MEENA IN DØ RUN II

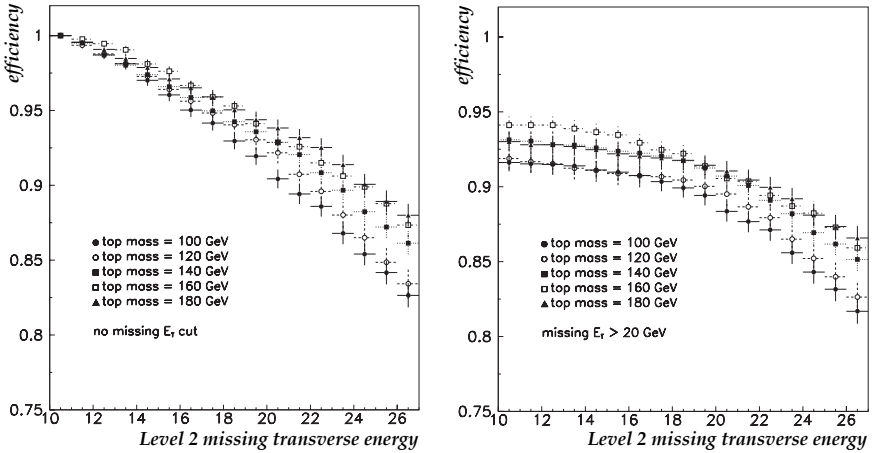
ROBERT KEHOE (SMU) **

MEENAKSHI NARAIN MEMORIAL SYMPOSIUM - MARCH 3, 2023

** S. JABEEN, J. HOBBS, I. IASHVILI, J. QIAN, B. KLIMA, D. DENISOV, T. BOSE, K. BLACK, A. SCHWARTZMANN, S. PROTOPROPESCU, P. GRANNIS

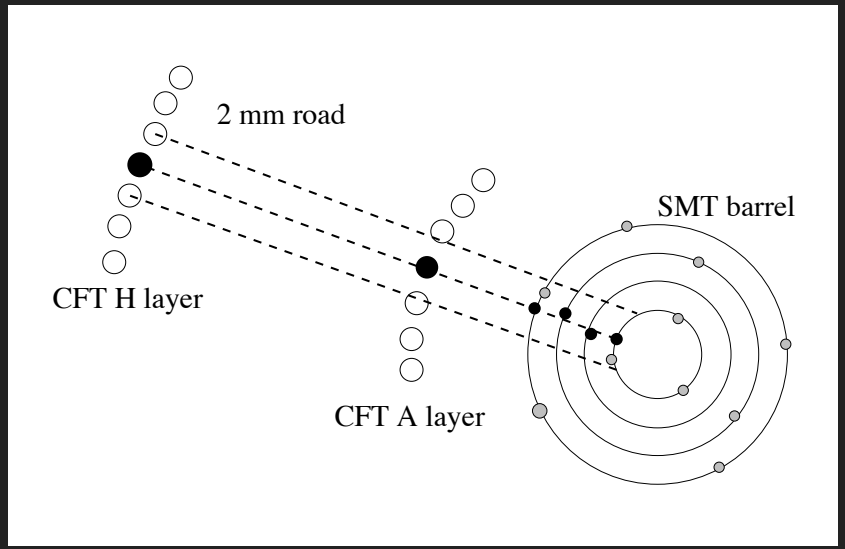
TRIGGER

- Improve trigger rate while preserving efficiency
  - My first study with Meena in Top Group
- What does a Meena project look like?
  - Well-informed
  - Thorough
  - Flexible enough for changing requirements
  - You know you accomplished something
  - It is used



THE SILICON TRACK TRIGGER (STT)

- Early work to identify science motivation of STT
  - Study in $Z \to b\bar{b}$ simulation
- Not an easy trigger to develop
  - Not originally part of upgrade plan
- Cluster board became Meena's responsibility
  - Wrote algorithms, integration, commissioning
- Not a lot of hardware experience
  - Big change
  - Redefined self as person to deliver
  - Wonderful job getting hands dirty
- Force of nature
  - Xilinx donated a large # of FPGAs for free/reduced price as she just kept calling

