

Global Fits of sub-GeV Dark Matter

Taylor R. Gray

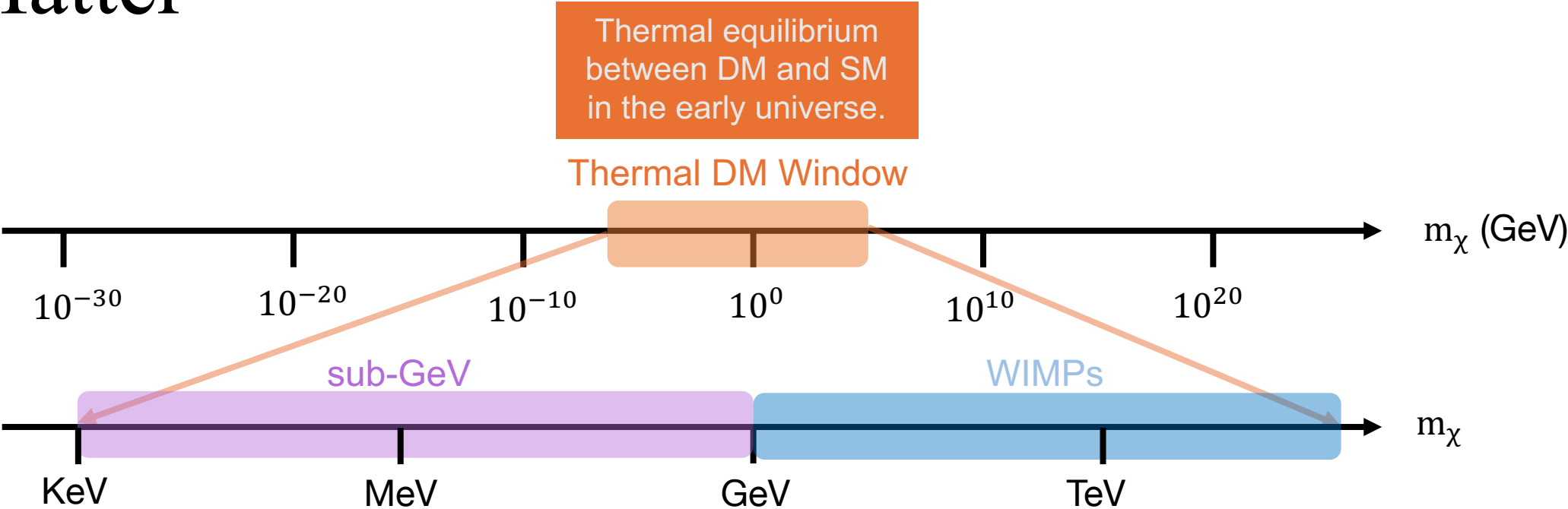
In collaboration with: Sowmiya Balan, Csaba Balazs, Torsten Bringmann, Christopher Cappiello, Riccardo Catena, Timon Emken, Tomás E. Gonzalo, Will Handley, Quan Huynh, Felix Kahlhoefer, and Aaron C. Vincent

