Be/X線連星A0535+262のgiant outburst 時の可視光高分散分光観測

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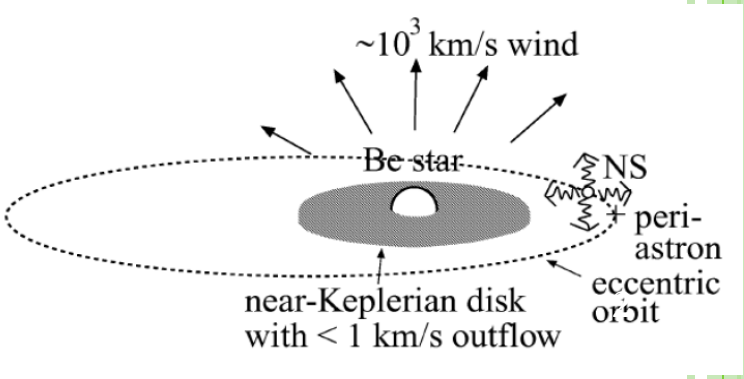
Be/X線連星について

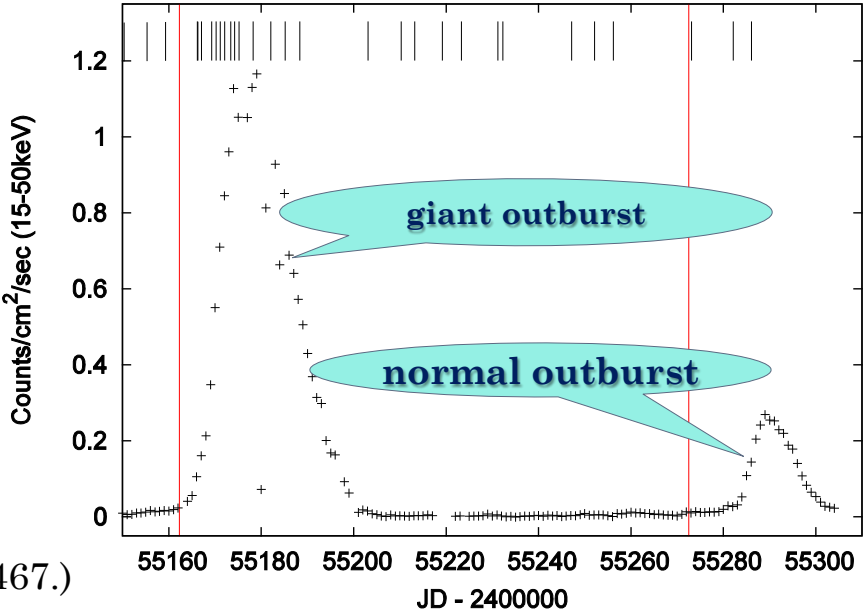
- Be/X線連星：Be 星 + コンパクト天体 (主にNS)
  - 軌道離心率の小さくないものが多い(> 0.3)
    ⇒X線で3つの状態に分かれる
    - Quiescent $L_X \lesssim 10^{36}$ erg/s
    - Normal (type I) outburst $L_X \sim 10^{36\text{-}37}$ erg/s Orbital modulation
    - Giant (type II) outburst $L_X \gtrsim 10^{37}$ erg/s normal outbursts より低頻度
- Be 星 (B 型輝線星):
  - 過去に1度でもBalmer線が輝線として観測されたB 型星
    (光度階級；III-V)
  - 幾何学的に薄い円盤(Be disk)
    - 赤道領域：
      1. 弱いoutflow($\lesssim$ 1 km/s),
      2. 重力～遠心力(高速自転 $\lesssim$ 数百km/s)



(Okazaki+ 2002, MNRAS, 337, 967)

A0535+262/V725 Tau

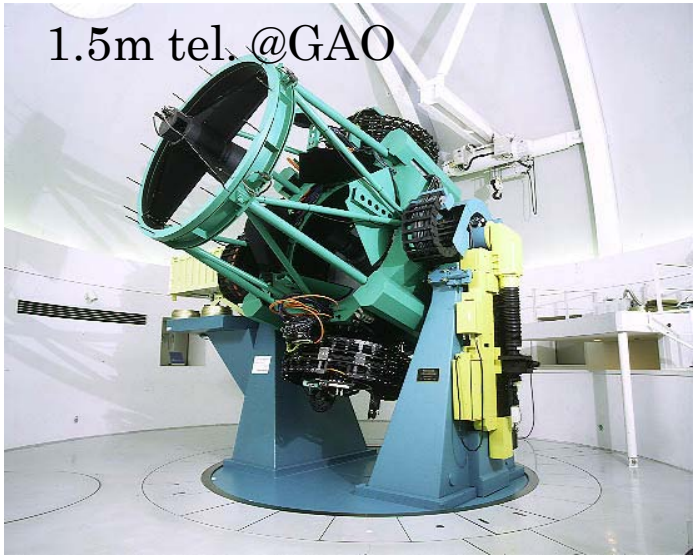
- O9.7IIIe + NS, m_V ~ 8.9 mag (Giangrande+ 1980, A&AS, 40, 289)
- P_{orb} = 110.24 days (Moritani+ 2010, MNRAS, 405,467)
- e ~ 0.47 (Finger+ 1994, AIPC, 308, 459)
- 2009年11月/12月のgiant outburst
  - 2005年以来
  - 10月から徐々に増光 (Sugizaki+ 2009, Atel. #2277)
  - 11/30 (JD 2455166)に急増光
  - ピーク時には3.1 Crab に到達 (Krimm + 2009, Atel. #2336)
  - 増光は約30日間続いた
  - その後の近星点通過時にnormal outburst (2010年3月、6月/7月)



Swift/BAT (15-50 keV) の光度曲線
黒線: 可視光分光観測を行った日
赤線: 近星点(Moritani+ 2010, MNRAS, 405,467.)

