



Status of ageing studies

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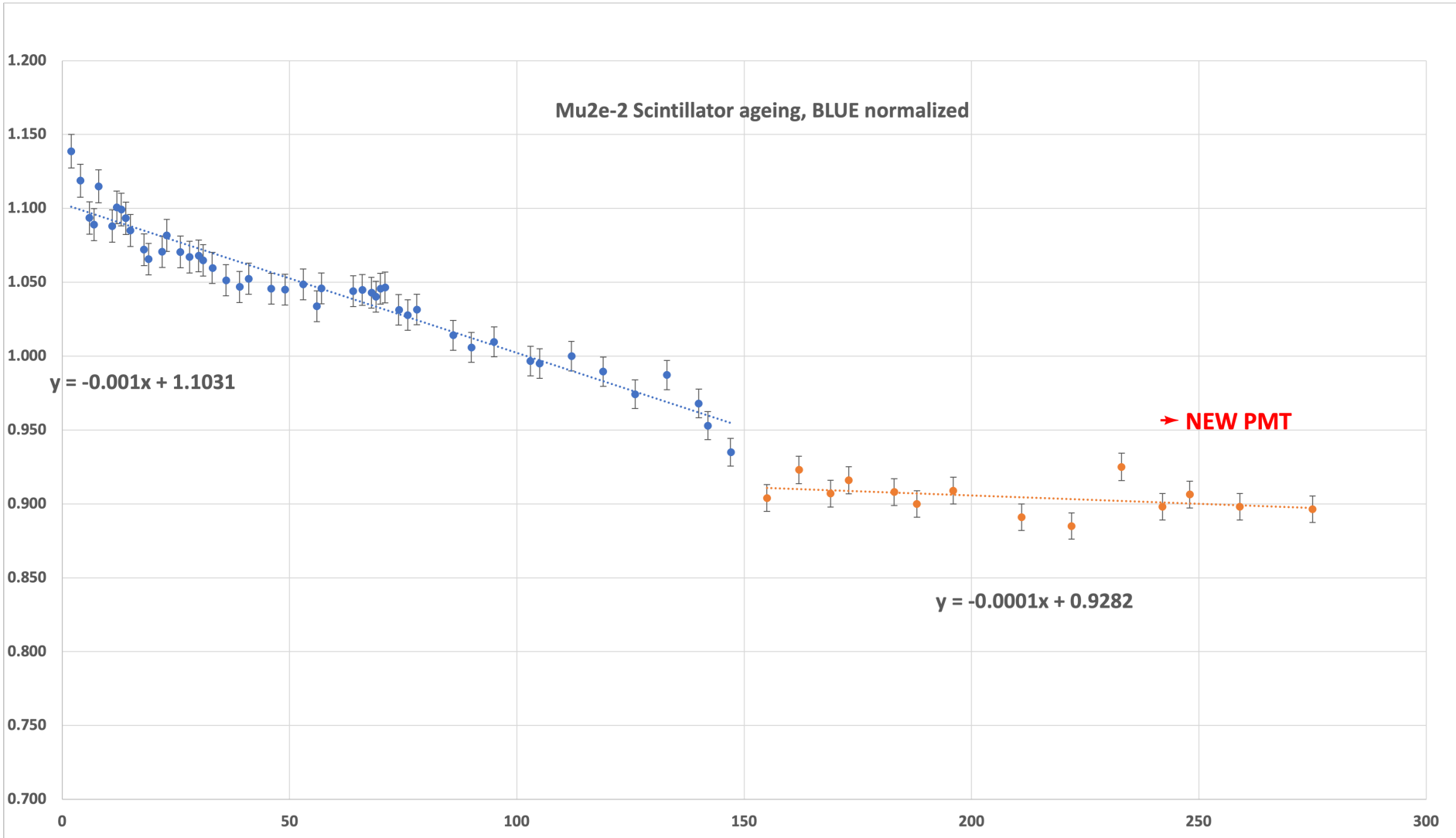
Scintillator R&D Meeting