Chalmers University of Technology

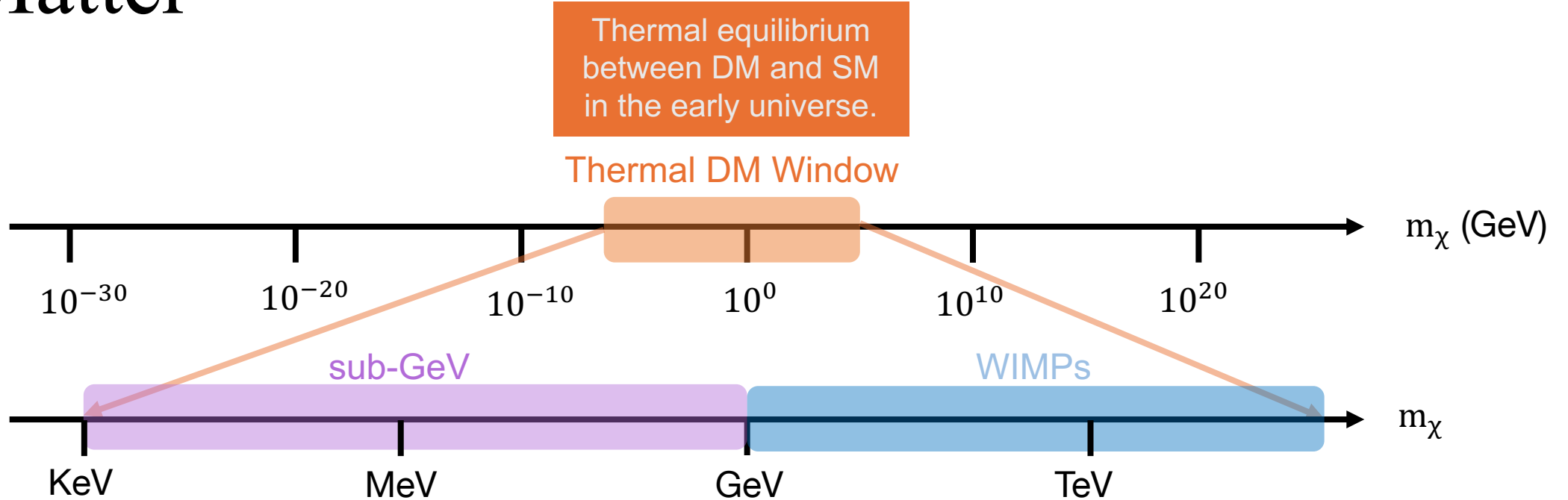
4th EuCAPT Symposium



Sub-GeV Dark Matter

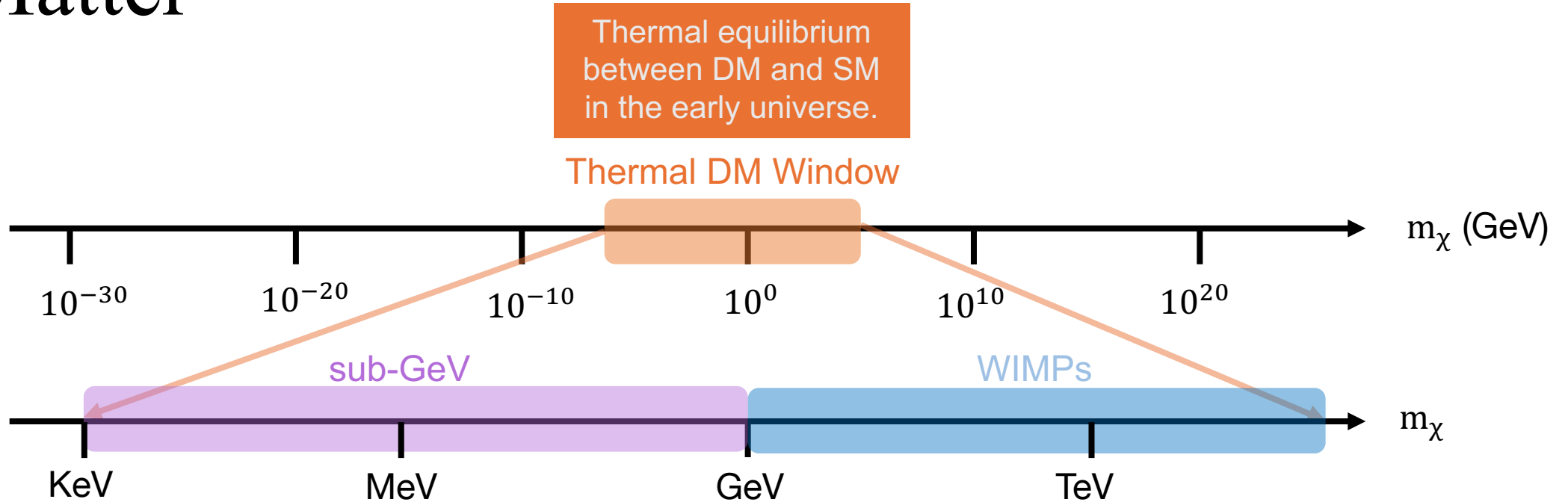


