****,**
- **7-** ***DENIS and ISOGAL properties of variable star candidates in the Galactic Bulge*****,**
- **8-** ***The search for YSOs from ISOGAL data*****,**
- **9-** ***Low resolution spectroscopy of ISOGAL sources: Search for early-type stars with infrared excess*****,**
- **10-** ***Mass-losing Semiregular Variable Stars in Baade's Windows*****,**
- **11-** ***Young massive stars in the ISOGAL survey. II. The catalogue of bright YSO candidates*****,**
- **12-** ***Infrared dark clouds from the ISOGAL survey. Constraints on the interstellar extinction curve*****,**
- **13-** ***Radio-millimetre investigation of galactic infrared dark clouds*****,**
- **14-** ***Stellar sources in the ISOGAL intermediate bulge fields***
- **15-** ***The ISOGAL field -18.63+00.35: Mid-infrared interstellar extinction and stellar populations*****,**
- **16-** ***86 GHz SiO maser survey of late-type stars in the Inner Galaxy. I. Observational data*****,**
- **17-** ***Infrared stellar populations across the inner Galactic Bulge*****,**
- **18-** ***Explanatory Supplement of the ISOGAL-DENIS Point Source Catalogue*****,**
- **19-** ***Near-IR spectra of ISOGAL sources in the inner Galactic Bulge. Stellar population analysis*****,**
- **20-** ***ISOGAL: a deep survey at 7μm and 15μm of the obscure inner Milky Way with near-infrared DENIS associations*** **,**

Magellanic Clouds

- **M R Cioni**, PhD Leiden, 2001 , supervisor, H. Habing
- **N. Delmotte**, PhD. 2002 Strasbourg/ESO, supervisor, D. Egret

Magellanic Clouds

- Catalogue of LMC & SMC prepared at Leiden Observatory (DCMC) **(Cioni et al., 2000, A&AS, 144, 235)**
- Objects detected at least in 2 colours

	LMC	SMC
Covered Area Center	19.9 ° x 16° 05:27:20 -69:00:00	14.7° x 10° 01:02:40-73:00:00
Number of sources	1 319 900	315 780

