BGS logistics *for* **re-CMX**

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on behalf of the BGS WG

Oct 16, 2020 — Data Systems telecon — DocDB 5748

BGS priority is to *maximize* the ***magnitude-limited sample***

footprint	$t_{\rm nom}$ [1]	$r_{\rm lim}$ [2]	$r < r_{\rm lim}$ *complete sample size*
9000 w/ twilight			
9000 w/o twilight			
...			...
14000 w/ twilight			
14000 w/o twilight			

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9000 w/ twilight			
9000 w/o twilight			
...			...
14000 w/ twilight			
14000 w/o twilight			

[1] *nominal exposure time to achieve 3 passes with sufficient margins*

[2] *95% redshift completeness for* $r < r_{\rm lim}$

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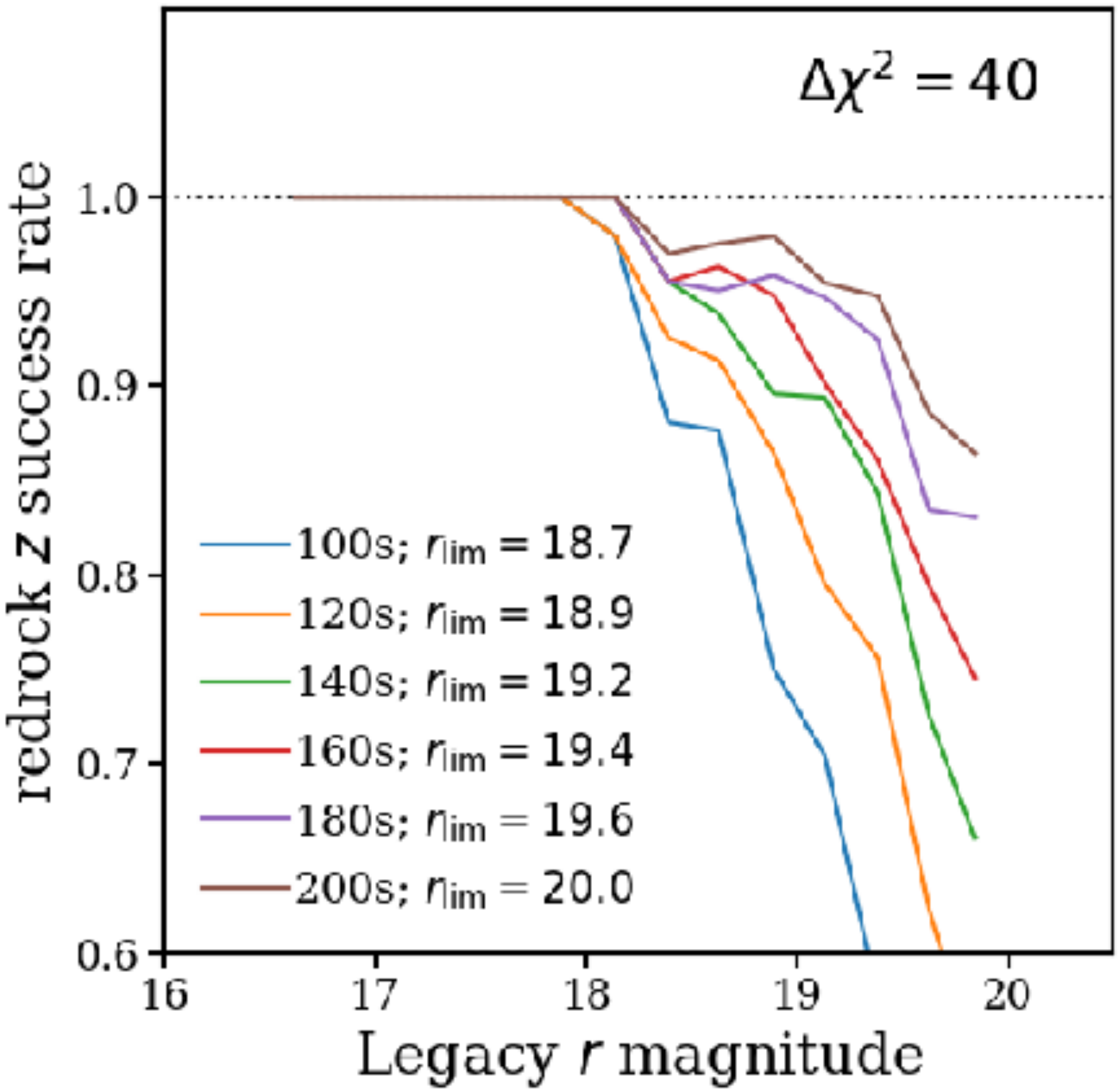
9000 w/ twilight			
9000 w/o twilight			
...			...
14000 w/ twilight			
14000 w/o twilight			

$t_{\rm nom} - r_{\rm lim}$ *relation* can be determined from **spectral simulations**

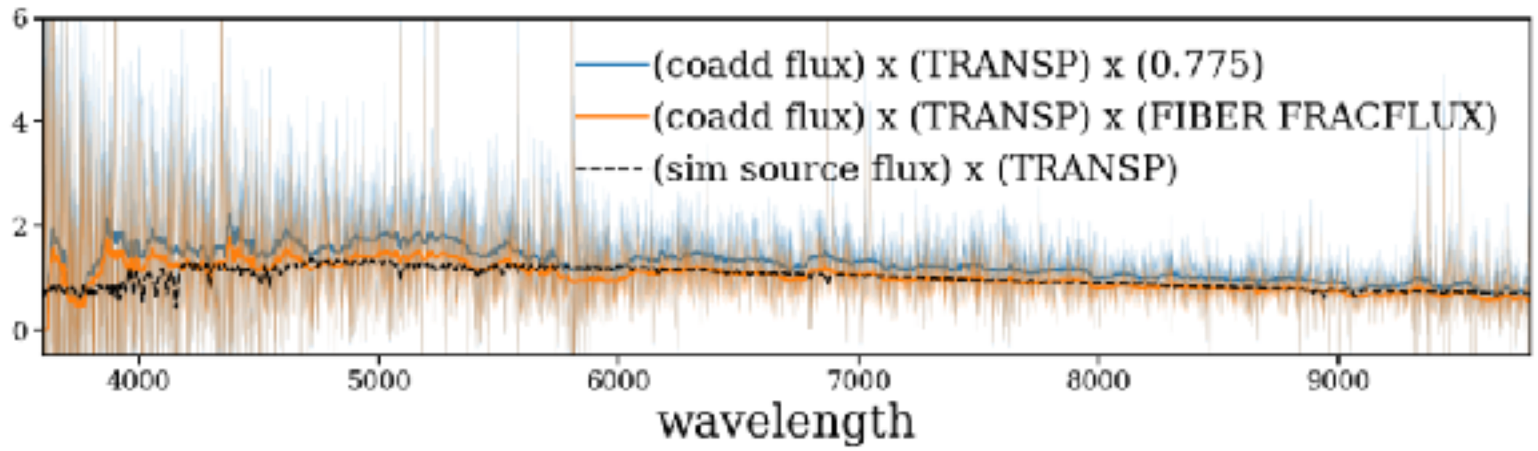
footprint — $t_{\rm nom}$ *relation* can be determined from **strategy simulations**

