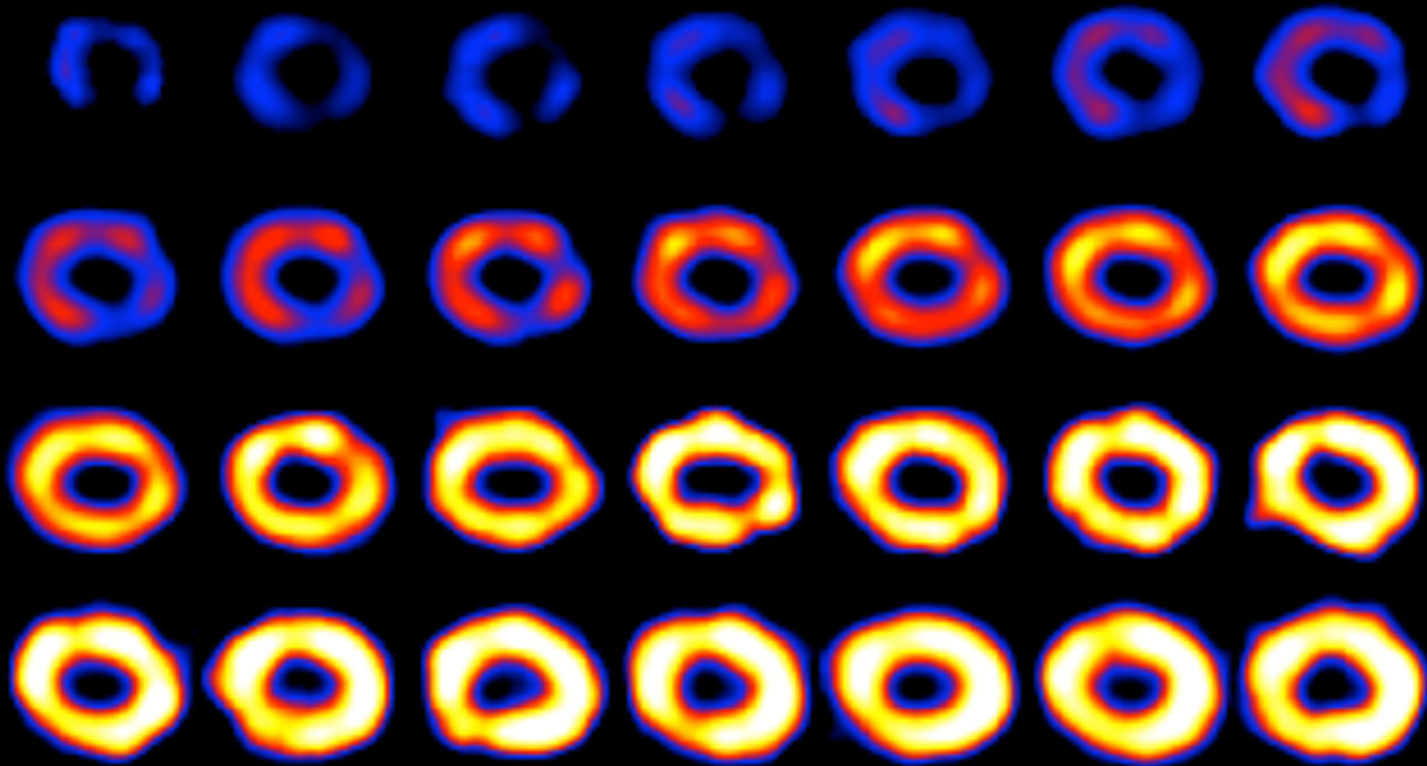


# Chandra Observations of SN 1987A



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# SN 1987A: Birth of a SNR



- The first
  - nearby SN in 400 years (in LMC)
  - **observed with modern instruments**
    - **extensively monitored in radio, IR, optical, UV, and X-ray**
  - identification of progenitor
    - Blue supergiant Sanduleak -69°202 in LMC
  - detection of extrasolar neutrinos (core-collapse)
- **First opportunity to study birth and early development of a SNR in detail**
  - **X-rays directly trace progress of blast wave**

