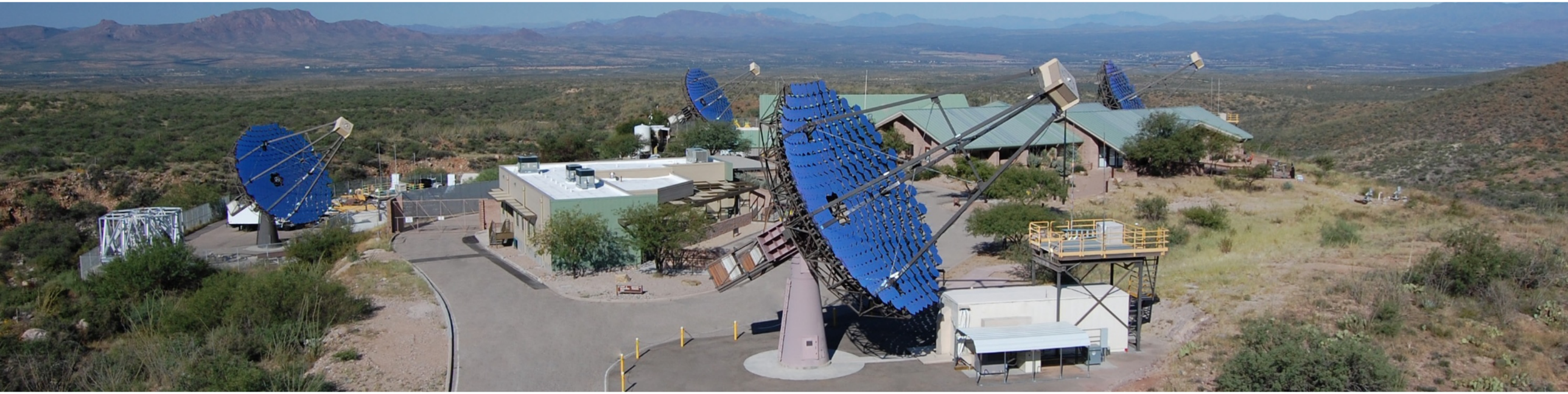
Optical Microlensing by Primordial Black Holes with IACTs.



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Konstantin Pfrang [a], Tarek Hassan [b], and Elisa Pueschel [a]

[a] *Deutsches Elektronen Synchrotron DESY, Platanenallee 6, 15738 Zeuthen, Germany*

[b] *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT),Av. Complutense, 40, E-28040 Madrid, Spain*

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

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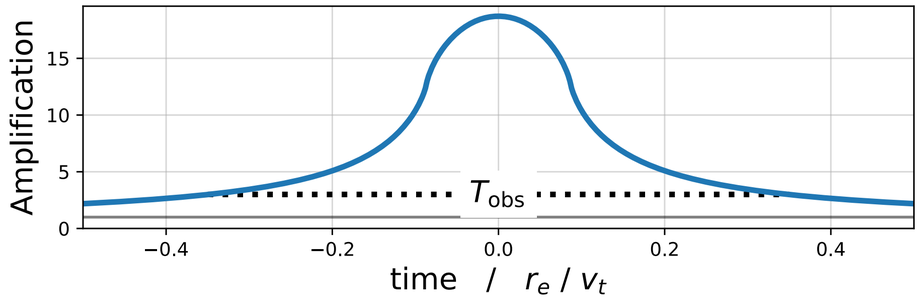
DESY.

