

# *Supernovae Photometric Classification*

Emille E. O. Ishida

*Laboratoire de Physique Corpusculaire  
Universite Blaise Pascal  
Clermont Ferrand, France*

# *Supernovae Photometric Classification*

THE ROAD SO FAR

# Current proposed strategies

## Template Fitting

Campbell *et al.*, 2013 – SNID  
Hlozek *et al.*, 2011 – SNID  
Bazin *et al.*, 2011 – parametrization  
etc...

## Empirical (data driven)

Zaidi & Narayan, 2016 – PCA + Random Forest  
Ishida & de Souza, 2013 – kPCA + NN  
Karpenka *et al.*, 2013 - parametrization + Neural Networks  
Richards *et al.*, 2012 – Diffusion maps + Random Forest  
etc ...

*Recent compilation by Lochner *et al.*, 2016*

*Parametric and non-parametric feature extraction  
A few different machine learning algorithms*

# Current proposed strategies

## Template Fitting

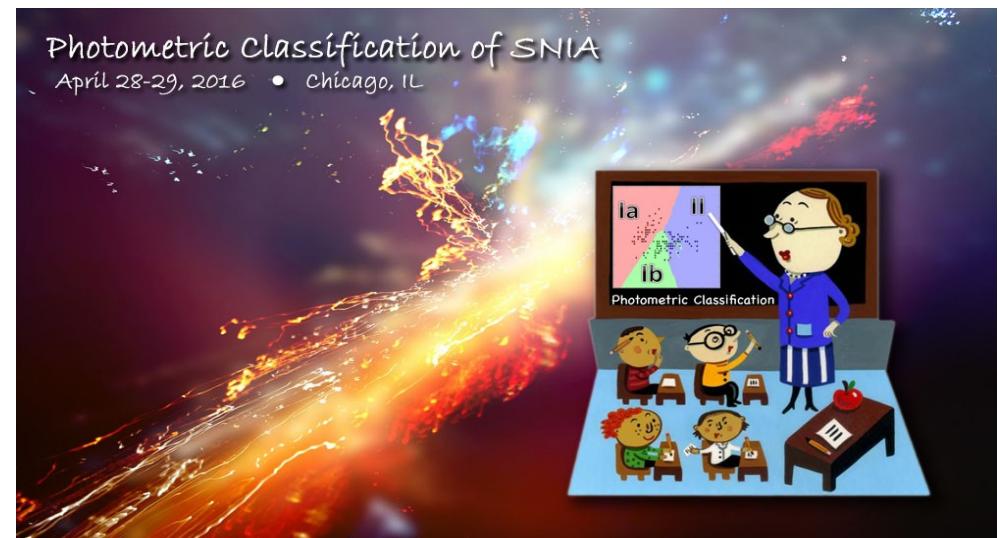
Campbell *et al.*, 2013 – SNID  
Hlozek *et al.*, 2011 – SNID  
Bazin *et al.*, 2011 – parametrization  
etc...

## Empirical (data driven)

Zaidi & Narayan, 2016 – PCA + Random Forest  
Ishida & de Souza, 2013 – kPCA + NN  
Karpenka *et al.*, 2013 - parametrization + Neural Networks  
Richards *et al.*, 2012 – Diffusion maps + Random Forest  
etc ...

Recent compilation by Lochner *et al.*, 2016

Parametric and non-parametric feature extraction  
A few different machine learning algorithms



# Current proposed strategies

## Template Fitting

Campbell *et al.*, 2013 – SNID  
Hlozek *et al.*, 2011 – SNID  
Bazin *et al.*, 2011 – parametrization  
etc...

