

Introduction to Using the GES Science Archive

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GES 2014: Gaia-ESO Survey Second Science Meeting

Introduction

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- The workshop is a hands-on introduction to using the archive:
 - won't turn you into an expert,
 - but enough to get going.
- Structure of the workshop:
 - quick recap on the basics of the archive,
 - logging on,
 - brief introduction to SQL,
 - then...
- Using the archive to:
 - query target stars,
 - query spectra,
 - retrieve copies of spectra,
 - query recommended analyses,
 - query other analyses,
 - query atomic and molecular line lists.

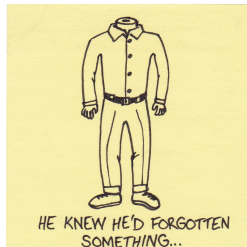
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Pre-requisites

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- Registered as a user of the archive, and have your:
 - username,
 - password,
 - community.
- Have your own laptop,
 - with wireless access enabled.
- The laptop should have a Web browser installed,
 - Firefox recommended, but most should be ok.
- Additional software that is useful but not necessary:
 - TOPCAT (for viewing FITS tables),
 - fv (for viewing spectrum files in FITS format).



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Archive Basics

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- Archive contains:
 - reduced spectra from those GES-acquired observations that are part of the release,
 - 'metadata' describing these spectra,
 - abundances and physical parameters derived from both newly-acquired and archival spectra,
 - atomic data used in the analyses.
- There are a series of releases, each in its own database:
 - we'll use iDR2 (and iDR3 will be very similar).
- The Spectra are held as FITS files in a Unix directory structure.
- The tabular data are held in a relational database management system (RDBMS):
 - Microsoft SQL Server,
 - accessed or queried using SQL (Standard Query Language).

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Important Tables

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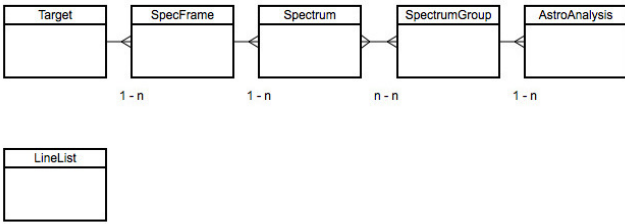
- **Target**
 - list of stars observed as part of the survey.
- **SpecFrame**
 - list of frames, fields or observing blocks.
- **Spectrum**
 - list of spectra (potentially several per target)
- **AstroAnalysis**
 - list of analyses (usually several per spectrum)
- **Linelist**
 - list of atomic and molecular lines

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Relation Between Tables

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Getting Started

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<http://ges.roe.ac.uk>

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Gaia-ESO Survey Science Archive

The Gaia-ESO Survey science archive comprises calibrated one- and two-dimensional spectra for stars observed in the Gaia-ESO Survey (GES), and a variety of astrophysical parameters (heliocentric radial velocity, effective temperature, surface gravity, metallicity etc) derived from these spectra.

GES is a public spectroscopic survey of approximately 100,000 stars, systematically covering all the major components of the Milky Way, from the halo to star-forming regions and providing the first homogeneous overview of the distributions of kinematics and elemental abundances. The target stars were observed using the FLAMES spectrograph on the ESO VLT at Paranal in Chile. The survey was conducted in support of the ESA Gaia astrometric satellite, but will have numerous other uses.

Release notes give details of the latest release and the history of archive releases, updates and bug fixes is recorded under the release history page.

Please note that all use of parameters obtained from the archive in publications and analyses leading to publications must conform with the PI Policy Statement on the use of DR2 parameters and abundances.

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Links | Credits

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Edinburgh, EH9 3HJ, UK
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or +44 131 668 8100 (switchboard)

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Accessing the Archive

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SQL: Querying the Archive

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- Search (or 'query') the archive to find spectra and results of interest.
- Currently only SQL queries are supported.
- SQL is the standard language for querying relational databases.
- But beware: most relational database management systems come with their own dialect of SQL;
 - SQL Server has T-SQL.
- Powerful and flexible once you get used to it...
- ...but most astronomers are not familiar with SQL.
- Plenty of examples and help are available on the Web site.