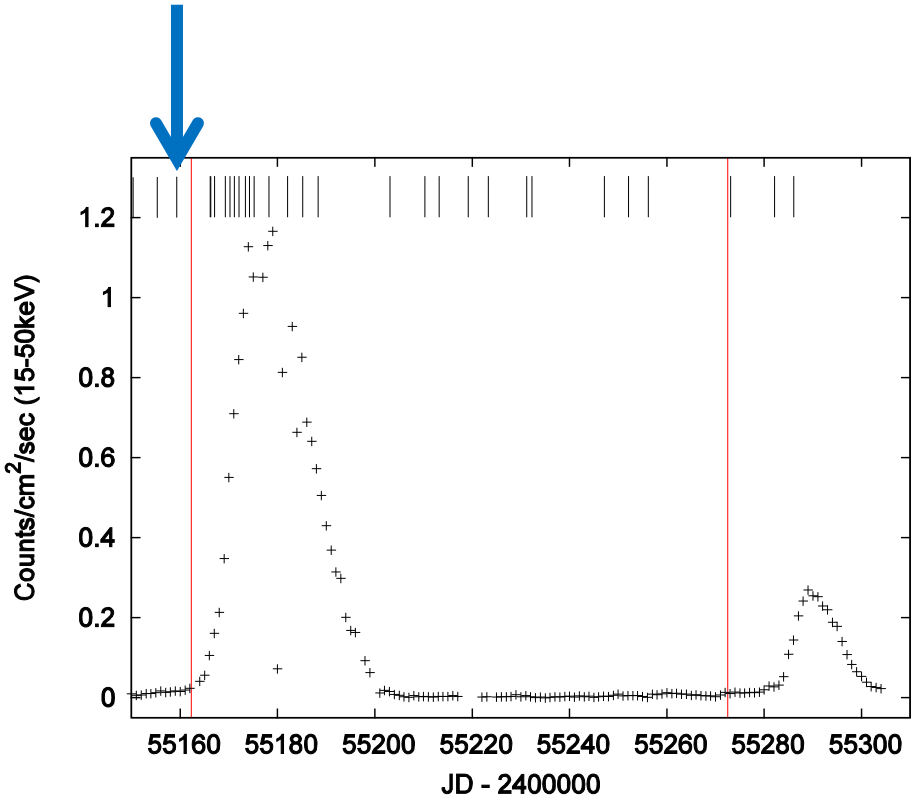
観測の概要

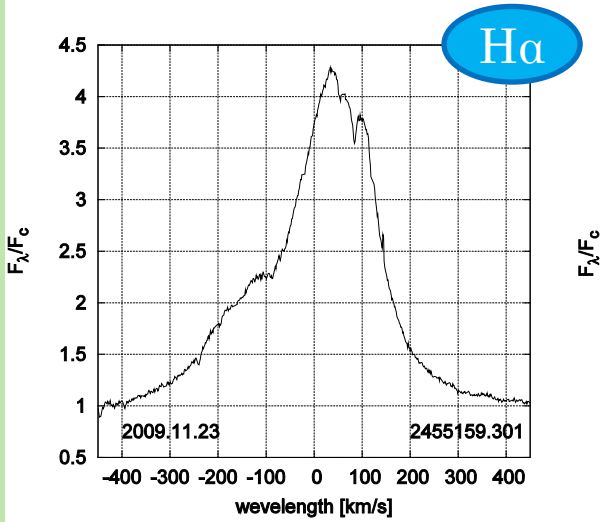
- OAO/HIDES, GAO/GAOES：Echelle spectrograph
- 波長分解能R ≳ 50,000、S/N ~ 100
- 観測波長と主なlines;
- OAO/HIDES:3800 – 6700 Å
  …Hα, Hβ, Hγ, He Iλ6678, He Iλ5876, He Iλ4471 等
- GAO/GAOES:4800 – 6700 Å
  … Hα, Hβ, He Iλ5876

