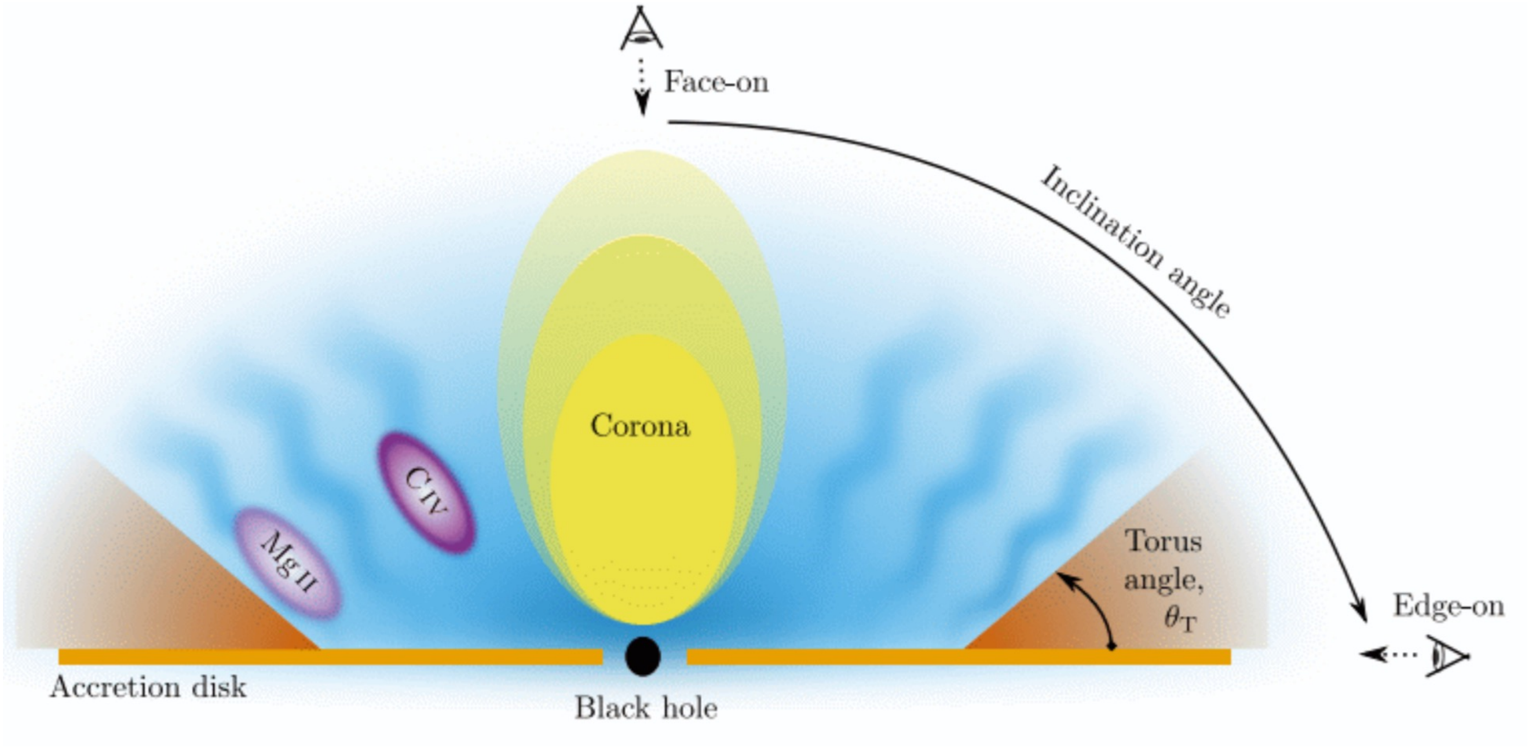
Accretion-modified stars in AGNs: theory and observations



Jian-Min Wang 2023/12/12. Shanghai

PHYSICAL REVIEW LETTERS **125,** 101102 (2020)

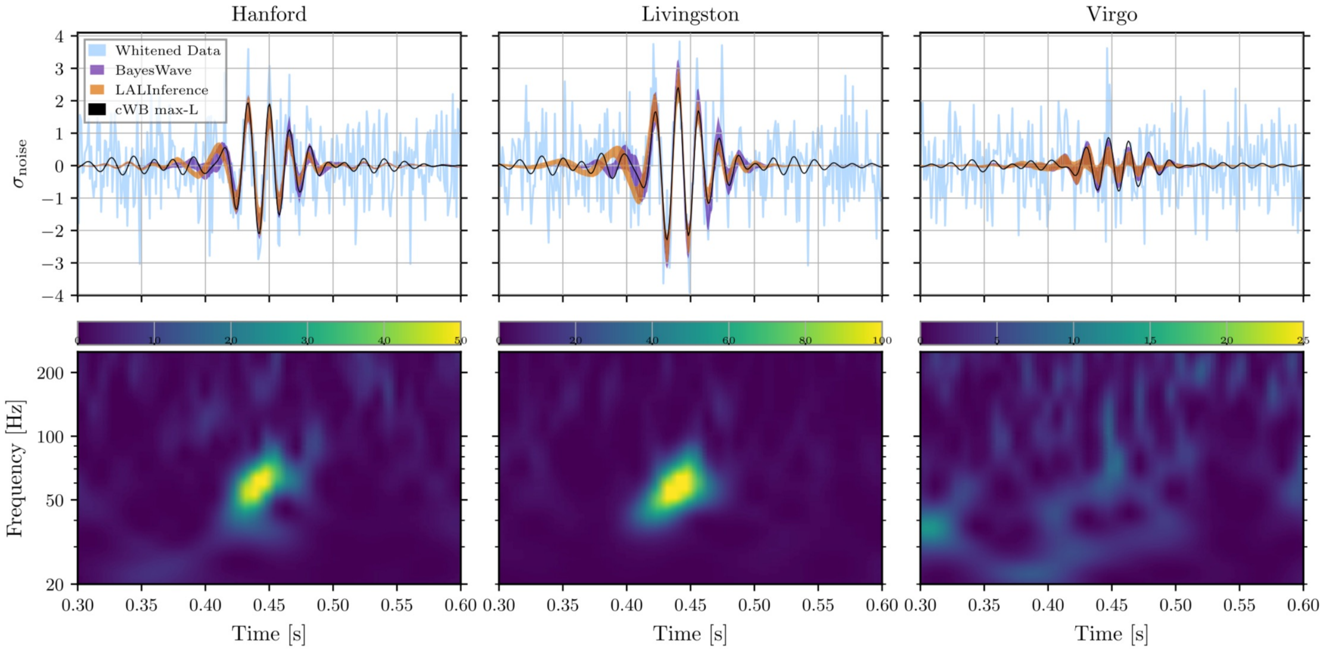
Editors' Suggestion | Featured in Physics

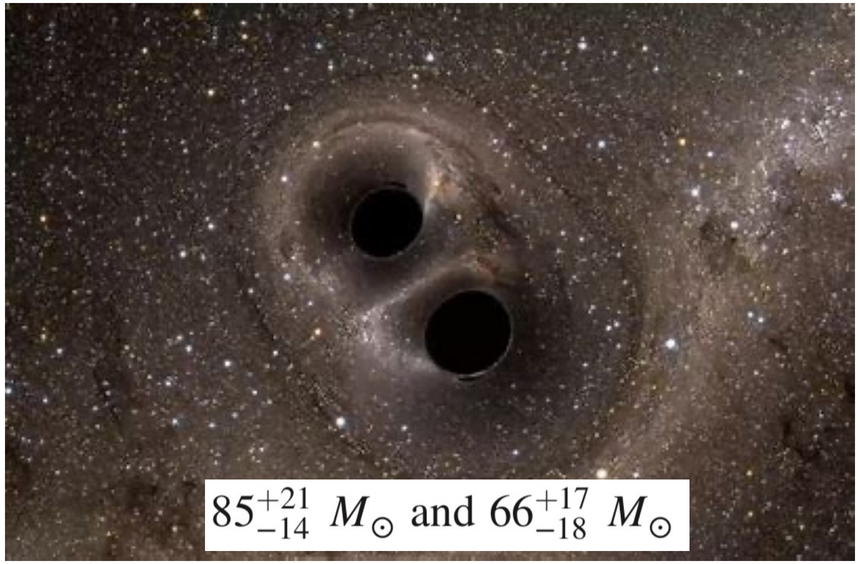
GW190521: A Binary Black Hole Merger with a Total Mass of 150 $M_\odot$

R. Abbott *et al.*[*]

(LIGO Scientific Collaboration and Virgo Collaboration)

(Received 30 May 2020; revised 19 June 2020; accepted 9 July 2020; published 2 September 2020)



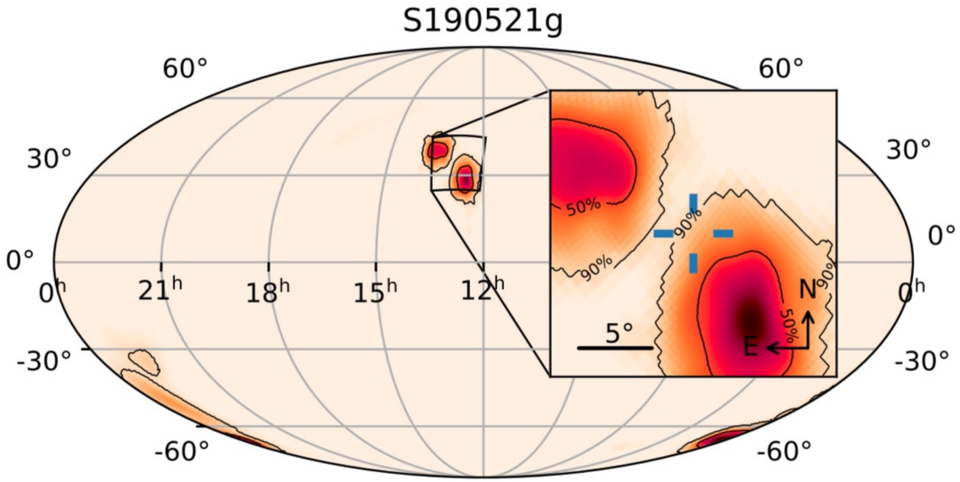


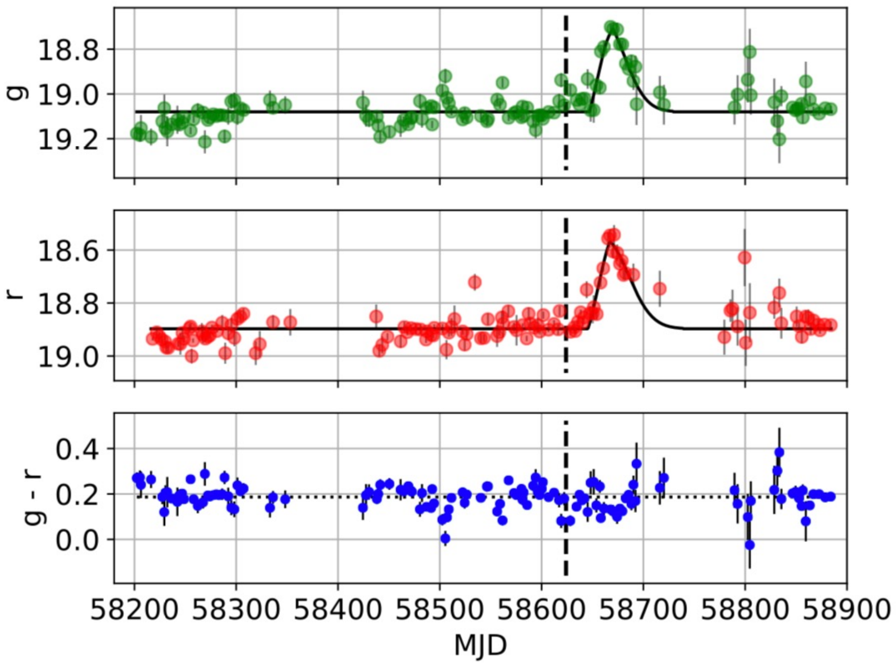
PHYSICAL REVIEW LETTERS 124, 251102 (2020)

Editors' Suggestion Featured in Physics

Candidate Electromagnetic Counterpart to the Binary Black Hole Merger Gravitational-Wave Event S190521g*

M. J. Graham,[1,†] K. E. S. Ford,[2,3,4] B. McKernan,[2,3,4] N. P. Ross,[5] D. Stern,[6] K. Burdge,[1] M. Coughlin,[7,8] S. G. Djorgovski,[1] A. J. Drake,[1] D. Duev,[1] M. Kasliwal,[1] A. A. Mahabal,[1] S. van Velzen,[9,10] J. Belecki,[11] E. C. Bellm,[12] R. Burruss,[11] S. B. Cenko,[13,14] V. Cunningham,[9] G. Helou,[15] S. R. Kulkarni,[1] F. J. Masci,[15] T. Prince,[1] D. Reiley,[11] H. Rodriguez,[11] B. Rusholme,[15] R. M. Smith,[11] and M. T. Soumagnac[16,17]





Questions: 1) how to form $80M_\odot$?

2) host galaxy?

nature astronomy

Article

https://doi.org/10.1038/s41550-023-01998-8

A long-duration gamma-ray burst of dynamical origin from the nucleus of an ancient galaxy

Received: 9 February 2023

Accepted: 5 May 2023

Published online: 22 June 2023

Check for updates

Andrew J. Levan[1,2], Daniele B. Malesani[1,3,4,5], Benjamin P. Gompertz[6], Anya E. Nugent[7], Matt Nicholl[6], Samantha R. Oates[6], Daniel A. Perley[8], Jillian Rastinejad[7], Brian D. Metzger[9,10], Steve Schulze[11], Elizabeth R. Stanway[2], Anne Inkenhaag[1,12], Tayyaba Zafar[13,14], J. Feliciano Agüí Fernández[15], Ashley A. Chrimes[1], Kornpob Bhirombhakdi[16], Antonio de Ugarte Postigo[17], Wen-fai Fong[7], Andrew S. Fruchter[16], Giacomo Fragione[7], Johan P. U. Fynbo[3,4], Nicola Gaspari[1], Kasper E. Heintz[3,4], Jens Hjorth[18], Pall Jakobsson[19], Peter G. Jonker[1,12], Gavin P. Lamb[8,20], Ilya Mandel[21,22], Soheb Mandhai[23], Maria E. Ravasio[1,24], Jesper Sollerman[25] & Nial R. Tanvir[20]

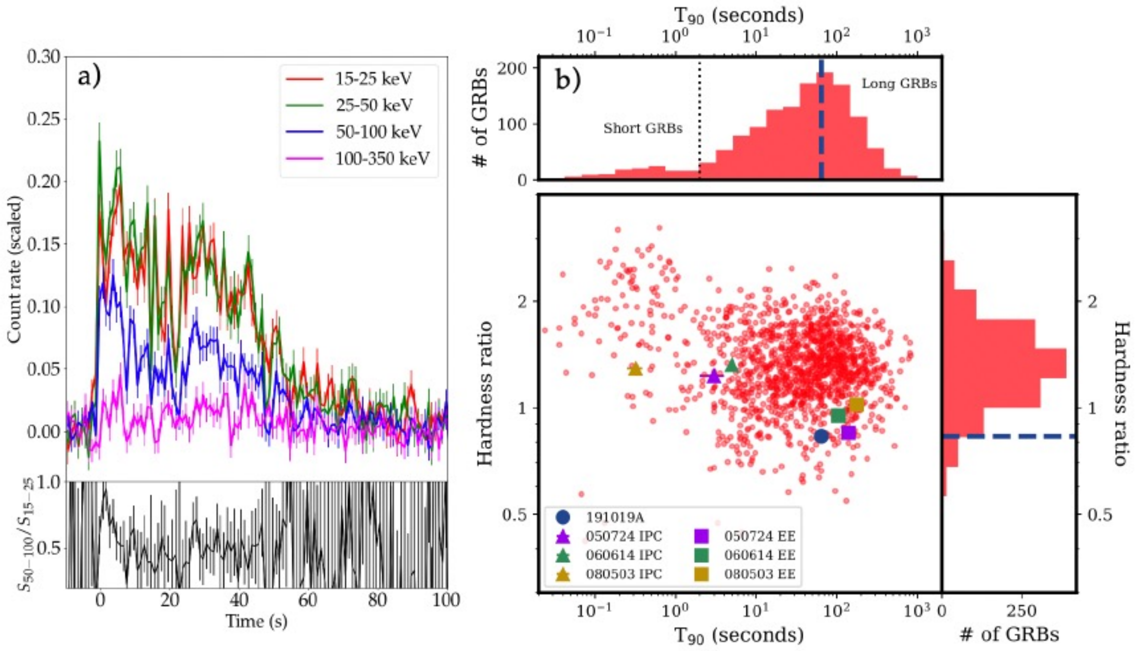


Fig. 1 a) The γ-ray light curve of GRB 191019A as observed by the *Swift*-BAT. The burst

The Astrophysical Journal Letters, 950:L20 (6pp), 2023 June 20 https://doi.org/10.3847/2041-8213/acd18c

GRB 191019A: A Short Gamma-Ray Burst in Disguise from the Disk of an Active Galactic Nucleus

Davide Lazzati[1], Rosalba Perna[2,3], Benjamin P. Gompertz[4], and Andrew J. Levan[5,6]
[1] Department of Physics, Oregon State University, 301 Weniger Hall, Corvallis, OR 97331, USA; lazzatid@science.oregonstate.edu
[2] Department of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794-3800, USA
[3] Center for Computational Astrophysics, Flatiron Institute, New York, NY 10010, USA
[4] School of Physics and Astronomy & Institute for Gravitational Wave Astronomy, University of Birmingham, Birmingham, B15 2TT, UK
[5] Department of Astrophysics/IMAPP, Radboud University Nijmegen, P.O. Box 9010, 6500 GL Nijmegen, The Netherlands
[6] Department of Physics, University of Warwick, Coventry, CV4 7AL, UK
Received 2023 March 22; revised 2023 April 20; accepted 2023 April 23; published 2023 June 22

Draft version November 8, 2023
Typeset using LaTeX default style in AASTeX631

Afterglows from binary neutron star post-merger systems embedded in AGN disks

Adithan Kathirgamaraju[1,2] Hui Li[1] Benjamin R. Ryan[2] and Alexander Tchekhovskoy[3]

Astron. Astrophys. 323, 659–673 (1997)

ASTRONOMY
AND
ASTROPHYSICS

Gamma-ray bursts from radio-quiet quasars

N. Schartel[1,2], H. Andernach[3,4], and J. Greiner[5]

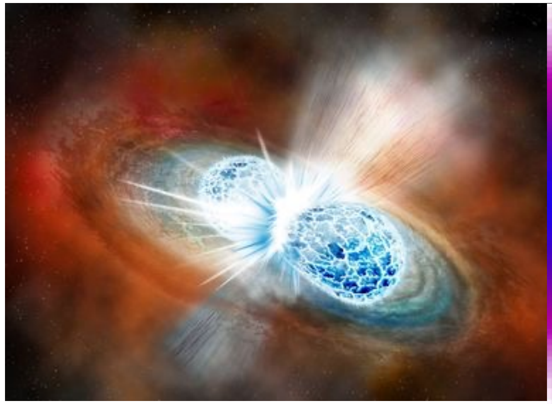
[1] ESA, IUE Observatory, P.O. Box 50727, E-28080 Madrid, Spain
[2] Affiliated to the Astrophysics Division, Space Science Department, ESTEC
[3] INSA; ESA IUE Observatory, P.O. Box 50727, E-28080 Madrid, Spain
[4] Depto. de Astronomía, Univ. Guanajuato, Apdo. Postal 144, 36000 Guanajuato, Mexico
[5] Max-Planck-Institut für extraterrestrische Physik, D-85740 Garching, Germany

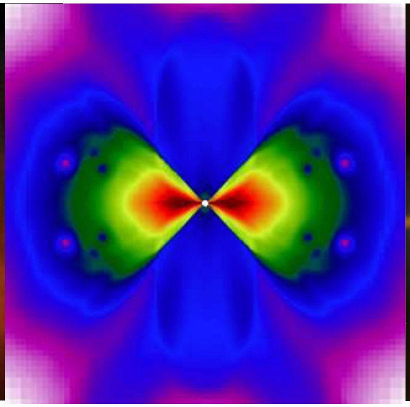
Received 17 July 1996 / Accepted 14 January 1997

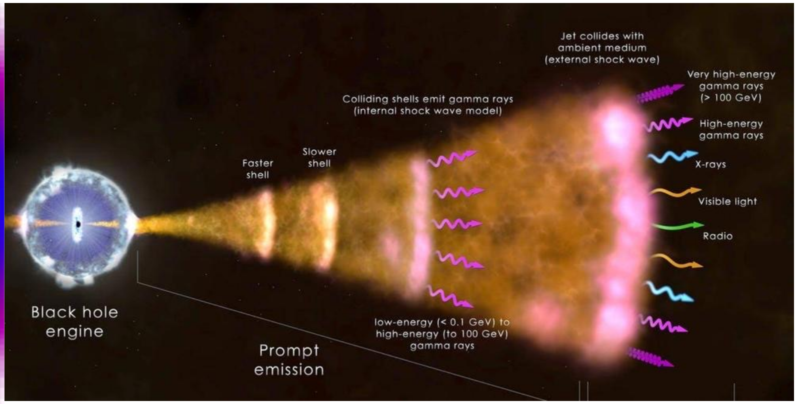
1) NS merger
(Paczynski 1986)

2) Massive star
(Woosley 1993)

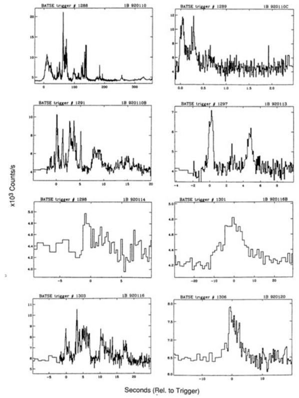
metal-rich regions?