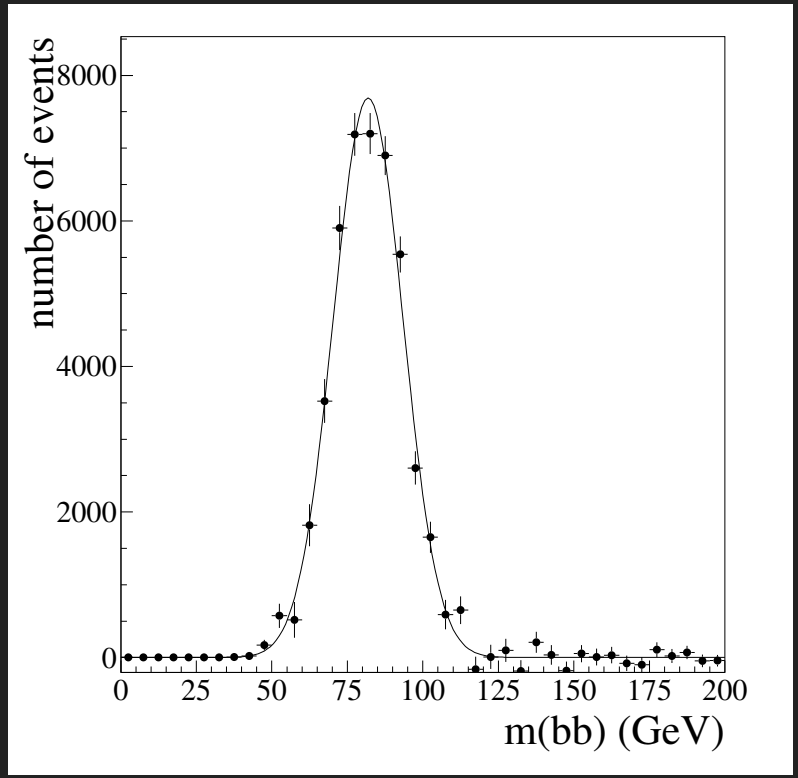


"Extremely strong contribution"

"Important role in everything"

ROLE IN RUN 2

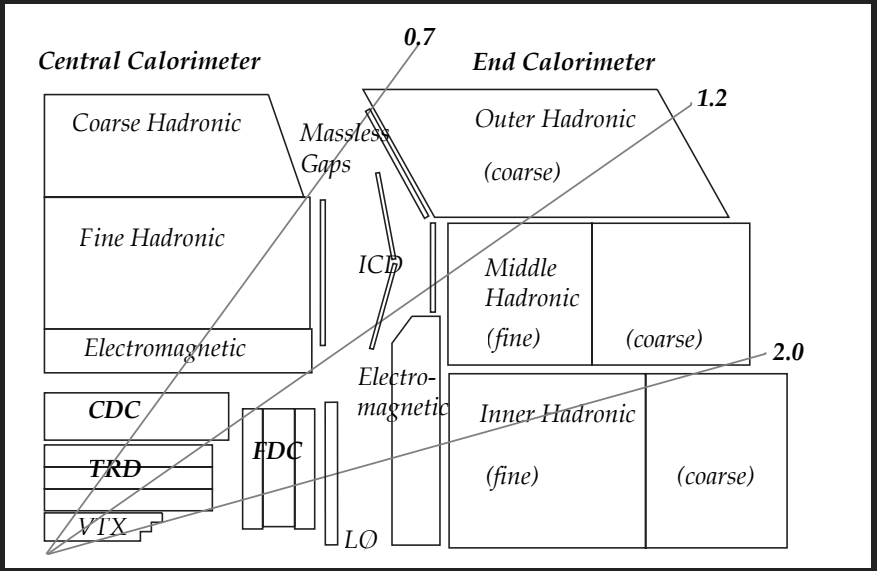
- Early commissioning
  - Organized shifts to help test offline code from SUNY
  - Involved On 9/11 first integration tests @ BU
  - Intense period
    - Not a lot of testing before
    - Run parasitically
  - Biggest overall contribution
    - Make sure on time
    - The person putting pressure
- 2006 shutdown Work on trigger boards
  - Involved in trigger till end of Run 2
- Fly in, work to late night every day, fly out
  - Important for understanding background distributions