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SQL: Querying the Archive

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- Some simple SQL queries, using table Target:

```
SELECT COUNT(*) FROM Target;
```

```
SELECT * FROM Target;
```

```
SELECT TOP 10 * FROM Target;
```

```
SELECT TOP 10 cname, ra, dec, bmag FROM Target;
```

```
SELECT TOP 10 cname, ra, dec, bmag FROM Target  
WHERE bmag > 18.0 AND bmag < 18.5;
```

```
SELECT TOP 10 cname, ra, dec, bmag FROM Target  
WHERE bmag > 18.0 AND bmag < 18.5  
ORDER BY bmag;
```

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Schema Browser

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Queries on Target Stars

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- Column Target.cName contains star 'names' in the ESO standard format:
hhmmssss±ddmmsss
- Is a star in the archive?

```
SELECT * FROM Target WHERE cName = '11053303-7700120';
```
- Which of a list of stars are in the archive?

```
SELECT * FROM Target WHERE cName IN ('11034945-7700101', '11044460-7706240');
```
- List the stars in a range of RA and Dec:

```
SELECT * FROM Target WHERE (ra BETWEEN 70 AND 80) AND (dec BETWEEN -45 AND -30);
```

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Queries on Spectra

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- Spectra are tabulated in table Spectrum.
- Which spectra are available for a given star?

```
SELECT * FROM Spectrum WHERE cName = '11053303-7700120';
```
- Which of a list of stars are in the archive?

```
SELECT * FROM Spectrum WHERE cName IN ('11034945-7700101', '11044460-7706240');
```
- How many spectra are available for each of a given list of stars?

```
SELECT cName, count(cName) AS no_of_spectra FROM Target WHERE cName IN ('11034945-7700101', '11044460-7706240') GROUP BY cName ORDER BY cName;
```

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Identifiers in Archive Tables

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- In the Target table stars are identified by their cName, but also by a unique numeric identifier, targetID

```
SELECT TOP 10 cName, targetID, ra, dec FROM Target;
```
- Similarly table Spectrum contains column specID which uniquely identifies spectra.

```
SELECT TOP 10 specID, FROM Spectrum;
```
- The Spectrum table also lists the targetID of the star from which the spectrum was observed. This feature allows the Target and Spectrum to be unambiguously and efficiently joined:

```
SELECT TOP 10 sp.specID, tg.cName, tg.targetID FROM Spectrum sp, Target tg WHERE sp.targetID = tg.targetID;
```
- Many of the archive tables contain such identifiers and you will often use them to join tables when formulating queries.

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Queries on Spectra

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- As we've seen, spectra are tabulated in table Spectrum.
- All the GES spectra are acquired by multi-object spectrographs and the details of the 'frames' (or 'fields' or 'observing blocks') of spectra obtained by these instruments are held in table SpecFrame.
- SpecFrame tabulates the details common to all the spectra in the frame (eg. the spectrograph used).
- Column SpecFrame.specFrameID identifies each frame, - and is also tabulated in Spectrum to allow the tables to be joined.
- So, for example, to list the instrument used to observe each spectrum:

```
SELECT TOP 10 spec.cName, frame.instrument
FROM Spectrum spec, SpecFrame frame
WHERE spec.specFrameID = frame.specFrameID;
```

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Retrieve Copies of Spectra

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- The archive contains two types of files:
SingleSpec: contains a single stacked spectrum,
ManySpec: contains all the spectra in a stacked frame.
- The names of these files are tabulated in different tables:

Type of file	Table	Column
SingleSpec	SpectrumGroup	fileName
ManySpec	SpecFrame	fileName

- Table SpectrumGroup is used to group the files that are analysed together (we'll come to that next) and includes the SpecID.

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Retrieve Copies of Spectra

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- So to retrieve the file names:

```
SELECT DISTINCT TOP 10
spec.cName, spec.specID, spg.specID, spg.fileName
FROM Spectrum spec, SpectrumGroup spg
WHERE spec.specID = spg.specID;
```

- To facilitate retrieving large numbers of files:

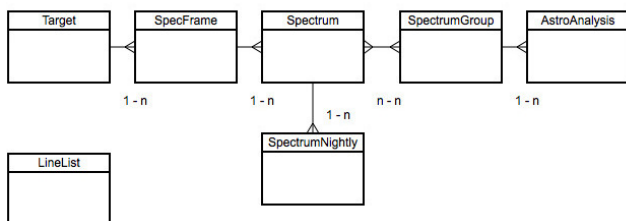
```
SELECT DISTINCT TOP 10
spec.cName, spec.specID, spg.specID, spg.fileName,
dbo.fWgetCmd(spg.fileName)
FROM Spectrum spec, SpectrumGroup spg
WHERE spec.specID = spg.specID;
```

