# Science at CDS

# Strategy

- A data center without active science is dead
- Need for experience in different astronomical subjects to maintain and develop the scientific content and the relevance of the data
- Multiple external and internal collaborations
- Use of and participation in large projects

# The scientifc diversity at CDS

- **Stellar Astronomy**
  - Circumstellar matter, AGB/post AGB stars       C. Loup
- **Galactic Astronomy**
  - ISM, star formation                    L. Cambrésy
  - Galactic disk formation, large surveys, simulations  A. Siebert
- **Extragalactic Astronomy**
  - ISM, nearby galaxies                    C. Bot
  - Cluster galaxies, galactic centers, galaxy evolution  B. Vollmer
  - AGN, 'VO science'                    M. Allen
- **Information research and processing**
  - Ontologies, semantics, information discovery  S. Derrière
  - Cross-identification methods                    S. Derrière,
                                                  F.-X. Pineau, T. Boch
  - Image processing                                    F. Bonnarel,
                                                  M. Louys, B. Vollmer

# Scientific interactions

- With the « Equipe galaxies »
  - common projects, common seminar

- With the « Equipe hautes énergies »
  - common projects (supervision of FX Pineau's PhD thesis), exchange of expertise

- Use of large facilities
  - VLT, HST, Spitzer, VLA, Herschel, Planck, Gaia

- Participation in large projects/surveys
  - VO, XMM, 2MASS, RAVE, NGVS

# AGBs and RSGs in the LMC

C. Loup

- Aim: 'proper' catalog from heterogeneous multiwavelength data   ->   long-term project
- Problem: cross-identification between catalogues with varying astrometry and photometry
- Cross-id catalogues (1960-2010) + 2MASS + DENIS + MSX + verification by eye: identification of 13000 AGBs (10000 with spectral type)
- cross-id Spitzer; addition of LPV OGLE (2009); non-identified candidates selected by NIR+MIR
- Luminosity estimate based on multiple bands (optical to MIR)
- Project 1 : luminosity functions for different spectral types
- Project 2 : revisit of P-L relation

