

# Run CST codes (Coherent Structure Tracking)

Martine Chane-Yook (IAS)  
&  
Thierry Roudier (IRAP)

March 4, 2020

# What do we need ?

- 1 A computing cluster

# What do we need ?

- ① A computing cluster
- ② CST codes from MEDOC/Tools, then CST codes

# What do we need ?

- ① A computing cluster
- ② CST codes from MEDOC/Tools, then CST codes
- ③ HMI/SDO 45s-cadence intensity and Doppler data series from JSOC

# What do we need ?

- 1 A computing cluster
- 2 CST codes from MEDOC/Tools, then CST codes
- 3 HMI/SDO 45s-cadence intensity and Doppler data series from JSOC
- 4 Training exercise : running CST codes for 30 min of SDO/HMI observation (data) on November, 29, 2018

# What do we need ?

- ① A computing cluster
- ② CST codes from MEDOC/Tools, then CST codes
- ③ HMI/SDO 45s-cadence intensity and Doppler data series from JSOC
- ④ Training exercise : running CST codes for 30 mins of SDO/HMI observation (data)
- ⑤ How many observation days to run ? from 1 to 6 days

- 1 A computing cluster
- 2 CST codes from MEDOC/Tools, then CST codes
- 3 HMI/SDO 45s-cadence intensity and Doppler data series from JSOC
- 4 Training exercise : running CST codes for 30 mins of SDO/HMI observation (data)
- 5 How many observation days to run ? from 1 to 6 days
- 6 Frequent troubles encountered

- 1 A computing cluster
- 2 CST codes from MEDOC/Tools, then CST codes
- 3 HMI/SDO 45s-cadence intensity and Doppler data series from JSOC
- 4 Training exercise : running CST codes for 30 mins of SDO/HMI observation (data)
- 5 How many observation days to run ? from 1 to 6 days
- 6 Frequent troubles encountered
- 7 Work in progress



- 1 A computing cluster
- 2 CST codes from MEDOC/Tools, then CST codes
- 3 HMI/SDO 45s-cadence intensity and Doppler data series from JSOC
- 4 Training exercise : running CST codes for 30 mins of SDO/HMI observation (data)
- 5 How many observation days to run ? from 1 to 6 days
- 6 Frequent troubles encountered
- 7 Work in progress
- 8 Contacts (SAV)

# 1. Computing cluster

- CST codes are written in Fortran 90 and IDL
- We need
  - `ifort` fortran compiler
  - SolarSoft (`SSWIDL`) software
  - `slurm` workload manager (for example)
- Morning of workshop 2nd day will be devoted to CST codes installation on your computing cluster

## 2. CST codes (CST\_V 1.0)

- [Documentation](#) and [Quick start guide](#) are available.

## 2. CST codes (CST\_V 1.0)

- **Documentation** and **Quick start guide** are available.  
→ *A section devoted to the description of IDL and Fortran subroutines is missing : work is in progress (online soon)*

## 2. CST codes (CST\_V 1.0)

- [Documentation](#) and [Quick start guide](#) available.  
→ *A section dedicated to the description of IDL and Fortran subroutines is missing : work is in progress*
- CST\_V1.0 directory contains :
  - a test case [CST\\_TEST\\_30min](#) using 30 min HMI observation data (Nov, 29, 2018)

## 2. CST codes (CST\_V 1.0)

- **Documentation** and **Quick start guide** available.  
→ *A section dedicated to the description of IDL and Fortran subroutines is missing : work is in progress*
- CST\_V1.0 directory contains :
  - a test case **CST\_TEST\_30min** using 30 min HMI observation data (Nov, 29, 2018) → **special treatment**
  - source codes to deal with 1 to 6 HMI observation days  
**CST\_1\_TO\_6\_DAYS**

## 2. CST codes (CST\_V 1.0)

- **Documentation** and **Quick start guide** available.  
→ *A section dedicated to the description of IDL and Fortran subroutines is missing : work is in progress*
- CST\_V1.0 directory contains :
  - a test case **CST\_TEST\_30min** using 30 min HMI observation data (Nov, 29, 2018) → **special treatment**
  - source codes to deal with 1 to 6 HMI observation days  
**CST\_1\_TO\_6\_DAYS**
- each folder contains Fortran files (**codes\_CST\_Fortran** directory corresponding to **part 2** of CST algorithm) and IDL files (**codes\_CST\_IDL** directory corresponding to **parts 1 and 3** of CST algorithm)

## 2. Scheme of CST codes

- **STEP 1 (IDL)** : `codes_CST_IDL` directory  
Files : - `reduction_doppler_intensity_all_days_apres.pro`,  
- `reduction_doppler_intensity_all_days_avant.pro`  
Input : intensity and Doppler HMI data  
Output/input in STEP 2 :  
dayX\_`apres`\_int\_derot\_NNNN.fits, ...,  
dayX\_`avant`\_int\_derot\_NNNN.fits, ...  
...
- **STEP 2 (FORTRAN)** : `codes_CST_Fortran` directory  
Files : `cst_labv7_FS_2017.f90` (main program), Makefile, ...  
Output/input in STEP 3 : `ux_ZZZ`, ..., `uy_ZZZ`, ...



## 2. Scheme of CST codes

- **STEP 3 (IDL)** : `codes_CST_IDL` directory

**Files** : - `transform_uxuy_vxvy_all_dates_step_30min.pro`,  
- `correct_mvtSDO_sur_Vx_et_Vy_precis_all_dates_apres.pro`,  
- `correct_mvtSDO_sur_Vx_et_Vy_precis_all_dates_avant.pro`,  
- `transfor_Vx_Vy_Vdop_vthe_vphi_vr_all_dates_step_30min.pro`

**Output** : `Vr_Vtheta_Vphi_derot_dayX_ap.dat`,  
`Vr_Vtheta_Vphi_derot_dayX_av.dat`, ...

# 3. Procedure to take HMI/SDO 45s-cadence intensity and Doppler data from JSOC

Click on [Data Access](#) then on [Lookdata](#)

Joint Science Operations Center (JSOC) Data Products - Mozilla Firefox

Joint Science Operations Center (JSOC)

Search Match ALL words v

[HMI Data Products](#)  
[AIA Data Products](#)  
[MDI Data Products](#)  
[SHA Data Products](#)  
[IRIS Data Products](#)  
[SID Data Products](#)

**\*\* Useful Links \*\***

- [SDO Data Use Policy](#)
- [HMI Coverage Tables](#)
- [HMI Support Information](#)
- [AIA Coverage Tables & Release Notes](#)
- [JSOC Processing Status](#)
- [JSOC System Status](#)
- [HMI Event Tables](#)

Welcome to the Joint Science Operations Center (JSOC) Science Data Processing (SDP) home. Data products from the Solar Dynamics Observatory, as well as certain other missions and instruments, are available and projects have data archived here:

**Helioseismic and Magnetic Imager (HMI):** is one of three instruments aboard the Solar Dynamics Observatory (SDO) that observe the solar surface. HMI observes the full solar disk at 6173 Å with a resolution of 1 arc second and is a successor to the Heliospheric Observatory (SOHO).

