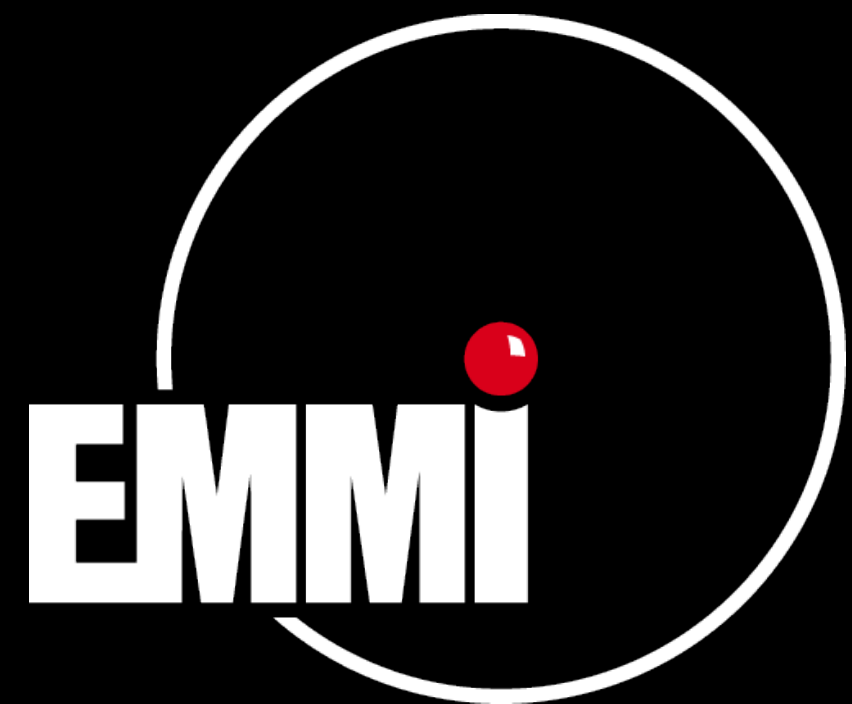
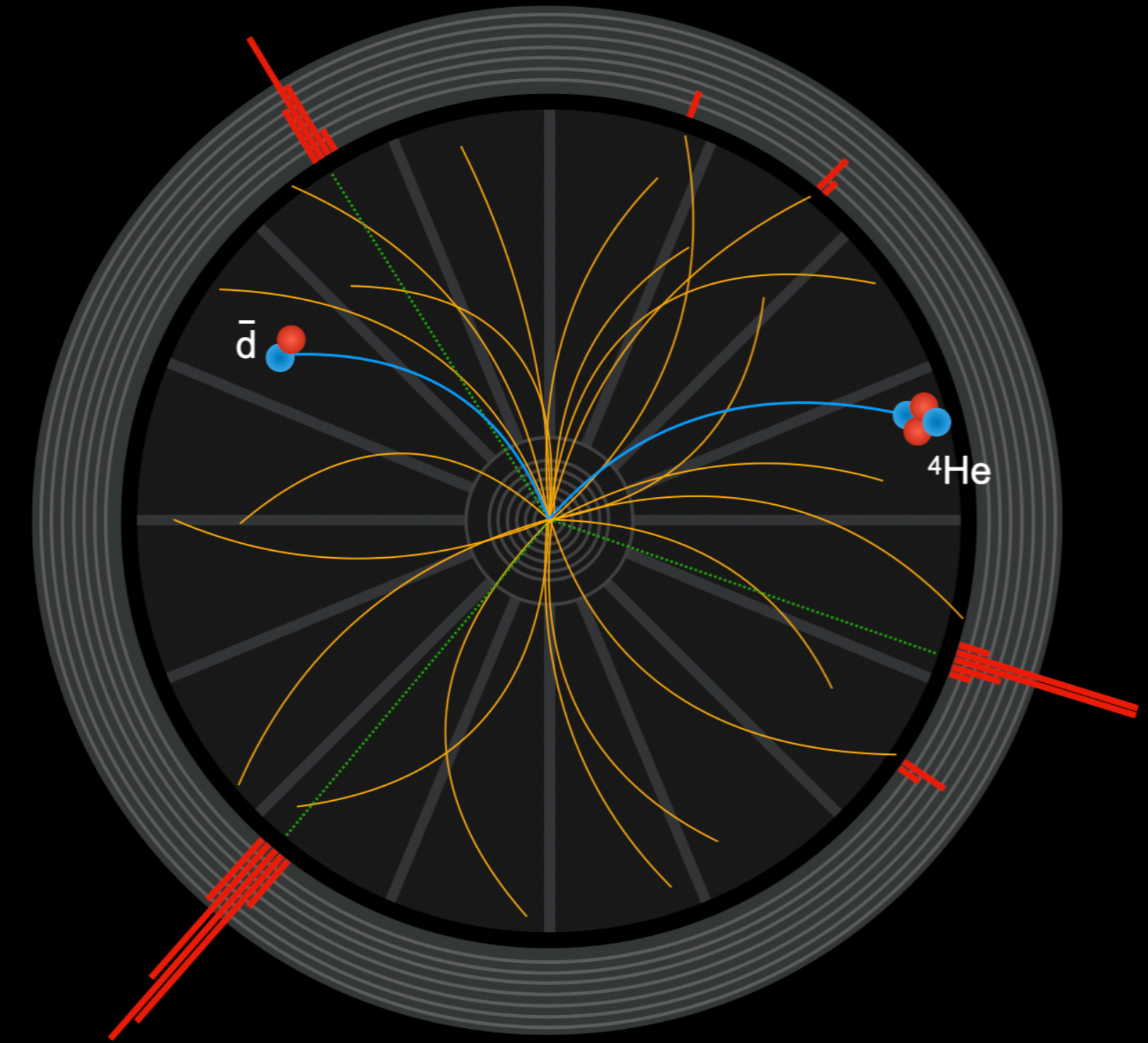


# Rapid Reaction Task Force on

## *Understanding the production of light (anti)nuclei at RHIC and LHC*

8 – 12 April, 2024

Organizers: A. Caliva, H. Elfner, J. Schukraft, K. Blum



Program of the week  
and general information



# Goals of this meeting

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1. Carefully review all available models that describe the production of (anti)nuclei and critically assess their strength and limitations

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- How to calculate the wave function of nuclei?
- How to treat quantum-mechanical effects of interactions in the kinetic approaches?

