





# The *Quarkonia as Tools* workshop series: change the paradigm

#### J.P. Lansberg

IJCLab Orsay - Paris Saclay U. - CNRS

March 8, 2021 GDR QCD Annual meeting, March 8-10, 2021





J.P. Lansberg (IJCLab)



Quarkonia as Tools March 8, 2021

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March 8, 2021 2 / 4

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- Enough time to let everybody express his/her doubts and views, to ask things they never dared asked before, to realise that one in fact (dis)agrees, ...



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- A seemingly unsolvable puzzle : quarkonium production!



J.P. Lansberg (IJCLab) Quarkonia as Tools

- QaT 2019: https://indico.cern.ch/e/OniumTools2019:
  - 41 participants,
  - 26 talks,
  - 10h of round tables,
  - 2h30 of question time (50% reserved to young participants) and
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  - Virtual meeting;
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- QaT' 2021: hopefully in Aussois during the week of June 20, 2021.

 In 2019 and 2020, we mostly focused on the LHC

#### Perspectives for quarkonium studies at the high-luminosity LHC

Émilien Chapon-<sup>11</sup>, David d'Enternia<sup>11</sup>, Bertrand Ducloué<sup>11</sup>, Miguel G. Echevarria<sup>11</sup>, Pol-Bernard Gossiaux-<sup>11</sup>, Vato Karrvelishvili<sup>13</sup>, Tomas Kasemets<sup>13</sup>, Jean-Philippe Lansbergha<sup>1</sup>, Ronan McNulty<sup>14</sup>, Darren D. Price<sup>13</sup>, Hua-Sheng Shao<sup>13</sup>, Charlotte Van Hulse<sup>13</sup>, Michael Winn<sup>13</sup>, Jaroslav Adam<sup>17</sup>, Liupan An<sup>13</sup>, Denys Yen Arrebato Villar<sup>1</sup>, Shohini Bhattacharya<sup>13</sup>, Francesco G. Celbertoria<sup>13</sup>, Cvetan Cheskkov<sup>13</sup>, Umber Di O'Alesio<sup>1</sup>, Cesar da Silva<sup>13</sup>, Elen G. Ferrciro<sup>13</sup>, Chris A. Flett<sup>19</sup>, Carlo Flore<sup>1</sup>, Maria Vittoria Garzelli<sup>13</sup>, Donathan Gaune<sup>14</sup>, Jibo He<sup>34</sup>, Yannis Makris<sup>1</sup>, Cyrille Marqueri<sup>14</sup>, Lauren Karnis<sup>15</sup>, Marcin Almali<sup>18</sup>, Picard Scapara<sup>18</sup>, Maxim A. Nefedov<sup>13</sup>, Melih A. Ozcelik<sup>18</sup>, Biswarup Paul<sup>17</sup>, Cristian Pisano<sup>1</sup>, Jian-Wei Qiu<sup>1</sup>, Sangen Rajesh<sup>18</sup>, Matto Rinaldi<sup>18</sup>, Florent Scapara<sup>18</sup>, Maddi<sup>18</sup>, Smith<sup>18</sup>, Pieter Taels<sup>18</sup>, Amy Tee<sup>1</sup>, Oleg Teryaev<sup>18</sup>, Ivan Vitev<sup>18</sup>, Kazuhiro Watanabe<sup>18</sup>, Nodoka Yamanaka<sup>18,20</sup>, Xisoiun Yao<sup>19</sup>, Yani Zhang<sup>28,30</sup>, Yani Zhang<sup>28,30</sup>

#### Abstract

We review the prospects for quarkonium-production studies in proton and nuclear collisions accessible during the upconing phases of the CERN Large Hadron Collider operation after 2011, including the ultimate high-luminosity phase, with increased luminosities compared to LHC Runs 1 and 2. We address the current experimental and theoretical open issues in the field and the perspectives for future studies in quarkonium-related physics through the exploitation of the huge data samples to be collected in proton-proton, with integrated luminosities reaching up to L = 3 a  $h^{-1}$ , in proton-nucleas and in nucleus-nucleus collisions, both in the collider and fixed-target modes. Such investigations include, among others, those of: (i) the quarkonia produced in association with other hard particles; (ii) the  $\chi_{\rm Q}$  and  $\eta_{\rm Q}$  down to small transverse momenta; (iii) the constraints brought in by quarkonia on gluon PDFs, nuclear PDFs, TMDs, GPDs and GTMDs, as well as on the lower sparn of synamics; (iv) the gluon Sivers effect in polarised-nucleon collisions; (v) the properties of the quark-gluon plasma produced in ultra-relativistic heavy-ion collisions and of collective narronic effects in energical and (vi) double and trition bard no starterines.

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#### Perspectives for quarkonium studies at the high-luminosity LHC

Emilien Chapom<sup>3.</sup>, David d'Emernia<sup>3.</sup>, Bertrand Ducloue<sup>3.</sup>, Miguel G. Echevarria<sup>4.</sup>,
Pol-Bernard Gossauc<sup>4.</sup>, Van Karvelishvilid<sup>7.</sup>, Drums Kasemets<sup>4.</sup>, Lean-Philippe Lansbergh<sup>3.</sup>,
Ronan McNuly<sup>4.</sup>, Darren D. Pricci<sup>4.</sup>, Hua-Sheng Shao<sup>5.</sup>, Charlotte Van Hulse<sup>4.</sup>, Michael Winn<sup>1.</sup>,
Jaroslav Adam<sup>18.</sup>, Liupan Ani<sup>7</sup>, Denys Yen Arrebato Villar<sup>4.</sup>, Shohini Bhattacharya<sup>9.</sup>
Francesco G. Ceiberno<sup>36.4.</sup>, Cvean Cheshkovi<sup>4.</sup>, Unberto D'Alesio<sup>7.</sup>, Cosar da Silva<sup>7.</sup>, Elena G. Ferreiro<sup>3.</sup>,
Criris A. Fiett<sup>9.2.</sup>, Carlo Flore<sup>3.</sup>, Maria Vittoria Garzelli<sup>56.20,5</sup>, Jonathan Gaunti<sup>56.31</sup>, Jibo Hey<sup>4.</sup>,
Yiannis Makris, 'Cyrille Marquee', Luure Massacrie<sup>7.</sup>, Thomas Mehrei, 'Cedric Merzeg', Luca Micheletti<sup>8</sup>, Riccardo Nagar<sup>50</sup>, Maxin A. Nefedovi<sup>8.</sup>, Melih A. Ozeclik<sup>8.</sup>, Biswarup Paul<sup>7.</sup>,
Cristian Pisano<sup>7.</sup>, Jian-Wel Qin<sup>8.2.</sup>, Sagnem Rajesh<sup>8.5.</sup>, Matto Rinaldi<sup>8.4.</sup>, Ploren Scarpi<sup>3.6.5.</sup>, Madide Smith<sup>6</sup>,
Pieter Taels<sup>50</sup>, Amy Tee<sup>6</sup>, Oleg Teryase<sup>500</sup>, Ivan Viter<sup>8.6.</sup>, Kazuhiro Watanabe<sup>8.6.5.</sup>, Nodoka Yamanaka<sup>500,500</sup>, Xiouni Yao<sup>50</sup>, Yani Zhang<sup>500</sup>, Sari Zhang<sup>500</sup>,

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- Aim: write an add-on about quarkonium production to the EIC Yellow Report

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