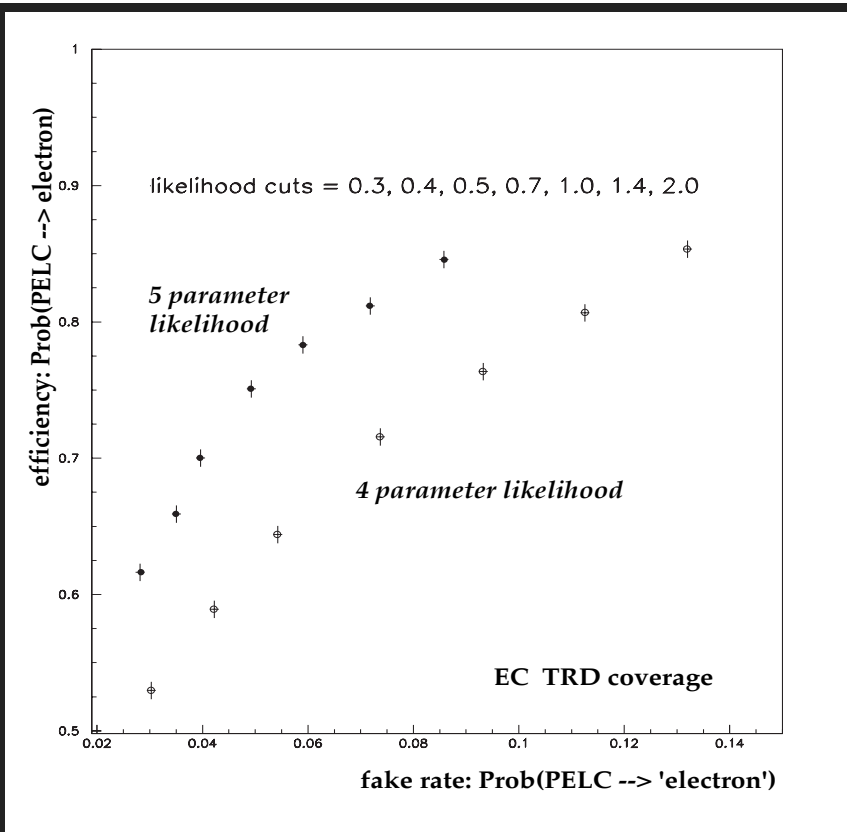


- Used in many Higgs triggers
  - Supported final D0 analyses
- B_s oscillations analysis
  - need cross checks, BG samples
  - Critical at analysis stage

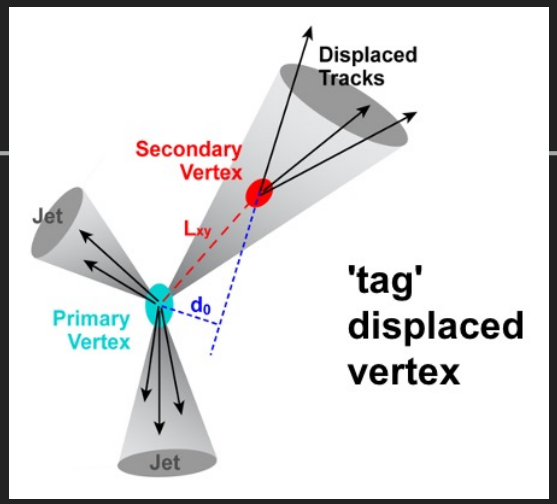
PARTICLE ID AND RECONSTRUCTION

- Run 1 TRD in forward region
  - Possibly a bridge too far…
  - Not what designed for
- How does Meena approach?
  - Pragmatic: TRD software may not be up to it
  - Very high standard of correctness, usefulness and usability
  - Very thorough

