Stable Auroral Red (SAR) Arcs:
Complex Modes of Inner-Magnetosphere-Ionosphere Coupling

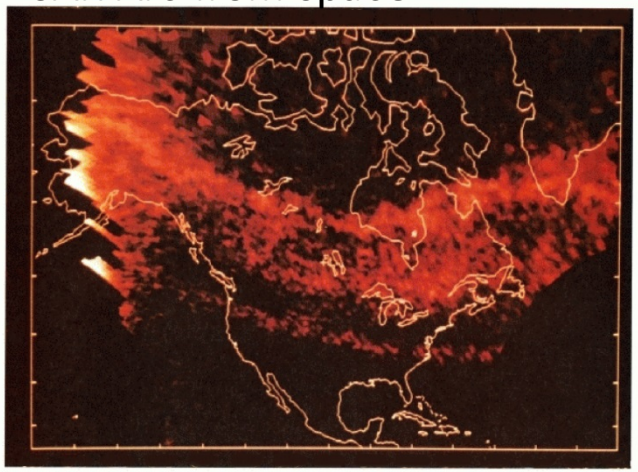
Michael Mendillo, Jeffrey Baumgardner, Joei Wroten, Carlos Martinis
Center for Space Physics
Boston University

CEDAR/GEM Workshop June 2016 Santa Fe

Imaging science

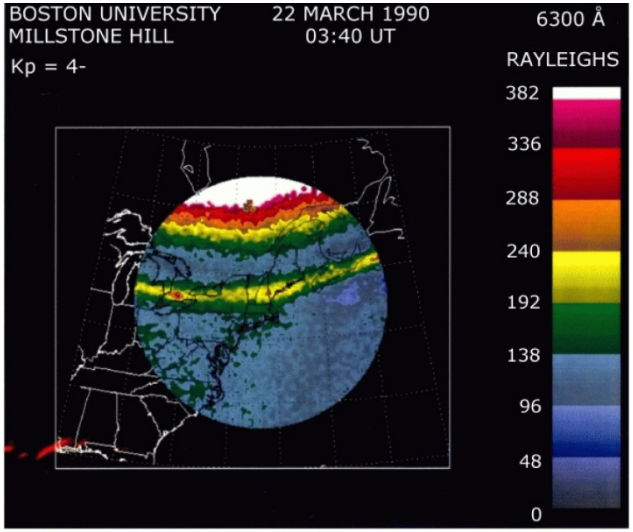
Sub-Auroral Inner Magnetosphere Science

SAR Arc from space



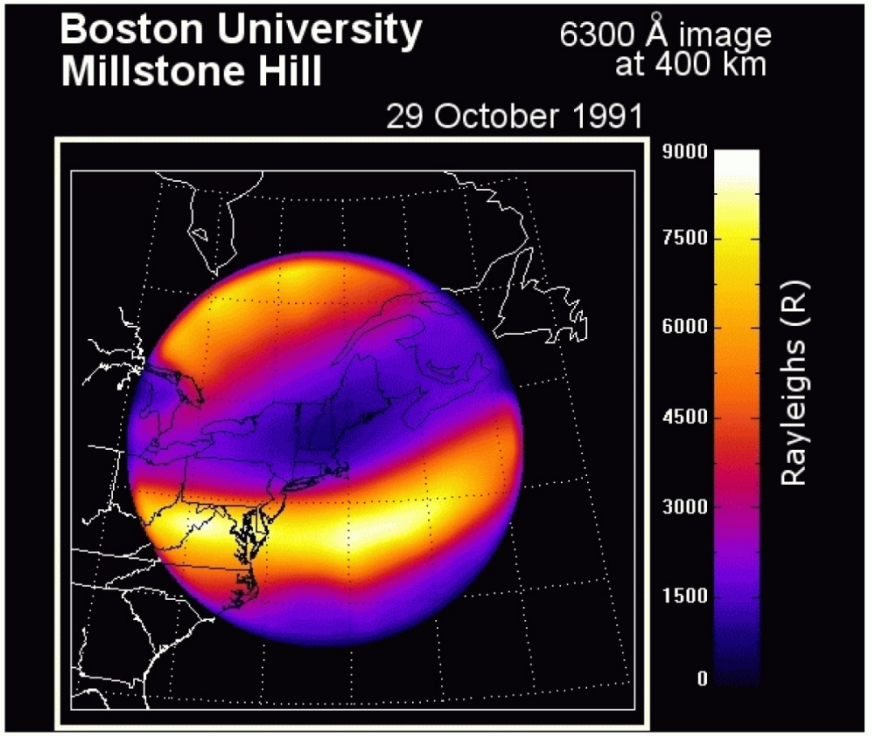
[Craven et al., 1980]

