XU LAB
Innovation through Catalysis

北京大學
PEKING UNIVERSITY

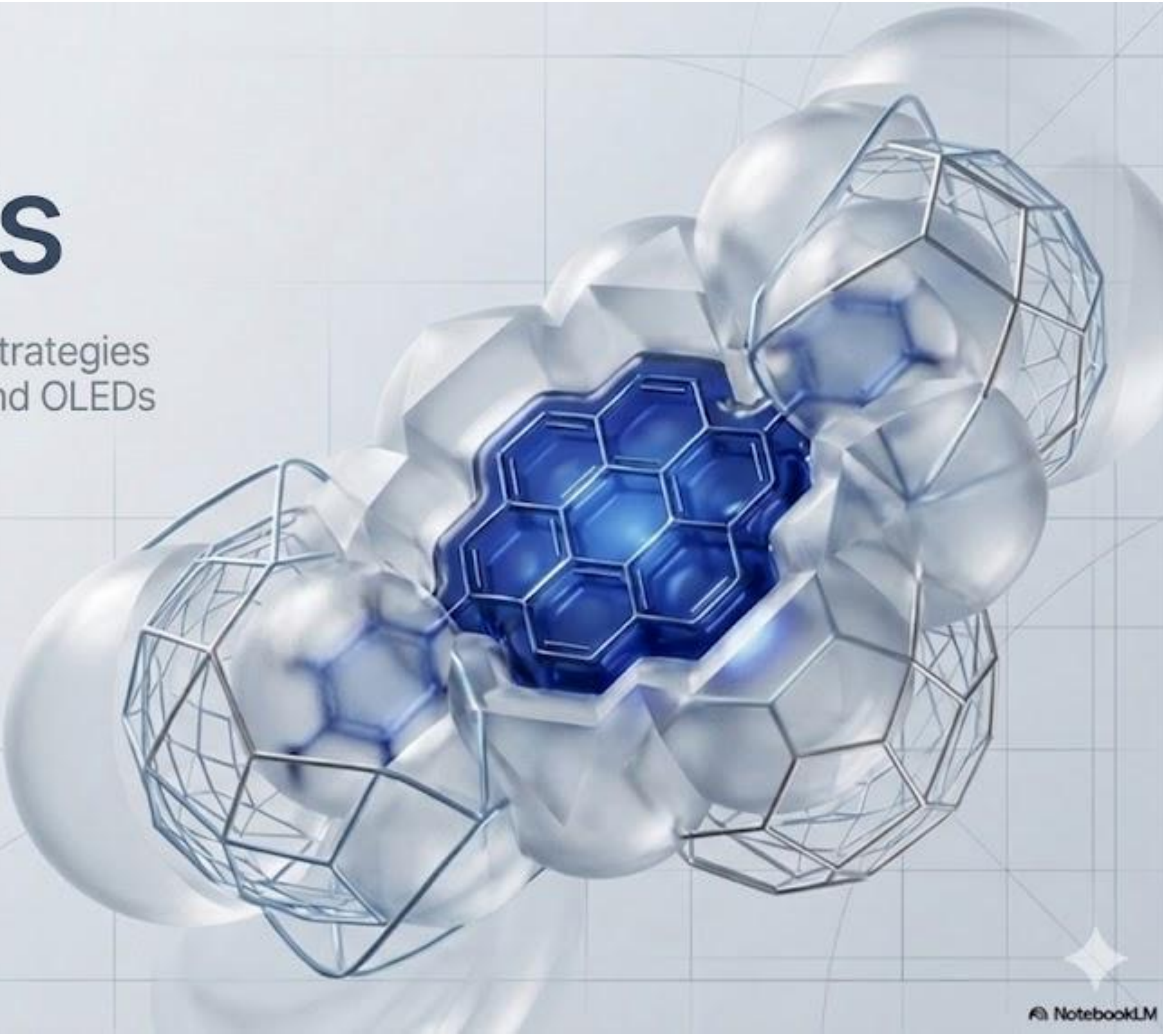
XU GROUP
Department of Chemistry, Peking University

Selected Weekly Literature Presentations

Disclaimer:
These slides contain personal interpretations and may include errors or subjective views.

MR-TADFs

Systematic structural engineering strategies to unlock high-efficiency, narrowband OLEDs at mass-production doping ratios.



Zisheng Xue
2026.04.11

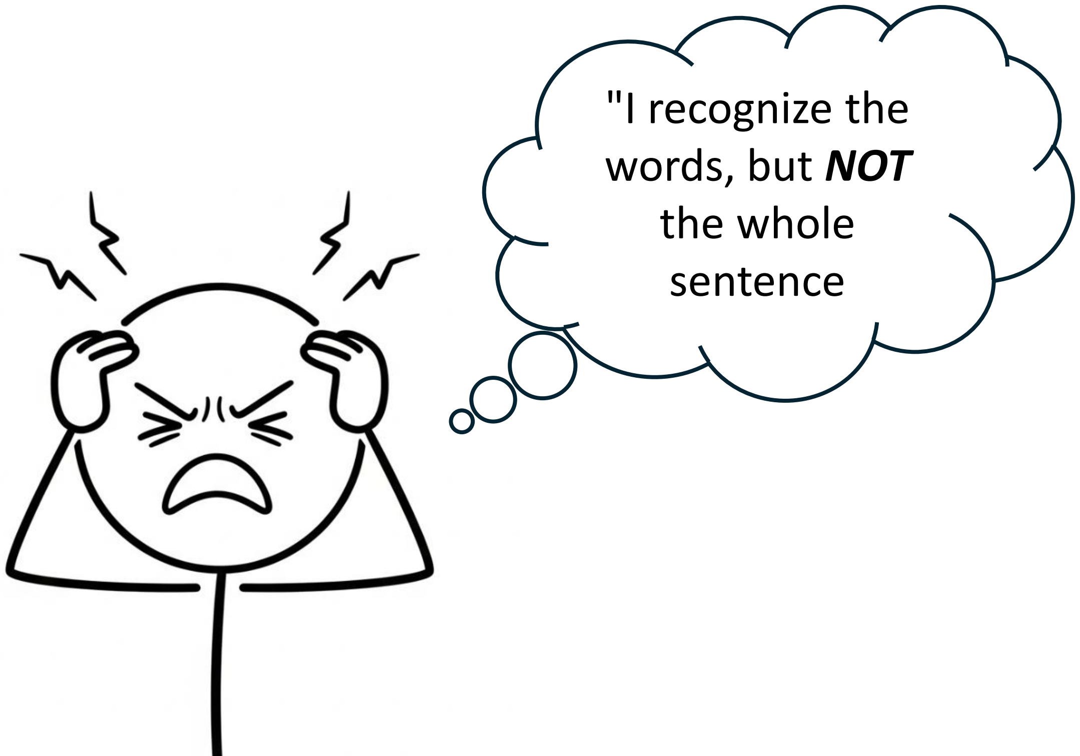
MR-TADFs
Content

- *TADFs and Essential Theoretical Backgrounds*
- *D-A type TADFs and their limitations*
- *MR-TADFs*
- *Towards Deep RED Emission*
- *Towards Brighter OLEDs: faster RISC*
- *Towards Brighter OLEDs: against ACQs*

MR-TADFs

Multiple Resonance

Thermally Activated Delayed Fluorescence



History and Essential theoretical background of TADF

What is TADF and Why we need TADF?

When a device is electrically excited: 3:1 ratio of T:S

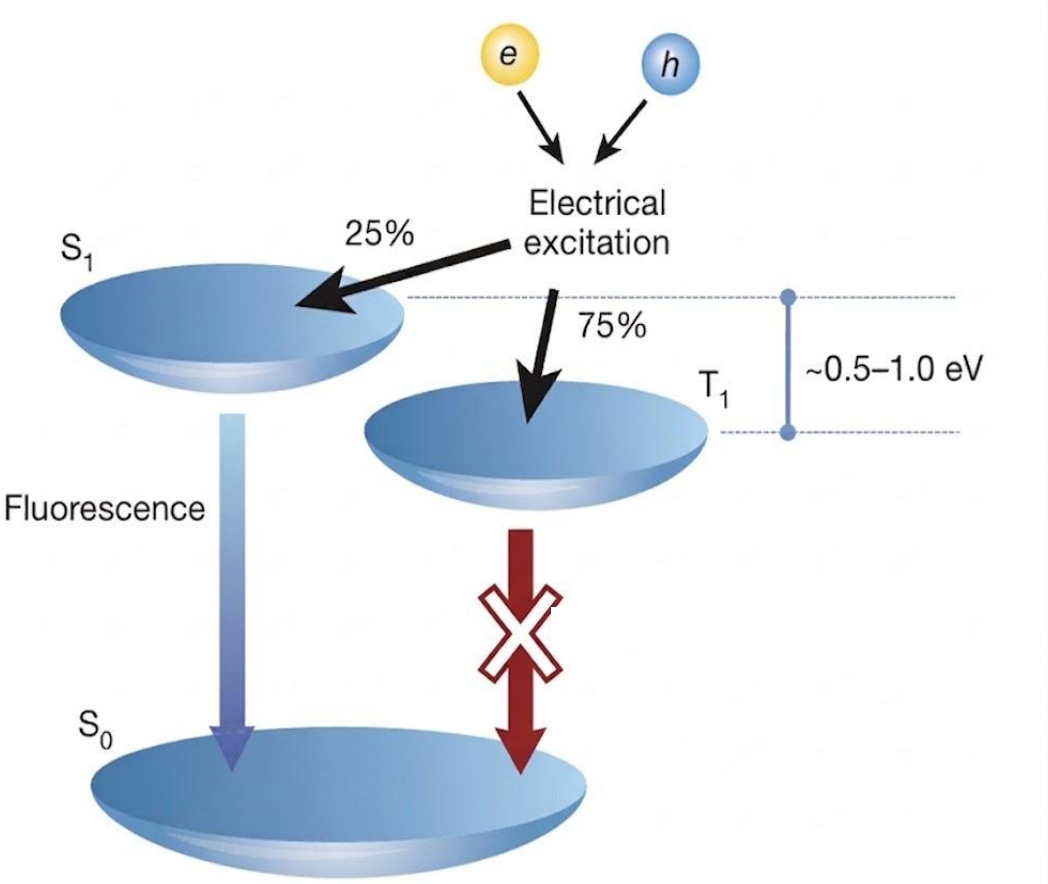
For Normal fluorescent material **only S state** can be used for **emitting lights: Maxium EQE: 25%**

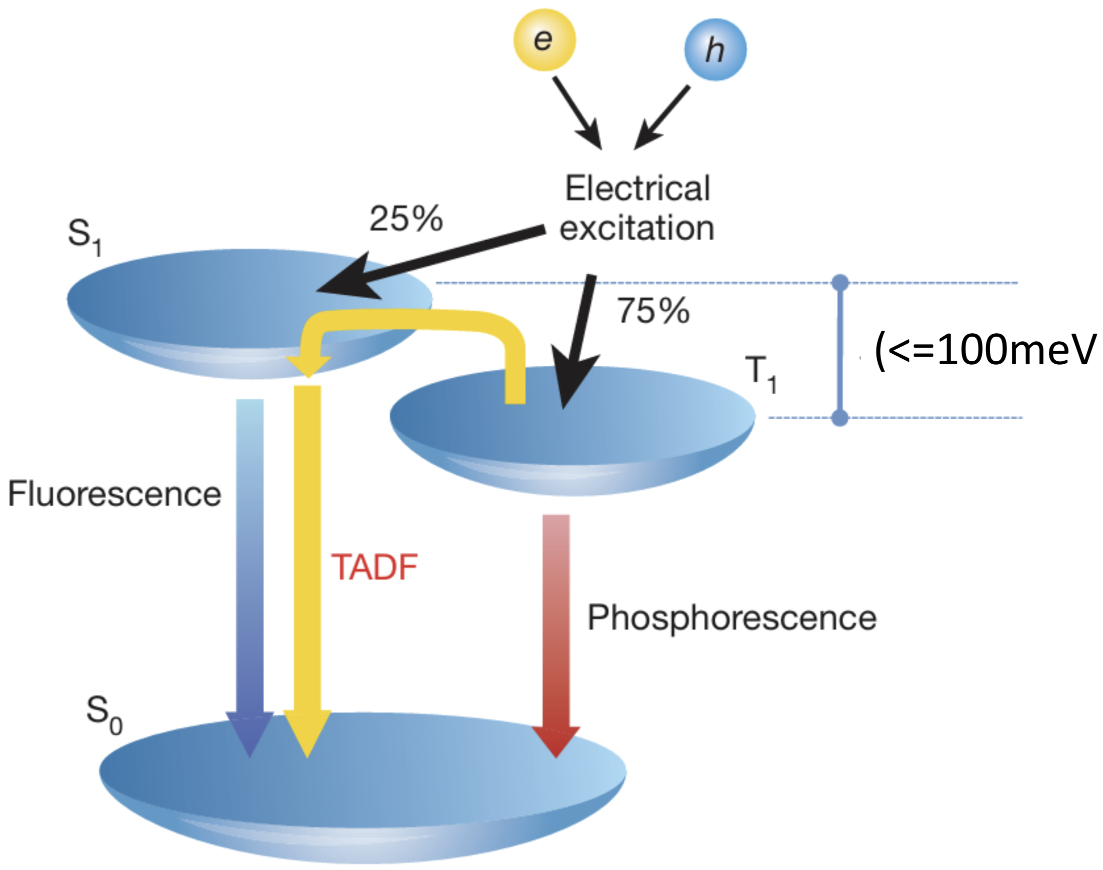
ΔE_{ST} small enough (<=100meV)

↓

Fast enough RISC (Reverse ISC, T1→S1)

→ **Maxium EQE: 100%**





What determines ΔE_{ST}

$$\Delta E_{\{ST\}} = 2J$$

$$J = \int\int \phi_H(r_1)\phi_L(r_1)\frac{e^2}{|r_1 - r_2|}\phi_H(r_2)\phi_L(r_2)d\mathbf{r_1}\, d\mathbf{r_2}$$

Exchange Integral
(交换积分)

Physical Meaning:

泡利不相容原理，三线态的两个电子无法在空间中靠近。减少了电子斥力

$$\Delta E_{ST} \propto K \propto \langle \phi_H | \phi_L \rangle$$

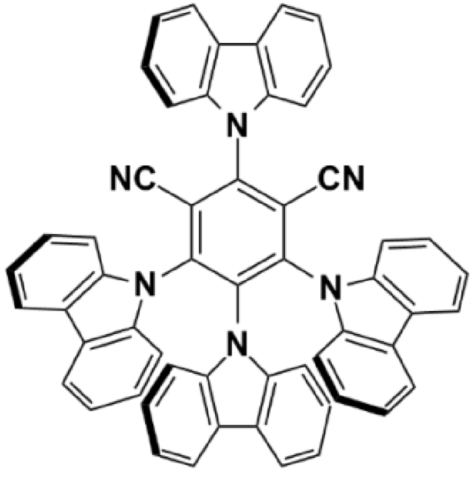
HOMO-LUMO overlap

Molecular design? → Small HOMO-LUMO overlap → Small ΔE_{ST} → Faster RISC; better EQE

Gen1 TADF molecular Donor- Acceptor type

Chihaya Adachi (安达千波矢)

Kyushu University

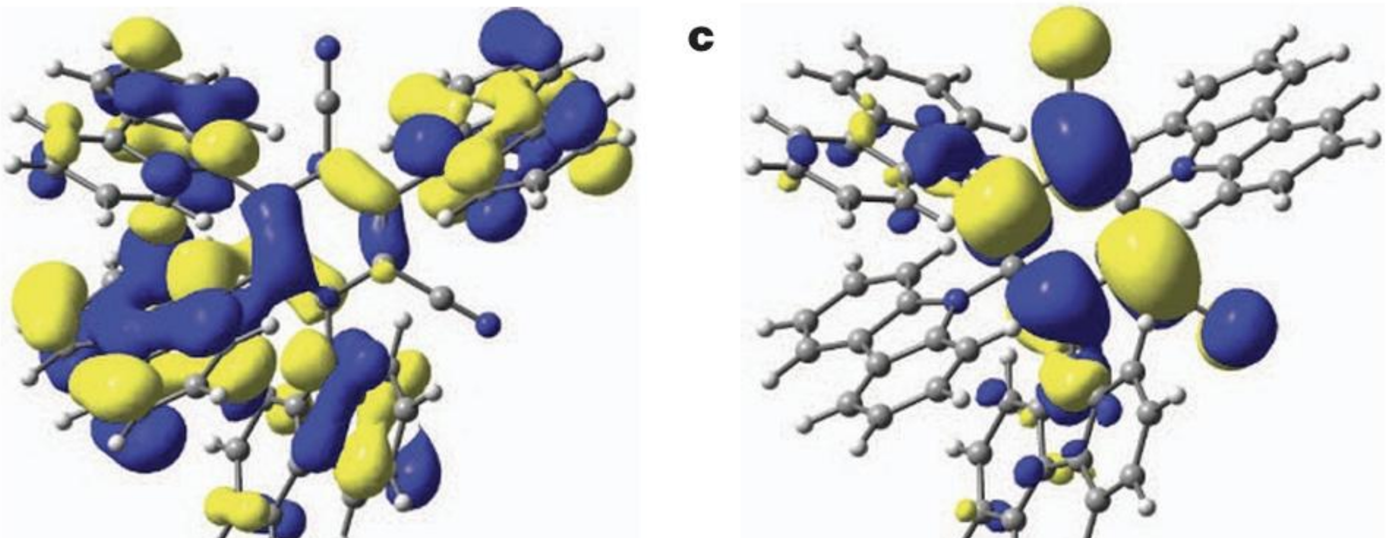


4CzIPN

Highly distorted from the dicyanobenzene plane by steric hindrance

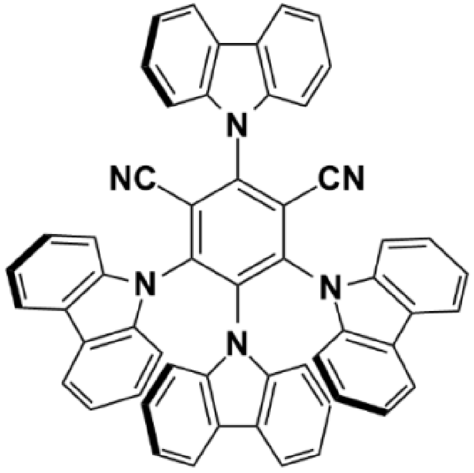
HOMO/LUMO locates on Donor/Acceptor

S1 usually represents a Charge transfer state (donor to acceptor)



Chihaya Adachi *etal. Nature* **492**, 234–238 (2012).