**Atmospheric Imaging Assembly (AIA):** is another instrument aboard the Solar Dynamics Observatory (SDO) that observes the solar atmosphere. AIA provides simultaneous full disc images in multiple wavelengths of the corona and transitional region (up to half a solar radius above the solar surface) in a wide range of temporal cadence or better. The primary goal of the AIA Science Investigation is to significantly improve our understanding of the solar atmosphere, which drives space weather in the heliosphere and in planetary environments.

**Michelson Doppler Imager (MDI):** is the predecessor to the current HMI and was launched aboard the Solar and Heliospheric Observatory (SOHO). It is a project of the Stanford-Lockheed Institute for Space Research and part of an international collaboration to study the interior structure and dynamics of the Sun. All the data observed by MDI is now archived in the JSOC.

**Stanford Helioseismology Archive (SHA):** is a compilation of helioseismology data from various missions including Global Oscillations Network Group (GONG), Mount Wilson, Magneto-Optic Two-Height Instrument (MOTH), Taiwan Oscillations Network (TON) and others to facilitate research.

**Interface Region Imaging Spectrograph (IRIS):** is a multi-channel imaging spectrograph with a 20 cm UV telescope which will obtain UV spectra and images of the solar atmosphere with high resolution in space (0.33-0.4 arc sec) and time (1s) focused on the chromosphere and transition region of the Sun. The primary goal of the IRIS explorer is to understand how the solar atmosphere is energized.

**Sudden Ionosphere Disturbance (SID) Monitors program** is an educational project to build and distribute inexpensive ionospheric monitors to students around the world. These monitors detect solar flares and other ionospheric disturbances. JSOC is the central data repository where students can exchange and compare data.

[Data Access](#) [Visual Catalog](#) [Docs](#) [News & Events](#)

**Getting Data**

- [FAQ](#)
- [Data products to Data series Map](#)
- [Exportdata](#)
- [Register Email](#)
- [Lookdata](#)
- [Script Driven](#)
- [VSO](#)

[Contacts](#) | [JSOC Home](#) | [Exportdata](#) | [Lookdata](#) | [SDO-NASA](#) | [Stanford Solar Home](#) | [Stanford Solar-Center](#)

[SDO\\_Privacy\\_Notice](#)

jsoc.stanford.edu/ajax/lookdata.html

# 3. Procedure to take HMI/SDO 45s-cadence intensity and Doppler data from JSOC

Click on **Fetch seriesname list** in yellow or type (on left) **lc\_45s**

JSOC Lookdata - Mozilla Firefox

JSOC Lookdata

jsoc.stanford.edu/ajax/lookdata.html

Les plus visités Restez toujours conn... Débuter avec Firefox Integrated Data and ...

JSOC SDO JSOC Data Explore Info and Export Reset Page Disable Tabs Disable Nanny Disable Help 0 Requests Pending

? About Help jsoc.stanford.edu gives access to export series. Consult JSOC staff for access to internal series.

Series Select Series Content RecordSet Select Values Display Export Data Graph

? You may go directly to Step 3 on the above **RecordSet Select** tab if you know which series you want.

**1. Find list of dataseries**

Enter a dataseries match pattern to search for seriesnames, or leave blank to select from all series.

? Seriesname filter

Fetch seriesname list

TBD Series match this selection filter.

**2. Pick series to use**

? Select data series here.

Home pages for: [SDO-JSOC](#) | [SHA](#)

# 3. Procedure to take HMI/SDO 45s-cadence intensity

Several series appear on the right window. Select `hmi.lc_45s-continuum intensities with a cadence of 45 seconds`

JSOC Lookdata - Mozilla Firefox

JSOC Lookdata

jsoc.stanford.edu/ajax/lookdata.html

Les plus visités Restez toujours conn... Débuter avec Firefox Integrated Data and ...

JSOC SDO JSOC Data Explore Info and Export Reset Page Disable Tabs Disable Nanny Disable Help 0 Requests Pending

? About Help jsoc.stanford.edu gives access to export series. Consult JSOC staff for access to internal series.

Series Select Series Content RecordSet Select Values Display Export Data Graph

? You may go directly to Step 3 on the above **RecordSet Select** tab if you know which series you want.

**1. Find list of dataserries**

Enter a dataserries match pattern to search for seriesnames, or leave blank to select from all series.

? Seriesname filter

Fetch seriesname list

296 Series match this selection filter.

**2. Pick series to use**

? Select data series here.

- hmi.lc\_45s — continuum intensities with a cadence of 45 seconds.
- hmi.lc\_45s\_dcon — continuum intensities with a cadence of 45 seconds, constructed w
- hmi.lc\_720s — continuum intensities with a cadence of 720 seconds.
- hmi.lc\_720s\_dcon — continuum intensities with a cadence of 720 seconds, constructe
- hmi.lc\_720s\_dconS — continuum intensities with a cadence of 720 seconds, scattered I
- hmi.lc\_noLimbDark\_720s — Continuum intensities with limb darkening removed
- hmi.Ld\_45s\_dcon — linedepths with a cadence of 45 seconds, constructed with hmi.lc
- hmi.Ld\_720s — linedepths with a cadence of 720 seconds.

Home pages for: [SDO-JSOC](#) | [SHA](#)

# 3. Procedure to take HMI/SDO 45s-cadence intensity

Write for example 30 mins on November, 29, 2018 (see [Examples](#) for syntax) :

hmi.lc\_45s[2018.11.29\_08:00\_TAI-2018.11.29\_08:30\_TAI]

→ For 1 day : hmi.lc\_45s[2018.11.29/1d]