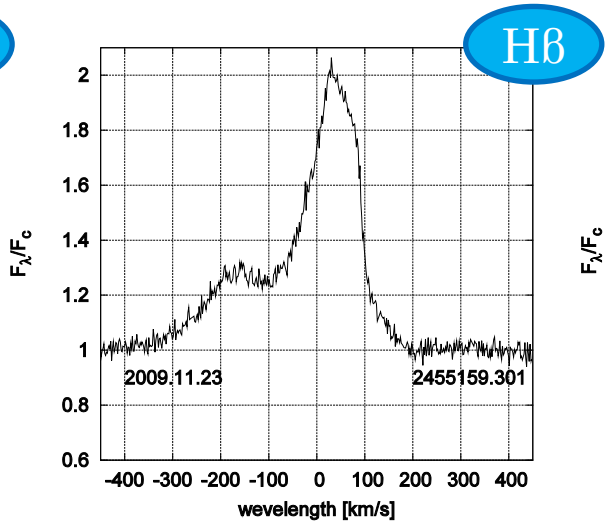


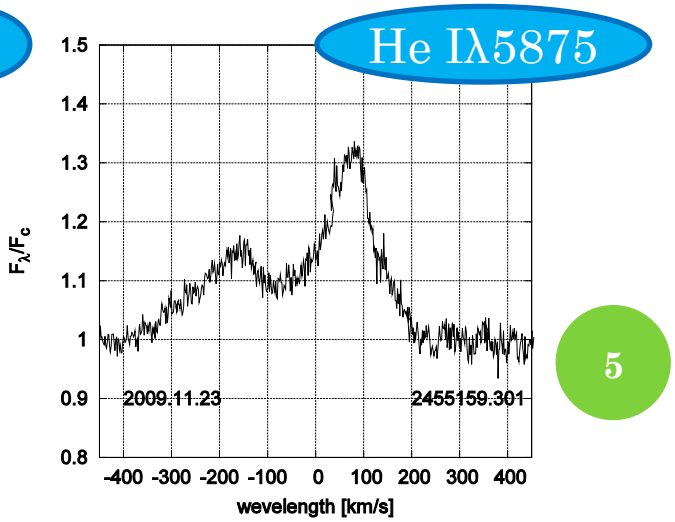
結果

- 代表的なline profiles









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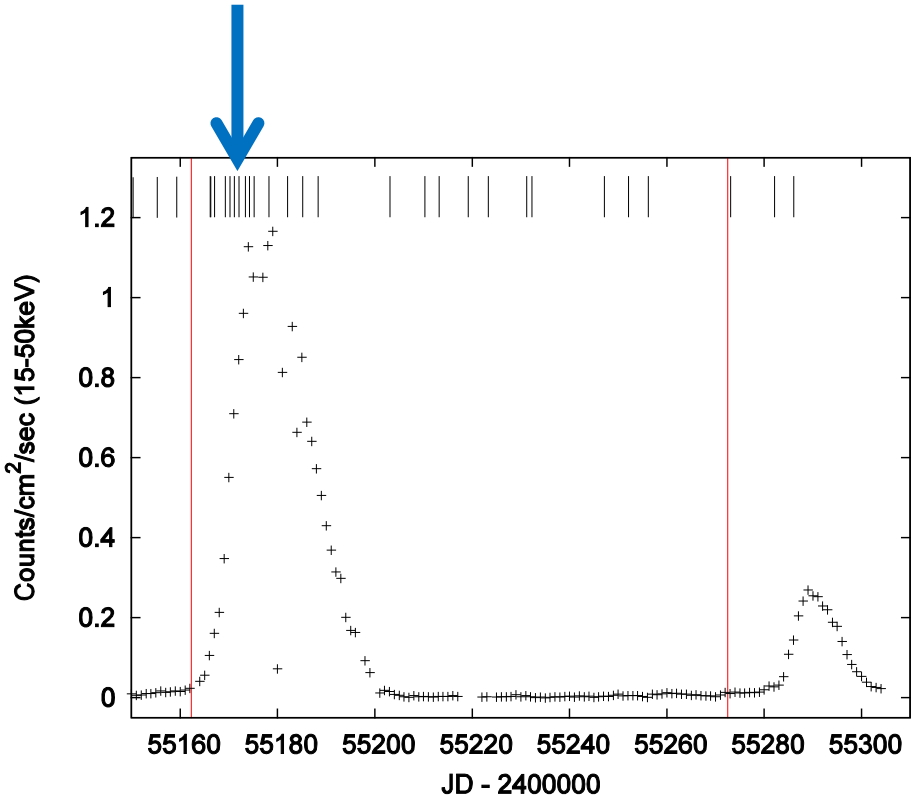

