Primordial Black Holes from Cosmic Inflation

International Emerging Action
2020-2021

Kickoff workshop, 18-19 May 2020

International Emerging Action

- CNRS funded

- Goal: initiate and strengthen collaborative work between two groups of researchers, one in France and one abroad

Paris

PI: Vincent Vennin

Jacopo Fumagalli
Julien Grain
Sebastien Renaux-Pétel
Lucas Pinol
Lukas Witkowski

+

Hassan Firouzjahi
Madiyar Noorbala
Nahid Ahmadi
Mohsen Khodadi
Alierza Talebian
(IPM Tehran)

+

Emmanuel Frion
Tays Miranda
(UFES Vitoria)

Portsmouth

PI: David Wands

Guilherme Brando
Matteo Fasiello
Laura Iacconi
Kazuya Koyama
Chris Pattison

Topic:
PBHs, Stochastic Inflation

- Multiple Fields (e.g. hybrid inflation, curved field space, geometrical destabilisation etc)

- Non slow roll models, ultra slow roll

- Non Gaussianities

- Preheating instability

- Contracting cosmologies

- GW signatures

- etc…

Budget

Total: 17.5 k€	2020	2021
CNRS “missions”	3.75 k€	3.75 k€
CNRS small conference		6 k€
ICG mission	2 k€	2 k€

We need to reconsider.

CNRS refused to shift the time window —> 2021,2022

Instead of short meetings, fund a few long stay visits (mostly of PhD students / postdocs)?

Still try to organise a small conference around summer 2021?

Any idea welcome!

Kickoff meeting

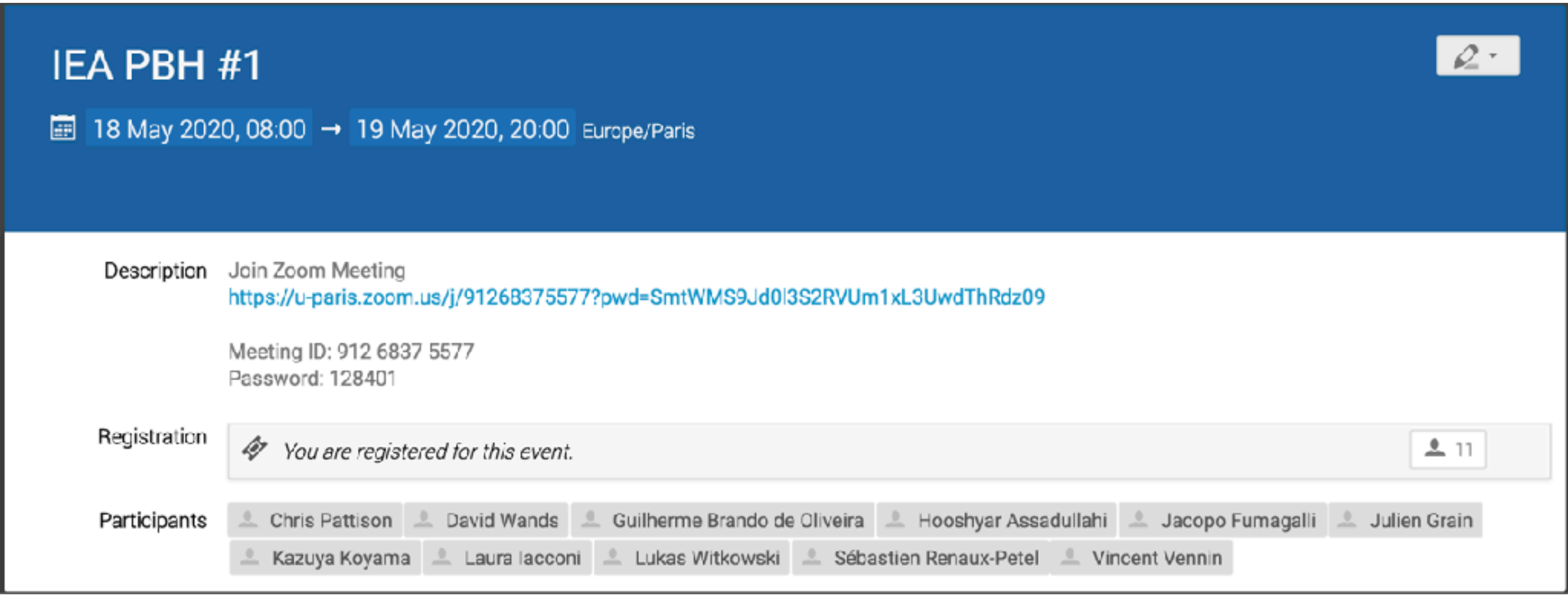
- Introduce ourselves (not enough time for everyone to give a talk, will need to organise a second workshop after the summer!)

- Bring everyone on the same page

- Identify several topics of common interest / projects we could start working on. Share open questions, unsolved problems

