Scientific Information Service

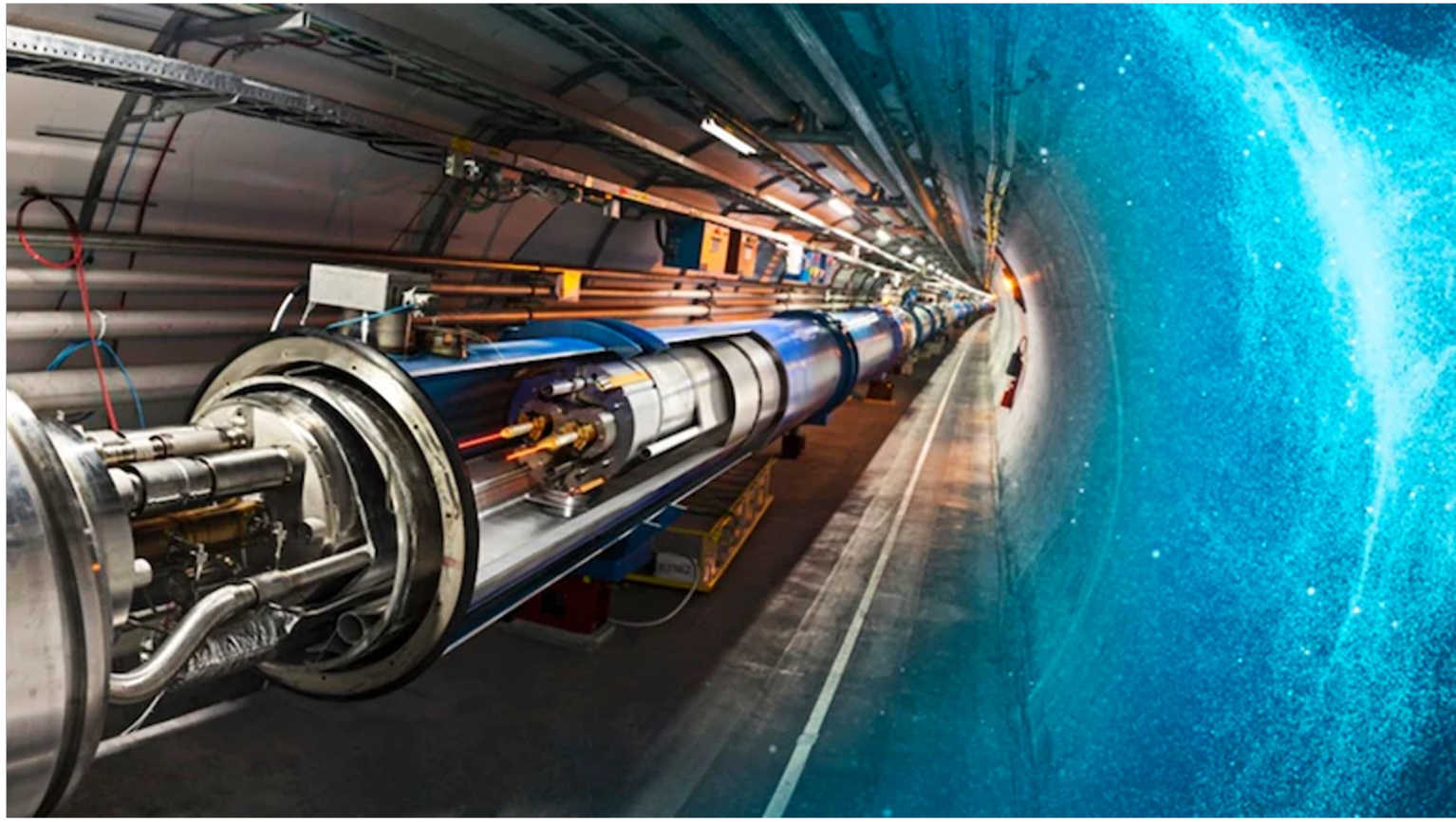
Sauvegarder et ouvrir la recherche pour tous

Leçons tirées du développement de services globaux
pour les sciences ouvertes et la gestion des données de recherche

Dr. Sünje Dallmeier-Tiessen, CERN
Cotonou, Octobre 2022

Mission du CERN

Fournir une gamme unique d'accélérateurs de particules qui permettent la recherche à la pointe des connaissances humaines, effectuent des recherches de classe mondiale en physique fondamentale, unissent des personnes du monde entier pour repousser les frontières de la science et de la technologie, **au profit de tous**



Collaboration ouverte et inclusive créée en 1954 avec 12 états membres européens

23 États membres
Autriche – Belgique – Bulgarie – République tchèque – Danemark – Finlande – France – Allemagne – Grèce – Hongrie – Israël – Italie – Pays-Bas – Norvège – Pologne – Portugal – Roumanie – Serbie – Slovaquie Espagne – Suède – Suisse – Royaume-Uni

3 États membres associés dans la phase préalable à l'adhésion
Chypre – Estonie – Slovénie

7 États membres associés
Croatie – Inde – Lettonie – Lituanie – Pakistan Turquie – Ukraine

6 Observateurs
Japon – Russie – États-Unis Union européenne – JINR – UNESCO

Le budget annuel du CERN est de 1200 MCHF

~ 2'600 Collaborateurs
~ 2'000 Contractors
~ 13'000 Physiciens (utilisateurs)

Plus de 50 accords de coopération avec des États et territoires non membres

Albanie – Algérie – Argentine – Arménie – Australie – Azerbaïdjan – Bangladesh – Biélorussie – Bolivie Bosnie-Herzégovine – Brésil – Canada – Chili – Colombie – Costa Rica – Équateur – Égypte – Géorgie – Islande
Iran – Jordanie – Kazakhstan – Liban – Malte – Mexique – Mongolie – Monténégro – Maroc – Népal
Nouvelle-Zélande – Macédoine du Nord – Palestine – Paraguay – République populaire de Chine – Pérou – Philippines – Qatar
République de Corée – Arabie saoudite – Sri Lanka – Afrique du Sud – Thaïlande – Tunisie – Émirats arabes unis – Vietnam

"... et les résultats de ces travaux expérimentaux et théoriques sont publiés ou de toute autre façon rendus généralement accessibles."

Convention de fondation du CERN (1953)