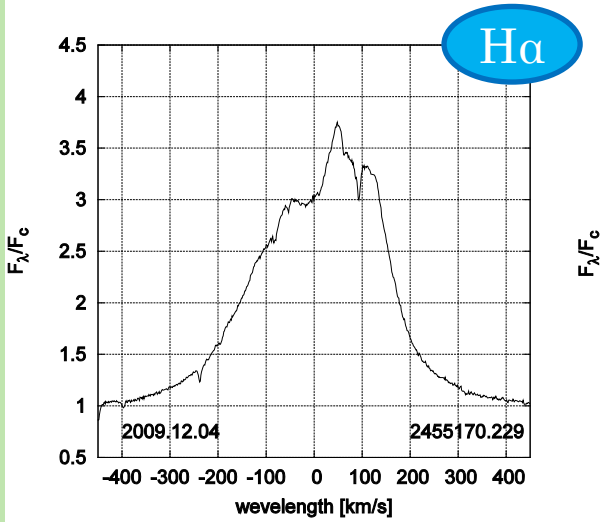

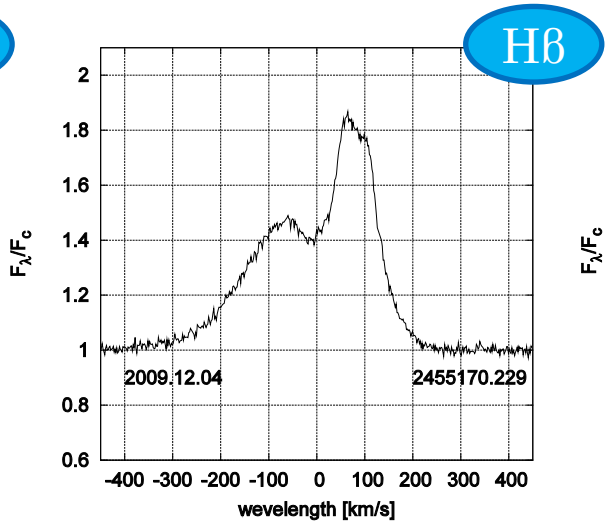

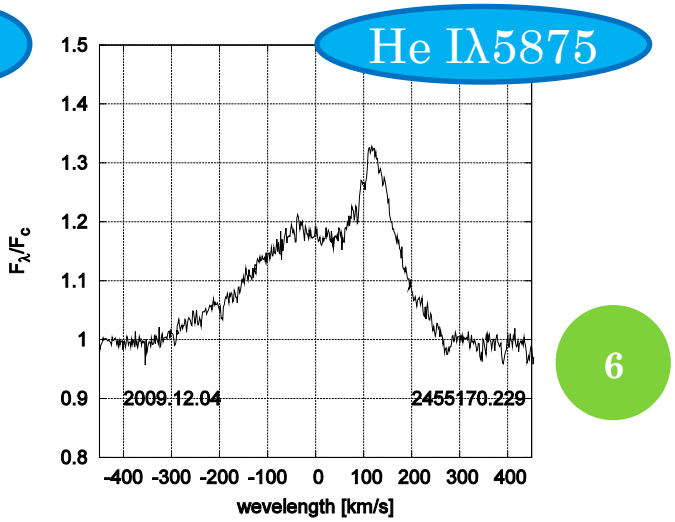

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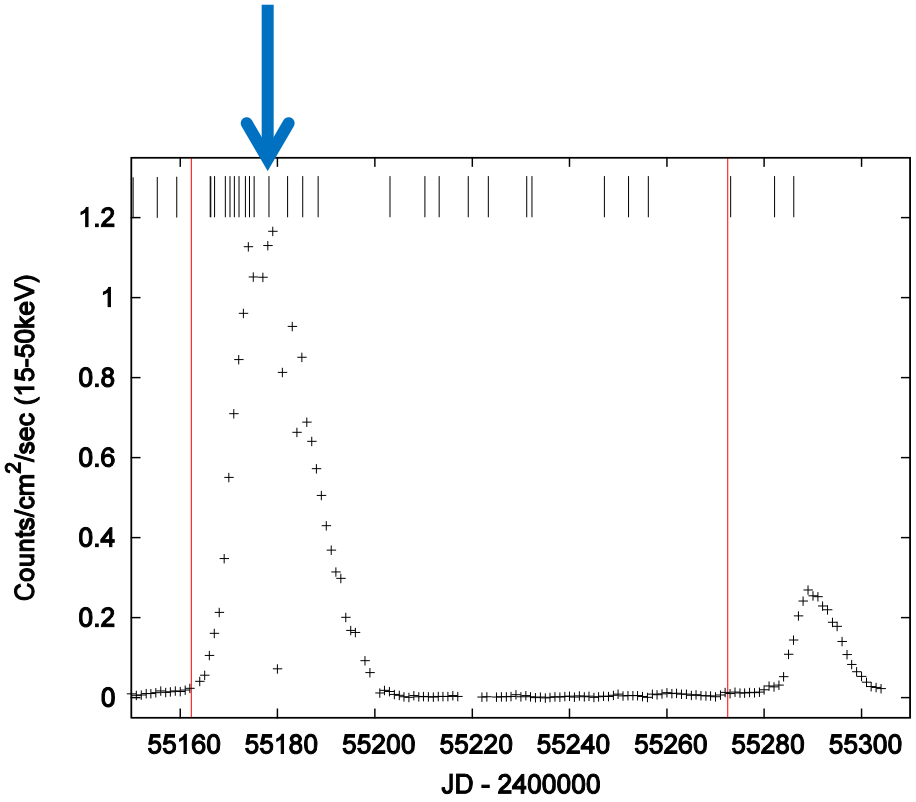

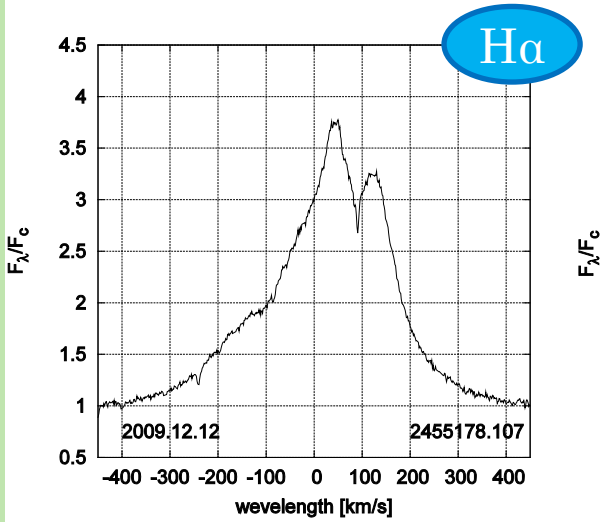

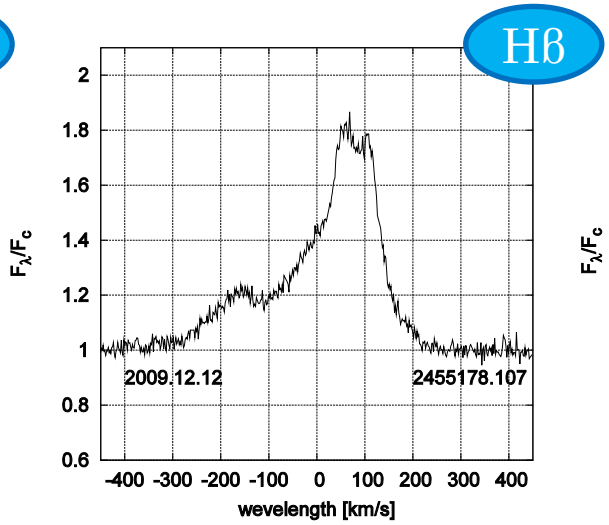

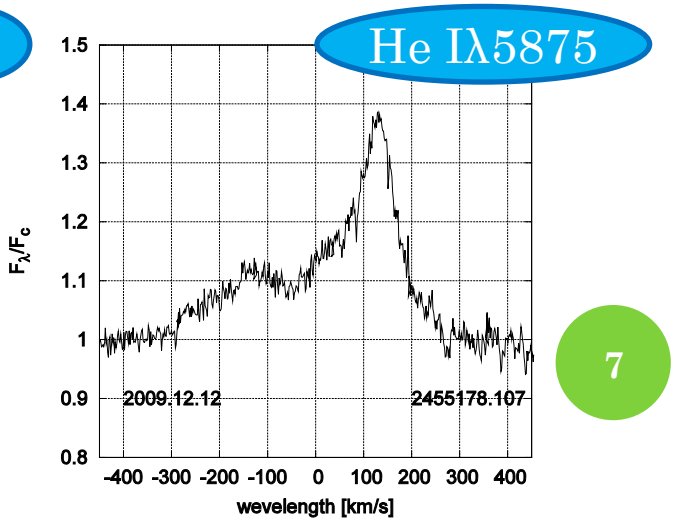

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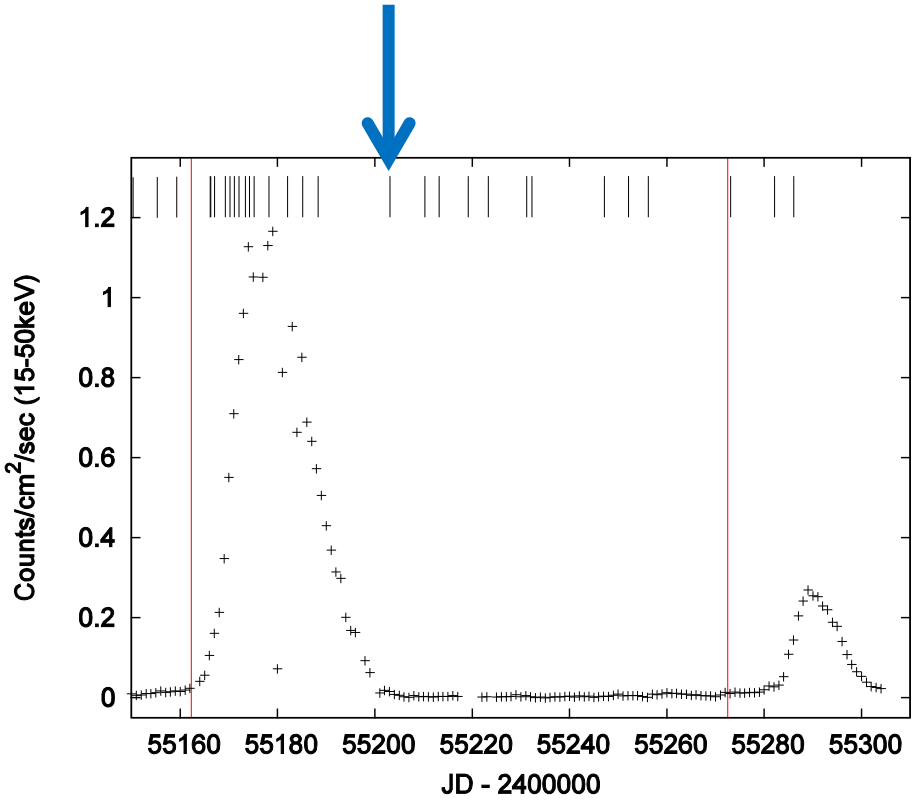

