# NUTX Leader in Targeted Protein Modulation

# Targeting Degraders to the CNS for the Treatment of Cancer

Educational Session

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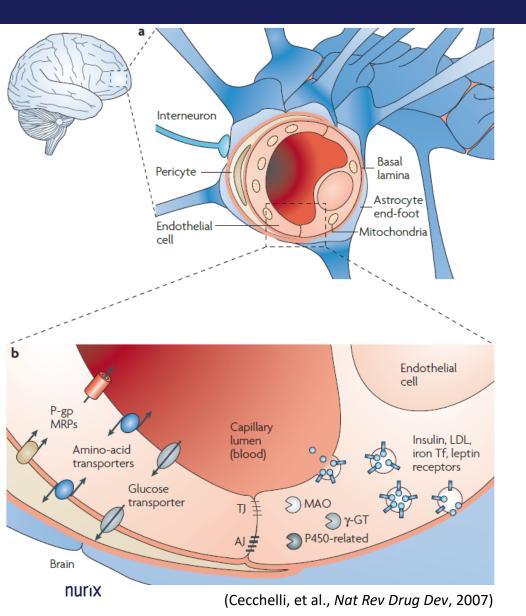
AACR April 5<sup>th</sup>, 2024

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# Designing Compounds With Optimal CNS Exposure: For *small molecule* drugs, established metrics can aid in CNS-penetrant designs



- The BBB is a selective barrier that protects the brain from harmful compounds and precisely regulates its microenvironment
- The CNS multiparameter optimization score (MPO score) defines chemical properties that are optimal for CNS therapeutic agents
- Determining the parameters and characteristics that predict CNS exposure of degraders are of high interest

Property	More Desirable Less Desirab		
ClogP	≤ 3	≥ 5	
ClogD	≤ 2	≥ 4	
MW	≤ 360	≥ 500	
TPSA	40 to 90	< 20, > 120	
HBD	≤ 1	≥4	
рКа	≤ 8	≥ 10	

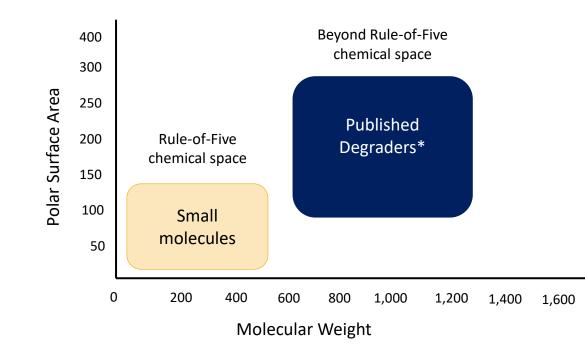
# Each property assigned a score from 0.0 to 1.0 and summed. 77% of marketed CNS drugs had an MPO score $\geq$ 4.0 (Wager, et al., ACS Chem Neuro, 2016)

#### **CNS MPO Properties and Parameter Ranges**

# Degraders Occupy Non-Traditional Chemical Space Where Historical Rules Don't Apply

Degraders occupy space 'Beyond-the-Rule-of-Five' where established guidelines for

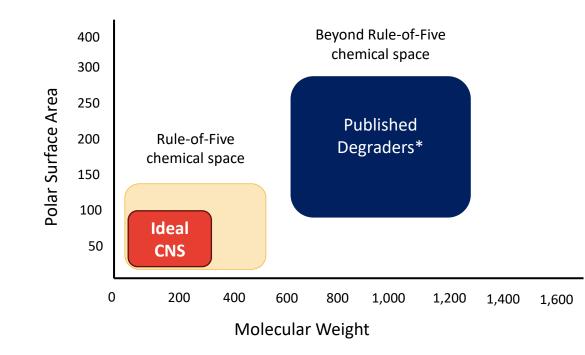
physicochemical properties associated with drug-likeness can't easily be applied



