

BlueMUSE

Data Analysis Software – DAS

Formerly Advanced Data Products (Software) – ADP(S)

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Why do we want Data Analysis Software

- i. Facilitate science. Automatic identification and cataloging of everything seen by BlueMUSE (MUSE).
- ii. Data volumes of Large Format-IFUs are enormous:
 - 3.5 Mvoxels for MUSE & 2.5 M for BlueMUSE
 - 20,000 cMpc³ for a MUSE survey & 9500 for BlueMUSE
- iii. Targets are diverse. Surveys find:
 - many things you want for your science
 - many things you don't want for your science
- iv. Efficiency: Assemble suite of software for all (e.g. Source Detection; talk by R.Bacon yesterday). *DAS does not prevent people from developing own algorithms.*
- v. Maximize the use of BlueMUSE data in the scientific community (easy to access and analyse→ increase discovery space)
- vi. motivate ESO investments and return

What should Data Analysis Software be?

- i. General enough to be a useful product to many. A valuable community resource
- ii. Simple & robust enough to work reliably on majority of BlueMUSE/MUSE (and WST) datacubes
- iii. Something we can use immediately to optimize our GTO data

Work Package Status

- Begun writing a Roadmap
 - Introduction
 - Module Description
 - Interaction with DRS
 - I/O & Libraries
 - Roadmap & FTE estimates
 - Example Use Cases
 - Risk Analysis

- Complete first version will be available by Oct 2024

Today's objective

- i. Status report: structure of DAS and workflow
- ii. Look for missing things, develop/improve structure of proposed DAS, start to define minimum requirements
- iii. Identify other consortium members to develop and review DAS

The ~~ADPS~~ DAS survey of 2023

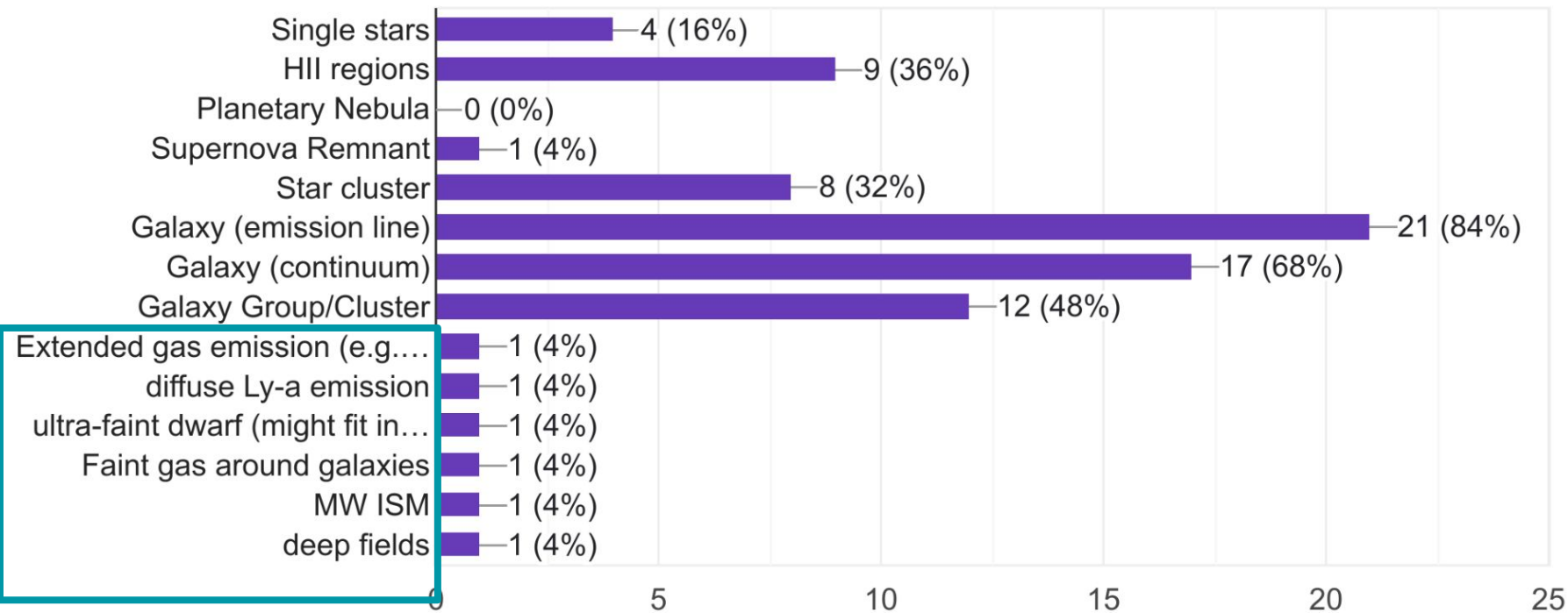
Goal: identify what we (~user community) think we need and we do not have yet

