{{Starbox begin

| name=HDE 226868 }}

{{Starbox image

| image=[[Image:Cygnus constellation map.png|250px]]

| caption=在這幅天鵝座星圖上，HDE 226868（未標示）位于η星（中下）旁。<ref name=bernard/> }}

{{Starbox observe

| epoch=J2000

| ra={{RA|19|58|21.6756}}<ref name=SIMBAD>{{cite web

| author=Staff | date=March 3, 2003

| url=http://simbad.u-strasbg.fr/simbad/sim-id?protocol=html&Ident=HDE+226868

| title=V\* V1357 Cyg -- High Mass X-ray Binary

| publisher=Centre de Données astronomiques de Strasbourg

| accessdate=2008-03-03 }}</ref>

| dec={{DEC| +35|12|05.775}}<ref name=SIMBAD/>

| appmag\_v=8.95<ref name=SIMBAD/>

| constell=[[天鵝座]] }}

{{Starbox character

| class=O9.7Iab<ref name=SIMBAD/>

| b-v=+0.81<ref name=lob647>{{cite journal

| last=Bregman | first=J.

| coauthors=Butler, D.; Kemper, E.; Koski, A.; Kraft, R. P.; Stone, R. P. S.

| title=Colors, magnitudes, spectral types and distances for stars in the field of the X-ray source Cyg X-1

| journal=Lick Observatory Bulletin

| year=1973 | volume=647

| url=http://cdsads.u-strasbg.fr/cgi-bin/nph-bib\_query?1973LicOB..24....1B

| accessdate=2008-03-03 }}</ref>

| u-b=−0.30<ref name=lob647/>

| variable=[[Variable star|Ellipsoidal variable]] }}

{{Starbox astrometry

| radial\_v=−13<ref name=SIMBAD/>

| prop\_mo\_ra=−3.82<ref name=SIMBAD/>

| prop\_mo\_dec=−7.62<ref name=SIMBAD/>

| gal\_lat=+03.0668

| gal\_lon=071.3350

| parallax=0.58

| p\_error=1.01

| parallax\_footnote=<ref>{{cite journal

| author=Perryman, M.A.C. et al.

| title=The Hipparcos Catalogue

| journal=Astronomy & Astrophysics

| year=1997 | volume=323 | pages=L49–L52

| url=http://cdsads.u-strasbg.fr/cgi-bin/nph-bib\_query?1997A%26A...323L..49P

| accessdate=2008-03-03 }}</ref>

| absmag\_v=−6.5&nbsp;±&nbsp;0.2<ref name=apj321>{{cite journal

| last=Ninkov | first=Z. | coauthors=Walker, G. A. H.; Yang, S.

| title=The primary orbit and the absorption lines of HDE 226868 (Cygnus X-1)

| journal=Astrophysical Journal, Part 1

| year=1987 | volume=321 | pages=425–437

| url=http://adsabs.harvard.edu/abs/1987ApJ...321..425N

| accessdate=2008-05-02

| doi=10.1086/165641 }}</ref> }}

{{Starbox detail

| mass=20–40<ref name=iorio/>

| radius=20–22<ref name=MNRAS358/>

| luminosity=(3–4){{e|5}}<ref name=MNRAS358/>

| temperature=31,000<ref name=eas030610/>

| gravity=3.31&nbsp;±&nbsp;0.07<ref name=hadrava>{{cite conference

| first=Petr | last=Hadrava

| title=Optical spectroscopy of Cyg X-1

| booktitle=Proceedings of RAGtime 9: Workshops on black holes and neutron stars

| date=September 15–21, 2007

| location=Opava, Czech Republic

| url=http://adsabs.harvard.edu/abs/2007arXiv0710.0758H

| accessdate=2008-05-03 }}</ref>

| metal=

| rotation=

| age=5&nbsp;million<ref name=science300/>

}}

{{Starbox catalog

| names=[[Astronomische Gesellschaft Katalog|AG (or AGK2)]]+35&nbsp;1910, [[Bonner Durchmusterung|BD]]+34 3815, [[Henry Draper catalogue|HD (or HDE)]]&nbsp;226868, [[Hipparcos catalogue|HIP]]&nbsp;98298, [[Smithsonian Astrophysical Observatory|SAO]]&nbsp;69181, V1357&nbsp;Cyg.<ref name=SIMBAD/> }}

{{Starbox end}}

'''天鵝座X-1'''（簡稱'''Cyg X-1'''）<ref name=science3656/>是一個位于[[天鵝座]]的星系，是著名的[[X射線源]]。<ref>{{cite news

| author=Staff | date=2004-11-05 | publisher=ESA

| title=Observations: Seeing in X-ray wavelengths

| url=http://www.esa.int/esaSC/SEMTA2T1VED\_index\_0.html

| accessdate=2008-08-12

}}</ref>它在1964年的一次[[火箭]]彈道飛行時被發現，是從地球觀測最強的X射綫源之一，其頂峰X射綫[[通量]]為2.3{{e|−23}} [[瓦特|W]][[公分|m]]<sup>−2</sup>[[赫茲|Hz]]<sup>−1</sup><ref>{{cite book

| first=Walter | last=Lewin

| coauthors=Van Der Klis, Michiel | year=2006

| title=Compact Stellar X-ray Sources

| publisher=Cambridge University Press

| pages=159 | isbn=0521826594 }}</ref><ref>The following source:

:{{cite web

| title=2010 X-Ray Sources | publisher=U.S. Naval Observatory

| work=The Astronomical Almanac

| url=http://asa.usno.navy.mil/SecH/Xray.html

| accessdate=2009-08-04 }}

gives a range of {{nowrap|235–1320 μJy}} at energies of {{nowrap|2–10 kEv}}.</ref>天鵝座X-1是最先被廣泛承認為[[黑洞]]的候選[[星體]]，也是同類星體中最受研究關注的。現在估計其質量為[[太陽質量]]的8.7倍，<ref name=iorio/>而其密度之高使黑洞成爲唯一一種解釋。如果如此，它的[[事件視界]]半徑約為26公里。<ref>{{cite web

| last=Harko | first=T. | date=June 28, 2006

| url=http://www.physics.hku.hk/~astro/harko\_science.html

| title=Black Holes | publisher=University of Hong Kong

| accessdate=2008-03-28 }}</ref>

天鵝座X-1屬於一個[[X射線雙星#高質量X射線雙星|高質量X射線雙星]]系統，其距離[[太陽]]大約6,000[[光年]]，另一成員為一顆[[超巨星]][[變星]]，編號為HDE 226868。兩者相互圍繞公轉，距離為0.2天文單位，即地球和太陽間距離的20%。該星的[[星風]]為X射綫源的[[吸積盤]]提供物質。<ref name=apj304/>盤的内部溫度達到幾百萬[[開氏度|K]]，因此輻射出X射綫。<ref>{{cite web

