

Astroteilchenphysik II: Gammastrahlung

Vorlesung 10

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Aktive Galaktische Kerne und Gammastrahlenblitze (GRBs)

Emissions- und Absorptionsprozesse

- Akkretionsscheibe und Gastorus
- Plasmastrahlen (Jets) und Knoten

Nachweis Schwarzer Löcher

- Keplerbahnen und Dopplereffekt
- Eddingtonschanke

Unmittelbare Umgebung von Schwarzen Löchern

- Akkretionsscheibe und Gastorus
- Plasmastrahlen (Jets) und Knoten

Eigenschaften von Gamma-Strahlen-Blitzen

- Entdeckung und erste Beobachtungen
- Energiespektren und Zeitvariabilität
- Verteilung im Universum
- Luminositätsabschätzungen

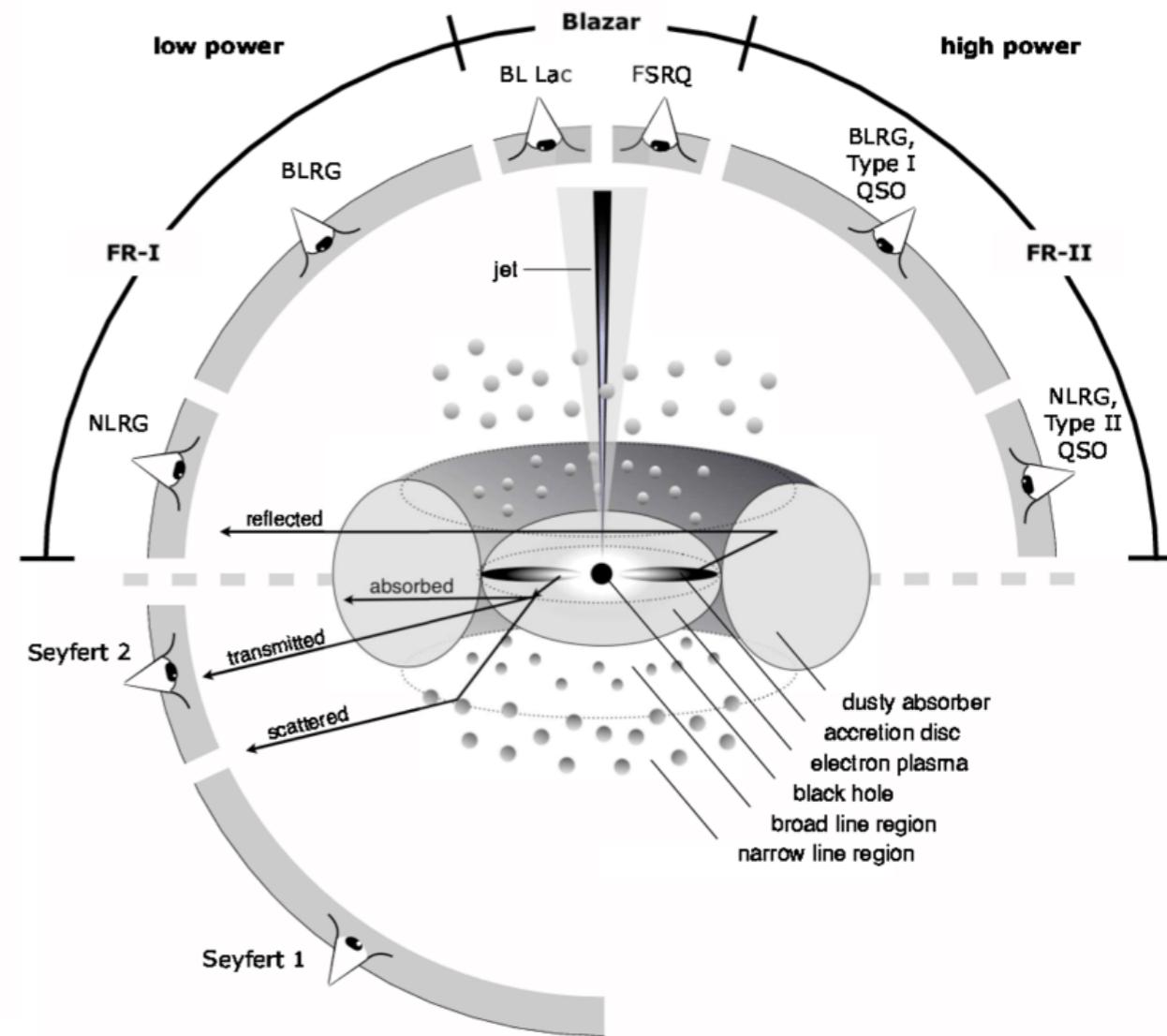
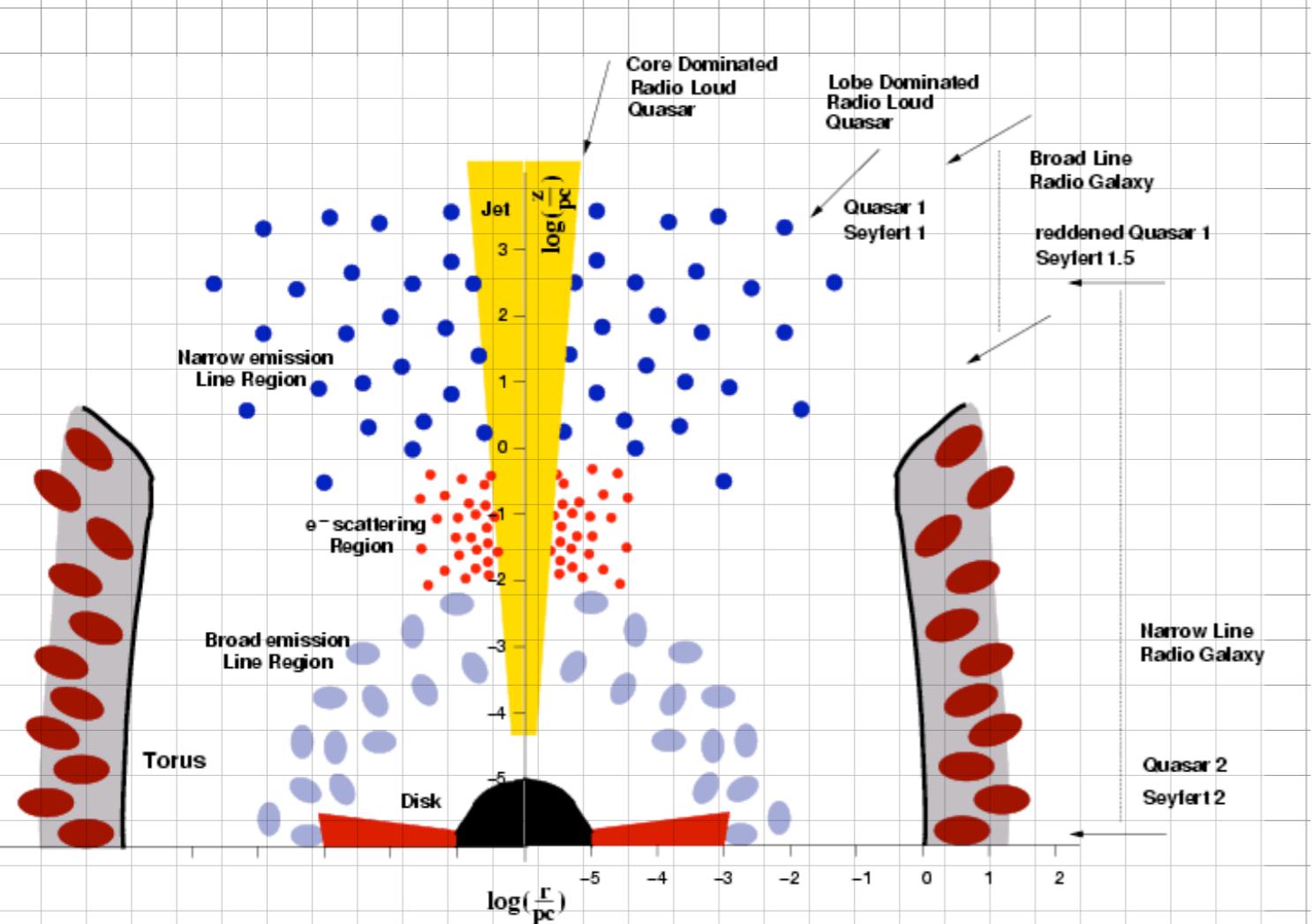
Interpretation und Physik von Gamma-Strahlen-Blitzen

- allgemeine Deutung der Beobachtungen
- Modell des relativistischen Feuerballs
- Plasmastrahlen und relativistische Effekte

