

DISPERSION RELATIONS IN MELLIN SPACE

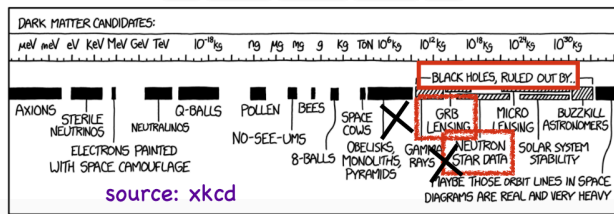
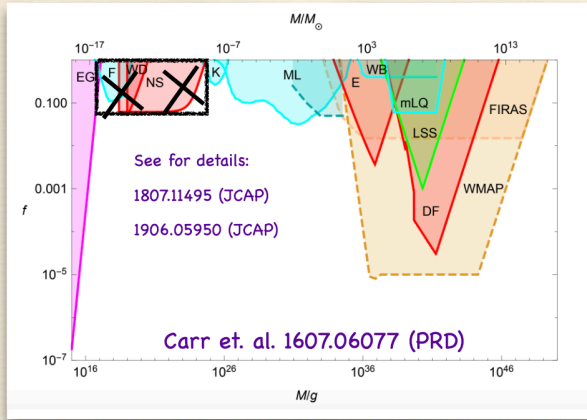
- * To push this approach further need to fix contact Witten diagrams
- * One approach is to use dispersion relations to constrain Mellin amplitudes and then impose Polyakov conditions.
- * Can try to use Regge boundedness of $M(s,t)$ to write a subtracted dispersion relation. - Sum over poles of $M(s,t)$ in two channels
- * Reproduces many of the earlier results of ϵ -expansion by solving for sum rules obtained by Polyakov condns. (Penados, Silva, Zhiboedov + Carmi)
- * Disadvantage of not preserving crossing symmetry manifestly.
- * Recent approach for crossing symmetric dispersion relations - using work of '70's (Arbenson-Khuri etc.). Applied to S-matrix bootstrap. (Sinha + A. Zahed)
- * Promising sum rules beyond existing ones in applying to Mellin space - well defined crossing symm. approach. (R.A., Sinha + Zahed, to appear)

Prof. Aninda Sinha Chair of the session on Formal Theory said "Bootstrap was an ambitious idea in the 1960s building on ideas by Heisenberg, Wheeler, Mandelstam and many others. This led to the birth of string theory but was abandoned in the 1970s in favour of QCD and the renormalization group approach of QFT. Over the last 10 years, it has resurfaced owing to advanced and novel numerical strategies as well as new analytical techniques. For conformal field theories it gives very accurate critical exponents for the 3d Ising model, which is arguably better than available Monte Carlo and other techniques. Recent attempts have also been made to resurrect the S-matrix bootstrap program, eg. in the context of pion scattering, with promising leads. Gopakumar summarized succinctly certain results achieved in this direction, including Indian efforts, and summarized the promising future directions."

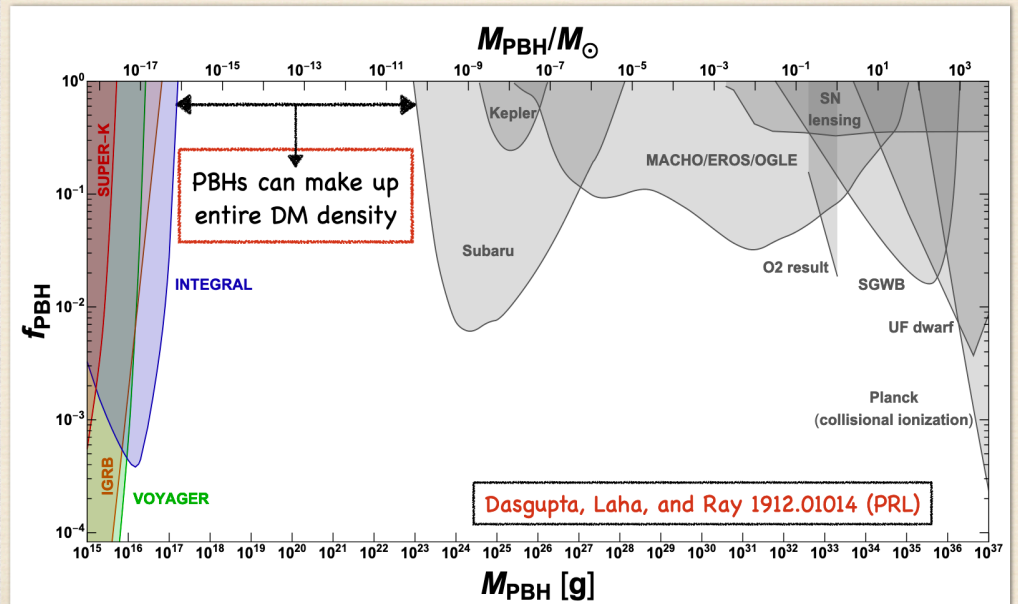
PBHs as DM (in 2016-2017)