## Empirical (data driven)

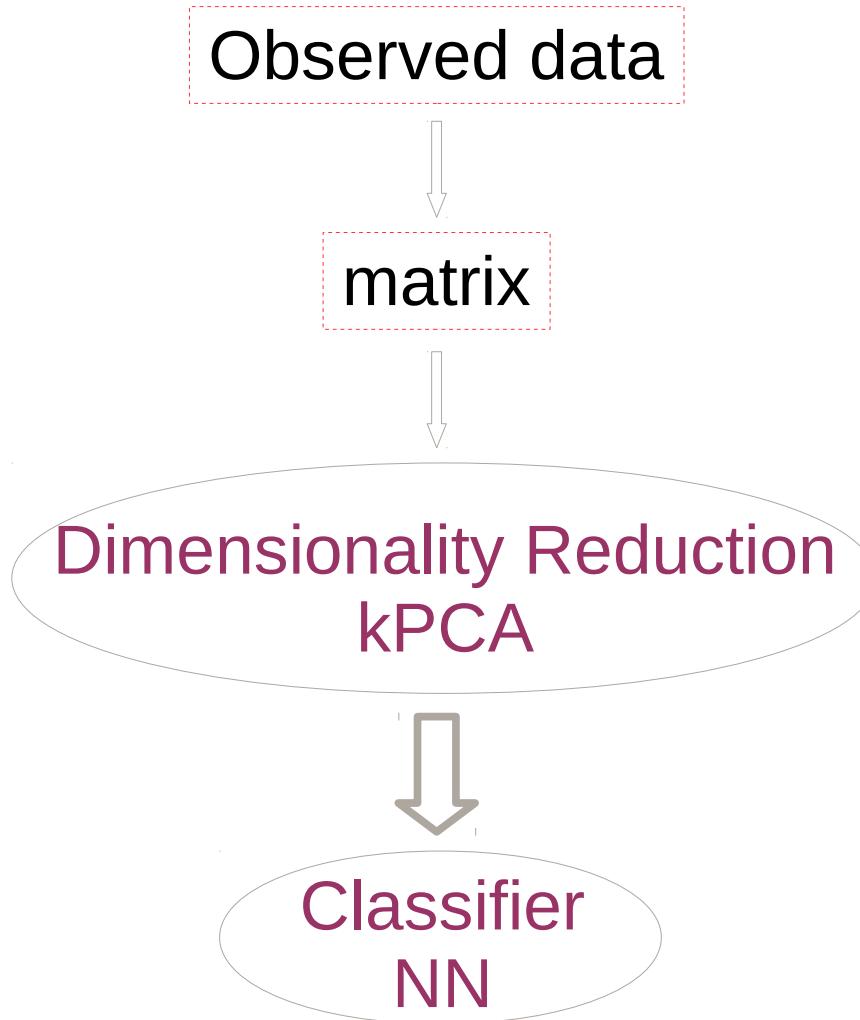
Zaidi & Narayan, 2016 – PCA + Random Forest  
Ishida & de Souza, 2013 – kPCA + NN  
Karpenka *et al.*, 2013 - parametrization + Neural Networks  
Richards *et al.*, 2012 – Diffusion maps + Random Forest  
etc ...

