# SHARING SOLAR DATA
WITH ESCAPE AND SOLARNET

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SOLAR PHYSICS COMMUNITY: FACT SHEET

▶ ~615 European Solar physicists

▶ About the same in USA

▶ + Japan, South Korea, China

Source:
Results GREST project (2016)

Much smaller than Astronomy!
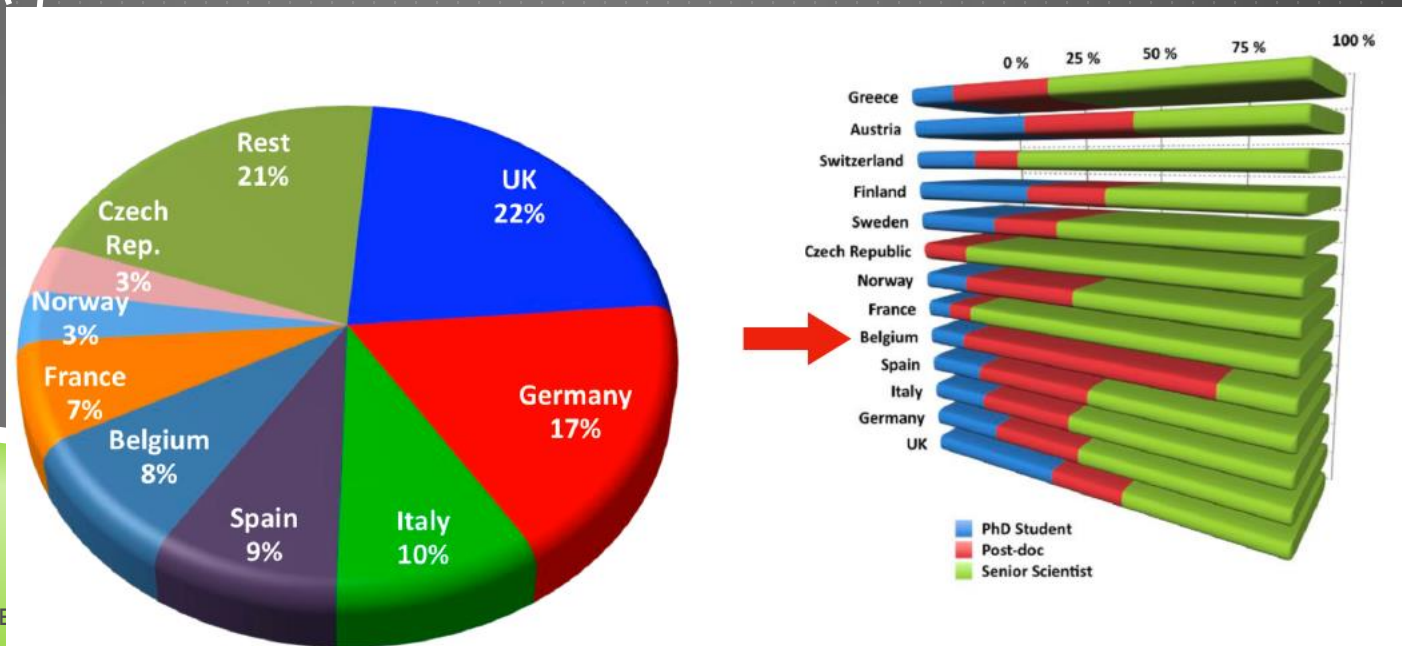
SOLAR PHYSICS COMMUNITY SPLIT IN GROUND-BASED   VS   SPACE-BASED

- European solar telescope (EST) is the next generation large aperture (4m) telescope for solar physics, to be built in Canary Island
- Since 2016, EST is part of the ESFRI roadmap
- EST takes part in ESCAPE

- Mostly driven by three main Space Agencies: ESA / NASA / JAXA

PROCESSING SOLAR IMAGE

▶ FITS format almost a standard, but FITS keywords (metadata) far from being standardized, esp. for ground based data

▶ Difference with astronomy: we catch the dynamics of the Sun in all its details

  ▶ Image series (movies) and event databases are important

  ▶ Besides a few exceptions, event databases are still far from being FAIR

▶ Since 2010, explosion in data volumes, dictating the need for automated processing (machine learning)

  ▶ Event databases populated by output of image processing algorithms running in real time on solar data