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- How to deal with unknown hadron states in SHM?
- How to calculate the wave function of nuclei?
- How to treat quantum-mechanical effects of interactions in the kinetic approaches?

2. Discuss in detail and with constructive approach the main open problems and try to reach a consensus on most of them

- is 4-momentum conservation really violated in the coalescence approach?
- is the (anti)nuclei formation time really  $\tau > \hbar/(2E_b)$ ? Does this affect applicability of kinetic approaches?
- are nuclei produced as compact multi-quark systems?
- does 2-body coalescence of hypertriton make sense?

# Available rooms for working sessions

## Wednesday 10 April

KBW 5.29 - whole day  
KBW 5.32 - until 13:00

## Thursday 11 April

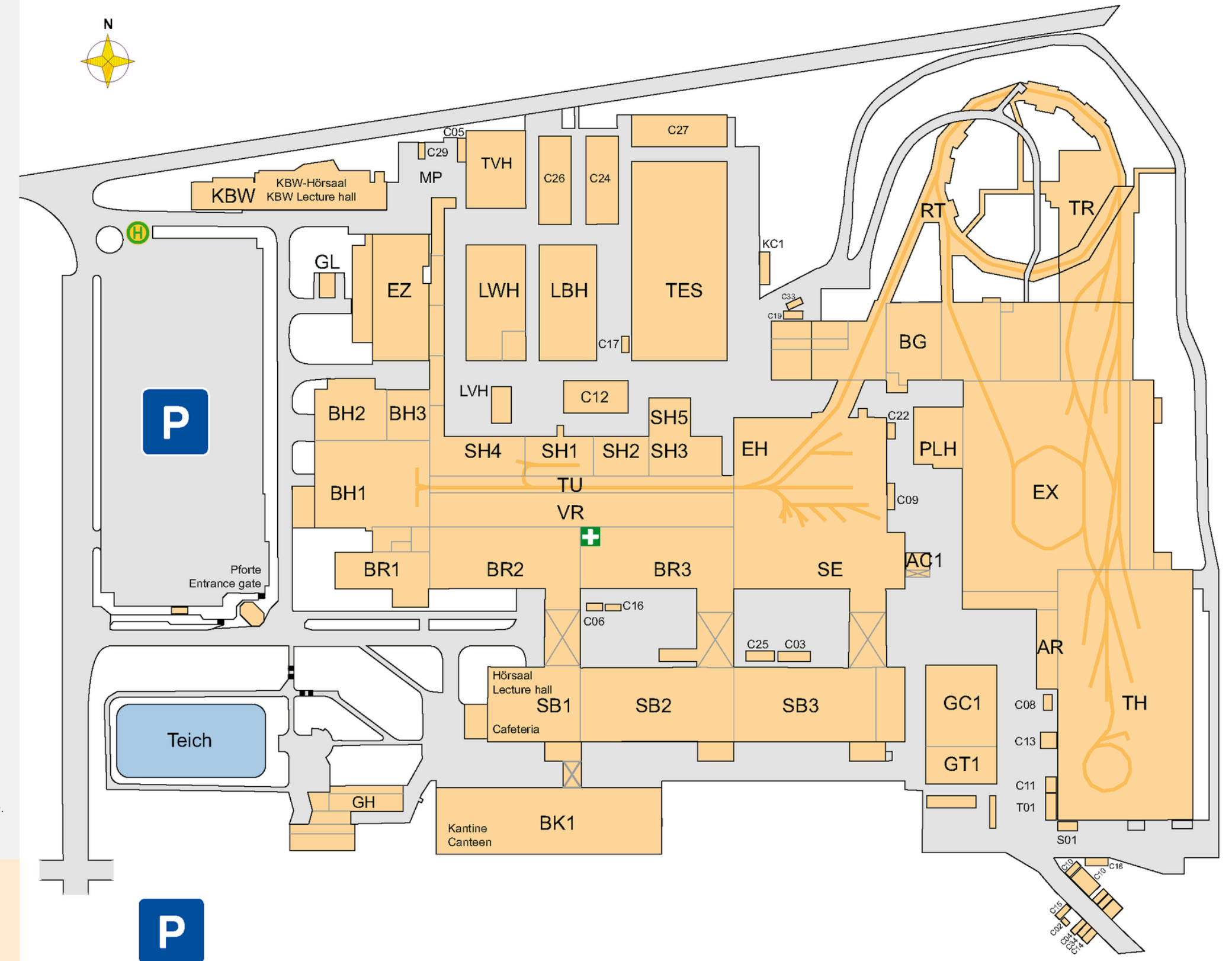
KBW 2.27 - whole day  
KBW 5.29/5.32 - whole day