SAR Arc from Millstone Hill



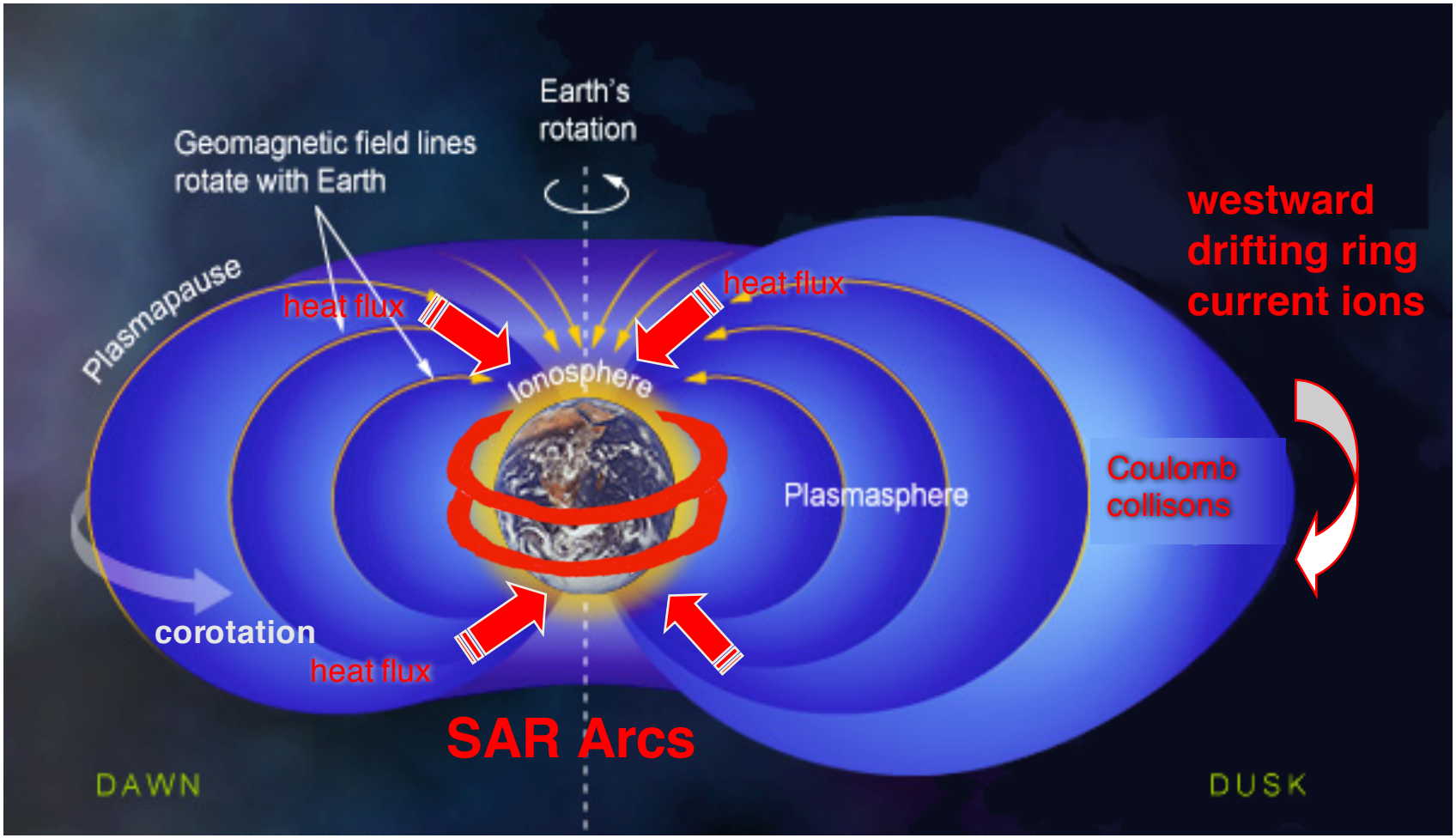
[Foster et al., 1994]