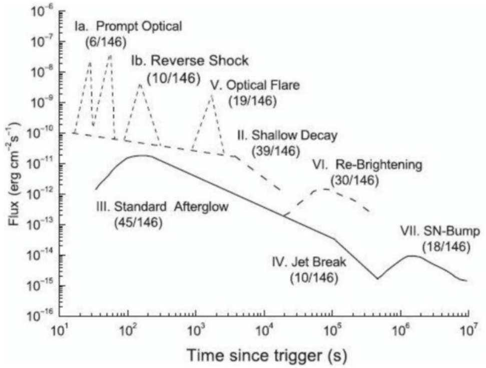




GRB firball



GRB light curves



GRB afterglow

Quasars are metal-rich：GRB from quasar?

The Astrophysical Journal, 521:502–508, 1999 August 20

THE FORMATION AND MERGER OF COMPACT OBJECTS IN THE CENTRAL ENGINE OF ACTIVE GALACTIC NUCLEI AND QUASARS: GAMMA-RAY BURST AND GRAVITATIONAL RADIATION

K. S. Cheng
Physics Department, University of Hong Kong, Hong Kong, People's Republic of China

and

Jian-Min Wang
Astronomy Department, Beijing Normal University, Beijing 100875; Astronomy Department, Nanjing University, Nanjing 210008; and Chinese Academy of Sciences-Peking University Joint Beijing Astrophysical Center (CAS-PKU.BAC), Beijing 100871, People's Republic of China

Received 1998 October 7; accepted 1999 April 1

AGN → high density of compact objects

Mergers → GRB and GWs

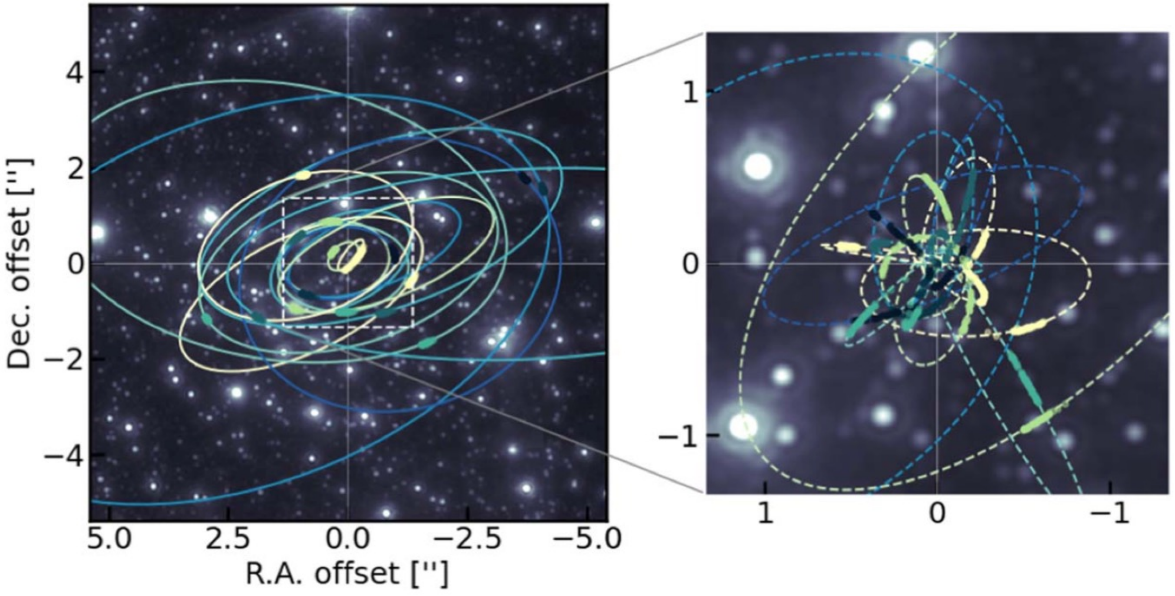
Galactic center：

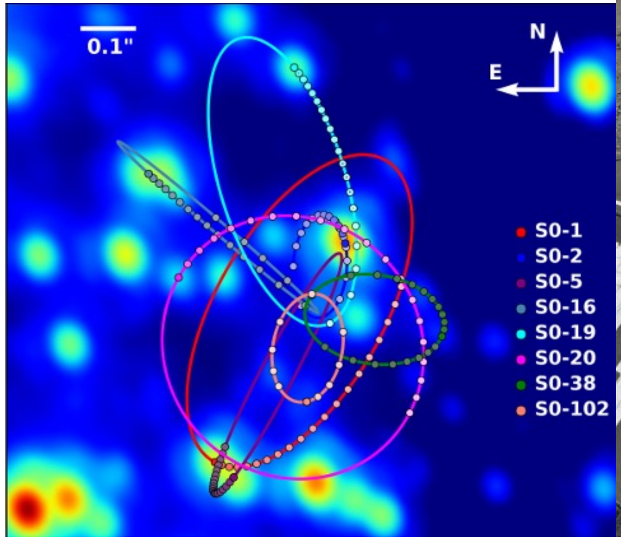
motivation

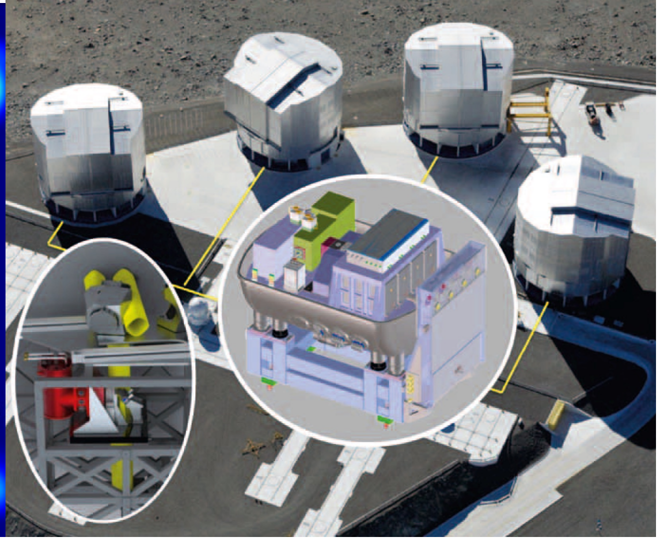
The Astrophysical Journal Letters, 932:L6 (29pp), 2022 June 10 https://doi.org/10.3847/2041-8213/ac68ef

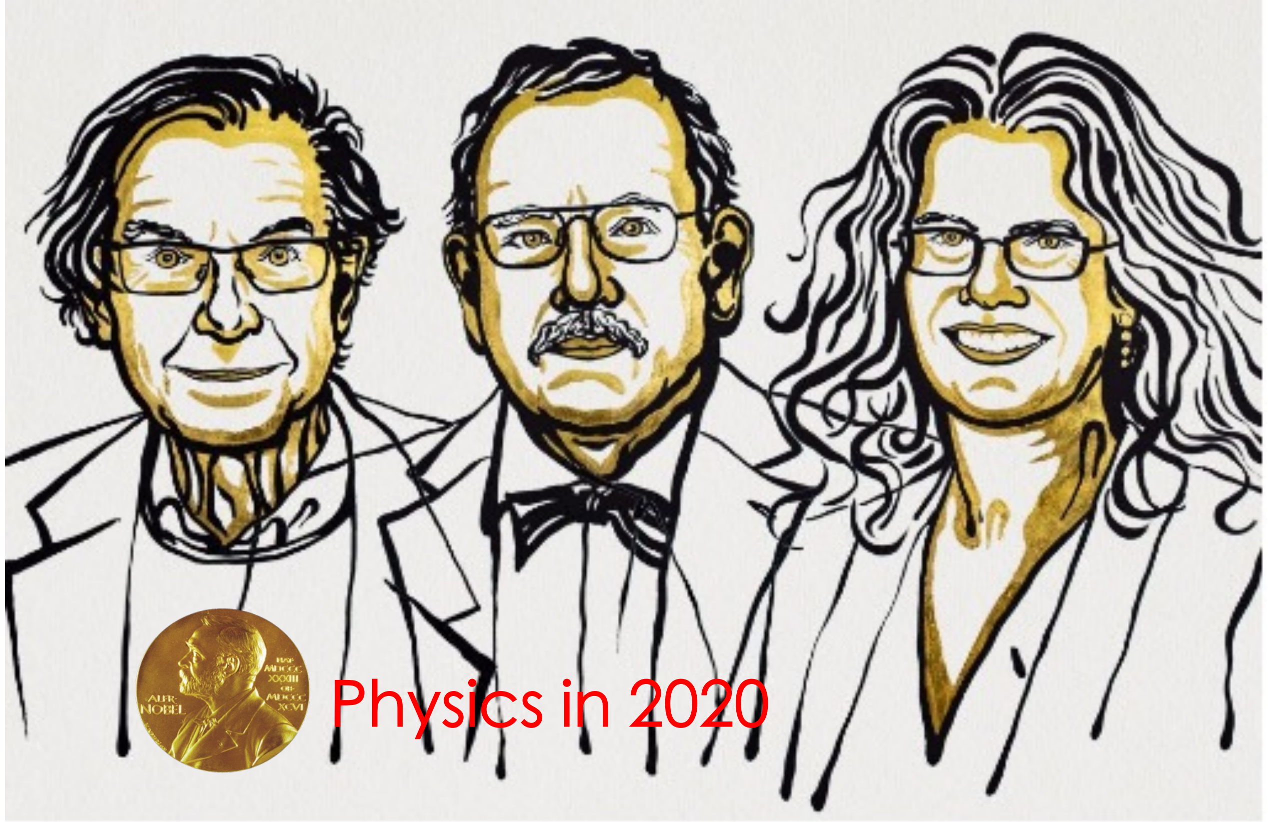
The Young Stars in the Galactic Center

Sebastiano D. von Fellenberg[1,2], Stefan Gillessen[2], Julia Stadler[3], Michi Bauböck[4], Reinhard Genzel[2,5], Tim de Zeeuw[2,6], Oliver Pfuhl[7], Pau Amaro Seoane[2,8,9,10], Antonia Drescher[2], Frank Eisenhauer[2], Maryam Habibi[2], Thomas Ott[2], Felix Widmann[2], and Alice Young[2]





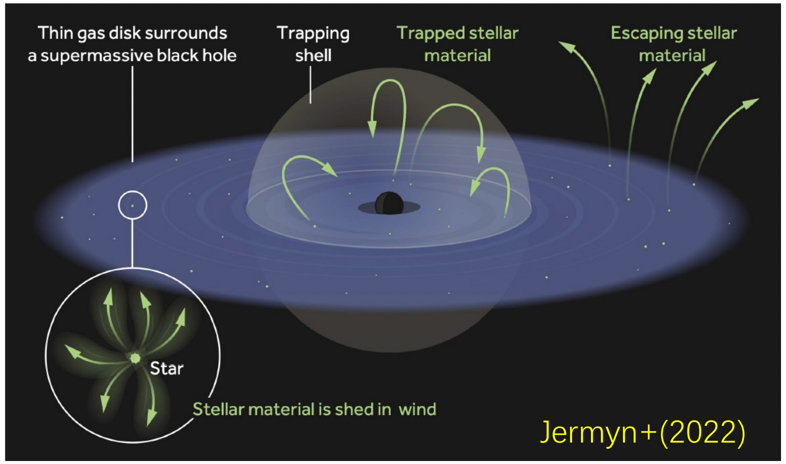


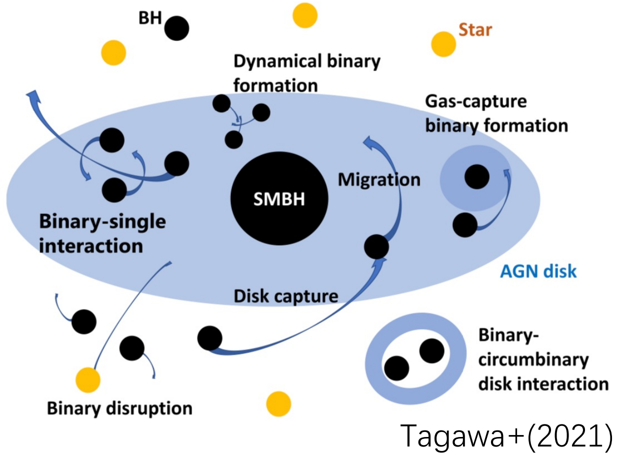


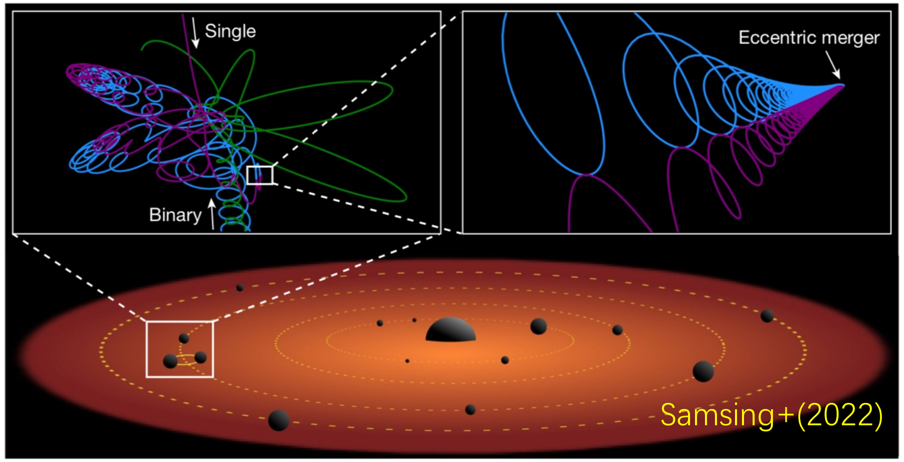
A new field：accretion-modified stars in AGN disk

evolutions of massive stars

binaries of compact objects







Many questions: challenges and opportunities

Questions: dynamics and radiation

- Evolution of massive stars in AGN disk： iron production
- Dynamical friction of disk gas on stars?

  compact stars, normal stars?
- Collapse of massive stars: dwarf, neutron stars
- Evolution of binary stars: compacts-compact, star-compact?
- Accretion-modified stars:
  - Outflow-driven cavity
  - Binary evolution inside cavity
  - GW from the binaries
- Feedback to AGN
  - Accretion disk
  - BLR, Torus
- Gravitational waves

