

**START OF THE WORKSHOP: Wednesday 27 May, 2:00 pm**

## **1 Introductory talks**

1. Standard Model problems and FIPs from theoretical viewpoint (naturalness, etc);  
proposed speaker: *Raman Sundrum\**,  
*Raman answered on 28/12 he still does not know whether he can come, I (=Gaia) told him we can wait, he will let us know by February 7th at latest.*  
possible other speakers: *Gilad Perez, Jonathan Feng, Christophe Grojean, Neal Weiner*  
**time: 25'+5'**
2. What can we learn for particle physics from DM cosmological observations?  
proposed speaker: *Alexey Boyarsky*,  
**time: 25'+5'**
3. Theory overview of DM models.  
proposed speaker: *Yonit Hochberg\**  
If Yonit cannot make it, ask to *Simon Knapen*  
possible replacements: *Tim Tait, Yoni Kahn, Geraldine Servant, Tongyan Lin, Kai Schmidt-Hoberg*  
**time: 25'+5'**
4. Status and prospects of DM direct detection experiments in the low (< 10 GeV) mass range  
proposed speakers: *Susana Cebrian (Zaragoza)*  
**time: 25'+5'**  
**COFFEE BREAK: 20', 4:00 - 4:30 pm**
5. Search for FIPs at collider-based experiments (overview)  
proposed speaker: *Heather Russell (ATLAS)*  
**time: 25' + 5'**
6. Search for FIPs with experiments at extracted beams (beam dump, fixed target) (overview)  
proposed speaker: *Bertrand Echenard (CALTECH)*  
**time: 25'+5'**
7. Search for very low mass FIPs (atomic physics, quantum technologies, etc.).  
proposed speaker: *Peter Graham\**,  
if Peter cannot make it, Albert will look for another good name in that community.  
other possible speakers: *Surjeet Rajendran, Kathryn Zurek*  
**time: 25'+5'**

# First Day - afternoon Introductory Talks

**WELCOME DRINK**

**SECOND DAY: Thursday 28 May, morning session: 9-12:30 pm**

## **2 Feebly-interacting Heavy Neutral Leptons (Fermion portal)**

1. Theoretical introduction to seesaw models and their connection to leptogenesis (thermal, resonant and via neutrino oscillations), including 3-4 slides about phenomenology of HNL production/decays.  
proposed speaker: *Marco Drewes ?*  
other speakers: Belen Gavela, Enrique Fernandez-Martinez  
**time: 25+5**
2. HNLs and their relation to astroparticle and cosmology (3.5 keV line, BBN, measurement of the absolute neutrino masses (KATRIN, Euclid, etc.).  
proposed speaker: *Oleg Ruchayskiy*  
**time: 20+5**
3. HNLs and their relation (or non-relation) to active neutrino physics (PMNS,  $\delta_{CP}$ ,  $0\nu\beta\beta$  decay,  $m(\text{highest neutrino}), \dots$ );  
proposed speaker: *Jacobo Lopez-Pavon*  
**time: 20+5**

### **COFFEE BREAK**

4. Search for HNLs at extracted beams (neutrino experiments (T2K), NA62-kaon and dump, prospects for DUNE);  
proposed speaker: *Alexandre Izmaylov*  
**time: 20+5**
5. Search for HNLs at LHCb, ATLAS, CMS  
proposed speaker: *Lesya Shchutka (must be careful with speakers' committees..)* .  
**time: 20+5**
6. Prospects to search for HNLs with SHiP, MATHUSLA, FASER, and CODEX-b  
proposed speaker: *Nicola Serra*.  
**time: 20+5**
7. Prospects to search for HNLs at future  $ee/ep/pp$  colliders  
proposed speaker: *Oliver Fischer*  
**time: 20+5**

**LUNCH**

# Second Day - morning Heavy Neutral Leptons

**SECOND DAY: Thursday 28 May, afternoon session: 2-5:30 pm**

**3 Feebly-interacting Vector particles at large (not only kinetic mixing) (Vector portal)**

1. Early cosmology (BBN, re-ionisation, 21 cm) constraints on new (feebly-interacting) physics (covering vector, scalar, pseudo-scalar portals)  
proposed speaker: **Maxim Pospelov**.  
time: 25'+5'
2. Search for LDM and vector mediators at accelerator-based experiments in US (HPS, BDX, Mini-Boone, LDMX);  
proposed speaker: **Timothy Nelson**  
time: 25+5'
3. Search for LDM and Vector/ALPs mediators at experiments at extracted beam lines (NA64, NA62, MESA) (mass range typically covered:  $< 1$  GeV).  
proposed speaker: **Sergei Gninenko**  
time: 20+5'
4. Search for LDM and vector mediators at B-factories (Belle-II, including BaBar and Belle results)  
proposed speaker: **Christopher Hearty**  
time: 20+5'