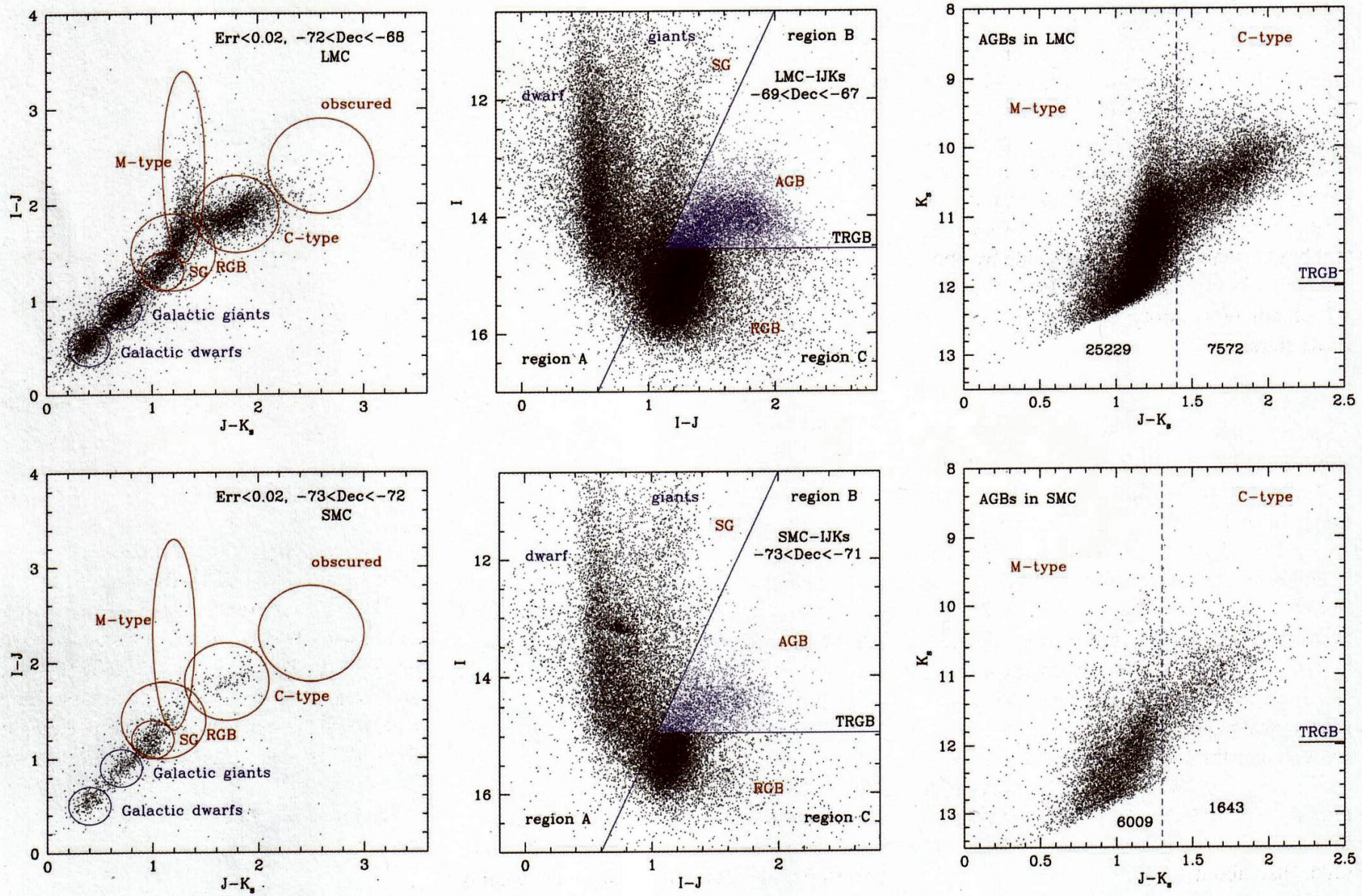


Figure 2: Colour–colour diagram (*I* –*J*, *J* –*Ks*) (left), colour–magnitude diagram (*I* –*J*, *I*) (centre) and (*J* –*Ks*, *Ks*) (right) of sources detected simultaneously in *I*, *J* and *Ks* in the LMC (top row) and in the SMC (bottom row). The horizontal line marks the position of the TRGB, and the slanted line at $I = -4.64(I - J) + 19.78$ defines the regions A, B and C explained in the text. The vertical dashed line discriminates M– type from C–type stars.