In recent years,

- Multiple exclusion limits are shown to be ineffective.
- Many existing limits are significantly revised.
- Many new exclusion limits are added especially in the low mass range.



PBHs as DM (in 2020-)



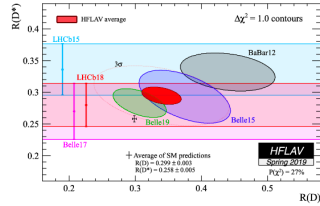
See also Carr et. al. 2002.12778, Carr et. al. 2006.02838, Green et. al. 2007.10722, and <https://github.com/bradkav/PBHbounds>.

Prof Girish Kulkarni, Chair of the session on Cosmology and Particle Astrophysics said: “In the Cosmology and Astro-particle Physics II parallel session on 15 December 2020, a highlight was the mini-review talk by Anupam Ray (TIFR) on primordial black holes (PBHs) as a dark matter candidate. Primordial black holes can be formed in the very early Universe due to gravitational collapse of extreme density perturbations. Unfortunately, the expected incidence rate of PBHs is unknown because the spectrum of the primordial density perturbations at the relevant scales is not known. However, constraining the incidence rate of PBHs is important as they are a promising candidate for the dark matter in the Universe. Until recently, it was thought that PBHs are ruled out as dark matter candidates given the data from a wide variety of experiments. In his talk, Ray made the powerful point that most PBH exclusion limits have been shown to be ineffective, many limits have been revised, and new limits have now been added. As a result the possibility of PBHs as a dark matter candidate is now wide open. Ray then discussed work by him as well as by other on various ways in which the incidence rate of PBHs can be constrained. He ended the talk by commenting on future prospects.

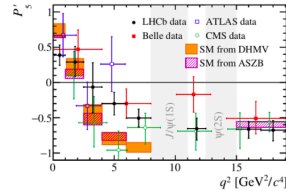
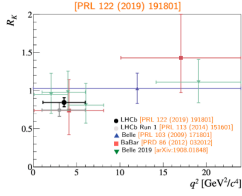
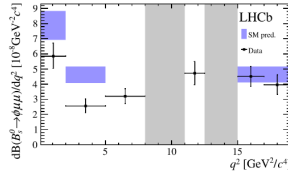
Slide: https://www.niser.ac.in/daehep2020/talkposter/Anupam_Ray_876_775.pdf

Anomalies on the horizon

- Some cracks in the big picture have been developing in the last few years:
 - $B \rightarrow D^{(*)} \tau \nu - R(D)$ and $R(D^*)$;
 - deviations from Lepton Flavor Universality, partial branching fractions, and angular distributions in $b \rightarrow s l^+ l^-$ ($l = e, \mu$) transitions;
- A significant pattern seems to emerge from a global analysis of the anomalies;



LHCb Collaboration, JHEP 09 (2015) 179



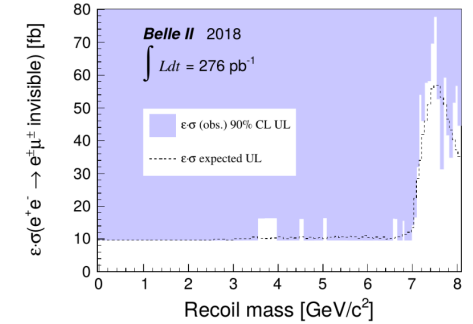
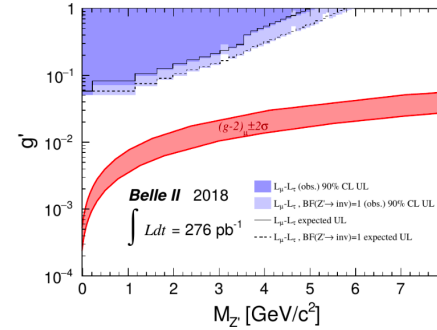
- These are intriguing hints need independent confirmation, also on channels not yet investigated (e.g. $b \rightarrow s \nu \bar{\nu}$, $b \rightarrow s \tau^+ \tau^-$, ...).