# Degraders Occupy Non-Traditional Chemical Space Where Historical Rules Don't Apply

Designing blood-brain-barrier penetration in the bifunctional targeted protein degrader space is particularly

challenging due to well-established limitations on both molecular weight and polar surface area

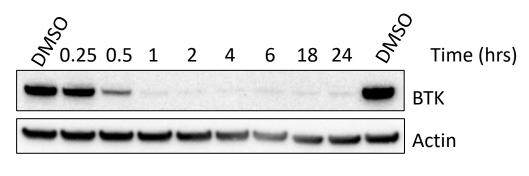


## Case Study: BTK Degrader NX-5948 for the Treatment of B cell Malignancies Optimized for Cellular Potency and Oral Bioavailability

Primary Human B cells

N=3 independent donors 4 hour treatment SEM error bars are smaller than symbols

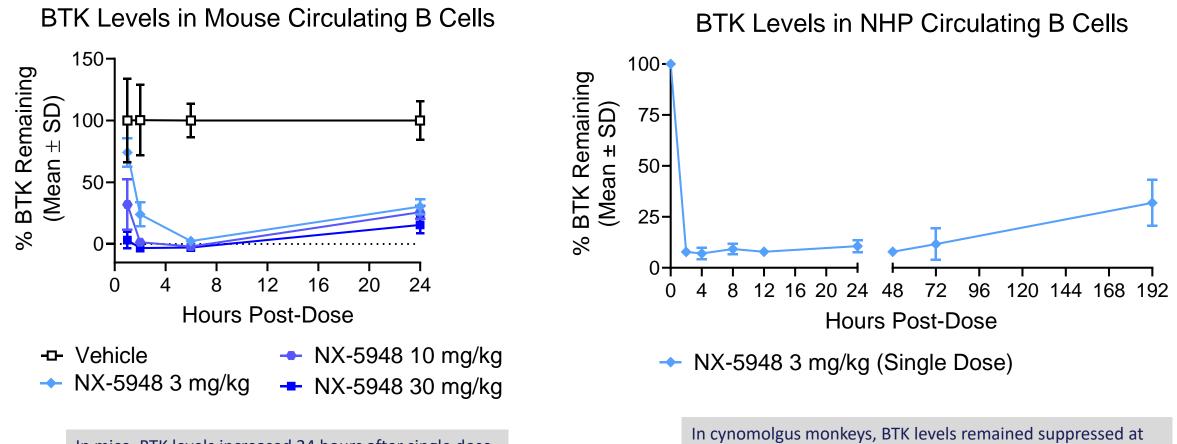
#### Ramos Cells (Human Burkitt Lymphoma)



10 nM NX-5948

## Case Study: BTK Degrader NX-5948 for the Treatment of B cell Malignancies Optimized for Cellular Potency and Oral Bioavailability

> A Single Oral Dose of NX-5948 Promotes Rapid and Compete BTK Degradation in Mouse and NHP B cells



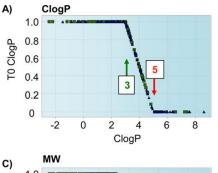
In mice, BTK levels increased 24 hours after single dose

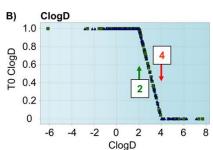
nurix

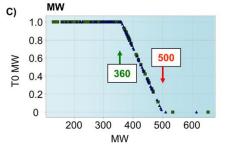
48 hours and return to 32% of baseline after 8 days

# Case Study: BTK Degrader NX-5948 for the Treatment of B cell Malignancies Existing metrics for predicting CNS penetration suggest NX-5948 unlikely to show CNS exposure

# Six property desirability functions used to generate the CNS MPO







2 3

HBD

HBD

0

0

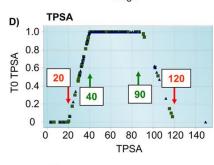
1.0

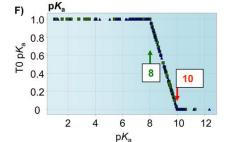
0.2

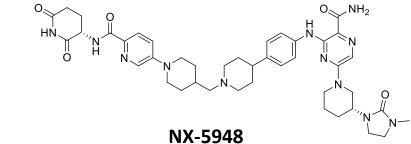
0

E)