**COFFEE BREAK**

5. Search for LDM and vector mediators at LHCb, ATLAS and CMS;  
proposed speaker: **Philip Ilten**  
time: 20+5'
6. Search for LDM and vector mediators at FASER, CODEX-b, SHiP, MATHUSLA  
proposed speaker: **Felix Kling\*** (FASER).  
time: 20+5'

**SOCIAL DINNER: evening**

**Second Day - afternoon**  
- Early cosmology constraints on FIPs (Pospelov)  
- Exp sensitivities to Vector Portal

Friday, 29 May, MORNING SESSION: 9-12:30

#### 4 Feebly-interacting pseudo-scalar particles at large (axions/ALPs)

1. Status of stellar and astrophysics constraints on new (feebly-interacting) physics (covering vector, scalar, pseudo-scalar portals)  
proposed speaker: **Georg Raffelt, Javier Redondo** → **declined**;  
contacted: *Maurizio Giannotti\**  
*other possible names: A. Mirizzi*  
**time: 25'+5'**
2. Axions/ALPs as DM and/or light DM mediators: phenomenology  
proposed speaker: *Anson Hook* → *declined*  
possible replacement: *Andreas Ringwald*  
**time: 25+5**
3. Axions/ALPs as DM and/or light DM mediators: overview of experimental approaches in the low mass range.  
proposed speaker: **Igor Irastorza**  
**time: 25+5**  
  
**COFFEE BREAK: 30'**
4. axions/ALPs phenomenology at accelerator-based experiments  
proposed names: **Felix Kahlhoefer ?**  
*Kai Schmidt-Hoberg? Lucian Harland-Lang*  
**time: 25+5**
5. Search for axions/ALPs at the LHC (ATLAS, CMS, LHCb): mass range > 10 GeV.  
proposed names: **David D'Enterria (CMS)**  
**time: 20+5**
6. (to be discussed) Relaxion phenomenology and its connection to DM  
proposed speaker: *Gilad Perez ?*  
**time: 25+5**

LUNCH TIME

## Third Day - morning

- Stellar and astrophysics constraints on FIPs
- axions/ALPs phenomenology and experimental results.

Friday, 29 May, AFTERNOON SESSION: 2-4:30 pm

## 5 Feebly-interacting Scalar Particles at large (Scalar portal)

1. Scalar portal and its connection to Higgs physics from a theory viewpoint  
proposed speakers: **Stefania Gori**  
time: 25+5
2. Experimental constraints on the exotic Higgs width  
proposed speakers: **Maria Cepeda (CMS)**  
time: 20+5
3. Direct searches for feebly-interacting dark scalars at the central detectors of the LHC: status and prospects.  
proposed speaker: **Chris Hays (ATLAS)**  
time: 20+5
4. Cosmology and particle phenomenology of feebly interacting scalars  
proposed speaker: **Fedor Bezrukov**.  
time: 25+5
5. Search for light feebly-interacting scalar particles at extracted beam lines (SeaQuest @ FNAL, NA62, SHiP,...)  
proposed speaker: **Joel Swallow\* (NA62)**.  
time: 20+5
6. Prospects to search for light feebly-interacting scalar particles at MATHUSLA, CODEX-b, SHiP  
proposed speaker: **David Curtin\*, MATHUSLA**  
*he might have a constraint but he wants to come, he will let us know.*  
time: 20+5

COFFEE and END OF THE WORKSHOP: 5:00 pm.

# Third Day - afternoon Scalar portal

27-29 May 2020  
CERN  
Europe/Zurich timezone

**Overview**

- Timetable
- Registration
- Participant List
- Access to the site and other Practical information
- Accommodation
- Vidyo connection procedure
- Contact**

neutrino.secretariat@cer...

Feebly Interacting Particles (FIPs) are any new physics with coupling  $\ll 1$ .

With the establishment and maturation of the experimental programs searching for strongly-coupled physics at the LHC, there is an increasing interest in the broader particle and astrophysics community for feebly-interacting particles as a paradigm complementary to the strongly interacting sector at the TeV (or beyond) scale.

There are a multitude of initiatives that reflect the profound interest into this emerging field, including the [LHC Long-Lived Particle Community workshops and white paper](#), the [Physics Beyond Colliders initiative at CERN](#), recent studies for present and future neutrino experiments, and the recently published [Briefing Book of the European Strategy](#) update.

As a result, the time is ideal to hold a workshop fully dedicated to FIPs.

The main goal of the workshop will be to bring together experts from collider, beam dump, fixed target, astrophysics, axions/ALPs searches; current/future neutrino experiments; and dark matter direct and indirect detection communities to discuss progress in experimental searches and underlying theory models and to enhance the exchange and cross-fertilization across different fields.