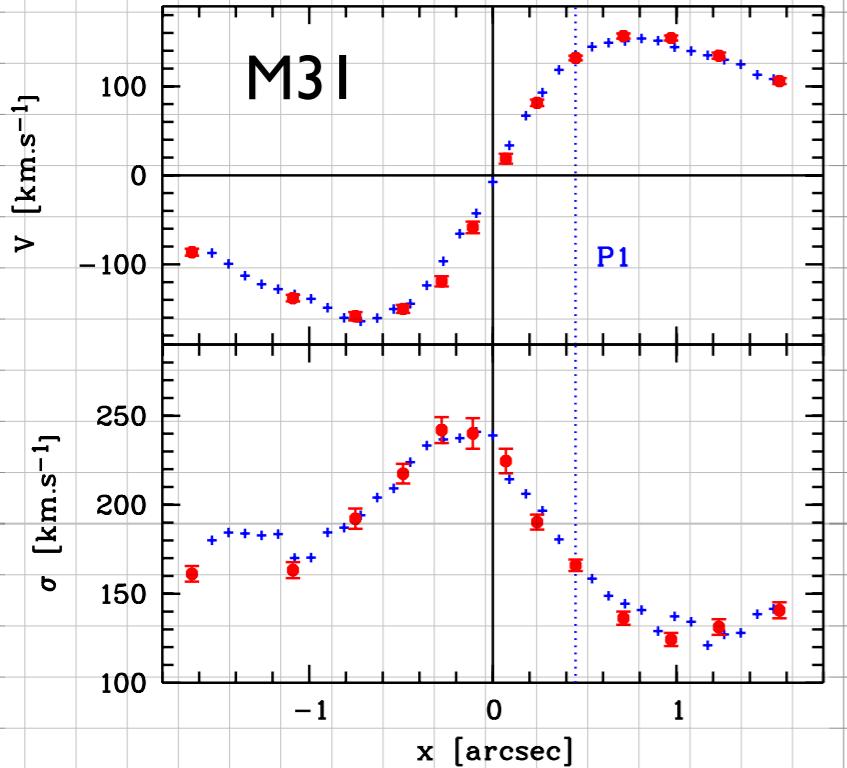
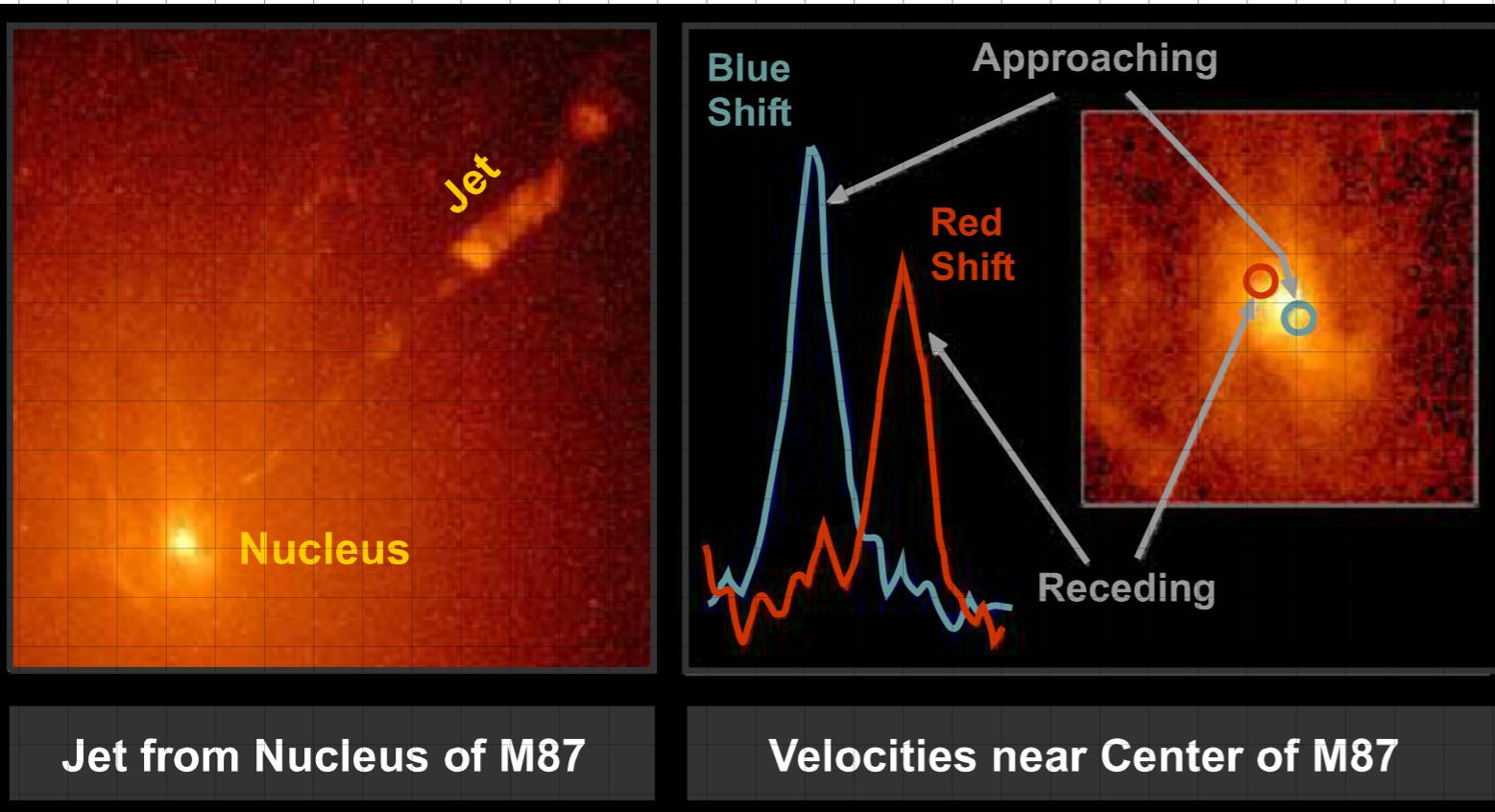
Vorlesung: Termine

Dienstag		Donnerstag	
		23.04.2020	Vorlesung
		30.04.2020	Vorlesung
		07.05.2020	Vorlesung
12.05.2020	Übung	14.05.2020	Vorlesung
		-	Feiertag
		28.05.2020	Vorlesung
		04.06.2020	Vorlesung
09.06.2020	Übung	-	Feiertag
		18.06.2020	Vorlesung
23.06.2020	Übung	25.06.2020	Ausgefallen
		02.07.2020	Vorlesung
07.07.2020	Übung	09.07.2020	Vorlesung
		16.07.2020	Vorlesung
21.07.2020	Übung	23.07.2020	Vorlesung

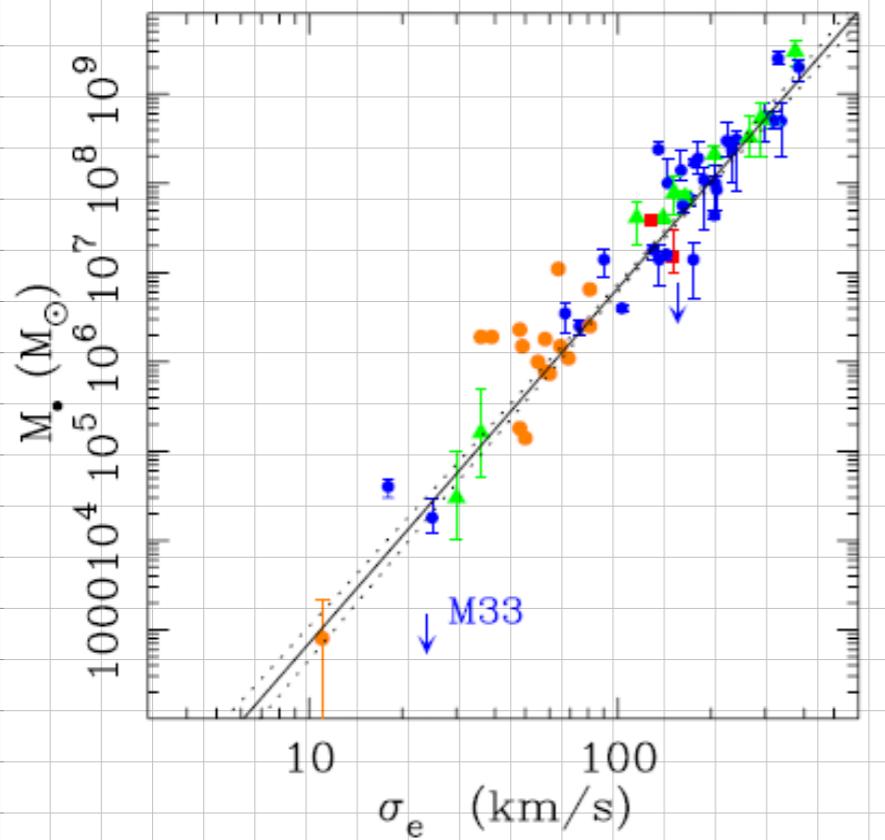
Vereinheitlichtes Modell: Aktive Galaktische Kerne



Superschwere schwarze Löcher: Dopplerverschiebung



Superschwere schwarze Löcher: Geschwindigkeitsvarianz

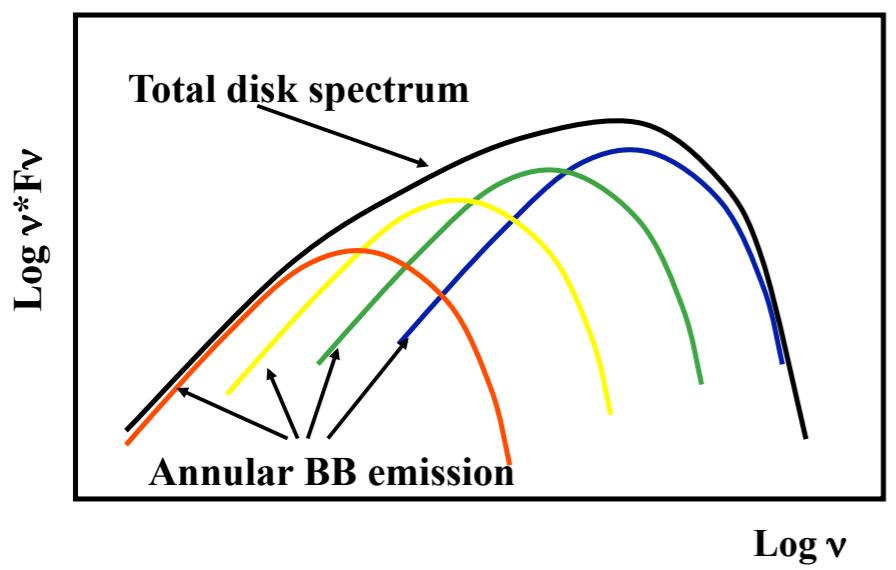
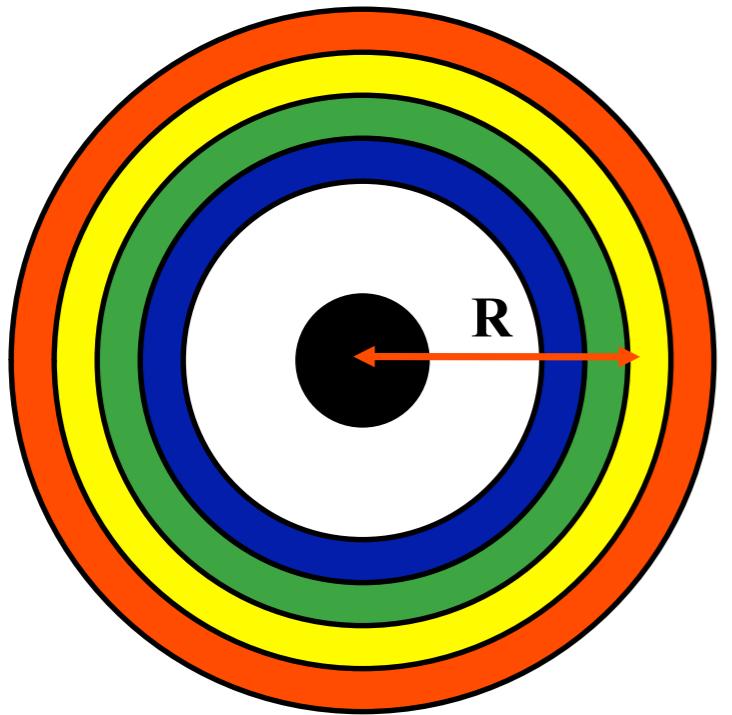