| last=Nayakshin | first=Sergei | coauthors=James B. Dove

| date=November 3, 1998

| url=http://adsabs.harvard.edu/abs/1998astro.ph.11059N

| title=X-rays From Magnetic Flares In Cygnus X-1: The Role Of A Transition Layer

| publisher=Cornell University | accessdate=2008-03-29 }}</ref><ref name=mnras325/>兩條垂直于吸積盤的[[相對論性噴流]]將被吸進的物質噴射出星際空間。<ref>{{cite journal

| last=Gallo | first=Elena | coauthors=Fender, Rob

| title=Accretion modes and jet production in black hole X-ray binaries

| journal=Memorie della Società Astronomica Italiana

| year=2005 | volume=75 | pages=282–290

| url=http://arxiv.org/abs/astro-ph?papernum=0509172

| accessdate=2008-03-29 }}</ref>

這個系統可能屬於一個名為天鵝座OB3的[[星協]]，意味著天鵝座X-1的年齡超過500萬年，並源于一顆質量大於40個太陽質量的原星。這顆原星的大部分質量都散失了，很可能是以星風的形式。如果該星以[[超新星]]的形式爆炸，則其威力足以將剩餘物質噴射出這個系統。因此它可能直接坍縮成一個黑洞。<ref name=science300/>

[[物理學家]][[史蒂芬·霍金]]和[[基普·索恩]]曾拿天鵝座X-1作了一場科學的賭局。當中霍金賭天鵝座X-1不是一顆黑洞。1990年霍金讓步，因爲觀測證據顯示這個系統中存在著[[引力奇點]]。<ref>{{cite news

| author=Staff | date=February 27, 2004

| title=Galaxy Entree or Main Course?

| publisher=Swinburne University

| url=http://astronomy.swin.edu.au/sao/astronomynews/astronews2004s1.xml

| accessdate=2008-03-31 }}</ref>

==發現及觀測==

通過對X射綫源的觀測，[[天文學家]]能研究涉及到幾百萬度熾熱氣體的天文現象。但由於X射綫被地球的[[大氣層]]遮擋了，因此[[X射綫天文學|對X射綫源的觀測]]不能在地表進行，而需要將儀器運送到有足夠X射綫能穿透的高度。<ref>{{cite book

| first=Friedman | last=Herbert | year=2002

| chapter=From the ionosphere to high energy astronomy&nbsp;– a personal experience

| title=The Century of Space Science

| publisher=Springer | isbn=0792371968 }}</ref><ref name=apj611/>發現天鵝座X-1的儀器是從[[新墨西哥州]][[白沙導彈靶場]]由火箭發射到彈道軌道。1964年時正進行一項觀測，目的是找出這些X射綫源。兩個空蜂火箭（Aerobee）彈道火箭運載著[[蓋革計數器]]升空，測量天空中8.4°範圍内[[波長]]從1至15[[埃|Å]]的X射綫源。<ref name=science3656/>

這項觀測發現了8個新的X射綫源，包括天鵝座的Cyg XR-1（後名Cyg X-1）。其[[天球坐標]]估計為[[赤經]]19<sup>h</sup>53<sup>m</sup>、[[赤緯]]34.6°。該X射綫源處並沒有明顯的[[無綫電天文學|無綫電]]或[[可見光]]源。<ref name=science3656>{{cite journal

| last=Bowyer | first=S. | coauthors=Byram, E. T.; Chubb, T. A.; Friedman, H.

| title=Cosmic X-ray Sources | journal=Science

| year=1965 | volume=147 | issue=3656 | pages=394–398

| url=http://www.sciencemag.org/cgi/content/abstract/147/3656/394

| accessdate=2008-03-10

| doi=10.1126/science.147.3656.394

| pmid=17832788 }}</ref>

由於需要更長時間的觀測研究，1963年[[里卡尔多·贾科尼]]和[[赫伯特·格斯基]]提出了首個研究X射綫源的軌道衛星。[[美國太空總署]]於1970年發射了[[乌呼鲁卫星]]，<ref>{{cite web

| author=Staff | date=June 26, 2003

| url=http://heasarc.gsfc.nasa.gov/docs/uhuru/uhuru.html

| title=The Uhuru Satellite | publisher=NASA

| accessdate=2008-05-09 }}</ref>進而發現了300個新X射綫源。<ref>{{cite web

| last=Giacconi | first=Riccardo

| date=December 8, 2002

| url=http://nobelprize.org/nobel\_prizes/physics/laureates/2002/giacconi-lecture.html

| title=The Dawn of X-Ray Astronomy

| publisher=The Nobel Foundation

| accessdate=2008-03-24 }}</ref>它對天鵝座X-1的長期觀測發現其X光強度有波動，頻率為每秒數次。<ref>{{cite journal

| last=Oda | first=M.

| coauthors=Gorenstein, P.; Gursky, H.; Kellogg, E.; Schreier, E.; Tananbaum, H.; Giacconi, R.

| title=X-Ray Pulsations from Cygnus X-1 Observed from UHURU

| journal=The Astrophysical Journal

| year=1999 | volume=166 | pages=L1–L7

| url=http://adsabs.harvard.edu/abs/1971ApJ...166L...1O

| accessdate=2008-03-11

| doi=10.1086/180726 }}</ref>如此快速的變動顯示，能量一定在很小的範圍内產生，大小約為10<sup>5</sup>公里<ref>這相當於光在三分之一秒内所走的距離。</ref>，因爲[[光速]]的限制使訊息不可能在更遠的範圍裏相互傳遞。作爲對比，[[太陽]]的直徑約為1.4{{e|6}}公里。

1971年四月至五月，[[萊登天文臺]]的Luc Braes和George Miley與[[美國國家射電天文臺]]的Robert M. Hjellming和Campbell Wade<ref>{{cite journal

| last=Kristian | first=J. | coauthors=Brucato, R.; Visvanathan, N.; Lanning, H.; Sandage, A.

| title=On the Optical Identification of Cygnus&nbsp;X-1

| url=http://adsabs.harvard.edu/abs/1971ApJ...168L..91K

| journal=The Astrophysical Journal

| year=1971 | volume=168 | pages=L91–L93 | accessdate=2008-03-10

| doi=10.1086/180790 }}</ref>獨立探測到來自天鵝座X-1的無綫電射綫，射綫源的準確位置指向AGK2&nbsp;+35 1910 = HDE&nbsp;226868。<ref>{{cite journal

| last=Braes | first=L.L.E. | coauthors=Miley, G.K.| date=July 23, 1971

| title=Physical Sciences: Detection of Radio Emission from Cygnus&nbsp;X-1

| journal=Nature

| volume=232 | pages=246

| doi=10.1038/232246a0 | bibcode=1971Natur.232Q.246B

| pmid=16062947

| issue=5308}}</ref><ref>{{cite journal

| last=Braes | first=L.L.E. | coauthors=Miley, G.K.