SOLARNET: ACHIEVEMENTS STANDARDISATION

FP7 SOLARNET (2013-2017)

► Recommendation for FITS metadata in case of space-based or ground-based observations (Stein Haugan)

► Development of a prototype of a Solar Virtual Observatory, as an entry point to access different data sets and catalogues

H2020 SOLARNET (2019-2022)

► Continue to provide SOLARNET recommendation for metadata

► Turn the prototype Solar VO into an operational tool

ESCAPE: MAKE THE DATA FAIR, CONNECT TO EUROPEAN OPEN SCIENCE CLOUD

▶ Foreseen contributions from ROB

   ▶ Data access and visualization tools : use (more) IVOA standards

   ▶ Interoperability between data access (FITS files) and data visualization tool

   ▶ Strengthen use of UCD, with the help a.o. of SOLARNET colleagues taking part in ESCAPE

CONNECTION BETWEEN EVENT CATALOGS, VISUALIZATION, AND DATA ACCESS TOOL
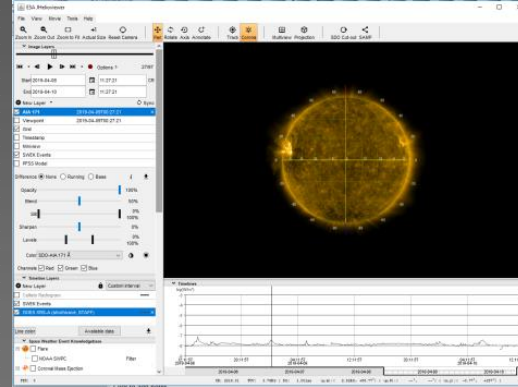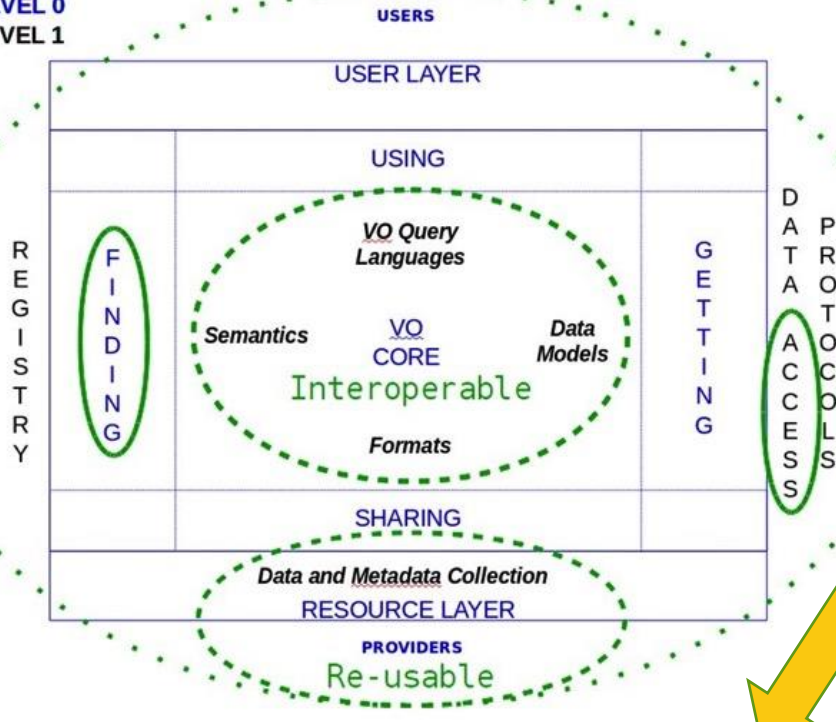
Access
JHelioviewer: visualization tool

Interoperable

Re-usable ROB EventDataBase (solar catalogs)

Access   Solar VO: one tool to access various datasets

SOLAR EVENT/FEATURE CATALOGS

▶ Many catalogs of solar features and events exist, each with its own output format:

  ▶ VOEvent (standard v1.11) used in Heliophysical Event Knowledge base (HEK), LMSAL, US

  ▶ VOTable used in Heliophysics Feature Catalog (ObsParis)

  ▶ Custom-designed database (ROB/SIDC)

▶ A same algorithm sometimes runs on different platforms, essentially giving the same catalog but with different formats and parameter names