The agenda will take shape over the coming months, but the following topics will be addressed:

- Standard Model problems and FIPs from theoretical perspectives
- Dark matter: what we know about it from a cosmological viewpoint, overview of models, status and prospects of collider, direct, and indirect detection experiments
- Experimental techniques for searching for FIPs at accelerator-based experiments.
- Very low-mass ( $< 100$  eV) FIPs
- Stellar, astrophysical, and cosmological constraints on FIPs
- Heavy neutral leptons and their relationships to leptogenesis, astrophysics, cosmology, SM neutrino physics.
- Light dark matter and corresponding mediators, including axions/ALPs: phenomenology, searches at accelerator-based experiments, helioscopes, haloscopes, relationship to astrophysics and cosmology.

More information will be forthcoming very soon, but please save the date and start planning your visit now.

A question:  
Do we want Vidyo ?

FIPs 2020 Website:  
<https://indico.cern.ch/event/864648/>

Please register !



# Timetable on the web site

## Timetable

Wed 27/05 Thu 28/05 Fri 29/05 All days

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Introductory Talks

### Wednesday 27 May

14:00	SM problems and FIPs from theoretical viewpoints	CERN	14:00 - 14:30
	What can we learn for particle physics from DM cosmological observations?	Alexey Bolarskiy	14:30 - 15:00
15:00	Theory overview of DM models	CERN	15:00 - 15:30
	Status and prospects of DM direct detection experiments in the low (< 10 GeV) mass region	Susana Cebrian	15:30 - 16:00
16:00	Coffee break	CERN	16:00 - 16:30
	Search for FIPs at collider based experiments (overview)	CERN	16:30 - 17:00
17:00	Search for FIPs with experiments at extracted beams (overview)	Bertrand Echenard	17:00 - 17:30
	Search for very low mass FIPs (atomic physics, quantum technology)	CERN	17:30 - 18:00

WELCOME DRINK

Wed 27/05 Thu 28/05 Fri 29/05 All days

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Feebly interacting vector... Fermion portal

### Thursday 28 May

09:00	Theoretical introduction to seesaw models and their connection to leptogenesis	CERN	09:00 - 09:30
	HNLs and their relation to astroparticle and cosmology (3.5 keV line, BBN, measurement of the absolute neutrino masses (KATRIN, Euclid, etc.))	Prof. Oleg Ruchayskiy	
10:00	HNLs and their relation (or non-relation) to active neutrino physics (PMNS, $\delta CP$ , $0 \nu\beta\beta$ decay, m(highest neutrino)...) coffee break	Jacobo Lopez Pavon	10:20 - 10:40
	Search for HNLs at extracted beams (neutrino experiments (T2K), NA62-kaon and dump, prospects for DUNE)	Alexander Izmaylov	
11:00	Search for HNLs at LHCb, ATLAS, CMS	Lesya Shchutska	11:05 - 11:30
	Prospects Search for HNLs with SHIP, MATHUSLA, FASER, and CODEX-b	Nicola Serra	11:30 - 11:55
12:00	Prospects to search for HNLs at future ee/ep/pp colliders	Oliver Fischer	11:55 - 12:20

LUNCH

14:00	Early cosmology (BBN, re-ionisation, 21 cm) constraints on new (feebly-interacting) physics (covering vector, scalar, pseudo-scalar portals)	Maxim Pospelov	
	Search for LDM and vector mediators at accelerator-based experiments in US (HPS, BDX, Mini-Boone, LDMX)	Timothy Knight Nelson	
15:00	Search for LDM and Vector/ALPs mediators at experiments at extracted beam lines (NA64, NA62, MESA) (mass range typically covered: < 1 GeV)	Sergei Gninenko	
	Search for LDM and vector mediators at B-factories (Belle-II, including BaBar and Belle results)	Prof. Christopher Hearty	15:25 - 15:50
16:00	coffee break	CERN	15:50 - 16:10
	Search for LDM and vector mediators at LHCb, ATLAS and CMS	Philip Ilten	16:10 - 16:35
	Search for LDM and vector mediators at FASER, CODEX-b, SHIP, MATHUSLA	CERN	16:35 - 17:00

SOCIAL DINNER

Wed 27/05 Thu 28/05 Fri 29/05 All days

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Feebly-interacting pseud... Feebly-interacting scalar...