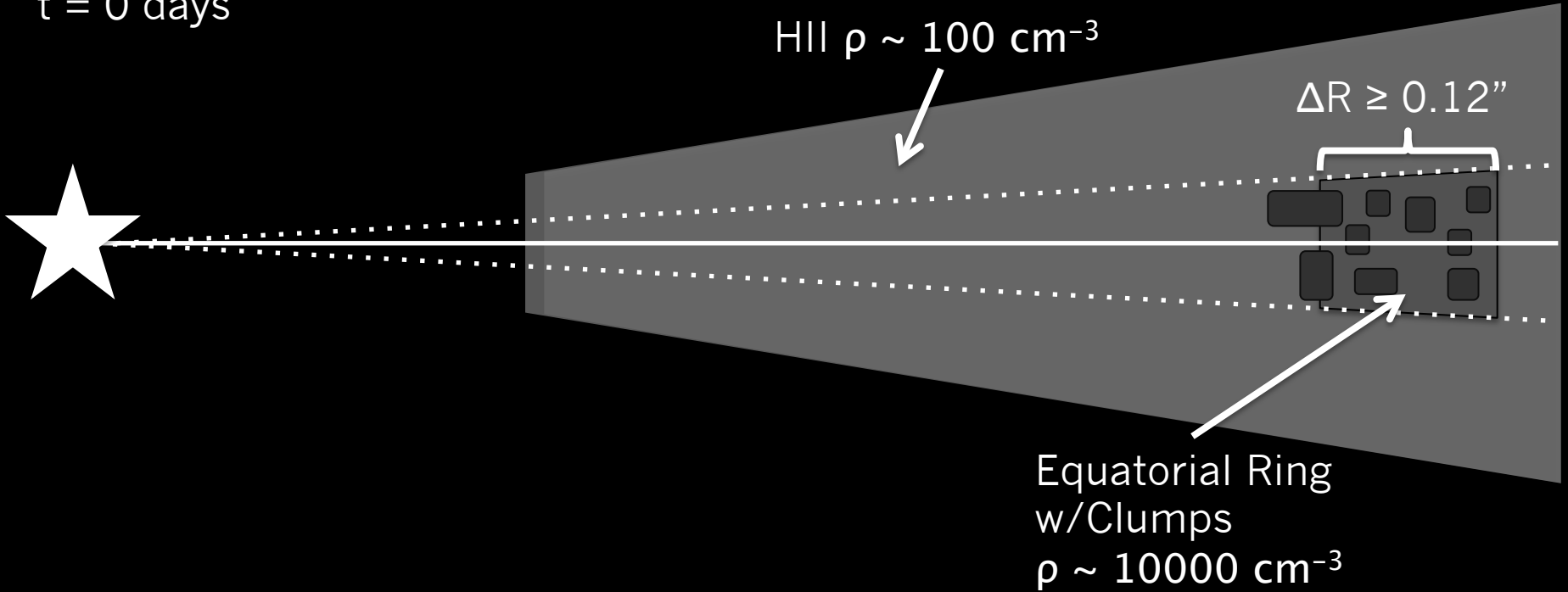
# Chandra Monitoring

- 1999 – Now  
(day 4600 – 10000)
- ~6 month intervals
- 29 Observations  
– 4 New

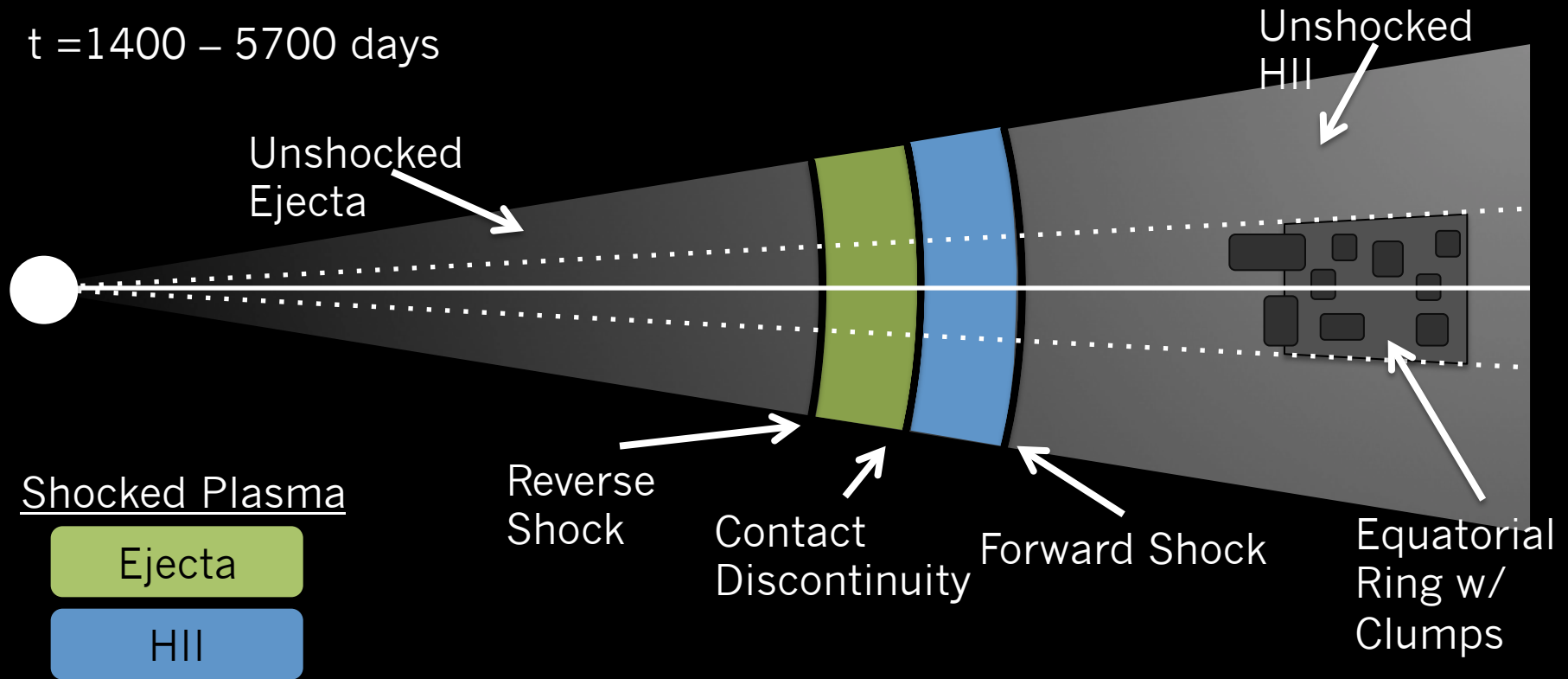
Date	Age	Grating
1999-10-06	4608	HETG
2000-01-17	4711	NONE
2000-12-07	5036	NONE
2001-04-25	5175	NONE
2001-12-12	5406	NONE
2002-05-15	5559	NONE
2002-12-31	5789	NONE
2003-07-08	5978	NONE
2004-01-02	6157	NONE
2004-07-22	6358	NONE
2005-01-09	6529	NONE
2005-07-11	6713	NONE
2006-01-28	6913	NONE
2006-07-27	7094	NONE
2007-01-19	7270	NONE
2007-07-13	7445	NONE
2008-01-09	7624	NONE
2008-07-01	7799	HETG
2009-01-18	8000	HETG
2010-03-28	8232	HETG
2010-09-28	8433	HETG
2011-03-25	8617	HETG
2011-09-21	8975	HETG
2012-03-28	9165	HETG
2013-03-21	9523	HETG
2013-09-28	9713	HETG
2014-03-19	9885	HETG
2014-09-20	10071	HETG