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

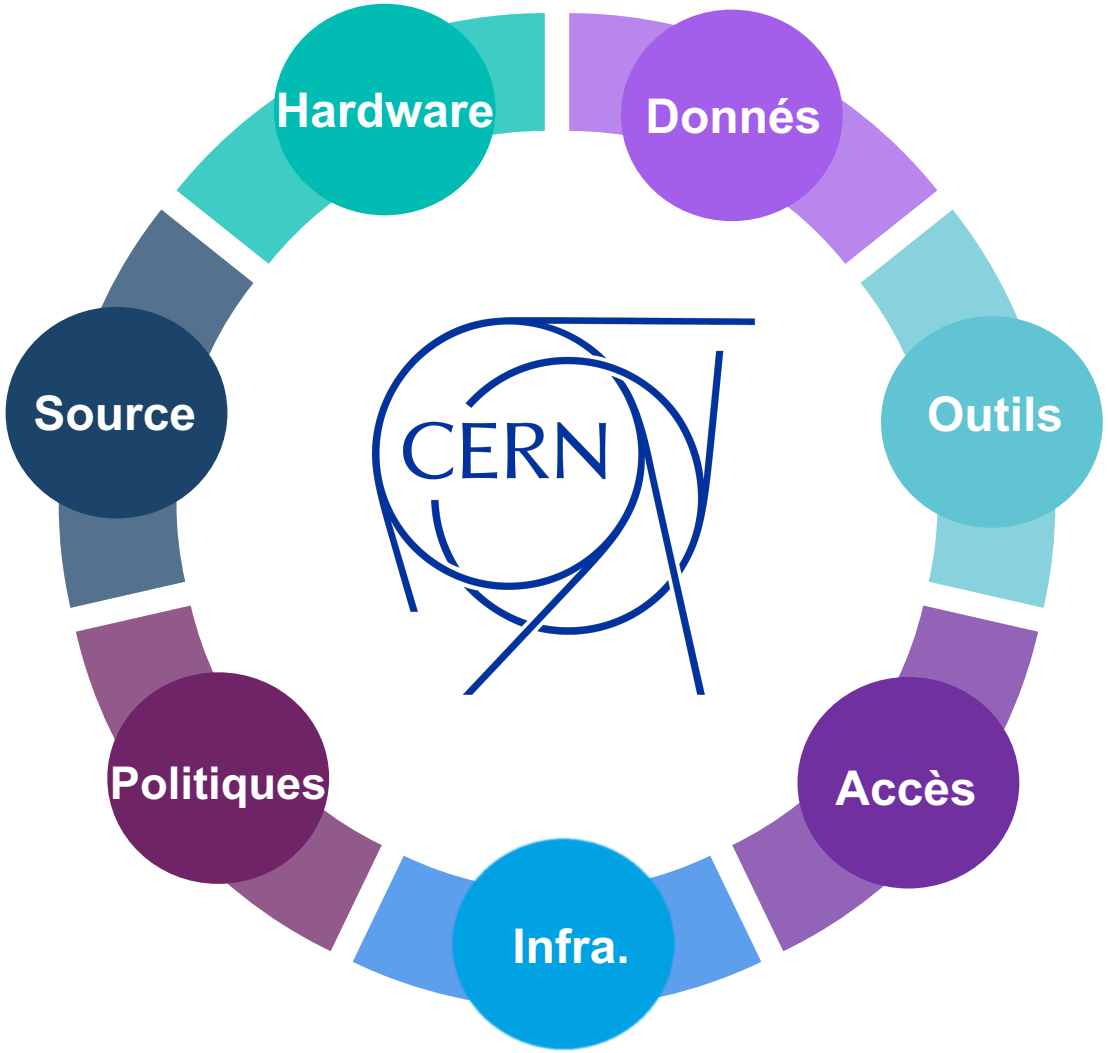
CONVENTION

FOR THE ESTABLISHMENT OF A EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH

PARIS, 1st JULY, 1953

Illustration par Stephanie van de Sandt

La science ouverte au CERN




OPEN
DATA

Le CERN stocke plus de 100 PB de données par an

Collection de données

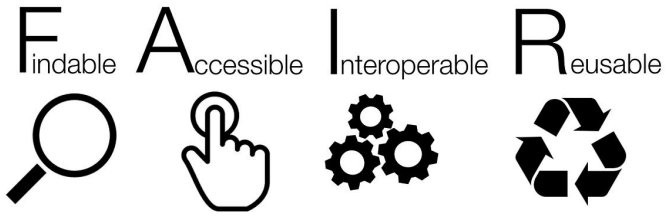
- 1 PB/sec de données de collisions impossibles à stocker
- Systèmes de déclenchement de chacun des 4 détecteurs principaux :
  - Niveau 1 : réduction presque en temps réel (< 2,5 microsecondes) à 100 000 événements/seconde
  - Niveau 2 : dans les 200 microsecondes, réduction supplémentaire à 1 000 événements/seconde pour le stockage
- 90 PB/an du LHC + 25 PB d'autres expériences

Stockage de données

- Le centre de données du CERN dispose de 411 PB sur bandes + 365 PB sur disques (y compris les doublons)
- EOS (le système de stockage propriétaire du CERN) héberge désormais plus de 5 milliards de fichiers et a servi 2,5 exaoctets de données (en 2020)
- Latence élevée des bandes problématique pour les services de données ouvertes (1-3 minutes ou même plus)

Au début: Les trois piliers de la réussite des données ouvertes

	Préservation et accès à long terme	Publier et partager	Réutilisation
Services	Plateformes d'archivage et publication	Plateformes numériques (+l'assurance qualité)	Plateformes d'analyse de données de recherche reproductibles

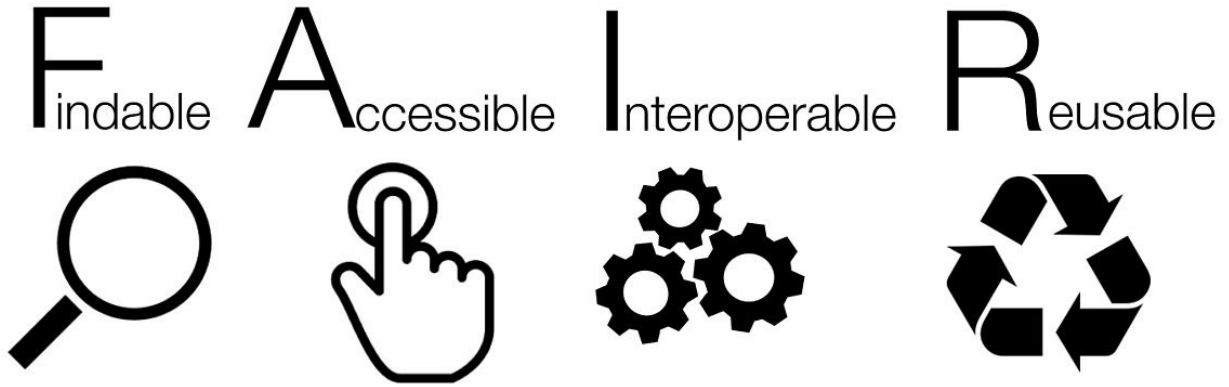


FAIR est le nouveau standard

Bien que les données ouvertes soient cruciales, **l'intégrité des résultats** de la recherche est la base.