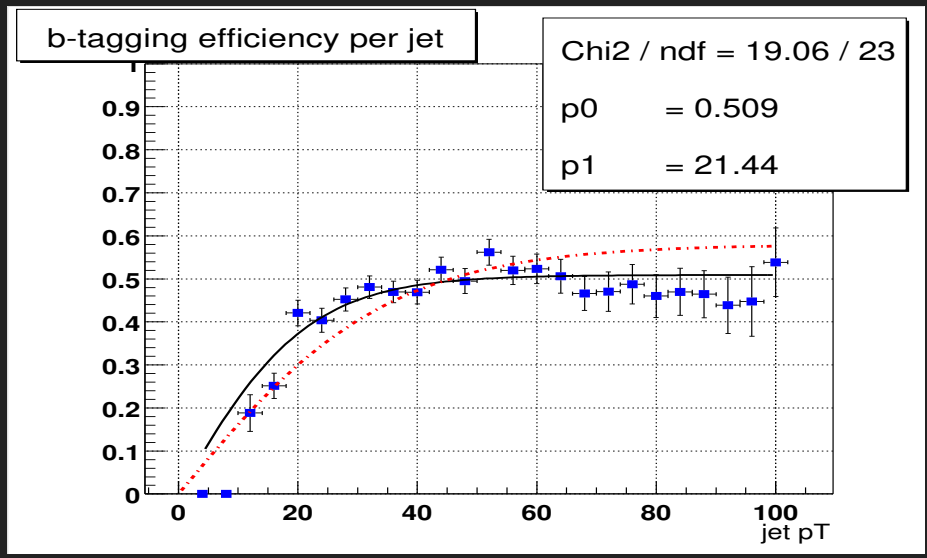




B-TAGGING IN RUN II

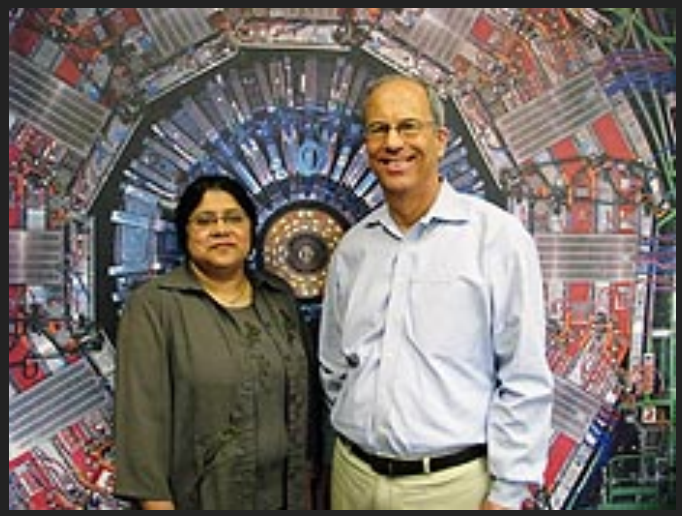


- Convenor of Vertexing group prior to Run 2
- Wrote new code for secondary vertex tagger (SVT)
- 2 years of software development and simulations
- Day and night work
  - Focus was using b-tagging to ID top quarks
- B ID convenor to 2005



"A driving force"

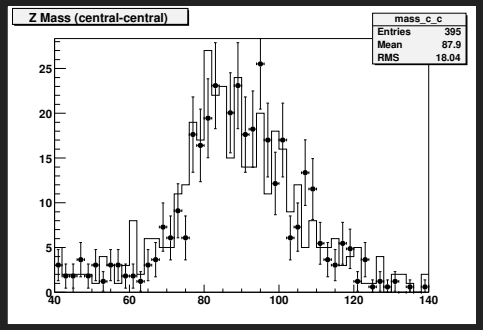
THE HIT GROUP – CO-CONVENOR

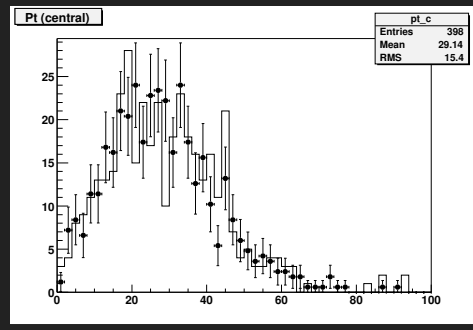


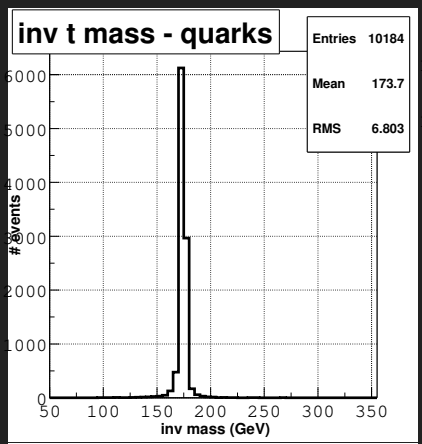
- Start search for Higgs
  - Exploit similarities in top and Higgs characteristics
  - Use experience of what worked in Run 1
- Build group, build structure, add more to plate
- Recruit people, energetic
- Motivated and challenged people
- Would go around to figure how you are progressing
  - Eg. MC generation –> unstick it
    - We need it in 2 weeks
  - help you get thru physics bureaucracy
    - Get things moving
  - Story all thru her career
- Set expectations high
  - Then keep with it – not absentee

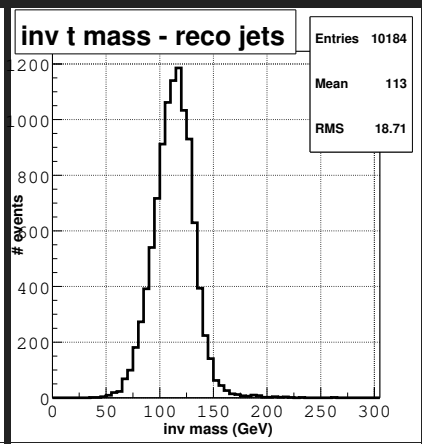
TOP QUARK MASS EARLY IN RUN II

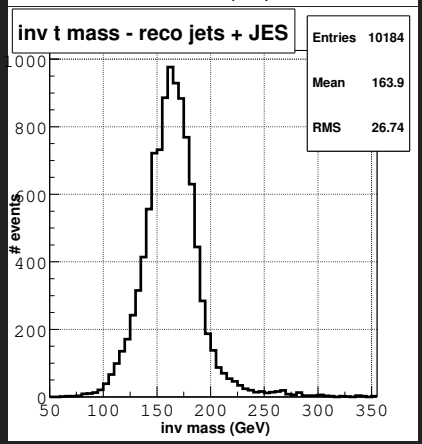
- lumi used 49.5 and 40.0 pb-1
- Testing and quantifying the ingredients
  - muon, jets, electron, Etmiss performance
- jet parton corrections
- Matrix element analysis very popular
- Pursue template approach instead
  - Resisted top group convenor
  - Simpler analysis: easier to understand while learning the new detector and data
  - Computationally fast
  - Better stat. Uncertainty lost due to large systematics (eg. JES)
  - Establish something that works first, then do more complex analysis