Received 25 responses (~80 science team members)

The ~~ADPS~~ DAS survey of 2023

What type of objects will be targeted in your science? [tick all that apply]

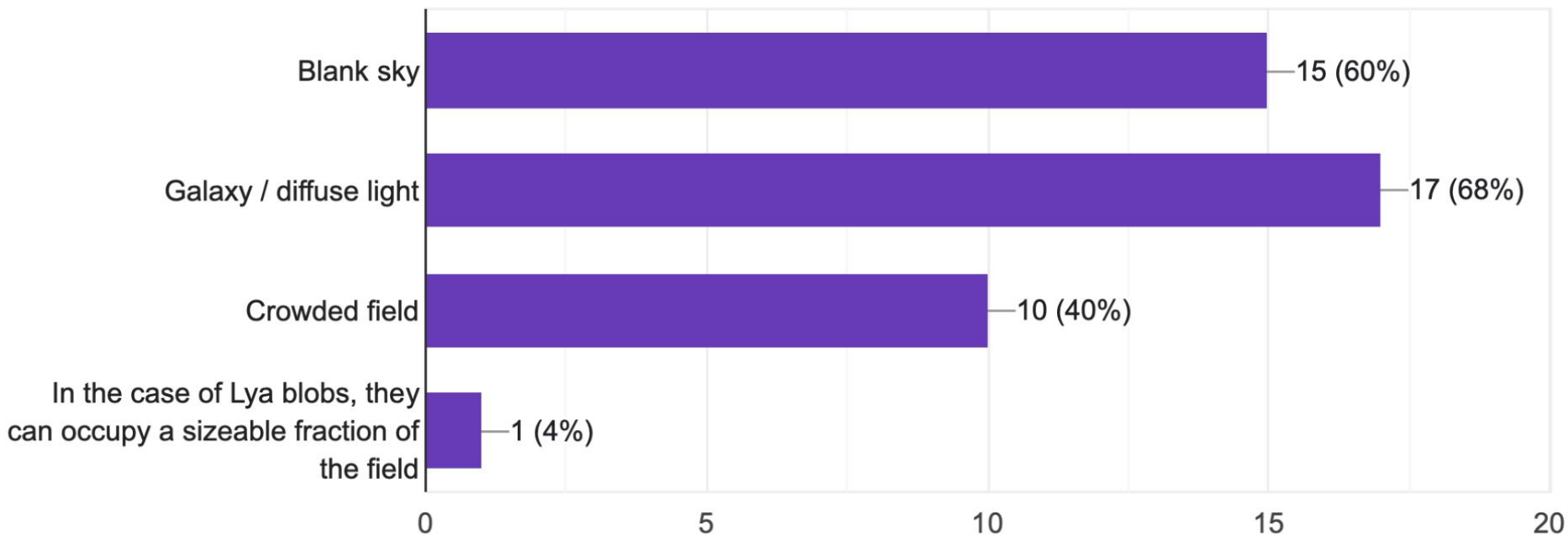
25 responses



The ~~ADPS~~ DAS survey of 2023

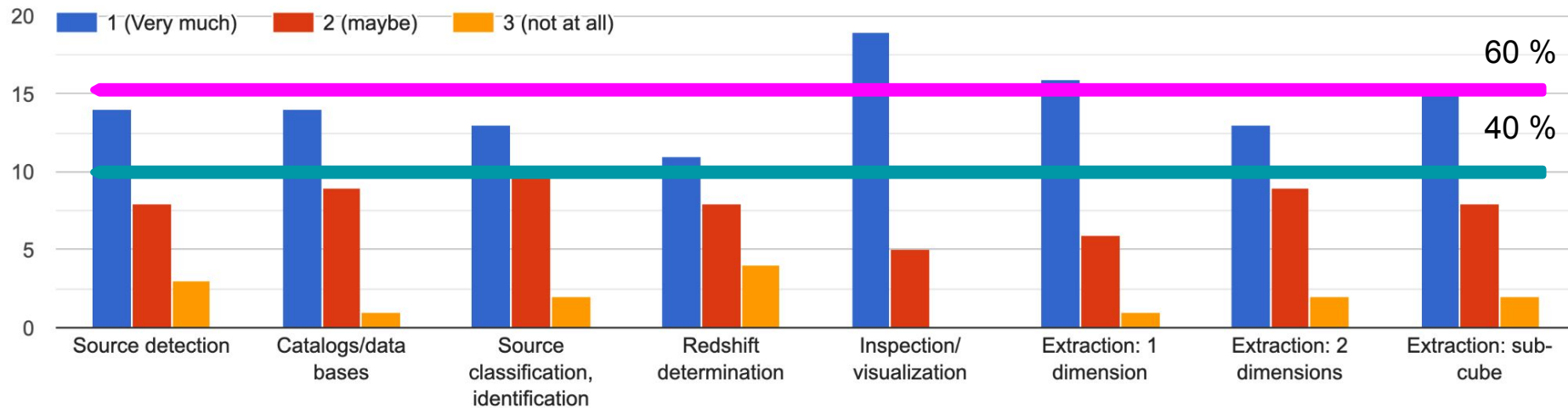
What is the background around your source / crowdedness of your field

25 responses



The ~~ADPS~~ DAS survey of 2023

What kind of ADP would support your science. 1 = 'I really want this' 3 = 'I am certain I will never use this'