| year=1971

| title=Variable Radio Emission from X-Ray Sources

| journal=Veröffentlichungen Remeis-Sternwarte Bamberg

| volume=9 | issue=100 | pages=173

| publisher=(IAU Colloquium No.15, Bamberg, Germany, August 31-September 3, 1971. Bibcode: 1972VeBam.100......)}}</ref>

[[天球]]上，這顆星與[[視星等]]為4級的[[天鵝座η]]相距半度。<ref name=bernard>{{cite book

| first=Bernard | last=Abrams | coauthors=Stecker, Michael

| title=Structures in Space: Hidden Secrets of the Deep Sky

| year=1999 | pages=91 | publisher=Springer

| isbn=1852331658 |quote=Eta Cygni is 25 arc minutes to the

west-south-west of this star.}}</ref>它是一顆[[超巨星]]，本身並不能發射所觀測到的X射綫。因此，此星必定有一顆能够將氣體加熱到幾百萬度的伴星，才可放射在天鵝座X-1觀測到的輻射。

[[皇家格林威治天文台]]的Louise Webster和Paul Murdin與<ref>{{cite journal

| last=Webster | first=B. Louise | coauthors=Murdin, Paul

| title=Cygnus X-1—a Spectroscopic Binary with a Heavy Companion?

| journal=Nature | year=1972

| volume=235 | issue=2 | pages=37–38

| url=http://www.nature.com/nature/journal/v235/n5332/abs/235037a0.html

| accessdate=2008-03-10 | doi=10.1038/235037a0 }}</ref>單獨在[[多倫多大學]][[大衛·鄧拉普天文台]]工作的 Charles Thomas Bolton<ref>{{cite journal

| last=Bolton | first=C. T. | year=1972

| title=Identification of Cygnus X-1 with HDE 226868

| journal=Nature | volume=235 | issue=2 | pages=271–273

| url=http://www.nature.com/nature/journal/v235/n5336/abs/235271b0.html

| accessdate=2008-03-10 | doi=10.1038/235271b0 }}</ref>於1971年公佈了HDE 226868巨型伴星的發現消息。該星光譜的[[多普勒效應]]顯示了其伴星的存在，人們也能根據軌道數據間接地測量其質量。<ref name=luminet>{{cite book

| first=Jean-Pierre | last=Luminet | year=1992

| title=Black Holes | publisher=Cambridge University Press

| isbn=0521409063 }}</ref>由於該天體質量很高，他們推測它可能是一個[[黑洞]]。因為最大的[[中子星]]也不可能超過3個[[太陽質量]]。<ref>{{cite journal

| last=Bombaci | first=I.

| title=The maximum mass of a neutron star

| journal=Astronomy and Astrophysics

| year=1996 | volume=305 | pages=871–877

| url=http://adsabs.harvard.edu/abs/1996A&A...305..871B

| accessdate=2008-03-11

| doi=10.1088/1367-2630/7/1/199 }}</ref>

隨著更多觀測證據的發現，到了1973年末，天文學界的普遍結論為天鵝座X-1最大可能為一黑洞。<ref>{{cite web

| last=Rolston | first=Bruce | date=November 10, 1997

| url=http://news.utoronto.ca/bin/bulletin/nov10\_97/art4.htm

| title=The First Black Hole | publisher=University of Toronto

| accessdate=2008-03-11 }}

</ref><ref>{{cite journal

| last=Shipman | first=H. L.

| title=The implausible history of triple star models for Cygnus X-1 Evidence for a black hole

| journal=Astrophysical Letters

| year=1975 | volume=16 | issue=1 | pages=9–12

| url=http://adsabs.harvard.edu/abs/1975ApL....16....9S

| accessdate=2008-03-11 }}</ref>對天鵝座X-1更精確的測量顯示出小至1毫秒的變化。這個間距與黑洞[[吸積盤]]物質的亂流相符。持續三分之一秒的X射線爆符合物質掉進黑洞預測所需的時間。<ref name=apj189>{{cite journal

| last=Rothschild | first=R. E.

| coauthors=Boldt, E. A.; Holt, S. S.; Serlemitsos, P. J.

| title=Millisecond Temporal Structure in Cygnus X-1

| journal=The Astrophysical Journal

| year=1974 | volume=189 | pages=77–115

| url=http://adsabs.harvard.edu/abs/1974ApJ...189L..13R

| accessdate=2008-03-11

| doi=10.1086/181452 }}</ref>

[[Image:Cygnus x1 xray.jpg|right|thumb|這張天鵝座X-1的X射線照片由高能複層式可見光天文望遠鏡（HERO）經氣球升空拍攝。''圖片由美國太空總署提供'']]

至今天鵝座X-1已被多部軌道及地面觀測儀器長期觀測。<ref name=SIMBAD/>X射線雙星（如HDE 226868/天鵝座X-1）和[[活動星系核]]間有眾多相似之處，顯示它們有共同的運行原理：黑洞、旋轉中的吸積盤和[[相對論性噴流|噴流]]。<ref>{{cite journal

| last=Koerding | first=Elmar

| coauthors=Jester, Sebastian; Fender, Rob

| title=Accretion states and radio loudness in Active Galactic Nuclei: analogies with X-ray binaries

| journal=Monthly Notices of the Royal Astronomical Society

| year=2006 | volume=372 | pages=1366–1378

| url=http://arxiv.org/abs/astro-ph/0608628

| accessdate=2007-03-24

| doi=10.1111/j.1365-2966.2006.10954.x }}</ref>因此，天鵝座X-1被歸於一類稱為[[微類星體]]的雙星系統。對諸如HDE 226868/天鵝座X-1的雙星系統的科學研究能使科學家對[[活動星系]]的運動原理有更深入的認知。<ref>{{cite web

| last=Brainerd | first=Jim | date=July 20, 2005

| url=http://www.astrophysicsspectator.com/topics/observation/XRayAGN.html

| title=X-rays from AGNs | publisher=The Astrophysics Spectator

| accessdate=2008-03-24 }}</ref>

==恆星系統==

天鵝座X-1中的[[緻密星]]和[[藍超巨星]]組成一個[[雙星系統]]，以{{nowrap|5.599829 ± 0.000016天}}的周期繞質心公轉。<ref>{{cite journal

| last=Brocksopp | first=C.

| coauthors=Tarasov, A. E.; Lyuty, V. M.; Roche, P.

