The ChANUREPS and ORChESTRA platforms

ChETEC-INFRA II General Assembly

31st May to 1st June 2022, Padova (Italy)

Umberto Battino (University of Hull, NuGrid Collaboration)

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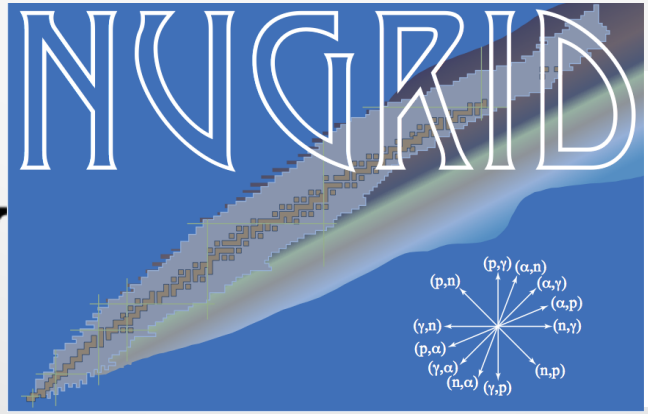
UNIVERSITY OF HULL



ChETEC INFRA

WP4 deliverables targeted

- **D4.2:** Create and maintain a platform on the ChETEC-INFRA web page where nuclear astrophysics data can be exchanged, connecting theoretical predictions with nuclear experimental data and stellar yields → **ChANUREPS**

- **D4.3:** Create, update and publish regularly a fully documented library of certified trajectories, covering a wide range of stellar conditions for nuclear astrophysics simulations → **ORChESTRA**

The ChANUREPS platform

ChETEC **A**stro**NU**clear **REP**ositorie**S**

- I wanted the platform's name to be a cool one
- Got inspired by *Keanu Reeves* → *ChEANU REEPS*
- Then I suddently got paranoid and feared some sort of copyright infringement, hence…

Ch~~E~~ANU RE~~E~~PS → ***ChANUREPS***

KEANU APPROVES

The ChANUREPS platform

- ChANUREPS is designed using WordPress
- It is currently hosted on ChETEC-INFRA server at the University of Frankfurt, using Apache set up with PHP-FPM, and can be found here:

  http://141.2.212.122/chanureps/

- Considering costs and long term maintenance and management, we will create a subdomain of chetec-infra.eu:

  chanureps.chetec-infra.eu

The ChANUREPS platform

- ChANUREPS allows the nuclear-astrophysics community to easily share and distribute newly published nuclear reaction rates, and other users to easily find them open source and with the same format.
- These rates could be used for many research tasks, e.g stellar nucleosynthesis calculations, nuclear sensitivity and uncertainty studies, experimental proposals for new measurements and much more.
- Once a member of the community has published a new rate or a new set of rates, a simple interface is already available to upload the rate, while for other users it is possible to choose the rate and download it.

