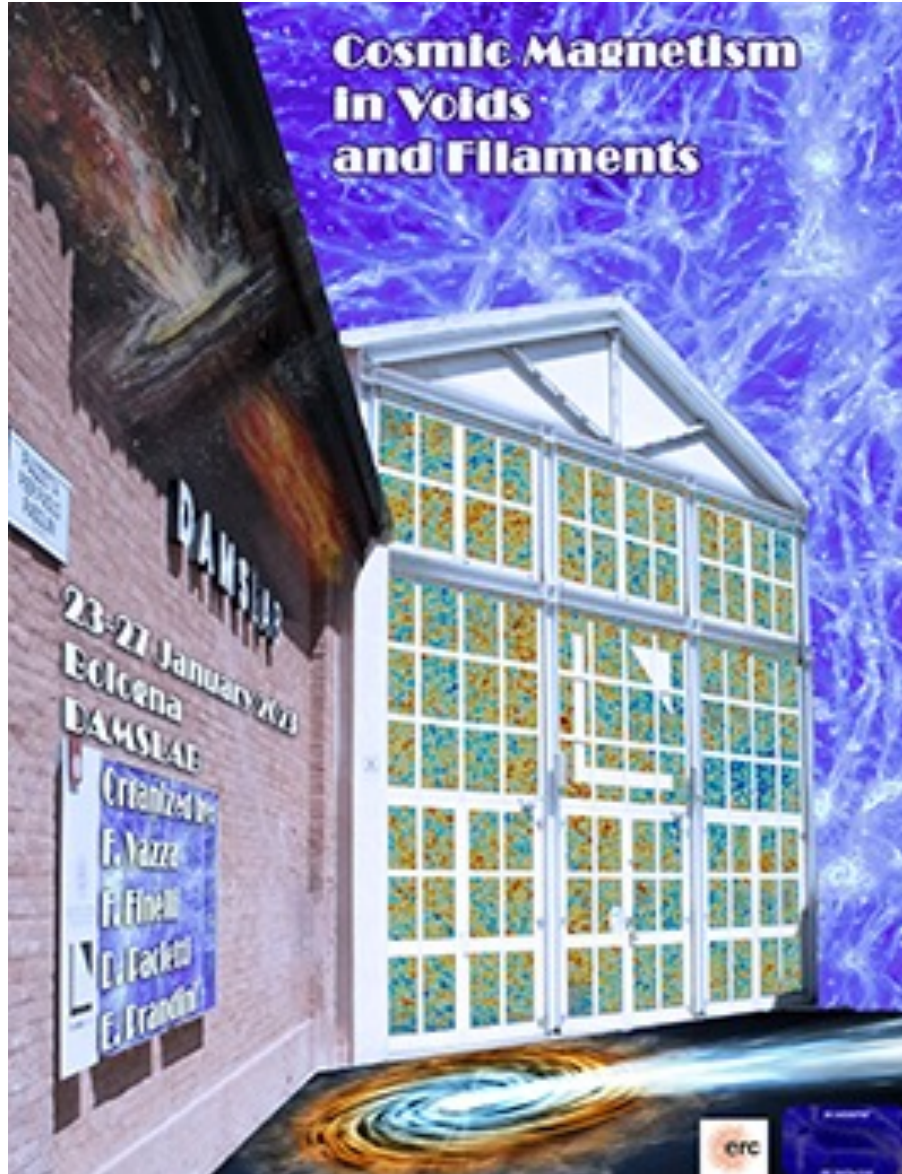


## Cosmic Magnetism in Voids and Filaments



# IGMF limits with gamma rays

Discussion session