- AR Annex-Radiologie
- AC Annex Container
- BG Betriebsgebäude
- BH Betriebshalle
- BK Büro- & Kantinegebäude
- BR Betriebsräume
- C Container
- EH Experimentierhalle
- EX Neue Experimentierhalle
- EZ Energiezentrale
- GC Green IT Cube
- GH Gästehaus
- GL Gefahrstofflager
- GT Green IT Technikgebäude
- KBW Konferenz- und Bürogebäude West
- LBH Leichtbauhalle
- LVH Lager- und Vorfertigungshalle
- LWH Lager- und Werkstatthalle
- MP Wertstoffhof, Müllpresse
- PLH Phelix
- RT Ringtunnel
- SB Südbau
- SE Schnelle Experimente
- SH Stripperhalle
- TES Testinghalle
- TH Targethalle
- TR Transferhalle
- TU Tunnel
- TVH Tankverkupferungshalle
- VR Versorgungsräume

 Sanitätsraum/First Aid Ward  
Im Notfall bitte die Pforte kontaktieren.  
In case of emergency, please contact the entrance gate.  
Telefon/Phone: +49 6159 71 2210

**Ortsbezeichnung/Room numbering:**  
Beispiel/Example: SB2.4.123  
SB2. Gebäude/Building  
4. Ebene/Level  
123 Raumnummer/Room number



# Monday 8 April

---

General information, structure and goal of this meeting

A. Calivà

14:00 - 15:30

**Coffee Break**

15:30 - 16:00

Free discussions on selected topics from the symposium extracted from the box

16:00 - 17:00

**Welcome drink**

17:00 - 19:00

# Monday 8 April

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General information, structure and goal of this meeting

A. Calivà

14:00 - 15:30

**Coffee Break**

15:30 - 16:00

Free discussions on selected topics from the symposium extracted from the box

16:00 - 17:00

**Welcome drink**

17:00 - 19:00

Each day will be concluded with a short summary talk given by volunteers that I will decide

This talk will contain the main points that have been debated and the summary of the discussions during the day



# Tuesday 9 April

---

|                                                                   |               |               |                                                                 |            |               |
|-------------------------------------------------------------------|---------------|---------------|-----------------------------------------------------------------|------------|---------------|
| Experimental overview on hypertriton measurements at RHIC and LHC | M. Puccio     | 9:00 - 9:45   | Thermal model to describe hypertriton production                | K. Redlich | 14:00 - 14:45 |
| Correlation measurements at the LHC                               | B. Singh      | 9:45 - 10:30  | Coalescence model to describe hypertriton production            | B. Dönigus | 14:45 - 15:30 |
| <b>Coffee Break</b>                                               |               | 10:30 - 11:00 | <b>Coffee Break</b>                                             |            | 15:30 - 16:00 |
| Correlation measurements at RHIC                                  | H. Zbroszczyk | 11:00 - 11:45 | Hypernuclei with $A=4$ and perspectives for future measurements | J. Ditzel  | 16:00 - 16:45 |
| Free discussion                                                   |               | 11:45 - 12:30 | Free discussion + summary talk                                  |            | 16:45 - 18:00 |

# Wednesday 10 April

---

|                                               |             |               |                                                   |                |               |
|-----------------------------------------------|-------------|---------------|---------------------------------------------------|----------------|---------------|
| Thermal model: current status and limitations | A. Andronic | 9:00 - 10:00  | Coalescence model: current status and limitations | Che-Ming Ko    | 14:00 - 14:45 |
| Free discussion                               |             | 10:00 - 10:30 | Connection between correlations and coalescence   | M. Horst       | 14:45 - 15:30 |
| <b>Coffee Break</b>                           |             | 10:30 - 11:00 | <b>Coffee Break</b>                               |                | 15:30 - 16:00 |
| Thermal model and exotic (charm) states       | J. Stachel  | 11:00 - 12:00 | Perspectives for the coalescence model            | S. Mrowczynski | 16:00 - 16:45 |
| Free discussion                               |             | 12:00 - 12:30 | Free discussion + summary talk                    |                | 16:45 - 18:00 |

# Thursday 11 April

---

|                                                  |               |
|--------------------------------------------------|---------------|
| Production/Transport of light nuclei using URQMD | M. Bleicher   |
|                                                  | 9:00 - 10:00  |
| Free discussion                                  |               |
|                                                  | 10:00 - 10:30 |
| <b>Coffee Break</b>                              |               |
|                                                  | 10:30 - 11:00 |
| Production/Transport of light nuclei using SMASH | M. Ege        |
|                                                  | 11:00 - 12:00 |
| Free discussion                                  |               |
|                                                  | 12:00 - 12:30 |

|                                                  |               |
|--------------------------------------------------|---------------|
| Production/Transport of light nuclei using PHQMD | J. Aichelin   |
|                                                  | 14:00 - 15:00 |
| Free discussion                                  |               |
|                                                  | 14:45 - 15:30 |
| <b>Coffee Break</b>                              |               |
|                                                  | 15:30 - 16:00 |
| Free discussion on selected topics               |               |
|                                                  | 16:00 - 17:30 |
| Summary talk                                     |               |
|                                                  | 17:30 - 18:00 |

# Friday 12 April

---

Free discussion on selected topics

9:00 - 10:30

**Coffee Break**

10:30 - 11:00

Summary

11:00 - 12:30

Available slot for further discussions in the morning from 9:00 to 10:30

Summary of the discussions: the summary of the paper has to reflect the conclusions discussed in this session

- Definition of the roadmap for the publication  
→ should be within ~ 6 months!
- Definition of roles for writing up the document

# Written report: shared overleaf

Shared overleaf project:

<https://www.overleaf.com/3777778379cbhpsqhjpcgf#08a9ff>

Granted edit rights to all members

→ please check

Current title:

*Comparative study of phenomenological models of (anti)nuclei production at RHIC and LHC energies*

Write down on a card your proposed title and put the card inside the box

→ best title will be selected by Friday

1 Comparative study of phenomenological models of (anti)nuclei  
2 production at RHIC and LHC energies

3 J. Aichelin<sup>a</sup>, A. Andronic<sup>b</sup>, F. Bellini<sup>c</sup>, M. Bleicher<sup>d</sup>, K. Blum<sup>e</sup>, E. Bratkovskaya<sup>f</sup>,  
4 P. Braun-Munzinger<sup>f,g</sup>, A. Calivà<sup>h</sup>, K. Che-Ming<sup>i</sup>, J. Ditzel<sup>j</sup>, B. Dönigus<sup>j</sup>, M. S. Ege<sup>j</sup>,  
5 H. Elfner<sup>f</sup>, S. Glaessel<sup>d</sup>, M.V. Hartung<sup>j</sup>, M. Horst<sup>k</sup>, R. Lea<sup>l</sup>, M. Lorenz<sup>m</sup>, D. Miśkowiec<sup>f</sup>,  
6 S. Mrowczynski<sup>n</sup>, C. Pinto<sup>o</sup>, M. Puccio<sup>o</sup>, K. Redlich<sup>p</sup>, B. Singh<sup>k</sup>, J. Stachel<sup>q</sup>, K.J. Sun<sup>r</sup>,  
7 B. Tomášik<sup>s</sup>, V. Vovchenko<sup>t</sup>, Z. Xu<sup>u</sup>, and H. Zbroszczyk<sup>v</sup>

8 <sup>a</sup>*SUBATECH, IMT Atlantique, Université de Nantes, CNRS-IN2P3, Nantes, France*

9 <sup>b</sup>*Institut für Kernphysik, Universität Münster, Germany*

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13 <sup>f</sup>*GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany*

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18 <sup>k</sup>*Physics Department, Technical University of Munich, Munich, Germany*

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26 <sup>s</sup>*Physics Department, Czech Technical University, Prague*

27 <sup>t</sup>*Physics Department, University of Houston, Houston, USA*

28 <sup>u</sup>*Kent State University and Brookhaven National Laboratory, USA*

29 <sup>v</sup>*Physics Department, Warsaw University of Technology (WUT), Warsaw, Poland*  
30

# Written report: shared overleaf

Shared overleaf project:

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Granted edit rights to all members

→ please check

Current title:

*Comparative study of phenomenological models of (anti)nuclei production at RHIC and LHC energies*

Write down on a card your proposed title and put the card inside the box

→ best title will be selected by Friday

**Suggestion:** Write down your notes on overleaf daily!

1 Comparative study of phenomenological models of (anti)nuclei  
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30

# Structure of the paper

Current structure:

- Introduction
- Experimental overview
- Theory overview
- Summary
- acknowledgments

→ propose a different structure if you prefer

## 35 1 Introduction

36 Introduction

## 37 2 Experimental overview

38 Experimental overview

### 39 2.1 Hypertriton results at RHIC and LHC

40 Responsible: Janik Ditzel

### 41 2.2 Measurements of (anti)nuclei at RHIC

42 Responsible: Zhangbu Xu

### 43 2.3 Measurements of (anti)nuclei at the LHC

44 Responsible: Chiara Pinto

### 45 2.4 Correlation measurements

46 Responsible: Bhawani Singh

## 47 3 Theory overview

48 Theory overview

49 Some paper [1]

### 50 3.1 Canonical thermal model

51 Responsible: Volodymyr Vovchenko

### 52 3.2 Grand-canonical thermal model

53 Responsible: Anton Andronic

54 Some papers on the Statistical Hadronization Model [2–7].

### 55 3.3 Coalescence model

56 Responsible: Kai-Jia Sun

57 Some papers on the baryon coalescence model [8–13].

### 58 3.4 Kinetic production using URQMD

59 Responsible: Marcus Bleicher

### 60 3.5 Kinetic production using SMASH

61 Responsible: Marthe Ege

### 62 3.6 Kinetic production using PHQMD

63 Responsible: Susanne Glassel

64 Some papers on PHQMD [14–16] some papers on the comparison  
65 approaches [17, 18]

# Summary and acknowledgments

66 **4 Summary**

67 Summary

68 **5 Acknowledgments**

69 We thank the ExtreMe Matter Institute EMMI at GSI, Darmstadt, for support in the framework of  
70 an EMMI Rapid Reaction Task Force meeting during which this work has been initiated.

The summary will be discussed together on Friday morning

Text for the acknowledgments taken directly from EMMI suggestions:

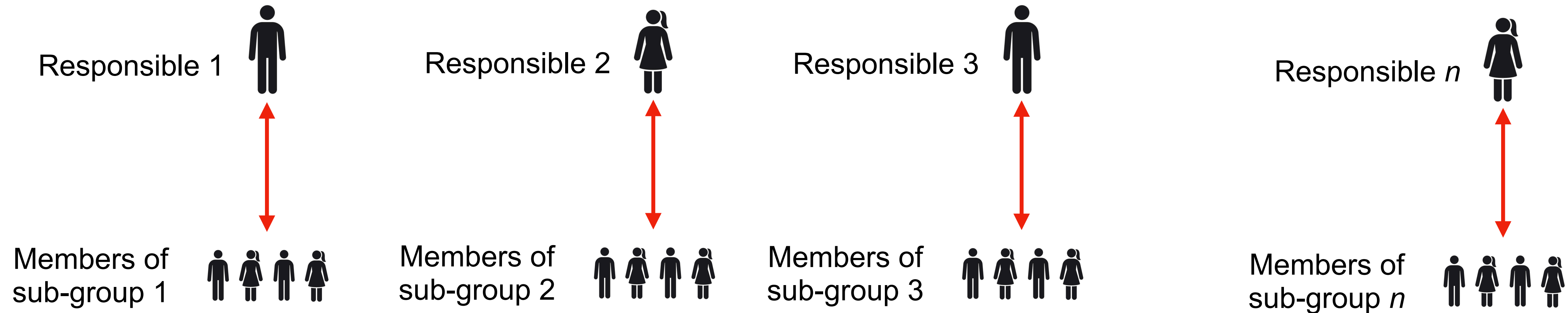
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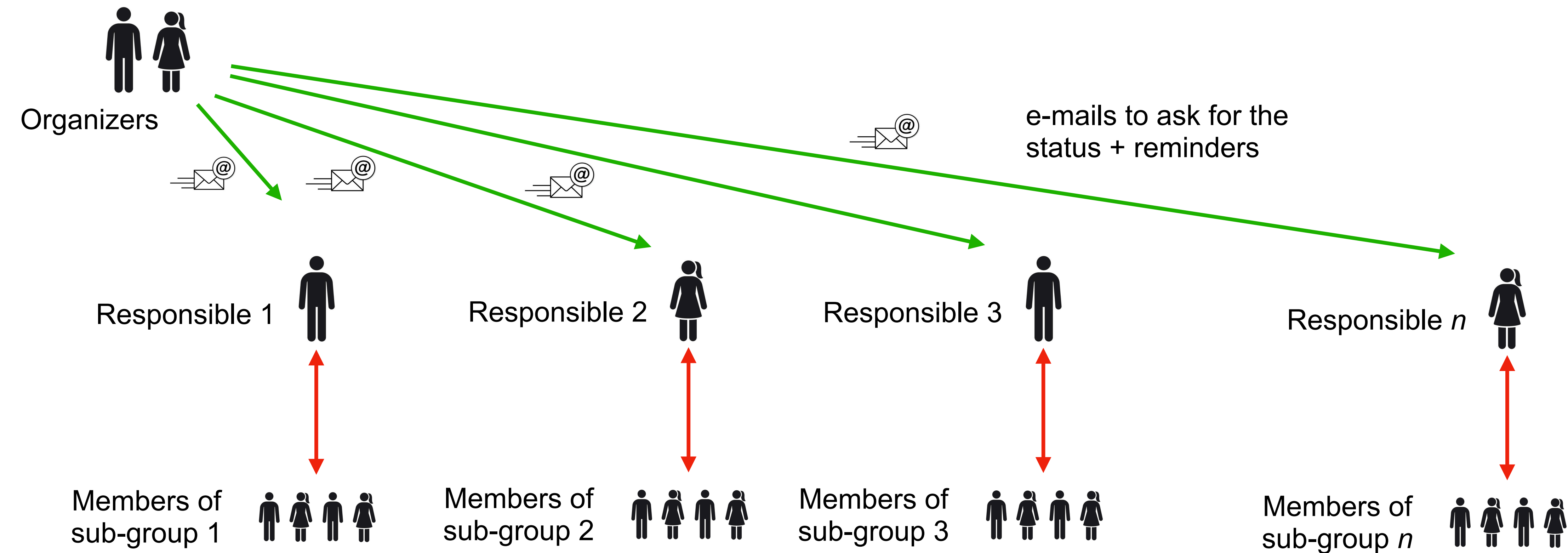


