Neutrino BSM Theory

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Neutrino physics

- observation of neutrino oscillations: **one of the few signs** of physics beyond the SM
- neutrinos could be first messenger of the BSM sector $\rightarrow$ **neutrino windows to new physics**
- still many **open questions** in neutrino physics: leptonic CPV, flavor symmetries, neutrino mass scale, mass ordering, nature/origin neutrino mass term, new neutrino interactions, sterile neutrinos, connections to other open problems of SM

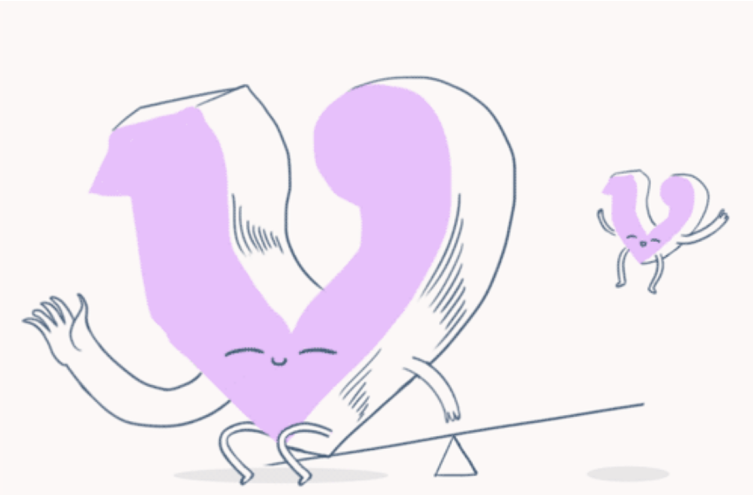
$\Rightarrow$ many research opportunities accompanied by tremendous experimental progress in the next years

LOI on testable neutrinos mass models

- direct consequence of observation of neutrino oscillations: **massive** neutrinos!
- origin of mass term **unknown**
- popular idea: seesaw mechanism

$$m_\nu \sim \frac{m_D^2}{M_R}$$

with $m_D \approx \mathcal{O}(100\ \text{GeV}) \rightarrow M_R \approx \mathcal{O}(10^{14}\ \text{GeV})$



LOI on testable neutrinos mass models

- popular idea: seesaw mechanism $\Rightarrow$ **very hard** to test experimentally!
- put forward experimentally **testable** neutrino mass models: **low-scale neutrino mass models**
- instead of suppression of EW scale by large mass scale: small lepton number breaking parameter, radiative seesaw models, introduce new gauge group
- low-scale neutrino mass models: **rich phenomenology, connection to other open problems of SM!**

Snowmass Letter of Interest:
Testable neutrino mass models

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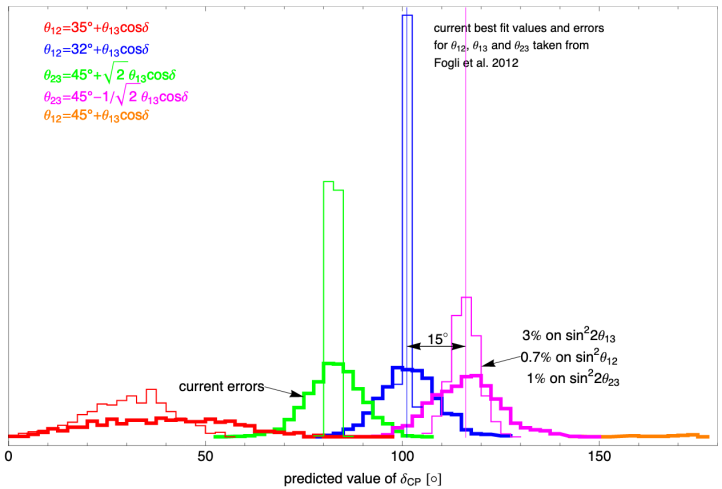
LOI on leptonic sum rules

- entering precision era of neutrino physics: precise measurement of all mixing parameters anticipated in near future
  $\Rightarrow$ Is there a flavor symmetry in the lepton sector? What kind of flavor symmetry is it?
- most predictive flavor models predict **correlations** between mixing parameters
- study of required sensitivity to distinguish flavor models prominent in Snowmass13 $\Rightarrow$ motivated sensitivity goal for DUNE