The ChANUREPS platform

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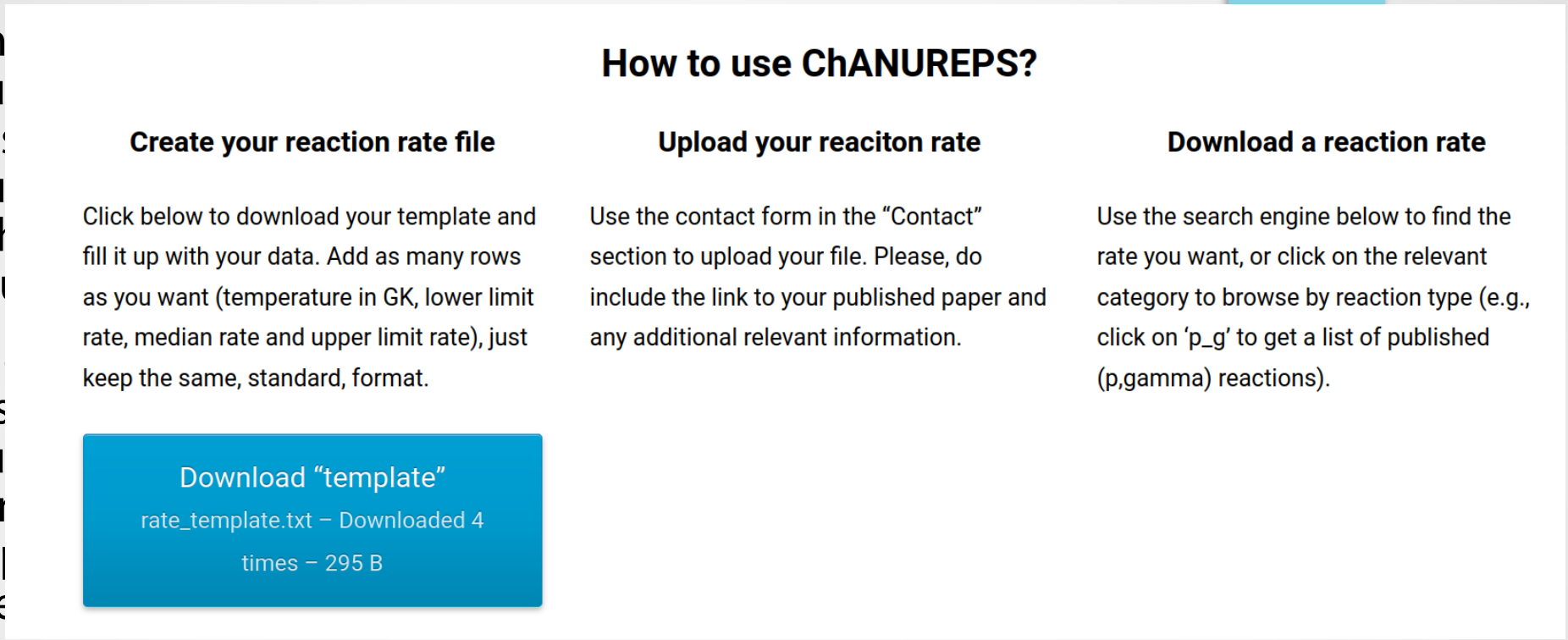

How to use ChANUREPS?

Create your reaction rate file

Click below to download your template and fill it up with your data. Add as many rows as you want (temperature in GK, lower limit rate, median rate and upper limit rate), just keep the same, standard, format.

Download “template”

rate_template.txt – Downloaded 4 times – 295 B

Upload your reaciton rate

Use the contact form in the “Contact” section to upload your file. Please, do include the link to your published paper and any additional relevant information.

Download a reaction rate

Use the search engine below to find the rate you want, or click on the relevant category to browse by reaction type (e.g., click on ‘p_g’ to get a list of published (p,gamma) reactions).