### Friday 29 May

09:00	Status of stellar and astrophysics constraints on new (feebly-interacting) physics (covering vector, scalar, pseudo-scalar portals)		
	Axions/ALPs as DM and/or light DM mediators: phenomenology	CERN	09:30 - 10:00
10:00	Axions/ALPs as DM and/or light DM mediators: overview of experimental approaches in the low mass range	CERN	10:00 - 10:30
	coffee break	CERN	10:30 - 10:50
11:00	axions/ALPs phenomenology at accelerator-based experiments	Felix Kahlhoefer	10:50 - 11:20
	Search for axions/ALPs at the LHC (ATLAS, CMS, LHCb): mass range > 10 GeV	CERN	11:20 - 11:45
12:00	Relaxion phenomenology and its connection to DM	CERN	11:45 - 12:10

LUNCH

14:00	Scalar portal and its connection to Higgs physics from a theory viewpoint	Stefania Gori	14:00 - 14:30
	Experimental constraints on the exotic Higgs width	CERN	14:30 - 14:55
15:00	Direct searches for feebly-interacting dark scalars at the central detectors of the LHC: status and prospects	CERN	14:55 - 15:20
	Cosmology and particle phenomenology of feebly interacting scalars	Fedor Bezrukov	15:20 - 15:50
16:00	coffee break	CERN	15:50 - 16:10
	Search for light feebly-interacting scalar particles at extracted beam lines (SeaQuest @ FNAL, NA62, SHIP,...)	CERN	16:10 - 16:30
	Prospects to search for light feebly-interacting scalar particles at MATHUSLA, CODEX-b, SHIP	CERN	16:30 - 16:55

# FIPs 2020

Workshop on  
Feebly-Interacting  
Particles

27-29 May 2020  
CERN

FIPs at colliders (including  
ATLAS, CMS, LHCb)

extracted beams

neutrino near detectors

direct and indirect dark  
matter detection

axion/ALP experiments

and beyond

Organizers:

Martin Bauer  
James Beacham  
Albert De Roeck  
Gian Giudice  
Pilar Hernandez  
Igor Trastorza  
Joerg Jaeckel  
Gordan Krnjaic  
Gaia Lanfranchi  
Jocelyn Monroe  
Silvia Pascoli  
Joshua Ruderman  
Philip Schuster  
Mikhail Shaposhnikov  
Jessie Shelton

[indico.cern.ch/e/FIPs\\_May\\_2020](https://indico.cern.ch/e/FIPs_May_2020)



## FIPs 2020 poster:

Plan is to print o(20) posters at CERN  
for local use (CERN and nearby Universities & labs)  
and then attach the poster to the Indico page  
so people can download it and print at home.

Please send me comments about the poster  
by January 15<sup>th</sup>. After that date we will print it.



# What's left ?

## We are there.

- people responded to the invitations very positively and the agenda grew up quickly
- only a few names to be fixed yet.

## Now we have to advertise the event !

- Please do it in your home institutions and communities.
- I will do with the PBC and SHiP,NA62, and LHCb collaborations.
- James already did with the LLP@LHC community
- Albert can do it with the neutrino platform
- .....

# Tentative draft email for advertising FIPs 2020 (optional)

Dear Colleagues,

It is our pleasure to announce the first workshop fully dedicated to feebly-interacting particles, FIPs 2020, which will take place at CERN from May 27 to May 29, 2020:

<https://indico.cern.ch/event/864648/overview>

With the establishment and maturation of the experimental programs searching for strongly-coupled physics at the LHC, there is an increasing interest in the broader particle and astrophysics community for feebly-interacting particles as a paradigm complementary to the strongly interacting sector at the TeV (or beyond) scale.

There are a multitude of initiatives that reflect the profound interest into this emerging field, including the [LHC Long-Lived Particle Community workshops and white paper](#), the [Physics Beyond Colliders initiative at CERN](#), recent studies for present and future neutrino experiments, and the recently published [Briefing Book of the European Strategy](#) update.

The main goal of the workshop will be to bring together experts from collider, beam dump, fixed target, astrophysics, axions/ALPs searches; current/future neutrino experiments; and dark matter direct and indirect detection communities to discuss progress in experimental searches and underlying theory models and to enhance the exchange and cross-fertilization across different fields.

We look forward to welcoming you at CERN for FIPs 2020.

The Organizing Committee

Martin Bauer, James Beacham, Albert De Roeck, Gian Francesco Giudice, Pilar Hernandez, Igor Irastorza, Joerg Jaeckel, Gordan Krnjaic, Gaia Lanfranchi, Jocelyn Monroe, Silvia Pascoli, Joshua Ruderman, Philip Schuster, Mikhail Shaposhnikov, Jessie Shelton.

Text available at the following link:

[https://docs.google.com/document/d/1qInHkAkYoXuKYH-cSyg-W2qtQcXHNN\\_\\_pbVDbDiRJeE/edit](https://docs.google.com/document/d/1qInHkAkYoXuKYH-cSyg-W2qtQcXHNN__pbVDbDiRJeE/edit)