# The Trifid molecular cloud

Cambrésy et al. 2011
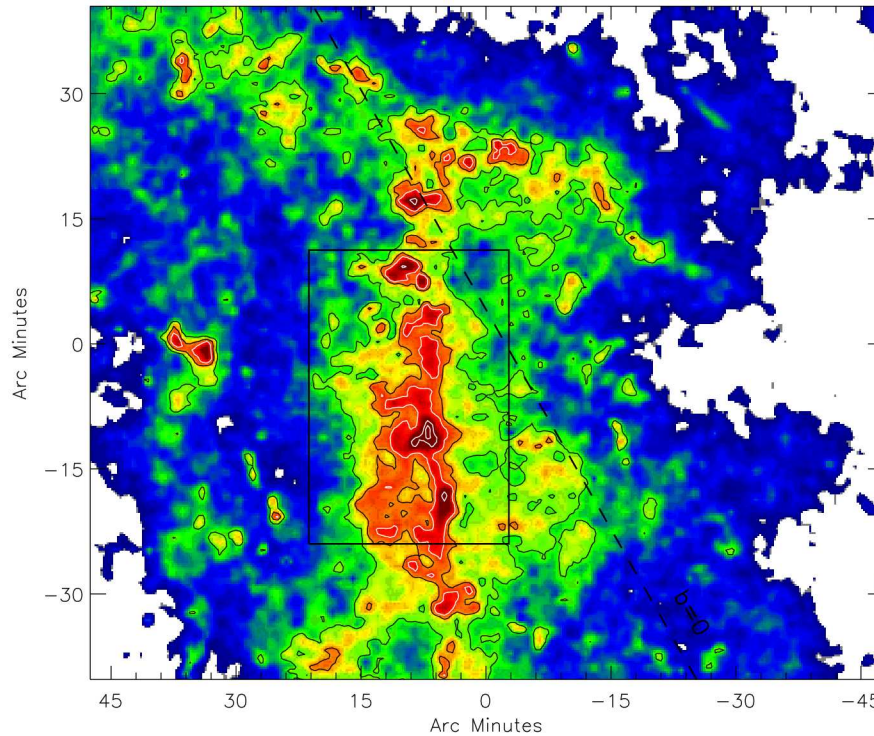


Center: R.A. 18 01 35.27    Dec  −22 54 13.5
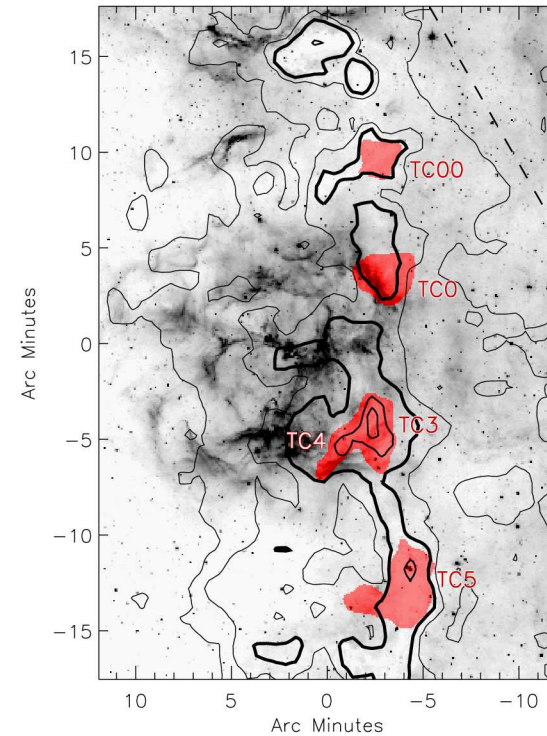


Center: R.A. 18 02 16.19    Dec  −23 00 45.7

- Extinction map

  - Data : 2MASS + UKIDSS + Spitzer

  - **Flattening of the extinction beyond 3µm for Av>20 mag** (not observed before)

  - M=5.8 $10^5$ M_sol  (=2x Orion)

  - D=2.7 kpc (instead of 1.7 kpc  used before)

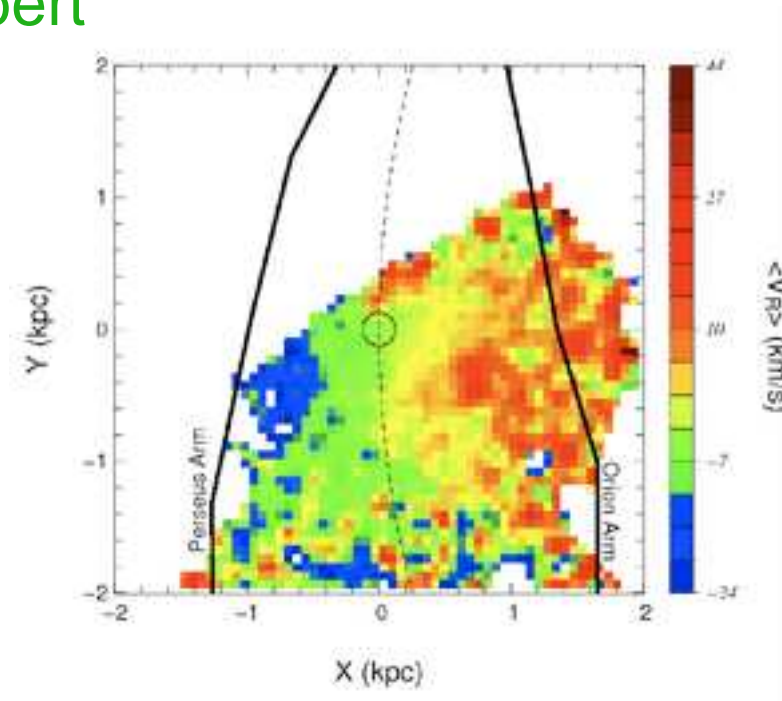GLIMPSE/Spitzer 8µm image + extinction contours + core at 1.2mm

**Emissivity of the Trifid Cores (TC) ~2 higher than in other dense regions**

# Galactic dynamics and kinematics

## A. Siebert
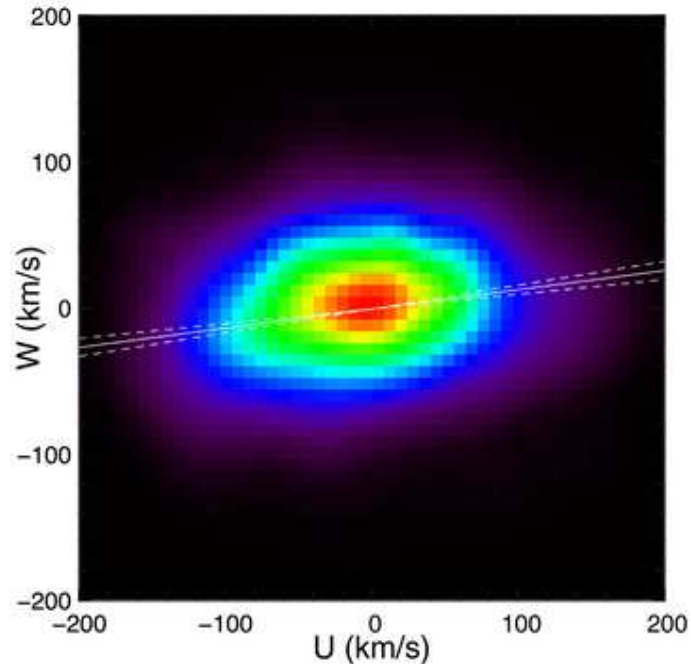


First measure of the inclination of the velocity ellipsoid at 1kpc below the Galactic plane based on RAVE (Siebert et al., 2008)

