
Dark Matter, Black Holes and Phase Transitions

Michael J. Baker

UMass Amherst

NEHOP
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Aidan Symons
PhD Student

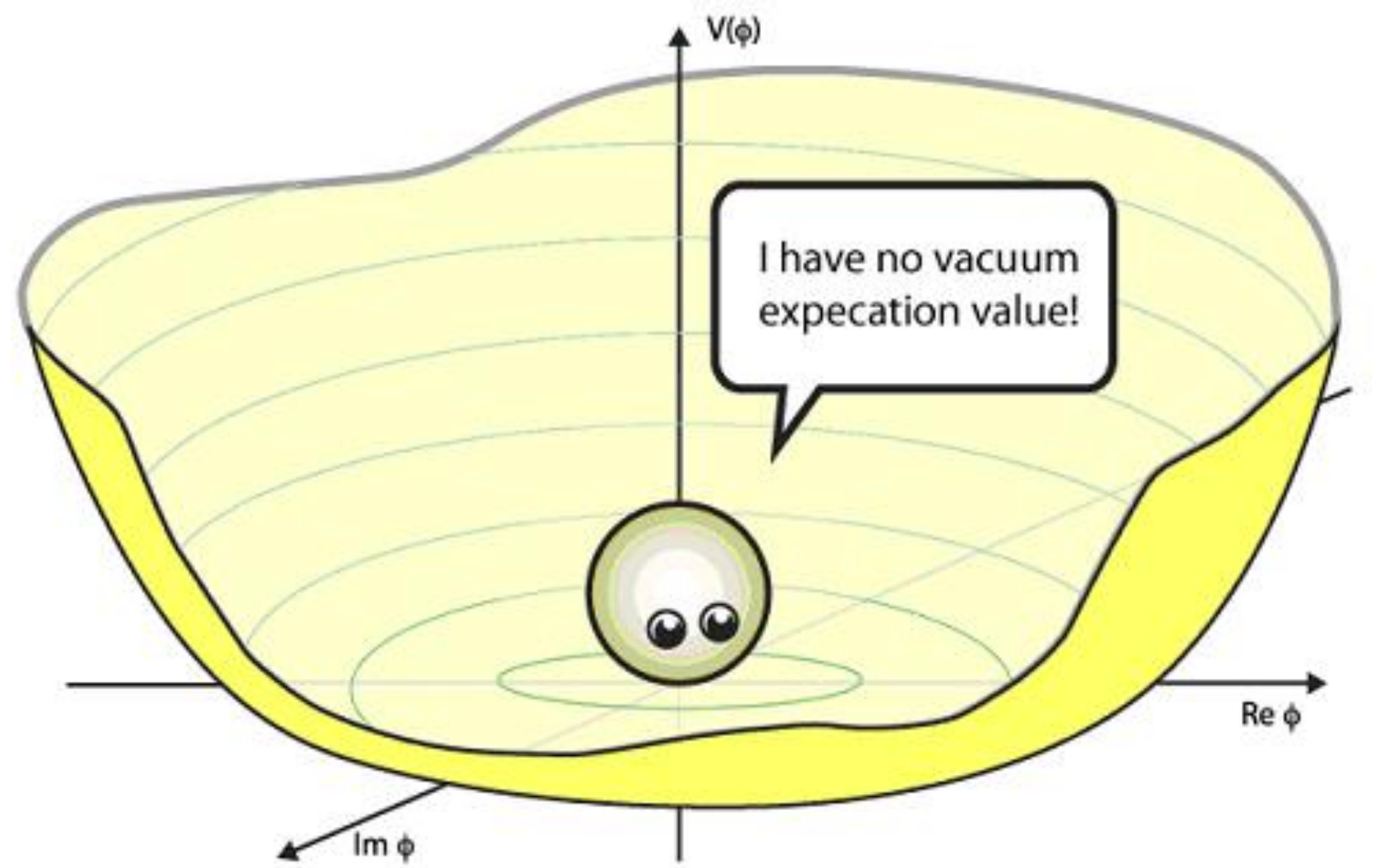


Joaquim Iguaz Juan
Postdoc

- Phase Transitions & Dark Matter Production
 - Filtered Dark Matter
 - Filtered Baryogenesis
- Phase Transitions & Primordial Black Hole Production

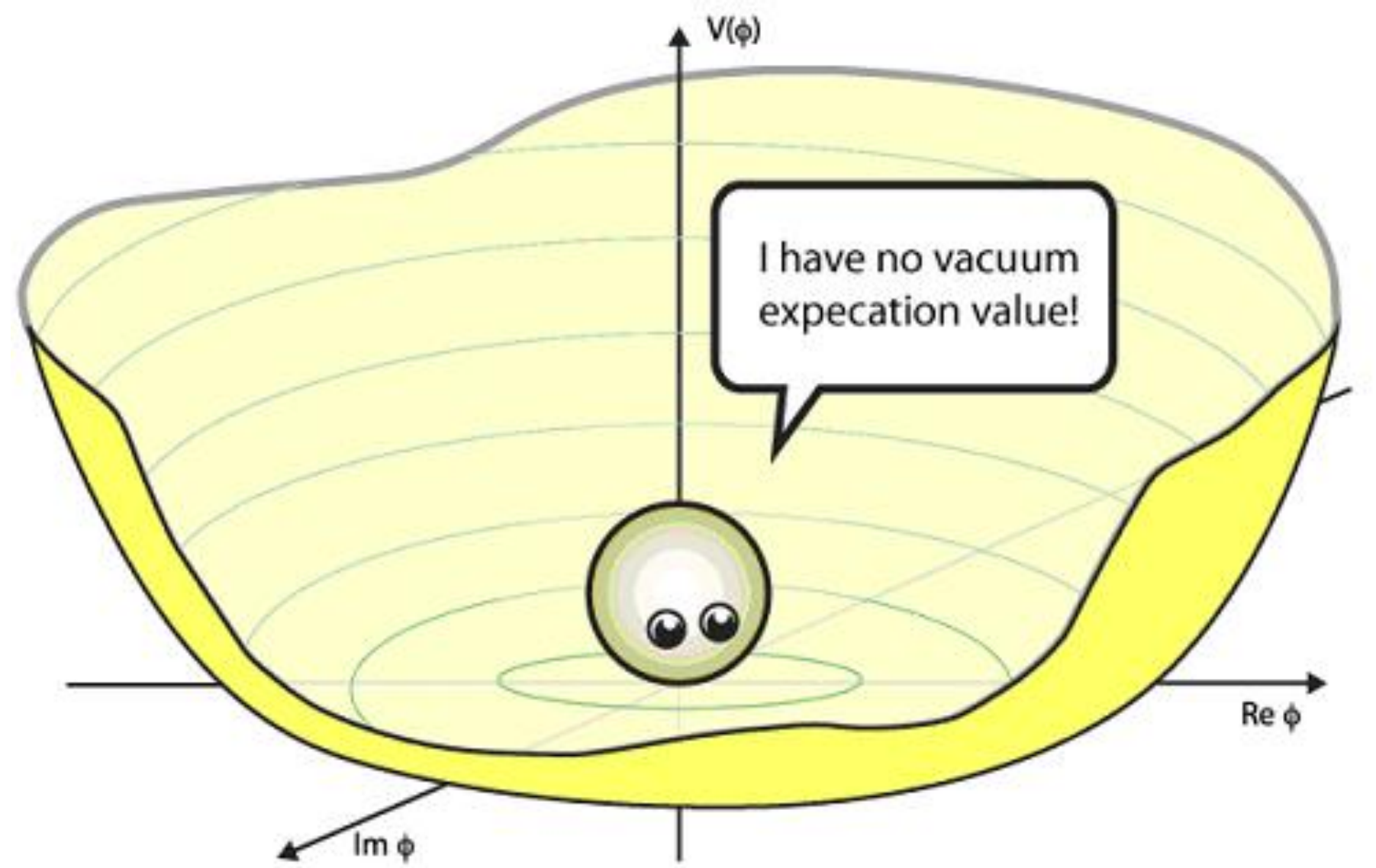
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$$T \gg T_{EW}$$



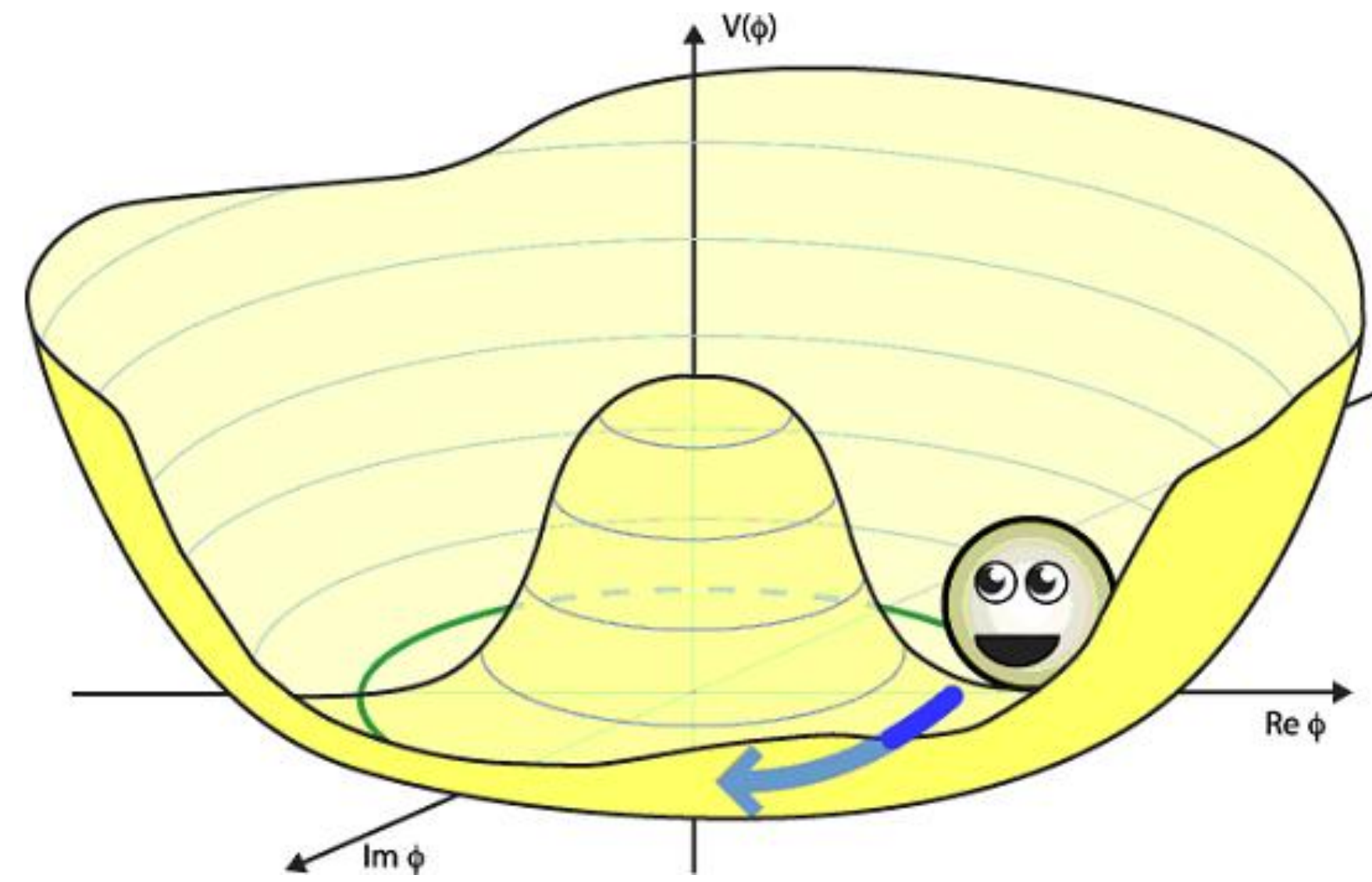
[Philip Tanedo]