The screenshot shows the JSOC Lookdata web interface in a Mozilla Firefox browser. The page title is "JSOC Lookdata - Mozilla Firefox". The address bar shows "jsoc.stanford.edu/ajax/lookdata.html". The page content includes a navigation bar with "JSOC Data Explore Info and Export" and buttons for "Reset Page", "Disable Tabs", "Disable Nanny", "Disable Help", and "0 Requests Pending". Below the navigation bar, there is a section "About Help" with the text "jsoc.stanford.edu gives access to export series. Consult JSOC staff for access to internal series." The main content area is titled "Series Select: Series Content | RecordSet Select | Values Display | Export Data | Graph". Under "Information about selected series", it shows "Current Series is: hmi.lc 45s", "PrimeKeys: T\_REC, CAMERA", "DBIndex: T\_REC, CAMERA", "Data is archived, online retention 10000 days", "Unitsize: 32 records", and "Owner: slony". The "Series Description" section includes a "(refresh)" button and text: "continuum intensities with a cadence of 45 seconds.", "Release Notes for Lookdata, and for hmi Keyword Notes (pdf)", "First Record = hmi.lc 45s[2010.03.29 08:00:00 TAI][2]", "Last Record = hmi.lc 45s[2020.02.18 23:53:15 TAI][2]", and "First Rec., Last Rec. and largest used recnums: 4203388, 9588608, 9588608 resp.". The "4. Select Keywords" section includes a "Use Series Content to choose which keywords are visible here." and a list of keywords: "NONE", "ALL", "cparams\_sg000", "continuum\_bzero", "continuum\_bscale", "DATE", "DATE\_OBS", "TELESCOP". The "5. Select Segments" section includes "NONE", "ALL", and "continuum". The "6. Select Links" section is partially visible. The "Record Limit" is set to "none" and "Optional, + for from start, - for from end." The "GetRecordCount" button is highlighted, and the "Record Count:" is shown. There are several checkboxes for query options: "Check to Get Record Query.", "Check to Allow Huge Record Queries.", "Check to show full segment info.", "Check to make local file links (only at JSOC).", "Check to truncate long strings in values display.", and "Prepare keyword table in plain text format, e.g. as show\_info output, in new window. (No \*dirtime\* or \*logdir\* keywords)". A "Fetch Keyword Values for RecordSet" button is also visible.

# 3. Procedure to take HMI/SDO 45s-cadence intensity

Click on [GetRecordCount](#) in yellow to obtain the number of files requested. For our example of 30 mins of observation, we have 41 files

The screenshot shows the JSOC Lookdata web interface in a Mozilla Firefox browser. The page title is "JSOC Data Explore Info and Export". The URL is [jsoc.stanford.edu/ajax/lookdata.html](http://jsoc.stanford.edu/ajax/lookdata.html). The page displays information for the series "hmi.Lc\_45s".

**Information about selected series**  
Current Series is: hmi.Lc\_45s  
PrimeKeys: T REC, CAMERA  
DBIndex: T REC, CAMERA  
Data is archived, online retention 10000 days  
UnitSize: 32 records  
Owner: slony

**Series Description** (Refresh) continuum intensities with a cadence of 45 seconds.  
**Release Notes for Lookdata, and for hmi Keyword Notes (pdf)**  
First Record = hmi.Lc\_45s[2010.03.29\_08:00:00\_TAI][2]  
Last Record = hmi.Lc\_45s[2020.02.18\_23:53:15\_TAI][2]  
First Rec., Last Rec. and largest used recnums: 4203388, 9588608, 9588608 resp.

**4. Select Keywords**  
Select Keywords, Segments, and Links for table of values.  
Use Series Content to choose which keywords are visible here.

**5. Select Segments**

**6. Select Links**

**3. Select Records and Get Record Count**  
Enter RecordSet Specification here for keyword listings and for export. [Examples](#)  
 Check box to show the QueryBuilder.  
Request may take a while if the recordset is large (more than a few thousand records).

?

Record Limit  Optional, + for from start, - for from end.

[GetRecordCount](#) Record Count: 41

- Check to Get Record Query.
- Check to Allow Huge Record Queries.
- Check to show full segment info.
- Check to make local file links (only at JSOC).
- Check to truncate long strings in values display.
- Prepare keyword table in plain text format, e.g. as show\_info output, in new window. (No \*dirmtime\* or \*logdir\* keywords)

[Fetch Keyword Values for RecordSet](#)

Home pages for: [SDO-JSOC](#) | [SHA](#)

### 3. Procedure to take HMI/SDO 45s-cadence intensity

Click on [Export Data](#) at the top of the page, then on [Export](#) on the right

JSOC Lookdata - Mozilla Firefox

JSOC Lookdata

jsoc.stanford.edu/ajax/lookdata.html

Les plus visités Restez toujours conn... Débuter avec Firefox Integrated Data and ...

**JSOC** **SDO** **JSOC Data Explore Info and Export** [Reset Page](#) [Disable Tabs](#) [Disable Nanny](#) [Disable Help](#) 0 Requests Pending

? [About Help](#) jsoc.stanford.edu gives access to export series. Consult JSOC staff for access to internal series.

Series Select Series Content RecordSet Select Values Display **Export Data** Graph

8. RecordSet to export: hmi.Lc\_45s[2018.11.29\_08:00\_TAI-2018.11.29\_08:30\_TAI] Record Limit: none [Export](#) Click to jump to new export page.

Home pages for: [SDO-JSOC](#) | [SHA](#)

# 3. Procedure to take HMI/SDO 45s-cadence intensity

Select [get url-tar](#), fill your email address, your name, click on [Check Params for Export](#), when green click on [Request Export Status](#)

JSOC Export Data - Mozilla Firefox

JSOC Lookdata JSOC Export Data

Restez toujours conn... Débuter avec Firefox Integrated Data and ...

JSOC SDO JSOC Data Export reset page Turn Help Off 1 Requests Pending, Loading...

### JSOC Data Export Request Generation

[Help with Error Messages](#) [Release Notes](#)

If the Method is changed from "url\_quick" or "url\_direct" you will have additional options to specify. "url\_direct" is temporarily disabled.

After the request is submitted for Methods of "url", "ftp", "url-tar" or "ftp-tar" you will receive ON THIS PAGE a "Request ID" that will be used to access the data when it is ready.

If you enter an email address you will be notified when the data is ready. If you do not provide an email address you must leave this page open or save the Request\_ID in order to access the data.

RecordSet from file  Check box to allow upload of RecordSet list file, file will be requested after Submit button click.

RecordSet

Record Limit  Optional manual limit to number of records to export.

Record Count   Limit for AIA to about 15,000 and for HMI about 30,000 in each request.

Method  Choose method, url\_quick or url for now. url\_quick implies protocol of "as-is"

Filename Format  File name template.

Processing  Enable Processing

Protocol  Choose protocol, "FITS", "JPEG", "MPG", "MP4", or "as-is". Note uncompressed FITS not an option

Notify  OK Provide your email address for notification. If Requestor is your SolarMail name you may use "solarmail" here.

Requestor  Provide an optional identifier.

Check Params for Export OK to proceed

Request Export Status Export request submitted, please wait...

check to show export params.

RequestID  This is the ID tag for your export request. Use the Status Request button below to retrieve the links to the data.

Status

Data Location

### JSOC Data Export Status and Retrieval

RequestID  This is the ID tag for your export request.