# Physical Model

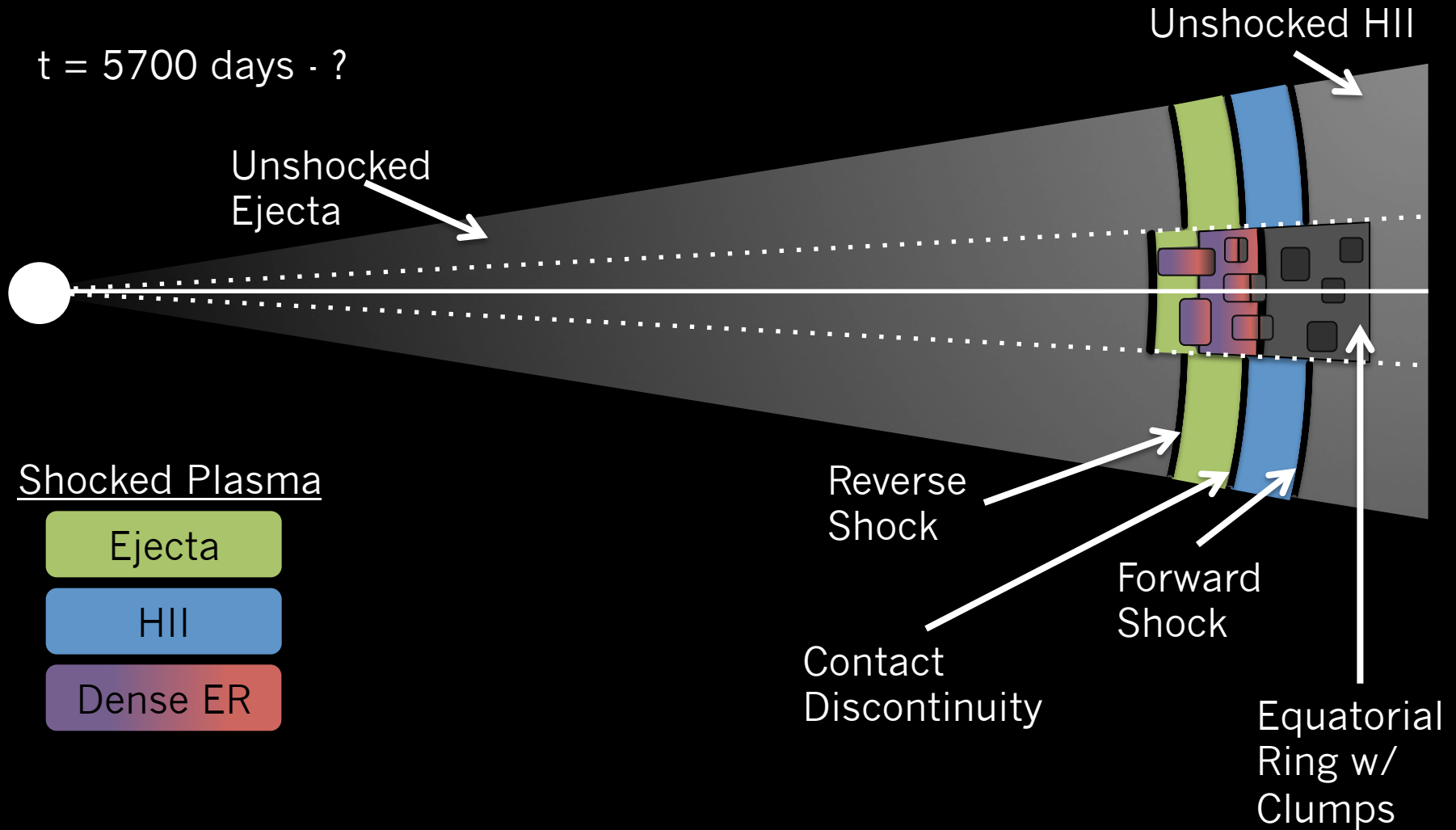
$t = 0$  days

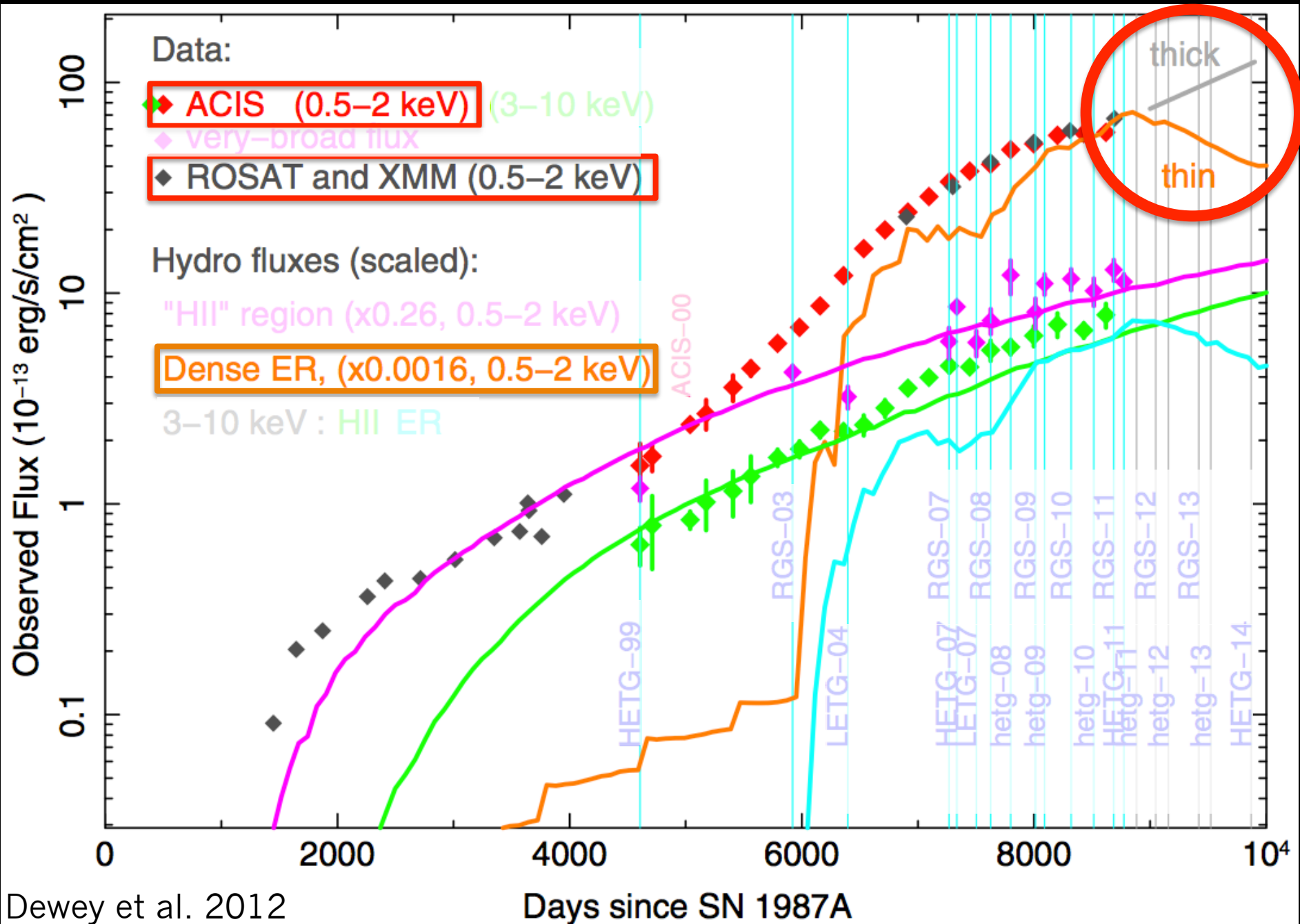


# Physical Model