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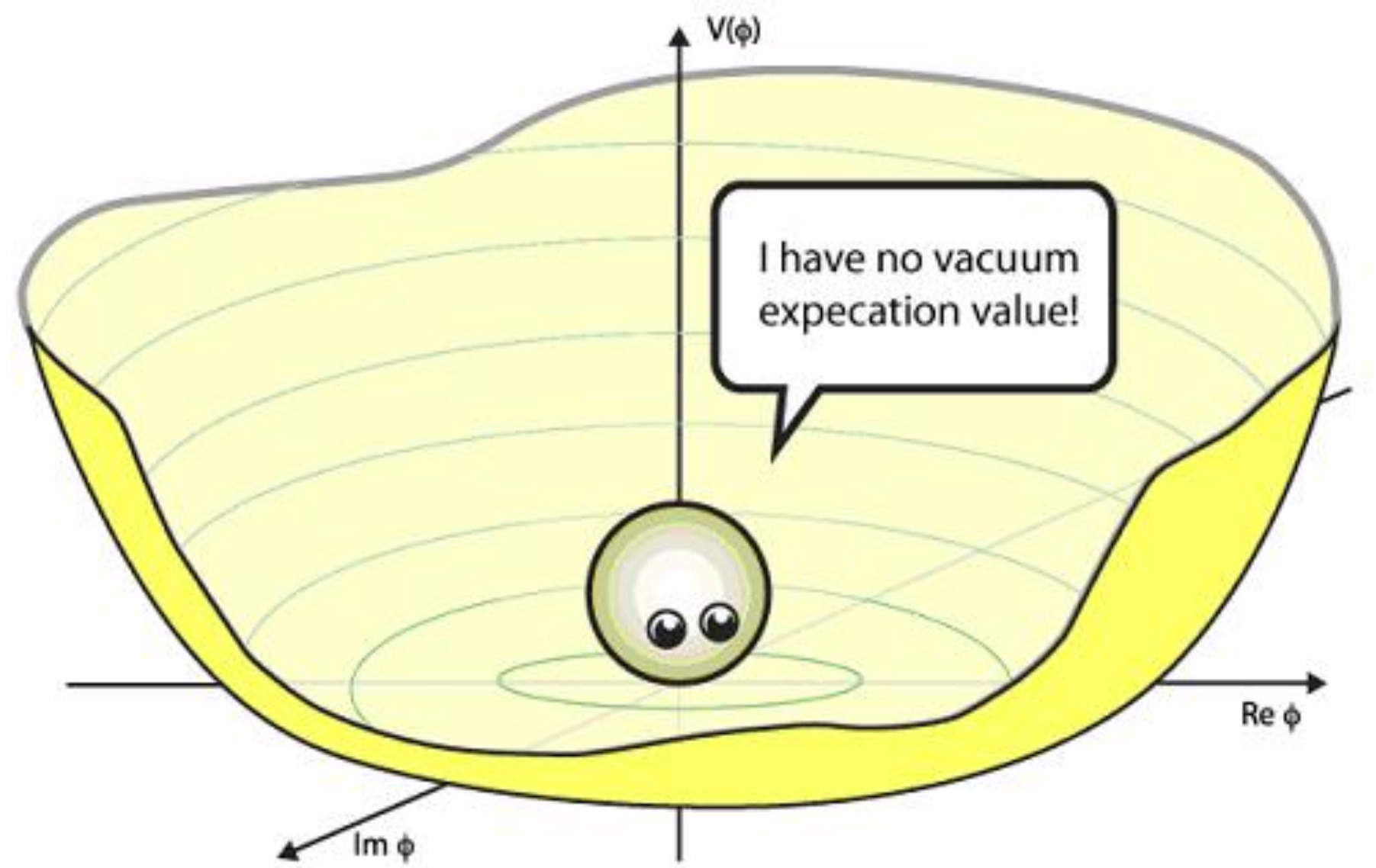


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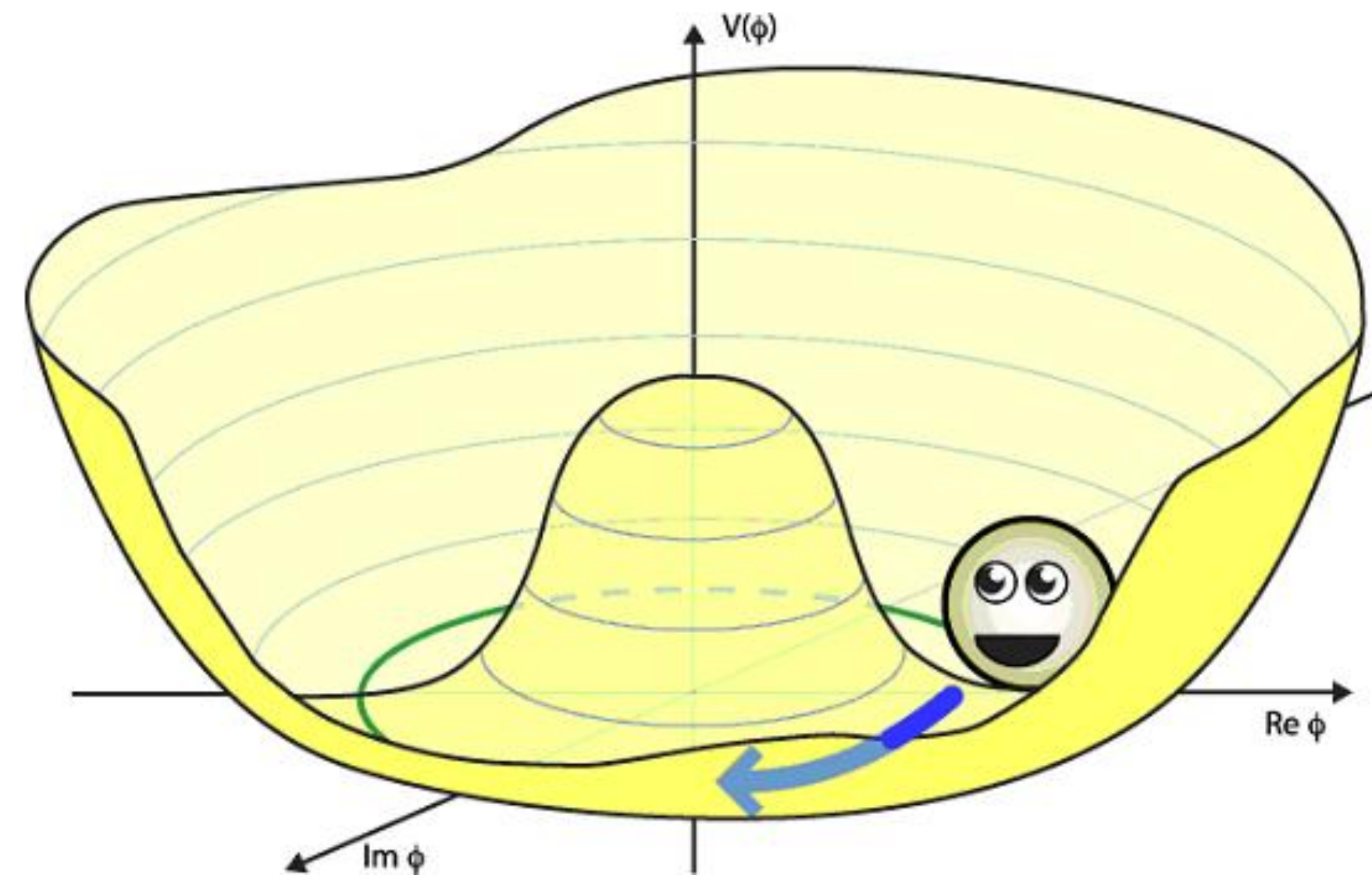


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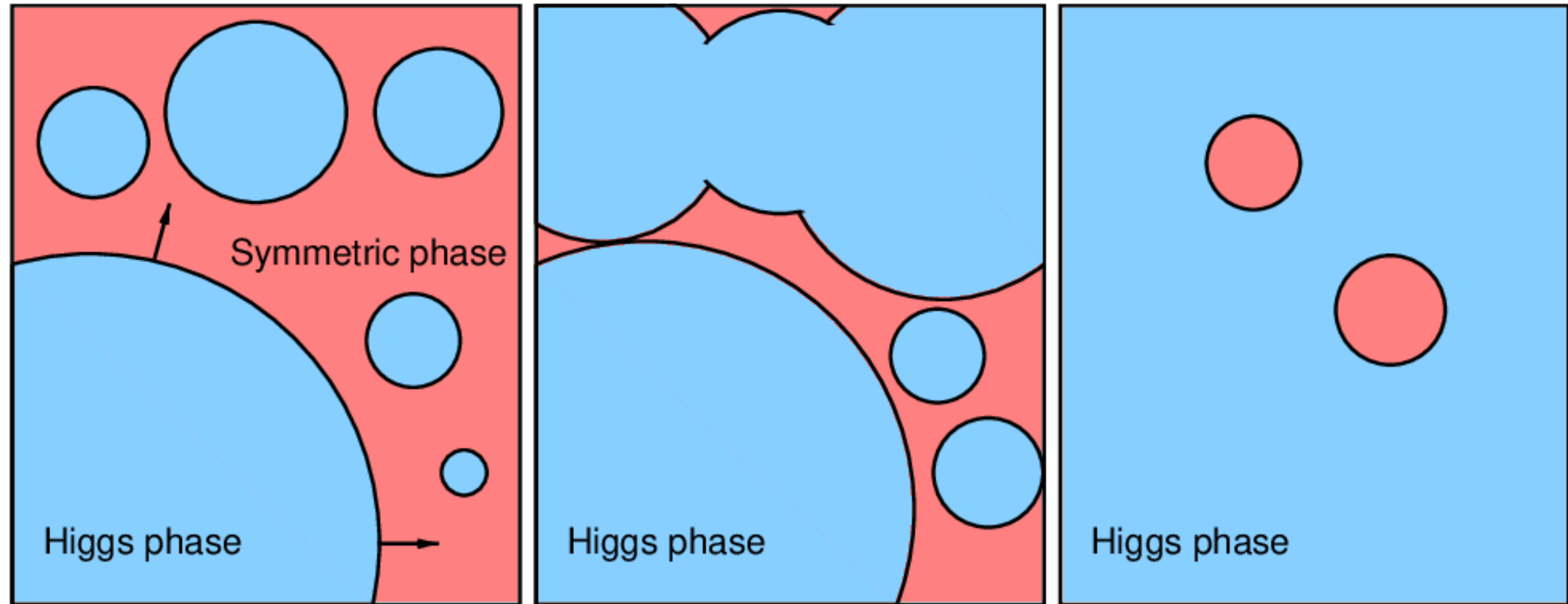


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The SM EWPT is a cross-over. We'll be interested in first-order PTs of BSM scalars



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- Stable
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- Dark
- Not part of the Standard Model
- Abundance known to 2% accuracy

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However, not discovered yet. Maybe phase transitions explain why?



1912.02830 (PRL) - MJB, J. Kopp, A. Long

2112.08987 (JHEP) - MJB, M. Breitbach, J. Kopp, L. Mitnacht, Y. Soreq

| Field | Spin | \mathbb{Z}_2 |
|--------|---------------|----------------|
| S | 0 | +1 |
| χ | $\frac{1}{2}$ | -1 |