95% $r < \mathbf{r}_{\mathrm{lim}}$ completeness given *nominal exposure time* t_{nom} from spectral simulations



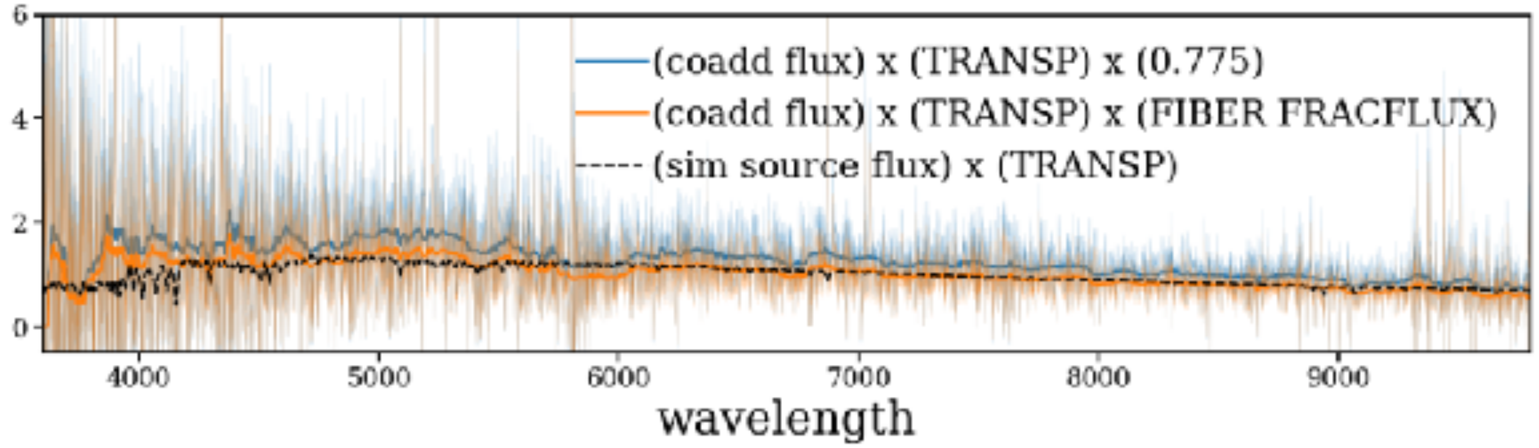
we need at least $t_{\mathrm{nom}} \sim 170s$ for $r_{\mathrm{lim}} \sim 19.5$

we've run a number of *validation tests* on the ***spectral simulation*** using **CMX data**



source fluxes *(AGN template + GAMA emission lines)* are **consistent with CMX data**

we've run a number of *validation tests* on the ***spectral simulation*** using **CMX data**



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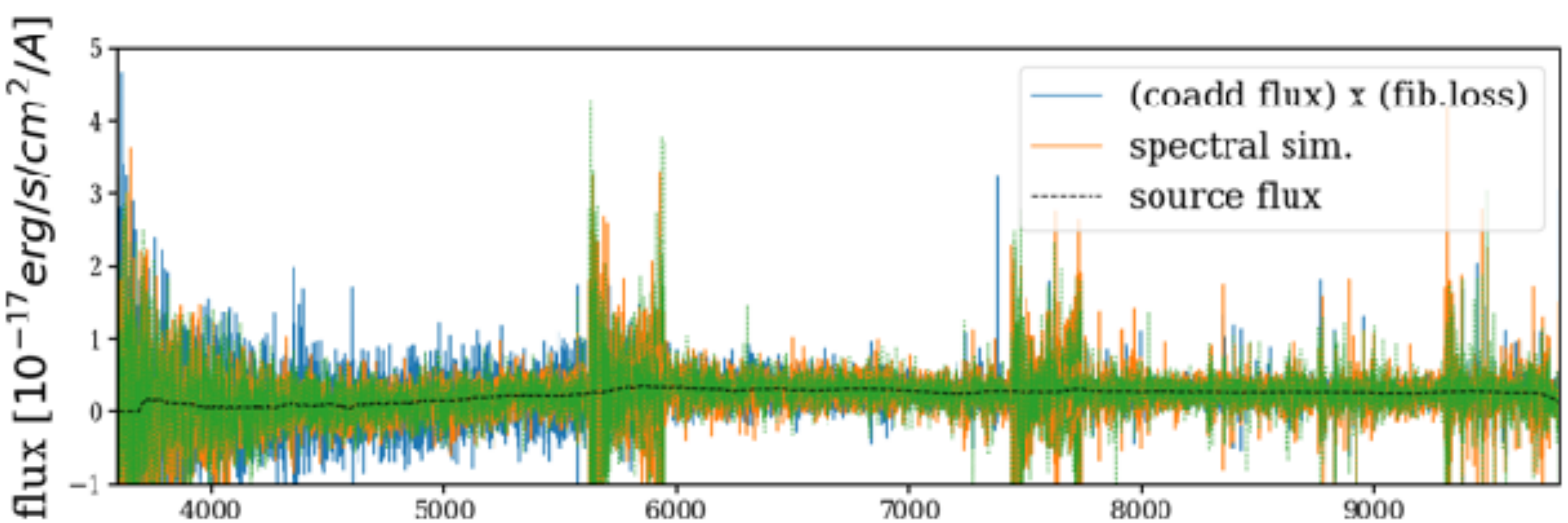