From Cioni et al., ESO Messenger March 2004

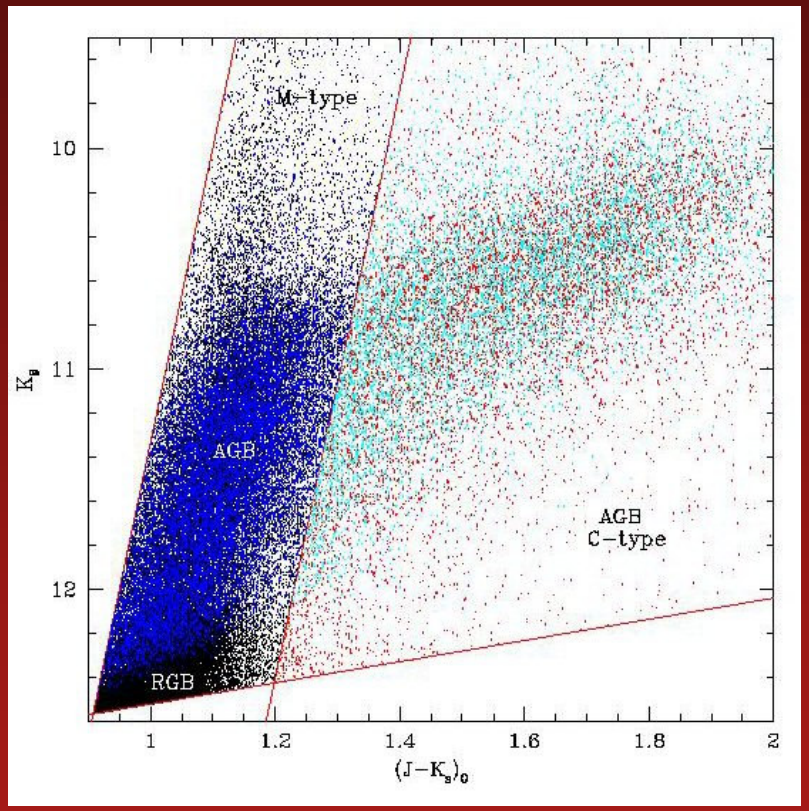
AGB stars in the Magellanic Clouds

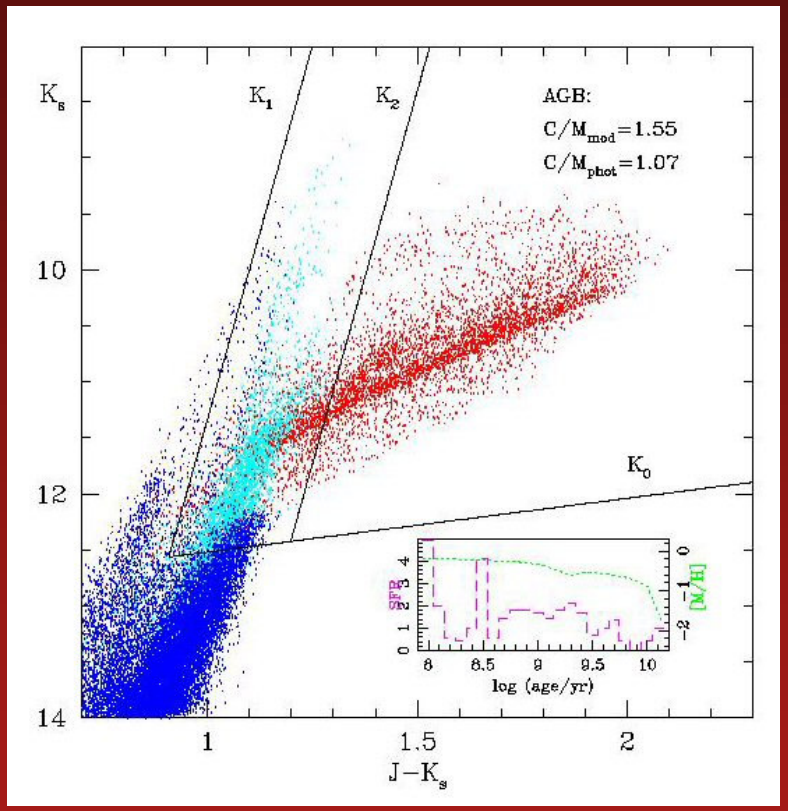
- **MCs Distance**
  - 18.55± 0.08 & 18.99± 0.08
- **variability**
- **C/M ratio**
- **Map of metallicity**

See also :