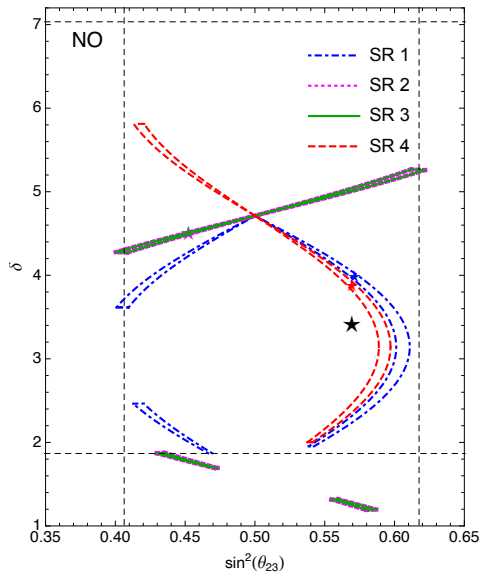


LOI on leptonic sum rules

- most predictive flavor models predict correlations between mixing parameters
- **in the future**: reconsider this study and expand to other flavor models

Snowmass Letter of Interest:
Leptonic Sum Rules

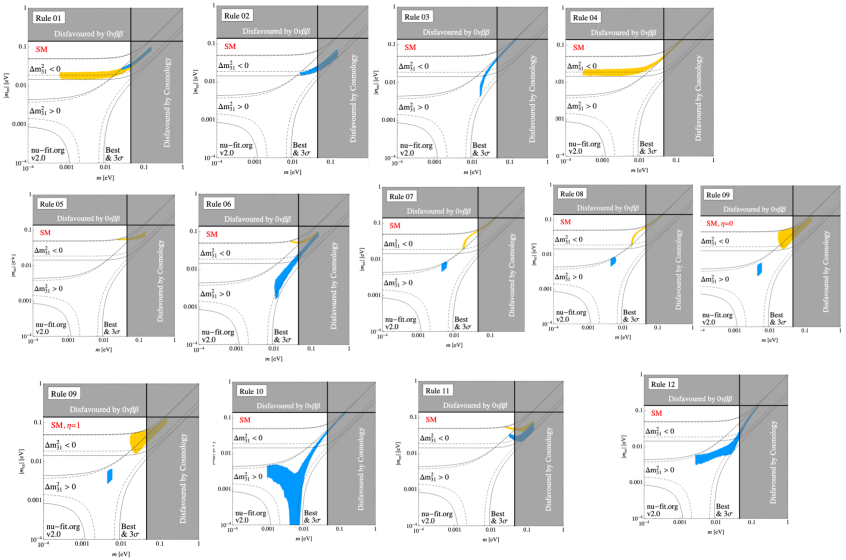
Julia Gehrlein,[1,*] Silvia Pascoli,[2] Serguey Petcov,[3,4] Martin Spinrath,[5] and Arsenii Titov[6]



JG, Spinrath '20

LOI on leptonic sum rules

- progress experiments measuring neutrino mass related observables (measurements of absolute neutrino mass scale, mass ordering, neutrinoless double beta decay)
- predictive flavor models relate neutrino masses to each other $\Rightarrow$ testable neutrino mass sum rules e.g. $m_1 e^{i\alpha_1} + m_2 e^{i\alpha_2} + m_3 = 0$
- study predictions of mass sum rules to **plan stages, sensitivities** of $0\nu\nu\beta$ experiments