Superschwere Schwarze Löcher: Luminosität

Eddington-Schranke

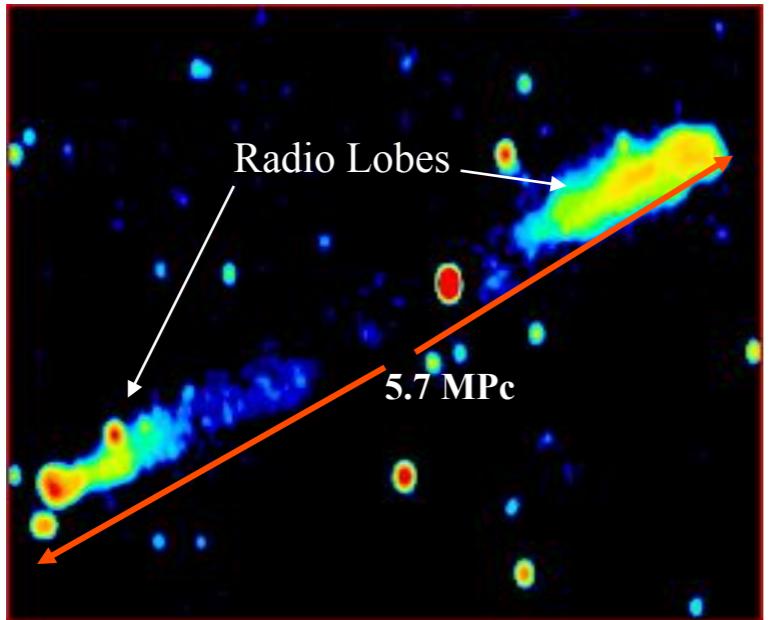
Eddingtonschranke

Akkretionsscheiben

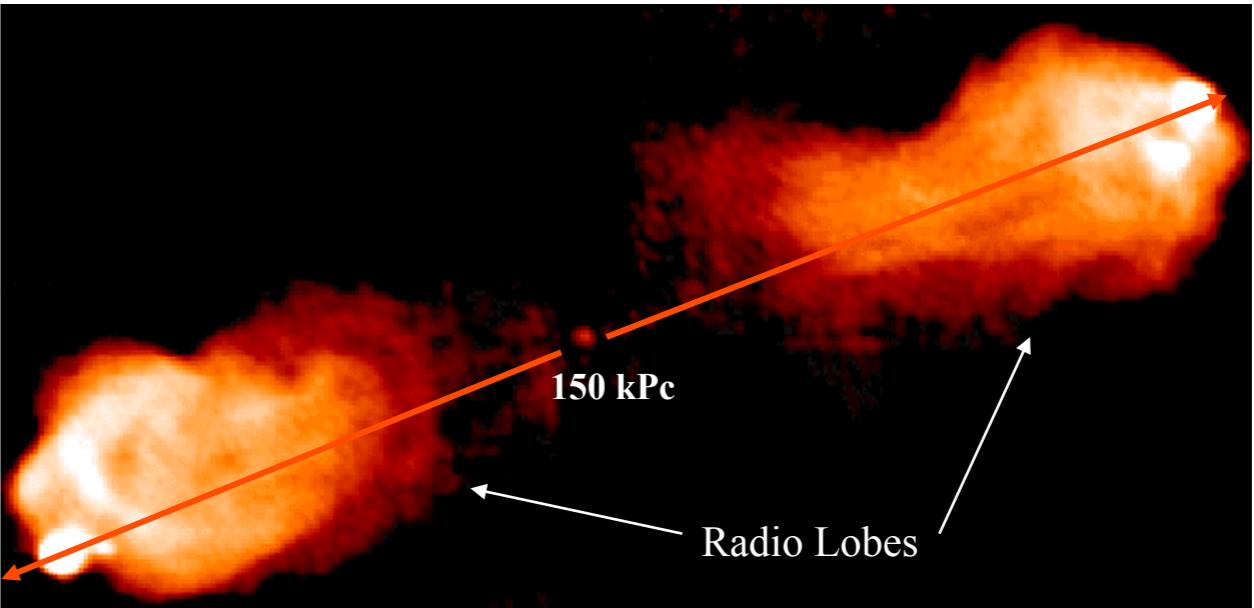


Akkretionsrate und Luminosität

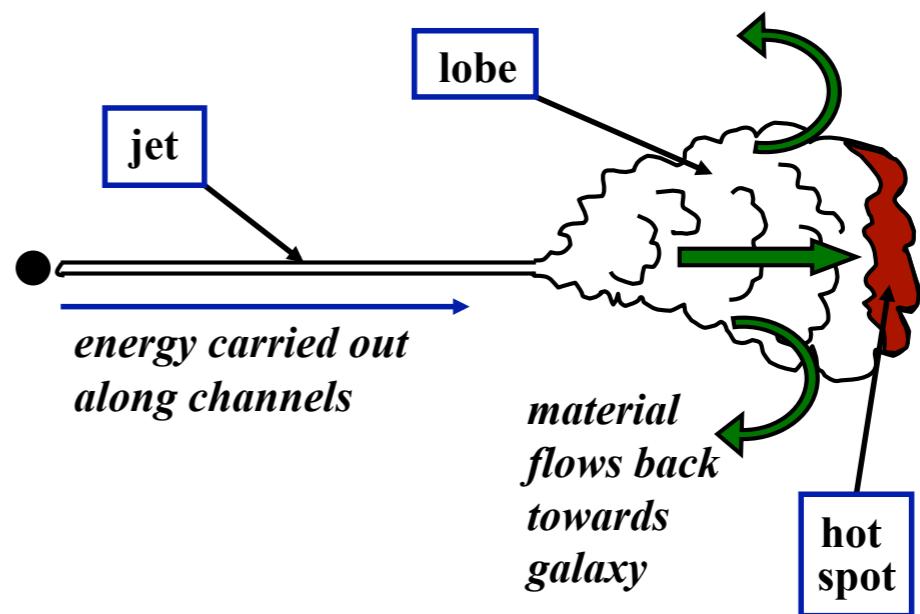
Plasmajets von Aktiven Galaktischen Kernen



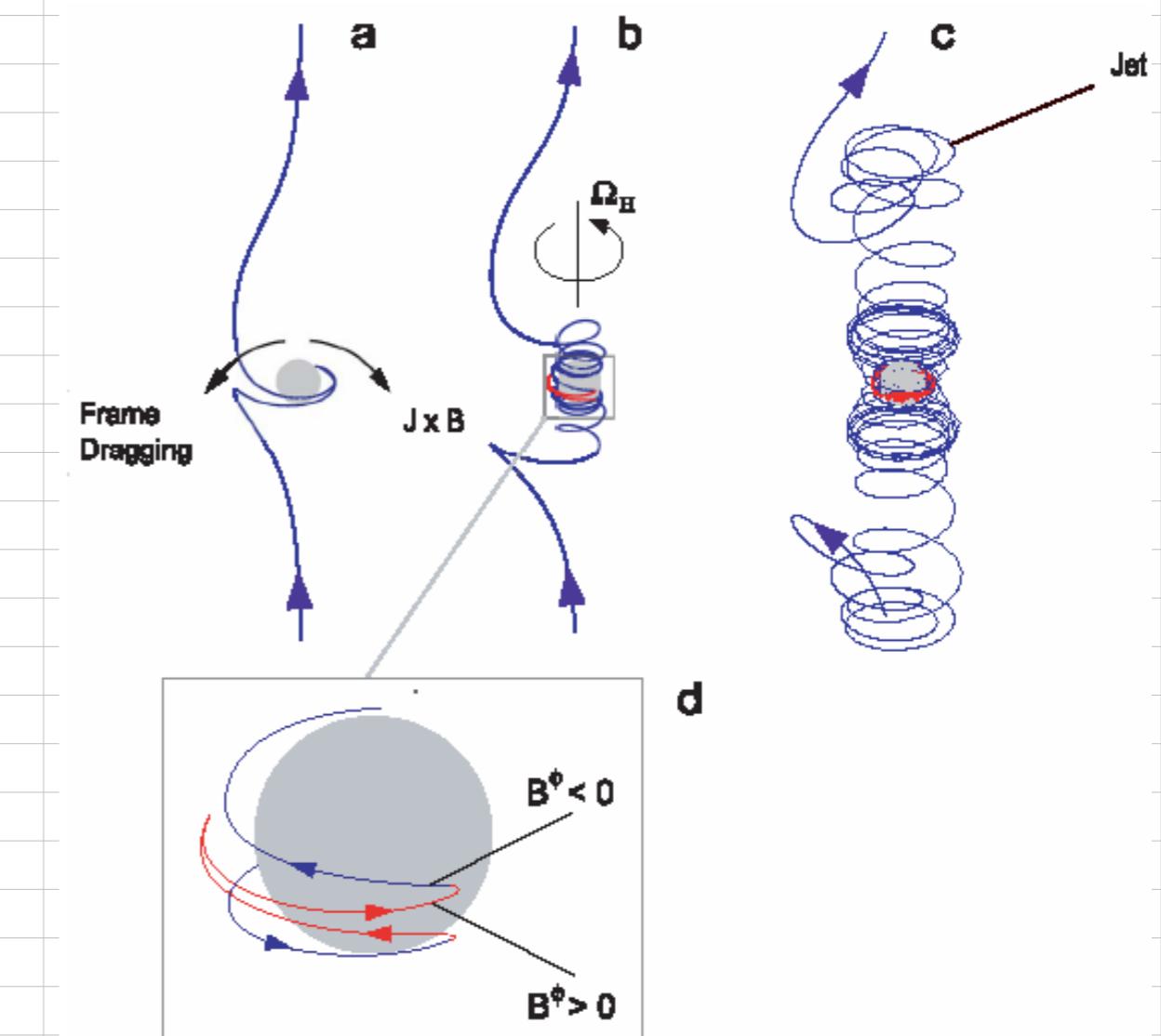
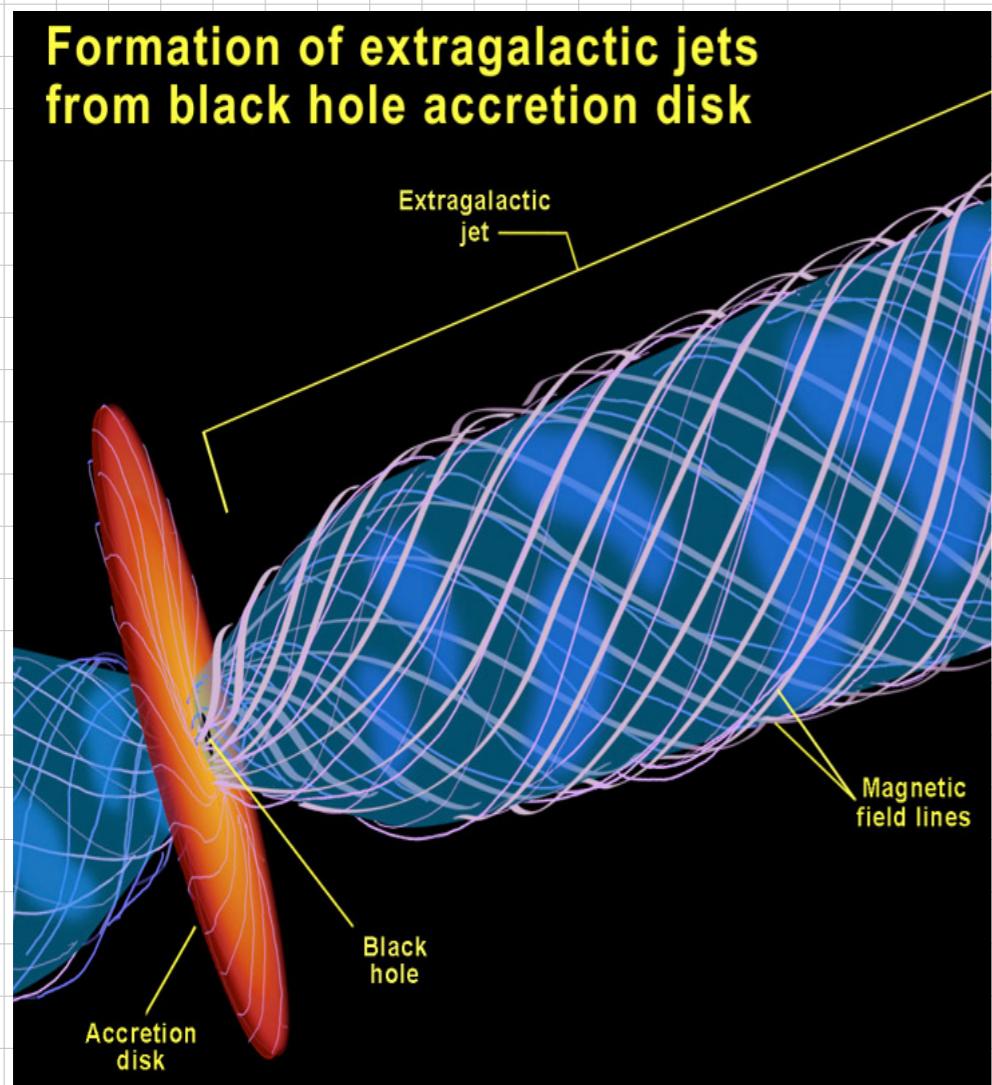
3C 236 ($d = 490$ Mpc)