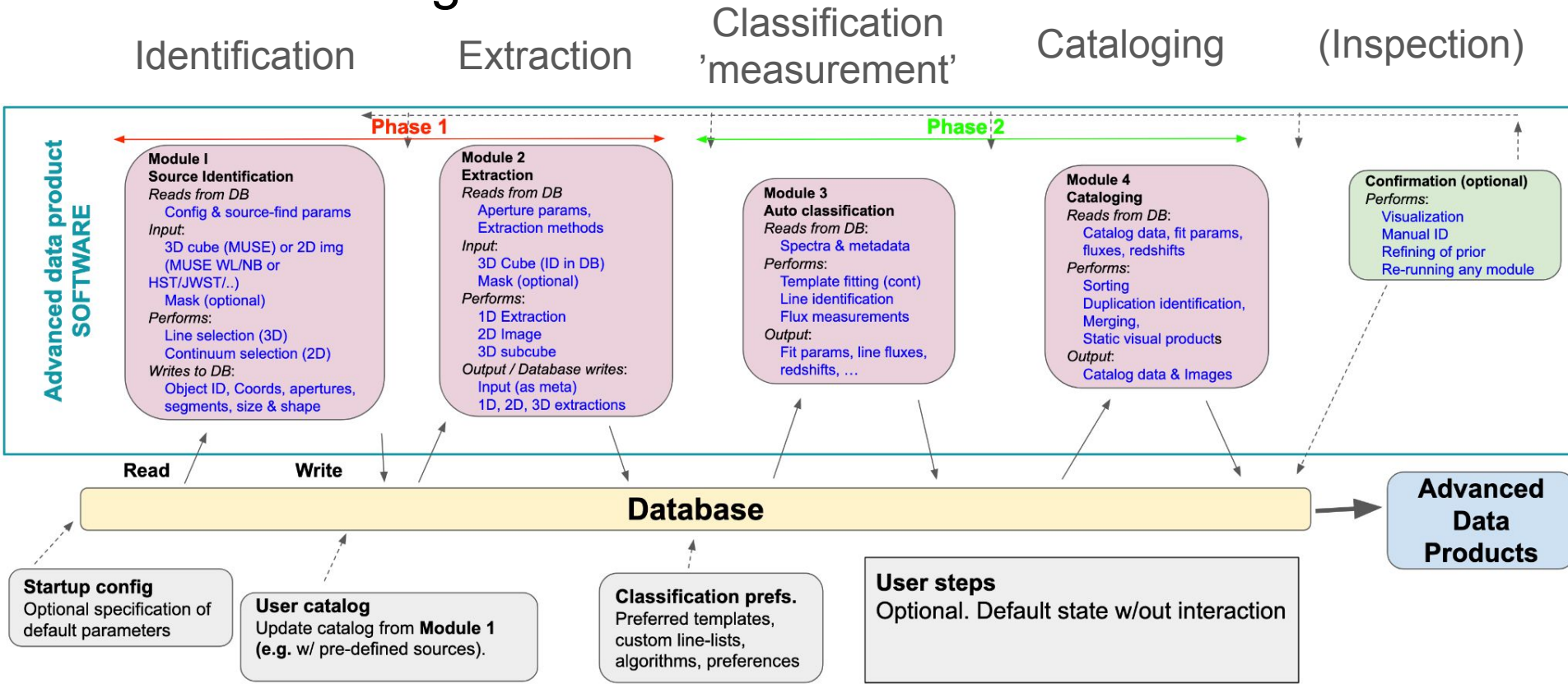


Free text answers

Beyond the above: what ADP (software/product) could be useful for your science and/or broader application in the community

1. Extraction of stellar spectra on top of ionized gas.
2. narrow-band images, list of emission line fluxes, associations to other catalogs (e.g. Hubble, Chandra, etc.), in deep fields: extracted SED info - stellar masses, SFRs, E(B-V)...
3. In case of observations of (deep) fields, catalogs containing redshifts and cross-correlated with HST or JWST observations.
4. 1D extraction would only be on regions of interest, probably not automatic. Not sure if "redshift" here would also cover 2D maps of velocities/kinematics... MaNGA-like data products would be cool.
5. A unified format (fits, etc) for all sources etc.
6. Matching cubes to HST and JWST imaging at sub-galactic scale
7. Adaptive kernel smoothing

DAS Block Diagram



Note: No algorithms are decided. Use most appropriate at time of development

DAS Modules

Module I

Source Identification

Reads from DB

Config & source-find params

Input:

3D cube (BlueMUSE) or 2D img
(BlueMUSE WL/NB or HST/JWST/..)

Mask (optional)

Performs:

Line selection (3D)

Continuum selection (2D)

Writes to DB:

Object ID, Coords, apertures,
segments, size & shape

DAS Modules

Module 2 Extraction

Reads from DB

Aperture params,
Extraction methods

Input:

3D Cube (ID in DB)
Mask (optional)

Performs:

1D Extraction
2D Image
3D subcube

Output / Database writes:

Input (as meta)
1D, 2D, 3D extractions

DAS Modules

Module 3

Auto classification

Reads from DB:

Spectra & metadata

Performs:

Template fitting (cont)

Line identification

Flux measurements

Output:

Fit params, line fluxes,