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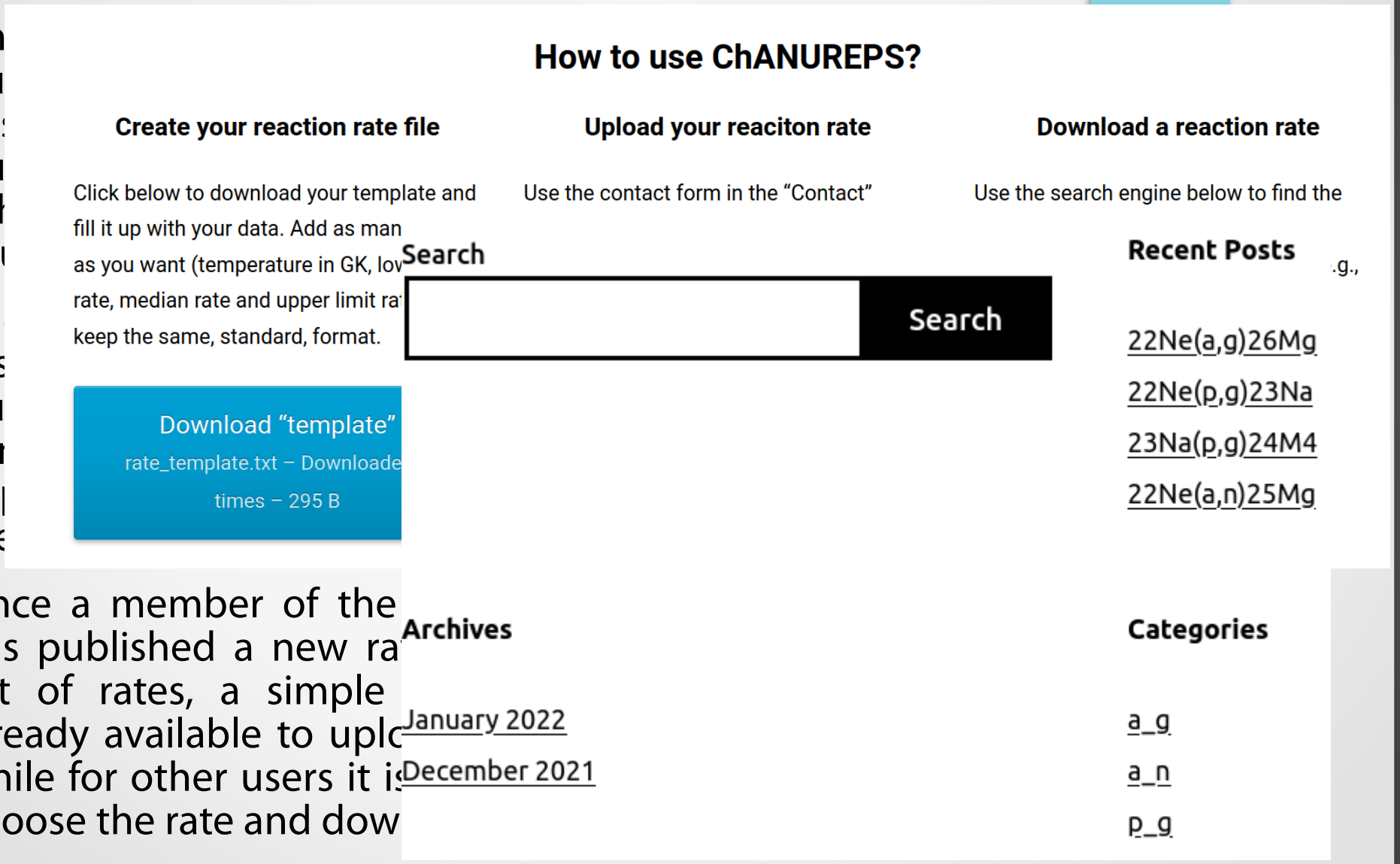