Cygnus A ($d=190$ Mpc)

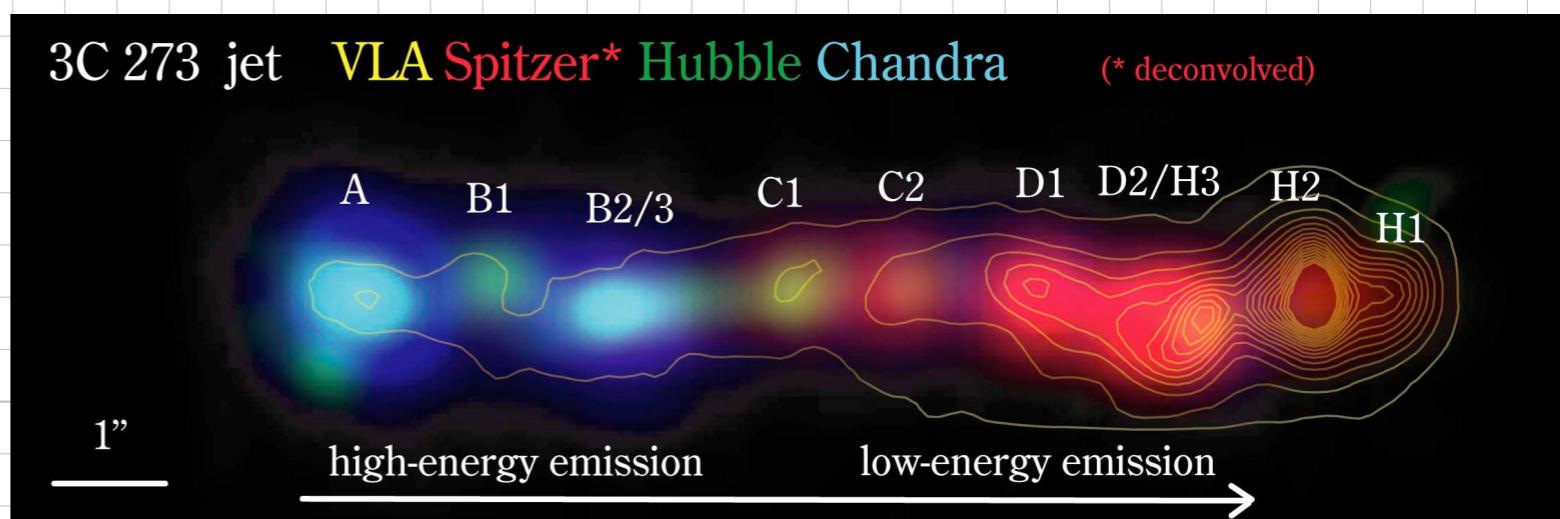
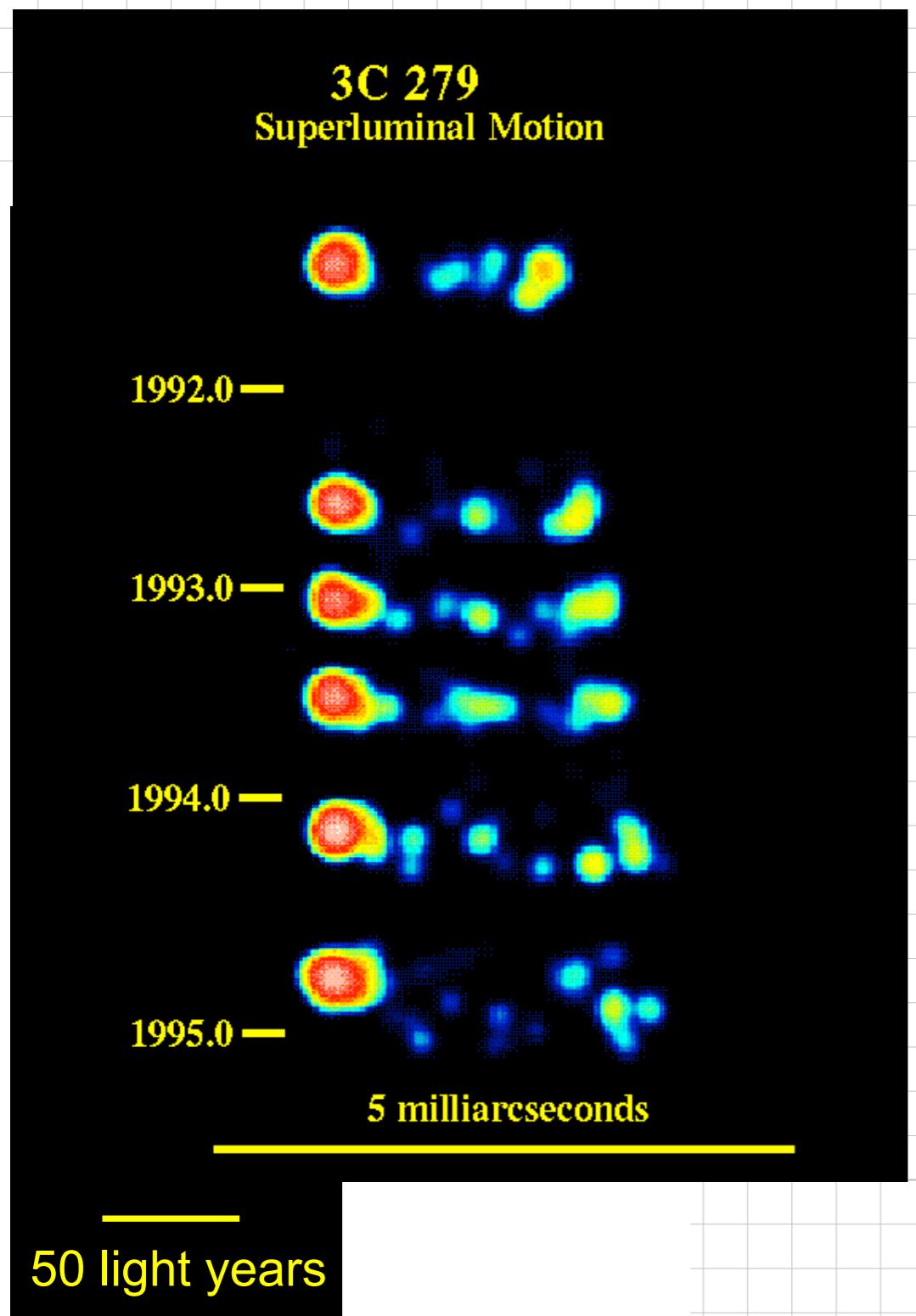