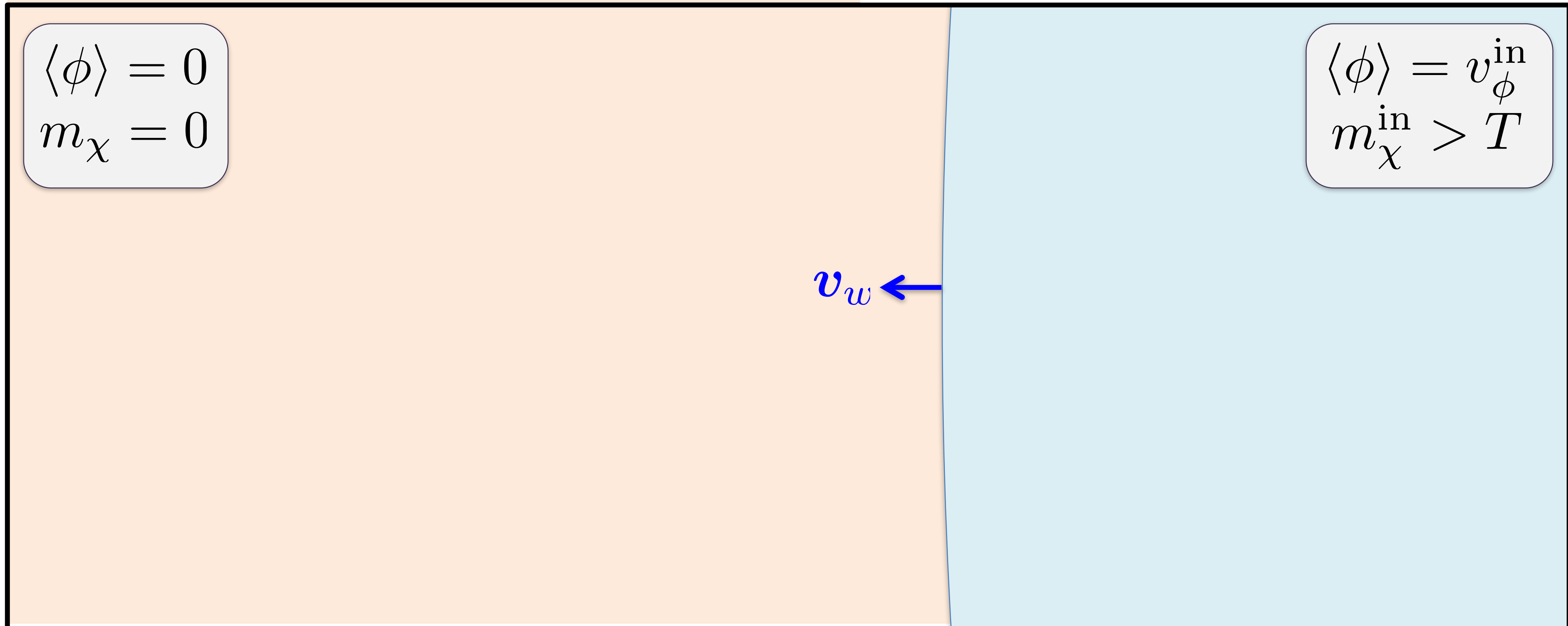
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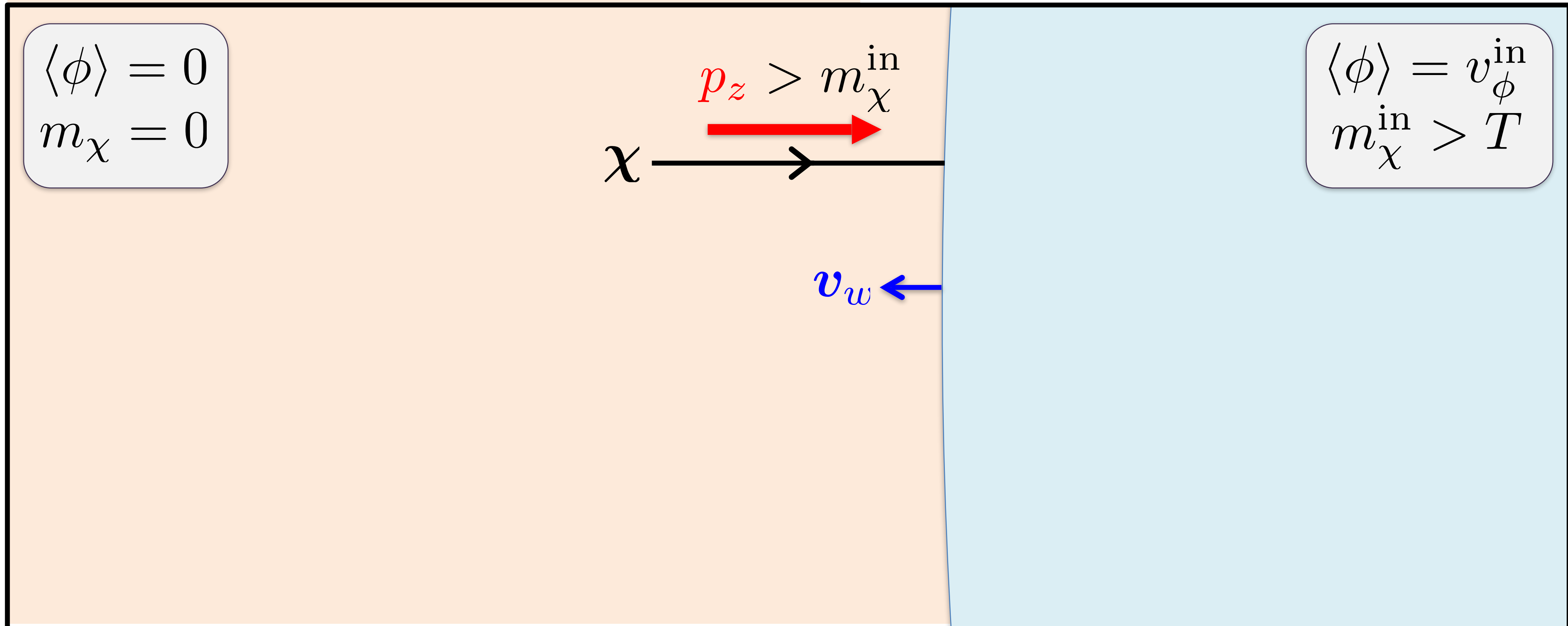
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$$-y_\chi \phi \bar{\chi} \chi \xrightarrow{\text{PT}} -y_\chi \langle \phi \rangle \bar{\chi} \chi = -m_\chi \bar{\chi} \chi$$