A SAR Arc of Visible Brightness

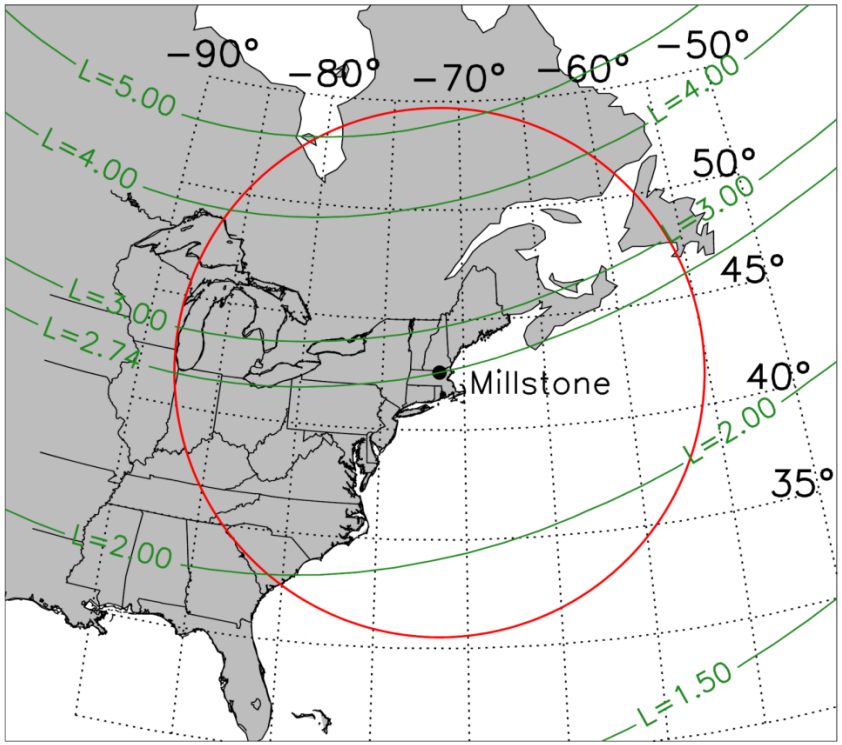


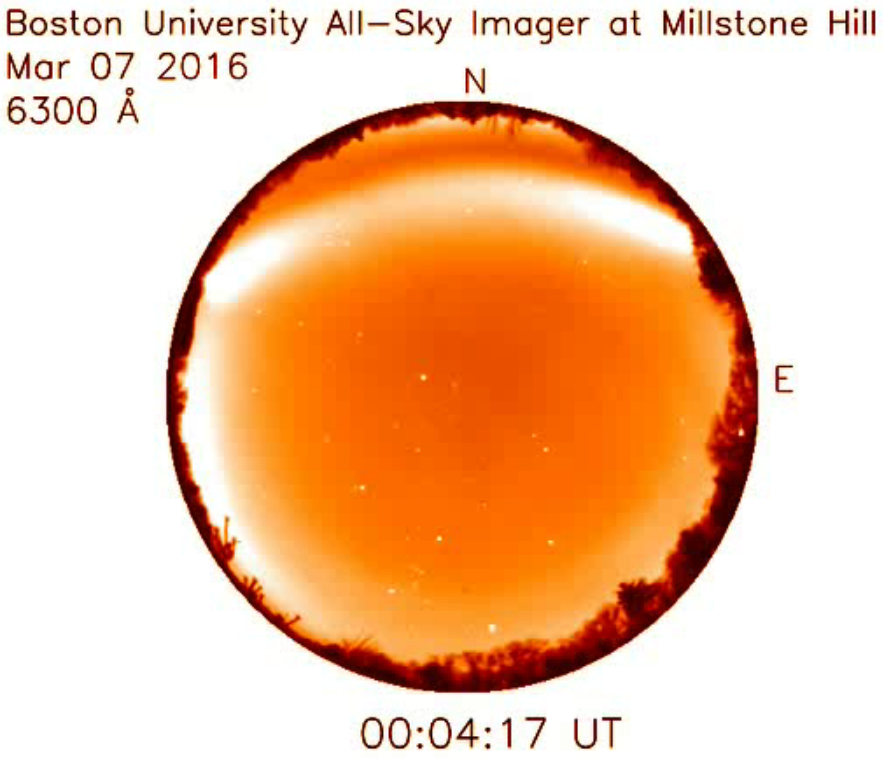
[Baumgardner et al., 2007]