Detection of a velocity gradient in the extended solar neighborhood with RAVE data: effect of spiral arms? (Siebert et al, 2011)

and RAVE 3rd data release: Siebert et al. 2011

# Dust properties in nearby galaxies

C. Bot

- *Spitzer, WMAP, ToPHat (mm), Planck data*

- *Small Magellanic Cloud (nearby galaxy of low metallicity*



• Detection of known sub-mm excess emission (Bot et al. 2010a)

• Fore- and background contamination (Galactic cirrus with color variations, Bot et al. 2009a; CMB, Planck collaboration 2011)

• Extension of excess emission to the mm-cm domain (Bot et al. 2010b, Planck collaboration 2011)

• Conclusion: Very cold dust emission excluded. Best model: intrinsic properties of amorphous grains + rotating dust grains

• Towards a new understanding of dust emission in the sub-mm to cm domain
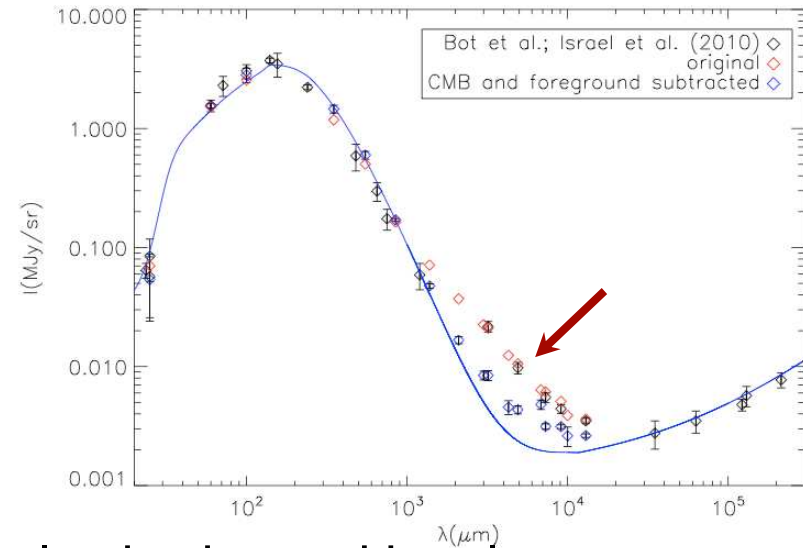
# First model-based ram pressure stripping time sequence for Virgo cluster spiral galaxies

Vollmer (2009), synthesis of 8 articles
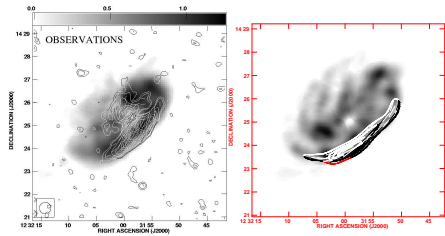
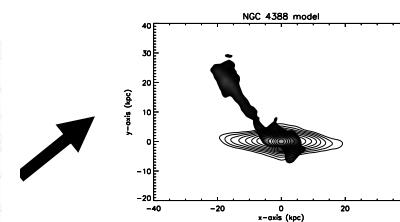NGC 4501          NGC 4438
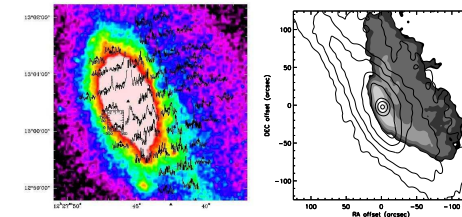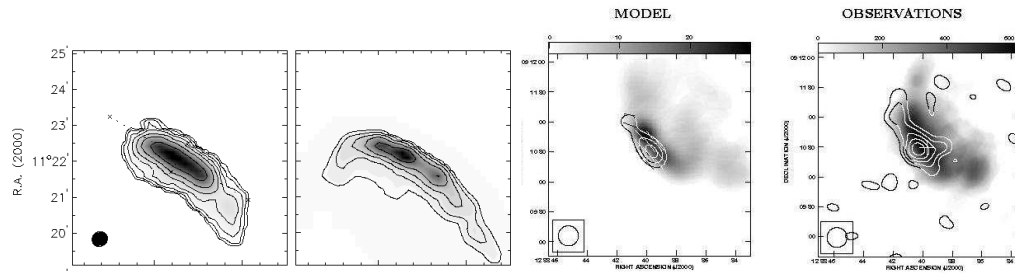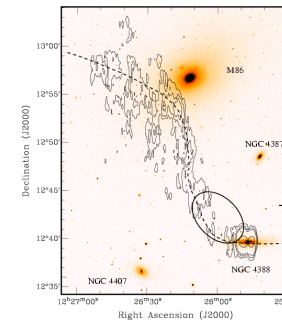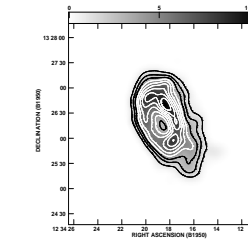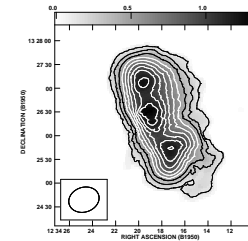


