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# Exploration of Heavy Hadrons At Thresholds

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[ExHAT]

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*Ivan Polyakov, Mikhail Mikhasenko, et al.*

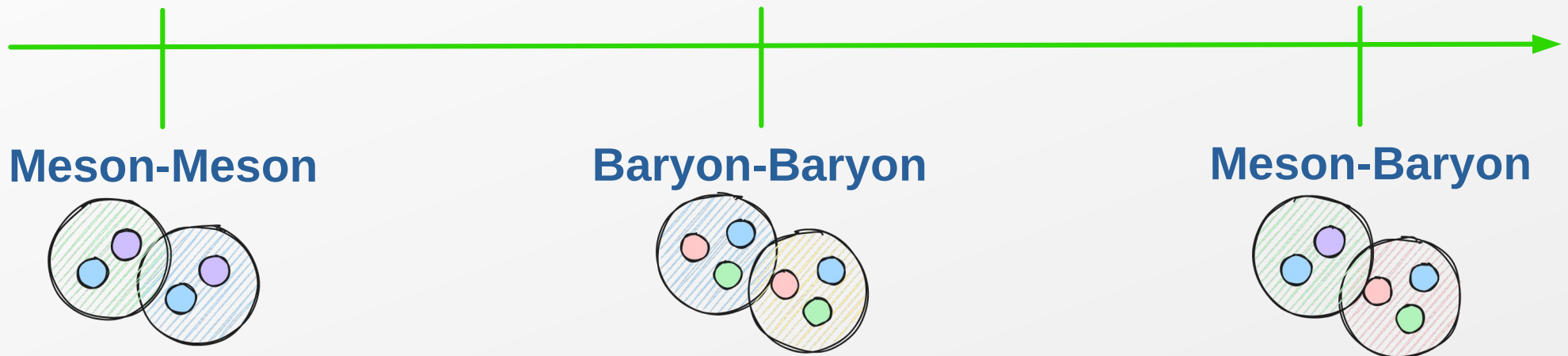
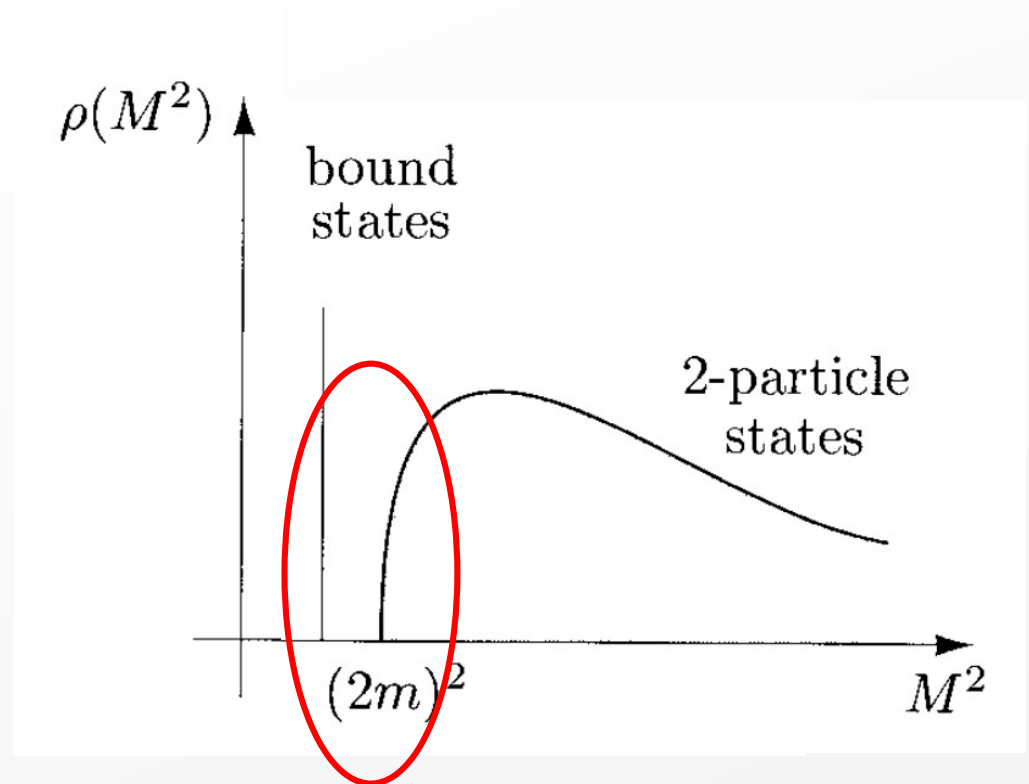
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# Defining focus