specsim pipeline reproduces the S/N of **CMX spectra**

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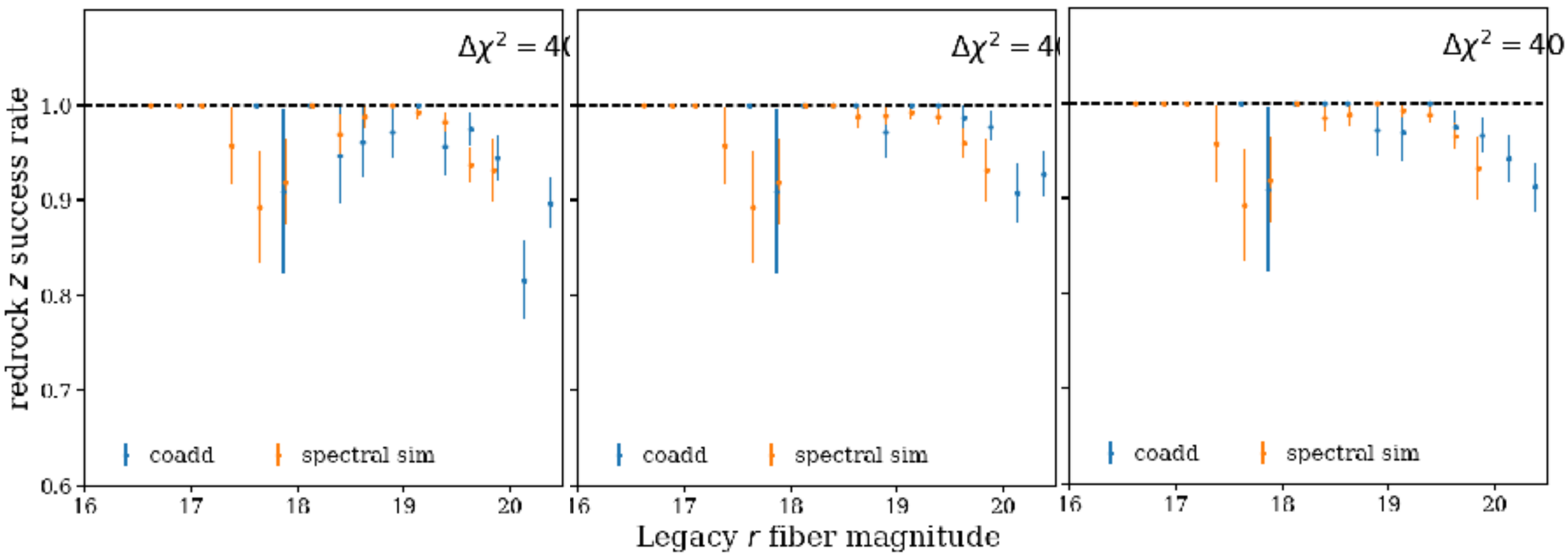
we've run a number of *validation tests* on the ***spectral simulation*** using **CMX data**



we reproduce the z success rates of ***VI tile exposures***

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BGS priority is to *maximize* the ***magnitude-limited sample***

footprint	t_{nom} [1]	r_{lim} [2]	$r < r_{lim}$ ***complete sample size***
9000 w/ twilight			
9000 w/o twilight			
...			...
14000 w/ twilight			
14000 w/o twilight			

t_{nom} — r_{lim} *relation* can be determined from **spectral simulations**

footprint — t_{nom} *relation* can be determined from **strategy simulations**

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exposure times in the *strategy simulation* are scaled by $f_{\rm sky}$ to ***match nominal dark time SNR***

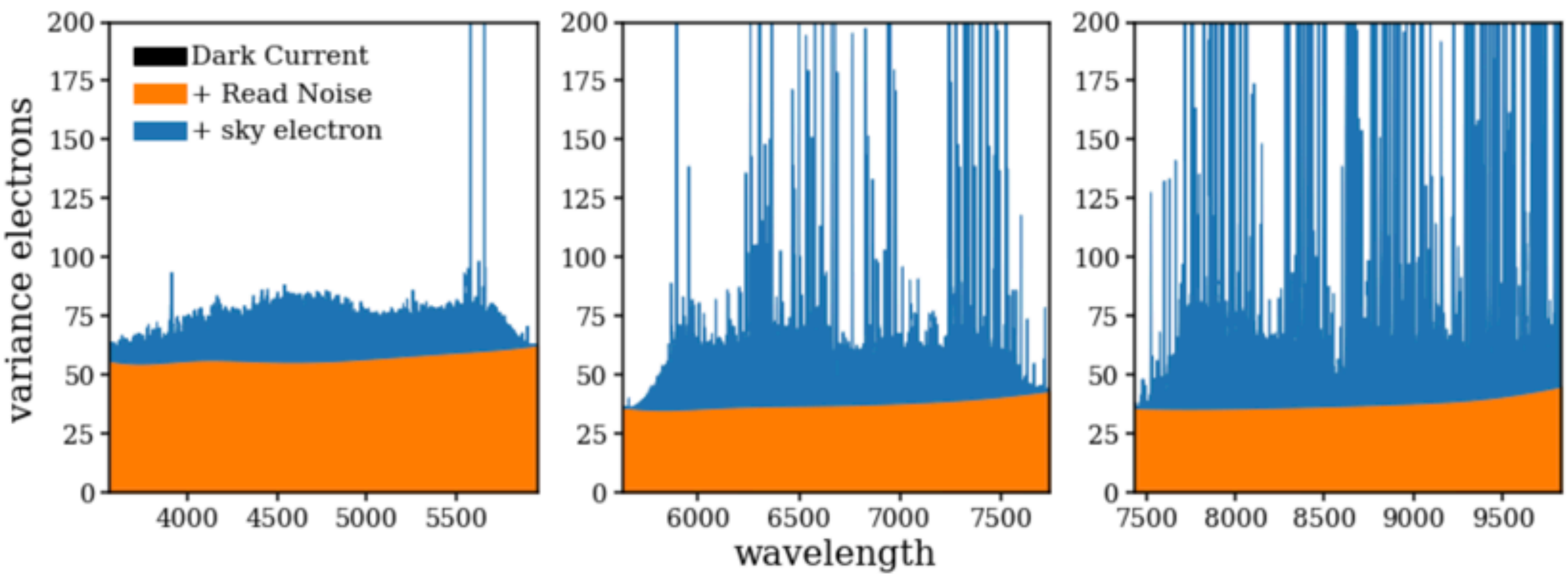
$$\mathrm{SNR} = \frac{S \times t}{\sqrt{(S + Sky + n_{pix} \times DC) \times t + n_{pix} \times RN^2}} \simeq S \times \sqrt{\frac{t}{Sky}}$$

previously *(before June 11, 2020)* we used

$$t_{\rm BGS} = t_{\rm nom} f_{\rm sky} = t_{\rm nom} \frac{(\rm sky)_{BGS}}{(\rm sky)_{nom}}$$

exposure times in the *strategy simulation* are scaled by f_{sky} to ***match nominal dark time SNR***

$$\mathrm{SNR} = \frac{S \times t}{\sqrt{(S + Sky + n_{pix} \times DC) \times t + n_{pix} \times RN^2}} \simeq \cancel{S \times \sqrt{\frac{t}{Sky}}}$$