model          model

model          model

NGC 4330          NGC 4522          NGC 4388          NGC 4569
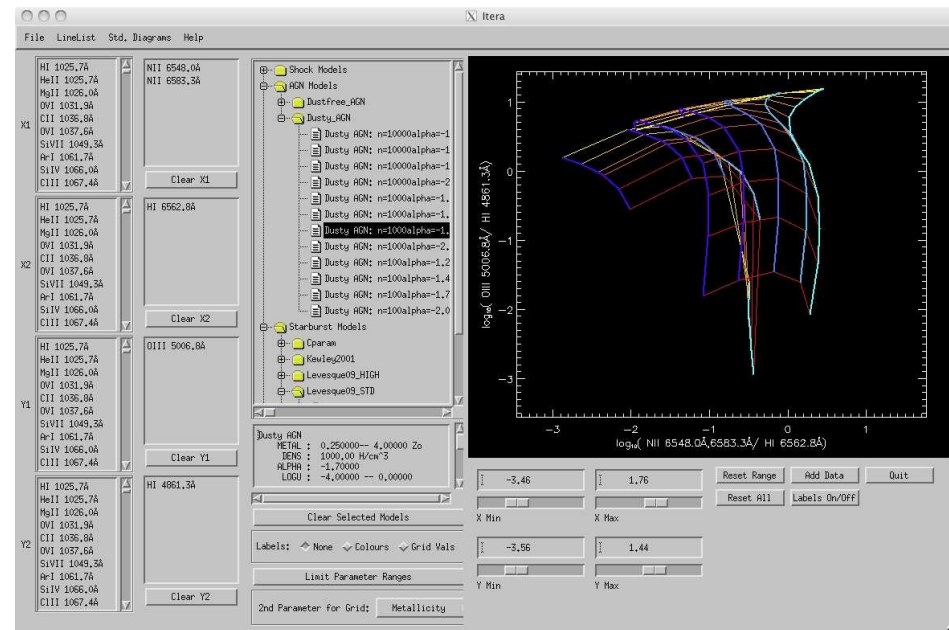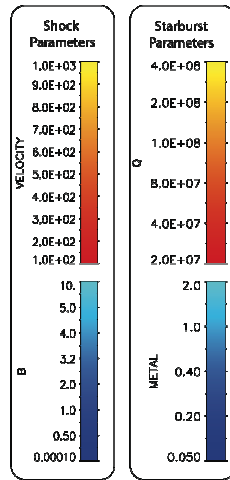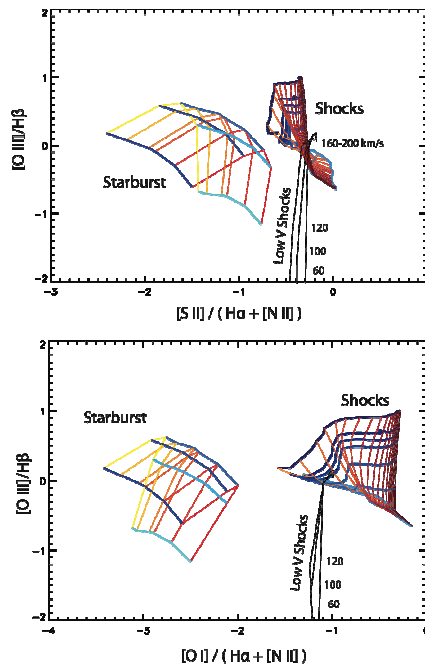
pre-peak          near peak          ~150Myr after peak  ~300Myr after peak