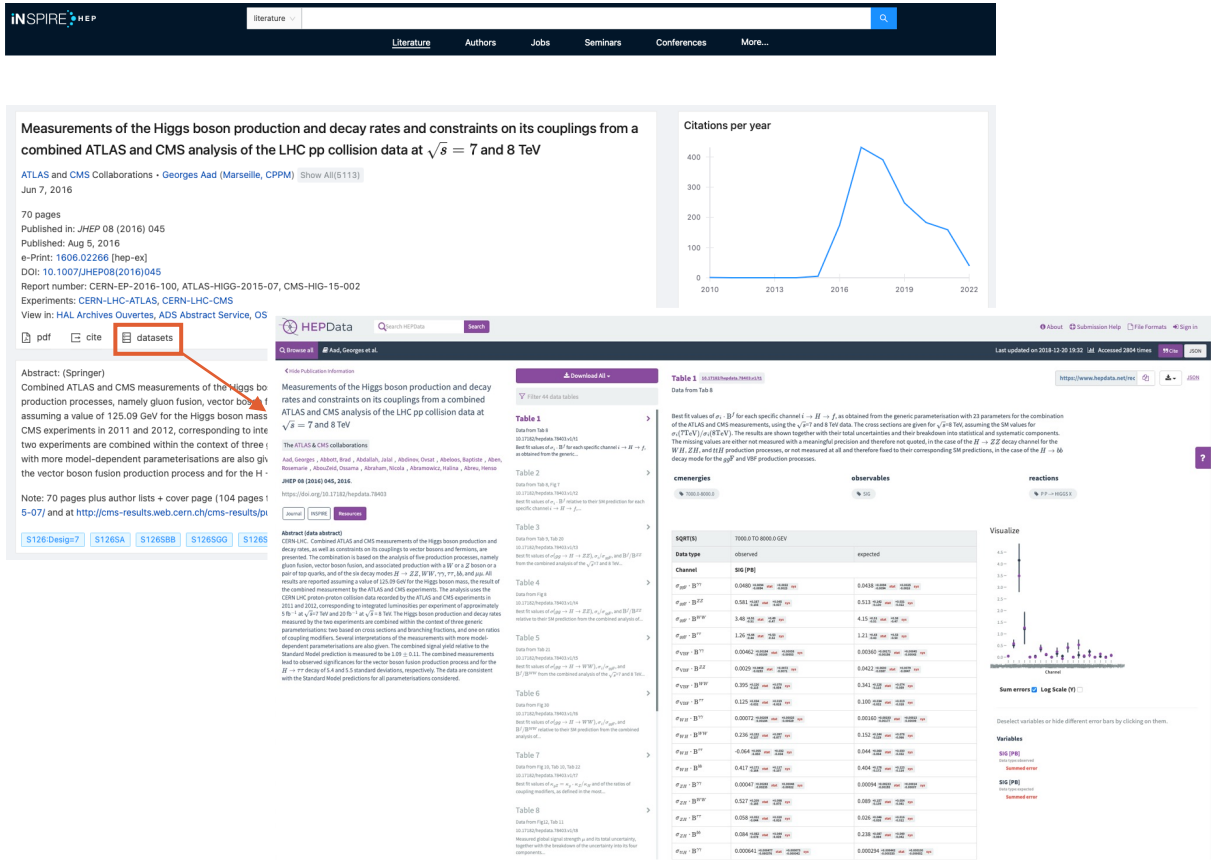
La préservation des résultats tout au long du processus de recherche est nécessaire afin d'assurer…

- La découvrabilité, trouvabilité
- L'accessibilité à long terme
- La standardisation, interopérabilité
- L'assurance qualité
- La (ré)utilisation

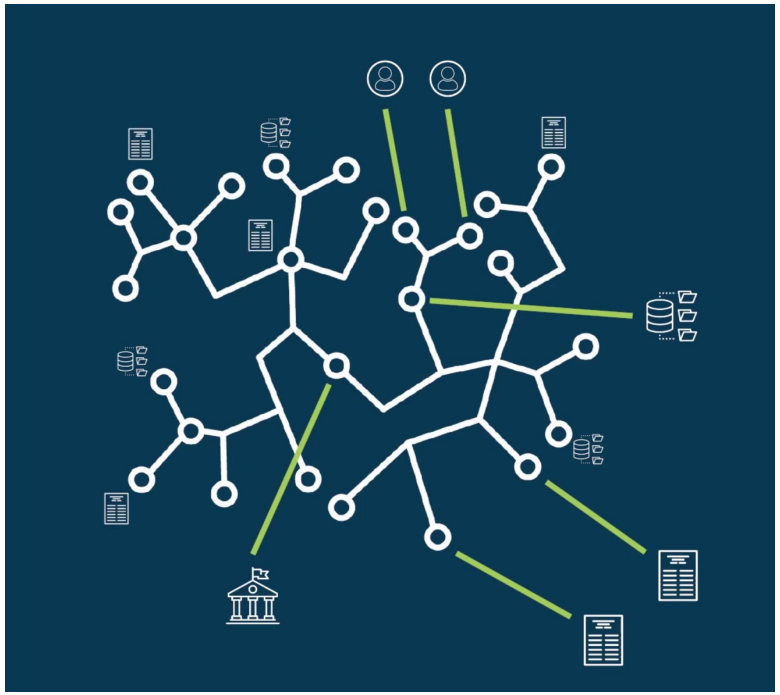


FAIR partage de données : identifiants persistants (e.g. DOI)

- Connecter les articles, les données et les logiciels…



Les identifiants persistants sont la clé !

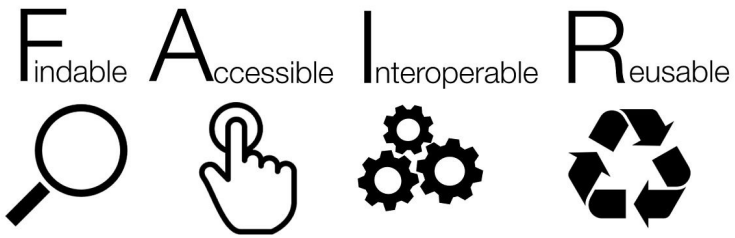


https://doi.org/10.5281/zenodo.4028383

Le CERN et ses partenaires ont créé une suite d'outils de gestion des données de la recherche

- Le portail Open Data du CERN permet aux expériences HEP de partager leurs données (collisions, simulations, logiciels associés, etc.)
- Contient déjà > 2 PB de données

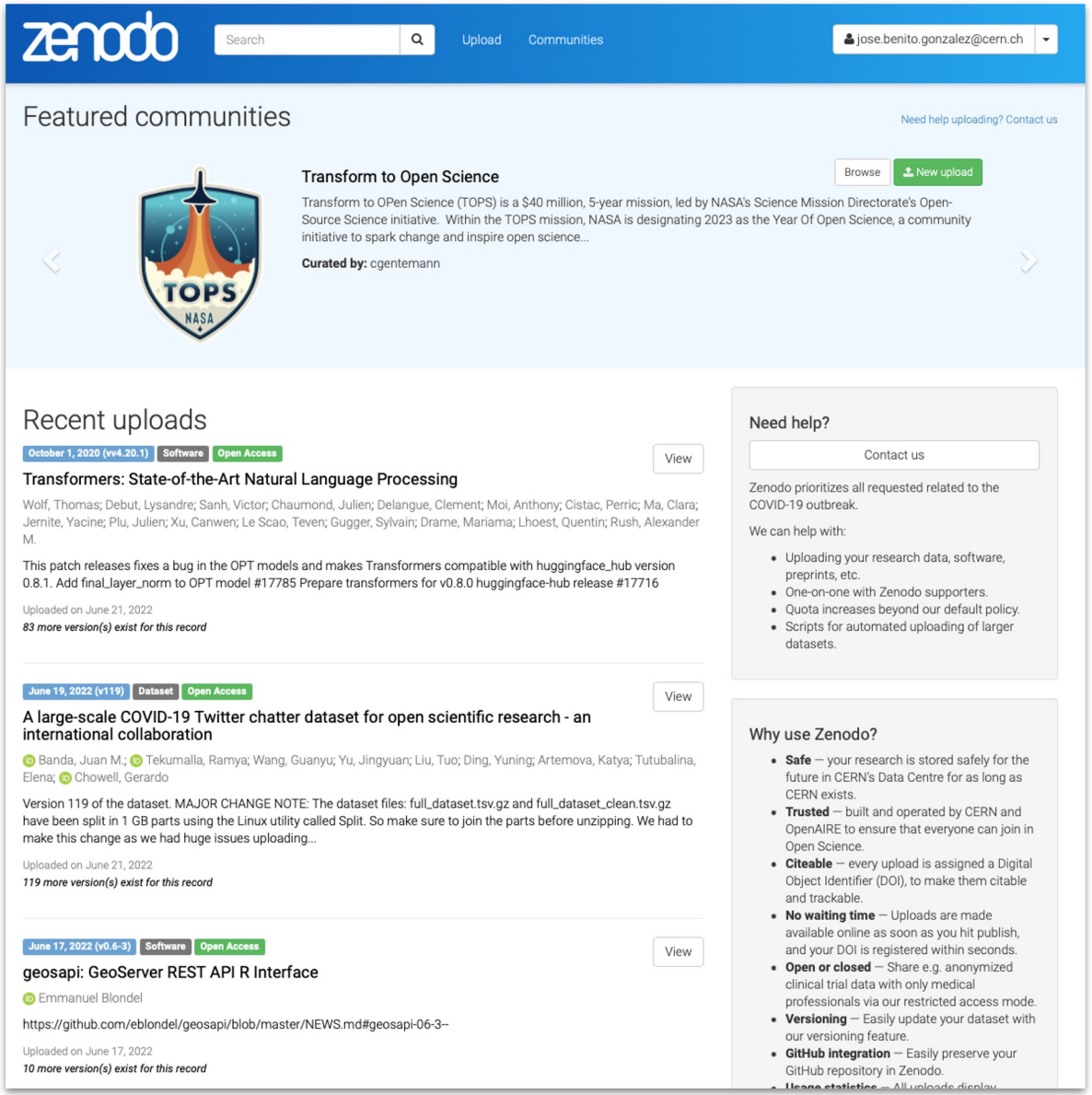
- Zenodo est un serveur de recherche ouvert multidisciplinaire commandé par la EC
- Inclut 80 % des DOI de logiciels du monde



