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Fraunhofer SCAI

Kairntech / SCAI Webinar

“Automatic relation extraction from biomedical content for knowledge graph creation and maintenance”

June 8, 2022

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Welcome! Agenda:

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- Introduction: Your hosts for today:

Prof. Martin Hofmann-Apitius
Head of Bioinformatics
Fraunhofer-SCAI
St. Augustin

Stefan Geißler
Co-founder, COO
Kairntech
Grenoble, Neckargemünd

- Construction of Knowledge Graphs on biomedical topics (Martin Hofmann-Apitius, 20min)
- AI powered content analysis (Stefan Geißler, 20min)
- Larger context, wrapping up and next steps (Martin Hofmann-Apitius, 10min)

- Q&A, Discussion, next steps, (all, 30min)

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Introducing Kairntech

1. French NLP/AI startup created in December 2018
2. Grenoble, France (headquarter), Paris and Heidelberg, Germany
3. Selected customers: Boehringer-Ingelheim, SCAI-Fraunhofer, AFP, French Government, Groupe Revue Fiduciaire,…
4. Mission: Making NLP / Machine Learning accessible for domain experts (“No code / Low code platform”)

Project Intro & Background

- Spring 2021: SCAI: “We are looking for an automatic procedure to **extract** information about entities and their **relations** from a larger corpus on psychiatric disorders and render that in the BEL language. Can you do that?”

- Kairntech: “Sure!”

- Implementation phase until Sept 2021, assessment by SCAI

- Since then
  - Defined future cooperation in MOU
  - Joint publication efforts: https://www.biorxiv.org/content/10.1101/2022.03.07.483233v1
  - Deployed Kairntech software at large SCAI High Performance Computing cluster
  - Preparing joint activities

Kairntech Studio (build a pipeline)

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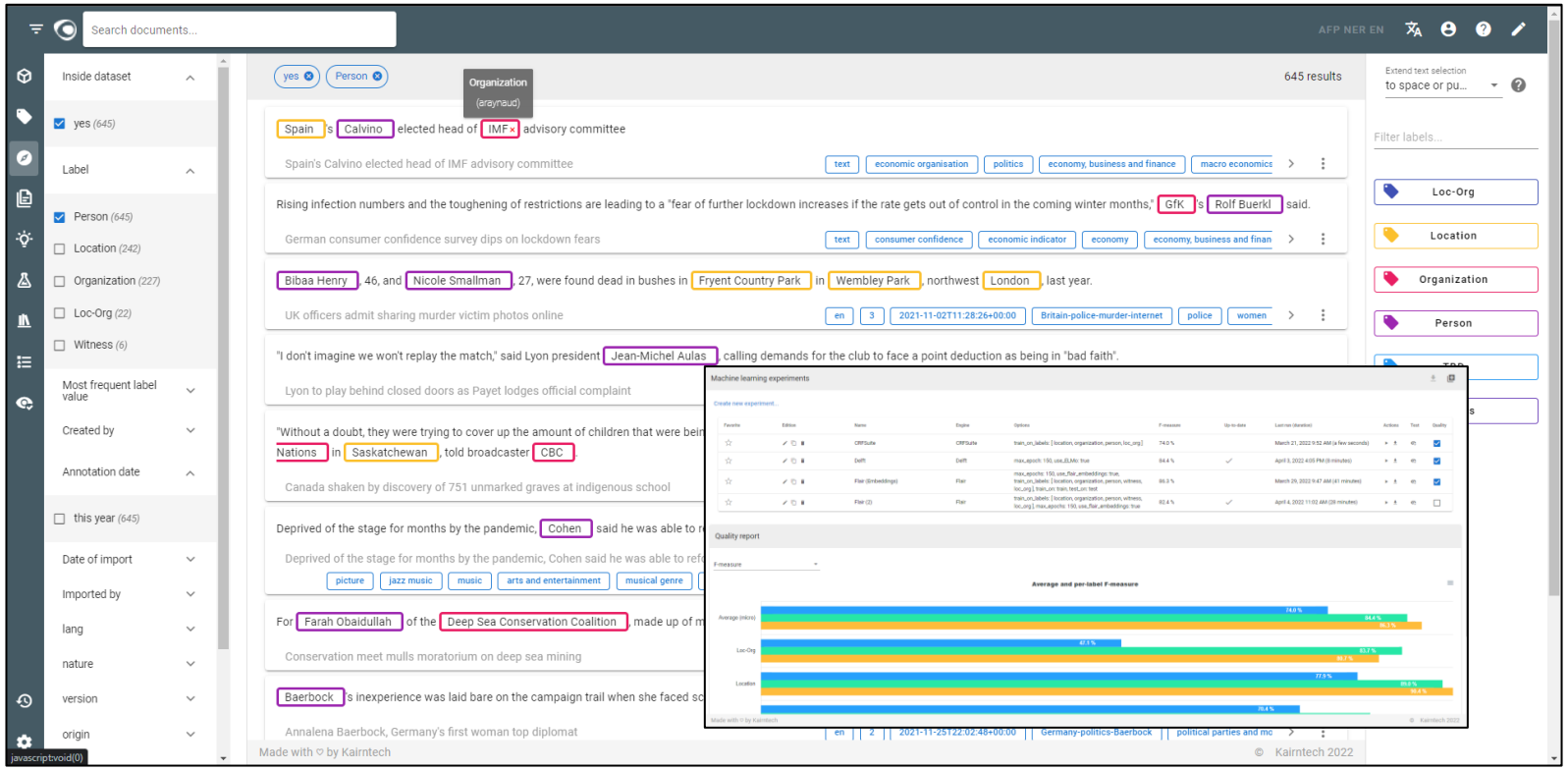
Import documents	Create a training dataset	Create and compare learning models	Create NLP pipelines
TXT, PDF, Word, HTML, XML, JSON…	Explore, label text with manual or assisted **text annotation tools**	Using built-in and state-of-the-art **algorithms**.	Combining **models**, client **taxonomy**, **Knowledge graphs**, technical **components**…