# Modeling of fast radiative shocks, AGN and starburst ionization
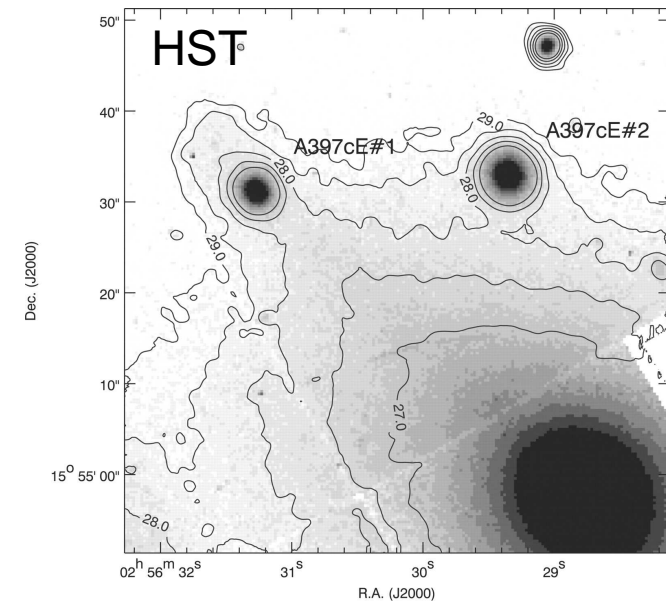
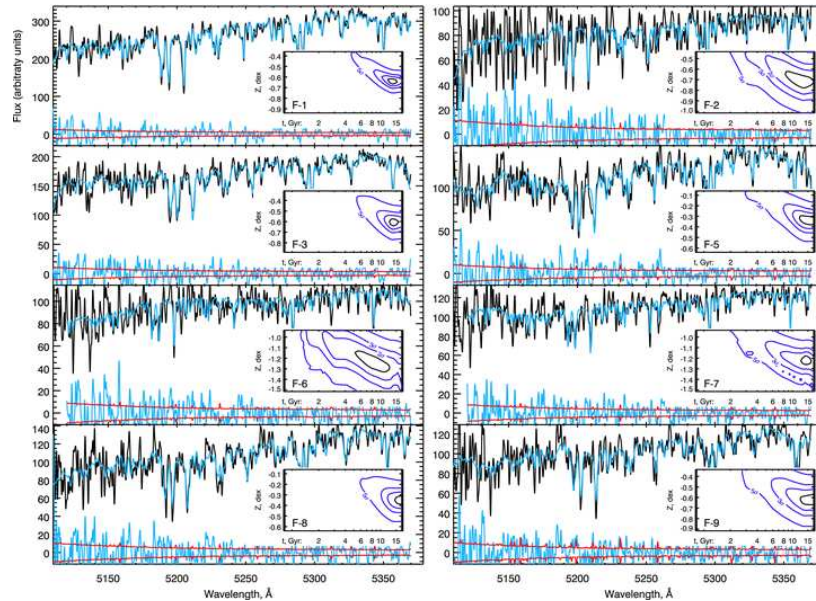ITERA, IDL tool for Emission Line Ratio Analysis



**Allen et al. 2008, Groves & Allen 2010**

# Compact ellipticals and ultracompact dwarf galaxies

*I. Chilingarian*

- Datamining using the Virtual Observatory
- Optical spetroscopy
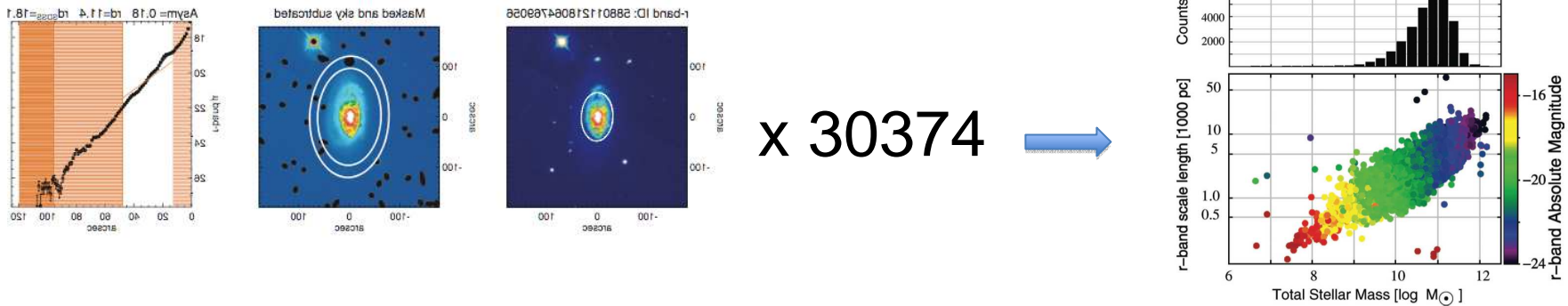- Stellar population synthesis
- Use of workflows



Chilingarian et al. (2009)



VLT Giraffe
Chilingarian et al. (2011)