Sub-GeV Dark Matter



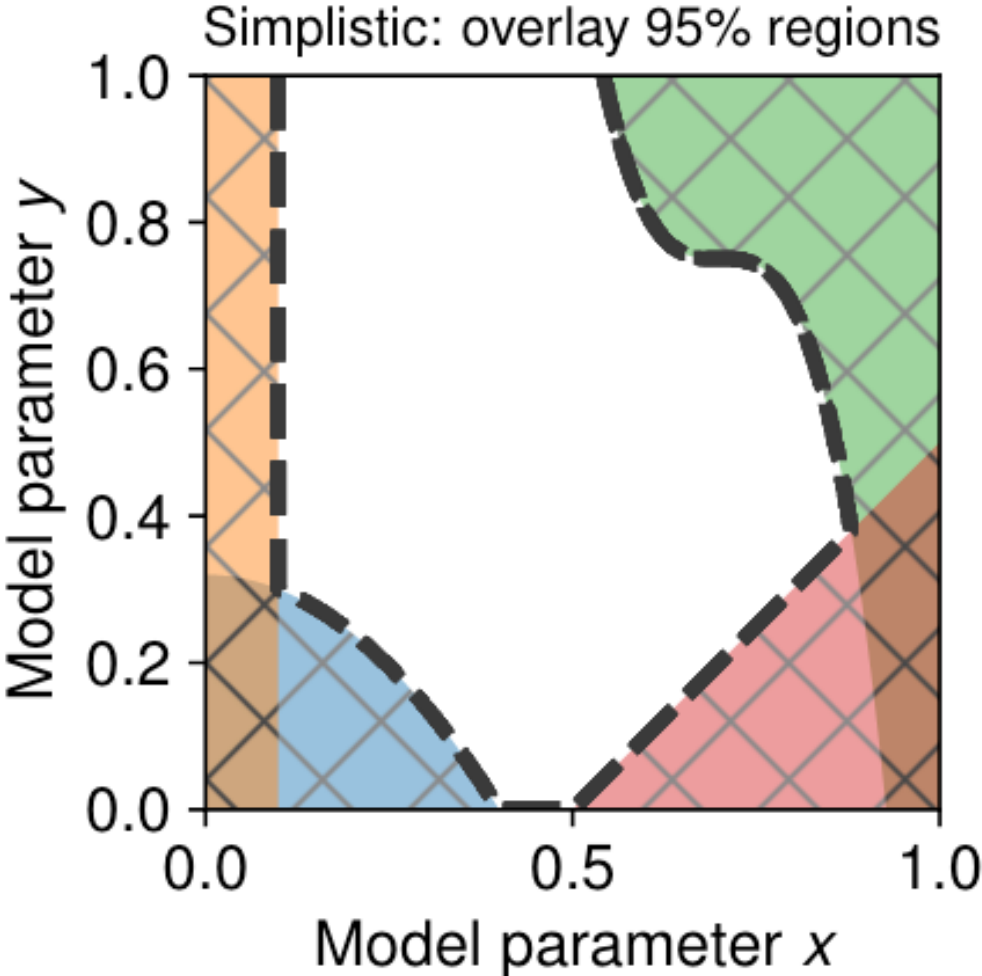
- DM produced through freeze-out near weak scale
- GeV-TeV scale thermal DM already widely tested