Gen1 TADF molecular Donor- Acceptor type



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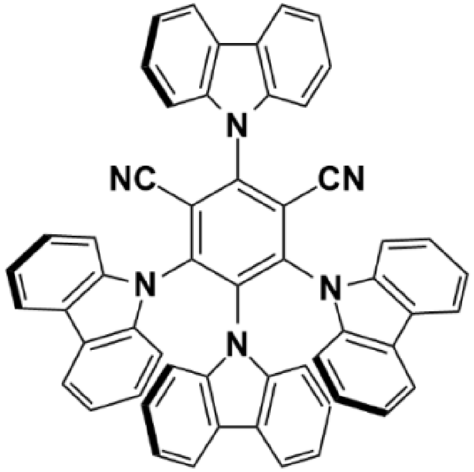
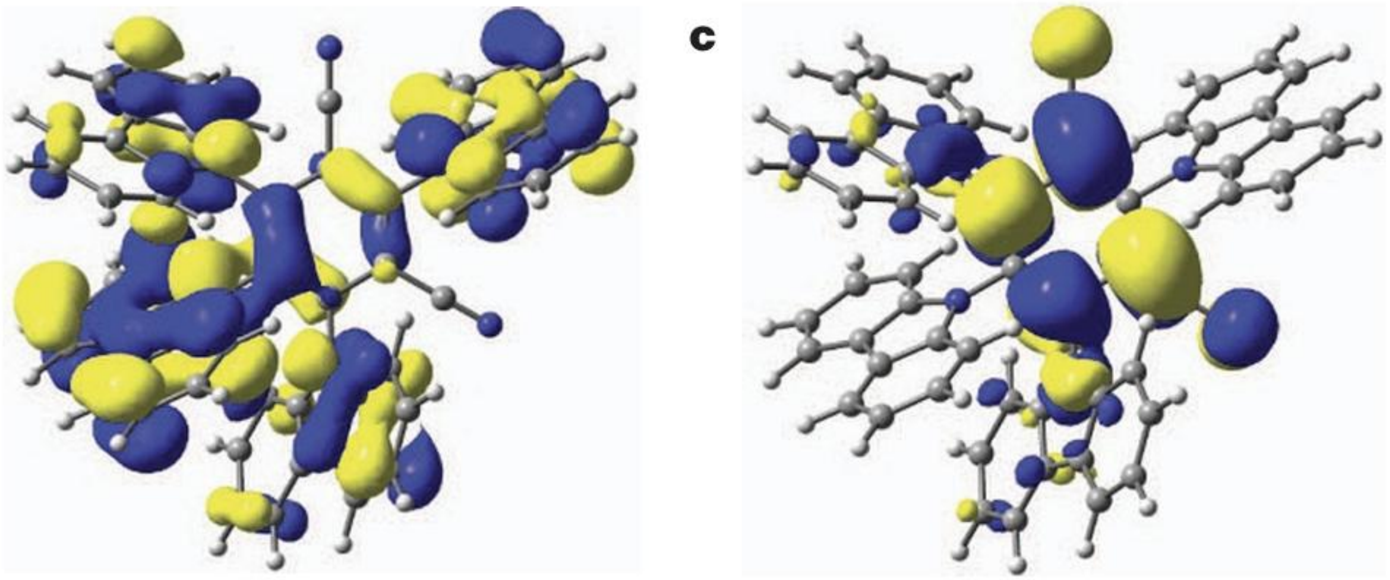


4CzIPN

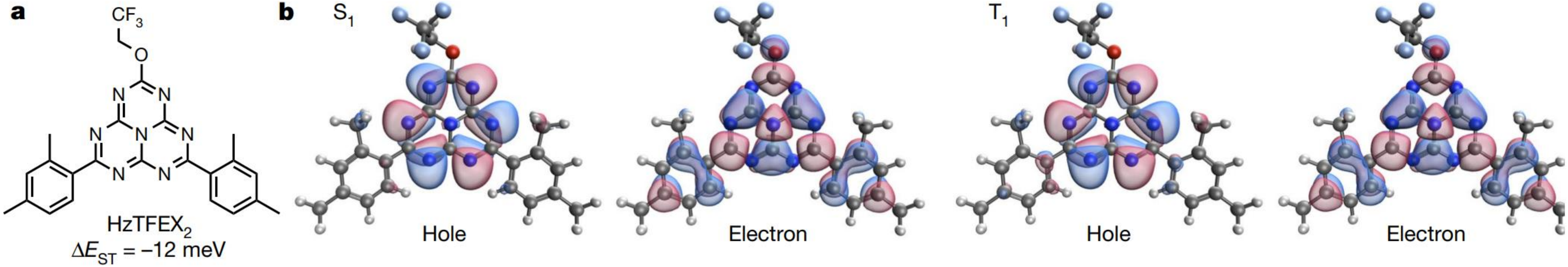
$\Delta \mathbf{E}_{\mathbf{ST}}$ =83meV
EQE=11.2%
Much higher than 1gen OLED
(apox. 5%)



Chihaya Adachi *etal. Nature* **492**, 234–238 (2012).

How small ΔE_{ST} could be?

ΔE_{ST} could be <0 with proper molecular design



But, At what cost?

$$f \propto \left| \int \phi_H(r) r \, \phi_L(r) dr \right|^2$$

振子强度:
描述发光
“速率”

For HzTFEX_2 only very low emission

Miyajima, D. *etal*. Nature 2022, 609 (7927), 502−506.

What determines K_{RIST}

ΔE_{ST} is NOT the only factor matters in RISC process

Spin-Orbit Coupling

$$k_{RISC} \propto |H_{SOC}|^2 \cdot \exp\left(-\frac{\Delta E_{ST}}{k_B T}\right)$$

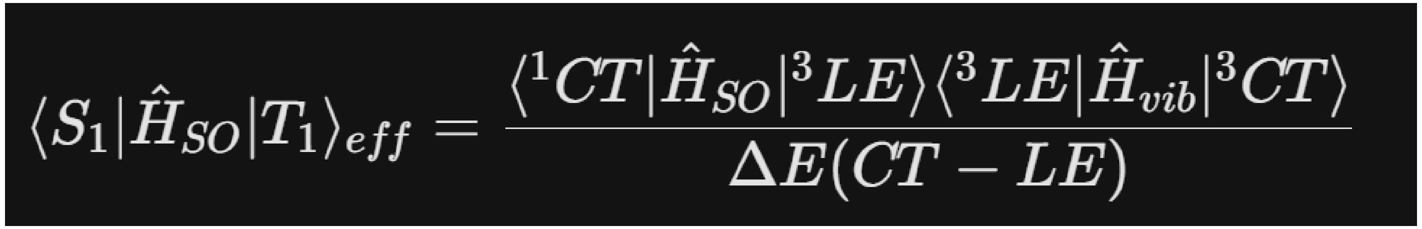
$$\widehat{H_{SOC}} = \sum_i \xi(r_i)\widehat{\mathbf{L}}_i \cdot \widehat{\mathbf{S}}_i$$

“Heavy atom effect “

Both S_1 and T_1 are Charge transfer state (usually π–π)

Other state need to be coupled

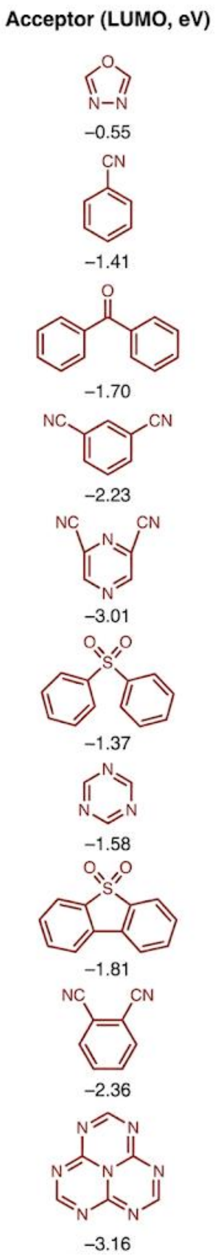
Normally it should be ^3LE



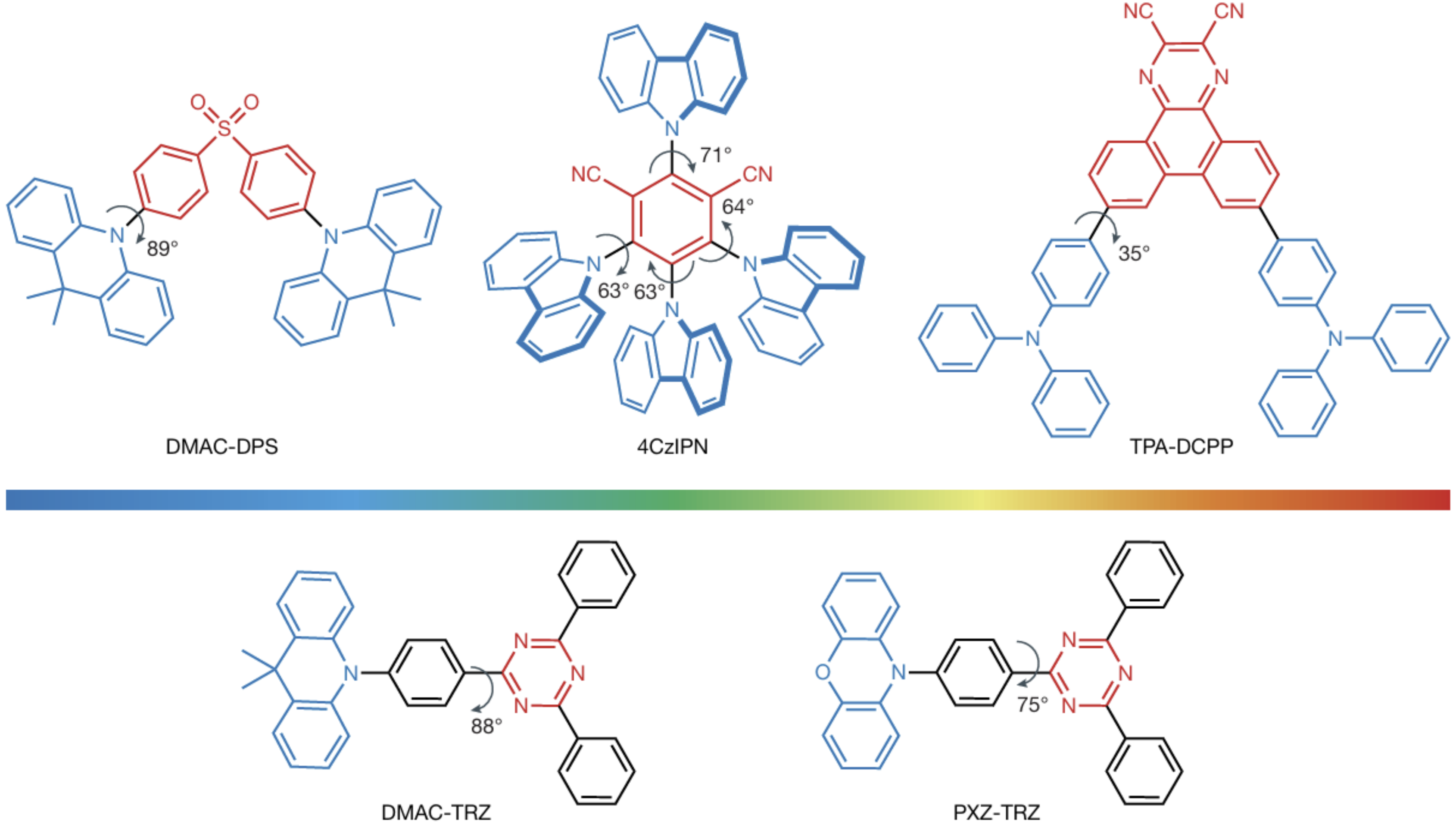
$$\langle S_1|\hat{H}_{SO}|T_1\rangle_{eff} = \frac{\langle ^1CT|\hat{H}_{SO}|^3LE\rangle\langle ^3LE|\hat{H}_{vib}|^3CT\rangle}{\Delta E(CT - LE)}$$

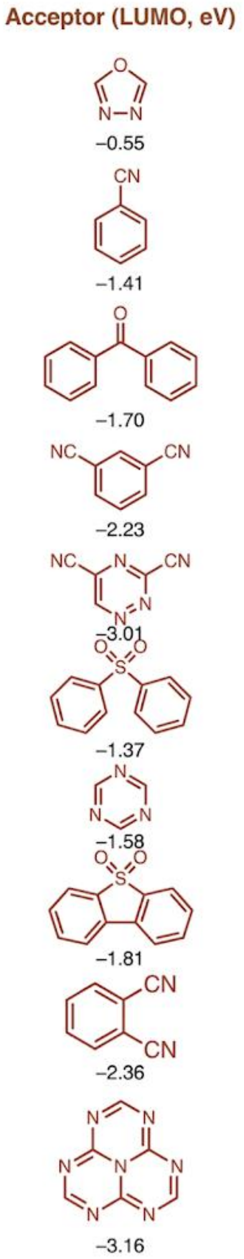
For Acceptor/Donor Design an Energy Accessible LE State Should be Find

Donor- Acceptor type TADF materials



Chemical structures of representative TADF molecules



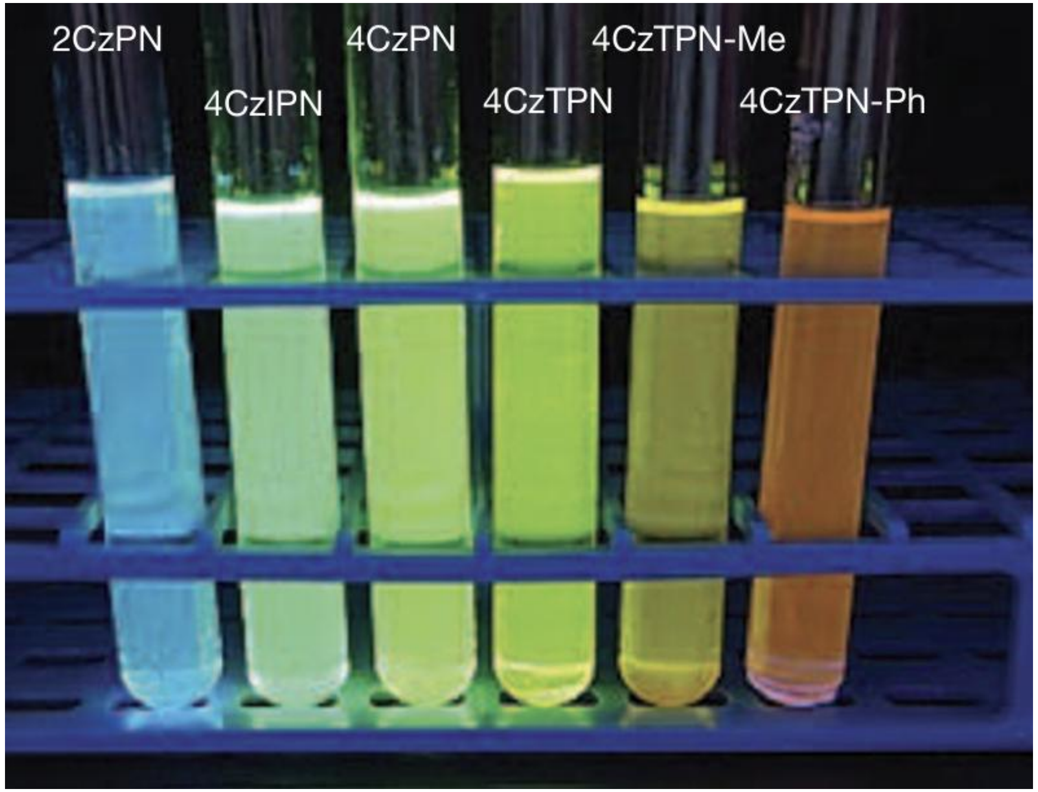


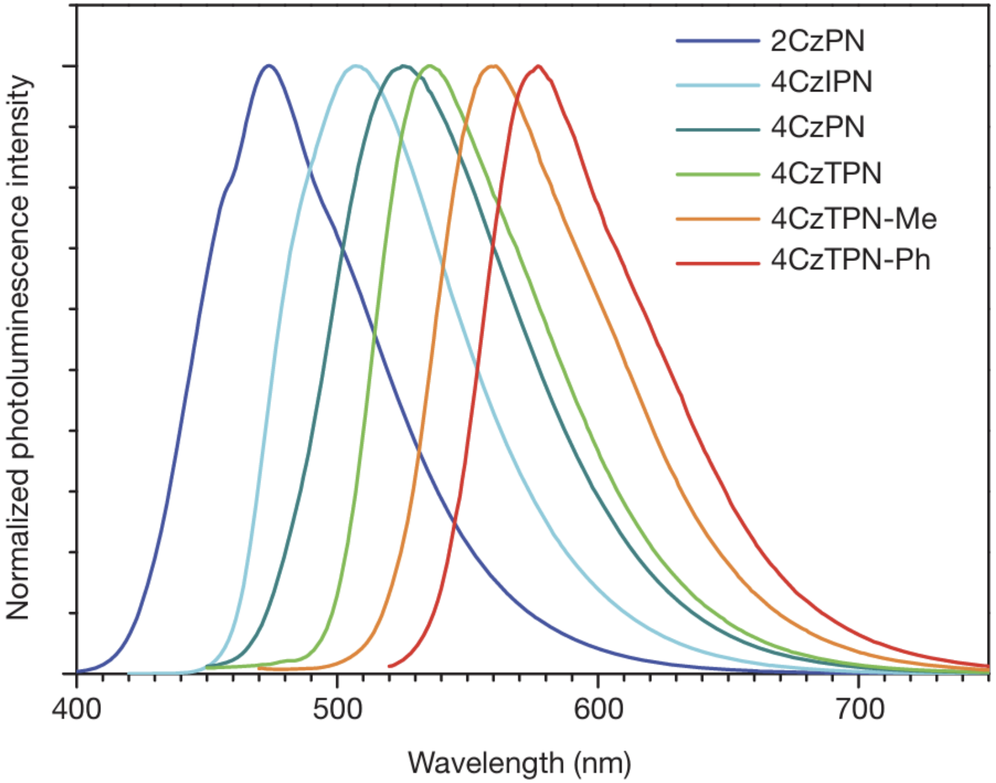
Chemical Reviews **2025** *125* (14), 6685-6752

Major Drawbacks in Gen1 TADF

Several drawbacks (low stability, roll-off, etc.) origins from the D-A molecular

But there’s one that is Intolerable.





No way this is a blue emitter.

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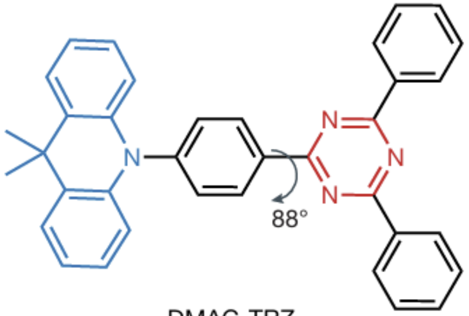
What determines FWHM?

$$FWHM = 2\sqrt{2\ln 2}$$

$$\sigma^2 = \sum_{\alpha} S_{\alpha}(\hbar\omega_{\alpha})^2(2n_{\alpha}+1)$$

$$S_{\alpha} = \frac{M_{\alpha}\omega_{\alpha}\Delta Q_{\alpha}^2}{2\hbar}$$

ΔQ_{α} : measurement of structure difference between Excite state and ground state.

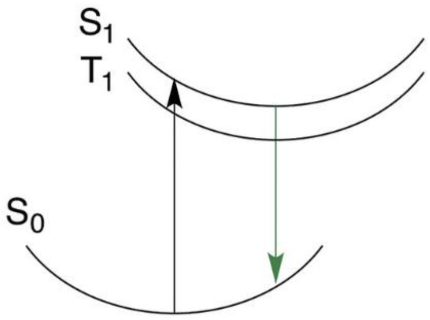


DMAC-TRZ

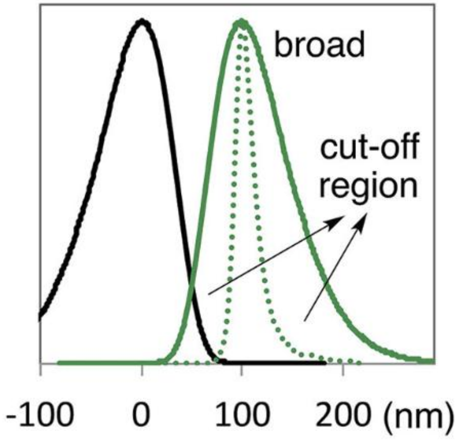
S1 of D-A type TADF: CT state huge difference

How to achieve small structure difference ?