Entstehung von Plasmajets

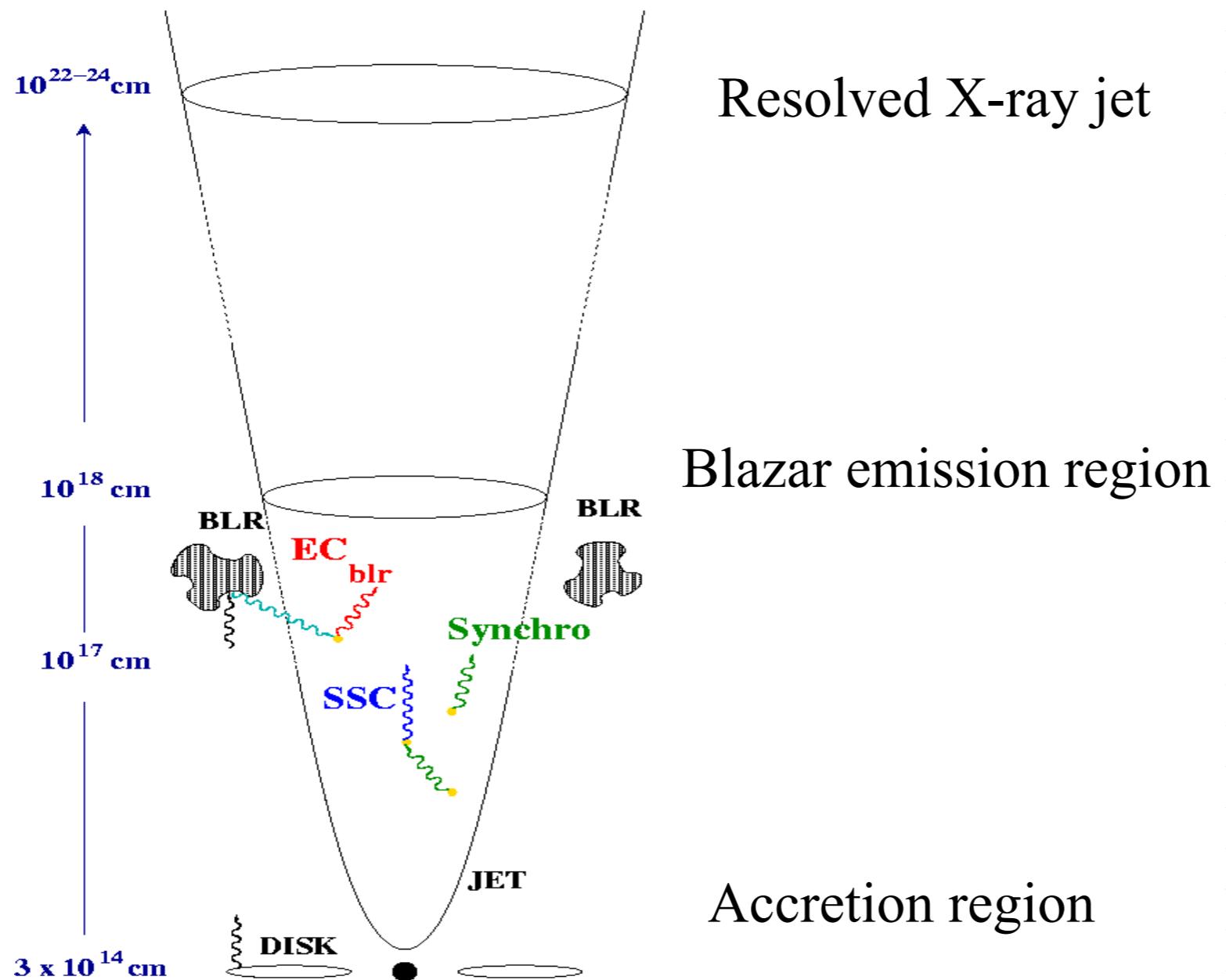


Modell von Blandford und Znajek, 1977

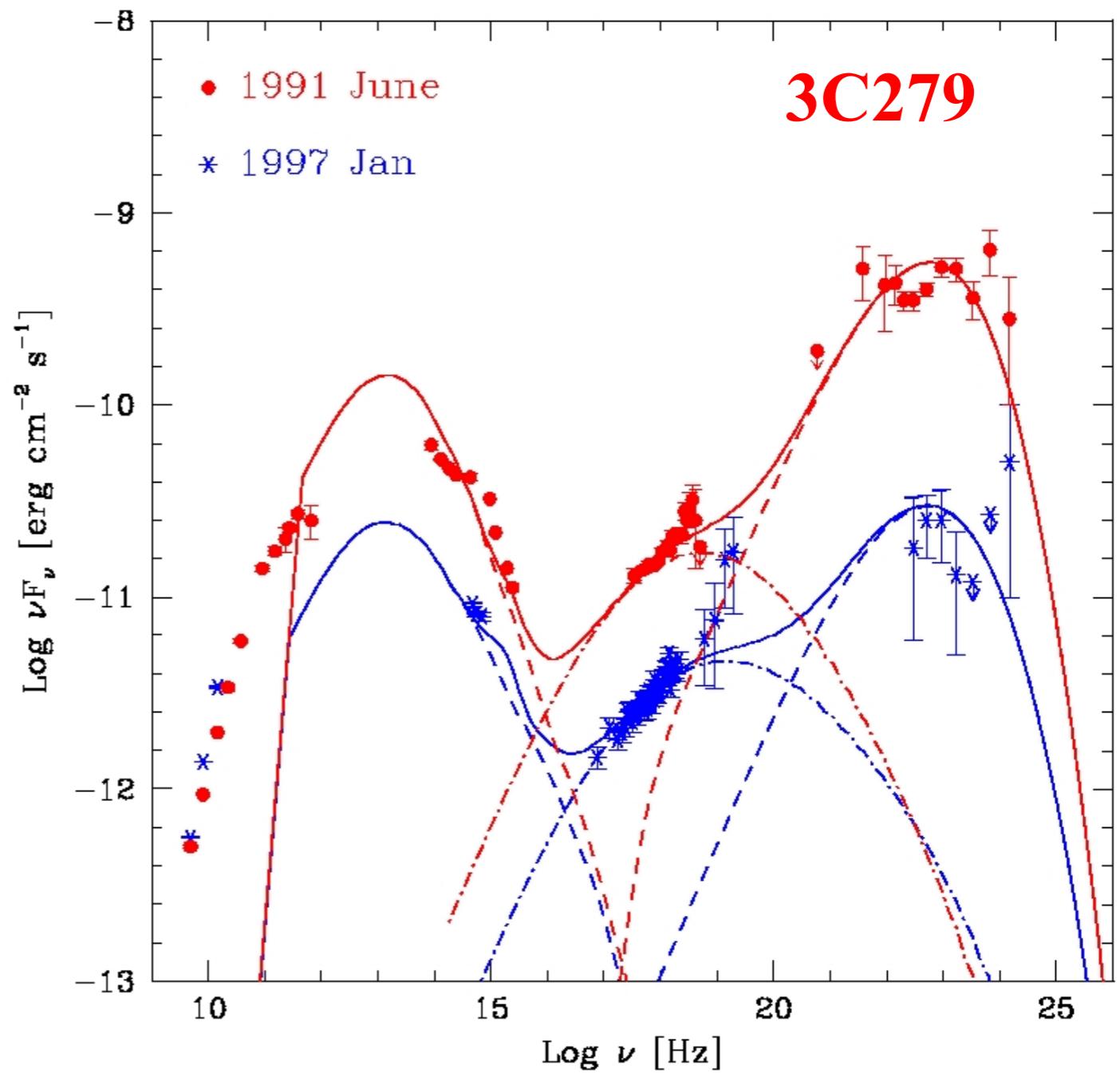
Superluminale Bewegung der Knoten in Jets



Teilchenbeschleunigung und Gamma-Strahlung



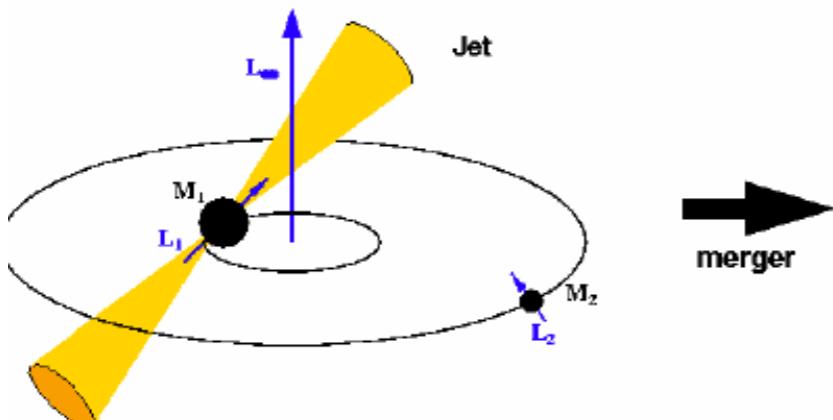
Modellbeschreibung der Gamma-Strahlung



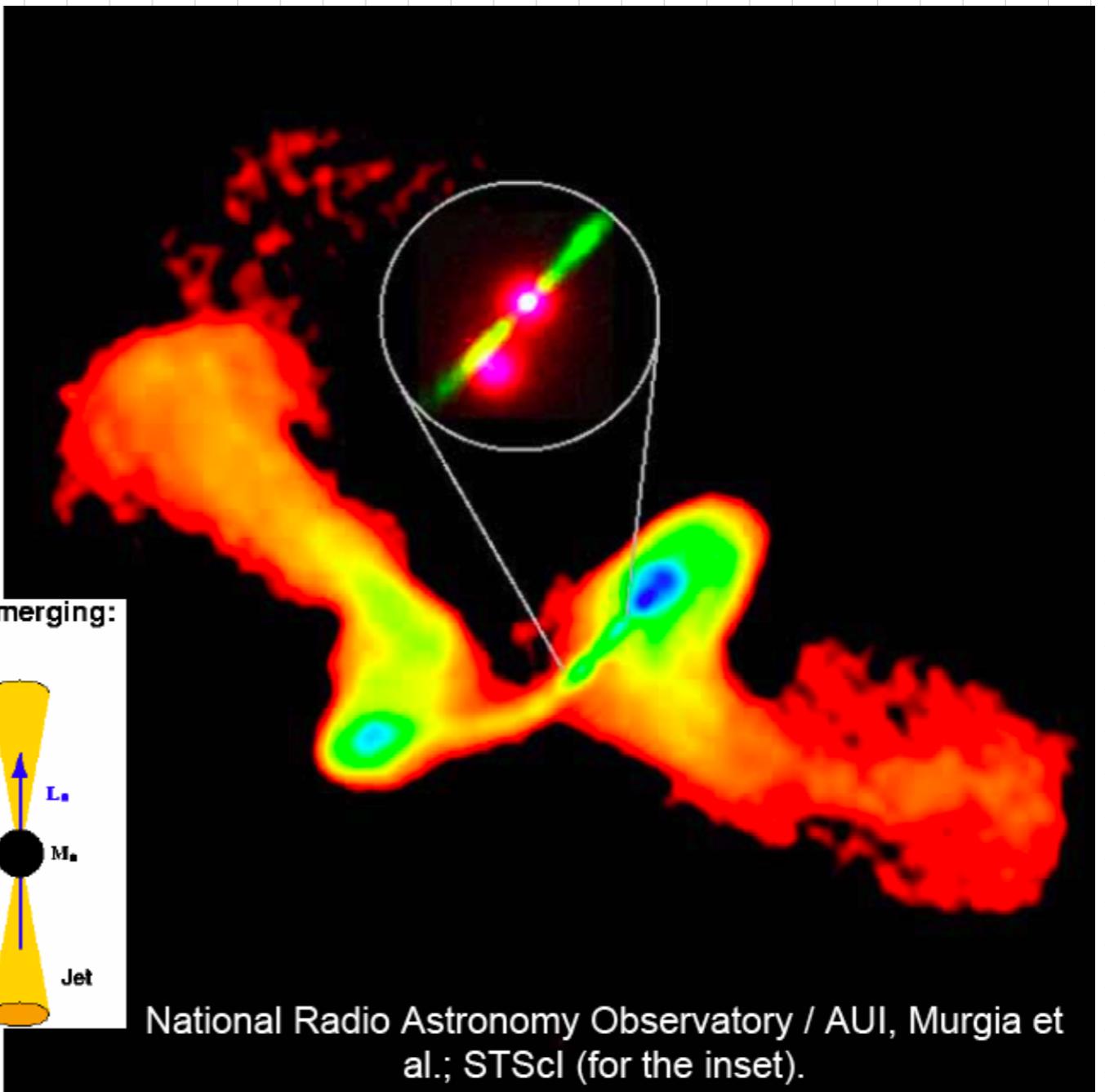
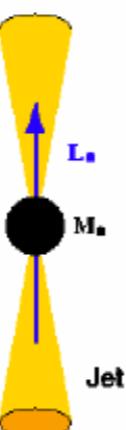
Vereinigung von Schweren Löchern

- NGC 326
- Merging of Black Holes:
Jets change their direction
- Jet-flip due to Spin-flip of the primary Black Hole

Before merging:

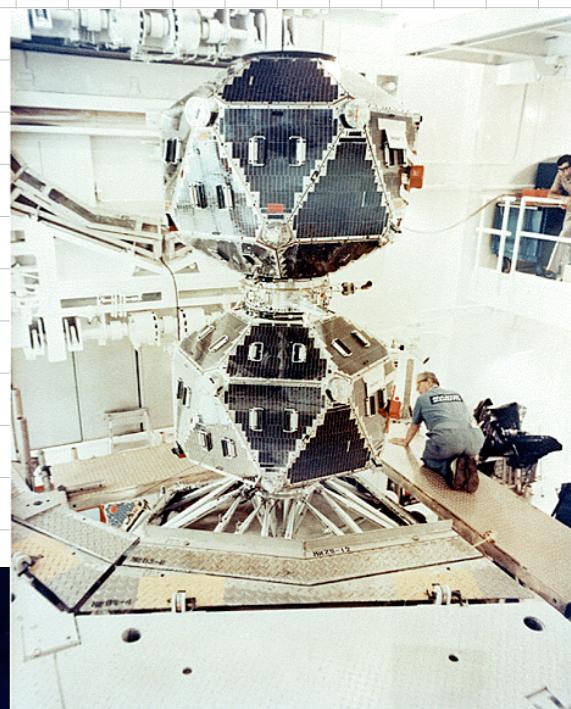
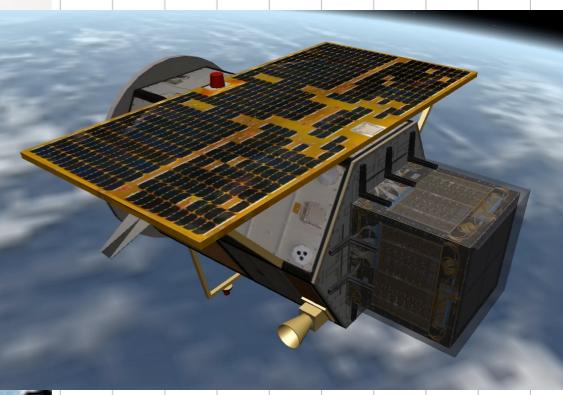