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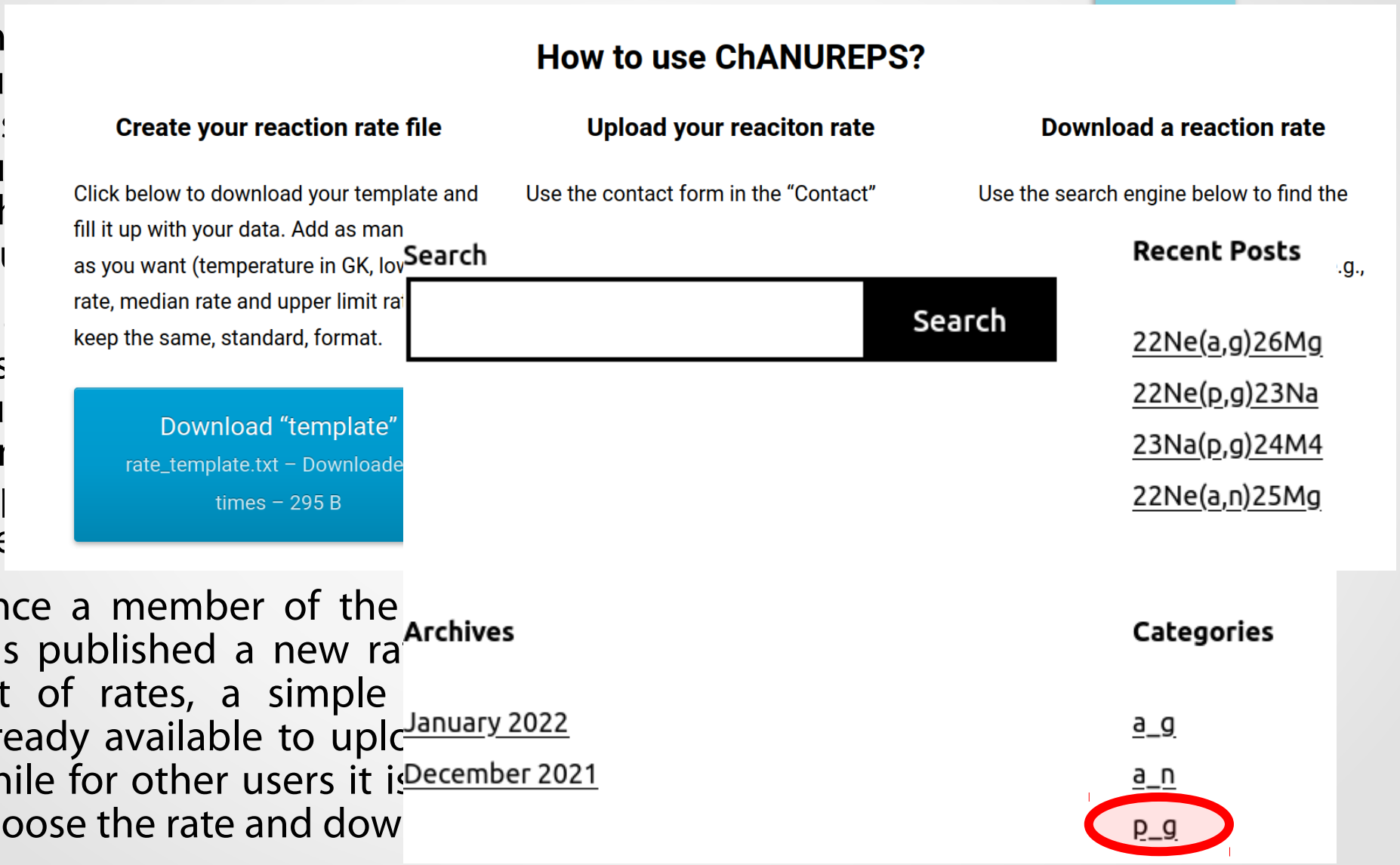

22Ne(p,g)23Na

22Ne(p,g)23Na Iliadis et al. 2010 Thermonuclear reaction rate obtained using a method based on Monte Carlo techniques. Low rate, median rate and high rate correspond to the 0.16, 0.50 and 0.84 quantiles, respectively, of the cumulative reaction rate distribution. Link to the publication: Nuclear Physics A 841 (2010) 31–250 Williams et al. 2020 This study… Continue reading

Published December 10, 2021 Edit
Categorized as p_g

23Na(p,g)24M4

23Na(p,g)24M4 Iliadis et al. 2010 Thermonuclear reaction rate obtained using a method based on Monte Carlo techniques. Low rate, median rate and high rate correspond to the 0.16, 0.50 and 0.84 quantiles, respectively, of the cumulative reaction rate distribution. Link to publication: Nuclear Physics A 841 (2010) 31–250

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Williams et al. 2020

This study presents new strength values for seven resonances, as well as a study of direct capture. The experiment was performed in inverse kinematics by impinging an intense isotopically pure beam of ^{22}Ne onto a windowless H_2 gas target.