March 7th, 2022

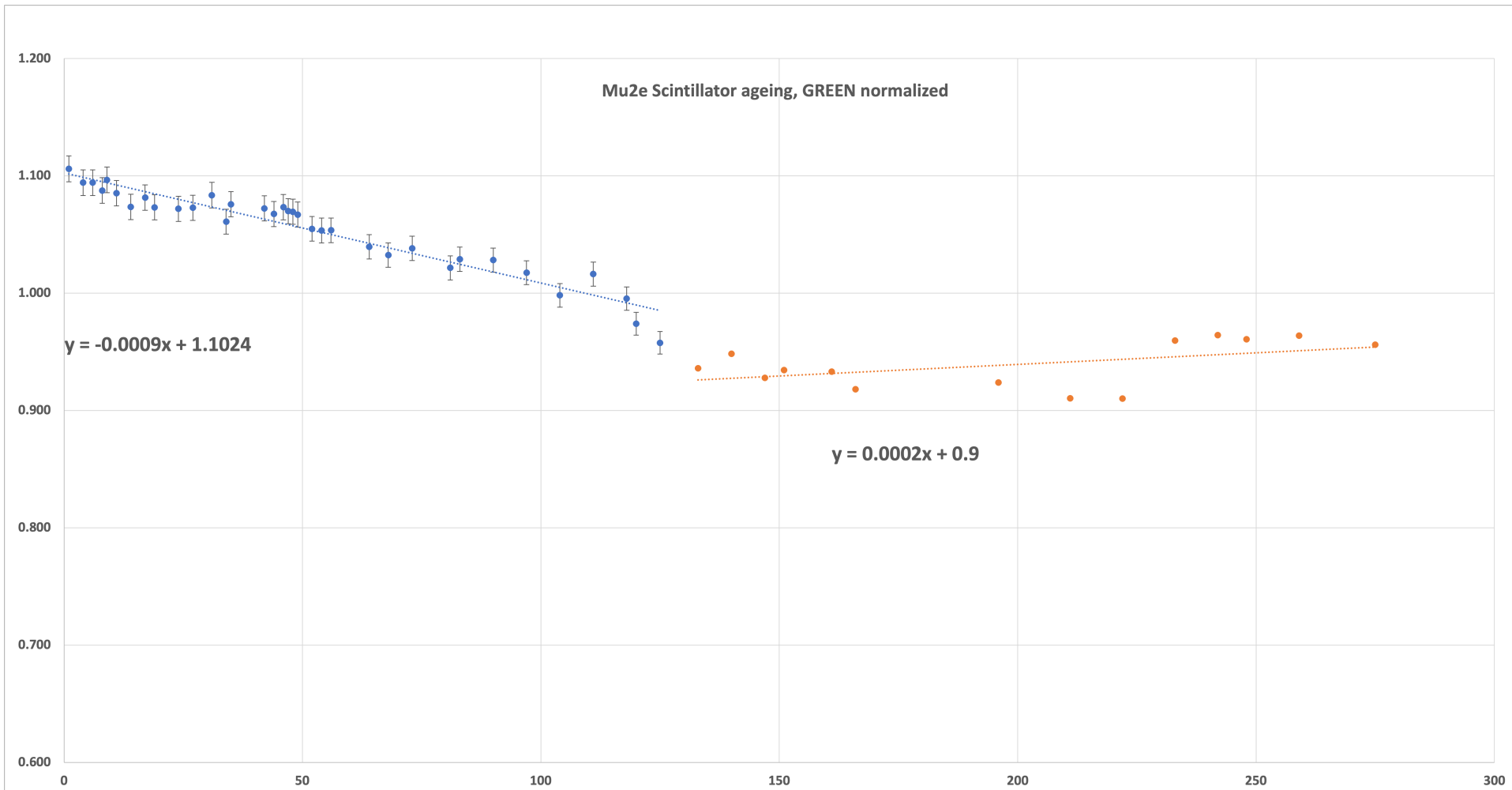
Ageing studies

- The first round of ageing studies started almost a year ago using a Mu2e sample that was produced in 2019 (had been on the shelf for ~ 2 years).
- Source: ^{207}Bi
- Used two references:
 - Blue scintillator
 - Green scintillator with similar fluorescence to WLS fiber
- Note: during this time, we have replaced our shaper amp and PMT (🤪).