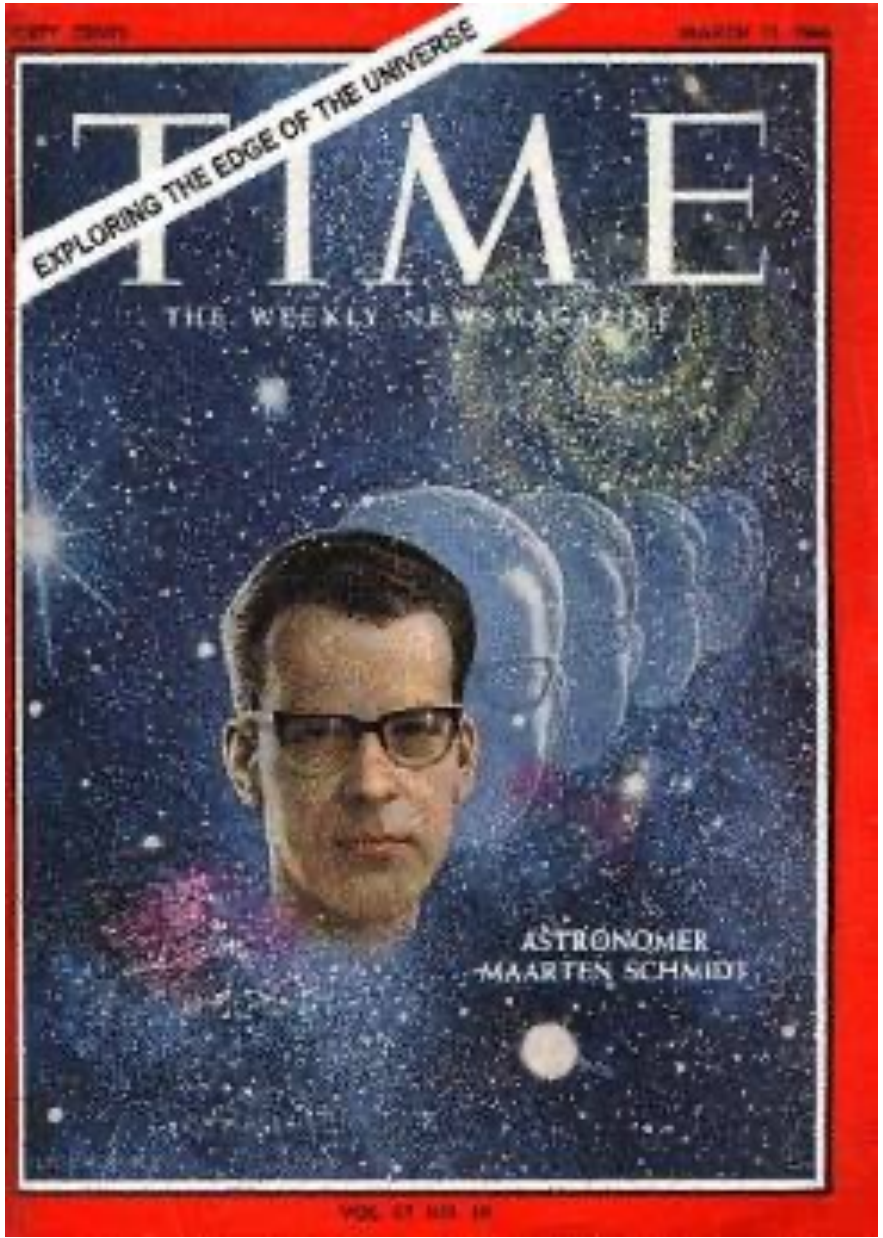
Iron abundance in AGN

1040 NATURE March 16, 1963 Vol. 197

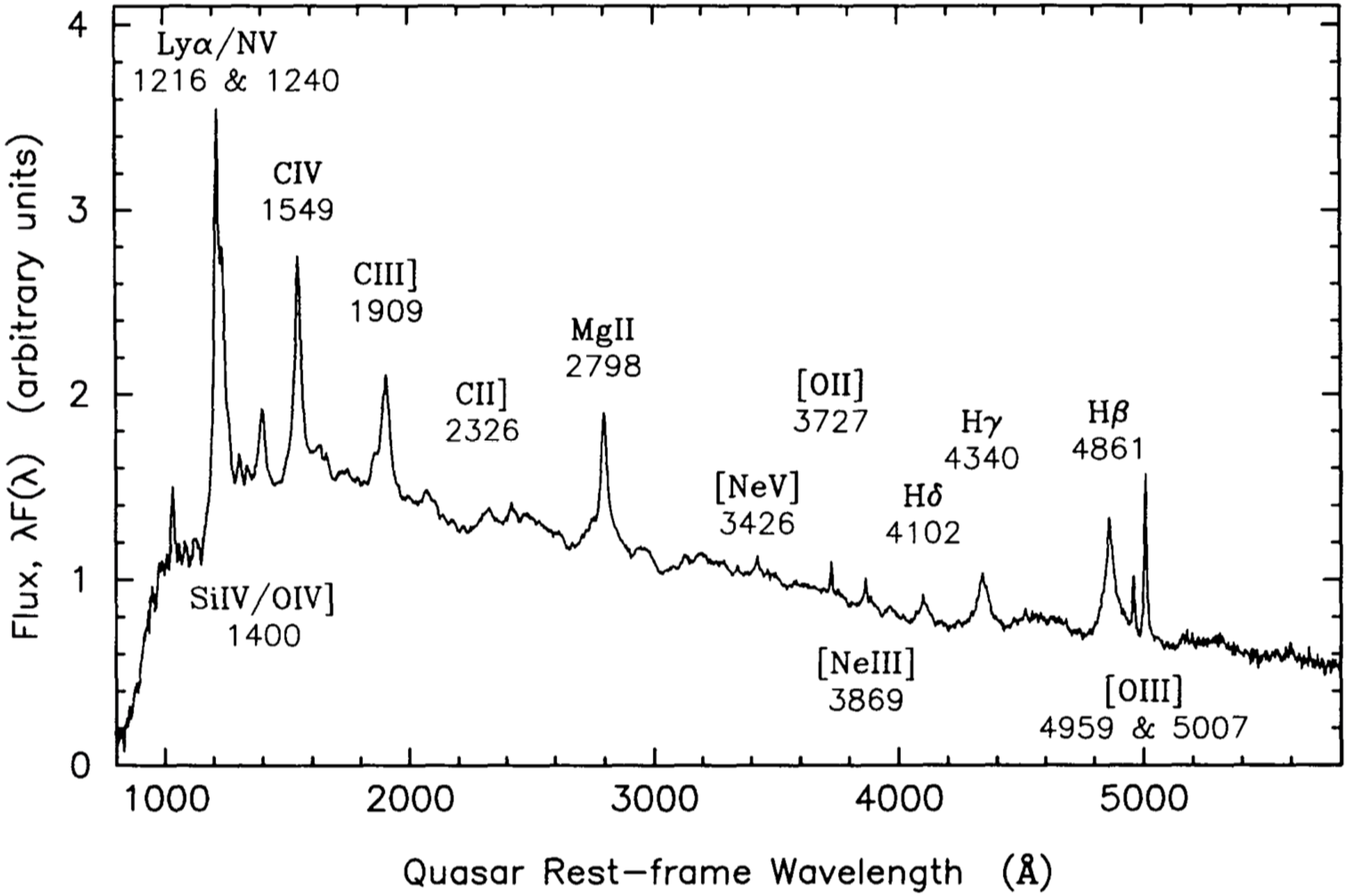
3C 273: A STAR-LIKE OBJECT WITH LARGE RED-SHIFT

By Dr. M. SCHMIDT

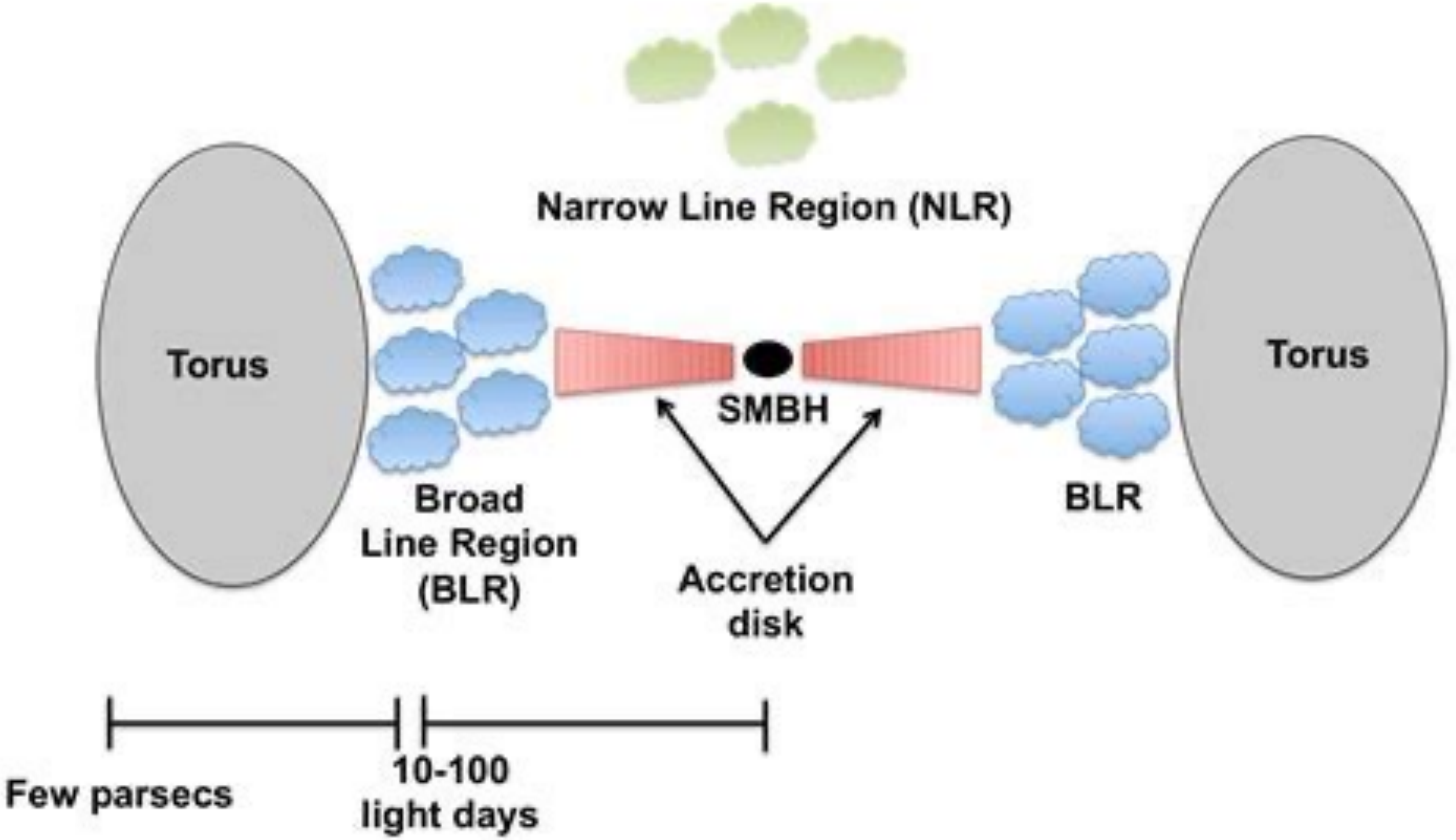
Mount Wilson and Palomar Observatories, Carnegie Institution of Washington, California Institute of Technology, Pasadena



1. SMBH mass,
2. accretion rates
3. and metallicity



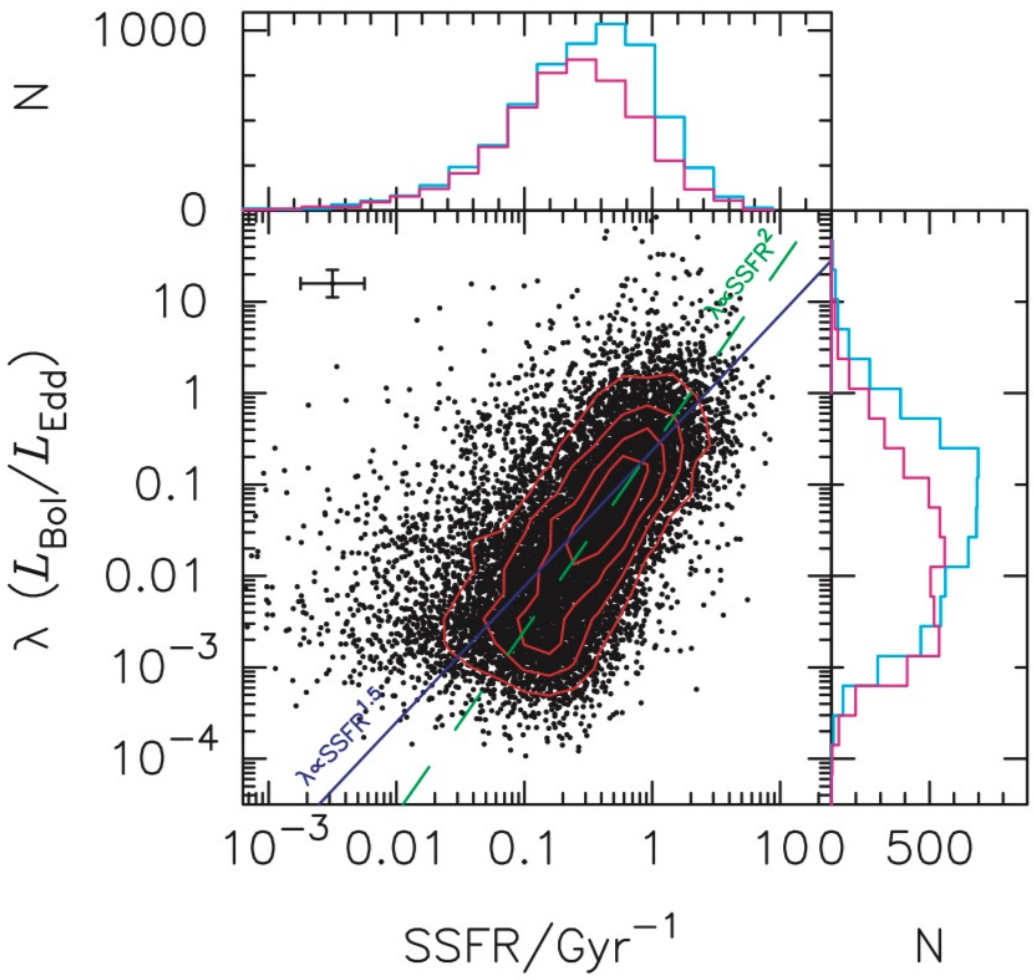
Basic structures of AGNs：why and how?



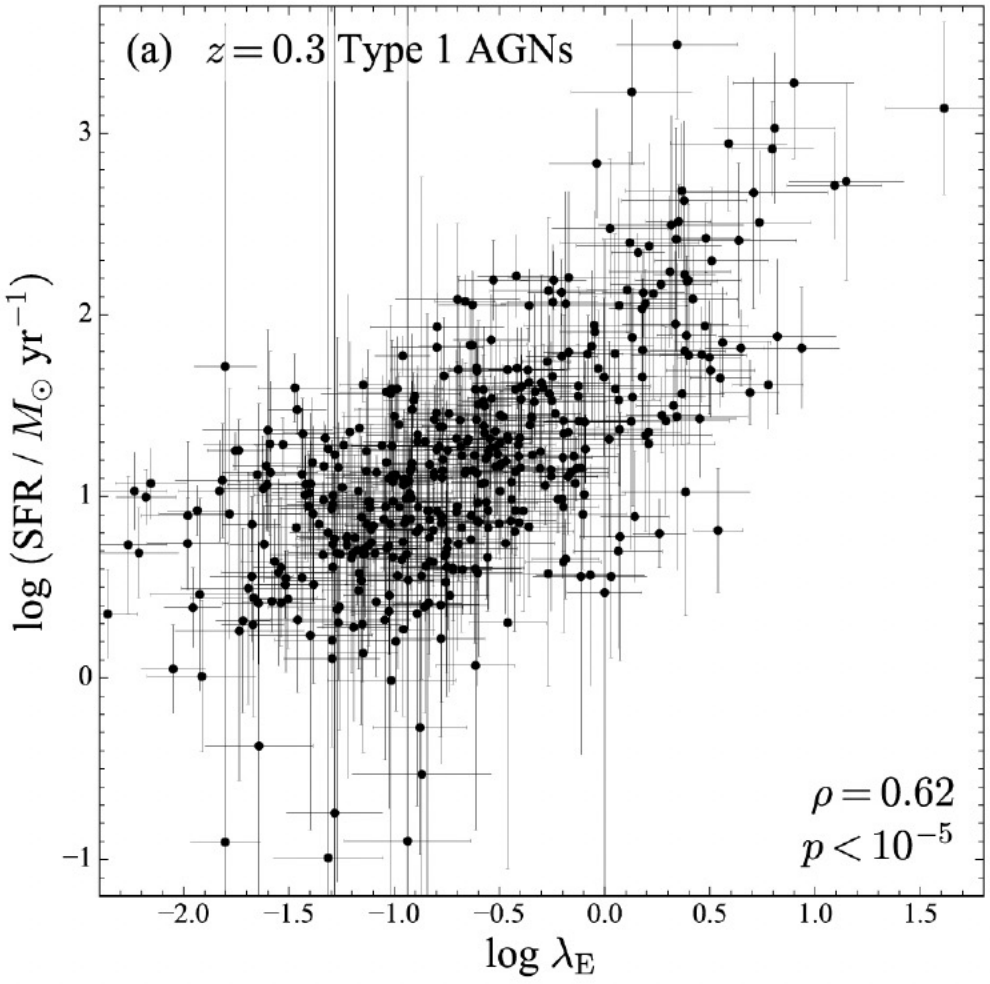
Metallicity

Structure formation

Evidence for this procees



Chen, Y.-M.+(2009, ApJ, 695, L130)



Zhuang, M. & Ho, L.C. (2022, ApJ,)

The Astrophysical Journal, 695:L130–L133, 2009 April 20 doi:10.1088/0004-637X/695/2/L130

THE STARBURST–ACTIVE GALACTIC NUCLEUS CONNECTION: THE ROLE OF YOUNG STELLAR POPULATIONS IN FUELING SUPERMASSIVE BLACK HOLES

Yan-Mei Chen[1], Jian-Min Wang[1,2], Chang-Shuo Yan[1], Chen Hu[1], and Shu Zhang[1]
[1] Key Laboratory for Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences, 19B Yuquan Road, Beijing 100049, China
[2] Theoretical Physics Center for Science Facilities, Chinese Academy of Sciences, Beijing 100049, China
Received 2008 December 28; accepted 2009 March 3; published 2009 March 27

The Astrophysical Journal, 701:L7–L11, 2009 August 10 doi:10.1088/0004-637X/701/1/L7

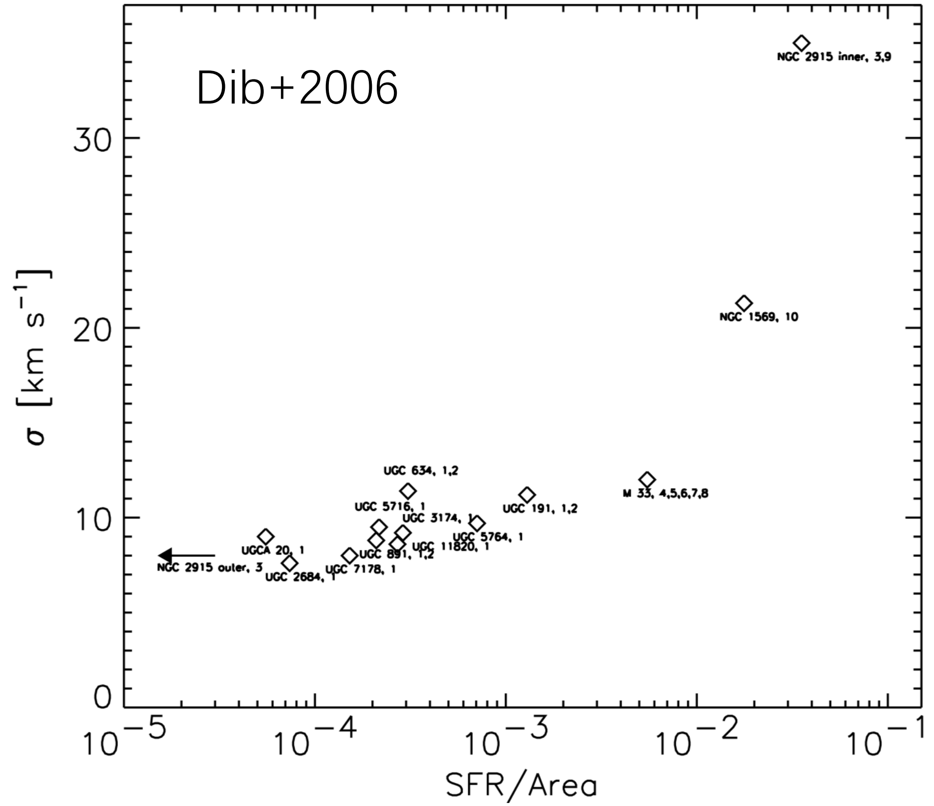
EVOLUTION OF GASEOUS DISK VISCOSITY DRIVEN BY SUPERNOVA EXPLOSIONS IN STAR-FORMING GALAXIES AT HIGH REDSHIFT

Jian-Min Wang[1,2], Chang-Shuo Yan[1,3], Yan-Rong Li[1,3], Yan-Mei Chen[1,3], Fei Xiang[1], Chen Hu[1], Jun-Qiang Ge[1,3], and Shu Zhang[1]
[1] Key Laboratory for Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences, 19B Yuquan Road, Beijing 100049, China
[2] Theoretical Physics Center for Science Facilities, Chinese Academy of Sciences, China
[3] Graduate University of Chinese Academy of Sciences, 19A Yuquan Road, Beijing 100049, China
Received 2009 May 29; accepted 2009 June 29; published 2009 July 22

The Astrophysical Journal, 725:2359–2380, 2010 December 20 doi:10.1088/0004-637X/725/2/2359

EVOLUTION OF GASEOUS DISK VISCOSITY DRIVEN BY SUPERNOVA EXPLOSION. II. STRUCTURE AND EMISSIONS FROM STAR-FORMING GALAXIES AT HIGH REDSHIFT

Chang-Shuo Yan[1,2] and Jian-Min Wang[1,3]
[1] Key Laboratory for Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences, 19B Yuquan Road, Beijing 100049, China; wangjm@ihep.ac.cn
[2] Graduate University of Chinese Academy of Sciences, 19A Yuquan Road, Beijing 100049, China
Received 2010 February 24; accepted 2010 October 20; published 2010 December 7



$$\nu = \alpha V_{\rm tur} H, \qquad \dot{M}_\bullet = 2\pi \nu \Sigma_{\rm gas} \Omega',$$

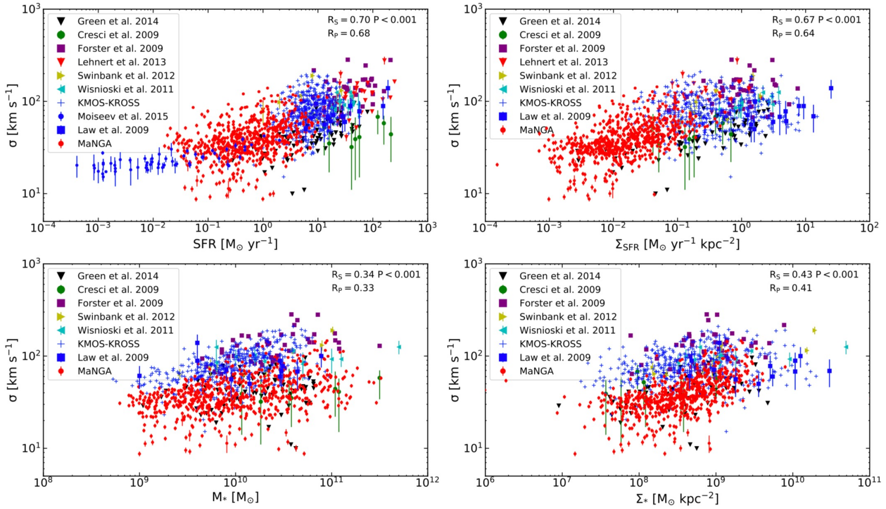
$$\lambda \propto M_*^{0.48\gamma - 0.57} Q^{4/3} \mathrm{SSFR}^{1.8} = M_*^{-0.3} Q^{4/3} \mathrm{SSFR}^{1.8},$$