Sub-GeV Dark Matter

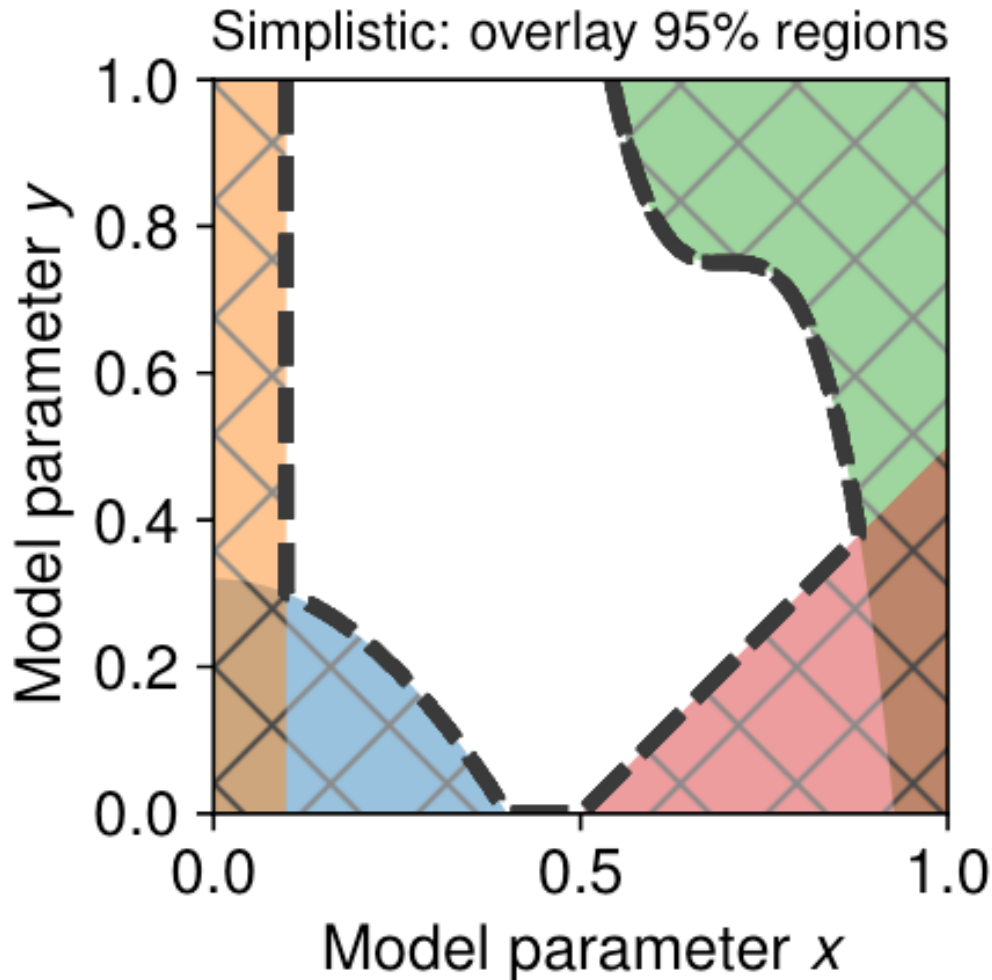


- Sub-GeV DM is largely experimentally **unexplored..**
 - Out of reach of nuclear recoil direct detection expts
 - Electron recoils and accelerator expts
- DM produced through freeze-out near weak scale
- GeV-TeV scale thermal DM already widely tested