# Support to Euro-VO Research Initiative programs

**Scalelength of disc galaxies  - Fathi et al. 2010**
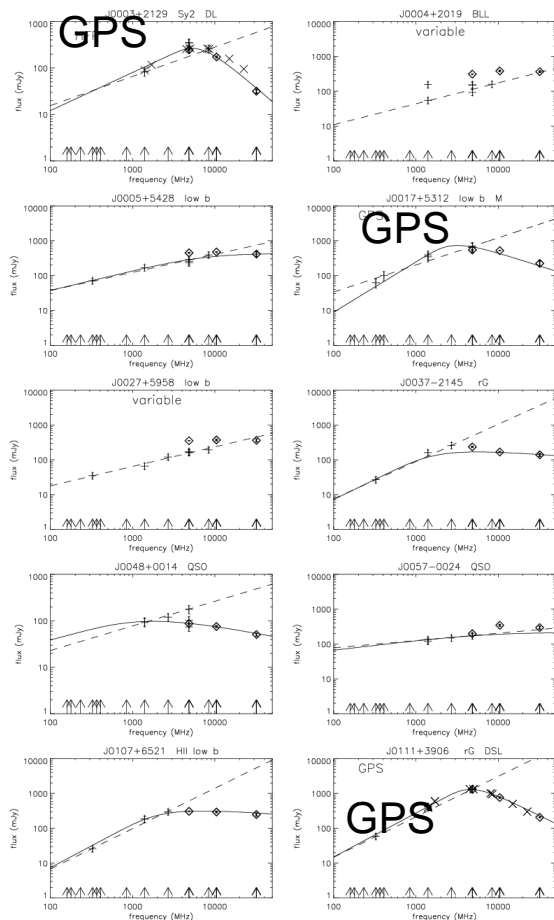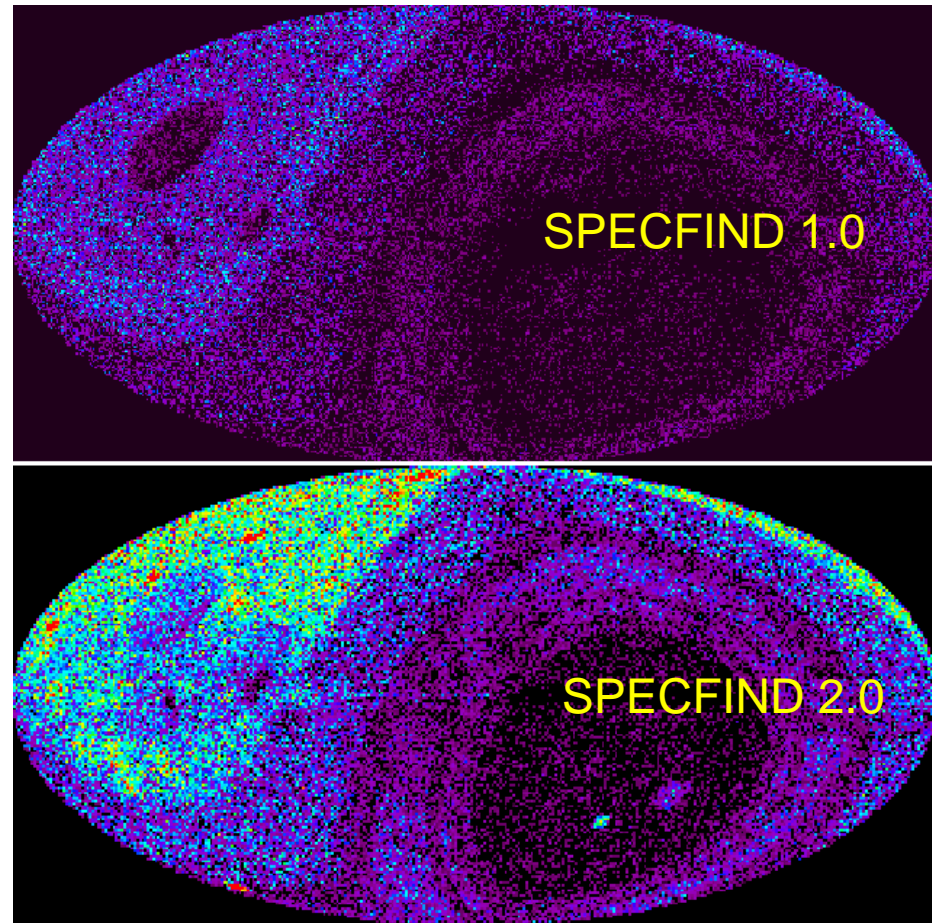


x 30374

M. Allen, T. Boch

# SPECFIND: cross-identification of radio sources in VizieR

Datamining in the SPECFIND 1.0 catalog: Giga Hertz Peaked Sources (GPS)=young AGNs not well-stufdied Vollmer et al. (2008)

New release SPECFIND 2.0 based on VO: 115 tables (SPECFIND 1.0: 20) 107500 cross-ids (SPECFIND 1.0: 67000) Vollmer et al. (2010)

# Detecting low surface brightness galaxies with Markovian modelling

B. Vollmer, F. Bonnarel, M. Louys

- Markovian approach based on hierarchical neighbourhood relations + Bayesian inference