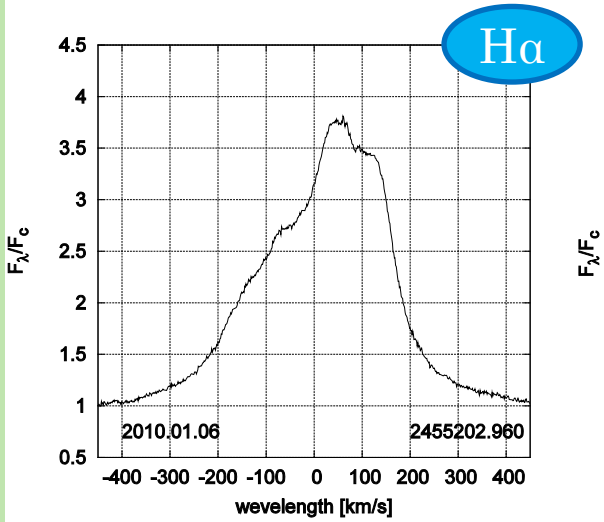

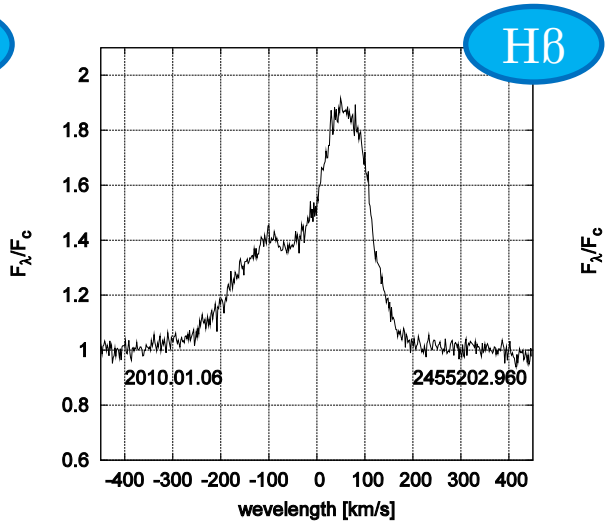

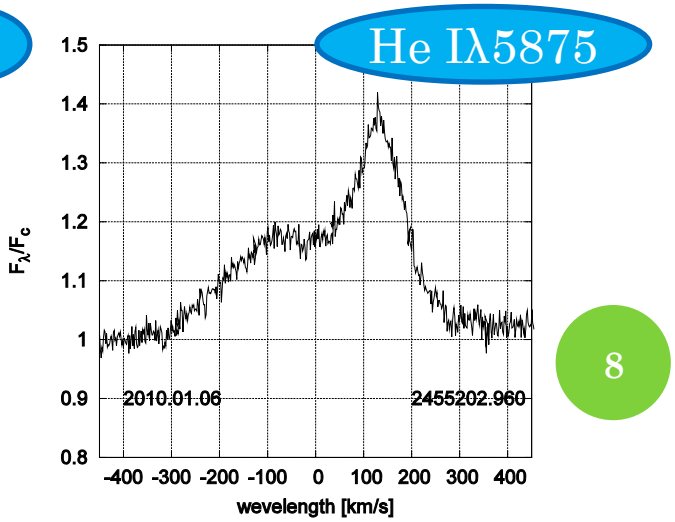

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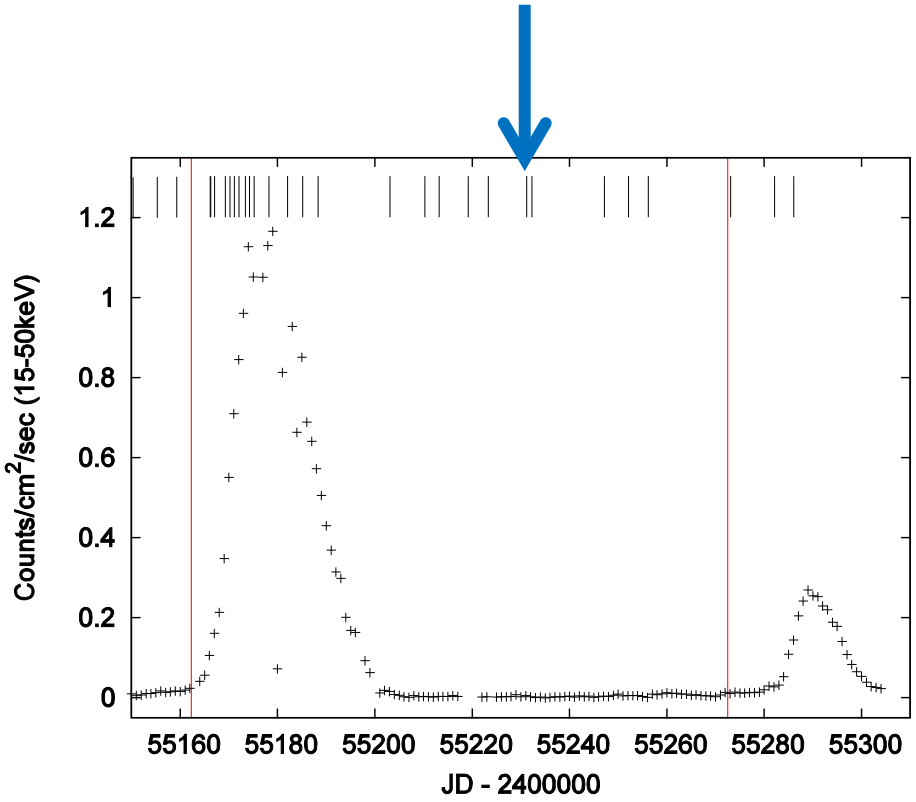