Simplified graphical explanation



large Stokes shift



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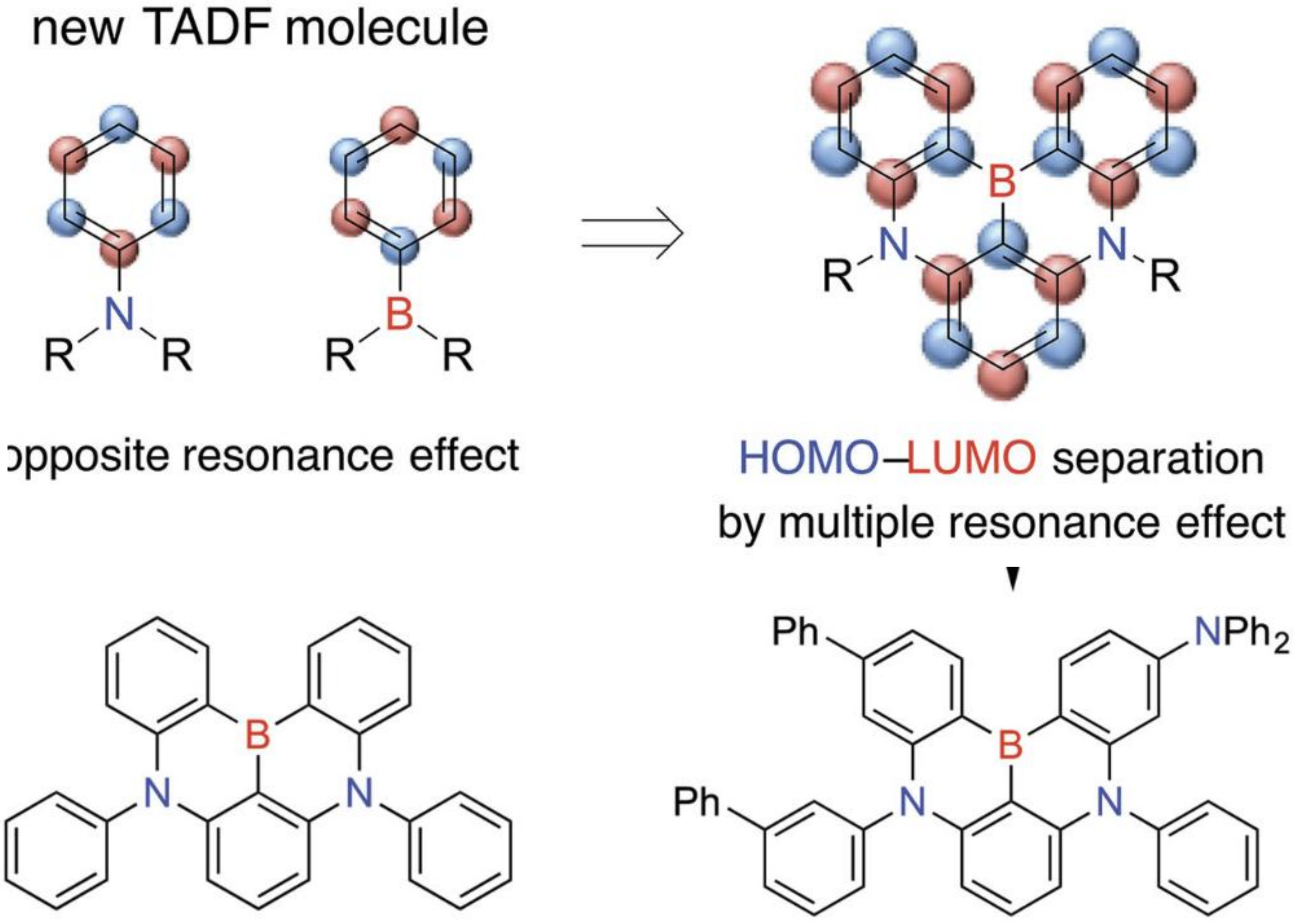
MR-TADF

畠山 琢次
Takuji Hatakeyama



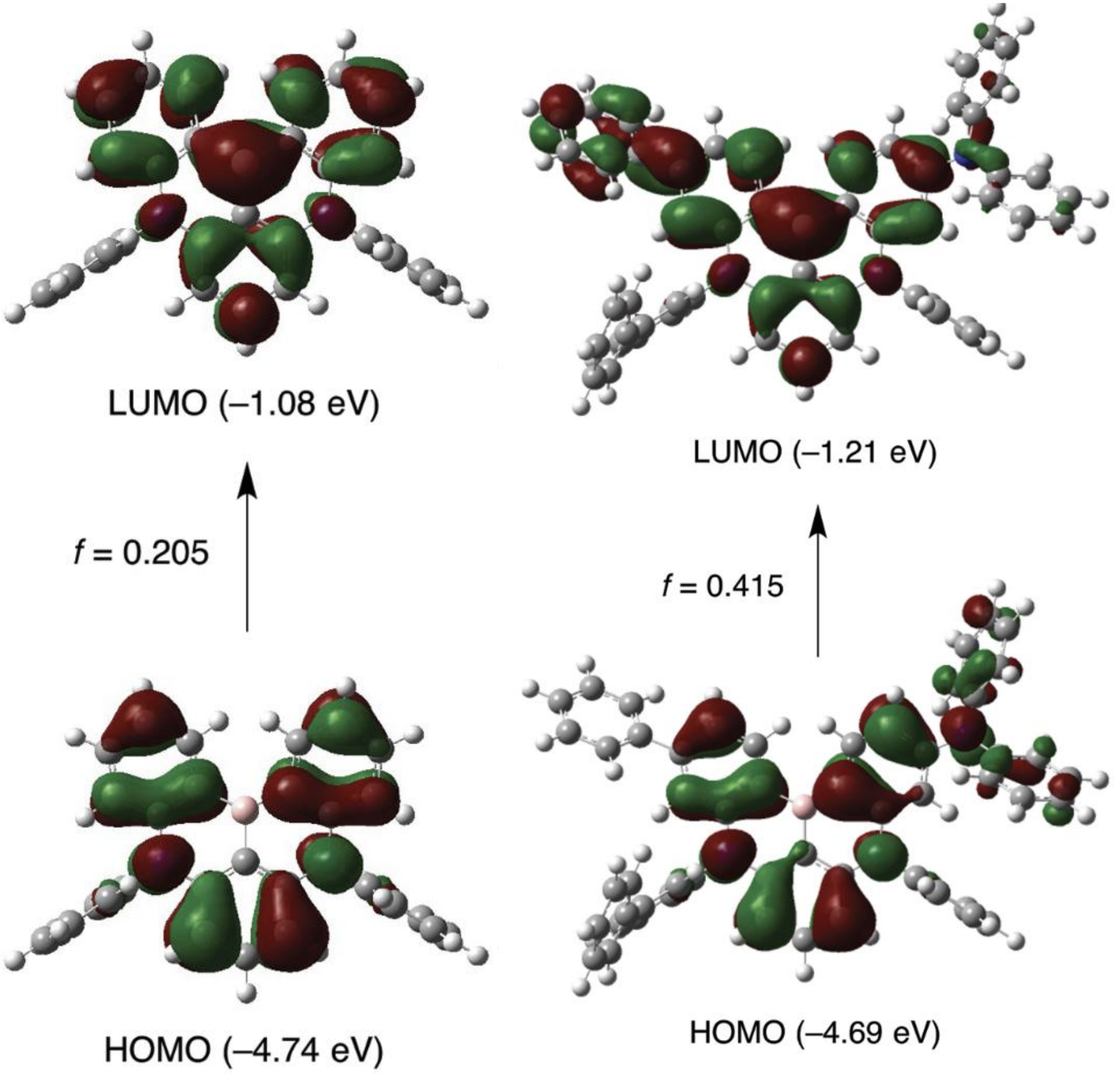
DABNA-1

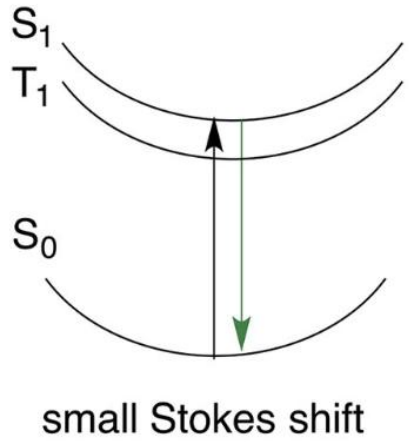
DABNA-2

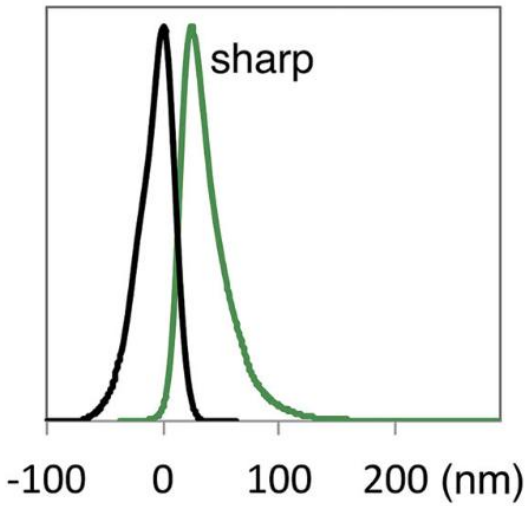
Takuji Hatakeyama *etal.* Adv. Mater. 2016, 28, 2777–2781

MR-TADF

畠山 琢次
Takuji Hatakeyama



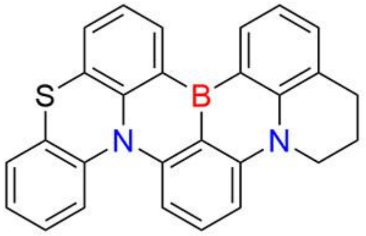




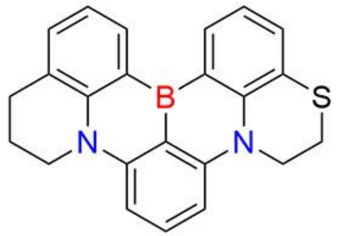
Takuji Hatakeyama *etal.* Adv. Mater. 2016, 28, 2777–2781

Three major family of MR-TADF Molecular

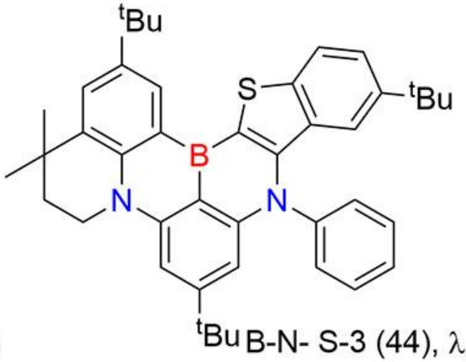
B-N type molecular



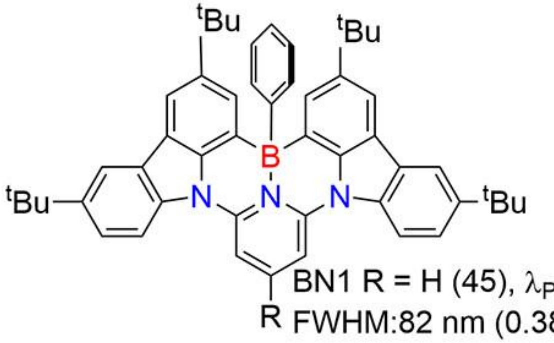
B-N- S-1 (42), λ_{PL}:483 nm
FWHM:41 nm (0.218 eV)



B-N- S-2 (43), λ_{PL}:458 nm
FWHM:33 nm (0.195 eV)

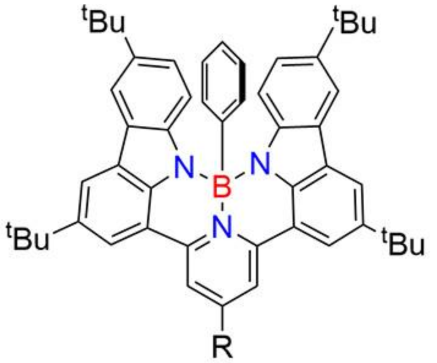


B-N- S-3 (44), λ_{PL}:457 nm
FWHM:25 nm (0.149 eV)

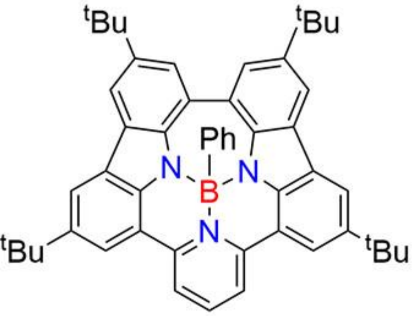


BN1 R = H (45), λ_{PL}:514 nm
FWHM:82 nm (0.387 eV)

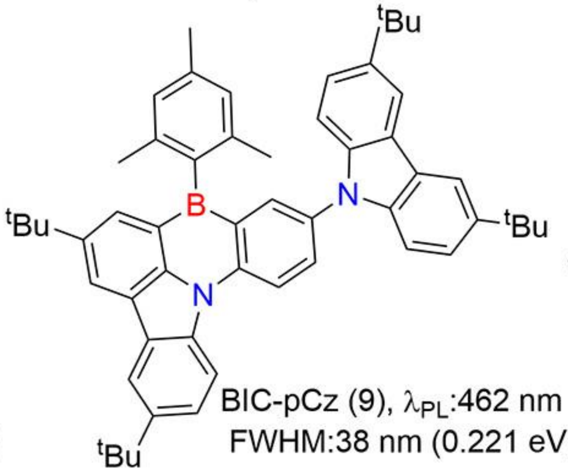
TCz-BN1 R = tCz (46), λ_{PL}:517 nm
FWHM:89 nm (0.416 eV)



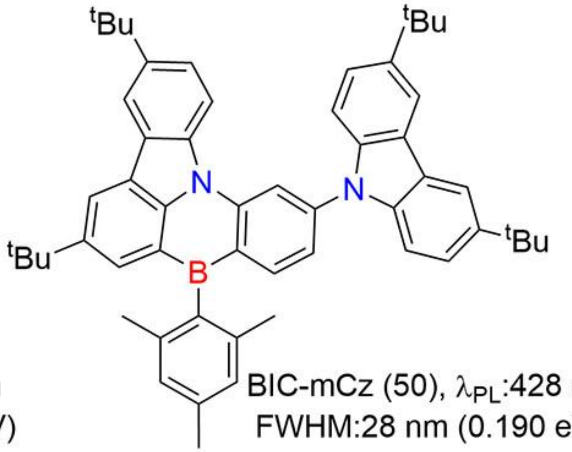
BN2 R = H (47), λ_{PL}:567 nm
FWHM:97 nm (0.377 eV)
TCz-BN2, R = tCz (48), λ_{PL}:584 nm
FWHM:108 nm (0.396 eV)



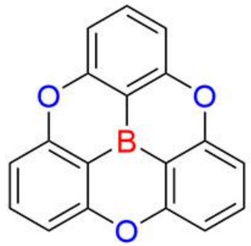
BN3 (49), λ_{PL}:694 nm
FWHM:151 nm (0.393 eV)



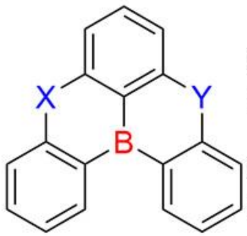
BIC-pCz (9), λ_{PL}:462 nm
FWHM:38 nm (0.221 eV)



BIC-mCz (50), λ_{PL}:428 nm
FWHM:28 nm (0.190 eV)



BOOO (51)
λ_{PL}:386 nm



BOS X=O Y= S (53), λ_{PL}:434 nm
FWHM:29 nm (0.191 eV)

BSS X=S Y= S (6), λ_{PL}:457 nm
FWHM:27 nm (0.160 eV)

BOO X= Y= O or DOBNA (52)
λ_{PL}:396 nm, FWHM:30 nm (0.238 eV)

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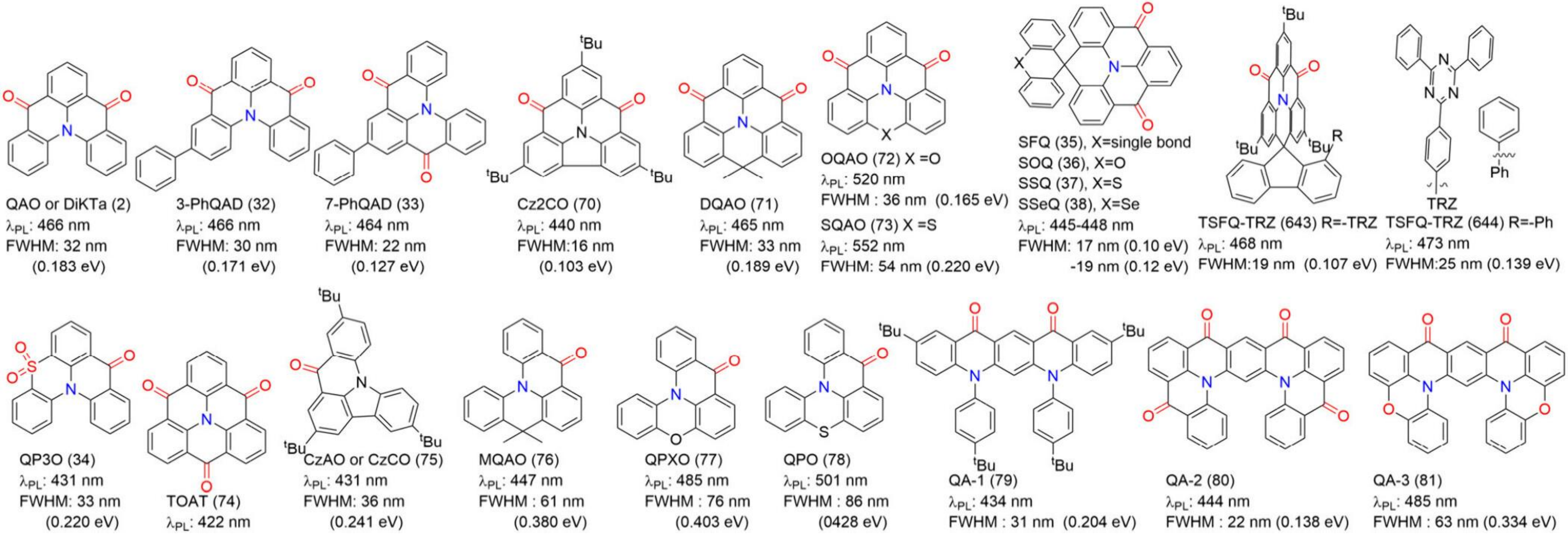
Three major family of MR-TADF Molecular

N-CO type molecular



QAO or DiKTa (2)
λ_{PL}: 466 nm
FWHM: 32 nm
(0.183 eV)

3-PhQAD (32)
λ_{PL}: 466 nm
FWHM: 30 nm
(0.171 eV)

7-PhQAD (33)
λ_{PL}: 464 nm
FWHM: 22 nm
(0.127 eV)

Cz2CO (70)
λ_{PL}: 440 nm
FWHM:16 nm
(0.103 eV)

DQAO (71)
λ_{PL}: 465 nm
FWHM: 33 nm
(0.189 eV)

OQAO (72) X =O
λ_{PL}: 520 nm
FWHM : 36 nm (0.165 eV)
SQAO (73) X =S
λ_{PL}: 552 nm
FWHM: 54 nm (0.220 eV)

SFQ (35), X=single bond
SOQ (36), X=O
SSQ (37), X=S
SSeQ (38), X=Se
λ_{PL}: 445-448 nm
FWHM: 17 nm (0.10 eV)
-19 nm (0.12 eV)

TSFQ-TRZ (643) R=-TRZ
λ_{PL}: 468 nm
FWHM:19 nm (0.107 eV)

TSFQ-TRZ (644) R=-Ph
λ_{PL}: 473 nm
FWHM:25 nm (0.139 eV)

QP3O (34)
λ_{PL}: 431 nm
FWHM: 33 nm
(0.220 eV)

TOAT (74)
λ_{PL}: 422 nm

CzAO or CzCO (75)
λ_{PL}: 431 nm
FWHM: 36 nm
(0.241 eV)

MQAO (76)
λ_{PL}: 447 nm
FWHM : 61 nm
(0.380 eV)

QPXO (77)
λ_{PL}: 485 nm
FWHM : 76 nm
(0.403 eV)

QPO (78)
λ_{PL}: 501 nm
FWHM : 86 nm
(0428 eV)

QA-1 (79)
λ_{PL}: 434 nm
FWHM : 31 nm (0.204 eV)

QA-2 (80)
λ_{PL}: 444 nm
FWHM : 22 nm (0.138 eV)

QA-3 (81)
λ_{PL}: 485 nm
FWHM : 63 nm (0.334 eV)