Export request waiting for processing

Clear old status RequestID

Home page for: SDO-JSOC



### 3. Procedure to take HMI/SDO 45s-cadence intensity

- An email has been sent to you with a link



#### JSOC export complete - JSOC\_20200223\_803

Expéditeur : "JSOC User" <jsoc@cl2n014.stanford.edu>

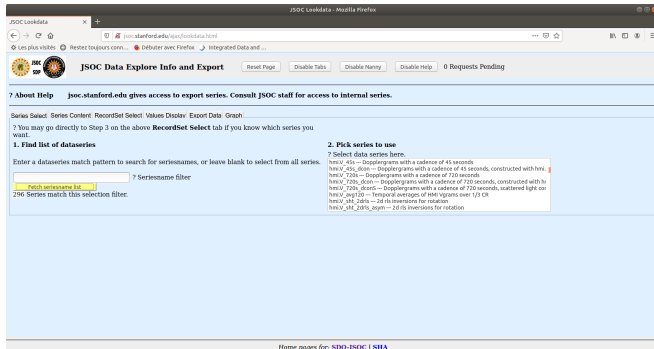
À : "Martine Chane Yook" <martine.chane-yook@ias.u-psud.fr>

JSOC export request JSOC\_20200223\_803 is complete.  
Results at <http://jsoc.stanford.edu/SUM66/D1262818333/S00000>

- To get files from a server, type the following linux commands :
  - `wget http://jsoc.stanford.edu/SUM66/D1262818333/S00000/JSOC\_20200223\_803.tar`
  - `tar -xvf JSOC_20200223_803.tar`
- You get 41 **intensity** files from  
[hmi.lc\\_45s.20181129\\_080000\\_TAI.2.continuum.fits](#) up to  
[hmi.lc\\_45s.20181129\\_083000\\_TAI.2.continuum.fits](#)

### 3. Procedure to take HMI/SDO 45s-cadence Doppler

- Repeat the procedure to get Doppler data : select **hmi.V\_45s-Dopplergrams** with a cadence of 45 seconds



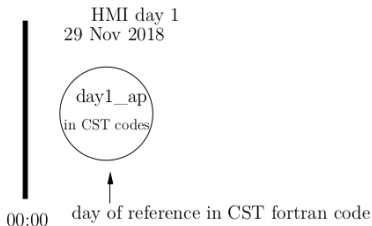
- You get 41 Dopplergram files
- 30 mins HMI data (intensity and Doppler) → 2,7 G  
→ see 4. Example of running CST codes (training exercise)
- 1 day HMI data (intensity and Doppler) → 63 G

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - Connection to IAS computing cluster

- login : `cst2020-1` → `cst2020-5`
- password : `cst2020@MEDOC!`
- Hereafter, all linux commands in this presentation are written in orange
- connection to the cluster :  
`ssh -X -l login ias-ssh.ias.u-psud.fr`  
`ssh -X cluster-r730-2` : connection to a cluster node for running SSWIDL  
`ssh -X cluster-head` : for running FORTRAN
- Copy `CST_TEST_30min` directory in your home :  
`cp -R /data/cluster/workshop_CST2020/cst2020/CST_TEST_30min .`

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - **STEP 1 (IDL)**

- It's the same case as for 1 day (reference day) according to the figure below



- Create **day1\_apres** directory and put HMI data (intensity and Doppler) inside : done !  
→ /data/cluster/workshop\_CST2020/day1\_apres
- Create result directory **treated\_day1\_ap** in your home (/home/cst2020-1:5)
- **cd CST\_TEST\_30min**

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - **STEP 1 (IDL)**

- **cd codes\_CST\_IDL**
- Reduction IDL file :  
reduction\_doppler\_intensity\_all\_days\_apres.pro
- **Adapt the 4 following parameters :**
  - **path** : path to HMI data (intensity and Doppler) directory (day1\_apres)
  - **path\_out** : path to the result directory (treated\_day1\_ap)
  - **rota=0** (for standard rotation, quiet Sun) or **rota=1** (rotation is measured directly on the data)
  - spawn, 'rm /tmp/HMI\*' (for IAS cluster)
- **Limitation of the code** : if 2 users read HMI files at the same time on a same cluster node, they try to write the same temporary file, which has always the same name ! It is due to a bad way of managing temporary file with SSWIDL.  
→ **IDL parts will be written in Python**

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - **STEP 1 (IDL)**

- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi` (for IAS cluster)  
`.r reduction_doppler_intensity_all_days_apres.pro`
- Optimal condition for CPU Time : 8 min
- The result directory (treated\_day1\_ap) contains :
  - `co_latitude_HMI_4096.fits`
  - `co_latitude_HMI_586.fits`
  - `day1_apres_int_derot_0001.fits` → `0041.fits` : **input files in STEP 2**
  - `donnees_correction_CST.dat`
  - `Doppler_derot_30mn.dat`
  - `Doppler_derot_raw_0001.fits` → `0041.fits`
  - `Doppler_derot_smooth_0001.fits` → `0041.fits`
  - `Doppler_limb4096_0001.fits` → `0041.fits`
  - `Doppler_raw_0001.fits` → `0041.fits`

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - **STEP 1 (IDL)**

- The result directory (treated\_day1\_ap) contains :
  - Doppler\_smooth\_0001.fits → 0041.fits
  - Doppler\_with\_rotation.dat
  - latitude\_HMI\_4096.fits
  - latitude\_HMI\_586.fits - longitude\_HMI\_4096.fits
  - longitude\_HMI\_586.fits
  - SDO\_Dop\_cormvt\_0001.fits → 0041.fits
  - SDO\_seq\_doppler\_0001.fits → 0041.fits
  - SDO\_seq\_int\_avec\_rot\_0001.fits → 0041.fits
- If there are not 41 files, it is necessary to complete from the last (copy the last file)

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - **STEP 2 (FORTRAN)**

- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to modify are :
  - `param_seq_29nov2018_EOS_30mn` : **prefix** (path to `day1_apres_int_derot_files`), **input\_file**, **arcsec**, **pixel**
  - `script_29nov2018.sh` : adapt 4 times the name of **param\_seq\_29nov2018\_EOS\_30mn**, `NINDEX=0`, `while [ $NINDEX -le 0 ]` (for 30 min HMI data)
- `sbatch script_29nov2018.sh`
- There is a defect in the Makefile which obliges to run the `sbatch 2` times or more (in order to get executable file `"cst_labv7_FS_2017"`).
  - Makefile will be reviewed and improved to avoid this problem
- Optimal condition for CPU time :  $\sim 1h - 1h20$  (`#SBATCH -cpus-per-task=18`)



## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - STEP 2 (FORTRAN)