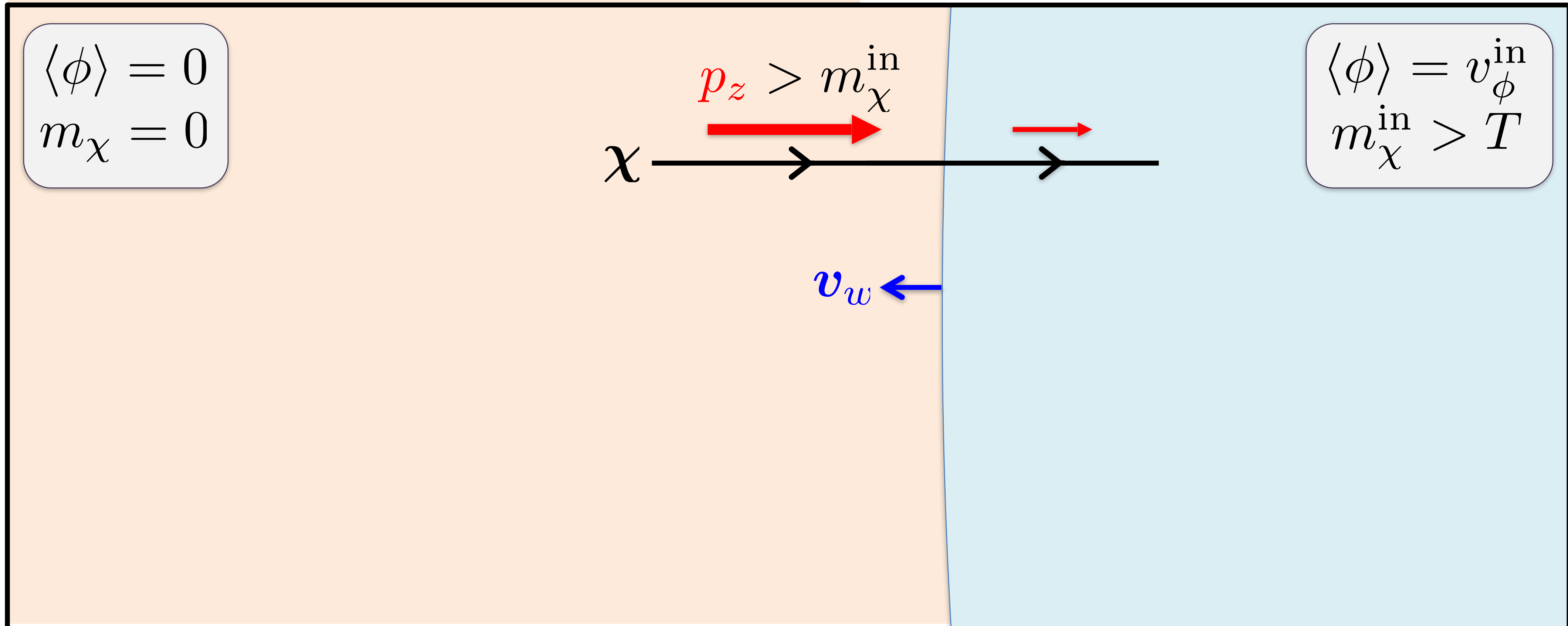
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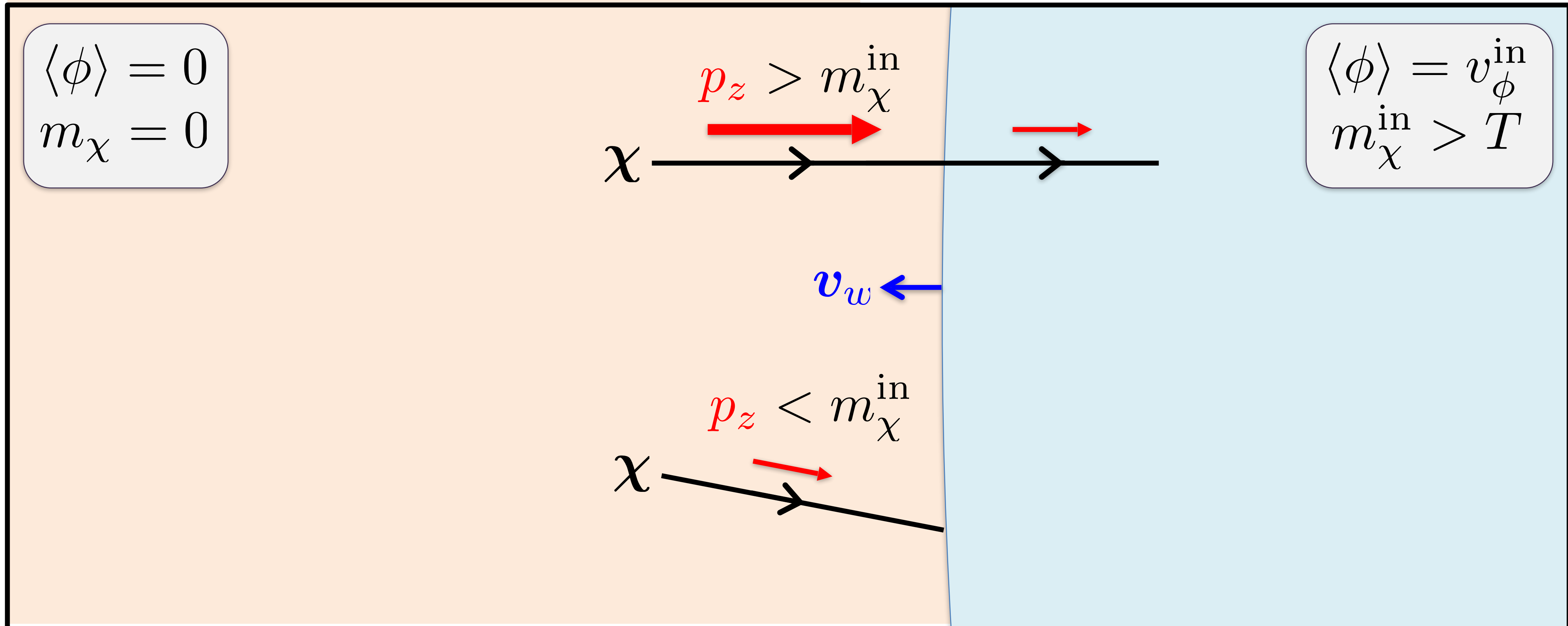
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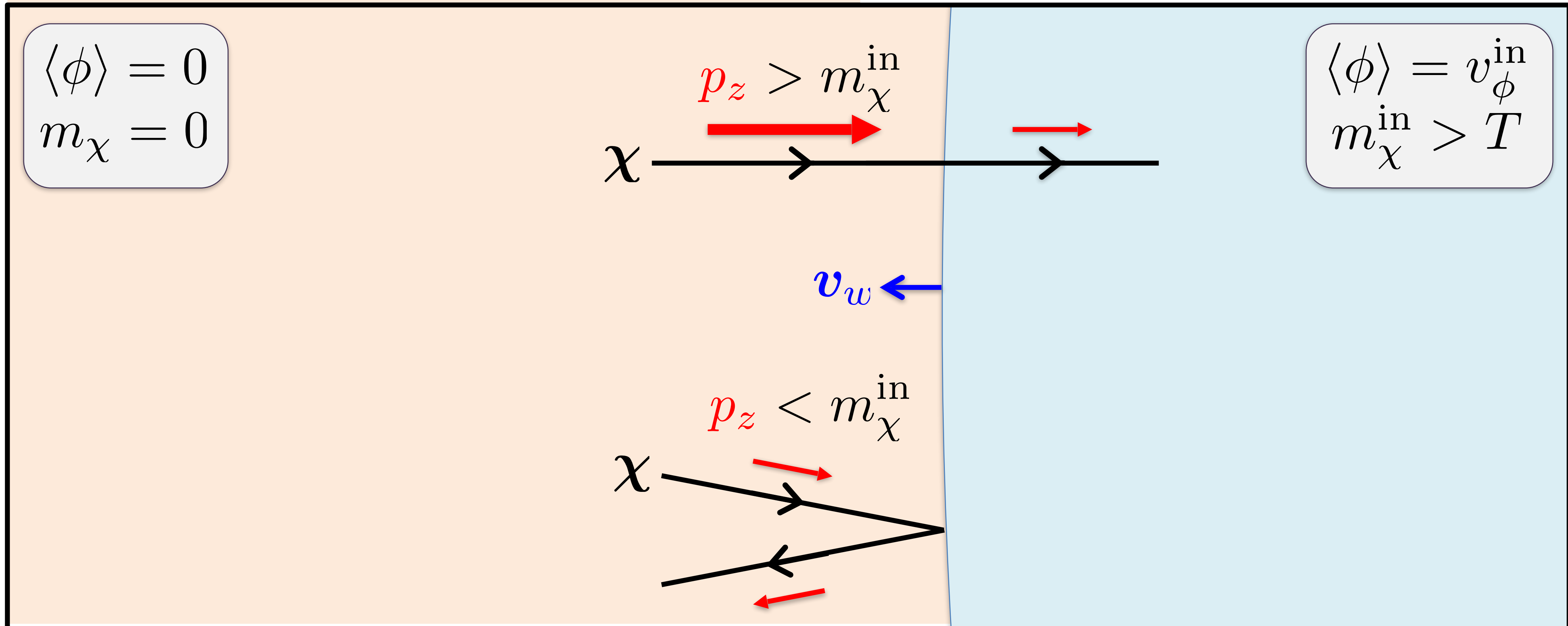
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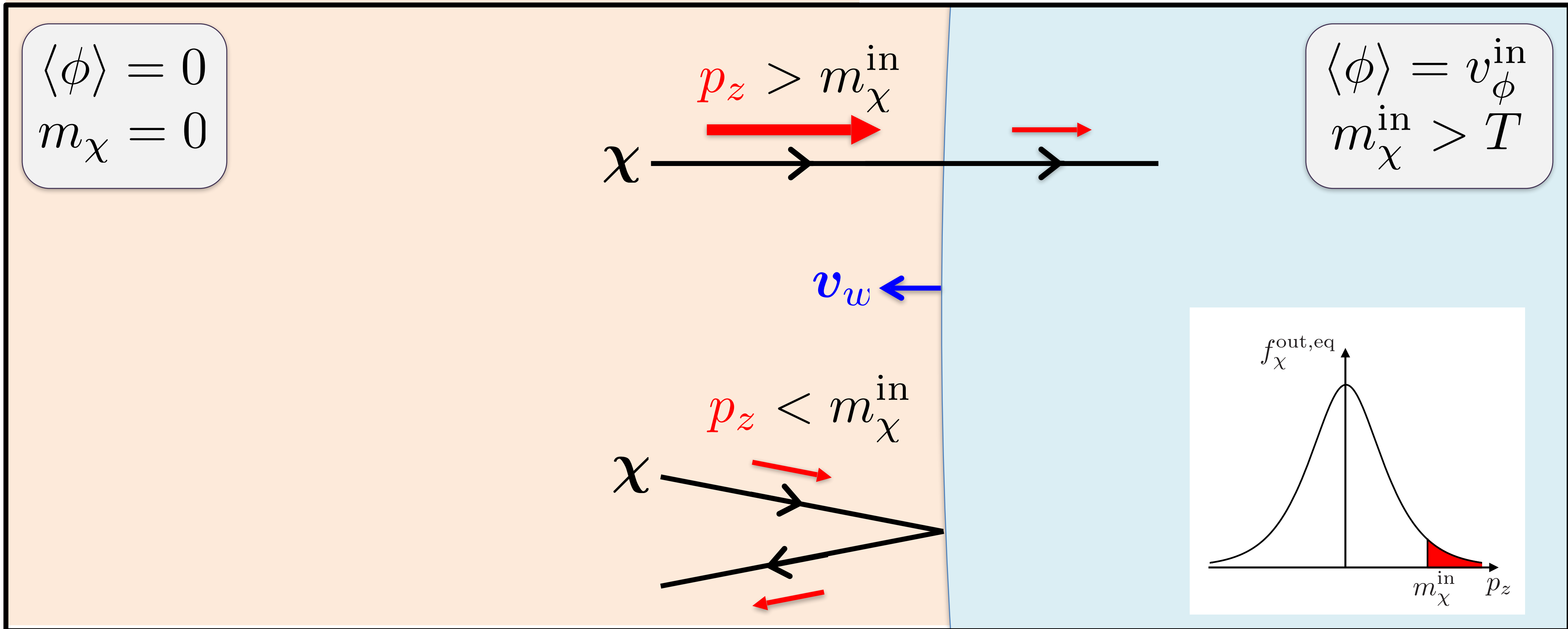
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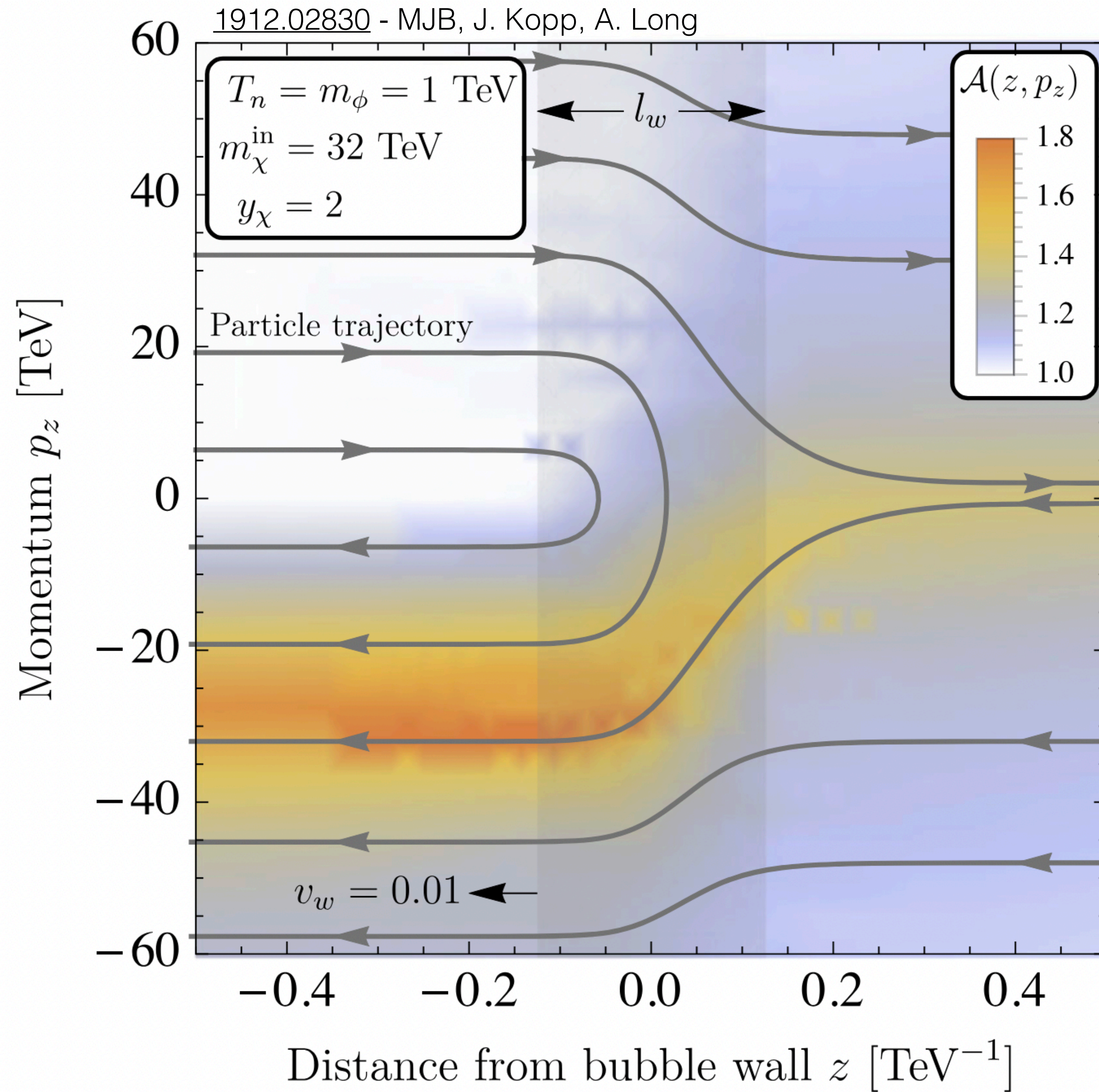