*Recent compilation by Lochner *et al.*, 2016*

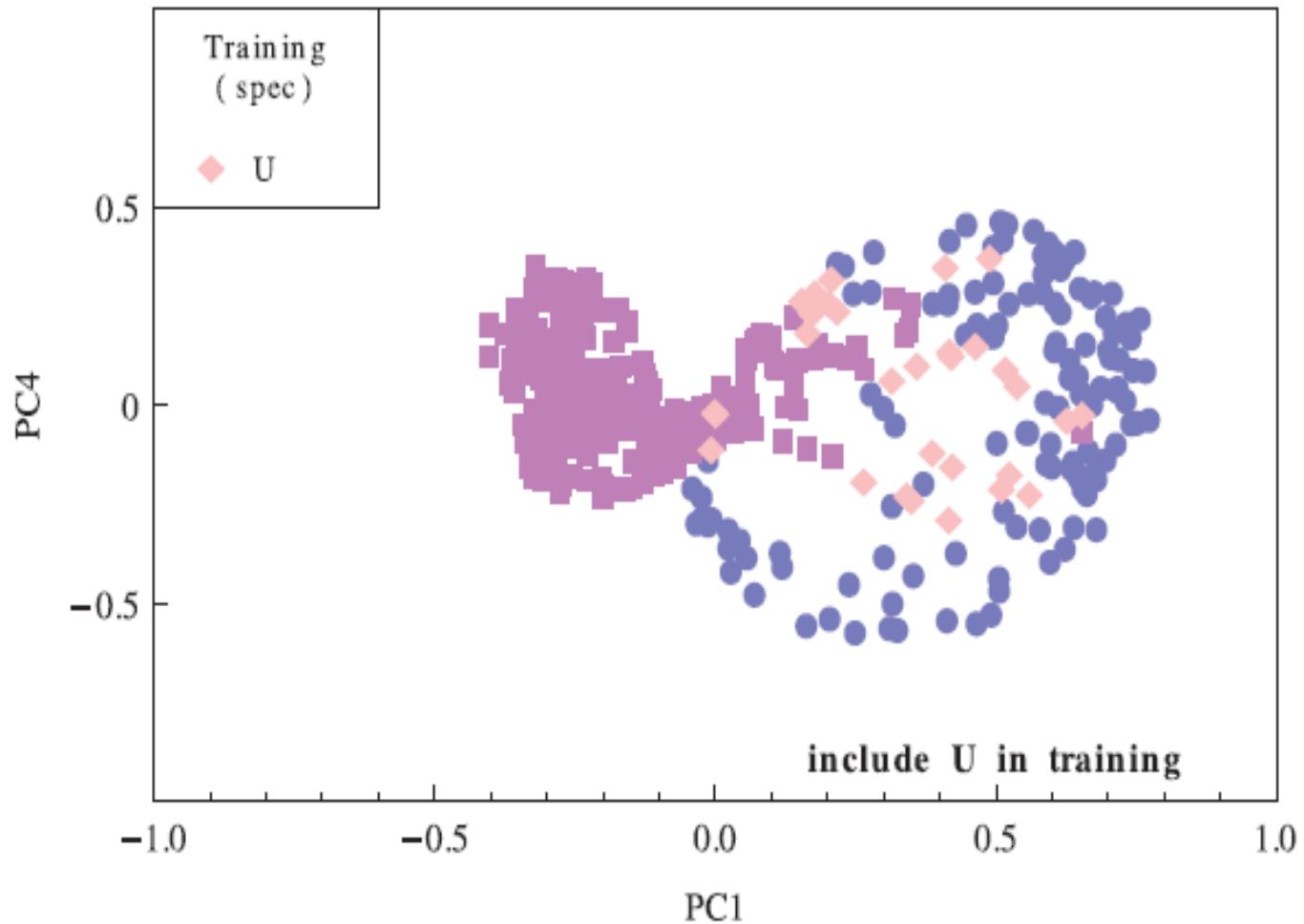
*Parametric and non-parametric feature extraction  
A few different machine learning algorithms*