Round 1



Round 1

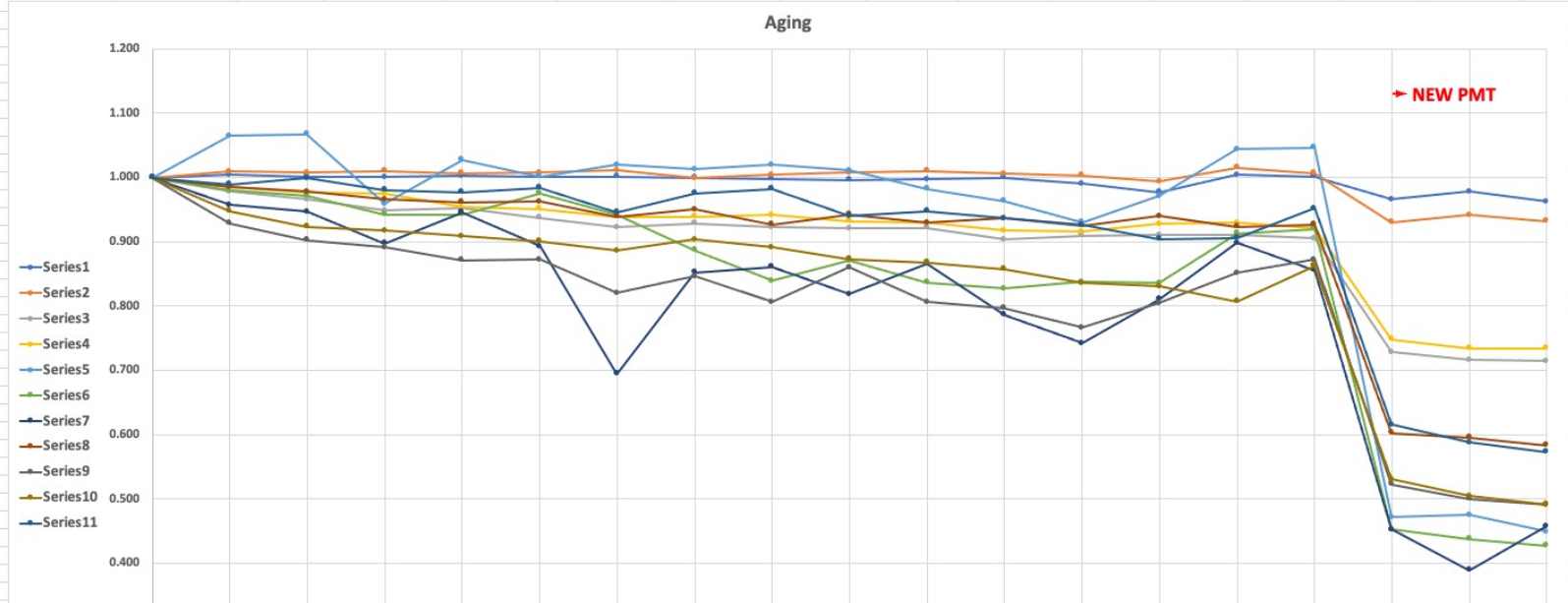


Round 2

- New Samples of the Mu2e extrusion and the new EGP triangle were produced
 - Mu2e: May 2021
 - EGP: June 2021
- Samples with and without fiber, with and without glue, with and without reflective tape