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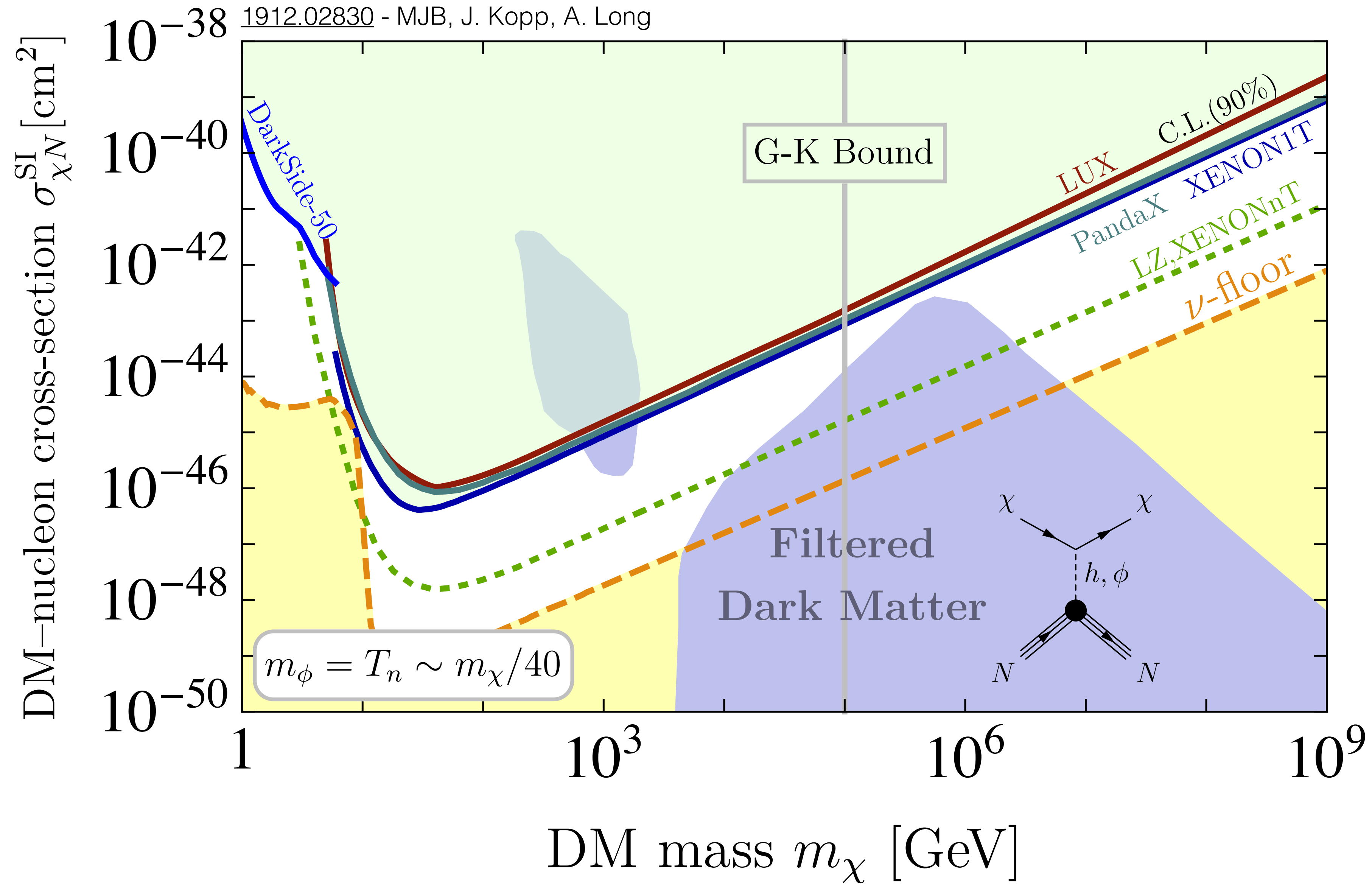
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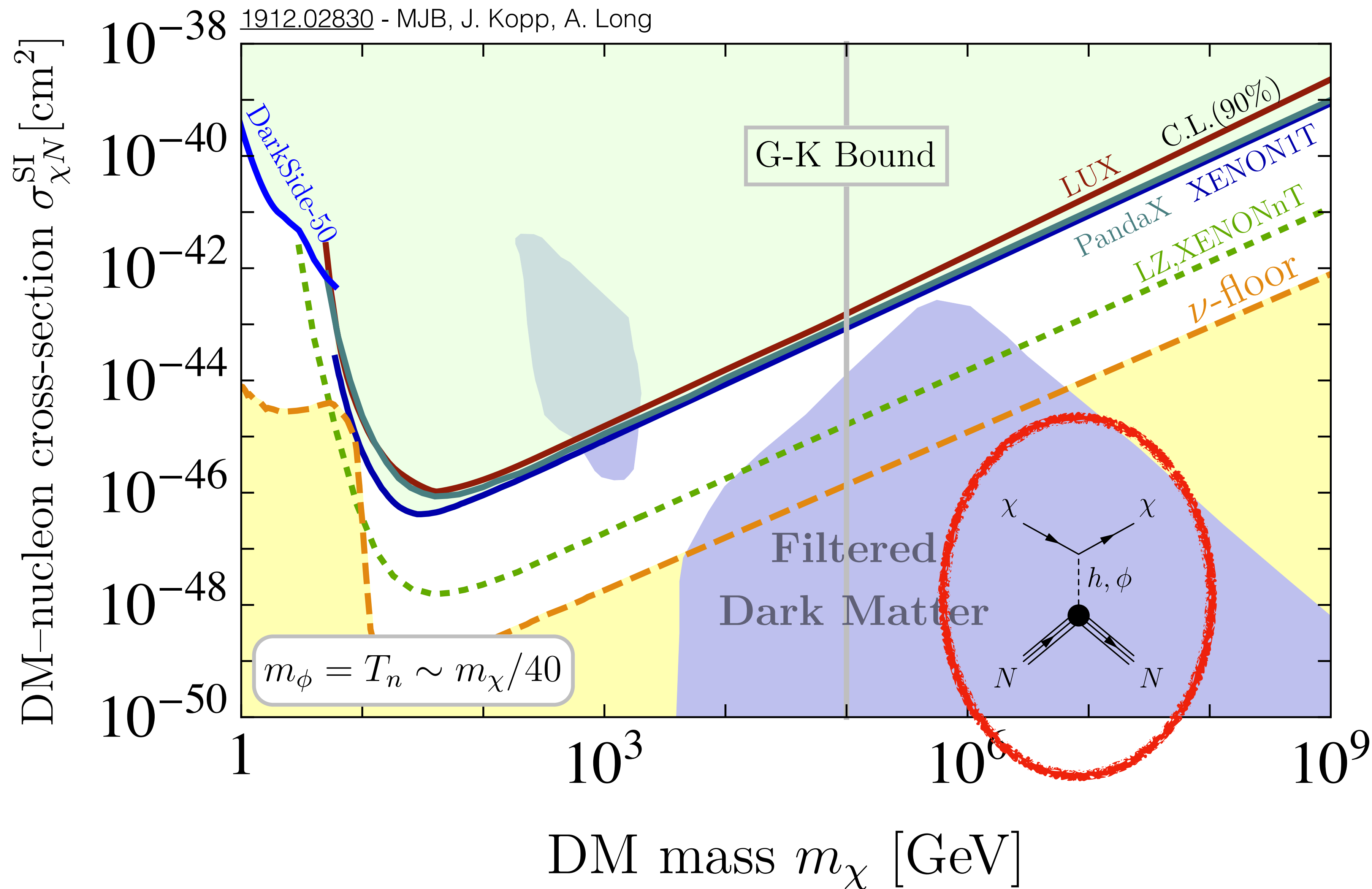
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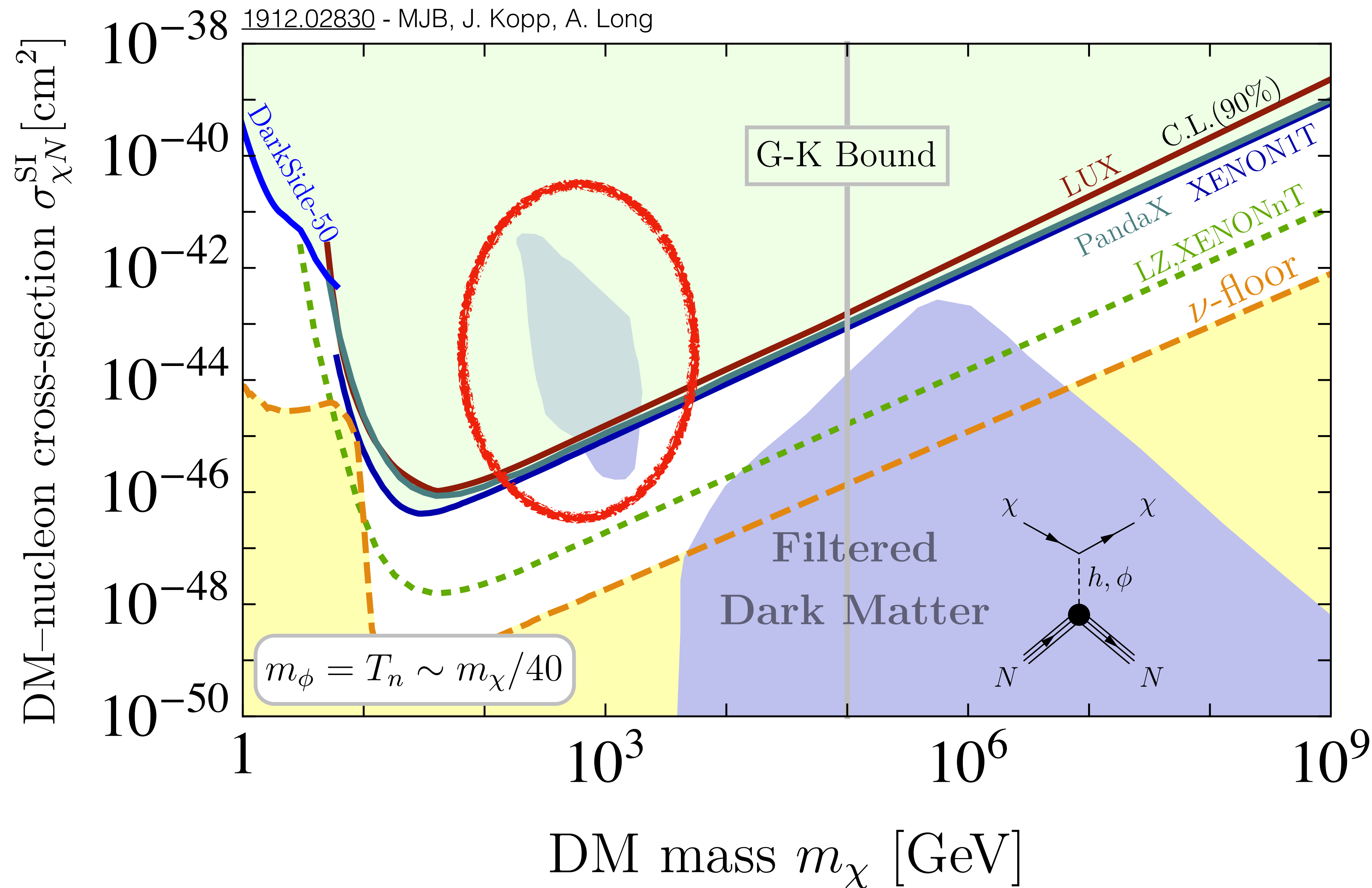
Can finally solve using the Method of Characteristics