Link to publication: Phys. Rev. C **102**, 035801

Download "22Ne(p,g)23Na Williams et al. 2020"

Williams2020_Ne22pg.txt – Downloaded 6 times – 3 KB

Open Save

T9	RRate_low	Median Rate	RRate_high
0.010	4.210e-25	6.750e-25	1.080e-24
0.011	1.580e-23	2.440e-23	3.780e-23
0.012	3.210e-22	4.810e-22	7.210e-22
0.013	4.030e-21	5.930e-21	8.710e-21
0.014	3.490e-20	5.080e-20	7.370e-20
0.015	2.230e-19	3.240e-19	4.680e-19
0.016	1.130e-18	1.620e-18	2.350e-18
0.018	1.630e-17	2.360e-17	3.440e-17
0.020	1.350e-16	1.980e-16	2.900e-16
0.025	5.690e-15	8.640e-15	1.300e-14
0.030	6.550e-14	1.020e-13	1.570e-13
0.040	1.250e-12	2.050e-12	3.250e-12
0.050	7.000e-12	1.160e-11	1.890e-11
0.060	2.360e-11	3.810e-11	6.130e-11
0.070	1.000e-10	1.340e-10	1.870e-10
0.080	8.250e-10	9.220e-10	1.050e-09
0.090	6.570e-09	7.100e-09	7.710e-09
0.100	3.900e-08	4.180e-08	4.490e-08
0.110	1.740e-07	1.860e-07	1.980e-07
0.120	6.200e-07	6.560e-07	6.950e-07
0.130	1.830e-06	1.930e-06	2.030e-06
0.140	4.650e-06	4.880e-06	5.140e-06
0.150	1.050e-05	1.100e-05	1.150e-05
0.160	2.140e-05	2.240e-05	2.350e-05
0.180	7.140e-05	7.440e-05	7.770e-05
0.200	1.930e-04	2.010e-04	2.090e-04
0.250	1.830e-03	1.880e-03	1.940e-03
0.300	2.000e-02	2.070e-02	2.150e-02
0.350	1.580e-01	1.640e-01	1.700e-01
0.400	7.980e-01	8.280e-01	8.590e-01
0.450	2.860e+00	2.960e+00	3.070e+00
0.500	7.980e+00	8.260e+00	8.550e+00
0.600	3.790e+01	3.920e+01	4.040e+01
0.700	1.180e+02	1.220e+02	1.260e+02

Plain Text Tab Width: 8 Ln 2, Col 35 INS

Same standard format for all the rates

The *ORChESTRA platform*

Currently hosted on Zenodo:

https://zenodo.org/communities/chetec-infra-wp4/

- The aim of ORChESTRA is to regularly pubblish a fully documented library of certified trajectories, covering a wide range of stellar conditions for nuclear astrophysics simulations.
- Trajectories with initial conditions, origin and relevant information will be fully available.
- The required data to upload a trajectory are:

    1) Initial isotopic abundances;
    2) Evolution over time of temperature and density;
    3) Final isotopic abundances;
    4) Main description of the trajectory source;
    5) Description for a safe use of the trajectory, i.e., which studies can (**and cannot**) be done accurately using the data provided.

The *ORChESTRA platform*

- For each stellar trajectory, the main procedure to follow before publication in the library is:

  1) Extraction from published model;

  2) Nucleosynthesis validation;

  3) release and publication.

- In this preliminary stage we started from already existing trajectories. Namely, we have added the following three trajectories:

  a) Main s-process in AGB stars, Cescutti et al.; MNRAS (2018).

  b) Weak s-process in massive stars, Nishimura et al.; MNRAS (2017)

  c) Nova nucleosynthesis, Jose & Hernanz, ApJ (1998)

