Equatorial projections of Cassini-INCA ENA observations

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Citation of this dataset

Please cite the following publication which details this dataset's processing and usage caveats:

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"A complete dataset of equatorial projections of Saturn's energetic neutral atom emissions observed by Cassini-INCA" (2021)
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This data repository can additionally be referenced using doi:10.17635/lancaster/researchdata/384 if wished.

Contents of this dataset

- `README.pdf`

  This file.

- `all_INCA_projections_YYYY.zip`

  Zip archives including all projections, sorted by year.

- `inca_projection_code.zip`

  Zip archive with code. Includes one subfolder with all routines used for generating this dataset and one subfolder with routines needed for loading the data in Python.

Links

- Original uncalibrated Cassini-INCA dataset `CO-E_J_S_SW-MIMI-2-INCA-UNCALIB-V1.1` can be obtained from NASA's Planetary Data System (`https://pds.jpl.nasa.gov/`).
- Companion research letter detailing the statistical morphology of the ENA emission based on this dataset (`https://doi.org/10.1029/2020GL091595`).
- Further information on INCA as well as data and analysis utilities can be found on the MIMI website (`http://cassini-mimi.jhuapl.edu/`).

Usage of the data loading routine

This code snippet, also included in the `inca_projection_code.zip` archive with name `load_example.py`, shows how to use `load_inca_projection.py` to (relatively) efficiently load projected ENA observations directly from their zip archive. The data zip archive doesn't need to be unpacked. The routine also returns metadata for each projection and some geometric information useful for further calculations or data selection, if wished.

```
import zipfile

# import INCA projection loading routine
import load_inca_projection

# location of zip archive with some data
arch = "D:/all_INCA_projections_2011.zip"
# list all files in this archive
with zipfile.ZipFile(arch, 'r') as zipdata:
    allfiles = zipdata.namelist()
# pick an example file to load
thisfile = allfiles[0]

# load file using routine provided
data = load_inca_projection.loadFits(
        thisfile,
        ziparchive=arch,
        returnGeometry=True)

# access projections
# numpy array with shape (m,nx,ny), where
# m = number of projections on this day and
# nx/ny = number of px between [-30,30] Rs in X & Y KSMAG axes
projections = data['img']

# access metadata (simple dictionary)
metadata = data['meta']
# information contained:
# (all arrays of length m)
metadata['STARTUTC']    # start of the exposure, string
metadata['STOPUTC']     # end of this exposure, string
metadata['XKSMAG']      # X_KSMAG coordinate of Cassini
                        # (mid-exposure) in units of Rs
metadata['YKSMAG']      # Y_KSMAG coordinate of Cassini
                        # (mid-exposure) in units of Rs
metadata['ZKSMAG']      # Z_KSMAG coordinate of Cassini
                        # (mid-exposure) in units of Rs
metadata['OBSTYPE']     # string like "H_024_055" indicating type of
                        # particle and energy band observed

# access geometry information (only returned if returnGeometry=True)
# all numpy arrays
data['xyzlocs']     # shape (m, nx, ny, 3), contains X/Y/Z KSMAG
                    # central position of each pixel in units of Rs
data['rltlocs']     # shape (m, nx, ny, 2), contains radial and LT
                    # central position of each pixel in units of Rs
                    # and hours LT, respectively
data['totdist']     # shape (m, nx. ny), contains line of sight
                    # distance of Cassini from each pixel in Rs
data['elevation']   # shape (m, nx. ny), contains elevation
                    # of Cassini above each pixel in degrees
data['flowobsangle']    # shape (m, nx. ny), contains angle
                        # between corotational flow and INCA
                        # viewing direction for each pixel
                        # in degrees
                        # 0 deg = plasma flow parallel to view
                        # (away from the detector)
                        # 180 deg = plasma flow antiparallel to view
                        # (into the detector)
```

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