see also S. Choudhury and S. Halder in BSM-SM parallel sessions

Dark Sector: $Z' \rightarrow$ invisible

PRL 124, 141801 (2020)

- We place nontrivial exclusion limits, both in the $L_\mu - L_\tau$ model, and in the LFV scenario (model independent);

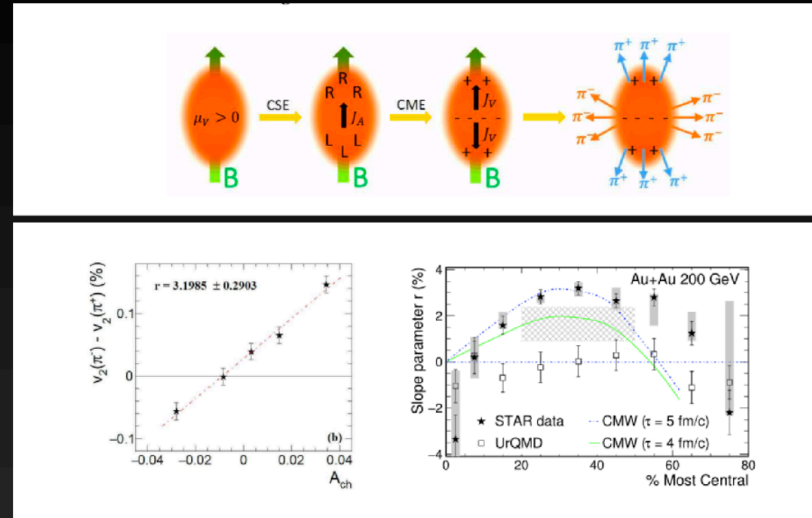


- Not yet probing the region interesting for the $(g-2)_\mu$ anomaly... but here we are using just a tiny fraction of the data available!

Prof. Gagan B. Mohanty, Chair of the session on Standard model and beyond said: “With no hints of new physics found in direct searches by CMS and ATLAS experiments, much of the recent attention has been directed to the so-called flavor anomalies, where in its test for lepton family universality LHCb has found about 2.5-sigma deviation with respect to standard model predictions. These intriguing hints need to be verified in other complementary experimental setups, where Belle II would be a prime candidate as it accumulates more and more data. In addition to indirectly probing physics beyond the standard model via precision measurements of beauty and charm mesons as well as tau leptons, Belle II is looking for the existence of light dark matter candidates. For instance, in its first physics publication published to PRL it has searched for an additional Z-like boson (Z'), which can explain the muon $(g-2)$ anomaly, with a small amount of data. The future seems to be bright for this line of attack on dark matter. The talk was given by Dr. Ale Gaz (Physics Coordinator of Belle II).

Slides: https://www.niser.ac.in/daehep2020/talkposter/Alessandro_Gaz_804_773.pdf

The Chiral-Magnetic Effect: Need for RMHD



the slope parameter r displays no obvious trend of the beam energy dependence for 10 – 60% centrality at $\sqrt{s}_{NN} = 20 - 200$ GeV

Strength of the magnetic field \times lifetime \sim Constant

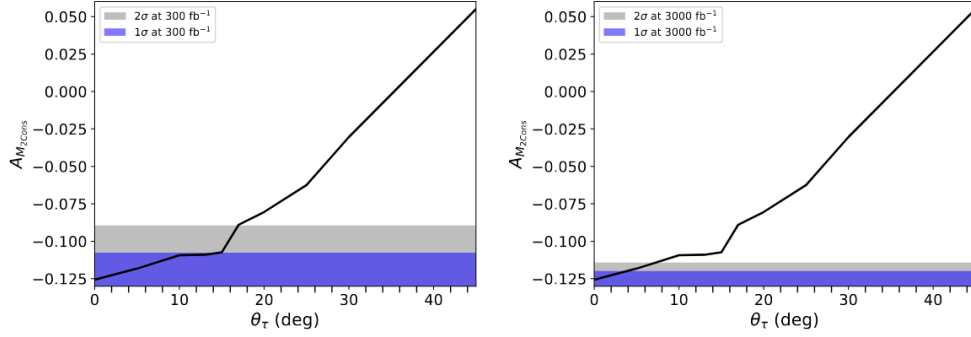
Important to know the spatio-temporal evolution of magnetic fields

$$\frac{\partial \mathbf{B}}{\partial t} = \nabla \times (\mathbf{v} \times \mathbf{B}) + \frac{1}{\sigma \mu} \left(\nabla^2 \mathbf{B} - \mu \epsilon \frac{\partial^2 \mathbf{B}}{\partial t^2} \right)$$