MR properties relays on CO’s pai*

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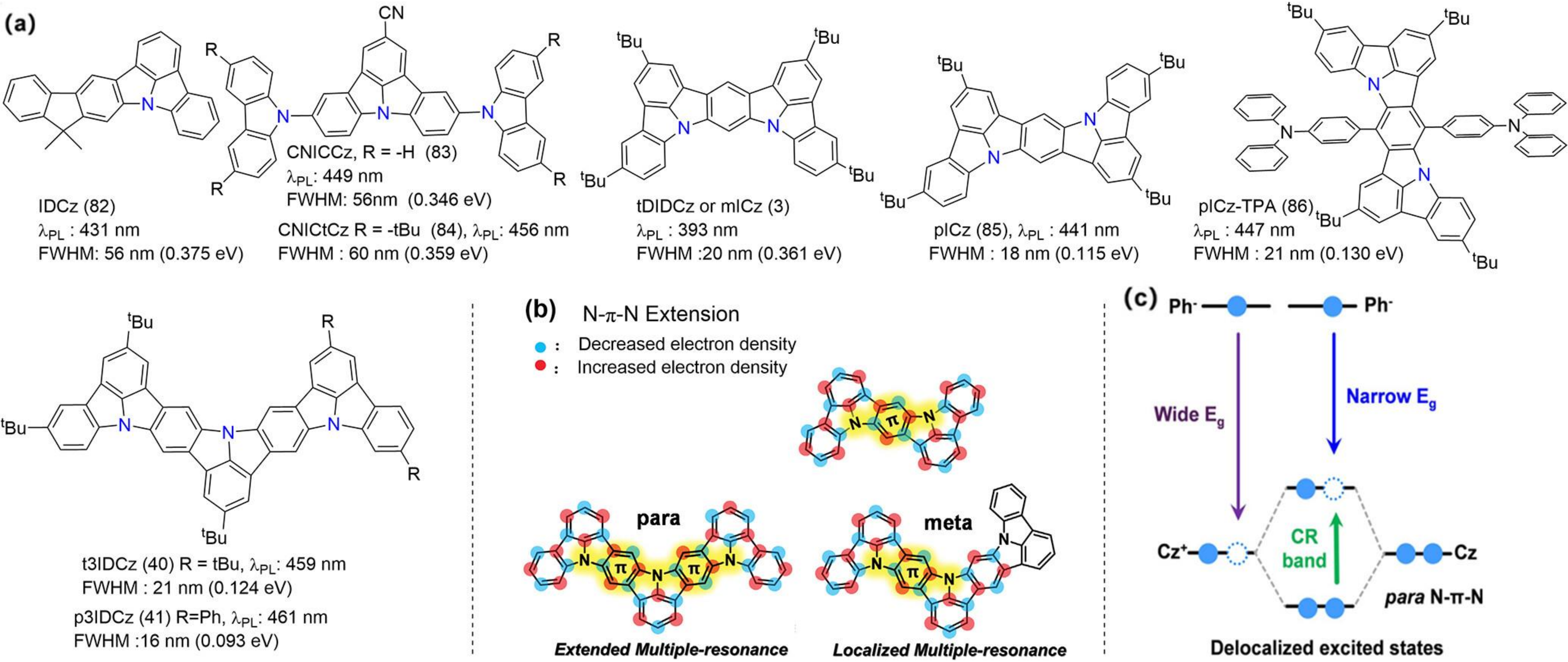
Three major family of MR-TADF Molecular

N-PAHs type molecular



IDCz (82)
λ_{PL} : 431 nm
FWHM: 56 nm (0.375 eV)

CNICCz, R = -H (83)
λ_{PL}: 449 nm
FWHM: 56nm (0.346 eV)
CNICtCz R = -tBu (84), λ_{PL}: 456 nm
FWHM : 60 nm (0.359 eV)

tDIDCz or mICz (3)
λ_{PL} : 393 nm
FWHM :20 nm (0.361 eV)

pICz (85), λ_{PL} : 441 nm
FWHM : 18 nm (0.115 eV)

pICz-TPA (86)
λ_{PL} : 447 nm
FWHM : 21 nm (0.130 eV)

t3IDCz (40) R = tBu, λ_{PL}: 459 nm
FWHM : 21 nm (0.124 eV)
p3IDCz (41) R=Ph, λ_{PL}: 461 nm
FWHM :16 nm (0.093 eV)

MR properties relays on PAH's pai*

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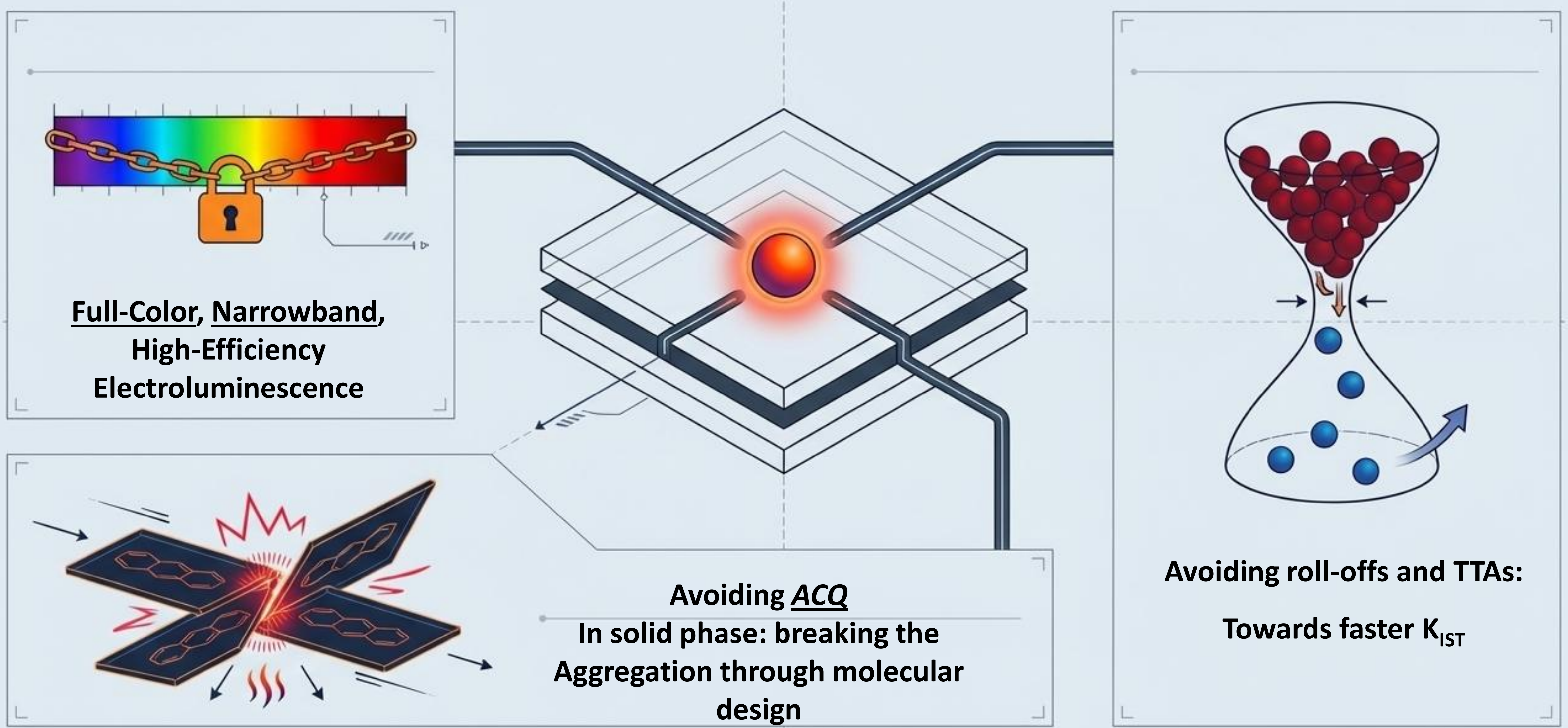
Three Key Challenges within MR-TADFS



<u>Full-Color</u>, <u>Narrowband</u>, High-Efficiency Electroluminescence

Avoiding *<u>ACQ</u>*
In solid phase: breaking the Aggregation through molecular design

Avoiding roll-offs and TTAs:

Towards faster K_{IST}

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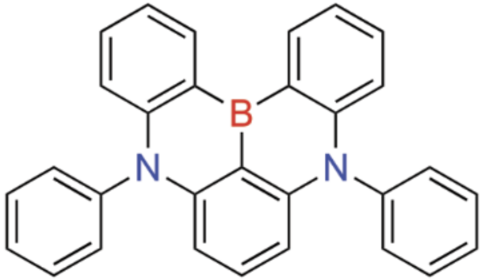
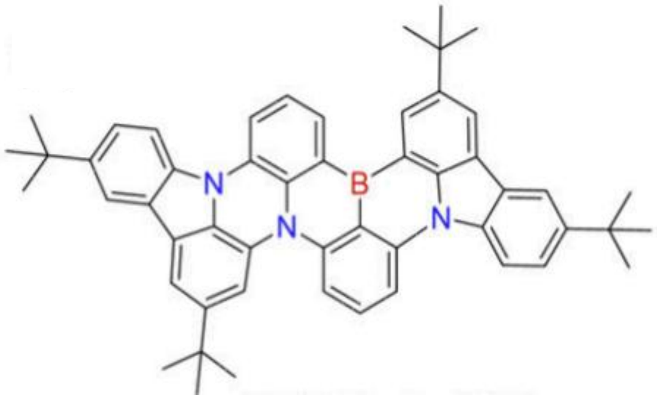
Towards Deep RED Emission: The issue

Challenge： Adding Donor/Acceptor on the compound
Will cause decrease property in MR-TADF



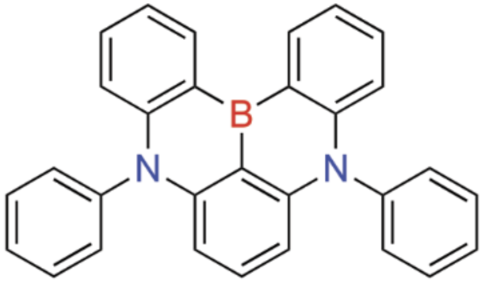
DABNA-1

λ_{PL}: 437 nm
FWHM: 33 nm



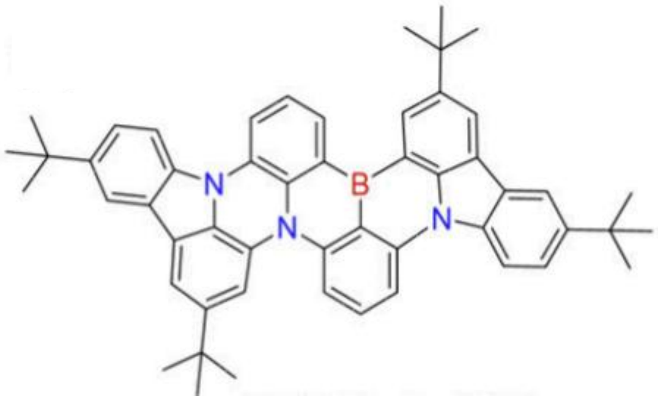
Small step in wavelength
Huge step in wavewidth

λ_{PL}: 564 nm
FWHM: 60 nm



DABNA-1

Short-Term Charge
Transfer Dominates (SRCT)



More **LRCT** combines
More properties like D-A type TADFs

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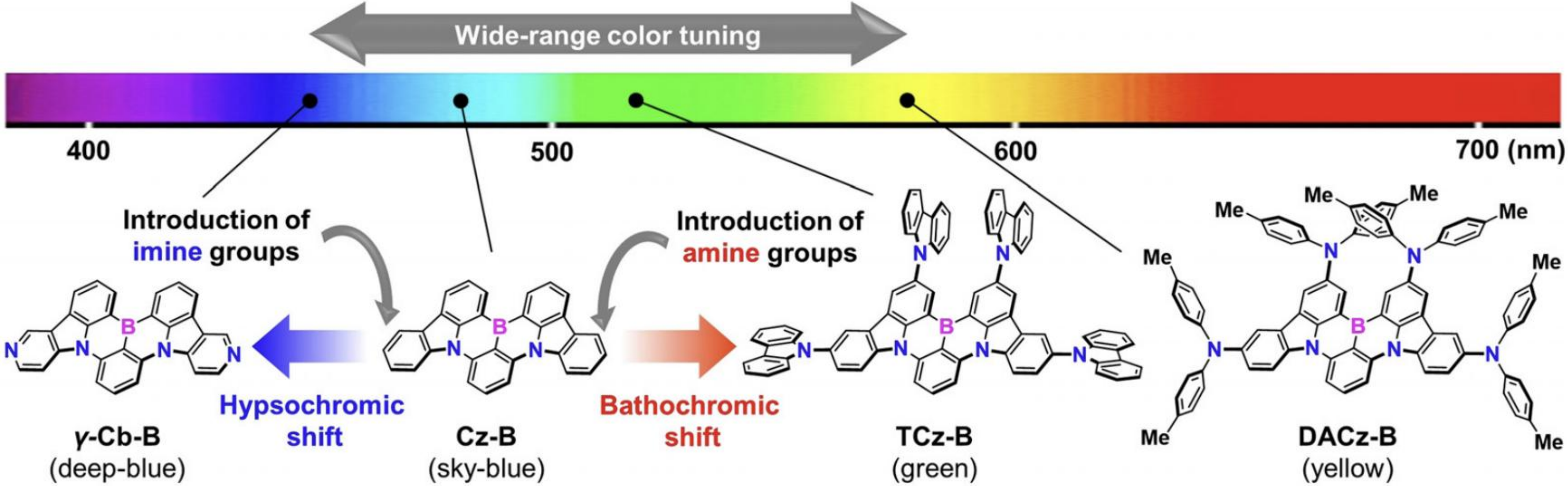
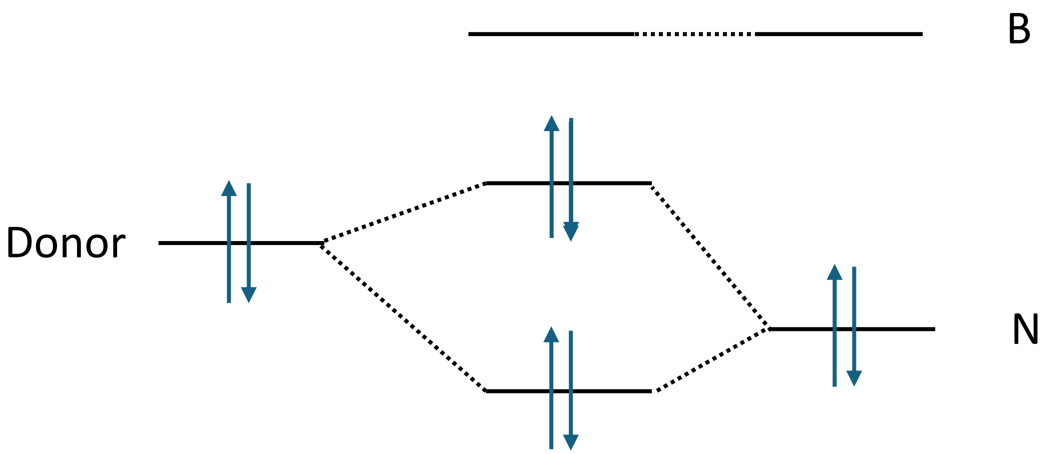
Solution 1: Finding the balance

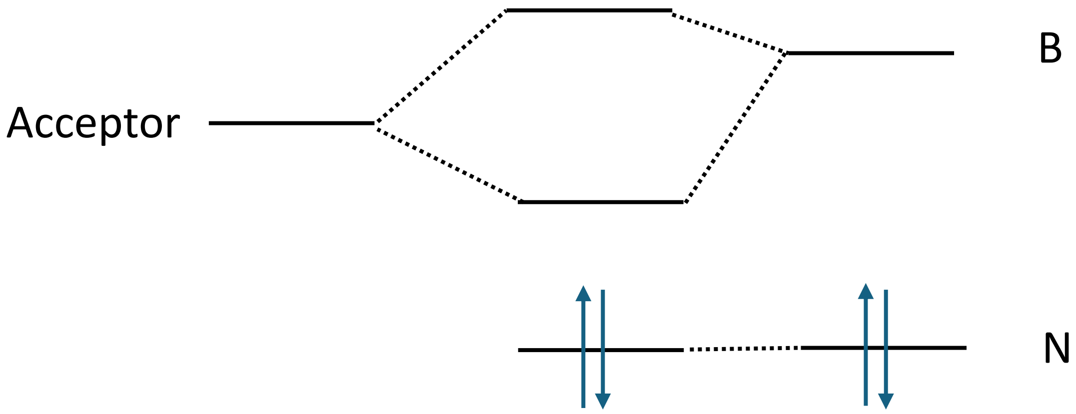


Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2021, 60, 23142 –23147
Chenglong Li *et.al* Angew. Chem. Int. Ed. 2023, 62, e202216473
Chuluo Yang *et.al* Adv. Funct. Mater. 2021, 31, 2102017