Global Fits



Global Fits



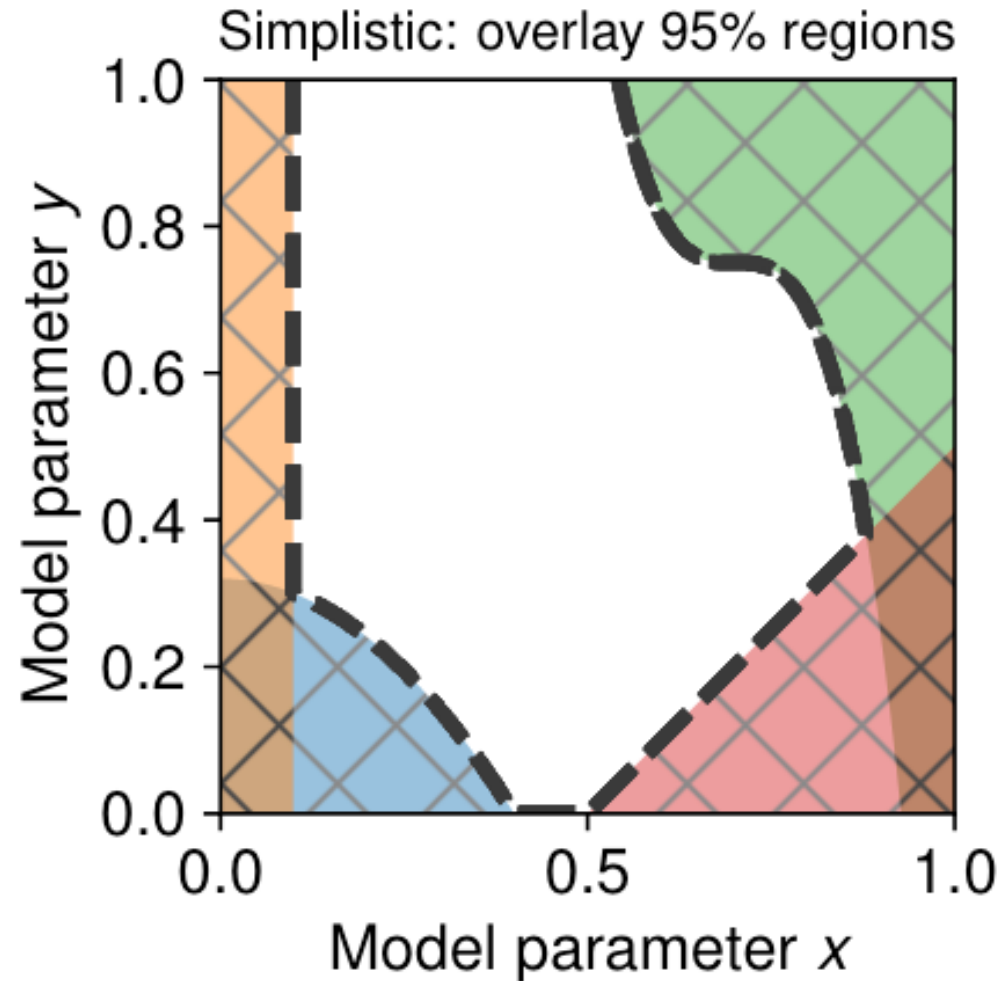
95% confidence exclusion bound:
rate at which the true parameter values are excluded is limited to 5%

Global Fits



Many experiments with their own exclusion bounds.
If you approximate the combined exclusion bound as the intersection..