- **Heavy quark systems** – driving force in exploration of the QCD
  - since 1970's: Conventional charmonium
  - since 2000's: Exotic hadrons with heavy quarks
  - 2025: ?
- **Reference** – a key for advancing the precision

# Ideal reference

- **Thresholds** are the references to be used



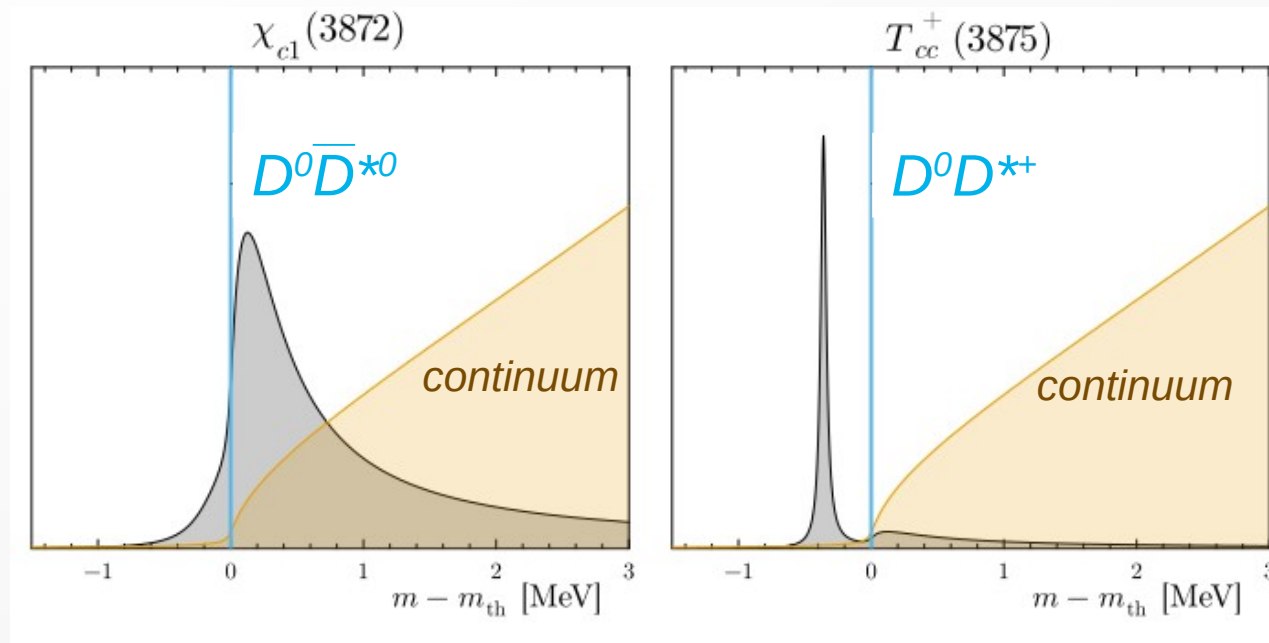
# Research objectives, MM

Meson-Meson

Baryon-Baryon

Meson-Baryon

- The  $\chi_{c1}(3872)$  and  $T_{cc}(3875)^+$  \* near  $D^0\bar{D}^{*0}$  and  $D^0D^{*+}$



- $T_{cc} \rightarrow D^0D^0\pi^+$  amplitude analysis,  
 $T_{cc}$  and  $\chi_{c1}(3872)$  production in pp and heavy-ion, ...