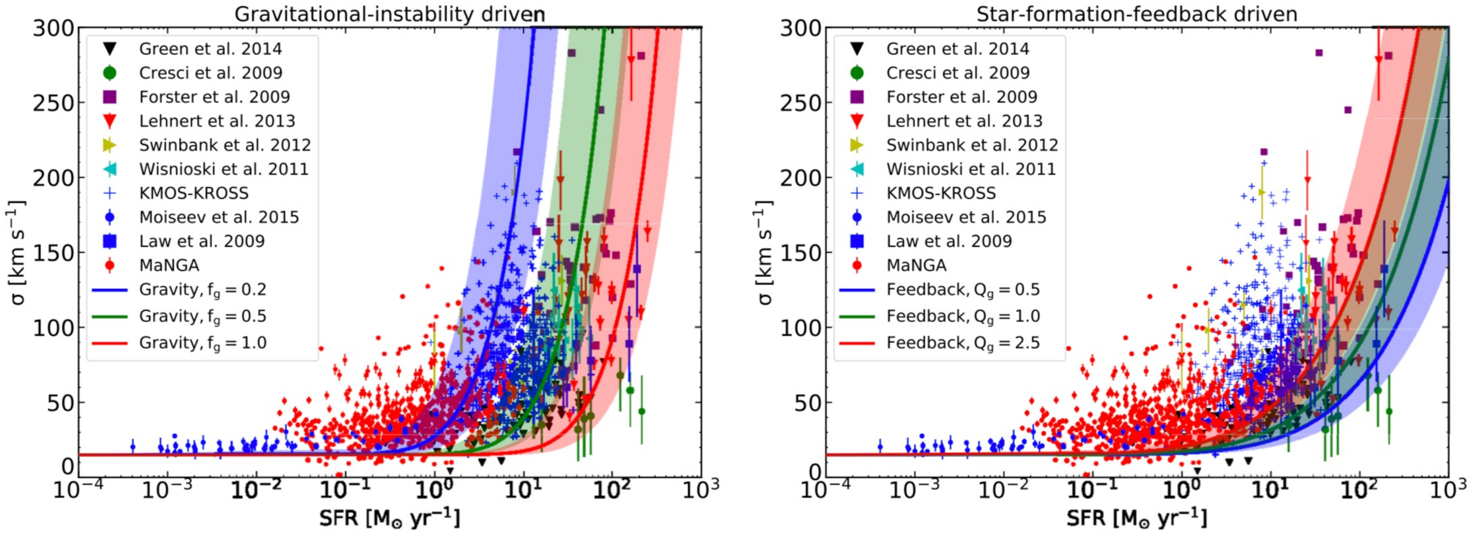
Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **486,** 4463–4472 (2019)
Advance Access publication 2019 April 26
doi:10.1093/mnras/stz1146

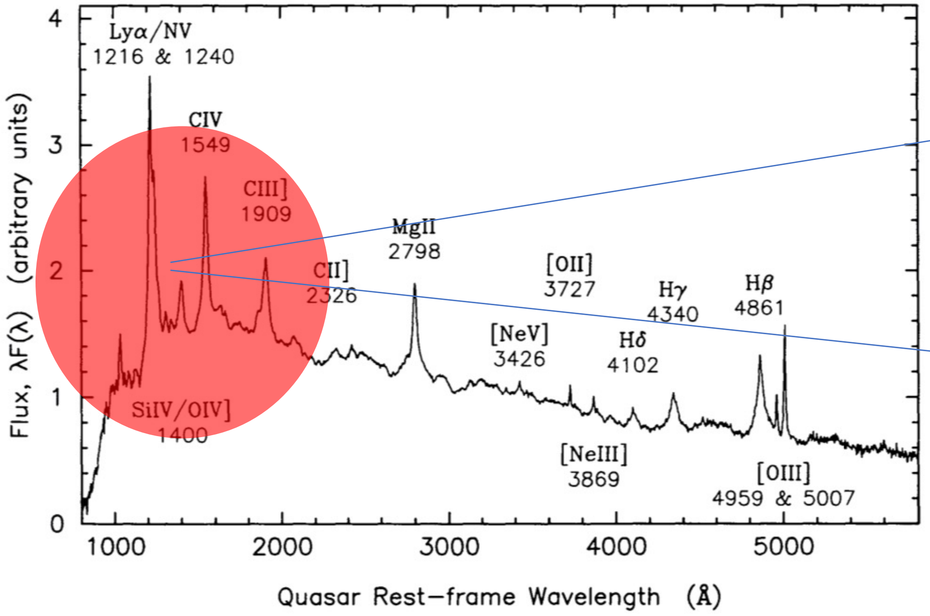
What drives the velocity dispersion of ionized gas in star-forming galaxies?

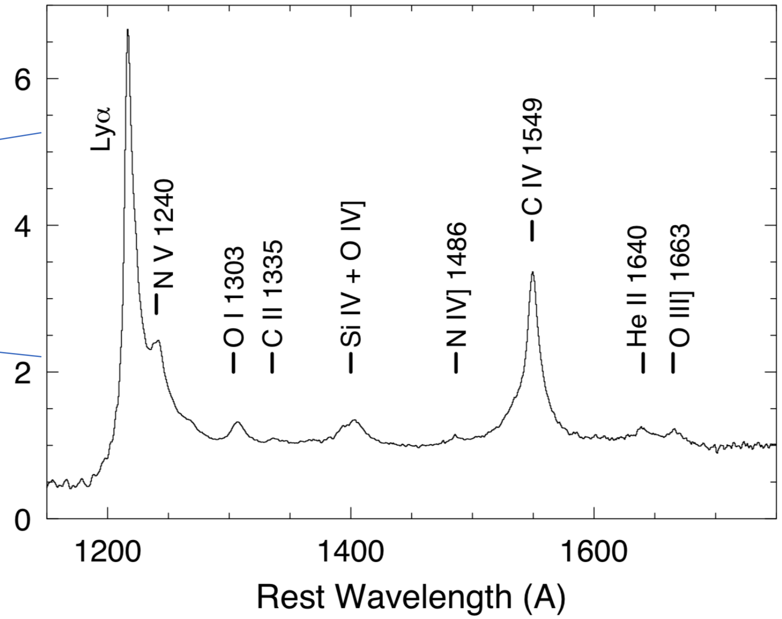
Xiaoling Yu, [1,2] Yong Shi, [1,2]★ Yanmei Chen, [1,2] David R. Law, [3] Dmitry Bizyaev, [4,5] Longji Bing, [1,2] Songlin Li, [1,2] Luwenjia Zhou, [1,2] Jianhang Chen, [1,2] Rogemar A. Riffel, [6,7] Rogério Riffel, [7,8] Kai Zhang, [9] Yongyun Chen [1,2] and Kaike Pan [4]

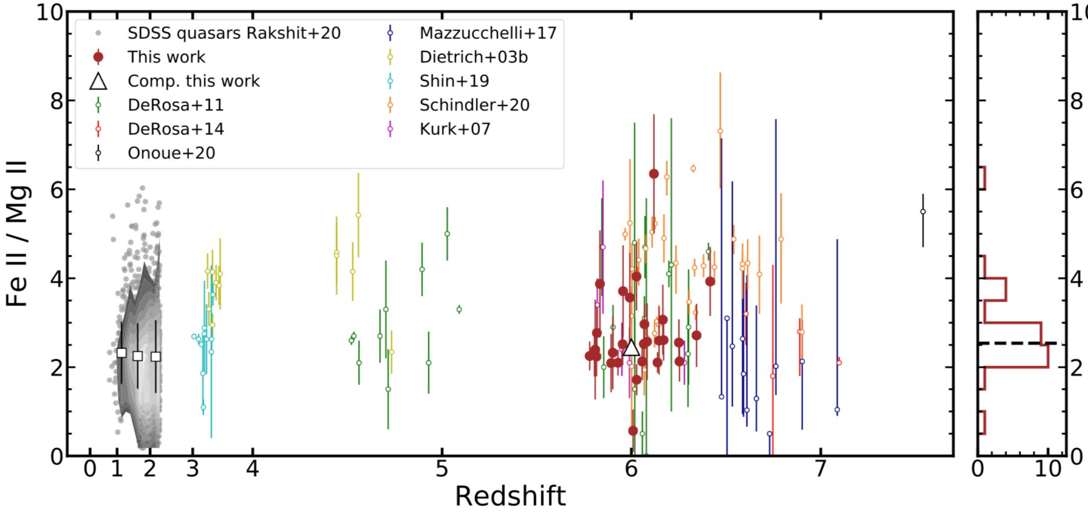


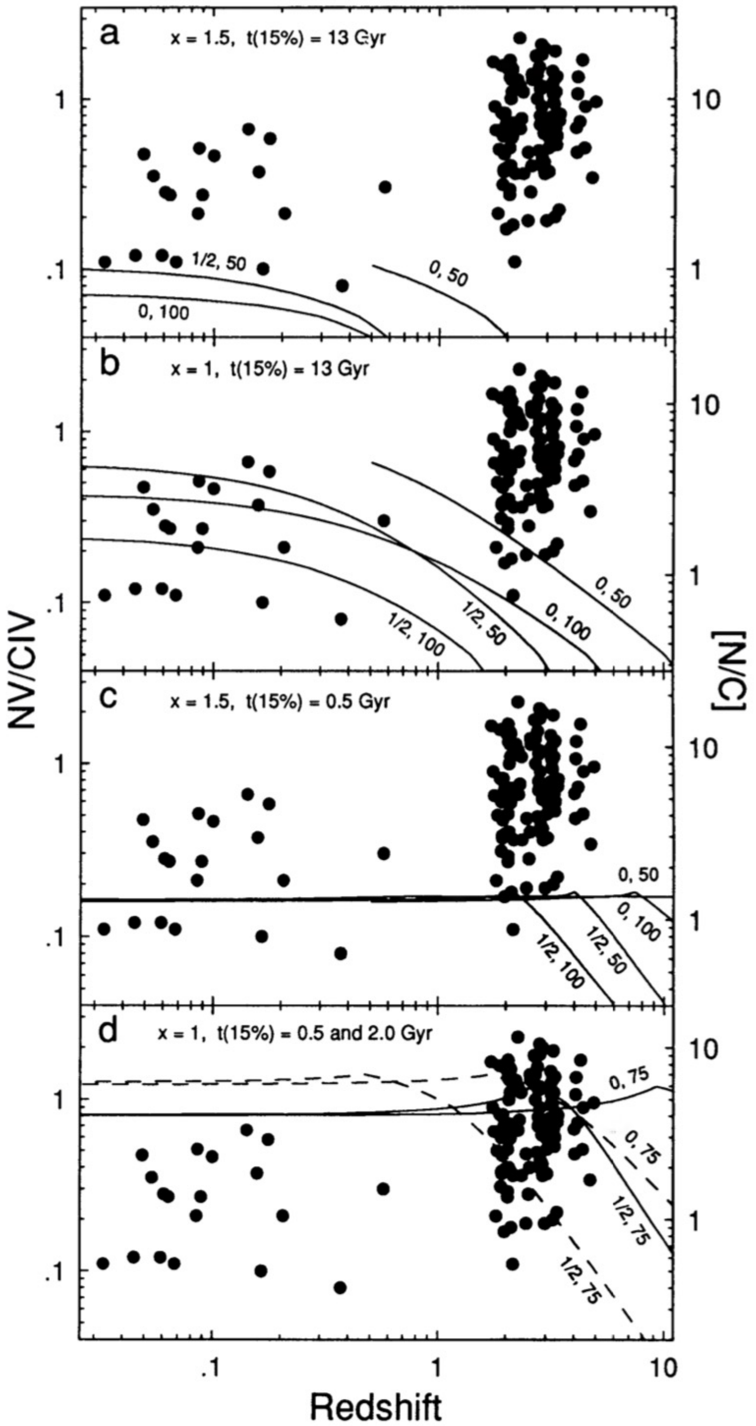


Quasar metallicity (Hamann & Ferland 1992,1999)









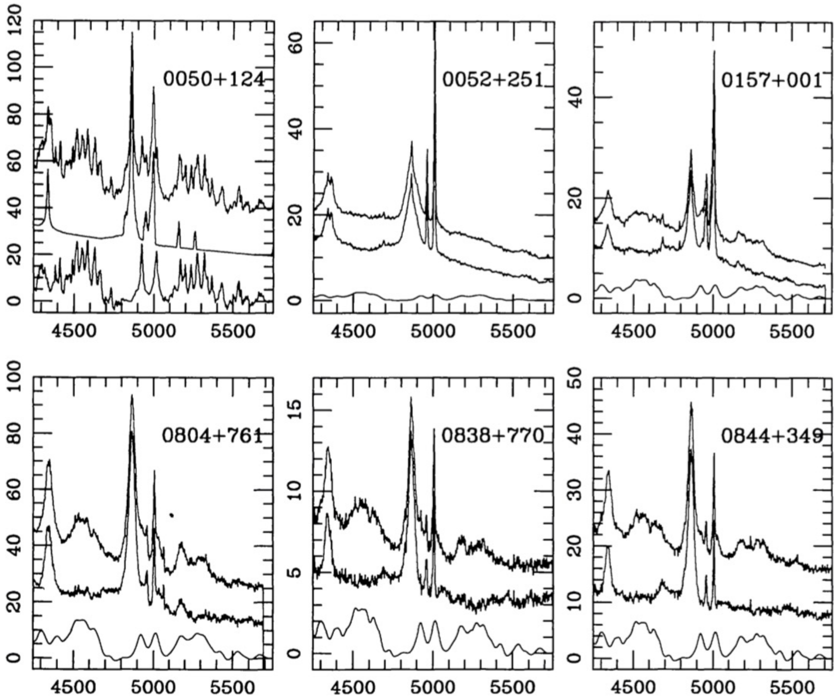
Strong Fe!

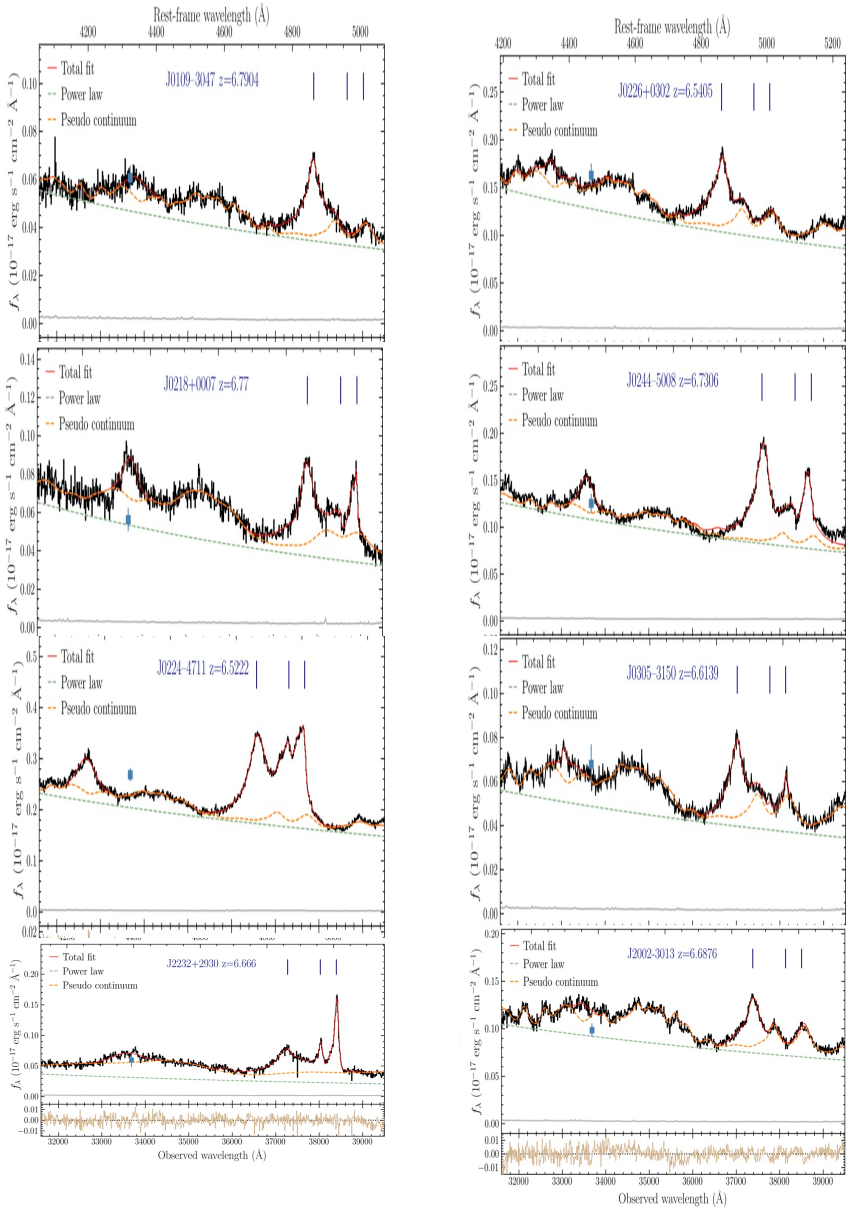
JWST （Yang+2023）

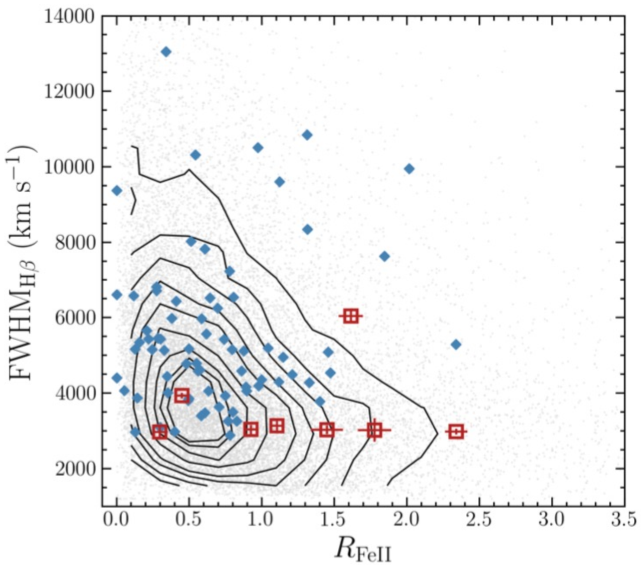
THE ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES, 80:109–135, 1992 May

THE EMISSION-LINE PROPERTIES OF LOW-REDSHIFT QUASI-STELLAR OBJECTS

TODD A. BOROSON AND RICHARD F. GREEN
Kitt Peak National Observatory, National Optical Astronomy Observatories,[1] P.O. Box 26732, Tucson, AZ 85726
Received 1991 August 2; accepted 1991 October 14







The Astrophysical Journal, 937:61 (12pp), 2022 October 1 https://doi.org/10.3847/1538-4357/ac8163

Potential Signature of Population III Pair-instability Supernova Ejecta in the BLR Gas of the Most Distant Quasar at $z = 7.54$*

Yuzuru Yoshii[1,2], Hiroaki Sameshima[1], Takuji Tsujimoto[3], Toshikazu Shigeyama[4], Timothy C. Beers[5], and Bruce A. Peterson[6]

[1] Institute of Astronomy, School of Science, The University of Tokyo, 2-21-1 Osawa, Mitaka, Tokyo 181-0015, Japan; yoshii@ioa.s.u-tokyo.ac.jp
[2] Steward Observatory, University of Arizona, 933 North Cherry Avenue, Room N204, Tucson, AZ 85721-0065, USA
[3] National Astronomical Observatory of Japan, Mitaka-shi, Tokyo 181-8588, Japan
[4] Research Center for the Early universe, Graduate School of Science, University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan
[5] Department of Physics and JINA Center for the Evolution of the Elements (JINA-CEE), University of Notre Dame, Notre Dame, IN 46556, USA
[6] Mount Stromlo Observatory, Research School of Astronomy and Astrophysics, Australian National University, Weston Creek P.O., ACT 2611, Australia
Received 2021 August 13; revised 2022 July 12; accepted 2022 July 13; published 2022 September 28

z = 7.54, age：0.7Gyr;　Fe：20 solar

The outer parts of the accretion disks around supermassive black holes in galaxy nuclei and quasars