$$\text{Error rate} = 1 - 0.95^n$$



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Global Fits

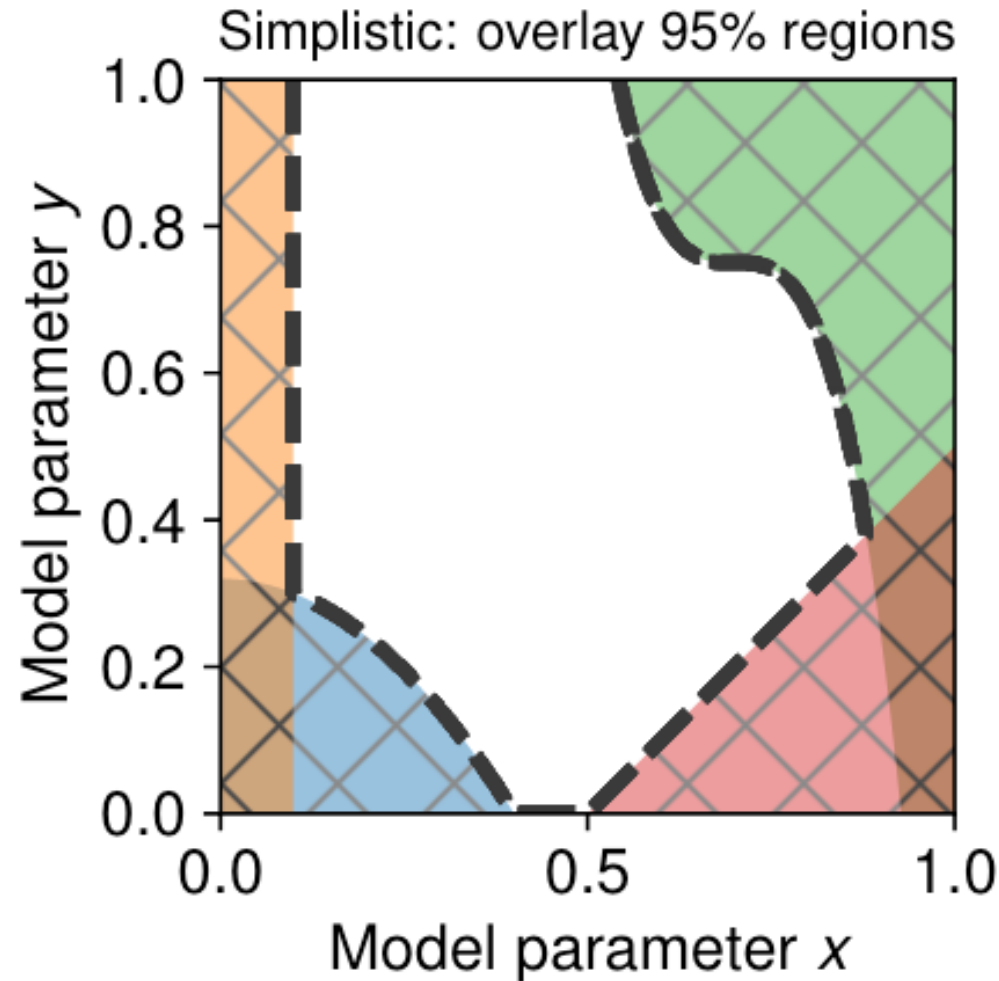


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Example: 5 experiments

- error rate = $1 - 0.95^5 = 23\%$
- falsely reporting 95% C.L.