After merging:

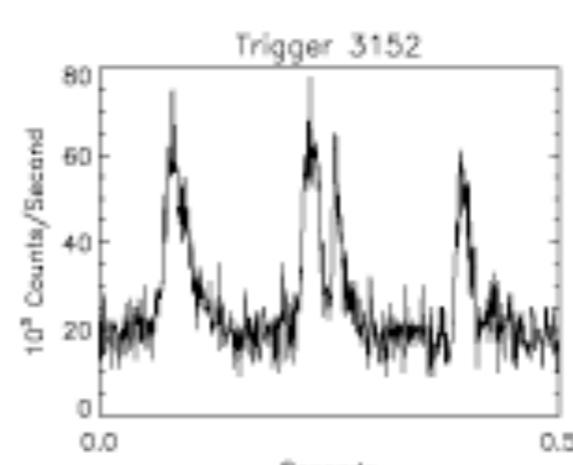
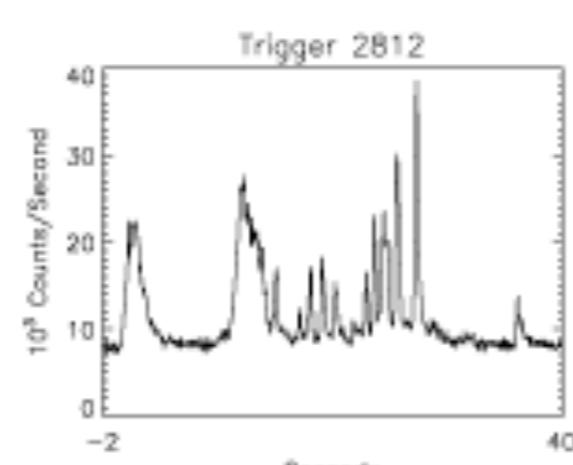
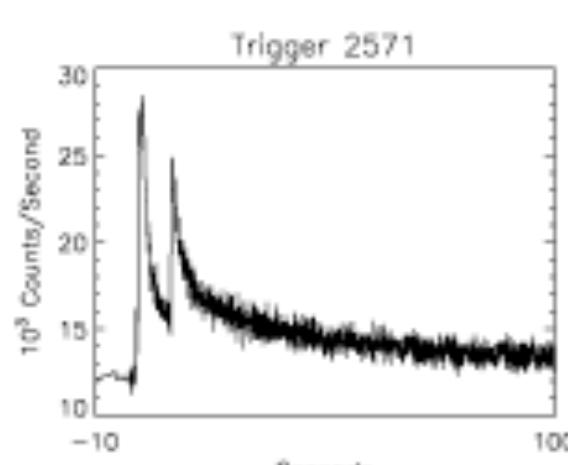
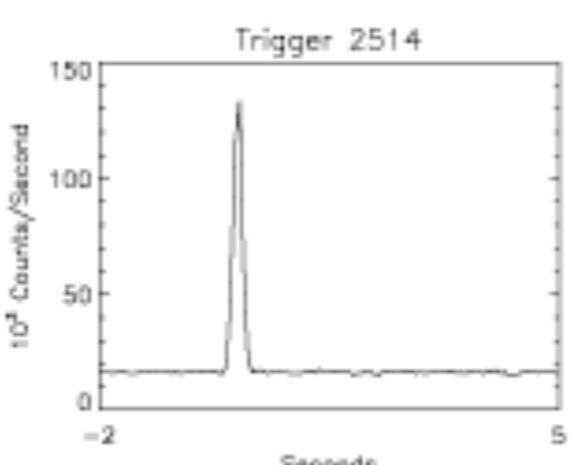
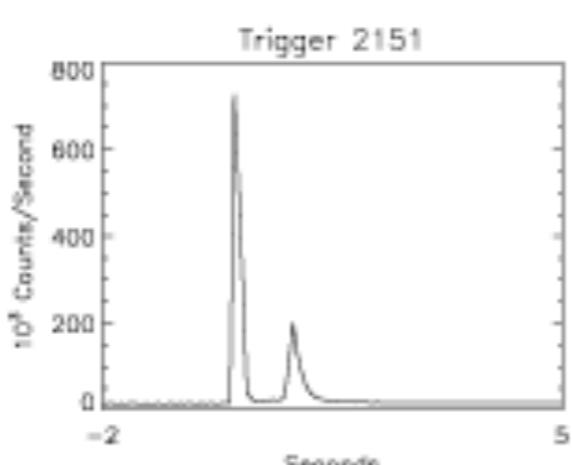
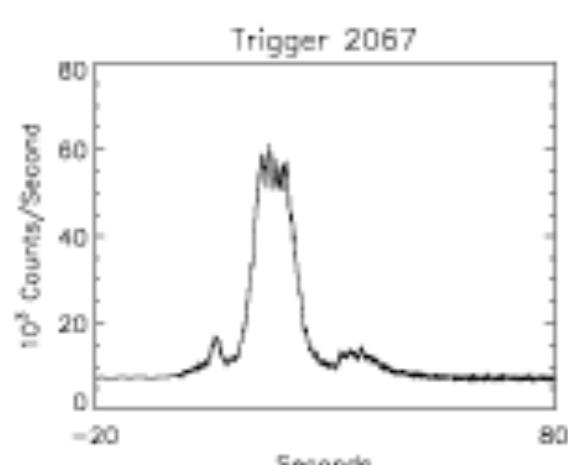
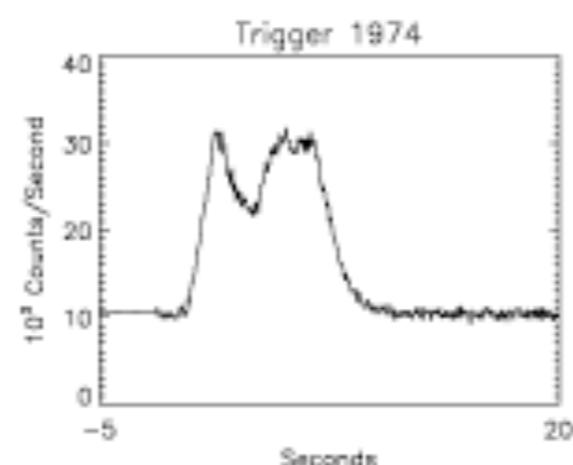
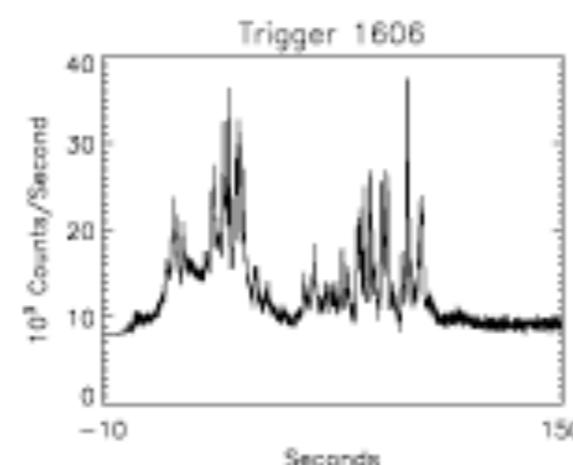
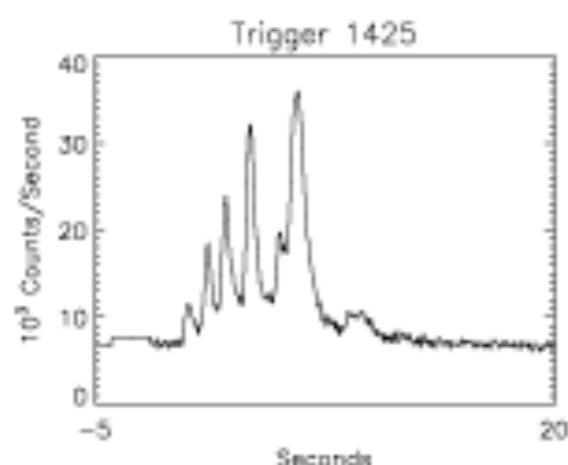
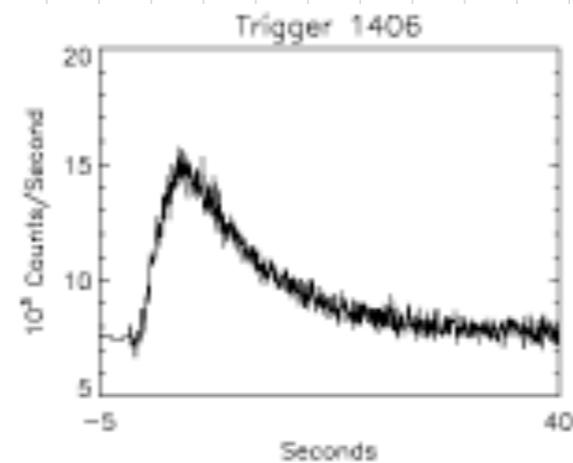
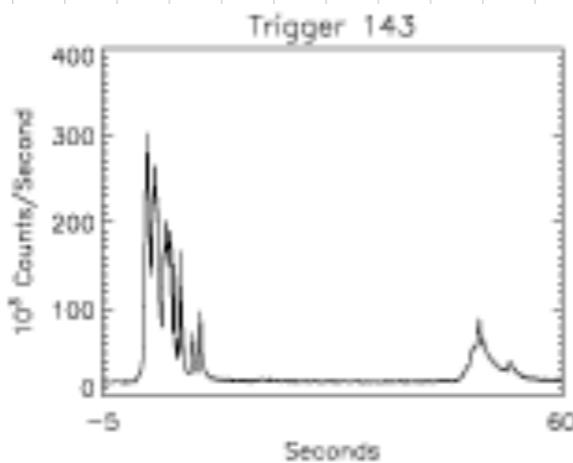
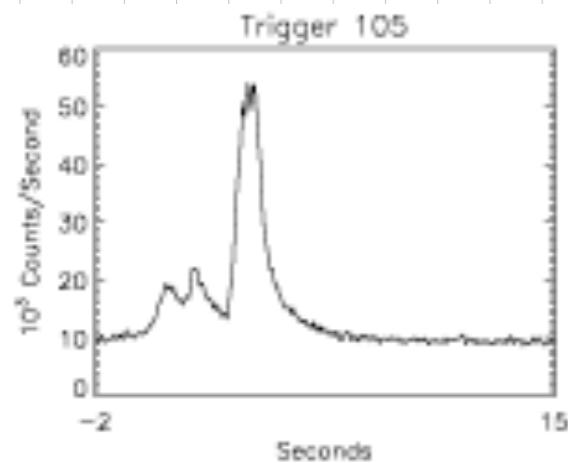