- HEPData est la plateforme principale pour les tableaux et les ensembles de données liés à env. 10'000 articles.
- Géré par l'Université de Durham en collaboration avec le CERN

ZENODO

un exemple de réalisation

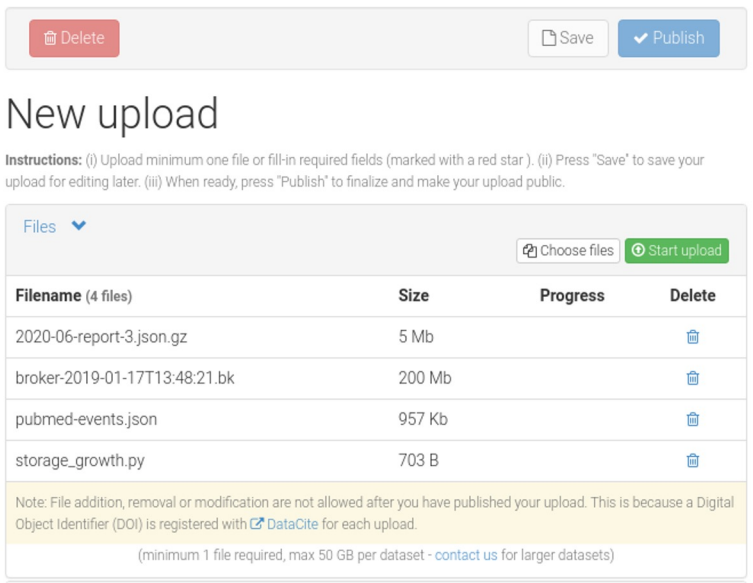


https://zenodo.org/

Faciliter la tâche des utilisateurs (*Zenodo)

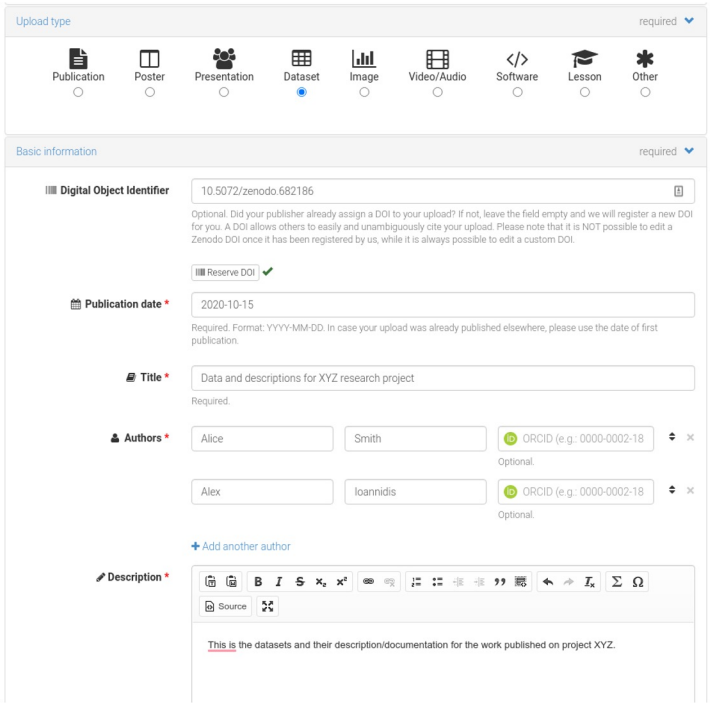
Télécharger

50 GB* pour chaque set de données
Tous les formats de fichiers sont acceptés



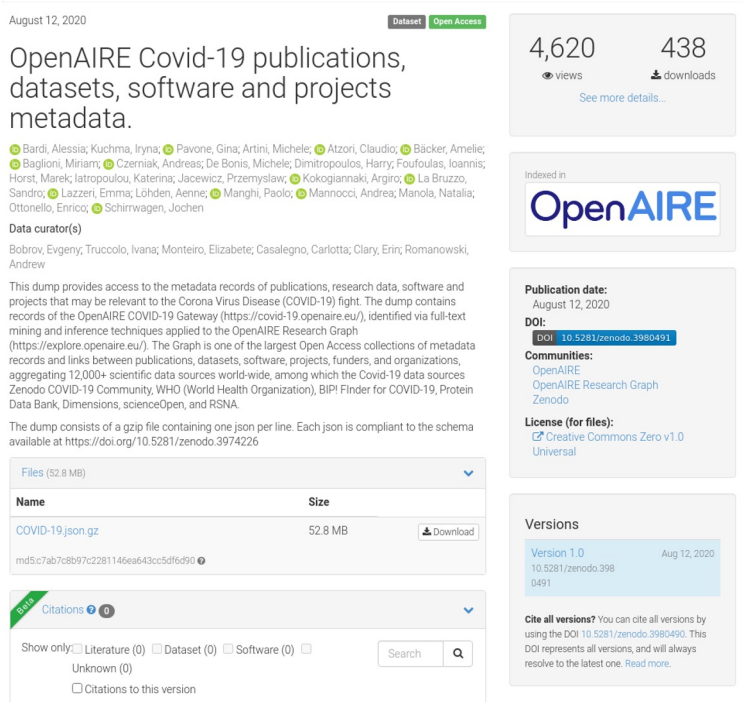
Décrire

Métadonnées riches mais flexibles
Basées sur le schéma DataCite
Réserver le DOI avant la publication