*\* we are the ones who discovered the  $T_{cc}$  and  
posses expertise on how it should not be studied*

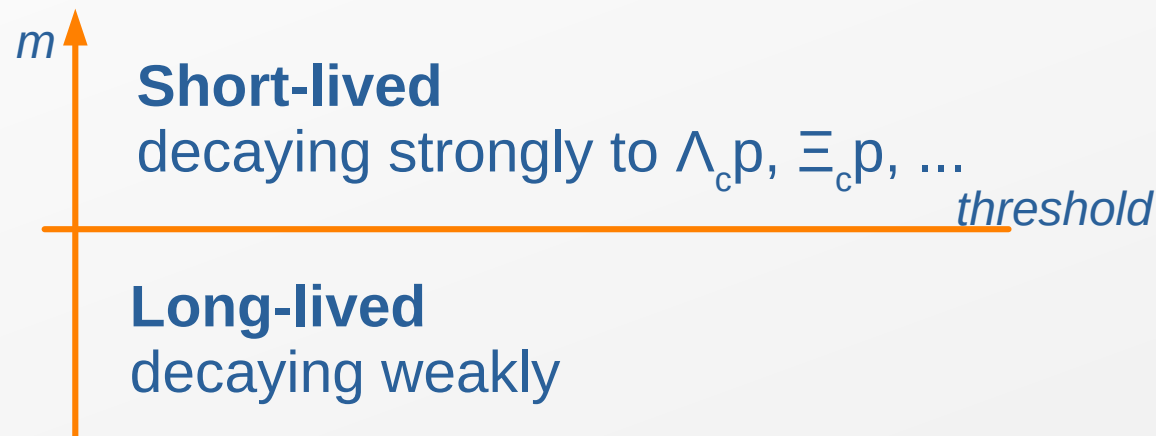
# Research objectives, BB

Meson-Meson

Baryon-Baryon

Meson-Baryon

- States of 6 quarks – dibaryons/hexaquarks
- Previous studies in light sector  
 $\Lambda\Lambda$ ,  $p\Omega$ ,  $p\Xi$ , ... picture not clear ...
- Focus on states with **heavy quarks**



- Linking hadron spectroscopy and nuclear physics

# Research objectives, MB

Meson-Meson

Baryon-Baryon

Meson-Baryon

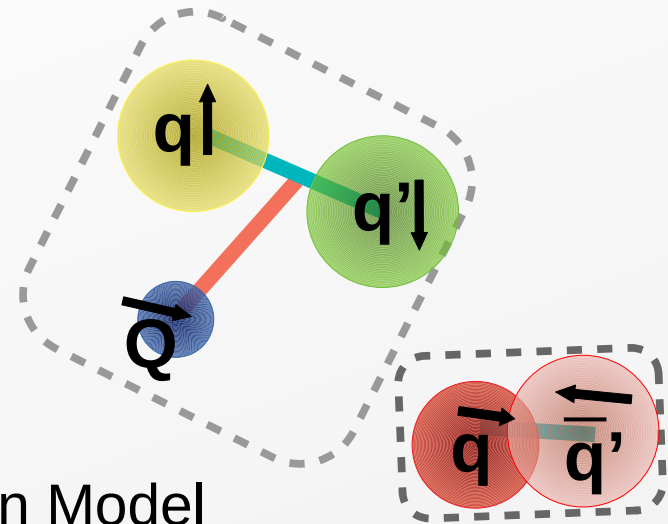
- Heavy baryons is an ideal laboratory for understanding