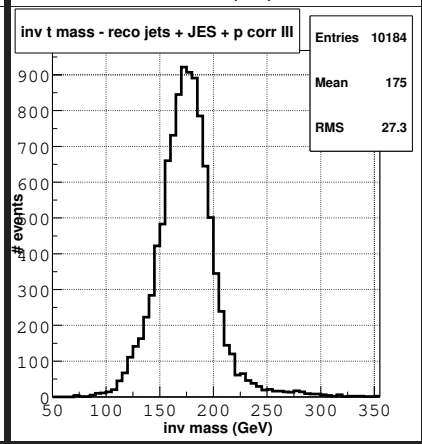






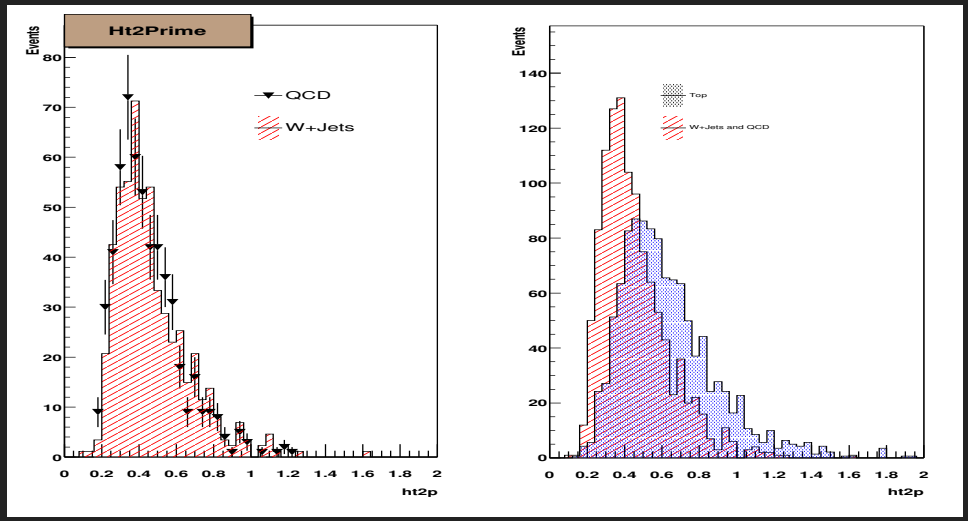


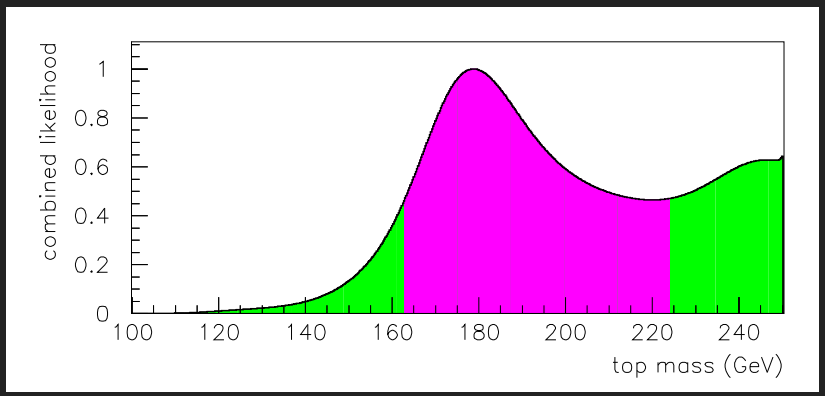




TOP QUARK MASS

- Two analyses
  - topological variables
  - Btag analysis
    - first D0 top mass effort with b-tagging
- Made sure people worked on this got credit and it was presented adequately
- Problem of stuck code
  - Anecdote: trouble with code that needed Fortran: stuck
    - Meena understood what to do, could look at the code and work out the problem
  - Pushed whole thing along