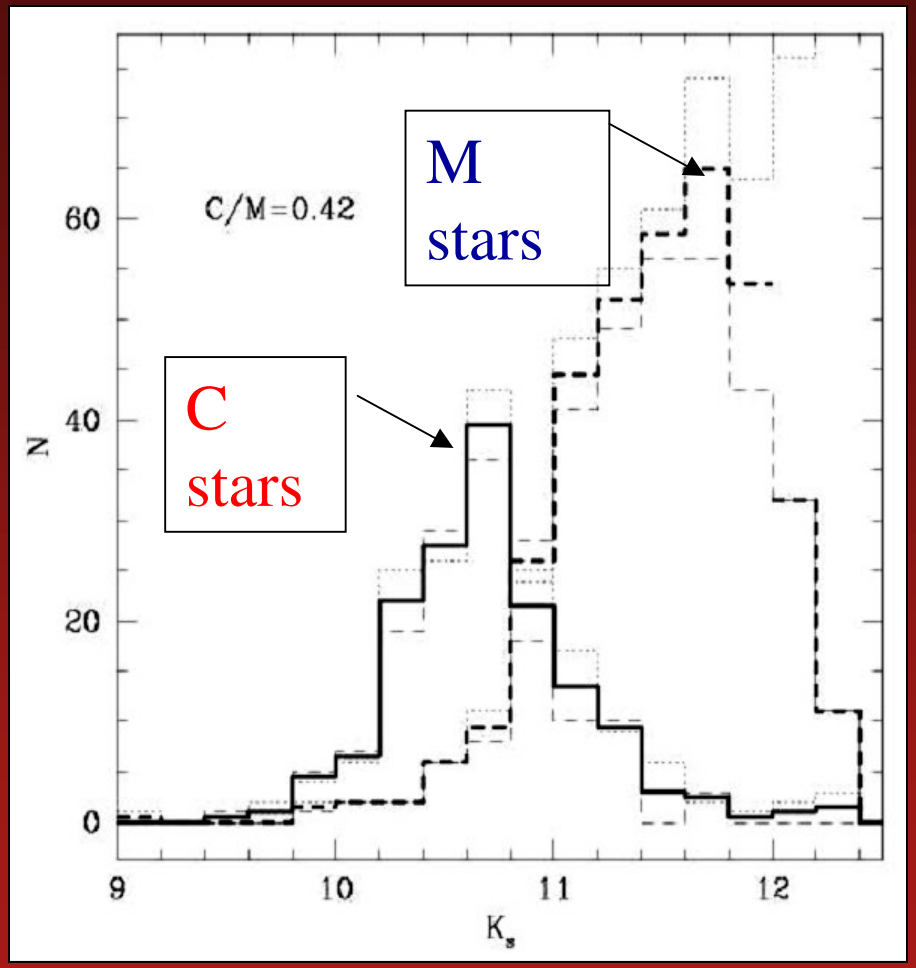
- Delmotte et al., 2002 A&A 396, 143 (merging DENIS & 2MASS data)
- Marigo et al., 2003, A&A 403, 225
- **Cioni et al. 2004, The Messenger 115, 22**