- Diquarks

- Threshold dynamics

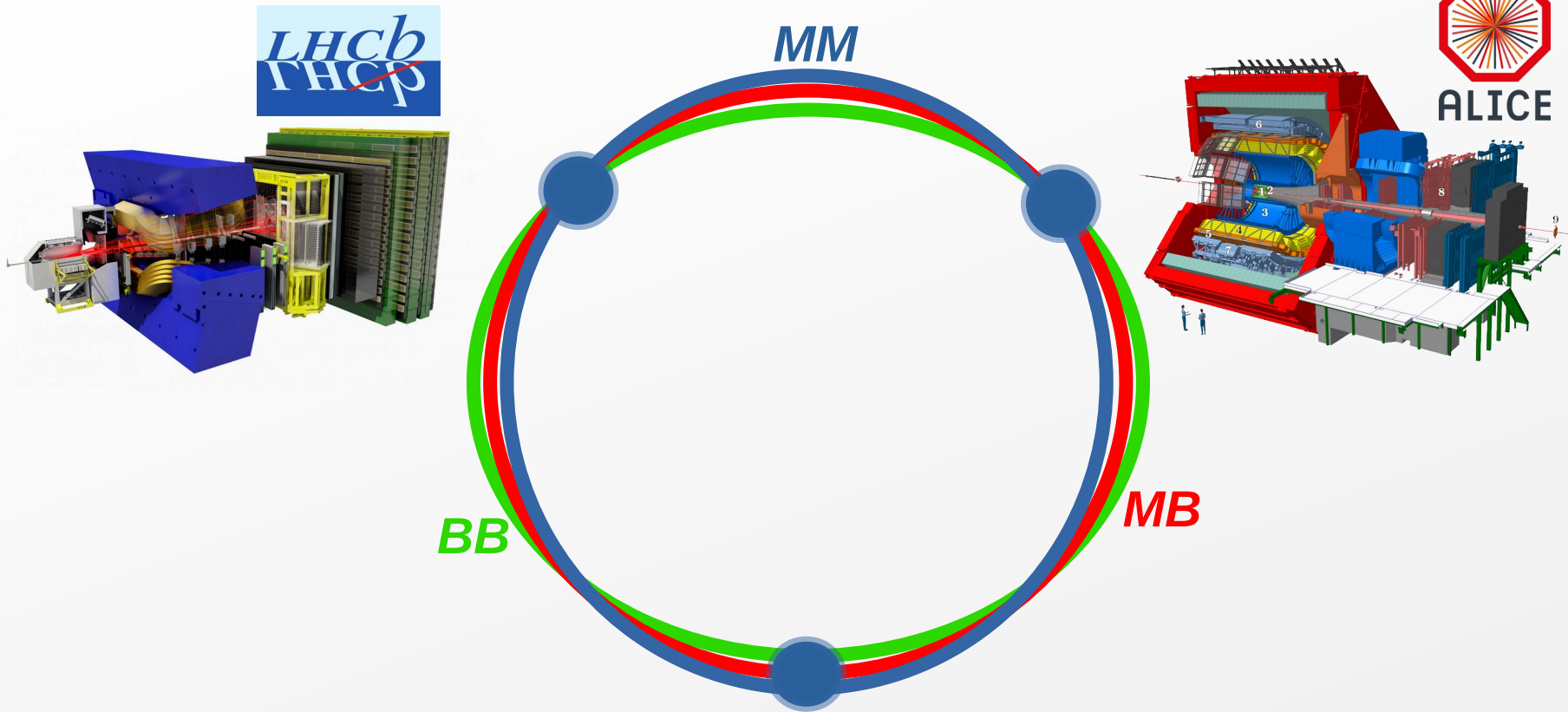
- Input to Statistical Hadronization Model used for the QGP studies