Formation of SAR Arcs



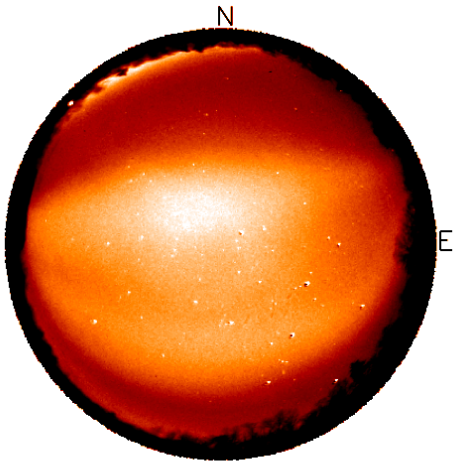
“Normal” SAR Arc





Most SAR Arcs do not conform to “standard pattern”

Multiple & Double SAR arcs



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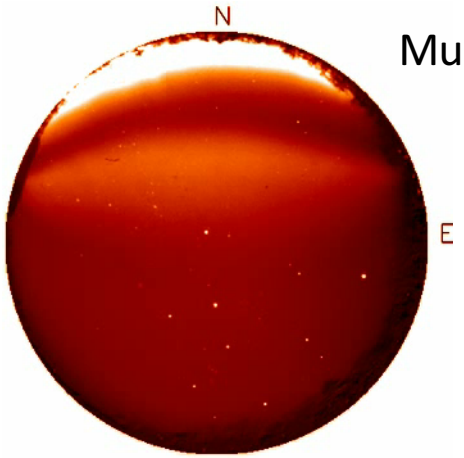
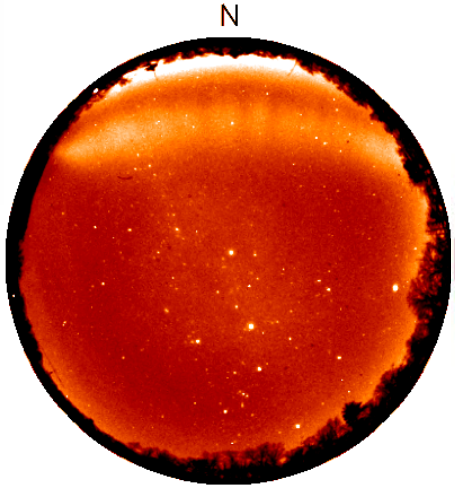


03:54:03 UT
27 Dec 2002

Small Scale Structures



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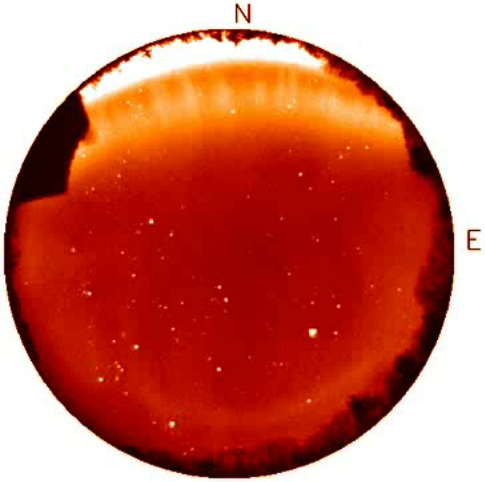

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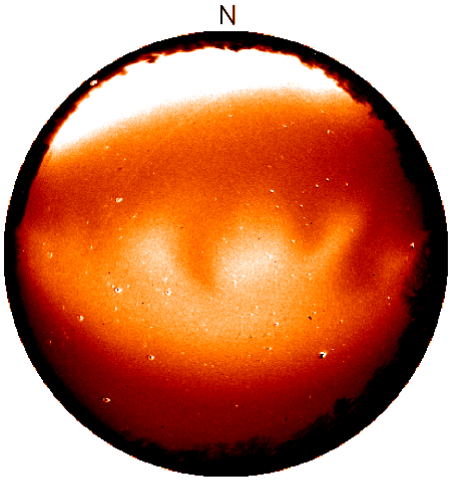