- Different files are created : slurm-XXX.out in current folder, output\_XXX.log in JOB\_XXX directory
- The results are in JOB\_XXX/results directory
- Copy the following files from JOB\_XXX/results to treated\_day1\_ap directory :
  - ux\_b\_0000
  - ux\_h\_0000
  - ux\_k\_0000
  - ux\_l\_0000
  - ux\_m\_0000
  - uy\_b\_0000
  - uy\_k\_0000
  - uy\_l\_0000
  - uy\_m\_0000

## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - STEP 3 (IDL)

- **Reminder** : 2 users can't run STEP 3 IDL codes at the same time on a same cluster node because of tempory file problem (see STEP 1)
- Adapt the following parameters :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro : **path, path\_out**
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro : **path, path\_out, path\_vit, spawn,'rm /tmp/HMI\*'**
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro : **path1, path, path\_out**
- **ssh -X cluster-r730-2** (connection to a node of the cluster)  
**cd codes\_CST\_IDL**  
**ssw hmi**  
**.r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro**  
**.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro**  
**.r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro**

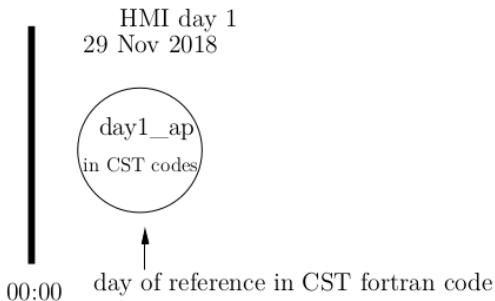
## 4. Training exercise : running CST codes for 30 mins of SDO/HMI observation (data) - STEP 3 (IDL)

- CPU time : fast  $\sim$  2 min
- The output files in `treated_day1_ap` directory are :
  - `vit_cent_18coeurs.dat`
  - `Vr_Vtheta_Vphi_derot_day1_ap.dat`
  - `Vx_h_moy30mn_18coeurs_cor_0001.fits`
  - `Vx_moy30mn_derot_18coeurs_0001.fits`
  - `vx_vy_h_derot_moy30mn_18coeurs.sav`
  - `Vy_h_moy30mn_18coeurs_cor_0001.fits`
  - `Vy_moy30mn_derot_18coeurs_0001.fits`
- `treated_day1_ap` directory : 19 G

## 5. How many observation days to run ?

- CST codes can be run up to 6 days and the reference day is the 4th day
- The number of days is very important for the preparation of the directories which will contain the HMI data and the results of CST codes
- We will see different cases (1 day, 2 days, ..., 6 days) and directories to create before running different parts of CST codes

## 5. Running CST codes for 1 observation day - **STEP 1**



- Create **day1\_apres** directory and put HMI data (intensity and Doppler) inside  
→ 1920 files : 63 G
- Create **treated\_day1\_ap** result directory
- **cd CST\_1\_TO\_6\_DAYS/codes\_CST\_IDL**
- Reduction IDL file :  
`reduction_doppler_intensity_all_days_apres.pro`

## 5. Running CST codes for 1 observation day - **STEP 1**

- Adapt the 4 following parameters :
  - **path** : path to HMI data (intensity and Doppler) directory (day1\_apres)
  - **path\_out** : path to the result directory (treated\_day1\_ap)
  - **rota=0** (for standard rotation, quiet Sun) or **rota=1** (rotation is measured directly on the data)
  - spawn, '**rm /tmp/HMI\***' (for IAS cluster)
- **ssh -X cluster-r730-2** (connection to a node of the cluster)  
**cd codes\_CST\_IDL**  
**ssw hmi**  
**.r reduction\_doppler\_intensity\_all\_days\_apres.pro**  
**reduction\_doppler\_intensity\_all\_days\_apres,1,rota**
- The result directory (treated\_day1\_ap) contains :
  - ..., day1\_apres\_int\_derot\_0001.fits → 1909.fits, ...
- CPU time : ~ 8h - 10h

## 5. Running CST codes for 1 observation day - STEP 2

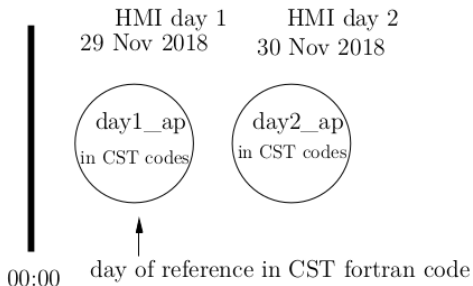
- If there are not 1920 files (corresponding to 1 day), it is necessary to complete from the last (copy the last file)
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to modify are :
  - `param_seq_29nov2018_EOS_30mn` : `prefix` (path to `day1_apres_int_derot_files`), `input_file`, `arcsec`, `pixel`
  - `script_29nov2018.sh` : adapt 4 times the name of `param_seq_29nov2018_EOS_30mn`
- `sbatch script_29nov2018.sh` (several times if necessary - check `slurm-XXX.out` file)
- The results are in `JOB_XXX/results` directory
- Copy all `ux` and `uy` files from `JOB_XXX/results` directory to `treated_day1_ap` directory
- CPU time : ~ 20h - 24h

## 5. Running CST codes for 1 observation day - **STEP 3**

- Adapt the following parameters :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro : **path**, **path\_out** (for day=1)
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro : **path**, **path\_out**, **path\_vit**, **spawn**, **'rm /tmp/HMI\*'** (for day=1)
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro : **path1**, **path**, **path\_out** (for day=1)
- **ssh -X cluster-r730-2** (connection to a node cluster)
  - cd codes\_CST\_IDL**
  - ssw hmi**
  - .r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro**
  - .r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro**
  - .r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro**
- CPU time : fast ~ 2 min - 5 min
- treated\_day1\_ap directory : **854 G**
- JOB\_XXX directory : **11 G** (in codes\_CST\_Fortran directory)



## 5. Running CST codes for 2 observation days



- Create **day1\_apres** directory and put HMI data (intensity and Doppler) on November, 29, 2018 inside : **1920 files (63G)**
- Create **day2\_apres** directory and put HMI data (intensity and Doppler) on November, 30, 2018 inside : **1920 files (63G)**
- Create result directory : **treated\_day1\_ap** (29 Nov 2018)
- Create result directory : **treated\_day2\_ap** (30 Nov 2018)

## 5. Running CST codes for 2 observation days - STEP 1

- `cd CST_1_TO_6_DAYS/codes_CST_IDL`
- IDL file : `reduction_doppler_intensity_all_days_apres.pro`
- Adapt the 4 following parameters :
  - `path` : path to HMI data (intensity and Doppler) directory (`day1_apres`)
  - `path_out` : path to the result directory (`treated_day1_ap`)
  - `rota=0` (for standard rotation, quiet Sun) or `rota=1` (rotation is measured directly on the data)
  - `spawn,'rm /tmp/HMI*'` (for IAS cluster)
- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi`  
`.r reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_apres,2,rota`
- Result directories (`treated_day1_ap` and `treated_day2_ap`) contain respectively : ..., `day1_apres_int_derot_0001.fits` → `1909.fits`,  
..., `day2_apres_int_derot_0001.fits` → `1909.fits`, ...