| title=An Improved Orbital Ephemeris for Cygnus X-1

| journal=Astronomy & Astrophysics

| year=1999 | volume=343 | pages=861–864

| url=http://arxiv.org/abs/astro-ph/9812077

| accessdate=2008-03-18 }}</ref>從地球的角度觀看，那顆緻密星從來不運行到其伴星後，也就是這個系統不會發生[[掩星]]。不過，其[[軌道傾角]]與地球視線的角度仍然是未知的，估值為27°至65°。一項2007年的研究估計角度為{{nowrap|48.0 ± 6.8°}}，也就是軌道[[半長軸]]為0.2[[天文單位]]（地球與太陽距離的20%）。[[軌道離心率]]為約{{nowrap|0.06 ± 0.01}}，幾乎為正圓形。<ref name=iorio/><ref name="apj200">{{cite journal

| last=Bolton | first=C. T.

| title=Optical observations and model for Cygnus X-1

| journal=The Astrophysical Journal

| year=1975 | volume=200 | pages=269–277

| url=http://adsabs.harvard.edu/abs/1975ApJ...200..269B

| accessdate=2008-03-12

| doi=10.1086/153785 }}</ref>[[依巴谷衛星]]測量出地球距離該系統約2,000[[秒差距]]（6,000[[光年]]），但這個數據的相對誤差較大。<ref name=SIMBAD/>

天鵝座OB3是一個包含大型恆星的星協，距離太陽2,000秒差距。HDE 226868/天鵝座X-1系統與天鵝座OB3有著相同的直線運動速度及方向，意味著它們可能在同一時期同一地區形成。這樣，該系統的年齡就是約{{nowrap|500 ± 150萬年}}。HDE 226868相對天鵝座OB3的運動速度為9 ± 3公里每秒，是星協中隨機運動的典型速度。HDE 226868距離星協中心約60秒差距，要達到這個距離可能需要{{nowrap|700 ± 200萬年}}，粗略符合該星協的估計年齡。<ref name=science300>{{cite journal

| last=Mirabel | first=I. Félix | coauthors=Rodrigues, Irapuan

| title=Formation of a Black Hole in the Dark

| journal=Science | year=2003 | volume=300

| issue=5622 | pages=1119–1120

| url=http://www.sciencemag.org/cgi/content/full/300/5622/1119

| accessdate=2008-03-15 | doi=10.1126/science.1083451

| pmid=12714674 }}</ref>

該系統位於[[銀道坐標系|銀緯]]4°銀經71°<ref name=SIMBAD/>，也就是在[[銀河系]][[獵戶臂]]的內側，<ref>{{cite journal

| last=Gursky | first=H. | year=1971

| coauthors=Gorenstein, P.; Kerr, F. J.; Grayzeck, E. J.

| url=http://adsabs.harvard.edu/abs/1971ApJ...167L..15G

| title=The Estimated Distance to Cygnus X-1 Based on its Low-Energy X-Ray Spectrum

| journal=Astrophysical Journal | volume=167 | pages=L15

| accessdate=2008-06-29

| doi=10.1086/180751 }}</ref>接近[[人馬臂]]處，<ref>{{cite web

| url=http://www.vectorsite.net/tastgal\_07.html

| title=7.0 The Milky Way Galaxy

| first=Greg | last=Goebel | publisher=In The Public Domain

| accessdate=2008-06-29 }}</ref>然而銀河系的確切結構還在研究當中。

===緻密天體===

對該密集天體質量的測量存在著一定的誤差。星體演化模型顯示其質量為{{nowrap|20 ± 5[[太陽質量]]}}，<ref name=MNRAS358>{{cite journal

| last=Ziółkowski | first=J.

| title=Evolutionary constraints on the masses of the components of HDE 226868/Cyg X-1 binary system

| journal=Monthly Notices of the Royal Astronomical Society

| year=2005 | volume=358 | pages=851–859

| url=http://arxiv.org/abs/astro-ph/0501102

| doi=10.1111/j.1365-2966.2005.08796.x

| accessdate=2008-03-04 }} Note: for radius and luminosity, see Table 1 with ''d''=2&nbsp;kpc.</ref>而其它的方法則得出10太陽質量。通過測量該天體附近X射線的週期性，又能得出一個更加精確的數字{{nowrap|8.7 ± 0.8太陽質量}}。無論是哪一個數據，這個天體都最有可能是一個黑洞，<ref name=iorio>{{cite journal

| last=Iorio | first=Lorenzo

| date=July 24, 2007 | journal=E-print

| title=On the orbital and physical parameters of the HDE 226868/Cygnus X-1 binary system

| url=http://adsabs.harvard.edu/abs/2007arXiv0707.3525I

| accessdate=2008-03-14

| doi=10.1007/s10509-008-9839-y

| volume=315

| pages=335

}}</ref><ref name=esa070516>{{cite web

| last=Strohmayer | first=Tod | date=May 16, 2007

| coauthors=Shaposhnikov, Nikolai; Schartel, Norbert

| url=http://www.esa.int/esaCP/SEMDMAV681F\_index\_0.html

| title=New technique for ‘weighing’ black holes

| publisher=[[European Space Agency|ESA]] | accessdate=2008-03-10 }}</ref>其[[引力場]]之強使[[電磁波]]都無法從內部逃離出去。這個空間的邊緣成為[[事件視界]]，半徑為[[史瓦西半徑]]。天鵝座X-1的[[史瓦西半徑]]約為26公里。<ref>{{cite journal

| last=Rössler | first=O. E.

| coauthors=Kuypers, H.; Diebner, H. H.

| title=Almost-Black-Holes: an old—new paradigm

| journal=Chaos, Solitons & Fractals

| year=1998 | volume=9 | issue=7 | pages=1025–1034

| doi=10.1016/S0960-0779(98)80004-0

}}</ref>任何東西（包括[[物質]]和[[光子]]等）只要越過了這個邊界，便無法再逃脫出去。<ref>{{cite web

| author=Staff | date=January 9, 2006

| url=http://web.mit.edu/newsoffice/2006/blackhole1.html

| title=Scientists find black hole's 'point of no return'

| publisher=Massachusetts Institute of Technology

| accessdate=2008-03-28 }}</ref>

在1992年[[哈勃太空望遠鏡]]上[[高速光度計]]的[[紫外線]]觀測發現事件視界存在的證據。當一些發光的物質螺旋進入黑洞的事件視界時，其輻射會以一系列受[[引力紅移]]影響的脈衝發放。也就是，根據[[廣義相對論]]的預測，輻射的[[波長]]會逐漸增加。物質與普通的緻密天體相撞會產生一股能量爆，但通過事件視界的物質則不會。這樣的一系列衰減的脈衝已經觀測到兩個了，表明一個黑洞的存在。<ref name=pasp113>{{cite journal

| last=Dolan | first=Joseph F.