# Code ready to be included in the pipeline

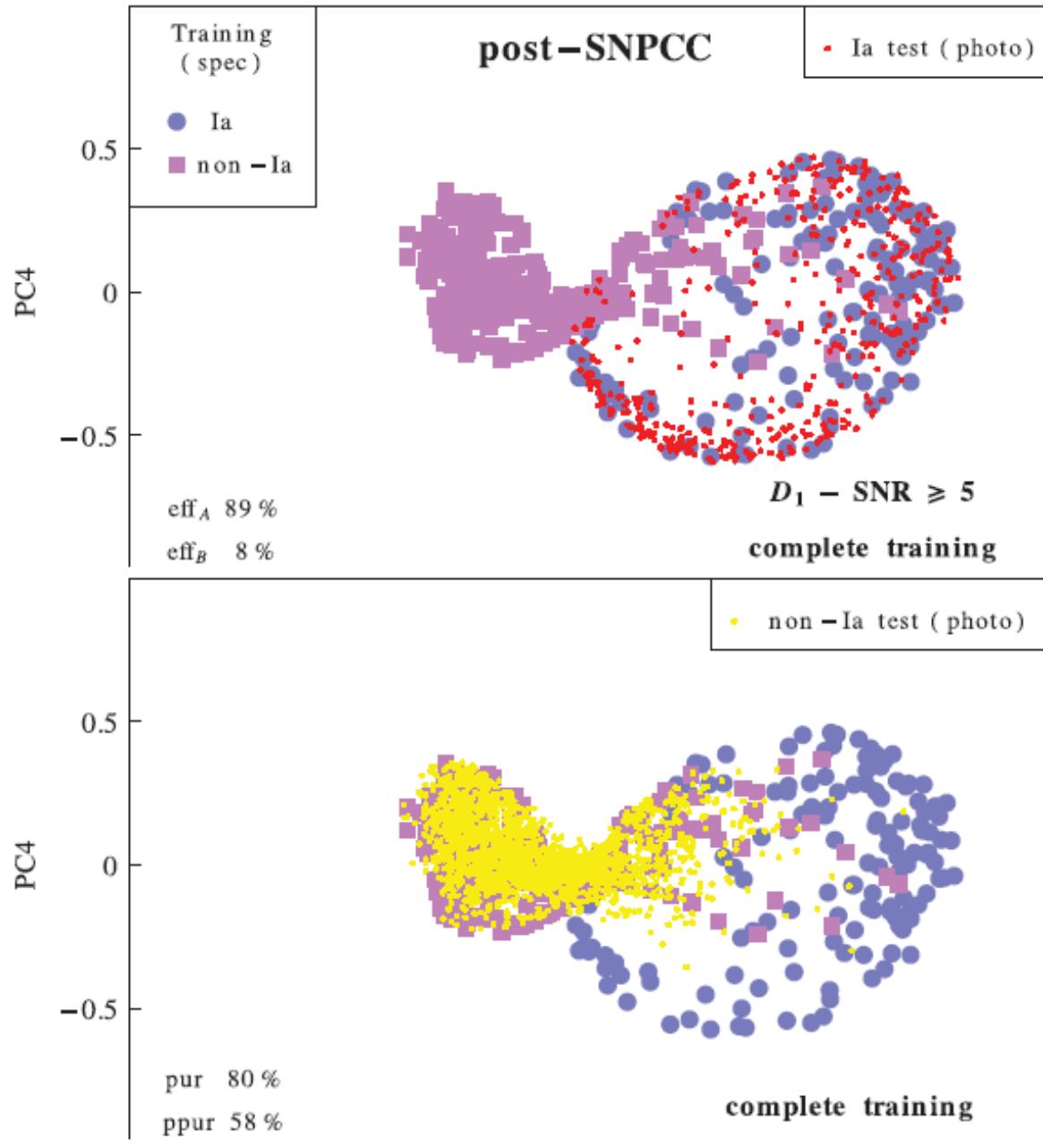
# Kernel PCA + Nearest Neighbor



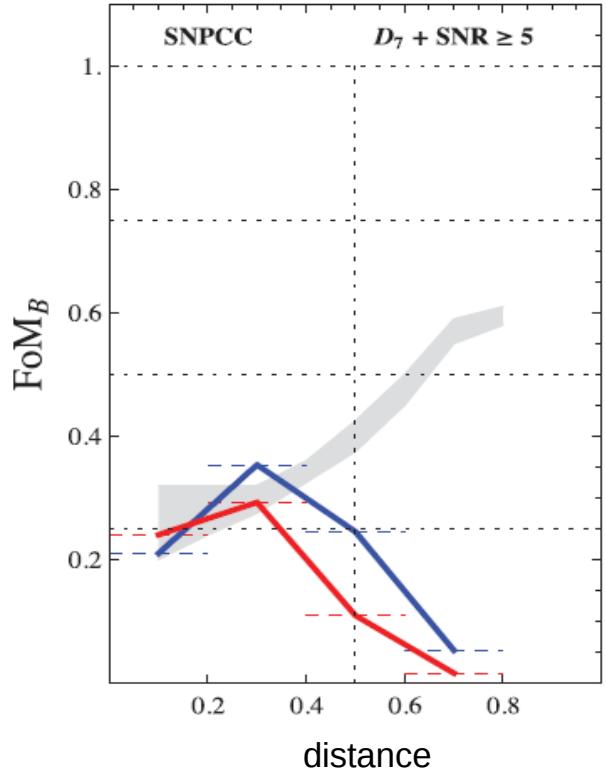
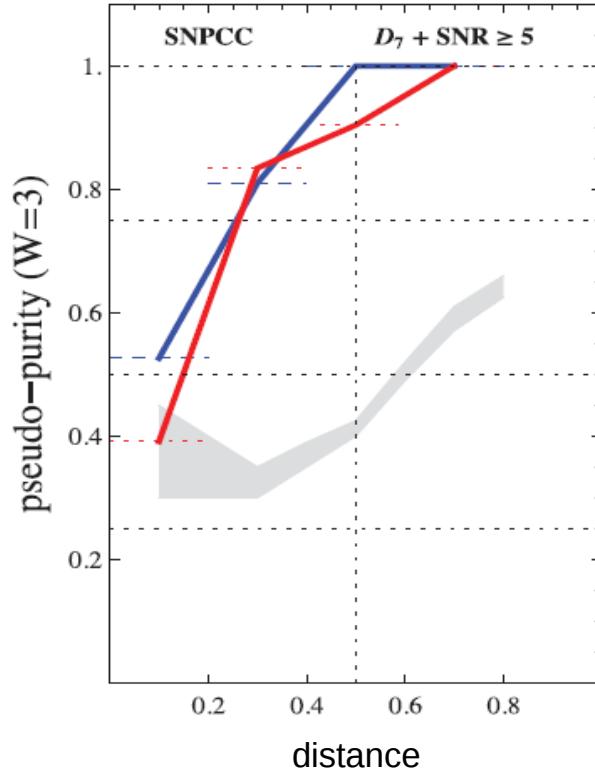
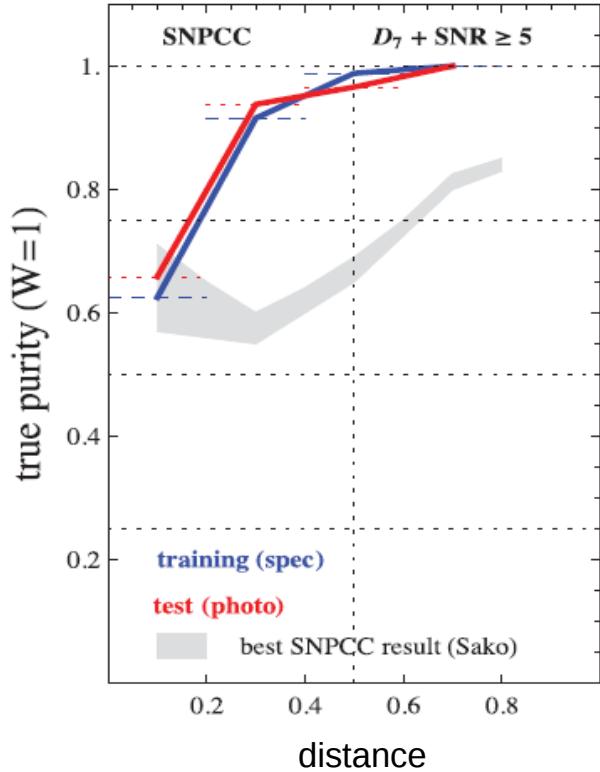
# Kernel PCA + Nearest Neighbor



# Kernel PCA + Nearest Neighbor



# Kernel PCA + Nearest Neighbor



97% purity

$$\text{pur} = \frac{N_{\text{Ia}}^{\text{SC}}}{N_{\text{nonIa}}^{\text{WC}} + N_{\text{Ia}}^{\text{SC}}}$$

$$\text{ppur} = \frac{N_{\text{Ia}}^{\text{SC}}}{N_{\text{Ia}}^{\text{SC}} + W N_{\text{nonIa}}^{\text{WC}}}$$

$$\text{FoM} = \frac{N_{\text{Ia}}^{\text{SC}}}{N_{\text{Ia}}^{\text{tot}}} \times \frac{N_{\text{Ia}}^{\text{SC}}}{N_{\text{Ia}}^{\text{SC}} + W N_{\text{nonIa}}^{\text{WC}}}$$