## 5. Running CST codes for 2 observation days - STEP 2

- If there are not 1920 files (corresponding to 1 day), it is necessary to complete from the last (copy the last file)
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to create and to modify are :
  - `param_seq_29nov2018_EOS_30mn` : `prefix` (path to `day1_apres_int_derot_files`), `input_file`, `arcsec`, `pixel`
  - `param_seq_30nov2018_EOS_30mn` : `prefix` (path to `day2_apres_int_derot_files`), `input_file`, `arcsec`, `pixel`
  - `script_29nov2018.sh` : adapt 4 times the name of `param_seq_29nov2018_EOS_30mn`
  - `script_30nov2018.sh` : adapt 4 times the name of `param_seq_30nov2018_EOS_30mn`

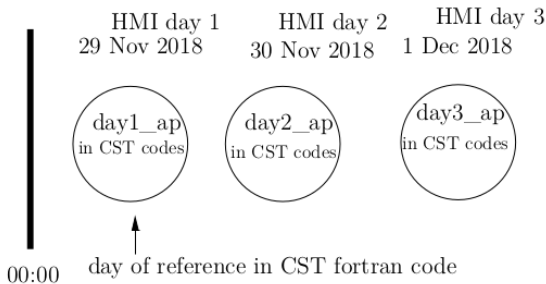
## 5. Running CST codes for 2 observation days - STEP 2

- FORTRAN jobs can be run in parallel
- `sbatch script_29nov2018.sh` (several times if necessary - check `slurm-XXX.out` file)
- `sbatch script_30nov2018.sh` (several times if necessary - check `slurm-ZZZ.out` file)
- The results are in `JOB_XXX/results` directory for the 1st day
- The results are in `JOB_ZZZ/results` directory for the 2nd day
- Copy all `ux` and `uy` files from `JOB_XXX/results` directory to `treated_day1_ap` directory
- Copy all `ux` and `uy` files from `JOB_ZZZ/results` directory to `treated_day2_ap` directory

## 5. Running CST codes for 2 observation days - STEP 3

- Adapt the following parameters in :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro : **path**, **path\_out** (for day=1 and day=2)
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro : **path**, **path\_out**, **path\_vit**, **spawn**, **'rm /tmp/HMI\*'** (for day=1 and day=2)
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro : **path1**, **path**, **path\_out** (for day=1 and day=2)
- **ssh -X cluster-r730-2** (connection to a node cluster)  
**cd codes\_CST\_IDL**  
**ssw hmi**  
**.r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro**  
**.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro**  
**.r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro**
- Results are in **treated\_day1\_ap** and **treated\_day2\_ap** directories

## 5. Running CST codes for 3 observation days



- Create `day1_apres`, `day2_apres`, `day3_apres` directories and put respectively HMI data inside (Nov 29, Nov 30, Dec 1, 2018)
- Create result directories : `treated_day1_ap` (Nov 29), `treated_day2_ap` (Nov 30), `treated_day3_ap` (Dec 1)

## 5. Running CST codes for 3 observation days - STEP 1

- `cd CST_1_TO_6_DAYS/codes_CST_IDL`
- Adapt paths and parameters in :  
`reduction_doppler_intensity_all_days_apres.pro`
- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi`  
`.r reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_apres,3,rota`
- Result directories (`treated_day1_ap`, `treated_day2_ap`,  
`treated_day3_ap`) contain respectively : ...,  
`day1_apres_int_derot_0001.fits` → 1909.fits, ...,  
`day2_apres_int_derot_0001.fits` → 1909.fits, ...,  
`day3_apres_int_derot_0001.fits` → 1909.fits, ...

## 5. Running CST codes for 3 observation days - STEP 2

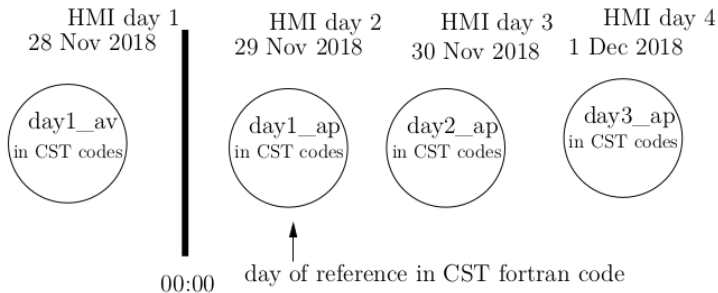
- If there are not 1920 files for each day, complete by copying
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to create and to modify are :
  - `param_seq_29nov2018_EOS_30mn`
  - `param_seq_30nov2018_EOS_30mn`
  - `param_seq_1dec2018_EOS_30mn`
  - `script_29nov2018.sh`
  - `script_30nov2018.sh`
  - `script_1dec2018.sh`
- Run in parallel theses 3 jobs (several times if necessary) :
  - `sbatch script_29nov2018.sh` → JOB\_AAA
  - `sbatch script_30nov2018.sh` → JOB\_BBB
  - `sbatch script_1dec2018.sh` → JOB\_CCC
- Copy all `ux` and `uy` files from each `JOB_XXX/results` folder to `treated_day1_ap`, `treated_day2_ap` and `treated_day3_ap` folders respectively



## 5. Running CST codes for 3 observation days - STEP 3

- Adapt paths in IDL files for day=1, day=2, day=3 :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- ssh -X cluster-r730-2 (connection to a node cluster)  
cd codes\_CST\_IDL  
ssw hmi  
.r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro  
.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro  
.r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Results are in treated\_day1\_ap, treated\_day2\_ap and treated\_day3\_ap directories

## 5. Running CST codes for 4 observation days



- Create `day1_avant`, `day1_apres`, `day2_apres`, `day3_apres` directories and put respectively HMI data inside (Nov 28, Nov 29, Nov 30, Dec 1, 2018)
- Create result directories : `treated_day1_av` (Nov 28), `treated_day1_ap` (Nov 29), `treated_day2_ap` (Nov 30), `treated_day3_ap` (Dec 1)

## 5. Running CST codes for 4 observation days - STEP 1

- `cd CST_1_TO_6_DAYS/codes_CST_IDL`
- Adapt paths/parameters in :  
`reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_avant.pro`
- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi` (Respect the order of runs)  
`.r reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_apres,3,rota`  
`.r reduction_doppler_intensity_all_days_avant.pro`  
`reduction_doppler_intensity_all_days_avant,1,rota`
- Result directories (`treated_day1_av`, `treated_day1_ap`,  
`treated_day2_ap`, `treated_day3_ap`) contain respectively : ...,  
`day1_avant_int_derot_0001.fits` → 1909.fits, ...,  
`day1_apres_int_derot_0001.fits` → 1909.fits, ...,  
`day2_apres_int_derot_0001.fits` → 1909.fits, ...,  
`day3_apres_int_derot_0001.fits` → 1909.fits, ...