for BGS you can't ignore read noise

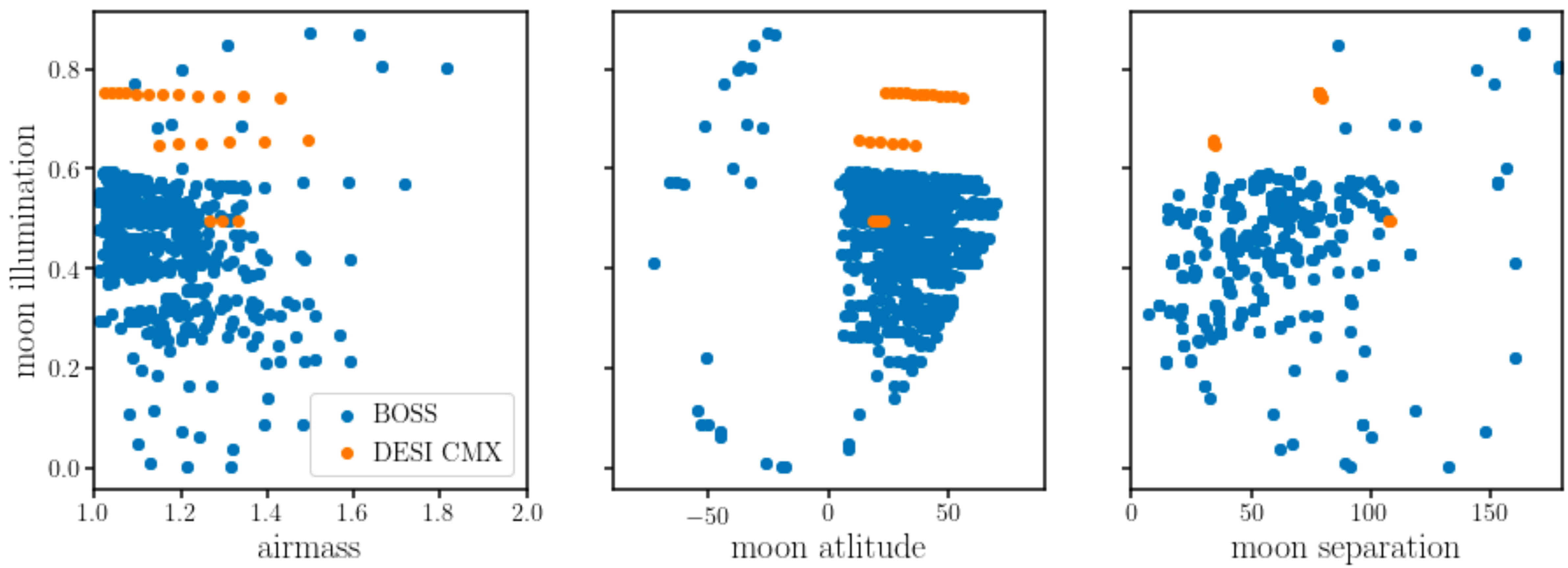
exposure times in the *strategy simulation* are scaled by $f_{\rm sky}$ to ***match nominal dark time SNR***

$$\mathrm{SNR} = \frac{S \times t}{\sqrt{(S + Sky + n_{pix} \times DC) \times t + n_{pix} \times RN^2}} \simeq \cancel{S \times \sqrt{\frac{t}{Sky}}}$$

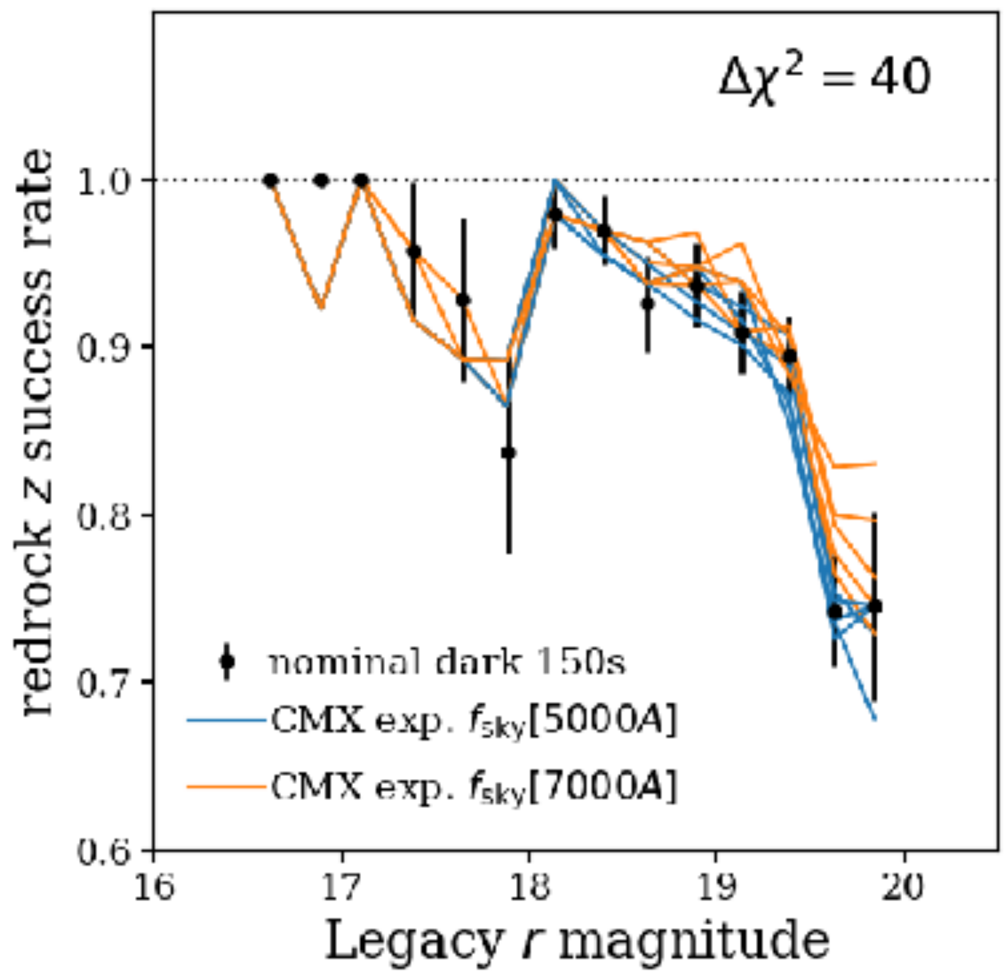
$$t_{\rm BGS} = t_{\rm nom} \frac{(\text{sky flux})\mathrm{t_{nom}} + \sqrt{\mathrm{t^2_{nom}}(\text{sky flux})^2_{\rm BGS} + 4\mathrm{RN}^2((\text{sky flux})_{\rm nom}\mathrm{t_{nom}} + \mathrm{RN}^2)}}{2((\text{sky flux})_{\rm nom}\mathrm{t_{nom}} + \mathrm{RN}^2)}$$