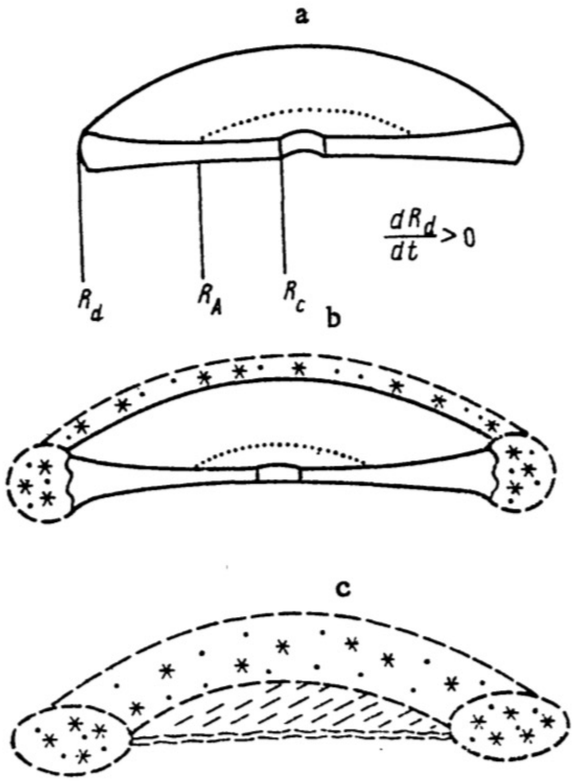
P. I. Kolykhalov and R. A. Syunyaev

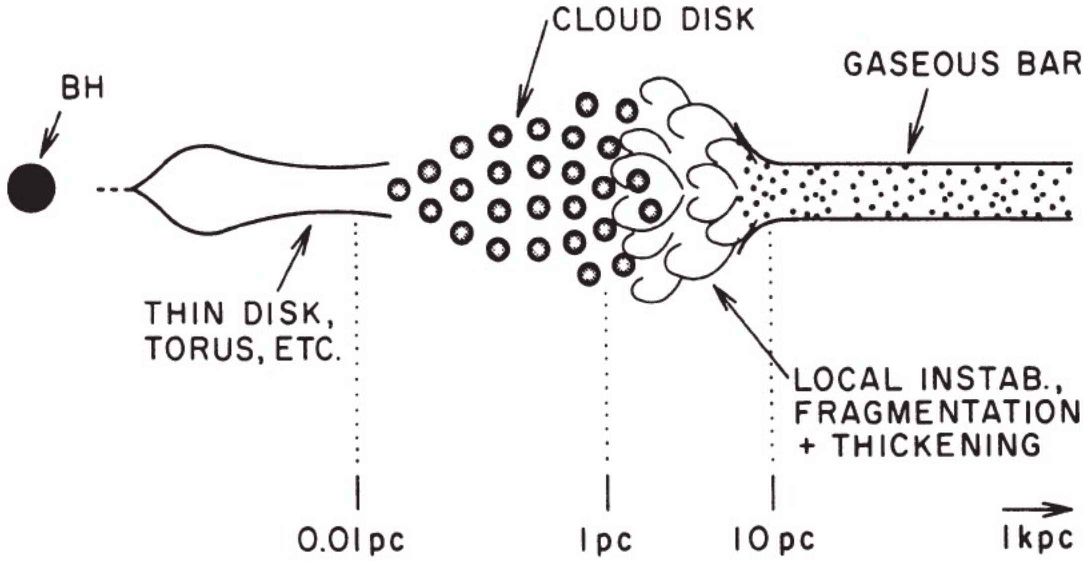
Institute for Space Research, USSR Academy of Sciences, Moscow

(Submitted August 15, 1980)

Pis'ma Astron. Zh. **6**, 680–686 (November 1980)

1980SvAL....6..357K

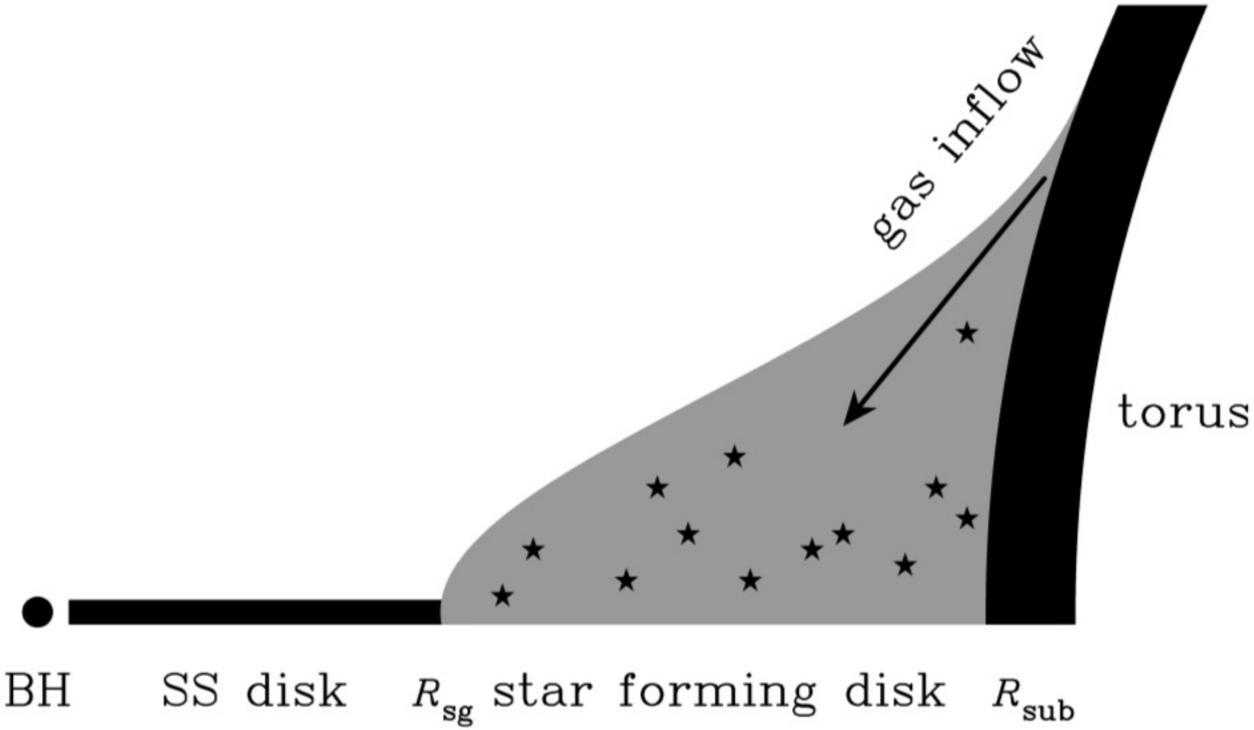




Begelman+(1989)

SMBH accretion rates： starburst

(Wang+2010, ApJ, 719, L48)

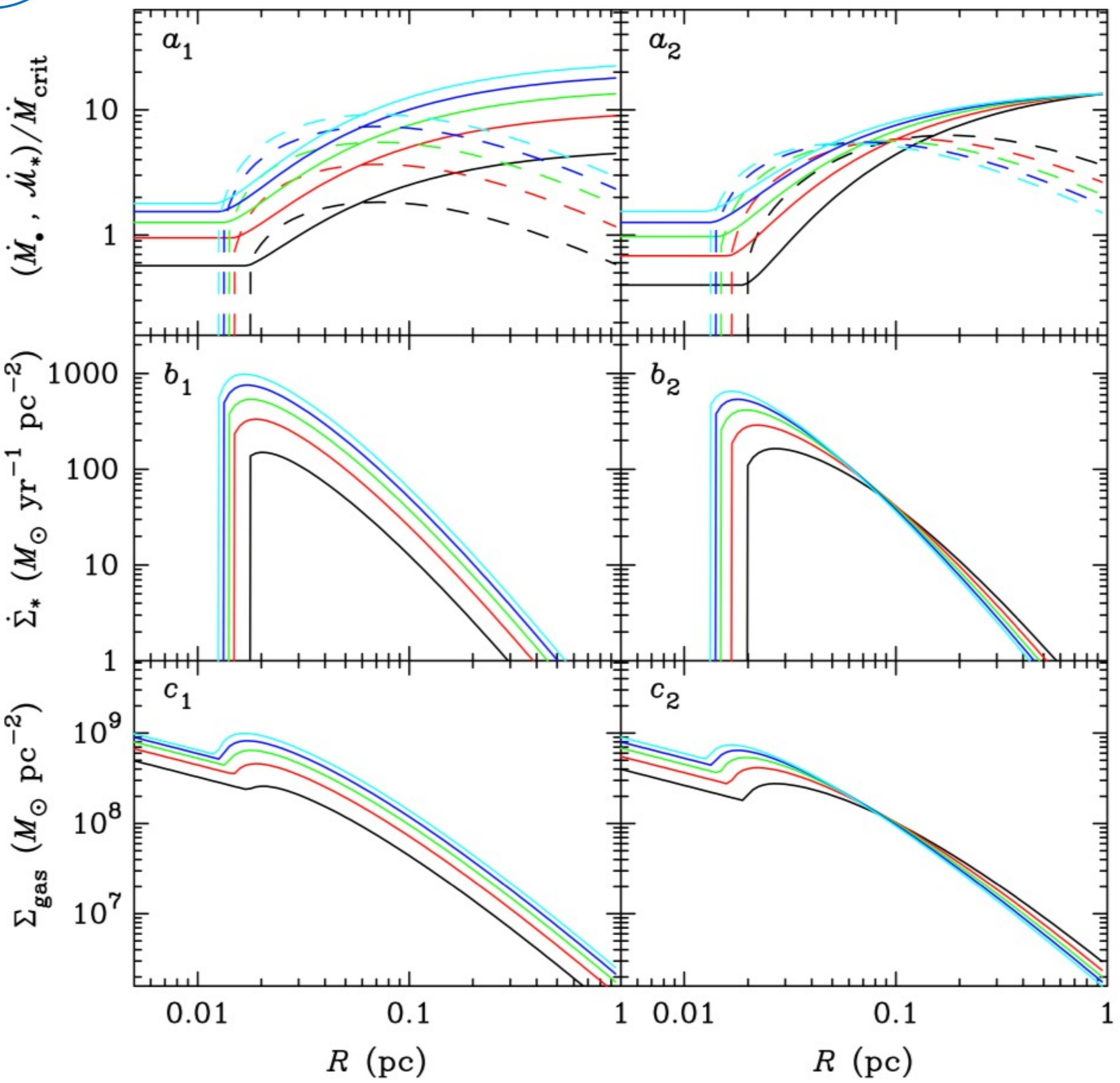


$$\frac{\partial \Sigma_{\rm gas}}{\partial t} = \frac{1}{2\pi R}\frac{\partial}{\partial R}\left\{\left[\frac{d\left(R^2\Omega\right)}{dR}\right]^{-1}\frac{\partial \mathcal{G}}{\partial R}\right\} - \dot{\Sigma}_* + \dot{\Sigma}_{\rm SN},$$

$$\frac{P_{\rm tur}}{H} = \left(\frac{GM_\bullet}{R^3}H + 2\pi G\Sigma_{\rm gas}\right)\rho_{\rm gas} \approx \Omega_{\rm K}^2 H\rho_{\rm gas}.$$

$$\frac{\rho_{\rm gas}V_{\rm tur}^2}{t_{\rm dis}} = \frac{\rho_{\rm gas}V_{\rm tur}^3}{H} = \epsilon f_*\dot{\rho}_* E_{\rm SN},$$

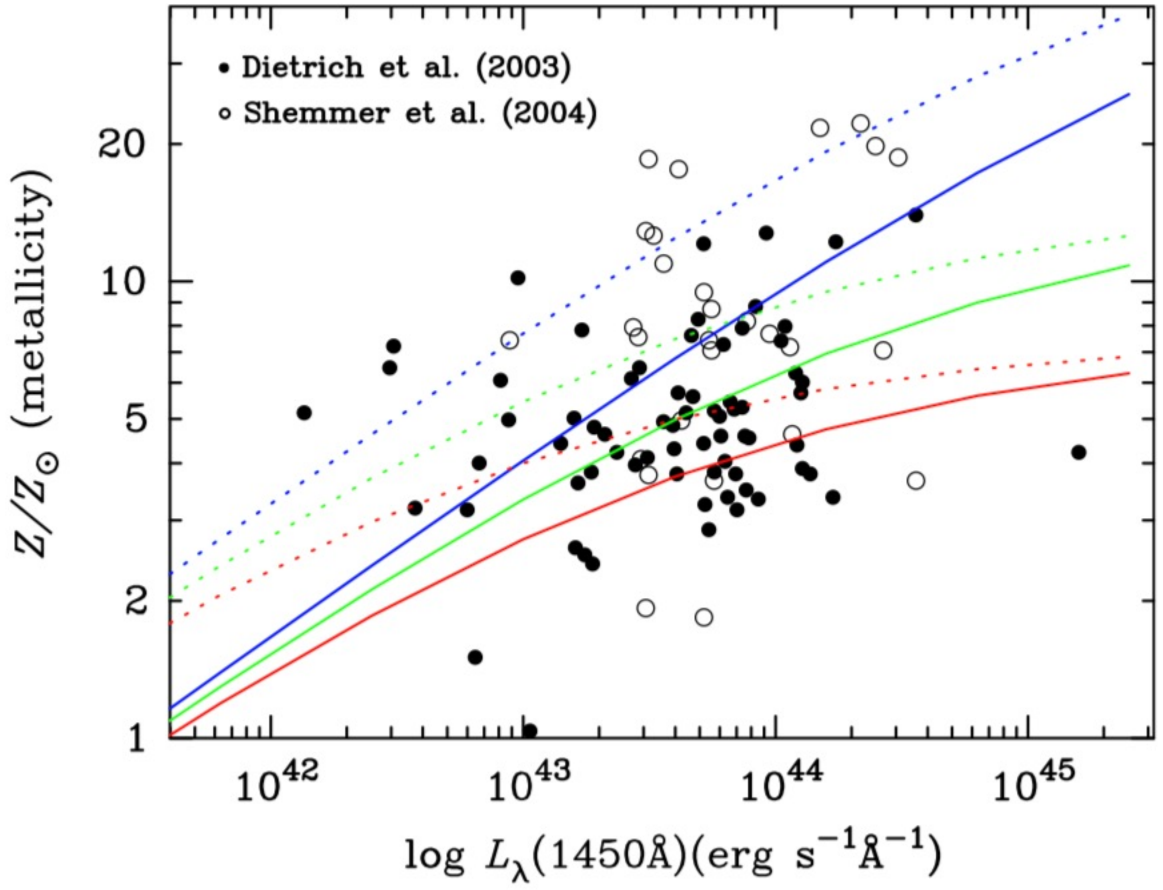
Analytical solution



$$\dot{M}_{\rm gas} \sim \dot{M}_{\rm star} \sim 10\ M_\odot\ {\rm yr}^{-1}$$

$$\dot{M}_{\rm SMBH} \sim 1\ M_\odot\ {\rm yr}^{-1}$$

Metallicity and luminosity



$$Z(t)M_{\rm gas}(t) = \int_0^t (Z_0\dot{M}_{\rm out} + f_c\dot{\mathcal{R}}_* m_Z - \varepsilon_1 Z\dot{M}_\bullet - \varepsilon_2 Z\dot{\mathcal{R}}_*)d\tau.$$

$$Z_{\rm max} = Z_0(1-\Lambda) + f_c(m_Z - Z_0)\Lambda \approx \frac{c_0 f_c m_Z}{\varepsilon_1 + \varepsilon_2 c_0 \dot{M}_\bullet^{0.4}}\dot{M}_\bullet^{0.4},$$

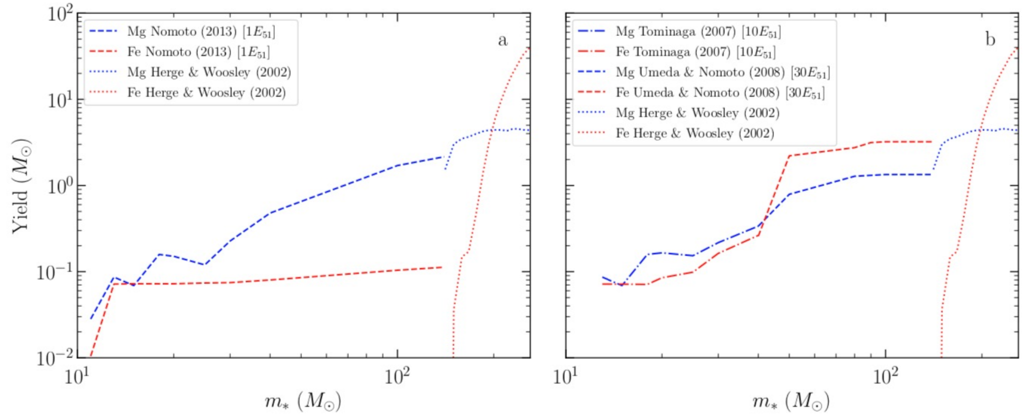
Compact objects?

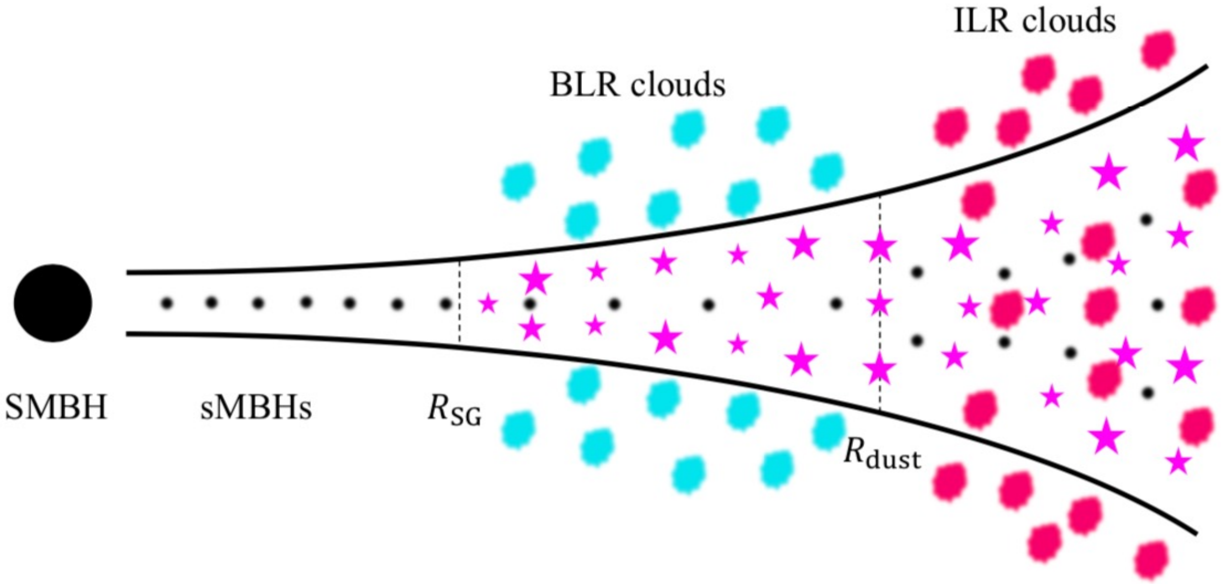
The Astrophysical Journal, 954:84 (33pp), 2023 September 1 https://doi.org/10.3847/1538-4357/acdf48