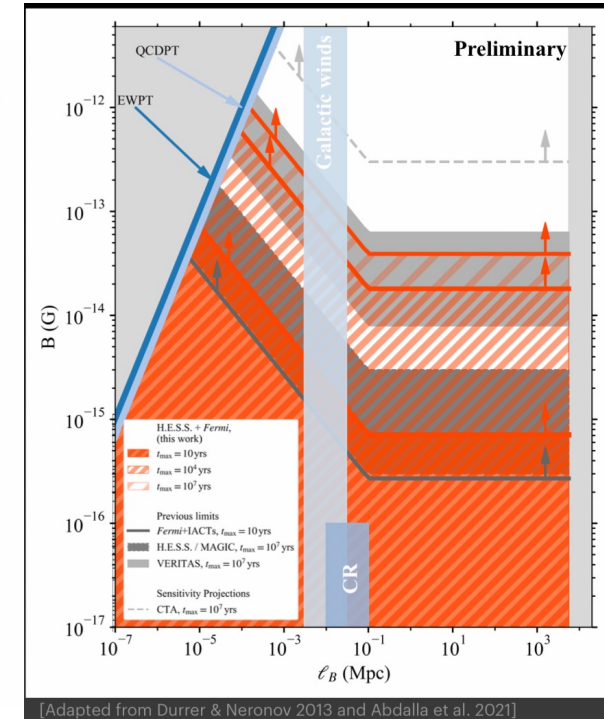
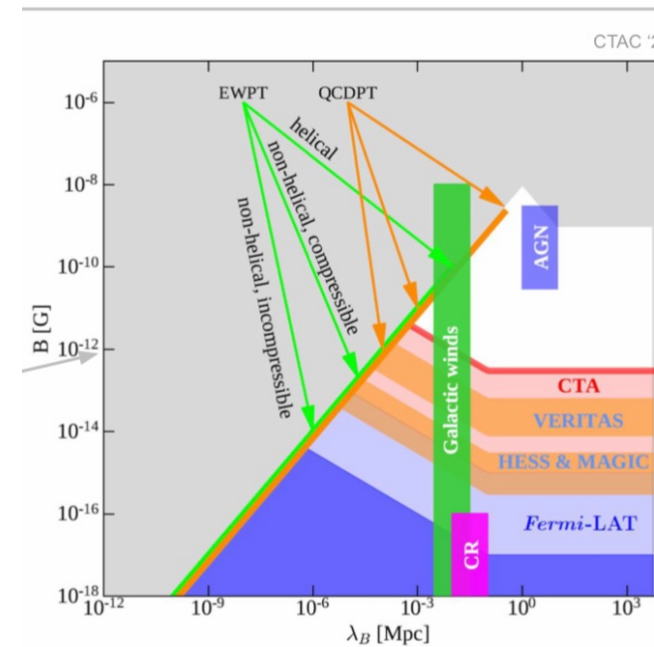
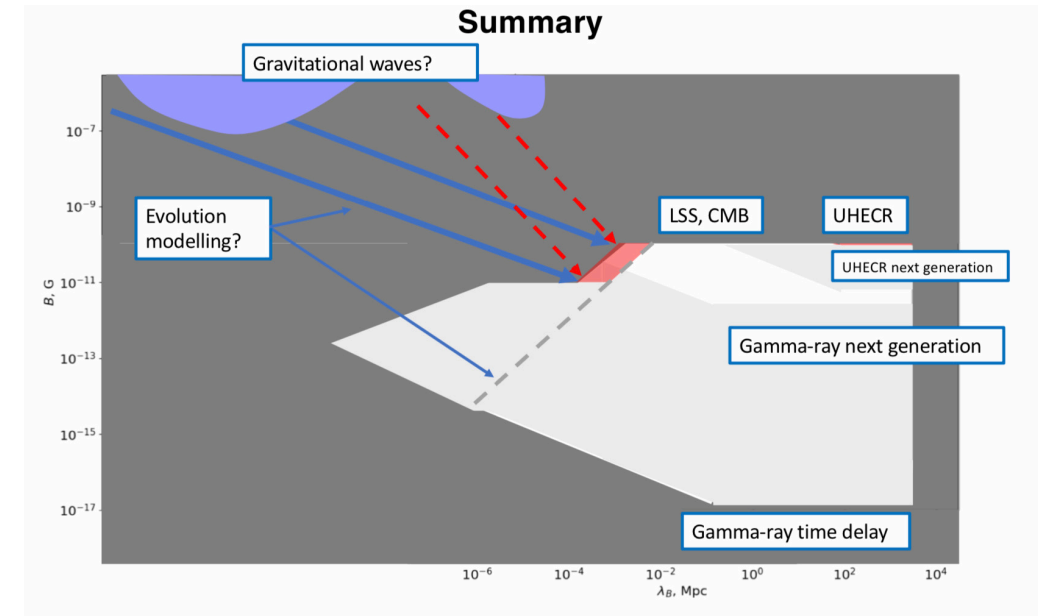
# State of the art