Gamma-Strahlen-Blitze (GRBs): Historisches

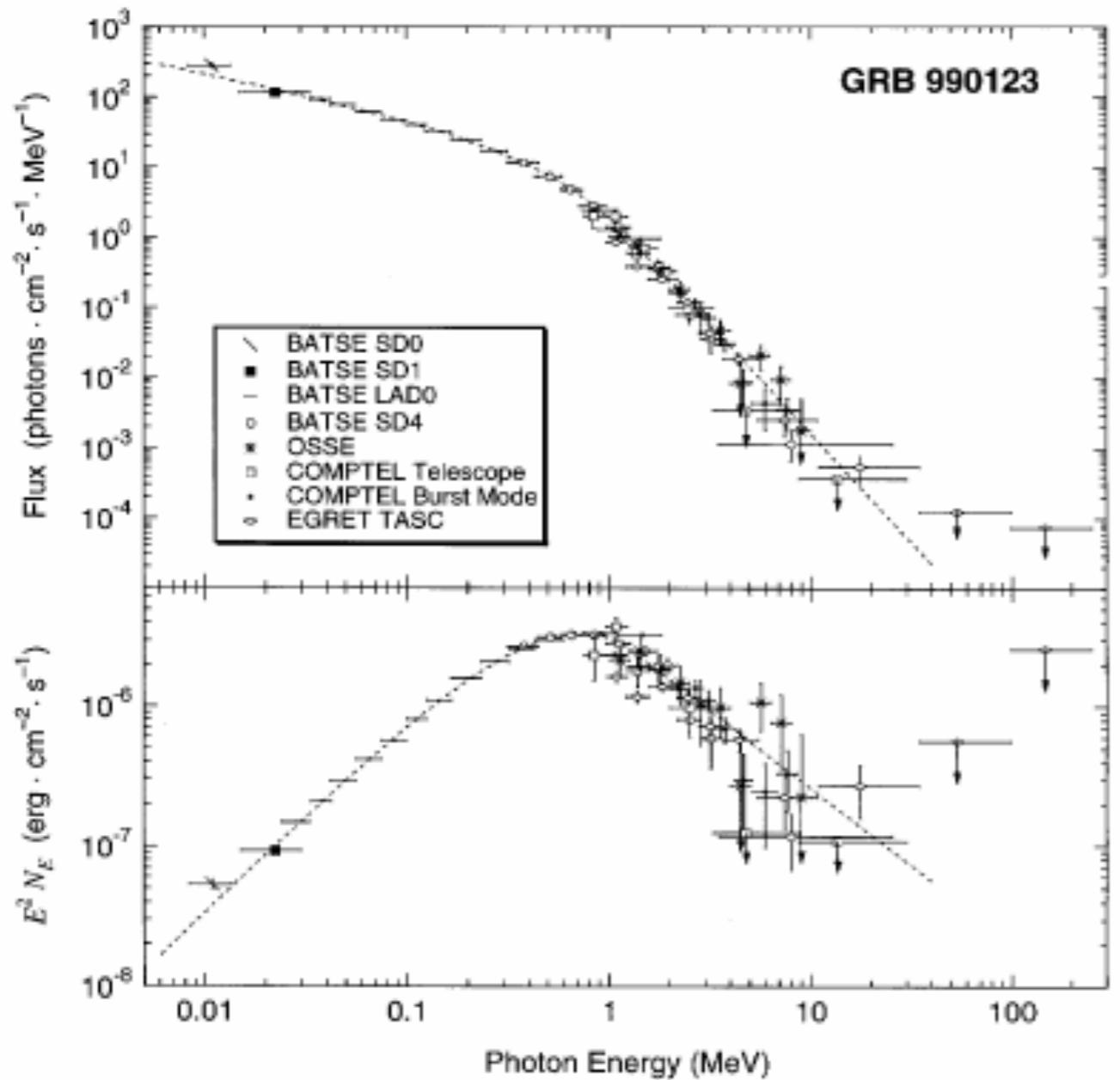
- 1967 Entdeckung (Vela-Satelliten)
- 1991 Compton Gamma Ray Observatory (CGRO), BATSE-Detektor
- 1997 Beppo-SAX-Satellit, anschließend HETE-2
- 2004 Swift-Satellit
- AGILE-Satellit
Fermi-Satellit (GLAST)
MAGIC (HESS, VERITAS, ...)



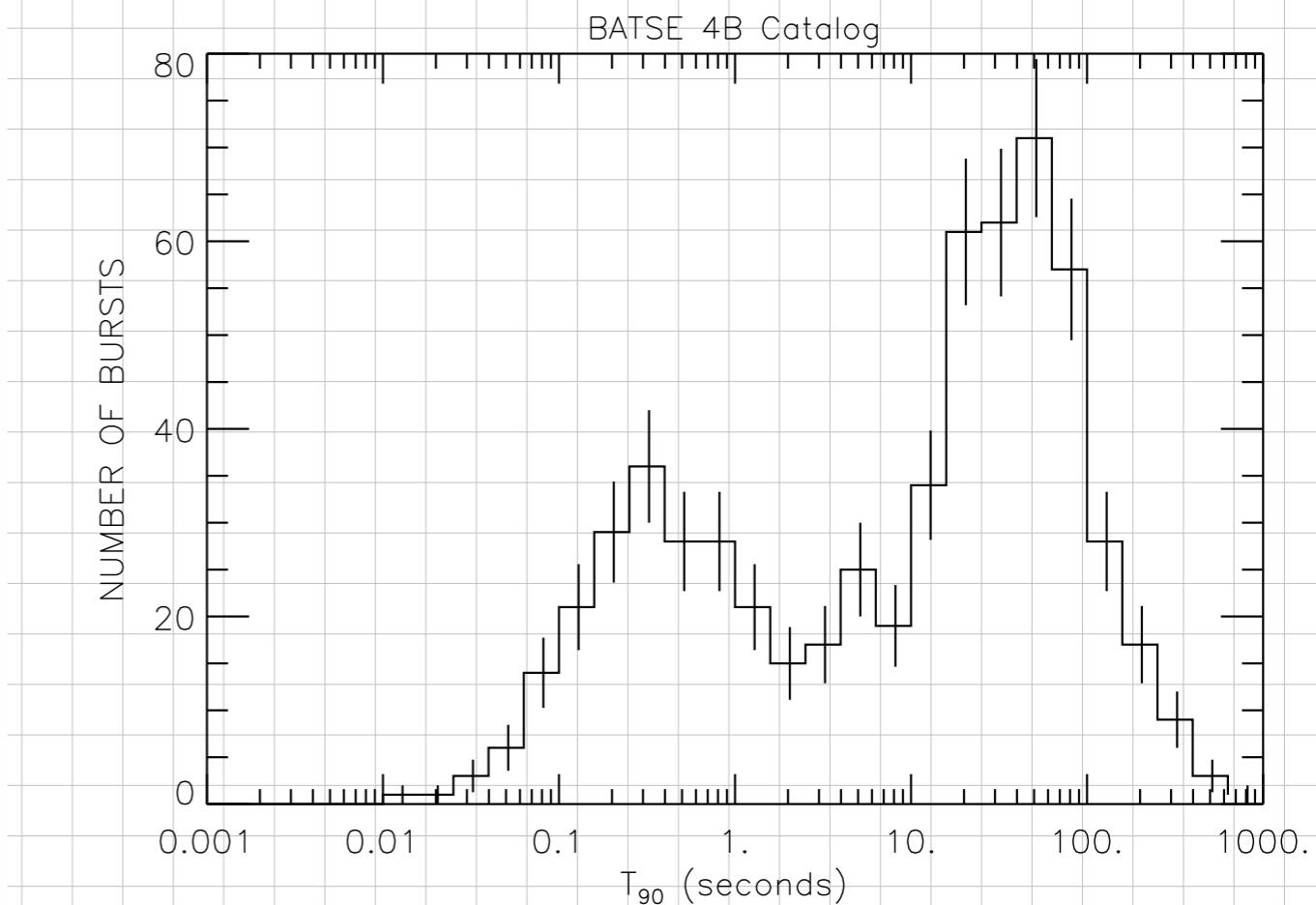
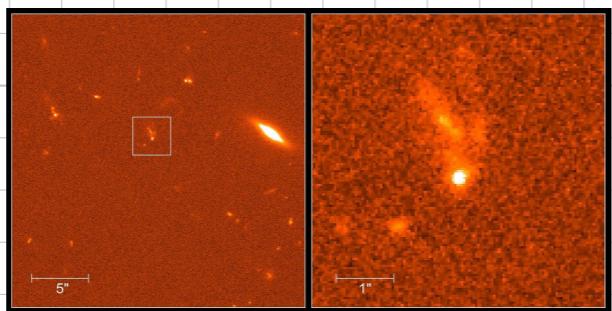
GRB- Eigenschaften