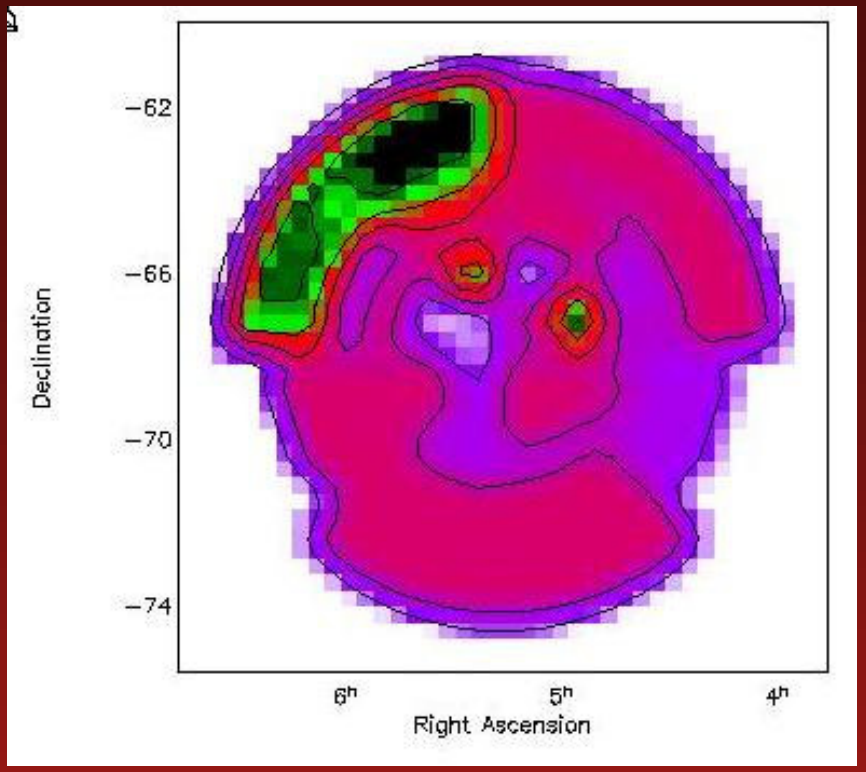
AGB stars in the Magellanic Clouds





From Cioni et al., 2005, Astro-ph 0509881





Distribution of metallicity (z=0.003 – 0.015) from the C star distribution

From Cioni et al., 2005, Astro-ph 0509881

Extragalactic catalogues

- Identify known galaxies (LEDA)
  - **Vauglin et al., 1999, A&AS, 135, 133**
  - **Vauglin et al., 2002, A&A 387,1**
  - **Paturel et al. 2003, A&A 405, 1**
  - **Paturel et al. 2005, A&A 430, 751 →**
    - http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=VII/234
    - http://cdsweb.u-strasbg.fr/cgi-bin/qcat?]J/A+A/430/751
- Last catalogue contains 668 000 , 576 000, 357 000 I,J, K magnitudes
- Discover hidden galaxies (ZOA)
  - Schroeder et al. , 2004
- Final catalogue (Mamon et al. in preparation)
- Prepare spectroscopic surveys (6df)

Paturel's catalogue of DENIS galaxies (2005)

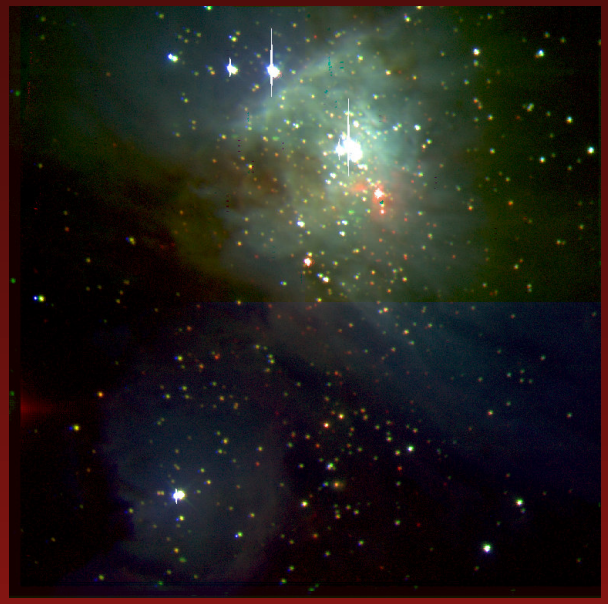
	I	J	Ks
magnitudes	**668 000**	**576 000**	**357 000**
diameters	**452 000**	**299 000**	**114 000**
limiting surface brightnesses mag/arcsec^2	**22.5**	**21.0**	**20.0**

The legacy of DENIS

- A final catalogue of almost half a billion stars
- A unique catalogue in the I band
- Excellent astrometric positions
- Photometry (good and improving)
- Complement 2MASS (althouhg less sensitive by ~1.5 magnitude in K; and ~1 mag in J)
- Provides similar data for another epoch
- Image data bank : 1 million 12' x 12' in (IJK)
- Training of a dozen of PhD & postdoc students
- 150 referred papers based on DENIS (1/3 of 2MASS)
- Data accessible through usual tools of CDS (*SIMBAD*, *VIZIER*, *ALADIN*)

in progress

- Final release (3rd incremental)
- Full image data bank release (Aladin)
- Image mosaiking
- Improve photometry
- Remove multiple entries
- Clean up remaining artefacts



We strongly encourage the community to use DENIS data and report problems (access, calibrations, etc...)