trajectory.input (~/Downloads/weak_s/Nishimura_2016) - gedit

Open | Save

Williams2020_Ne22pg(2).txt | trajectory.input

```
# time T rho
# YRS/SEC; T8K/T9K; CGS/LOG
# FORMAT: '(10x,A3)'
AGEUNIT = YRS
TUNIT   = T9K
RHOUNIT = CGS
ID = 0
0.00000000000000E+00   3.341950E-02   3.083190E+00
7.92202195350724E+02   3.341950E-02   3.083190E+00
1.58440439070145E+03   3.341950E-02   3.083190E+00
2.37660658605217E+03   3.090540E-02   2.418410E+00
3.16880878140289E+03   3.580960E-02   3.767040E+00
3.56490987907826E+03   3.580960E-02   3.767040E+00
4.15906152559130E+03   3.580960E-02   3.767040E+00
4.95126372094202E+03   3.476570E-02   3.457300E+00
5.74346591629275E+03   3.580960E-02   3.766760E+00
6.13956701396811E+03   3.580960E-02   3.764970E+00
6.73371866048115E+03   3.580960E-02   3.762260E+00
7.52592085583188E+03   3.580960E-02   3.758650E+00
8.31812305118260E+03   3.578420E-02   3.753030E+00
9.11032524653332E+03   3.575680E-02   3.747280E+00
9.90252744188405E+03   3.572960E-02   3.741590E+00
1.06947296372348E+04   3.572730E-02   3.736410E+00
1.14869318325855E+04   3.572730E-02   3.731260E+00
1.22791340279362E+04   3.572730E-02   3.726100E+00
1.30713362232869E+04   3.571150E-02   3.720620E+00
1.38635384186377E+04   3.568420E-02   3.714930E+00
1.46557406139884E+04   3.565700E-02   3.709290E+00
1.54479428093391E+04   3.564510E-02   3.703970E+00
1.62401450046898E+04   3.564510E-02   3.698880E+00
1.70323472000406E+04   3.564510E-02   3.693770E+00
1.78245493953913E+04   3.563910E-02   3.689150E+00
1.86167515907420E+04   3.561180E-02   3.686320E+00
```

Plain Text | Tab Width: 8 | Ln 1, Col 14

Same standard and consistent format for all the trajectories and initial abundances in the dataset

iniab1.4E-02As09.ppn (~/Downloads/weak_s/Nishimura_2016) - gedit

Open | Save

```
 1 h    1        7.1538567255E-01
 1 h    2        1.4307999611E-05
 2 he   3        4.4869800150E-05
 2 he   4        2.7025513111E-01
 3 li   6        6.4407632918E-10
 3 li   7        9.1487407785E-09
 4 be   9        1.6779801602E-10
 5 b   10        7.7517077092E-10
 5 b   11        3.4321757098E-09
 6 c   12        2.4825306734E-03
 6 c   13        3.0083012115E-05
 7 n   14        7.3396723494E-04
 7 n   15        1.8049744286E-06
 8 o   16        6.0761694571E-03
 8 o   17        2.4526323005E-06
 8 o   18        1.3703983054E-05
 9 f   19        5.3616432419E-07
10 ne  20        1.2296781652E-03
10 ne  21        3.0951292777E-06
10 ne  22        9.9459969635E-05
11 na  23        3.1065056525E-05
12 mg  24        5.8658056252E-04
12 mg  25        7.7354275135E-05
12 mg  26        8.8573739201E-05
13 al  27        5.9143643625E-05
14 si  28        6.4949100308E-04
14 si  29        3.4157416484E-05
14 si  30        2.3293263117E-05
15 p   31        6.1930702445E-06
16 s   32        3.1124169469E-04
16 s   33        2.5696373982E-06
16 s   34        1.4944470132E-05
16 s   36        7.3769494686E-08
17 cl  35        6.5187895016E-06
```

Summary and next steps

- **ChANUREPS** (ChETEC AstroNUclear REPositorieS) and **ORChESTRA** (Online Repository of ChETEC Stellar TRAjectories) both online and fully operative, D4.2 and 4.3 succesfully completed.
- Concrete effort to bridge and connect the stellar and nuclear communities
- The main difference between **ChANUREPS** and the main nuclear libraries for astrophysics is that there is not any “superuser” selection, or recommended set of nuclear reactions.
- New nuclear rates are directly provided by the authors in a standard format once published and inserted into their relevant categories, in order to be quickly found and downloaded by other users.

Summary and next steps

- The more the platforms will be used by the community, the better they will get. How can we make them more useful and accessible to the community? Suggestions are welcome.
- It would be useful to make use of the platforms in future chetec-infra activities. E.g., in schools supported by chetec-infra & outreach activities.
- **Warning**: correct use of the platforms. Work in progress to make goals and limitations of the platform as clear as possible. For instance, Orchestra has the great potential to bridge an important gap between astrophysicists and the nuclear physics community, but it should be used correctly.