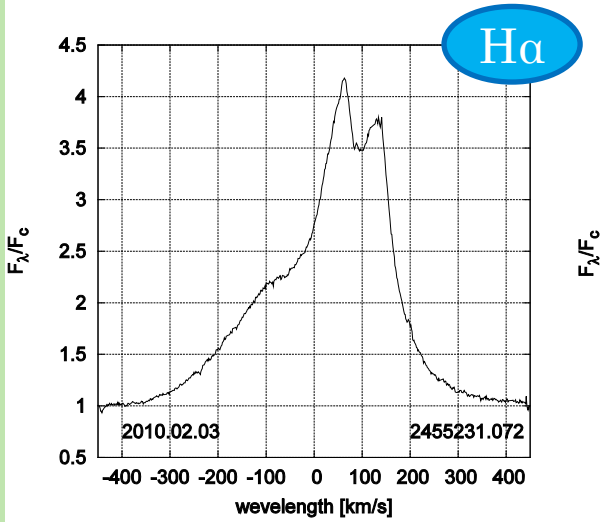

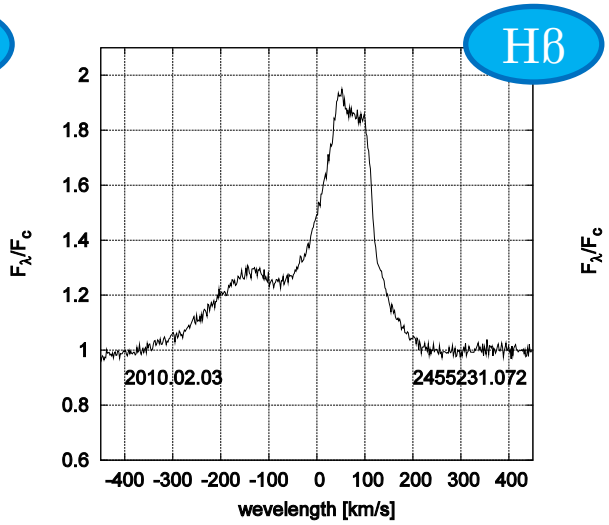

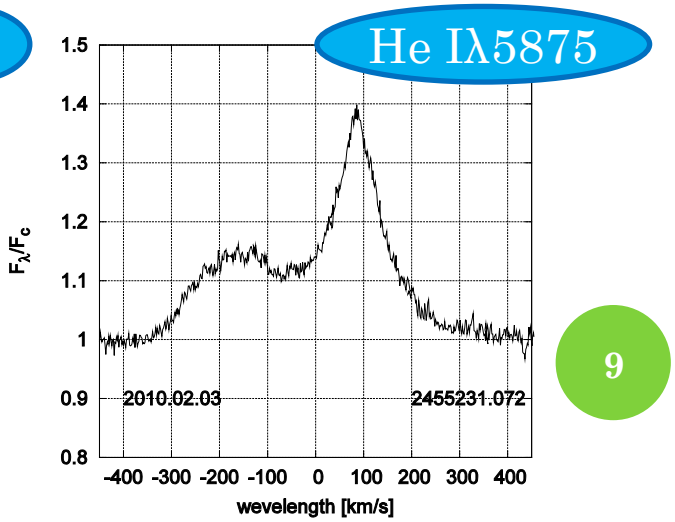

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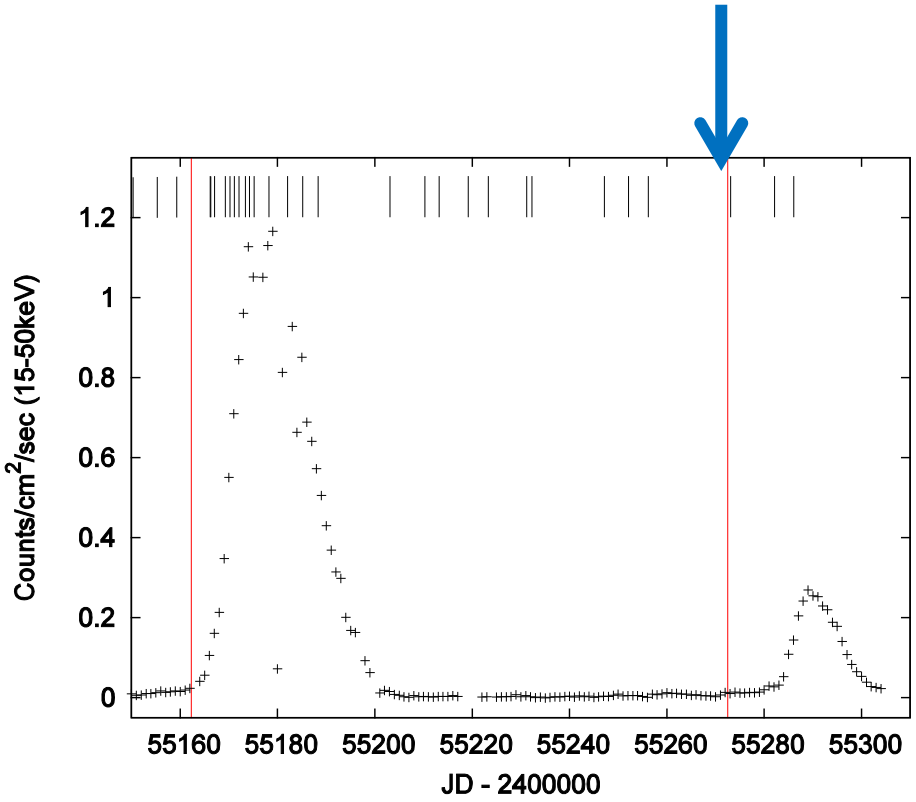