## 5. Running CST codes for 4 observation days - STEP 2

- If there are not 1920 files for each day, complete by copying
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to create and to modify are :
  - `param_seq_28nov2018_EOS_30mn`
  - `param_seq_29nov2018_EOS_30mn`
  - `param_seq_30nov2018_EOS_30mn`
  - `param_seq_1dec2018_EOS_30mn`
  - `script_28nov2018.sh`
  - `script_29nov2018.sh`
  - `script_30nov2018.sh`
  - `script_1dec2018.sh`

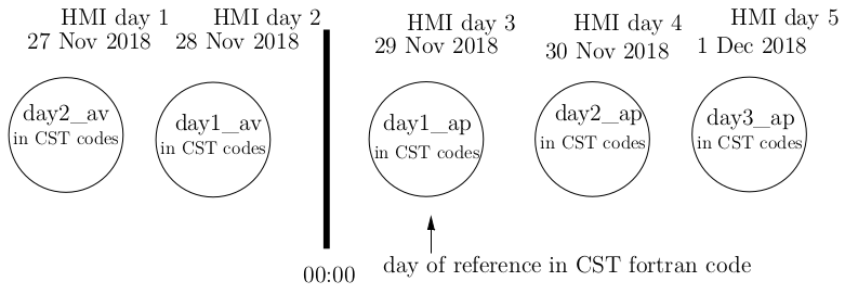
## 5. Running CST codes for 4 observation days - STEP 2

- Run in parallel theses 4 jobs (several times if necessary) :  
    **sbatch script\_28nov2018.sh** → JOB\_DDD  
    **sbatch script\_29nov2018.sh** → JOB\_AAA  
    **sbatch script\_30nov2018.sh** → JOB\_BBB  
    **sbatch script\_1dec2018.sh** → JOB\_CCC
- Copy all ux and uy files from each JOB\_XXX/results folder to **treated\_day1\_av**, **treated\_day1\_ap**, **treated\_day2\_ap** and **treated\_day3\_ap** folders respectively

## 5. Running CST codes for 4 observation days - STEP 3

- Adapt paths in IDL files for day=1, day=2, day=3, day=4 :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Adapt paths in IDL file for day=1, day=2, day=3 :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro
- Adapt paths in IDL file for day=1 :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro
- ssh -X cluster-r730-2 (connection to a node cluster)  
cd codes\_CST\_IDL  
ssw hmi (Respect the order of runs)  
.r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro  
.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro  
.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro  
.r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Results : treated\_day1\_av, treated\_day1\_ap,  
treated\_day2\_ap and treated\_day3\_ap directories

## 5. Running CST codes for 5 observation days



- Create `day2_avant`, `day1_avant`, `day1_apres`, `day2_apres`, `day3_apres` directories and put respectively HMI data inside (Nov 27, Nov 28, Nov 29, Nov 30, Dec 1, 2018)
- Create result directories `treated_day2_av` (Nov 27), `treated_day1_av` (Nov 28), `treated_day1_ap` (Nov 29), `treated_day2_ap` (Nov 30), `treated_day3_ap` (Dec 1)

## 5. Running CST codes for 5 observation days - STEP 1

- `cd CST_1_TO_6_DAYS/codes_CST_IDL`
- Adapt paths/parameters in :  
`reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_avant.pro`
- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi` (Respect the order of runs)  
`.r reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_apres,3,rota`  
`.r reduction_doppler_intensity_all_days_avant.pro`  
`reduction_doppler_intensity_all_days_avant,2,rota`
- Results respectively in each `treated_day_av/ap` directories :  
`day2_avant_int_derot_0001.fits` → 1909.fits, ...,  
`day1_avant_int_derot_0001.fits` → 1909.fits, ...,  
`day1_apres_int_derot_0001.fits` → 1909.fits, ..., `day2_apres_`, ...,  
`day3_apres_int_derot_0001.fits` → 1909.fits, ...



## 5. Running CST codes for 5 observation days - STEP 2

- If there are not 1920 files for each day, complete by copying
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to create and to modify are :
  - `param_seq_27nov2018_EOS_30mn`
  - `param_seq_28nov2018_EOS_30mn`
  - `param_seq_29nov2018_EOS_30mn`
  - `param_seq_30nov2018_EOS_30mn`
  - `param_seq_1dec2018_EOS_30mn`
  - `script_27nov2018.sh`
  - `script_28nov2018.sh`
  - `script_29nov2018.sh`
  - `script_30nov2018.sh`
  - `script_1dec2018.sh`

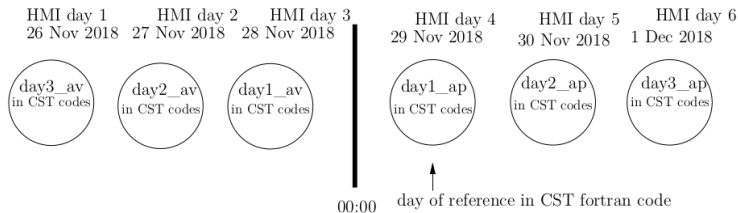
## 5. Running CST codes for 5 observation days - STEP 2

- Run in parallel theses 5 jobs (several times if necessary) :  
    `sbatch script_27nov2018.sh` → JOB\_EEE  
    `sbatch script_28nov2018.sh` → JOB\_DDD  
    `sbatch script_29nov2018.sh` → JOB\_AAA  
    `sbatch script_30nov2018.sh` → JOB\_BBB  
    `sbatch script_1dec2018.sh` → JOB\_CCC
- Copy all ux and uy files from each JOB\_XXX/results folder to `treated_day2_av`, `treated_day1_av`, `treated_day1_ap`, `treated_day2_ap` and `treated_day3_ap` folders respectively

## 5. Running CST codes for 5 observation days - STEP 3

- Adapt paths in IDL files for day=1, day=2, day=3, day=4, day=5 :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Adapt paths in IDL file for day=1, day=2, day=3 :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro
- Adapt paths in IDL file for day=1, day=2 :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro
- ssh -X cluster-r730-2 (connection to a node cluster)  
cd codes\_CST\_IDL  
ssw hmi (Respect the order of runs)  
.r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro  
.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro  
.r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro  
.r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Results : treated\_day2\_av, treated\_day1\_av,  
treated\_day1\_ap, treated\_day2\_ap, treated\_day3\_ap