Usage via No-code & easy-to-use web application

or

via RestAPI



Kairntech Server (run the pipeline in production)

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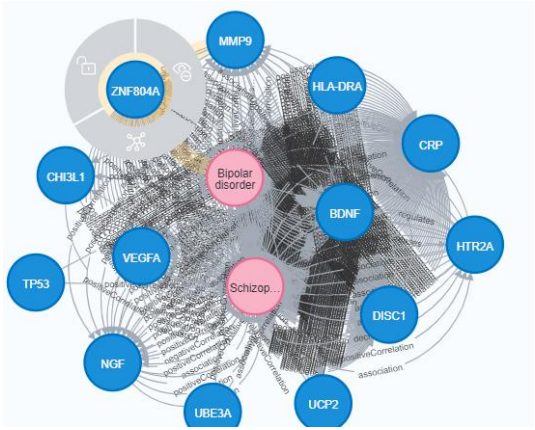


Knowledge applications

REST API

NLP Pipeline for SCAI

Link entities to WikiData taxonomies	Refine entity extraction	Compute add'tl entity properties	Build relations between entities	Format results to output
• Large-scale entity recognition • Multi-topic • Multi-lingual • Constantly updated • Linked to background information	Custom housekeeping to improve recognition quality: Filtering	Proteins receive label about protein modification (ex: phosphorylation)	Apply custom-trained relation extraction model	Return results in BEL format for integration in SCAI Knowledge Graph environment

Entity Linking & Namespaces

Kairntech entity extraction off-the-shelf ready to cover this and many other requirements. Here nothing had to be built for the project.