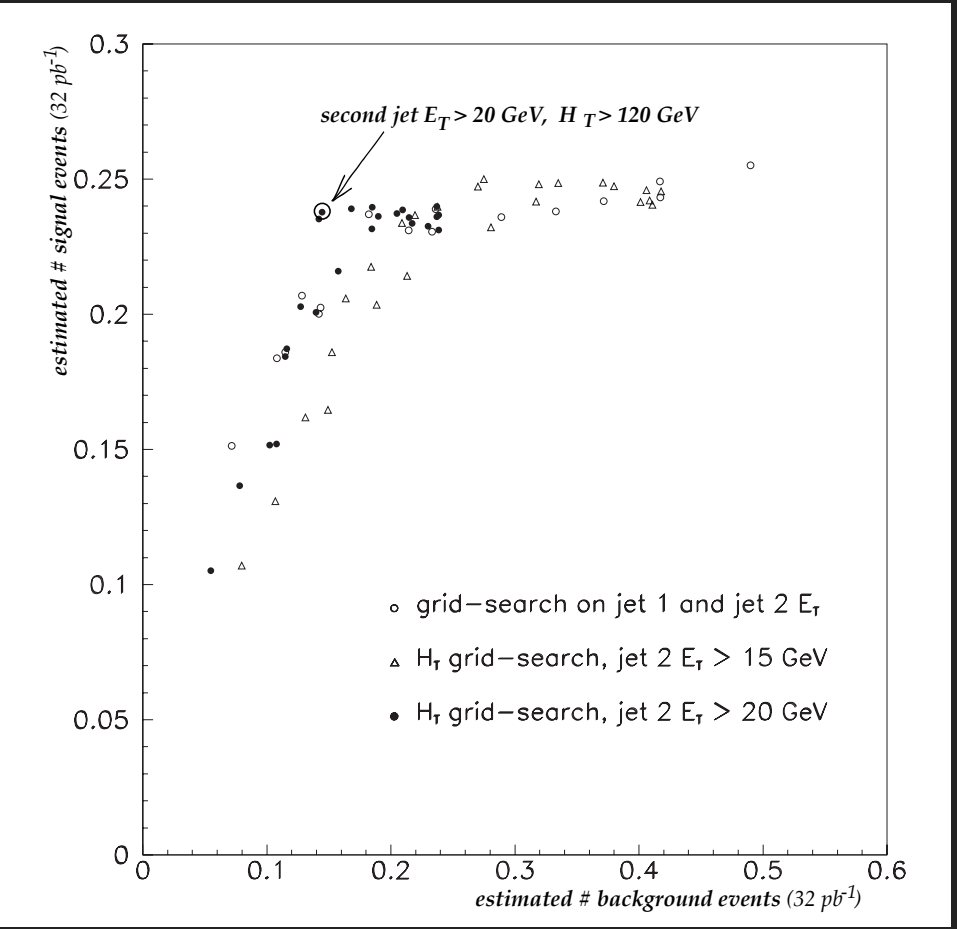




"Felt protected"