Publication

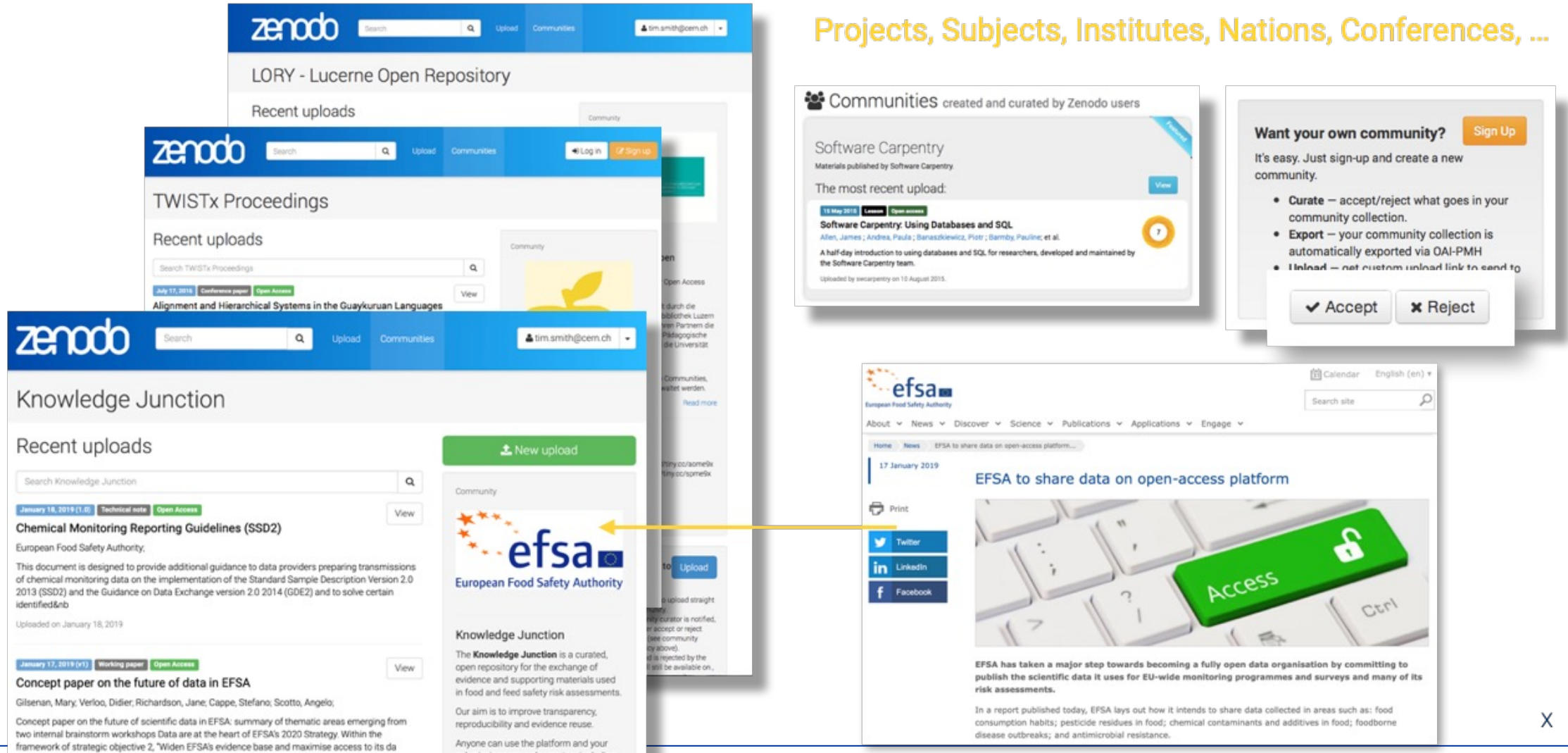
DOI citable
Formats d'exportation



Donner le pouvoir aux utilisateurs !

Communities

Projects, Subjects, Institutes, Nations, Conferences, ...



X

Standardisation et flexibilité

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December 31, 2018 Figure Open Access

Fig. 7 in A mountain of millipedes VI. New records, new species, a new genus and a general discussion of Odontopygidae from the Udzungwa Mts, Tanzania (Diplopoda, Spirostreptida, Odontopygidae)

Enghoff, Henrik

Fig. 7. Hoffmanides dissutus (Hoffman, 1963), ♂, from Udzungwa Mts National Park. Photograph by A. Illum. Scale bar = 5 mm.

Preview

Files (2.8 MB)

Name	Size	
figure.png	2.8 MB	Preview Download

md5:9191af35e44c7ba2659ed5a41b2bf22b

Beta Citations 0

Show only: Literature (0) Dataset (0) Software (0) Unknown (0) Citations to this version

Search

No citations.

Part of Biodiversity Literature Repository

Indexed in OpenAIRE

Publication date: December 31, 2018

DOI: DOI 10.5281/zenodo.1146170

Keyword(s): Biodiversity Taxonomy Animalia Arthropoda Diplopoda Spirostreptida Odontopygidae Hoffmanides

Published in: European Journal of Taxonomy: 394 pp. 1-29.

Related identifiers:
Cited by:
http://treatment.plazi.org/id/038D2864FFA3FFA2FDA4FEBA88B9FCD9
Part of:
10.5852/ejt.2018.394, *urn:lsid:plazi.org:pub:FFB4501CFFB2FFB1FF94FFB0892EFF8E* (LSID), https://zenodo.org/record/1146158, 10.5852/ejt.2018.394, https://zenodo.org/record/1146158

Communities: Biodiversity Literature Repository

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Versions

Version 1 10.5281/zenodo.1146170 Dec 31, 2018

Cite all versions? You can cite all versions by using the DOI 10.5281/zenodo.1146169. This DOI represents all versions, and will always resolve to the latest one. Read more.

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Keyword(s):

PID Graph, research.fi, persistent identifier, interoperability, legal interoperability, research output

Subject(s):

research work | research activity | academic writing | research data | identifiers (information) | interoperability

Meeting:

Pidapalooza 2021, 27-28.01.2021 (Session Block 2, track 2)

Custom keywords:

Genus
Pliolestes

Species
venetus

Kingdom
Animalia

Order
Paucituberculata

Scientific name authorship
Goin

Phylum
Chordata

Taxon rank
species

Family
Caenolestidae

Related identifiers:

Cites
10.11646/zootaxa.4193.3.7 (Publication)
10.1653/0015-4040(2005)88[502:KTTFOC]2.0.CO;2 (Publication)
10.11646/zootaxa.4747.2.10 (Publication)

Has part
http://treatment.plazi.org/id/03DF87B7FF86FFBFFF68FF340F5BFE10 (Taxonomic treatment)
http://treatment.plazi.org/id/03DF87B7FF86FFBFFF68FDB00FE8FC3A (Taxonomic treatment)
http://treatment.plazi.org/id/03DF87B7FF86FFBFFF68FB9D0B1CF82B (Taxonomic treatment)
http://treatment.plazi.org/id/03DF87B7FF83FFBAFF68FF3408D7FAD2 (Taxonomic treatment)
10.5281/zenodo.5497141 (Figure)
10.5281/zenodo.5497144 (Figure)

Locations:

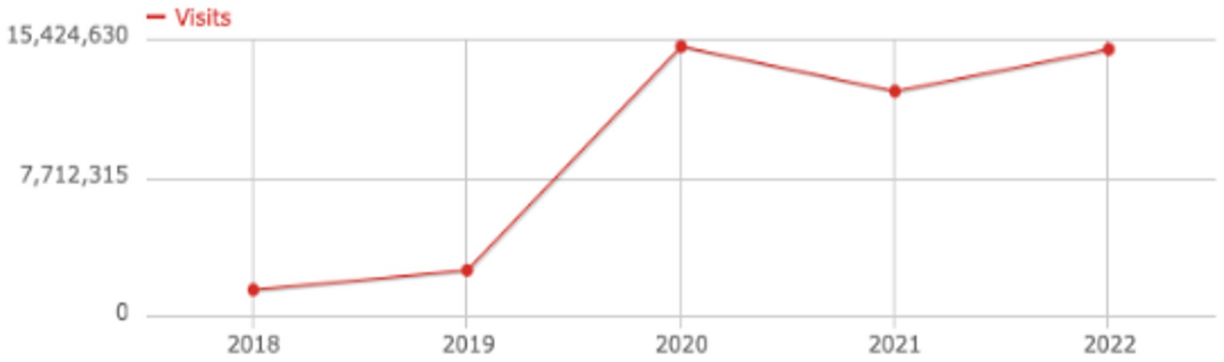
R / V Alis, EBISCO Expedition, st. DW 2613, Plateau des Chesterfield (-19.616667, 158.7)
NEW CALEDONIA: 42.5 × 19.4 mm, R/V Alis, EBISCO Expedition, st. DW 2613, Plateau des Chesterfield, 19°37' S, 158°42' E, 519-522 m (MNHN IM-2007-30854; Fig. 9A; GenBank accession number (cox1 sequence): KJ550158).

