Microlensing for dark matter

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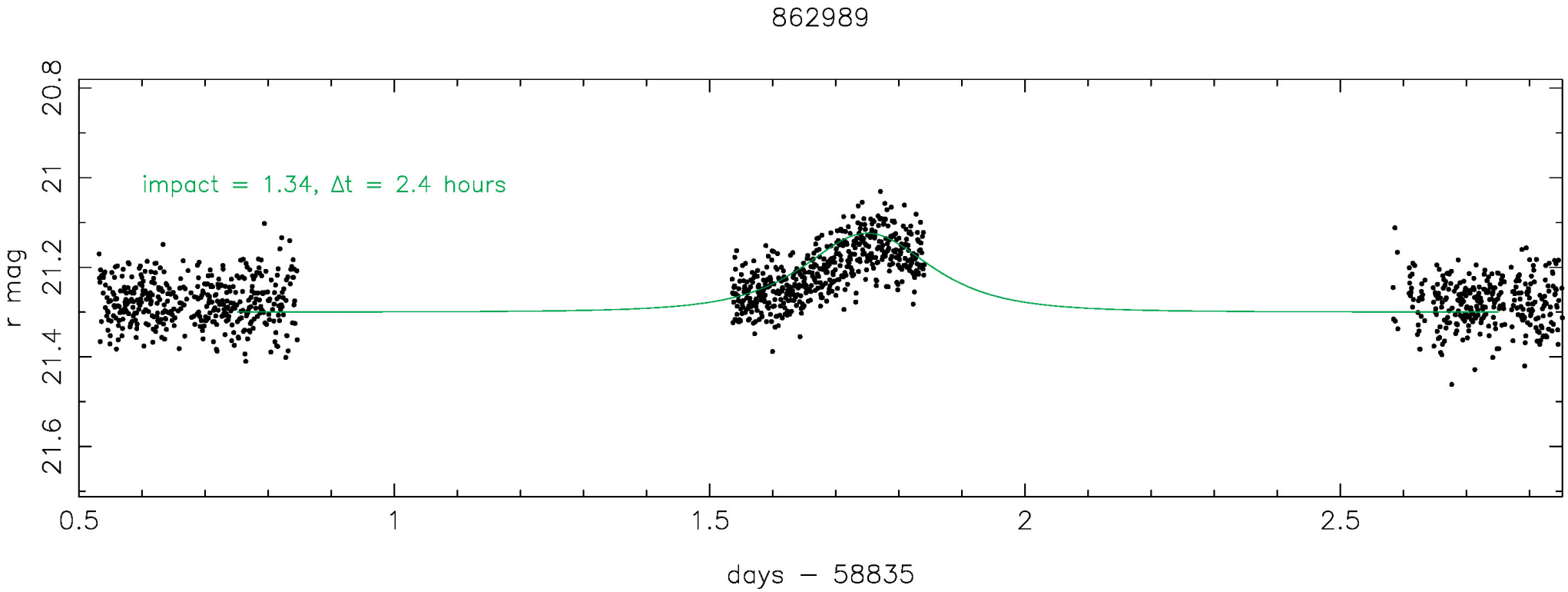
DECam microlensing, LMC field 51, Key et al 2026



Δt gives the mass: 10^{-7} solar masses

Interstellar moon or primordial black hole ?

Optical depth to microlensing i.e. its probability

$$\tau = \int \frac{\rho(x)}{m} \pi U_T^2 R_0^2(x) dx$$ *along the line of sight*

$\rho(x)$ is the density of dark matter (or moons),

m is the mass of the lens,

U_T is its tangential velocity/c.