0.8 0.6 0.4







Property	More Desirable	Less Desirable	NX-5948 Property value	NX-5948 MPO score
ClogP	≤ 3	> 5	3.6	0.7
ClogD	≤ 2	> 4	0.9	1.0
MW	≤ 360	> 500	807	0
TPSA	40 to 90	≤ 20, > 120	202	0
HBD	≤ 1	> 4	5	0
рКа	≤ 8	> 10	9.1*	0.45
				Total = 2.2

\*Measured pKa

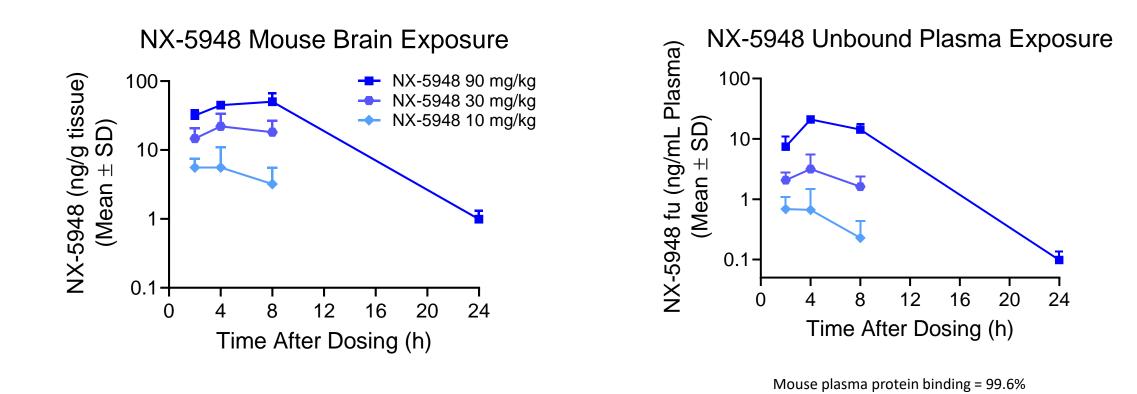
#### MPO >4 generally required for CNS small molecules

Figure from Wager, et al., ACS Chem Neuro, 2016

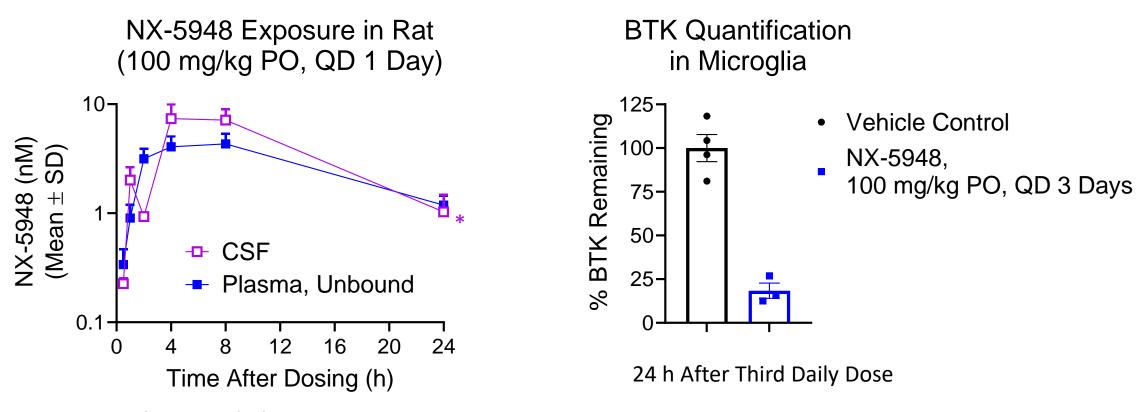
4

5

# However, a Single Oral Dose of NX-5948 in Mice Results in Dose-Dependent CNS Tissue Exposure



A More Detailed Study in the Rat Shows Oral Dosing of NX-5948 Results in Similar CSF and Unbound Plasma Exposures and Degrades BTK in Microglia