Not everything is at CDS !

Next step

deeper surveys
&
at longer wavelengths

Future panoramic IR surveys: deeper & @ longer wavelengths

Ground		Space	
UKIDSS	Deeper in K	Spitzer (now)	Longer λ
WIRCAM (2005)		ASTRO-F (2007)	Longer λ
VISTA			
AMIDST @ Dome C (2012?)	Longer λ	WISE (2008)	All sky
		JWST (2012)	Deeper Longer λ

3-5 µm panoramic surveys in Antarctica

- Italo-French CONCORDIA station now in operation in Winter (2005)
- A superb site for IR surveys
  - **Cold (T down to -90C)**
  - **Dry (H ~ 150 µm)**
- Low background
- Gain 2 to 3 magnitudes in K_{dark}, L, M
- Good seeing (especially above 20-30m : 0.3 '')
- Low OH airglow emission (better J, H)
- **European network to evaluate preliminary studies: ARENA (start January 2006)**

Antarctic Mid Infrared Deep Survey Telescope (AMIDST)

- 3 meter class wide field telescope at Dome C optimized for the K, **L and M** windows (2.3-5.5μm)
- Low emissivity configuration (off-axis?)
- Extension of VISTA toward longer wavelengths
- Gain **2 magnitudes** / *Spitzer* (IRAC/Glimpse) @ K and L
- Gain 4 to 8 on angular resolution / Spitzer/WISE
- Survey thousands square degrees std. Mode (30s IT)/ a few hundreds in deeep mode (30 mn IT)
- Astrometry → *JWST*
- Possibly extended to 10-30 μm
- integral field spectrosopy (3-5 μm)

Detection limit (5σ) point source

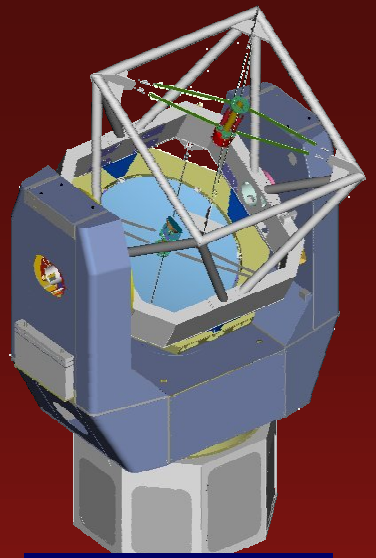
	AMIDST « standard » Survey	AMIDST « deep» Survey	SPITZER (IRAC) (Glimpse)	WISE Pxl = 5"	VISTA
	ANTARCTICA 3m		space 80 cm	space 40 cm	Paranal 4 m
Int.Time	30s	30 mn	1 sec		
K diffract.	0.4"		1.4"	2.5 "	0.28 "
K_d	21.8 *(17.9)*	25.8 *(20.1)*	n.a.	n.a.	K_s 19 21 22
L'	16.5 *(13.7)*	18.7 *(15.8)*	15.4	16.6	n.a.
M'	13.3 *(10.7)*	14.5 --	15.0	15.9	n.a.

Science Case for AMIDST

- **Very low mass stellar populations (T_{eff}<1200K)**
- **isolated planets; galaxies**
- **Search for exo-Earths (3-5 μm) - (coronography)**
- **cosmologic** interest (galaxies large z …) window at 4 μm
- **Global monitoring of variability of stars in wide fields (clusters, Magellanic Clouds)**
- **Astrometry and proper motions** (deep probe of underluminous stars in the solar neighborhood)
- And much more….