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Queries on NightlySpectra

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- Queries like:

```
SELECT TOP 10 spec.cName, sn.vel, sn.velErr
FROM Spectrum spec, SpectrumNightly sn
WHERE spec.specID = sn.specID;
```



Queries on Recommended Analyses

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- To recap, the Consortium produces analyses on the spectra to derive element abundances and astrophysical parameters.
- Analyses are typically performed on a group of spectra of the same star, - often a red-blue pair.
- Several sets of parameters are produced for each spectrum:-
- Recommended parameters
 - the final, overall, homogenised parameters produced by WG15 from the results of the other working groups.
- Recommended parameters produced by the individual WGs 10-14.
- Parameters produced by each of the individual nodes with each of the WGs.
- All these parameters are stored in table AstroAnalysis.



Queries on Recommended Analyses

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Queries on Recommended Analyses

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- A series of 'views' (or subsets) are defined on table AstroAnalysis corresponding to the various types of parameter:

View	Description
AstroAnalysis	Table: all results.
RecommendedAstroAnalysis	WG15 parameters and abundances
WgRecommendedAstroAnalysis	WG parameters and abundances
WpNaAstroAnalysis	Node abundances, WG parameters
NpNaAstroAnalysis	Node abundances, node parameters

- Reiterate: usually use RecommendedAstroAnalysis.



Queries on Recommended Analyses

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- To list recommended analysis parameters:

```
SELECT TOP 10 cName, wg, teff, logg, feh, li1, c1  
FROM RecommendedAstroAnalysis;
```

- To list recommended analysis parameters for a given star:

```
SELECT cName, wg, teff, logg, feh, li1, c1  
FROM RecommendedAstroAnalysis  
WHERE cName = '11053303-7700120';
```



Queries on Recommended Analyses

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- To list recommended analysis parameters alongside information about the spectra from which they were obtained:
- need to join view RecommendedAstroAnalysis with table Spectrum,
- but recall that spectra are analysed in groups (eg. red-blue pair),
- therefore they cannot be joined directly,
- but rather they use an intermediate table SpectrumGroup:

```
SELECT TOP 10 * from SpectrumGroup;
```



Queries on Recommended Analyses

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- So, to list recommended analysis parameters for a given star:

```
SELECT
  racc.cName, racc.teff, racc.logg, racc.feh,
  sp.expTime, sp.snr,
  spg.fileName
FROM
  RecommendedAstroAnalysis racc,
  SpectrumGroup spg,
  Spectrum sp
WHERE racc.specGroupId = spg.specGroupId
      AND spg.specId = sp.specId
      AND racc.cName = '11053303-7700120';
```



Queries WG Recommended and Node Analyses

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- The recommended parameters will usually be used but...
- to use the WG recommended or node analyses simply:
 - replace 'RecommendedAstroAnalysis' with the name of the appropriate view,
 - perhaps add a selection for the WG or node required.
- For example:

```
SELECT cName, wg, nodeName, teff, logg, feh, li1, c1
FROM NpNaAstroAnalysis
WHERE cName = '11053303-7700120' and wg='WG11'
ORDER BY nodeName;
```

Here we are:

- selecting WG11,
- ordering the results by the names of the individual nodes.



Queries on Line Lists

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- All the atomic and molecular data are held in table LineList.
- Again there are a set of views for different sorts of data:

View	Description
LineList	Table: all lines
LineAtomHfs	Atomic lines with hyperfine splitting
LineAtomNoHfs	Atomic lines without hyperfine splitting
LineMol	Molecular lines with hyperfine splitting
LineMolAtomHfs	Molecular lines without hyperfine splitting



Queries on Line Lists

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- Simply query the appropriate table or the whole view.
- Which lines are available in a given wavelength range?

```
SELECT * FROM LineAtomHfs  
WHERE lambda BETWEEN 4500 AND 4800  
ORDER BY lambda ASC;
```

- Which lines are available for a given species?

```
SELECT * FROM LineAtomHfs  
WHERE name1 = 'Al' and ion = 1  
ORDER BY lambda ASC;
```

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Workshop

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