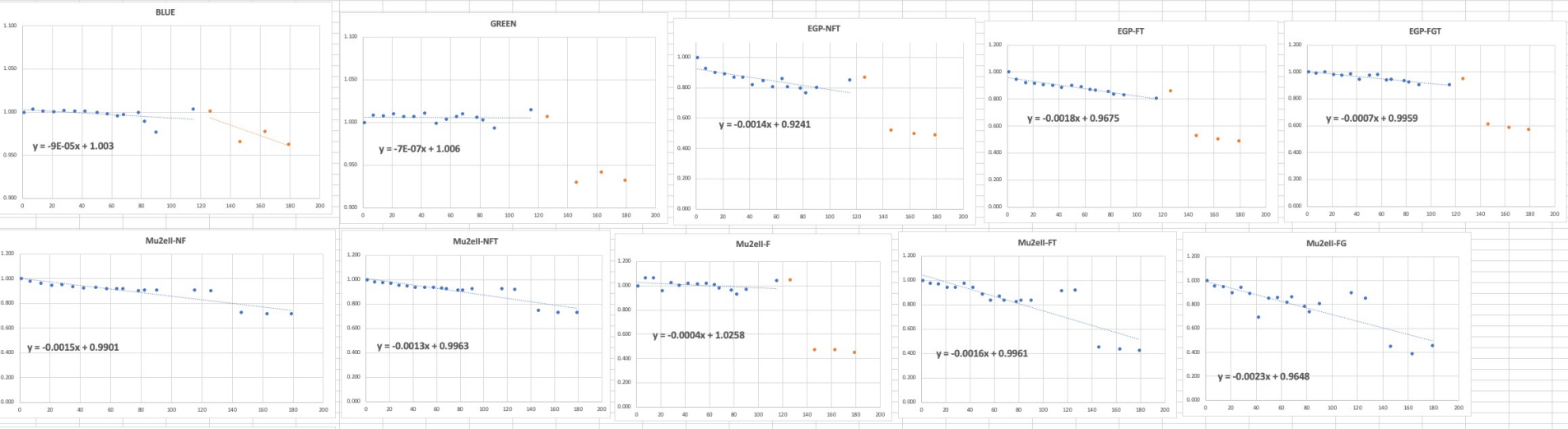
Round 2

	DATE	DAYS	BLUE	GREEN	Mu2ell-NF	Mu2ell-NFT	Mu2ell-F	Mu2ell-FT	Mu2ell-FG	Mu2ell-FGT	EGP-NFT	EGP-FT	EGP-FGT	Measured by:
Reference (LDL 150) 8/18	18-Aug	1	227,580,478	250,511,791	68,237,475	81,309,101	5,405,016	12,576,955	19,470,591	34,970,387	5,105,004	8,705,714	13,627,961	
	18-Aug	1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	AB
Mu2ell produced 5/18/21	25-Aug	7	1.004	1.009	0.978	0.985	1.065	0.979	0.957	0.985	0.928	0.948	0.989	AB
EGP produced 6/15/21	1-Sep	14	1.002	1.008	0.966	0.976	1.067	0.972	0.947	0.978	0.902	0.924	0.999	BL
	8-Sep	21	1.001	1.010	0.948	0.974	0.959	0.943	0.898	0.966	0.891	0.917	0.981	AB
	15-Sep	28	1.002	1.007	0.952	0.953	1.028	0.943	0.946	0.961	0.872	0.909	0.977	BL
	22-Sep	35	1.002	1.007	0.938	0.951	1.001	0.976	0.893	0.962	0.873	0.901	0.984	AB
	29-Sep	42	1.002	1.011	0.923	0.939	1.020	0.943	0.694	0.939	0.820	0.886	0.946	BL
	7-Oct	50	1.000	0.999	0.928	0.939	1.013	0.887	0.852	0.950	0.847	0.903	0.975	AB
	14-Oct	57	0.998	1.004	0.922	0.941	1.019	0.839	0.861	0.927	0.806	0.891	0.982	BL
	21-Oct	64	0.996	1.007	0.920	0.932	1.011	0.871	0.819	0.942	0.860	0.873	0.940	AB
	25-Oct	68	0.997	1.010	0.922	0.929	0.982	0.836	0.866	0.929	0.806	0.868	0.948	BL
	4-Nov	78	1.000	1.006	0.903	0.918	0.964	0.827	0.787	0.936	0.797	0.857	0.936	AB
	9-Nov	82	0.990	1.003	0.909	0.916	0.930	0.838	0.742	0.925	0.766	0.836	0.926	BL
	17-Nov	90	0.977	0.994	0.911	0.928	0.971	0.836	0.810	0.940	0.805	0.830	0.904	AB
	12-Dec	115	1.004	1.015	0.910	0.930	1.044	0.913	0.899	0.923	0.851	0.807	0.906	AB
	23-Dec	126	1.001	1.007	0.905	0.922	1.047	0.920	0.856	0.927	0.872	0.863	0.952	AB
	12-Jan	146	0.966	0.930	0.728	0.748	0.472	0.453	0.452	0.602	0.523	0.530	0.616	AB
	29-Jan	163	0.978	0.942	0.716	0.734	0.475	0.437	0.389	0.595	0.500	0.504	0.588	AB
	14-Feb	179	0.963	0.932	0.714	0.734	0.449	0.427	0.458	0.583	0.491	0.492	0.573	AB