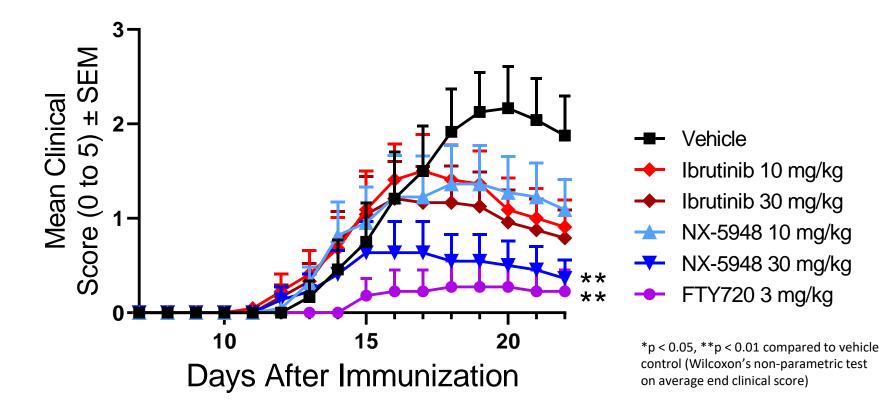
Rat plasma protein binding = 98.4%

nurix

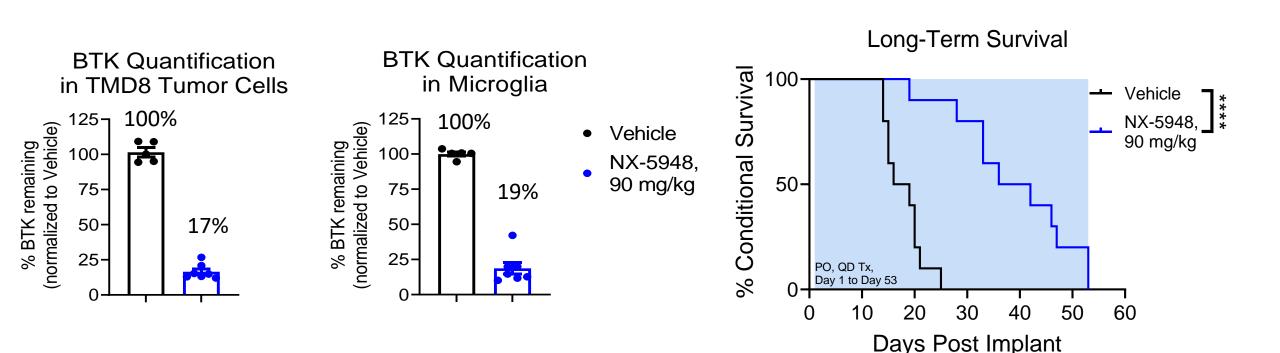
\*One of three CSF samples collected at 24 h was excluded as an outlier based on criteria defined by Motulsky et al., Detecting outliers when fitting data with nonlinear regression – a new method based on robust nonlinear regression and the false discovery rate. BMC Bioinformatics 7, 123 (2006).