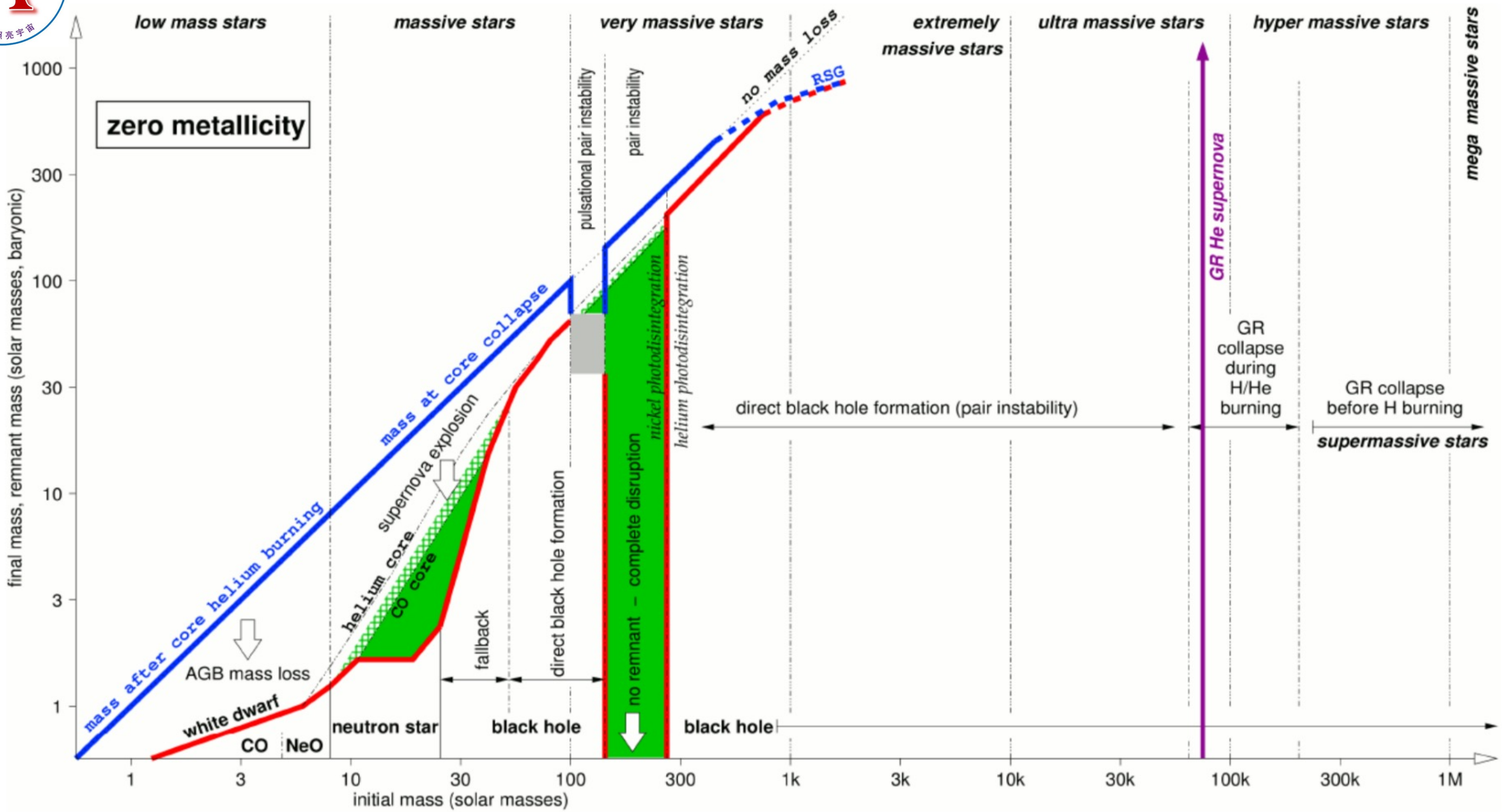
Star Formation in Self-gravitating Disks in Active Galactic Nuclei. III. Efficient Production of Iron and Infrared Spectral Energy Distributions

Jian-Min Wang[1,2,3], Shuo Zhai[1,4], Yan-Rong Li[1], Yu-Yang Songsheng[1], Luis C. Ho[5,6], Yong-Jie Chen[1,4], Jun-Rong Liu[1,4], Pu Du[1], and Ye-Fei Yuan[7]

1






zero metallicity
low mass stars
massive stars
very massive stars
extremely massive stars
ultra massive stars
hyper massive stars
mega massive stars
no mass loss
RSG
pulsational pair instability
pair instability
GR He supernova
mass at core collapse
mass after core helium burning
supernova explosion
helium core
CO core
nickel photodisintegration
helium photodisintegration
no remnant – complete disruption
direct black hole formation
fallback
AGB mass loss
white dwarf
CO
NeO
neutron star
black hole
black hole
direct black hole formation (pair instability)
GR collapse during H/He burning
GR collapse before H burning
supermassive stars
final mass, remnant mass (solar masses, baryonic)
initial mass (solar masses)
1000
300
100
30
10
3
1
1
3
10
30
100
300
1k
3k
10k
30k
100k
300k
1M

Stellar populations: mass function

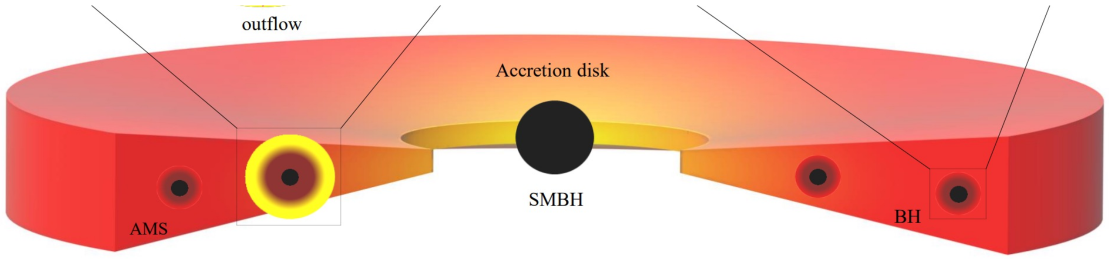
$$\frac{\partial}{\partial t}\Psi(m_*,t) + \frac{\partial}{\partial m_*}\left[\dot{m}_*\Psi(m_*,t)\right] = -\dot{\mathcal{R}}_{\rm SN}(m_*,t) + \dot{\mathcal{S}}_{\rm AD}(m_*,t)$$

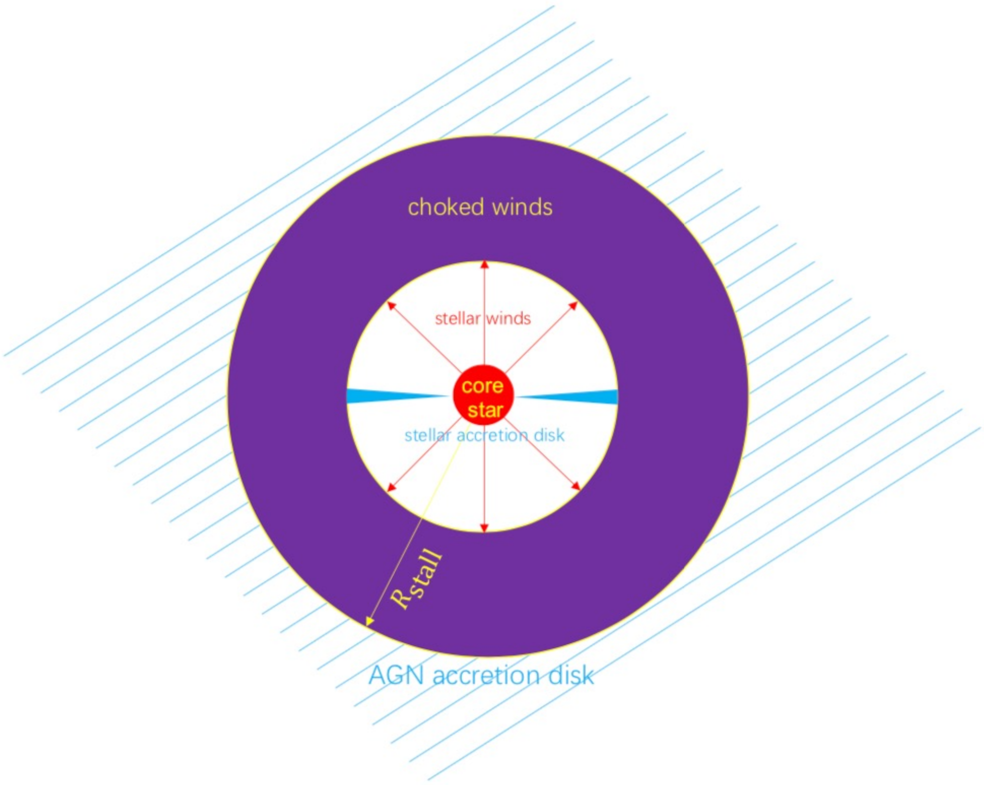
$$\dot{m}_* = \dot{m}_{\rm ac} - \dot{m}_{\rm w}$$

Stars: accretion and stellar

Black Holes Light up the Universe 黑洞照亮宇宙

Accretion-modified stars: AMS





$$\rho_{\rm d} = 0.92 \times 10^{-12}\ (\alpha_{0.1} M_8)^{-7/10}\, \dot{\mathscr{M}}^{11/20} r_5^{-15/8}\, {\rm g\,cm^{-3}},$$

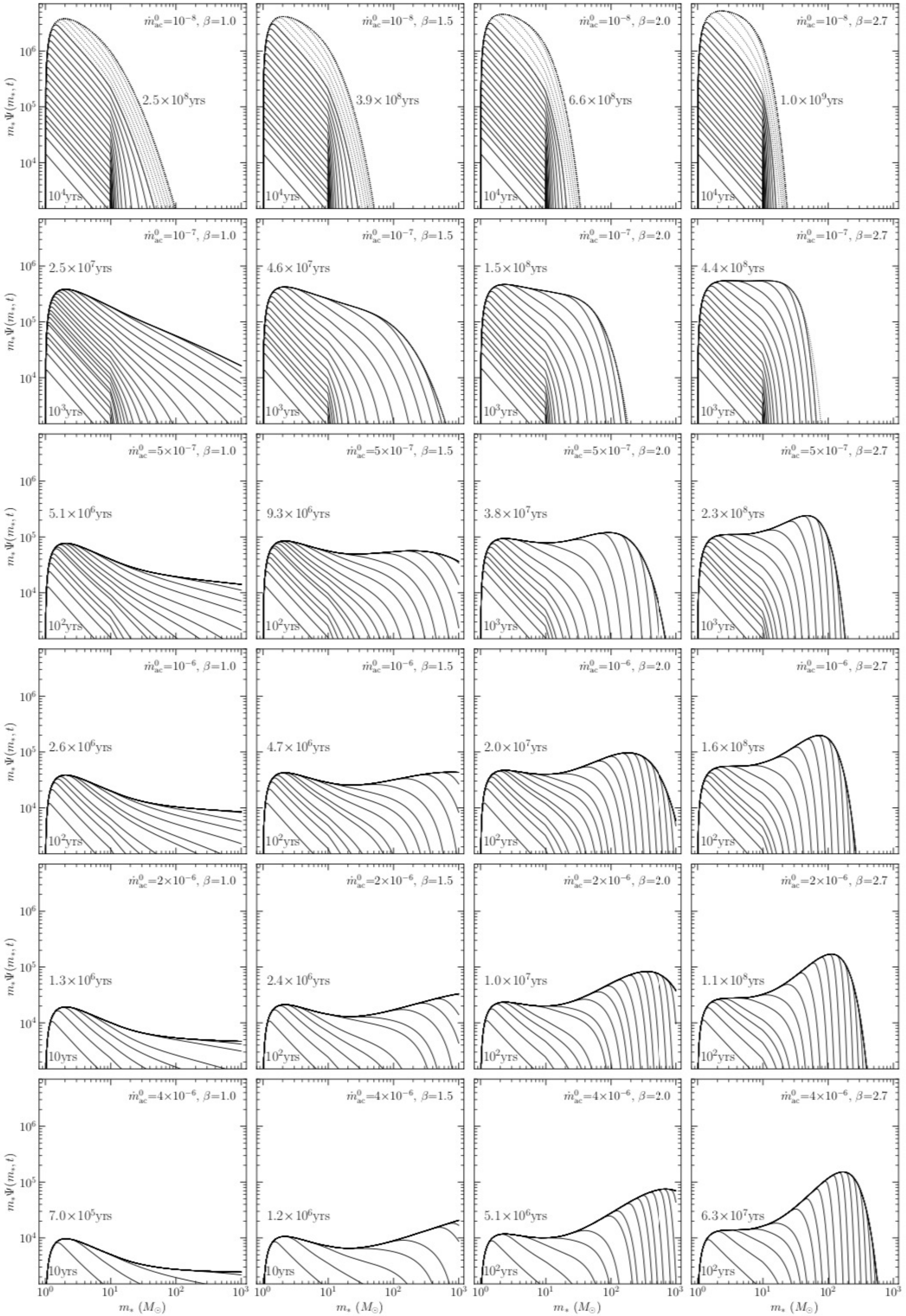
$$T_c = 0.82 \times 10^{3}\ (\alpha_{0.1} M_8)^{-1/5}\, \dot{\mathscr{M}}^{3/10} r_5^{-3/4}\, {\rm K},$$

$$t_{\rm stall} = 2.4\, L_{37}^{3/2} T_3^{-3/4} \rho_{\bar{12}}^{-3/2} \left(\frac{m_*}{10^2\, M_\odot}\right)^{-2} {\rm yr},$$