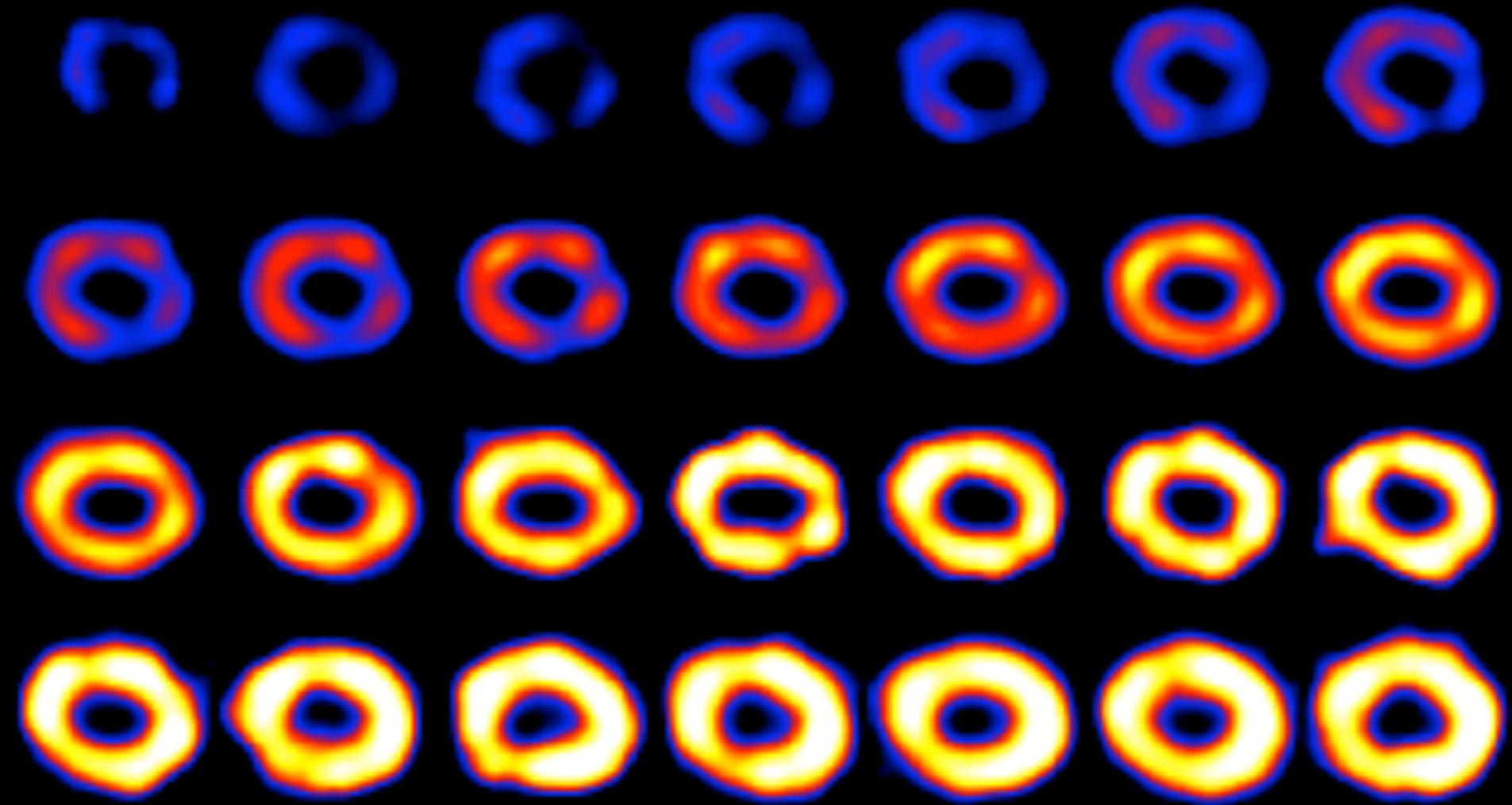


# Physical Model



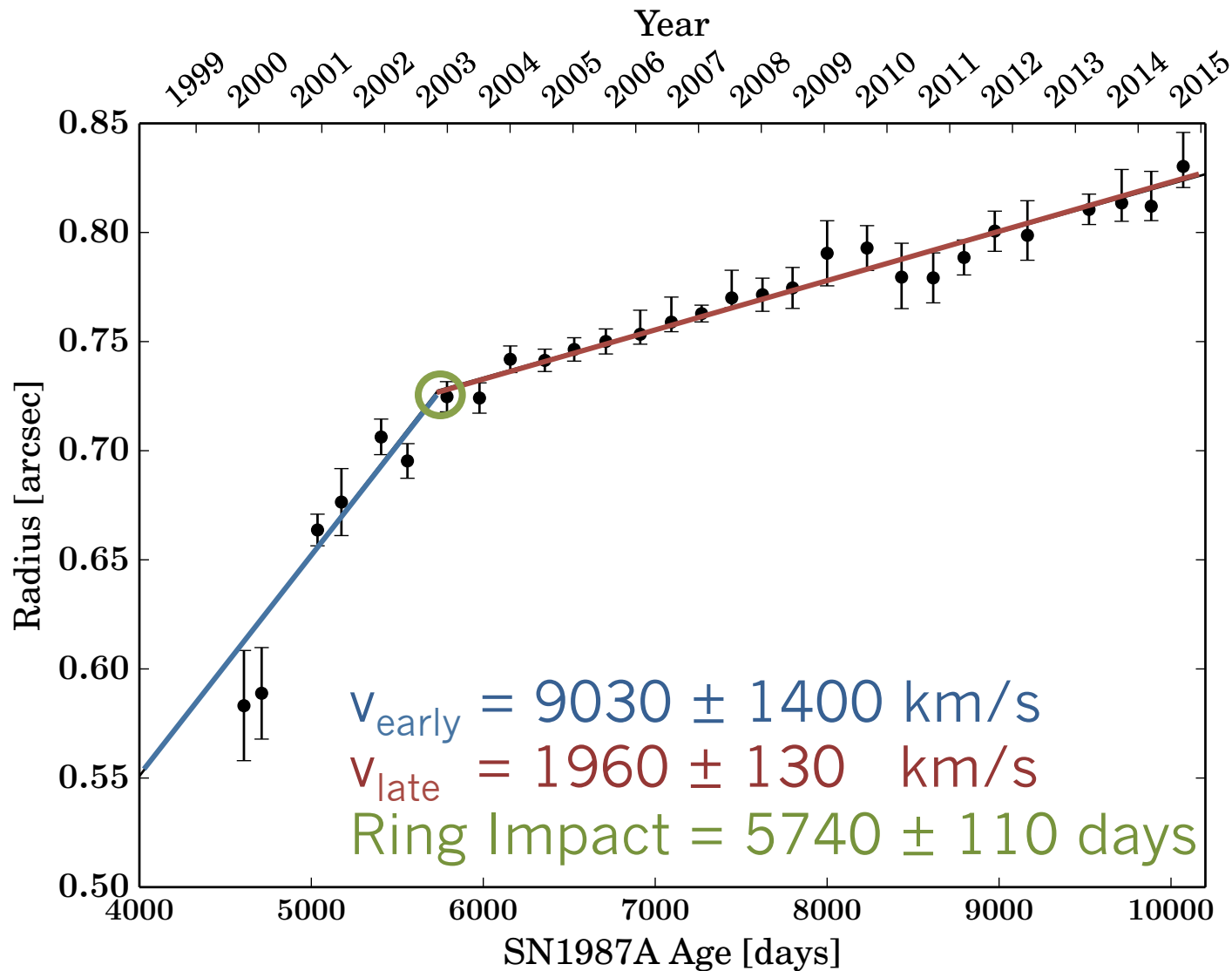


# Morphological Evolution