# NX-5948 Superior to Ibrutinib in Preclinical Model of CNS Disease Experimental autoimmune encephalomyelitis (EAE), a model of multiple sclerosis





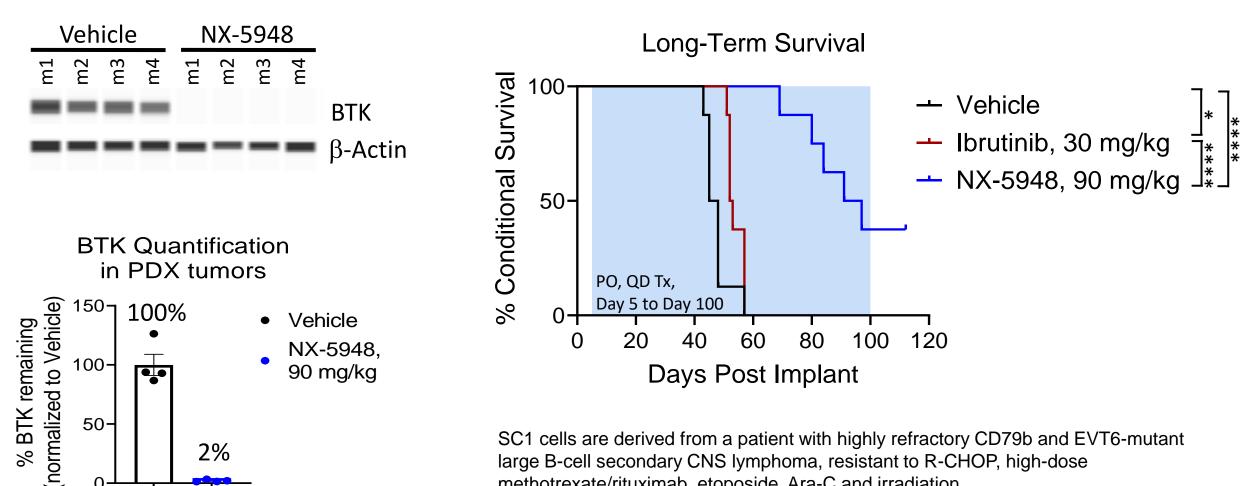
# Daily Oral Administration of NX-5948 to Mice With Intracranial TMD8 DLBCL Tumors Degrades BTK in Brain-Resident Cells and Prolongs Survival



5 x 10<sup>5</sup> TMD8 cells implanted by intracranial injection on Day 0 NX-5948 administered orally QD Days 1-11 (left) or Days 1-53 (right) BTK levels assessed 24 h after the 11<sup>th</sup> dose by flow cytometry

> \*\*\*\*p < 0.0001 compared to vehicle control (Log-rank test)

# Daily Oral Administration of NX-5948 to Mice Implanted with Intracranial **DLBCL PDX Cells Drives Potent BTK Degradation and Prolongs Survival**