Energiespektrum und Ausbruchsdauer

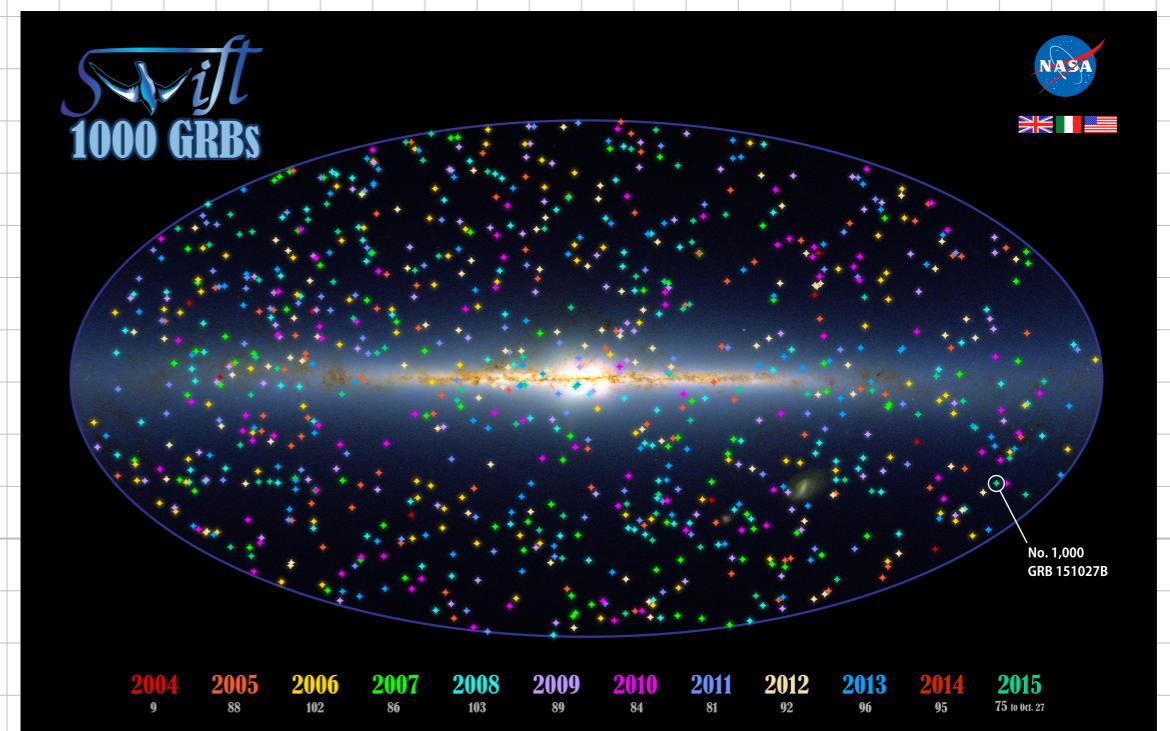
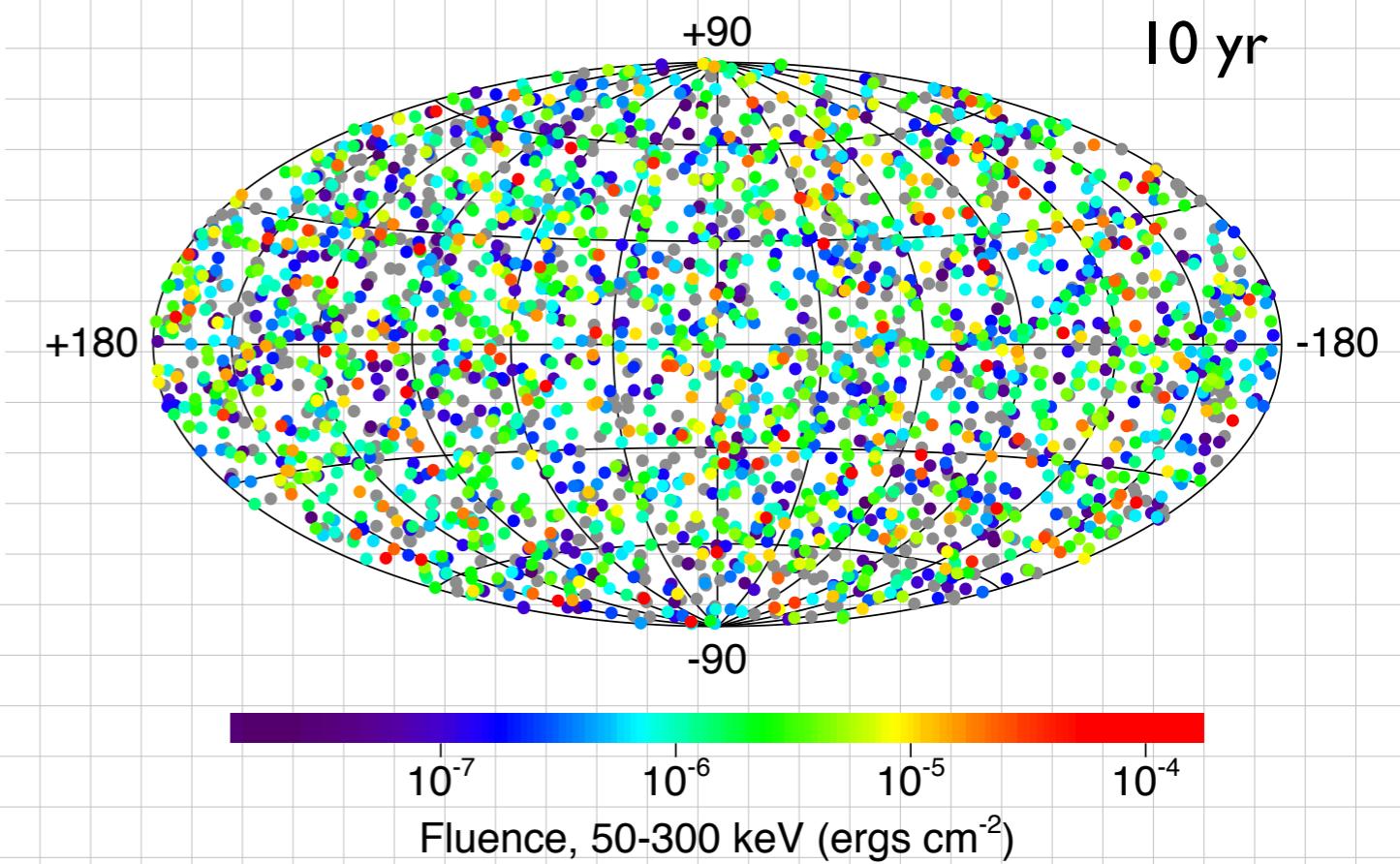
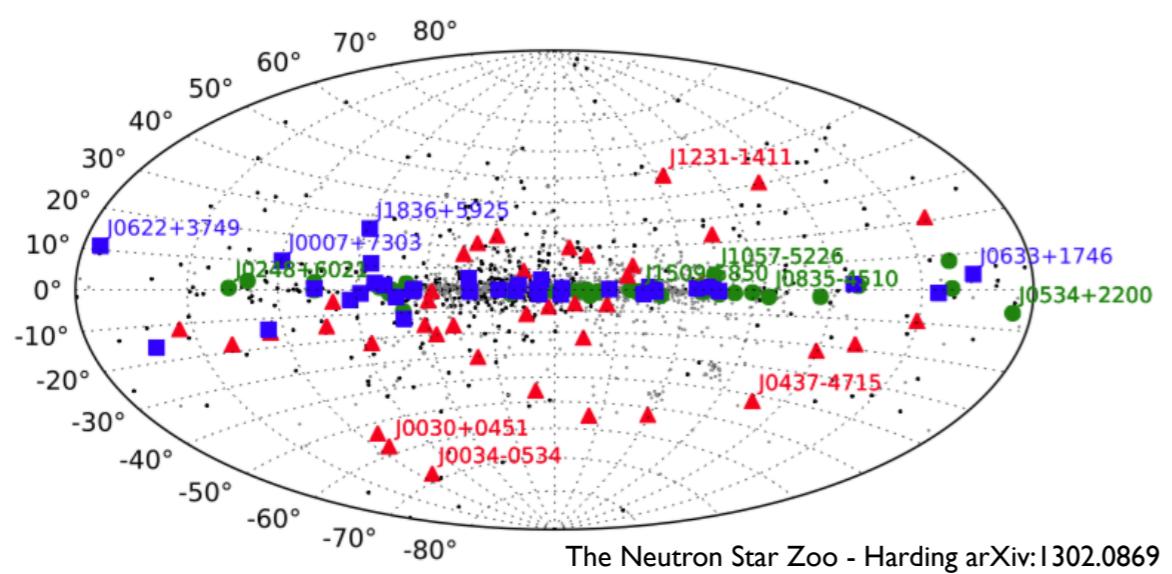


First detected in
gamma-ray, x-ray, radio
and optical spectrums



Richtungsverteilung

2704 BATSE Gamma-Ray Bursts



Erwartete Verteilung der GRBs

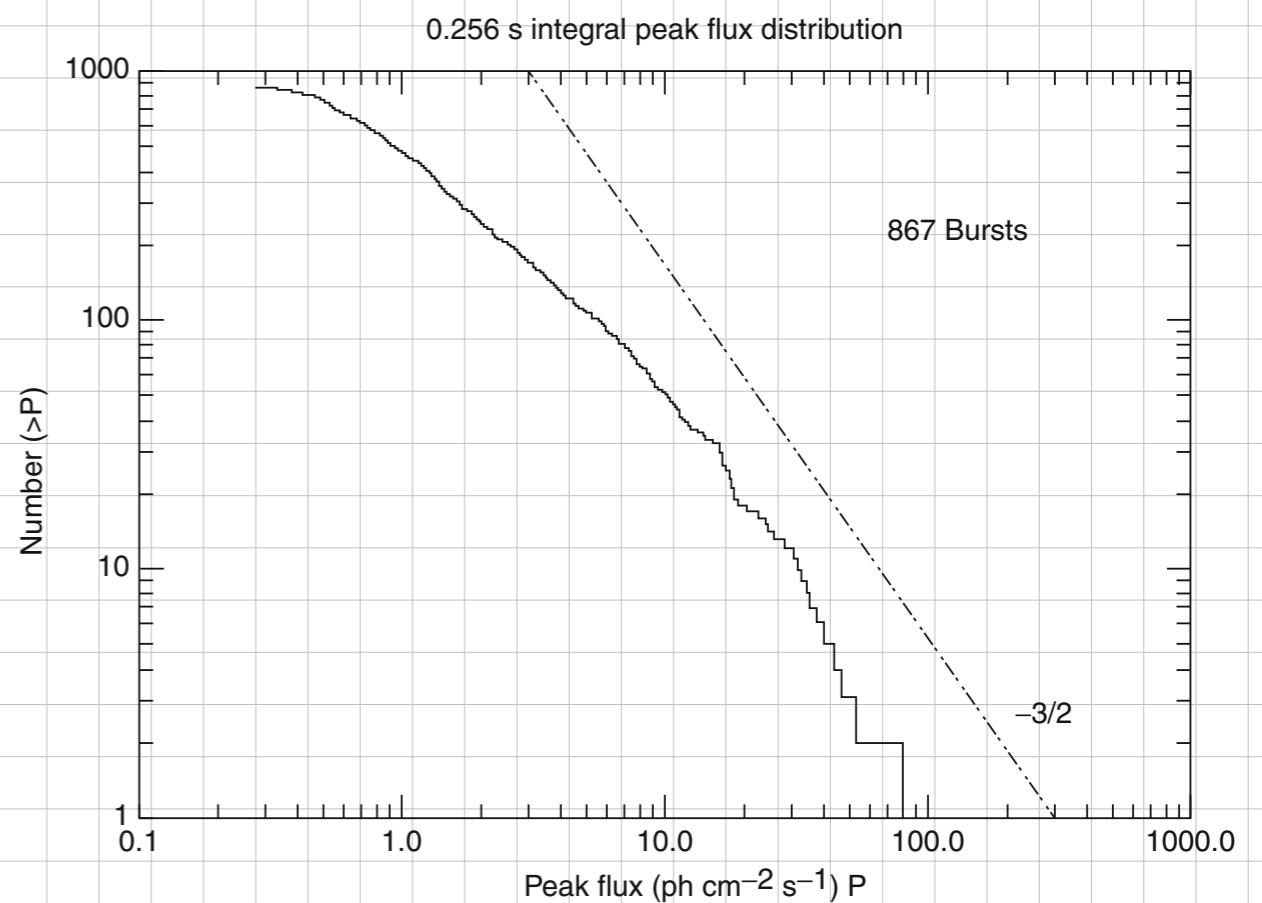


Fig. 19.4 The number of GRBs whose peak flux is brighter than flux P . A homogeneous distribution of bursts in space would imply a slope of $-3/2$ (see text) (Data from BATSE, figure from P. Meszaros (<http://www2.astro.psu.edu/users/nnp/cosm.html>))