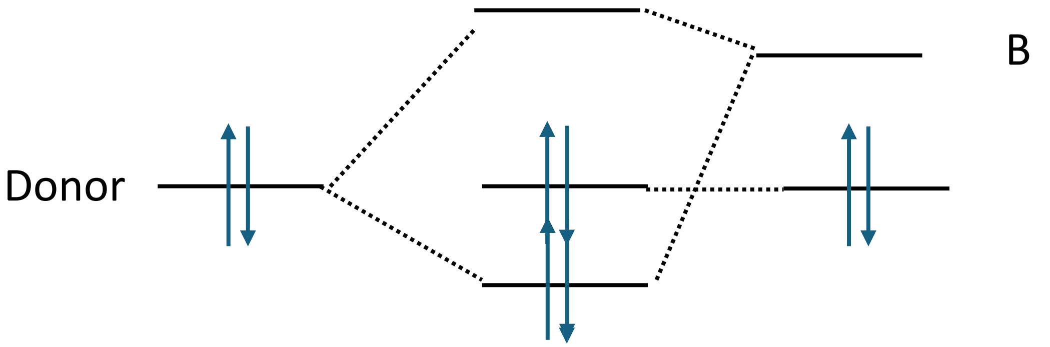
A-para-B/ D-para-N



D-para-N: Red shift



A-para-B: Red shift

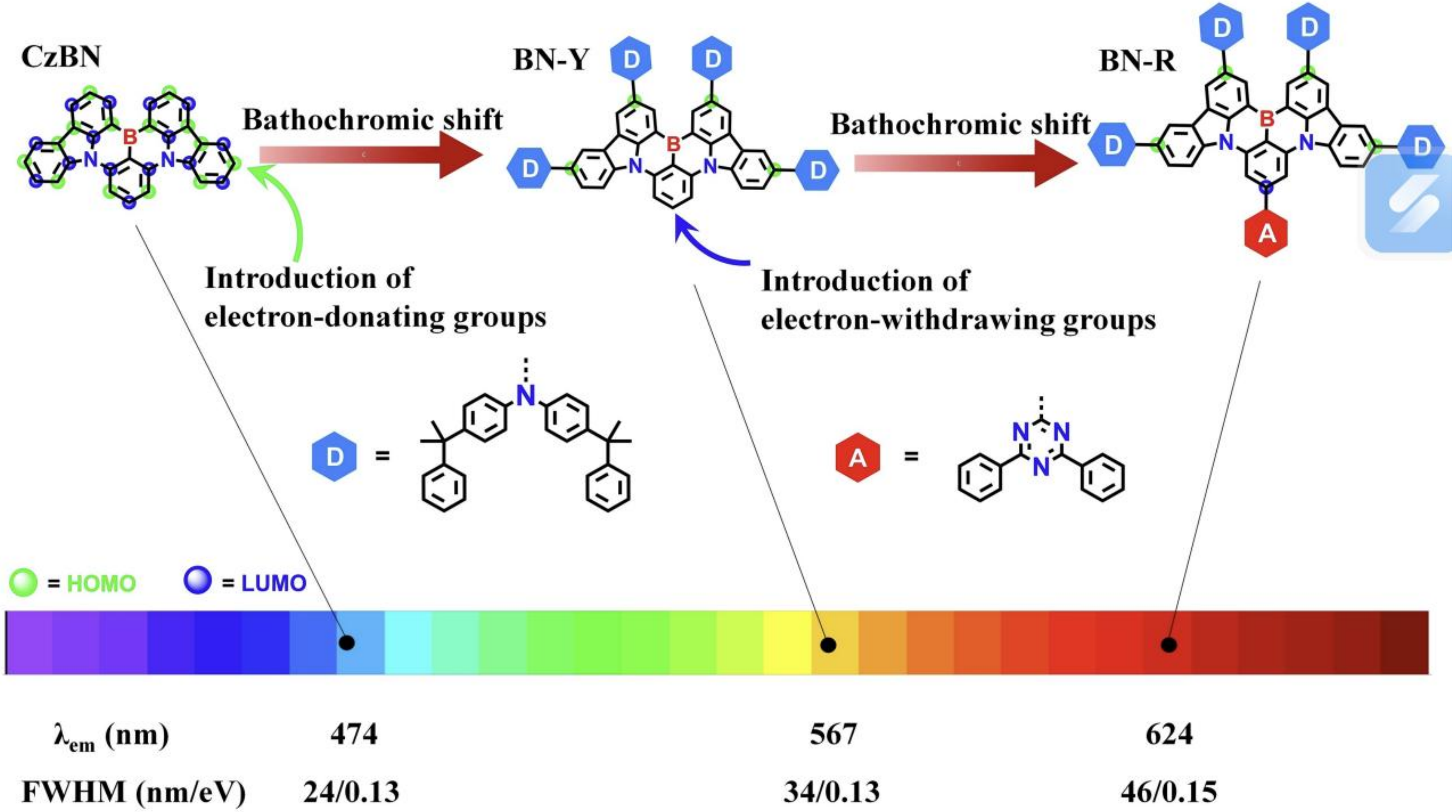


D-para-B: Blue Shift

And *vice versa*

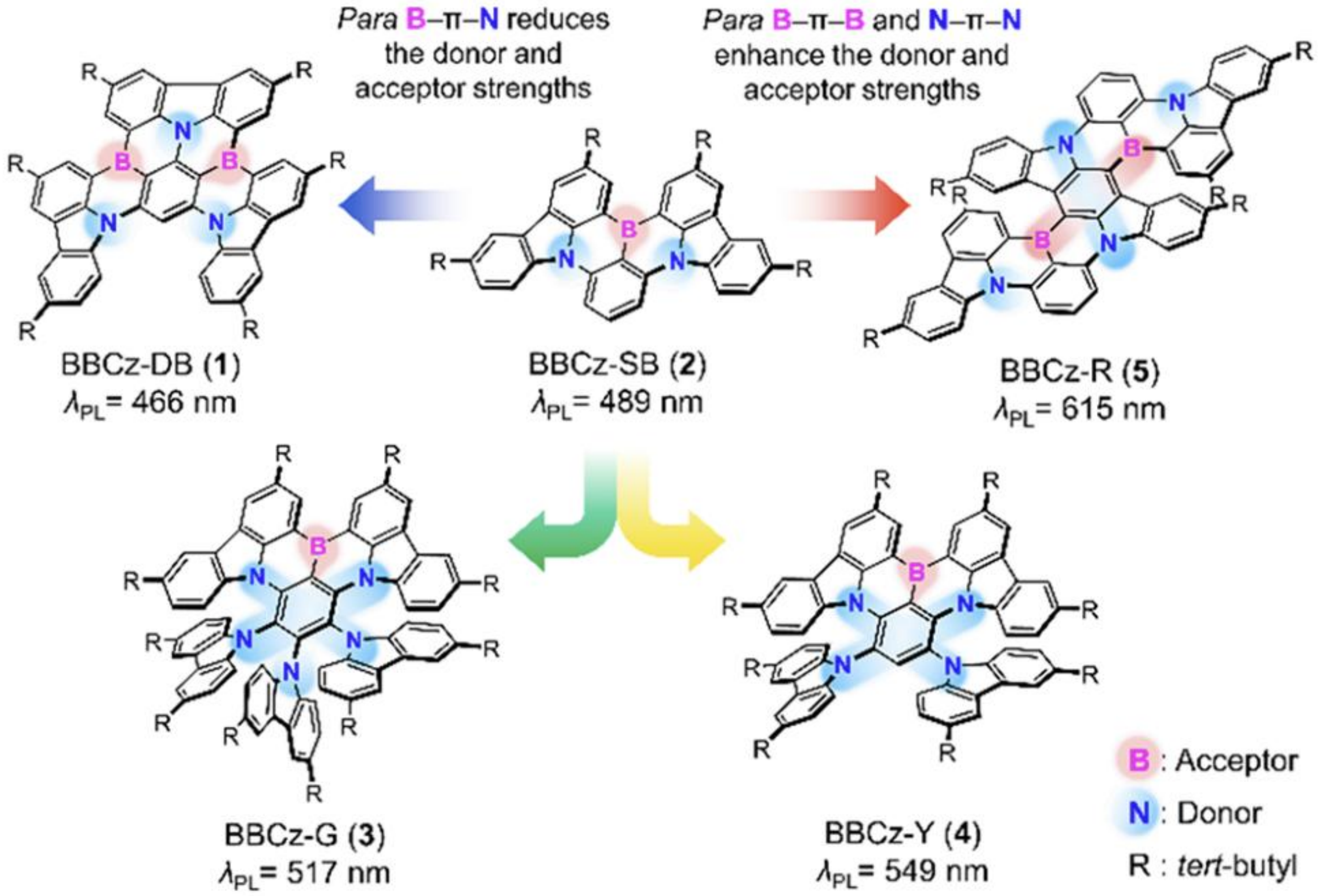
Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2021, 60, 23142 –23147
Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2023, 62, e202216473
Chuluo Yang *et.al* Adv. Funct. Mater. 2021, 31, 2102017

Solution 1: Finding the balance



Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2021, 60, 23142 –23147
Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2023, 62, e202216473
Chuluo Yang *et.al* Adv. Funct. Mater. 2021, 31, 2102017

Solution 2: Enhancing SRCT/LRCT



Para B–π–N reduces the donor and acceptor strengths

Para B–π–B and N–π–N enhance the donor and acceptor strengths

BBCz-DB (**1**)
λ_{PL}= 466 nm

BBCz-SB (**2**)
λ_{PL}= 489 nm

BBCz-R (**5**)
λ_{PL}= 615 nm

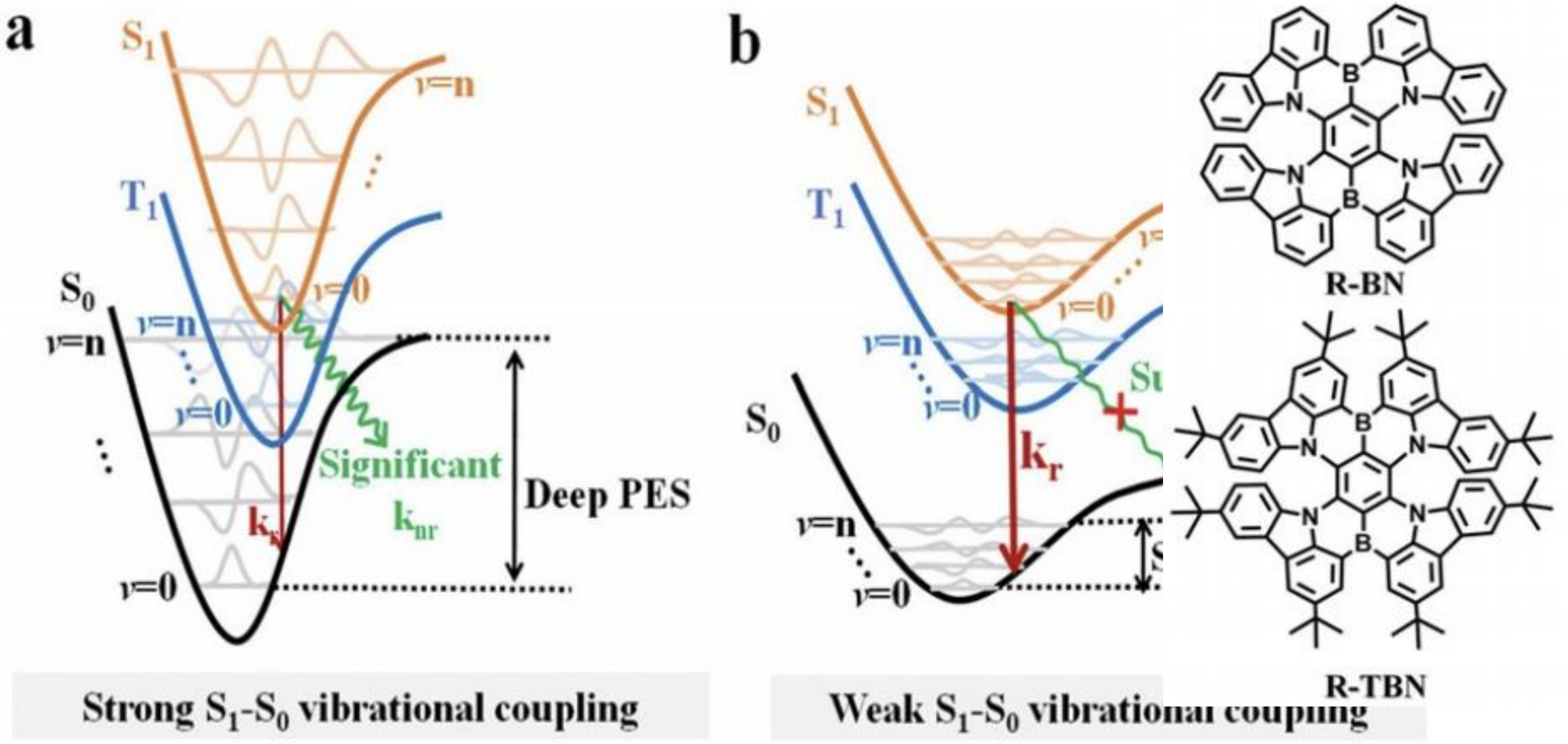
BBCz-G (**3**)
λ_{PL}= 517 nm

BBCz-Y (**4**)
λ_{PL}= 549 nm

B : Acceptor
N : Donor
R : *tert*-butyl

Takuma Yasuda *et.al* J. Am. Chem. Soc. 2020, 142, 19468−19472
Lian Duan *et.al* Angew. Chem. Int. Ed. 2021, 60, 20498– 20503
Chuluo Yang *et.al* Angew. Chem. Int. Ed. 2024, 63, e202318433

Solution 2: Enhancing SRCT/LRCT



Strong S_1-S_0 vibrational coupling

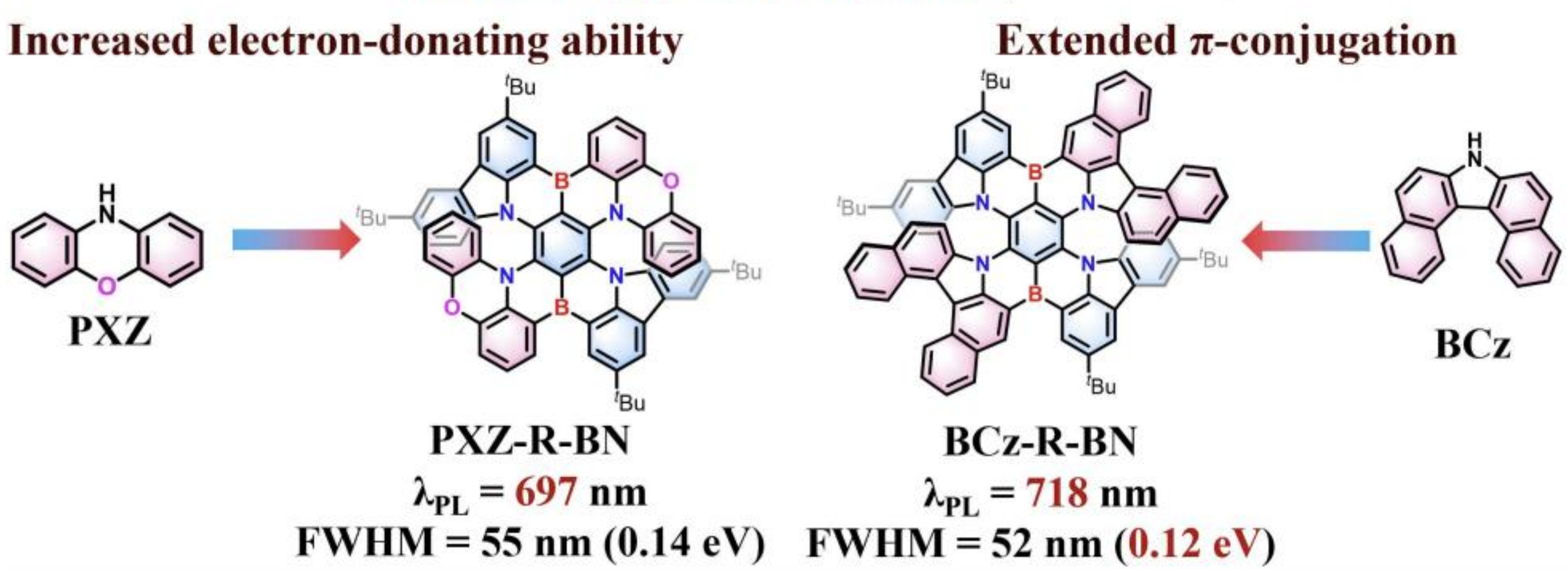
Weak S_1-S_0 vibrational coupling

R-BN

R-TBN

Takuma Yasuda *et.al* J. Am. Chem. Soc. 2020, 142, 19468−19472
Lian Duan *et.al* Angew. Chem. Int. Ed. 2021, 60, 20498– 20503
Chuluo Yang *et.al* Angew. Chem. Int. Ed. 2024, 63, e202318433

Solution 2: Enhancing SRCT/LRCT



Increased electron-donating ability

Extended π-conjugation

PXZ-R-BN
λ_{PL} = 697 nm
FWHM = 55 nm (0.14 eV)

BCz-R-BN
λ_{PL} = 718 nm
FWHM = 52 nm (0.12 eV)

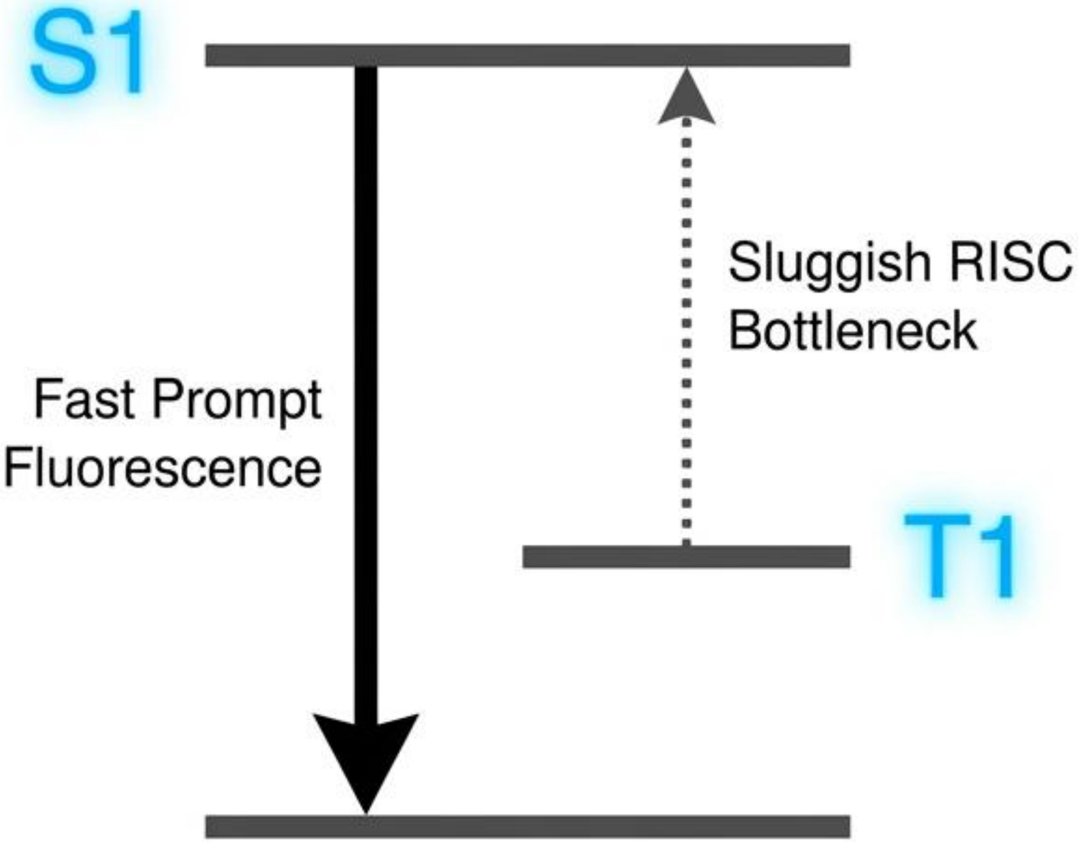
Takuma Yasuda *et.al* J. Am. Chem. Soc. 2020, 142, 19468−19472
Takuma Yasuda *et.al* Angew. Chem. Int. Ed. 2021, 60, 20498– 20503
Chuluo Yang *et.al* Angew. Chem. Int. Ed. 2024, 63, e202318433

MR-TADFs
Content

- *TADFs and Essential Theoretical Backgrounds*
- *D-A type TADFs and their limitations*
- *MR-TADFs*
- *Towards Deep RED Emission*
- *Towards Brighter OLEDs: faster RISC*
- *Towards Brighter OLEDs: against ACQs*
- *Beyond MR-TADFs: state-of-the-art*

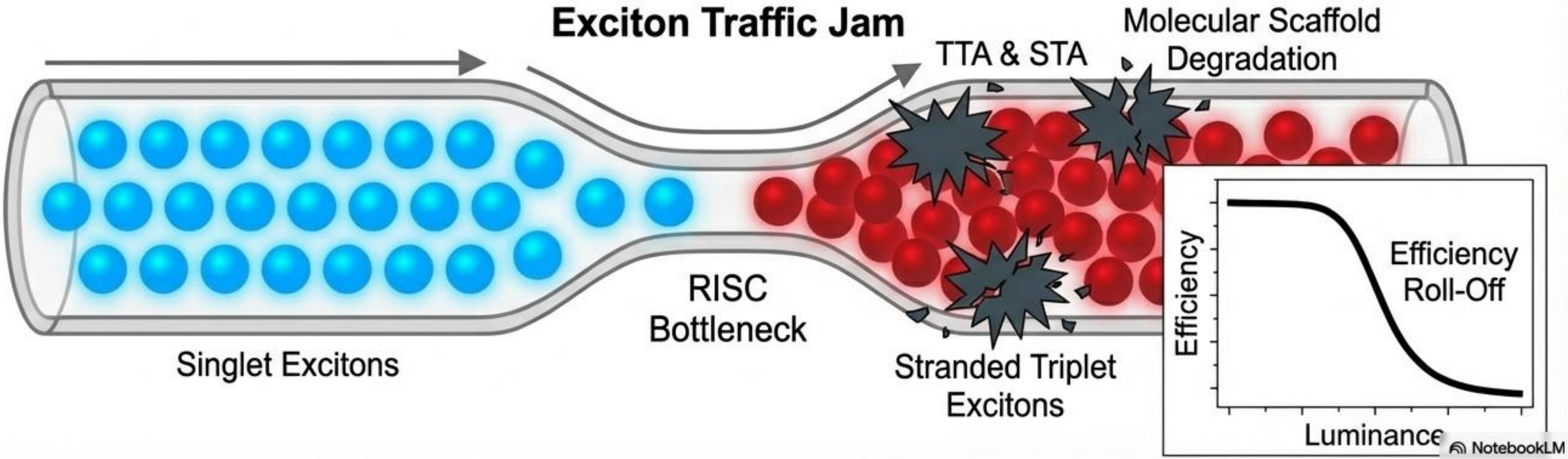
The Kinetic Bottleneck: Sluggish Reverse Intersystem Crossing

- MR-TADF materials exhibit inherently weak Spin-Orbit Coupling (SOC) between singlet and triplet states.
- This weak SOC results in a severely restricted Reverse Intersystem Crossing rate.



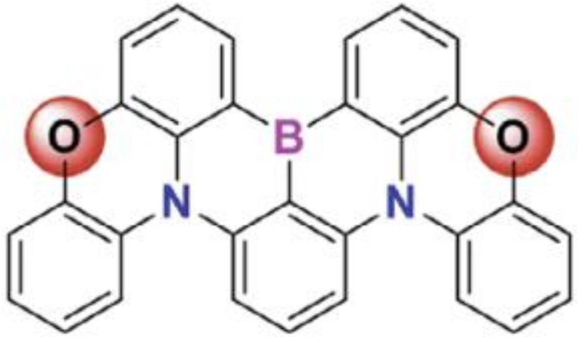
Consequence: Severe Efficiency Roll-Off and Exciton Annihilation

- At high excitation densities, slow spin-flipping causes massive triplet retention.
- Stranded triplets trigger destructive Triplet-Triplet Annihilation (TTA) and Singlet-Triplet Annihilation (STA).
- Result: Irreversible exciton loss and rapid device aging.

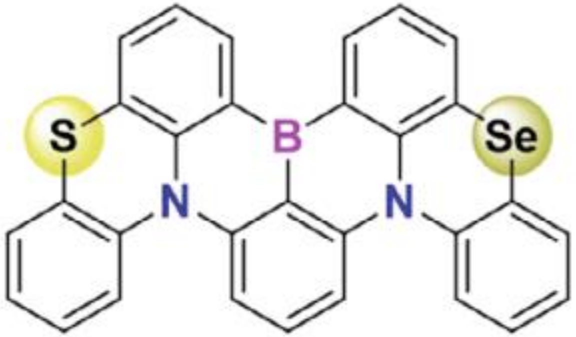


Solution1: Heavy Atom Effect

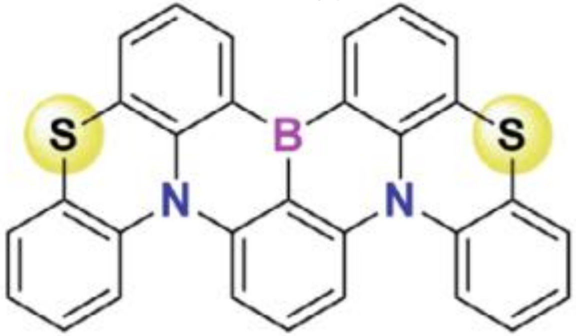
Where should we put the heavy atom?