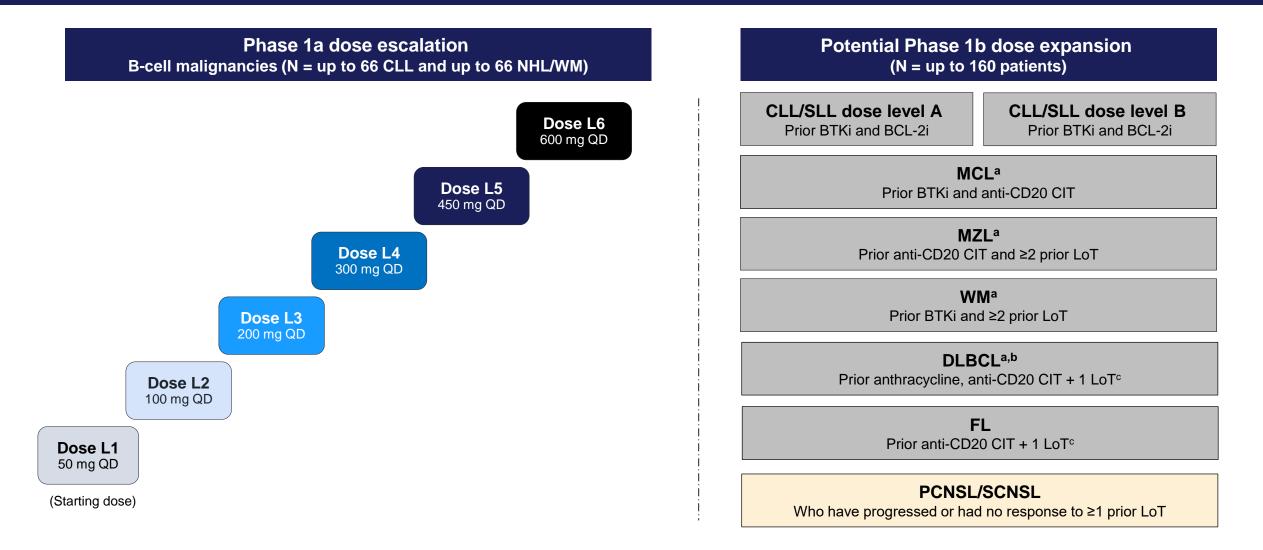


SC1 cells are derived from a patient with highly refractory CD79b and EVT6-mutant large B-cell secondary CNS lymphoma, resistant to R-CHOP, high-dose methotrexate/rituximab, etoposide, Ara-C and irradiation.

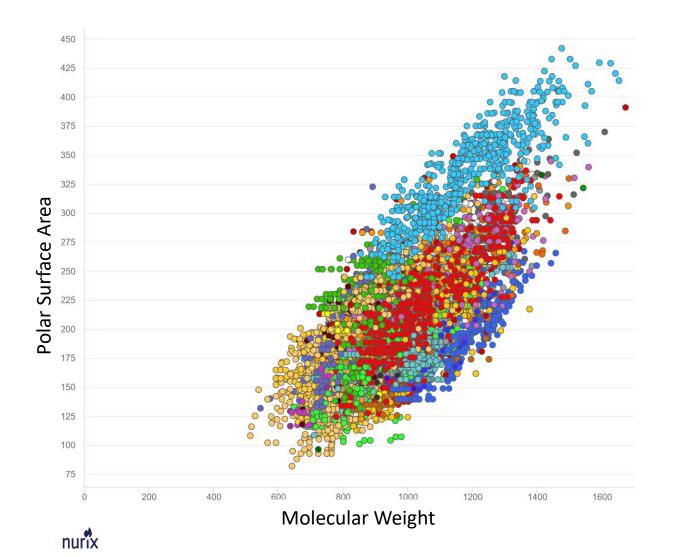
13

2%

### Phase 1 Trial of NX-5948 in Adults With Advanced B-cell Malignancies Only BTK Degrader trial to permit patients with CNS involvement at baseline



# Can We Identify Additional CNS-Penetrant Degraders? >12,000 Nurix degraders designed between 2022-2023 plotted by MW vs PSA



Compounds represent 34 programs, colored by target

Broad property space anchored by profile of POI binder

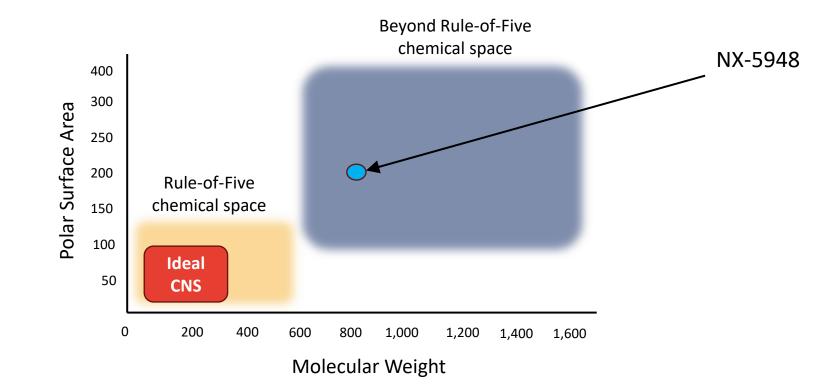
Represents a larger property range vs public database