Round 2

Note: 1% per year = $\sim 3 \times 10^{-5}$



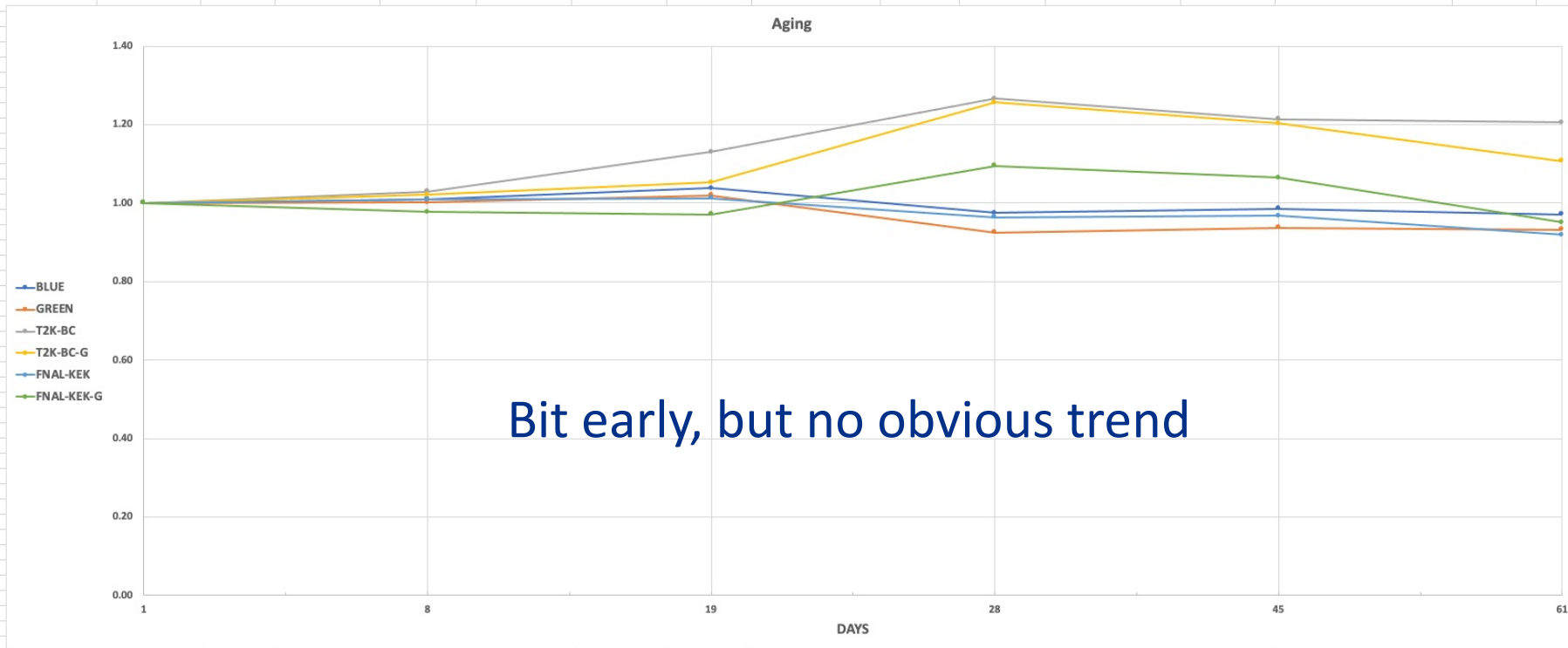
- Conclusions:
 - All samples have large initial ageing rate
 - 85% down to 16%
 - No obvious correlation with glue/no-glue, fiber/no-fiber, etc.

Round 3

- Obtained 1 X 1 cm samples from T2K which were made in Canada (following exactly our formula) -- 2010
- 1 X 1 cm samples made at Fermilab -- 2014

Round 3

	DATE	DAYS	BLUE	GREEN	T2K-BC	T2K-BC-G	FNAL-KEK	FNAL-KEK-G	Measured by:	Notes			
Reference (LDL 150) 12/15	15-Dec	1	225,556,380	251,744,428	19,067,868	19,408,051	14,420,065	20,403,490	AB				
		1	1	1	1	1	1	1		Ratio T2K-BC-G/T2K-BC	1.018	Ratio FNAL-KEK-G/FNAL-KEK	1.415
	23-Dec	8	1.010	1.002	1.029	1.021	1.009	0.977	AB		0.991	1.371	
T2K-BC produced in 2010	3-Jan	19	1.038	1.020	1.131	1.052	1.013	0.971	AB		0.947	1.357	
FNAL-KEK produced in 2014	12-Jan	28	0.975	0.926	1.267	1.256	0.964	1.095	AB		1.010	1.607	
	29-Jan	45	0.986	0.937	1.214	1.203	0.968	1.065	AB		1.009	1.557	
	14-Feb	61	0.971	0.933	1.206	1.108	0.920	0.951	AB		0.935	1.463	



Conclusions

- If we wait long enough, we have seen leveling off of the light decrease
- No clear indicator as to what the issue is
 - Likely scenario is that is multiple things
 - Let's see what Brian and Mackenzie have to say
- Old scintillator does not appear to age, but it is early.
 - May indicate that sample prep does not cause the problem