$f_{\rm sky}$ is ***lower*** than pre-June 11,2020 model

$f_{\rm sky}$ model fit to **CMX** and **BOSS** sky surface brightness ratios at 5000Å



we validate $f_{\rm sky}$ model using CMX data



we can reproduce the nominal dark z-success rate by scaling any CMX exposure by $f_{\rm sky}$

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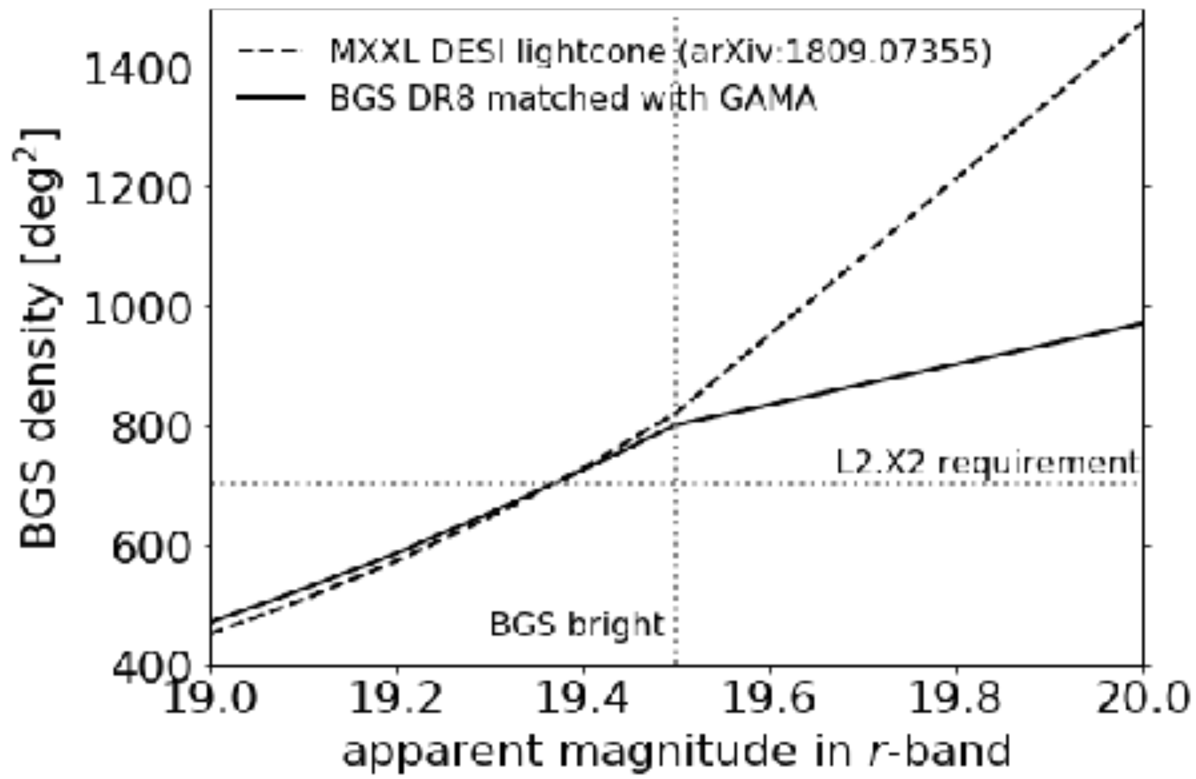
Now fill out the table by running *survey simulations*

footprint	t_{nom} [1]	r_{lim} [2]	$r < r_{\mathrm{lim}}$ ***complete sample size***
9000 w/ twilight			
9000 w/o twilight			
...			
14000 w/ twilight			
14000 w/o twilight			

($r < r_{\mathrm{lim}}$ *complete sample size*) =
(*footprint*) x (*target density*) x ($95\,\%$ z *completeness*) x (*fiber efficiency*)

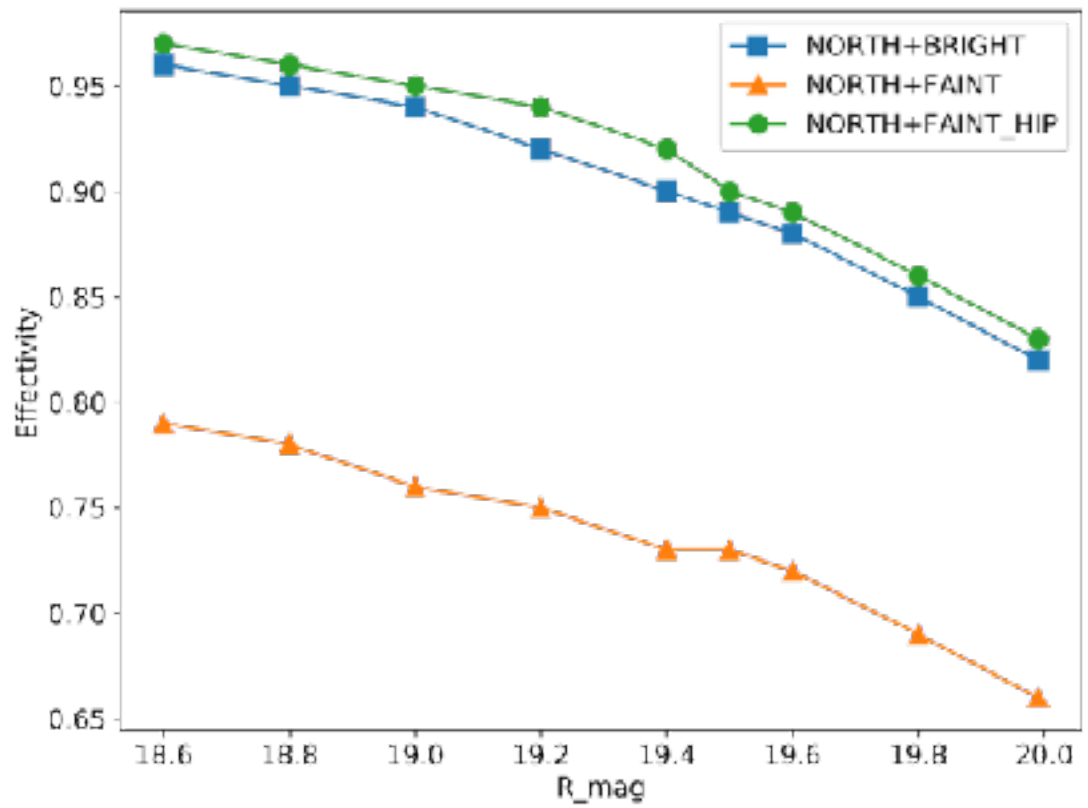
target density from MXXL mocks



($r < r_{\rm lim}$ *complete sample size*) =
(*footprint*) x (*target density*) x ($95\ \%\ z$ *completeness*) x (*fiber efficiency*)

from Omar, Pauline, Shaun

fiber efficiency for different r magnitude limit



($r < r_{\mathrm{lim}}$ *complete sample size*) =

(*footprint*) x (*target density*) x ($95\ \%$ z *completeness*) x (*fiber efficiency*)