15

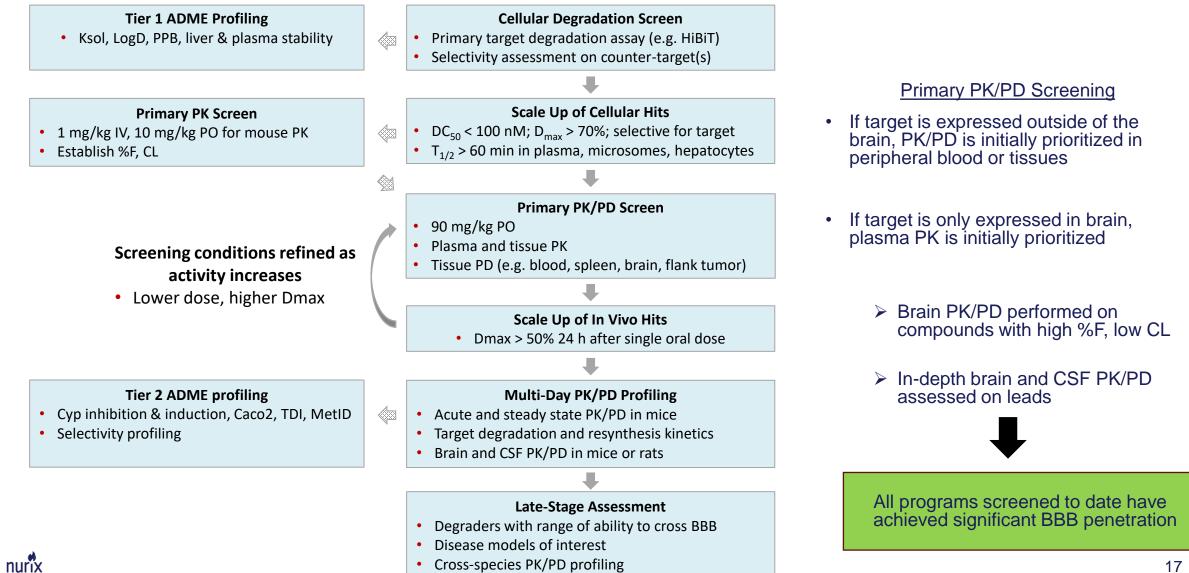
# When You Lack a Rulebook, You Screen

CNS-penetrant drugs occupy a small quadrant of the traditional small molecule chemical space

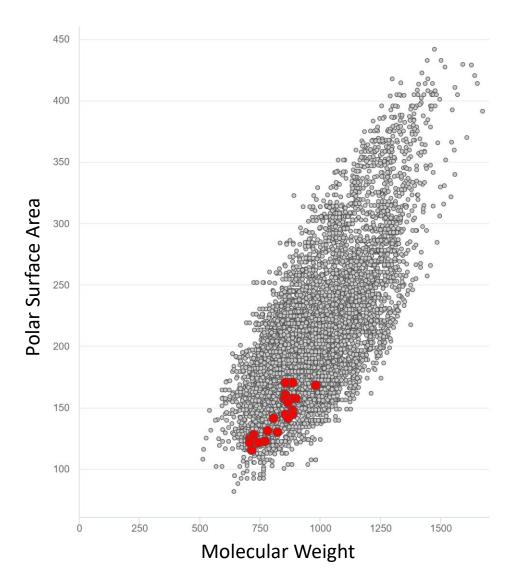
#### What Parameters Define CNS-Penetrant Degraders?

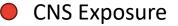


# Empirical Testing Funnel for Identifying Degraders that Cross the BBB



# CNS-Penetrant Degraders Cluster in Small Quadrant of Degrader Design Space





 No CNS Exposure, or Not Selected For PK/PD Screening

## Empirical Screening for CNS-Penetrant Degraders is a Viable Discovery Strategy

>50% of Degraders emerging from dedicated in vivo testing funnel show CNS penetration CNS-penetrant degraders are much more prevalent than expected

Molecular weight range limitation of small molecule design space for CNS is not relevant for degraders