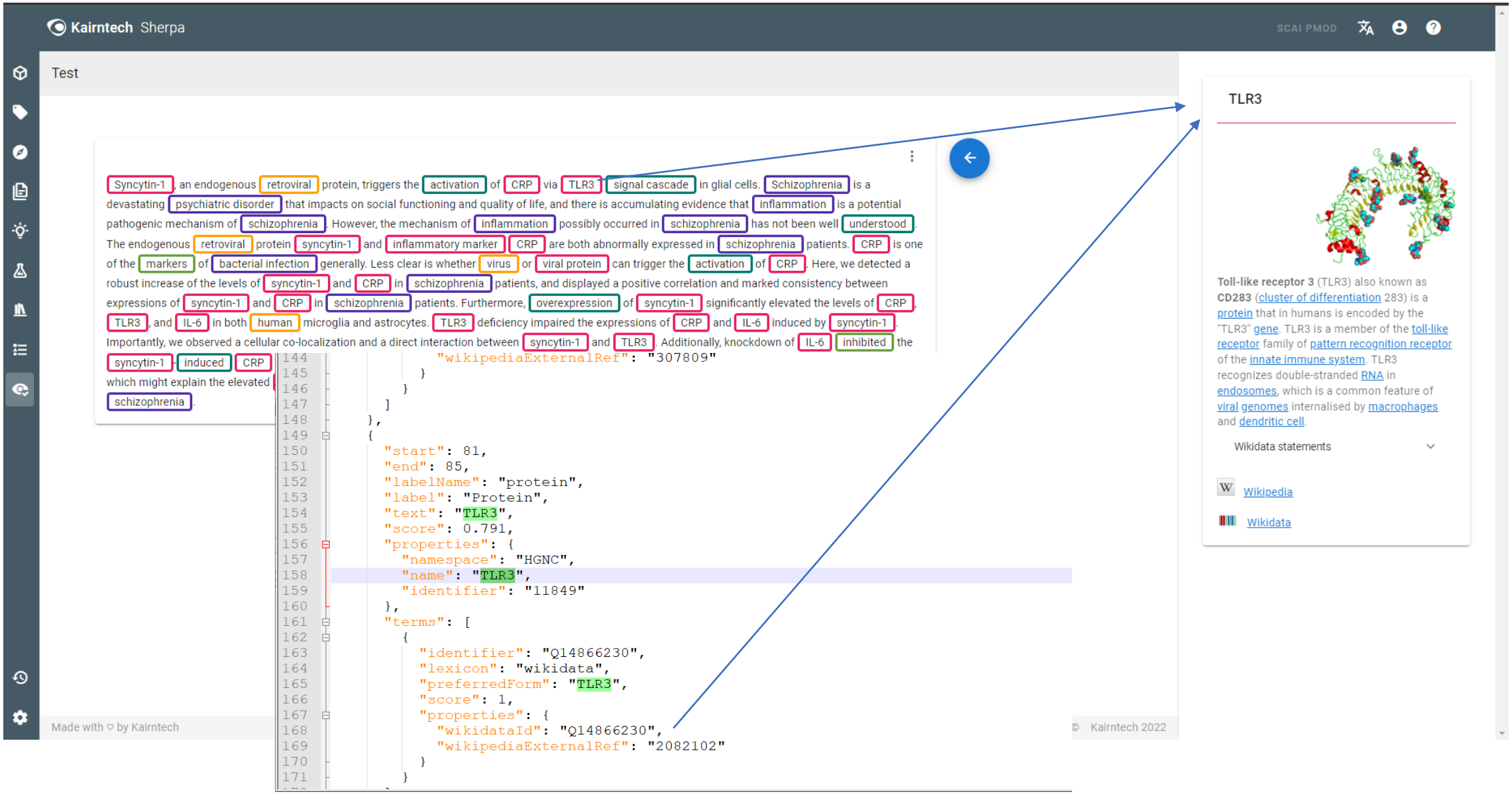
A subset of namespaces is used:

- HGNC for proteins
- MeSH for pathologies
- CheBI for drug/chemical abundances
- GO for biological processes

Recognized entities are

- Disambiguated (“cancer”: animal or disease?)
- Scored (if the concept at the core of a document’s topic or peripheral?)
- Normalized (synonyms → preferred form, ex: “NIDDM” → “Diabetes Mellitus Type 2”
- Linked: Entities are linked to world-knowledge

NLP Pipeline for Entity Recognition & Linking: Example!



Relationship extraction

- Trained on a **training data set** provided by Fraunhofer SCAI
- The table (right) lists the most important relations addressed in the project
- The model determines whether between any pair of entities a relation holds or not (“NoRelation”) and if yes, which one
- Quality decreases with smaller numbers of training examples per relationship type (as expected).
- Manual inspection of (a sample of) the results from Kairntech by SCAI experts: ~73% of the relations returned by Kairntech are valid

RELATION NoRelation

RELATION increases
RELATION decreases
RELATION regulates
RELATION positiveCorrelation
RELATION association
RELATION negativeCorrelation

Complete NLP Pipeline with Relationship Extraction: Example!