If interstellar moons have a stellar distribution,

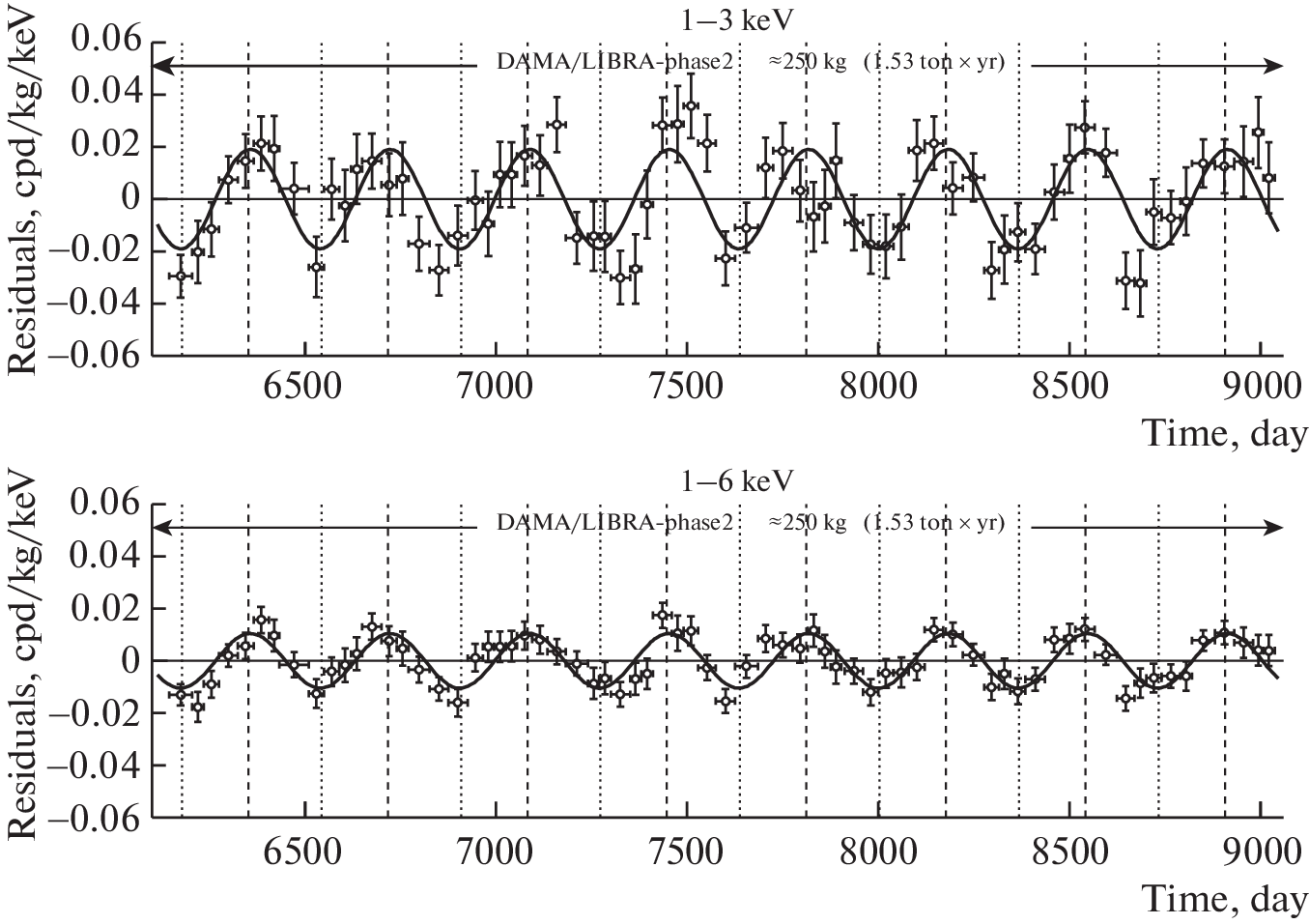
τ (DM) >> τ (ISM)

The scorecard

Anne Green 2026

Survey	Duration (years)	Field of view (deg2)	Number of stars, (million)	Number of events
MACHO	5.7	14	12	13
EROS	~ 12	88 (EROS-2)	~ 25	1
OGLE	~ 20	105 (OGLE-IV)	78.7	13
AMDC	1	3	3	1
SUBARU		M31		4-12