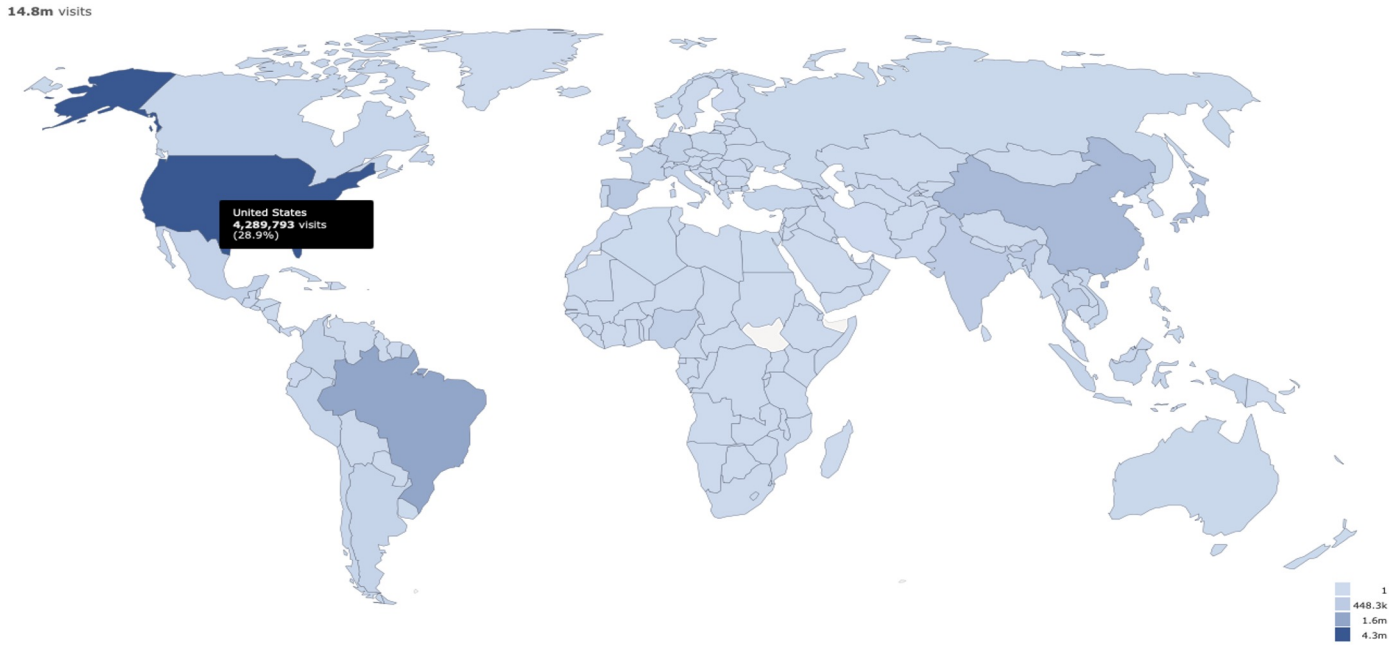
R / V Alis, EBISCO Expedition, st. DW 2610, Plateau des Chesterfield (-19.566668, 158.68333)
16.3 × 13.0 mm, R/V Alis, EBISCO Expedition, st. DW 2610, Plateau des Chesterfield, 19°34' S, 158°41' E, 486-494 m (MNHN IM-2000-30789; paratype 2; Fig. 9D; fragment of the spire, well preserved).

Coral Sea (-19.616667, 158.7)
NEW CALEDONIA: Coral Sea, Plateau des Chesterfield, 19°37' S, 158°42' E, 519-522 m (EBISCO st. DW 2613).

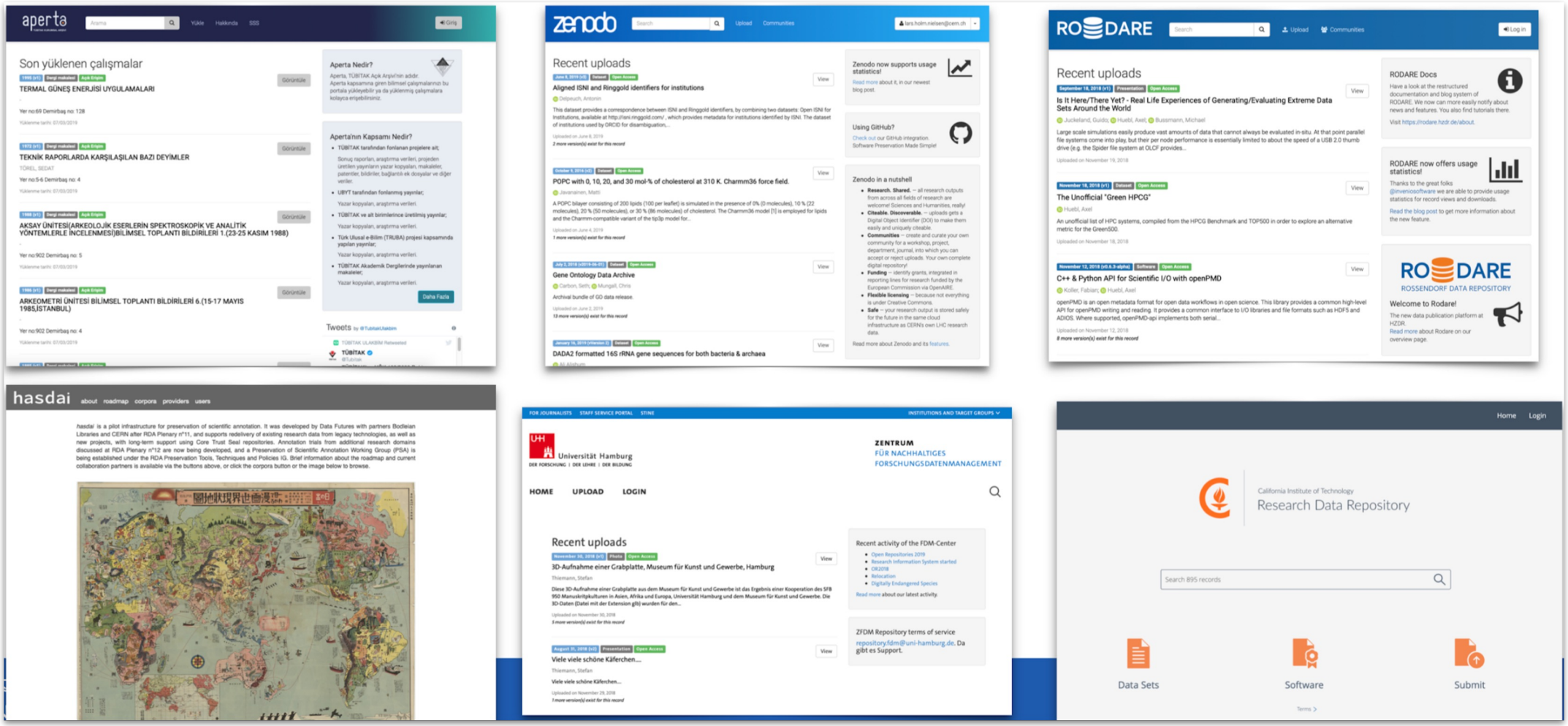
Zenodo en chiffres

- **~2,8 millions d'entrées**
  - 1.5m textes
  - 750k images
  - 200k logiciels
  - 200k sets de données
- **1000 TB de données,**
- **~8 millions de fichiers**
- **~10 000 communautés**
- **15 millions de visiteurs/an**
- **Déjà 14,8 millions en juin 2022**





ZENODO A OUVERT LA VOIE AUX "CLONES" À SUIVRE



Scientific
Information
Service

INVENIO RDM

Le référentiel clé en main de gestion des données de recherche

https://inveniosoftware.org/products/rdm/

Développé en partenariat avec plus de 25 organisations

Principes pour les infrastructures ouvertes (une sélection)

- **Open source**
- **Conduit par la communauté (=écouter les utilisateurs)**
- **Gouverné de manière transparente**
- **Prestation de services/décisions transparentes**
- **Financé durablement**

Avantage pour vous:

Vous et la communauté le pilotez ensemble, vous avez votre mot à dire, et vous contrôlez le budget durablement.