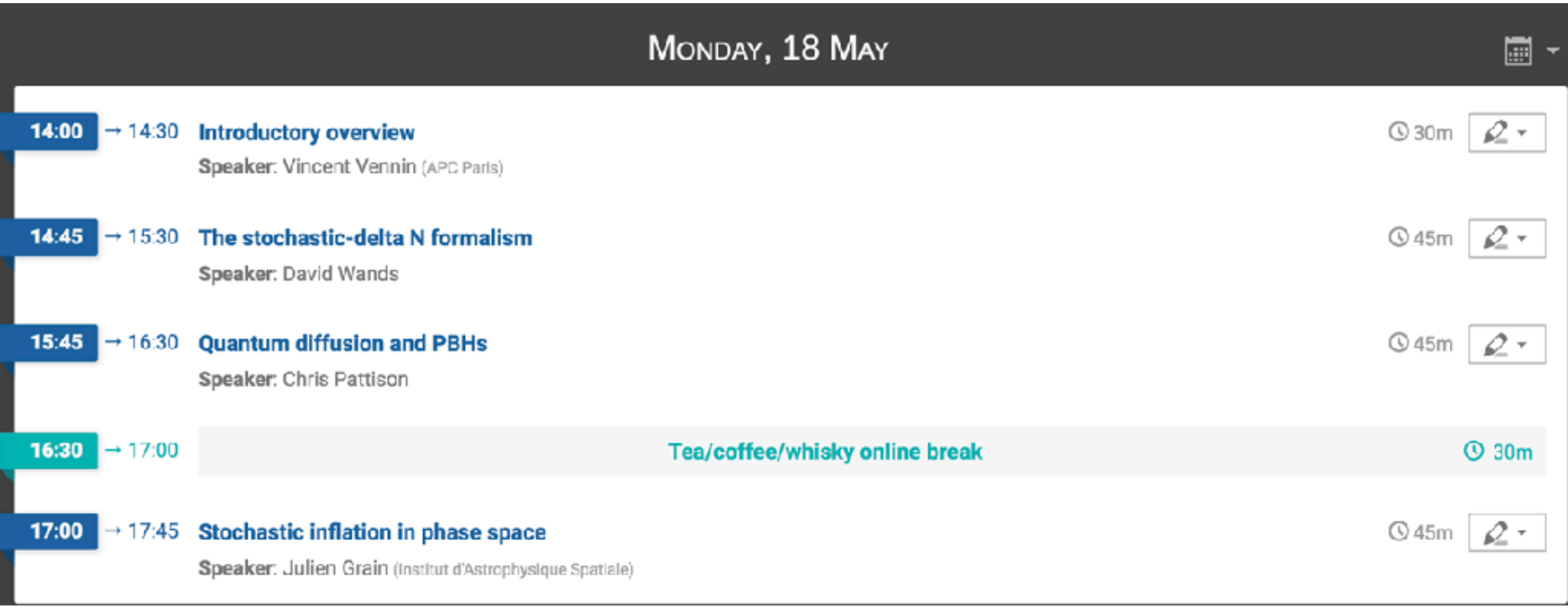
- Break into overlapping smaller working groups and start working on those!

Kickoff meeting



Please register!

Kickoff meeting



Kickoff meeting

Tuesday, 19 May

14:00 → 15:00 **APC theory talk: General relativistic weak-field limit and Newtonian N-body simulations** 1h

Abstract: Future galaxy surveys such as Euclid, LSST and SKA will cover larger and larger scales where general relativistic effects become important. On the other hand, our study of large scale structure still relies on Newtonian N-body simulations. I show how standard Newtonian N-body simulations can be interpreted in terms of the weak-field limit of general relativity. Our framework allows the inclusion of radiation perturbations and the non-linear evolution of matter. I show how to construct the weak-field metric by combining Newtonian simulations with results from Einstein-Boltzmann codes. I discuss observational effects on weak lensing and ray tracing, identifying important relativistic corrections. Finally, I briefly discuss recent developments of GR simulations in cosmology.

Speaker: Kazuya Koyama

15:15 → 16:00 **Turning in the landscape: a new mechanism for generating Primordial Black Holes** 45m

Speaker: Jacopo Fumagalli feat Lukas Witkowski (IAP)

16:00 → 16:30 **Tea/coffee/whisky online break** 30m

16:30 → 17:15 **PBHs from the preheating instability** 45m

Speaker: Lucas Pinol (Institut d'Astrophysique de Paris)

17:15 → 18:15 **Concluding discussions** 1h

Questions

- From David's slides:

further work:

- stochastic δN in alternative PBH models
  - transient non-slow-roll backgrounds, e.g., inflection point inflation (e.g., Garcia-Bellido & Ruiz, Germani & Prokopec, Motohashi & Hu 2017)
- explore nature of non-Gaussianity beyond leading order (classical) δN
  - corrections to tail of distribution even close to classical limit?
  - understand consistency of non-Gaussian pdf with absence of correlation between large and small physical scales in single-clock inflation (e.g., Pajer, Schmidt & Zaldarriaga 2013)

Questions

- From Julien's slides:

Next steps

- Application to U.S.R. and bounce
  - → Gauge-corrections in the momentum direction
  - → Phase-space alignments of the noise
  - → Stochastic anisotropies for « contracton » field

- Test fields to explore stochastic contraction
  - → Noise alignment in the absence of attractor ?
  - → Non-Bunch-Davies vacuum states ?
  - → Scale of « classicality » vs. horizon scale

- Role of anisotropic modes ; formal aspects
  - → Gauge-fixing in separate universe vs. cosmo. pert.
  - → Is flat FLRW the right separate universe ?
    - Bianchi I to capture the anisotropic modes
    - Close/open FLRW to capture bits on inhomogeneities

Questions

- Separate universe and the gauge issue in contracting cosmologies
- Stochastic inflation for fields with non canonical kinetic terms (non-Gaussian noises? etc)
- Stochastic effects in the tensor sector
- Stochastic effects with semi heavy fields (cosmological collider program)
- How realistic are the boundary conditions in the ultra-slow-roll toy models? (USR really ends at a fixed field value?)
- Delta N formalism and stochastic inflation in anisotropic background

Questions

- Stochastic GW background in scenarios with sharp turns in field space

- Non-Gaussianities in the form of scale correlations for PBHs? In stochastic delta N? N-point correlation functions in real space in stochastic delta N?