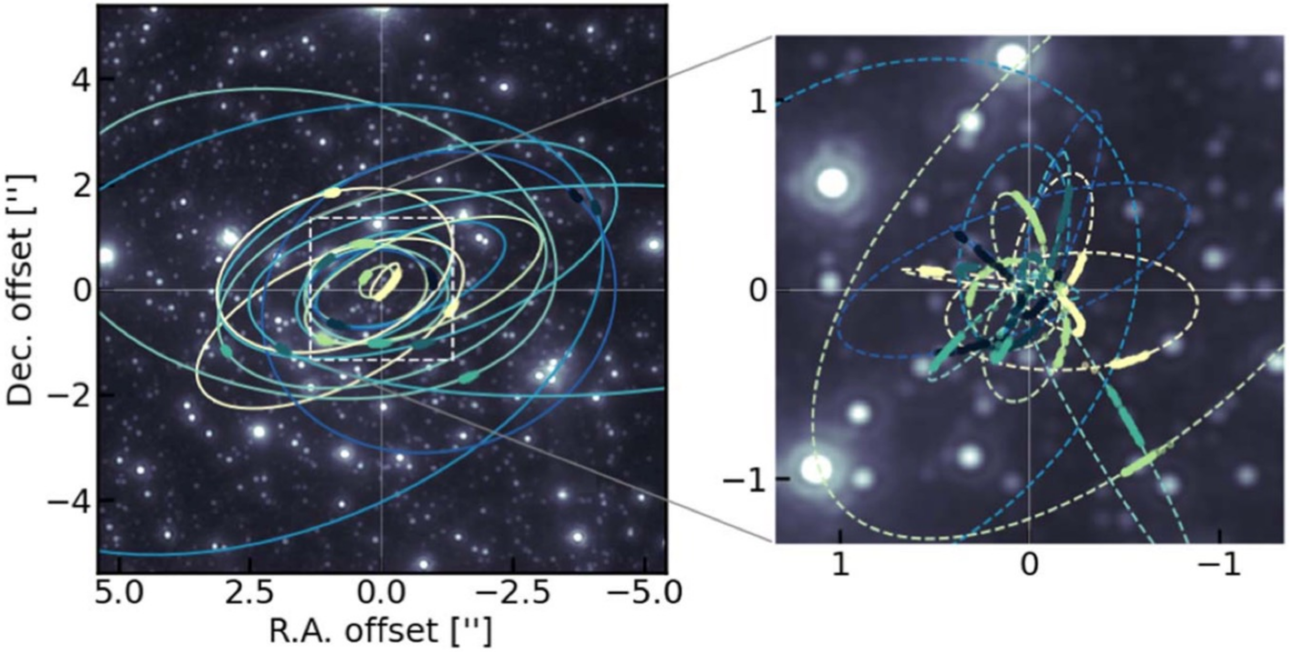
Mass function：

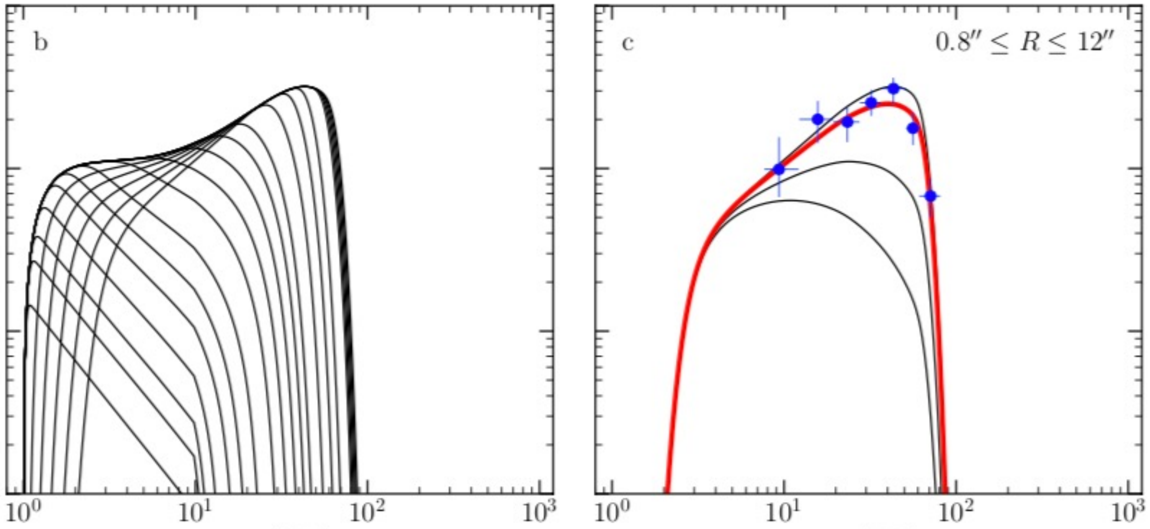
pile-up distribution

$$\dot{m}_* = \dot{m}_{\rm ac} - \dot{m}_{\rm w}$$

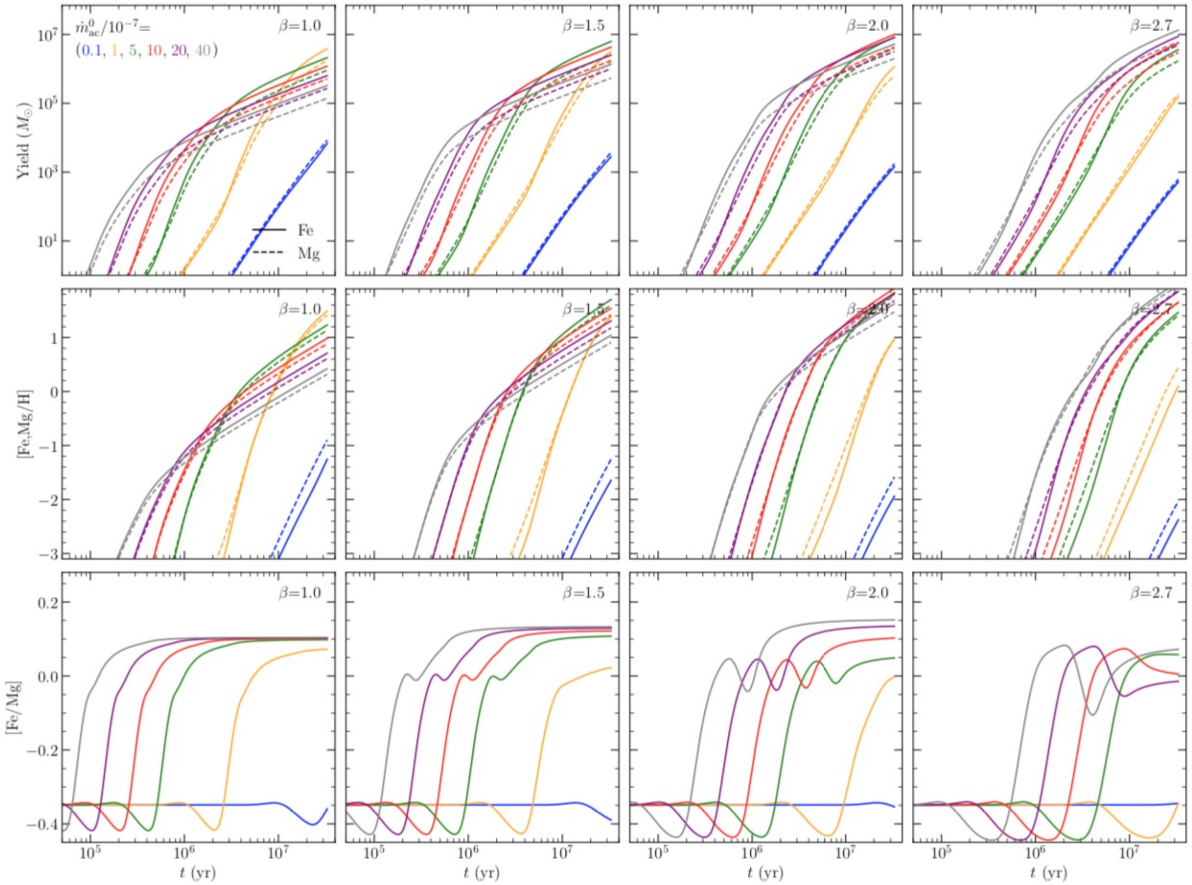


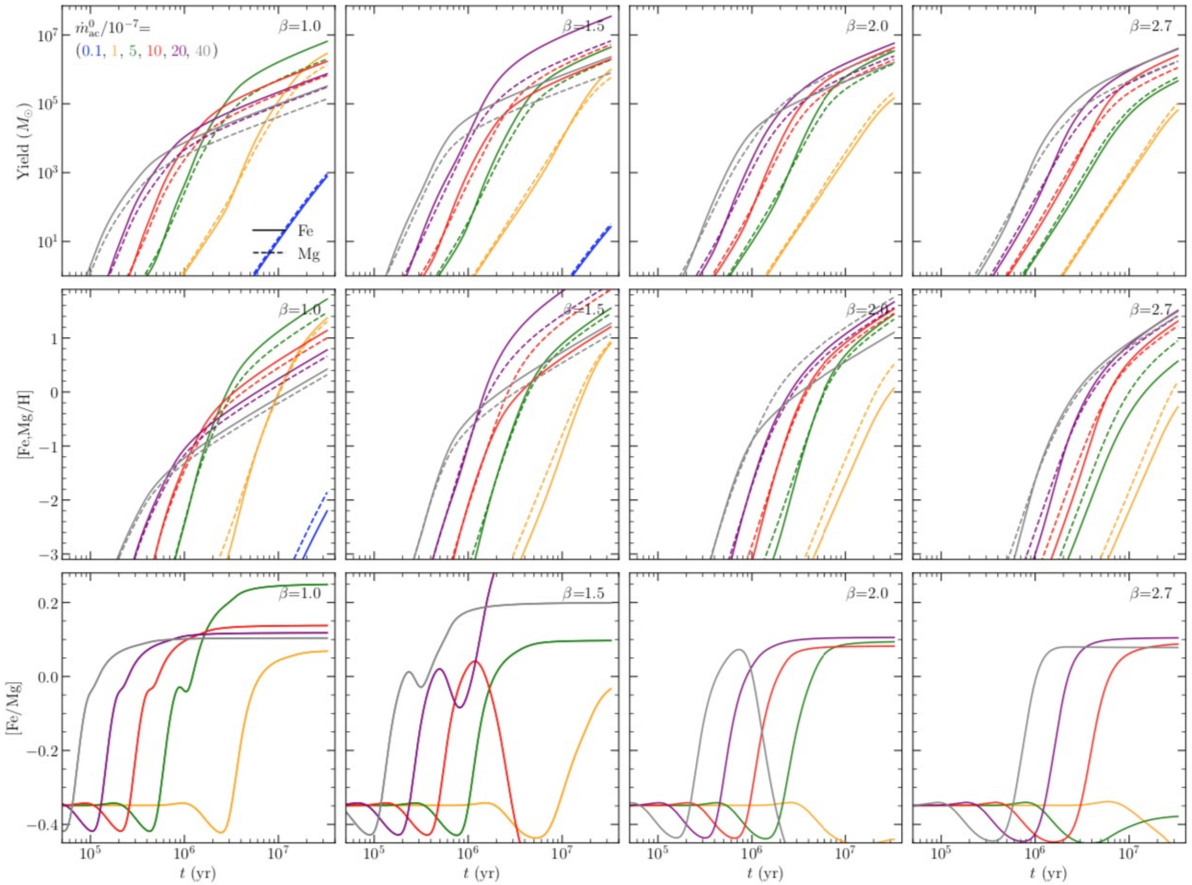
Galactic center： young massive stars



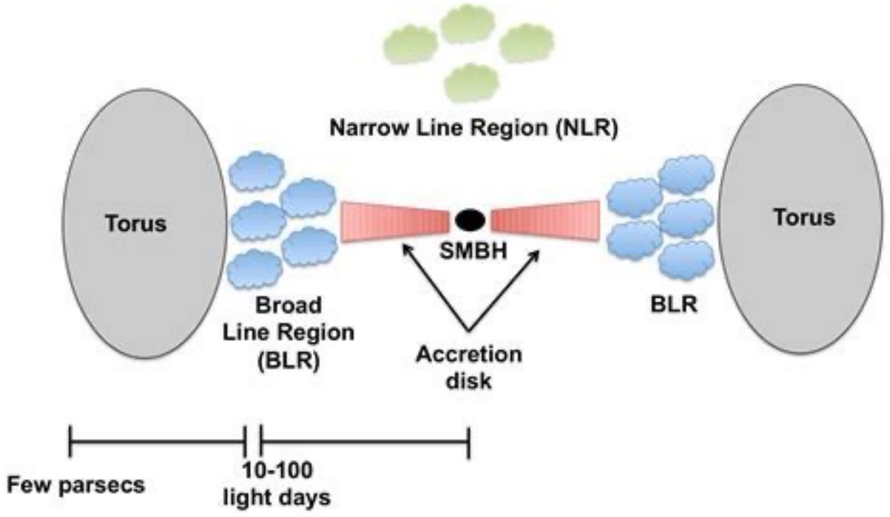


Iron abundance





Formation of dusty torus



$$f_{\rm SN} \approx \frac{N_*}{\tau_{\rm evo}} = 0.1\, N_5 \tau_{\rm 3Myr}^{-1}\,{\rm yr}^{-1},$$

$$L_{\rm SN} = E_{\rm SN}\dot{\mathcal{R}}_{\rm SN} = 3.2\times 10^{42}\left(\frac{E_{\rm SN}}{10^{51}\,{\rm erg}}\right)\left(\frac{f_{\rm SN}}{0.1\,{\rm yr}^{-1}}\right){\rm erg\,s^{-1}},$$

$$\dot{E}_{\rm dis} = 2\times 10^{40}\,R_{\rm pc}\left(\frac{v_{\rm orb}}{200\,{\rm km\,s^{-1}}}\right)^3 \epsilon_{\rm dis} N_{\rm cl,24}\,{\rm erg\,s^{-1}},$$

Compact objects：

accretion

Bondi explosion

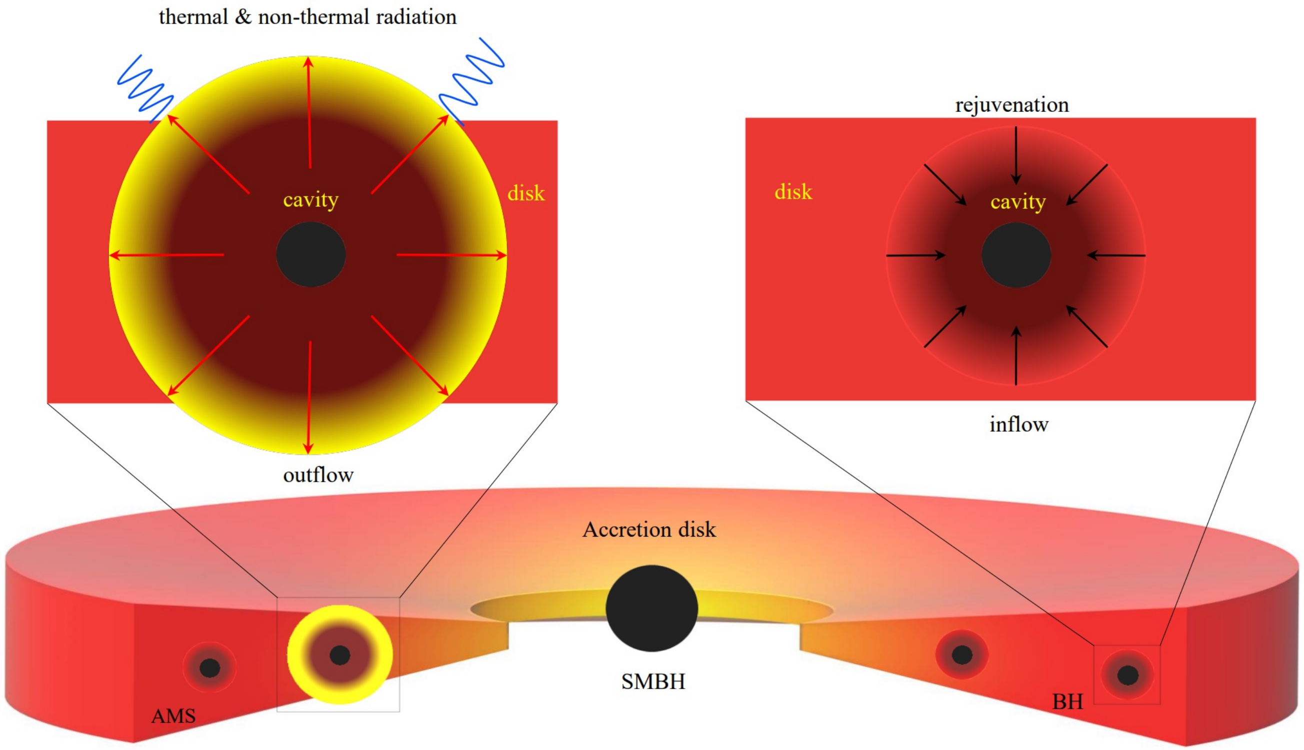
Mergers

Gravitational waves

Accretion-modified Stars (AMS)

Wang et al. 2021, ApJL911, L14

Chen, K.+(2023)



AMS

Hyper-Eddington Accretion

↓

Bondi explosion

↓

AMS rejuvenation

$$\dot{m}_{\rm Bon} = \frac{\dot{M}_{\rm Bon}}{\dot{M}_{\rm Edd}}$$

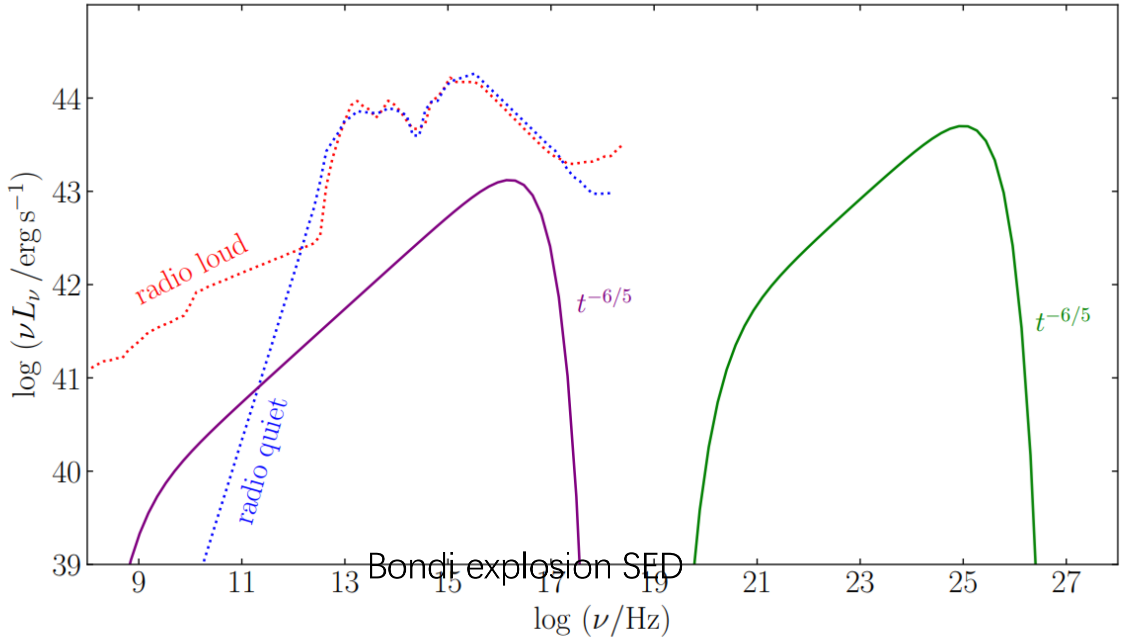
$$\approx \begin{cases} 8.9 \times 10^8\, m_1(\alpha_{0.1}M_8)^{-2/5}\dot{\mathscr{M}}^{1/10} r_4^{-3/4} & \text{(for corotation)}, \\ 5.1\, m_1(\alpha_{0.1}M_8)^{-7/10}\dot{\mathscr{M}}^{11/20} r_4^{-3/8} & \text{(for counter rotation)} \end{cases}$$

$$\text{rej} = \frac{R_{\rm exp}}{c_s} = 268.9\, \alpha_{0.1}^{3/10} M_8^{11/20} \dot{\mathscr{M}}^{-13/40} r_4^{21/16} E_{52}^{1/4}\,\text{yr}.$$

The Astrophysical Journal Letters, 911:L14 (8pp), 2021 April 10
https://doi.org/10.3847/2041-8213/abee81

Accretion-modified Stars in Accretion Disks of Active Galactic Nuclei: Slowly Transient Appearance

Jian-Min Wang[1,2,3], Jun-Rong Liu[1,2], Luis C. Ho[4,5], and Pu Du[1]



Bondi explosion SED

Obs chacract.

Shock acceleration

↓

Lorentz factor $\gamma \sim 10^5$

↙ ↘

Synchrotron | Ex. Compton (EIC)

$$\nu_{\rm syn}^{\rm max} \approx 0.17\, B_0 \gamma_{\rm max,5}^2\ \mathrm{keV}$$

$$\nu_{\rm IC}^{\rm max} \approx \gamma_{\rm max}^2 \nu_{\rm UV} \approx 41.7\, \gamma_{\rm max,5}^2 \nu_{15}^{\rm UV}\ \mathrm{GeV}$$

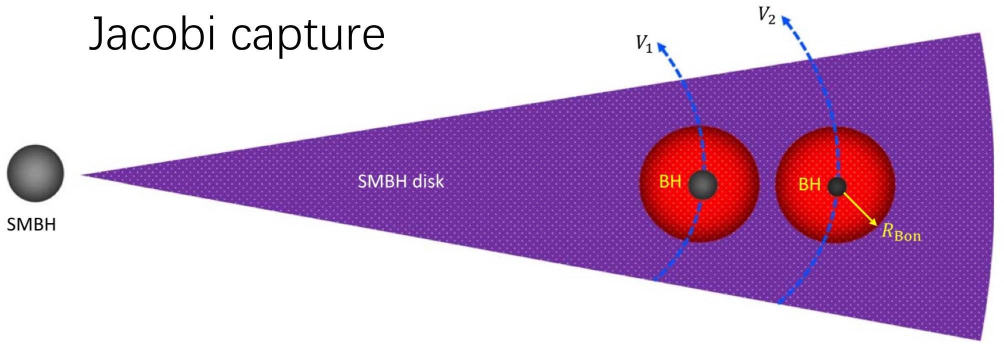
- Bondi explosion： enhanced radio emissions
- EIC: peak≈40 GeV *Fermi*-LAT.

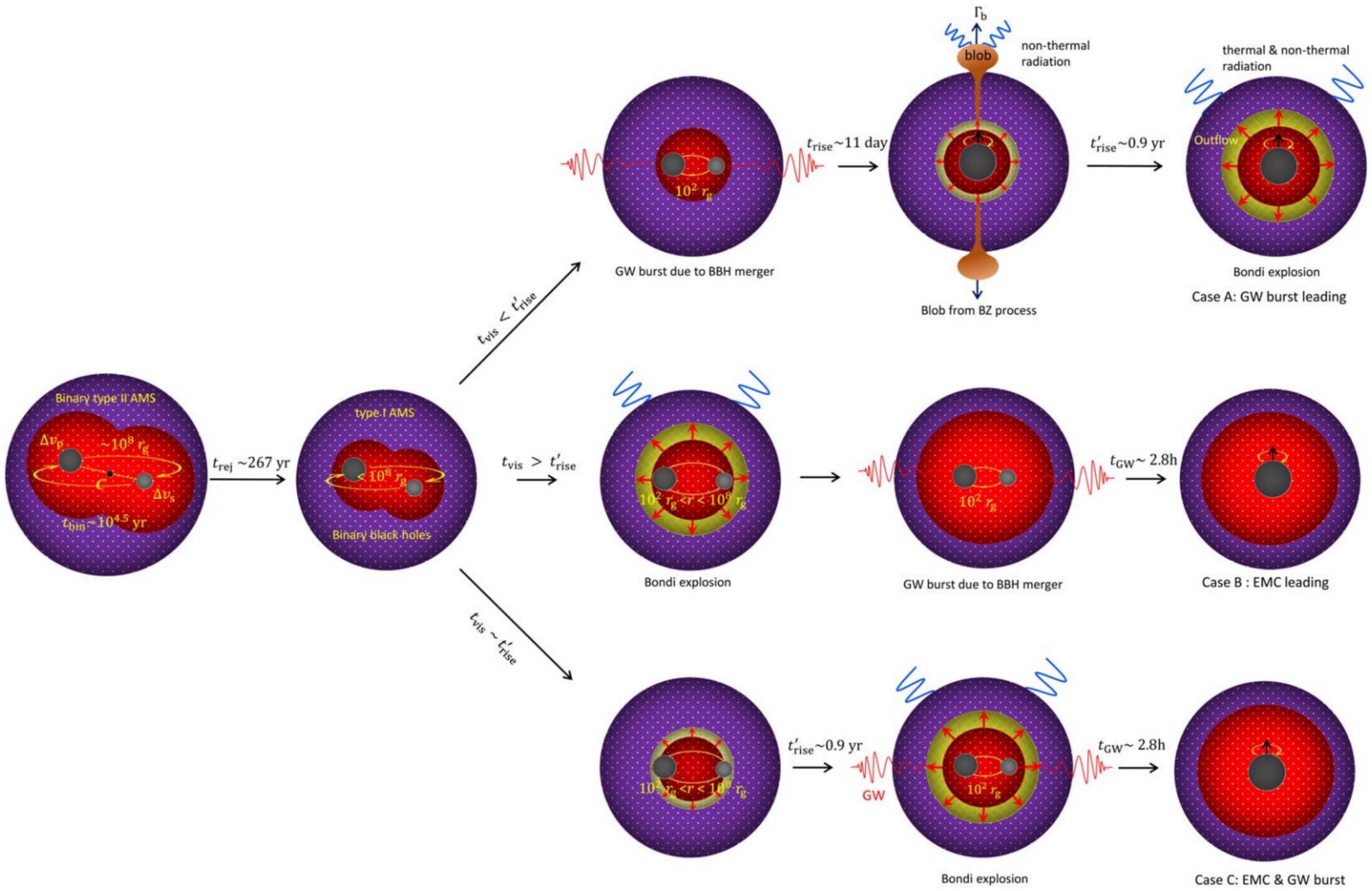
The Astrophysical Journal Letters, 916:L17 (11pp), 2021 August 1 https://doi.org/10.3847/2041-8213/ac0b46

Accretion-modified Stars in Accretion Disks of Active Galactic Nuclei: Gravitational-wave Bursts and Electromagnetic Counterparts from Merging Stellar Black Hole Binaries

Jian-Min Wang[1,2,3], Jun-Rong Liu[1,2], Luis C. Ho[4,5], Yan-Rong Li[1], and Pu Du[1]