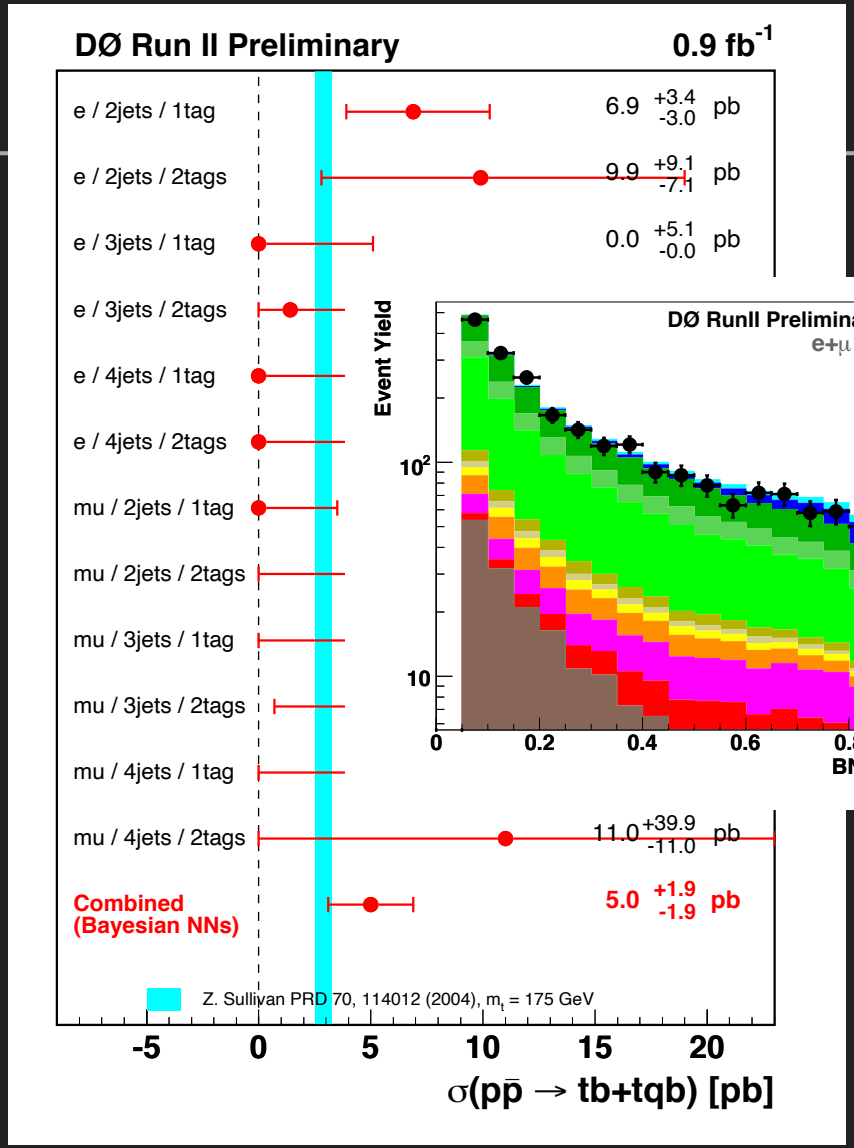
SEARCHES FOR TOP

- Search for top-antitop
  - High mass top optimization
- Very orderly development guided by Meena
- Look at new variables
  - Event shapes, kinematic calculations
  - What works?
  - What can be modeled adequately
  - Some crazy ideas got shot down
- Systematic scan thru cut space
  - Figure of merit at each operating point
  - Objective determination of optimal point
- Once you pick it, stick with it!



SEARCH FOR SINGLE TOP

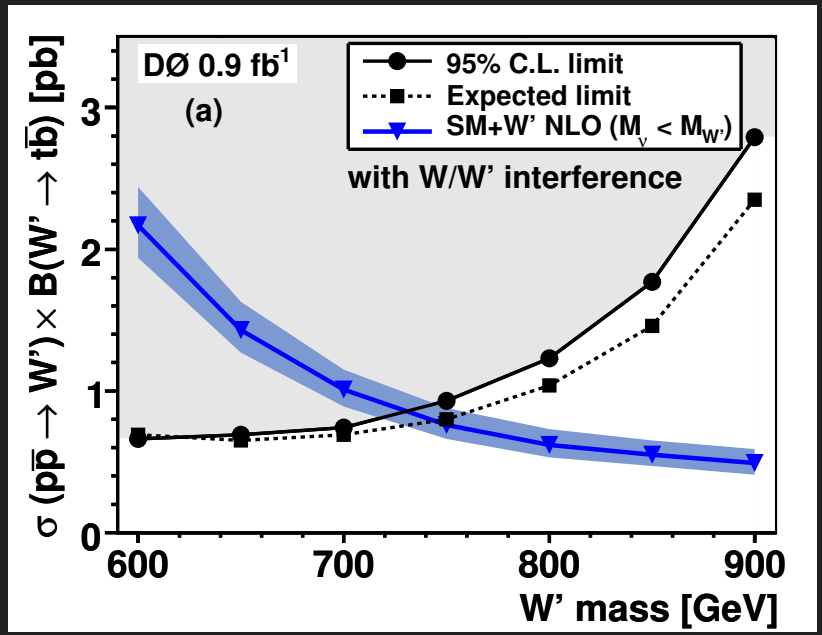
- One of three methods: Bayesian NN
  - Others already going and well along
- A very active role, technical details
- Hands-on, running scripts, talking to others
- Learned from Meena: vision for automation
  - Start from single thing, build up whole analysis
- Thru Observation in 2.3 fb-1



"Never give up"

SEARCH FOR W'