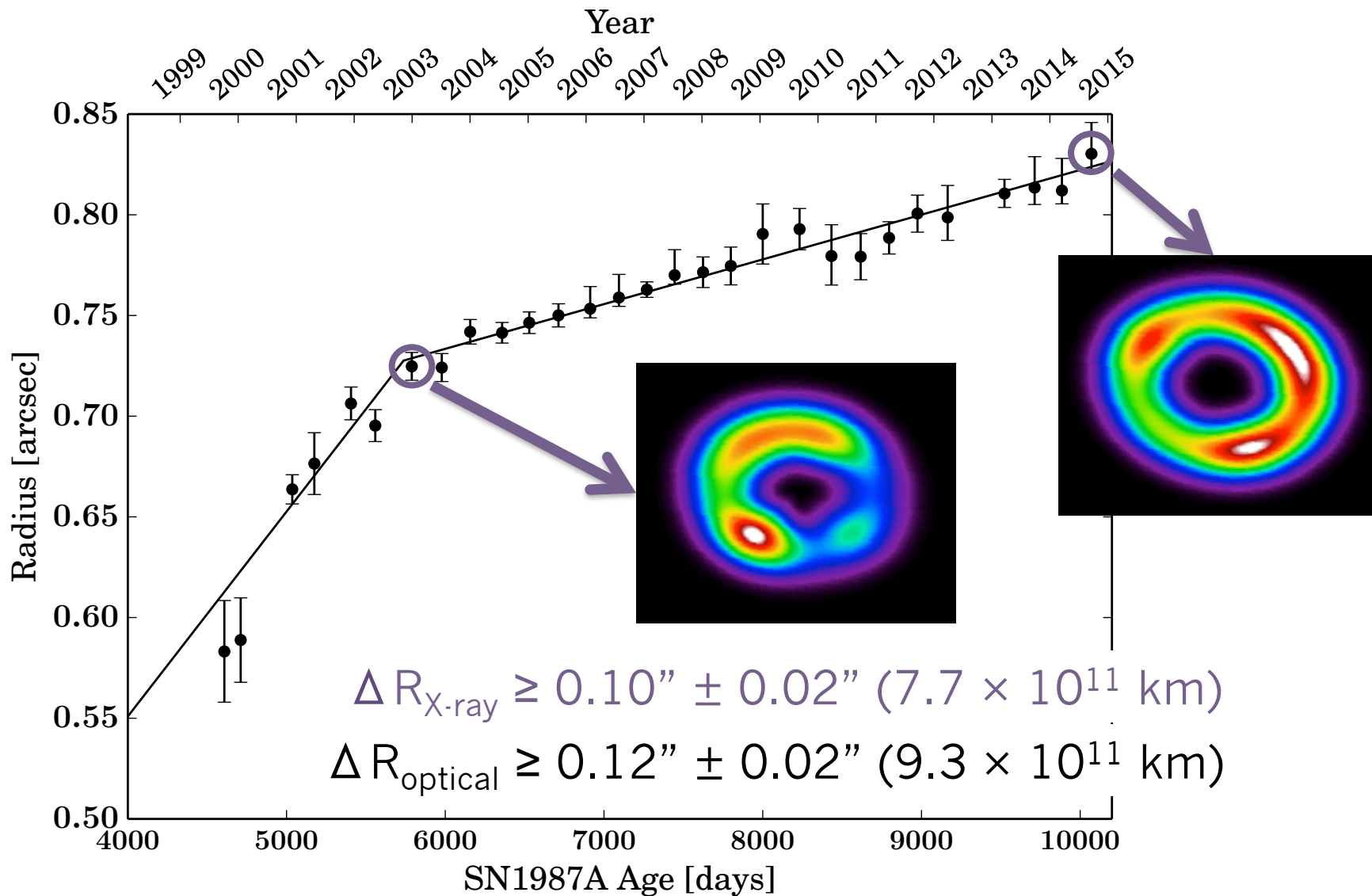




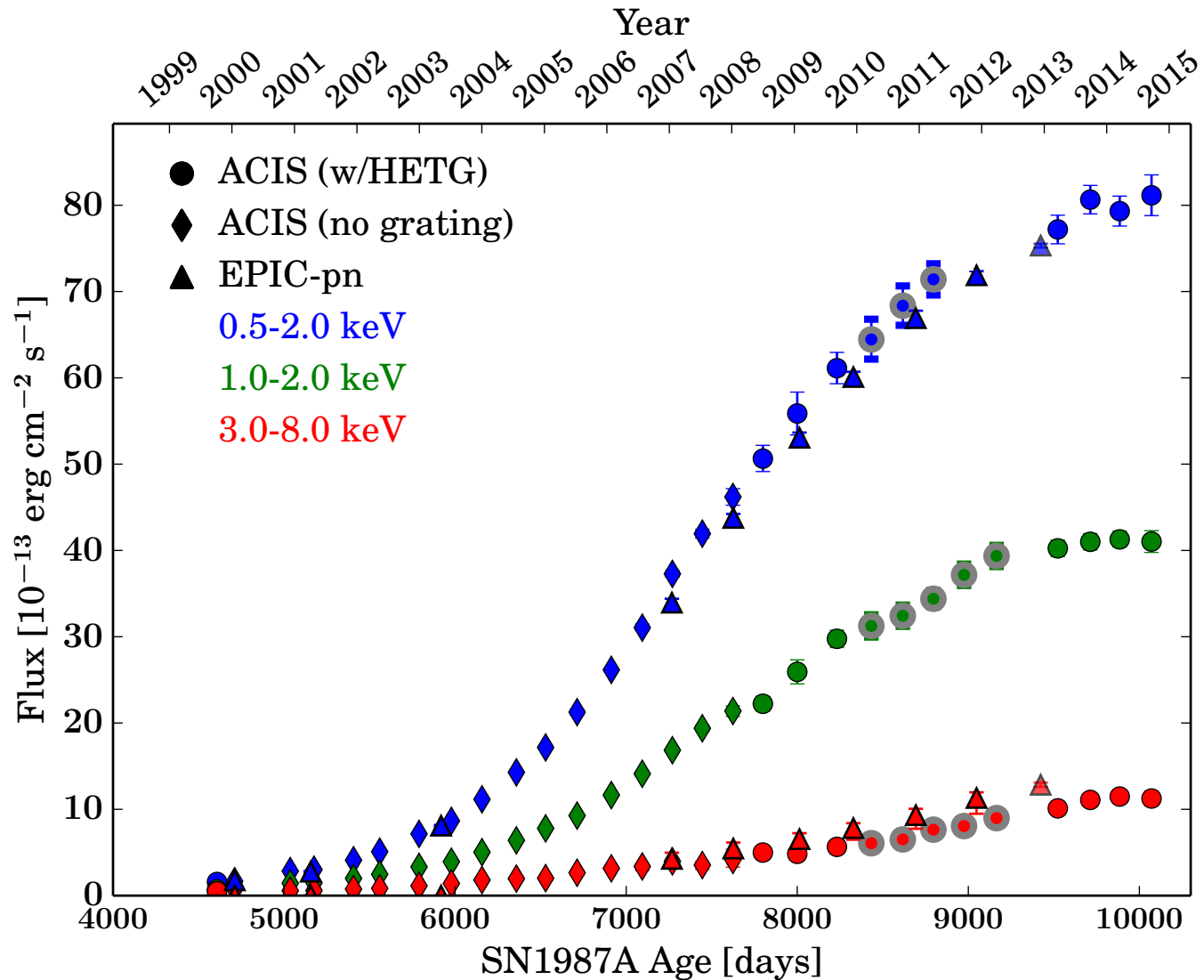
# Blast Wave Velocity



# Blast Wave Progression

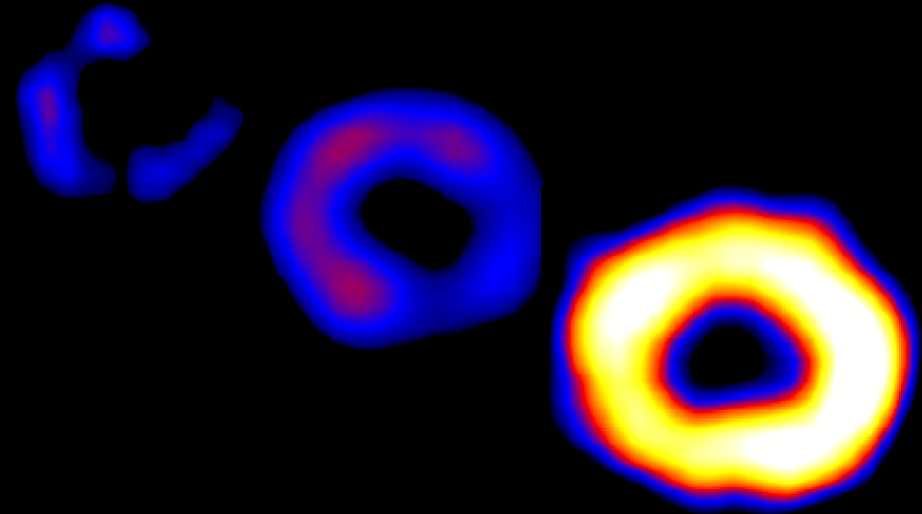