Jacobi capture



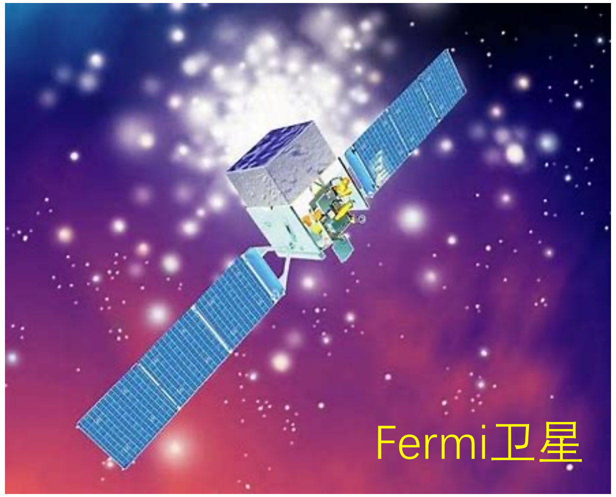


AMS: radio、γ-rays

slow transients

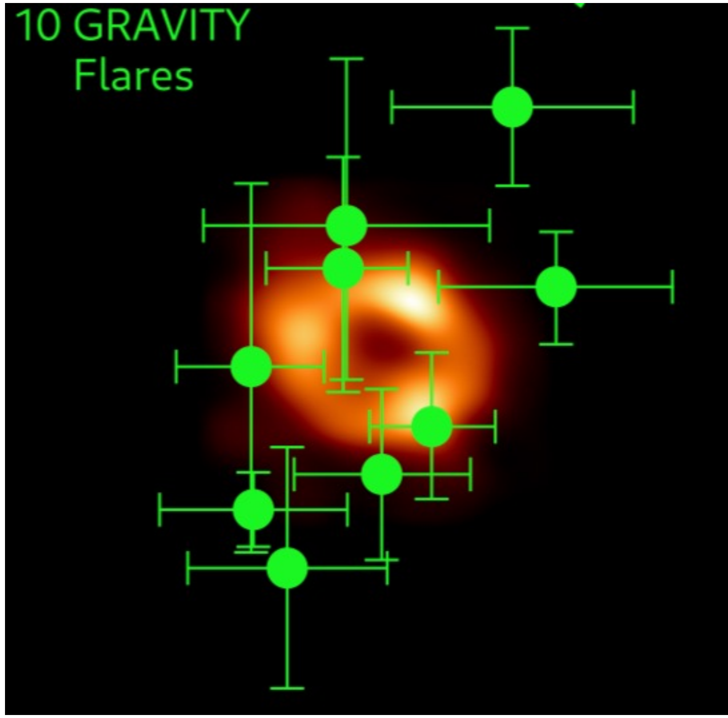
Merger rates: a few per year

LIGO: 10^2Hz GWs



Sgr A

A&A 677, L10 (2023)
https://doi.org/10.1051/0004-6361/202347416



Letter to the Editor

Polarimetry and astrometry of NIR flares as event horizon scale, dynamical probes for the mass of Sgr A*[★]

GRAVITY Collaboration: R. Abuter[4], N. Aimar[2,★★], P. Amaro Seoane[18,1,25,19], A. Amorim[8,7], M. Bauböck[16], J. P. Berger[3,4], H. Bonnet[4], G. Bourdarot[1], W. Brandner[5], V. Cardoso[7,21], Y. Clénet[2], R. Davies[1], P. T. de Zeeuw[24], J. Dexter[11], A. Drescher[1,★★], A. Eckart[6,17], F. Eisenhauer[1,23], H. Feuchtgruber[1], G. Finger[1], N. M. Förster Schreiber[1], A. Foschi[7,10], P. Garcia[12,7], F. Gao[13,1], Z. Gelles[26], E. Gendron[2], R. Genzel[1,14], S. Gillessen[1], M. Hartl[1], X. Haubois[9], F. Haussmann[1], G. Heißel[20,2], T. Henning[5], S. Hippler[5], M. Horrobin[6], L. Jochum[9], L. Jocou[3], A. Kaufer[9], P. Kervella[2], S. Lacour[2], V. Lapeyrère[2], J.-B. Le Bouquin[3], P. Léna[2], D. Lutz[1], F. Mang[1], N. More[1], T. Ott[1], T. Paumard[2], K. Perraut[3], G. Perrin[2], O. Pfuhl[4,1], S. Rabien[1], D. C. Ribeiro[1,★★], M. Sadun Bordoni[1], S. Scheithauer[5], J. Shangguan[1], T. Shimizu[1], J. Stadler[15,1], O. Straub[1,22], C. Straubmeier[6], E. Sturm[1], L. J. Tacconi[1], F. Vincent[2], S. von Fellenberg[17,1], F. Widmann[1], M. Wielgus[17], E. Wieprecht[1], E. Wiezorrek[1], and J. Woillez[4]

(Affiliations can be found after the references)

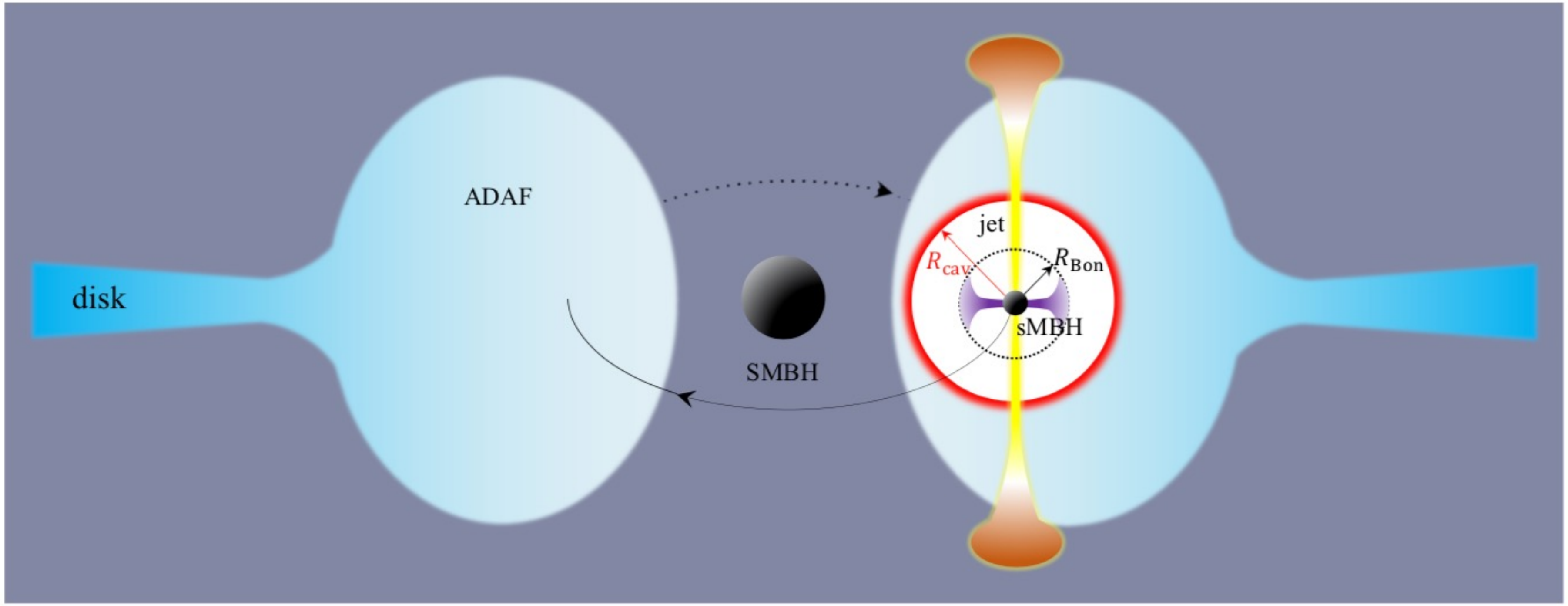
Received 10 July 2023 / Accepted 2 August 2023

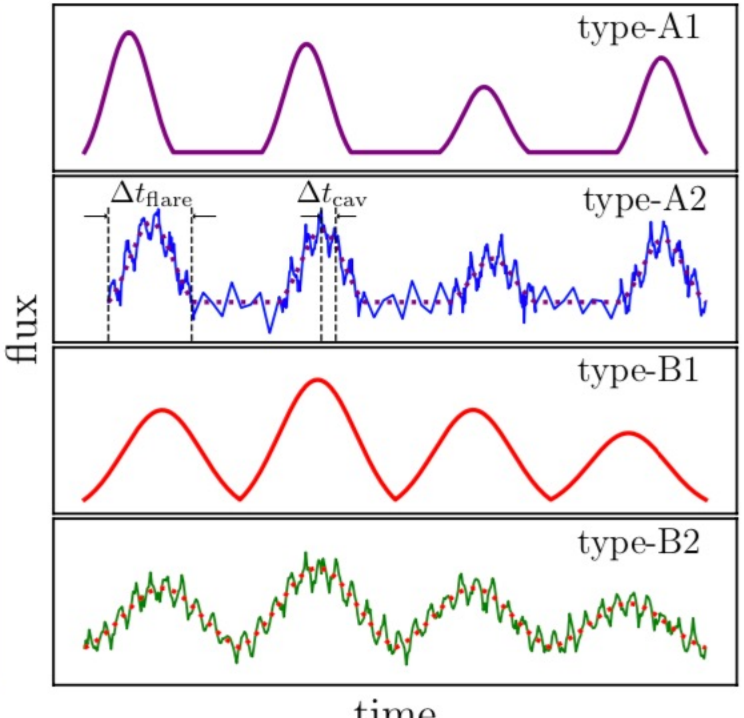
Sgr A

DRAFT VERSION NOVEMBER 14, 2023
Typeset using LATEX default style in AASTeX62

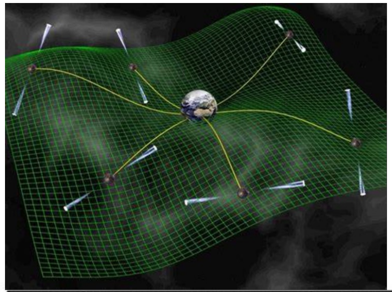
Accretion-modified Stars in Accretion Disks of Active Galactic Nuclei: the Low-luminosity Cases and an Application to Sgr A*

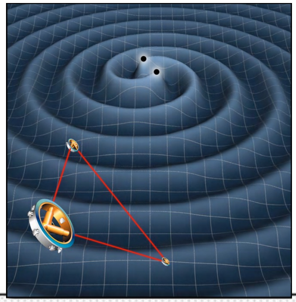
JIAN-MIN WANG,[1,2,3] JUN-RONG LIU,[1,4] YAN-RONG LI,[1] YU-YANG SONGSHENG,[1] YE-FEI YUAN,[5] AND LUIS C. HO[6,7]

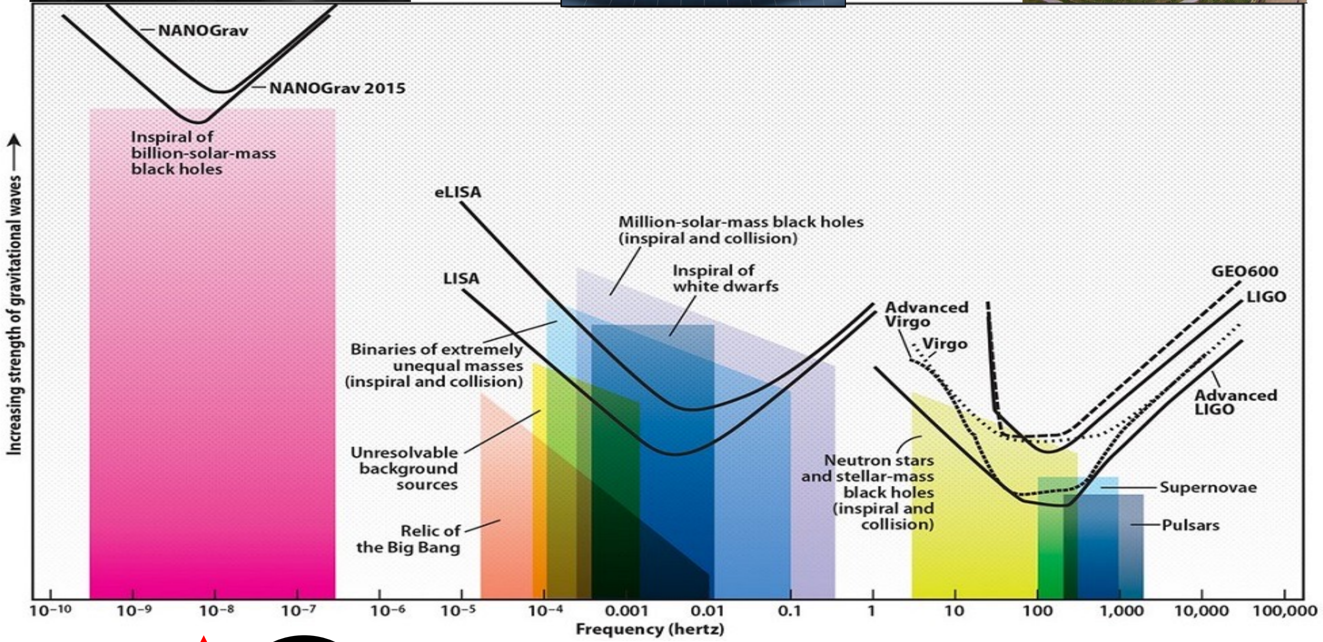


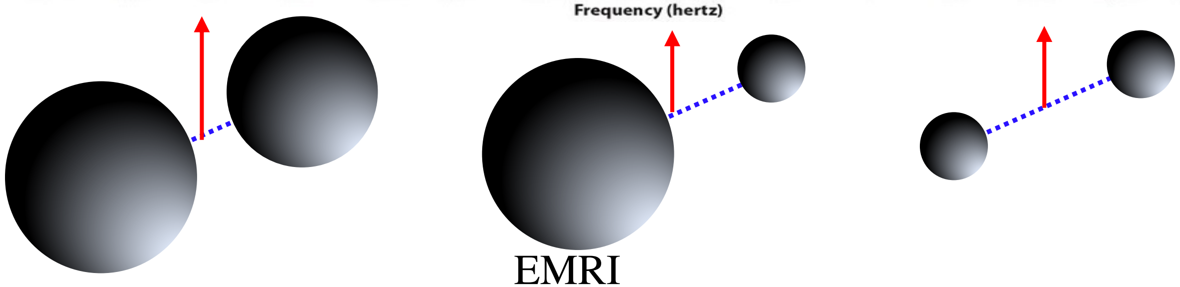


AGNs/Sgr A*： binary BHs and satellite BHs







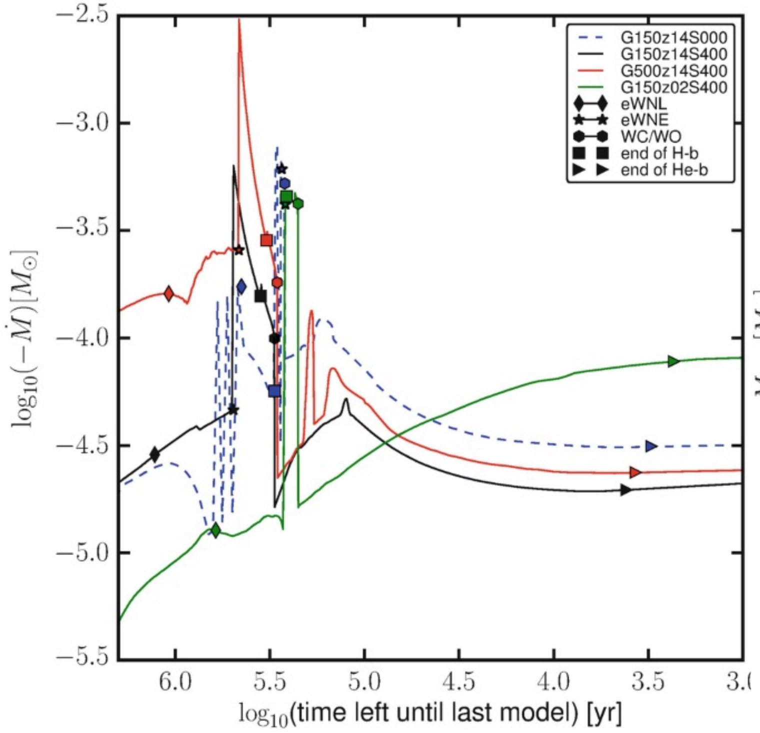


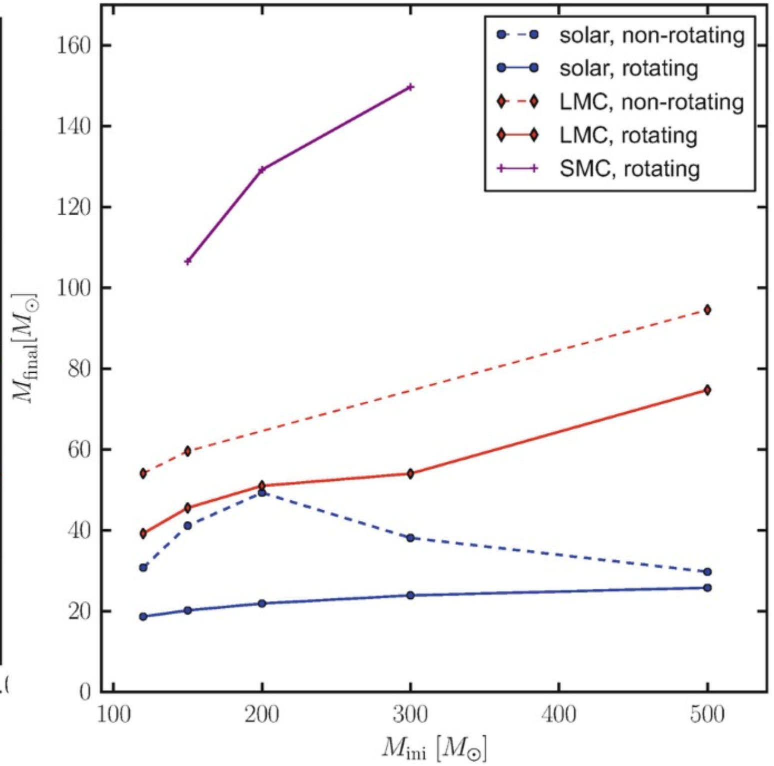
Conclusions

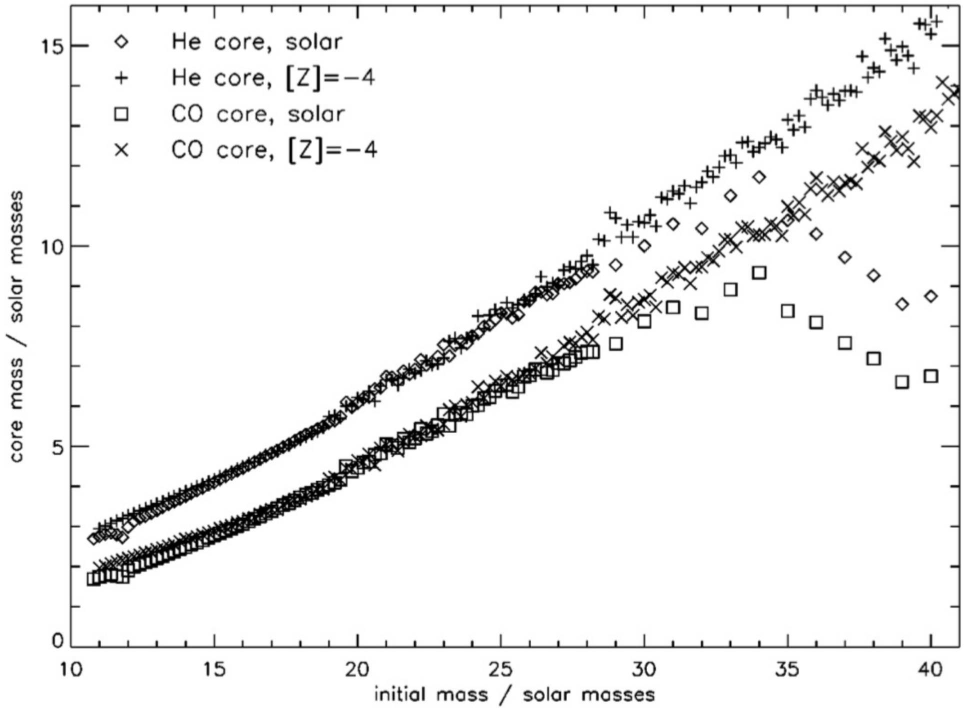
- Accretion-modified stars in AGN disks
- Metallicity and compact stars
- Mergers and GWs
- Radiation from radio to gamma-rays
- Sgr A*: EMRI

Thank you

Massive stars: stellar winds







Hirschi(2017); Yusolf+(2022)

Woosley& Heger (2002)