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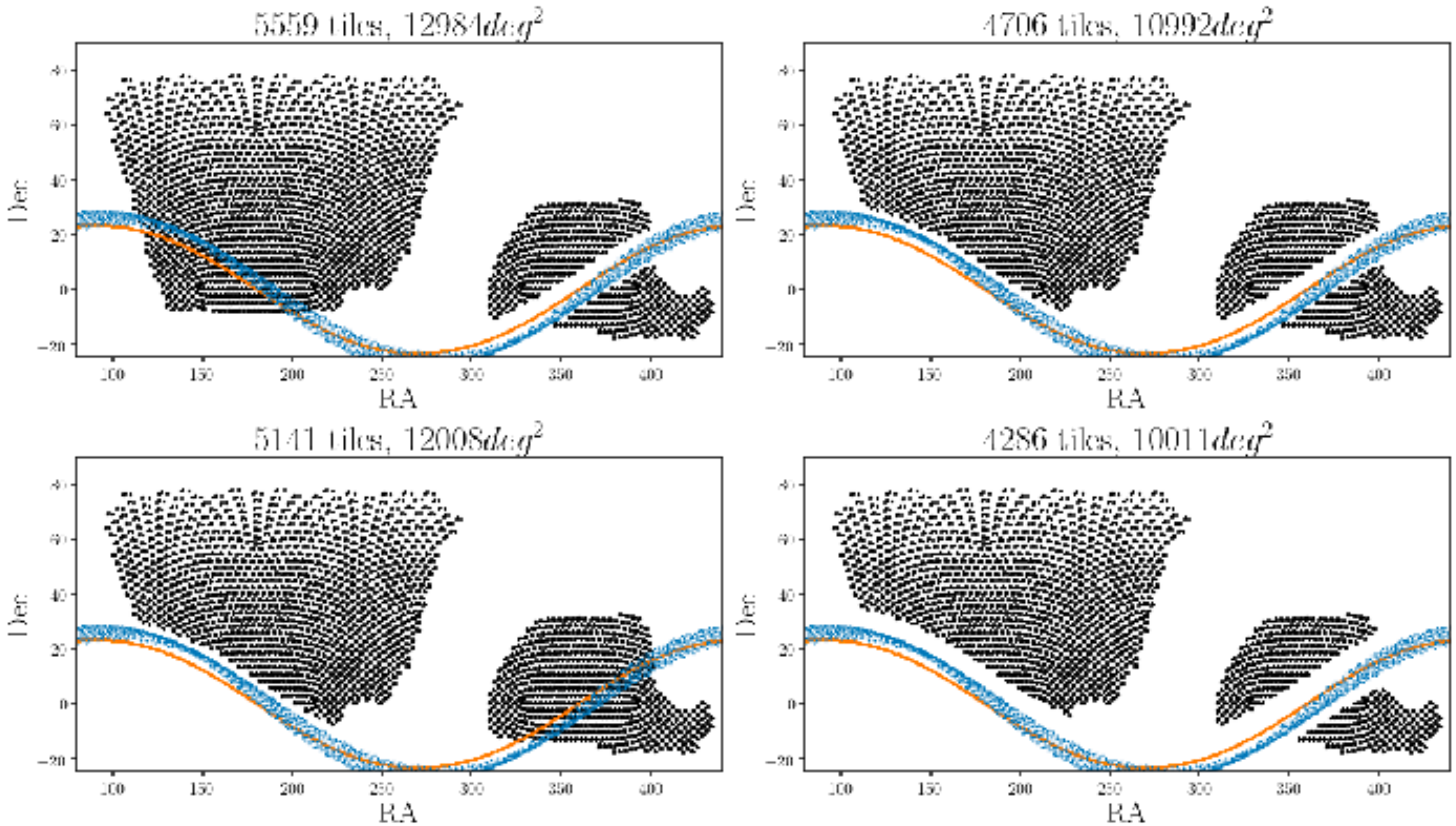
DR8 estimates from David Sierra Porta

survey simulations to determine the footprint we can cover with 3 passes and ~20% margins



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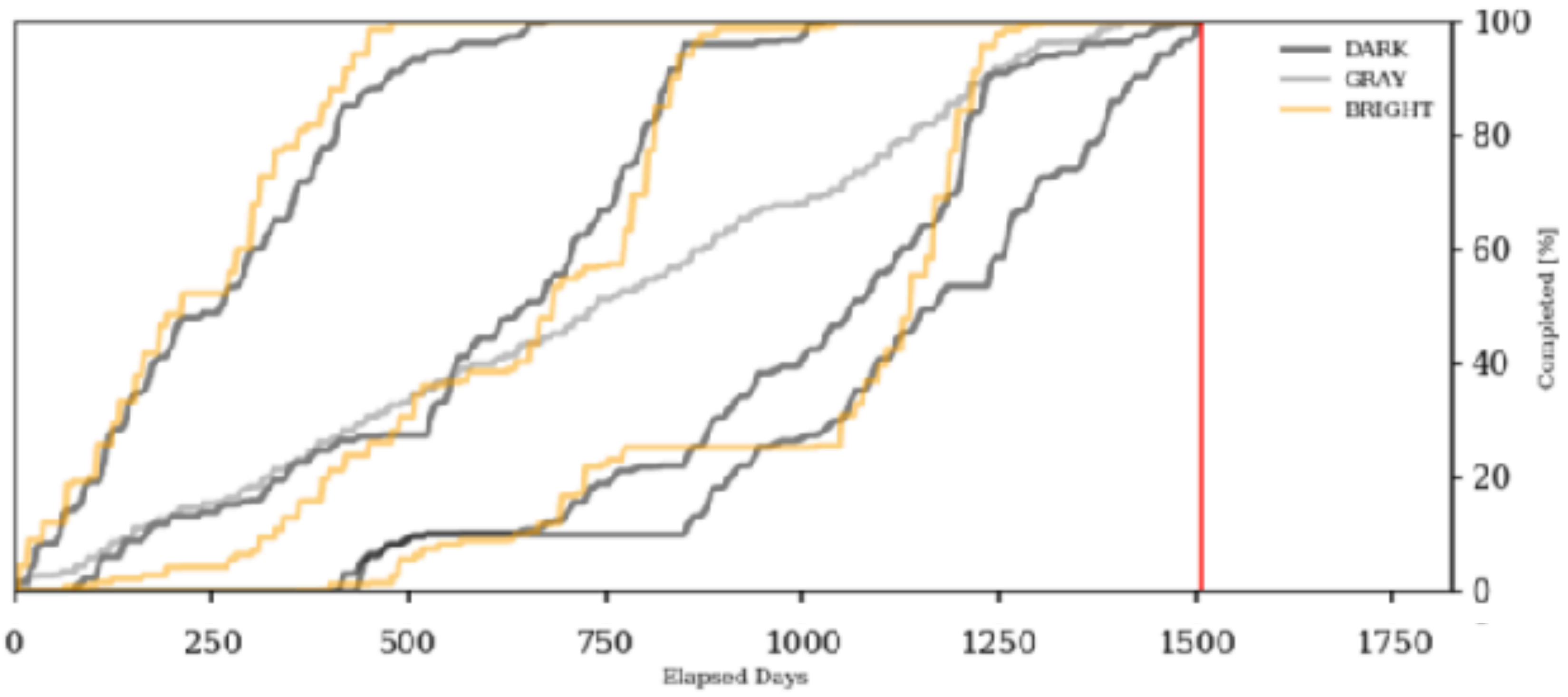
sky coverage	$t_{\rm nom}$ [1]	$r_{\rm lim}$ [2]	**target density**	**fiber eff.**	**margins**	$r < r_{\rm lim}$ ***complete sample size***
10000 w/o twilight	300	___	___	___	20%	___
11000 w/o twilight	270	___	___	___	19%	___
12000 w/o twilight	250				22%	
13000 w/o twilight	200	20.0	1000	0.83	22%	10M
14000 w/o twilight	180	19.5	800	0.9	22%	10M