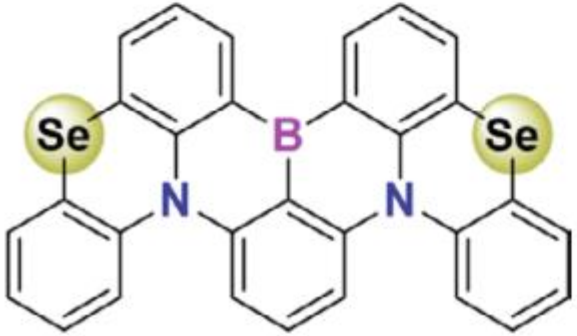
2PXZBN $k_{RISC}/10^4=4.3$



BNSSe $k_{RISC}/10^4=600$

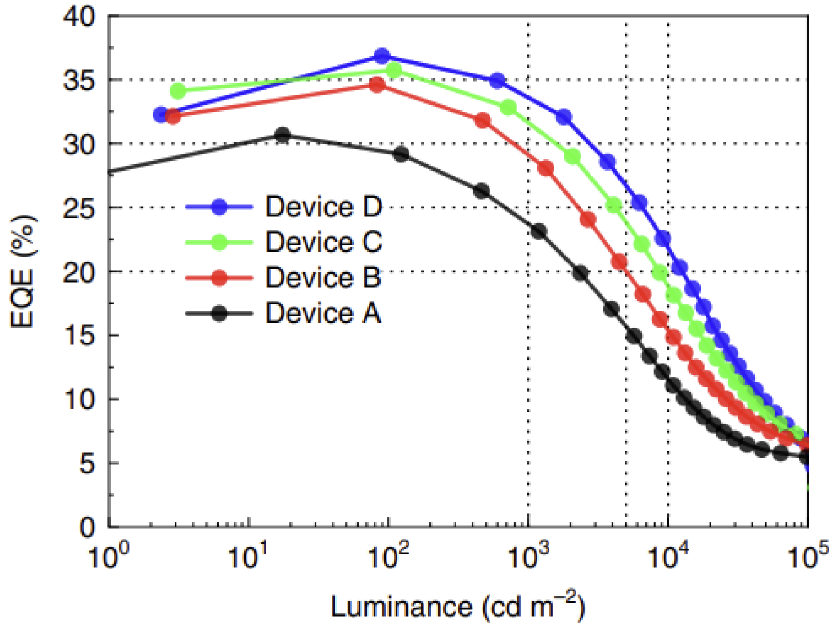


BNSSe
$k_{RISC}/10^4=190$



BNSeSe
$k_{RISC}/10^4=2000$

low roll-off*

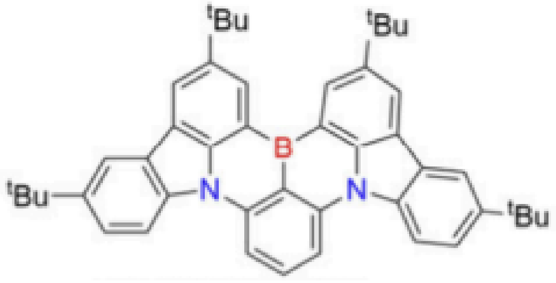


40.5% EQE:
Super
dominating

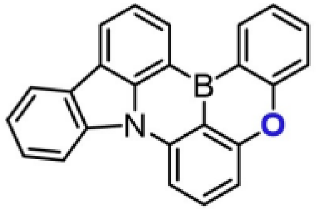
Chuluo Yang *etal.* Nat. Photon. 16, 803–810 (2022)
*As sensitizer

Solution1: Heavy Atom Effect

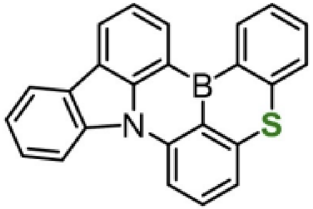
Where should we put the heavy atom?



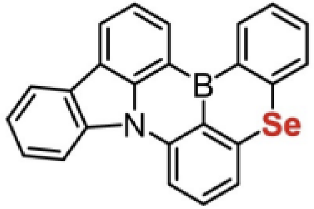
FWHM: 24 nm



CzBO



CzBS



CzBSe

FWHM: 26 nm
$K_{RISC}/10^4 = 0.9$

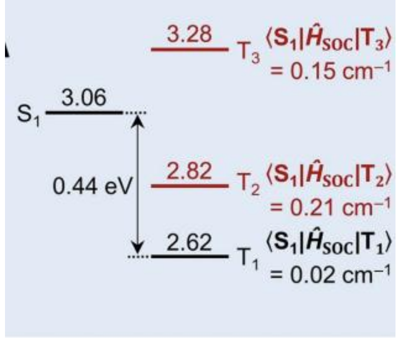
FWHM: 28 nm
$K_{RISC}/10^4 = 22$

FWHM: 33 nm
$K_{RISC}/10^4 = 18000$

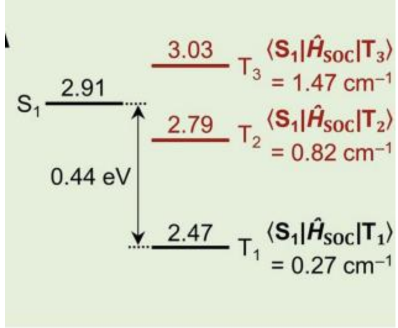
Conformational flexibility increased

Yasuda *etal.*Angew. Chem. Int. Ed. 2022, 61, e202205684

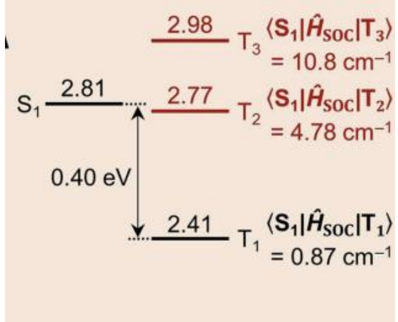
CzBO



CzBS



CzBSe



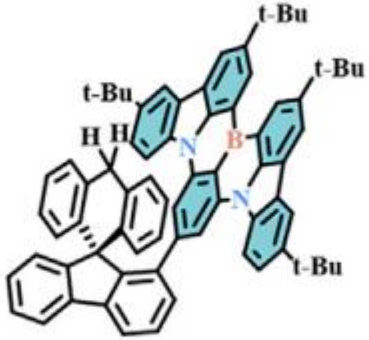
More than heavy atom effect

LE of Cz contribution

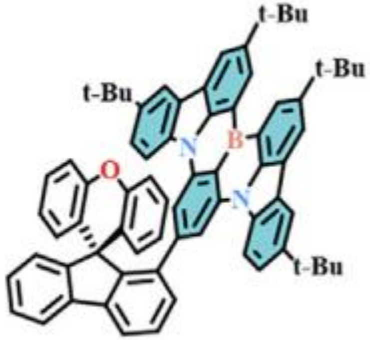
Solution1: Heavy Atom Effect

Through Space Heavy atom effect

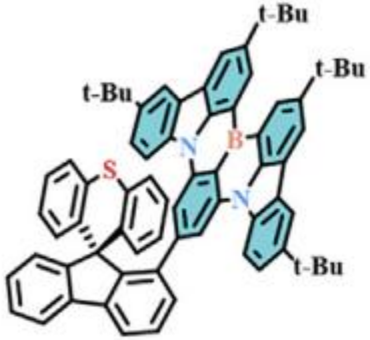
BNCz



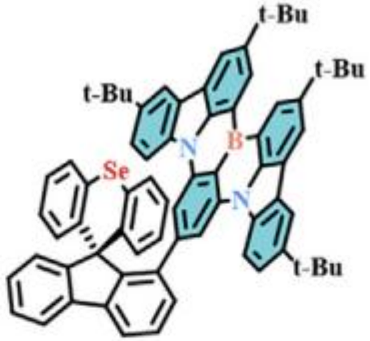
CH_2-SFBN



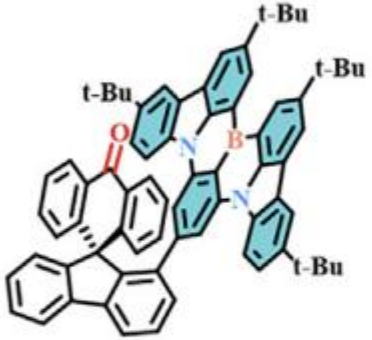
O-SFBN



S-SFBN

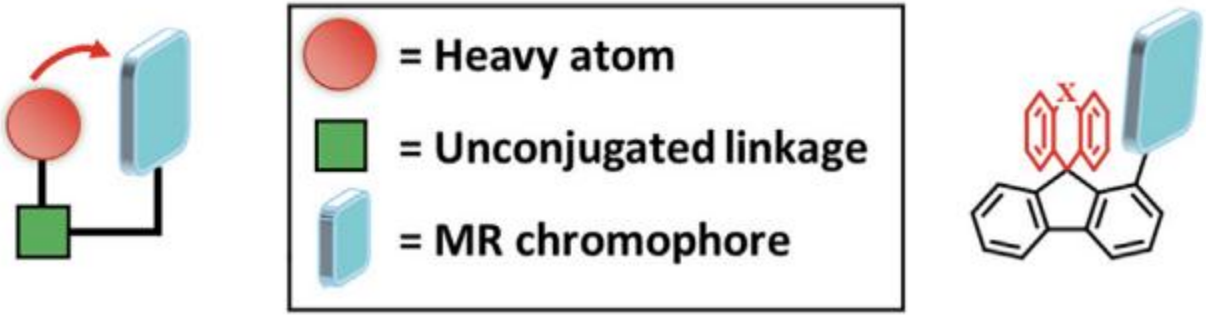


Se-SFBN



CO-SFBN

Avoid Flexibility of C-Chalo



🔴 = Heavy atom

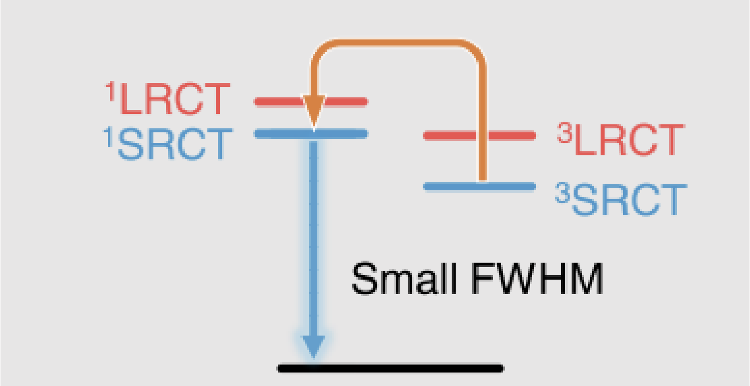
🟩 = Unconjugated linkage

▮ = MR chromophore

Emitters	FWHM (nm/eV)	krISC (104 s−1)
CH2-SFBN	25 / 0.12	0.81
O-SFBN	23 / 0.12	0.81
S-SFBN	24 / 0.12	5.16
Se-SFBN	24 / 0.12	10.50
CO-SFBN	24 / 0.12	6.64
BNCz	22 / 0.11	3.0

Zuo-Quan Jiang *etal*.,Chem 11, 102353

Solution2: Transient ^{3}LRCT state



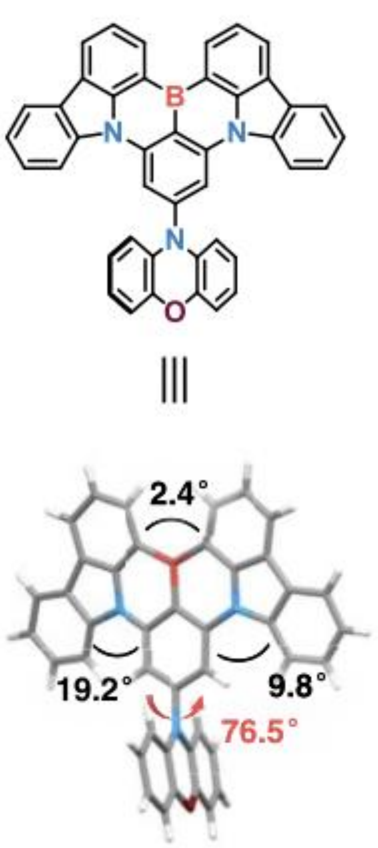
Ideal scenario:

^{1}LRCT > ^{1}SRCT ≈ ^{3}LRCT > ^{3}SRCT

Simplified:
^{3}SRCT → ^{3}LRCT → ^{3}SRCT

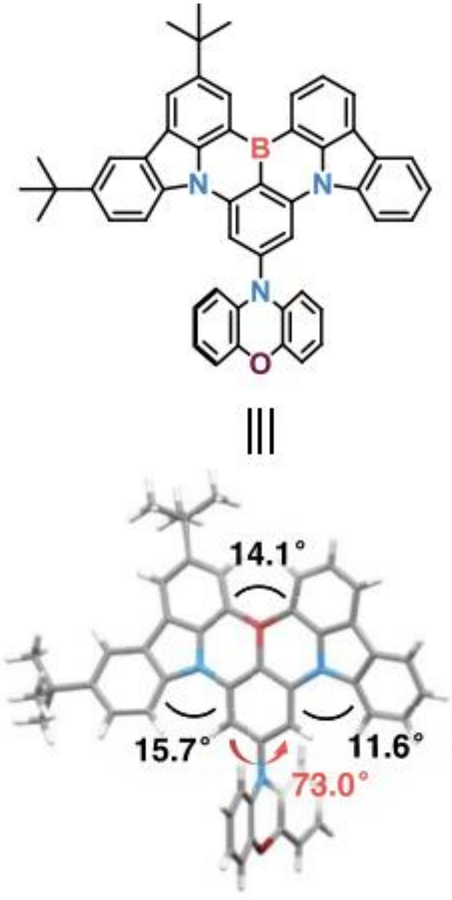
Mathematically: recalls

$$\langle S_1|\hat{H}_{SO}|T_1\rangle_{eff} = \frac{\langle ^1CT|\hat{H}_{SO}|^3LE\rangle\langle ^3LE|\hat{H}_{vib}|^3CT\rangle}{\Delta E(CT-LE)}$$



