Introduction

- NASA's X-ray space telescope, managed by the Marshall Space Flight Center.
- Designed to provide order-of-magnitude improvements to existing Xray imaging resolutions

- These high resolution imaging results were accomplished which is roughly recognizable on these pictures
- Left side: ROSAT Telescope, a german satellite observing x-rays. It got destroyed in 2011 reentering earths athmosphere
- We see not only significantly higher resolution, but also chandra is able to do spectroscopy. Different colors indicate different energies
- It is in a highly elliptical orbit around Earth with an orbital period of ~64h.
- The high eccentricity allows it to escape Earth's radiation belt
- Long period is great for longer integration times
- The observatory is a spacecraft with scientific instruments.

-> Change slide

- These include the High Resolution Mirror Assembly, the high resolution camera, the Advanced CCD Imaging Spectrometer (ACIS) and 2 objective transmission gratings
- These will be discussed by José and Tiepolo
- After a discussion of the telesopes features, Ruben will talk about the sources that we detect with it
- I'm gonna present the last part which will be examples of scientific discoveries made with Chandra

Example discoveries

Earliest images of x-rays in shockwaves of supernova

- called SN1987A implicating ....
- In Large Magellanic Cloud which is a dwarf satellite galaxy of our milky way
- We see propagating shockwave. Core collapses and forms pressure wave, turns into spherically outwards propagating shockwave

*

- now here you see data from ALMA (radio, newly formed dust), HUBBLE and CHANDRA
- We don't know what object actually lies in the center of this supernova now
- Could be star that's shielded from our view due to dust in the way
- Star could have (by accreting matter) futher collapsed into a BH or neutron star but we can't see it because no matter falls into it

*

Halo of hot gas surrounding milky way

- Spans over 300.000 light years and has mass of all of the stars in MW combined
- How did we find out? Observe 8 bright x-ray sources located far beyond (100s of mills of l.y.) the galaxy
- Data actually revealed that x-rays are selectively absorbed by oxygen ions in the gas
- We could determine the Temperature of the gas to be 1-2.5 million K.

*

Hand of god photograph

- What we see here is the picture of a pulsar, right here
- 17.000 ly away. Pulsars are rapidly spinning neutron stars (around 7 per s)
- what we see here is what's called the pulsar nebula
- Star exploded and formed a neutron star

- The charged particles in the matter of the cloud are formed in a certain shape due to the rotation of the strong magnetic field
- We can actually observe these clouds in the x-ray spectrum because there's a lot of synchroton rad.
- Appears to look like a giant hand
- Also dust cloud that gets heated up (lower E)
*

Beethoven burst

- Beethoven burst. Is gamma ray bust. Name because discovery coinciding with 229th anniversary of Beethoven Bday
- What roughly is a Gamma Ray Burst? Very highly luminous flash associated with an astronomical explosion
- And what did Chandra see?
*

- We see the afterglow
- A GRB typically has an afterglow emitting in different wavelenghts, we're interested in X-ray
- We see the K_alpha line of iron. The presence of iron indicates a massive star
- This led scientists to believe that what caused the GRB was actually a hypernova
-> really massive star collapses
*

New type of black hole detected by Chandra

- in Galaxy M82, here a picture by the Hubble telescope
- here with Chandra, of the X-rays
- We're actually only interested in a very small part of this image, namely the central region
- What do we see here? Picture taken at some point, other picture taken 3 months later
-> Fluctuating x-ray emissions around 600 ly away from the center of the Galaxy
- fluctuations on such a short timescale indicate black hole
- but not as heavy as a supermassive BH (like this one here) but heavier than a stellar black hole
-> Intermediate-Mass-Black hole!!

Thank you for your attention!