

Fig. S1. (a) NIR emission spectra of the β -PbF₂: Tm³⁺/Yb³⁺ GCs under the same 976 nm laser excitation at the room temperature (293 K). (b) The relative integral intensity normalized at 0.0005Tm of different NIR emissions dependent on the Tm³⁺ doping concentration.

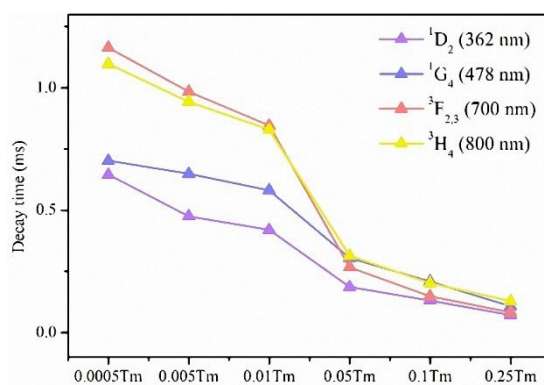


Fig. S2. Lifetimes of the different excited state transitions in β -PbF₂: Tm³⁺/Yb³⁺ GCs with variable Tm³⁺ concentration measured at room temperature (293 K).

Table S1 Values of the fitting parameters by Equation 1 for the measured data of ${}^1\text{G}_4$ state lifetimes of 0.0005Tm, 0.01Tm, and 0.05Tm samples

Sample	τ_0 (ms)	C	E_0 (cm ⁻¹)
0.0005Tm	0.83	4.86	744.83
0.01Tm	0.63	14.74	1039.97
0.05Tm	0.35	72.98	1415.31