Prof. Najmul Haque, Chair of the session on QCD and Heavy-ion collisions said: “This session was dedicated to the discussion of the various properties of the hot and dense magnetized medium produced in heavy-ion collisions experiments. The mini review by Dr. Victor Roy was excellent in which he explained the necessity of magnetohydrodynamics to see the chiral-magnetic effect. In the parallel talk by Rajesh, he explained the causality and stability in magnetohydrodynamics. Mahfuzur, Manu, Subhasis and Snigdha have presented some interesting findings about the various transport coefficients in the magnetized medium.”

Slide: https://www.niser.ac.in/daehep2020/talkposter/Victor_Roy_820_794.pdf

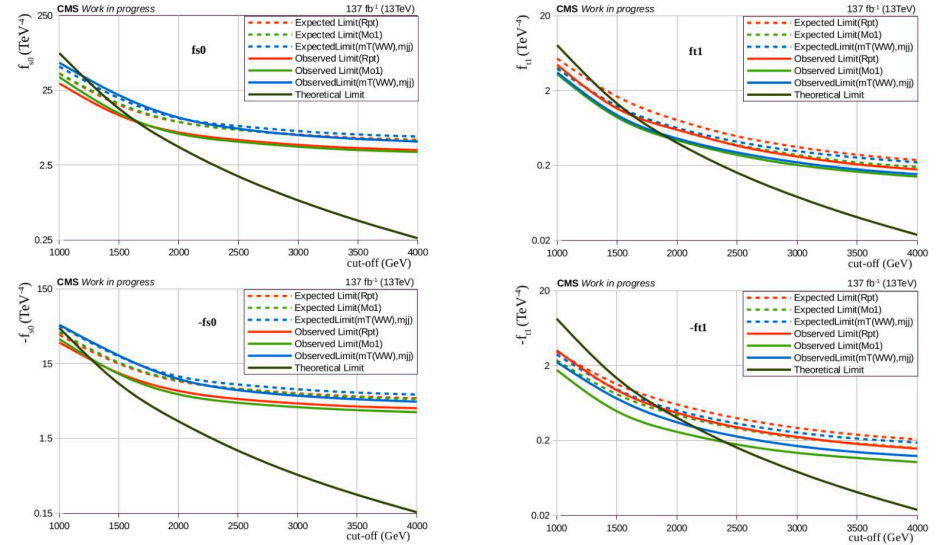
Results and Discussion : M_{2Cons}



$$A_{M_{2Cons}} = \frac{\mathcal{N}(X_{M_{2Cons}} > 0.5) - \mathcal{N}(X_{M_{2Cons}} < 0.5)}{\mathcal{N}(X_{M_{2Cons}} > 0.5) + \mathcal{N}(X_{M_{2Cons}} < 0.5)},$$



Selected Results (fS0 & fT1)



SANDEEP KAUR

DAE-BRNS-HEP 2020

15

Prof. Ujjal Kumar Dey, Chair of the session on Standard model and Beyond said: “This session discussed quite diverse topics, namely collider aspects, dark matter and B-mesons. The utility of kinematic variable M_{2Cons} as a probe of CP phase of the $H \rightarrow \tau\tau$ was discussed (speaker: A. Swain). The validity issues of EFT in the analysis of anomalous quartic gauge couplings was presented. Respective constraints on relevant Wilson coefficients were presented (speaker: S. Kaur). Scalar extended dark matter models in the context of LHC (speaker: A. Dey) and XENON1T (speaker: V. Sahdev) were discussed. The B-meson properties, namely the lepton flavor violation in its decay at Belle and the correction to its mass formula were also presented (speakers: B. Nayak and K K Vishwakarma respectively).”

Slide: https://www.niser.ac.in/daehep2020/talkposter/Abhaya_Swain_TLK_608_591.pdf
and https://www.niser.ac.in/daehep2020/talkposter/Kaur_Sandeep_TLK_63_190.pdf