# X-ray Light Curve

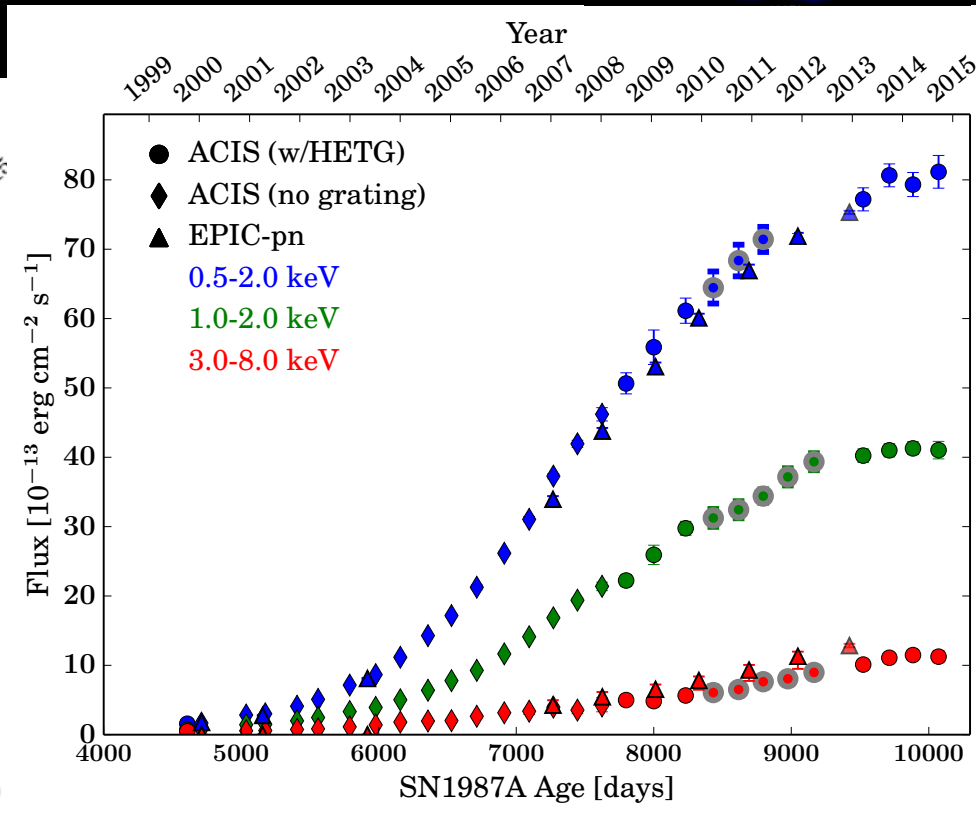
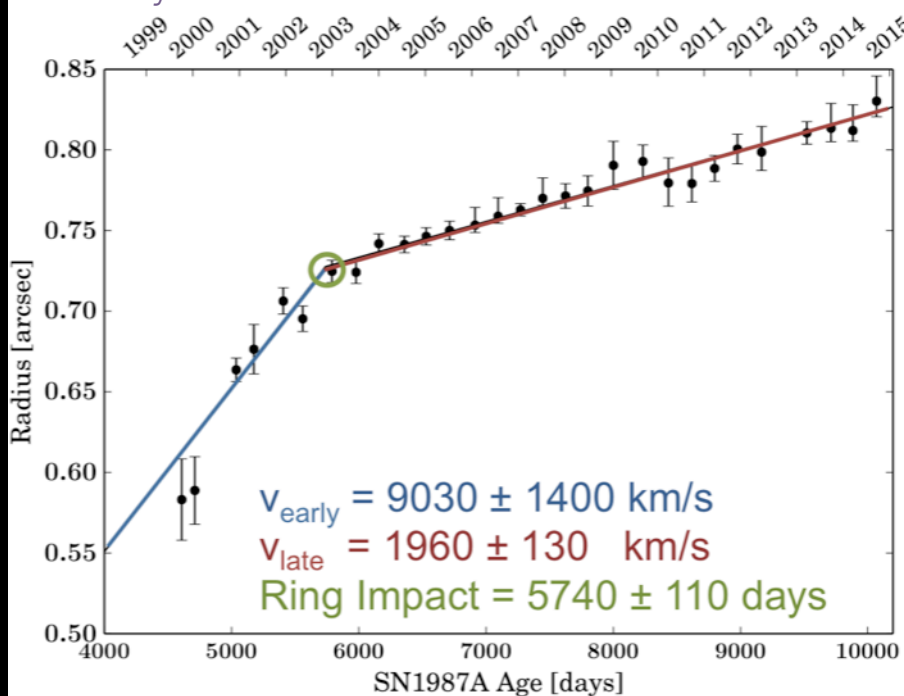


# Conclusions

- Chandra provides excellent record
- Blast wave leaving known ring?  
(but beware OBF contamination)
- Stay tuned for future exploration!



$$\Delta R_{X\text{-ray}} \geq 0.10'' \pm 0.02'' \quad (7.7 \times 10^{11} \text{ km})$$



# References

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