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KAIRNTECH Sherpa

Demonstation page

Sherpa URL: https://sherpa-scw.kairntech.com/

Name: demo

Password: ••••••••

Connect

Select project: Scai Pmod

Select annotator: BEL Relations

▼ Built with Streamlit and sherpa-streamlit

Input text to analyze

Syncytin-1, an endogenous retroviral protein, triggers the activation of CRP via TLR3 signal cascade in glial cells. Schizophrenia is a devastating psychiatric disorder that impacts on social functioning and quality of life, and there is accumulating evidence that inflammation is a potential pathogenic mechanism of schizophrenia. However, the mechanism of inflammation possibly occurred in schizophrenia has not been well understood. The endogenous retroviral protein syncytin-1 and inflammatory marker CRP are both abnormally expressed in schizophrenia patients. CRP is one of the markers of bacterial infection generally. Less clear is whether virus or viral protein can trigger the activation of CRP. Here, we detected a robust increase of the levels of syncytin-1 and CRP in schizophrenia patients, and displayed a positive correlation and marked consistency between expressions of syncytin-1 and CRP in schizophrenia patients. Furthermore, overexpression of syncytin-1 significantly elevated the levels of CRP, TLR3, and IL-6 in both human microglia and astrocytes. TLR3 deficiency impaired the expressions of CRP and IL-6 induced by syncytin-1. Importantly, we observed a cellular co-localization and a direct interaction between syncytin-1 and TLR3. Additionally, knockdown of IL-6 inhibited the syncytin-1-induced CRP expression. Thus, the totality of these results showed that viral protein syncytin-1 could trigger the activation of CRP, which might explain the elevated CRP in sterile inflammation and exhibit a novel mechanism for regulation of inflammation by syncytin-1 in schizophrenia.

1603/100000

Process Text

Or upload text/json file to analyze

Drag and drop file here
Limit 200MB per file

Browse files

Process File

Annotation & formatting successful!