Comment créer une plateforme de données de recherche

- Gardez le processus ouvert et participatif
- Intégrez les commentaires et les besoins des utilisateurs (cela semble plus simple que ça ne l'est !).

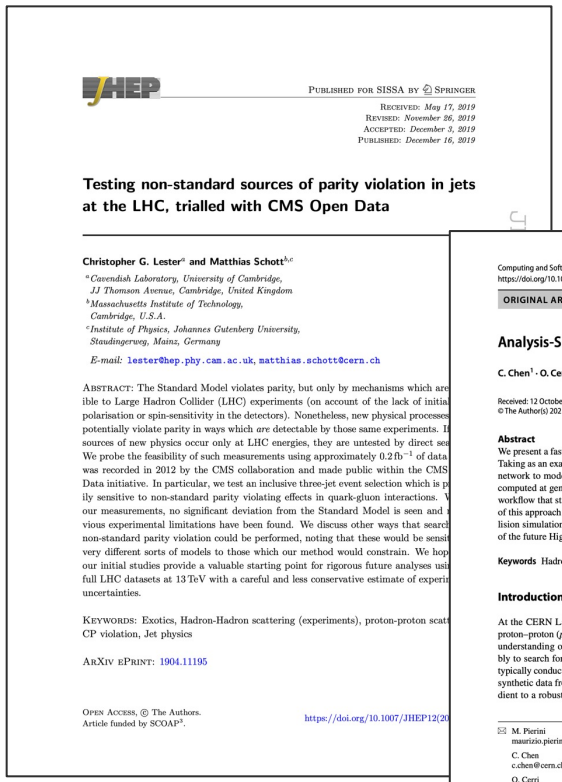
La plateforme elle-même

- Rendez-la utilisable et focusses sur des interface et processus simples
- Utilisez une infrastructure ouverte et fiable (extensible, modifiable, personnalisable aux sous-groupes), par ex. Dataverse, DSpace, InvenioRDM, etc.
- **Contenu : aussi ouvert que possible, aussi fermé que necessaire**

Frais:

- Coûts de mise en œuvre, par ex. frais de personnel ou par l'intermédiaire d'un service/d'une société de logiciels. InvenioRDM, Dataverse etc sont gratuits et open source.
- Coûts opérationnels à long terme : fonctionnement, développement d'améliorations et de personnalisation, coûts de conservation ou de modération (selon la configuration). Bénéfice : vous renforcez vous-même vos capacités.

Un peu de motivation : les chercheurs du monde entier utilisent les données ouvertes du LHC@CERN



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Testing non-standard sources of parity violation in jets at the LHC, trialled with CMS Open Data

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[b] Massachusetts Institute of Technology, Cambridge, U.S.A.
[c] Institute of Physics, Johannes Gutenberg University, Staudingerweg, Mainz, Germany

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Abstract: The Standard Model violates parity, but only by mechanisms which are ible to Large Hadron Collider (LHC) experiments (on account of the lack of initia polarisation or spin-sensitivity in the detectors). Nonetheless, new physical processes potentially violate parity in ways which *are* detectable by those same experiments. I sources of new physics occur only at LHC energies, they are untested by direct se We probe the feasibility of such measurements using approximately 0.2 fb^{-1} of data was recorded in 2012 by the CMS collaboration and made public within the CMS Data initiative. In particular, we test an inclusive three-jet event selection which is p ily sensitive to non-standard parity violating effects in quark-gluon interactions. V our measurements, no significant deviation from the Standard Model is seen and vious experimental limitations have been found. We discuss other ways that searc non-standard parity violation could be performed, noting that these would be sensit very different sorts of models to those which our method would constrain. We hop our initial studies provide a valuable starting point for rigorous future analyses usi full LHC datasets at 13 TeV with a careful and less conservative estimate of experi uncertainties.

Keywords: Exotics, Hadron-Hadron scattering (experiments), proton-proton scatt CP violation, Jet physics

ArXiv ePrint: 1904.11195

https://doi.org/10.1007/JHEP12(20

MIT-CTP 4891

Exposing the QCD Splitting Function with CMS Open Data

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[2] University at Buffalo, The State University of New York, Buffalo, NY 14260-1500, USA
[3] Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA

The splitting function is a universal property of quantum chromodynamics (QCD) which describes how energy is shared between partons. Despite its ubiquitous appearance in many QCD calculations, the splitting function cannot be measured directly, since it always appears multiplied by a collinear singularity factor. Recently, however, a new jet substructure observable was introduced which asymptotes to the splitting function for sufficiently high jet energies. This provides a way to expose the splitting function through jet substructure measurements at the Large Hadron Collider. In this letter, we use public data released by the CMS experiment to study the 2-prong substructure of jets and test the $1 \to 2$ splitting function of QCD. To our knowledge, this is the first ever physics analysis based on the CMS Open Data.

Computing and Software for Big Science (2021) 5:15
https://doi.org/10.1007/s41781-021-00060-4

ORIGINAL ARTICLE

Analysis-Specific Fast Simulation at the LHC with Deep Learning

C. Chen[1] · O. Cerri[2] · T. Q. Nguyen[2] · J. R. Vlimant[2] · M. Pierini[3]

Received: 12 October 2020 / Accepted: 12 May 2021 / Published online: 9 June 2021

Abstract
We present a fast-simulation application based on a deep neural network, designed to create large analysis-specific datasets. Taking as an example the generation of $W+$jet events produced in $\sqrt{s} = 13$ TeV proton–proton collisions, we train a neural network to model detector resolution effects as a transfer function acting on an analysis-specific set of relevant features, computed at generation level, i.e., in absence of detector effects. Based on this model, we propose a novel fast-simulation workflow that starts from a large amount of generator-level events to deliver large analysis-specific samples. The adoption of this approach would result in about an order-of-magnitude reduction in computing and storage requirements for the collision simulation workflow. This strategy could help the high energy physics community to face the computing challenges of the future High-Luminosity LHC.

Keywords Hadron Collider Physics · Fast Simulation · Deep Learning · High Energy Physics computing

Introduction

At the CERN Large Hadron Collider (LHC), high-energy proton–proton (pp) collisions are studied to consolidate our understanding of physics at the energy frontier and possibly to search for new phenomena. While these studies are typically conducted according to a data driven methodology, synthetic data from simulated pp collisions are a key ingredient to a robust analysis development. Particle physicists rely extensively on an accurate simulation of the physics processes under study, including a detailed description of the response of their detector to a given set of incoming particles. These large sets of synthetic data are typically generated with experiment-specific simulation software, based on the GEANT4 [1] library. Through Monte Carlo techniques, GEANT4 provides the state of the art in terms of simulation accuracy. The first two runs of the LHC highlighted the remarkable agreement between data and simulation, with discrepancies observed at the level of a few percent. On the other hand, running GEANT4 is demanding in terms of resources. As a consequence of this, delivering synthetic data at the pace at which the LHC delivers real data is one of the most challenging tasks for the computing infrastructures of the LHC experiments. It is then more and more common for LHC physics analyses to be affected by large systematic uncertainties due to the limited amount of simulated data. This is particularly true for precise measurements of Standard Model processes for which large datasets are already available today. In the future, with the high-luminosity LHC upgrade, this will become a serious problem for most of the LHC data analyses [2]. Our community is called to reduce the computing resources needed for central simulation workflows by at least one order of magnitude, not to jeopardize the accuracy gain expected when operating the LHC at a high luminosity.