- Gaps to be identified by theory and filled by experiment



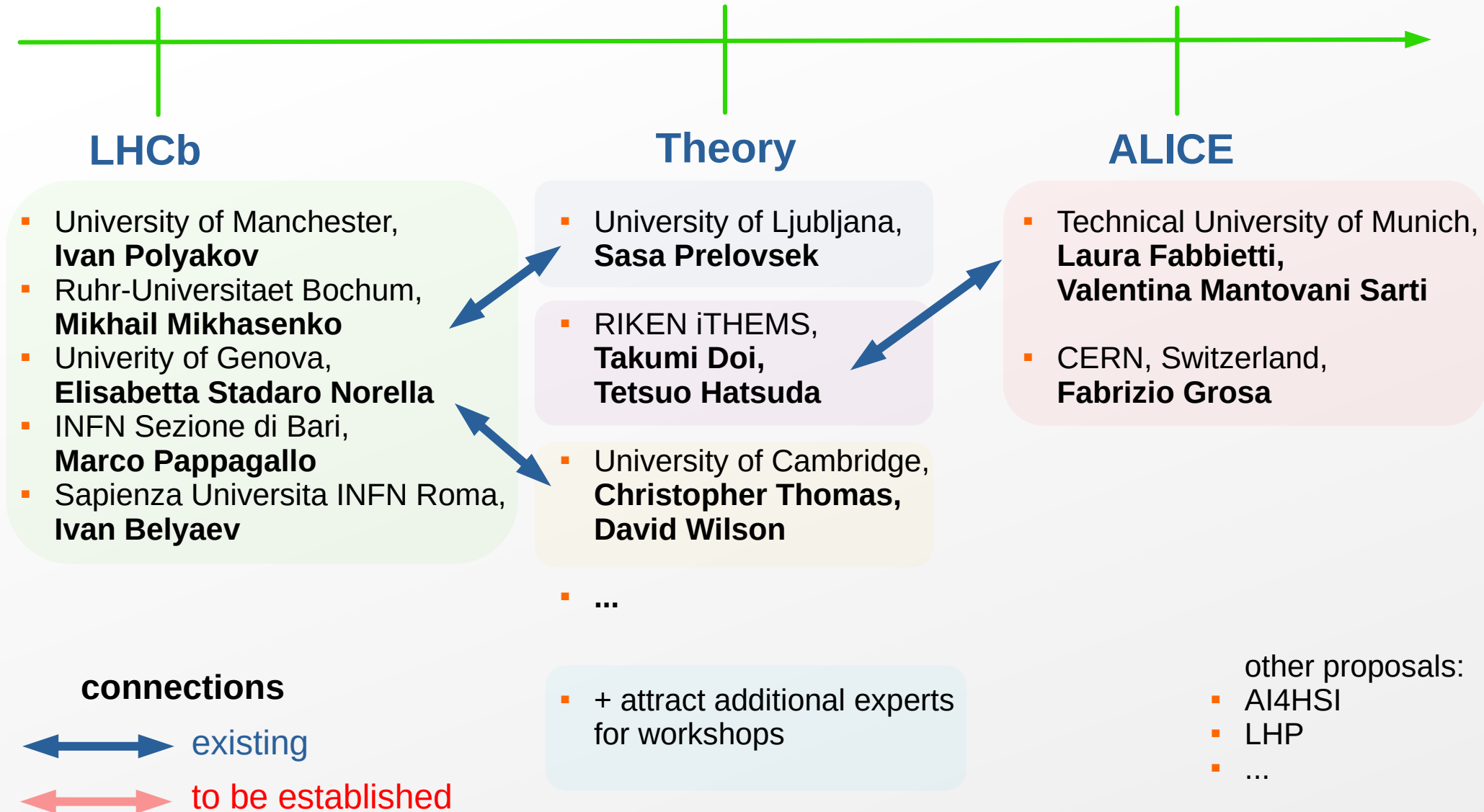
# Infrastructure

- **LHC** at CERN is the **most powerful factory** of the states under consideration
- **Theory** is **essential** part of the new **research consortium**