▶ Objective: (more) harmonization

DATA ACCESS: SOLAR VIRTUAL OBSERVATORY

http://solarnet.oma.be/
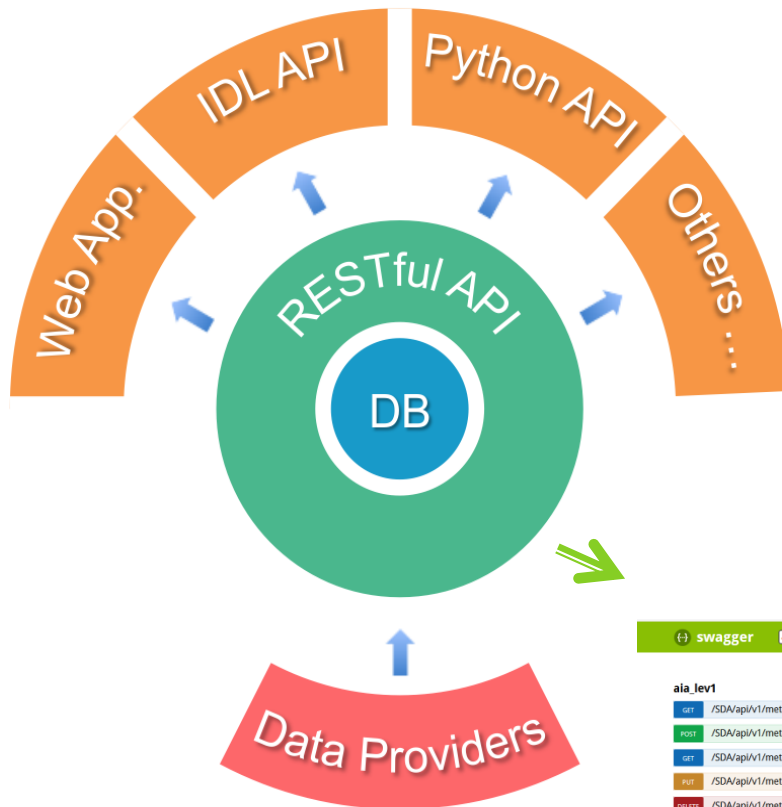
- The data are hosted on the servers of the data providers.
- SVO collect the metadata into a central searchable database.
- To interface with the database we use the **RESTful** API
- User friendly web App
- IDL and Python API to make more complex searches and to be used in programs and scripts.

DATASETS

▶ Only a few datasets at the moment (prototype) but possibility to do search based on characteristics (ground-based, Full Sun, partial sun, EUV, …) and tags (moon transit, planet transit, test data, etc,…)