| title=Dying Pulse Trains in Cygnus XR-1: Evidence for an Event Horizon?

| journal=The Publications of the Astronomical Society of the Pacific

| year=2001 | volume=113 | issue=786 | pages=974–982

| url=http://adsabs.harvard.edu/abs/2001PASP..113..974D

| accessdate=2008-03-20

| doi=10.1086/322917 }}</ref>

[[File:381549main cygX1 final 665.jpg|thumb|right|昌德拉X射線天文台拍攝的天鵝座X-1照片。]]

位於太空的[[昌德拉X射線天文台]]曾用於測量圍繞在該天體周圍的[[鐵]]原子的[[譜線]]。一個旋轉的黑洞能拖拽其周圍的空間，使得原子能在更靠近事件視界的軌道上運行。而在天鵝座X-1附近，沒有原子在小於160公里的軌道上運行。因此，如果這個天體是個黑洞，那它並沒有明顯的自轉。<ref>{{cite conference

| last=Miller | first=J. M.

| coauthors=Fabian, A. C.; Nowak, M. A.; Lewin, W. H. G.

| title=Relativistic Iron Lines in Galactic Black Holes: Recent Results and Lines in the ASCA Archive

| booktitle=Proceedings of the 10th Annual Marcel Grossmann Meeting on General Relativity

| location=Rio de Janeiro, Brazil | date=July 20–26, 2003

| url=http://arxiv.org/abs/astro-ph/0402101

| accessdate = 2008-03-11 }}

</ref><ref>{{cite news

| last=Roy | first=Steve | coauthors=Watzke, Megan

| date=September 17, 2003

| title="Iron-Clad" Evidence For Spinning Black Hole

| publisher=Chandra press Room

| url=http://chandra.harvard.edu/press/03\_releases/press\_091703.html

| accessdate=2008-03-11 }}</ref>

====形成====

天鵝座OB3星協中最大星體的質量為40太陽質量。由於較大的星體演化得較快，這表明天鵝座X-1的前身的質量超過40個太陽質量。根據現時估計的黑洞質量，該星體損失了超過30個太陽質量的物質。其部分質量可能流失給HDE 226868，而其餘的則很可能被一股強大的星風吹走。HDE 226868的外大氣層中的高[[氦]]含量有可能是這次物質傳遞的證據。<ref>{{cite journal

| last=Podsiadlowski | first=Philipp

| coauthors=Saul, Rappaport; Han, Zhanwen

| title=On the formation and evolution of black-hole binaries

| journal=Monthly Notices of the Royal Astronomical Society

| year=2002 | issue=2 | volume=341 | pages=385–404

| url=http://arxiv.org/abs/astro-ph/0207153

| accessdate=2008-03-24

| doi=10.1046/j.1365-8711.2003.06464.x }}</ref>其前身可能曾演化成一顆[[沃爾夫-拉葉星]]，並透過強星風拋出了大氣層中一大部分的物質。<ref name=science300/>

對同類天體的觀測顯示，如果其前身曾爆炸成為[[超新星]]，其殘骸很可能會以相對高的速度被拋射出這個系統。由於拋出的物質仍然留在軌道上運行，表明其前身是直接坍縮成一顆黑洞，沒有經過爆炸（或僅僅是相對輕微的爆炸）。<ref name=science300/>

====吸積盤====

[[Image:Cygx1 spectrum.jpg|right|thumb|[[昌德拉X射線天文台|昌德拉]]對天鵝座X-1的X射線光譜在6.4 [[電子伏特|keV]]處顯示出獨特的高峰，這是因為吸積盤中的電離[[鐵]]。這個高峰值被引力紅移，因[[多普勒現象]]放寬，並偏向較低的能量值。<ref>{{cite web

| author=Staff | date=August 30, 2006

| url=http://chandra.harvard.edu/photo/2003/bhspin/more.html

| title=More Images of Cygnus X-1, XTE J1650-500 & GX 339-4

| publisher=Harvard-Smithsonian Center for Astrophysics/Chandra X-ray Center

| accessdate=2008-03-30 }}</ref>]]

這個緻密天體周圍公轉著一個平坦的、薄薄的物質盤，稱為[[吸積盤]]。由於電離氣體在內圈快速運行，而在外圈則較為緩慢，其之間的摩擦力使得這個吸積盤被加熱到很高的溫度。它分為兩部分：內圈的物質有著較高的溫度和電離度，形成[[電漿]]；外圈的物質有著較低的溫度和電離度，並延伸到史瓦西半徑的500倍遠，<ref name=mnras325>{{cite journal

| last=Young | first=A. J.

| coauthors=Fabian, A. C.; Ross, R. R.; Tanaka, Y.

| title=A Complete Relativistic Ionized Accretion Disc in Cygnus X-1

| journal=Monthly Notices of the Royal Astronomical Society

| year=2001 | volume=325 | pages=1045–1052

| url=http://arxiv.org/abs/astro-ph/0103214

| accessdate=2008-03-13

| doi=10.1046/j.1365-8711.2001.04498.x }}</ref>也就是15,000公里。

儘管變化很大，很難預測，但天鵝座X-1通常天空中是最亮的持久硬X射線源。硬X射線的能級介乎30至數百電子伏特。<ref name=apj611>{{cite journal

| last=Liu | first=C. Z. | coauthors=Li, T. P.

| title=X-Ray Spectral Variability in Cygnus X-1

| journal=The Astrophysical Journal

| year=1999 | volume=611 | pages=1084–1090

| url=http://www.journals.uchicago.edu/doi/abs/10.1086/422209

| accessdate=2008-03-28 | doi=10.1086/422209 }}</ref>X射線先是以位於內吸積盤的低能光子產生，再通過[[康普頓散射]]獲得更多能量。<ref>{{cite journal

| last=Ling | first=J. C.

| coauthors=Wheaton, Wm. A.; Wallyn, P.; Mahoney, W. A., et al.

| title=Gamma-Ray Spectra and Variability of Cygnus X-1 Observed by BATSE

| journal=The Astrophysical Journal

| year=1997 | volume=484 | pages=375–382

| url=http://www.journals.uchicago.edu/doi/abs/10.1086/304323

| accessdate=2008-03-04 | doi=10.1086/304323 }}</ref><ref>{{cite journal

| last=Kylafis | first=N. | coauthors=Giannios, D.; Psaltis, D.