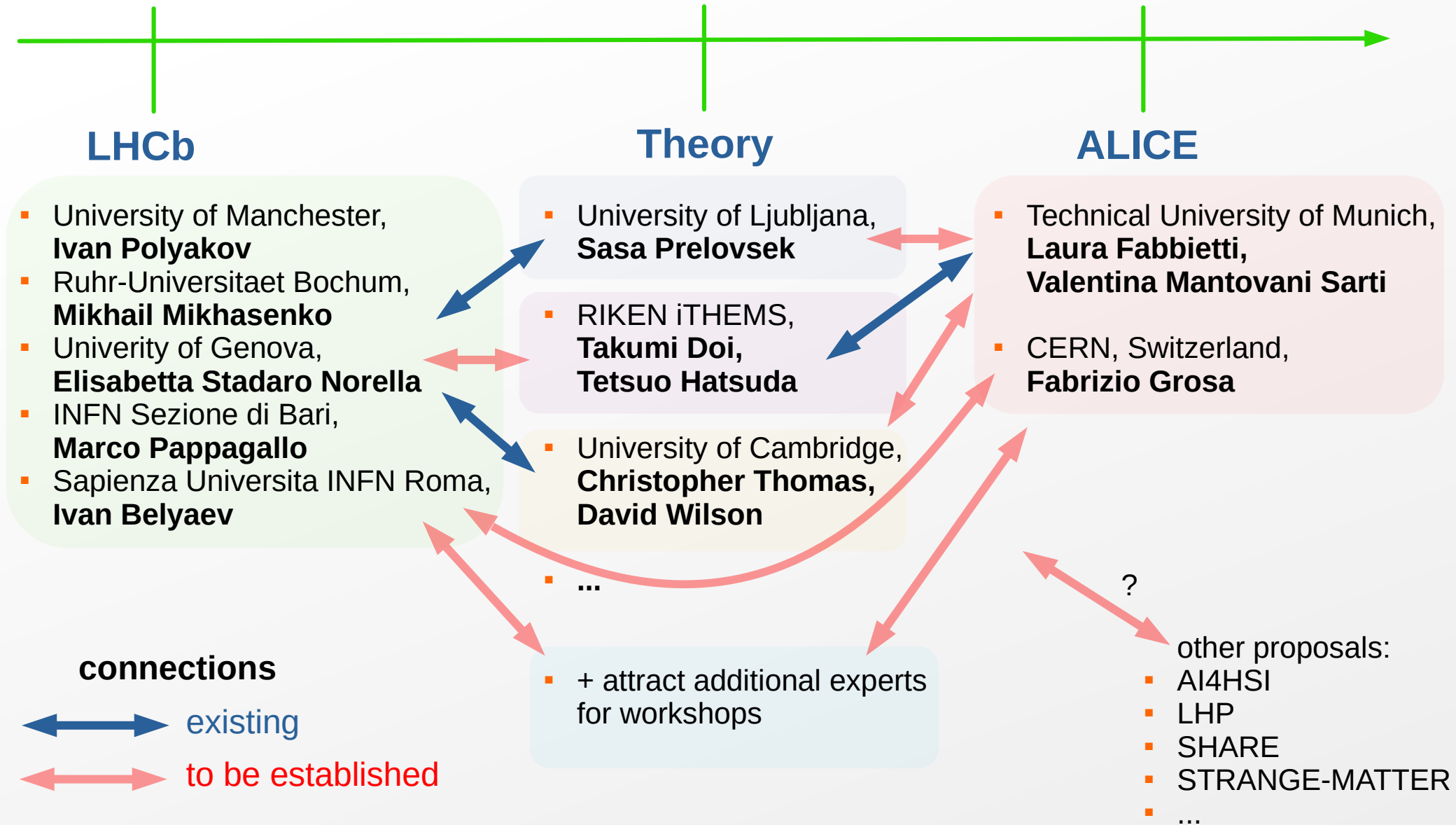
$$L_{QCD} = \sum_q \bar{\psi}_q \left( i \gamma_\mu D^\mu - m_q \right) \psi_q - \frac{1}{2} \text{Tr} \left[ \bar{G}_{\mu\nu} \bar{G}^{\mu\nu} \right]$$

# Coherence in the efforts





# Coherence in the efforts



# Estimated budget

- PostDoc to boost activities in LHCb/ALICE/theory (4y FTE) – **€360k**  
*we have preliminary agreement with the institutions that each of the positions will get supplementary local funds for another 12-18 months. PhD positions funded by Universities aligned with the project.*
- Travel – **€170k**  
*for 14 participants: approx. 2 trips/year (€500/trip) and 15 days/year stay (€135/day)*
- Workshops – **€50k**  
*five topic-focused 2-day workshops over four years*
- Outreach & training – **€10k**
- Total – **€590k**

# Summary

- Focus on **Heavy hadrons** – systems with most potential for advancing knowledge
- **Thresholds** – to achieve the highest precision
- **Synergy of experiment** (LHCb, ALICE)  
and **theory** (LatticeQCD, advanced quark models)  
and of **hadron spectroscopy** and **nuclear physics**
- Infrastructure access – **LHC** at CERN

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# Backup

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# Instead of summary

*Experiment*

*Theory*