## 5. Running CST codes for 6 observation days



- Create `day3_avant`, `day2_avant`, `day1_avant`, `day1_apres`, `day2_apres`, `day3_apres` directories and put respectively HMI data inside (Nov 26, Nov 27, Nov 28, Nov 29, Nov 30, Dec 1, 2018)
- Create result directories : `treated_day3_av` (Nov 26), `treated_day2_av` (Nov 27), `treated_day1_av` (Nov 28), `treated_day1_ap` (Nov 29), `treated_day2_ap` (Nov 30), `treated_day3_ap` (Dec 1)

## 5. Running CST codes for 6 observation days - STEP 1

- `cd CST_1_TO_6_DAYS/codes_CST_IDL`
- Adapt paths/parameters, for day=1 to day=3, in :  
`reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_avant.pro`
- `ssh -X cluster-r730-2` (connection to a node of the cluster)  
`cd codes_CST_IDL`  
`ssw hmi` (Respect the order of runs)  
`.r reduction_doppler_intensity_all_days_apres.pro`  
`reduction_doppler_intensity_all_days_apres,3,rota`  
`.r reduction_doppler_intensity_all_days_avant.pro`  
`reduction_doppler_intensity_all_days_avant,3,rota`
- Results are respectively in each `treated_dayN_av/ap` directory :  
`day1_avant_int_derot_0001.fits` → 1909.fits, ..., `day2_avant_`, ...,  
`day3_avant_int_derot_0001.fits` → 1909.fits, ...  
`day1_apres_int_derot_0001.fits` → 1909.fits, ..., `day2_apres_`, ...,  
`day3_apres_int_derot_0001.fits` → 1909.fits, ...

## 5. Running CST codes for 6 observation days - STEP 2

- If there are not 1920 files for each day, complete by copying
- `ssh -X cluster-head`
- `cd codes_CST_Fortran`
- Files to create and to modify are :
  - `param_seq_26nov2018_EOS_30mn`
  - `param_seq_27nov2018_EOS_30mn`
  - `param_seq_28nov2018_EOS_30mn`
  - `param_seq_29nov2018_EOS_30mn`
  - `param_seq_30nov2018_EOS_30mn`
  - `param_seq_1dec2018_EOS_30mn`
  - `script_26nov2018.sh`
  - `script_27nov2018.sh`
  - `script_28nov2018.sh`
  - `script_29nov2018.sh`
  - `script_30nov2018.sh`
  - `script_1dec2018.sh`

## 5. Running CST codes for 6 observation days - STEP 2

- Run in parallel theses 6 jobs (several times if necessary) :  
`sbatch script_26nov2018.sh` → JOB\_FFF  
`sbatch script_27nov2018.sh` → JOB\_EEE  
`sbatch script_28nov2018.sh` → JOB\_DDD  
`sbatch script_29nov2018.sh` → JOB\_AAA  
`sbatch script_30nov2018.sh` → JOB\_BBB  
`sbatch script_1dec2018.sh` → JOB\_CCC
- Copy all ux and uy files from each JOB\_XXX/results folder to `treated_day3_av`, `treated_day2_av`, `treated_day1_av`, `treated_day1_ap`, `treated_day2_ap` and `treated_day3_ap` folders respectively

## 5. Running CST codes for 6 observation days - STEP 3

- Adapt paths in IDL files for day=1 to day=6 :
  - transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro
  - transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Adapt paths in IDL file for **day=1, day=2, day=3** :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro
- Adapt paths in IDL file for **day=1, day=2, day=3** :
  - correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro
- **ssh -X cluster-r730-2 (connection to a node cluster)**  
**cd codes\_CST\_IDL**  
**ssw hmi (Respect the order of runs)**
  - .r transform\_uxuy\_vxvy\_all\_dates\_step\_30min.pro
  - .r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_apres.pro
  - .r correct\_mvtSDO\_sur\_Vx\_et\_Vy\_precis\_all\_dates\_avant.pro
  - .r transfor\_Vx\_Vy\_Vdop\_vthe\_vphi\_vr\_all\_dates\_step\_30min.pro
- Results are in **treated\_day3\_av, treated\_day2\_av, treated\_day1\_av, treated\_day1\_ap, treated\_day2\_ap, treated\_day3\_ap** directories



## 6. Frequent troubles encountered

- IDL parts : IDL codes of STEP 1 and 3 use the same “temporary” directory (/tmp) when reading SDO data. So you should not run the IDL code for 2 data sets at the same time, otherwise the SDO decompression files (in /tmp directory) will be destroyed by the 2nd IDL run
- The first time you run CST Fortran codes, you need to make sbatch several times because of a link editing problem in the Makefile.

## 6. Frequent troubles encountered

- When you apply CST codes to 1 day HMI observations or more, sometimes it can happen that CST Fortran part (Step 2) does not calculate all the velocities  $u_x$  and  $u_y$  in JOB\_XXX/results. Generally, one FITS file (day1\_apres\_int\_derot\_xxxx.fits) is corrupted (we don't know why) but you can overcome that problem by replacing the corrupted file by the precedent FITS file (which is good) of the series. In order to know which FITS file is corrupted (day1\_apres\_int\_derot\_xxxx.fits), you must locate it in "output\_XXX.log" file. Then, you run CST Fortran program (step 2) to calculate the missing  $u_x$  and  $u_y$ . In that case, like for example NINDEX=0, in "script\_DDMMMYYY.sh", is switched into NINDEX=20 (if  $u_x_{0020}$  is not computed) and we also modify the line :  
while [ \$NINDEX -le 47 ] to while [ \$NINDEX -le 20 ] .

## 7. Work in progress

- CST\_V1.1 online soon : in STEP 3, there is only 1 IDL file instead of 3
  - step3\_CST\_IDL\_apres.pro
  - step3\_CST\_IDL\_avant.pro (depending of the treated case)
- Add to user guide a section on description of the codes
- IDL parts will be written in Python
- Makefile in FORTRAN part will be improved to avoid several sbatch for the compilation
- ...
- **Next workshop in 2021 !**

## 8. Contacts (SAV)

Don't hesitate to contact us if you have any problem

Thierry Roudier : [thierry.roudier@irap.omp.eu](mailto:thierry.roudier@irap.omp.eu)

Martine Chane-Yook : [martine.chane-yook@ias.u-psud.fr](mailto:martine.chane-yook@ias.u-psud.fr)



malware.com