# Roles and committees

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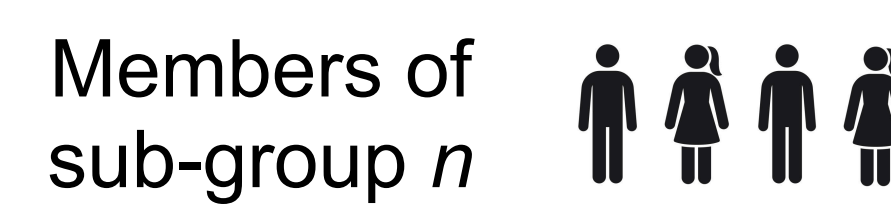
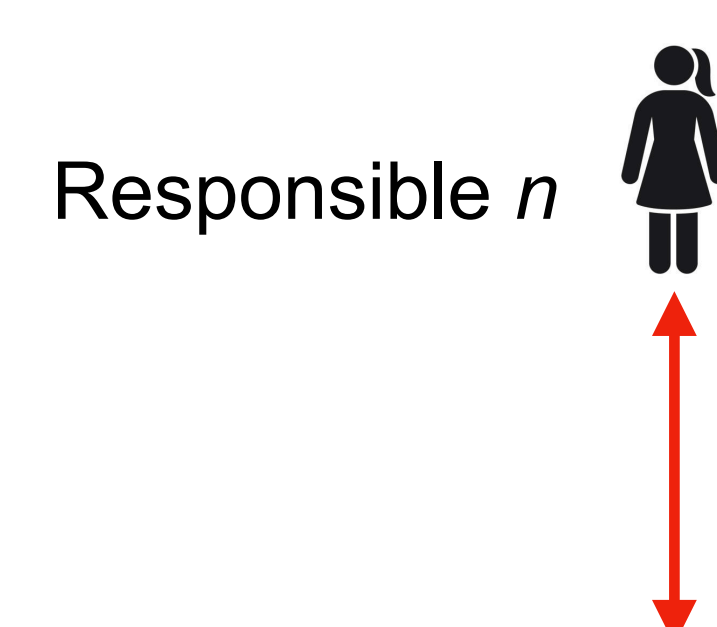
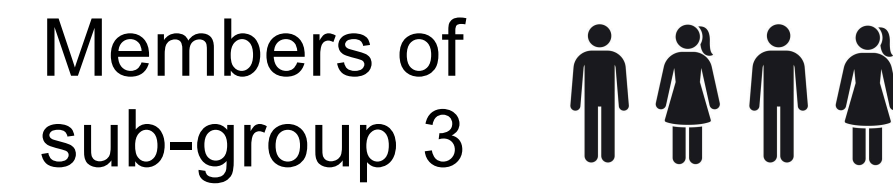
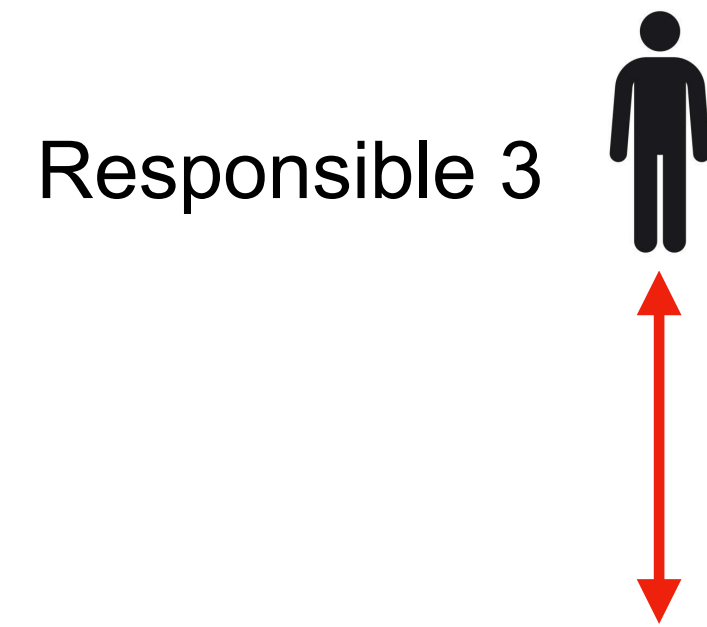
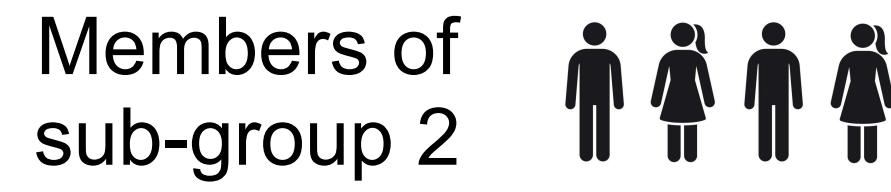
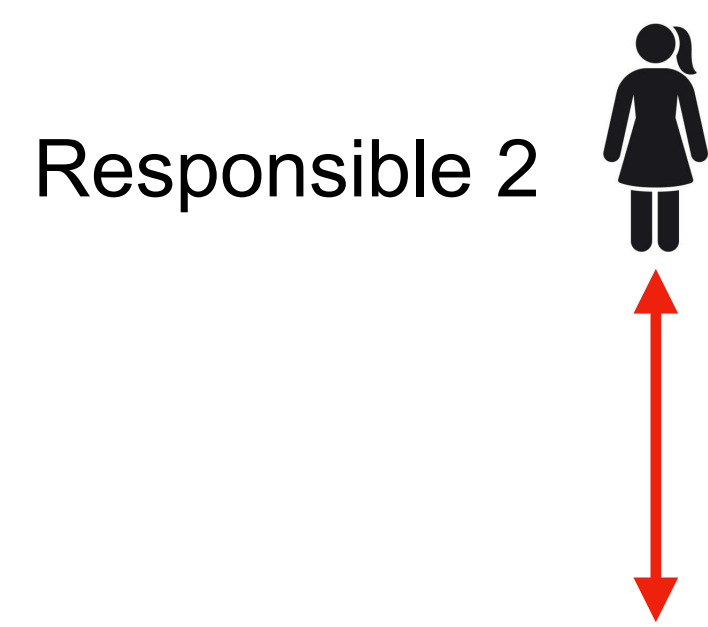
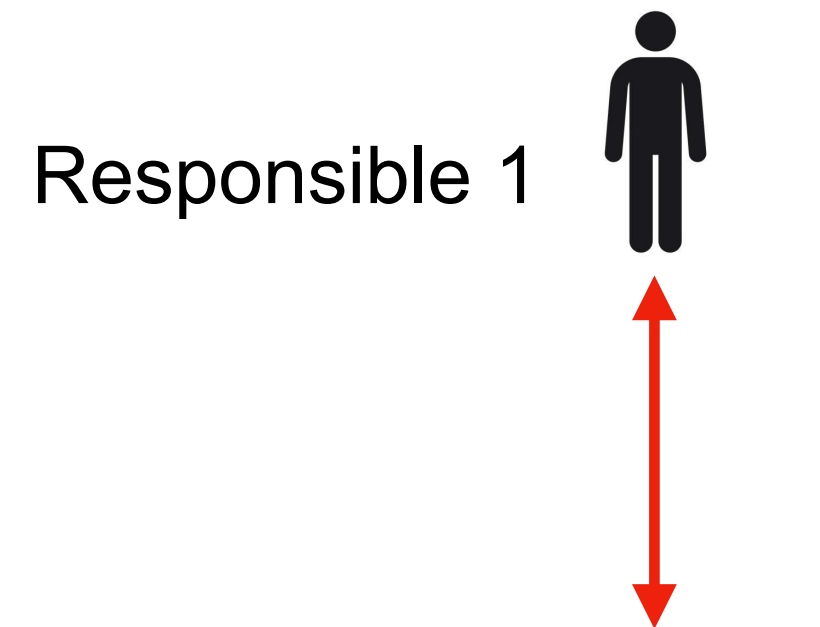