Primordial Black Holes

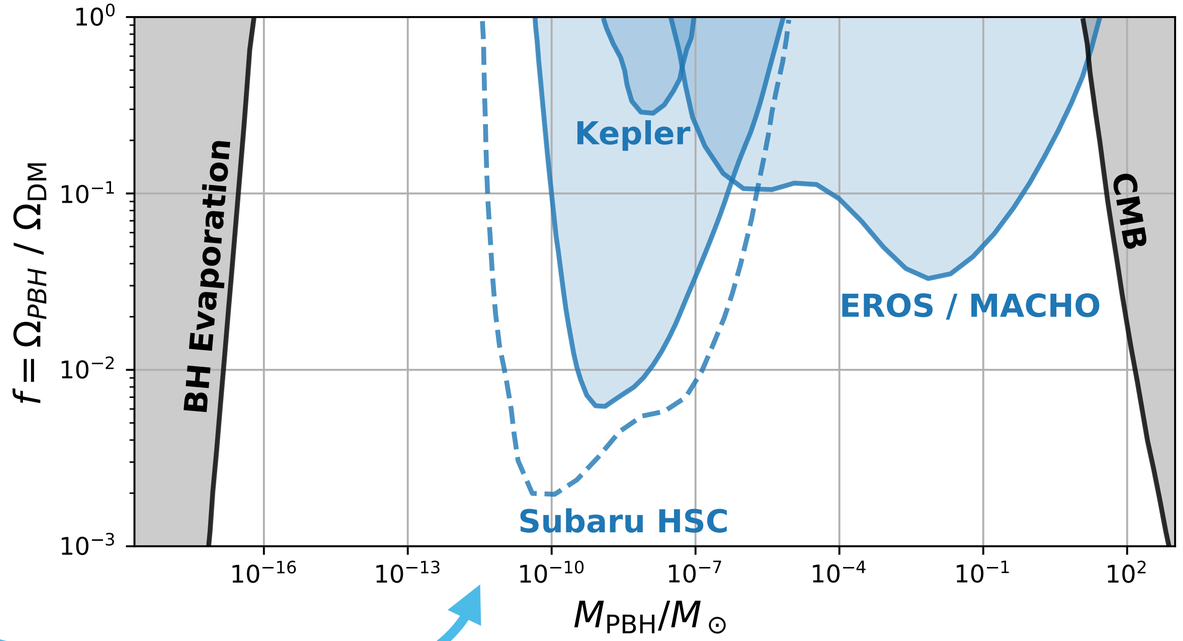
- Primordial Black Holes (PBHs) are a **DM candidate** [1]
- Hypothetical formation at wide range of masses in early universe due to density perturbations

- **Microlensing by PBHs** is a powerful method to constrain ~11 orders of PBH mass
- Sampling speed limiting factor at low M_{PBH}
- **Unconstrained range** from 10^{-10} to $10^{-16} M_{\odot}$



Optical Observations with IACT [2]

- **Large reflective area** reduces scintillation noise
  → powerful optical instruments with **up to GHz sampling**
- Modest optical quality
- **VERITAS** used as example for current generation



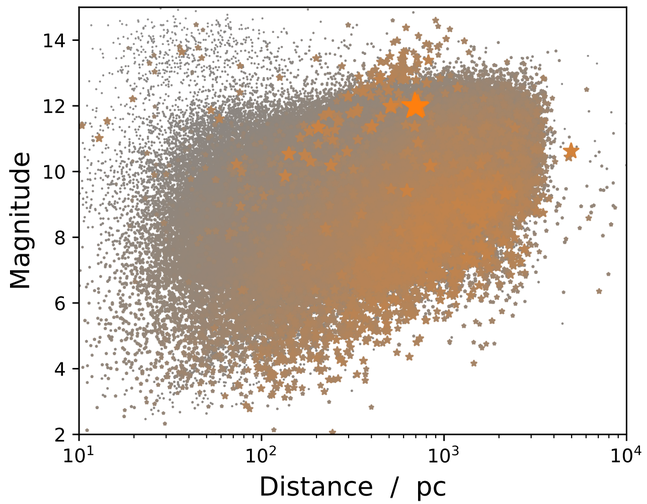
IACTs?