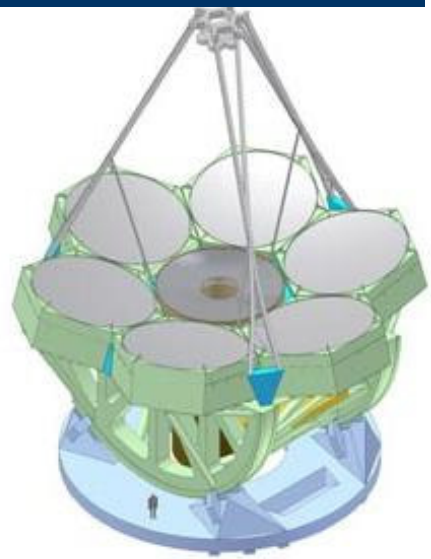
«AMIDST» concepts

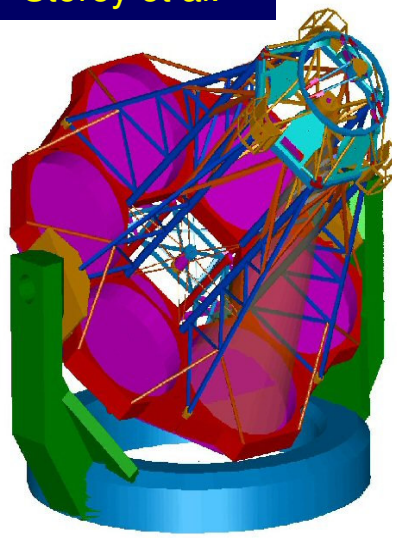
- Wide- field 2-3-meter class telescope
  - ✓ AO simple
  - ✓ Primary Off axis? (High Dynamic imagery / low emissivity)
  - ✓ Passive cooling at 200-220K
  - ✓ High level of **robotisation** mandatory
  - ✓ **ESO NTT**? (NTT on ice)
- A multi-mirror telescope ?
  - ✓ 6 discs of ~ 2-8 m f/2 or faster (f/1!)
  - ✓ Very compact – easily movable
  - ✓ Allows 6 instruments simultaneously on same field!.
  - ✓ Possibility of beam recombination – interferometric capability
  - ✓ Examples: LPT concept (NG-CFHT) or GMT / New Planetary Telescope (small version)



Australian PILOT EOST; Storey et al.

Giant Magellan Telescope (Angel et al.)