with updated f_{sky} model, BGS can cover $14{,}000\ \mathrm{deg}^2$ using $t_{\mathrm{nom}} = 170s$ with ~25% margins *without twilight*



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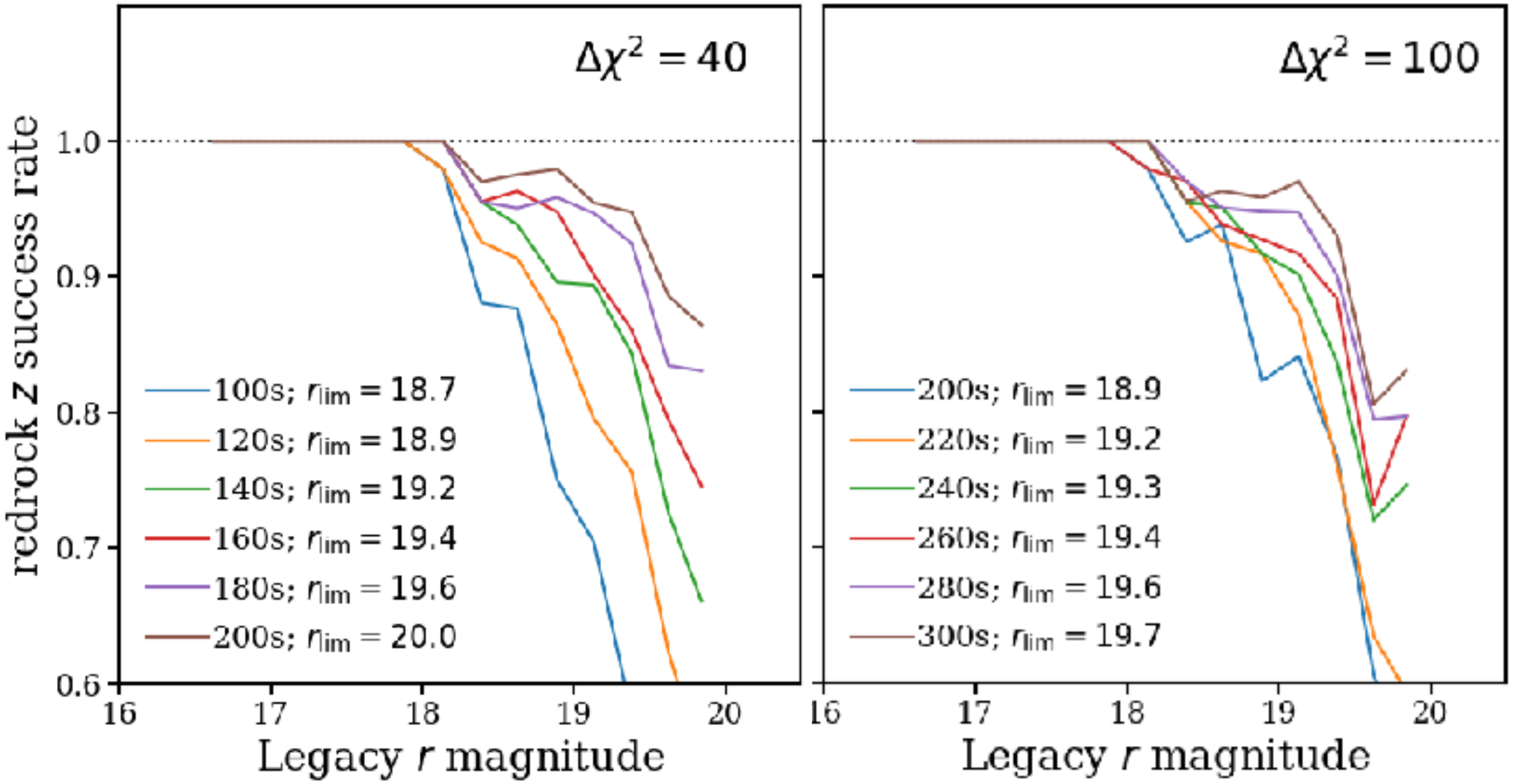
these forecasts are based on *95% redshift completeness* with $\Delta\chi^2 = 40$, but $r_{\rm lim}$ *decreases substantially with* $\Delta\chi^2 = 100$