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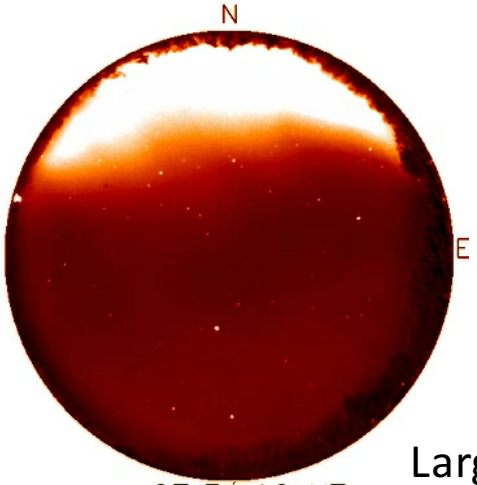
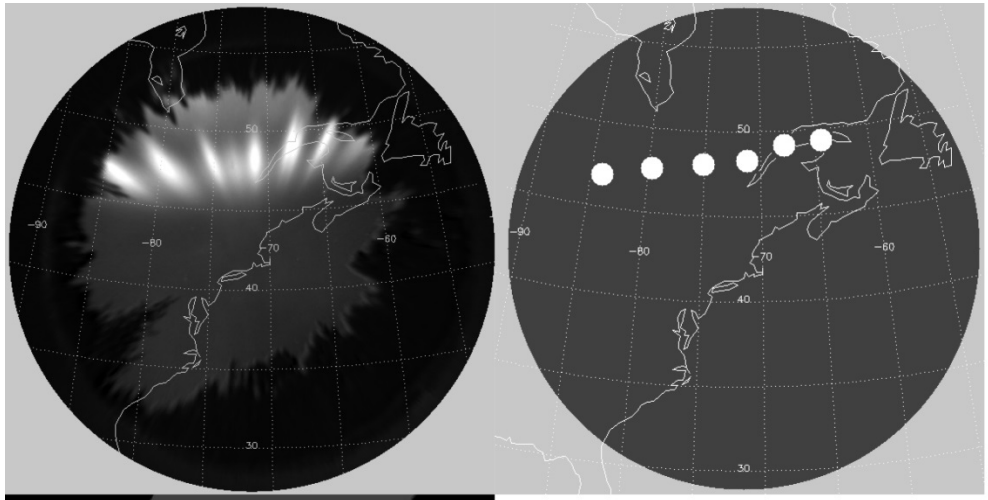


07:34:10 UT
17 Mar 2013

Large Scale Structures

Mapping 6300Å Brightness Patches to Geomagnetic Equatorial Plane

Streaks due to emission extended along B

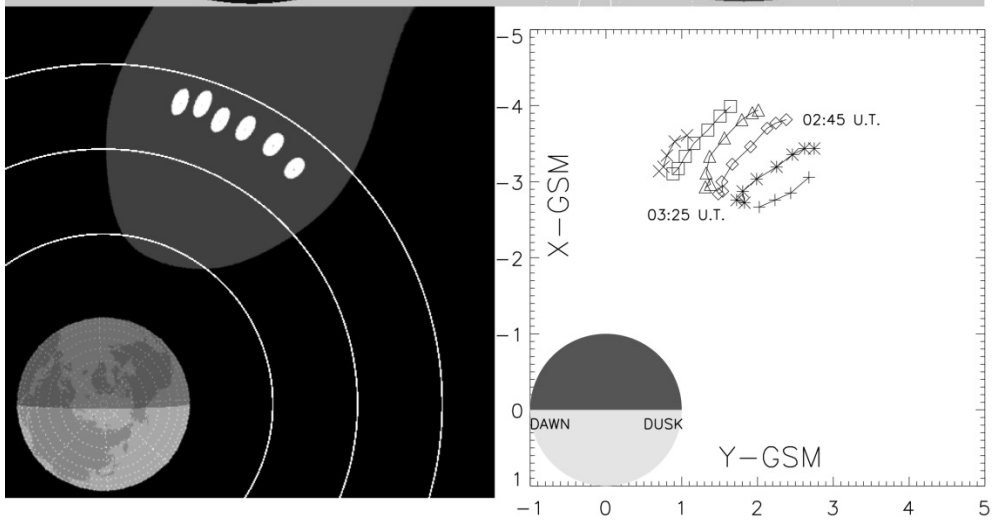


Estimate fluxtube Circular footprints of emission at 400km

Circular cross-sections map to elliptical patterns in equatorial plane:

Long/Zonal by $L^{3/2}$
Lat/Radial by $2L[L^{-3/4}]^{1/2}$

(Moser, 1970)



Radial distance vs. time for each emission patch

No Van Allen Probes or Themis spacecraft in this sector on 2 Oct 2013

Summary

- Multiple Solar Cycle database of SAR arcs at Millstone Hill
  [All images on BU website: http://buimaging.com/data]
- “Stability” term coined in 1950 prior to high performance CCD detectors
- At least 50% of all stable auroral red arcs are, in fact, variable
- Non-uniform brightness and dynamical features offer new insights into M-I Coupling in L = 3-5 domain
- SAR Arc Database during Van Allen Probes era at http://buimaging.com/VanAllen/