- In collaboration with Ch. Collet at LSIIT

- Result: image pixels are sorted into different classes according to their surface brightness and spatial continuity (typically 5-10 classes);

- class 0: noise; class 1 or 2: LSB

- Application to NGVS data (g r i)

- Second step: LSB galaxy identification via the surface brightness profile
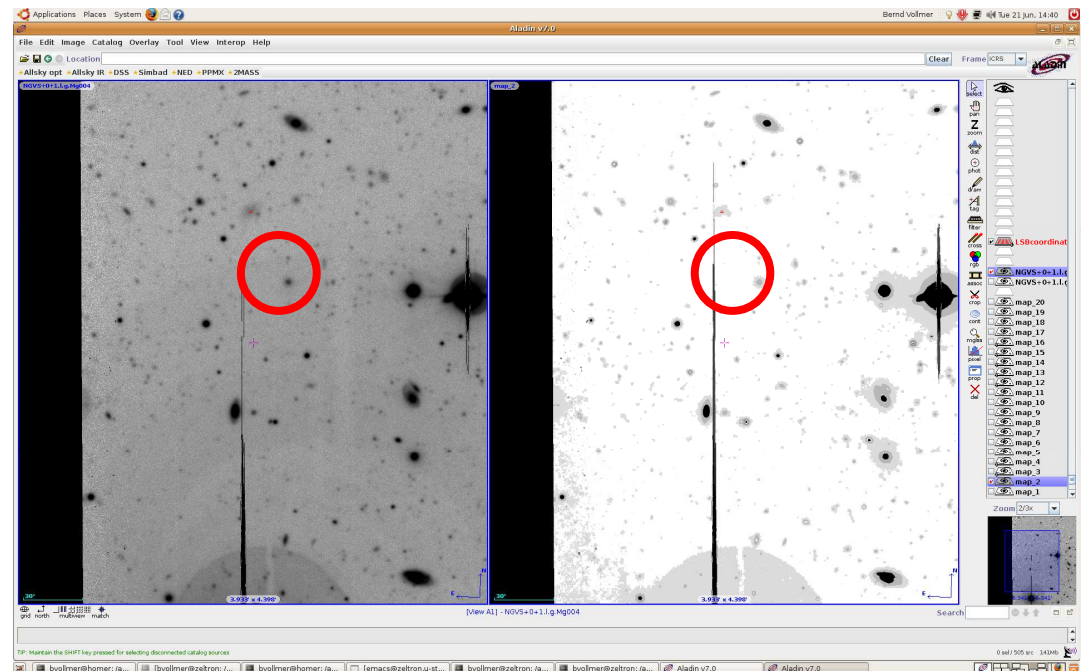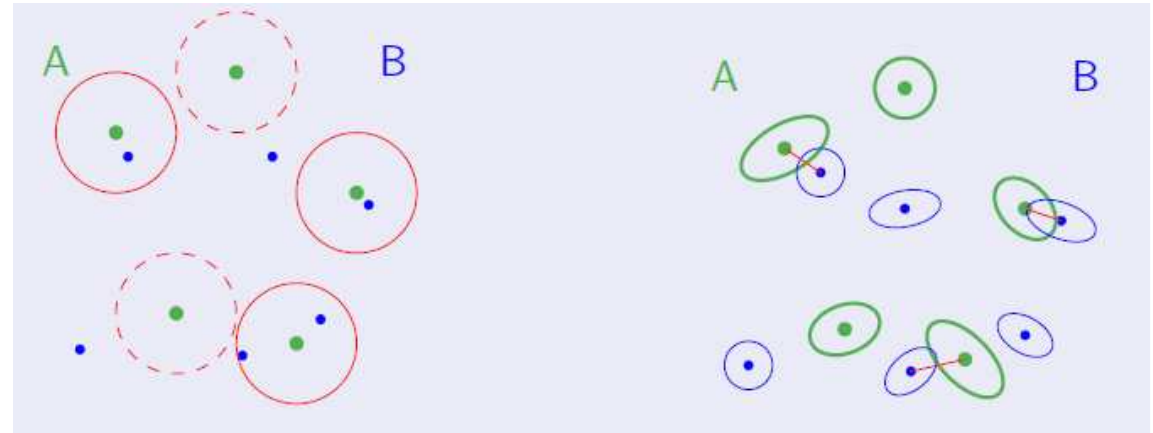
# Cross-identification (1)