EVENTS: API TO LINK TO THE HEK

https://www.jhelioviewer.org/

OVERVIEW CAPABILITIES FROM JHELIOVIEWER
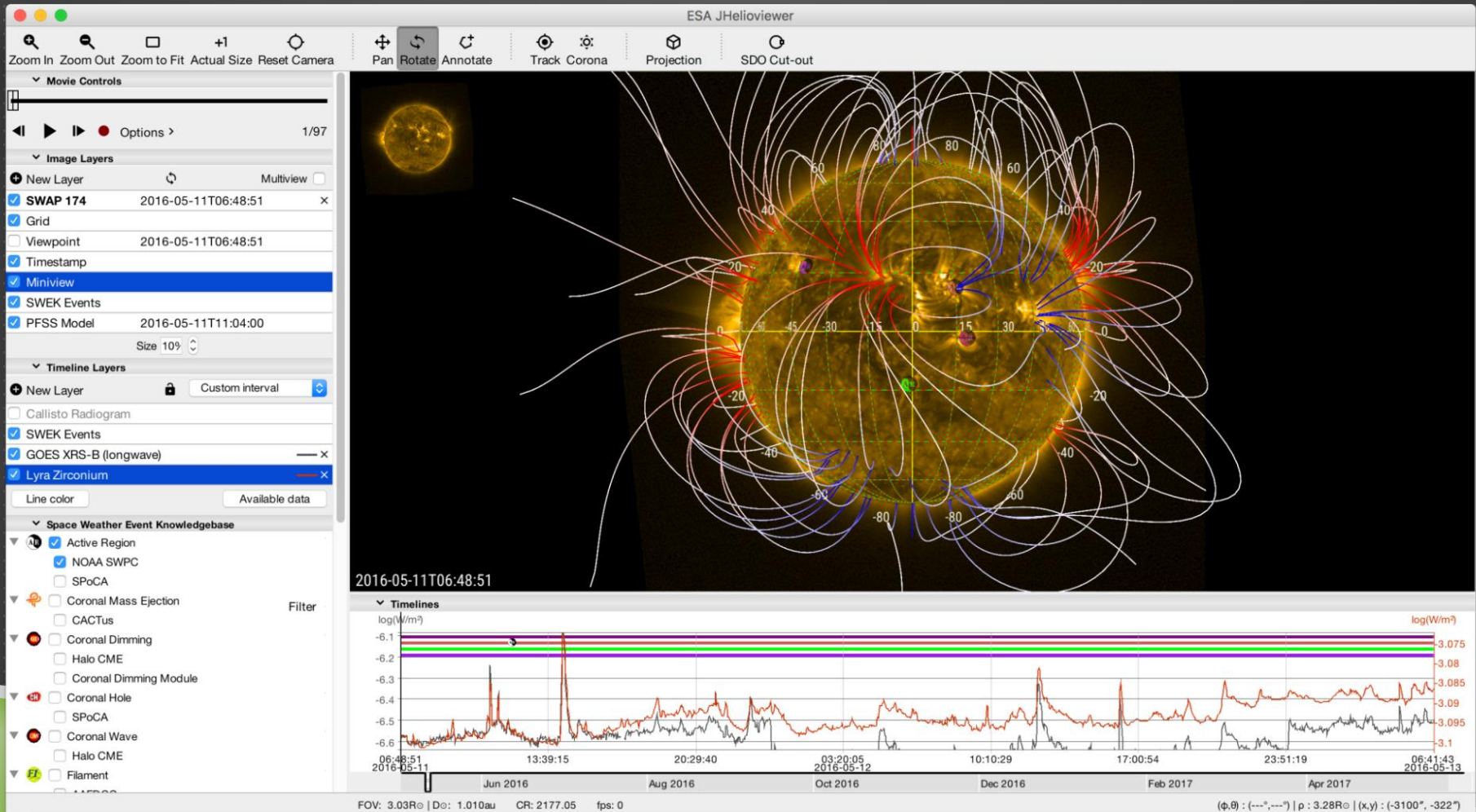
JHELIOVIEWER & SAMP
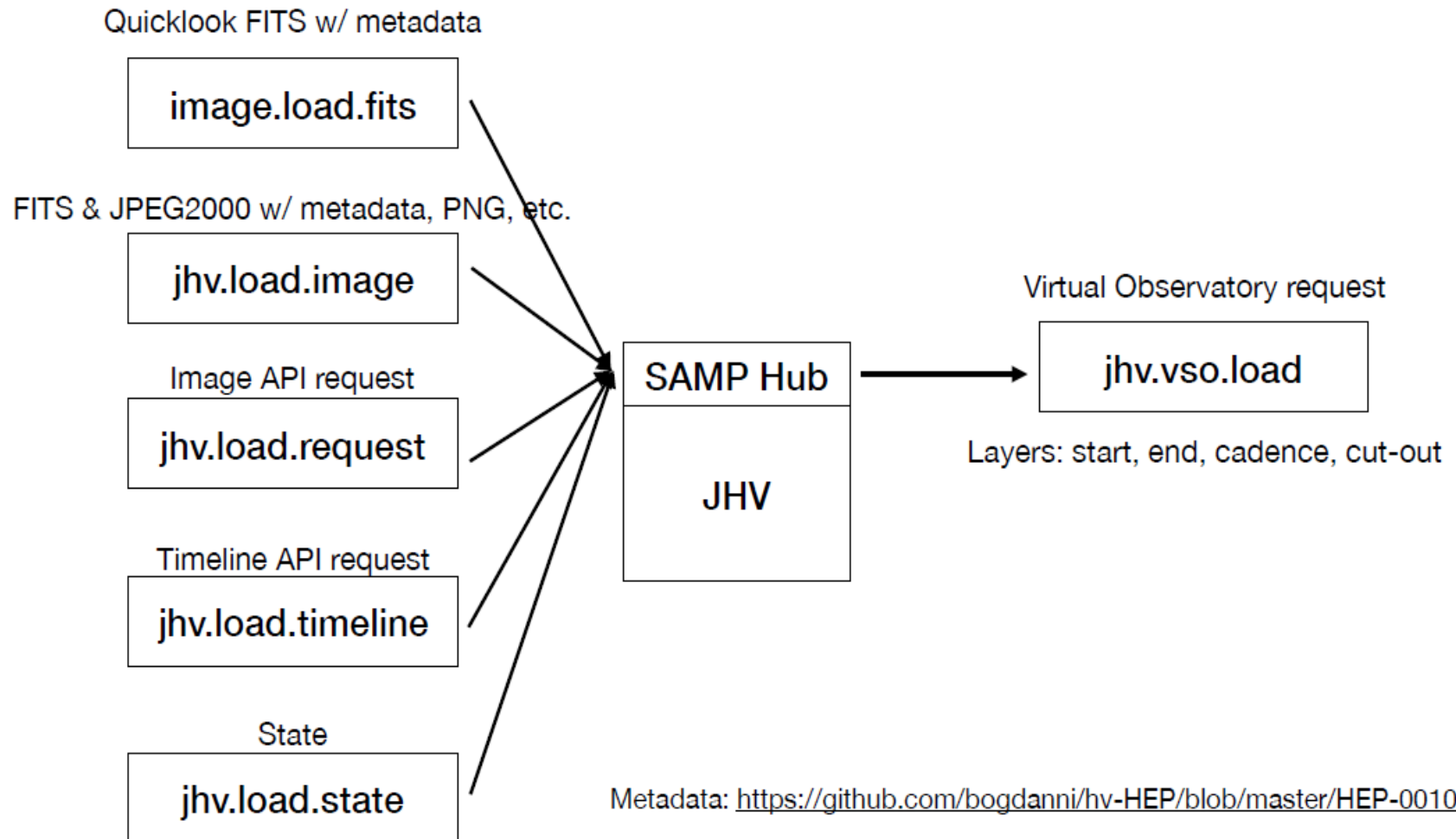
IN THE FUTURE:

JHelioviewer

▶ Modify JHelioviewer to support TAP in order to search and retrieve data

▶ Primary Targets:

- ▶ Solar Orbiter data archive
- ▶ Event Database from ROB

Programmatic question: Size of effort to implement a TAP service?

Solar VO

▶ Build a TAP service layer around the RESTful API (possibly using DaCHS)

▶ Versioning: if a field in table A is pointing to a key in the other table B: what if A or B are updated independently?

▶ concept of "ownership" of the link: this is the Element that owns the link which decides on its update

RECOMMENDATION FOR FITS KEYWORD & UCD

SOLARNET FITS keyword (Haugan, 2017): origin, acquisition,…

▶ PROJECT: Name(s) of the project(s) affiliated with the data

▶ MISSION: Typically used only in space-based settings

▶ OBSRVTRY: Name of the observatory

▶ TELESCOP: Name of the telescope.

▶ TELCONFG: Telescope configuration.

▶ INSTRUME: Name of the instrument.

▶ CAMERA: Name of the camera.

▶ FILTER: Name(s) of the filter(s) used during the observation.

▶ DETECTOR: Name of the detector.

▶ OBS_MODE: A string identifying operation mode

▶ SETTINGS: Other settings – "parameter1=n, …

▶ OBSERVER: Who acquired the data.

▶ PLANNER: Observation planner(s).

▶ REQUESTR: Who requested this particular observation.

Corresponding UCD (Version1.3)

▶ PROJECT:

▶ MISSION: *instr.obsty*

▶ OBSRVTRY: *instr.obsty*

▶ TELESCOP: *instr.tel*

▶ TELCONFG:

▶ INSTRUME: instr

▶ CAMERA:

▶ FILTER: *instr.filter*

▶ DETECTOR: *instr.det*

▶ OBS_MODE: *phys.? Instr.setup?*

▶ SETTINGS:,

▶ OBSERVER:

▶ PLANNER:

▶ REQUESTR:

UCD may provide ideas for
new FITS keywords recommendation

Q | instr	Instrument
E | instr.background	Instrumental background
Q | instr.bandpass	Bandpass (e.g.: band name) of instrument
Q | instr.bandwidth	Bandwidth of the instrument
Q | instr.baseline	Baseline for interferometry
S | instr.beam	Beam
Q | instr.calib	Calibration parameter
S | instr.det	Detector
Q | instr.det.noise	Instrument noise
Q | instr.det.psf	Point Spread Function
Q | instr.det.qe	Quantum efficiency
Q | instr.dispersion	Dispersion of a spectrograph
Q | instr.experiment	Experiment or group of instruments
S | instr.filter	Filter
S | instr.fov	Field of view
S | instr.obsty	Observatory, satellite, mission
Q | instr.obsty.seeing	Seeing
Q | instr.offset	Offset angle respect to main direction of observation
Q | instr.order	Spectral order in a spectrograph
Q | instr.param	Various instrumental parameters
S | instr.pixel	Pixel (default size: angular)
S | instr.plate	Photographic plate
Q | instr.plate.emulsion	Plate emulsion
Q | instr.precision	Instrument precision
Q | instr.rmsf	Rotation Measure Spread Function
Q | instr.saturation	Instrument saturation threshold
Q | instr.scale	Instrument scale (for CCD, plate, image)
Q | instr.sensitivity	Instrument sensitivity, detection threshold
Q | instr.setup	Instrument configuration or setup

RECOMMENDATION FOR FITS KEYWORD & UCD-1+

SOLARNET FITS keywords: data statistics

- ▶ DATAMIN : the minimum data value
- ▶ DATAMAX : the maximum data value
- ▶ DATAMEAN : the average data value
- ▶ DATAMEDN : the median data value.
- ▶ DATARMS : the RMS deviation from the mean
- ▶ DATAKURT : the kurtosis
- ▶ DATASKEW : the skewness

UCD-1+

- ▶ DATAMIN : stat.min
- ▶ DATAMAX : stat.max
- ▶ DATAMEAN : stat.mean
- ▶ DATAMEDN : stat.median
- ▶ DATARMS : stat.rms
- ▶ DATAKURT : stat.kurt ?
- ▶ DATASKEW : stat.skew?

↑

SOLARNET keywords may provide ideas for new UCD-1+ names

EVENT/FEATURE CATALOGS: METADATA STANDARD?

Active Region catalog in HEK (part)

- Event_Probability Event_Importance
- Event_Type   KB_ArchivDate KB_ArchivID
- KB_Archivist   KB_ArchivURL
- Event_CoordSys Event_CoordUnit   Event_EndTime
- Event_StartTime   Event_Expires   Event_Coord1
- Event_Coord2   Event_Coord3
- Event_MapURL   Event_MaskURL
- Event_PeakTime   Event_C1Error
- Event_C2Error   Event_ClippedSpatial
- Event_ClippedTemporal   Event_TestFlag
- Event_Description   FRM_Contact
- FRM_DateRun   FRM_HumanFlag
- FRM_Identifier   FRM_Institute
- FRM_Name   FRM_ParamSet
- FRM_VersionNumber   FRM_URL
- FRM_SpecificID   OBS_Observatory
- OBS_ChannelID   OBS_Instrument
- OBS_MeanWavel   OBS_WavelUnit
- Bound_CCStartC1
- Bound_CCStartC2
- Bound_ChainCode   BoundBox_C1LL
- BoundBox_C2LL   BoundBox_C1UR
- BoundBox_C2UR   ChainCodeType

Active Region catalog in HFC (part)

- FRC_INFO_ID OBSERVATIONS_ID
- OBSERVATIONS_ID_T FEAT_DATE
- FEAT_DATE_PREV FEAT_X_ARCSEC
- FEAT_Y_ARCSEC FEAT_X_PIX
- FEAT_Y_PIX FEAT_HG_LONG_DEG
- FEAT_HG_LAT_DEG FEAT_CARR_LONG_DEG
- FEAT_CARR_LAT_DEG FEAT_AREA_PIX
- FEAT_AREA_MM2 FEAT_AREA_DEG2
- BR_X0_ARCSEC BR_Y0_ARCSEC
- BR_X1_ARCSEC BR_Y1_ARCSEC
- BR_X2_ARCSEC BR_Y2_ARCSEC
- BR_X3_ARCSEC

Not a single name in common!

Difficult to change the names themselves (history etc…), but whenever possible should associate the corresponding Unified content descriptor **Need for UCD in VOEvent**