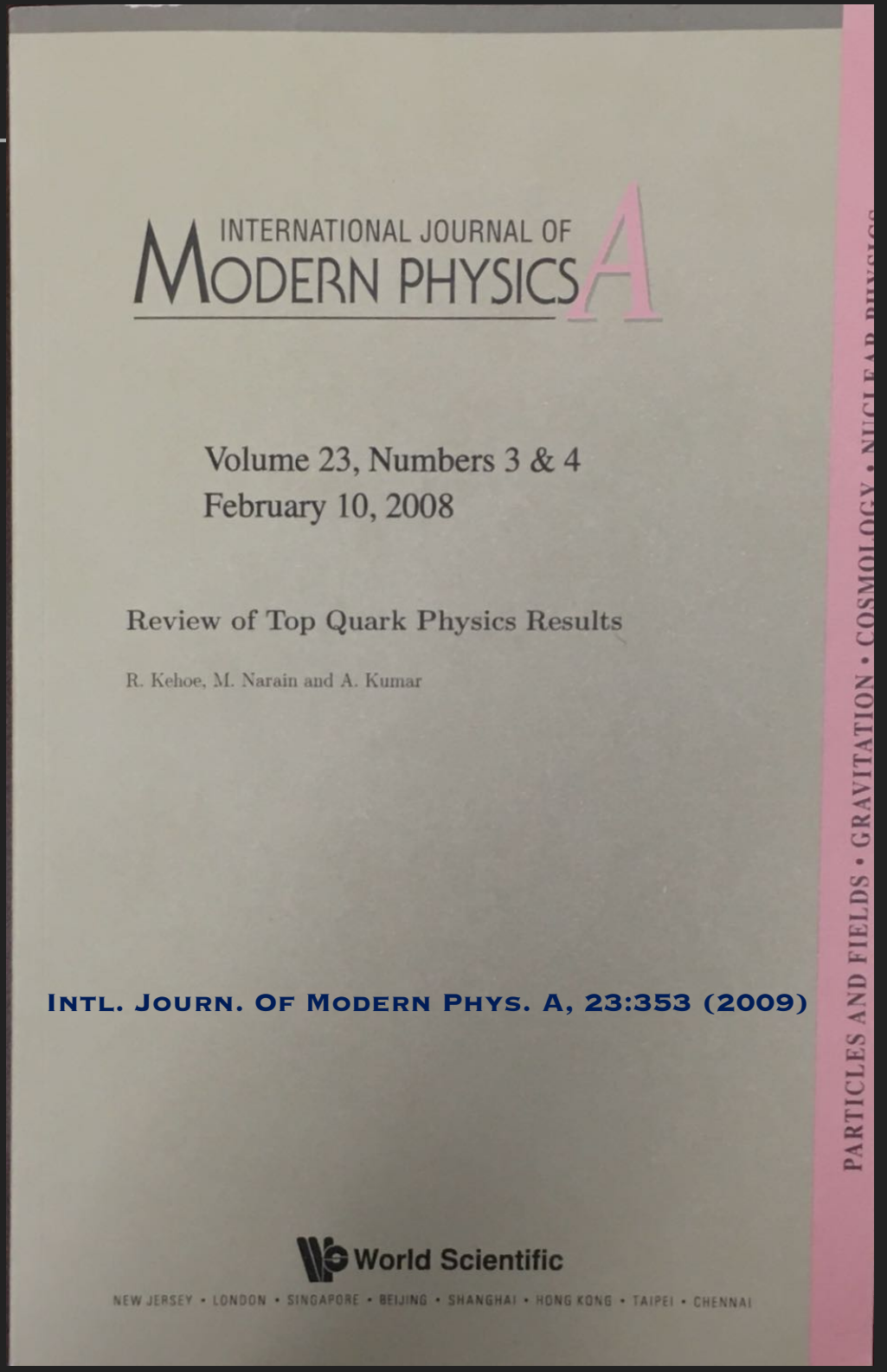
- Straightforward evolution of single top
- Effort to 2010
- Interference between W and W'
  - Can yield lower rate
  - Few included interference (still rare)
- Meena worked well with theorists
- Moscow State produced signal modeling
- Use BDT for analysis
- First analysis with large data sample (2008)



"pretty hands on"

REVIEW OF TOP QUARK PHYSICS

- Wanted comprehensive review
- Initially asked Meena, started in 2006
- LHC results hoped for, but only Tevatron in end
- Meena wanted to do single top
  - Excellent, concise review of very complex analysis
  - Includes 'evidence' results
- Also did portions of rest, including parts of
  - top properties
  - nonstandard production and decay, incl. W'
- Editing/proofing of whole
- Very enjoyable collaboration
  - Focused on making it the best it could be



OTHER CONTRIBUTIONS

- Higgs associated production - WH
- Technicolor search - $\rho_T, \omega_T \rightarrow e^- e^+$
- $t\bar{t}$ cross section - topological selection
- $t\bar{t}$ cross section - b-tag selection
- Top width measurement
- $\left| V_{tb} \right|$ measurement
- $t\bar{t}$ resonances
- $t\bar{t}$ forward-backward asymmetry

- And those she has taught:
  - Balamurali V. (Notre Dame)
  - Robert Kehoe (Notre Dame)
  - Sailesh Chopra
  - Ariel Schwartzmann (Buenos Aires)
  - Kevin Black (BU)
  - Lorenzo Feligioni (BU)
  - Monica Panglinan (Brown)

FAREWELL

"Work ethic 2nd to none"

"Great example for women, can have everything"

"An unstoppable force"

"Would not suffer a fool"

"Almost seemed invincible"

"Loved challenges"

"Very good at organizing people"

"She's right!"

"Drives everyone to be more productive"

"You are not alone, we will help you"

"A brilliant physicist!"

"A great loss"