**Algorithm**

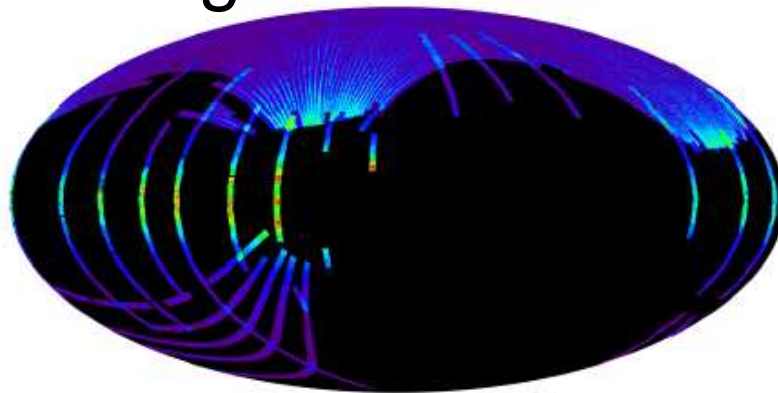S. Derriere, F.-X. Pineau, T. Boch

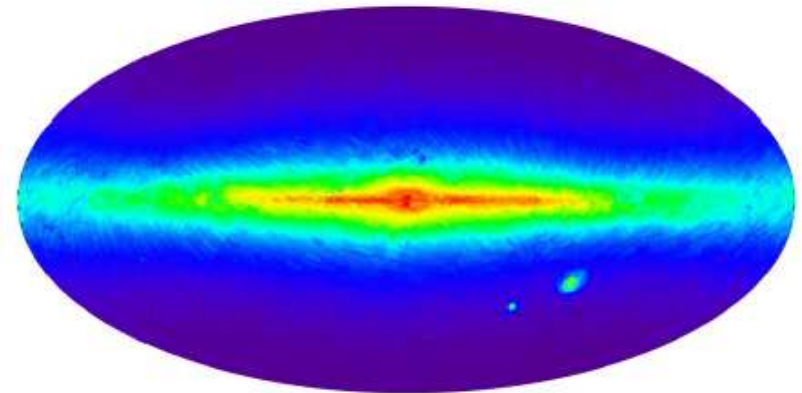positions & erreurs

Sky partition : HEALPIX

modified spherical kd-tree



## Can be applied to large catalogs
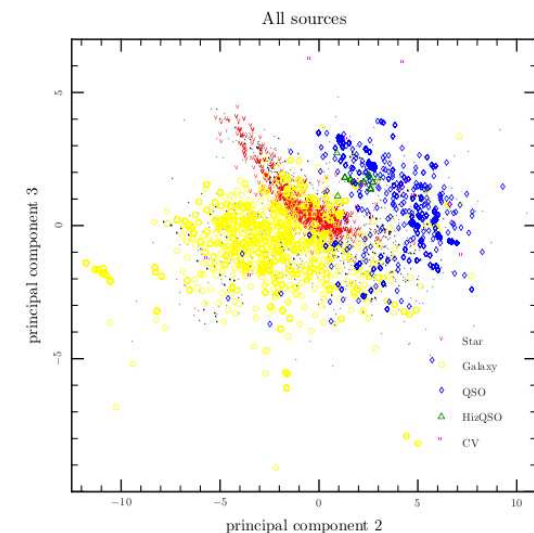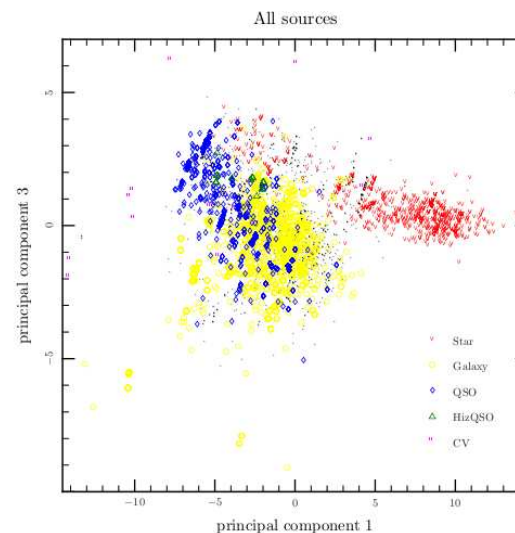


SDSS DR7 (∼357 000 000 sources)

2MASS (∼470 000 000 sources)

# Cross-identification (2)

S. Derriere, F.-X. Pineau, T. Boch

Statistical
 approach

Source
 classification

 Modified PCA

 kNN

Application to
 2XMMi

$$LR = \frac{r \exp\left(-\frac{1}{2}r^2\right)}{2\lambda r} = \frac{\exp\left(-\frac{1}{2}r^2\right)}{2\lambda}$$

# Ontology of object types

S. Derriere, A. Preite Martinez,
L. Cambrésy, A. Richard

« Intelligent » search for information

Concepts and their relations

# Conclusions

- Healthy mix of astronomical subjects

- Need for internal and external collaborations

- Active scientific environment at CDS and the Observatory

- CDS services indeed benefit from the scientific variety