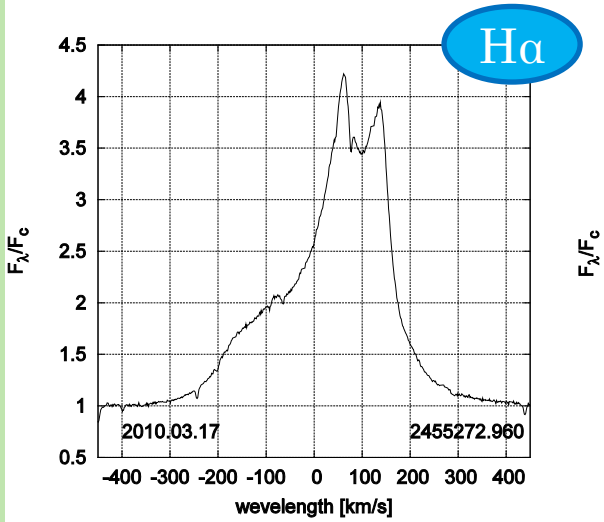

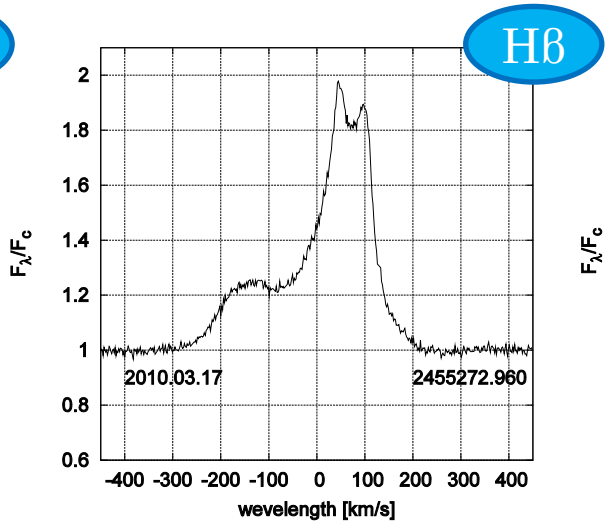

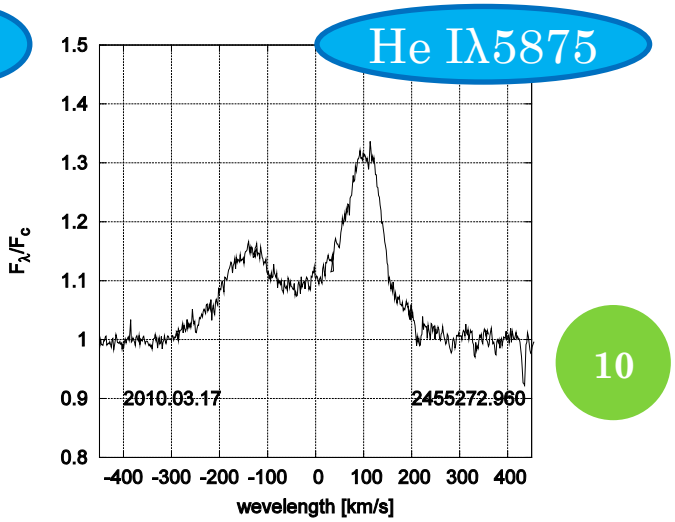

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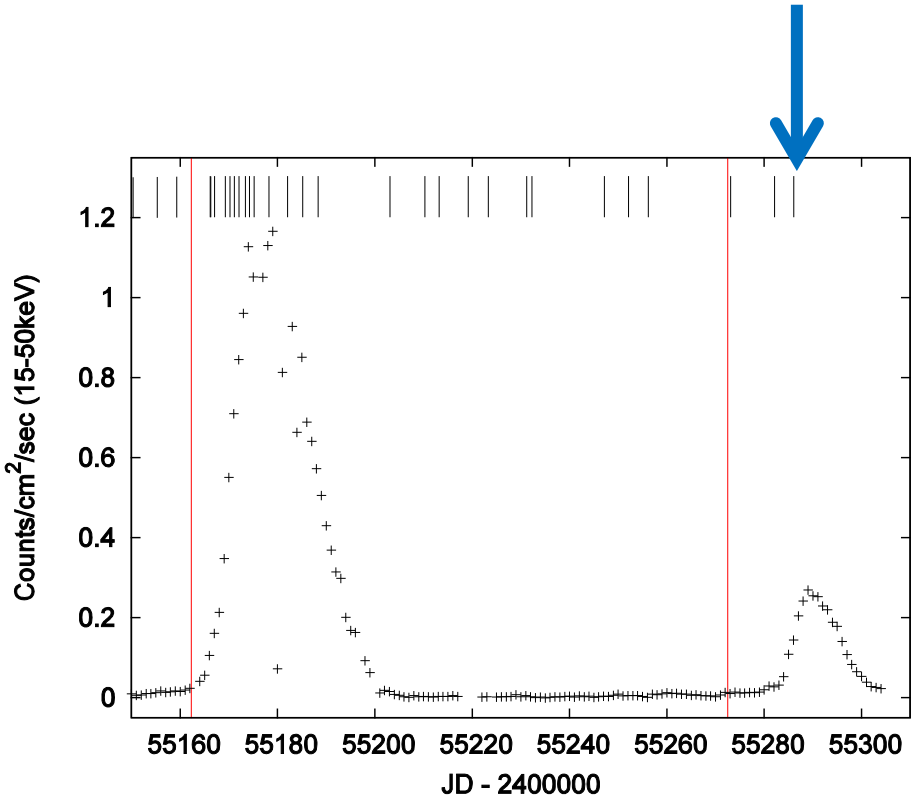
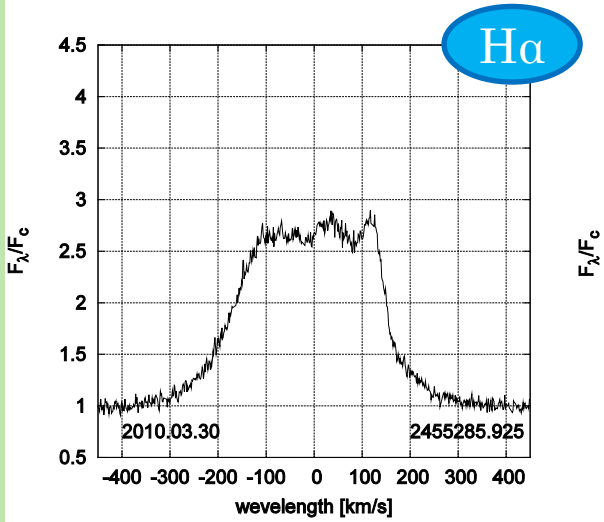
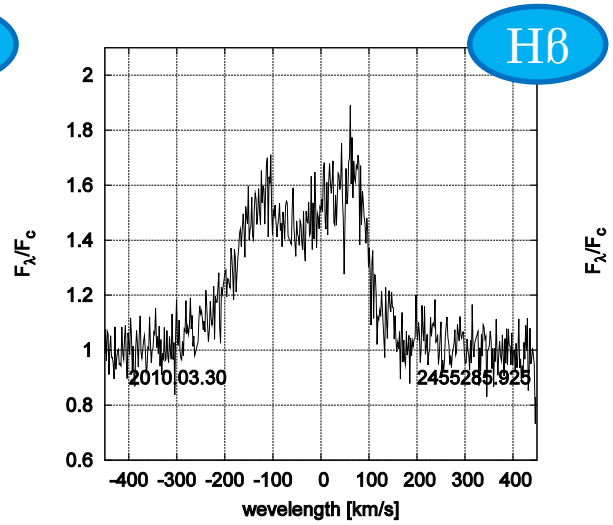
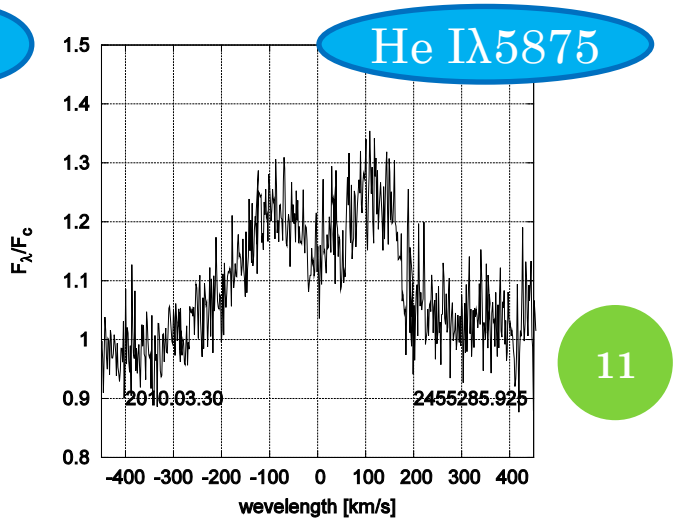


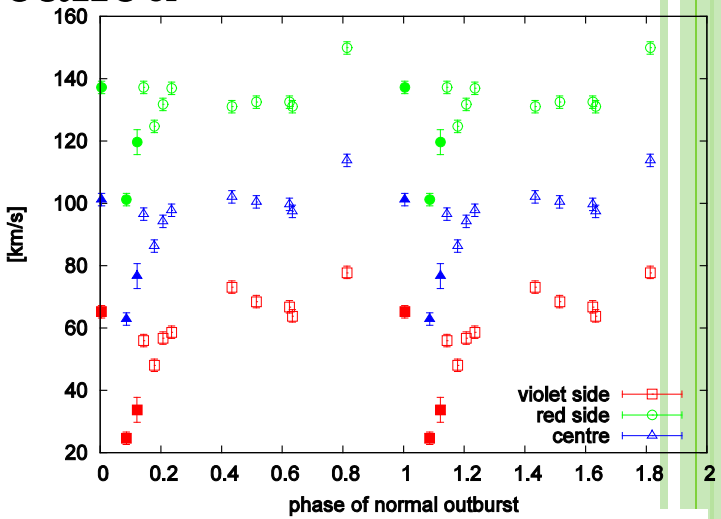


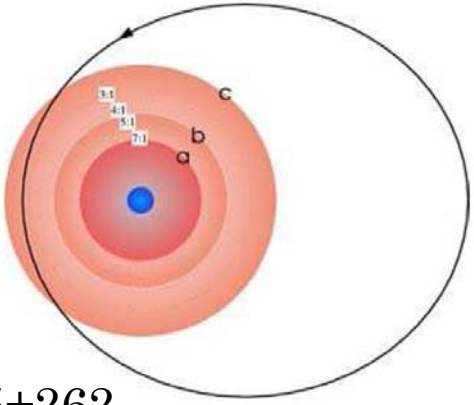




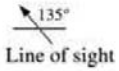
赤い側、明るい部分について

- 各輝線の赤方偏移100km/s付近に見られる明るい成分
  …Hα線：double-peaked、他：single-peaked
- Be disk からか、NS周りの降着円盤か
- 視線速度の動き
  - 近星点通過時に遠ざかる
    ⇒明るい成分はBe disk 由来
- Warped Be disk？





The geometry of A0535+262
(Coe + 2006, MNRAS, 368,447)



まとめ

- Be/X線連星A0535+262/V725 Tauにおいて、2009年11月に約5年ぶりのX線giant outburst が観測された
  - Be disk の様子をOAO/HIDES, GAO/GAOESを用いて分光モニター観測した
- 観測中、輝線は激しいprofile 変動を見せた
- 輝線の赤方偏移~100km/sにある明るい成分はBe disk由来である(降着円盤からの寄与ではない)
  - Be disk がwarpedしている可能性が高い
- Giant outburst 後近星点通過時にoutburst が観測
  - Be disk はまだ活発
- 2010年10月の近星点通過時の観測:OAO共同利用観測
- ＜4000 ÅのH I,He I …吸収線
  吸収線のパラメータから輝線成分のみを取出せないか？