# Roles and committees

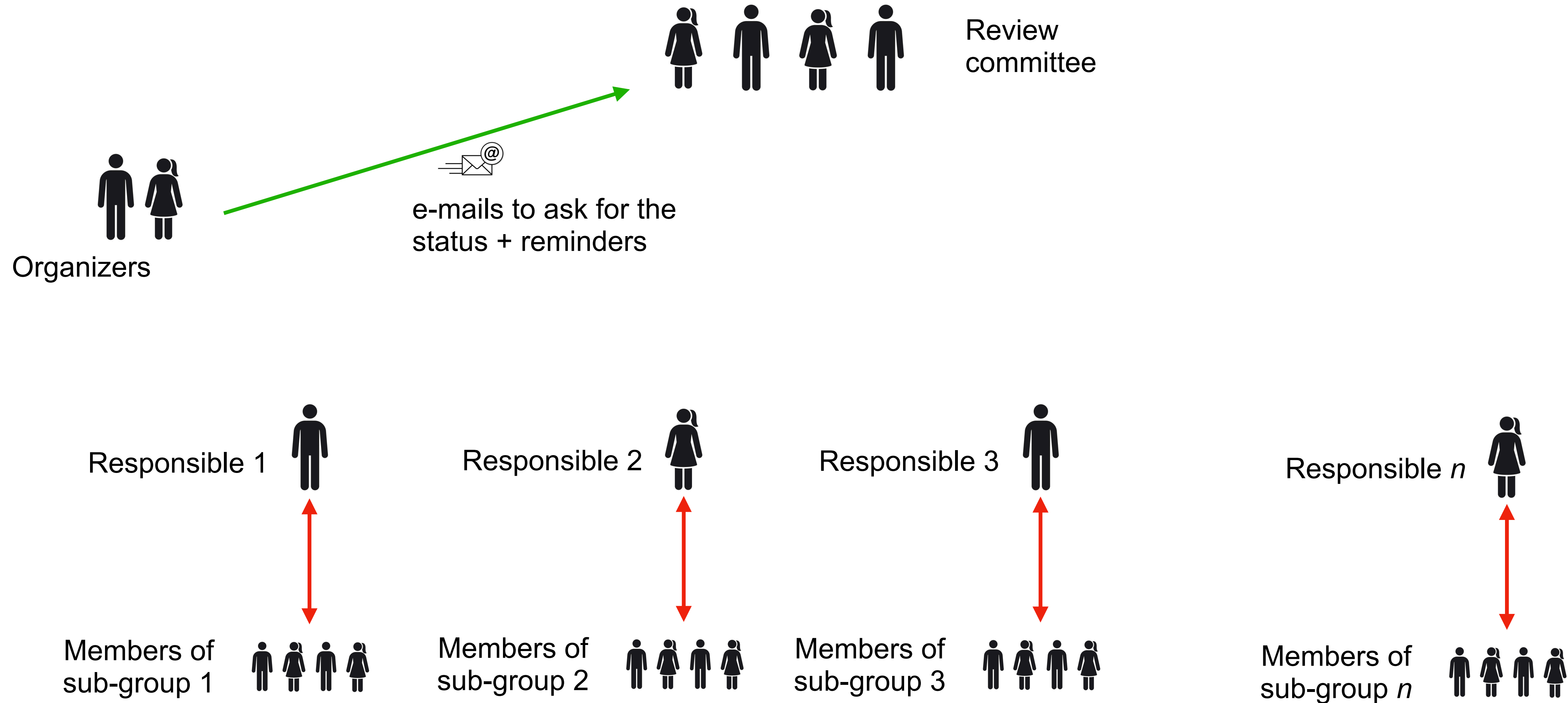


# Roles and committees

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# Roles and committees



# Deadlines

---

- Different sub-groups write their chapters independently
  - The responsible is also a reviewer for the chapter
- converge by 15 June 2024

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  - The RC makes sure the text reflects discussions during the RRTF
- 1 month to write the review, i.e. converge by 15 July 2024

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  - interactions with the RC are encouraged (to clarify comments, ...)
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# Deadlines

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- One round of general review by all participants (deadline: 15 September 2024)
- (minor) proposed changes compiled by the RC and sent back (deadline: 30 September 2024)
- Apply changes and send draft back (deadline: 15 October 2024)
- When the RC approves the draft, it is submitted by organizers (deadline: November 2024)