Physicists' scorecard: WIMPs



Bernabei et al

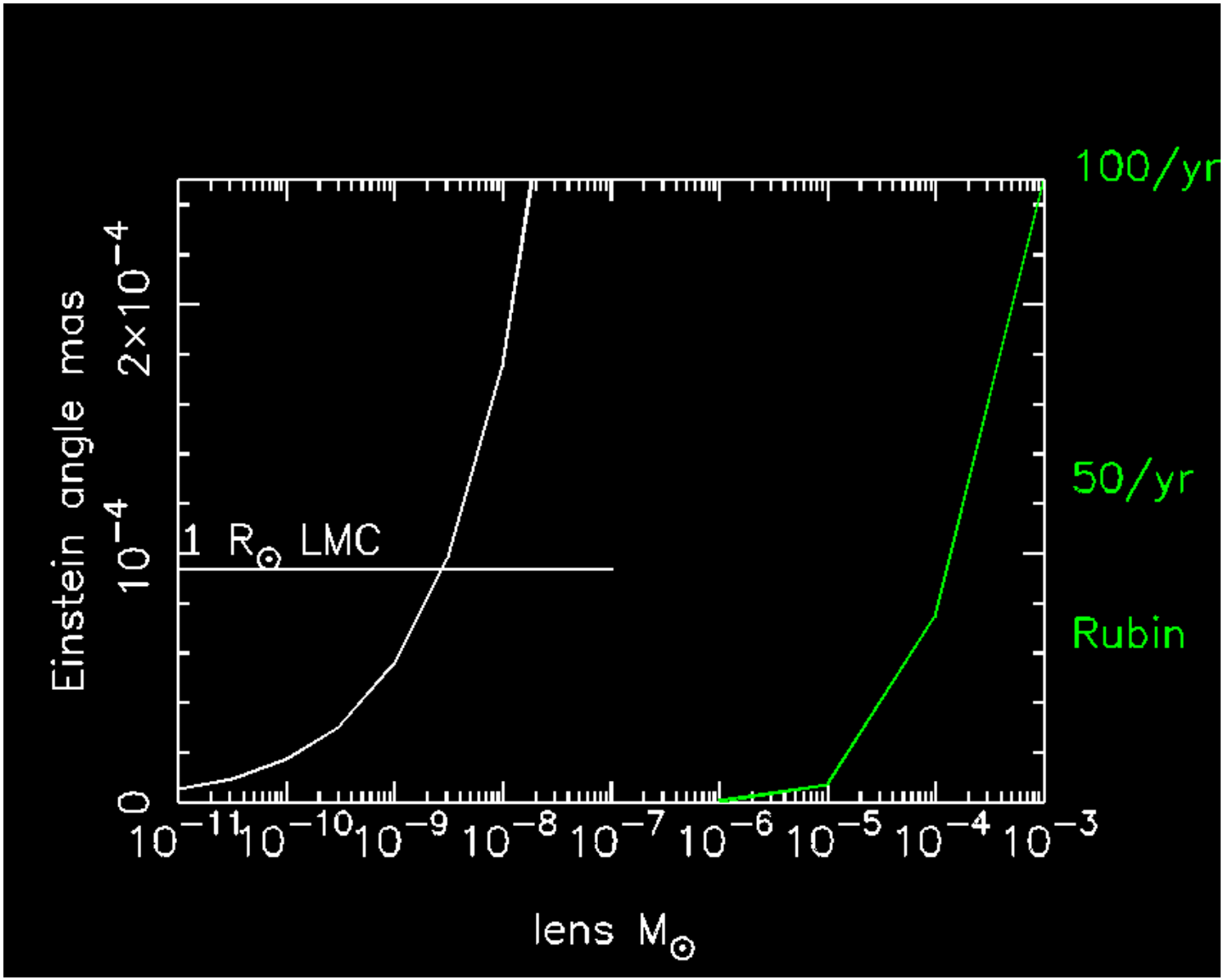
DAMA/Libra

Annual modulation

LNGS

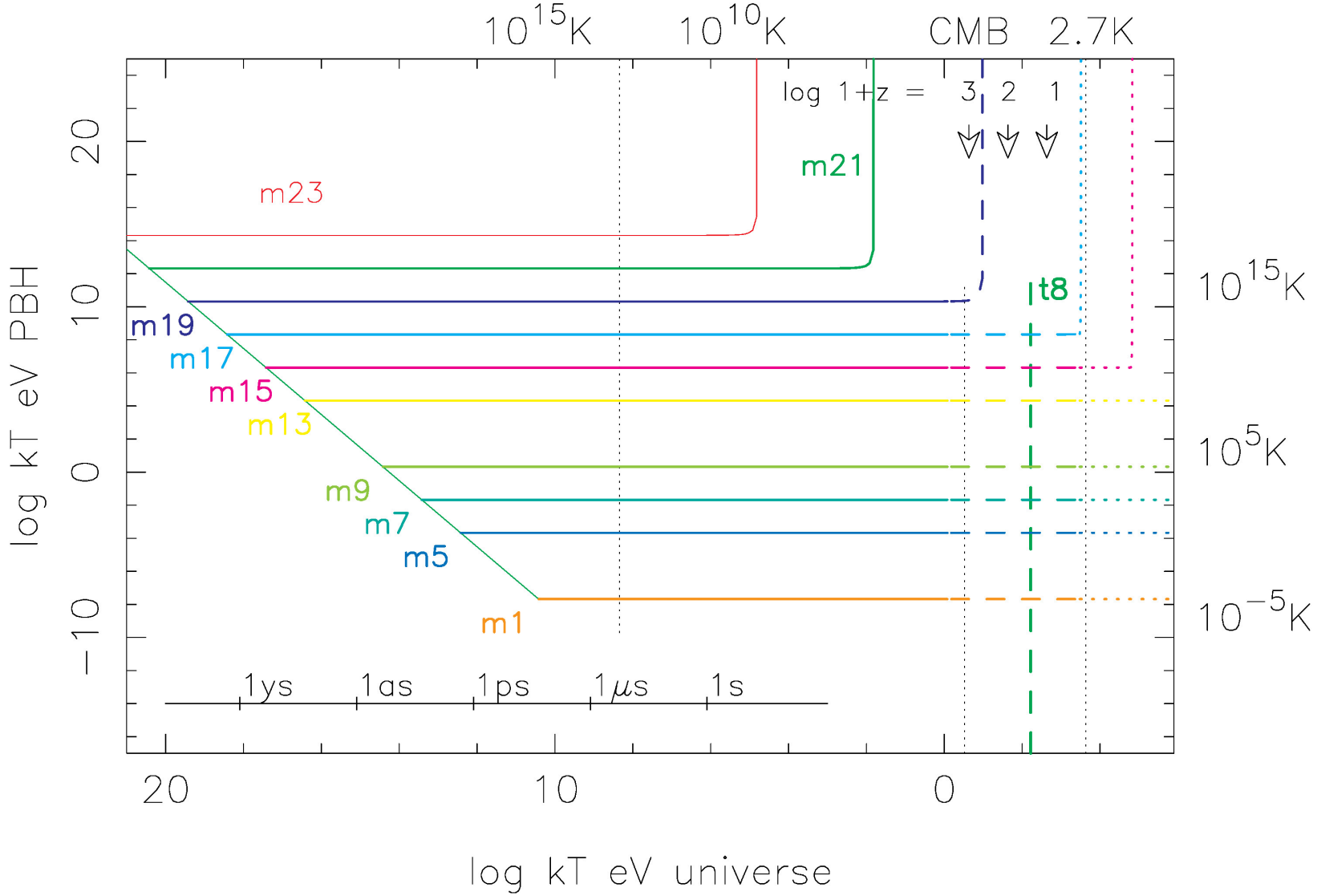
Roman microlensing space

Rubin estimates from Romao et al (2025) for $f_{PBH} = 0.1$



PBH evolution

origin (dρ/ρ) is unclear, but their evolution was worked out by Hawking



Dark matter may be all of these non-baryonic entities

Type	Evidence	Interpretation
WIMPS	Fermi-LAT Galactic Centre Excess DAMA-Libra experiment	Annihilation radiation or MSPs ? Unconfirmed by e.g. Xenon1T
Axions	Cavity experiments (nondetection)	BSM = Beyond the Standard Model
PBHs	Microlensing	PBHs or Interstellar Planets ?
CDM or WDM	Gravitation only	Physicists' nightmare scenario

Uncertainties about PBHs

- Do PBHs form during inflation?
- • Do they form during the radiation dominated era?
- • What is their initial mass function ?
- • How is it related to the primordial spectrum of fluctuations?
- • Do PBHs always emit Hawking radiation?
- • Do the small ones evaporate completely or leave a relic?
- • Do the large ones accrete mass?
- • What accreted fraction is turned into radiation?
- • SMBHs have magnetospheres, do PBHs have them too ?
- • Do they cluster significantly?
- • Is there a large or small dispersion in the PBH to baryon ratio?
- • Are there processes by which they gain or lose angular momentum?

Potential impacts of PBHs on astrophysics

Reference	Possible role	Alternative	Reference
30	PBHs as dark matter	WIMPs	22
2	Microlensing	Interstellar planets	23
29	Triggering SNeIa	No trigger required	31
33	Binary inspiral of subsolar masses	Low S/N detections	
34	Hubble tension	Early dark energy	24
35	Bulk flow tension	Rare event	25
36	Early galaxy formation	Population III	26
32, 37	JWST Little Red Dots	Direct collapse black holes	27
38	Pre-galactic globular clusters	Blue color metallicity, not age related	
39	Initiating comets	Tidal disruption of Oort cloud	28

Udalski & Mroz arxiv 2606.19442

lunar mass PBH or variable star ?