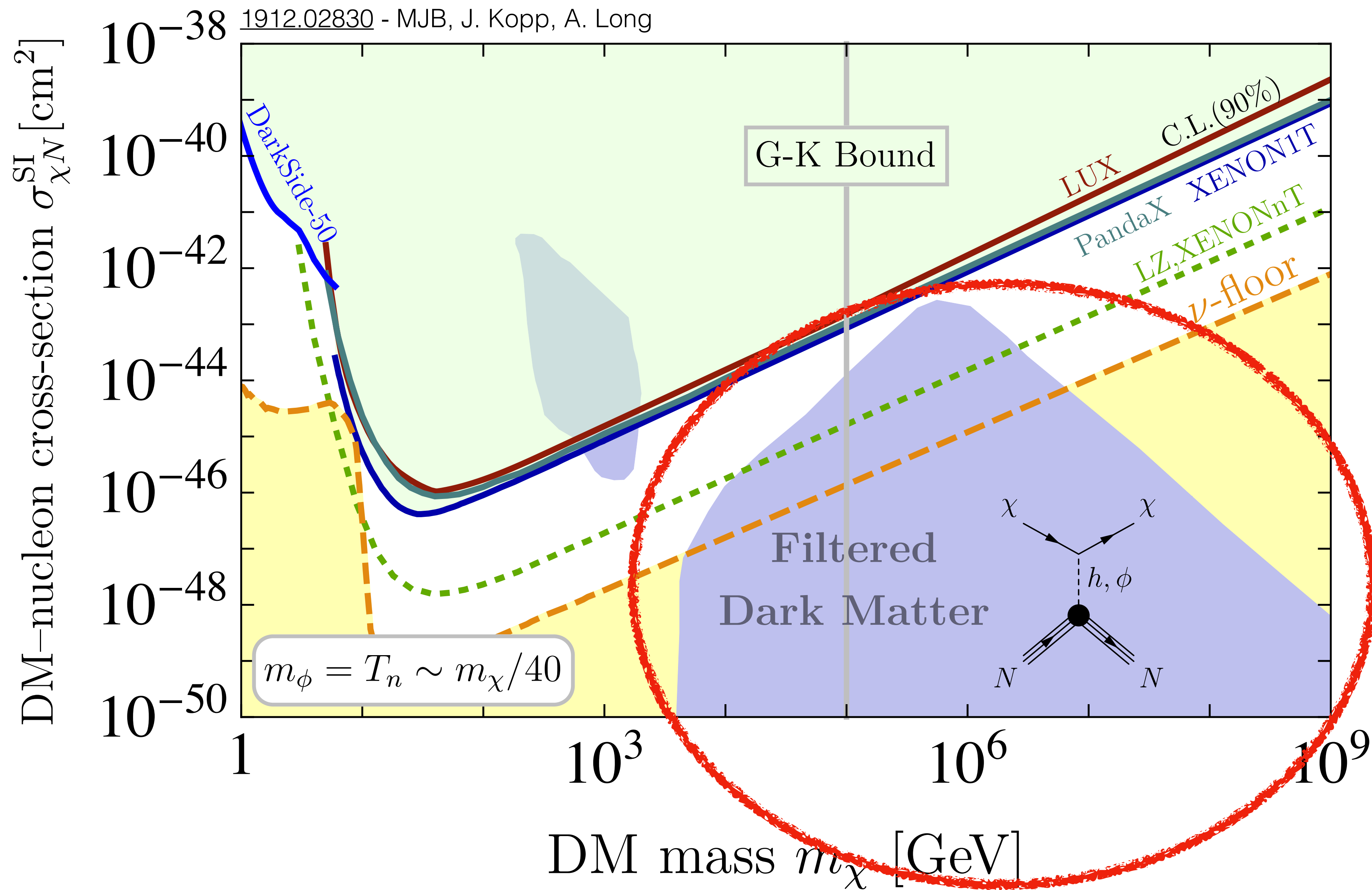
Dark Matter: Filtered Dark Matter







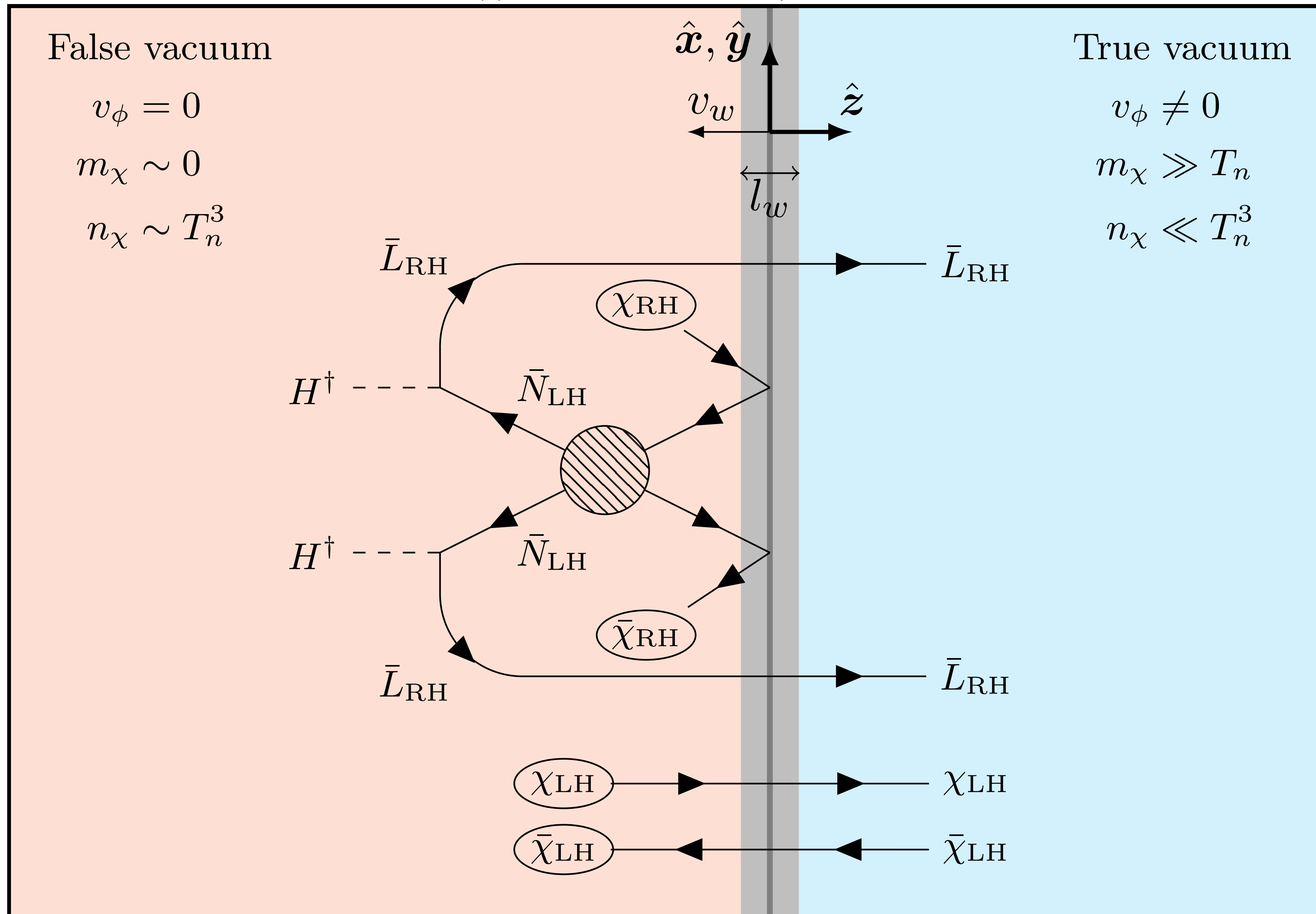


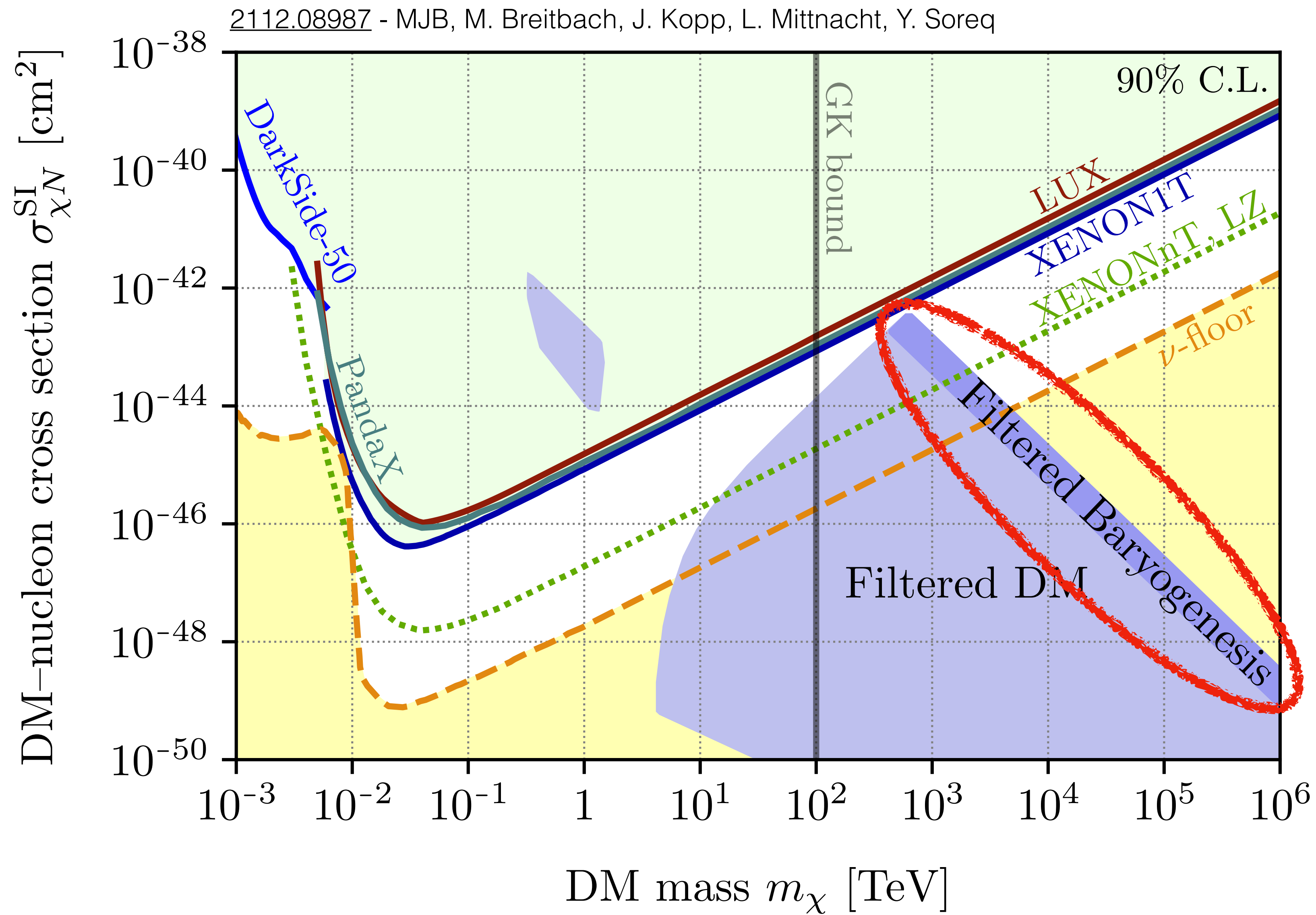


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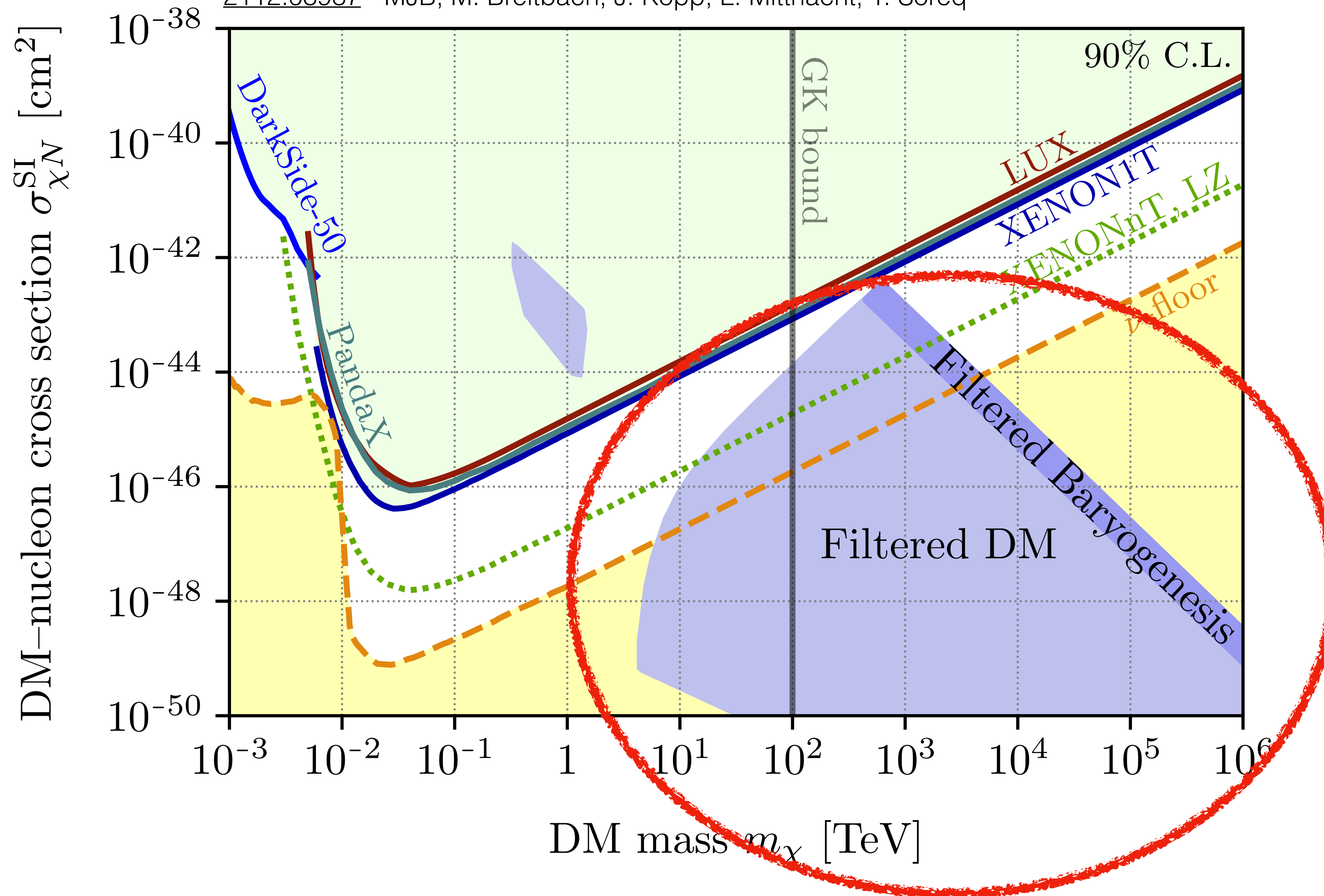


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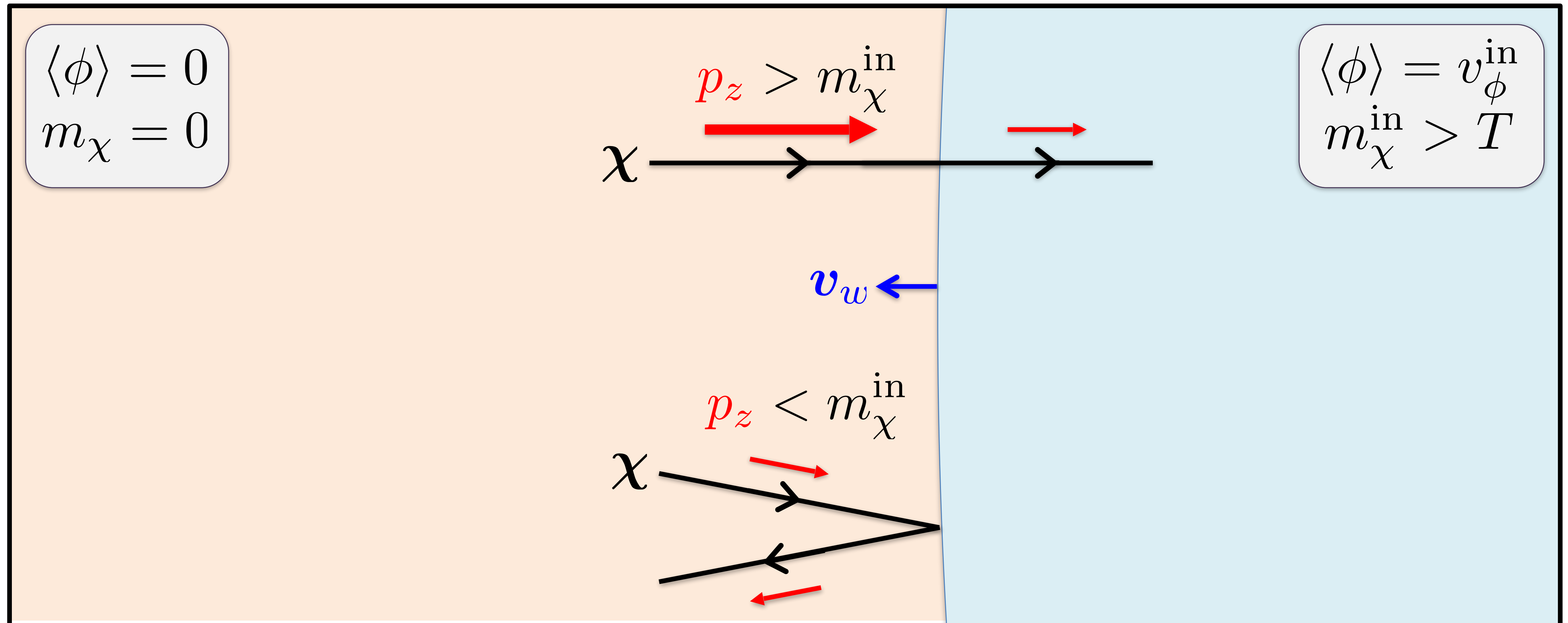


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- Production mechanisms
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- We proposed a new production mechanism based on Filtered DM