# Group leaders and review committee

## **2.1 Hypertriton results at RHIC and LHC**

Responsible: Janik Ditzel

## **2.2 Measurements of (anti)nuclei at RHIC**

Responsible: Zhangbu Xu

## **2.3 Measurements of (anti)nuclei at the LHC**

Responsible: Chiara Pinto

## **2.4 Correlation measurements**

Responsible: Bhawani Singh

## **Proposal for the review committee**

1. Peter Braun-Munzinger
2. Ramona Lea
3. Che Ming-Ko
4. Hanna Zbroszczyk

## **3.1 Canonical thermal model**

Responsible: Volodymyr Vovchenko

## **3.2 Grand-canonical thermal model**

Responsible: Anton Andronic

## **3.3 Coalescence model**

Responsible: Kai-Jia Sun

## **3.4 Kinetic production using URQMD**

Responsible: Marcus Bleicher

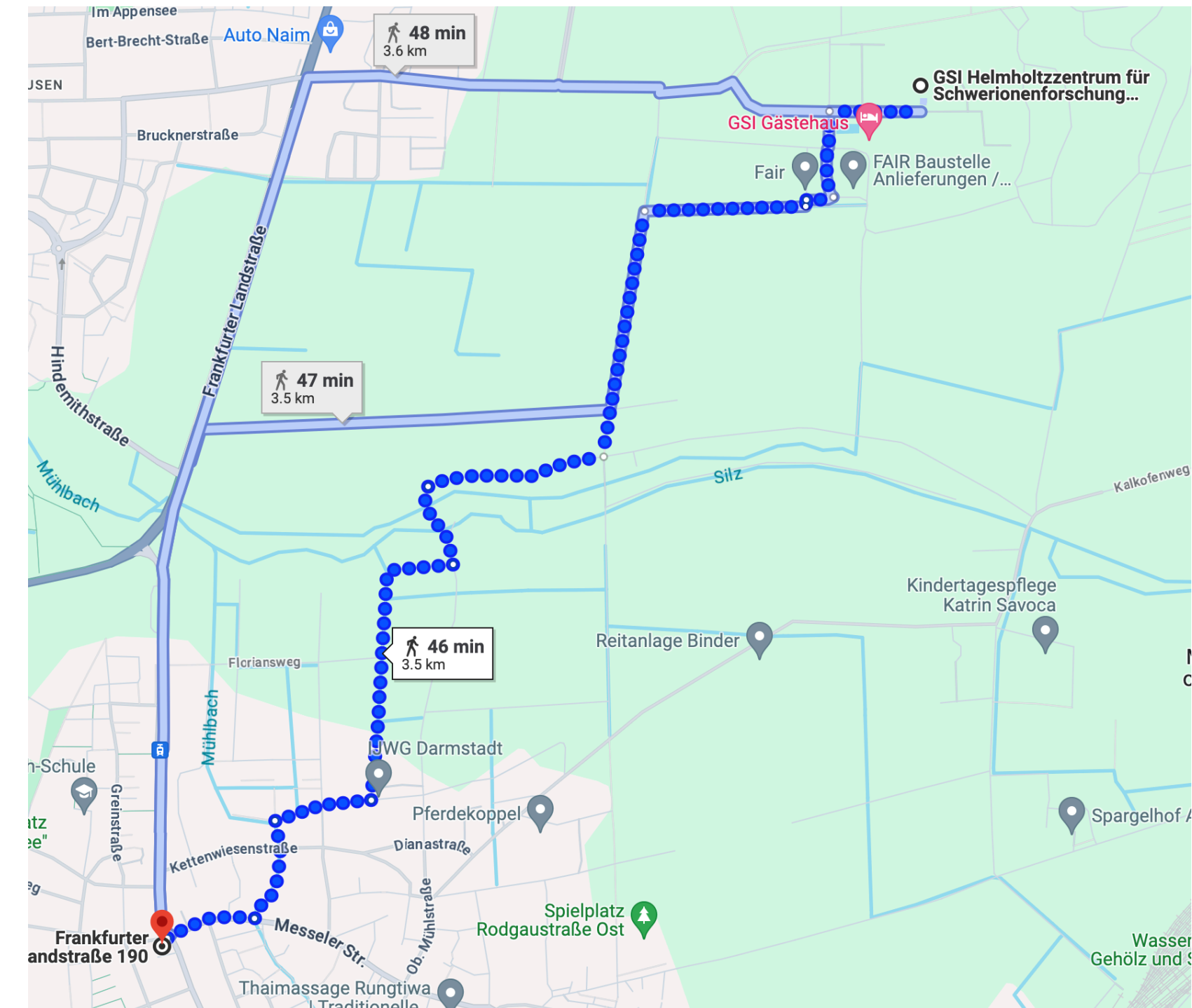
## **3.5 Kinetic production using SMASH**

Responsible: Marthe Ege

## **3.6 Kinetic production using PHQMD**

Responsible: Susanne Glassel

# Social dinner



The social dinner will be on Thursday 11 April evening at the Restaurant of the Hotel Weisser Schwan starting at 19:00

Hotel location: Frankfurter Landstraße 190, 64291 Darmstadt, Germany

# EMMI refund rules

EMMI covers the travel and accommodation costs up to a maximum amount. The conference dinner and welcome drink are also provided

The participants can apply for reimbursement by presenting the receipts to the EMMI secretariat (Maria Wallner).

E-Mail: [emmi-office@gsi.de](mailto:emmi-office@gsi.de)

**IMPORTANT: scan all the receipts and produce 1 single PDF file!**

Maximum costs that will be refunded by EMMI:

- Round-trip flights for participants from overseas → **max. 1200 EUR**
- Round-trip flights or train tickets for participants from Europe → **max. 500 EUR**
- Round-trip flights or train tickets for participants from Germany → **max. 150 EUR**
- Travel by car → **max 150 EUR**
- For hotel/accommodation → **max. 80 EUR per night, max 6 nights**



# EMMI code of conduct

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It is the policy of EMMI that all participants, including attendees, speakers, award recipients, volunteers, staff, contractors and all other stakeholders at EMMI meetings, **will conduct themselves in a professional manner contributing to the advancement of science.**

Creating a constructive environment to enable respectful exchanges is the responsibility of all participants, which excludes any form of discrimination, harassment or retaliation.

<https://www.gsi.de/emmi-code-of-conduct>

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Enjoy the discussions