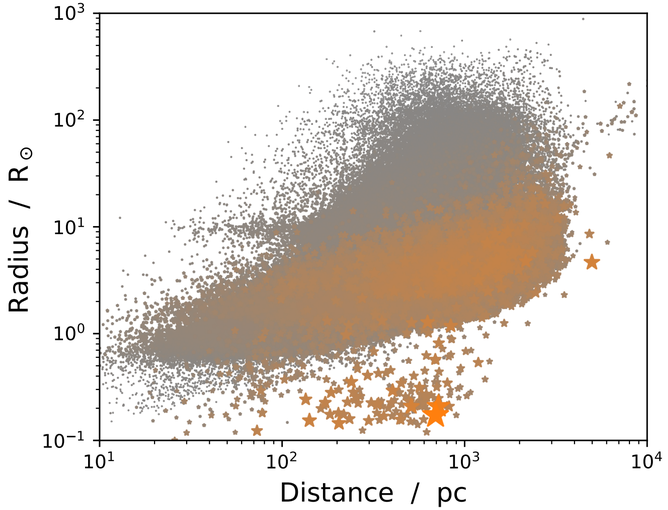
[1] S. Hawking. *Nature, 248, 1974*
[2] W. Benbow et al. *Nat. Astron,* 3:511-516, 2019
[3] N. Niikura et al. *Nat. Astron.* 3:524-534, 2019

Results

Target selection

- Select star to **optimise event rate** for low PBH masses
- Best candidate is hot subdwarf **PG 0240+046** [6]
- Shot noise with constant night sky background level





Event Rate and Duration

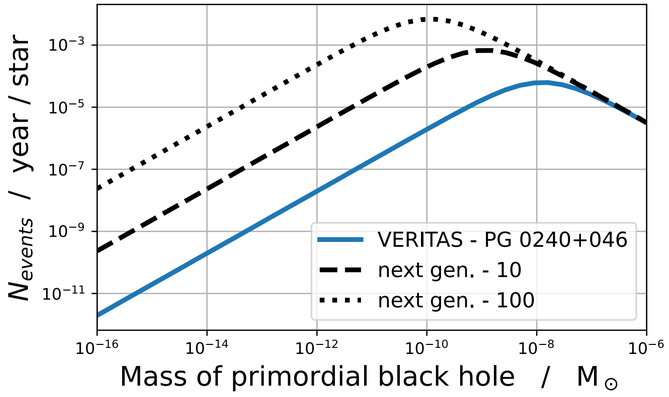
- Scaled uncertainty to **50Hz**
- 4 consecutive samples enhanced by more than $3\,\sigma$

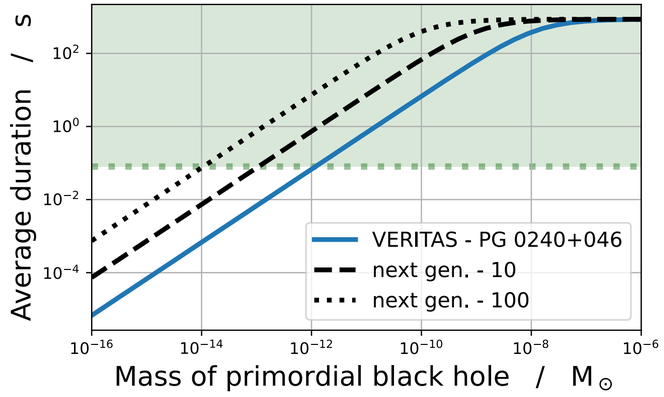
VERITAS *(Blue solid line)*

- Duration detectable down to $10^{-12}\,M_\odot$
- $< 10^{-6}$ events per year $< 10^{-10}\,M_\odot$

Next-generation improved sensitivity by factor 100 (*black dotted line*)

- Timescales detectable down to $10^{-14}\,M_\odot$
- $< 10^{-2}$ events per year below $10^{-10}\,M_\odot$





[4] H.J. Witt et al. *Astrophysical J.*, 430:505 1994
[5] K. Griest et al. *Phys. Rev. Lett.*, 107, 2011
[6] S. Geier, *A&A*, 635:A193, 2020