High Dynamic range telescope for NG-CFHT

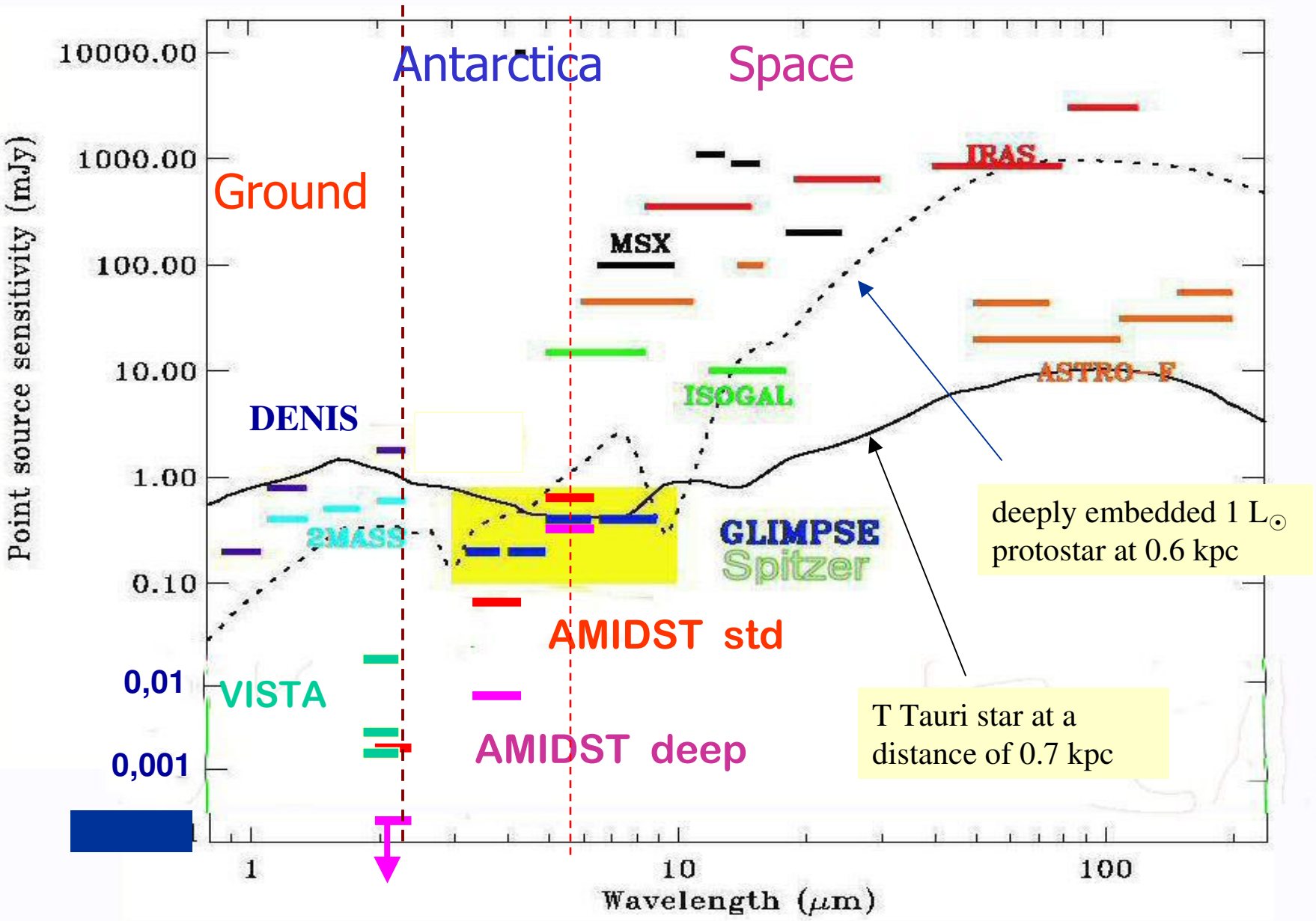
IR focal equipment for AMIDST

Multicolour observations

- ✓ IR camera(s) (4 k x 4 k) K_{dark}, L_s , L', M'
  - ✓ (e.g.. HgCdTe Hawaii 2RG or InSb Aladdin)
- ✓ no «warm» optics
  - ✓ cooled dichroïc beamsplitters
  - ✓ optimised for each channel
- ✓ FOV 32' x 32' or 16' x 16'
- ✓ scale : 0.48 / 0.24 arcsec. *(diffraction limited @ 3.8 µm (0.65 arcsec)*

✓ possibly a camera 10-25 µm - 300 µm

✓ spectro imaging instrument (3 µm)(IFTS)


Antarctica
Space
Ground
10000.00
1000.00
100.00
10.00
1.00
0.10
0,01
0,001
Point source sensitivity (mJy)
IRAS
MSX
ISOGAL
ASTRO-F
DENIS
2MASS
GLIMPSE
Spitzer
AMIDST std
VISTA
AMIDST deep
deeply embedded 1 L⊙
protostar at 0.6 kpc
T Tauri star at a
distance of 0.7 kpc
1
10
100
Wavelength (μm)

Pre-announcement

October 9-12, 2006, Roscoff (France)

Large astronomical infrastructures at CONCORDIA, prospects and constraints

sponsored by ARENA EC network