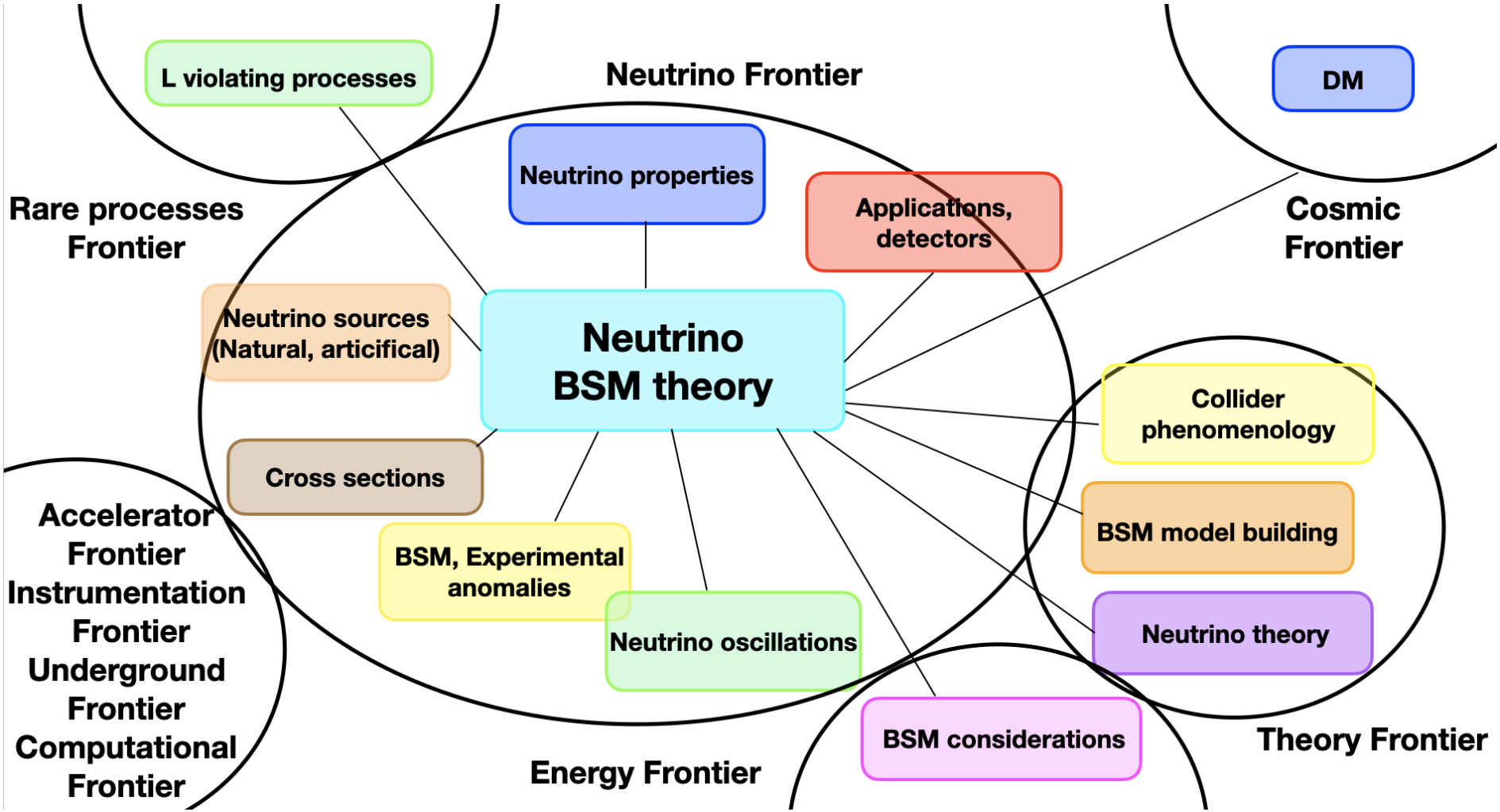


JG, Merle, Spinrath '16

Neutrino white papers

- LOIs feed into white papers, TG report:
  - **Theory of Neutrinoless Double Beta Decay** (Neutrino Theory, Artificial neutrino sources, Neutrino Properties, Neutrino BSM, Computation frontier)
  - **BSM effects on neutrino flavor** (Neutrino BSM, Neutrino oscillations, Neutrino properties, BSM model building)
- research connection to Neutrino Theory Group (TF11), Neutrino BSM Group (NF03): serve as **early career liaison**
- co-organized mini-workshop on neutrino theory in Sep 2020
- co-chaired NuTau2021, editor of NuTau white paper, contributed BSM theory sections

Neutrino BSM at Snowmass



End of the talk

Thank you for your attention!