| title=Spectra and time variability of black-hole binaries in the low/hard state

| journal=Advances in Space Research

| year=2006 | volume=38 | issue=12 | pages=2810–2812

| url=http://linkinghub.elsevier.com/retrieve/pii/S0273117705014286

| accessdate=2007-02-04 | doi=10.1016/j.asr.2005.09.045 }}</ref>

天鵝座X-1的X射線放射以一種稱為[[准週期振盪]]的重複模式波動。緻密天體的質量似乎決定了開始產生准週期振盪的電漿物質的軌道半徑，其半徑隨質量的降低而縮短。這個方法已被用於估計天鵝座X-1的質量。<ref>{{cite web

| last=Titarchuk | first=Lev | coauthors=Shaposhnikov, Nikolai

| title=On the nature of the variability power decay towards soft spectral states in X-ray binaries. Case study in Cyg X-1

| date=February 9, 2008

| url=http://arxiv.org/abs/0802.1278

| work=The Astrophysical Journal

| accessdate=2008-04-02 }}</ref>

中子星產生的週期脈衝沒有在天鵝座X-1上發現。<ref>{{cite journal

| last=Fabian | first=A. C. | coauthors=Miller, J. M.

| title=Black Holes Reveal Their Innermost Secrets

| journal=Science | date=August 9, 2002

| volume=297 | issue=5583 | pages=947&ndash;948

| url=http://www.sciencemag.org/cgi/content/full/297/5583/947

| accessdate=2008-03-29

| doi=10.1126/science.1074957

| pmid=12169716 }}

</ref><ref>{{cite web

| last=Wen | first=Han Chin | month=March | year=1998

| url=http://adsabs.harvard.edu/abs/1997PhDT.........6W

| title=Ten Microsecond Time Resolution Studies of Cygnus X-1

| publisher=Stanford University | accessdate=2008-03-29 }}</ref>中子星產生的脈衝是因為其磁場，而[[無毛定理]]表明了黑洞不可能有磁極。譬如，X射線雙星系統[[V 0332+53]]曾被認為是一個可能的黑洞，直到人們發現了脈衝。<ref>{{cite journal

| last=Stella | first=L.

| coauthors=White, N. E.; Davelaar, J.; Parmar, A. N.; Blissett, R. J.; van der Klis, M.

| title=The discovery of 4.4 second X-ray pulsations from the rapidly variable X-ray transient V0332 + 53

| journal=Astrophysical Journal, Part 2 - Letters to the Editor

| year=1985 | volume=288 | pages=L45–L49

| url=http://adsabs.harvard.edu/abs/1985ApJ...288L..45S

| accessdate=2008-07-28

| doi=10.1086/184419 }}</ref>天鵝座X-1亦沒有產生過類似中子星的X射線暴。<ref>{{cite journal

| last=Narayan | first=Ramesh

| title=Evidence for the black hole event horizon

| journal=Astronomy & Geophysics | year=2003

| volume=44 | issue=6 | pages=77–115

| url=http://www3.interscience.wiley.com/journal/118896663/abstract?CRETRY=1&SRETRY=0

| accessdate=2008-07-28 }}</ref>

天鵝座X-1不可預測地在兩個X射線狀態間變換，或逐漸地轉換為另一個狀態。較不常見的那個狀態的X射線較“柔和”，其能量較低。這個狀態的變動也較大。另一個狀態相信源自圍繞著吸積盤內圈的冕。較柔和的狀態會在吸積盤接近緻密天體時（最近處可能達到150公里）產生，同時冕也會降溫並噴射物質。當一個新的冕產生出來，天鵝座X-1會回到另一個狀態。<ref name=apj626/>

天鵝座X-1的X射線通量有週期性的變化，週期為5.6天，特別是當這個系統[[合 (天體位置)|合]]，且該緻密天體處於後方的時候。這表示射線被星周物質部分遮擋，而這些物質可能來自HDE 226868的星風。另外每約300天又有另一個射線週期，這可能是因為吸積盤的[[進動]]。<ref name=apj531>{{cite journal

| last=Kitamoto | first=S.

| coauthors=E. Wataru, E.; Miyamoto, S.; Tsunemi, H.; Ling, J. C.; Wheaton, W. A.; Paul, B.

| title=''GINGA'' All-Sky Monitor Observations of Cygnus X-1

| journal=The Astrophysical Journal | year=2000 | volume=531

| pages=546–552 | doi=10.1086/308423 }}</ref>

====噴流====

吸積物質墮入緻密天體時會流失其引力[[勢能]]。一部分能量會通過垂直於吸積盤面的[[相對論性噴流]]流失，向外以[[狹義相對論|相對論]]速度（與光速量級相近）噴射出去。這一對噴流為吸積盤提供了發放多餘能量和[[角動量]]的途徑。噴流可能是由圍繞緻密天體的氣體內的磁場產生。<ref>{{cite journal

| last=Begelman | first=Mitchell C.

| title=Evidence for Black Holes | pages=1898–1903

| journal=Science | year=2003 | volume=300 | issue=5627

| url=http://www.sciencemag.org/cgi/content/full/300/5627/1898

| accessdate=2008-04-28 | doi=10.1126/science.1085334

| pmid=12817138 }}</ref>

天鵝座X-1噴流的能量中很少以[[電磁波]]的形式放射，因此噴流顯得很“暗”。噴流與視線夾角估計為30°，並可能正在進動。<ref name=apj626>{{cite journal

| last=Torres | first=Diego F.

| coauthors=Romero, Gustavo E.; Barcons, Xavier; Lu, Youjun

| title=Probing the Precession of the Inner Accretion Disk in Cygnus X-1

| journal=The Astrophysics Journal

| year=2005 | volume=626 | pages=1015–1019

| url=http://arxiv.org/abs/astro-ph/0503186

| accessdate=2008-03-21

| doi=10.1086/430125 }}</ref>其中一條噴流與一部分密度較高的[[星際物質]]相撞，產生一個能量很高的環，其放射的無線電波能被探測得到。這個碰撞產生了一個[[星雲]]，其[[可見光]]部分已被觀測到。要產生這個星雲，這條噴流必須擁有(4–14){{e|36}} [[erg]]/s或(9 ± 5){{e|29}}[[瓦]]的估計平均功率。<ref>{{cite journal

| last=Russell | first=D. M.

| coauthors=Fender, R. P.; Gallo, E.; Kaiser, C. R.

| title=The jet-powered optical nebula of Cygnus X-1

| journal=Monthly Notices of the Royal Astronomical Society

| year=2007 | volume=376 | issue=3 | pages=1341–1349

| url=http://arxiv.org/abs/astro-ph/0701645

| accessdate=2008-03-19

| doi=10.1111/j.1365-2966.2007.11539.x }}</ref>這是太陽功率的1,000倍。<ref>{{cite journal

| last=Sackmann | first=I.-Juliana

| coauthors=Boothroyd, Arnold I.; Kraemer, Kathleen E.

