# Properties of meteoroids derived using narrow-band photometry

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9<sup>th</sup> June - Meteoroids 2016 ESTEC, The Netherlands



meteoroids 2016

Colour video spectra – J. Izquierdo (UCM)



# **TBT** project



50-cm telescopes -- NEOs and satellites













# Undergraduate Project

 Simulations to optimise the detection of meteors Departamento de Astrofísica y CC de la Atmósfera Universidad Complutense de Madrid



#### Narrow-band photometry of meteors



Francisco Ocaña González Final year research project , under the supervision of Profs. Jaime Zamorano y Jesús Gallego.





# Introduction

- Final year research project
- Arquimedes Award (Ministry of Education of Spain)
- Master project using spectra from literature
  - 14 spectra
  - Manually digitised
  - Some basic science cases and colour-colour diagrams





# Introduction

- Master thesis: Integral Field Spectroscopy of LCBGs
- Synthetic photometry using spectra
- Spectra analysis
  - 22 galaxies
  - 331 fibers per pointing
  - Around 30k spectra!





# Narrow-band photometry



- Narrow-band filters to study the properties of the meteoroids (low-res spectroscopy)
- Other similar works: ALIS system (Brändtström+,2001), Leonids (Pellinnen-Wannberg+,2004)

# Narrow-band photometry

#### • Why?

- Easier calibration
- No need to use an order blocking filter
- Larger dynamic range
  - Background is reduced
  - Optimise each band (different gain/sensor for different lines)
- Continuous monitoring of the extinction
- Observation of dimmer meteors
- Use of BVR/RGB images
- Automatic pipeline!

# Design of the system

- Emission and continuum measures
- Measuring at least Ca, Cr, Fe, Mg, Mn, N, Na y Si
- System reffered to  $N_{Fe}$
- Optical range (H&K CaII 800nm)
- Hot and main components
- Filter bandwidth~10nm  $\rightarrow$  R~50
- Elements with different excitation states
- Cost of the setup is proportional to the number of bands  $\rightarrow$  modular

# Design of the system



- Simulation for different meteor spectra, bandwiths, sky emission
- Characteristics
  - 7 to 15nm width
  - R~50
  - 15 bands
  - Covering 150nm (of the 400nm)



Results from experimental setup at UCM Observatory

# Synthetic photometry

- Master project
- VO tools for synthetic photometry

- Spectra from literature
  - 14 spectra
  - Manually digitised
  - Some basic science cases and colour-colour diagrams



# Input data

Catalogue of representative meteor spectra. Vojáček+,2015.
A&A 580, A67

#### Catalogue of representative meteor spectra\*

V. Vojáček<sup>1,2</sup>, J. Borovička<sup>1</sup>, P. Koten<sup>1</sup>, P. Spurný<sup>1</sup>, and R. Štork<sup>1</sup>

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- <sup>2</sup> Institute of Astronomy, Charles University in Prague, Faculty of Mathematics and Physics, V Holešovičkách 2, 18000 Prague 8, Czech Republic
- Vizier archive
- Received 24 September 2014 / Accepted 6 May 2015
- J/A+A/580/A67 Catalogue of representative meteor spectra (Vojacek+, 2015)
- Sample
  - 84 meteor spectra (54 sporadic, 30 shower member)
  - Range 370-880nm, σ 1.5 -3 nm
  - Magnitude -2, +3 (1-10mm)
  - Total intensities of multiplets Mg1-2, Na1-1, and Fe1-15
  - All of them have orbit and trajectory computerd

## Input data







## Input data

#### Raw data





Synthetic photometry for 15 bands + BVR filters

Can we get the fluxes from synthetic photometry ?

## Some results



Vojacek+, 2015

### Some results



Cannot differentiate between Mg and Fe lines (around 500-550 nm)





Artifact resulting from spectra resolution impact on synthetic photometry!

# Design of the system



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Results from experimental setup at UCM Observatory

# **BVR** photometry



V-R colour index vs speed Fast meteors are redder (R < V)

See also: S. Ehlert, this conf.

**Observational bias?** 

Adding more filters to the VO tool

e.g., Nikon D3 and Nikon D3S RGB filters (some of the cameras used by astronauts at the ISS)



## **Observational setups**

#### Real photometry!



Ocaña+, 2011



Gural, 2015

Bloxam+, this conf!

# Conclusions / Discussion

Narrow-band photometry of meteors have quite some advantages over spectroscopy

Dimmer objects! Spectra from very dim objects (see Watanabe+, this conf!)

This work, using **synthetic photometry**, shows that some results from spectroscopy are **reproducible**!

Some groups are already making some observations → real narrow-band photometry

**Open questions?** 

Extend it to 800nm -1100nm? Or to <400nm (observations from cubesats) Other bands? Sloan? RGB?

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#### Questions? Contact me! fog@astrax.fis.ucm.es



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