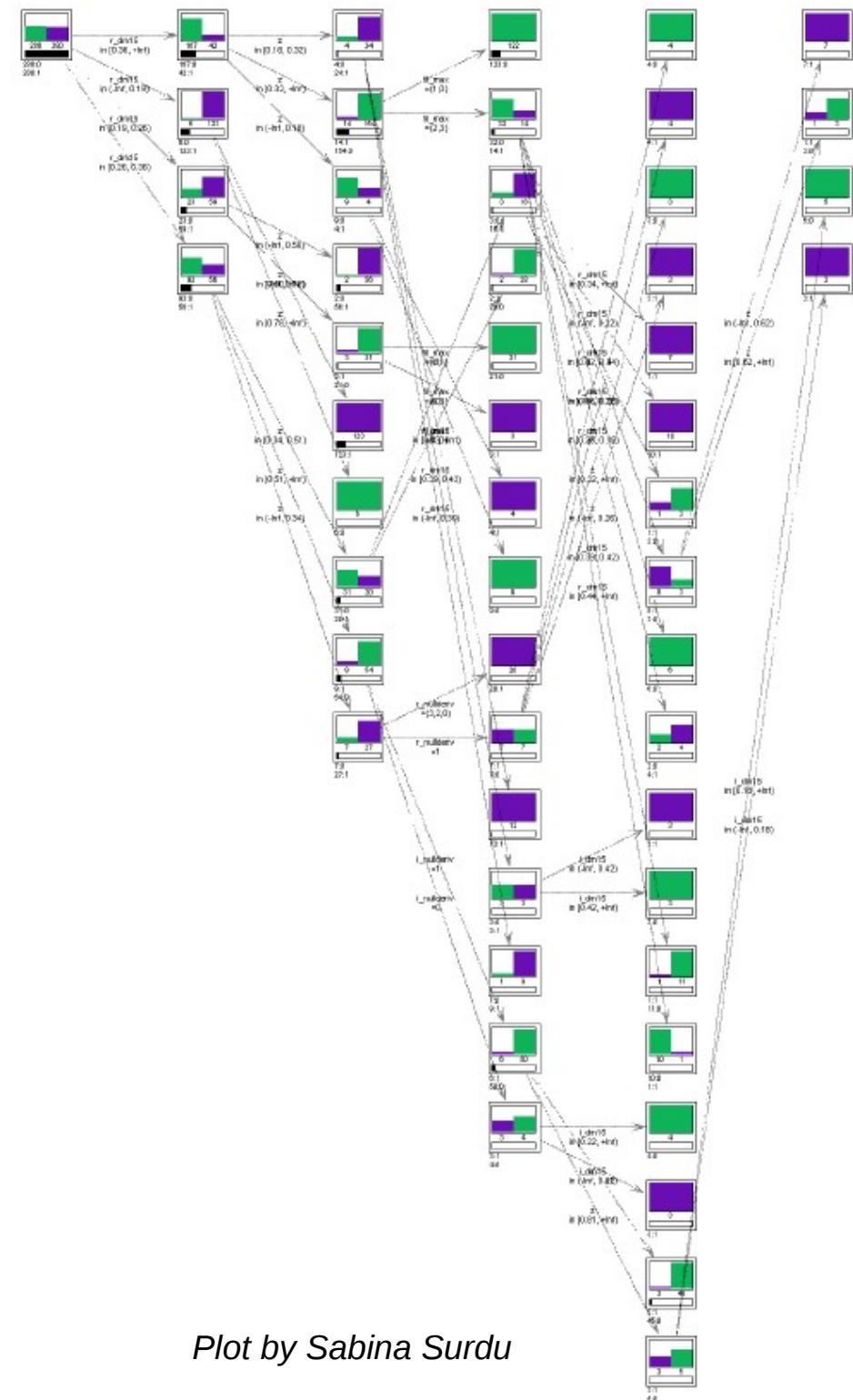
# Decision Trees

*In collaboration with INSA-Lyon*

# Decision Trees

## C4.5 algorithm

Current tunning classifier in training data

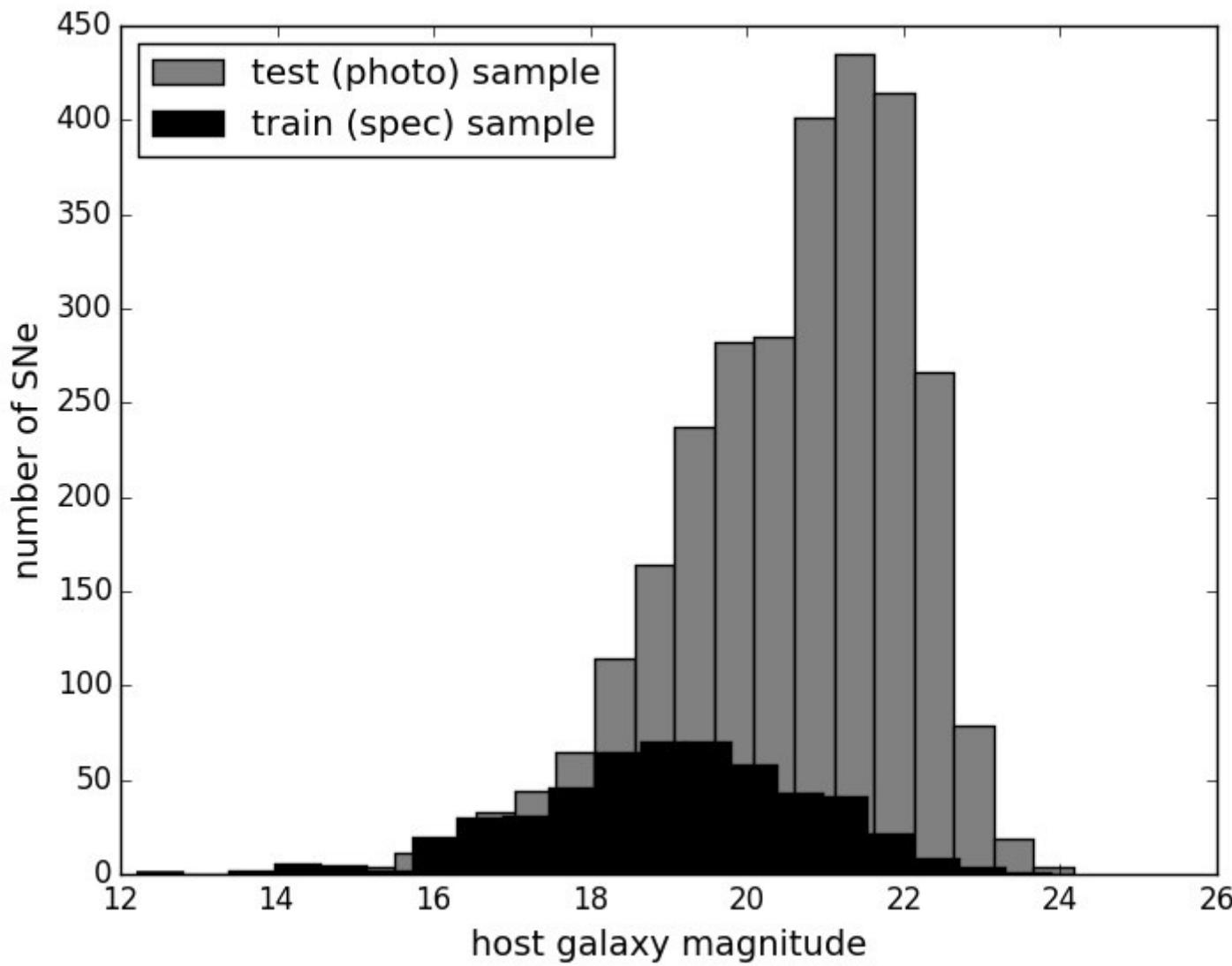


Plot by Sabina Surdu

# Domain Adaptation

*In collaboration with*  
*Pattern Recognition Laboratory*  
*U. Houston*

# Domain Adaptation and Active Learning



# Conclusions

We need more non-Ia data!

Inclusion of kPCA classifier into the classification pipeline to be started in the Oxford meeting

On going work to deal with non-representativeness and optimization of spectroscopic follow-up

# Thank you!