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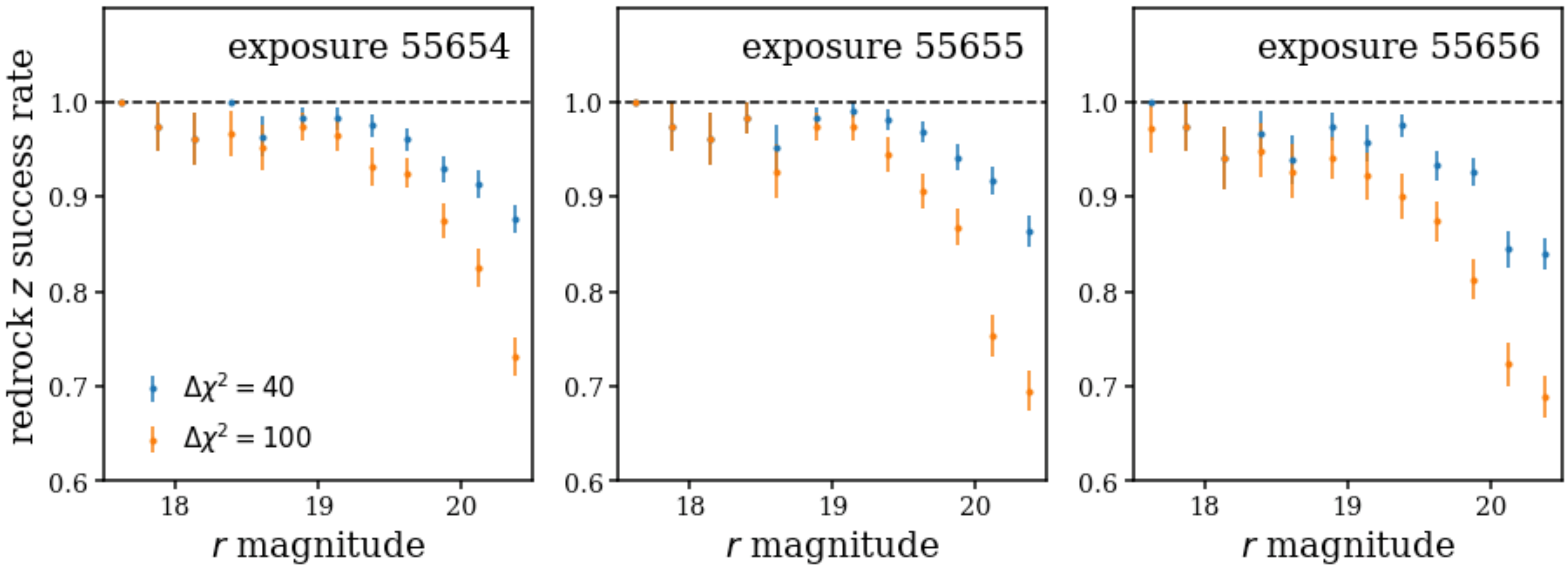
sky coverage	$t_{\rm nom}$ [1]	$r_{\rm lim}$ [2] $\Delta\chi^2 = 40/\ 100$	**target density**	**fiber eff.**	**margins**	$r < r_{\rm lim}$ ***complete sample size***
10000 w/o twilight	300	____ / 19.7	____ / 900	____ /0.87	20%	____ / 7.8M
11000 w/o twilight	270	____ / 19.5	____ / 800	____ / 0.9	19%	____ / 7.9M
12000 w/o twilight	250				22%	
13000 w/o twilight	200	20.0 / 18.9	1000 / 500	0.83 / 0.94	22%	10M / 6.1M
14000 w/o twilight	180	19.5 / 18.8	800 / <500	0.9 / 0.95	22%	10M / <6.6M

in the 3 VI exposures only ***4 out of 170 false positives*** with $40 < \Delta\chi^2 < 100$



each panel is a single 450s exposure

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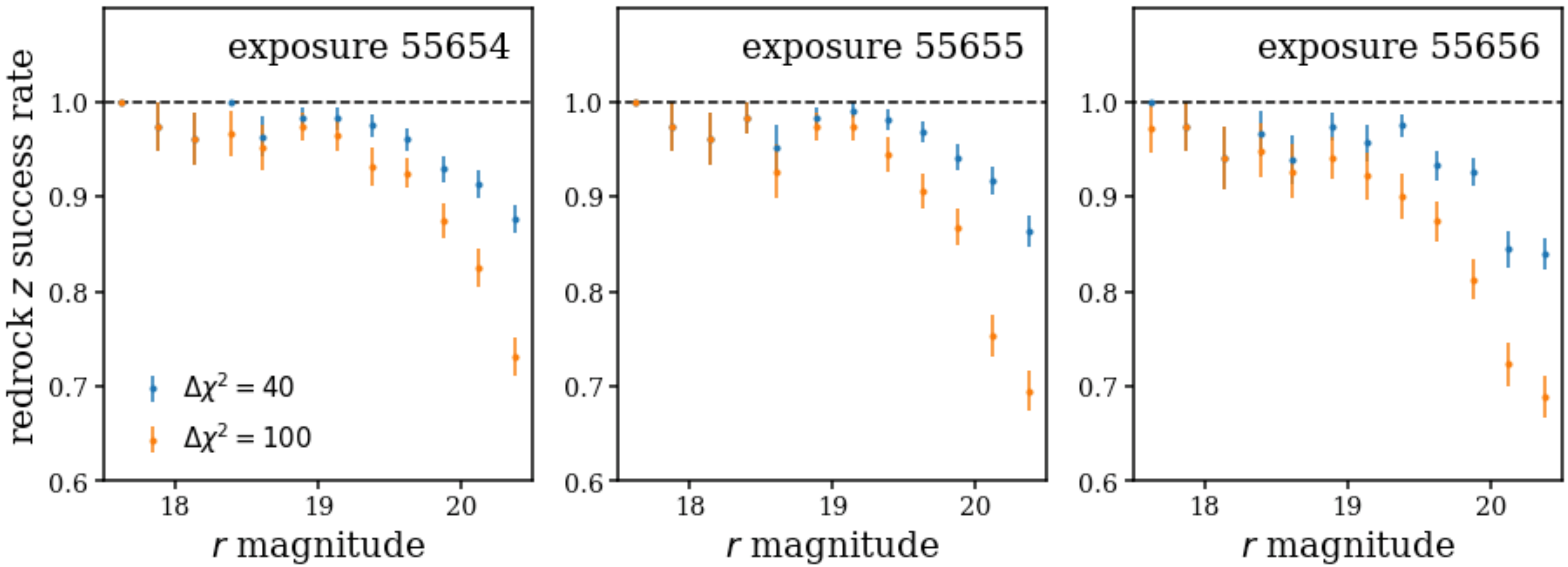
in the 3 VI exposures only ***4 out of 170 false positives*** with $40 < \Delta\chi^2 < 100$ but they were 450s exposures w/ dark sky



each panel is a single 450s exposure

BGS re-CMX wishlist

for a single BGS field

- 1 - 4 exps during **dark time**
- 2 consecutive exps during **bright time** with $f_{\rm sky} \times \ (t_{\rm nom} = 170s)$
- repeat on different bright night

sky fibers during **bright time**: *high moon illumination, high moon altitude, and low moon separation*