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Springer

MIT-CTP 5129

Exploring the Space of Jets with CMS Open Data

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[2] Department of Physics, Harvard University, Cambridge, MA 02138, USA

We explore the metric space of jets using public collider data from the CMS experiment. Starting from 2.3 fb^{-1} of proton-proton collisions at $\sqrt{s} = 7$ TeV collected at the Large Hadron Collider in 2011, we isolate a sample of 1,690,984 central jets with transverse momentum above 375 GeV. To validate the performance of the CMS detector in reconstructing the energy flow of jets, we compare the CMS Open Data to corresponding simulated data samples for a variety of jet kinematic and substructure observables. Even without detector unfolding, we find very good agreement for track-based observables after using charged hadron subtraction to mitigate the impact of pileup. We perform a range of novel analyses, using the "energy mover's distance" (EMD) to measure the pairwise difference between jet energy flows. The EMD allows us to quantify the impact of detector effects, visualize the metric space of jets, extract correlation dimensions, and identify the most and least typical jets in datasets and
hundred gigab

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PHYSICAL REVIEW D **100,** 015021 (2019)

Searching in CMS open data for dimuon resonances with substantial transverse momentum

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We study dimuon events in 2.11 fb^{-1} of 7 TeV pp collisions, using CMS Open Data, and search for a narrow dimuon resonance with moderate mass (14–66 GeV) and substantial transverse momentum (p_T). Applying dimuon p_T cuts of 25 and 60 GeV, we explore two overlapping samples: one with isolated muons, and one with prompt muons without an isolation requirement. Using the latter sample requires information about detector effects and QCD backgrounds, which we obtain directly from the CMS Open Data. We present model-independent limits on the product of cross section, branching fraction, acceptance, and efficiencies. These limits are stronger, relative to a corresponding inclusive search without a p_T cut, by factors of as much as 9. Our "p_T-enhanced" dimuon search strategy provides improved sensitivity to models in which a new particle is produced mainly in the decay of something heavier, as could occur, for example, in decays of the Higgs boson or of a TeV-scale top partner. An implementation of this method with the current 13 TeV data should improve the sensitivity to such signals further by roughly an order of magnitude.

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I. INTRODUCTION

The CERN Open Data portal [1] aims to make data from the Large Hadron Collider (LHC) publicly available as a long-term archive, with the first research-grade data from the CMS experiment released in 2014 [2]. In order to identify any issues that might interfere with their use by physicists of the future, it is important that open data frameworks be tested today. There are good scientific motivations to make use of this resource [3]. Open data make it possible for scientists outside of the LHC collaborations to study standard model (SM) processes that are not well modeled by Monte Carlo (MC) generators, such as rare QCD backgrounds. Together with detector-simulated samples, open data also make it possible to test event analysis strategies that rely on a detailed understanding of detector effects. The value of the CMS Open Data for exploratory studies of QCD has been demonstrated in Refs. [4,5]; see Refs. [6–8] for machine-learning studies on detector-simulated CMS samples, Refs. [9–11] for QCD studies on archival ALEPH data, and Ref. [12] for a diphoton analysis with public LHCb data.

In this paper, we report the first utilization of the CMS Open Data in a search for beyond the standard model (BSM) phenomena. We seek a new particle V that decays promptly to dimuon pairs ($\mu^+\mu^-$) and is typically produced with substantial transverse momentum (p_T). Our analysis is based on 2.11 fb^{-1} of 7 TeV center-of-mass pp collision events recorded by the CMS experiment during the first part of 2011 and made public through the CERN Open Data portal [13]. We perform a narrow resonance search in the dimuon mass range $m_V \in [14, 66]$ GeV and study the effect of modest cuts on p_T, namely, $p_T^j > 25$ GeV and 60 GeV; this approach (which we refer to as p_T enhanced) could be applied to larger p_T values as well, or alternatively to a cut on the V boost factor p_T^V/m_V. This type of search strategy was suggested some time ago [14], as one of several unconventional approaches for finding low-mass dilepton and diphoton resonances [15], but to our knowledge has never been carried out as a public analysis by the LHC collaborations. For this reason, the mass and p_T regime we cover is relatively unexplored. Moreover, our

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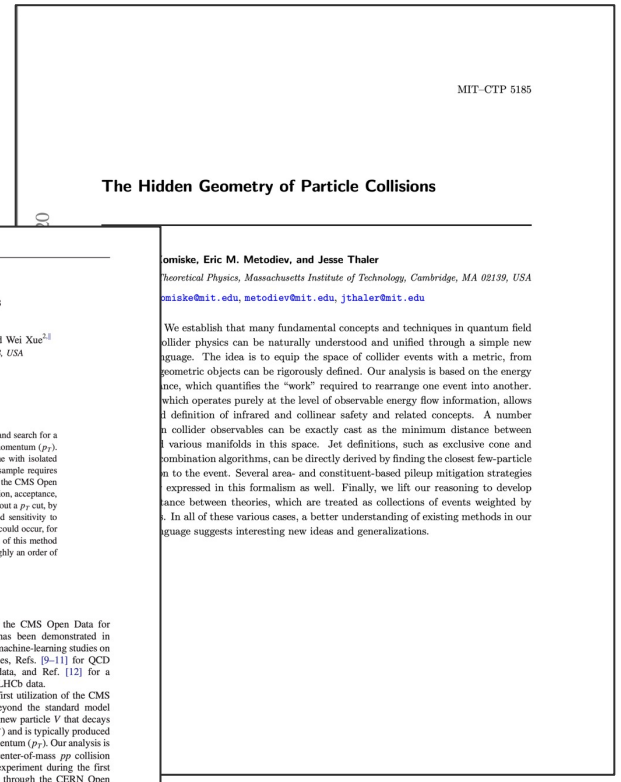

The Hidden Geometry of Particle Collisions

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We establish that many fundamental concepts and techniques in quantum field ollider physics can be naturally understood and unified through a simple new nguage. The idea is to equip the space of collider events with a metric, from geometric objects can be rigorously defined. Our analysis is based on the energy nce, which quantifies the "work" required to rearrange one event into another. which operates purely at the level of observable energy flow information, allows d definition of infrared and collinear safety and related concepts. A number n collider observables can be exactly cast as the minimum distance between l various manifolds in this space. Jet definitions, such as exclusive cone and combination algorithms, can be directly derived by finding the closest few-particle n to the event. Several area- and constituent-based pileup mitigation strategies expressed in this formalism as well. Finally, we lift our reasoning to develop tance between theories, which are treated as collections of events weighted by . In all of these various cases, a better understanding of existing methods in our nguage suggests interesting new ideas and generalizations.

Merci beaucoup!

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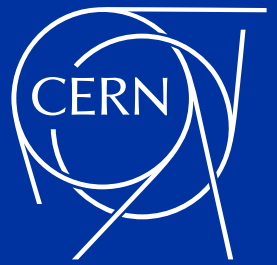

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