redshifts, ...

DAS Modules

Module 4 Cataloging

Reads from DB:

Catalog data, fit params,
fluxes, redshifts

Performs:

Sorting
Duplication identification,
Merging,
Static visual products

Output:

Catalog data & Images

DAS Modules

Confirmation (optional)

Performs:

Visualization

Manual ID

Refining of prior

Re-running **Module 3**

Example Use Cases

i. A Ly-alpha emitter survey

Blank sky survey observation → Emission line detection → 1D spectral extraction & 2D NB images → Line identification → Classification → redshift → Flux measurements → Cataloging.

ii. A survey for quenched galaxies

Blank sky survey observation → Continuum detection → 1D spectral extraction & 2D BB images → Template fitting – Classification → redshift → Magnitude measurements → Cataloging.

iii. Search for planetary nebulae

Galaxy observation → Emission line detection → 1D spectral extraction & 2D NB images for visualization → Line identification → Classification → velocity → Flux measurements → Cataloging.

iv. Spectral classification of pre-identified sources in NGC 0987654

Galaxy observation → No detection, but locations and apertures provided → 1D spectral extraction & 2D NB images for visualization → Line identification → Classification → velocity → Flux measurements → Cataloging.

Possible Risks

- i. DAS is not taken up broadly by the community
- ii. DAS will not be accurate/specific enough
- iii. Not sufficiently general/broad or adaptable enough

Solutions

- **Key point: I didn't say anything that has not been done before!**
- Publish widely, ASCL, packaged for installers, distributed with example workbooks.
- MPDAF & similar tools have been used.
- Use extensively on GTO data & publicize.
- ... More please !