Download result

Table

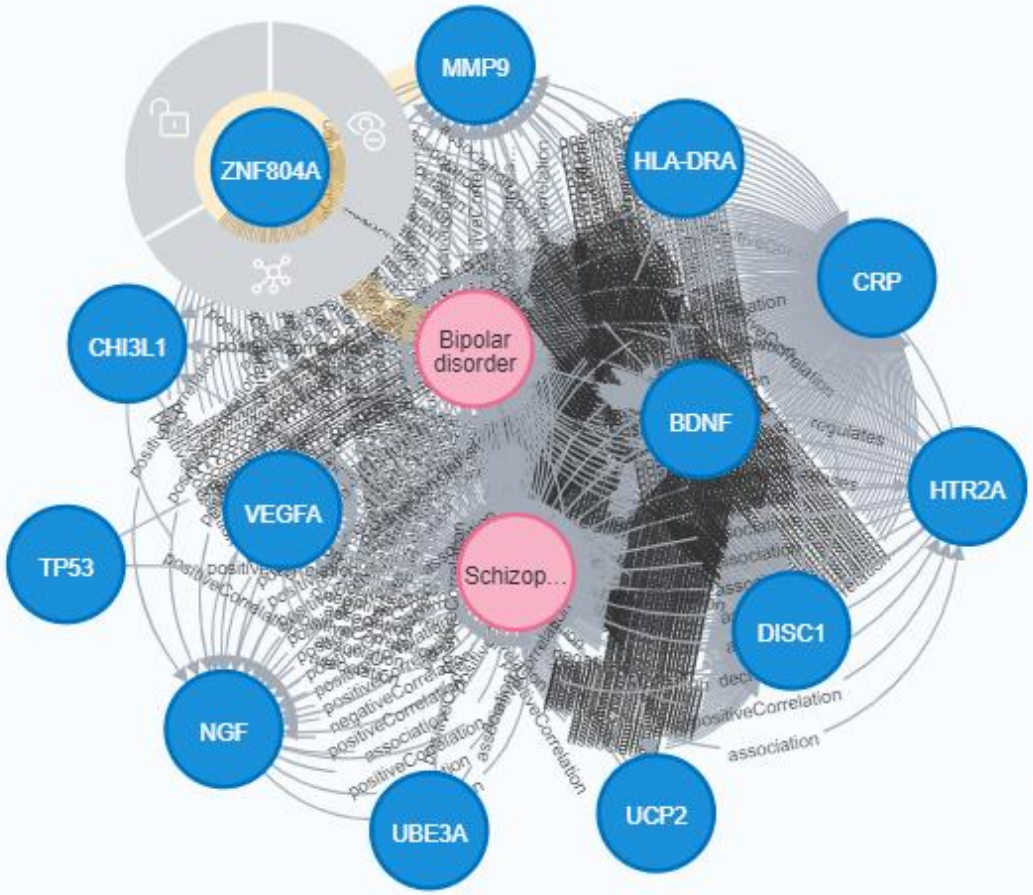
Sheet1

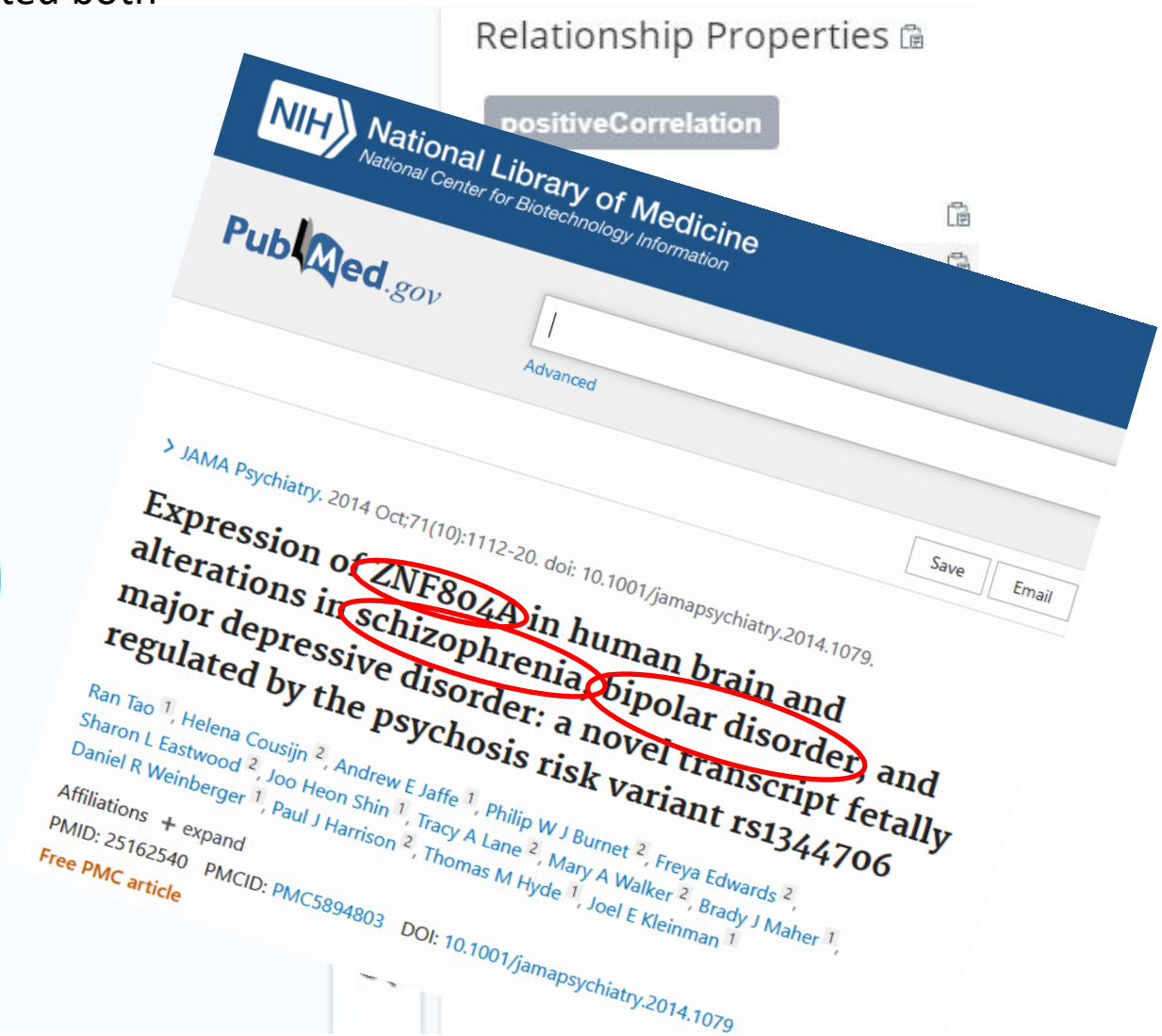
	Subject	Subject.start	Subject.end	Subject.text	Relation	Object	Object.start	Object.end	Object.text	Score	PubMedID	EvidenceSentence	PublicationTitle	Journal
0	p(HGNC:13525 ! ERVW-1)	0	10	Syncytin-1	increases	p(HGNC:2367 ! CRP)	73	76	CRP	0.9514	<NA>	Syncytin-1, an endogenous...	<NA>	<NA>
1	p(HGNC:11849 ! TLR3)	81	85	TLR3	increases	p(HGNC:2367 ! CRP)	73	76	CRP	0.8791	<NA>	Syncytin-1, an endogenous...	<NA>	<NA>
2	path(MESHD:D012559 ! sch...	106	119	schizophrenia	positiveCorrelation	p(HGNC:13525 ! ERVW-1)	34	44	syncytin-1	0.8251	<NA>	The endogenous retroviral ...	<NA>	<NA>
3	path(MESHD:D012559 ! sch...	106	119	schizophrenia	positiveCorrelation	p(HGNC:2367 ! CRP)	69	72	CRP	0.8706	<NA>	The endogenous retroviral ...	<NA>	<NA>
4	path(MESHD:D012559 ! sch...	75	88	schizophrenia	positiveCorrelation	p(HGNC:13525 ! ERVW-1)	53	63	syncytin-1	0.9507	<NA>	Here, we detected a robust ...	<NA>	<NA>
5	p(HGNC:6018 ! IL6)	27	31	IL-6	increases	p(HGNC:2367 ! CRP)	65	68	CRP	0.9419	<NA>	Additionally, knockdown o...	<NA>	<NA>
6	p(HGNC:13525 ! ERVW-1)	46	56	syncytin-1	increases	p(HGNC:2367 ! CRP)	65	68	CRP	0.9454	<NA>	Additionally, knockdown o...	<NA>	<NA>
7	p(HGNC:13525 ! ERVW-1)	62	72	syncytin-1	increases	p(HGNC:2367 ! CRP)	105	108	CRP	0.9561	<NA>	Thus, the totality of these r...	<NA>	<NA>
8	p(HGNC:13525 ! ERVW-1)	62	72	syncytin-1	increases	p(HGNC:2367 ! CRP)	143	146	CRP	0.9534	<NA>	Thus, the totality of these r...	<NA>	<NA>

Thus, the totality of these results showed that viral protein syncytin-1 could trigger the activation of CRP, which might explain the elevated CRP in sterile inflammation and exhibit a novel mechanism for regulation of inflammation by syncytin-1 in schizophrenia.

Results displayed as a Knowledge Graph: Example!

"Which proteins are known to be positively correlated both with Schizophrenia as well as Bipolar Disorders?"





Ongoing work

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- Speed up the analysis by parallelizing the process: Make use of SCAI's high performance computing cluster, leverage SCAI expertise in parallelizing complex software processes
- Investigate extension to other therapeutic areas
- Define joint approach & offering for industry use cases on
  - computing topic specific knowledge graphs
  - Updating/extending knowledge graphs
- Expand approach to cover large chunks (all?) of Medline?

Conclusion / findings

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- Kairntech off-the-shelf entity extraction performs well even in this highly specific subdomain
- Kairntech notion of processing pipelines allows to define sophisticated processing chains (here: entity recognition, application of specific custom model (ModType), relation extraction, output encoding into BEL syntax)
- Relation results assessed and declared useful by SCAI experts after detailed manual analysis
- Relation extraction from large literature corpus to feed Knowledge Graphs is feasible