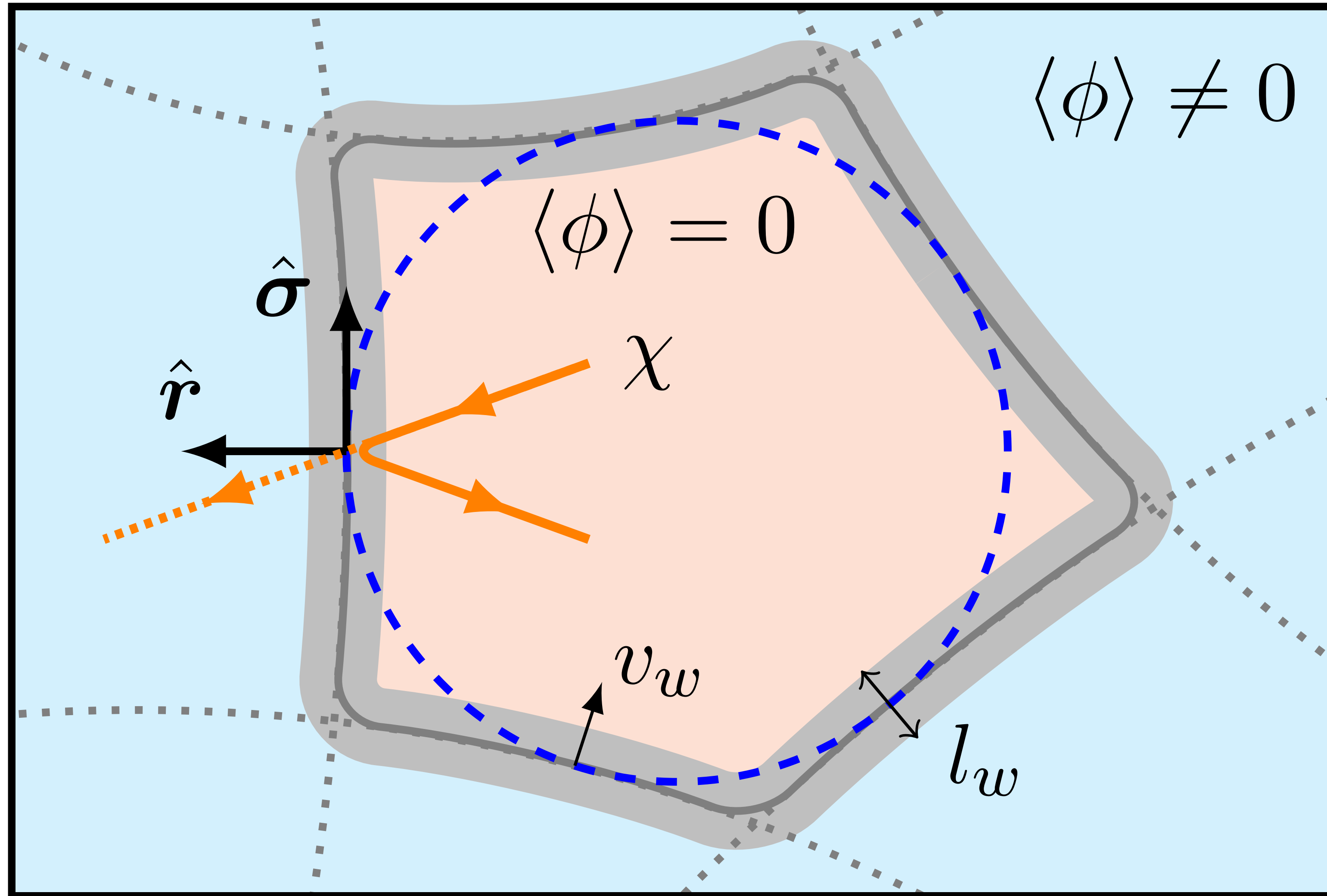
Primordial Black Holes Production

2105.07481 - MJB, M. Breitbach, J. Kopp, L. Mitnacht

2110.00005 - MJB, M. Breitbach, J. Kopp, L. Mitnacht



2105.07481, 2110.00005 - MJB, M. Breitbach, J. Kopp, L. Mitnacht





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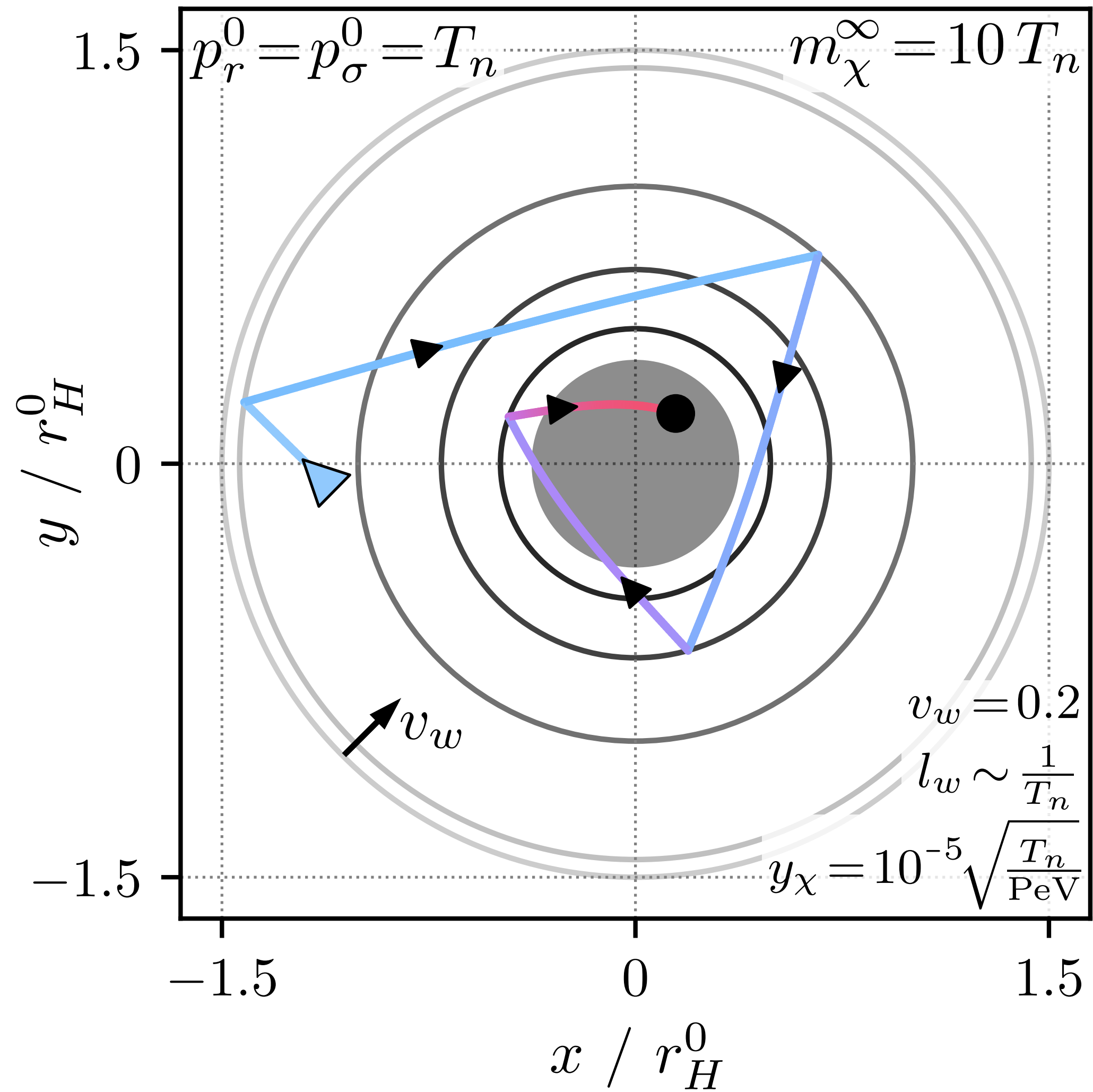
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Now considerably more complicated:

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- Need to solve in whole volume, not just near wall

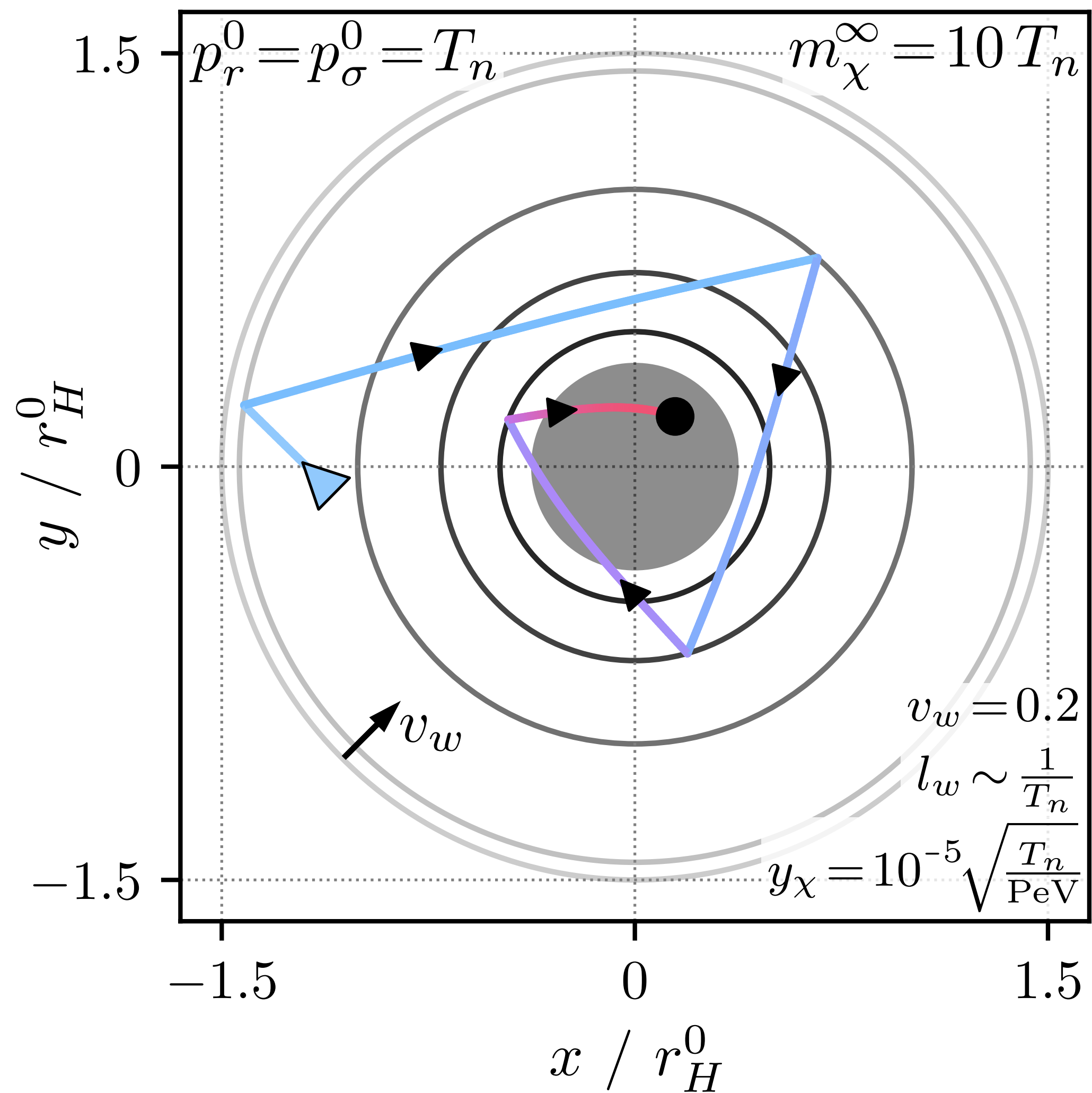
2110.00005 - MJB, M. Breitbach, J. Kopp, L. Mitnacht