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Global Fits

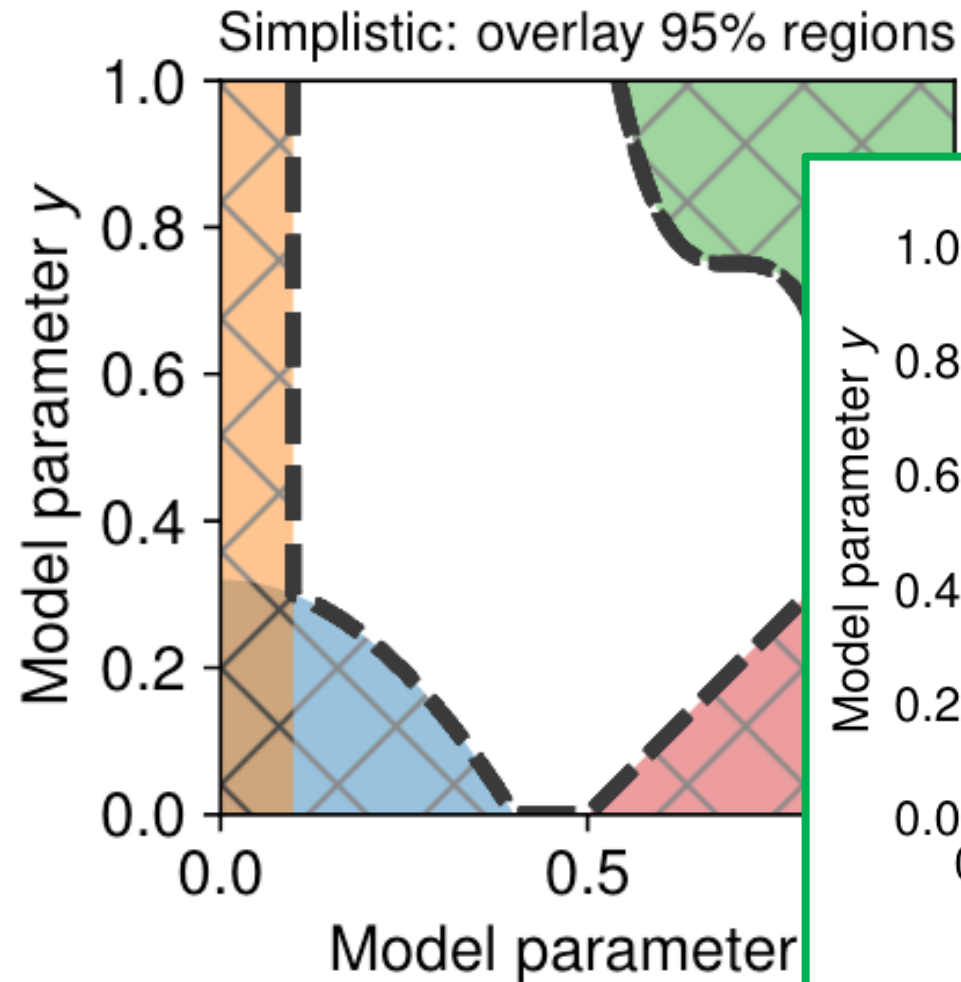


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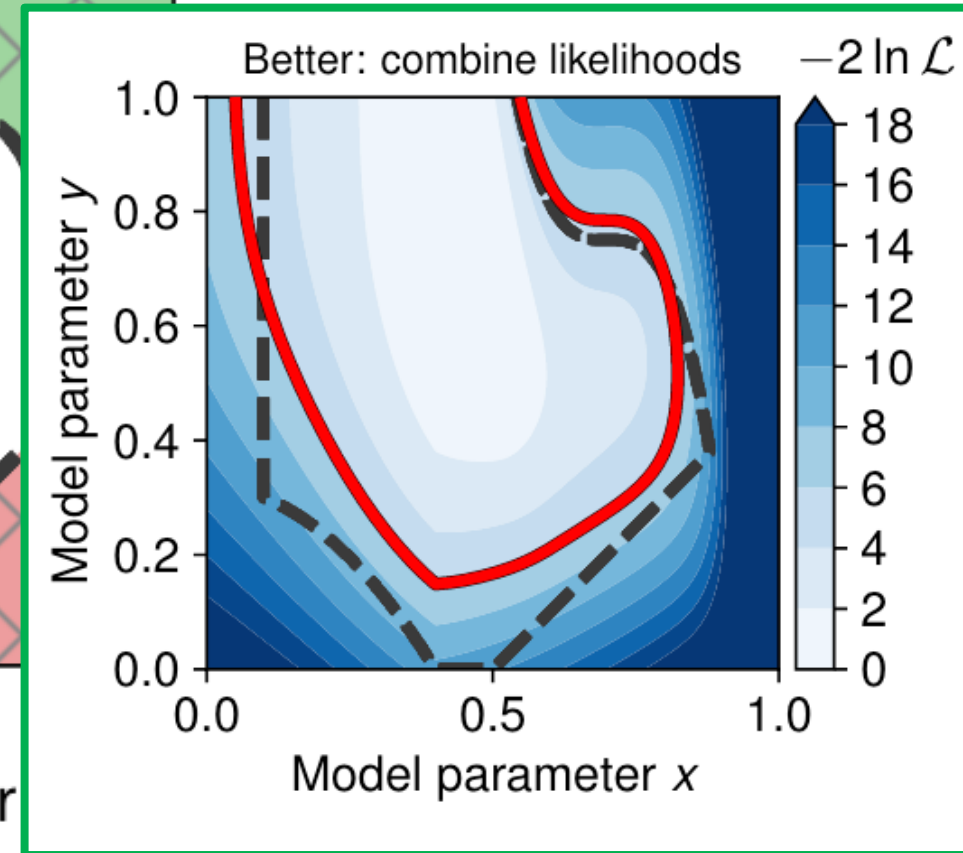
Example: 5 experiments

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Composite likelihood function,

$$\mathcal{L}_{\text{total}} = \mathcal{L}_{\text{DD}} \times \mathcal{L}_{\text{ID}} \times \mathcal{L}_{\text{Collider}} \times \dots$$



Global Fits of sub-GeV DM

Bayesian and Frequentist scans of
complex scalar and Dirac fermion DM

We consider constraints from:

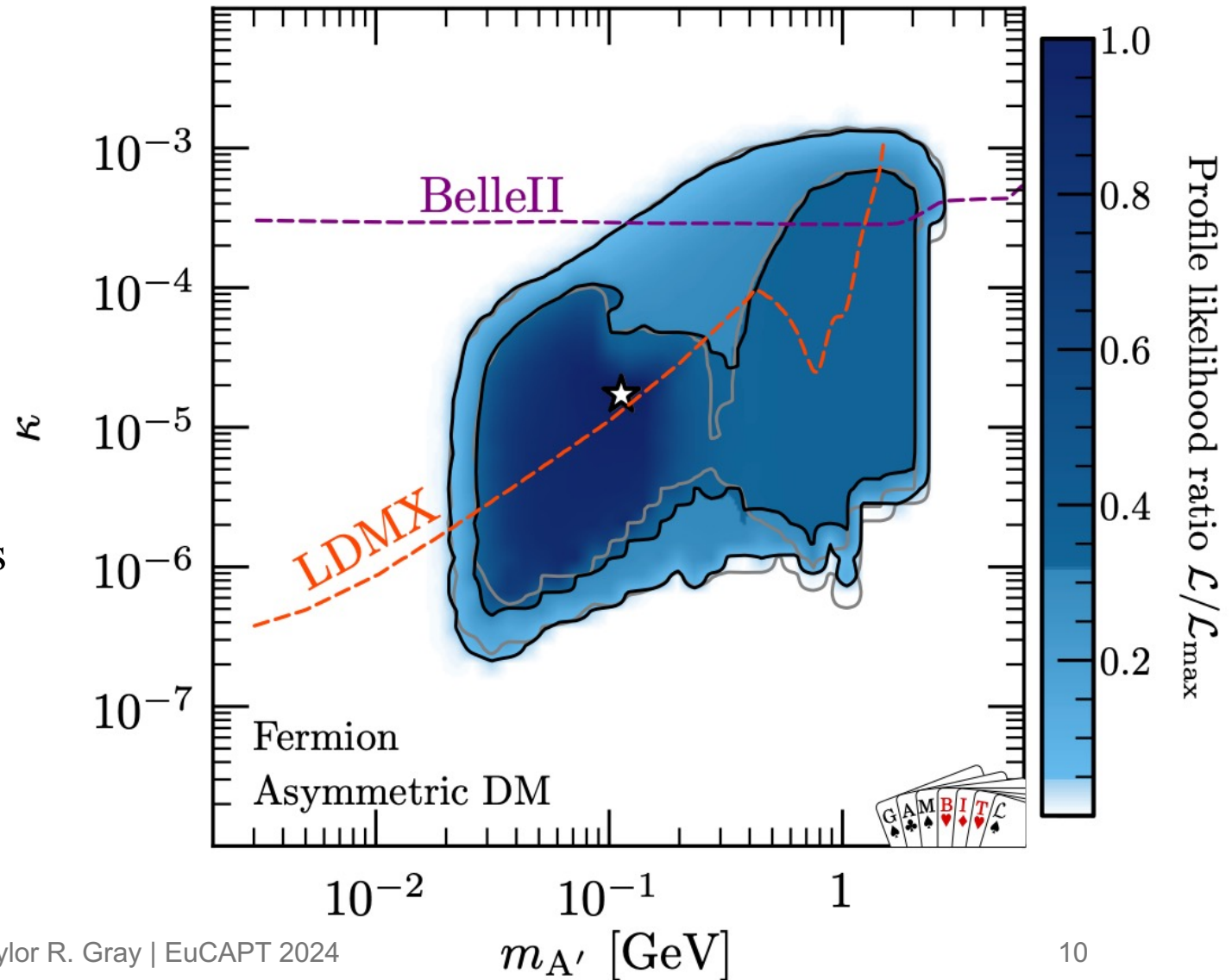
- Cosmology
- Astrophysics
- Accelerator experiments
- Direct detection

Dirac fermion DM subject to strong constraints from indirect detection

- Relax by introducing asymmetry

Near-future experiments can probe significant parts of the allowed parameter space

$$m_{A'} = 2.5m_{DM}$$
$$\alpha_{DM} = 0.3$$



Summary

- Global fits on models of **sub-GeV DM with a dark photon** using implementation of **GAMBIT**
- **Fermionic DM**
 - Preferred region is resonant freeze-out
 - Or, introduce asymmetry
- **Scalar DM**
 - Weak indirect detection constraints
 - Subject to constraints from fixed target/collider experiments