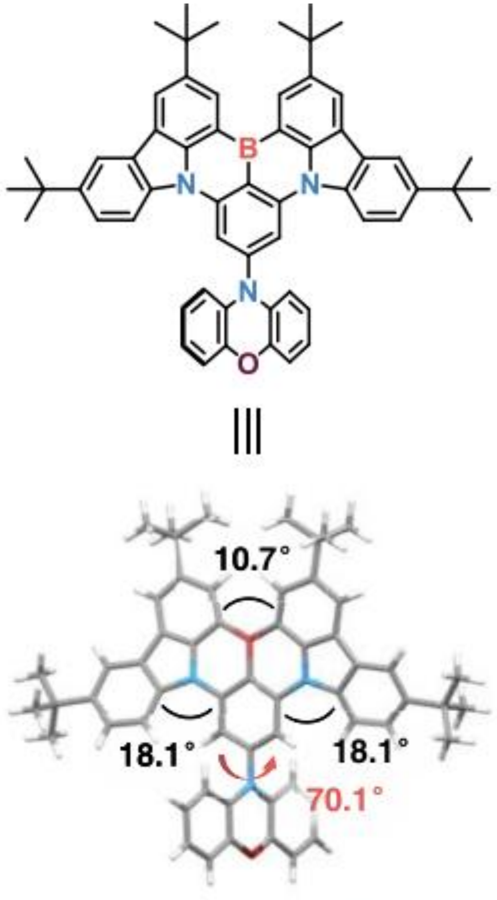
$k_{RISC} = 2.0 \times 10^6\ s^{-1}$

CzBN1



$k_{RISC} = 7.9 \times 10^5\ s^{-1}$

CzBN2



$k_{RISC} = 3.3 \times 10^5\ s^{-1}$

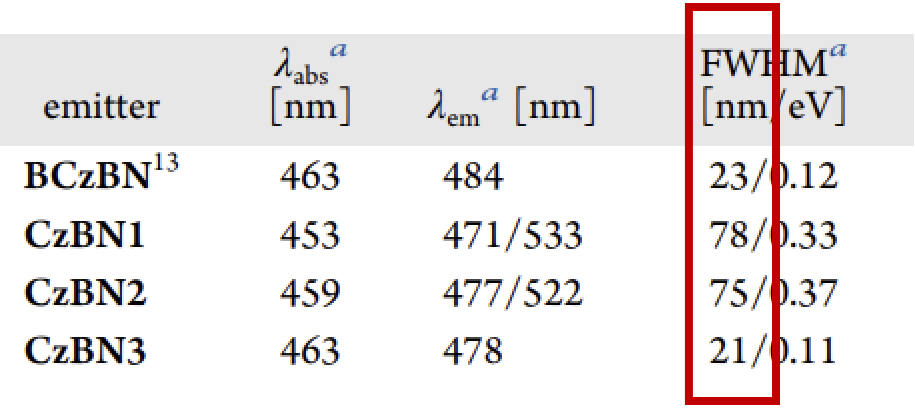
CzBN3

Similar K_{RISC}

Chuluo Yang *etal.*, J. Am. Chem. Soc. 2023, 145, 12550−12560

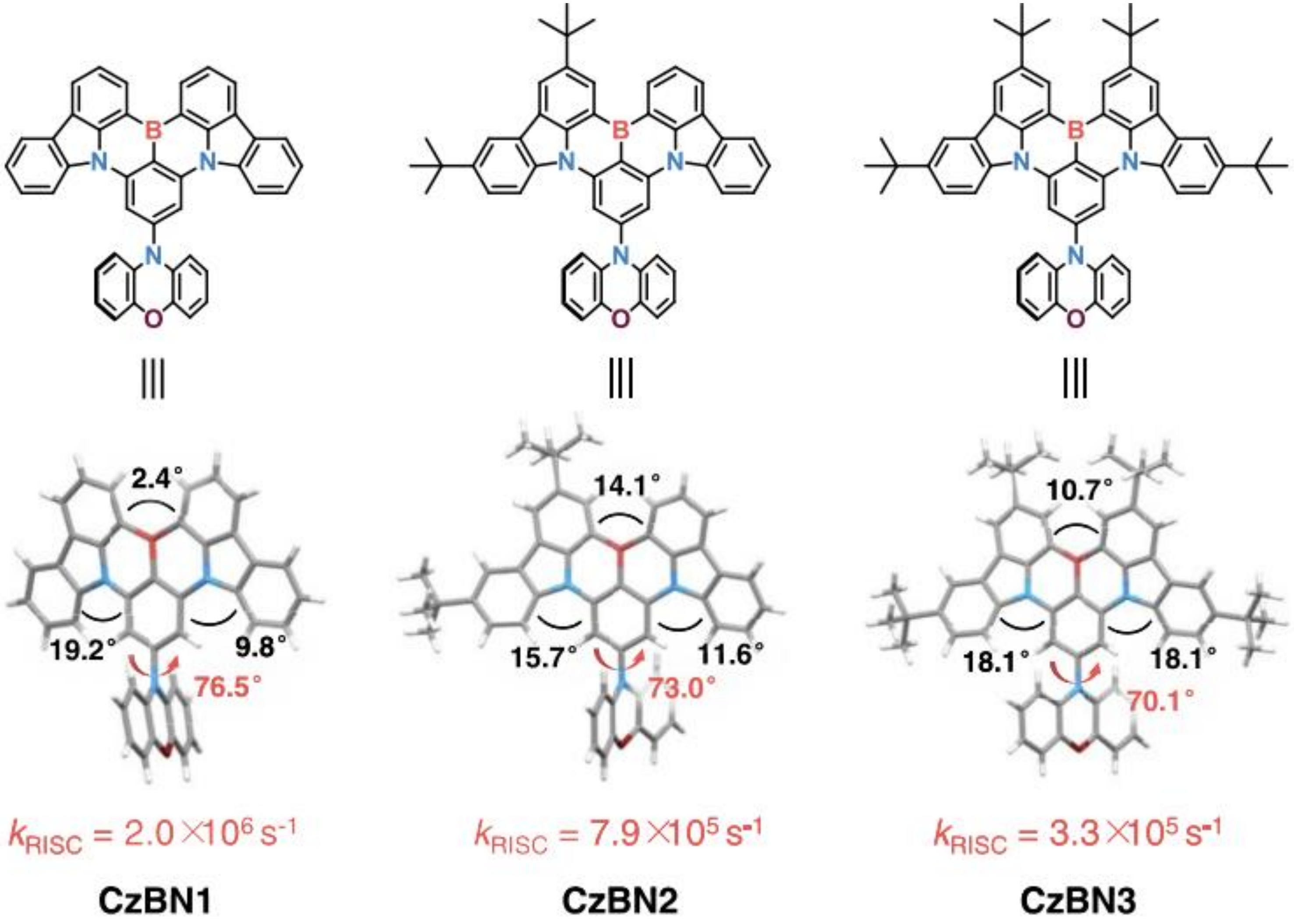
Solution2: Transient ^{3}LRCT state

But very interestingly……



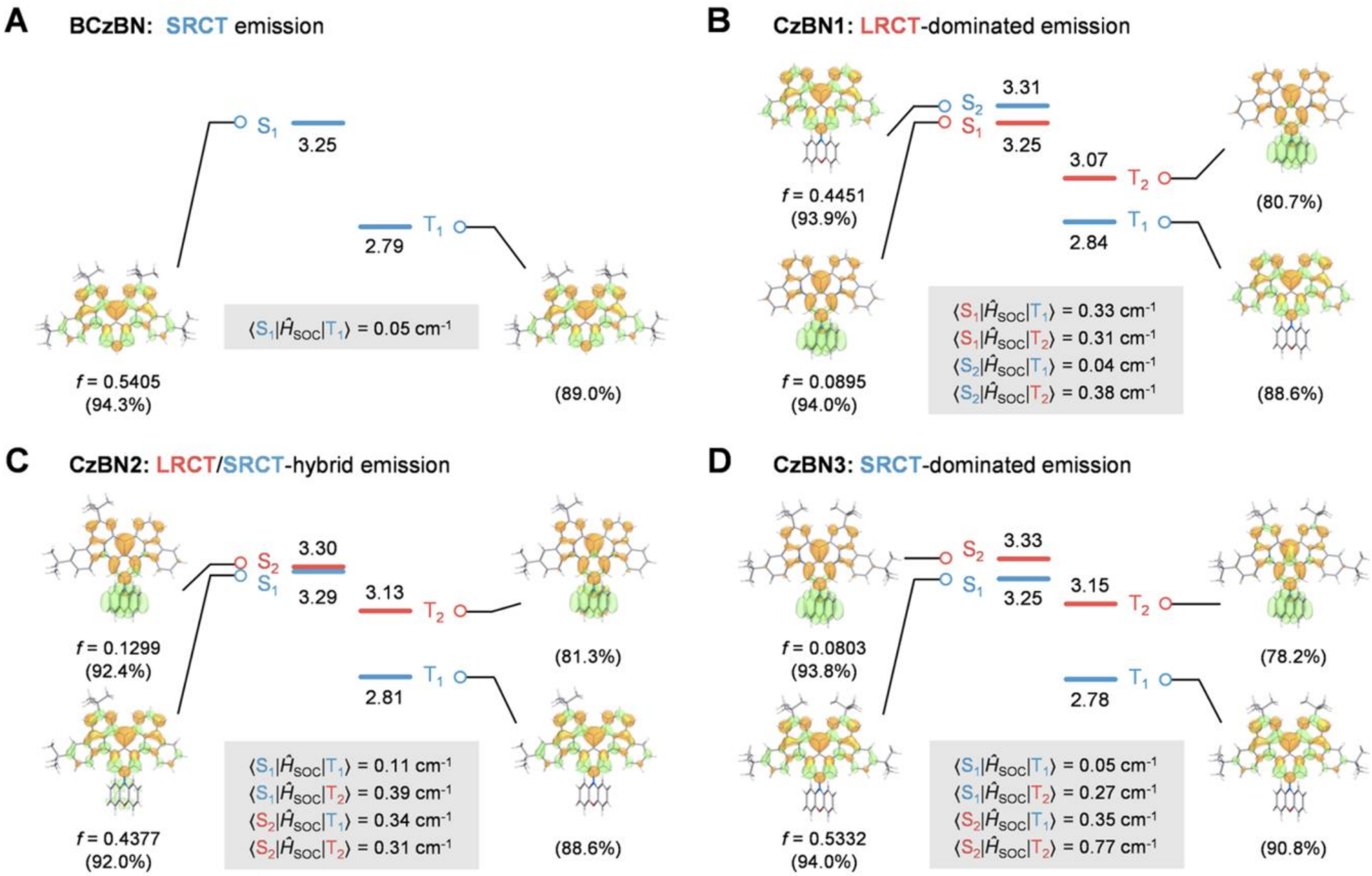
emitter	λ_{abs}[a] [nm]	λ_{em}[a] [nm]	FWHM[a] [nm/eV]
BCzBN[13]	463	484	23/0.12
CzBN1	453	471/533	78/0.33
CzBN2	459	477/522	75/0.37
CzBN3	463	478	21/0.11

Huge difference in FWHM
Why?



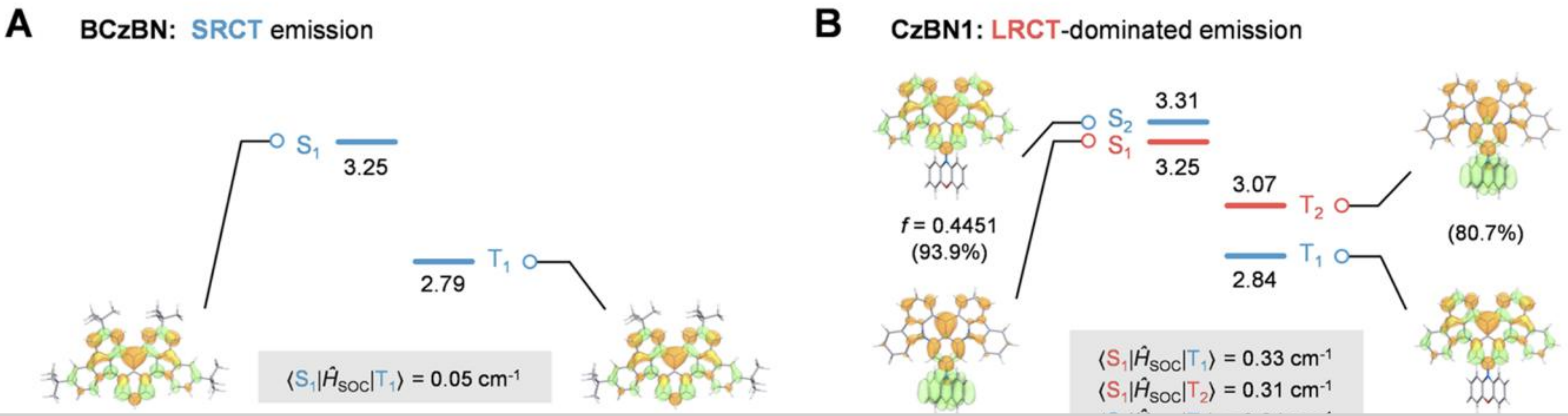
Chuluo Yang *etal.*, J. Am. Chem. Soc. 2023, 145, 12550−12560

Solution2: Transient ^{3}LRCT state



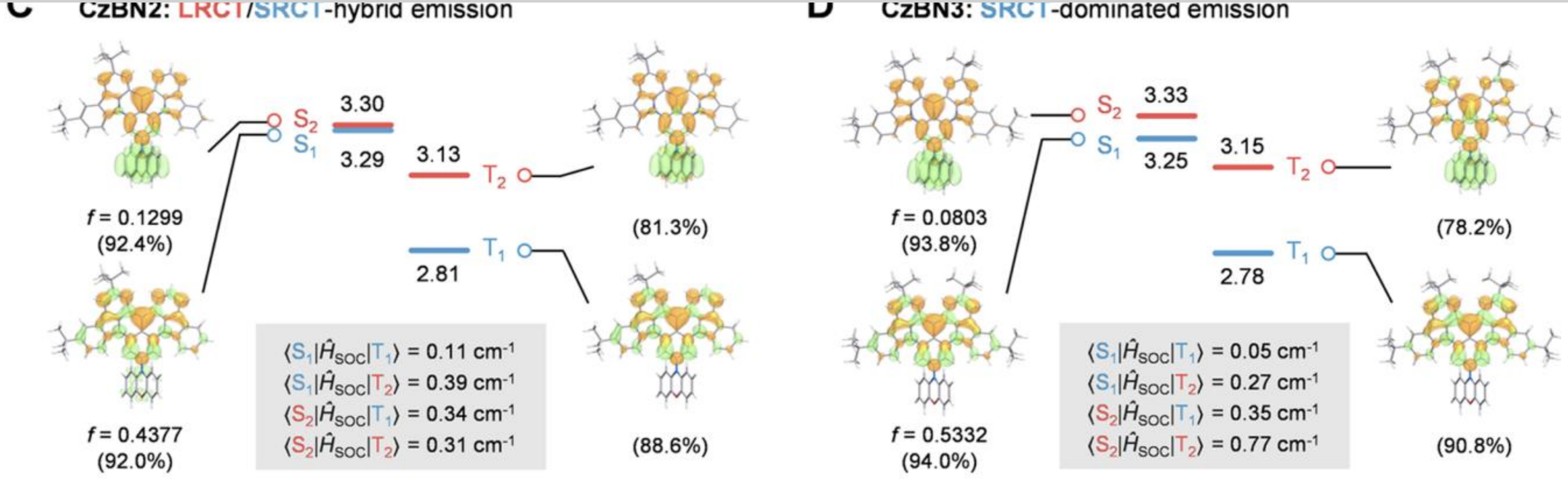
Chuluo Yang *etal.*, J. Am. Chem. Soc. 2023, 145, 12550−12560

Solution2: Transient ^{3}LRCT state



The emission should happen in ^{1}SRCT

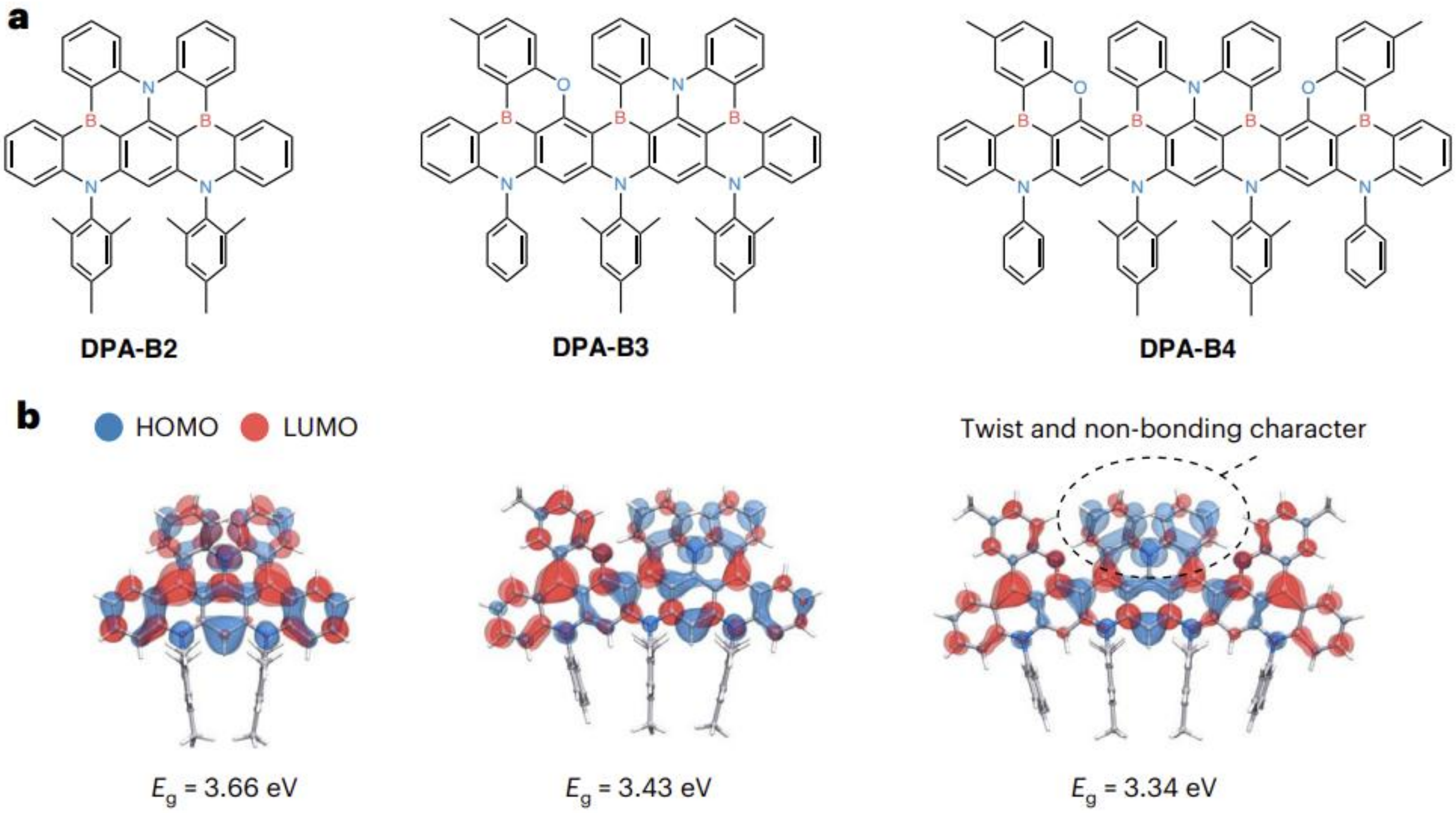
^{3}SRCT >> ^{1}SRCT=^{3}LRCT > ^{3}SRCT



Chuluo Yang *etal.*, J. Am. Chem. Soc. 2023, 145, 12550−12560

Solution2: Transient ^{3}LRCT state

- **highly twisted core**
- **Linear π-conjugation extension**
- **Substitution with Oxygen**



Chuluo Yang *etal*., Nat. Photon. 18, 1161–1169 (2024)

Solution2: Transient ^{3}LRCT state

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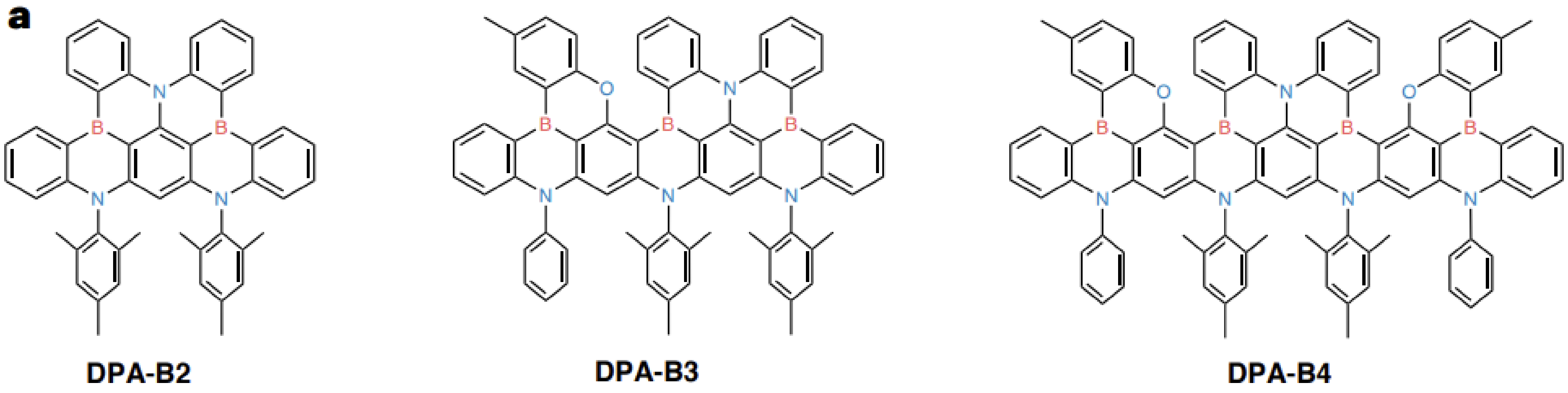
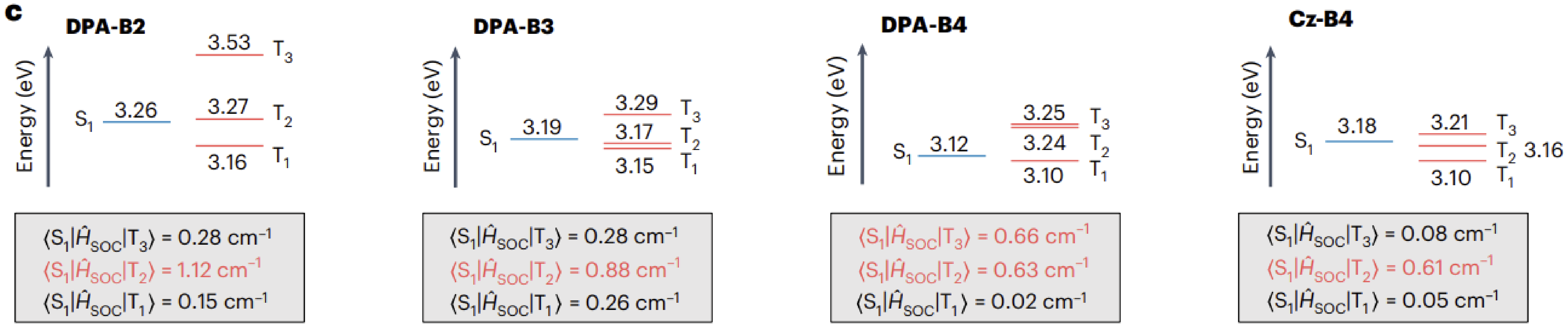


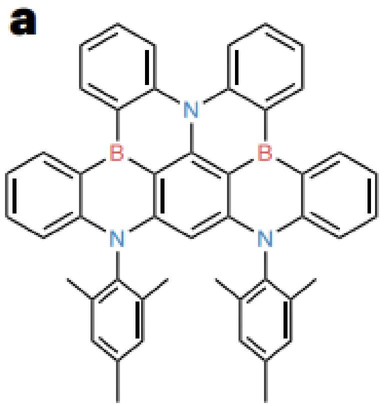


Ultra-fast RISC Rate (2.29×106*s*−1) without Heavy Atoms

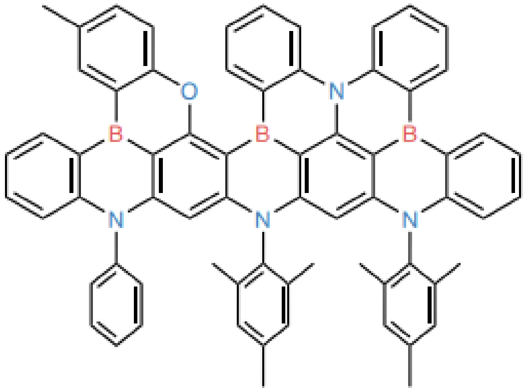
Chuluo Yang *etal*., Nat. Photon. 18, 1161–1169 (2024)

Solution2: Transient ^{3}LRCT state

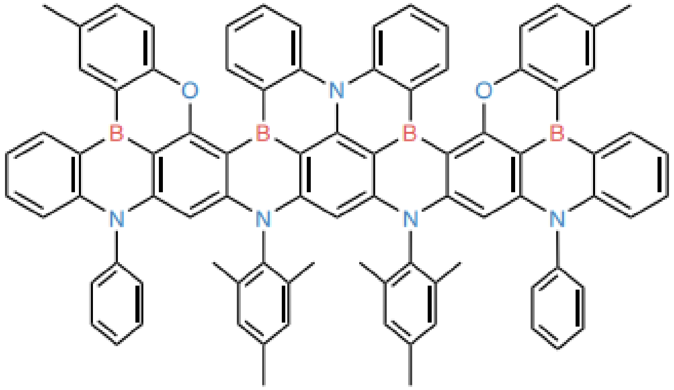
- highly twisted core
- **Linear π-conjugation extension**
- **Substitution with Oxygen**