| title=Our Sun. III. Present and Future

| journal=The Astrophysical Journal

| year=1993 | volume=418 | pages=457–468

| url=http://adsabs.harvard.edu/abs/1993ApJ...418..457S

| accessdate=2008-03-19

| doi=10.1086/173407 }}</ref>相反的一條噴流並沒有產生同樣的環，因為它對準一部分密度較低的星際物質。<ref>{{cite journal

| last=Gallo | first=E. | coauthors=Fender, Rob; Kaiser, Christian; Russell, David; Morganti, Raffaella; Oosterloo, Tom; Heinz, Sebastian

| title=A dark jet dominates the power output of the stellar black hole Cygnus X-1

| journal=Nature | year=2005 | volume=436

| issue=7052 | pages=819–821

| url=http://arxiv.org/abs/astro-ph/0508228

| accessdate=2008-03-19

| doi=10.1038/nature03879

| pmid=16094361 }}</ref>

於2006年，有證據顯示天鵝座X-1發放極高能量（超過100 GeV）[[伽瑪射線]]，使其成為第一顆此類大質量黑洞候選星體。這個信號被發現的同時，也短暫地觀測到了硬X射線，顯示兩個事件之間存在一定的聯繫。這下X射線突然的閃耀可能產生於噴流的底部，而伽瑪射線則可能是在與HDE 226868星風相互作用的地方產生。<ref>{{cite journal

| author=Albert, J. ''et al.''

| title=Very High Energy Gamma-ray Radiation from the Stellar-mass Black Hole Cygnus X-1

| journal=Astrophysical Journal Letters

| year=2007 | volume=665 | pages=L51–L54

| url=http://arxiv.org/abs/0706.1505

| accessdate=2008-03-04 | doi = 10.1086/521145

}}</ref>

===HDE 226868===

[[Image:Cygnus\_X-1.png|right|thumb|藝術家對HDE 226868–天鵝座X-1雙星系統的意想圖。''ESA/Hubble illustration.'']]

HDE 226868是一顆超巨星，[[光譜型]]為O9.7 Iab，<ref name=SIMBAD/>處於O型和B型恆星之間的邊界上。其估計表面溫度為31,000[[熱力學溫標|K]]，<ref name=eas030610>{{cite web

| author=Staff | date=June 10, 2003

| url=http://hubble.esa.int/science-e/www/object/index.cfm?fobjectid=32700

| title=Integral's view of Cygnus X-1 | publisher=ESA

| accessdate=2008-03-20 }}</ref>質量約為20–40太陽質量。根據恆星演化模型，其距離估計為2,000秒差距，因此半徑應為太陽半徑的20–22倍，亮度為太陽的300,000–400,000倍。<ref name=iorio/><ref name=MNRAS358/>天鵝座X-1緻密天體與HDE 226868距離為約40個太陽半徑，也就是該星半徑的兩倍。<ref name=apj620/>

HDE 226868的表面因其伴星產生的強大的[[潮汐力]]而變形，形成水滴狀，其自轉更加扭曲其形狀。這使得它每5.6天（公轉週期）上下波動0.06視星等。<ref name=caballero>{{cite conference

| first=M. D. | last=Caballero

| title=OMC-INTEGRAL: Optical Observations of X-Ray Sources

| booktitle=Proceedings of the 5th INTEGRAL Workshop on the INTEGRAL Universe

| pages=875–878 | publisher=ESA

| date=16–20 February 2004 | location=Munich, Germany

| url=http://adsabs.harvard.edu/abs/2004ESASP.552..875C

| accessdate=2008-03-17 }}</ref>其亮度變化形成的“橢球形”形狀是因表面的[[周邊昏暗]]和[[重力昏暗]]引起。<ref>{{cite book

| first=Arthur C. | last=Cox | year=2001 | pages=407

| title=Allen's Astrophysical Quantities

| publisher=Springer | id=ISBN 038795189X }}</ref>

當HDE 226868的光譜與一顆相似的恆星[[參宿二]]比較時，前者大氣層裡的[[氦]]比正常多，而[[碳]]則比正常要少。<ref>{{cite journal

| last=Canalizo | first=G.

| coauthors=Koenigsberger, G.; Peña, D.; Ruiz, E.

| title=Spectral variations and a classical curve-of-growth analysis of HDE 226868 (Cyg X-1)

| journal=Rev. Mex. Astron. Astrofis.

| year=1995 | volume=31 | issue=1

| pages=63–86

| url=http://adsabs.harvard.edu/abs/1995RMxAA..31...63C

| accessdate=2008-03-20 }}</ref>HDE 226868的[[紫外線]]和[[H-α]]光譜線與[[天鵝座P]]相似。這顯示該星被一個氣體包層包圍，而該包層正加速遠離恆星中心，目前速度為大約1,500公里每秒。<ref>{{cite journal

| last=Conti | first=P. S.

| title=Stellar parameters of five early type companions of X-ray sources

| journal=Astronomy and Astrophysics

| year=1978 | volume=63 | pages=1–2

| url=http://adsabs.harvard.edu/abs/1978A%26A....63..225C

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| last=Sowers | first=J. W.

| coauthors=Gies, D. R.; Bagnuolo, W. G.; Shafter, A. W.; Wiemker, R.; Wiggs, M. S.

| title=Tomographic Analysis of Hα Profiles in HDE 226868/Cygnus X-1

| journal=The Astrophysical Journal

| year=1998 | volume=506

| issue=1 | pages=424–430

| url=http://adsabs.harvard.edu/abs/1998ApJ...506..424S

| accessdate=2008-03-20

| doi=10.1086/306246 }}</ref>

和其他同光譜型的恆星一樣，人們認為HDE 226868也是以一股[[星風]]向外流失質量，速率為每年2.5{{e|-6}}太陽質量<ref>{{cite journal

| last=Hutchings | first=J. B.

| title=Stellar winds from hot supergiants

| journal=The Astrophysical Journal

| year=1976 | volume=203 | pages=438–447

| url=http://adsabs.harvard.edu/abs/1976ApJ...203..438H

| accessdate=2007-02-04

| doi=10.1086/154095 }}</ref>這相等於每400,000年流失一個太陽質量。其緻密的伴星正在影響這股星風的形狀，使其更為集中，而不是對稱的球體。<ref name=apj620>{{cite journal

| last=Miller | first=J. M.

| coauthors=Wojdowski, P.; Schulz, N. S.; Marshall, H. L.; Fabian, A. C.; Remillard, R. A.; Wijnands, R.; Lewin, W. H. G.

| title=Revealing the Focused Companion Wind in Cygnus X-1 with ''Chandra''

| journal=The Astrophysical Journal

| year=2005 | volume=620 | pages=398–404

| doi=10.1086/426701 }}</ref>緻密天體周圍空間發出的X射線加熱並電離這股星風。當它通過星風的不同位置時，紫外線<ref>{{cite journal

| last=Vrtilek | first=Saeqa D.