Trapped trajectory

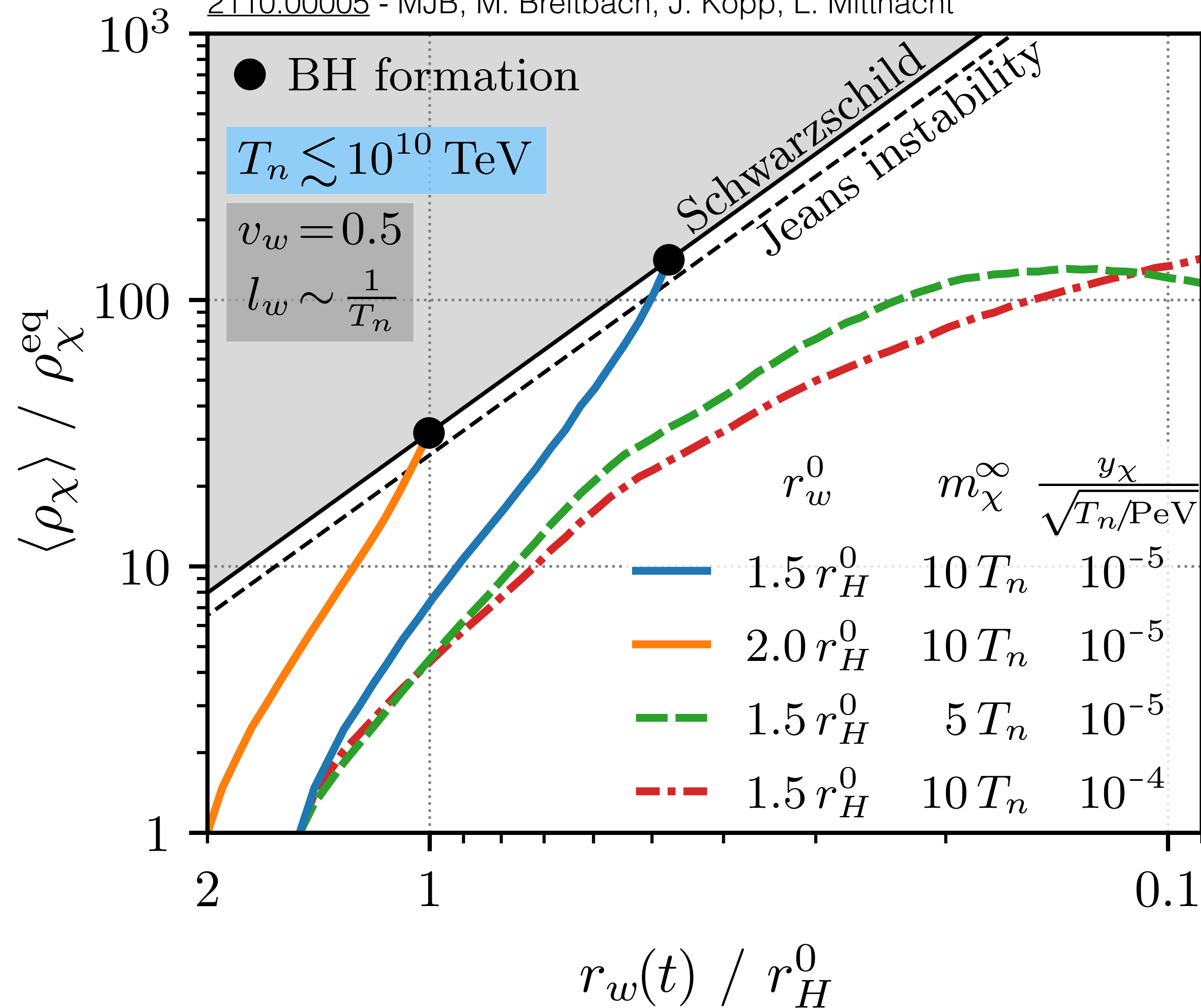


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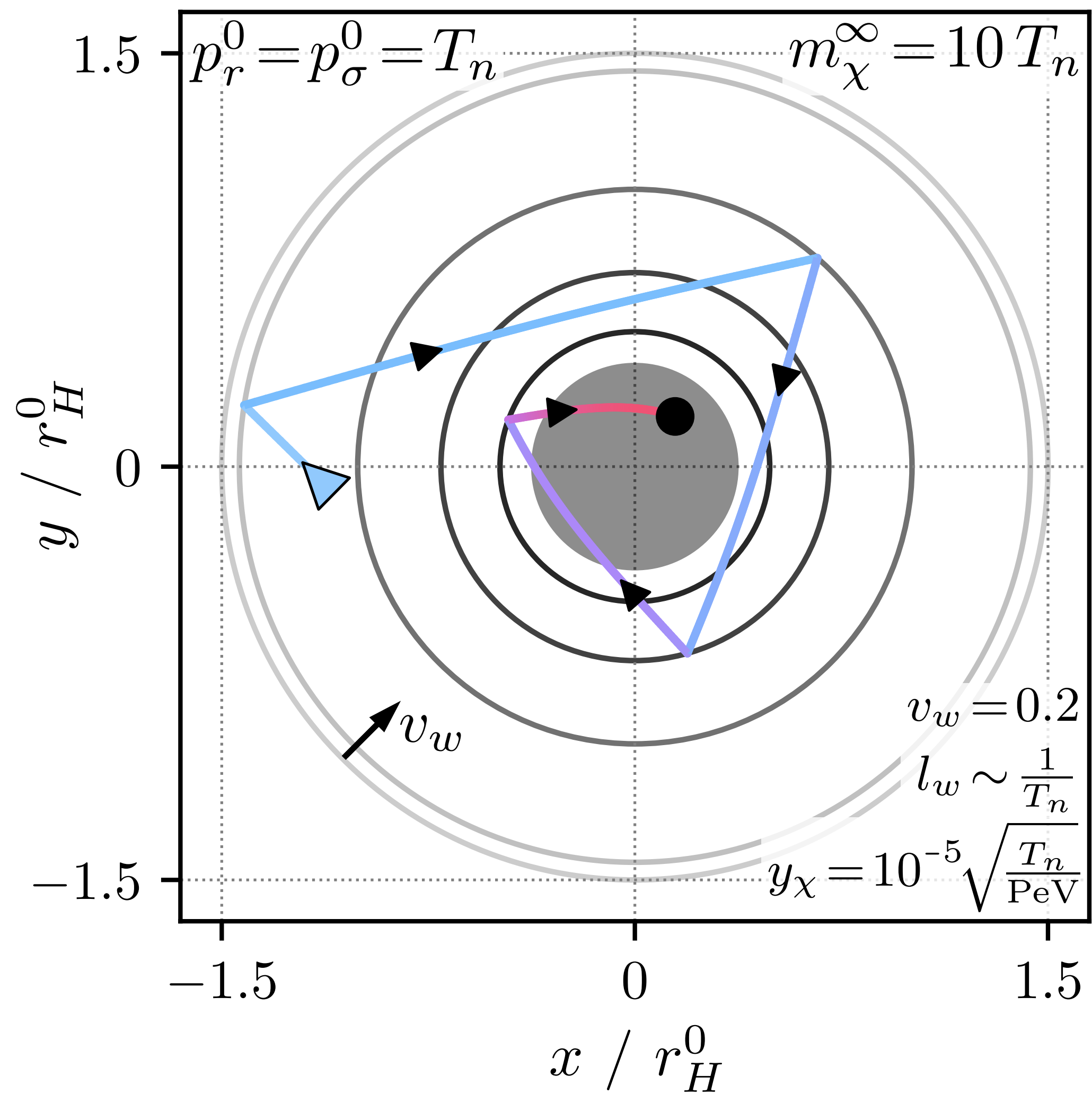


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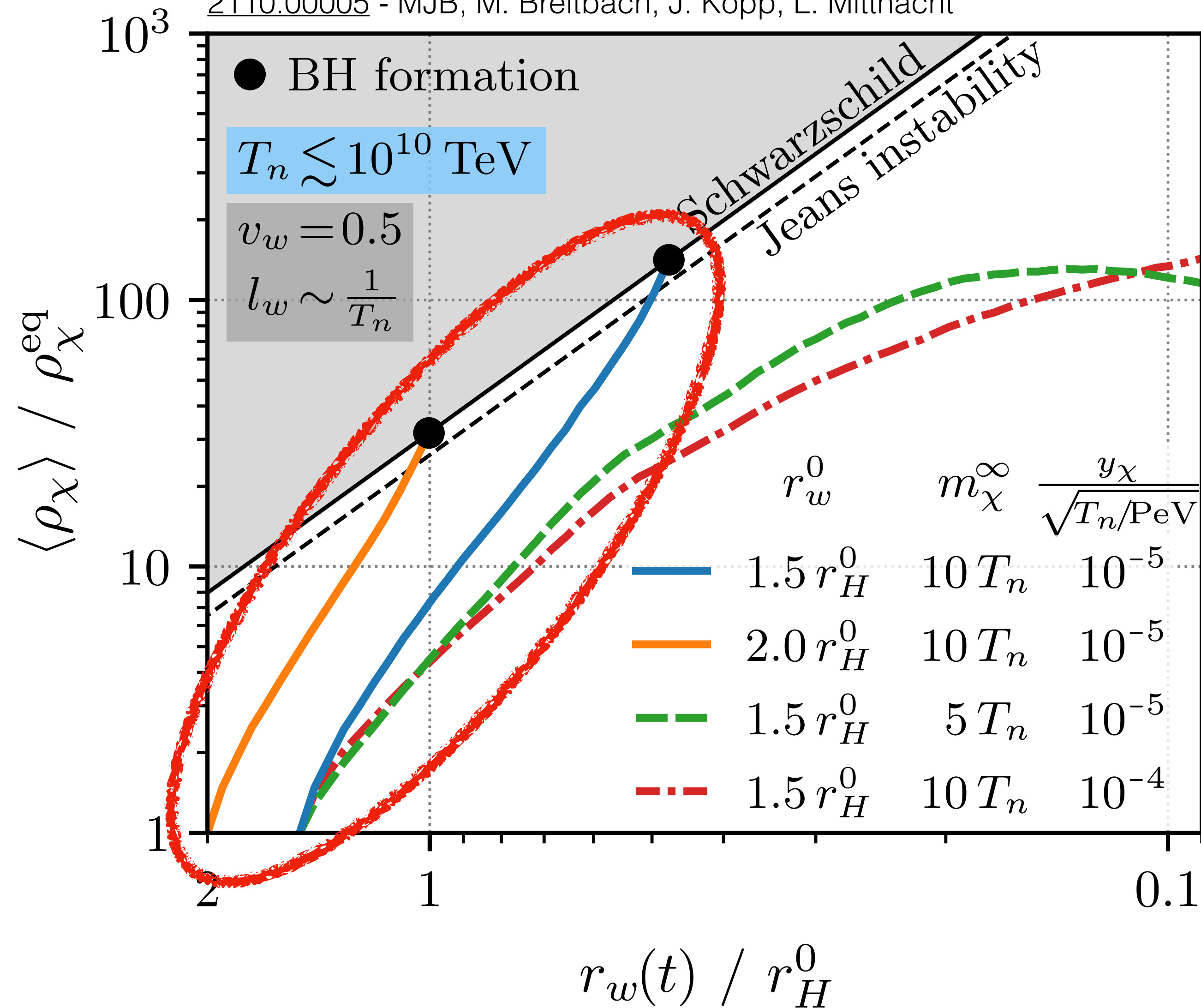


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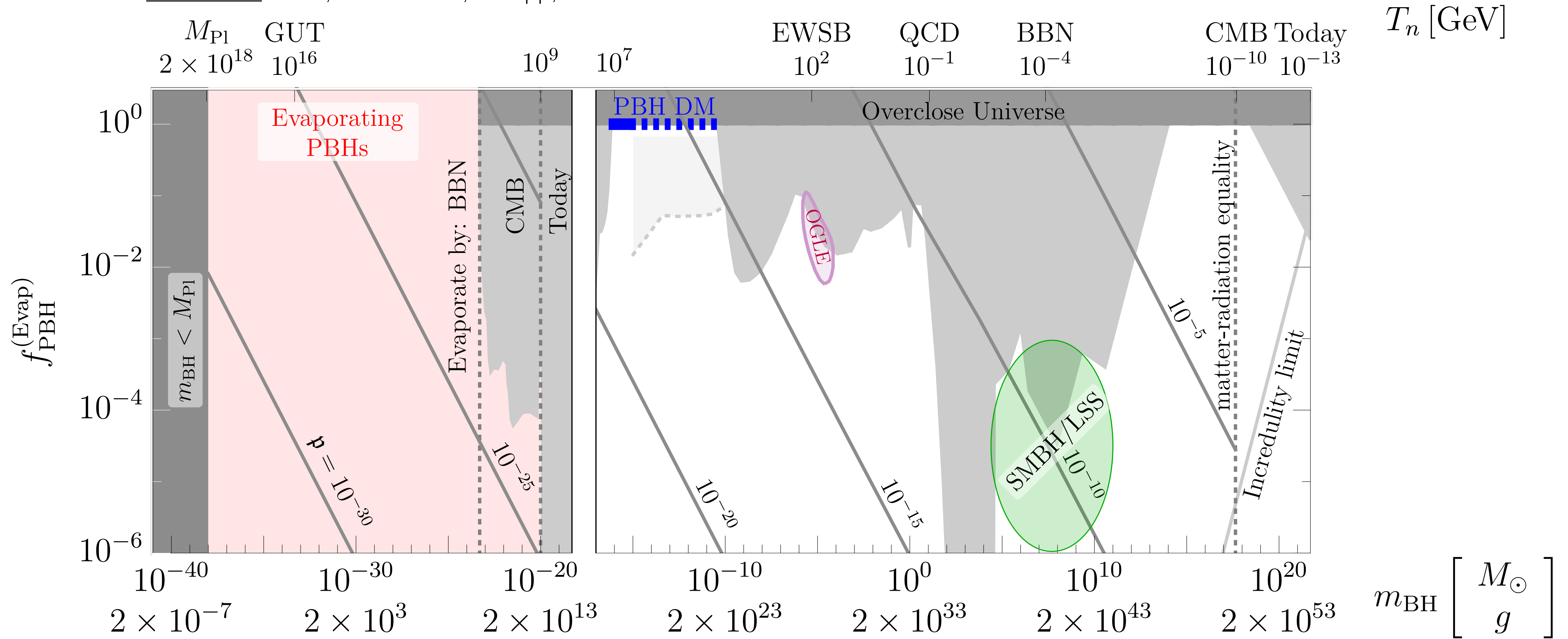
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Primordial Black Holes Production



2105.07481 - MJB, M. Breitbach, J. Kopp, L. Mitnacht



Conclusions



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Thank you!