

The ALMA keyword filler program

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IT ARC node, and many others

ALMA Science Archive FITS Data product requirements and recommendations.

V. 1.8, E. Muller, Nov 2015

WHO:

- Inter-ARC ALMA Science Archive Working Group (ASAWG)
- pipeline group (+ AQUA)

Scope:

- ALMA FITS products easily accessible by the ALMA Science Archive (ASA).
- consultation throughout the members respective ARCs, with the considered and assumed preferences of the ALMA user-base in mind.

Motivation:

- benefit for archive researchers: easily and efficiently access and filter
- reference document for the pipeline and archive groups
- standardizing the ALMA-archived science data structure
- provide all the relevant information of FITS images in their header

SCIREQ TICKET: SCIREQ-111

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FITS keywords categories:

- **Primary HDU**
e.g. SIMPLE, BITPIX, NAXIS, NAXISn, END
- **WCS & Coordinate information**
e.g. CRVAL, CDELTA, CTYPE, RA, DEC, ...
- **Observations Time information**
e.g. DATE-OBS, DATE-END, MJD-OBS, MJD-AVG, ...
- **Image and Beam properties**
e.g. BMAJ, BMIN, DATAMIN, DATAMAX, DYNRANGE, ...
- **Telescope & Data acquisition information**
e.g. MINELTP, MINEL12, MINEL7, OBSMODE, ...
- **PI & Proposal and PI information**
e.g. PROPCODE, OBSERVER, TITLE, ...
- **Pipeline, Archive and Request information**
e.g. PIPEVER, CASAVR, MEMBER, ...

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e.g.

BNDCTR

new ALMA keyword

Description: The center frequency of data in the FITS array

Type: Float

Required units: Hz

Note, there is some overlap in scope of this keyword with CTYPE='FREQ'.

Does not exist in CASA FITS products.

EXAMPLE OF FITS HEADER IS ALSO GIVEN

DYNRANGE = 5.0	/ Actual achieved Dynamic range in dataset.
NPOL = 2	/ Number of orthogonal polarizations observed
STOKES = '1'	/ List of data Stokes parameters
BNDCTR = 2.315424966698E+11	/ [Hz] Center frequency of data in the FITS array
BNDWID = 1.875E+9	/ [Hz] Effective bandwidth of data in the FITS array
BNDRES = 0.488281E+6	/ [Hz] Effective frequency resolution of data in the FITS array
MAXANGSC = 2000.0	/ Maximum angular scale of data in FITS

IT ARC WORK

NOT ALL KEYWORDS EXIST IN CASA FITS PRODUCTS !!

Deliver a code:

- Python
- with input the fits image + related ms
- with output a dictionary with all the missing keywords
- 12m , 7m, TP, polarization, spectral line, mosaic data
- Standalone: provide kws without the use of analysis utils
- CASA toolkit Reference manual used :
<https://casa.nrao.edu/docs/casaref/CasaRef.html>
- Other involved people: Felix, Erick M., Liz, John and Suzanne (for pipeline and AQUA)

SCIREQ TICKET: SCIREQ-652

CODE SCHEME

Input: image name with path (=ImName)

Requirement: all the ms in the same folder

class ArchInfo

```
def GetImagesInfo  
    (ImName)  
    field_name, spw, header, statistics, ms list
```

```
def GetMSInfo  
    (mslist)  
    source_id, field_id list, freq
```

```
def Init:  
self.KwsImage (ImName)  
self.KwsMS (ImName)
```

```
def KwsMS (ImName)
```

```
def KwsImage (ImName)
```

Output: Dictionary with Kws

CODE SCHEME

Example of def KwIMS (ms, fieldid)

```
def UVrange(self, ms, fieldid):

    tb.open(ms)
    punt = tb.query('FIELD_ID==' + str(fieldid) + ' && DATA_DESC_ID==' + self.ImageDict['spw'])

    uvw = punt.getcol("UW")
    tb.close()

    try:
        u = uvw[0]
        v = uvw[1]
    except:
        u = nan
        v = nan

    uvdist = (u**2+v**2)**0.5

    return uvdist
```

CODE SCHEME

- **def KwsMS (imName)**

Loop on ms in mslist

Loop on fieldid in fieldidlist

```
Kw1Ms = self.Kw1Ms(ms, fieldid)
```

```
|||||
```

```
KwNMs = self.kwNMs(ms, fieldid)
```

(operations on KW1Ms to obtain the final KW1MS)

```
self.Metadata['Kw1'] = Kw1Ms
```

```
|||||
```

```
self.Metadata['KwN'] = KwNMs
```


CODE SCHEME

Example of def KwImage (ImName)

```
def GetStokes(self, imName):
    if len(self.ImageDict.keys())<1:
        self.GetImagesInfo(imName)

    stokes= self.ImageDict['header']['perplanebeams']['nStokes']
    if stokes == 1:
        stokes = 'I'
    elif stokes == 2:
        stokes = 'Q'
    elif stokes == 3:
        stokes= 'U'
    elif stokes == 4:
        stokes= 'V'
    elif stokes == -5:
        stokes= 'XX'
    elif stokes == -6:
        stokes = 'YY'

    self.Metadata['STOKES'] = stokes
    return
```

LIST OF HANDLED KEYWORDS

PADLIST
INSTRUME
NANT
MINPRBL
MAXPRBL
UVRANGE
BNDRES
CHANRMS
SPATRES
STOKES
MJD-OBS
MJD-AVG
DATE-OBS
DATE-END
DATAMAX
DATAMIN
DYNRANGE
BNDCRT
BNDWID
MINEL
EXPTIM
MAXANGSC