## Current limits:

- GeV (reprocessed emission) -> Fermi/IACTs
- Multi TeV (primary spectrum) -> IACTs

## Observational remark:

- FoV of IACT is small, observations should be planned
- Observation strategy for transients (search for delayed emission) has to be optimized

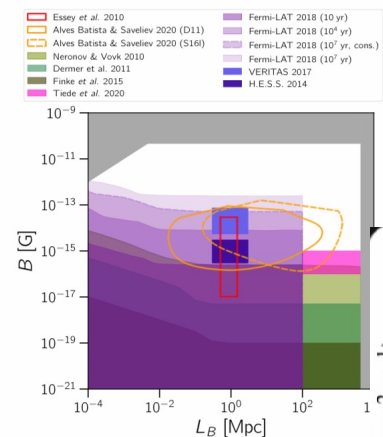


[Adapted from Durrer & Neronov 2013 and Abdalla et al. 2021]

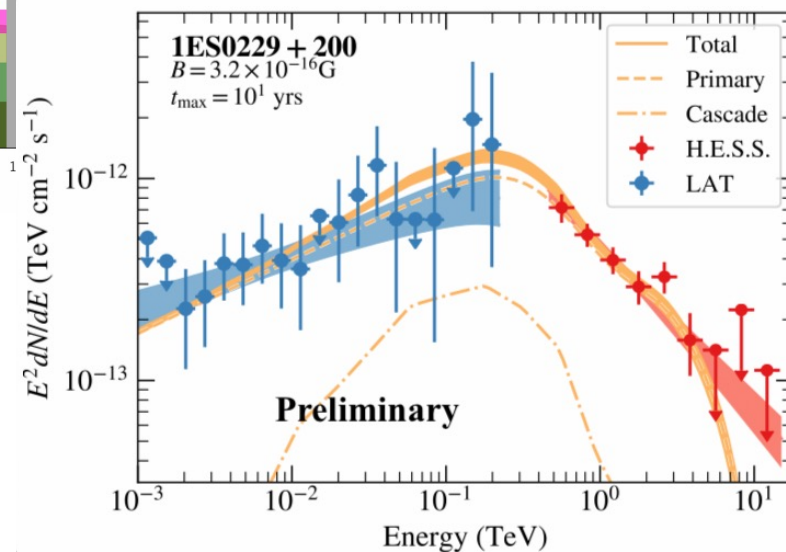
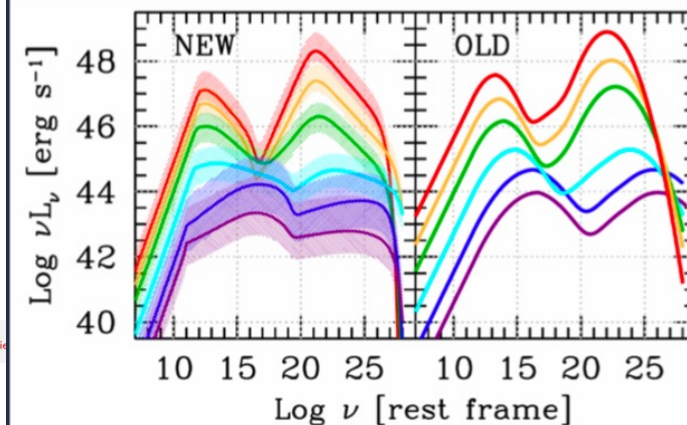
# Sources