DPA-B2

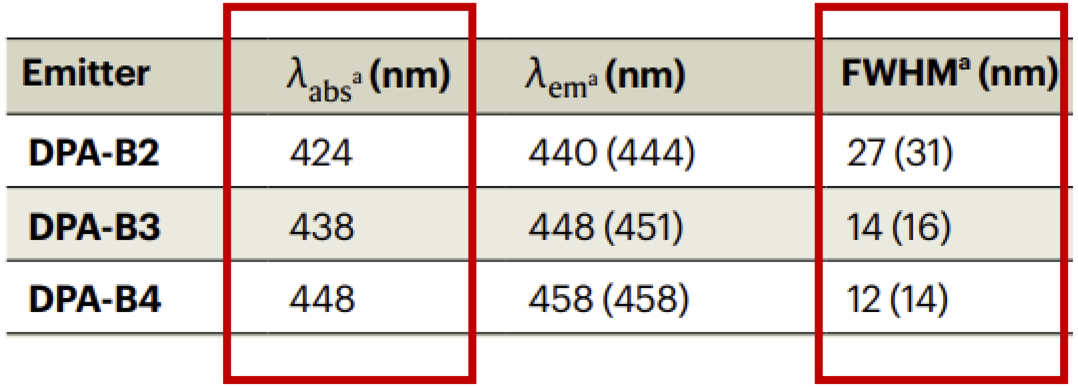


DPA-B3



DPA-B4

Ultra Sharp



Emitter	$\lambda_{abs}{}^a$ (nm)	$\lambda_{em}{}^a$ (nm)	FWHM^a (nm)
DPA-B2	424	440 (444)	27 (31)
DPA-B3	438	448 (451)	14 (16)
DPA-B4	448	458 (458)	12 (14)

Deep Blue

EQE=39.2%(single device)
/74.5%(hyperfluorescence device)

Current State of the art

Chuluo Yang *etal*., Nat. Photon. 18, 1161–1169 (2024)

MR-TADFs
Content

- *TADFs and Essential Theoretical Backgrounds*
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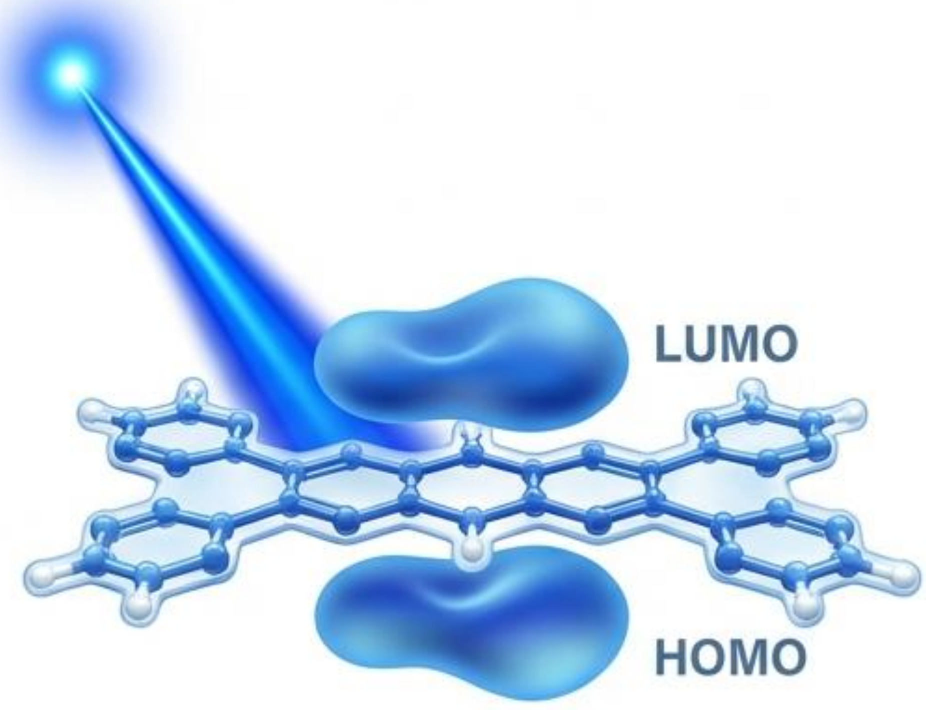
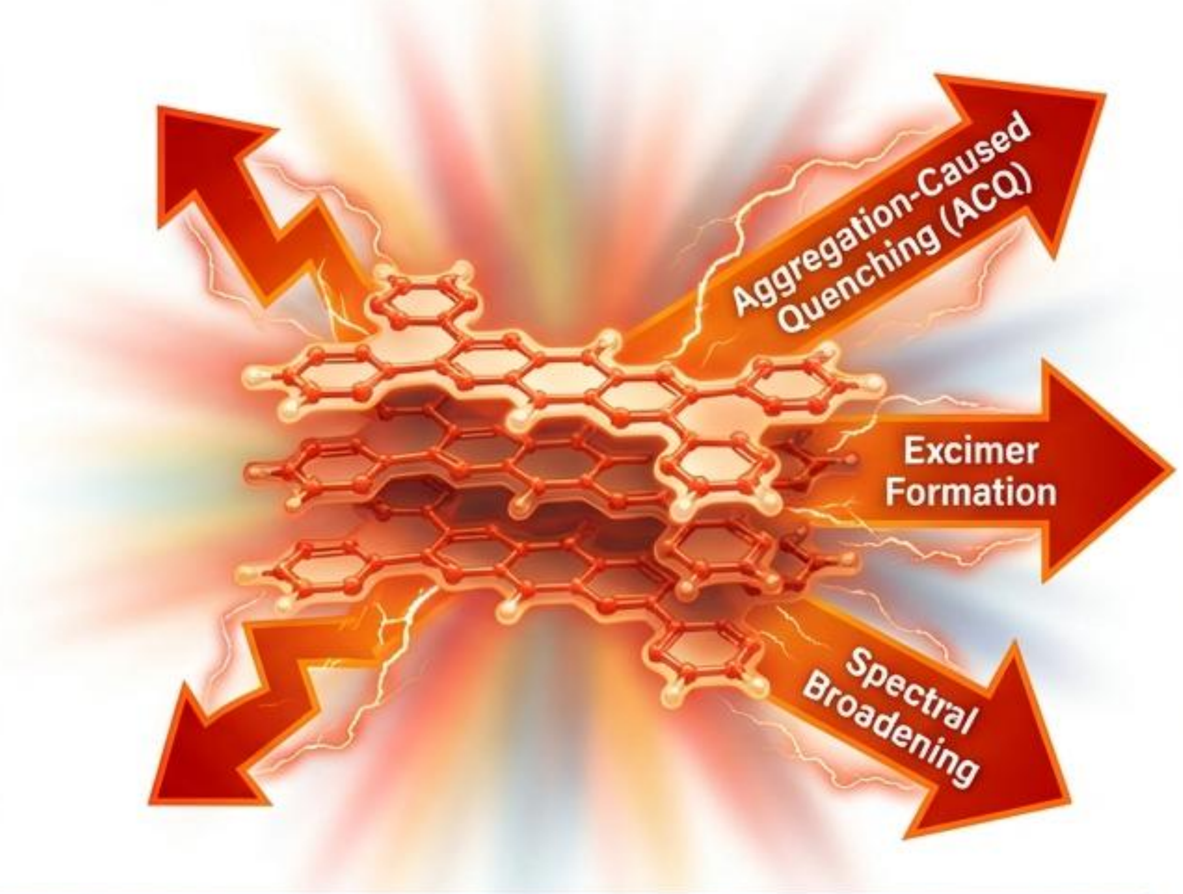
- *MR-TADFs*
- *Towards Deep RED Emission*
- *Towards Brighter OLEDs: faster RISC*
- *Towards Brighter OLEDs: against ACQs*

The Planar Perfection of MR-TADF Cores is Their Primary Downfall

The Ideal



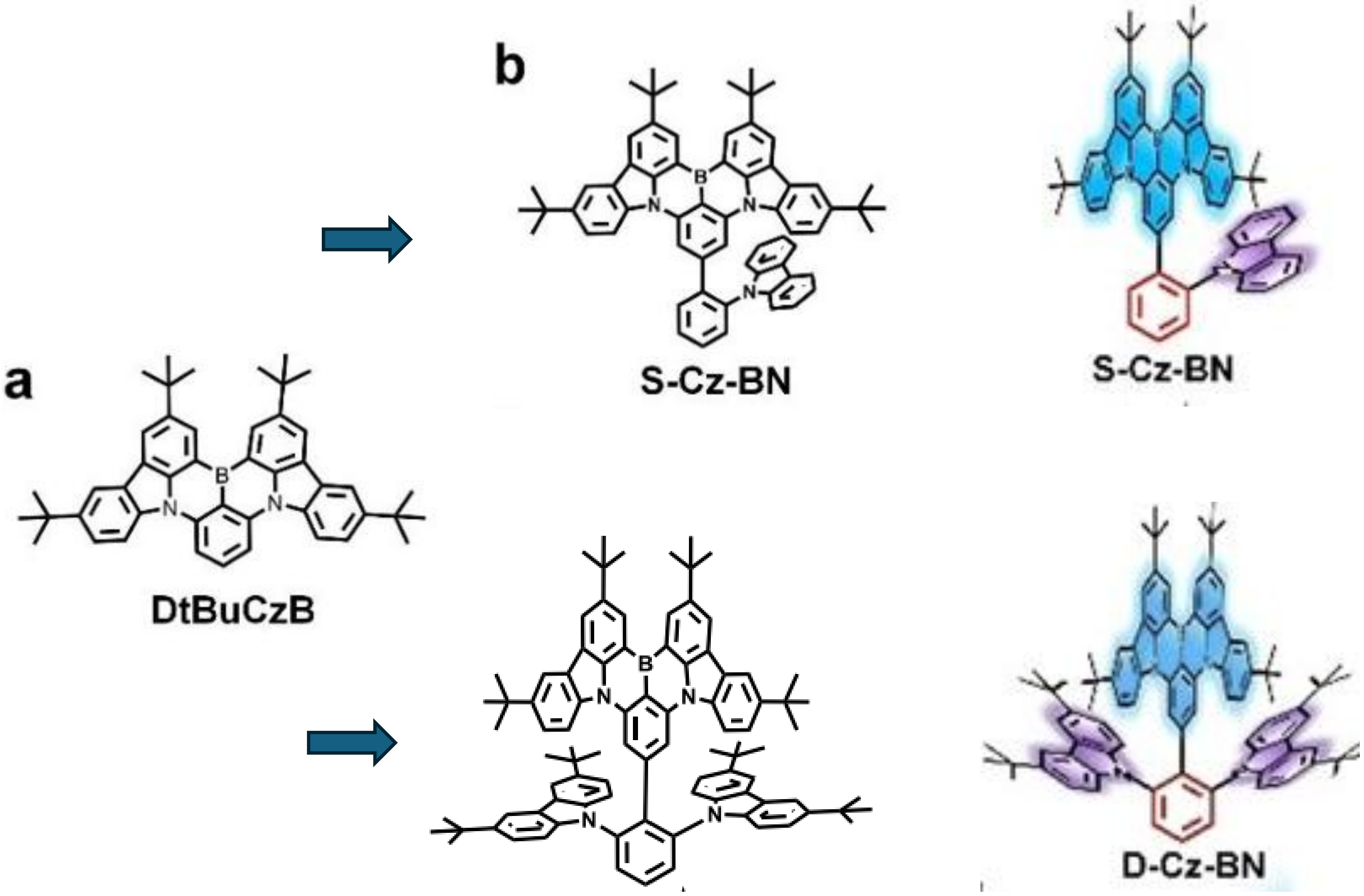
The Reality



Rigid, planar polycyclic frameworks enable pristine narrowband emission, but cause fatal interchromophore π-π stacking at high doping ratios.

The result is broadened spectra, quenched external quantum efficiency (EQE), and severe triplet annihilation.

Introduction of steric hindrance



	FWHM (nm)	kRISC (104 s−1)
DtBuCzB	25	3.0
S-Cz-BN	23	1.8
D-Cz-BN	22	1.8

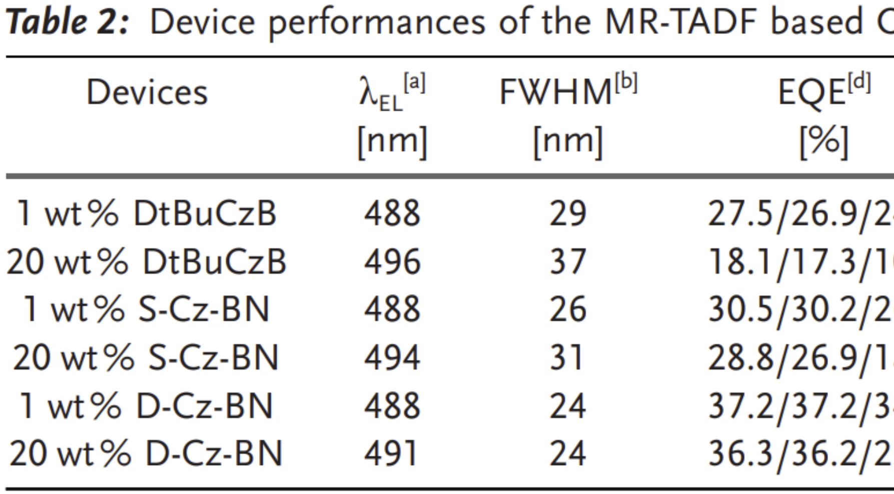
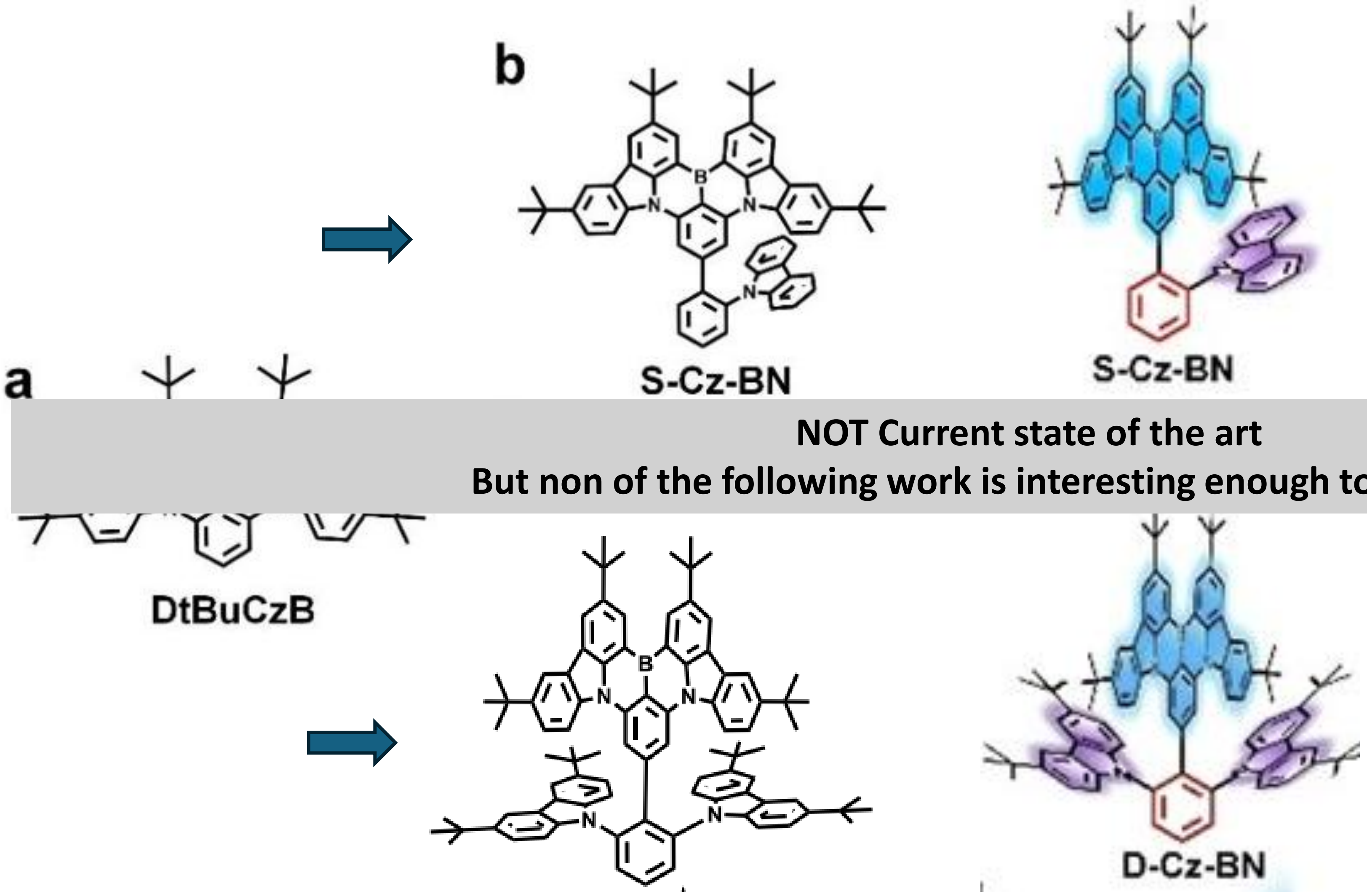


Table 2: Device performances of the MR-TADF based C

Devices	λ_{EL}[a] [nm]	FWHM[b] [nm]	EQE[d] [%]
1 wt% DtBuCzB	488	29	27.5/26.9/2
20 wt% DtBuCzB	496	37	18.1/17.3/1
1 wt% S-Cz-BN	488	26	30.5/30.2/2
20 wt% S-Cz-BN	494	31	28.8/26.9/1
1 wt% D-Cz-BN	488	24	37.2/37.2/3
20 wt% D-Cz-BN	491	24	36.3/36.2/2

Lian Duan, *etal.* Angew. Chem. Int. Ed. 2022, 61, e202113206

Introduction of steric hindrance



	FWHM (nm)	kRISC (104 s−1)
DtBuCzB	25	3.0
S-Cz-BN	23	1.8
D-Cz-BN	22	1.8

NOT Current state of the art
But non of the following work is interesting enough to discuss here

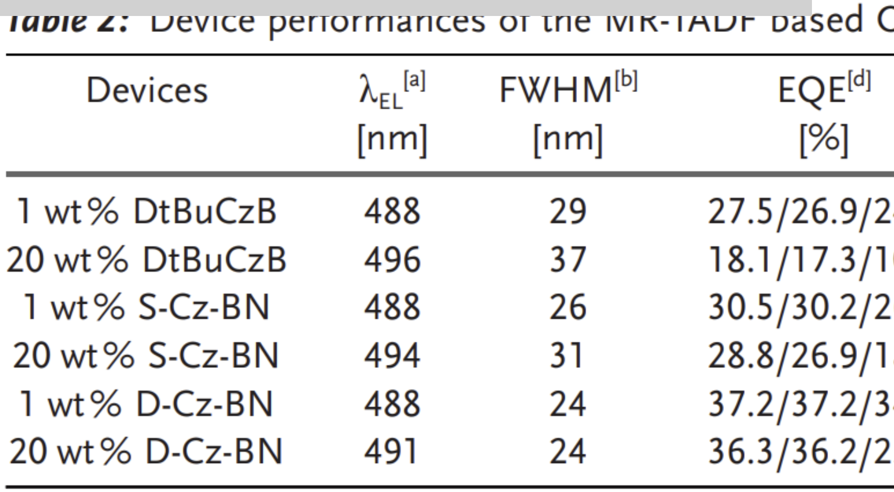


Table 2: Device performances of the MR-TADF based

Devices	λ_{EL}[a] [nm]	FWHM[b] [nm]	EQE[d] [%]
1 wt% DtBuCzB	488	29	27.5/26.9/2
20 wt% DtBuCzB	496	37	18.1/17.3/1
1 wt% S-Cz-BN	488	26	30.5/30.2/2
20 wt% S-Cz-BN	494	31	28.8/26.9/1
1 wt% D-Cz-BN	488	24	37.2/37.2/3
20 wt% D-Cz-BN	491	24	36.3/36.2/2

Chuluo Yang *etal.*, J. Am. Chem. Soc. 2023, 145, 12550−12560

Conclusion

- *Balancing ΔE_{ST} , f, and H_{soc}*
- *D-A type TADFs and their limitations: Huge FHWM*
- *MR-TADFs gives small FHWM (SRCT)*
- *Towards Deep RED Emission through controlling SRCT and bigger BN ring*
- *Faster RISC: Heavy atom effect + combing other state*
- *Against ACQs: Introducing stertics*