| coauthors=Hunacek, A.; Boroson, B. S.

| title=X-Ray Ionization Effects on the Stellar Wind of Cygnus X-1

| journal=Bulletin of the American Astronomical Society

| year=2006 | volume=38 | pages=334

| url=http://adsabs.harvard.edu/abs/2006HEAD....9.0131V

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}}</ref>無線電<ref>{{cite journal

| last=Pooley | first=G. G.

| coauthors=Fender, R. P.; Brocksopp, C.

| title=Orbital modulation and longer-term variability in the radio emission from Cygnus X-1

| journal=Monthly Notices of the Royal Astronomical Society

| year=1999 | volume=302 | issue=1 | pages=L1–L5

| url=http://arxiv.org/abs/astro-ph/9809305v1

| accessdate=2008-03-28

| doi=10.1046/j.1365-8711.1999.02225.x }}</ref>和X射線也會有變動。<ref>{{cite journal

| last=Gies | first=D. R.

| coauthors=Bolton, C. T.; Thomson, J. R.; Huang, W.; McSwain, M. V.; Riddle, R. L.; Wang, Z.; Wiita, P. J.; Wingert, D. W.; Csák, B.; Kiss, L. L.

| title=Wind Accretion and State Transitions in Cygnus X-1

| journal=The Astrophysical Journal

| year=2003 | volume=583 | pages=424–436 | doi = 10.1086/345345

}}</ref>

HDE 226868的[[洛希瓣]]內的所有物質都被引力捕獲。任何在洛希瓣之外的物質都有可能墮入其伴星。這個洛希瓣相信十分靠近HDE 226868的表面，但並不在其之下，因此其表面物質並不會被緻密伴星吸走。然而，它吹出的一大部分星風在離開洛希瓣後就被吸入其伴星的吸積盤裡。<ref name=apj304>{{cite journal

| last=Gies | first=D. R. | coauthors=Bolton, C. T.

| title=The optical spectrum of HDE 226868 = Cygnus X-1. II&nbsp;— Spectrophotometry and mass estimates

| journal=The Astrophysical Journal, Part 1

| year=1986 | volume=304 | pages=371–393

| url=http://adsabs.harvard.edu/abs/1986ApJ...304..371G

| accessdate=2008-03-18

| doi=10.1086/164171 }}</ref>

太陽和HDE 226868之間的氣體和塵埃降低了它的視亮度，並使它顯得更紅，因為紅光能更有效地穿透星際物質中的塵埃。星際物質的[[消光]] （A<sub>V</sub>）值大約是3.3[[視星等]]。<ref>{{cite journal

| last=Margon | first=Bruce

| coauthors=Bowyer, Stuart; Stone, Remington P. S.

| title=On the Distance to Cygnus X-1

| journal=The Astrophysical Journal

| year=1973 | volume=185 | issue=2 | pages=L113–L116

| url=http://articles.adsabs.harvard.edu/abs/1973ApJ...185L.113M

| accessdate=2008-03-19

| doi=10.1086/181333 }}</ref>如果除去中間的物質，HDE 226868的視星等會是5等，<ref>{{cite web

| url=http://astronomy.swin.edu.au/cosmos/I/Interstellar+Reddening

| title=Interstellar Reddening

| publisher=Swinburne University of Technology

| accessdate=2006-08-10

}}</ref>且能被肉眼觀測到。<ref>{{cite web

| last=Kaler | first=Jim

| url=http://www.astro.uiuc.edu/~kaler/sow/cygx1.html

| title=Cygnus X-1 | publisher=University of Illinois

| accessdate=2008-03-19 }}</ref>

==史蒂芬·霍金與基普·索恩==

天鵝座X-1曾是物理學家[[史蒂芬·霍金]]和[[基普·索恩]]打賭的主角，霍金賭這個空間裡沒有黑洞存在。霍金後來解釋，這是一個“保險措施”。在《[[時間簡史]]》裡，霍金寫道：{{cquote|這對我而言是一個保險的形式。我對黑洞做了許多研究，如果發現黑洞不存在，則這一切都成為徒勞。但在這種情形下，我將得到贏得打賭的安慰，他要給我4年的雜誌《私人眼睛》。如果黑洞確實存在，基普·索恩將得到1年的《閣樓》。我們在1975年打賭時，大家80%斷定，天鵝座是一個黑洞。迄今，我可以將大約95%是肯定的，但輸贏最終尚未見分曉。<ref>{{cite book

| first=Stephen | last=Hawking | year=1988

| title=A Brief History of Time | publisher=Bantam Books

| isbn=0-553-05340-X }}</ref>}}

根據《時間簡史》的十週年更新版本，霍金已經輸了打賭，<ref>{{cite book

| first=Stephen | last=Hawking | year=1998

| title=A Brief History of Time

| edition=Updated and Expanded Tenth Anniversary

| publisher=Bantam Doubleday Dell Publishing Group

| isbn=0553380168 }}</ref>因為之後的觀測數據支持黑洞理論。在索恩的《[[黑洞與時間扭曲]]》中，索恩寫道：1990年霍金到南加州大學演講，當時索恩人在莫斯科，於是霍金大張旗鼓闖入索恩的辦公室拿出當年的賭據來按手指認輸。<ref>{{cite book

| last=Thorne | first=Kip | year=1994

| title=Black Holes and Time Warps: Einstein's Outrageous Legacy

| publisher=W. W. Norton & Company

| isbn = 0-393-31276-3}}</ref>

==參見==

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\*{{cite web

| author=Staff | date=April 1, 1996

| url=http://www.oa.uj.edu.pl/research/cygx1.html

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\*{{WikiSky|z=8}}

{{Sky|19|58|21.6756|+|35|12|05.775|6000}}

[[Category:雙星]]

[[Category:O型超巨星]]

[[Category:天鵝座]]

[[Category:X射線雙星]]

[[Category:黑洞]]

[[af:Cygnus X-1]]

[[ar:نجم الدجاجة إكس-1]]

[[br:Cygnus X-1]]

[[ca:Cygnus X-1]]

[[cs:Cygnus X-1]]

[[de:Cygnus X-1]]

[[es:Cygnus X-1]]

[[fa:ماکیان ایکس یک]]

[[fr:Cygnus X-1]]

[[ko:고니자리 X-1]]

[[it:Cygnus X-1]]

[[lv:Gulbis X-1]]

[[nl:Cygnus X-1]]

[[ja:はくちょう座X-1]]

[[pl:Cygnus X-1]]

[[pt:Cygnus X-1]]

[[ru:Лебедь X-1]]

[[simple:Cygnus X-1]]

[[sk:Cygnus X-1]]

[[fi:Cygnus X-1]]

[[sv:Cygnus X-1]]

[[tr:Cygnus X-1]]