- Need: **multi TeV primary photons**
- Obvious candidate: **extreme blazars**
  - BUT: faint both at GeV (Fermi) and TeV (IACTs), few sources known
- Multimessenger observations of blazars
- Recently: **GRBs** to probe smallest  $B$  range
  - BUT: still the population is small

Limits on IGMF using Multimessengers [Alves Batista and Saveliev]



## Blazar sequence

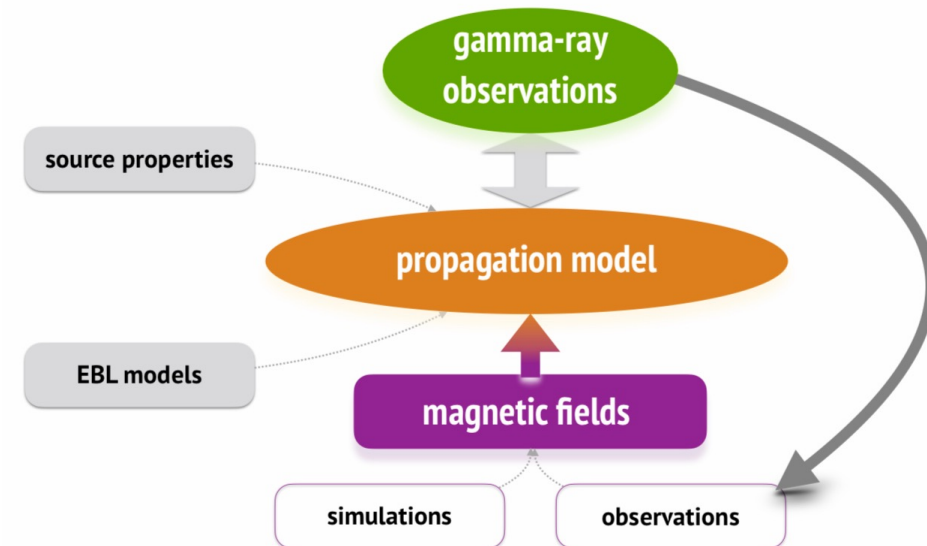


# Comments

- Nice limits... but we do not have to forget our assumptions:
  - Intrinsic spectrum (including cutoff at TeV)
  - Variability
  - Extragalactic background light (uncertain at large  $z$ )
  - Iterative propagation model
- Future instruments will boost this science case!
  - CTA
  - LHAASO/SWGO

## Sensitivity to Assumptions on Spectra

- Consider impact on predicted  $f_c$  and  $f_c$  upper limit of
  - EBL model
    - From Gilmore 2012 (arXiv:1104.0671, fiducial model) & Franceschini 2008 (arXiv:0805.1841)
  - Intrinsic spectrum
    - Assume spectral index  $\Gamma = 1.660$ , based on Fermi measurement
      - Does not account for possible variability on longer timescales
      - Consider  $\Gamma = [1.460, 1.660, 1.860]$
    - Assume intrinsic spectrum described by exponentially cut-off power law
      - No cutoff in VERITAS spectrum != no cutoff
      - Highest energy spectral point @ 4 TeV
      - $E_c = [5, 10, 20]$  TeV





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Eclitena  
EAMSUAE

Organized by  
F. Vazza  
F. Finelli  
D. Eckert  
E. Frandini

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# IGMF detection with gamma rays

Discussion session

# Open questions

- Can we set upper limits from gamma-ray data
- How solid are current limits?
  - Dependence on the line of sight → can this be optimized/tested/...
- Can we remove some of the assumptions?
- Do we have observables to test IGMF models?